Court of Appeal File No.: C65807

COURT OF APPEAL FOR ONTARIO

IN THE MATTER OF A REFERENCE to the Court of Appeal pursuant to section 8 of the *Courts of Justice Act*, RSO 1990, c. C.34, by Order-in-Council 1014/2018 respecting the constitutionality of the *Greenhouse Gas Pollution Pricing Act*, Part 5 of the *Budget Implementation Act, 2018, No. 1*, SC 2018, c. 12

RECORD OF THE ATTORNEY GENERAL OF CANADA
Volume 2 of 4

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RECORD OF THE ATTORNEY GENERAL OF CANADA

I N D E X

This is **Exhibit H** referred to in the

affidavit of **John Moffet**

affirmed before me on **January 29, 2019**

Commissioner for Oaths for Québec

#224458

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

UNITED NATIONS
1992

FCCC/INFORMAL/84
GE.05-62220 (E) 200705

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

The Parties to this Convention,

Acknowledging that change in the Earth's climate and its adverse effects are a common concern of humankind,

Concerned that human activities have been substantially increasing the atmospheric concentrations of greenhouse gases, that these increases enhance the natural greenhouse effect, and that this will result on average in an additional warming of the Earth's surface and atmosphere and may adversely affect natural ecosystems and humankind,

Noting that the largest share of historical and current global emissions of greenhouse gases has originated in developed countries, that per capita emissions in developing countries are still relatively low and that the share of global emissions originating in developing countries will grow to meet their social and development needs,

Aware of the role and importance in terrestrial and marine ecosystems of sinks and reservoirs of greenhouse gases,

Noting that there are many uncertainties in predictions of climate change, particularly with regard to the timing, magnitude and regional patterns thereof,

Acknowledging that the global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their common but differentiated responsibilities and respective capabilities and their social and economic conditions,

Recalling the pertinent provisions of the Declaration of the United Nations Conference on the Human Environment, adopted at Stockholm on 16 June 1972,

Recalling also that States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction,

Reaffirming the principle of sovereignty of States in international cooperation to address climate change,

Recognizing that States should enact effective environmental legislation, that environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply, and that standards applied by some countries may be inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries, *Recalling* the provisions of General Assembly resolution 44/228 of 22 December 1989 on the United Nations Conference on Environment and Development, and resolutions 43/53 of 6 December 1988, 44/207 of 22 December 1989, 45/212 of 21 December 1990 and 46/169 of 19 December 1991 on protection of global climate for present and future generations of mankind,

Recalling also the provisions of General Assembly resolution 44/206 of 22 December 1989 on the possible adverse effects of sea-level rise on islands and coastal areas, particularly low-lying coastal areas and the pertinent provisions of General Assembly resolution 44/172 of 19 December 1989 on the implementation of the Plan of Action to Combat Desertification,

Recalling further the Vienna Convention for the Protection of the Ozone Layer, 1985, and the Montreal Protocol on Substances that Deplete the Ozone Layer, 1987, as adjusted and amended on 29 June 1990,

Noting the Ministerial Declaration of the Second World Climate Conference adopted on 7 November 1990,

Conscious of the valuable analytical work being conducted by many States on climate change and of the important contributions of the World Meteorological Organization, the United Nations Environment Programme and other organs, organizations and bodies of the United Nations system, as well as other international and intergovernmental bodies, to the exchange of results of scientific research and the coordination of research,

Recognizing that steps required to understand and address climate change will be environmentally, socially and economically most effective if they are based on relevant scientific, technical and economic considerations and continually re-evaluated in the light of new findings in these areas,

Recognizing that various actions to address climate change can be justified economically in their own right and can also help in solving other environmental problems,

Recognizing also the need for developed countries to take immediate action in a flexible manner on the basis of clear priorities, as a first step towards comprehensive response strategies at the global, national and, where agreed, regional levels that take into account all greenhouse gases, with due consideration of their relative contributions to the enhancement of the greenhouse effect,

Recognizing further that low-lying and other small island countries, countries with low-lying coastal, arid and semi-arid areas or areas liable to floods, drought and desertification, and developing countries with fragile mountainous ecosystems are particularly vulnerable to the adverse effects of climate change,

Recognizing the special difficulties of those countries, especially developing countries, whose economies are particularly dependent on fossil fuel production, use and exportation, as a consequence of action taken on limiting greenhouse gas emissions, *Affirming* that responses to climate change should be coordinated with social and economic development in an integrated manner with a view to avoiding adverse impacts on the latter, taking into full account the legitimate priority needs of developing countries for the achievement of sustained economic growth and the eradication of poverty,

Recognizing that all countries, especially developing countries, need access to resources required to achieve sustainable social and economic development and that, in order for developing countries to progress towards that goal, their energy consumption will need to grow taking into account the possibilities for achieving greater energy efficiency and for controlling greenhouse gas emissions in general, including through the application of new technologies on terms which make such an application economically and socially beneficial,

Determined to protect the climate system for present and future generations,

Have agreed as follows:

Article 1

DEFINITIONS*

For the purposes of this Convention:

1. "Adverse effects of climate change" means changes in the physical environment or biota resulting from climate change which have significant deleterious effects on the composition, resilience or productivity of natural and managed ecosystems or on the operation of socio-economic systems or on human health and welfare.

2. "Climate change" means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

3. "Climate system" means the totality of the atmosphere, hydrosphere, biosphere and geosphere and their interactions.

4. "Emissions" means the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time.

5. "Greenhouse gases" means those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation.

6. "Regional economic integration organization" means an organization constituted by sovereign States of a given region which has competence in respect of matters governed by this Convention or its protocols and has been duly authorized, in accordance with its internal procedures, to sign, ratify, accept, approve or accede to the instruments concerned.

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* Titles of articles are included solely to assist the reader.

7. “Reservoir” means a component or components of the climate system where a greenhouse gas or a precursor of a greenhouse gas is stored.

8. “Sink” means any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere.

9. “Source” means any process or activity which releases a greenhouse gas, an aerosol or a precursor of a greenhouse gas into the atmosphere.

Article 2

OBJECTIVE

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

Article 3

PRINCIPLES

In their actions to achieve the objective of the Convention and to implement its provisions, the Parties shall be guided, inter alia, by the following:

1. The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.

2. The specific needs and special circumstances of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change, and of those Parties, especially developing country Parties, that would have to bear a disproportionate or abnormal burden under the Convention, should be given full consideration.

3. The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost. To achieve this, such policies and measures should take into account different socio-economic contexts, be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors. Efforts to address climate change may be carried out cooperatively by interested Parties.

4. The Parties have a right to, and should, promote sustainable development. Policies and measures to protect the climate system against human-induced change should be appropriate for the specific conditions of each Party and should be integrated with national development programmes, taking into account that economic development is essential for adopting measures to address climate change.

5. The Parties should cooperate to promote a supportive and open international economic system that would lead to sustainable economic growth and development in all Parties, particularly developing country Parties, thus enabling them better to address the problems of climate change. Measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade.

Article 4

COMMITMENTS

1. All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, shall:

(a) Develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties;

(b) Formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and measures to facilitate adequate adaptation to climate change;

(c) Promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors;

(d) Promote sustainable management, and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases not controlled by the Montreal Protocol, including biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems;

(e) Cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods;

(f) Take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessments, formulated and determined nationally, with a view to minimizing adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change;

(g) Promote and cooperate in scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives related to the climate system and intended to further the understanding and to reduce or eliminate the remaining uncertainties regarding the causes, effects, magnitude and timing of climate change and the economic and social consequences of various response strategies;

(h) Promote and cooperate in the full, open and prompt exchange of relevant scientific, technological, technical, socio-economic and legal information related to the climate system and climate change, and to the economic and social consequences of various response strategies;

(i) Promote and cooperate in education, training and public awareness related to climate change and encourage the widest participation in this process, including that of non-governmental organizations; and

(j) Communicate to the Conference of the Parties information related to implementation, in accordance with Article 12.

2. The developed country Parties and other Parties included in Annex I commit themselves specifically as provided for in the following:

(a) Each of these Parties shall adopt national[1] policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs. These policies and measures will demonstrate that developed countries are taking the lead in modifying longer-term trends in anthropogenic emissions consistent with the objective of the Convention, recognizing that the return by the end of the present decade to earlier levels of anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol would contribute to such modification, and taking into account the differences in these Parties' starting points and approaches, economic structures and resource bases, the need to maintain strong and sustainable economic growth, available technologies and other individual circumstances, as well as the need for equitable and appropriate contributions by each of these Parties to the global effort regarding that objective. These Parties may implement such policies and measures jointly with other Parties and may assist other Parties in contributing to the achievement of the objective of the Convention and, in particular, that of this subparagraph;

[1] This includes policies and measures adopted by regional economic integration organizations.

(b) In order to promote progress to this end, each of these Parties shall communicate, within six months of the entry into force of the Convention for it and periodically thereafter, and in accordance with Article 12, detailed information on its policies and measures referred to in subparagraph (a) above, as well as on its resulting projected anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol for the period referred to in subparagraph (a), with the aim of returning individually or jointly to their 1990 levels these anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol. This information will be reviewed by the Conference of the Parties, at its first session and periodically thereafter, in accordance with Article 7;

(c) Calculations of emissions by sources and removals by sinks of greenhouse gases for the purposes of subparagraph (b) above should take into account the best available scientific knowledge, including of the effective capacity of sinks and the respective contributions of such gases to climate change. The Conference of the Parties shall consider and agree on methodologies for these calculations at its first session and review them regularly thereafter;

(d) The Conference of the Parties shall, at its first session, review the adequacy of subparagraphs (a) and (b) above. Such review shall be carried out in the light of the best available scientific information and assessment on climate change and its impacts, as well as relevant technical, social and economic information. Based on this review, the Conference of the Parties shall take appropriate action, which may include the adoption of amendments to the commitments in subparagraphs (a) and (b) above. The Conference of the Parties, at its first session, shall also take decisions regarding criteria for joint implementation as indicated in subparagraph (a) above. A second review of subparagraphs (a) and (b) shall take place not later than 31 December 1998, and thereafter at regular intervals determined by the Conference of the Parties, until the objective of the Convention is met;

(e) Each of these Parties shall:

(i) coordinate as appropriate with other such Parties, relevant economic and administrative instruments developed to achieve the objective of the Convention; and

(ii) identify and periodically review its own policies and practices which encourage activities that lead to greater levels of anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol than would otherwise occur;

(f) The Conference of the Parties shall review, not later than 31 December 1998, available information with a view to taking decisions regarding such amendments to the lists in Annexes I and II as may be appropriate, with the approval of the Party concerned;

(g) Any Party not included in Annex I may, in its instrument of ratification, acceptance, approval or accession, or at any time thereafter, notify the Depositary that it intends to be bound by subparagraphs (a) and (b) above. The Depositary shall inform the other signatories and Parties of any such notification.

3. The developed country Parties and other developed Parties included in Annex II shall provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties in complying with their obligations under Article 12, paragraph 1. They shall also provide such financial resources, including for the transfer of technology, needed by the developing country Parties to meet the agreed full incremental costs of implementing measures that are covered by paragraph 1 of this Article and that are agreed between a developing country Party and the international entity or entities referred to in Article 11, in accordance with that Article. The implementation of these commitments shall take into account the need for adequacy and predictability in the flow of funds and the importance of appropriate burden sharing among the developed country Parties.

4. The developed country Parties and other developed Parties included in Annex II shall also assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects.

5. The developed country Parties and other developed Parties included in Annex II shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention. In this process, the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country Parties. Other Parties and organizations in a position to do so may also assist in facilitating the transfer of such technologies.

6. In the implementation of their commitments under paragraph 2 above, a certain degree of flexibility shall be allowed by the Conference of the Parties to the Parties included in Annex I undergoing the process of transition to a market economy, in order to enhance the ability of these Parties to address climate change, including with regard to the historical level of anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol chosen as a reference.

7. The extent to which developing country Parties will effectively implement their commitments under the Convention will depend on the effective implementation by developed country Parties of their commitments under the Convention related to financial resources and transfer of technology and will take fully into account that economic and social development and poverty eradication are the first and overriding priorities of the developing country Parties.

8. In the implementation of the commitments in this Article, the Parties shall give full consideration to what actions are necessary under the Convention, including actions related to funding, insurance and the transfer of technology, to meet the specific needs and concerns of developing country Parties arising from the adverse effects of climate change and/or the impact of the implementation of response measures, especially on:

(a) Small island countries;

(b) Countries with low-lying coastal areas;

(c) Countries with arid and semi-arid areas, forested areas and areas liable to forest decay;

(d) Countries with areas prone to natural disasters;

(e) Countries with areas liable to drought and desertification;

(f) Countries with areas of high urban atmospheric pollution;

(g) Countries with areas with fragile ecosystems, including mountainous ecosystems;

(h) Countries whose economies are highly dependent on income generated from the production, processing and export, and/or on consumption of fossil fuels and associated energy-intensive products; and

(i) Landlocked and transit countries.

Further, the Conference of the Parties may take actions, as appropriate, with respect to this paragraph.

9. The Parties shall take full account of the specific needs and special situations of the least developed countries in their actions with regard to funding and transfer of technology.

10. The Parties shall, in accordance with Article 10, take into consideration in the implementation of the commitments of the Convention the situation of Parties, particularly developing country Parties, with economies that are vulnerable to the adverse effects of the implementation of measures to respond to climate change. This applies notably to Parties with economies that are highly dependent on income generated from the production, processing and export, and/or consumption of fossil fuels and associated energy-intensive products and/or the use of fossil fuels for which such Parties have serious difficulties in switching to alternatives.

Article 5

RESEARCH AND SYSTEMATIC OBSERVATION

In carrying out their commitments under Article 4, paragraph 1 (g), the Parties shall:

(a) Support and further develop, as appropriate, international and intergovernmental programmes and networks or organizations aimed at defining, conducting, assessing and financing research, data collection and systematic observation, taking into account the need to minimize duplication of effort;

(b) Support international and intergovernmental efforts to strengthen systematic observation and national scientific and technical research capacities and capabilities, particularly in developing countries, and to promote access to, and the exchange of, data and analyses thereof obtained from areas beyond national jurisdiction; and

(c) Take into account the particular concerns and needs of developing countries and cooperate in improving their endogenous capacities and capabilities to participate in the efforts referred to in subparagraphs (a) and (b) above.

Article 6

EDUCATION, TRAINING AND PUBLIC AWARENESS

In carrying out their commitments under Article 4, paragraph 1 (i), the Parties shall:

(a) Promote and facilitate at the national and, as appropriate, subregional and regional levels, and in accordance with national laws and regulations, and within their respective capacities:

(i) the development and implementation of educational and public awareness programmes on climate change and its effects;

(ii) public access to information on climate change and its effects;

(iii) public participation in addressing climate change and its effects and developing adequate responses; and

(iv) training of scientific, technical and managerial personnel;

(b) Cooperate in and promote, at the international level, and, where appropriate, using existing bodies:

(i) the development and exchange of educational and public awareness material on climate change and its effects; and

(ii) the development and implementation of education and training programmes, including the strengthening of national institutions and the exchange or secondment of personnel to train experts in this field, in particular for developing countries.

Article 7

CONFERENCE OF THE PARTIES

1. A Conference of the Parties is hereby established.

2. The Conference of the Parties, as the supreme body of this Convention, shall keep under regular review the implementation of the Convention and any related legal instruments that the Conference of the Parties may adopt, and shall make, within its mandate, the decisions necessary to promote the effective implementation of the Convention. To this end, it shall:

(a) Periodically examine the obligations of the Parties and the institutional arrangements under the Convention, in the light of the objective of the Convention, the experience gained in its implementation and the evolution of scientific and technological knowledge;

(b) Promote and facilitate the exchange of information on measures adopted by the Parties to address climate change and its effects, taking into account the differing circumstances, responsibilities and capabilities of the Parties and their respective commitments under the Convention;

(c) Facilitate, at the request of two or more Parties, the coordination of measures adopted by them to address climate change and its effects, taking into account the differing circumstances, responsibilities and capabilities of the Parties and their respective commitments under the Convention;

(d) Promote and guide, in accordance with the objective and provisions of the Convention, the development and periodic refinement of comparable methodologies, to be agreed on by the Conference of the Parties, inter alia, for preparing inventories of greenhouse gas emissions by sources and removals by sinks, and for evaluating the effectiveness of measures to limit the emissions and enhance the removals of these gases;

(e) Assess, on the basis of all information made available to it in accordance with the provisions of the Convention, the implementation of the Convention by the Parties, the overall effects of the measures taken pursuant to the Convention, in particular environmental, economic and social effects as well as their cumulative impacts and the extent to which progress towards the objective of the Convention is being achieved;

(f) Consider and adopt regular reports on the implementation of the Convention and ensure their publication;

(g) Make recommendations on any matters necessary for the implementation of the Convention;

(h) Seek to mobilize financial resources in accordance with Article 4, paragraphs 3, 4 and 5, and Article 11;

(i) Establish such subsidiary bodies as are deemed necessary for the implementation of the Convention;

(j) Review reports submitted by its subsidiary bodies and provide guidance to them;

(k) Agree upon and adopt, by consensus, rules of procedure and financial rules for itself and for any subsidiary bodies;

(l) Seek and utilize, where appropriate, the services and cooperation of, and information provided by, competent international organizations and intergovernmental and non-governmental bodies; and

(m) Exercise such other functions as are required for the achievement of the objective of the Convention as well as all other functions assigned to it under the Convention.

3. The Conference of the Parties shall, at its first session, adopt its own rules of procedure as well as those of the subsidiary bodies established by the Convention, which shall include decision-making procedures for matters not already covered by decision-making procedures stipulated in the Convention. Such procedures may include specified majorities required for the adoption of particular decisions.

4. The first session of the Conference of the Parties shall be convened by the interim secretariat referred to in Article 21 and shall take place not later than one year after the date of entry into force of the Convention. Thereafter, ordinary sessions of the Conference of the Parties shall be held every year unless otherwise decided by the Conference of the Parties.

5. Extraordinary sessions of the Conference of the Parties shall be held at such other times as may be deemed necessary by the Conference, or at the written request of any Party, provided that, within six months of the request being communicated to the Parties by the secretariat, it is supported by at least one third of the Parties.

6. The United Nations, its specialized agencies and the International Atomic Energy Agency, as well as any State member thereof or observers thereto not Party to the Convention, may be represented at sessions of the Conference of the Parties as observers. Any body or agency, whether national or international, governmental or non-governmental, which is qualified in matters covered by the Convention, and which has informed the secretariat of its wish to be represented at a session of the Conference of the Parties as an observer, may be so admitted unless at least one third of the Parties present object. The admission and participation of observers shall be subject to the rules of procedure adopted by the Conference of the Parties.

Article 8

SECRETARIAT

1. A secretariat is hereby established.

2. The functions of the secretariat shall be:

(a) To make arrangements for sessions of the Conference of the Parties and its subsidiary bodies established under the Convention and to provide them with services as required;

(b) To compile and transmit reports submitted to it;

(c) To facilitate assistance to the Parties, particularly developing country Parties, on request, in the compilation and communication of information required in accordance with the provisions of the Convention;

(d) To prepare reports on its activities and present them to the Conference of the Parties;

(e) To ensure the necessary coordination with the secretariats of other relevant international bodies;

(f) To enter, under the overall guidance of the Conference of the Parties, into such administrative and contractual arrangements as may be required for the effective discharge of its functions; and

(g) To perform the other secretariat functions specified in the Convention and in any of its protocols and such other functions as may be determined by the Conference of the Parties.

3. The Conference of the Parties, at its first session, shall designate a permanent secretariat and make arrangements for its functioning.

Article 9

SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE

1. A subsidiary body for scientific and technological advice is hereby established to provide the Conference of the Parties and, as appropriate, its other subsidiary bodies with timely information and advice on scientific and technological matters relating to the Convention. This body shall be open to participation by all Parties and shall be multidisciplinary. It shall comprise government representatives competent in the relevant field of expertise. It shall report regularly to the Conference of the Parties on all aspects of its work.

2. Under the guidance of the Conference of the Parties, and drawing upon existing competent international bodies, this body shall:

(a) Provide assessments of the state of scientific knowledge relating to climate change and its effects;

(b) Prepare scientific assessments on the effects of measures taken in the implementation of the Convention;

(c) Identify innovative, efficient and state-of-the-art technologies and know-how and advise on the ways and means of promoting development and/or transferring such technologies;

(d) Provide advice on scientific programmes, international cooperation in research and development related to climate change, as well as on ways and means of supporting endogenous capacity-building in developing countries; and

(e) Respond to scientific, technological and methodological questions that the Conference of the Parties and its subsidiary bodies may put to the body.

3. The functions and terms of reference of this body may be further elaborated by the Conference of the Parties.

Article 10

SUBSIDIARY BODY FOR IMPLEMENTATION

1. A subsidiary body for implementation is hereby established to assist the Conference of the Parties in the assessment and review of the effective implementation of the Convention. This body shall be open to participation by all Parties and comprise government representatives who are experts on matters related to climate change. It shall report regularly to the Conference of the Parties on all aspects of its work.

2. Under the guidance of the Conference of the Parties, this body shall:

(a) Consider the information communicated in accordance with Article 12, paragraph 1, to assess the overall aggregated effect of the steps taken by the Parties in the light of the latest scientific assessments concerning climate change;

(b) Consider the information communicated in accordance with Article 12, paragraph 2, in order to assist the Conference of the Parties in carrying out the reviews required by Article 4, paragraph 2 (d); and

(c) Assist the Conference of the Parties, as appropriate, in the preparation and implementation of its decisions.

Article 11

FINANCIAL MECHANISM

1. A mechanism for the provision of financial resources on a grant or concessional basis, including for the transfer of technology, is hereby defined. It shall function under the guidance of and be accountable to the Conference of the Parties, which shall decide on its policies, programme priorities and eligibility criteria related to this Convention. Its operation shall be entrusted to one or more existing international entities.

2. The financial mechanism shall have an equitable and balanced representation of all Parties within a transparent system of governance.

3. The Conference of the Parties and the entity or entities entrusted with the operation of the financial mechanism shall agree upon arrangements to give effect to the above paragraphs, which shall include the following:

(a) Modalities to ensure that the funded projects to address climate change are in conformity with the policies, programme priorities and eligibility criteria established by the Conference of the Parties;

(b) Modalities by which a particular funding decision may be reconsidered in light of these policies, programme priorities and eligibility criteria;

(c) Provision by the entity or entities of regular reports to the Conference of the Parties on its funding operations, which is consistent with the requirement for accountability set out in paragraph 1 above; and

(d) Determination in a predictable and identifiable manner of the amount of funding necessary and available for the implementation of this Convention and the conditions under which that amount shall be periodically reviewed.

4. The Conference of the Parties shall make arrangements to implement the above-mentioned provisions at its first session, reviewing and taking into account the interim arrangements referred to in Article 21, paragraph 3, and shall decide whether these interim arrangements shall be maintained. Within four years thereafter, the Conference of the Parties shall review the financial mechanism and take appropriate measures.

5. The developed country Parties may also provide and developing country Parties avail themselves of, financial resources related to the implementation of the Convention through bilateral, regional and other multilateral channels.

Article 12

COMMUNICATION OF INFORMATION RELATED TO IMPLEMENTATION

1. In accordance with Article 4, paragraph 1, each Party shall communicate to the Conference of the Parties, through the secretariat, the following elements of information:

(a) A national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, to the extent its capacities permit, using comparable methodologies to be promoted and agreed upon by the Conference of the Parties;

(b) A general description of steps taken or envisaged by the Party to implement the Convention; and

(c) Any other information that the Party considers relevant to the achievement of the objective of the Convention and suitable for inclusion in its communication, including, if feasible, material relevant for calculations of global emission trends.

2. Each developed country Party and each other Party included in Annex I shall incorporate in its communication the following elements of information:

(a) A detailed description of the policies and measures that it has adopted to implement its commitment under Article 4, paragraphs 2 (a) and 2 (b); and

(b) A specific estimate of the effects that the policies and measures referred to in subparagraph (a) immediately above will have on anthropogenic emissions by its sources and removals by its sinks of greenhouse gases during the period referred to in Article 4, paragraph 2 (a).

3. In addition, each developed country Party and each other developed Party included in Annex II shall incorporate details of measures taken in accordance with Article 4, paragraphs 3, 4 and 5.

4. Developing country Parties may, on a voluntary basis, propose projects for financing, including specific technologies, materials, equipment, techniques or practices that would be needed to implement such projects, along with, if possible, an estimate of all incremental costs, of the reductions of emissions and increments of removals of greenhouse gases, as well as an estimate of the consequent benefits.

5. Each developed country Party and each other Party included in Annex I shall make its initial communication within six months of the entry into force of the Convention for that Party. Each Party not so listed shall make its initial communication within three years of the entry into force of the Convention for that Party, or of the availability of financial resources in accordance with Article 4, paragraph 3. Parties that are least developed countries may make their initial communication at their discretion. The frequency of subsequent communications by all Parties shall be determined by the Conference of the Parties, taking into account the differentiated timetable set by this paragraph.

6. Information communicated by Parties under this Article shall be transmitted by the secretariat as soon as possible to the Conference of the Parties and to any subsidiary bodies concerned. If necessary, the procedures for the communication of information may be further considered by the Conference of the Parties.

7. From its first session, the Conference of the Parties shall arrange for the provision to developing country Parties of technical and financial support, on request, in compiling and communicating information under this Article, as well as in identifying the technical and financial needs associated with proposed projects and response measures under Article 4. Such support may be provided by other Parties, by competent international organizations and by the secretariat, as appropriate.

8. Any group of Parties may, subject to guidelines adopted by the Conference of the Parties, and to prior notification to the Conference of the Parties, make a joint communication in fulfilment of their obligations under this Article, provided that such a communication includes information on the fulfilment by each of these Parties of its individual obligations under the Convention.

9. Information received by the secretariat that is designated by a Party as confidential, in accordance with criteria to be established by the Conference of the Parties, shall be aggregated by the secretariat to protect its confidentiality before being made available to any of the bodies involved in the communication and review of information.

10. Subject to paragraph 9 above, and without prejudice to the ability of any Party to make public its communication at any time, the secretariat shall make communications by Parties under this Article publicly available at the time they are submitted to the Conference of the Parties.

Article 13

RESOLUTION OF QUESTIONS REGARDING IMPLEMENTATION

The Conference of the Parties shall, at its first session, consider the establishment of a multilateral consultative process, available to Parties on their request, for the resolution of questions regarding the implementation of the Convention.

Article 14

SETTLEMENT OF DISPUTES

1. In the event of a dispute between any two or more Parties concerning the interpretation or application of the Convention, the Parties concerned shall seek a settlement of the dispute through negotiation or any other peaceful means of their own choice.

2. When ratifying, accepting, approving or acceding to the Convention, or at any time thereafter, a Party which is not a regional economic integration organization may declare in a written instrument submitted to the Depositary that, in respect of any dispute concerning the interpretation or application of the Convention, it recognizes as compulsory ipso facto and without special agreement, in relation to any Party accepting the same obligation:

(a) Submission of the dispute to the International Court of Justice; and/or

(b) Arbitration in accordance with procedures to be adopted by the Conference of the Parties as soon as practicable, in an annex on arbitration.

A Party which is a regional economic integration organization may make a declaration with like effect in relation to arbitration in accordance with the procedures referred to in subparagraph (b) above.

3. A declaration made under paragraph 2 above shall remain in force until it expires in accordance with its terms or until three months after written notice of its revocation has been deposited with the Depositary.

4. A new declaration, a notice of revocation or the expiry of a declaration shall not in any way affect proceedings pending before the International Court of Justice or the arbitral tribunal, unless the parties to the dispute otherwise agree.

5. Subject to the operation of paragraph 2 above, if after twelve months following notification by one Party to another that a dispute exists between them, the Parties concerned have not been able to settle their dispute through the means mentioned in paragraph 1 above, the dispute shall be submitted, at the request of any of the parties to the dispute, to conciliation.

6. A conciliation commission shall be created upon the request of one of the parties to the dispute. The commission shall be composed of an equal number of members appointed by each party concerned and a chairman chosen jointly by the members appointed by each party. The commission shall render a recommendatory award, which the parties shall consider in good faith.

7. Additional procedures relating to conciliation shall be adopted by the Conference of the Parties, as soon as practicable, in an annex on conciliation.

8. The provisions of this Article shall apply to any related legal instrument which the Conference of the Parties may adopt, unless the instrument provides otherwise.

Article 15

AMENDMENTS TO THE CONVENTION

1. Any Party may propose amendments to the Convention.

2. Amendments to the Convention shall be adopted at an ordinary session of the Conference of the Parties. The text of any proposed amendment to the Convention shall be communicated to the Parties by the secretariat at least six months before the meeting at which it is proposed for adoption. The secretariat shall also communicate proposed amendments to the signatories to the Convention and, for information, to the Depositary.

3. The Parties shall make every effort to reach agreement on any proposed amendment to the Convention by consensus. If all efforts at consensus have been exhausted, and no agreement reached, the amendment shall as a last resort be adopted by a three-fourths majority vote of the Parties present and voting at the meeting. The adopted amendment shall be communicated by the secretariat to the Depositary, who shall circulate it to all Parties for their acceptance.

4. Instruments of acceptance in respect of an amendment shall be deposited with the Depositary. An amendment adopted in accordance with paragraph 3 above shall enter into force for those Parties having accepted it on the ninetieth day after the date of receipt by the Depositary of an instrument of acceptance by at least three fourths of the Parties to the Convention.

5. The amendment shall enter into force for any other Party on the ninetieth day after the date on which that Party deposits with the Depositary its instrument of acceptance of the said amendment.

6. For the purposes of this Article, “Parties present and voting” means Parties present and casting an affirmative or negative vote.

Article 16

ADOPTION AND AMENDMENT OF ANNEXES TO THE CONVENTION

1. Annexes to the Convention shall form an integral part thereof and, unless otherwise expressly provided, a reference to the Convention constitutes at the same time a reference to any annexes thereto. Without prejudice to the provisions of Article 14, paragraphs 2 (b) and 7, such annexes shall be restricted to lists, forms and any other material of a descriptive nature that is of a scientific, technical, procedural or administrative character.

2. Annexes to the Convention shall be proposed and adopted in accordance with the procedure set forth in Article 15, paragraphs 2, 3 and 4.

3. An annex that has been adopted in accordance with paragraph 2 above shall enter into force for all Parties to the Convention six months after the date of the communication by the Depositary to such Parties of the adoption of the annex, except for those Parties that have notified the Depositary, in writing, within that period of their non-acceptance of the annex. The annex shall enter into force for Parties which withdraw their notification of non-acceptance on the ninetieth day after the date on which withdrawal of such notification has been received by the Depositary.

4. The proposal, adoption and entry into force of amendments to annexes to the Convention shall be subject to the same procedure as that for the proposal, adoption and entry into force of annexes to the Convention in accordance with paragraphs 2 and 3 above.

5. If the adoption of an annex or an amendment to an annex involves an amendment to the Convention, that annex or amendment to an annex shall not enter into force until such time as the amendment to the Convention enters into force.

Article 17

PROTOCOLS

1. The Conference of the Parties may, at any ordinary session, adopt protocols to the Convention.

2. The text of any proposed protocol shall be communicated to the Parties by the secretariat at least six months before such a session.

3. The requirements for the entry into force of any protocol shall be established by that instrument.

4. Only Parties to the Convention may be Parties to a protocol.

5. Decisions under any protocol shall be taken only by the Parties to the protocol concerned.

Article 18

RIGHT TO VOTE

1. Each Party to the Convention shall have one vote, except as provided for in paragraph 2 below.

2. Regional economic integration organizations, in matters within their competence, shall exercise their right to vote with a number of votes equal to the number of their member States that are Parties to the Convention. Such an organization shall not exercise its right to vote if any of its member States exercises its right, and vice versa.

Article 19

DEPOSITARY

The Secretary-General of the United Nations shall be the Depositary of the Convention and of protocols adopted in accordance with Article 17.

Article 20

SIGNATURE

This Convention shall be open for signature by States Members of the United Nations or of any of its specialized agencies or that are Parties to the Statute of the International Court of Justice and by regional economic integration organizations at Rio de Janeiro, during the United Nations Conference on Environment and Development, and thereafter at United Nations Headquarters in New York from 20 June 1992 to 19 June 1993.

Article 21

INTERIM ARRANGEMENTS

1. The secretariat functions referred to in Article 8 will be carried out on an interim basis by the secretariat established by the General Assembly of the United Nations in its resolution 45/212 of 21 December 1990, until the completion of the first session of the Conference of the Parties.

2. The head of the interim secretariat referred to in paragraph 1 above will cooperate closely with the Intergovernmental Panel on Climate Change to ensure that the Panel can respond to the need for objective scientific and technical advice. Other relevant scientific bodies could also be consulted.

3. The Global Environment Facility of the United Nations Development Programme, the United Nations Environment Programme and the International Bank for Reconstruction and Development shall be the international entity entrusted with the operation of the financial mechanism referred to in Article 11 on an interim basis. In this connection, the Global Environment Facility should be appropriately restructured and its membership made universal to enable it to fulfil the requirements of Article 11.

Article 22

RATIFICATION, ACCEPTANCE, APPROVAL OR ACCESSION

1. The Convention shall be subject to ratification, acceptance, approval or accession by States and by regional economic integration organizations. It shall be open for accession from the day after the date on which the Convention is closed for signature. Instruments of ratification, acceptance, approval or accession shall be deposited with the Depositary.

2. Any regional economic integration organization which becomes a Party to the Convention without any of its member States being a Party shall be bound by all the obligations under the Convention. In the case of such organizations, one or more of whose member States is a Party to the Convention, the organization and its member States shall decide on their respective responsibilities for the performance of their obligations under the Convention. In such cases, the organization and the member States shall not be entitled to exercise rights under the Convention concurrently.

3. In their instruments of ratification, acceptance, approval or accession, regional economic integration organizations shall declare the extent of their competence with respect to the matters governed by the Convention. These organizations shall also inform the Depositary, who shall in turn inform the Parties, of any substantial modification in the extent of their competence.

Article 23

ENTRY INTO FORCE

1. The Convention shall enter into force on the ninetieth day after the date of deposit of the fiftieth instrument of ratification, acceptance, approval or accession.

2. For each State or regional economic integration organization that ratifies, accepts or approves the Convention or accedes thereto after the deposit of the fiftieth instrument of ratification, acceptance, approval or accession, the Convention shall enter into force on the ninetieth day after the date of deposit by such State or regional economic integration organization of its instrument of ratification, acceptance, approval or accession.

3. For the purposes of paragraphs 1 and 2 above, any instrument deposited by a regional economic integration organization shall not be counted as additional to those deposited by States members of the organization.

Article 24

RESERVATIONS

No reservations may be made to the Convention.

Article 25

WITHDRAWAL

1. At any time after three years from the date on which the Convention has entered into force for a Party, that Party may withdraw from the Convention by giving written notification to the Depositary.

2. Any such withdrawal shall take effect upon expiry of one year from the date of receipt by the Depositary of the notification of withdrawal, or on such later date as may be specified in the notification of withdrawal.

3. Any Party that withdraws from the Convention shall be considered as also having withdrawn from any protocol to which it is a Party.

Article 26

AUTHENTIC TEXTS

The original of this Convention, of which the Arabic, Chinese, English, French, Russian and Spanish texts are equally authentic, shall be deposited with the Secretary-General of the United Nations.

IN WITNESS WHEREOF the undersigned, being duly authorized to that effect, have signed this Convention.

DONE at New York this ninth day of May one thousand nine hundred and ninety-two.

Annex I

Australia
Austria
Belarus[a]
Belgium
Bulgaria[a]
Canada
Croatia[a] *
Czech Republic[a] *
Denmark
European Economic Community
Estonia[a]
Finland
France
Germany
Greece
Hungary[a]
Iceland
Ireland
Italy
Japan
Latvia[a]
Liechtenstein*
Lithuania[a]
Luxembourg
Monaco*
Netherlands
New Zealand
Norway
Poland[a]
Portugal
Romania[a]
Russian Federation[a]
Slovakia[a] *
Slovenia[a] *
Spain
Sweden
Switzerland
Turkey
Ukraine[a]
United Kingdom of Great Britain and Northern Ireland
United States of America

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[a] Countries that are undergoing the process of transition to a market economy.

* *Publisher's note*: Countries added to Annex I by an amendment that entered into force on 13 August 1998, pursuant to decision 4/CP.3 adopted at COP.3.

Annex II

Australia
Austria
Belgium
Canada
Denmark
European Economic Community
Finland
France
Germany
Greece
Iceland
Ireland
Italy
Japan
Luxembourg
Netherlands
New Zealand
Norway
Portugal
Spain
Sweden
Switzerland
United Kingdom of Great Britain and Northern Ireland
United States of America

Publisher's note: Turkey was deleted from Annex II by an amendment that entered into force 28 June 2002, pursuant to decision 26/CP.7 adopted at COP.7.

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This is **Exhibit I** referred to in the

affidavit of **John Moffet**

affirmed before me on **January 29, 2019**

Commissioner for Oaths for Québec

#224458

United Nations

FCCC/CP/2015/10/Add.1

Framework Convention on Climate Change

Distr.: General
29 January 2016

Original: English

Conference of the Parties

Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015

Addendum

Part two: Action taken by the Conference of the Parties at its twenty-first session

Contents

Decisions adopted by the Conference of the Parties

Decision 1/CP.21

Adoption of the Paris Agreement

The Conference of the Parties,

Recalling decision 1/CP.17 on the establishment of the Ad Hoc Working Group on the Durban Platform for Enhanced Action,

Also recalling Articles 2, 3 and 4 of the Convention,

Further recalling relevant decisions of the Conference of the Parties, including decisions 1/CP.16, 2/CP.18, 1/CP.19 and 1/CP.20,

Welcoming the adoption of United Nations General Assembly resolution A/RES/70/1, "Transforming our world: the 2030 Agenda for Sustainable Development", in particular its goal 13, and the adoption of the Addis Ababa Action Agenda of the third International Conference on Financing for Development and the adoption of the Sendai Framework for Disaster Risk Reduction,

Recognizing that climate change represents an urgent and potentially irreversible threat to human societies and the planet and thus requires the widest possible cooperation by all countries, and their participation in an effective and appropriate international response, with a view to accelerating the reduction of global greenhouse gas emissions,

Also recognizing that deep reductions in global emissions will be required in order to achieve the ultimate objective of the Convention and *emphasizing* the need for urgency in addressing climate change,

Acknowledging that climate change is a common concern of humankind, Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights, the right to health, the rights of indigenous peoples, local communities, migrants, children, persons with disabilities and people in vulnerable situations and the right to development, as well as gender equality, empowerment of women and intergenerational equity,

Also acknowledging the specific needs and concerns of developing country Parties arising from the impact of the implementation of response measures and, in this regard, decisions 5/CP.7, 1/CP.10, 1/CP.16 and 8/CP.17,

Emphasizing with serious concern the urgent need to address the significant gap between the aggregate effect of Parties' mitigation pledges in terms of global annual emissions of greenhouse gases by 2020 and aggregate emission pathways consistent with holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels,

Also emphasizing that enhanced pre-2020 ambition can lay a solid foundation for enhanced post-2020 ambition,

Stressing the urgency of accelerating the implementation of the Convention and its Kyoto Protocol in order to enhance pre-2020 ambition,

Recognizing the urgent need to enhance the provision of finance, technology and capacity-building support by developed country Parties, in a predictable manner, to enable enhanced pre-2020 action by developing country Parties,

Emphasizing the enduring benefits of ambitious and early action, including major reductions in the cost of future mitigation and adaptation efforts, *Acknowledging* the need to promote universal access to sustainable energy in developing countries, in particular in Africa, through the enhanced deployment of renewable energy,

Agreeing to uphold and promote regional and international cooperation in order to mobilize stronger and more ambitious climate action by all Parties and non-Party stakeholders, including civil society, the private sector, financial institutions, cities and other subnational authorities, local communities and indigenous peoples,

I. Adoption

1. *Decides* to adopt the Paris Agreement under the United Nations Framework Convention on Climate Change (hereinafter referred to as "the Agreement") as contained in the annex;

2. *Requests* the Secretary-General of the United Nations to be the Depositary of the Agreement and to have it open for signature in New York, United States of America, from 22 April 2016 to 21 April 2017;

3. *Invites* the Secretary-General to convene a high-level signature ceremony for the Agreement on 22 April 2016;

4. *Also invites* all Parties to the Convention to sign the Agreement at the ceremony to be convened by the Secretary-General, or at their earliest opportunity, and to deposit their respective instruments of ratification, acceptance, approval or accession, where appropriate, as soon as possible;

5. *Recognizes* that Parties to the Convention may provisionally apply all of the provisions of the Agreement pending its entry into force, and *requests* Parties to provide notification of any such provisional application to the Depositary;

6. *Notes* that the work of the Ad Hoc Working Group on the Durban Platform for Enhanced Action, in accordance with decision 1/CP.17, paragraph 4, has been completed;

7. *Decides* to establish the Ad Hoc Working Group on the Paris Agreement under the same arrangement, mutatis mutandis, as those concerning the election of officers to the Bureau of the Ad Hoc Working Group on the Durban Platform for Enhanced Action;[1]

8. *Also decides* that the Ad Hoc Working Group on the Paris Agreement shall prepare for the entry into force of the Agreement and for the convening of the first session of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement;

9. *Further decides* to oversee the implementation of the work programme resulting from the relevant requests contained in this decision;

10. *Requests* the Ad Hoc Working Group on the Paris Agreement to report regularly to the Conference of the Parties on the progress of its work and to complete its work by the first session of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement;

11. *Decides* that the Ad Hoc Working Group on the Paris Agreement shall hold its sessions starting in 2016 in conjunction with the sessions of the Convention subsidiary bodies and shall prepare draft decisions to be recommended through the Conference of the Parties to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for consideration and adoption at its first session;

[1] Endorsed by decision 2/CP.18, paragraph 2.

II. Intended nationally determined contributions

12. *Welcomes* the intended nationally determined contributions that have been communicated by Parties in accordance with decision 1/CP.19, paragraph 2(b);

13. *Reiterates* its invitation to all Parties that have not yet done so to communicate to the secretariat their intended nationally determined contributions towards achieving the objective of the Convention as set out in its Article 2 as soon as possible and well in advance of the twenty-second session of the Conference of the Parties (November 2016) and in a manner that facilitates the clarity, transparency and understanding of the intended nationally determined contributions;

14. *Requests* the secretariat to continue to publish the intended nationally determined contributions communicated by Parties on the UNFCCC website;

15. *Reiterates* its call to developed country Parties, the operating entities of the Financial Mechanism and any other organizations in a position to do so to provide support for the preparation and communication of the intended nationally determined contributions of Parties that may need such support;

16. *Takes note* of the synthesis report on the aggregate effect of intended nationally determined contributions communicated by Parties by 1 October 2015, contained in document FCCC/CP/2015/7;

17. *Notes with concern* that the estimated aggregate greenhouse gas emission levels in 2025 and 2030 resulting from the intended nationally determined contributions do not fall within least-cost 2 ˚C scenarios but rather lead to a projected level of 55 gigatonnes in 2030, and *also notes* that much greater emission reduction efforts will be required than those associated with the intended nationally determined contributions in order to hold the increase in the global average temperature to below 2 ˚C above pre-industrial levels by reducing emissions to 40 gigatonnes or to 1.5 ˚C above pre-industrial levels by reducing to a level to be identified in the special report referred to in paragraph 21 below;

18. *Further notes*, in this context, the adaptation needs expressed by many developing country Parties in their intended nationally determined contributions;

19. *Requests* the secretariat to update the synthesis report referred to in paragraph 16 above so as to cover all the information in the intended nationally determined contributions communicated by Parties pursuant to decision 1/CP.20 by 4 April 2016 and to make it available by 2 May 2016;

20. *Decides* to convene a facilitative dialogue among Parties in 2018 to take stock of the collective efforts of Parties in relation to progress towards the long-term goal referred to in Article 4, paragraph 1, of the Agreement and to inform the preparation of nationally determined contributions pursuant to Article 4, paragraph 8, of the Agreement;

21. *Invites* the Intergovernmental Panel on Climate Change to provide a special report in 2018 on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways;

III. Decisions to give effect to the Agreement

Mitigation

22. *Also invites* Parties to communicate their first nationally determined contribution no later than when the Party submits its respective instrument of ratification, acceptance, approval or accession of the Paris Agreement; if a Party has communicated an intended

nationally determined contribution prior to joining the Agreement, that Party shall be considered to have satisfied this provision unless that Party decides otherwise;

23. *Requests* those Parties whose intended nationally determined contribution pursuant to decision 1/CP.20 contains a time frame up to 2025 to communicate by 2020 a new nationally determined contribution and to do so every five years thereafter pursuant to Article 4, paragraph 9, of the Agreement;

24. *Also requests* those Parties whose intended nationally determined contribution pursuant to decision 1/CP.20 contains a time frame up to 2030 to communicate or update by 2020 these contributions and to do so every five years thereafter pursuant to Article 4, paragraph 9, of the Agreement;

25. *Decides* that Parties shall submit to the secretariat their nationally determined contributions referred to in Article 4 of the Agreement at least 9 to 12 months in advance of the relevant session of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement with a view to facilitating the clarity, transparency and understanding of these contributions, including through a synthesis report prepared by the secretariat;

26. *Requests* the Ad Hoc Working Group on the Paris Agreement to develop further guidance on features of the nationally determined contributions for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

27. *Agrees* that the information to be provided by Parties communicating their nationally determined contributions, in order to facilitate clarity, transparency and understanding, may include, as appropriate, inter alia, quantifiable information on the reference point (including, as appropriate, a base year), time frames and/or periods for implementation, scope and coverage, planning processes, assumptions and methodological approaches including those for estimating and accounting for anthropogenic greenhouse gas emissions and, as appropriate, removals, and how the Party considers that its nationally determined contribution is fair and ambitious, in the light of its national circumstances, and how it contributes towards achieving the objective of the Convention as set out in its Article 2;

28. *Requests* the Ad Hoc Working Group on the Paris Agreement to develop further guidance for the information to be provided by Parties in order to facilitate clarity, transparency and understanding of nationally determined contributions for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

29. *Also requests* the Subsidiary Body for Implementation to develop modalities and procedures for the operation and use of the public registry referred to in Article 4, paragraph 12, of the Agreement, for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

30. *Further requests* the secretariat to make available an interim public registry in the first half of 2016 for the recording of nationally determined contributions submitted in accordance with Article 4 of the Agreement, pending the adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement of the modalities and procedures referred to in paragraph 29 above;

31. *Requests* the Ad Hoc Working Group on the Paris Agreement to elaborate, drawing from approaches established under the Convention and its related legal instruments as appropriate, guidance for accounting for Parties' nationally determined contributions, as referred to in Article 4, paragraph 13, of the Agreement, for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session, which ensures that:

(a) Parties account for anthropogenic emissions and removals in accordance with methodologies and common metrics assessed by the Intergovernmental Panel on Climate Change and adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement;

(b) Parties ensure methodological consistency, including on baselines, between the communication and implementation of nationally determined contributions;

(c) Parties strive to include all categories of anthropogenic emissions or removals in their nationally determined contributions and, once a source, sink or activity is included, continue to include it;

(d) Parties shall provide an explanation of why any categories of anthropogenic emissions or removals are excluded;

32. *Decides* that Parties shall apply the guidance referred to in paragraph 31 above to the second and subsequent nationally determined contributions and that Parties may elect to apply such guidance to their first nationally determined contribution;

33. *Also decides* that the forum on the impact of the implementation of response measures, under the subsidiary bodies, shall continue, and shall serve the Agreement;

34. *Further decides* that the Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation shall recommend, for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session, the modalities, work programme and functions of the forum on the impact of the implementation of response measures to address the effects of the implementation of response measures under the Agreement by enhancing cooperation amongst Parties on understanding the impacts of mitigation actions under the Agreement and the exchange of information, experiences, and best practices amongst Parties to raise their resilience to these impacts;

35. *Invites* Parties to communicate, by 2020, to the secretariat mid-century, long-term low greenhouse gas emission development strategies in accordance with Article 4, paragraph 19, of the Agreement, and *requests* the secretariat to publish on the UNFCCC website Parties' low greenhouse gas emission development strategies as communicated;

36. *Requests* the Subsidiary Body for Scientific and Technological Advice to develop and recommend the guidance referred to under Article 6, paragraph 2, of the Agreement for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session, including guidance to ensure that double counting is avoided on the basis of a corresponding adjustment by Parties for both anthropogenic emissions by sources and removals by sinks covered by their nationally determined contributions under the Agreement;

37. *Recommends* that the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement adopt rules, modalities and procedures for the mechanism established by Article 6, paragraph 4, of the Agreement on the basis of:

(a) Voluntary participation authorized by each Party involved;

(b) Real, measurable, and long-term benefits related to the mitigation of climate change;

(c) Specific scopes of activities;

(d) Reductions in emissions that are additional to any that would otherwise occur;

(e) Verification and certification of emission reductions resulting from mitigation activities by designated operational entities;

(f) Experience gained with and lessons learned from existing mechanisms and approaches adopted under the Convention and its related legal instruments;

38. *Requests* the Subsidiary Body for Scientific and Technological Advice to develop and recommend rules, modalities and procedures for the mechanism referred to in paragraph 37 above for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

39. *Also requests* the Subsidiary Body for Scientific and Technological Advice to undertake a work programme under the framework for non-market approaches to sustainable development referred to in Article 6, paragraph 8, of the Agreement, with the objective of considering how to enhance linkages and create synergy between, inter alia, mitigation, adaptation, finance, technology transfer and capacity-building, and how to facilitate the implementation and coordination of non-market approaches;

40. *Further requests* the Subsidiary Body for Scientific and Technological Advice to recommend a draft decision on the work programme referred to in paragraph 39 above, taking into account the views of Parties, for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

Adaptation

41. *Requests* the Adaptation Committee and the Least Developed Countries Expert Group to jointly develop modalities to recognize the adaptation efforts of developing country Parties, as referred to in Article 7, paragraph 3, of the Agreement, and make recommendations for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

42. *Also requests* the Adaptation Committee, taking into account its mandate and its second three-year workplan, and with a view to preparing recommendations for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session:

(a) To review, in 2017, the work of adaptation-related institutional arrangements under the Convention, with a view to identifying ways to enhance the coherence of their work, as appropriate, in order to respond adequately to the needs of Parties;

(b) To consider methodologies for assessing adaptation needs with a view to assisting developing country Parties, without placing an undue burden on them;

43. *Invites* all relevant United Nations agencies and international, regional and national financial institutions to provide information to Parties through the secretariat on how their development assistance and climate finance programmes incorporate climate-proofing and climate resilience measures;

44. *Requests* Parties to strengthen regional cooperation on adaptation where appropriate and, where necessary, establish regional centres and networks, in particular in developing countries, taking into account decision 1/CP.16, paragraph 30;

45. *Also requests* the Adaptation Committee and the Least Developed Countries Expert Group, in collaboration with the Standing Committee on Finance and other relevant institutions, to develop methodologies, and make recommendations for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session on:

(a) Taking the necessary steps to facilitate the mobilization of support for adaptation in developing countries in the context of the limit to global average temperature increase referred to in Article 2 of the Agreement;

(b) Reviewing the adequacy and effectiveness of adaptation and support referred to in Article 7, paragraph 14(c), of the Agreement;

46. *Further requests* the Green Climate Fund to expedite support for the least developed countries and other developing country Parties for the formulation of national adaptation plans, consistent with decisions 1/CP.16 and 5/CP.17, and for the subsequent implementation of policies, projects and programmes identified by them;

Loss and damage

47. *Decides* on the continuation of the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts, following the review in 2016;

48. *Requests* the Executive Committee of the Warsaw International Mechanism to establish a clearing house for risk transfer that serves as a repository for information on insurance and risk transfer, in order to facilitate the efforts of Parties to develop and implement comprehensive risk management strategies;

49. *Also requests* the Executive Committee of the Warsaw International Mechanism to establish, according to its procedures and mandate, a task force to complement, draw upon the work of and involve, as appropriate, existing bodies and expert groups under the Convention including the Adaptation Committee and the Least Developed Countries Expert Group, as well as relevant organizations and expert bodies outside the Convention, to develop recommendations for integrated approaches to avert, minimize and address displacement related to the adverse impacts of climate change;

50. *Further requests* the Executive Committee of the Warsaw International Mechanism to initiate its work, at its next meeting, to operationalize the provisions referred to in paragraphs 48 and 49 above, and to report on progress thereon in its annual report;

51. *Agrees* that Article 8 of the Agreement does not involve or provide a basis for any liability or compensation;

Finance

52. *Decides* that, in the implementation of the Agreement, financial resources provided to developing country Parties should enhance the implementation of their policies, strategies, regulations and action plans and their climate change actions with respect to both mitigation and adaptation to contribute to the achievement of the purpose of the Agreement as defined in its Article 2;

53. *Also decides* that, in accordance with Article 9, paragraph 3, of the Agreement, developed countries intend to continue their existing collective mobilization goal through 2025 in the context of meaningful mitigation actions and transparency on implementation; prior to 2025 the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall set a new collective quantified goal from a floor of USD 100 billion per year, taking into account the needs and priorities of developing countries;

54. *Recognizes* the importance of adequate and predictable financial resources, including for results-based payments, as appropriate, for the implementation of policy approaches and positive incentives for reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks; as well as alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests; while reaffirming the importance of non-carbon benefits associated with such

approaches; encouraging the coordination of support from, inter alia, public and private, bilateral and multilateral sources, such as the Green Climate Fund, and alternative sources in accordance with relevant decisions by the Conference of the Parties;

55. *Decides* to initiate, at its twenty-second session, a process to identify the information to be provided by Parties, in accordance with Article 9, paragraph 5, of the Agreement with a view to providing a recommendation for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

56. *Also decides* to ensure that the provision of information in accordance with Article 9, paragraph 7, of the Agreement shall be undertaken in accordance with the modalities, procedures and guidelines referred to in paragraph 91 below;

57. *Requests* the Subsidiary Body for Scientific and Technological Advice to develop modalities for the accounting of financial resources provided and mobilized through public interventions in accordance with Article 9, paragraph 7, of the Agreement for consideration by the Conference of the Parties at its twenty-fourth session (November 2018), with a view to making a recommendation for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

58. *Decides* that the Green Climate Fund and the Global Environment Facility, the entities entrusted with the operation of the Financial Mechanism of the Convention, as well as the Least Developed Countries Fund and the Special Climate Change Fund, administered by the Global Environment Facility, shall serve the Agreement;

59. *Recognizes* that the Adaptation Fund may serve the Agreement, subject to relevant decisions by the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol and the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement;

60. *Invites* the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol to consider the issue referred to in paragraph 59 above and make a recommendation to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

61. *Recommends* that the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall provide guidance to the entities entrusted with the operation of the Financial Mechanism of the Convention on the policies, programme priorities and eligibility criteria related to the Agreement for transmission by the Conference of the Parties;

62. *Decides* that the guidance to the entities entrusted with the operations of the Financial Mechanism of the Convention in relevant decisions of the Conference of the Parties, including those agreed before adoption of the Agreement, shall apply mutatis mutandis to the Agreement;

63. *Also decides* that the Standing Committee on Finance shall serve the Agreement in line with its functions and responsibilities established under the Conference of the Parties;

64. *Urges* the institutions serving the Agreement to enhance the coordination and delivery of resources to support country-driven strategies through simplified and efficient application and approval procedures, and through continued readiness support to developing country Parties, including the least developed countries and small island developing States, as appropriate;

Technology development and transfer

65. *Takes note* of the interim report of the Technology Executive Committee on guidance on enhanced implementation of the results of technology needs assessments as contained in document FCCC/SB/2015/INF.3;

66. *Decides* to strengthen the Technology Mechanism and *requests* the Technology Executive Committee and the Climate Technology Centre and Network, in supporting the implementation of the Agreement, to undertake further work relating to, inter alia:

(a) Technology research, development and demonstration;

(b) The development and enhancement of endogenous capacities and technologies;

67. *Requests* the Subsidiary Body for Scientific and Technological Advice to initiate, at its forty-fourth session (May 2016), the elaboration of the technology framework established under Article 10, paragraph 4, of the Agreement and to report on its findings to the Conference of the Parties, with a view to the Conference of the Parties making a recommendation on the framework to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for consideration and adoption at its first session, taking into consideration that the framework should facilitate, inter alia:

(a) The undertaking and updating of technology needs assessments, as well as the enhanced implementation of their results, particularly technology action plans and project ideas, through the preparation of bankable projects;

(b) The provision of enhanced financial and technical support for the implementation of the results of the technology needs assessments;

(c) The assessment of technologies that are ready for transfer;

(d) The enhancement of enabling environments for and the addressing of barriers to the development and transfer of socially and environmentally sound technologies;

68. *Decides* that the Technology Executive Committee and the Climate Technology Centre and Network shall report to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, through the subsidiary bodies, on their activities to support the implementation of the Agreement;

69. *Also decides* to undertake a periodic assessment of the effectiveness and adequacy of the support provided to the Technology Mechanism in supporting the implementation of the Agreement on matters relating to technology development and transfer;

70. *Requests* the Subsidiary Body for Implementation to initiate, at its forty-fourth session, the elaboration of the scope of and modalities for the periodic assessment referred to in paragraph 69 above, taking into account the review of the Climate Technology Centre and Network as referred to in decision 2/CP.17, annex VII, paragraph 20, and the modalities for the global stocktake referred to in Article 14 of the Agreement, for consideration and adoption by the Conference of the Parties at its twenty-fifth session (November 2019);

Capacity-building

71. *Decides* to establish the Paris Committee on Capacity-building whose aim will be to address gaps and needs, both current and emerging, in implementing capacity-building in developing country Parties and further enhancing capacity-building efforts, including with regard to coherence and coordination in capacity-building activities under the Convention;

72. *Also decides* that the Paris Committee on Capacity-building will manage and oversee the workplan referred to in paragraph 73 below;

73. *Further decides* to launch a workplan for the period 2016–2020 with the following activities:

(a) Assessing how to increase synergies through cooperation and avoid duplication among existing bodies established under the Convention that implement capacity-building activities, including through collaborating with institutions under and outside the Convention;

(b) Identifying capacity gaps and needs and recommending ways to address them;

(c) Promoting the development and dissemination of tools and methodologies for the implementation of capacity-building;

(d) Fostering global, regional, national and subnational cooperation;

(e) Identifying and collecting good practices, challenges, experiences and lessons learned from work on capacity-building by bodies established under the Convention;

(f) Exploring how developing country Parties can take ownership of building and maintaining capacity over time and space;

(g) Identifying opportunities to strengthen capacity at the national, regional and subnational level;

(h) Fostering dialogue, coordination, collaboration and coherence among relevant processes and initiatives under the Convention, including through exchanging information on capacity-building activities and strategies of bodies established under the Convention;

(i) Providing guidance to the secretariat on the maintenance and further development of the web-based capacity-building portal;

74. *Decides* that the Paris Committee on Capacity-building will annually focus on an area or theme related to enhanced technical exchange on capacity-building, with the purpose of maintaining up-to-date knowledge on the successes and challenges in building capacity effectively in a particular area;

75. *Requests* the Subsidiary Body for Implementation to organize annual in-session meetings of the Paris Committee on Capacity-building;

76. *Also requests* the Subsidiary Body for Implementation to develop the terms of reference for the Paris Committee on Capacity-building, in the context of the third comprehensive review of the implementation of the capacity-building framework, also taking into account paragraphs 71–75 above and paragraphs 79 and 80 below, with a view to recommending a draft decision on this matter for consideration and adoption by the Conference of the Parties at its twenty-second session;

77. *Invites* Parties to submit their views on the membership of the Paris Committee on Capacity-building by 9 March 2016;[2]

78. *Requests* the secretariat to compile the submissions referred to in paragraph 77 above into a miscellaneous document for consideration by the Subsidiary Body for Implementation at its forty-fourth session;

79. *Decides* that the inputs to the Paris Committee on Capacity-building will include, inter alia, submissions, the outcome of the third comprehensive review of the implementation of the capacity-building framework, the secretariat's annual synthesis report on the implementation of the framework for capacity-building in developing

[2] Parties should submit their views via the submissions portal at <http://www.unfccc.int/5900>.

countries, the secretariat's compilation and synthesis report on capacity-building work of bodies established under the Convention and its Kyoto Protocol, and reports on the Durban Forum and the capacity-building portal;

80. *Requests* the Paris Committee on Capacity-building to prepare annual technical progress reports on its work, and to make these reports available at the sessions of the Subsidiary Body for Implementation coinciding with the sessions of the Conference of the Parties;

81. *Decides*, at its twenty-fifth session, to review the progress, need for extension, the effectiveness and enhancement of the Paris Committee on Capacity-building and to take any action it considers appropriate, with a view to making recommendations to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session on enhancing institutional arrangements for capacity-building consistent with Article 11, paragraph 5, of the Agreement;

82. *Calls upon* all Parties to ensure that education, training and public awareness, as reflected in Article 6 of the Convention and in Article 12 of the Agreement, are adequately considered in their contribution to capacity-building;

83. *Invites* the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, at its first session, to explore ways of enhancing the implementation of training, public awareness, public participation and public access to information so as to enhance actions under the Agreement;

<u>Transparency of action and support</u>

84. *Decides* to establish a Capacity-building Initiative for Transparency in order to build institutional and technical capacity, both pre- and post-2020; this initiative will support developing country Parties, upon request, in meeting enhanced transparency requirements as defined in Article 13 of the Agreement in a timely manner;

85. *Also decides* that the Capacity-building Initiative for Transparency will aim:

(a) To strengthen national institutions for transparency-related activities in line with national priorities;

(b) To provide relevant tools, training and assistance for meeting the provisions stipulated in Article 13 of the Agreement;

(c) To assist in the improvement of transparency over time;

86. *Urges and requests* the Global Environment Facility to make arrangements to support the establishment and operation of the Capacity-building Initiative for Transparency as a priority reporting-related need, including through voluntary contributions to support developing country Parties in the sixth replenishment of the Global Environment Facility and future replenishment cycles, to complement existing support under the Global Environment Facility;

87. *Decides* to assess the implementation of the Capacity-building Initiative for Transparency in the context of the seventh review of the Financial Mechanism;

88. *Requests* that the Global Environment Facility, as an operating entity of the Financial Mechanism, include in its annual report to the Conference of the Parties the progress of work in the design, development and implementation of the Capacity-building Initiative for Transparency referred to in paragraph 84 above starting in 2016;

89. *Decides* that, in accordance with Article 13, paragraph 2, of the Agreement, developing country Parties shall be provided flexibility in the implementation of the provisions of that Article, including in the scope, frequency and level of detail of reporting,

and in the scope of review, and that the scope of review could provide for in-country reviews to be optional, while such flexibilities shall be reflected in the development of modalities, procedures and guidelines referred to in paragraph 91 below;

90. *Also decides* that all Parties, except for the least developed country Parties and small island developing States, shall submit the information referred to in Article 13, paragraphs 7, 8, 9 and 10, of the Agreement, as appropriate, no less frequently than on a biennial basis, and that the least developed country Parties and small island developing States may submit this information at their discretion;

91. *Requests* the Ad Hoc Working Group on the Paris Agreement to develop recommendations for modalities, procedures and guidelines in accordance with Article 13, paragraph 13, of the Agreement, and to define the year of their first and subsequent review and update, as appropriate, at regular intervals, for consideration by the Conference of the Parties, at its twenty-fourth session, with a view to forwarding them to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for consideration and adoption at its first session;

92. *Also requests* the Ad Hoc Working Group on the Paris Agreement, in developing the recommendations for the modalities, procedures and guidelines referred to in paragraph 91 above, to take into account, inter alia:

(a) The importance of facilitating improved reporting and transparency over time;

(b) The need to provide flexibility to those developing country Parties that need it in the light of their capacities;

(c) The need to promote transparency, accuracy, completeness, consistency and comparability;

(d) The need to avoid duplication as well as undue burden on Parties and the secretariat;

(e) The need to ensure that Parties maintain at least the frequency and quality of reporting in accordance with their respective obligations under the Convention;

(f) The need to ensure that double counting is avoided;

(g) The need to ensure environmental integrity;

93. *Further requests* the Ad Hoc Working Group on the Paris Agreement, in developing the modalities, procedures and guidelines referred to in paragraph 91 above, to draw on the experiences from and take into account other ongoing relevant processes under the Convention;

94. *Requests* the Ad Hoc Working Group on the Paris Agreement, in developing the modalities, procedures and guidelines referred to in paragraph 91 above, to consider, inter alia:

(a) The types of flexibility available to those developing country Parties that need it on the basis of their capacities;

(b) The consistency between the methodology communicated in the nationally determined contribution and the methodology for reporting on progress made towards achieving individual Parties' respective nationally determined contribution;

(c) That Parties report information on adaptation action and planning including, if appropriate, their national adaptation plans, with a view to collectively exchanging information and sharing lessons learned;

(d) Support provided, enhancing delivery of support for both adaptation and mitigation through, inter alia, the common tabular formats for reporting support, and taking into account issues considered by the Subsidiary Body for Scientific and Technological Advice on methodologies for reporting on financial information, and enhancing the reporting by developing country Parties on support received, including the use, impact and estimated results thereof;

(e) Information in the biennial assessments and other reports of the Standing Committee on Finance and other relevant bodies under the Convention;

(f) Information on the social and economic impact of response measures;

95. *Also requests* the Ad Hoc Working Group on the Paris Agreement, in developing recommendations for the modalities, procedures and guidelines referred to in paragraph 91 above, to enhance the transparency of support provided in accordance with Article 9 of the Agreement;

96. *Further requests* the Ad Hoc Working Group on the Paris Agreement to report on the progress of work on the modalities, procedures and guidelines referred to in paragraph 91 above to future sessions of the Conference of the Parties, and that this work be concluded no later than 2018;

97. *Decides* that the modalities, procedures and guidelines developed under paragraph 91 above shall be applied upon the entry into force of the Paris Agreement;

98. *Also decides* that the modalities, procedures and guidelines of this transparency framework shall build upon and eventually supersede the measurement, reporting and verification system established by decision 1/CP.16, paragraphs 40–47 and 60–64, and decision 2/CP.17, paragraphs 12–62, immediately following the submission of the final biennial reports and biennial update reports;

Global stocktake

99. *Requests* the Ad Hoc Working Group on the Paris Agreement to identify the sources of input for the global stocktake referred to in Article 14 of the Agreement and to report to the Conference of the Parties, with a view to the Conference of the Parties making a recommendation to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for consideration and adoption at its first session, including, but not limited to:

(a) Information on:

(i) The overall effect of the nationally determined contributions communicated by Parties;

(ii) The state of adaptation efforts, support, experiences and priorities from the communications referred to in Article 7, paragraphs 10 and 11, of the Agreement, and reports referred to in Article 13, paragraph 8, of the Agreement;

(iii) The mobilization and provision of support;

(b) The latest reports of the Intergovernmental Panel on Climate Change;

(c) Reports of the subsidiary bodies;

100. *Also requests* the Subsidiary Body for Scientific and Technological Advice to provide advice on how the assessments of the Intergovernmental Panel on Climate Change can inform the global stocktake of the implementation of the Agreement pursuant to its Article 14 and to report on this matter to the Ad Hoc Working Group on the Paris Agreement at its second session;

101. *Further requests* the Ad Hoc Working Group on the Paris Agreement to develop modalities for the global stocktake referred to in Article 14 of the Agreement and to report to the Conference of the Parties, with a view to the Conference of the Parties making a recommendation to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for consideration and adoption at its first session;

Facilitating implementation and compliance

102. *Decides* that the committee referred to in Article 15, paragraph 2, of the Agreement shall consist of 12 members with recognized competence in relevant scientific, technical, socioeconomic or legal fields, to be elected by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on the basis of equitable geographical representation, with two members each from the five regional groups of the United Nations and one member each from the small island developing States and the least developed countries, while taking into account the goal of gender balance;

103. *Requests* the Ad Hoc Working Group on the Paris Agreement to develop the modalities and procedures for the effective operation of the committee referred to in Article 15, paragraph 2, of the Agreement, with a view to the Ad Hoc Working Group on the Paris Agreement completing its work on such modalities and procedures for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

Final clauses

104. *Also requests* the secretariat, solely for the purposes of Article 21 of the Agreement, to make available on its website on the date of adoption of the Agreement as well as in the report of the Conference of the Parties on its twenty-first session, information on the most up-to-date total and per cent of greenhouse gas emissions communicated by Parties to the Convention in their national communications, greenhouse gas inventory reports, biennial reports or biennial update reports;

IV. Enhanced action prior to 2020

105. *Resolves* to ensure the highest possible mitigation efforts in the pre-2020 period, including by:

(a) Urging all Parties to the Kyoto Protocol that have not already done so to ratify and implement the Doha Amendment to the Kyoto Protocol;

(b) Urging all Parties that have not already done so to make and implement a mitigation pledge under the Cancun Agreements;

(c) Reiterating its resolve, as set out in decision 1/CP.19, paragraphs 3 and 4, to accelerate the full implementation of the decisions constituting the agreed outcome pursuant to decision 1/CP.13 and enhance ambition in the pre-2020 period in order to ensure the highest possible mitigation efforts under the Convention by all Parties;

(d) Inviting developing country Parties that have not submitted their first biennial update reports to do so as soon as possible;

(e) Urging all Parties to participate in the existing measurement, reporting and verification processes under the Cancun Agreements, in a timely manner, with a view to demonstrating progress made in the implementation of their mitigation pledges;

106. *Encourages* Parties to promote the voluntary cancellation by Party and non-Party stakeholders, without double counting, of units issued under the Kyoto Protocol, including certified emission reductions that are valid for the second commitment period;

107. *Urges* host and purchasing Parties to report transparently on internationally transferred mitigation outcomes, including outcomes used to meet international pledges, and emission units issued under the Kyoto Protocol with a view to promoting environmental integrity and avoiding double counting;

108. *Recognizes* the social, economic and environmental value of voluntary mitigation actions and their co-benefits for adaptation, health and sustainable development;

109. *Resolves* to strengthen, in the period 2016–2020, the existing technical examination process on mitigation as defined in decision 1/CP.19, paragraph 5(a), and decision 1/CP.20, paragraph 19, taking into account the latest scientific knowledge, including by:

(a) Encouraging Parties, Convention bodies and international organizations to engage in this process, including, as appropriate, in cooperation with relevant non-Party stakeholders, to share their experiences and suggestions, including from regional events, and to cooperate in facilitating the implementation of policies, practices and actions identified during this process in accordance with national sustainable development priorities;

(b) Striving to improve, in consultation with Parties, access to and participation in this process by developing country Party and non-Party experts;

(c) Requesting the Technology Executive Committee and the Climate Technology Centre and Network in accordance with their respective mandates:

(i) To engage in the technical expert meetings and enhance their efforts to facilitate and support Parties in scaling up the implementation of policies, practices and actions identified during this process;

(ii) To provide regular updates during the technical expert meetings on the progress made in facilitating the implementation of policies, practices and actions previously identified during this process;

(iii) To include information on their activities under this process in their joint annual report to the Conference of the Parties;

(d) Encouraging Parties to make effective use of the Climate Technology Centre and Network to obtain assistance to develop economically, environmentally and socially viable project proposals in the high mitigation potential areas identified in this process;

110. *Encourages* the operating entities of the Financial Mechanism of the Convention to engage in the technical expert meetings and to inform participants of their contribution to facilitating progress in the implementation of policies, practices and actions identified during the technical examination process;

111. *Requests* the secretariat to organize the process referred to in paragraph 109 above and disseminate its results, including by:

(a) Organizing, in consultation with the Technology Executive Committee and relevant expert organizations, regular technical expert meetings focusing on specific policies, practices and actions representing best practices and with the potential to be scalable and replicable;

(b) Updating, on an annual basis, following the meetings referred to in paragraph 111(a) above and in time to serve as input to the summary for policymakers referred to in paragraph 111(c) below, a technical paper on the mitigation benefits and co-benefits of policies, practices and actions for enhancing mitigation ambition, as well as on options for supporting their implementation, information on which should be made available in a user-friendly online format;

(c) Preparing, in consultation with the champions referred to in paragraph 121 below, a summary for policymakers, with information on specific policies, practices and actions representing best practices and with the potential to be scalable and replicable, and on options to support their implementation, as well as on relevant collaborative initiatives, and publishing the summary at least two months in advance of each session of the Conference of the Parties as input for the high-level event referred to in paragraph 120 below;

112. *Decides* that the process referred to in paragraph 109 above should be organized jointly by the Subsidiary Body for Implementation and the Subsidiary Body for Scientific and Technological Advice and should take place on an ongoing basis until 2020;

113. *Also decides* to conduct in 2017 an assessment of the process referred to in paragraph 109 above so as to improve its effectiveness;

114. *Resolves* to enhance the provision of urgent and adequate finance, technology and capacity-building support by developed country Parties in order to enhance the level of ambition of pre-2020 action by Parties, and in this regard *strongly urges* developed country Parties to scale up their level of financial support, with a concrete road map to achieve the goal of jointly providing USD 100 billion annually by 2020 for mitigation and adaptation while significantly increasing adaptation finance from current levels and to further provide appropriate technology and capacity-building support;

115. *Decides* to conduct a facilitative dialogue in conjunction with the twenty-second session of the Conference of the Parties to assess the progress in implementing decision 1/CP.19, paragraphs 3 and 4, and identify relevant opportunities to enhance the provision of financial resources, including for technology development and transfer, and capacity-building support, with a view to identifying ways to enhance the ambition of mitigation efforts by all Parties, including identifying relevant opportunities to enhance the provision and mobilization of support and enabling environments;

116. *Acknowledges* with appreciation the results of the Lima-Paris Action Agenda, which build on the climate summit convened on 23 September 2014 by the Secretary-General of the United Nations;

117. *Welcomes* the efforts of non-Party stakeholders to scale up their climate actions, and *encourages* the registration of those actions in the Non-State Actor Zone for Climate Action platform;[3]

118. *Encourages* Parties to work closely with non-Party stakeholders to catalyse efforts to strengthen mitigation and adaptation action;

119. *Also encourages* non-Party stakeholders to increase their engagement in the processes referred to in paragraph 109 above and paragraph 124 below;

120. *Agrees* to convene, pursuant to decision 1/CP.20, paragraph 21, building on the Lima-Paris Action Agenda and in conjunction with each session of the Conference of the Parties during the period 2016–2020, a high-level event that:

(a) Further strengthens high-level engagement on the implementation of policy options and actions arising from the processes referred to in paragraph 109 above and paragraph 124 below, drawing on the summary for policymakers referred to in paragraph 111(c) above;

(b) Provides an opportunity for announcing new or strengthened voluntary efforts, initiatives and coalitions, including the implementation of policies, practices and actions arising from the processes referred to in paragraph 109 above and paragraph 124

[3] <http://climateaction.unfccc.int/>.

below and presented in the summary for policymakers referred to in paragraph 111(c) above;

(c) Takes stock of related progress and recognizes new or strengthened voluntary efforts, initiatives and coalitions;

(d) Provides meaningful and regular opportunities for the effective high-level engagement of dignitaries of Parties, international organizations, international cooperative initiatives and non-Party stakeholders;

121. *Decides* that two high-level champions shall be appointed to act on behalf of the President of the Conference of the Parties to facilitate through strengthened high-level engagement in the period 2016–2020 the successful execution of existing efforts and the scaling-up and introduction of new or strengthened voluntary efforts, initiatives and coalitions, including by:

(a) Working with the Executive Secretary and the current and incoming Presidents of the Conference of the Parties to coordinate the annual high-level event referred to in paragraph 120 above;

(b) Engaging with interested Parties and non-Party stakeholders, including to further the voluntary initiatives of the Lima-Paris Action Agenda;

(c) Providing guidance to the secretariat on the organization of technical expert meetings referred to in paragraph 111(a) above and paragraph 129(a) below;

122. *Also decides* that the high-level champions referred to in paragraph 121 above should normally serve for a term of two years, with their terms overlapping for a full year to ensure continuity, such that:

(a) The President of the twenty-first session of the Conference of the Parties should appoint one champion, who should serve for one year from the date of the appointment until the last day of the twenty-second session of the Conference of the Parties;

(b) The President of the twenty-second session of the Conference of the Parties should appoint one champion who should serve for two years from the date of the appointment until the last day of the twenty-third session of the Conference of the Parties (November 2017);

(c) Thereafter, each subsequent President of the Conference of the Parties should appoint one champion who should serve for two years and succeed the previously appointed champion whose term has ended;

123. *Invites* all interested Parties and relevant organizations to provide support for the work of the champions referred to in paragraph 121 above;

124. *Decides* to launch, in the period 2016–2020, a technical examination process on adaptation;

125. *Also decides* that the process referred to in paragraph 124 above will endeavour to identify concrete opportunities for strengthening resilience, reducing vulnerabilities and increasing the understanding and implementation of adaptation actions;

126. *Further decides* that the process referred to in paragraph 124 above should be organized jointly by the Subsidiary Body for Implementation and the Subsidiary Body for Scientific and Technological Advice, and conducted by the Adaptation Committee;

127. *Decides* that the process referred to in paragraph 124 above will be pursued by:

(a) Facilitating the sharing of good practices, experiences and lessons learned;

(b) Identifying actions that could significantly enhance the implementation of adaptation actions, including actions that could enhance economic diversification and have mitigation co-benefits;

(c) Promoting cooperative action on adaptation;

(d) Identifying opportunities to strengthen enabling environments and enhance the provision of support for adaptation in the context of specific policies, practices and actions;

128. *Also decides* that the technical examination process on adaptation referred to in paragraph 124 above will take into account the process, modalities, outputs, outcomes and lessons learned from the technical examination process on mitigation referred to in paragraph 109 above;

129. *Requests* the secretariat to support the process referred to in paragraph 124 above by:

(a) Organizing regular technical expert meetings focusing on specific policies, strategies and actions;

(b) Preparing annually, on the basis of the meetings referred to in paragraph 129(a) above and in time to serve as an input to the summary for policymakers referred to in paragraph 111(c) above, a technical paper on opportunities to enhance adaptation action, as well as options to support their implementation, information on which should be made available in a user-friendly online format;

130. *Decides* that in conducting the process referred to in paragraph 124 above, the Adaptation Committee will engage with and explore ways to take into account, synergize with and build on the existing arrangements for adaptation-related work programmes, bodies and institutions under the Convention so as to ensure coherence and maximum value;

131. *Also decides* to conduct, in conjunction with the assessment referred to in paragraph 113 above, an assessment of the process referred to in paragraph 124 above, so as to improve its effectiveness;

132. *Invites* Parties and observer organizations to submit information on the opportunities referred to in paragraph 125 above by 3 February 2016;

V. Non-Party stakeholders

133. *Welcomes* the efforts of all non-Party stakeholders to address and respond to climate change, including those of civil society, the private sector, financial institutions, cities and other subnational authorities;

134. *Invites* the non-Party stakeholders referred to in paragraph 133 above to scale up their efforts and support actions to reduce emissions and/or to build resilience and decrease vulnerability to the adverse effects of climate change and demonstrate these efforts via the Non-State Actor Zone for Climate Action platform[4] referred to in paragraph 117 above;

135. *Recognizes* the need to strengthen knowledge, technologies, practices and efforts of local communities and indigenous peoples related to addressing and responding to climate change, and *establishes* a platform for the exchange of experiences and sharing of best practices on mitigation and adaptation in a holistic and integrated manner;

[4] <http://climateaction.unfccc.int/>.

136. *Also recognizes* the important role of providing incentives for emission reduction activities, including tools such as domestic policies and carbon pricing;

VI. Administrative and budgetary matters

137. *Takes note* of the estimated budgetary implications of the activities to be undertaken by the secretariat referred to in this decision and *requests* that the actions of the secretariat called for in this decision be undertaken subject to the availability of financial resources;

138. *Emphasizes* the urgency of making additional resources available for the implementation of the relevant actions, including actions referred to in this decision, and the implementation of the work programme referred to in paragraph 9 above;

139. *Urges* Parties to make voluntary contributions for the timely implementation of this decision.

Annex

Paris Agreement

The Parties to this Agreement,

Being Parties to the United Nations Framework Convention on Climate Change, hereinafter referred to as “the Convention”,

Pursuant to the Durban Platform for Enhanced Action established by decision 1/CP.17 of the Conference of the Parties to the Convention at its seventeenth session,

In pursuit of the objective of the Convention, and being guided by its principles, including the principle of equity and common but differentiated responsibilities and respective capabilities, in the light of different national circumstances,

Recognizing the need for an effective and progressive response to the urgent threat of climate change on the basis of the best available scientific knowledge,

Also recognizing the specific needs and special circumstances of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change, as provided for in the Convention,

Taking full account of the specific needs and special situations of the least developed countries with regard to funding and transfer of technology,

Recognizing that Parties may be affected not only by climate change, but also by the impacts of the measures taken in response to it,

Emphasizing the intrinsic relationship that climate change actions, responses and impacts have with equitable access to sustainable development and eradication of poverty,

Recognizing the fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse impacts of climate change,

Taking into account the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities,

Acknowledging that climate change is a common concern of humankind, Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights, the right to health, the rights of indigenous peoples, local communities, migrants, children, persons with disabilities and people in vulnerable situations and the right to development, as well as gender equality, empowerment of women and intergenerational equity,

Recognizing the importance of the conservation and enhancement, as appropriate, of sinks and reservoirs of the greenhouse gases referred to in the Convention,

Noting the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity, recognized by some cultures as Mother Earth, and noting the importance for some of the concept of “climate justice”, when taking action to address climate change,

Affirming the importance of education, training, public awareness, public participation, public access to information and cooperation at all levels on the matters addressed in this Agreement,

Recognizing the importance of the engagements of all levels of government and various actors, in accordance with respective national legislations of Parties, in addressing climate change, *Also recognizing* that sustainable lifestyles and sustainable patterns of consumption and production, with developed country Parties taking the lead, play an important role in addressing climate change,

Have agreed as follows:

Article 1

For the purpose of this Agreement, the definitions contained in Article 1 of the Convention shall apply. In addition:

(a) "Convention" means the United Nations Framework Convention on Climate Change, adopted in New York on 9 May 1992;

(b) "Conference of the Parties" means the Conference of the Parties to the Convention;

(c) "Party" means a Party to this Agreement.

Article 2

1. This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:

(a) Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;

(b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production; and

(c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.

2. This Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

Article 3

As nationally determined contributions to the global response to climate change, all Parties are to undertake and communicate ambitious efforts as defined in Articles 4, 7, 9, 10, 11 and 13 with the view to achieving the purpose of this Agreement as set out in Article 2. The efforts of all Parties will represent a progression over time, while recognizing the need to support developing country Parties for the effective implementation of this Agreement.

Article 4

1. In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty.

2. Each Party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions.

3. Each Party's successive nationally determined contribution will represent a progression beyond the Party's then current nationally determined contribution and reflect its highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

4. Developed country Parties should continue taking the lead by undertaking economy-wide absolute emission reduction targets. Developing country Parties should continue enhancing their mitigation efforts, and are encouraged to move over time towards economy-wide emission reduction or limitation targets in the light of different national circumstances.

5. Support shall be provided to developing country Parties for the implementation of this Article, in accordance with Articles 9, 10 and 11, recognizing that enhanced support for developing country Parties will allow for higher ambition in their actions.

6. The least developed countries and small island developing States may prepare and communicate strategies, plans and actions for low greenhouse gas emissions development reflecting their special circumstances.

7. Mitigation co-benefits resulting from Parties' adaptation actions and/or economic diversification plans can contribute to mitigation outcomes under this Article.

8. In communicating their nationally determined contributions, all Parties shall provide the information necessary for clarity, transparency and understanding in accordance with decision 1/CP.21 and any relevant decisions of the Conference of the Parties serving as the meeting of the Parties to this Agreement.

9. Each Party shall communicate a nationally determined contribution every five years in accordance with decision 1/CP.21 and any relevant decisions of the Conference of the Parties serving as the meeting of the Parties to this Agreement and be informed by the outcomes of the global stocktake referred to in Article 14.

10. The Conference of the Parties serving as the meeting of the Parties to this Agreement shall consider common time frames for nationally determined contributions at its first session.

11. A Party may at any time adjust its existing nationally determined contribution with a view to enhancing its level of ambition, in accordance with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement.

12. Nationally determined contributions communicated by Parties shall be recorded in a public registry maintained by the secretariat.

13. Parties shall account for their nationally determined contributions. In accounting for anthropogenic emissions and removals corresponding to their nationally determined contributions, Parties shall promote environmental integrity, transparency, accuracy, completeness, comparability and consistency, and ensure the avoidance of double counting, in accordance with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement.

14. In the context of their nationally determined contributions, when recognizing and implementing mitigation actions with respect to anthropogenic emissions and removals, Parties should take into account, as appropriate, existing methods and guidance under the Convention, in the light of the provisions of paragraph 13 of this Article.

15. Parties shall take into consideration in the implementation of this Agreement the concerns of Parties with economies most affected by the impacts of response measures, particularly developing country Parties.

16. Parties, including regional economic integration organizations and their member States, that have reached an agreement to act jointly under paragraph 2 of this Article shall notify the secretariat of the terms of that agreement, including the emission level allocated to each Party within the relevant time period, when they communicate their nationally determined contributions. The secretariat shall in turn inform the Parties and signatories to the Convention of the terms of that agreement.

17. Each party to such an agreement shall be responsible for its emission level as set out in the agreement referred to in paragraph 16 of this Article in accordance with paragraphs 13 and 14 of this Article and Articles 13 and 15.

18. If Parties acting jointly do so in the framework of, and together with, a regional economic integration organization which is itself a Party to this Agreement, each member State of that regional economic integration organization individually, and together with the regional economic integration organization, shall be responsible for its emission level as set out in the agreement communicated under paragraph 16 of this Article in accordance with paragraphs 13 and 14 of this Article and Articles 13 and 15.

19. All Parties should strive to formulate and communicate long-term low greenhouse gas emission development strategies, mindful of Article 2 taking into account their common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

Article 5

1. Parties should take action to conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases as referred to in Article 4, paragraph 1(d), of the Convention, including forests.

2. Parties are encouraged to take action to implement and support, including through results-based payments, the existing framework as set out in related guidance and decisions already agreed under the Convention for: policy approaches and positive incentives for activities relating to reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries; and alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests, while reaffirming the importance of incentivizing, as appropriate, non-carbon benefits associated with such approaches.

Article 6

1. Parties recognize that some Parties choose to pursue voluntary cooperation in the implementation of their nationally determined contributions to allow for higher ambition in their mitigation and adaptation actions and to promote sustainable development and environmental integrity.

2. Parties shall, where engaging on a voluntary basis in cooperative approaches that involve the use of internationally transferred mitigation outcomes towards nationally determined contributions, promote sustainable development and ensure environmental integrity and transparency, including in governance, and shall apply robust accounting to ensure, inter alia, the avoidance of double counting, consistent with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement.

3. The use of internationally transferred mitigation outcomes to achieve nationally determined contributions under this Agreement shall be voluntary and authorized by participating Parties.

4. A mechanism to contribute to the mitigation of greenhouse gas emissions and support sustainable development is hereby established under the authority and guidance of the Conference of the Parties serving as the meeting of the Parties to this Agreement for use by Parties on a voluntary basis. It shall be supervised by a body designated by the Conference of the Parties serving as the meeting of the Parties to this Agreement, and shall aim:

(a) To promote the mitigation of greenhouse gas emissions while fostering sustainable development;

(b) To incentivize and facilitate participation in the mitigation of greenhouse gas emissions by public and private entities authorized by a Party;

(c) To contribute to the reduction of emission levels in the host Party, which will benefit from mitigation activities resulting in emission reductions that can also be used by another Party to fulfil its nationally determined contribution; and

(d) To deliver an overall mitigation in global emissions.

5. Emission reductions resulting from the mechanism referred to in paragraph 4 of this Article shall not be used to demonstrate achievement of the host Party's nationally determined contribution if used by another Party to demonstrate achievement of its nationally determined contribution.

6. The Conference of the Parties serving as the meeting of the Parties to this Agreement shall ensure that a share of the proceeds from activities under the mechanism referred to in paragraph 4 of this Article is used to cover administrative expenses as well as to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.

7. The Conference of the Parties serving as the meeting of the Parties to this Agreement shall adopt rules, modalities and procedures for the mechanism referred to in paragraph 4 of this Article at its first session.

8. Parties recognize the importance of integrated, holistic and balanced non-market approaches being available to Parties to assist in the implementation of their nationally determined contributions, in the context of sustainable development and poverty eradication, in a coordinated and effective manner, including through, inter alia, mitigation, adaptation, finance, technology transfer and capacity-building, as appropriate. These approaches shall aim to:

(a) Promote mitigation and adaptation ambition;

(b) Enhance public and private sector participation in the implementation of nationally determined contributions; and

(c) Enable opportunities for coordination across instruments and relevant institutional arrangements.

9. A framework for non-market approaches to sustainable development is hereby defined to promote the non-market approaches referred to in paragraph 8 of this Article.

Article 7

1. Parties hereby establish the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view

to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal referred to in Article 2.

2. Parties recognize that adaptation is a global challenge faced by all with local, subnational, national, regional and international dimensions, and that it is a key component of and makes a contribution to the long-term global response to climate change to protect people, livelihoods and ecosystems, taking into account the urgent and immediate needs of those developing country Parties that are particularly vulnerable to the adverse effects of climate change.

3. The adaptation efforts of developing country Parties shall be recognized, in accordance with the modalities to be adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement at its first session.

4. Parties recognize that the current need for adaptation is significant and that greater levels of mitigation can reduce the need for additional adaptation efforts, and that greater adaptation needs can involve greater adaptation costs.

5. Parties acknowledge that adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems, with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions, where appropriate.

6. Parties recognize the importance of support for and international cooperation on adaptation efforts and the importance of taking into account the needs of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change.

7. Parties should strengthen their cooperation on enhancing action on adaptation, taking into account the Cancun Adaptation Framework, including with regard to:

(a) Sharing information, good practices, experiences and lessons learned, including, as appropriate, as these relate to science, planning, policies and implementation in relation to adaptation actions;

(b) Strengthening institutional arrangements, including those under the Convention that serve this Agreement, to support the synthesis of relevant information and knowledge, and the provision of technical support and guidance to Parties;

(c) Strengthening scientific knowledge on climate, including research, systematic observation of the climate system and early warning systems, in a manner that informs climate services and supports decision-making;

(d) Assisting developing country Parties in identifying effective adaptation practices, adaptation needs, priorities, support provided and received for adaptation actions and efforts, and challenges and gaps, in a manner consistent with encouraging good practices; and

(e) Improving the effectiveness and durability of adaptation actions.

8. United Nations specialized organizations and agencies are encouraged to support the efforts of Parties to implement the actions referred to in paragraph 7 of this Article, taking into account the provisions of paragraph 5 of this Article.

9. Each Party shall, as appropriate, engage in adaptation planning processes and the implementation of actions, including the development or enhancement of relevant plans, policies and/or contributions, which may include:

(a) The implementation of adaptation actions, undertakings and/or efforts;

(b) The process to formulate and implement national adaptation plans;

(c) The assessment of climate change impacts and vulnerability, with a view to formulating nationally determined prioritized actions, taking into account vulnerable people, places and ecosystems;

(d) Monitoring and evaluating and learning from adaptation plans, policies, programmes and actions; and

(e) Building the resilience of socioeconomic and ecological systems, including through economic diversification and sustainable management of natural resources.

10. Each Party should, as appropriate, submit and update periodically an adaptation communication, which may include its priorities, implementation and support needs, plans and actions, without creating any additional burden for developing country Parties.

11. The adaptation communication referred to in paragraph 10 of this Article shall be, as appropriate, submitted and updated periodically, as a component of or in conjunction with other communications or documents, including a national adaptation plan, a nationally determined contribution as referred to in Article 4, paragraph 2, and/or a national communication.

12. The adaptation communications referred to in paragraph 10 of this Article shall be recorded in a public registry maintained by the secretariat.

13. Continuous and enhanced international support shall be provided to developing country Parties for the implementation of paragraphs 7, 9, 10 and 11 of this Article, in accordance with the provisions of Articles 9, 10 and 11.

14. The global stocktake referred to in Article 14 shall, inter alia:

(a) Recognize adaptation efforts of developing country Parties;

(b) Enhance the implementation of adaptation action taking into account the adaptation communication referred to in paragraph 10 of this Article;

(c) Review the adequacy and effectiveness of adaptation and support provided for adaptation; and

(d) Review the overall progress made in achieving the global goal on adaptation referred to in paragraph 1 of this Article.

Article 8

1. Parties recognize the importance of averting, minimizing and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events, and the role of sustainable development in reducing the risk of loss and damage.

2. The Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts shall be subject to the authority and guidance of the Conference of the Parties serving as the meeting of the Parties to this Agreement and may be enhanced and strengthened, as determined by the Conference of the Parties serving as the meeting of the Parties to this Agreement.

3. Parties should enhance understanding, action and support, including through the Warsaw International Mechanism, as appropriate, on a cooperative and facilitative basis with respect to loss and damage associated with the adverse effects of climate change.

4. Accordingly, areas of cooperation and facilitation to enhance understanding, action and support may include:

(a) Early warning systems;

(b) Emergency preparedness;

(c) Slow onset events;

(d) Events that may involve irreversible and permanent loss and damage;

(e) Comprehensive risk assessment and management;

(f) Risk insurance facilities, climate risk pooling and other insurance solutions;

(g) Non-economic losses; and

(h) Resilience of communities, livelihoods and ecosystems.

5. The Warsaw International Mechanism shall collaborate with existing bodies and expert groups under the Agreement, as well as relevant organizations and expert bodies outside the Agreement.

Article 9

1. Developed country Parties shall provide financial resources to assist developing country Parties with respect to both mitigation and adaptation in continuation of their existing obligations under the Convention.

2. Other Parties are encouraged to provide or continue to provide such support voluntarily.

3. As part of a global effort, developed country Parties should continue to take the lead in mobilizing climate finance from a wide variety of sources, instruments and channels, noting the significant role of public funds, through a variety of actions, including supporting country-driven strategies, and taking into account the needs and priorities of developing country Parties. Such mobilization of climate finance should represent a progression beyond previous efforts.

4. The provision of scaled-up financial resources should aim to achieve a balance between adaptation and mitigation, taking into account country-driven strategies, and the priorities and needs of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change and have significant capacity constraints, such as the least developed countries and small island developing States, considering the need for public and grant-based resources for adaptation.

5. Developed country Parties shall biennially communicate indicative quantitative and qualitative information related to paragraphs 1 and 3 of this Article, as applicable, including, as available, projected levels of public financial resources to be provided to developing country Parties. Other Parties providing resources are encouraged to communicate biennially such information on a voluntary basis.

6. The global stocktake referred to in Article 14 shall take into account the relevant information provided by developed country Parties and/or Agreement bodies on efforts related to climate finance.

7. Developed country Parties shall provide transparent and consistent information on support for developing country Parties provided and mobilized through public interventions biennially in accordance with the modalities, procedures and guidelines to be adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement, at its

first session, as stipulated in Article 13, paragraph 13. Other Parties are encouraged to do so.

8. The Financial Mechanism of the Convention, including its operating entities, shall serve as the financial mechanism of this Agreement.

9. The institutions serving this Agreement, including the operating entities of the Financial Mechanism of the Convention, shall aim to ensure efficient access to financial resources through simplified approval procedures and enhanced readiness support for developing country Parties, in particular for the least developed countries and small island developing States, in the context of their national climate strategies and plans.

Article 10

1. Parties share a long-term vision on the importance of fully realizing technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions.

2. Parties, noting the importance of technology for the implementation of mitigation and adaptation actions under this Agreement and recognizing existing technology deployment and dissemination efforts, shall strengthen cooperative action on technology development and transfer.

3. The Technology Mechanism established under the Convention shall serve this Agreement.

4. A technology framework is hereby established to provide overarching guidance to the work of the Technology Mechanism in promoting and facilitating enhanced action on technology development and transfer in order to support the implementation of this Agreement, in pursuit of the long-term vision referred to in paragraph 1 of this Article.

5. Accelerating, encouraging and enabling innovation is critical for an effective, long-term global response to climate change and promoting economic growth and sustainable development. Such effort shall be, as appropriate, supported, including by the Technology Mechanism and, through financial means, by the Financial Mechanism of the Convention, for collaborative approaches to research and development, and facilitating access to technology, in particular for early stages of the technology cycle, to developing country Parties.

6. Support, including financial support, shall be provided to developing country Parties for the implementation of this Article, including for strengthening cooperative action on technology development and transfer at different stages of the technology cycle, with a view to achieving a balance between support for mitigation and adaptation. The global stocktake referred to in Article 14 shall take into account available information on efforts related to support on technology development and transfer for developing country Parties.

Article 11

1. Capacity-building under this Agreement should enhance the capacity and ability of developing country Parties, in particular countries with the least capacity, such as the least developed countries, and those that are particularly vulnerable to the adverse effects of climate change, such as small island developing States, to take effective climate change action, including, inter alia, to implement adaptation and mitigation actions, and should facilitate technology development, dissemination and deployment, access to climate finance, relevant aspects of education, training and public awareness, and the transparent, timely and accurate communication of information.

2. Capacity-building should be country-driven, based on and responsive to national needs, and foster country ownership of Parties, in particular, for developing country Parties,

including at the national, subnational and local levels. Capacity-building should be guided by lessons learned, including those from capacity-building activities under the Convention, and should be an effective, iterative process that is participatory, cross-cutting and gender-responsive.

3. All Parties should cooperate to enhance the capacity of developing country Parties to implement this Agreement. Developed country Parties should enhance support for capacity-building actions in developing country Parties.

4. All Parties enhancing the capacity of developing country Parties to implement this Agreement, including through regional, bilateral and multilateral approaches, shall regularly communicate on these actions or measures on capacity-building. Developing country Parties should regularly communicate progress made on implementing capacity-building plans, policies, actions or measures to implement this Agreement.

5. Capacity-building activities shall be enhanced through appropriate institutional arrangements to support the implementation of this Agreement, including the appropriate institutional arrangements established under the Convention that serve this Agreement. The Conference of the Parties serving as the meeting of the Parties to this Agreement shall, at its first session, consider and adopt a decision on the initial institutional arrangements for capacity-building.

Article 12

Parties shall cooperate in taking measures, as appropriate, to enhance climate change education, training, public awareness, public participation and public access to information, recognizing the importance of these steps with respect to enhancing actions under this Agreement.

Article 13

1. In order to build mutual trust and confidence and to promote effective implementation, an enhanced transparency framework for action and support, with built-in flexibility which takes into account Parties' different capacities and builds upon collective experience is hereby established.

2. The transparency framework shall provide flexibility in the implementation of the provisions of this Article to those developing country Parties that need it in the light of their capacities. The modalities, procedures and guidelines referred to in paragraph 13 of this Article shall reflect such flexibility.

3. The transparency framework shall build on and enhance the transparency arrangements under the Convention, recognizing the special circumstances of the least developed countries and small island developing States, and be implemented in a facilitative, non-intrusive, non-punitive manner, respectful of national sovereignty, and avoid placing undue burden on Parties.

4. The transparency arrangements under the Convention, including national communications, biennial reports and biennial update reports, international assessment and review and international consultation and analysis, shall form part of the experience drawn upon for the development of the modalities, procedures and guidelines under paragraph 13 of this Article.

5. The purpose of the framework for transparency of action is to provide a clear understanding of climate change action in the light of the objective of the Convention as set out in its Article 2, including clarity and tracking of progress towards achieving Parties' individual nationally determined contributions under Article 4, and Parties' adaptation

actions under Article 7, including good practices, priorities, needs and gaps, to inform the global stocktake under Article 14.

6. The purpose of the framework for transparency of support is to provide clarity on support provided and received by relevant individual Parties in the context of climate change actions under Articles 4, 7, 9, 10 and 11, and, to the extent possible, to provide a full overview of aggregate financial support provided, to inform the global stocktake under Article 14.

7. Each Party shall regularly provide the following information:

(a) A national inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases, prepared using good practice methodologies accepted by the Intergovernmental Panel on Climate Change and agreed upon by the Conference of the Parties serving as the meeting of the Parties to this Agreement; and

(b) Information necessary to track progress made in implementing and achieving its nationally determined contribution under Article 4.

8. Each Party should also provide information related to climate change impacts and adaptation under Article 7, as appropriate.

9. Developed country Parties shall, and other Parties that provide support should, provide information on financial, technology transfer and capacity-building support provided to developing country Parties under Articles 9, 10 and 11.

10. Developing country Parties should provide information on financial, technology transfer and capacity-building support needed and received under Articles 9, 10 and 11.

11. Information submitted by each Party under paragraphs 7 and 9 of this Article shall undergo a technical expert review, in accordance with decision 1/CP.21. For those developing country Parties that need it in the light of their capacities, the review process shall include assistance in identifying capacity-building needs. In addition, each Party shall participate in a facilitative, multilateral consideration of progress with respect to efforts under Article 9, and its respective implementation and achievement of its nationally determined contribution.

12. The technical expert review under this paragraph shall consist of a consideration of the Party's support provided, as relevant, and its implementation and achievement of its nationally determined contribution. The review shall also identify areas of improvement for the Party, and include a review of the consistency of the information with the modalities, procedures and guidelines referred to in paragraph 13 of this Article, taking into account the flexibility accorded to the Party under paragraph 2 of this Article. The review shall pay particular attention to the respective national capabilities and circumstances of developing country Parties.

13. The Conference of the Parties serving as the meeting of the Parties to this Agreement shall, at its first session, building on experience from the arrangements related to transparency under the Convention, and elaborating on the provisions in this Article, adopt common modalities, procedures and guidelines, as appropriate, for the transparency of action and support.

14. Support shall be provided to developing countries for the implementation of this Article.

15. Support shall also be provided for the building of transparency-related capacity of developing country Parties on a continuous basis.

Article 14

1. The Conference of the Parties serving as the meeting of the Parties to this Agreement shall periodically take stock of the implementation of this Agreement to assess the collective progress towards achieving the purpose of this Agreement and its long-term goals (referred to as the "global stocktake"). It shall do so in a comprehensive and facilitative manner, considering mitigation, adaptation and the means of implementation and support, and in the light of equity and the best available science.

2. The Conference of the Parties serving as the meeting of the Parties to this Agreement shall undertake its first global stocktake in 2023 and every five years thereafter unless otherwise decided by the Conference of the Parties serving as the meeting of the Parties to this Agreement.

3. The outcome of the global stocktake shall inform Parties in updating and enhancing, in a nationally determined manner, their actions and support in accordance with the relevant provisions of this Agreement, as well as in enhancing international cooperation for climate action.

Article 15

1. A mechanism to facilitate implementation of and promote compliance with the provisions of this Agreement is hereby established.

2. The mechanism referred to in paragraph 1 of this Article shall consist of a committee that shall be expert-based and facilitative in nature and function in a manner that is transparent, non-adversarial and non-punitive. The committee shall pay particular attention to the respective national capabilities and circumstances of Parties.

3. The committee shall operate under the modalities and procedures adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement at its first session and report annually to the Conference of the Parties serving as the meeting of the Parties to this Agreement.

Article 16

1. The Conference of the Parties, the supreme body of the Convention, shall serve as the meeting of the Parties to this Agreement.

2. Parties to the Convention that are not Parties to this Agreement may participate as observers in the proceedings of any session of the Conference of the Parties serving as the meeting of the Parties to this Agreement. When the Conference of the Parties serves as the meeting of the Parties to this Agreement, decisions under this Agreement shall be taken only by those that are Parties to this Agreement.

3. When the Conference of the Parties serves as the meeting of the Parties to this Agreement, any member of the Bureau of the Conference of the Parties representing a Party to the Convention but, at that time, not a Party to this Agreement, shall be replaced by an additional member to be elected by and from amongst the Parties to this Agreement.

4. The Conference of the Parties serving as the meeting of the Parties to this Agreement shall keep under regular review the implementation of this Agreement and shall make, within its mandate, the decisions necessary to promote its effective implementation. It shall perform the functions assigned to it by this Agreement and shall:

(a) Establish such subsidiary bodies as deemed necessary for the implementation of this Agreement; and

(b) Exercise such other functions as may be required for the implementation of this Agreement.

5. The rules of procedure of the Conference of the Parties and the financial procedures applied under the Convention shall be applied *mutatis mutandis* under this Agreement, except as may be otherwise decided by consensus by the Conference of the Parties serving as the meeting of the Parties to this Agreement.

6. The first session of the Conference of the Parties serving as the meeting of the Parties to this Agreement shall be convened by the secretariat in conjunction with the first session of the Conference of the Parties that is scheduled after the date of entry into force of this Agreement. Subsequent ordinary sessions of the Conference of the Parties serving as the meeting of the Parties to this Agreement shall be held in conjunction with ordinary sessions of the Conference of the Parties, unless otherwise decided by the Conference of the Parties serving as the meeting of the Parties to this Agreement.

7. Extraordinary sessions of the Conference of the Parties serving as the meeting of the Parties to this Agreement shall be held at such other times as may be deemed necessary by the Conference of the Parties serving as the meeting of the Parties to this Agreement or at the written request of any Party, provided that, within six months of the request being communicated to the Parties by the secretariat, it is supported by at least one third of the Parties.

8. The United Nations and its specialized agencies and the International Atomic Energy Agency, as well as any State member thereof or observers thereto not party to the Convention, may be represented at sessions of the Conference of the Parties serving as the meeting of the Parties to this Agreement as observers. Any body or agency, whether national or international, governmental or non-governmental, which is qualified in matters covered by this Agreement and which has informed the secretariat of its wish to be represented at a session of the Conference of the Parties serving as the meeting of the Parties to this Agreement as an observer, may be so admitted unless at least one third of the Parties present object. The admission and participation of observers shall be subject to the rules of procedure referred to in paragraph 5 of this Article.

Article 17

1. The secretariat established by Article 8 of the Convention shall serve as the secretariat of this Agreement.

2. Article 8, paragraph 2, of the Convention on the functions of the secretariat, and Article 8, paragraph 3, of the Convention, on the arrangements made for the functioning of the secretariat, shall apply *mutatis mutandis* to this Agreement. The secretariat shall, in addition, exercise the functions assigned to it under this Agreement and by the Conference of the Parties serving as the meeting of the Parties to this Agreement.

Article 18

1. The Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation established by Articles 9 and 10 of the Convention shall serve, respectively, as the Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation of this Agreement. The provisions of the Convention relating to the functioning of these two bodies shall apply *mutatis mutandis* to this Agreement. Sessions of the meetings of the Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation of this Agreement shall be held in conjunction with the meetings of, respectively, the Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation of the Convention.

2. Parties to the Convention that are not Parties to this Agreement may participate as observers in the proceedings of any session of the subsidiary bodies. When the subsidiary

bodies serve as the subsidiary bodies of this Agreement, decisions under this Agreement shall be taken only by those that are Parties to this Agreement.

3. When the subsidiary bodies established by Articles 9 and 10 of the Convention exercise their functions with regard to matters concerning this Agreement, any member of the bureaux of those subsidiary bodies representing a Party to the Convention but, at that time, not a Party to this Agreement, shall be replaced by an additional member to be elected by and from amongst the Parties to this Agreement.

Article 19

1. Subsidiary bodies or other institutional arrangements established by or under the Convention, other than those referred to in this Agreement, shall serve this Agreement upon a decision of the Conference of the Parties serving as the meeting of the Parties to this Agreement. The Conference of the Parties serving as the meeting of the Parties to this Agreement shall specify the functions to be exercised by such subsidiary bodies or arrangements.

2. The Conference of the Parties serving as the meeting of the Parties to this Agreement may provide further guidance to such subsidiary bodies and institutional arrangements.

Article 20

1. This Agreement shall be open for signature and subject to ratification, acceptance or approval by States and regional economic integration organizations that are Parties to the Convention. It shall be open for signature at the United Nations Headquarters in New York from 22 April 2016 to 21 April 2017. Thereafter, this Agreement shall be open for accession from the day following the date on which it is closed for signature. Instruments of ratification, acceptance, approval or accession shall be deposited with the Depositary.

2. Any regional economic integration organization that becomes a Party to this Agreement without any of its member States being a Party shall be bound by all the obligations under this Agreement. In the case of regional economic integration organizations with one or more member States that are Parties to this Agreement, the organization and its member States shall decide on their respective responsibilities for the performance of their obligations under this Agreement. In such cases, the organization and the member States shall not be entitled to exercise rights under this Agreement concurrently.

3. In their instruments of ratification, acceptance, approval or accession, regional economic integration organizations shall declare the extent of their competence with respect to the matters governed by this Agreement. These organizations shall also inform the Depositary, who shall in turn inform the Parties, of any substantial modification in the extent of their competence.

Article 21

1. This Agreement shall enter into force on the thirtieth day after the date on which at least 55 Parties to the Convention accounting in total for at least an estimated 55 per cent of the total global greenhouse gas emissions have deposited their instruments of ratification, acceptance, approval or accession.

2. Solely for the limited purpose of paragraph 1 of this Article, “total global greenhouse gas emissions” means the most up-to-date amount communicated on or before the date of adoption of this Agreement by the Parties to the Convention.

3. For each State or regional economic integration organization that ratifies, accepts or approves this Agreement or accedes thereto after the conditions set out in paragraph 1 of this Article for entry into force have been fulfilled, this Agreement shall enter into force on the thirtieth day after the date of deposit by such State or regional economic integration organization of its instrument of ratification, acceptance, approval or accession.

4. For the purposes of paragraph 1 of this Article, any instrument deposited by a regional economic integration organization shall not be counted as additional to those deposited by its member States.

Article 22

The provisions of Article 15 of the Convention on the adoption of amendments to the Convention shall apply *mutatis mutandis* to this Agreement.

Article 23

1. The provisions of Article 16 of the Convention on the adoption and amendment of annexes to the Convention shall apply *mutatis mutandis* to this Agreement.

2. Annexes to this Agreement shall form an integral part thereof and, unless otherwise expressly provided for, a reference to this Agreement constitutes at the same time a reference to any annexes thereto. Such annexes shall be restricted to lists, forms and any other material of a descriptive nature that is of a scientific, technical, procedural or administrative character.

Article 24

The provisions of Article 14 of the Convention on settlement of disputes shall apply *mutatis mutandis* to this Agreement.

Article 25

1. Each Party shall have one vote, except as provided for in paragraph 2 of this Article.

2. Regional economic integration organizations, in matters within their competence, shall exercise their right to vote with a number of votes equal to the number of their member States that are Parties to this Agreement. Such an organization shall not exercise its right to vote if any of its member States exercises its right, and vice versa.

Article 26

The Secretary-General of the United Nations shall be the Depositary of this Agreement.

Article 27

No reservations may be made to this Agreement.

Article 28

1. At any time after three years from the date on which this Agreement has entered into force for a Party, that Party may withdraw from this Agreement by giving written notification to the Depositary.

2. Any such withdrawal shall take effect upon expiry of one year from the date of receipt by the Depositary of the notification of withdrawal, or on such later date as may be specified in the notification of withdrawal.

3. Any Party that withdraws from the Convention shall be considered as also having withdrawn from this Agreement.

Article 29

The original of this Agreement, of which the Arabic, Chinese, English, French, Russian and Spanish texts are equally authentic, shall be deposited with the Secretary-General of the United Nations.

DONE at Paris this twelfth day of December two thousand and fifteen.

IN WITNESS WHEREOF, the undersigned, being duly authorized to that effect, have signed this Agreement.

This is **Exhibit J** referred to in the

affidavit of **John Moffet**

affirmed before me on **January 29, 2019**

Commissioner for Oaths for Québec

#224458

CANADA'S 2017 NATIONALLY DETERMINED CONTRIBUTION SUBMISSION TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

Following the release of the Pan-Canadian Framework on Clean Growth and Climate Change, Canada's plan to address climate change and grow the economy, the Government of Canada is pleased to update its Nationally Determined Contribution submission under the Paris Agreement. Canada recognizes the need to reduce greenhouse gas emissions and considers addressing climate change as an opportunity to transition to a strong, diverse and competitive low-carbon economy.

Canada's action to address climate change at home will be guided by the collective long-term goal agreed in Paris to hold the increase in the global average temperature to well below 2 degrees Celsius above pre-industrial levels, and to pursue efforts to limit that increase to below 1.5 degrees. Canada recognizes that meeting the temperature commitment in the Paris Agreement will take global action to reduce greenhouse gases, including carbon dioxide, and short-lived climate pollutants such as hydrofluorocarbons and methane covered under the United Nations Framework Convention on Climate Change (UNFCCC).

To contribute to the achievement of the Paris Agreement, Canada is committed to reduce greenhouse gas emissions by 30 percent below 2005 levels by 2030. In addition to addressing gases covered under the UNFCCC, Canada is taking action to reduce black carbon – a short-lived climate pollutant of particular significance in the Arctic due to its contribution to Arctic warming. In Canada, the Arctic has already warmed by 2.2 degrees between 1948 and 2013.

The Pan-Canadian Framework on Clean Growth and Climate Change
As a first step towards implementing the commitments Canada made under the Paris Agreement, First Ministers released the Vancouver Declaration on Clean Growth and Climate Change on March 3, 2016. Through the Vancouver Declaration, working groups were established to develop options for pricing carbon pollution; complementary actions to reduce emissions; adaptation and climate resilience; and clean technology, innovation and jobs. This process was supported and informed by an extensive process to engage Indigenous Peoples, experts, stakeholders and the public.

As a result of these efforts, the Pan-Canadian Framework on Clean Growth and Climate Change was adopted on December 9, 2016. It is a comprehensive plan to reduce emissions across all sectors of the economy, accelerate clean economic growth, and build resilience to the impacts of climate change. The actions outlined in the Pan-Canadian Framework, supported by federal investments announced in Budget 2017, will enable Canada to meet or even exceed its target to reduce emissions to 30% below 2005 levels by 2030.

The PCF builds on the early leadership of provinces and territories and the diverse array of policies and measures already in place across Canada to reduce greenhouse gas emissions in all sectors of the economy, as highlighted by Canada's Biennial Reports. Many of the policies and measures in the Framework are intended to be scalable to enable increasing ambition over time, and will be subject to rigorous and ongoing evaluation in order to ensure that Canada is well-positioned to meet its current and future climate change commitments.

Pricing Carbon Pollution
Pricing carbon pollution is central to Canada's plan. The Government of Canada has outlined a benchmark for pricing carbon pollution that will build on existing provincial systems and ensure a minimum price of $10 per tonne is in place across Canada by 2018, rising to $50 per tonne by 2022. Provinces and territories will continue to have the flexibility to implement either an explicit price on carbon (e.g., through a carbon tax) or cap-and-trade systems and will retain all revenue generated by carbon pricing. Carbon pricing will help influence investment and purchase decisions towards lower carbon-intensive options.

Complementary Mitigation Actions
In addition to carbon pricing, the complementary mitigation measures included in the Framework will enable Canada to achieve emissions reductions across all sectors, both in the near-term and as part of a longer-term strategy. Expanding the use of clean electricity and low-carbon fuels are foundational actions that will reduce emissions across the economy.

To increase the use of low-carbon fuels, the federal government, working with provincial and territorial governments, industry and other stakeholders, will develop a clean fuel standard to reduce emissions from fuels used in transportation, buildings, and industry.

Using a mix of regulations and investments, Canada will also continue to drive down emissions from electricity. This will include new regulations to accelerate the phase-out of traditional coal units by 2030 and performance standards for natural gas-fired electricity. These actions will be complemented by investments to modernize Canada's electricity systems, including in smart grid and energy storage technologies, and new and enhanced transmission lines to connect new sources of clean power with places that need it.

In addition to transitioning to lower-carbon fuels and clean electricity in the built environment, transportation, and industrial sectors, Canada will take action to reduce energy use by improving energy efficiency, fuel switching and supporting innovative alternatives. In the built environment sector, this will include developing "net-zero energy ready" building codes to be adopted by 2030 for new buildings; retrofitting existing buildings based on new retrofit codes and providing businesses and consumers with information on energy performance; and improving energy efficiency of appliances and equipment.

Actions in the transportation sector include continuing to set increasingly stringent standards for light- and heavy-duty vehicles, as well as taking action to improve efficiency and support fuel switching in the rail, aviation, marine, and off-road sectors; developing a zero-emissions vehicle strategy by 2018 and investing in infrastructure to support zero-emissions vehicles; and investing in public transit and other infrastructure to support shifts from higher- to lower-emitting modes of transportation.

To reduce emissions from industrial sectors, Canada is developing regulations to achieve a reduction of methane emissions from the oil and gas sector, including offshore activities, by 40-45 percent by 2025. Federal, provincial, and territorial governments will work together to help industries improve their energy efficiency and invest in new technologies to reduce emissions, including in the oil and gas sector. Canada has also committed to finalizing regulations to phase down the use of hydrofluorocarbons in line with the Kigali Amendment to the Montreal Protocol.

Other actions in the Pan-Canadian Framework include: protecting and enhancing carbon sinks including in forests, wetlands and agricultural lands; identifying opportunities to generate renewable fuel from waste; and demonstrating leadership by reducing emissions from government operations and scaling up the procurement of clean energy and technologies. The Framework also includes support for clean technology and innovation that promote clean growth, including for early-stage technology development, establishing international partnerships, and encouraging "mission-oriented" research to help generate innovative new ideas and create economic opportunities. Other complementary actions include: support for research, development, demonstration and adoption of clean technology in Canada's natural resource sectors; an Impact Canada Fund to support clean technology and a Smart Cities Challenge.

The Pan-Canadian Framework also recognizes the importance of building climate-resilience and sets out measures to help Canadians understand, plan for, and take action to adapt to the unavoidable impacts of climate change. For example, the federal government will establish a new Canadian Centre for Climate Services and work with provinces and territories and other partners to build regional adaptation capacity and expertise that will make it easier for governments, communities, and businesses to access and use climate data and information to make adaptation decisions. Measures to build resilience through infrastructure include climate-resilient codes and standards and a fund for built and natural, large-scale infrastructure projects that support mitigation of natural disasters, extreme weather events and climate resilience. A national action plan will be developed to respond to the range of health risks caused by climate change, including extreme heat and infectious diseases such as Lyme disease.

With the understanding that Indigenous Peoples and coastal and northern regions are particularly vulnerable to climate impacts, action is also being taken to help these communities thrive. This includes support for Indigenous Peoples to monitor changes in their communities and take action to address climate impacts, including repeated and severe flooding. In addition, targeted funding will be provided to enhance resilience in northern communities by increasing capacity to adapt and improve the design and construction of northern infrastructure.

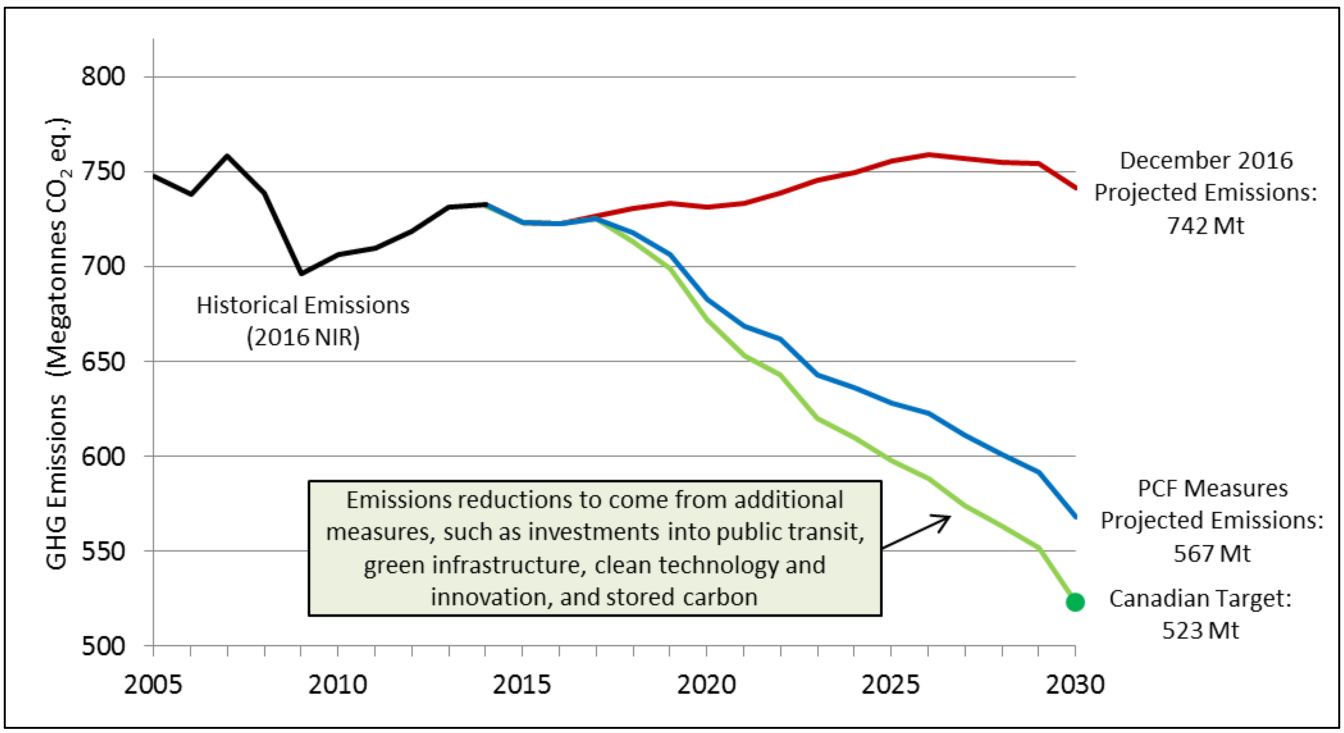
To support these measures, the Government of Canada has announced a number of significant investments. These include:

- A $2 billion Low Carbon Economy Fund to support new provincial and territorial actions to reduce emissions by 2030;

- $21.9 billion to support green infrastructure, including for electricity, renewable energy, reducing reliance on diesel in Indigenous, northern and remote communities, electric vehicle charging and natural gas and hydrogen refuelling stations, new building codes, and disaster mitigation and adaptation;
- $20.1 billion to support urban public transit; and,
- Over $2.2 billion in funding for clean technology initiatives, including nearly $1.4 billion in financing dedicated to financing clean technology firms. These investments support Canada's commitment in Mission Innovation to double investment in clean energy research, development and demonstration over the next five years.

Pathway to Canada's 2030 target
To achieve its target, Canada must reduce its total economy-wide emissions to 523 Mt in 2030. The Government of Canada uses a recognized energy and macroeconomic modeling framework[1] to produce emissions projections to 2030, which are published on an annual basis. The most recent emissions projections, published in December 2016 (https://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=1F24D9EE-1), indicate that with federal, provincial and territorial policies and measures that have legislated or funding certainty and were in place as of November 1st, 2016, (just prior to the Pan Canadian Framework) total Canadian GHG emissions would be 742 megatonnes of carbon dioxide equivalent (Mt CO2eq) in 2030.

Figure 1: Pathway to Canada's 2030 target



[1] For more information on ECCC modeling of GHG projections, please see link. (https://www.canada.ca/en/services/environment/weather/climatechange/climate-action/modelling-ghg-projections.html.)

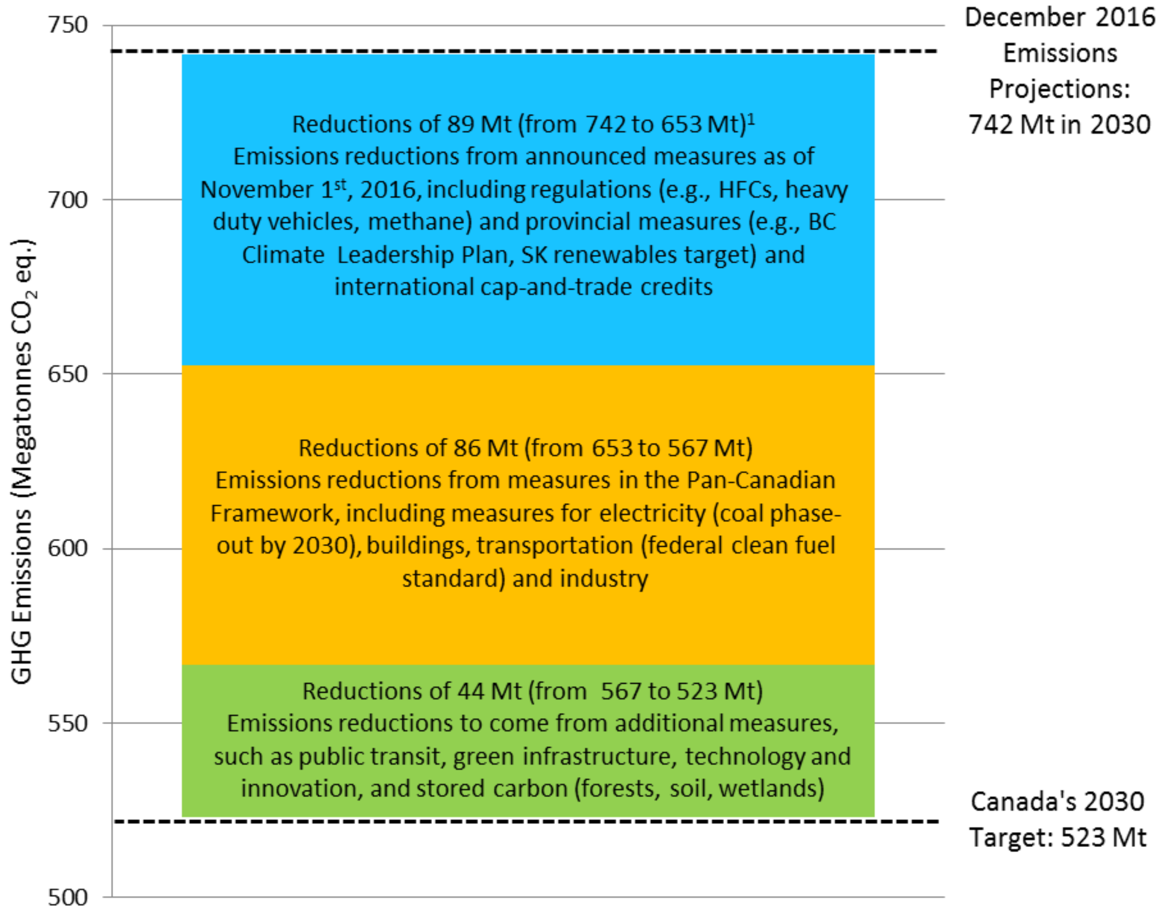
The federal, provincial and territorial policies within the pan-Canadian Framework that have been modelled are projected to decrease Canada's emissions by 175 Mt. This includes the estimated impacts of carbon pricing, proposed regulations (e.g., clean fuel standard, accelerated coal phase-out, vehicle efficiency standards, regulations for methane and HFCs), and some additional actions in electricity, buildings, transportation and industry.

This estimate of 175 Mt does not include the full suite of commitments under the Pan-Canadian Framework. Specifically, the emission reductions associated with the unprecedented levels of investment in public transit, green infrastructure, innovation and clean technologies have not yet been estimated or modelled. Emissions reductions from these investments will be assessed and quantified as specific projects are identified and programs are implemented.

Additionally the potential increases in stored carbon (carbon sequestration) in forests, soils and wetlands have not been included in the projected emissions reductions figure of 175 Mt. For a country such as Canada, carbon sequestration could make an important contribution to the achievement of the 2030 target.

Finally, the projected emissions reductions in the figure above do not assume that additional mitigation policies or measures would be implemented by the provinces and territories between now and 2030. Emissions reductions from additional future actions taken by other jurisdictions will be assessed if and when new measures are implemented.

Figure 2: Emissions Reductions from the Pan-Canadian Framework



Note: Reductions from carbon pricing are built into the different elements depending on whether they are implemented, announced, or included in the Pan-Canadian Framework. The path forward on pricing will be determined by the review to be completed by early 2022.

[1] Estimates assume purchase of carbon allowances (credits) from California by regulated entities under Quebec and Ontario's cap-and-trade system that are or will be linked through the Western Climate Initiative.

Transparency and Ongoing Evaluation

The measures and investments outlined in the Pan-Canadian Framework will enable Canada to meet or even exceed its 2030 target and provide a strong foundation to achieve deeper emissions reductions over time and build a highly competitive, low-carbon economy. Many of the policies and measures in the Framework are intended to be scalable to enable increasing ambition over time, and will be subject to rigorous and ongoing evaluation in order to ensure that Canada is well-positioned to meet its current and future climate change commitments. Canada's Mid-Century Long-Term Low-Greenhouse Gas Development Strategy, which was released in November 2016, describes various pathways for innovative and creative solutions to low-carbon development. This long-term perspective will help to guide the elaboration of policies and investments under the Pan-Canadian Framework, as Canada continues to take action to significantly reduce emissions by 2030 and on an ongoing basis.

The Pan-Canadian Framework commits to ongoing monitoring and reporting on results, in order to ensure that policies are effective, take stock of progress achieved, and to inform Canada's future national commitments in accordance with the Paris Agreement. This will include annual reporting to the Prime Minister of Canada and provincial and territorial Premiers; external assessment and advice by experts; meaningful engagement with Indigenous Peoples, including through distinction-based tables; and reviews of carbon pricing approaches in 2020 and 2022, including expert assessment of stringency and effectiveness that compares carbon pricing systems across Canada. In addition, the Government of Canada will continue to regularly evaluate regulatory approaches, track and report on progress. These and other mechanisms for transparency and accountability will enable Canada to track progress towards its target and adjust policies and approaches over time as needed.

Nationally Determined Contribution
Canada intends to achieve an economy-wide target to reduce its greenhouse gas emissions by 30% below 2005 levels by 2030.

Clarifying Information	
Base year	2005
Base year emissions (Mt CO^2 eq.)*	747
End year	2030
Target reduction (%)	30
Target (Mt CO^2 eq.)*	523
Type	Absolute reduction from base-year emissions
Coverage	Economy wide – 100% of Canadian greenhouse gas inventory
Gases covered	carbon dioxide (CO_2) methane (CH_4) nitrous oxide (N_2O) sulphur hexafluoride (SF_6) perfluorocarbons (PFCs) hydrofluorocarbons (HFCs) nitrogen trifluoride (NF_3)
Sectors	All Intergovernmental Panel on Climate Change (IPCC) sectors
Implementation	Domestically, the Government of Canada is taking steps to reduce greenhouse gas emissions. The Government of Canada is committed to taking strong action, with significant investments in a low-carbon economy, green infrastructure, and clean technology. The Government of Canada recognizes that collaboration on climate change action is important, which is why its approach builds on the efforts of provinces and territories, local governments, Indigenous organizations, businesses, youth, the academic community, and non-governmental organizations. To help achieve the goals and actions outlined in the Pan-Canadian Framework on Clean Growth and Climate Change, the programs and policies put in place will be monitored, results will be measured, and performance will be reported on domestically in a way that is transparent and open to external, independent review. The effectiveness of actions will also be assessed to ensure continual improvement and increase ambition over time, in accordance with Paris Agreement.

Key Assumptions	
Metric applied	100-year Global Warming Potential values from the IPCC Fourth Assessment Report
Methodologies for estimating emissions	IPCC 2006 Guidelines and IPCC 2013 Supplementary Methods on Wetlands
Approach to accounting for agriculture, forestry, and other land uses	Canada is examining its approach to accounting in the land use, land-use change and forestry sector. Canada will use “the IPCC production approach” to account for harvested wood products and will exclude the impacts of natural disturbances and focus on anthropogenic emissions and removals.

Contribution of international mechanisms	Canada will explore the use of international mechanisms in the overall effort to achieve its 2030 target, subject to the establishment of robust systems that deliver real and verified emissions reductions. Canada will work with Parties under the UNFCCC to ensure effective systems are established.

[*Based on Canada's 2016 National Inventory Report on greenhouse gas sources and sinks from 1990 to 2014]

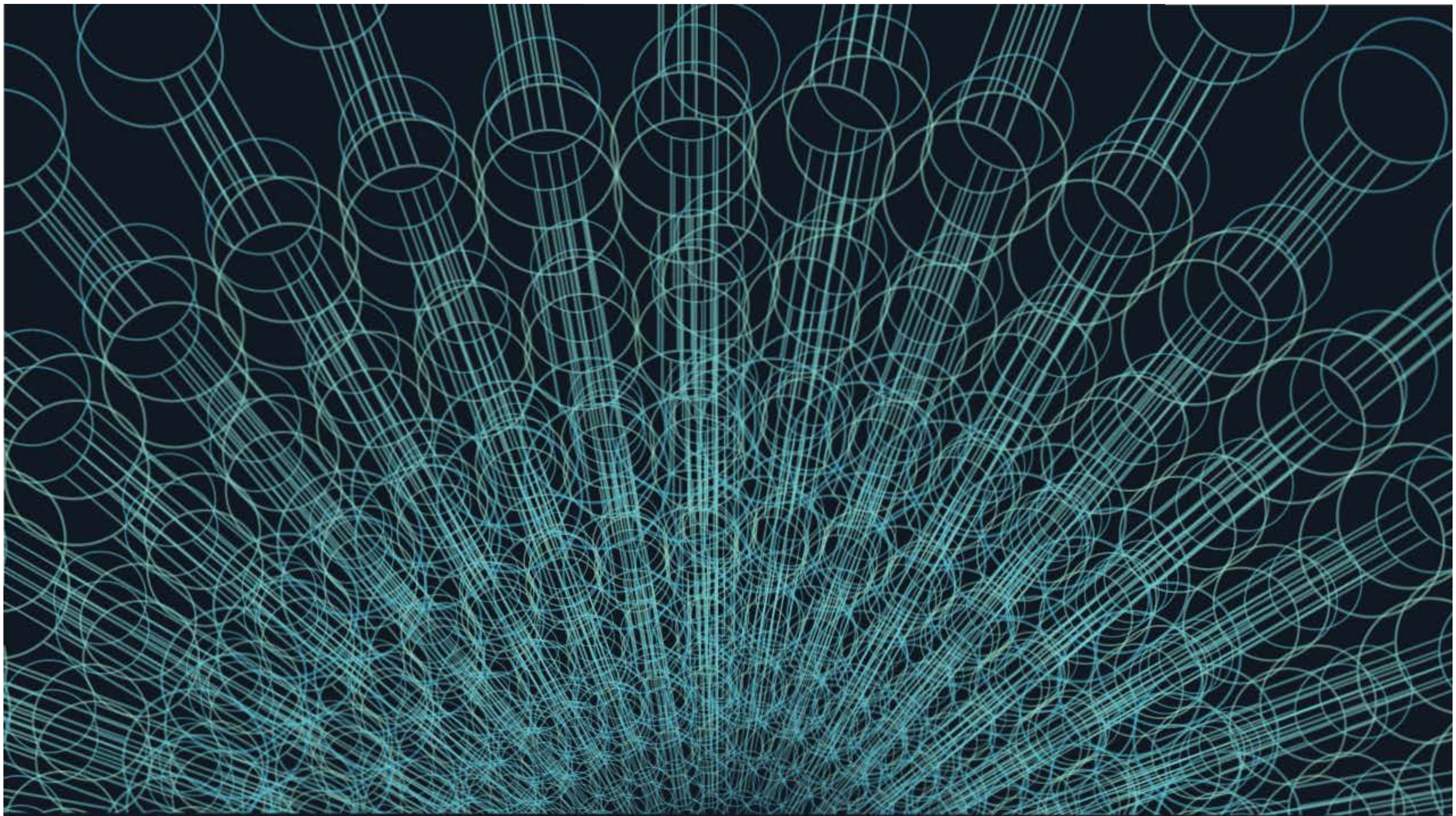
This is **Exhibit K** referred to in the

affidavit of **John Moffet**

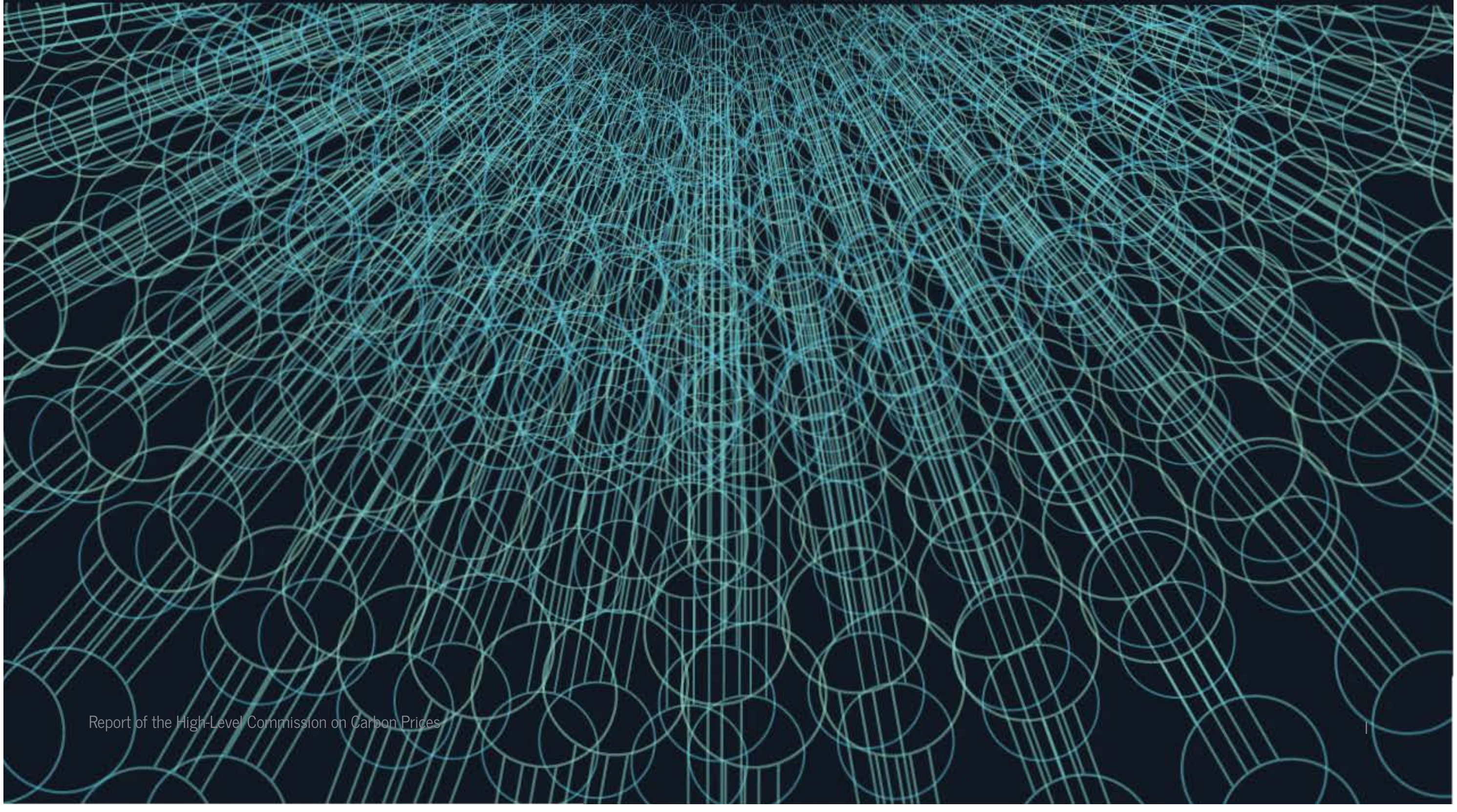
affirmed before me on **January 29, 2019**

Commissioner for Oaths for Québec

#224458



Report of the High-Level Commission on Carbon Prices



CARBON PRICING LEADERSHIP COALITION

MAY 29, 2017

Report of the High-Level Commission on Carbon Prices

supported by:

WORLD BANK GROUP

ADEME
Agence de l'Environnement et de la Maîtrise de l'Energie

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RÉPUBLIQUE FRANÇAISE

MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE ET SOLIDAIRE

This report of the High-Level Commission on Carbon Prices, a group of economists convened by the Carbon Pricing Leadership Coalition, was supported by staff of the International Bank for Reconstruction and Development/ International Development Association (The World Bank). It represents the collective views of the High-Level Commission on Carbon Prices. The Carbon Pricing Leadership Coalition (CPLC) is a voluntary partnership of national and sub-national governments, businesses, and civil society organizations that agree to advance the carbon pricing agenda. The CPLC secretariat is administered by The World Bank.

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The report was edited by Inge Pakulski and the graphic design is by Brad Amburn.

This booklet contains the overview of the Report of the High Level Commission on Carbon Pricing. A PDF of the final, full-length book is available at https://www.carbonpricingleadership.org. Please use the final version of the book for citation, reproduction, and adaptation purposes.

THE COMMISSION: OBJECTIVES

During the 22nd Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) held in Marrakech, Morocco, in 2016, at the invitation of the Co-Chairs of the Carbon Pricing Leadership Coalition (CPLC) High-Level Assembly, Ségolène Royal and Feike Sijbesma, Joseph Stiglitz, Nobel Laureate in Economics, and Lord Nicholas Stern, accepted to chair a new High-Level Commission on Carbon Prices comprising economists, and climate change and energy specialists from all over the world, to help spur successful implementation of the Paris Agreement.

The Commission's objective is to identify indicative corridors of carbon prices that can be used to guide the design of carbon-pricing instruments and other climate policies, regulations, and measures to incentivize bold climate action and stimulate learning and innovation to deliver on the ambition of the Paris Agreement and support the achievement of the Sustainable Development Goals.

Commission Chairs:

Joseph E. Stiglitz
(University Professor, Columbia University, United States)

Nicholas Stern
(IG Patel Professor of Economics and Government and Chair of the Grantham Research Institute, London School of Economics and Political Science, United Kingdom)

Commission Members:

Maosheng Duan
(Director of China Carbon Market Center of Tsinghua University, China)

Ottmar Edenhofer
(Deputy Director and Chief Economist at the Potsdam Institute for Climate Impact Research, Germany)

Gaël Giraud
(Chief Economist of the Agence Française de Développement, France)

Geoffrey Heal
(Donald C. Waite III Professor of Social Enterprise, Columbia Business School, United States)

Emilio Lèbre la Rovere
(Executive Coordinator of the Center for Integrated Studies on Climate Change and the Environment, Federal University of Rio, Brazil)

Adele Morris
(Senior Fellow and Policy Director for Climate and Energy Economics at the Brookings Institution, United States)

Elisabeth Moyer
(Associate Professor, Department of the Geophysical Sciences, University of Chicago, United States)

Mari Pangestu
(Professor of International Economics at the University of Indonesia; former Minister of Trade, Indonesia)

Priyadarshi R. Shukla
(Professor, Indian Institute of Management, Ahmedabad, India)

Youba Sokona
(Vice-Chair of the IPCC, Mali)

Harald Winkler
(Director, Energy Research Centre, University of Cape Town, South Africa)

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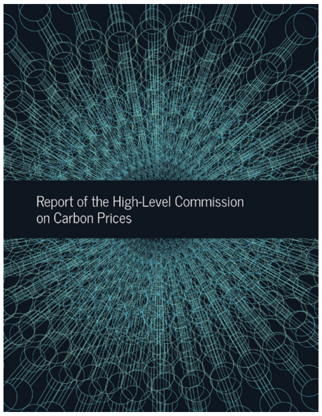
CONTENTS

ACRONYMS

CCGT	Combined Cycle Gas Turbine
CCS	Carbon Capture and Storage
CDP	Carbon Disclosure Project
CDM	Clean Development Mechanism
COP	Conference of the Parties
CPLC	Carbon Pricing Leadership Coalition
DDPP	Deep Decarbonization Pathways Project
EMF	Energy Modeling Forum
ETS	Emissions Trading System
EU	European Union
GHG	Greenhouse Gas
$GtCO_2e$	Giga (metric) tons of Carbon Dioxide equivalent
HDI	Human Development Index
IAM	Integrated Assessment Model
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
IPCC	International Panel on Climate Change
MDB	Multilateral Development Bank
MW	Megawatt
NDC	Nationally Determined Contribution
PMR	Partnership for Market Readiness
PPP	Purchasing Power Parity
R&D	Research and Development
SDG	Sustainable Development Goal
SSP	Shared Socioeconomic Pathway
tCO_2	(Metric) tons of Carbon Dioxide
tCO_2e	(Metric) tons of Carbon Dioxide equivalent
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY



The purpose of this Commission is to explore explicit carbon-pricing options and levels that would induce the change in behaviors—particularly in those driving the investments in infrastructure, technology, and equipment—needed to deliver on the temperature objective of the Paris Agreement, in a way that fosters economic growth and development, as expressed in the Sustainable Development Goals (SDGs). This report does not focus on the estimation and evaluation of the climate change impacts that would be avoided by reducing carbon emissions. While the Commission also covers other policies relevant and important to carbon-pricing design and delivery on the Paris agreement, its primary focus is on pricing.

This report has been prepared based on the Commission's assessment of the available evidence and literature as well as on its members' judgment, developed through their extensive international policy experience. While the commissioners are in broad agreement on the overall thrust of the arguments presented in the report, they may not necessarily support every single assertion and conclusion.

1. Tackling climate change is an urgent and fundamental challenge. At COP21 in Paris, in December 2015, nearly 200 countries agreed to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C." The goal of stabilizing the temperature increase well under 2°C is largely motivated by concerns over the immense potential scale of economic, social, and ecological damages that could result from the failure to manage climate change effectively. These temperature targets require a large-scale transformation in the structure of economic activity—including a major change in energy systems (especially power generation); industrial processes; space heating and cooling systems; transport and public transportation systems; urban forms; land use (including forests, grasslands, and agricultural land); and the behaviors of households. However, climate policies, if well designed and implemented, are consistent with growth, development, and poverty reduction. The transition to a low-carbon economy is potentially a powerful, attractive, and sustainable growth story, marked by higher resilience, more innovation, more livable cities, robust agriculture, and stronger ecosystems. To succeed, that is, to deliver efficiently and fully realize the potential benefits of climate policies, careful policy design is essential.

2. A well-designed carbon price is an indispensable part of a strategy for reducing emissions in an efficient way. Carbon prices are intended to incentivize the changes needed in investment, production, and consumption patterns, and to induce the kind of technological progress that can bring down future abatement costs. There are different ways to introduce a carbon price. Greenhouse gas

(GHG) emissions can be priced explicitly through a carbon tax or a cap-and-trade system. Carbon pricing can also be implemented by embedding notional prices in, among other things, financial instruments and incentives that foster low-carbon programs and projects. For instance, specific project-based credits, building upon the experience of the Clean Development Mechanism (CDM) of the Kyoto Protocol and on the mechanism established under Article 6 of the Paris Agreement, can provide similar incentives by applying a price to a unit of GHG emissions. Explicit carbon pricing can be usefully complemented by shadow pricing[1] in public sector activities and internal pricing in firms. Reducing fossil fuel subsidies is another essential step toward carbon pricing—in effect, these subsidies are similar to a *negative* emissions price. Governments can enhance the effectiveness of carbon pricing by establishing an enabling environment, building technical and institutional capacity, and establishing an appropriate regulatory framework. As carbon-pricing mechanisms take time to develop, countries should begin doing so immediately.

3. Achieving the Paris objectives will require all countries to implement climate policy packages. These packages can include policies that complement carbon pricing and tackle market failures other than the GHG externality. These failures are related to knowledge spillovers, learning and R&D, information, capital markets, networks, and unpriced co-benefits of climate action (including reducing pollution and protecting ecosystems). Some countries may conclude that the carbon-pricing trajectories required, if carbon pricing were the sole or dominant instrument, could entail excessive distributional or adjustment costs. Others may conclude that, given the uncertainties, requirements for learning, and scale and urgency of the transformation, rapid and more equitable change could be achieved more efficiently and effectively in other ways. The design of these policies will thus vary and always have to take into account national and local circumstances.

International cooperation—including international support and financial transfers, carbon-price-based agreements, and public guarantees for low-carbon investments—to promote consistency of action across countries can help lower costs, prevent distortions in trade and capital flows, and facilitate the efficient reduction of emissions (as well as the achievement of other Paris Agreement objectives, such as those related to the "financial flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development").

4. The Commission explored multiple lines of evidence on the level of carbon pricing that would be consistent with achieving the temperature objective of the Paris Agreement, including technological roadmaps, analyses of national mitigation and development pathways, and global integrated assessment models, taking into account the strengths and limitations of these various information sources. Efficient carbon-price trajectories begin with a strong price signal in the present and a credible commitment to maintain prices high enough in the future to deliver the required changes. Relatively high prices today may be more effective in driving the needed changes and may not require large future increases, but they may also impose higher, short-term adjustment

[1] *Shadow pricing*, the assignment of a dollar value to an unpriced commodity in a cost-benefit analysis or an impact assessment.

costs. In the medium to long term, explicit price trajectories may need to be adjusted based on the experience with technology development and the responsiveness to policy. The policy dynamics should be designed to both induce learning and elicit a response to new knowledge and lessons learned. Price adjustment processes should be transparent to reduce the degree of policy uncertainty.

5. Explicit carbon-pricing instruments can raise revenue efficiently because they help overcome a key market failure: the climate externality. The revenue can be used to foster growth in an equitable way, by returning the revenue as household rebates, supporting poorer sections of the population, managing transitional changes, investing in low-carbon infrastructure, and fostering technological change. Ensuring revenue *neutrality* via transfers and reductions in other taxes could be a policy option. Policy decisions will need to duly take into account the country's objectives and specific circumstances, while keeping in mind the development objectives and commitments agreed in relation to the Paris Agreement objectives.

6. Carbon pricing by itself may not be sufficient to induce change at the pace and on the scale required for the Paris target to be met, and may need to be complemented by other well-designed policies tackling various market and government failures, as well as other imperfections. A combination of policies is likely to be more dynamically efficient and attractive than a single policy. These policies could include investing in public transportation infrastructure and urban planning; laying the groundwork for renewable-based power generation; introducing or raising efficiency standards, adapting city design, and land and forest management; investing in relevant R&D initiatives; and developing financial devices to reduce the risk-weighted capital costs of low-carbon technologies and projects. Adopting other cost-effective policies can mean that a given emission reduction may be induced with lower carbon prices than if those policies were absent.

Conclusion

Countries may choose different instruments to implement their climate policies, depending on national and local circumstances and on the support they receive. Based on industry and policy experience, and the literature reviewed, duly considering the respective strengths and limitations of these information sources, this Commission concludes that the explicit carbon-price level consistent with achieving the Paris temperature target is at least US$40–80/t$CO_2$ by 2020 and US$50–100/t$CO_2$ by 2030, provided a supportive policy environment is in place.

The implementation of carbon pricing would need to take into account the non-climate benefits of carbon pricing (such as the use of revenues derived from it), the local context, and the political economy (including the policy environment, adjustment costs, distributional impacts, and political and social acceptability of the carbon price). Depending on other particular policies implemented, a carbon price could have powerful co-benefits that go beyond climate, for instance, potential improvements in air pollution and congestion, the health of ecosystems, access to modern energy, and so on. Further, in a realistic context where domestic and international compensatory transfers are limited, imperfect, and costly, it is impossible to disregard distributional and ethical considerations when designing climate policies. In view of this, the appropriate carbon-price levels will vary across countries. In lower-income countries they may actually be lower than the ranges proposed here, partly because complementary actions may be less costly and the distributional and ethical issues may be more complex.

It is of vital importance to the effectiveness of climate policy, particularly carbon pricing, that future paths and policies be clear and credible. New data will emerge continually and new knowledge be generated, and these facts and lessons learned should be taken into account—indeed, carbon pricing should foster learning and technological progress. It will be important to monitor and regularly review the evolution of emissions, technological costs, and the pace of technological change and diffusion so that carbon prices can be adjusted, particularly upward, if actual prices fail to trigger the required changes. Policy adjustments should be made based on criteria that are transparent and sound: policies should be "predictably flexible." It is desirable that the carbon-price range across countries narrow over the long term, in a time frame that depends on several factors, including the extent of international support and financial transfers, and the degree of convergence in living standards across countries.

The temperature objective of the Paris Agreement is also achievable with lower near-term carbon prices than indicated above if needed to facilitate transitions; doing so would require stronger action through other policies and instruments and/or higher carbon prices later, and may increase the aggregate cost of the transition. The carbon pricing and complementarity measures indicated here are substantially stronger than those in place at present (85 percent of global emissions are currently not priced, and about three quarters of the emissions that are covered by a carbon price are priced below US\$10/tCO_2). This statement is consistent with the observation that the Nationally Determined Contributions (NDCs) for 2030 associated with the Paris Agreement represent emission reductions that are substantially smaller than those necessary for achieving the Paris target of "well below 2°C."

1 INTRODUCTION

At the 21st session of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Paris in December 2015, nearly 200 countries agreed to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C." The High-Level Commission was established by the Carbon Pricing Leadership Coalition (CPLC), with the remit of examining the role of carbon pricing in achieving the Paris objectives.

The goal of limiting the global temperature increase to well under 2°C is largely motivated by concerns over the immense potential scale of economic, social, and ecological damages that could result from the failure to manage climate change effectively. Unmanaged climate change could pose a grave threat to the well-being, socioeconomic development and prosperity, and economic growth and stability of societies, as well as to the overall goal of poverty reduction. It would create severe obstacles to the achievement of the medium- and longer-term objectives reflected in the Sustainable Development Goals (SDGs) (Stern 2006; Bhattacharya, Oppenheim, and Stern 2015; Bhattacharya et al. 2016; IPCC 2014a; Hallegatte et al. 2015; World Bank 2010; and World Bank 2015).

Natural disasters—intensified by climate change in many regions—threaten the infrastructure that is necessary to modern economic production and to provide basic and essential services such as education, clean drinking water, and access to energy. They can also wipe out poor people's decades of savings in an instant, and often force people to cope by reducing their food intake or health care expenditures, or by taking children out of school (Hallegatte et al. 2017). Sea level rise, storm surges, and salinization may ruin land used for agriculture or other purposes. These phenomena may make the world's coastal cities highly vulnerable or force them to invest heavily to protect themselves against coastal floods. And carbon emissions do not only affect the global climate, they also lead to ocean acidification, which affects marine ecosystems. All of these forces, in combination with higher temperatures, are likely to reduce overall agricultural yield and food production, thereby threatening food security in vulnerable regions (IPCC 2014a). Making matters even worse, the poor people living in poor countries will be the ones hit earliest and hardest.

While the impacts of climate change are already visible, both in developed and developing countries, the total potential impact to be felt in the later part of this century is much larger and could have a profound effect on our daily lives and livelihoods, among other things, where human settlement would still be possible. Unmanaged climate change could, over the next century, reverse the development gains of the last seven decades, possibly lead to large-scale migration and sustained and severe conflicts, and threaten the prosperity of countries at every income level.

The recognition of the immensity of the potential impacts was a key element of the international agreement reached in December 2015 that laid down the target of "well below 2°C."

There is an urgency to act as only a limited carbon budget remains available to keep global temperature change well below 2°C. While greenhouse gases (GHGs) other than CO_2 also contribute to climate change, the anthropogenic temperature rise is largely caused by CO_2 emissions accumulated over time (IPCC 2013). What is more, the carbon budget once available to keep the global temperature increase below 1.5°C may already have been fully used up—and even to keep the temperature rise below 2°C, the remaining budget is at most a few decades of current emission levels, and close to the emissions associated with the remaining life of the existing energy infrastructure (Davis, Caldeira, and Matthews 2010; Pfeiffer et al. 2016; Rozenberg et al. 2015).

Achieving the Paris Agreement temperature target requires a large-scale transformation of economic activity and the underlying systems. This includes major changes in the energy system (especially power generation), industrial processes, heating and transportation systems, urban forms, land use (including forests, grasslands, and agriculture), and the behavior of households. To stabilize the rise in temperature at any given level requires reducing net emissions to zero (or "balancing sources and sinks," in the Paris Agreement language) in the second half of this century. The lower the targeted temperature increase, the sooner net emissions will have to reach zero. Achieving the broader Paris goals also requires increasing the ability to adapt to adverse climate change impacts, and making financial flows consistent with a pathway toward low-carbon emissions and climate-resilient development.

The global scenarios that achieve zero net emissions and maintain the temperature rise below 2°C *in a cost-effective way* show four parallel changes in the global economy, which involve the transformation of capital-intensive systems with long-lived assets (IDDRI and UNSDSN 2014; IEA 2014; Krey et al. 2014; Williams et al. 2012; Clarke et al. 2014; IPCC 2014c; Fay et al. 2015; NCE 2014, 2016, ETC 2017a, 2017b):

- ***Decarbonizing electricity production*** is necessary to stabilize climate change, through the use of either renewable energy or other zero-carbon forms of energy, or fossil fuels combined with carbon capture and sequestration/storage (CCS);
- ***Promoting electrification*** by increasing the use of carbon-free generated power, or (at least in a transition phase) switching to cleaner or zero-carbon fuels, is necessary in the housing, industry, and transport sectors;
- ***Enhancing efficiency***, by improving energy efficiency and reducing waste in all sectors (among others, manufacturing, services, agriculture, food consumption, residential energy use, and through reduced congestion in urban areas), contributes to reducing emissions and facilitates (and reduces the cost of) the transition to net-zero emissions;

- ***Optimizing landscapes***, by preserving and improving natural carbon sinks—through the creation of "climate-friendly" landscapes, the management of forests and other kinds of vegetation and soils, and changes in agricultural practices. This element is particularly important in countries where much of the emissions are linked to land use changes and is likely to play a critical role if negative emissions have to be achieved in the second part of this century.[2]

Current climate action is insufficient to achieve the main Paris Agreement objective. Further, as recognized in the Agreement, current plans or "Nationally Determined Contributions" (NDCs) up to 2030 fall substantially short of what is necessary. This explains the incorporation in the Agreement of the need to revise those plans by 2020 and raise ambitions for further reductions. All scenarios that are consistent with maintaining temperature rise "well below 2°C" and minimizing aggregate transition costs show emissions that are much lower than those reflected in current plans and trends.

The required action implies structural change, learning, experimentation, and technological changes, and involves large uncertainties. These uncertainties include those related to the availability and cost of various technologies (e.g., the availability of CCS at scale, at reasonable cost), the social and political acceptability of some technologies (e.g., nuclear energy or large-scale land mobilization for biofuel production), the quality of policies, and possible changes in consumption patterns or social norms (e.g., related to transportation or the human diet and meat consumption). Climate policies cannot be assessed in a static context where technologies and socioeconomic conditions are fixed. By contrast, dynamic processes such as learning-by-doing, innovation in technology and institutions, and long-term changes in norms and behaviors will play a key role. The vital importance of these issues and the uncertainty they embody must influence any assessment. They also make formal, large-scale modeling very challenging, as these aspects are difficult to capture in formulas. As a result, many attempts at formal modeling have proved misleading, in the sense that they omit many important opportunities and issues, particularly around economies of scale and changing technologies and methods.

The central role of learning, knowledge generation, and innovation, together with these uncertainties, means that policy design will have to be dynamic and adaptive (O'Brien and Selboe 2015; Kunreuther et al. 2014; Lempert and Schlesinger 2000). In particular, the impact of policies needs to be closely monitored over time and the policies have to be revised if they appear to be failing (that is, do not reduce emissions enough) or entailing unacceptable costs (e.g., threaten food security). But the criteria for revision should be clear and transparent to avoid unnecessary uncertainty, as this could inhibit investments.

[2] Negative emissions can be achieved by removing GHG from the atmosphere through air capture (which is inherently costly), or to a limited extent through biological methods: afforestation or the use of biofuels in power plants with carbon capture and sequestration. Negative emissions could permit net reduction in the concentration of GHG in the atmosphere over time, and/or the achievement of net-zero (or net-negative) global emissions, even with positive emissions in some sectors, regions, or countries that are difficult to decarbonize.

However, climate policies, if well designed and implemented, are consistent with growth, development, and poverty reduction. To succeed, that is, to deliver efficiently and fully realize the potential benefits of carbon pricing, careful policy design is essential. Achieving the Paris objectives will require all countries to implement climate policy packages, which should include multiple policies and instruments. While the design of these packages will vary, based on national and local circumstances, a well-designed carbon-pricing system is an indispensable part of a strategy for reducing emissions in an efficient way. Many have argued that the *transition to a low-carbon economy is a powerful growth story*. In the medium term, it can be a strong driver of discovery, innovation, and investment (Stern 2015b); in the shorter term, the necessary investments in sustainable infrastructure could be a key driver of growth (Abiad, Furceri, and Topalova 2014; IMF 2014). And in the longer term, any extended attempt at high-carbon development could create an environment hostile to global growth, threatening to undermine future development gains or even reverse past ones. There are strong arguments supporting the assertion that some of the key features of low-carbon growth (such as less pollution, less congestion, greater efficiency, and more robust ecosystems) are in and of themselves very attractive (NCE 2014; World Bank 2012).

The purpose of this Commission is to explore explicit carbon-pricing options and levels that would induce the change in behaviors—particularly in those driving the investments in infrastructure, technology, plants, and equipment—needed to deliver on the temperature objectives of the Paris Agreement, in a way that fosters economic growth and development, as expressed in the Sustainable Development Goals, among others. This report does not focus on the estimation and evaluation of the climate change impacts that would be avoided by reducing carbon emissions. While the Commission, unavoidably, also covers other policies relevant and important to carbon-pricing design and delivery on the Paris Agreement, its primary focus is on pricing. As was the case of the Paris Agreement of December 2015, the analysis is set in the context of the multiple objectives of the international community, including those related to economic growth and to development and poverty reduction, particularly the Sustainable Development Goals agreed at the United Nations in September 2015.

This report's conclusions represent a judgment on the relevant evidence critically reviewed and assessed by the Commission as a whole. The analysis and conclusions are based on the Commission's assessment of the information and literature available as well as on its members' judgment, developed through their extensive international policy experience. While the commissioners are in broad agreement with the overall thrust of the arguments presented in the report, they do not necessarily support every individual element or formulation.

2 CARBON PRICING: INDISPENSABLE FOR REDUCING EMISSIONS IN AN EFFICIENT WAY

A well-designed carbon price is an indispensable part of a strategy for reducing emissions in an effective and cost-efficient way. Carbon prices incentivize low-cost abatement options and can equalize marginal abatement costs[3] across the sources and sectors to which the carbon price applies. They do so by creating incentives for markets to use all levers available to reduce emissions: the type of activity pursued, the structure and energy intensity of a particular industry or of the economy as a whole, and the type of fuel chosen.[4]

Carbon pricing can apply to all GHGs. The carbon price is generally normalized to the amount of GHG that would lead to the same equivalent warming as a ton of CO_2 over a specific period, and is specified as a price per ton of CO_2e (or CO_2 equivalent). The time period considered can alter the relative penalty on emission of different GHGs (IPCC 2013, 2014c).

Carbon prices encourage producers to decrease the carbon intensity of the energy sector and manufactured products, and consumers to choose less carbon-intensive goods. More specifically, they encourage a shift to less carbon-intensive goods (such as public transportation) and enhance the efficient use of existing systems (e.g., through carpooling and eco-driving). They also promote the adoption and diffusion of existing abatement technologies, and redirect investment toward cleaner alternatives (such as more efficient cars).

By creating opportunities to increase profitability or save money through the reduction of GHG emissions, carbon pricing also promotes innovation and incentivizes the generation of new ideas and solutions. Pricing carbon can help drive innovation in technologies and business models that can reduce carbon emissions and promote resource efficiency, and thus boost productivity improvements. As the development of green technology often requires ongoing investments, some economists consider the potential of carbon pricing to help "kick-start" cleaner energy industries (Aghion, Veugelers, and Hemous 2009).

[3] The *marginal abatement cost* reflects the cost of one additional unit or ton of pollution that is abated, or not emitted.

[4] Under certain simple conditions, a carbon price ensures that firms equalize marginal abatement costs across different ways of reducing emissions, a necessary condition for an efficient transition (Nordhaus 1991; Pearce 1991; Pigou 1932). On the other hand, as we emphasize below, for a variety of reasons, it will generally be desirable to accompany carbon pricing with other measures. For instance, when faced with a lack of relevant knowledge and information, imperfect capital markets, and other imperfections, even a high carbon price may not lead to the most efficient long-term capital technologies being chosen. Advances in behavioral economics and theories of policy in imperfect markets have underscored the limitations of traditional economic models. In this context, efforts should be directed at developing a dynamic economics of public policy.

A carbon price can be introduced "upstream," thereby affecting the full supply chain of products without requiring tracking all emitting activities or measuring the carbon emissions embedded in goods and services. In energy-importing countries such as Morocco, where 90 percent of the energy and roughly all of the fossil fuels are imported, tax collection can be accomplished by merely monitoring the ports of entry, making a carbon tax easier to administer and enforce than other mitigation instruments or taxes.

2.1 Carbon-Pricing Options

Two main policy options are available for introducing an explicit carbon price in the economy. One option involves putting a price on carbon through a tax or fee on GHG emissions or the carbon content of fossil fuels. The second major option, known as a cap-and-trade scheme/system, limits the total allowable volume of emissions in a particular time period from a specified set of sources (the so-called cap on emissions), and allows economic actors to trade their emission rights.

If a cap-and-trade system functions well and emissions decline over time, GHG pollution will be reduced each year by a predictable amount, but the price at which the emission rights trade will be uncertain. The price of carbon in a cap-and-trade system can be hard to predict because the volume of emissions fluctuates for many reasons, such as varying economic growth rates and fossil fuel prices. Policy makers can narrow down the potential range of the price of carbon in a cap-and-trade system by allowing the banking and/or borrowing of emission rights over time; setting a floor price for auctioned emission rights; offering more emission rights to polluters if prices rise too much; or by making ex post cap adjustments (Wang, Jotzo, and Qi 2017). These mechanisms have proven their efficacy: analysts suggest that the drop in the European Union (EU) Emissions Trading System (ETS) emissions (by 2.4 percent in 2016) was primarily driven by the carbon-price floor introduced in the United Kingdom, where a £18/tCO_2 top-up on the EU ETS price resulted in the coal power plants reducing their emissions by 58 percent in 2016.[5]

A carbon tax requires economic actors to pay for every ton of GHGs released into the atmosphere, usually at a fixed price in any given year. Carbon taxes are generally easier to administer than a cap-and-trade system because they neither involve a market-based trading system nor require enforcing rules to prevent market manipulation. Moreover, they can be built on existing taxes (such as a fuel excise tax) and economic actors can predict their estimated liabilities reasonably well. Similarly, entrepreneurs who invest in low-GHG technologies can anticipate the market advantage of their products relative to their dirtier competitors. That said, in a world of uncertainties, a carbon tax does not guarantee hitting a particular emissions target in any given year. However, since the objective should be to ensure that the concentration of GHGs in the atmosphere does not exceed a specific level, what matters are the *cumulative* emissions—the year-to-year emissions are not of great concern in themselves. A carbon tax guarantees a maximum cost per unit of pollution in the sectors

[5] European Commission data on 2016 emissions data (https://ec.europa.eu/clima/policies/ets/registry_en#tab-0-1), accessed April 2017.

covered by it. If a carbon tax underperforms environmentally, policy makers can raise the tax or design it in a way that it will rise automatically in response to emission trends (Metcalf 2008; Aldy 2017).

Carbon tax and cap-and-trade systems have at times existed side by side in one and the same country. Both options are usually combined with complementary policies. The latter may include establishing norms for recommended emission levels or technical production guidelines that encourage producers to decrease the carbon intensity of their production processes. As these policies create a constraint (and a cost) for economic actors, they are sometimes interpreted as an *implicit* price of carbon. The combination of instruments—either multiple pricing systems or a mix of prices and complementary policies—may create synergies or weaken each other, depending on the specific design. These interactions need to be considered and managed carefully, and may influence the selection of instruments.[6]

Carbon pricing can also be implemented by embedding notional prices in, for example, financial instruments that reduce the capital costs of low-carbon programs and projects (compared with other, more carbon-intensive programs and projects). Because energy-efficient power generation and renewable energy often involve higher upfront costs and larger uncertainties (than traditional energy sources), the relatively high capital costs tend to encourage the use of fossil fuels. To achieve a given degree of decarbonization, countries with relatively high capital costs need to impose a higher price on carbon emissions than countries with lower capital costs (see section 4.2.1 for examples of how capital costs influence the carbon price required). This aspect is particularly important for developing and emerging economies, where capital costs tend to be higher than in rich countries (Hirth and Steckel 2016; De Gouvello and Zelenko 2010).

Countries can use financial instruments to reduce the upfront costs of mitigation actions, using tools such as public guarantees and other risk-reducing instruments; feebates;[7] and interest rate subsidies and tax breaks for low-carbon investments. These complementary policies can be defined based on an agreed carbon value (which can include both climate and non-climate considerations, see appendix B), which can help reduce the risk of arbitrariness and ensure economic efficiency. For instance, one option is to lower the risk-weighted capital cost of low-carbon investments in proportion to the present value of the carbon value attached to a given project (Hourcade, Perrissin-Fabert, and Rozenberg 2012). While these financial instruments can be used to implement a carbon price expressed as a monetary value (US\$/tCO_2), either as a standalone policy or as a complement to explicit carbon pricing, they can only be applied to new investments and thus do not affect *existing* assets (for instance, feebates for cars can influence the fleet composition and reduce GHG emissions from new cars, but they do not create an incentive to reduce the distance traveled by old cars, as does carbon pricing). The fact that these instruments do not affect existing assets makes them less effective than carbon pricing, but potentially more acceptable politically and socially (Rozenberg, Vogt-Schilb, and

[6] For instance, support to renewable energy reduces the price of emission rights in a cap-and-trade system. In general, the exogenous price of a carbon tax makes it easier to avoid problematic interactions with other climate policies than with the endogenous price in a cap-and-trade system (Goulder and Schein 2013).

[7] Feebate, a system of charges and rebates whereby energy-efficient or environmentally friendly practices are rewarded, while failure to adhere to such practices is penalized (see also section 6.2.)

Hallegatte 2014). As discussed in section 3.2., these instruments can also be used to foster international coordination, for instance, through the Article 6 mechanism of the Paris Agreement, which extends the experience of the Clean Development Mechanism (CDM) of the Kyoto Protocol. The presence of a multilateral or national development bank in a program can itself reduce political risk and the cost of capital. Given the right mix of instruments (including guarantees and equity), a development bank can also help manage risk, which can be acute in the early stages, and therefore help bring in private sector capital as well as act as a convener (see section 6.2).

Explicit carbon pricing can be usefully complemented by shadow pricing in public sector activities and internal pricing in firms. Governments, firms, and institutions often use shadow carbon pricing to help reorient investment decisions, anticipate future pricing or future changes in the carbon price, or account for indirect impacts on emissions (e.g., when public infrastructure investments affect emissions). The United Kingdom adopted the use of a shadow price for carbon in 2007 as the basis for incorporating carbon emissions in cost-benefit analyses and impact assessments. Institutional investors and lenders often incorporate a shadow carbon price into their environmental impact assessments and cost-benefit analyses as well. For instance, the European Investment Bank uses a shadow carbon price as a "non-financial value-added" in its cost-benefit analysis of projects. The World Bank employs a shadow price (referred to as the "social value of carbon") for use in the economic analysis of its operations and projects. Shadow pricing is increasingly becoming a common corporate practice—businesses have started setting internal shadow carbon prices to help guide decisions for a cleaner future (see section 2.4). Carbon-pricing policies can be implemented alongside these shadow carbon prices.

2.2 The Importance of Fossil Fuel Subsidies

Reducing fossil fuel subsidies is also part of carbon pricing—in effect, these subsidies act like a negative emissions price. According to the International Energy Agency (IEA), total fossil fuel subsidies in 40 (mostly developing) countries reached US$548 billion in 2013, or 5 percent of GDP and 25–30 percent of government revenues (IEA 2014). The OECD estimates that its member countries spent US$55–90 billion a year subsidizing fuels in the period 2005–11 (OECD 2013). In a more recent assessment covering most countries in the world, IMF estimates suggest that fiscal fossil fuel subsidies reached US$650 billion in 2015 (Coady et al. 2016). If unpriced pollution and other externalities associated with the use of fossil fuels are regarded as implicit subsidies, then overall post-tax subsidies can be estimated at over US$5 trillion per year (Coady et al. 2016).

Fossil fuel subsidies discourage investments in clean energy and energy efficiency, tilting the balance in favor of fossil fuels and making it difficult for renewable energy and energy-efficient equipment to compete. This is particularly obvious in the Middle East, where oil and gas subsidies reduce electricity prices to 30–45 percent of what they would be if full reference prices were paid (Fay et al. 2015). Electricity generation from oil is currently one of the lowest-cost options in the Middle East, but would be more expensive than wind, photovoltaic (PV), and even concentrated solar power, absent the subsidies. A number of countries find themselves subsidizing both fossil fuels and renewables—and sometimes even taxing carbon. An important component of achieving global temperature targets is the removal of such perverse policy incentives. Removing fossil fuel subsidies and distributing the resulting budget savings in the form of lump sum cash transfers would improve the situation of poor people (Arze del Granado, Coady, and Gillingham 2012), and the resources freed by the reform could be used for other policy goals or growth-enhancing investments (see chapter 5).

2.3 Effective Carbon Pricing through an Enabling Environment

The experience of the World Bank's Partnership for Market Readiness (PMR) shows that **developing "readiness" for carbon pricing requires both political leadership and technical/institutional readiness to advance the carbon-pricing agenda at the domestic level.** For many countries, the decision-making process surrounding the choice of an appropriate carbon-pricing approach is indeed an extensive and politically sensitive endeavor.

Carbon pricing is easier to implement if an enabling environment and an appropriate regulatory framework exist. Critical preparation steps for a carbon-pricing system include the following: setting the scope of the instruments (i.e., defining the sectors and GHGs to be priced—there may be some sectors and GHGs where direct regulation may be either an easier or more effective way of reducing emissions); collecting robust emissions data; and determining the ambition of the instruments, in line with the jurisdiction's overall climate change mitigation objectives, and how best to recycle the revenue from carbon taxes or auctioned emission rights. Once carbon-pricing instruments are in place and become effective, governments need to directly tackle implementation challenges related to the review and refinement of instruments. Some countries implementing carbon pricing will require more capacity and longer preparation than others, and the local institutional capacity and legal framework will influence the choice of instruments to price carbon. In particular, a carbon tax can rely on existing fiscal tools and institutions, and is simpler and quicker to implement than cap-and-trade systems, which require the creation of appropriate systems and institutions, and raising awareness and capacity in the private sector. Like all tax systems (see Mankiw, Weinzierl, and Yagan 2009), carbon-pricing schemes may show significant departures from the theoretically optimal setting and it is very important to apply learning and new knowledge to continuously improve these systems.

Continuous engagement with stakeholder groups—to understand and address their respective concerns—is also critical to avoiding policy misalignment (e.g., between energy market regulation and climate policy, see OECD 2015) and ensuring public and political support as well as encouraging collaboration between government and market players. While this process takes time and resources, it helps ensure the long-term credibility and sustainability of carbon pricing and reduces policy uncertainty, which is a key obstacle to investments in a low-carbon future. Carbon-pricing readiness can have benefits other than emission reductions, as improvements in technical and institutional capacity entail crosscutting benefits that can support other climate and development policy objectives beyond the implementation of a given emission-pricing instrument. This is particularly true when it comes to efforts to establish credible, compatible, and consistent standards and approaches for GHG mitigation (e.g., for data management and Monitoring, Reporting, and Verification (MRV) systems), and for economic and policy analysis that informs the selection, introduction, and future refinement of a carbon-pricing instrument.

2.4 Private Sector Gearing Up for Carbon Pricing[8]

Parts of the private sector are preparing for a future in which governments will put a price on carbon. In fact, many corporations have already introduced internal carbon prices in their decision making, but the private sector as a whole has not yet priced carbon at the rate and breadth required. Companies have three main rationales to adopt an internal carbon price. First, it incentivizes actors within a firm to reallocate resources toward low-carbon activities, and helps firms prepare for a future where carbon emissions are priced. Assigning a carbon cost to investment options creates a clear business case for innovation and for making changes toward reduced emissions. Second, it can be used to drive R&D investments, a priority for companies seeking to cut emissions from their manufacturing process and attract new business from customers interested in low-carbon, low-cost solutions. Lastly, assigning a financial value to both emitted and avoided volumes of CO_2 emissions helps reveal the hidden risks and opportunities in a company's operations and supply chain. This is particularly relevant for companies that have to navigate an array of carbon-pricing regulations because their operations span multiple countries.

In addition, investors are increasingly demanding comprehensive climate disclosure—including the assurance that companies are adequately lowering their risk exposure to policies that place a price on carbon and reallocating capital toward areas of their business that will see a higher return in a low-carbon economy. Transparency on the carbon footprint of firms and investments has been promoted by Mark Carney, as Governor of the Bank of England and Chairman of the G20's Financial Stability Board, the Carbon Disclosure Project (CDP), and the Task Force on Climate-Related Financial Disclosure. It is critical to increase awareness and help investors and consumers make decisions that account for their contribution to climate change and their exposure to climate policies.

Disclosures to the CDP in 2016 capture the corporate response: 517 companies are already using internal carbon prices as an accounting and risk management tool (which represents a 19 percent increase with respect to 2015), and an additional 732 companies have revealed plans to adopt an internal carbon price by 2018 (a 26 percent increase with respect to 2015) (CDP 2016). CDP reports that 147 companies are embedding an internal carbon price ever deeper within their business strategies and across their operations in order to take tangible action on climate change. A subset of 37 companies describe a variety of ways in which this tool has directly affected their budget allocations or investment decisions, which has resulted in tangible changes.

[8] This section is from CDP (2016).

3 CLIMATE POLICY PACKAGES: KEY TO ACHIEVING THE PARIS TEMPERATURE OBJECTIVE

3.1 Government and Market Failures Other Than GHG Externalities

To tackle climate change efficiently, market and government failures other than the climate externality need to be considered (Fay et al. 2015; Stern 2015a). More specifically, the following aspects should be duly addressed:

- ***Knowledge spillovers.*** Decarbonization requires drastically different technologies and knowledge spillovers represent a key market failure: not realizing the *social* benefits of such spillovers can impair or slow down the development of decarbonizing technologies. Knowledge is always, to some extent, a public good, and companies that invest in R&D into low-carbon technologies are therefore unable to capture the entire return of their investment (Jaffe, Newell, and Stavins 2005). Thus, in the absence of public support, private investments in knowledge and R&D will be below their optimum levels. Economies of scale, sunk costs, and the path dependency of research also give the established technologies (Acemoglu et al. 2012) an advantage, create entry barriers (Stiglitz et al. 2014), and possibly slow down the transition toward a zero-carbon economy.

- ***Incomplete and imperfect capital markets.*** Finance is a key requirement for the kind of innovation and investments needed to achieve the objectives of the Paris Agreement (NCE 2014; Gupta et al. 2014; Kennedy and Corfee-Morlot 2013; Fay et al. 2015). Governments in both developed and developing countries already struggle to finance infrastructure projects, and firms and households in developing countries are chronically credit-constrained. Plagued by incomplete financial and risk markets, innovative or large-infrastructure projects often struggle to secure the necessary funding, even when they are competitive. And the capital required to transition to low-carbon futures often faces large uncertainties, political risks, illiquid assets, and solid returns in the long term only. Aside from the standard credit constraints, investors lack the knowledge and information necessary to assess the quality of innovative, low-carbon projects.

- ***Network effects and coordination failures.*** Technologies that are components of interlocked networks—as in the case of electric or plug-in vehicles and specific charging infrastructure—can be difficult to establish through market forces alone due to the high upfront costs and long-term risky returns, but also due to coordination failures (Grübler, Nakićenović, and Victor 1999). Increasing the share of renewable energy in the energy mix requires investments in robust power grids and large-scale (often international) coordination. The challenge when trying to support low-carbon technologies and systems such as electricity grids, public transportation, recycling, or broadband networks, lies in offering the appropriate combination of economic, fiscal, and financial incentives.

- ***Lack of information.*** Information about the energy efficiency or carbon content of a product or production process may not be available, making it difficult for economic agents to make informed decisions. Individuals may also just prefer to rely on simple rules of thumb rather than carefully process the available information, or they exhibit systematic cognitive or behavioral biases (Weber and Johnson 2011). For these reasons, information disclosure efforts are often seen as a key step toward getting individuals to adopt more socially desirable behaviors.

- ***Unpriced co-benefits.*** Various co-benefits—for instance, lower air pollution, improved health, higher energy security, and lower expenditures—increase the value of reducing GHG emissions for the society. Some of these co-benefits have a direct *financial translation* (such as savings from reduced fuel use) while others (such as better health or the preservation of biodiversity) cannot be directly and consensually assigned a monetary value. Moreover, there are second-order impacts, including the freeing of public resources for alternative uses, and positive macroeconomic impacts (such as growth and higher employment) associated with climate-related investments. The co-benefits of mitigation can be substantial and are therefore often an important element in analyses by policy makers. Observational and modeling studies indicate that 3 million premature deaths are attributable to ambient air pollution and 4.3 million premature deaths to household pollution (WHO 2016). The global average marginal co-benefits of avoided mortality are estimated at US\$50–380/tCO_2 (West et al. 2013). In 2011, the United Nations Environment Programme (UNEP) estimated that fast action to reduce emissions could avoid 52 million tons (or 1 to 4 percent) of crop losses per year (UNEP 2011). In a 2014 World Bank study, the annual co-benefits of sector policies aimed at stimulating a shift to clean technologies in six regions (the United States, China, the EU, India, Mexico, and Brazil) were estimated at US\$1.8–2.6 trillion in GDP growth (World Bank 2014). Bollen (2015) estimates that the economic value of co-benefits could be as high as 75 percent of total climate policy costs in the developing world. However, in many cases, the co-benefits are not monetized, quantified, or even identified by decision makers and businesses.

- ***Inability to commit and other government failures.*** The transition toward zero net emissions is a long-term process that will span decades and involve infrastructure and urban planning decisions whose impact will still be felt in decades to come. Providing the right incentive for these decisions is made more difficult by the fact that governments have very limited ability to make commitments spanning such long periods (Brunner, Flachsland, and Marschinski 2012; Helm, Hepburn, and Mash 2003)—as Australia's recent reversal on carbon taxes illustrates. Other government failures that may reduce the efficiency of climate policies are the lack of enforcement of regulations (see Nepstad et al. 2014, for an example in Brazil) and allowing the capture by interest groups (Chang 2006; Hallegatte, Fay, and Vogt-Schilb 2013; Rodrik 2014).

- ***Distributional and ethical considerations.*** Distributional and ethical aspects may also influence the design of climate policies (Jenkins 2014; Nemet et al. 2017; Harrison 2013; Fay et al. 2015; Stern 2015, 2014). The transition toward carbon neutrality implies that some sectors, activities, and technologies will be replaced by new ones that are more efficient or based on zero-carbon energy sources. This transformation cannot be realized without some negative impact on the owners and employees of energy-intensive sectors (e.g., the coal industry), and on specific groups such as fishermen (who depend on diesel fuel), farmers (who use diesel pumps for irrigation), and small and medium-sized enterprises. Carbon pricing will no doubt lead to higher energy prices, at least in the short term, which may affect consumers—especially by undermining universal access to modern energy, with potentially dire health effects (e.g., because of the use of biomass for cooking). In some countries, pressures from those who may lose because of decarbonization have succeeded in raising impediments to the use of more efficient, low-emission technologies.

  Norms regarding what would be a "fair" distribution of the negative effects of carbon pricing touch on difficult ethical issues and, in the context of climate change, these effects are particularly severe and can lead to catastrophic outcomes and loss of life on a major scale. Given the uncertainties around future climate trajectories, it is also important to incorporate considerations regarding temporal (intergenerational) ethics in social decision making.

  The higher the carbon price, the larger its distributional impacts will be. Opposition may be partially overcome by using some of the revenues from carbon pricing to provide grants or other benefits to those groups adversely affected by the policy (see chapter 5); unfortunately, perfect targeting of specific population groups is rarely possible. In some cases, the carbon price required to achieve the desired reduction in emissions may be very high and the ability to undertake offsetting measures relatively low. And offsetting distributional effects with *imperfect* targeting may introduce new distortions and inefficiencies. As we noted earlier, complementary measures (such as the requirement that all new, coal-fired electricity generating plants have a minimum of carbon storage capacity) may significantly reduce the carbon price required to reach the Paris goals and mitigate the distributional impacts.

These issues not only interact with each other, but also with the climate change externality (Lipsey and Lancaster 1956; Meade 1955; Atkinson and Stiglitz 2015; Diamond and Mirrlees 1971; Drèze and Stern 1990). **As a result, efficiency and equity considerations may demand that governments complement carbon pricing with other policies.** In fact, a climate policy package can target these multiple issues and account for the political economy of reforms. More specifically, climate policy packages may include:[9]

- ***Carbon pricing.*** As discussed above, a well-designed policy to price carbon and other GHGs is an indispensable part of a strategy for reducing emissions in an efficient way.

- ***Complementary policies.*** In general, other policies can be useful to complement the carbon-pricing

[9] Other categories have been proposed, for instance, the *State and Trends or Carbon Pricing* Report (World Bank, Ecofys, and Vivid Economics 2016) uses the categories complementary, overlapping, and countervailing policies.

policy, especially in the context of other market failures and significant distributional impacts that are not easily compensated.

- ***Facilitating policies.*** To make climate action sustainable, action is needed to manage the distributional impacts and make the required climate policies socially and politically acceptable.

3.2 Country Policy Design: A Reflection of National and Local Circumstances

In a simple *theoretical* setting, assuming the possibility of unlimited and lump sum international transfers (i.e., transfers that would not affect the incentives of consumers, producers, and other economic agents) and in the absence of other relevant market failures, it is possible to separate the question of where emission reductions should take place and who should pay for them, and therefore to separate global efficiency from distributional considerations. Considering global climate objectives in such a setting, it would be optimal to seize the lowest-cost opportunities to reduce emissions first, regardless of their geographic location, through a carbon price that is uniform across countries. The resulting unequal distribution of mitigation efforts could then be corrected through transfers. (These transfers could also be achieved through the appropriate distribution of emission rights in a global carbon market.) In this case, the high elasticity of emissions typical of low-income countries (i.e., the existence of cheap emission reduction potentials) would lead to large reductions in these countries, compensated by large financial transfers from the rich to the poorer countries to pay for these reductions.

In a more realistic setting, such unlimited lump sum transfers are impossible and, as a result, efficiency and equity cannot be separated, nor can distributional and ethical considerations as well as other market failures be ignored when deciding where emission reductions should be implemented first. In such a situation (as shown in Chichilnisky and Heal 1994; Chichilnisky, Heal, and Starrett 2000), it is optimal for carbon prices to differ across countries.

With constrained transfers, there are two (interlinked) reasons why lower-income countries may choose lower carbon prices than high-income countries: (1) low-income countries tend to have less ambitious objectives for emission reductions; and (2) low-income countries tend to require a lower carbon price to achieve a given level of emission reductions.

First, climate policies need to be designed in a way that supports continued development and poverty reduction. Well-designed climate policies are compatible with development and poverty reduction. And recent technology development and policy instruments create some opportunities for low-income countries to benefit from low- or zero-carbon technologies and leapfrog fossil fuel technologies. For instance, small-scale solar energy and mini grids offer new opportunities to provide modern energy to low-density, remote rural areas, at a much lower price than gridded electricity or small-scale diesel generators. And since developing countries are building their energy infrastructure at present, they have the opportunity to build it in an efficient and low-carbon way at a moderately higher cost, rather than having to pay for costly retrofitting (Fay et al. 2015; NCE 2014; Stern 2015a).

Building low-carbon energy infrastructure also allows avoiding some of the negative side effects of fossil-based development, such as the local air pollution that is observed in many cities of emerging economies and kills millions each year.

When and where trade-offs between development and emission reductions exist, the imperative of development and poverty reduction may justify slower and more moderate emission reductions over the short term (Fleurbaey et al. 2014; Kolstad et al. 2014; Knopf et al. 2012; Stern 2014; and Agrawal and Narain 1991). In other words, these countries could do less to reduce their emissions in the short term to ensure rapid poverty reduction (which does not mean that they should do nothing; in particular, they have an interest in avoiding a costly lock-in in carbon dependency; see Avner, Hallegatte, and Rentschler 2014; Vogt-Schilb, Meunier, and Hallegatte 2014). Indeed, even if poor countries have cheaper emission reduction options, a similar amount of emission reductions in a low-income country may have a higher economic and welfare cost than in a higher-income country for the following reasons:

- The opportunity cost of consumption is higher in poor countries. Poor people have a higher marginal utility of consumption and losing a given amount of consumption means more to them than to wealthier individuals (Harberger 1984; Fleurbaey and Hammond 2004).
- Developing countries are at a development stage in which they are building their infrastructures and are still very dependent on energy-intensive industries like cement, steel, aluminum, and nonferrous and basic chemicals. Higher production costs in these sectors propagate throughout the economic system and generate higher costs in the manufacturing and services sectors, which may have negative repercussions for the overall social welfare of these countries (Crassous, Hourcade, and Sassi 2006; Luderer et al. 2012)
- Some substitution options may be unavailable in poor countries due to incomplete markets and market and government failures. For instance, a low-income country closing a coal power plant or not investing in it to reduce emissions may have more trouble replacing the power generation gap with renewables if the policy and political environment makes investment in renewable energy more expensive or less attractive to investors than in a richer country.

Lifting the poor out of poverty need not increase emissions significantly and poverty reduction can benefit from low-carbon investments and renewable energy (Tait and Winkler 2012; Hallegatte et al. 2015; IPCC 2014c). Since the Industrial Revolution, the largest share of GHG emissions has been derived from the industrialization of developed countries. Over the last few decades, total cumulative CO_2 emissions have increased by a factor of two—from about 910 $GtCO_2$ in the period 1750–1970 to about 2,000 $GtCO_2$ in the period 1750–2010 (IPCC 2014c). Regional patterns of GHG emissions are shifting along with changes in the world economy (ibid). Emissions associated with the activities of poor people account for a small share of global emissions (Chakravarty et al. 2009). Many recent studies support the idea that providing the extremely poor people with access to basic services would not jeopardize climate mitigation:

- Above a Human Development Index (HDI) of 0.8 (the threshold to be considered a developed country), carbon emissions and the HDI are decoupled (Steinberger and Roberts 2010).

- The IEA estimates that universal access to basic energy services by 2030 could be achieved by increasing electricity consumption by 2.5 percent, and fossil fuel consumption by 0.8 percent only (IEA 2011).
- The World Development Report 2010 estimates that the additional emissions that would be generated to provide universal access to electricity in 2010 could be offset by switching the standards of the United States vehicle fleet to European standards (World Bank 2010).

Energy poverty is a major development and poverty issue—lack of access to energy has a significant impact on economic and social development and on poverty, among others, through indoor pollution and its impacts, especially on women and children. Investments in renewable energy and energy efficiency can tackle this challenge, reduce the energy expenditures of the poor, and simultaneously reduce GHG emissions, which further contribute to the particularly high health costs in these countries (World Bank 2012a).

Second, even if low-income and higher-income countries aim for similar emission reductions (in relative terms), such reductions may be achieved with lower carbon prices in low-income countries. This is in part linked to the availability of cheaper emission reduction options and the higher price elasticity of emissions in low-income countries. A given carbon price (translated to local currency based on market exchange rates) will also be equivalent to a higher local price in poorer countries, since the Purchasing Power Parity (PPP)[10] exchange rates are usually higher than the market exchange rates (for instance, by a factor of 1.8 in China and Brazil, 3.8 in India, and 2.3 in South Africa).[11] The Deep Decarbonization Pathways Project (DDPP)[12] shows that pathways compatible with the objectives of the Paris Agreement usually show lower carbon prices for lower-income countries, partly because of a stronger behavioral response of poor economic agents to a given carbon-price level. However, higher capital costs in developing countries act in the opposite direction.

And, even if low-income countries and higher-income countries impose the same effective carbon price on their economies, the balance between explicit pricing and implicit pricing may be different in these two country categories. Given the concerns over distributional impacts and market failures (see section 3.1), countries may conclude that rapid and equitable changes can be achieved more efficiently and effectively with instruments other than an explicit carbon price. In particular, some policies—such as notional carbon prices embedded in subsidies, public guarantees and other forms of financial devices for renewables or energy efficiency, and performance standards for cars and buildings—do not make carbon emitters pay a fee for their emissions, but they still impose a cost on them, which can be interpreted as an implicit carbon price. The much larger market failures and constraints found in low-income countries can push their policy makers toward a stronger use of policies that put implicit prices on carbon, which makes it possible to achieve a similar emission reduction with a lower explicit carbon price.

[10] The *Purchasing power parity* (PPP) exchange rates are those that equalize the currency purchasing power in each of two countries compared. This means that the exchange rate between two countries should equal the ratio of the two countries' price level of a fixed basket of goods and services.

[11] World Development Indicators (http://data.worldbank.org/data-catalog/world-development-indicators), World Bank. Accessed: April 2017

[12] The Deep Decarbonization Pathways Project (DDPP) is a global collaboration of energy research teams charting practical pathways to deeply reduce GHG emissions in their own countries; see the background paper prepared by the DDPP for this report (DDPP 2017).

Furthermore, in developing countries, a climate-centric perspective focused on the carbon price as the only driver of transformation fails to capture the broad set of potential complementarities between the climate and other sustainable development objectives. The Indian DDPP team (Shukla et al. 2015) considered the role of carbon prices from the broader perspective of the integrated social, economic, and environmental value of mitigation. It shows the extent to which well-designed land use policies, transport infrastructure, urban planning legislation and development, building codes, education, technology substitution, and investment flows can deliver the same level of cumulative carbon emission reductions with a much lower carbon price.[13]

Finally, the decision on the appropriate value needs to take into account the benefits that can be generated by carbon pricing, aside from the reduction in carbon emissions. For instance, as discussed in chapter 5, the appropriate value for an explicit carbon price may be higher where it promotes efficiency and growth, for instance, because carbon-pricing revenues can be used to reduce other distortive taxes (Goulder 2013), improve the efficiency and fairness of the fiscal system (Liu 2013; Bento, Jacobsen, and Liu 2013), and finance public goods such as infrastructure, education, or health (Edenhofer et al. 2015; Franks, Edenhofer, and Lessmann 2015; Hallegatte et al. 2015).

Emission reductions may seem more profitable when considering their co-benefits, such as reduced air pollution and improved human health (West et al. 2013; Dubash and Joseph 2015). These considerations will affect both the ambitions of emission reductions in a given country (e.g., a country may decide to further reduce emissions to reduce local air pollution) and the appropriate balance between explicit and implicit pricing (e.g., a country may decide to increase the explicit price because the latter helps close its infrastructure financing gap). The benefits and co-benefits of climate action may be aggregated into a Social Value of Mitigation Action (or SVMA, see appendix B).

And many other characteristics will influence a country's decisions regarding explicit carbon pricing and the design of climate policies: resource endowments (e.g., geothermal energy), climate conditions (e.g., solar and wind potential), and the ability to innovate are important additional factors that need to be considered.

3.3 Dynamic and Adaptive Climate Policy Designs

Carbon prices are intended to incentivize the kind of changes needed in investment, production, and consumption patterns, and induce the pace and scale of technological progress that will bring down future abatement costs (NCE 2014). Higher prices today may be more effective in driving the needed changes and may not require large future increases, but they may also impose higher short-term adjustments costs. In the medium to longer term, explicit price trajectories may need to be adjusted, based on the experience of technology development and economic actors' responsiveness to policy. The policy dynamics should be designed to induce learning and should respond to new knowledge.

[13] The study does not make any conclusions regarding the aggregate efficiency of these different policy options.

The uncertainties around the carbon-price trajectories that are consistent with a 2°C target imply that policies will have to involve experimentation, be closely monitored over time, and revised when they seem to fail (that is, do not reduce emissions enough) or impose unacceptable costs (e.g., threaten food security). Carbon prices will have to be designed accordingly—based on predefined targets—and be revised over time as new information becomes available on the speed with which different targets can be reached (Metcalf 2009; Aldy 2017) or the appropriateness of different targets. For instance, if new, low-carbon technologies become available at a competitive price in the electricity sector, the price of carbon could be reduced; on the other hand, the price may have to be increased if some technologies are found to be impractical. Similarly, if climate change impacts are larger than expected, or if our ability to adapt is lower than expected, policy ambition may have to increase.

The efficiency of carbon-price signals in changing behaviors and driving investments depends on the long-term credibility and predictability of those signals. Policy frameworks that deliver carbon prices to match environment goals need to encourage the business and financial sector to explore lower-carbon strategies. In this context, confidence in the basic direction of energy and climate policy is crucial. Redirecting major investments toward low-carbon options requires credible carbon-price pathways spanning several decades. For example, France revised its policies in November 2015 to introduce a carbon-price component that will reach 56€/tCO_2 by 2020 and 100€/tCO_2 by 2030. Creating confidence in future policies is difficult because it requires credible commitment from policy makers over the medium and long term (Helm, Hepburn, and Mash 2003; Brunner, Flachsland, and Marschinski 2012). However, it is possible to improve credibility through institutional change (for example, by creating an independent commission on climate change) or legal tools (such as climate legislation).

At the same time, some degree of flexibility and the ability to adjust carbon prices in line with new information on technologies or the impact of policies remain necessary. The announcement of price "corridors"—that is, price ranges that will prevail in the future—provides a way to balance commitments, high prices, and flexibility in policy making. Still, policy revisions will have to be based on transparent criteria (Canfin and Grandjean 2015; Canfin, Grandjean, and Mestrallet 2016). To bolster the long-term credibility of the price signal, it is critical to build strong political support across political lines, engage economic decision makers, and manage the pressure from interest groups and distributional issues. But most important of all may well be to choose a carbon-price trajectory that people believe will be politically durable.

3.4 International Cooperation to Promote Consistency of Actions across Countries

Climate change is a global externality, and thus can be best tackled globally. However, there is an increasing recognition that the transition to a low-carbon economy is not only appealing because of the climate change impacts that can be avoided, but also because of the benefits and co-benefits it generates locally (in the country, region, or cities that are taking abatement action), in the short term. This widespread recognition contributed to the success of COP21 in Paris and facilitates international cooperation.

Nevertheless, there is a risk that if any country fails to take active measures, or if carbon prices vary widely across countries, sectors with high levels of carbon emissions may relocate to countries with laxer policies. This phenomenon is referred to as "(carbon) leakage." At present, however, leakage cannot be observed, probably because the differences in energy prices and environmental regulations across countries are dominated by other factors such as labor and transport costs or other regulatory elements (Branger and Quirion 2013; Demailly and Quirion 2008; Sartor 2013). Yet leakage may become an issue as climate policies become stricter in some countries. Moreover, even if the quantitative effects are limited, the political consequences of plants and jobs moving to another jurisdiction because of its lower carbon price can be significant, and undermine support for strong carbon policies.

Carbon-pricing strategies both benefit from international cooperation and in turn reinforce that cooperation. International coordination and convergence of carbon prices over time can prevent leakage and ensure efficiency across regions. Cooperation—among others, through international transfers—can help lower the overall cost of reducing emissions, prevent distortions in trade and capital flows, and facilitate the efficient reduction of emissions (as well as the achievement of other Paris Agreement objectives, such as those related to the "financial flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development").

International cooperation requires credible mutual commitments and stable incentive structures. If countries perceive that their own efforts are not being matched by corresponding climate policies in other countries, the willingness to "ratchet up" the NDCs could diminish (Ostrom and Walker 2005). Carbon prices are easy to compare and provide an approximate indicator of one aspect of countries' climate policy ambitions and abatement costs.

Eventually, global coordination needs to be set in the context of a burden-sharing mechanism involving rich and poor countries to enhance this reciprocity and enable countries to increase their domestic carbon prices. Some have proposed the *allocation of transfer payments* to poorer countries on condition that the latter accept a minimum price for emissions (MacKay et al. 2015), possibly with different minimum prices according to country groups. *Conditional* transfers would mitigate the incentive problem inherent in a voluntary commitment scheme, since a reduction in the level of ambition would lead to the loss of international support. Each country would benefit from the conditionality of the transfers, as faith that other countries will likewise pursue ambitious climate protection is increased and as contributions are part of an established, solid system for coordinating ambitious climate policies.

The *redirection of financial flows* recommended in Article 2 of the Paris Agreement opens another avenue for creating confidence with immediate tangible gains of cooperation—through financial devices that mobilize state and nonstate actors, and that could be based on public guarantees provided by donor countries to support low-carbon investments in developing countries. Public guarantees impose a limited burden on the richer countries because they are only paid if a particular project fails. On the other hand, they would definitely raise the number of economically viable, low-carbon investments (Sirkis et al. 2015; and Hourcade, Shukla, and Cassen 2015).

A more comprehensive and effective system would involve a much larger role for the multilateral development banks (MDBs) in fostering and financing sustainable investments, particularly in sustainable infrastructure. The presence of an MDB in a project or program in itself reduces political and other types of risks, and an MDB can provide a broad range of instruments to handle risk in the particularly difficult early stages of a project or program. MDBs can thus drastically reduce the cost of capital and help leverage substantial quantities of private sector capital. And a lower cost of capital can in turn have a profound effect on the relative profitability of cleaner technologies (see section 4.1).

While carbon prices will differ across countries, the range of carbon prices across countries can be expected to narrow over time, at least under an optimistic scenario. Such (partial) convergence may result from (i) convergence in countries' development and income levels, which would reduce the range of opportunity costs of consumption; (ii) convergence in the price elasticity of emissions, as the lowest-cost opportunities to reduce emissions are captured in low-income countries; (iii) a reduction in the number of market failures and implementation constraints in low-income countries that will shift the balance between implicit and explicit pricing toward explicit pricing; and (iv) an increase in the international transfers supporting lower-income countries.

4 EVIDENCE ON CARBON-PRICE TRAJECTORIES CONSISTENT WITH PARIS AGREEMENT TEMPERATURE OBJECTIVE

Analyses of least-cost stabilization pathways typically show global emissions peaking around 2020 and declining to net zero before the end of the century; the pace of transition is shaped in part by the slow turnover of long-lived energy infrastructure and the related capital stock. In those pathways, the earliest technological changes are occurring in the electricity sector, where conventional power generation is replaced by any of several near carbon-free alternatives: renewable energy, nuclear power, or fossil fuel-burning power with sequestration. These changes are paralleled by the electrification of much of industry, road transport, and household heating. A major transformation of the oil-reliant transport sector occurs—with different components (road, sea, air) facing different challenges. Public transportation and rail along with electrification play important roles in reducing emissions. And enhancing energy efficiency is a major component of cost-effective action throughout the economy.

In these stabilization pathways, carbon pricing begins immediately, with prices that drive technological change in the electricity sector and continue rising until mid-century to trigger the electrification of industry, household heating, and transport. How high such analyses expect prices to be toward the end of the century depends heavily on the availability of backstop technologies, for instance, systems that remove CO_2 directly from the air (so-called "negative emission technologies").

4.1 Evidence on Carbon Price That Would Be Consistent with the Paris Agreement

Three lines of evidence can be used to provide information about the carbon price that would be necessary to deliver the changes needed to achieve the objectives of the Paris Agreement: technological roadmaps, national modeling exercises, and global energy-economy models.

4.1.1. Technological roadmaps

Decarbonization strategies can be informed by technological roadmaps—that is, sectoral targets and milestones at different points in time, expressed using various sector-specific indicators (Fay et al. 2015; Rockström et al. 2017; IEA 2016; Williams et al. 2012; IDDRI and UNSDSN 2014; IPCC 2014c). Examples include renewable energy targets (produce at least 30 percent of electricity from renewable energy sources by 2025), efficiency targets (reach 90g of CO_2/km for vehicles sold in 2030), fuel-shifting targets (use 20 percent of wood for structure in new buildings in a city by 2025) and land use targets (increase forest cover by 2 percent per year). These sectoral pathways provide implementation guidance for sector plans, and make it possible to use existing regulatory standards and institutions to design and implement the necessary measures. In basic theories of cost-effective planning involving major changes, there is an iteration between overall strategies to achieve targets and the associated shadow prices that can incentivize the required change. This approach is particularly complex in the climate-change context because of the role of learning-by-doing and the pace and scale of the required changes.

These roadmaps can provide guidance on the carbon price that is required to achieve the temperature objective of the Paris Agreement, looking at the "switching prices" for various technologies in different countries. For instance, the carbon price that will make coal noncompetitive in Africa—in other words, that will stop all new investment in coal and lead to the retirement of old plants—is likely to be different than in Europe. The carbon price that will make CCS competitive is also different from the one that will make concentrated solar competitive or the one that will accelerate the move toward low-carbon transportation modes.

Available estimates reflect current uncertainties. The recent IEA publication *Energy, Climate Change and Environment: 2016 Insights* (IEA 2016) for coal/gas/wind[14] finds that switching carbon prices vary widely between regions, given different climate conditions, fossil fuel prices, plant technologies, capital costs, tax structures, and whether competition is between existing plants or for new build (table 1). The rapid pace of change in some technologies means that there is considerable uncertainty about switching prices. Moreover, a higher carbon price is obviously needed to displace existing assets where capital is sunk, compared to the case where competition is between two options for investment in new power generation facilities.

Table 1: Switching Prices for Onshore Wind in Three Countries

	New Onshore Wind vs. Existing Unabated Coal	New Onshore Wind vs. New Unabated Coal
United States	10	0
Germany	80	60
China	30	20

Source: Energy, Climate Change and Environment: 2016 Insights (IEA 2016).

Note: Unabated coal plants are plants that are not fitted with CCS technology, which captures the harmful emissions that cause global warming for permanent burial. All figures are expressed in US$/t$CO_2$ (United States dollars per ton of carbon dioxide emissions). Germany has less favorable wind conditions than China and the United States.

[14] This analysis uses 2015 information on fossil fuel prices and the cost of renewable energy. It is intended to illustrate the policy implications of varying circumstances rather than provide up-to-date information on the cost of switching to a different energy generation technology.

Many estimates have been proposed for some specific technologies. According to the Global CCS Institute, coal-fired generators in the United States with CCS capability would be on par with traditional (unabated) coal and gas generation if carbon were priced between US$48 and US$109 per ton of CO_2 (Global CCS Institute 2015). Estimates from the U.S. Clean Air Task Force (2013) suggest a similar range: assessed against the displacement of non-CCS coal-fired power supply, CCS appears to provide abatement at between US$65/t$CO_2$ (for a gas-fired power station with CCS) to US$115/t$CO_2$ (for a coal-fired power station with CCS). Rubin, Davison, and Herzog (2015) calculated the cost of CO_2 captured from supercritical pulverized coal plants and geologically stored as between US$46 and US$99/tCO_2 abated, whereas the cost of CO_2 captured from natural gas combined cycle plants and geologically stored are between US$59 and US$143/tCO_2 abated. Calculations for the future would depend on assumptions concerning economics of scale—CCS has not yet been implemented on a major scale although a number of project-based examples exist—and on learning and technological progress.

The Carbon Pricing Corridor Initiative led by We Mean Business and the Carbon Disclosure Project provide consistent estimates for the carbon price able to lead to the decarbonization of the power sector, but using a very different approach (see box 1).

Box 1: The Investment-Grade Carbon Pricing Corridors

The Investment-Grade Carbon Pricing Corridors Initiative, facilitated by We Mean Business and CDP, brings together leaders from across industry and the investment community to explore the carbon-related price signals that will decarbonize electricity generation and heavy industry through the short to medium-term (2020, 2025 and 2030) and help deliver a sub-2°C world as defined by the Paris Agreement.

While the Commission and this report cover all economic sectors, the first Corridors report focuses solely on the power sector, with plans to expand to other high-emitting sectors by mid-2017. Initial findings reveal that the industry-forecast aligns with most techno-economic models in the short run. Interestingly, the bottom range of the corridor remains at US$30 per ton of CO_2 from 2025 onward—this is partially explained by the expectation that the levelized-cost of renewable energy sources will continue to decrease. The report explores the variety of factors that influenced the carbon-price levels indicated by the panel members.

Year	Carbon-Price Corridor (US$/t$CO_2$)
2020	24-39
2025	30-60
2030	30-100

Source: The Investment-grade Carbon Pricing Corridors Initiative.

The carbon price needed to make low-carbon technology competitive depends on the cost difference with traditional, fossil fuel-based technologies. Therefore, the required price of carbon is lower if:

- R&D and pilot projects on low-carbon technologies are supported by innovation policies, and if support for R&D on fossil fuels is reduced or eliminated altogether.
- Exploration and investment in fossil fuel extraction is limited or stopped (or if fossil fuel subsidies are eliminated), so that fossil fuels become more expensive.

Switching prices also depend on the current and future costs of capital. As low-carbon technologies are often more capital-intensive but benefit from lower operational costs, they are at a disadvantage when upfront capital is expensive or limited. Switching prices also vary with political risk and risk perception. Low-carbon technologies are sometimes profitable precisely because climate policies are present. However, the risk of policy reversal leads to a risk premium being charged, which makes these technologies more expensive again; the size of this premium depends on the credibility of the policy over time. The required carbon price is lower if the long-term credibility of climate policies is higher.

The cost of capital can be reduced by classical fiscal and monetary policies, better investment climates and rule of law, or specific de-risking instruments such as guarantees, thereby reducing the carbon price needed to make some technology competitive. Finon (2017)[15] calculates switching prices for nuclear and CCS in the power sector (compared to reference emitting plants like gas-CCGT[16] and coal power plants) under three scenarios: (i) a common regime of investment with an identical capital cost of 8 percent for reference power plants and low-carbon technologies; (ii) differentiated capital costs with a government guarantee on investment in low-carbon technologies, which results in a capital cost of 5 percent while the capital cost for emitting plants is still 8 percent; and (iii) a scenario where the perceived risk of investors implies a capital cost of 12.5 percent in low-carbon technologies plants, while the capital cost is still 8 percent for gas CCGT and coal power plants. The results show that depending on the reference plant and the cost of capital, switching prices vary between 20€/tCO_2 and 120€/tCO_2 for CCS and between 12.5€/tCO_2 and 132€/tCO_2 for nuclear (table 2). Additional calculations in Hourcade et al. (2017) for Brazil, France, and India, show how switching prices can be lowered by public guarantees that decrease the projects' upfront cost by valuing avoided emissions with a shadow carbon price.

The required carbon price is likely to be lower if resources can be reallocated rapidly thanks, for example, to efficient capital markets, a highly skilled workforce with lifelong training, and strong social systems able to support the people and regions negatively affected. But, as discussed further in chapters 5 and 6, this requires the ability to deal with stranded assets (like coal power plants too expensive to be operated), skill mismatch of workers (such as people with a career in the mining industry), and industrial/economic redevelopment (in areas that are today specialized in fossil fuel-dependent industries).

[15] Input from Finon (2017), The Carbon Prices Making Low Carbon Plants Competitive, received for this report.

[16] A Combined Cycle Gas Turbine (CCGT) is a form of highly efficient energy generation technology that combines a gas-fired turbine with a steam turbine.

Table 2: Three Investment Scenarios for Switching from Fossil Fuel to Low-Carbon Technology Plants

8% (baseline) | 5% (guarantee on low-carbon technology investment) | 12.5% (risk aversion toward low-carbon technology investment)

COAL WITH CCS

Capital Cost Scenario		
8%	5%	12.5%
Ref: Gas CCGT 8% capital cost		
€85/tCO_2	€50/tCO_2	€120/tCO_2
Ref: Coal plant 8% capital cost		
€35/t	€20/t	€54/t

NUCLEAR

Capital Cost Scenario		
8%	5%	12.5%
Ref: Gas CCGT 8% capital cost		
€60/tCO_2	€20/tCO_2	€132/tCO_2
Ref: Coal plant 8% capital cost		
€30/t	€12.5/t	€60/t

Source: Finon (2017).

Note: CCS = Carbon Capture and Sequestering; CCGT = Combined Cycle Gas Turbine. The calculations are calibrated under 3 scenarios—with capital costs of 8%, 5%, and 12.5% respectively for low-carbon options, while the cost of capital remains at 8% for coal and gas. In the baseline scenario (capital cost of 8%), coal plants with CCS become competitive with simple coal plants at a carbon price of €35/tCO_2 and with CCGT at a carbon price of €85/tCO_2.

The switching price approach is used by the IEA to develop 2°C scenarios. Rather than assuming explicit carbon prices, the Energy Technology Perspectives scenarios use the marginal abatement cost of various technology options to construct least-cost scenarios. In some cases, standards, mandates, or subsidies rather than explicit carbon prices lead to deployment of these technologies. Under the 2°C scenario, carbon prices in 2030 rise to US$100/$tCO_2$ in the OECD regions and to US$75/$tCO_2$ in China, Russia, Brazil, and South Africa in the power and industrial sectors, accompanied by a phasedown of fossil fuel subsidies. Table 3 indicates the most expensive (marginal) technologies that are deployed in various time periods. According to recent estimates from the IEA and the IRENA in *Perspectives for the Energy Transition*, under a scenario with a 66 percent chance of maintaining temperature change below 2°C, carbon prices in 2030 will rise to US$120/$tCO_2$ in OECD countries and to US$90/$tCO_2$ in emerging economies for energy-related CO_2 emissions.

The pathways followed in technological roadmaps are not based solely on current marginal costs, but also on the timing of various investments (Vogt-Schilb and Hallegatte 2014; del Rio Gonzalez 2008). For example, a study on Brazil found that developing clean transport infrastructure is necessary over the short term, in spite of its relatively high cost, because clean transport is required to achieve deep decarbonization over the long term, and transport systems and infrastructure cannot be transformed quickly (Vogt-Schilb, Hallegatte, and de Gouvello 2014).[17] Similarly, while some of the technologies used to reduce emissions are relatively mature (e.g., wind turbines) and some are currently experiencing rapid reductions in cost (e.g., solar photovoltaics), others (such as electric cars) are still in earlier stages of development. Since the costs of these technologies will decrease as their deployment continues—through learning-by-doing effects, R&D, and economies of scale—it may make sense to use some of these options in the short term to bring down their cost (Azar and Sandén 2011; del Rio Gonzalez 2008; Gerlagh, Kverndokk, and Rosendahl 2008; Kalkuhl, Edenhofer, and Lessmann 2012).

[17] See Vogt-Schilb, Meunier and Hallegatte (2014) on the impact of capital accumulation pathways on the definition of marginal abatement costs.

Table 3: Global Marginal Abatement Costs and Example Marginal Abatement Options under the IEA 2°C Scenario

	2020	2030	2040	2050
Marginal cost (USD/tCO_2)	30-50	80-100	110-130	130-160
Energy conversion	• Onshore wind • Rooftop POV • Coal with CCS	• Utility scale PV • Offshore wind • Solar CSP • Natural gas with CSS • Enhanced geothermal systems	• Same as for 2030, but scaled up deployment in broader markets	• Biomass with CCS • Ocean energy
Industry	• Application of BAT in all sectors • Top-gas recycling blast furance • Improve catalytic process performance • CCS in ammonia and HVC	• Bio-based chemicals and plastics • Black liquor gasification	• Novel membrane separation technologies • Inert anodes and carbothermic reduction CCS in cement	• Hydrogen smelting and molten oxide electrolysis in iron and steel • New cement types • CCS in aluminium
Transport	• Diesel ICE • HEV • PHEV	• HEV • PHEV • BEV • Advanced biofuels	• Same as for 2030, but wider deployment and to all models	• FCEV • New aircraft concepts
Buildings	• Solar thermal space and water heating • Improved building shells	• Stability of organic LED • System integration and optimization with geothermal heat-pumps	• Solar thermal space cooling	• Novel buildings material; development of "smart buildings" • Fuel cells co-generation

Source: Energy Technology Perspectives 2012 (IEA 2012), as cited by Hood (2017).[18]

Note: BAT = Best Available Technology; BEV = Battery Electric Vehicle; CCS = Carbon Capture and Sequestration; CSP = Concentrating Solar Power; FCEV = Fuel-Cell Electric Vehicle; HEV = Hybrid Electric Vehicle; HVC = High-Value Chemical; ICE = Internal Combustion Engine; IEA = International Energy Agency; LED = Light-Emitting Diode; PHEV = Plug-in Hybrid Electric Vehicle; PV = Photovoltaic energy; USD = United States dollar.

4.1.2 Analysis of National Mitigation and Development Pathways

National-scale studies and modeling exercises sometimes provide estimates of the shadow price of carbon (or, in some cases, of the explicit price of carbon) that is required to deliver decarbonization in a given economy, and deal with some of the limitations of technological roadmaps (for instance, by considering interactions between sectors). Studies such as those conducted by the DDPP provide national policy makers with relevant information.[19] The DDPP accommodates different modeling paradigms supporting national decarbonization studies in different countries—ranging from sophisticated combinations of macroeconomic, technology stock turnover, and land use models to simple spreadsheet models (Pye and Bataille 2016).

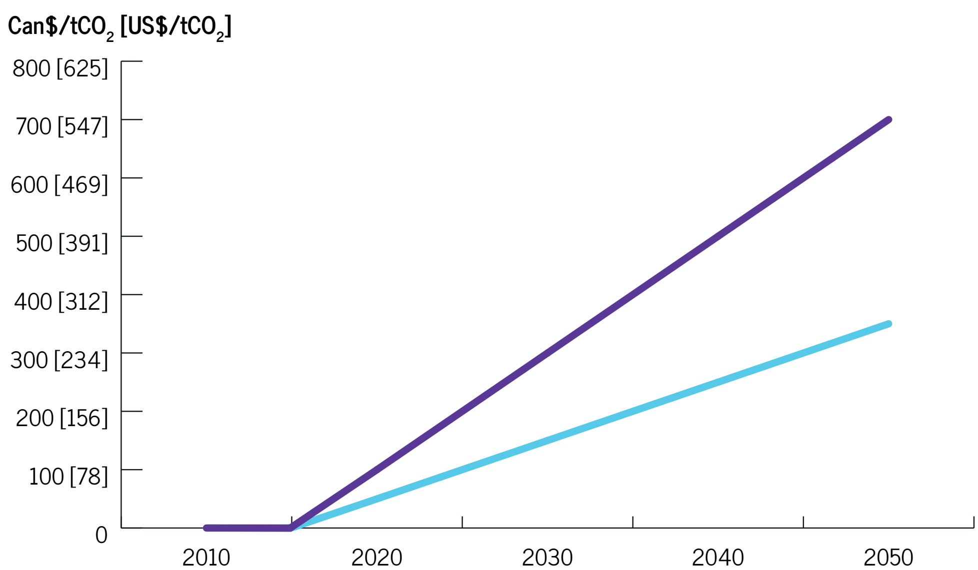
[18] Input received, in personal capacity, for this report (Hood 2017).
[19] See the background paper provided by the DDPP for this report (DDPP 2017).

In all national scenarios, the deep decarbonization of energy systems involves strong action on three pillars of decarbonization: (i) energy efficiency and conservation; (ii) decarbonization of energy carriers (electricity and fuels); and (iii) fuel switching toward low-carbon energy carriers in end-use sectors. In some countries, land use, natural sinks, and changes in agricultural practices represent a fourth pillar.

A key insight from DDPP on carbon prices is that, to make long-term decarbonization happen, a rapid increase in the signal on the shadow cost of carbon to emitting firms and households is needed in the short term. The need for high carbon prices is also valid in national modeling for developing countries, but the value appears lower in absolute terms in these countries than in the analysis for developed countries.

Simulations suggest that the carbon prices needed to achieve deep decarbonization depend on the presence of other policies—lower prices are needed if the price policies are complemented by additional measures. For instance, Bataille et al. (2015) developed scenarios for Canada that include either a single carbon price or a combination of: (i) economy-wide carbon pricing starting at Can$10/ tCO_2e (in 2015 Canadian dollars) and rising by Can$10 per year steadily through time, recycled equally to corporate and income taxes; (ii) sector-specific performance standards for new and retrofit transport and buildings falling to net-zero emissions by 2025–40; (iii) an intensity-based, tradable performance standard falling to –90 percent by 2050 for large emitters, using output-based allocations; and (iv) methane and land use regulations to achieve its DDPP target at the lowest possible carbon "sticker price." While this study does not provide an aggregate estimate for the cost of climate policies, figure 1 shows the carbon-price level needed to reach a level lower than $2tCO_2$ per capita in 2050 under the policy package described above, and the carbon price needed to reach the same emission levels if pricing is the only policy.[20] Involving other instruments is found to halve the requisite explicit carbon price.

Figure 1: Use of Carbon Price to Trigger Transition Toward Deep Decarbonization in Canada



Note: tCO_2 = tons of carbon dioxide. Prices are given in Canadian dollars (Can$) and United States dollars (US$), based on the average exchange rate for 2015. The blue line depicts the scenario with complementary polices, while the purple line depicts the scenario without complementary policies.

[20] Here the $2tCO_2$ per capita is used as a milestone in 2050 in the pathway toward zero-net emissions.

4.1.3. Global Integrated Assessment Models

Integrated Assessment Models (IAMs) produce global scenarios of future socioeconomic and technological development that are consistent with different global temperature targets, including the 2°C and 1.5°C target.[21] As global models, IAMs cannot have the same level of detail as national-level exercises. They also remain limited in their ability to capture some fundamental aspects of technological change, learning, and economies of scale that we know from experience are of vital importance—not only based on climate and sustainable innovations and investment that we have seen in recent years but also on past waves of technological change in economic history. Some also involve imperfect treatment of capital stock. However, they can account for some interactions between sectors (for instance, the link between power generation and transportation) and between countries (oil revenues and oil imports, impacts on trade). They can also investigate the timing of actions and emission reductions, and provide global emission scenarios and global cost estimates.

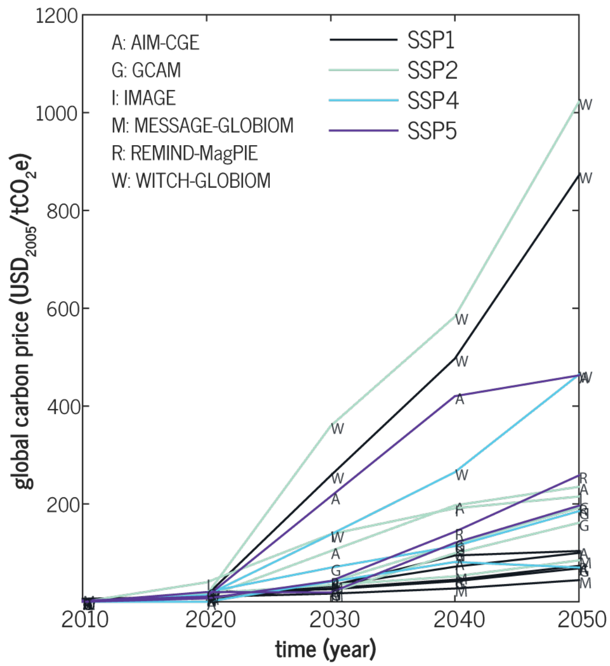
In some models, the carbon value is the shadow value of the carbon constraint, which is equal to the cost of reducing the last ton of GHG emissions needed to achieve the climate stabilization targets at the lowest cost (therefore, it is equal to the additional cost of using the most expensive technology needed for the transition). In other models, a carbon price is imposed exogenously so that emissions (or the carbon budget) meet some predetermined constraint. The difficulty with this exercise is that deep decarbonization involves nonmarginal and unprecedented changes in energy systems and other emitting activities, thus posing special analytical challenges to estimating the price that is consistent with a given carbon constraint.

While there is a consensus across models on the technical changes that are needed to maintain climate change below 2°C, models fail to agree on the carbon price required to trigger those changes. Based on the assessment provided in IPCC (2014c), scenarios that limit warming to below 2°C with a greater than 66 percent probability imply carbon prices increasing throughout the 21st century, but with prices ranging from US$15 to US$360 (in 2005 United States dollars) per tCO_2e in 2030, and from US$45 to US$1,000 (in 2005 United States dollars) per tCO_2e in 2050 (figure 2).[22]

[21] Few scenarios are currently available that achieve the 1.5°C target, but work is under way to produce more of these scenarios, in view of the Special Report of the IPCC on the 1.5°C target.

[22] In the models used to make these estimations, these "carbon" prices are applied to all anthropogenic GHG emissions, which are therefore expressed in US$ per metric ton of carbon dioxide equivalent emissions (US$/$tCO_2e$).

Figure 2: Carbon-Price Trajectories Limiting Warming in 21st Century below 2°C



Source: Riahi, van Vuuren, et al. 2017, as cited by Guivarch and Rogelj 2017.[23]

Note: Carbon-price trajectories that have a probability >66 percent of keeping global temperature change below 2°C, based on a review of six different Integrated Assessment Models (IAMs), and considering four different baselines (Shared Socioeconomic Pathways, SSPs).

This wide range reflects differences in baseline scenarios (what would be the world evolution in the absence of climate policies?), policy assumptions (what are the complementary policies implemented in parallel with pricing policies?), and modeling framework/structure and assumptions (how do the models assume that economic agents respond to price signals? how much learning-by-doing and technological change can be expected in response to climate policies?). The effects of these uncertainties are well understood:

- ***The price of carbon required to meet the 2°C target is lower in baseline scenarios*** with faster per capita growth, more expensive fossil fuels, or preferences for low-energy consumption patterns (e.g., regarding diets). Figure 3 shows the carbon price in 2050 consistent with a 2°C scenario, for three baseline scenarios involving increasing challenges for mitigation. Scenarios that limit warming to below 2°C with a greater than 66 percent probability imply carbon prices varying from US\$50 to US\$100 per tCO_2e with SSP1 assumptions, and US\$200-US\$450/tCO_2e with SSP5 in 2050.
- ***The price of carbon required to meet the 2°C target is lower the higher the credibility of the price signal.*** Models in which agents have perfect foresight of future technological and socioeconomic developments tend to have lower carbon prices in the short term because decisions that involve long-lived capital take into account the knowledge of (usually increasing) future prices. In models where emission reductions in the short term are only based on knowledge of current prices and costs, higher prices are required over the short term. Near-term carbon prices thus have to be assessed in the context of the credibility of their implied, long-term carbon-price signal.

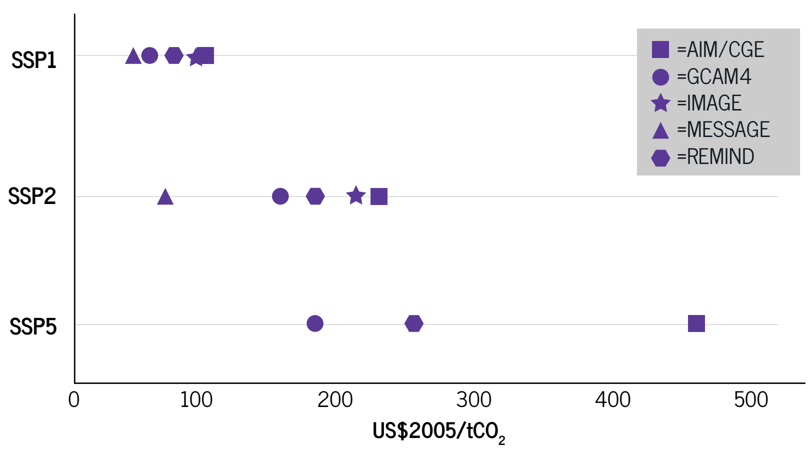
[23] Guivarch, C., and J. Rogelj. 2017. "Carbon Price Variations in 2°C Scenarios Explored." Paper commissioned for this report.

- ***The price of carbon required to meet the 2°C target is lower the better the potential for low-carbon technologies.*** The difference between price trajectories is strongly influenced by the models' structures and parameterization, in particular regarding the cost of new technologies and constraints on their penetration. Both aspects are difficult to model and forecast because they are driven by many factors such as innovation and learning, and institutional and financial constraints (Acemoglu et al, 2012; Wilson et al. 2013; van Sluisveld et al. 2015; Vogt-Schilb, Meunier, and Hallegatte 2014; WRI 2016).

- ***The price of carbon required to meet the 2°C target is lower the higher the ability to reallocate resources across the economy.*** In IAMs, constraints on technology penetration can be structural, meaning that the model by design cannot accommodate specific transformations—for instance, it does not allow installed capital to be early-scrapped or it limits the reallocation of workers across sectors.

The highest and lowest estimates of the carbon price needed to achieve the temperature objective of the Paris Agreement are explained by a combination of pessimistic or optimistic assumptions. The highest price is derived from the WITCH model, which incorporates pessimistic modeling assumptions—for example, very limited substitution between technologies—which explain why this model generates much higher shadow costs of carbon than other models. Similarly, the AIM model, assuming no induced technological change except in CCS, results in a relatively high shadow cost of carbon. At the other extreme, the MESSAGE model assumes perfect foresight and perfectly optimized responses to carbon prices, and therefore yields a very low shadow cost of carbon, especially when combined with the most optimistic baseline scenario—the SSP1 that assumes very low energy consumption and emissions, even in the absence of climate policies.

Figure 3: Carbon Prices in 2050 Consistent with a 2°C Scenario Depend on the Baseline Scenario



Note: The plot shows the 2050 CO_2 prices in the RCP2.6 scenarios for all SSP marker models (AIM/CGE, GCAM4, MESSAGE-GLOBIOM, REMIND-MAgPIE, IMAGE) and all scenarios with low to medium challenges for adaptation (SSP1, SSP2 and SSP5). From SSP1 to SSP5, socioeconomic challenges for mitigation increase from low (SSP1), and medium (SPS2) to high (SSP5) by varying assumptions on population and GDP growth, consumption patterns, development of technology costs and performances, resource availability, efficiency policies and environmental regulation, etc.

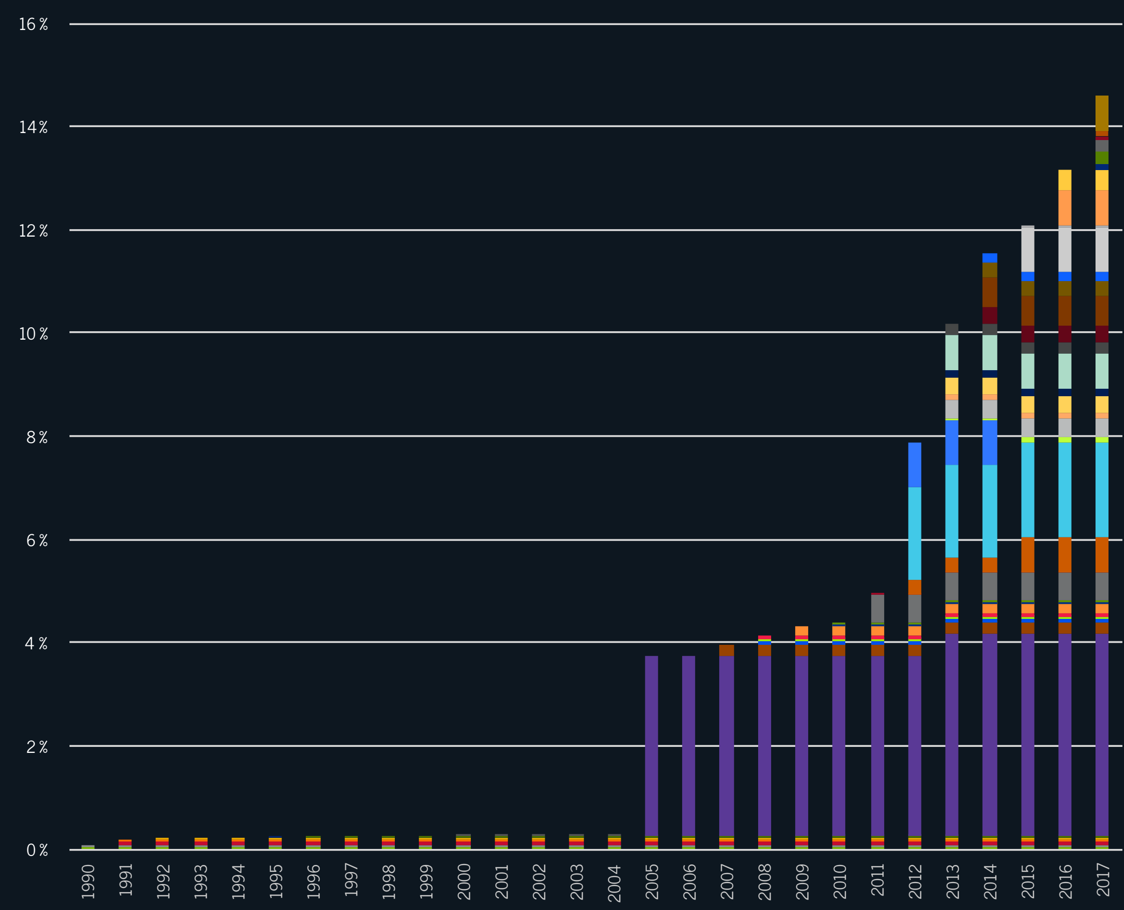
4.2 Current Level and Breadth of Carbon Pricing Inconsistent with Paris Agreement

The current levels of carbon prices are insufficient to induce the abatement levels consistent with the temperature objective of the Paris Agreement, and future prices will definitely have to be higher. The vast majority of governments around the globe—189 countries representing 96 percent of global GHG emissions and 98 percent of the world's population—have committed to reducing their GHG emissions and adapting to the changing climate through their Intended NDCs.

However, most emissions are currently not priced, and the range of carbon prices across existing initiatives remains substantially smaller than those necessary for achieving the Paris temperature target. The carbon prices observed span from less than US\$1/tCO_2e to US\$126/tCO_2e, 85 percent of global emissions are not priced today, and about three quarters of the emissions that are covered by a carbon price are priced below US\$10/tCO_2e (World Bank, Ecofys, and Vivid Economics 2016, PMR 2017; World Bank and Ecofys 2017).[24] Many countries have not put a price on carbon, or (as in the case of Australia) have removed carbon-pricing mechanisms. However, emissions covered by carbon pricing have increased threefold over the past decade. In addition, the number of initiatives implemented or scheduled for implementation has jumped from 9 to 42 in the same period (figure 4).

[24] Even including excise taxes, currently 80 percent of emissions from energy use are priced at less than US\$40/tCO_2 and 89 percent at less than US\$50/tCO_2.

Figure 4: Regional, National, and Subnational Carbon-Pricing Initiatives—Share of Global GHG Emissions Covered



Source: State and Trends of Carbon Pricing Report (World Bank and Ecofys 2017).

Note: Only the introduction or removal of an ETS or carbon tax is shown. Emissions are presented as a share of global GHG emissions in 2012. Annual changes in global, regional, national, and subnational GHG emissions are not shown in the graph.

5 TAPPING CARBON-PRICING REVENUES

The revenues derived from carbon pricing can be used in many different ways. The decision on how to spend the revenues from carbon pricing should be based on the objectives and circumstances of a particular country, bearing in mind the commitments made in regard to the Paris objectives. Since tax revenues are fungible, standard principles of public finance indicate that the decision on how to use carbon-pricing revenues should be no different than the decision on the use of any other tax revenue: revenues should be spent in the way that produces the highest value for the population. However, political economy considerations may affect this choice. Experience from fossil fuel subsidy reforms and carbon pricing show that policy packages that include both a revenue component (lower subsidy costs or higher revenues through a tax or other pricing instrument) and a spending component (e.g., a reduction in other taxes; increased spending on social protection, cash transfers, or public services; or increased investments) have a much higher probability of success than in the case of the revenue component alone (Fay et al. 2015; Ruggeri Laderchi 2014). For instance, after reviewing subsidy reform projects in the Middle East and North Africa, the IMF concludes that "*of the cases where cash and in-kind transfers were introduced* [as compensatory measures for energy price hikes], 100 *percent were associated with a successful outcome, while only* 17 *percent of the cases where these transfers were not introduced resulted in a successful reform*" (Sdralevich, Sab, and Zouhar 2014). In British Columbia, the introduction of the carbon tax was also facilitated by the parallel reduction in other taxes (Harrison 2013).

5.1 Carbon Pricing as a Source of Government Revenue

Explicit carbon-pricing instruments can raise significant revenue. Based on current CO_2 emissions and in the absence of any international transfers, a US\$30/tCO_2 domestic carbon tax would raise resources representing more than 1.5 percent of local GDP in half of the 87 countries (both developed and developing) analyzed in a recent study (Hallegatte et al. 2015). In British Columbia, the carbon tax currently provides 3 percent of the province's budget (Harrison 2013), and in Sweden, it contributes 1 to 2 percent of the national government budget.

Carbon prices raise revenues in an efficient way, in the sense that they tackle a key market failure, the climate externality. They can also provide a good tax base and limit tax evasion and collection costs.[25] However, the relative efficiency of carbon-pricing revenues depends on the way these revenues are spent and the policies they replace. Recycling revenue to reduce distortionary taxes may, under certain conditions, offer a "double dividend"—by providing both environmental benefits and an aggregate economic gain: taxing "bads" (pollutants) rather than "goods" (labor, capital) can allow

[25] Revenue accrues directly from carbon taxes while, in the case of a cap-and-trade system, revenue depends on the volume of allowances being auctioned (rather than allocated for free).

for a less costly tax system (Goulder 2013; de Mooij 2000). Still, under certain conditions, the fact that carbon taxes can be used to reduce other distortionary taxes has been shown to increase the desirable (or optimal) level of carbon tax.[26]

Carbon pricing offers a good tax base because a carbon price, if well structured, is difficult to evade. Carbon sources are concentrated, especially in countries that import their fossil fuels, making it easy to measure and monitor physical units of energy at the supplier level. Monitoring a carbon-pricing scheme is generally easier than monitoring other tax bases, such as hours worked, profits earned, or personal income. In Sweden, where a carbon tax has been in place since 1991, carbon tax evasion is less than 1 percent, substantially less than value added tax (VAT) evasion. In the United Kingdom, evasion is estimated at about 2 percent for the excise tax on diesel, as opposed to 9 percent for the corporate tax, 11 percent for the VAT, and 17 percent for income taxes (HM Revenue & Customs 2014).

In addition, for developing countries especially, carbon taxes offer a way to reduce incentives for firms and individuals to stay in the informal sector—while conventional taxes (like the ones levied on wages, sales, or profits) apply only to the formal sector, a fuel tax applies equally to the formal and informal sector. When carbon tax revenues are used to reduce other conventional taxes, the gap between the tax burden in the formal and informal sector decreases, which in turns reduces the incentive to join the informal sector (Bovenberg 1999; Goulder 2013). (Jobs in the formal sector typically provide more financial security and social protection.)

In cost-efficient decarbonization scenarios, revenues from carbon pricing remain significant for decades. While the ultimate objective is to reduce emissions over time (until they reach net zero), in many models, dynamic efficiency requires that carbon prices increase in real terms over time. In modeling exercises, such an increase keeps revenue streams relatively stable for an extended period of time, even as emissions decrease (e.g., Rausch and Reilly 2015). In any climate stabilization scenario, revenues do eventually drop essentially to zero, or even become negative in the presence of negative emissions, but only over the long term.

Recycling revenue from carbon pricing into broad cuts in other taxes—including through "revenue neutrality" of the reform—can help offset the economic burden of the carbon tax and, if used well, facilitate pro-growth tax reforms. The revenue can be used to foster growth in an equitable way, as revenue can be returned to consumers in the form of household rebates, thereby reducing the burden of other taxes, supporting poorer groups, managing transitional changes, investing in infrastructure, and fostering technological change. Numerous studies, synthesized in the IPCC reports, highlight the potential for benefits to be derived from such reforms (IPCC 2007, 2001).

Revenues can also be used to reduce the social charges imposed on labor costs. This may reduce unemployment rates and help increase real wages. This would also serve to counteract the

[26] See Stiglitz (2013), using a Ramsey (1927) optimal tax framework, extended to the context of corrective (environmental) taxation by Sandmo (1976). For a particular application using the DICE model, see Nordhaus (1993). For a broader discussion, see Stiglitz (2015) and also Goulder (1995a, 2013, 1995b), Bovenberg (1999), and de Mooij (2000).

potentially regressive effects of higher carbon prices and help poor people deal with the higher price levels caused by carbon pricing. It also has positive distributional impacts because of the larger share of wages in the total income of poor households (higher-income households may have other sources of income—capital, interest, and rents). Moreover, mitigation options (e.g., energy efficiency, renewables, and agricultural and forestry low-carbon practices) are generally more labor-intensive than economic activities based on fossil fuels. Therefore, recycling carbon tax revenues may generate a double dividend: fostering the transition toward decarbonization while simultaneously promoting economic growth and social development (Combet 2013; Grottera, William, and La Rovere 2016; La Rovere et al. 2017; Goulder 1995a).

5.2 Redistributing Carbon-Pricing Revenues to Protect the Poor and Vulnerable

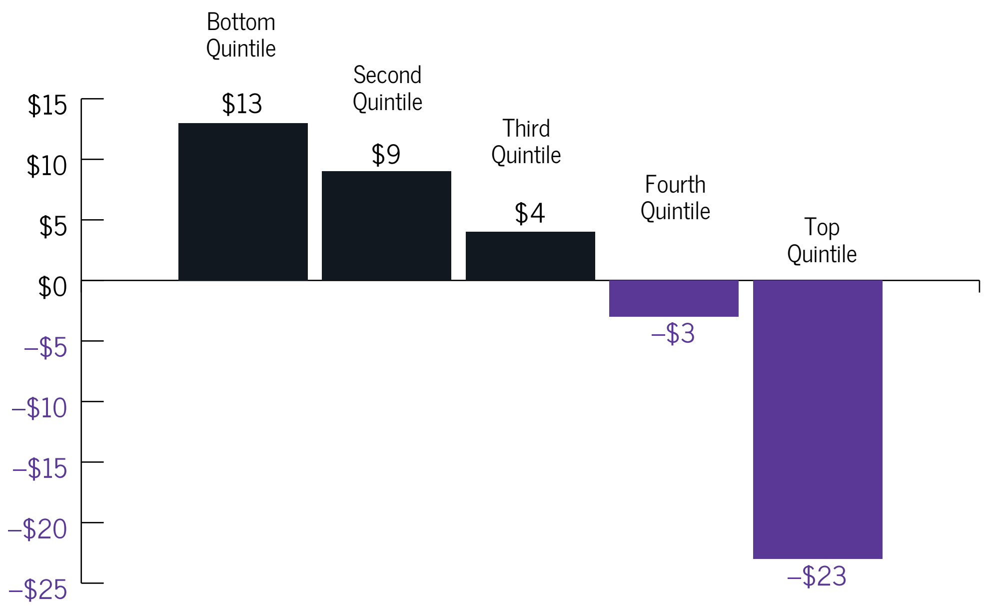
Revenues from carbon pricing can be redistributed to protect poor and vulnerable people. This is all the more important because carbon pricing can have significant impacts on the income and budgets of the poor, depending on their consumption patterns. On the consumption side, energy price increases may be progressive, as energy's share of household budgets usually rises with income in developing countries, contrary to the case of developed countries.[27] But the final impact will depend on the fuel mix used by poor people. Moreover, in a dynamic setting, higher prices for modern energy could slow down poor households' transition away from biomass to modern fuels for cooking, entailing significant adverse health impacts.

The distributional impact of carbon pricing will depend on the way revenues are used, but equal distribution per capita would benefit the poorest, and recycling only part of the revenues would suffice to make the overall scheme progressive. If rebates financed by a carbon-pricing instrument are divided equally (that is, adjusted for household size), then poor households would be better off than before the carbon tax. This is because, even though their carbon-related burden may represent a relatively small share of their overall income, higher-income people pay more in absolute terms and the revenue would be redistributed across all households. In Indonesia, for instance, the recycling of carbon revenue through uniform, lump-sum transfers would make a carbon tax progressive[28] (Yusuf and Resosudarmo 2015). Data from developing countries also suggest that taking US$100 away from fossil fuel subsidies and redistributing that money equally among the population would on average transfer US$13 to the bottom quintile and take US$23 away from the top quintile (figure 5). Poverty can be further reduced by using revenues to fund more targeted instruments that help poor people (such as targeted cash transfers), or existing social safety nets (such as school feeding). Reforms of fossil fuel subsidies provide useful lessons on how the freed-up resources can help poor households adjust to the change in energy prices, through in kind or in cash transfers (Ruggeri Laderchi 2014).

[27] Bacon, Bhattacharya, and Kojima (2010) used household survey data from nine developing countries in Africa and Asia, and found that in four countries, people in the lower quintiles spend more money on energy than people in the higher quintiles, while the shares were similar in five other countries. However, what matters is the share of income people spend on modern energy, which in the nine countries surveyed increased from the lower to the higher quintiles.

[28] A *progressive tax* collects a larger share of wealth, income, or consumption from richer people than from poorer people.

Figure 5: Benefit to the Poorest of Recycling US$100 from Fossil Fuel Subsidy Budget as a Universal Cash Transfer



Source: Based on Arze del Granado, Coady, and Gillingham 2012.

Note: All prices are expressed in United States dollars. Average over twenty developing countries from Africa, Asia, the Middle East, and Latin America.

Cash transfers to households (or "rebates" or "dividends") may improve the attractiveness and durability of carbon pricing as people receive immediate and tangible benefits, even as they face higher energy prices. Revenues can also be used directly to lower the energy bills of poor households. While this would have the advantage of directly offsetting the tax incorporated into energy prices, careful design would in this case be necessary to maintain the incentives to reduce energy consumption, as this is an important channel of emission reductions.

5.3 Carbon-Pricing Revenues to Smoothen the Transition toward Decarbonization

The transition to a deep decarbonization pathway can be disruptive in the short term, and a major advantage of explicit carbon pricing is that it raises revenue that can be redistributed to manage the negative side effects of the transition.

The introduction of a carbon price will cause losses concentrated in the carbon-intensive sectors, especially in the form of stranded assets—whose owners may therefore oppose the carbon tax. Climate stabilization will require that much of the known fossil fuel reserves be kept in the ground, leading to a loss of wealth for some countries and regions (McGlade and Ekins 2015). Where vulnerable sectors, such as steel or coal mining, dominate the local economy, regional impacts could be severe, with significant social, cultural, and political implications.

Many other groups have been found to be particularly vulnerable to climate policies, including fishermen (who depend on diesel fuel) and farmers (who use diesel pumps for irrigation), as well as small and medium-sized enterprises. Agricultural households are also affected—by higher fertilizer costs and higher transportation costs (raising the cost of getting their produce to markets).

Revenues from carbon pricing can be used to help those who may be burdened by emissions abatement policies. For instance, revenues may be used to reduce carbon leakage and unfair international competition if some countries fail to impose significant carbon constraints on their economic system. In that case, a share of carbon-pricing revenues could be rebated to firms that are both carbon-intensive and exposed to international competition. If the rebate is output-based, that is, based on the *value* of a firm's production rather than the production's carbon content, then it does not reduce the incentive to reduce emissions, but it does protect these firms against unfair competition (Monjon and Quirion 2011; Branger and Quirion 2013). Concerns over carbon leakage and unfair competition can also be tackled by improving policy coordination across countries and introducing so-called border carbon adjustments.[29]

Revenues can also be used to smooth the transition of declining sectors to mitigate social impacts. Studies show that accompanying measures can mitigate part of the losses from structural change at a very small aggregate cost (Porto and Lederman 2014; Trebilcock 2014). When Japan modernized its economy in the 1960s and early 1970s, more public support went to traditional industries (such as textiles) than to modern, growing sectors (such as electronics and manufacturing) (Beason and Weinstein 1996). Later, the 1978 Law for Temporary Measures for the Stabilization of Specific Depressed Industries helped smooth the decline of 14 "structurally depressed" industries—including textiles and ship building. It did this by planning capacity reduction, reallocating resources within and outside the depressed industries, providing financial assistance to troubled firms, and mitigating the negative impacts on labor (Krauss 1992; Peck, Levin, and Goto 1987). The compensatory approach has also been used by the United States in the context of trade liberalization—typically through wage subsidies in the sectors that benefit from liberalization (to help them absorb workers from declining sectors) and unemployment insurance for the workers who remain trapped in declining sectors. In the mid-1970s, U.S. Trade Adjustment Assistance (TAA) was used to provide re-employment services to displaced workers and financial assistance to manufacturers and service firms hurt by import competition.

Support for innovation can help affected sectors benefit from the transition. Some automakers already positioned themselves as leaders in green and electric or hybrid cars, and thus as potential winners from more ambitious climate mitigation. Oil and gas companies can reinvent themselves if they develop technologies to capture and store carbon from the atmosphere. Supporting R&D and innovation also facilitates this transition, provided it targets potential losers to transform them into potential winners. Furthermore, when pilot projects for green technologies are created, they can be located in the areas that are most likely to lose from climate policies, thereby ensuring that all regions derive some benefits from the reform. Innovative concentrated solar power generation or CCS plants could, for instance, be located in a

[29] *Border tax adjustments*, import fees levied by carbon-taxing countries on goods manufactured in countries that do not price carbon.

place where fossil fuels are extracted, thereby creating green jobs and activities in these locations, mitigating negative social impacts of (and building support for) climate policies. The above examples illustrate how well-designed policies could even turn some traditional opponents into supporters of the reforms.

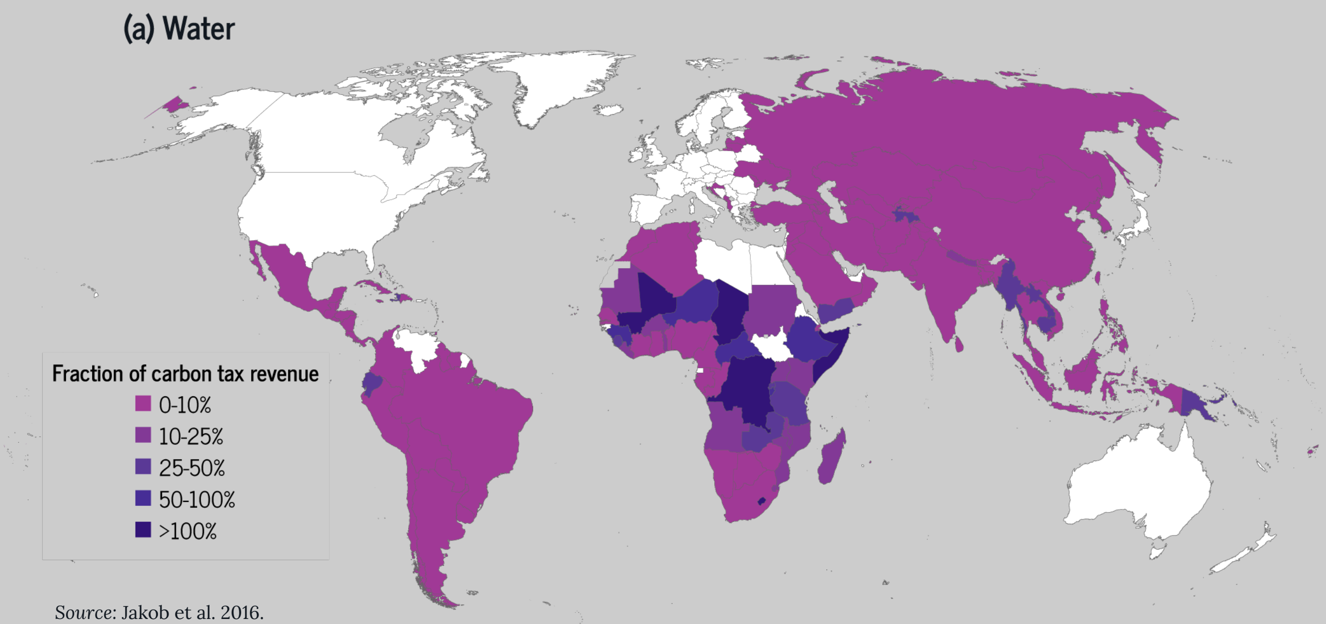
5.4 Boosting Investment and Economic Growth with Carbon-Pricing Revenues

Infrastructure investments are hampered by financing challenges, especially in developing countries. Many countries are simply too poor to generate the required savings domestically, while others lack local capital markets that are sufficiently developed to transform local liquidity into the patient capital that is needed for longer-term investments. Further, public spending is often limited by a small tax base (10 to 20 percent of GDP).

Revenues from carbon pricing could help close the gap in infrastructure investments in developing countries (i.e., provide funds for building the infrastructure required to provide universal access to basic services such as modern energy and promote growth and prosperity). One option would be to invest the tax proceeds directly into infrastructure development. In fact, research suggests that the amount raised through carbon pricing (at a level consistent with the 2°C target in seven models used in the EMF27 study[30]) would be sufficient to close the infrastructure gap, as shown in figure 6 (Jakob et al. 2016). These infrastructure developments could support and accelerate economic growth by making economies more productive and efficient (Abiad, Furceri, and Topalova 2014; IMF 2014). What is more, in contexts of depressed demand or high unemployment, these investments could stimulate the economy and reduce unemployment.

[30] The Stanford Energy Modeling Forum Study 27 (EMF27) investigated the importance of individual mitigation options such as energy intensity improvements, CCS, nuclear power, solar and wind power, and bioenergy for climate mitigation. It was driven by a model inter-comparison of 18 energy-economy and integrated assessment models.

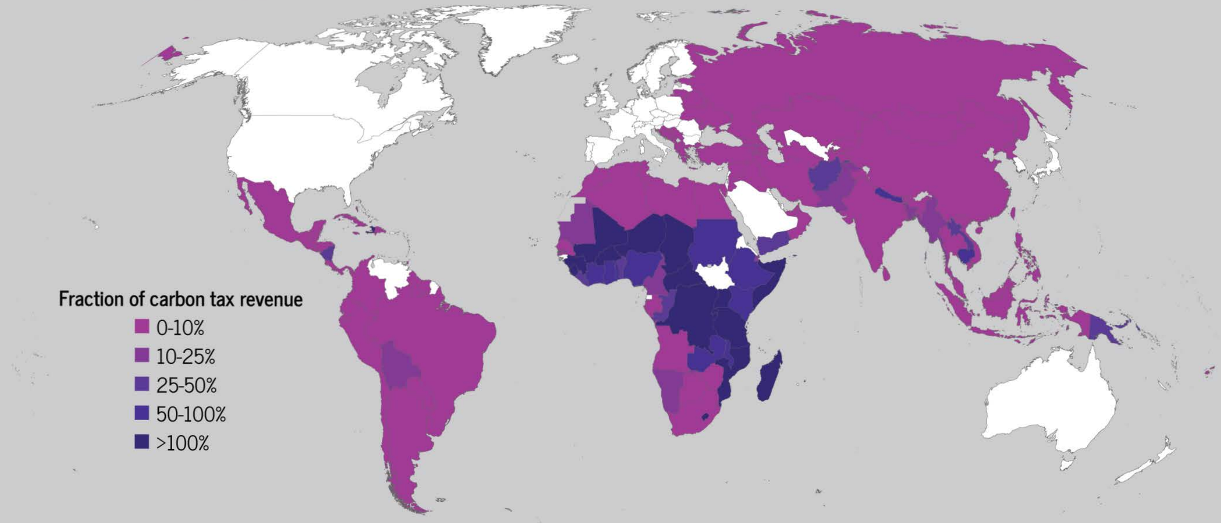
Figure 6: Share of Carbon-Price Revenues Required to Finance Universal Access to Infrastructure



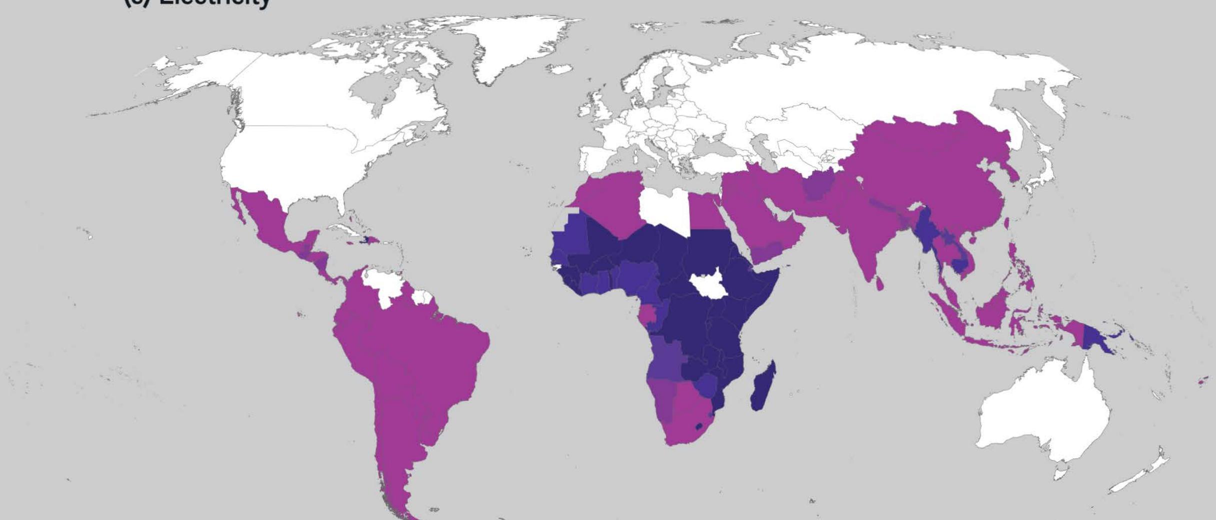
Source: Jakob et al. 2016.

Note: Share of carbon-pricing revenues required to finance universal access to infrastructure under domestic carbon pricing (i.e., without transfers between countries) for the 450 ppm scenario with full technological availability. (a) water, (b) sanitation, (c) electricity, and (d) costs of paving all unpaved roads. Countries in white are developed countries or countries where data are not available. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

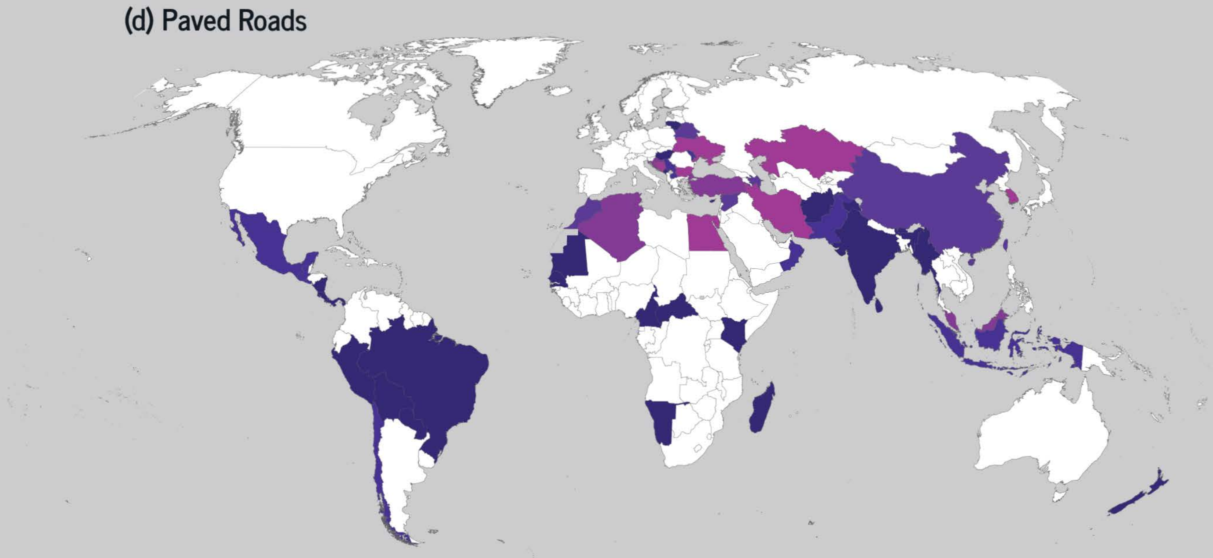
(b) Sanitation



(c) Electricity



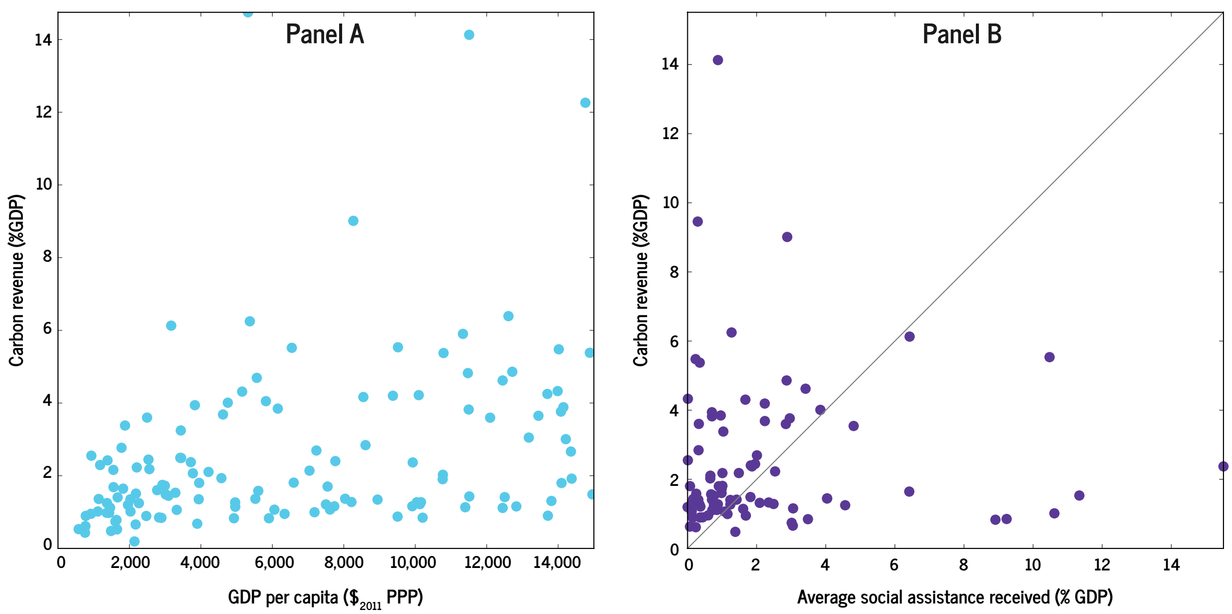
(d) Paved Roads



Revenues can also help finance public goods such as education and health, and social safety nets.

Without any international transfers, a US$30/t$CO_2$ domestic carbon tax would raise resources amounting to more than 1.5 percent of local GDP in most countries (figure 7, panel A). In the Sahel countries, 1.5 percent of GDP represents more than the amount needed to protect households affected by severe droughts, which have long-term negative repercussions for these countries' development prospects (Hallegatte et al. 2017). And in 60 of the 87 countries studied, a US$30/t$CO_2$ domestic tax would provide the resources to more than double current levels of social assistance in the country (figure 7, panel B).

Figure 7: Using Carbon-Pricing Revenues to Boost Social Assistance



Source: Shock Waves Report, by Hallegatte et al. 2015.

Note: Panel A shows the revenue derived from a carbon price of US$30/t$CO_2$, expressed as a fraction of Gross Domestic Product (GDP). Each dot represents a different country. PPP = Purchasing Power Parity. Panel B shows how this revenue compares to current social assistance benefits provided in those countries (based on the ASPIRE database). In 60 of the 87 countries for which data are available, a US$30/t$CO_2$ tax would provide sufficient resources to more than double current social assistance transfers (represented by the dots above the diagonal line in panel B). These calculations assume the energy consumption remains unchanged.

5.5 Carbon-Pricing Revenues to Foster Technological Change and Transition toward Decarbonization

Revenues could also pay directly for emission reductions or finance R&D in low-carbon technologies.

One option would be to earmark revenues to strengthen environment policy and invest in green projects or technologies. As discussed in chapter 3, without government support, private sector agents underinvest in R&D into low-carbon technologies. To resolve this issue, revenues can be used to fund investment tax credits, R&D tax credits, or support energy efficiency investments and innovation to help companies transition to a low-carbon future. Targeted R&D and investment credits can help improve the economic performance of supported industries and boost technological change. While these arguments apply generally to R&D underinvestment, they are particularly important in this context because of the scale of climate risk, the urgency of acting now, and because the use of any new technology benefits everyone (not just its user) through reduced emissions (Aghion, Veugelers, and Hemous 2012; Acemoglu et al. 2012).

Earmarking should be considered carefully, however, as it entails significant risks. While technological change could potentially be accelerated, a modest carbon-price path is likely to bring in more money than could be spent wisely on emissions abatement or low-carbon technologies. Since there is no particular connection between the amount of revenue a carbon-price policy raises and the appropriate level of spending on R&D, adaptation, or other climate goals, earmarking—for instance, a certain percentage of the revenue—for such purposes would not necessarily make fiscal sense. And there is a significant risk of capture of this revenue by well-connected interest groups (Rodrick 2014; Hallegatte, Fay, and Vogt-Schilb 2013). Moreover, from a fiscal policy standpoint, it would be wise to ensure that the benefits of climate-related spending are at least comparable to what they would be if the revenue were used for other purposes.

6 COMPLEMENTING CARBON PRICING WITH OTHER, WELL-DESIGNED POLICIES

Carbon pricing by itself may not be able to induce a transition at the pace and on the scale required for the Paris target of "well below 2°C" without unacceptable costs and distributional impacts. It is theoretically both unsound and impracticable to rely on carbon pricing only (Stern 2015a; Stiglitz 2013)—carbon pricing should be complemented by other well-designed policies. As explained in chapter 3, issues related to relevant market and government failures as well as distributional considerations should influence policy. If these aspects are properly addressed, the carbon price to be set may actually end up being lower than initially foreseen.

Such complementary policies could include the introduction of performance standards; new rules for city design, land and forest management, and investments in infrastructure; the development of new methods and technologies; and the use of financial instruments that foster private sector participation and reduce the risk-weighted capital costs of low-carbon technologies and projects (Fay et al. 2015; Bhattacharya et al. 2016). These policies would work alongside carbon prices and generally reduce the carbon price required to bring about the necessary emission reductions.

This chapter explores the important relationships between carbon pricing and some of these policies, with an eye to identifying those that can be efficient or equitable complements to carbon pricing. This applies especially when political economy issues result in carbon prices that are too low to induce change at the required pace and scale.

6.1 Using Complementary Infrastructure and Planning Approaches to Facilitate the Transition

The scale and pace of the required change may be supported by complementary infrastructure and planning approaches alongside carbon pricing. City design, transport infrastructure, and land use plans shape the options available to individuals and communities, how networks function and the way in which individuals interact, and the externalities they may inflict on each other. Priority policies in this context include the following:

- ***Investments in public transportation infrastructure and urban planning:*** Investments in transportation systems include large-scale provision of road and railway infrastructure support for carbon-free vehicles (via carbon-free, electricity-charging infrastructure), urban planning and housing investments to make public transit viable—by duly managing congestion and pollution, and offering broad access for all to jobs, services, and opportunities (Cervero 2014). A key aspect of transportation infrastructure is that it takes time to develop and has long-term implications for emissions and the ability to reduce them (Avner, Hallegatte, and Rentschler 2014). Moreover, transportation infrastructure projects do not respond strongly to the price signal, partly because most of these investments are publicly financed and driven by a variety of monetary and nonmonetary considerations (and not only by profit maximization).

- ***Efforts to improve the transmission and governance of the energy system to allow the development of renewable-based power generation*** are essential to incentivize private sector investment in renewable energy (Jorge and Hertwich 2014). Electricity transmission grids and the regulations governing them are critical for countries weighing major expansions of their renewable generation capacity (Haller, Ludig, and Bauer 2012).

A carbon price—whether or not it is used in an explicit pricing mechanism—can be used for project appraisal or public procurement, thereby promoting a shift toward low-carbon infrastructure investments. And, as described in section 2.4, it can be used by financial institutions and private firms to inform decision making regarding technologies, investment, and R&D.

6.2 Using Complementary Policies to Tackle Other Market Failures and Distributional Impacts

Well-designed complementary policies may be needed to tackle other market failures or manage distributional outcomes. More specifically, efficiency standards and investment incentives can be introduced where carbon pricing would be difficult to implement or just inefficient. Allocative inefficiencies can be resolved by the introduction of standards and incentives to encourage “sunrise” sectors or technologies. In situations marked by learning, economies of scale, and uncertainty, regulations can be more effective than prices, as illustrated by two successful government interventions—the banning of incandescent lights bulbs, which promoted the development of cheap and highly efficient LED, and the banning of lead in gasoline (with appropriate adjustment delays), which effectively reduced lead-based pollution. The DDPP studies found that for sectors that do not respond well to prices because of market failures or behavioral issues, the introduction of performance-based, potentially tradable GHG-intensity standards can approach or exceed the efficiency and effectiveness of carbon pricing (Jaffe, Newell, and Stavins 2005; DDPP, 2017). Renewable portfolio standards[31] can be combined with tradable renewable certificates and implemented with carbon pricing (Bertoldi and Huld 2006). In general, performance standards can be designed so that they are efficient, but policy makers need to duly consider the information and monitoring costs associated with their implementation.

Other policies can influence investment and purchase decisions. Feebates, that is, the combination of rebates for lower-carbon investments or purchases and a fee for carbon-intensive investments,

[31] *Renewable Portfolio Standard*, a regulatory mandate to increase production of energy from renewable sources such as wind, solar, biomass, and other alternatives to fossil and nuclear electric generation. It’s also known as a renewable electricity standard.

have the advantage of being revenue-neutral (provided the scheme is properly developed and consumer reactions are anticipated correctly). Given that such fiscal incentives to encourage desirable investments gradually transform the productive structure without affecting the owner of old capital, they can more easily be used in the early stages of the transition, and then gradually be phased-out and replaced by economy-wide pricing instruments as their social and political acceptability improves (Rozenberg, Vogt-Schilb, and Hallegatte 2014).

Massive investments are needed, and the financial sector regulations combined with financial instruments can either facilitate or impair the transition. Financial instruments that can be used include direct intervention through concessionary financing (or loan subsidies, directed credit), and instruments that rebalance risk perception between low-carbon and brown projects, thus facilitating access to finance through direct market creation (for example, Fornadin in Mexico). Multilateral or national development banks (such as the Brazilian National Bank for Economic and Social Development) reduce government-induced policy risk through their participation, help in designing the policy that can reduce such risk, and act as trusted conveners to bring in other financing institutions. Moreover, their set of instruments (including equity and guarantees) can help manage risks in the early stages of projects, where financing is most challenging.

Regulations forcing financial institutions to be transparent about the risk of stranded assets in fossil fuels encourage green investment, and reduce financial sector risk, as stressed in Mark Carney statements and reports from the Task Force on Climate-related Financial Disclosures. Bridging the finance gap requires looking at banking and financial regulations, and considering how they could be used to make long-term investments more attractive for investors and intermediaries (Campiglio 2016; Shukla et al. 2017). As many investments are necessarily long-term, dealing with the short-termism of the financial sector becomes particularly important.[32]

Decarbonization benefits from technological improvements can be supported by technology policies and R&D subsidies. Carbon prices can help overcome this constraint but it does require setting a carbon price higher than what would be needed in the presence of innovation policies, entailing high costs in the short term. A wide range of policies could instead be used to tackle this challenge, such as direct support for low-carbon sectors. Supporting investments in low-carbon technologies and sectors (Acemoglu et al. 2012; Rosendahl 2004) can likewise encourage investments in innovation in solar panels, electric cars, and the like (Gerlagh, Kverndokk, and Rosendahl 2014; Smulders, Withagen, and Toman 2014). Particularly promising technologies can also be promoted through targeted support. If one low-carbon technology displays high potential but high costs, specific support can be provided through feed-in tariffs, for example (del Rio Gonzalez 2008). Public procurement can be another tool to drive low-carbon innovation and generate economies of scale—especially in sectors where government demand is significant.

[32] See Stiglitz et al. (2015), and Bolton, Samama, and Stiglitz (2011).

Combined with estimates of knowledge spillovers, the potential of specific new technologies, and proposed roadmaps, a carbon value can be used to design specific policies to support innovation and the deployment of low-carbon technologies. Innovation in low-carbon technologies can also ease the adoption of carbon prices by aiding in the provision of alternatives to carbon-intensive technologies and lifestyles.

The restructuring process can be done quicker and more efficiently if it is supported by education, migration, and trade policies that accelerate technology transfers and innovation.

Decarbonization poses the usual challenges for policy makers trying to facilitate the restructuring and reduce the labor market adjustment costs, including those derived from a changing skills mix. Skill shortages may already be impeding the transition to green growth (World Bank 2012a). In 2011, the OECD (2011b) drew attention to widespread skill shortages in energy-efficient construction and retrofitting; renewable energy; energy and resource efficiency; and environmental services.

7 CONCLUSION

This Commission was tasked with identifying carbon-pricing corridors that, combined with other policies and international collaboration, could deliver on the Paris target of limiting global warming to "well below 2°C." The Commission's conclusions are based on its members' experience and judgment, and draw on multiple lines of evidence—including technological roadmaps and technology assessments, national pathway analyses, and integrated assessment models—taking into account the strengths and limitations of these various information sources. As all of these approaches inevitably involve many uncertainties, the focus has been on identifying carbon-price *ranges* rather than specific prices.

The Commission recognizes that different countries will choose different instruments to implement their climate policies and put a price on carbon, depending on national and local circumstances and on the support they receive.

Based on evidence from industry, policy experience, and relevant literature, and taking into account the strengths and limitations of the respective information sources, this Commission concludes that, in a supportive policy environment, the explicit carbon-price level consistent with the Paris temperature target is at least US$40–80/t$CO_2$ by 2020 and US$50–100/t$CO_2$ by 2030. The implementation of carbon pricing would also need to duly consider the non-climate benefits of carbon pricing (for instance, the generation of additional government revenue), the local context, and the political economy (including the policy environment, the adjustment costs, the distributional impacts, and the political and social acceptability of the carbon price).

Depending on the other particular policies adopted, large co-benefits may be derived that go beyond climate such as lower pollution and congestion levels, healthier ecosystems, broader access to modern energy, and so on. Furthermore, in a realistic context where domestic and international compensatory transfers are limited, imperfect, and costly, distributional and ethical considerations cannot be disregarded when designing climate policies. The appropriate carbon-price levels will therefore vary across countries. In lower-income countries they may actually be lower than the ranges proposed here, in part because complementary actions taken may be less costly or because the distributional and ethical issues to be tackled may be more complex.

The Commission believes that the carbon-price ranges suggested above would be able to deliver on the temperature objective of the Paris Agreement, provided the pricing policy is complemented with targeted actions and a supportive investment climate—in the absence of these elements, the carbon-price range required is likely to be higher. The temperature objective of the Paris Agreement is also achievable with lower near-term carbon prices than indicated above, but doing so would require stronger action through other policies and instruments and/or higher carbon prices later, and may increase the aggregate cost of the transition.

The proposed carbon-price range is narrower than the one that would have been derived from a simple literature review because the Commission has used its own judgment in assessing the relevance and appropriateness of some of the more extreme calculations.

- ***Lower bound.*** While governments do have some flexibility in the use of instruments at the country level, the Commission believes that decarbonizing the economy with very low carbon prices, and a relatively large focus on other instruments could be unnecessarily inefficient, due to the potential misallocation of efforts across sectors. In addition, a high short-term price gives a clear signal on the transition to investors and consumers, helps raise awareness of and attract attention to emission reduction opportunities, and may help tackle cognitive and behavioral biases. These elements explain the lower range of US$40–50 for the period 2020–30 for the carbon prices that are considered consistent with an efficient achievement of the temperature objectives of the Paris Agreement. National circumstances (related to adjustment costs and market failures, distributional impacts, social and political acceptability, etc.) may make it preferable to initially implement a lower carbon-price level. Yet strong investment decisions aimed at reducing emissions require absolute clarity that carbon prices will rise over the next few decades.
- ***Higher bound.*** Scenarios that suggest that the carbon prices consistent with the Paris Agreement are higher than US$80–100/t$CO_2$ in the period 2020–30 generally make more pessimistic assumptions regarding (the pace of) technological change and the impact of socioeconomic trends, or assume an unsupportive policy environment and little action being taken through other policy instruments.

Of vital importance for the effectiveness of climate policy, particularly carbon pricing, is that future paths and policies not only be clear but also credible. New evidence will emerge continually and new lessons drawn; indeed, the implementation of carbon pricing should foster knowledge generation and technical progress, and practical experience should be taken into account. It is also important to monitor and regularly review the evolution of emissions, technological costs, and the pace of technological change and its diffusion so that carbon prices can be adjusted, particularly upward, if existing prices fail to bring about the required changes. There is a rich and active area of research that can be very helpful in implementation and revision over time of carbon pricing instruments. It is desirable that the carbon-price ranges across countries narrow in the long term, in a time frame that depends on a number of factors—including the extent of international support and the degree of convergence of living standards across countries.

The carbon-pricing and complementarity measures indicated in this report are substantially stronger than those currently in place—85 percent of global emissions are currently not priced at all, and about three quarters of the emissions that are covered by a carbon price, are priced below US$10/t$CO_2$e (World Bank, Ecofys, and Vivid Economics 2016; Partnership for Market Readiness 2017). This statement is consistent with the observation made in the Paris Agreement that the NDCs for 2030 associated with the Agreement represent substantially smaller emission reductions than necessary for achieving the Paris temperature increase target of “well below 2°C.”

APPENDIX A: THE SOCIAL COST OF CARBON

While this report does not provide an estimation and evaluation of the climate change impacts that could be avoided, it did review the relevant literature on the matter. The Commission concluded, as did the fifth Assessment Report (AR5) of the IPCC and other review studies, that many of the impact functions used in modeling exercises to calculate the social costs of carbon are biased downward because they fail to consider many vitally important risks and costs associated with climate change—particularly the widespread biodiversity losses, long-term impacts on labor productivity and economic growth, impacts on the poorest and most vulnerable, rising political instability and the spread of violent conflicts, ocean acidification, large migration movements, as well as the possibility of extreme and irreversible changes (IPCC 2014a,b; Tol 2012; Stern 2013; Weitzman 2014; Dietz and Stern 2015).

According to some recent reviews, climate change impact on total factor productivity combined with the presence of discontinuity and tipping points may significantly increase the social cost of carbon (Moyer et al. 2014; Moore and Diaz 2015). The valuation of non-market impacts can also be an important driver for higher climate impacts (van den Bergh and Botzen 2014; Ackerman et al. 2009). Because poorer households and countries are more severely affected by climate impacts, the social cost of carbon may have to be adjusted upward, if the implementation of policies to reduce those inequalities is not feasible (Dennig et al. 2015; Mendelsohn, Dinar, and Williams 2006; Hallegatte and Rozenberg 2017).

For these reasons, many past modeling exercises to calculate the global social costs of carbon have produced numbers that *probably underestimate these costs by very large margins*. Some expert assessments have recommended updates to the methodologies being used to strengthen the scientific basis and improve the characterization of the uncertainties in these estimates (National Academies of Sciences, Engineering, and Medicine 2017; Rose et al. 2014; Pindyck 2013).

B APPENDIX B: THE SOCIAL VALUE OF MITIGATION ACTION

Carbon mitigation actions entail direct costs, co-benefits, and adverse side effects (IPCC, 2014b). Potential co-benefits include the following:

- The ***immediate benefits*** of avoided GHG emissions: (i) less adverse effects from local air pollution on health and agricultural productivity (Clarke et al. 2014); and (ii) countries' greater energy security and lower vulnerability of their trade balance to the volatility of oil price.
- An ***acceleration of technological change*** when early investments in low-carbon technologies deliver learning-by-doing effects with positive spillovers on technological change in the form of a "Schumpeterian" innovation wave (Stern 2015b; Bramoullé and Olson 2005).
- The ***short-term knock-on effects and long-term development benefits*** of a well-conducted low-carbon transition: (i) improving the use of savings by redirecting financial flows toward productive investments; (ii) strengthening the industrial fabric of each country through investing in low-carbon technologies and local resources; and (iii) reducing poverty through higher growth, higher employment, and better access to modern energy, transport, and housing infrastructures (Arezki et al. 2016).

The social value of mitigation action (SVMA) can be defined as the economic and environmental value of voluntary mitigation actions and their co-benefits for adaptation, health, and sustainable development (UNFCCC 2015, Para 108). The international community could encourage the use of SVMAs, taking into account avoided climate change impacts and global co-benefits from reducing emissions and stabilizing climate change, and use them, for instance, to design sectoral measures in carbon-intensive sectors or global financial instruments.

In a world with imperfect markets and constraints on compensatory transfers, SVMAs would differ across countries. Such national SVMAs would encompass the national benefits of keeping global warming below a globally agreed target (i.e., avoided climate change impacts) and the local development co-benefits of national mitigation activities. National SVMAs could be used as notional carbon prices, for instance, by being incorporated in financial mechanisms to redirect savings toward low-carbon investments or investments that are not based on some public decision-making process.

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During the 22nd Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) held in Marrakech, Morocco, in 2016, at the invitation of the Co-Chairs of the Carbon Pricing Leadership Coalition (CPLC) High Level Assembly, Ségolène Royal and Feike Sijbesma, Joseph Stiglitz, Nobel Laureate in Economics, and Lord Nicholas Stern, accepted to chair a new High-Level Commission on Carbon Prices comprising economists, and climate change and energy specialists from all over the world, to help spur successful implementation of the Paris Agreement.

The Commission's objective is to identify indicative corridors of carbon prices that can be used to guide the design of carbon-pricing instruments and other climate policies, regulations, and measures to incentivize bold climate action and stimulate learning and innovation to deliver on the ambition of the Paris Agreement and support the achievement of the Sustainable Development Goals.

This is **Exhibit L** referred to in the

affidavit of **John Moffet**

affirmed before me on **January 29, 2019**

Commissioner for Oaths for Québec

#224458

WORLD BANK GROUP

State and Trends of Carbon Pricing 2018

Washington DC, May 2018

State and Trends of Carbon Pricing 2018

Washington DC, May 2018

The preparation of this report was led by the World Bank, with the support of Ecofys, a Navigant company.

The World Bank team responsible for this report was composed of Céline Ramstein, Radhika Goyal, Steven Gray, and Angela Churie Kallhauge.

The Ecofys team included Long Lam, Noémie Klein, Lindee Wong, Maurice Quant, Sam Nierop, Tom Berg, and Paige Leuschner.

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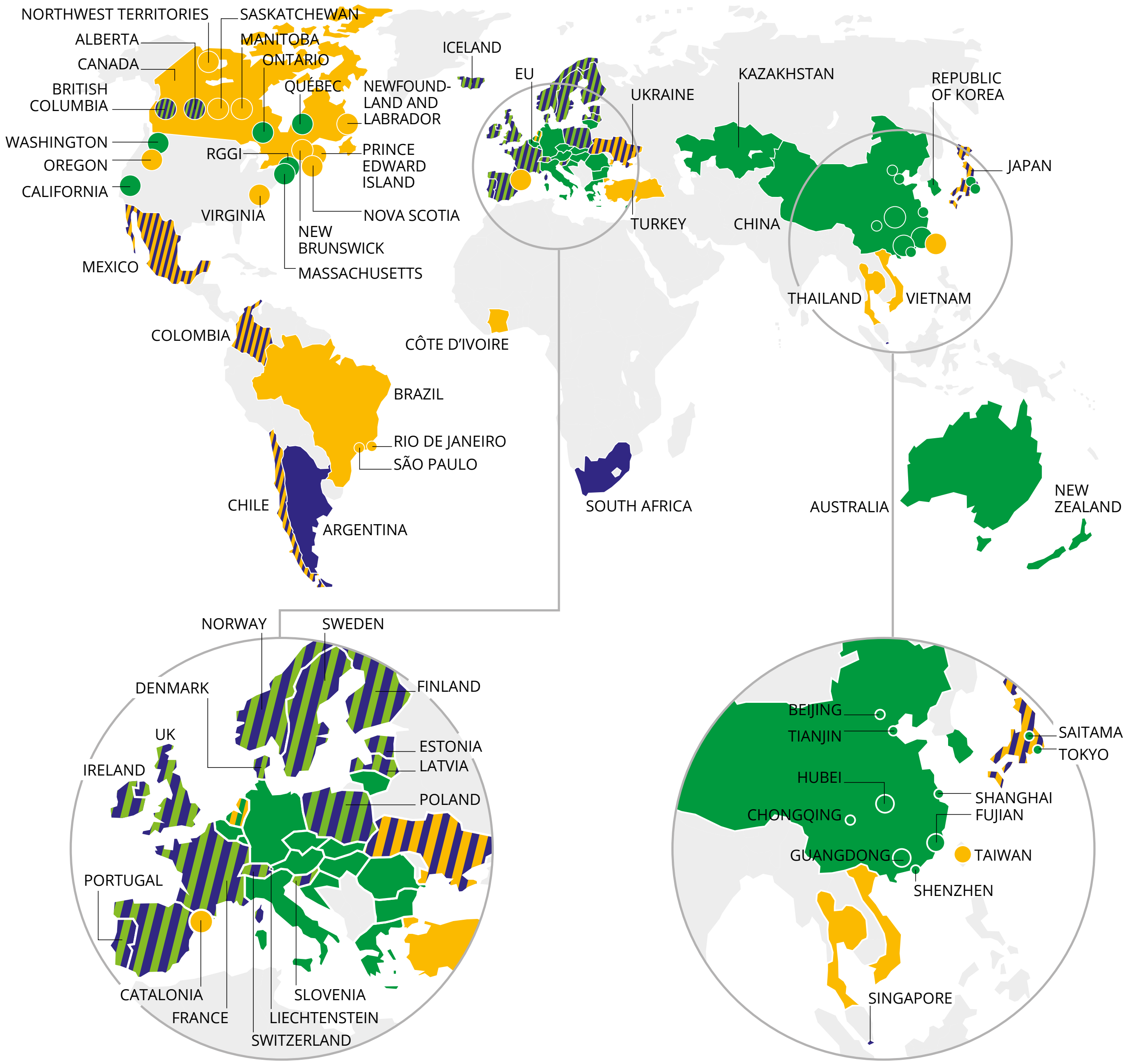
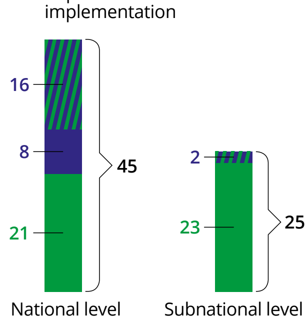
Figure 1 / Summary map of regional, national and subnational carbon pricing initiatives implemented, scheduled for implementation and under consideration (ETS and carbon tax)



Tally of carbon pricing initiatives implemented or scheduled for implementation



- ETS implemented or scheduled for implementation
- Carbon tax implemented or scheduled for implementation
- ETS or carbon tax under consideration
- ETS and carbon tax implemented or scheduled
- Carbon tax implemented or scheduled, ETS under consideration
- ETS implemented or scheduled, carbon tax under consideration

The circles represent subnational jurisdictions. The circles are not representative of the size of the carbon pricing instrument, but show the subnational regions (large circles) and cities (small circles).

Note: Carbon pricing initiatives are considered "scheduled for implementation" once they have been formally adopted through legislation and have an official, planned start date. Carbon pricing initiatives are considered "under consideration" if the government has announced its intention to work towards the implementation of a carbon pricing initiative and this has been formally confirmed by official government sources. The carbon pricing initiatives have been classified in ETSs and carbon taxes according to how they operate technically. ETS not only refers to cap-and-trade systems, but also baseline-and-credit systems as seen in British Columbia and baseline-and-offset systems as seen in Australia. The authors recognize that other classifications are possible. Due to the dynamic approach to continuously improve data quality, changes to the map not only reflect new developments, but also corrections following new information from official government sources, resulting in the addition of the carbon tax covering only F-gases in Spain.

This is **Exhibit M** referred to in the

affidavit of **John Moffet**

affirmed before me on **January 29, 2019**

Commissioner for Oaths for Québec

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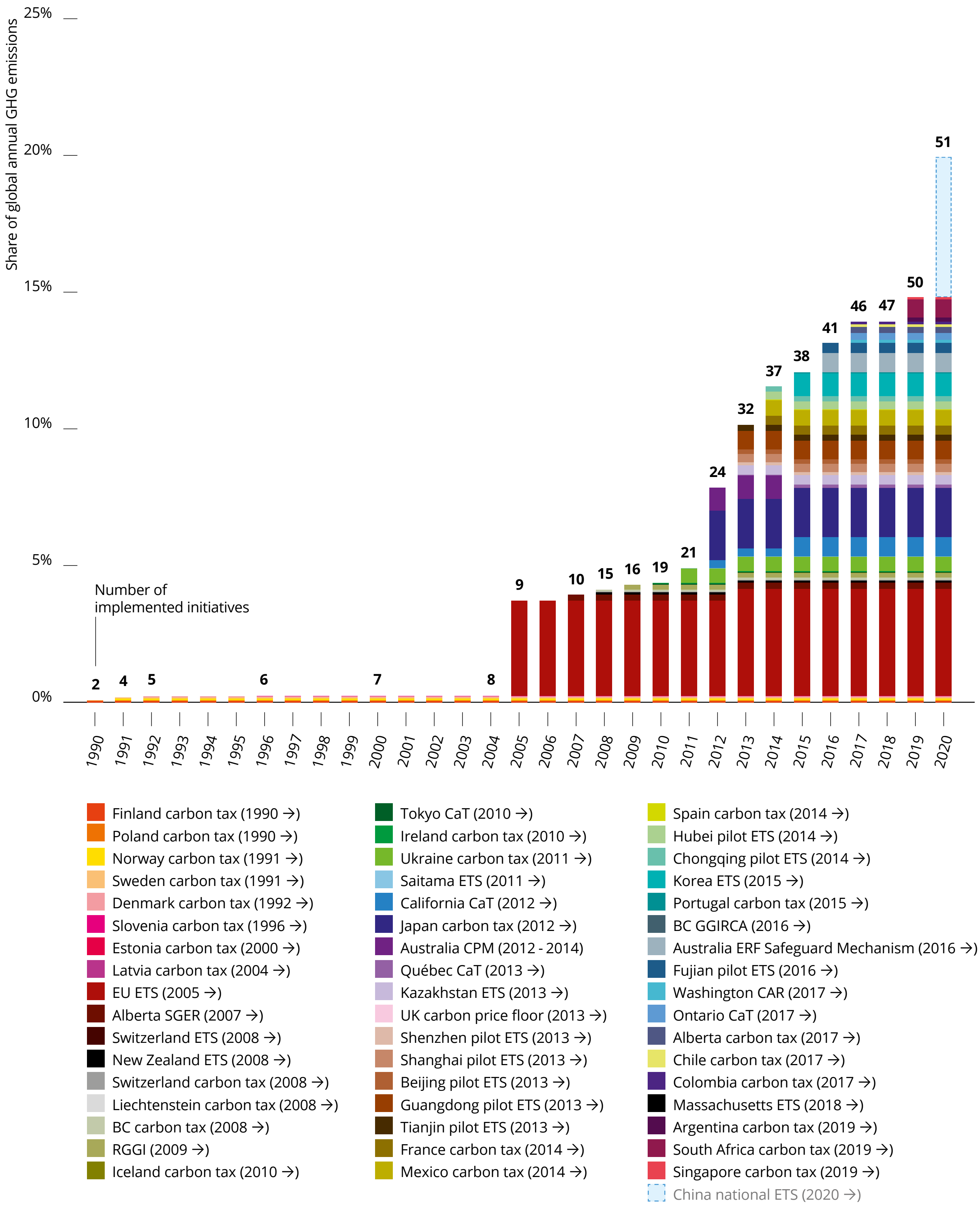
Figure 2 / Regional, national and subnational carbon pricing initiatives: share of global emissions covered



Note: Only the introduction or removal of an ETS or carbon tax is shown. Emissions are presented as a share of global GHG emissions in 2012 from (EDGAR) version 4.3.2 including biofuels emissions. Annual changes in GHG emissions are not shown in the graph. Due to the dynamic approach to continuously improve data quality using official government sources, the carbon tax only covering F-gases in Spain was added. The information on the China national ETS represents early unofficial estimates based on the announcement of China's National Development and Reform Commission on the launch of the national ETS of December 2017.

This is **Exhibit N** referred to in the
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affirmed before me on **January 29, 2019**

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January 2016 SDN/16/01

IMF STAFF DISCUSSION NOTE

After Paris: Fiscal, Macroeconomic, and Financial Implications of Climate Change

Mai Farid, Michael Keen, Michael Papaioannou,

Ian Parry, Catherine Pattillo, Anna Ter-Martirosyan,

and other IMF Staff

After Paris: Fiscal, Macroeconomic, and Financial Implications of Climate Change

Prepared by Mai Farid, Michael Keen, Michael Papaioannou, Ian Parry, Catherine Pattillo, Anna Ter-Martirosyan, and other IMF Staff[1]

Authorized for distribution by Vitor Gaspar and Siddharth Tiwari

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CONTENTS

Boxes

EXECUTIVE SUMMARY

The December 2015 Paris Agreement lays the foundation for meaningful progress on addressing climate change—now the focus must turn to the practical policy implementation issues. Against this background, this paper takes stock of the wide-ranging implications for fiscal, financial, and macroeconomic policies of coming to grips with climate change.

Most immediate, and key, is the need to recognize and exploit the potential role of fiscal policies in implementing the mitigation pledges submitted by 186 countries in the context of the Paris Agreement. At the heart of the climate change problem is an externality: firms and households are not charged for the environmental consequences of their greenhouse gases from fossil fuels and other sources. This means that establishing a proper charge on emissions—that is, removing the implicit subsidy from the failure to charge for environmental costs—has a central role.

Also critical are establishing a clear pathway to meeting complementary commitments on climate finance, effective adaptation, and ensuring financial markets play a full and constructive role. Fiscal policies are key to efficiently mobilizing both public and private sources of finance, while the need to adapt economies to climate change raises issues that have implications for the design of national tax and spending systems (for example, strengthening fiscal buffers and upgrading infrastructure in response to natural disaster risks). There is also a growing need to enhance the contribution of the financial sector to addressing climate challenges, by facilitating clean investments and pooling climate-related risks.

For reducing carbon emissions ('mitigation'), carbon pricing (through taxes or trading systems designed to behave like taxes) should be front and center. These are potentially the most effective mitigation instruments, are straightforward to administer (for example, building off fuel excises already commonplace in most countries), raise (especially timely) revenues for lowering debt or other taxes, and establish the price signals that are central for redirecting technological change towards low-emission investments. The challenges lie in gauging appropriate price paths and dealing with the adverse effects on vulnerable households and firms, and the consequent political sensitivities.

Moving ahead unilaterally with carbon pricing is likely to be in many countries' own interests, because of the domestic (non-climate) benefits of doing so, most notably fewer deaths from exposure to local air pollution. As national pricing schemes emerge, a natural way to enhance these efforts and address concerns regarding lost competitiveness would be through international carbon price floor arrangements, analogous to those developed to counter some cases of international competition over mobile tax bases.

For climate finance, carbon pricing in developing countries would establish price signals needed to attract private flows for mitigation. Substantial amounts could also be raised from charges on international aviation and maritime fuels. These fuels are a growing source of emissions, are underpriced, and charges would exploit a tax base not naturally belonging to national governments.

For adaptation, specific measures to strengthen resilience to climate change will depend on a country's specific circumstances and vulnerabilities. Policies should be worthwhile across a range of scenarios for (uncertain) local climate effects and are particularly important for low-income countries and small states prone to climate-related natural disasters.

In financial markets, increased disclosure of firms' carbon footprints, prudential requirements for the insurance sector, and appropriate stress testing for climate risks will help ensure financial stability during the transition to a low-carbon economy. Analyses of how firms' asset values could be impacted by de-carbonization are needed to efficiently allocate investments across carbon-intensive and other sectors. Strengthening countries' regulatory oversight is also needed to ensure sound and resilient institutions and well-functioning financial markets for providing instruments to manage climate risks. Besides promoting green financial instruments, catastrophe bonds and similar hedging instruments can transfer climate-damage risks to those who are better able to bear them.

I. INTRODUCTION

1. **The landmark December 2015 Paris Agreement on climate change provides a framework for meaningful progress on climate mitigation**. 186 countries submitted emission reduction pledges, covering 96 percent of global emissions, and parties agreed on procedures for evaluating progress on, and updating these pledges. Without mitigation, global temperatures are projected to rise by about 3–4°C over pre-industrial levels by 2100, but with risks of more catastrophic warming (Box 1). Many developing countries (those, for example, that are coastal or highly agriculture-dependent) are especially vulnerable to climate impacts. The success of the Paris Agreement will require sizable reductions in energy-related carbon dioxide (CO_2) in large emitters, including in developing economies. The key practical issue is what policies are best suited for making progress on these mitigation pledges—economic analysis provides especially useful guidance on this.

2. **The central problem is that no single firm or household has a significant effect on climate, yet collectively there is a huge effect—so pricing is necessary to force the factoring of climate effects into individual-level decisions**. This pricing aligns private and social costs, thereby promoting cleaner and less energy use, and encouraging innovation toward these ends.

3. **The Paris Agreement also reiterates and modestly extends previous commitments on finance, but without specifics**. Advanced economies are strongly urged to scale up their efforts with a concrete roadmap to achieve the goal of providing $100 billion a year in finance to support adaptation and mitigation in developing countries by 2020; subsequently, by 2025, the Parties to the Paris Agreement are expected to set a new collective, quantified goal from a floor of $100 billion

per year. This commitment is seen as a pre-requisite for developing countries moving forward on mitigation pledges though the allocation of finance remains contentious. The importance of compensation for climate disasters ('loss and damage') was recognized in the Paris Agreement, but it does not provide a basis for compensation liability for bad weather events in developing economies.

Box 1. Global Climate Change: Trends and Science

Atmospheric carbon dioxide (CO_2) concentrations increased from pre-industrial levels of 280 parts per million (ppm) to current levels of about 400 ppm. This increase mainly reflects fossil fuel CO_2 emissions (half of which enter the atmosphere where they remain, on average, for about 100 years), the annual flow of which increased from 2 billion (metric) tons in 1900 to 32 billion in 2013. Without mitigation, emissions are projected to approximately triple from current levels by 2100, raising atmospheric concentrations to about 700–900 ppm (though such forecasts are highly uncertain). Developing countries account for nearly three-fifths of global CO_2 emissions and essentially all of the rapid growth in projected future emissions. Land-use changes (mainly deforestation) add another 5 billion tons of CO_2, though their projected growth is slower than that of fossil fuels. Non-CO_2 greenhouse gasses (GHGs) (such as methane and nitrogen oxides) increase current CO_2-equivalent atmospheric concentrations to about 440 ppm. Ice core data indicate that concentrations have not exceeded 300 ppm in the last 800,000 years.

Globally-averaged surface temperature has risen by about 0.8°C since 1900, mostly from rising GHG concentrations. If CO_2 equivalent concentrations were stabilized at 450, 550, and 650 ppm, mean projected warming over pre-industrial levels would be 2.0, 2.9, and 3.6°C, respectively, once the climate system reaches equilibrium (which takes several decades due to gradual heat diffusion in the oceans). Mean projected warming in the absence of mitigation is expected to reach about 3–4°C by 2100. Actual warming may be substantially greater (or less) than projections due to poorly understood feedbacks in the climate system.

Physical risks include: changed precipitation patterns, shifting deserts and monsoons, sea level rise (up to several meters if ice sheets melt), more intense and frequent extreme weather, destruction of the marine food chain from ocean acidification, and changes in ocean circulation.

Sources: IEA (2014), IPCC (2014).

4. **Adaptation to climate change reduces the severity of impacts and, being in countries' own interests, does not raise the same collective action issues as mitigation.** However, it is difficult to provide general guidance, beyond laying out policy options and issues for consideration, as appropriate actions are highly specific to local climate impacts, national circumstances, and the need to be robust across different climate-change scenarios.

5. **There is growing debate on how financial markets can facilitate the transition to low-carbon, climate-resilient economies.** Central issues here include encouraging the disclosure and effective monitoring of firms' carbon footprints; developing and deploying financial instruments that

promote the reduction and mitigation of climate-related risks; and ensuring the efficient channeling of financial flows to low-carbon technologies.

6. The IMF's universal membership, global perspective, established expertise, and close relationship with finance ministries and financial market participants make it well positioned to contribute to the development and implementation of policies to address the challenges of climate change. The rest of the paper starts by taking stock of climate change impacts, especially for low-income countries (LICs) (Section II), then turns to policy design issues in regard to mitigation (Section III), climate finance (Section IV), adaptation (Section V), and financial markets (Section VI). The conclusion summarizes the contribution that the IMF can make (Section VII).[2]

II. MACROECONOMIC IMPACTS

7. Climate change is expected to significantly impact the global economy in the coming decades. Temperature increases and other physical effects (see Box 1) would translate into significant market impacts, with output losses through effects on climate-sensitive sectors (for example, agriculture, forestry, coastal real estate, tourism). Non-market impacts include ecosystem disruption, health damages, water stress, etc. Although the average impact from a 3°C increase in temperature is projected at about 2 percent of global GDP (Figure 1),[3] there is considerable variation across studies and essentially nothing is known about potential damages from extreme (and unprecedented) warming scenarios.[4]

8. Vulnerabilities vary considerably across regions, with greater impacts for regions with lower per capita income and higher initial temperatures. Most vulnerable to negative effects are sub-Saharan Africa (SSA), South East Asia (SEA), and Middle East and North Africa (MENA), while risks for the United States, Europe (EUR), and China are generally more moderate. According to a study by Roson and van der Mensbrugghe (2012) sea level rise and agriculture are the main channels of impact for SEA; water scarcity for MENA; labor productivity and health for SSA; negative impacts on labor productivity in the United States may be largely offset by tourism and agriculture in the United States; while in China, net positive effects are mostly due to increased crop productivity. In Europe, effects differ across sub-regions with the positive impact in the north slightly offsetting losses in other regions.[5] Other studies project broadly similar overall impacts across the

[2] The paper builds on an evolving body of analytical work at the IMF, see for example, IMF (2008a, 2008b, 2011a, 2011b), Parry, de Mooij, and Keen (2012), Parry and others (2014). See www.imf.org/environment

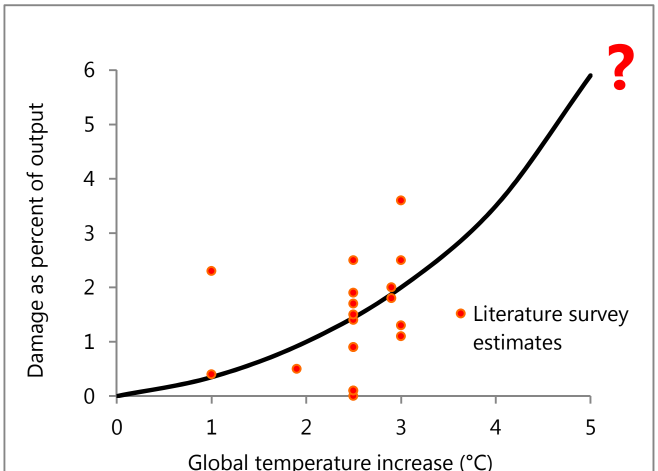
[3] This impact is measured as a percent deviation from potential output, implying that potential global GDP would be about 2 percent lower due to the climate impact.

[4] Illustrative calculations in Weitzman (2011), for example, suggest atmospheric accumulations by 2100 in the absence of mitigation would eventually increase global temperatures by more than 6°C with 22 percent probability and more than 10°C with 5 percent probability.

[5] According to most models, northern Europe will mainly benefit from positive impacts on crop productivity and tourism, while other regions are expected to experience adverse effects on labor productivity and agriculture, increased energy demand, and greater flooding.

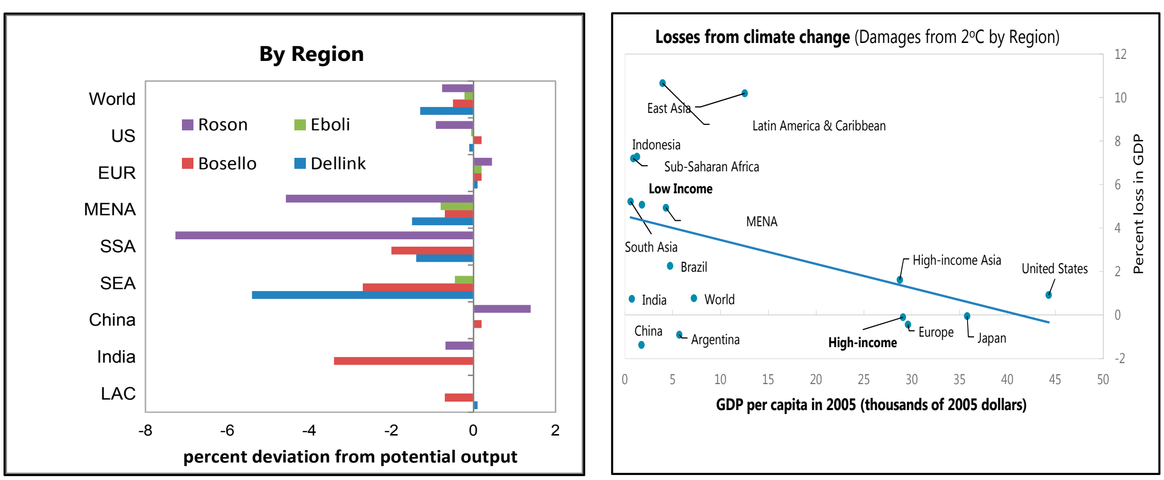
regions (Figure 2) but differ in their estimates of the specific sectoral effects (for example, Bosello and others, 2010, project greater negative impacts on agriculture in SSA ad SEA). However, most aggregate studies may underestimate effects of climate change due to relatively modest underlying assumptions and narrow distributions of risk (for example, Stern 2013). On the other hand, partial impact studies focusing on specific sectors or regions tend to show larger negative effects (not surprisingly as they often do not account for endogenous adjustment processes taking place within economies or changes in trade patterns—see Dellink and others 2014).

Figure 1. Impact of Warming on World Output



Source: Nordhaus (2013), Tol (2014).
Note. Projected damages are for some future year, typically 2100.

Figure 2. Projected Regional Impacts of Climate Change, 2050 or Thereabouts



Sources: Left panel: Bosello, Eboli, and Pierfederici (2012) (for 1.9°C increase by 2050); Dellink and others (2014) (1.5°C by 2060); Eboli, Parrado, and Roson (2010) (1.5°C by 2050); and Roson and van der Mensbrugghe (2012) (2°C by 2050). Right panel: Roson and van der Mensbrugghe (2012).

9. Greater risks for developing countries reflect in part their existing climate and limited ability to adapt. Many developing countries have large agricultural sectors, higher rainfall variability, and are relatively close to the equator where risks are greater (Figure 3, top panel):

- Although projected **temperature increases** are smaller closer to the equator, they come on top of higher baseline temperatures (already beyond the optimal for agriculture), resulting in above-average increases in the frequency and duration of extreme heat.[6]

- Projected **sea-level rise** for countries nearer the equator exceeds the global mean.[7] More generally some small island states and coastal countries (Bangladesh, Cambodia, China, Egypt, Guyana, Mauritania, Suriname, Thailand, Vietnam) could lose 10 percent of GDP or more under high sea level scenarios (for example, Dasgupta and others 2007, World Bank 2013). Rising sea levels could also increase the risks of storm surges and tropical cyclones, particularly in the Caribbean.

- Projected **water stress** (from enhanced evaporation and precipitation variability) is greater for drier climates. [8]

- Nearly 80 percent of LICs (and 50 percent of small developing states[9]) are assessed (Figure 3, middle and lower panels) as highly or extremely vulnerable to climate change, with limited "readiness" to leverage adaptation investments, compared with 40 percent in the rest of the world (See IMF 2015a on LICs vulnerability to climate change). This highlights the need for prioritizing resilience-building actions. Within countries, areas inhabited by the poor and other vulnerable groups are often the most sensitive to climate impacts (Hallegatte and others, 2015).

10. LICs and small states are often the hardest hit by natural disasters, which are expected to increase in frequency and severity. Over the period 1985–2015 (and accounting for country size), LICs are hit about one and a half times as often by climate-related disasters: floods, storms, and droughts (Figure 4, top left and bottom panels). The proportion of the domestic population affected by natural disasters is also higher compared with other countries, particularly for small developing and low-lying coastal states (Figure 4, bottom left). And within LICs, the poorest 25th percentile of countries faces the highest natural disaster risks (Figure 4, top right panel).

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[6] According to Verisk Maplecroft (2015), under a 2°C scenario, the share of land affected by unusual extreme heat at the end of the century is projected to be 30 percent in the MENA region, 30–40 percent in LAC, and 45 percent in SSA, compared, for example to 10–15 percent of land in Europe and Central Asia. Under a 4°C scenario, these shares would more than double.

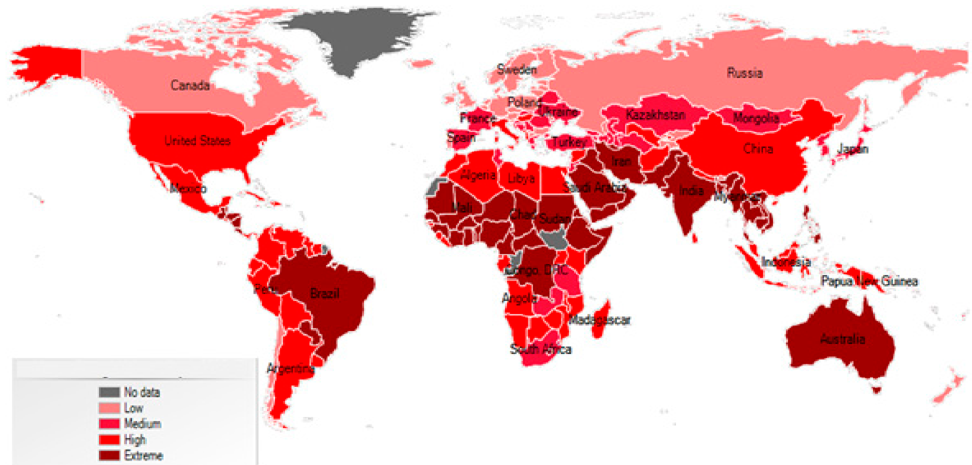
[7] For example, in a 2°C world (for the 2040s), sea levels are forecast to rise by about 30–70cm in SSA (with higher levels toward the south) and 20–65cm in MENA, and substantially more in a 4°C setting (for the 2080s).

[8] Even in a 2°C scenario (for the 2040s), water runoff declines by a projected 30–50 percent in SSA, 10–30 percent in LAC and perhaps (due to declining snow melt) more than 50 percent in the Euphrates and Tigris basin in MENA (see Schlosser and others 2014, Kochhar and others 2015).

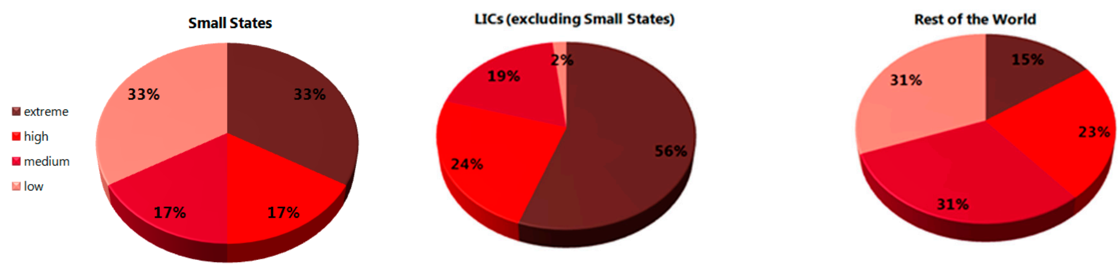
[9] Thirty-three small states (defined as countries with populations below 1.5 million) are members of the IMF, of which 20 are small developing states, 12 are middle-income, and 8 are low-income (based on the World Bank per capita income groups).

Figure 3. Impacts of Climate Change

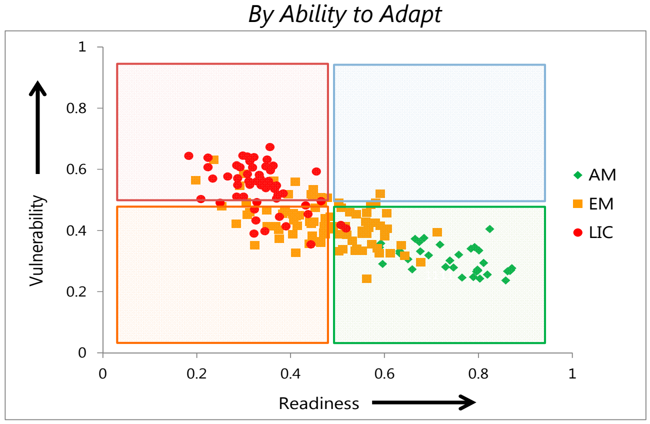
By Geographical Location



By Income Level, 2015



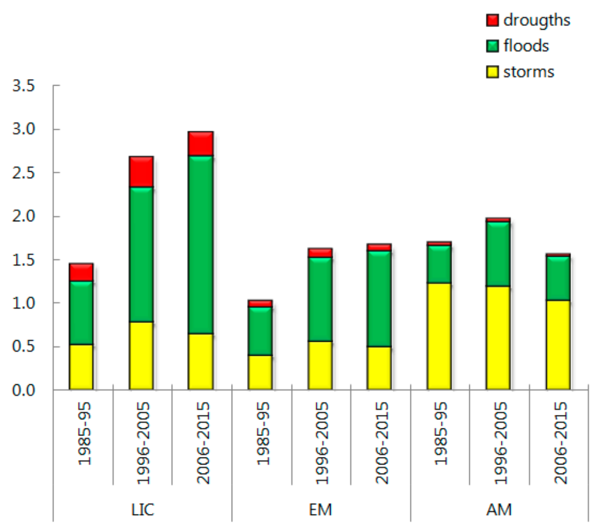
By Ability to Adapt



Source: Verisk Maplecroft (2015) Climate Change Exposure Index.
Note: The top and middle figures are based on the Climate Change Exposure Index, summarizing the vulnerability of human populations to the frequency and intensity of extreme climate events and predicted changes in baseline climate parameters from 2025–45, excluding the ability to adapt. The bottom figure is based on Global Adaptation Index.

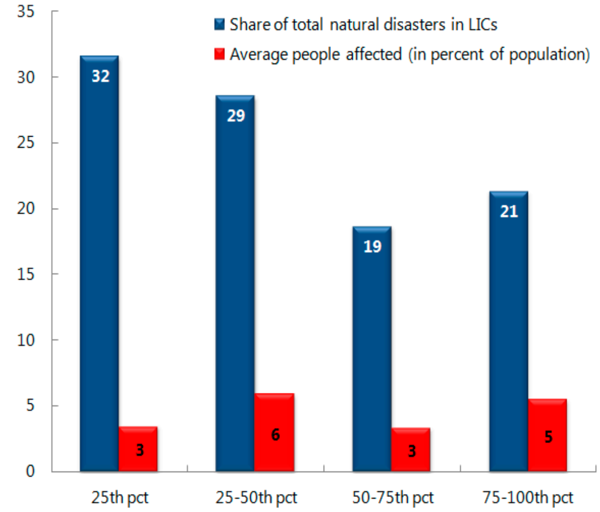
Figure 4. LICs Exposure to Climate-Related Disasters

Occurrence of Natural Disaster
Average Annual Number of Droughts, Floods and Storms per million sq km



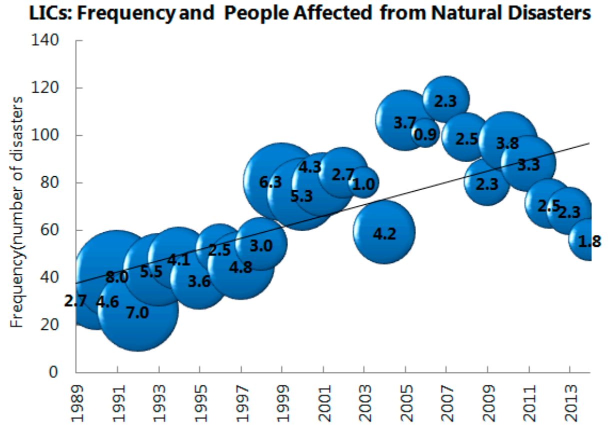
Source: EM-DAT and IMF estimates.
Note: A disaster is registered in the EM-DAT database if one of the following is met: (i) 15 or more fatalities; (ii) 100 or more people "affected" (fatal and non-fatal injuries and displaced); (iii) a call for international assistance; and (iv) the declaration of a state of emergency.
Total occurence by type of disaster (drought, floods and storms) is divided by total land area of each country grouping (LICs, EMs, and AMs).

Natural Disasters by Income Distribution



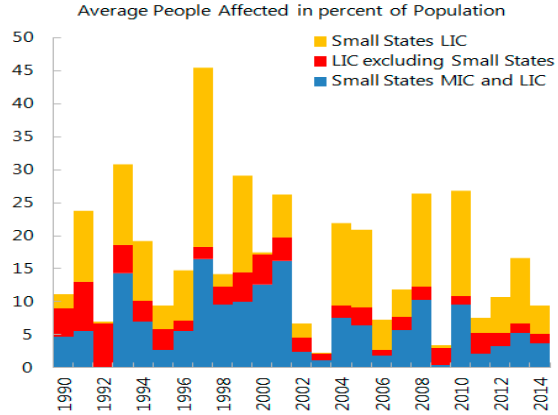
Sources: The International Disaster Database, CRED and IMF Staff estimation.
Note: Shares do not sum up to 100 since some countries are classified to more than one group.

LICs: Frequency and People Affected from Natural Disasters



Source: EM-DAT Natural Disasters database.
Note: Bubble size and the number indicate percent of LIC population affetced.

People Affected from Natural Disasters
Average People Affected in percent of Population



Source: EM-DAT.

11. Climate-related natural disasters and higher temperatures harm growth and exacerbate poverty in developing countries. Natural disasters reduce developing country GDP growth by an estimated 1–3 percentage points, depending on the type of disaster.[10] Temperature

[10] See Raddatz (2007) and Loayza and others (2009) on climatic disasters; Reilly and Schimmelpfennig (1999) and Fomby and others (2013) on severe droughts; Acevedo (2014) on impacts for the Caribbean; and Cabezon and others (2015) on the Pacific Islands.

increases are also associated with lower growth, for example, Dell, Jones, and Olken (2012) find that in LICs a 1°C rise in temperature from a country's mean temperature reduces economic growth by 1.3 percentage points on average, mainly by reducing agricultural output. Rising temperatures and greater rainfall volatility together with more frequent extreme weather events reduce agricultural productivity in LICs, an important growth channel given agriculture's large share in output.[11] Climate change and natural disaster risks also worsen poverty due to loss of productive economic assets combined with limited savings (Hallegatte and others 2015) and food vulnerability (Adedeji and others forthcoming).

12. Exposure to climate change and related extreme weather events affects tourism. Climate change is expected to affect tourists' destination choices, creating different patterns of tourism flows at the regional level. Losses are expected for most developing countries while high-latitude advanced economies would gain.

13. The impact on agriculture and food, water, and energy security could translate into significant migration pressures and heightened conflict risks, with economic impacts in many regions. The scale of internal and international migration is expected to rise with the combined pressures of climate change and environmental degradation (Hallegatte, Lecocq, and de Perthuis 2015, Adger and others 2014, Wodon and others 2014). Physical impacts related to climate change could increase fragility and conflict by creating or exacerbating food, water and energy scarcities, and triggering migration (Burke and others 2014). These potential GDP and growth impacts, for both developing and advanced economies, are not considered in standard models of the economic effects of climate change.

14. While global economic effects will be significant, uncertainty about the magnitudes stems from several sources. These include the uncertainties in models projecting the impact of climate change on the environment, the challenges of mapping those changes into economic effects, and in accounting for future adaptation strategies and technical innovation in mitigating those effects. In addition, most models tend to rely on relatively conservative climate scenarios as modeling extreme events is significantly more challenging (Burke and others 2015).[12]

III. FISCAL POLICY FOR MITIGATION

15. From a mitigation perspective, the key practical issues are choosing and designing the policy instruments best suited for implementing countries' Intended Nationally Determined Contributions (INDCs). INDCs typically state quantitative emissions targets (Table 1, middle

[11] See Garcia Verdu and others (2015). However, these findings may not be directly applicable to estimating long-term economic impacts of climate change as they do not account for adaptation, macroeconomic adjustments, or intensified impacts of climate change relative to small weather changes (for example, Dell, Jones, and Olken 2014).

[12] A recent study by Burke, Hsiang, and Miguel (2015) suggests that the unmitigated impact of climate change on world GDP per capita could be significantly larger—roughly 5–10 times—than current estimates (that is, 20 percent lower by 2100). The estimates include quite wide uncertainty bands, and project significant negative effects for many economies, both advanced and developing.

column). Although quantity-based instruments to meet these targets with confidence have natural appeal, the desirability of predictable emissions prices is also widely accepted (see below). This is one attraction of meeting INDCs through explicit carbon pricing, with prices set to meet annual emissions targets on average (though actual emissions will exceed or fall short of the target in any given year). Potential revenues from carbon pricing have obvious appeal on fiscal grounds.

Table 1. Submitted INDCs, Largest Emitting Countries/Regions

Country	Main mitigation pledge	Share of global emissions, 2012[a]
China	CO_2 peaking around 2030, lower CO_2 intensity of GDP 60-65%.	25.9
US	Reduce GHGs to 26-28% below 2005 levels by 2025.	16.0
EU	Reduce GHGs 40% below 1990 levels by 2030.	11.9
India	Reduce GHG intensity of GDP 33-35% below 2005 level by 2030.	6.2
Russia	Reduce GHGs 25-30% below 1990 levels by 2030.	5.2
Japan	Reduce GHGs 25% below 2005 levels by 2030.	3.9
Korea	Reduce GHGs 37% below BAU in 2030.	1.9
Canada	Reduce GHGs 30% below 2005 levels by 2030.	1.7
Brazil	Reduce GHGs 37% below 2005 levels by 2025.	1.4
Mexico	Reduce GHGs 25% below BAU in 2030.	1.4
Indonesia	Reduce GHGs 29% below BAU in 2030.	1.4
Australia	Reduce GHGs 26-28% below 2005 levels by 2030	1.2

Source. UNFCCC (2015), EIA (2015).
Note. [a]Refers to energy-related CO_2.

A. Choice of Mitigation Instruments: The Rationale for Fiscal Policies

16. Strategies for reducing emissions will reflect countries' differing initial positions and political constraints and circumstances; however, fiscal policies—carbon taxes or emissions trading systems (ETS)[13] with allowance auctions—have two key advantages over regulatory approaches:

- *They are environmentally effective.* Pricing carbon increases prices for fossil fuels, electricity, etc., which promotes—with one instrument—and strikes the efficient balance across, the entire range of mitigation opportunities. These include: replacing coal with (less carbon-intensive) natural gas in power generation, and shifting from these fuels to (zero-carbon) renewables and nuclear power; reducing the demand for electricity, transportation fuels, and heating fuels through higher energy efficiency and less use of energy-consuming products; and so on.

[13] Under these systems, covered sources are required to hold allowances for each ton of emissions; the government caps the quantity of allowances and market trading establishes the emissions price.

- *They can raise significant revenues,* creating space to reduce other taxes that create significant economic distortions.

Regulations (for example, emission rate, energy efficiency, and renewables standards):

- *are less effective,* as they focus on a narrower range of mitigation opportunities.[14] A combination of regulations is more effective, though not all opportunities can be exploited (for example, reductions in vehicle or air conditioner use), multiple programs are administratively complex, and implicit CO_2 prices typically vary considerably across sectors (an unintended distortion which means that the market is not left to achieve mitigation in the most efficient ways).

- *do not raise revenue.*

17. In principle, the choice between carbon taxes and ETSs is less important than doing either and getting the design basics right. Most important is to:

- *cover emissions comprehensively*

- *establish stable prices in line with environmental objectives*

- *exploit fiscal opportunities.*

ETSs can be as efficient as carbon taxes but so far:

- *have lacked full coverage,* as they have focused on large industrial sources, omitting small-scale sources, for example, from vehicles and buildings

- *require accompanying price stability provisions,* such as price floors and ceilings, to provide the certainty over emissions prices needed to encourage low-emission investments[15]

- *require auctioning of allowances* (instead of giving them away for free) so the resulting revenue can be used for broader fiscal reform.

18. The case for carbon taxes over other instruments can be particularly strong in developing economies. These countries may lack capacity to enforce regulations and trading,

[14] See the extensive modelling results for the United States summarized in Krupnick and others (2010), Figure 10.2, where a wide range of commonly used regulatory policies for the power sector, transport sector, and buildings by themselves have effectiveness of only about 1–25 percent of that from a broad-based carbon pricing policy.

[15] Controlling emissions, with variable prices, can be appropriate when there are thresholds in emissions levels beyond which environmental damages rise rapidly (for example, Weitzman 1974). However, this is not applicable to global warming where one year's emissions in one country adds very little to the global atmospheric stock of emissions, which has accumulated over decades and centuries.

potential markets may be thin,[16] and energy taxes may be a relatively effective way of raising revenue from hard-to-tax enterprises.

19. Carbon pricing provides opportunities for reforming energy and environmental policies at the national and sub-national level. With carbon efficiently priced, other policies rationalized in part on climate grounds might be scaled back, such as energy efficiency standards for appliances, buildings, and vehicles, and subsidies for renewables and electric or bio-fuel vehicles. National-level pricing may also preempt a proliferation of uncoordinated, sub-national initiatives.

20. Where regulations are utilized, they should conform to the same design principles as carbon taxes. Regulatory approaches are inferior to carbon pricing, but can be more politically acceptable. In such circumstances, regulations would ideally:

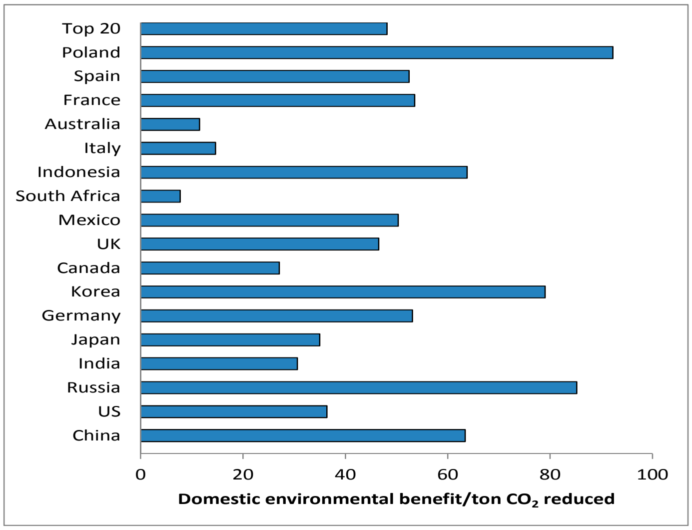
- *promote a broad range of mitigation opportunities*—for example, an emissions standard for power generation promotes all fuel switching possibilities, not just switching to renewables (for example, Krupnick and others 2010)
- *include price stability provisions*—for example, energy efficiency or emission rate standards can be converted into "feebates" which impose explicit fees, or provide rebates, if firms or products fall short, or exceed, the standard
- *align implicit prices across programs and sectors and with environmental objectives.*

21. Even leaving aside climate considerations, domestic environmental "co-benefits" warrant substantial carbon pricing. These benefits include fewer premature deaths from local air pollution as carbon pricing reduces coal, diesel, and other polluting fuels and (less importantly) reduce vehicle externalities (congestion, accidents, etc., to the extent they are not already charged through fuel taxes) as higher fuel prices cut vehicle use. Co-benefits alone would have warranted estimated CO_2 prices of $57 per ton in 2010, averaged across the top 20 emitters (Figure 5), which would have reduced their collective emissions by about 14 percent. This suggests countries will gain by implementing their INDCs irrespective of what others do (up to a point): even in terms of national self-interest there may well be no need to wait for others to mitigate. Co-benefits do, however, vary substantially across countries with, for example, air pollution emission rates and local population exposure.[17]

[16] See for instance South Africa National Treasury (2013).

[17] Domestic environmental problems are in principle more efficiently addressed through other policies including local air pollution taxes and peak-period pricing of congested roads. However, it will likely take a long time for these more efficient policies to be implemented comprehensively. In the meantime, it is appropriate to account for underpriced domestic environmental co-benefits when evaluating (nearer term) climate policies.

Figure 5. Domestic Environmental Benefits from Carbon Pricing, 2010



Source. Parry, Veung, and Heine (2014).

B. Design Principles—A Closer Look

(i) Administration

22. **A comprehensive carbon tax is straightforward to administer, simply requiring charges on fuel use in proportion to their CO_2 emissions rate.** Charges could be administered on domestic fuel supply at the extraction stage (for example, mine mouth or wellhead), or after processing (for example, at coal "washing" plants, the refinery gate, or fuel distributors). These charges would build on existing fuel taxes, which are well established in most countries and among the easiest of all taxes to administer.[18]

23. **Carbon taxes or ETSs implemented downstream on large industrial sources are less comprehensive and more administratively complex.** The EU ETS, for example, excludes about 50 percent of EU-wide CO_2 emissions. New administrative expertise is also required to monitor (actual or estimated) smokestack emissions and the larger number of installations.[19]

24. **Pricing non-CO_2 GHGs is more complex and will likely need to be introduced gradually.** Sources include methane (from natural gas systems, landfills, livestock, coal mining),

[18] See, for example, Calder (2015) on the practicalities of carbon tax administration. There are some complications (for example, payments would be needed for industrial sources with carbon capture and storage technologies) but these should be manageable.

[19] In both the United States or European Union, more than 10,000 entities need to be monitored in downstream systems, compared with about 1,500–3,000 entities in upstream systems (for example, Calder 2015), though even the former is modest compared, for example, with the number of firms and households paying income taxes.

nitrous oxide (from agricultural practices, industry, cars), and hydrofluorocarbons/fluorinated gases (from refrigerants, air conditioners) accounting for 16, 6, and 2 percent, respectively, of current global GHGs (IPCC 2014, p. 7). Some of these sources are practical to tax on a CO_2 equivalent basis as administrative capacity is developed,[20] though others (especially agricultural sources) might be better incorporated through offset credits,[21] where the onus falls on individual entities seeking credits to demonstrate valid reductions relative to some baseline.

25. Forest carbon sequestration might be promoted through annual subsidies/taxes for increases/decreases in stored carbon relative to a baseline (at least where property rights are well-defined). This avoids potentially large budgetary costs from paying for the entire carbon stored in forests, and the problem of gauging, on a project-by-project basis, whether changes in carbon storage would have occurred anyway without the program. Measuring stored carbon is tricky, though carbon inventories for some countries have been established using a combination of satellite and aerial photography and on-the-ground sampling of tree species.[22]

(ii) Carbon Price Level

26. Stable emissions prices are needed to contain volatility in mitigation costs and (more importantly) promote clean technology investments. Price volatility undermines the cost-effectiveness of carbon pricing because—for a given cumulative emissions reduction—it creates large differences in incremental abatement costs at different points in time.[23] And uncertainty over long-range emissions prices may deter research into, and deployment of, emissions-saving technologies, many of which (such as renewable plants) have high upfront costs and emissions reductions persisting for decades. Market-determined prices for emissions allowances have so far been quite volatile in the EU emissions trading system (EU ETS) (Figure 6), which has lacked explicit price stability mechanisms.

27. Prices can be set so as to achieve the mitigation goals in INDCs. First-pass estimates of emissions prices consistent with INDCs might be inferred using fuel use projections, carbon emissions factors, estimates of changes in future fuel prices from carbon pricing, and fuel price elasticity assumptions. If available, computational models of a country's energy system, capturing sector-specific adoption of emissions-saving technologies, can provide more sophisticated

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[20] See Calder (2015). According to US EPA (2014), a ton of methane and a ton of nitrous oxide are equivalent to 21 and 310 tons, respectively, of CO_2 in global warming equivalents over a century.

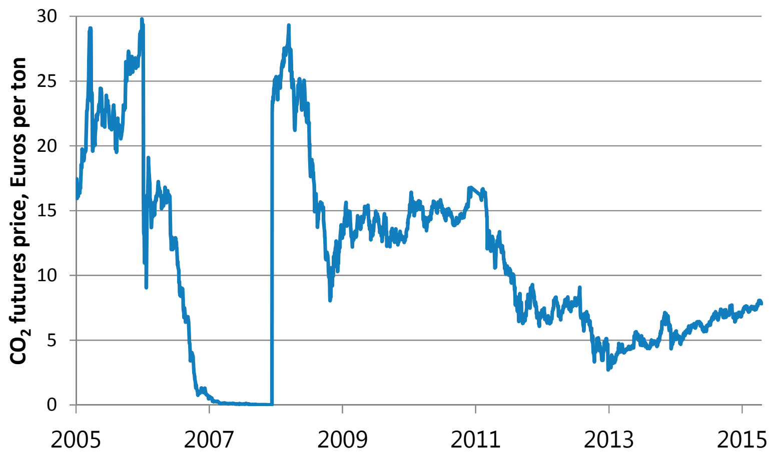
[21] Offset credits allow firms covered under a pricing regime to reduce their tax or permit obligations by funding emission reduction projects in sectors or countries outside of the pricing regime.

[22] See Mendelsohn, Sedjo, and Sohngen (2012) for further discussion of the practicalities of pricing forest carbon.

[23] For example Fell, MacKenzie, and Pizer (2012) estimate that expected price volatility under an ETS for the United States would increase costs by around 15–20 percent compared with a policy where prices rise annually at the rate of interest.

estimates.[24] Once in place, emissions prices can be periodically revised if emissions targets are systematically under- or over-shot, or adjusted as needed in response to evolving climate science.

Figure 6. Price Experience in the EU ETS



Source. Bloomberg (2015), EU ETS futures series "MO1 Comdty".

28. INDCs might include minimum price targets. These could complement emissions targets by establishing a minimum carbon price. This price might be based on the discounted global damage from future climate change caused by an extra ton of CO_2 which, for example, U.S. IAWG (2013) puts at about \$60 in 2030 (in \$2015).[25] Or prices could be aligned with climate stabilization goals: for example, models suggest global emissions prices of \$60 in 2030 would be roughly consistent with containing long run warming to 2.5°C.[26] Under either approach, emissions prices should rise at several percent a year.[27]

29. Countries need not impose the same emissions price. Some countries may set higher emissions prices because of domestic environmental co-benefits, fiscal needs, or greater political

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[24] For example, IEA (2014) has these models for large countries and regions. A rough rule of thumb for the United States from its Department of Energy's National Energy Modelling System is that cutting emissions by 10 percent requires prices in the order of \$30 per ton (Krupnick and others 2010). This suggests, speaking very loosely, the INDCs in Table 1 might require emissions prices above \$50 per ton.

[25] Though with range \$20–\$170 under different damage scenarios and discount rates (see, for example, Weitzman 2011, Stern 2007, and Nordhaus 2013 for different perspectives on this). To the extent that "last resort" technologies (such as solar radiation management or direct removal of CO_2 from the atmosphere) become feasible, there might be less need to fully reflect catastrophic risks in carbon prices (Aldy and others 2010).

[26] Nordhaus (2013) p. 228.

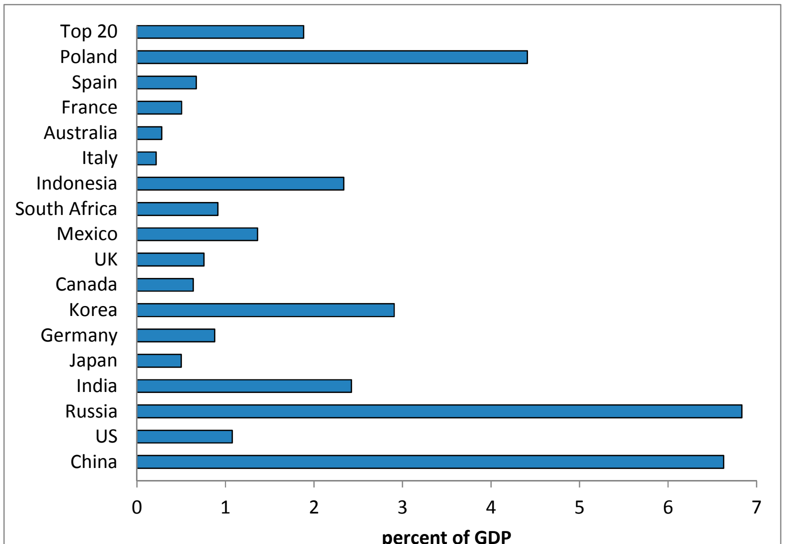
[27] Expectations of future CO_2 pricing could perversely hasten incentives for exploiting fossil fuel reserves in the near term (for example, Sinn 2012) underscoring the urgency of establishing pricing mechanisms.

support for pricing. Equity concerns may also favor low or zero emissions prices for low-income countries contributing negligibly to global emissions (Gillingham and Keen 2012), including sub-Saharan countries where electricity prices are already high, though ideally it is better to remove price distortions and help the poor through targeted measures.

(iii) Revenue Use

30. Carbon pricing can raise significant revenue. Pricing to reflect domestic environmental co-benefits alone would, averaged across the top 20 emitters, have raised revenues of almost 2 percent of GDP in 2010, and more than 5 percent in China (Figure 7).

Figure 7. Revenue from CO_2 Pricing for Domestic Environmental Benefits, 2010



Source. Parry, Veung, and Heine (2014).

31. Productive use of this revenue critical for containing the overall costs of carbon pricing for the economy. Revenues could be used for lowering taxes on labor and capital that distort economic incentives, producing a counteracting economic benefit to the costs of higher energy prices (see Figure 9 for illustrative calculations of this benefit for a typical large emitter).[28]

[28] Carbon pricing itself causes economic costs by inducing households and firms to consume less energy than they otherwise would and to pay more for cleaner (but more costly) energy. In addition, higher energy costs tend to contract overall economic activity, leading to a slight reduction in aggregate employment and investment. This produces significant additional economic costs by exacerbating distortions in factor markets created by taxes on labor and capital income. However, these harmful effects on the broader economy can be ameliorated by using carbon pricing revenues to cut taxes on labor and capital. See for example Bovenberg and Goulder (1996), Parry and Bento (2000).

The economic costs of carbon tax shifts (ignoring environmental benefits) might even be negative for modest emissions reductions if revenues cut an especially distorting tax.[29] Revenues could be used for new spending or reducing debt, though the social benefits should be comparable to those from cutting harmful taxes.

32. If revenues are not used efficiently the overall cost of carbon pricing for the economy is substantially higher. For a typical large emitter, cutting CO_2 emissions by 25 percent might cost about 1 percent of GDP when revenues finance transfer payments (that do not improve economic incentives), or under an ETS with free allowance allocation, compared with around 0.2 percent of GDP with revenues financing reductions in distortionary taxes (Figure 8). Earmarking of carbon tax revenues for environmental purposes (for example, clean technology programs, adaptation projects) also raises the cost of carbon pricing, unless this spending generates significant economic efficiency benefits. Efficient revenue use also limits any harmful effects on economic growth.[30]

(iv) Accompanying Measures

33. Measures to accompany carbon pricing may be needed to address technology barriers and burdens on vulnerable households and firms.

Technology Policies

34. Establishing a predictable CO_2 price is the single most important policy for providing across-the-board incentives for investments in emissions-saving technologies.[31] Further incentives for technology development and deployment may be needed, however, due to various market barriers.[32] The severity of these barriers varies across technologies; therefore, targeted

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[29] Early literature (for example, Bovenberg and Goulder 1996) suggested that swapping a carbon tax for a tax that distorts only labor markets has a positive economic cost (leaving aside environmental benefits). However, in reality labor income taxes cause a much broader range of distortions (for example, they also promote informal markets, excessive compensation in the form of untaxed fringe benefits, and excessive spending on tax-favored goods like housing). Accounting for the full range of distortions, the economic efficiency benefits from cutting broader taxes are larger, and the overall costs of carbon tax shifts smaller, than previously thought, and perhaps even negative over some range (for example, Parry and Bento 2000, Bento, Jacobsen, and Liu 2012).

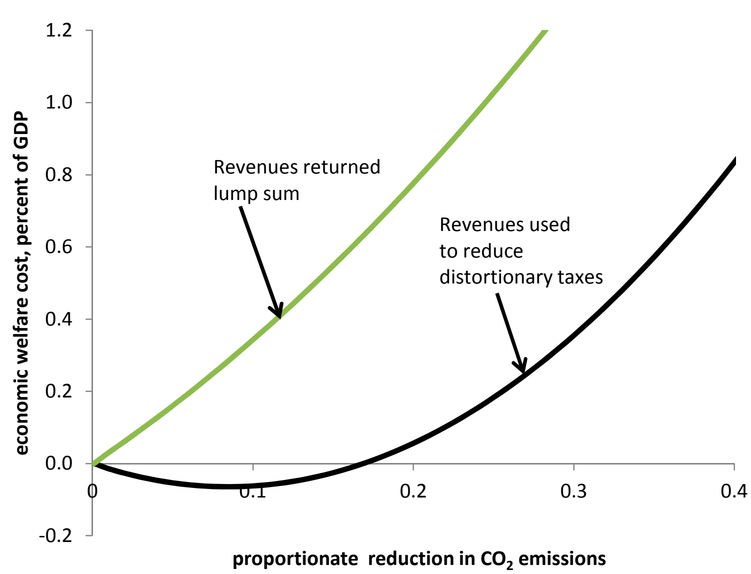
[30] See for example, Jorgenson and others (2013). Even prior to revenue use, Williams and Wichman (2015) suggest that carbon taxes are unlikely to reduce U.S. growth by more than 0.03 percent. For a broad discussion on the compatibility of growth and carbon mitigation see the Global Commission on the Economy and Climate (2014) report *New Climate Economy*.

[31] See, for example, Arezki and Obstfeld (2015).

[32] For example, firms may do too little R&D if it is difficult for them to capture spillover benefits to other firms from new technologies. And firms may be reluctant to pioneer use of a new technology because of economies of scale or if their learning about how to efficiently use the technology benefits rivals that may adopt the technology later on. These obstacles may be especially severe for long-lived, clean-energy technologies with high upfront costs, especially given uncertainty over future governments' commitments to emissions pricing or infrastructure investment (for example, grid extensions to renewable generation sites). It is sometimes suggested that the private sector also undervalues energy efficiency, though the evidence on this is mixed (for example, Allcott and Wozny 2013, Helfand and Wolverton 2011).

measures will be needed to supplement carbon pricing that encourage all technologies regardless of spillover benefits.

Figure 8. Estimated Cost of CO_2 Tax for a Representative Large Emitter, with and without Efficient Revenue Use



Source. Parry (2015).

Note. Costs can be moderately negative over some range when revenues are used to reduce an especially distorting tax.

35. **Technology policies need careful design.**[33] Tax credits for private R&D do little for innovative start-ups (with little taxable income) and do not differentiate between more and less socially valuable innovation. Intellectual property protection is better in the latter regard, as patent value depends on commercial viability, though patents cause tension between R&D incentives and diffusion—diffusion is greater when firms can "imitate around" patented technologies but this lowers returns to innovation. Technology prizes avoid this tension, but they require well-defined, measureable objectives that can be stated in advance.[34] Instruments targeted at deploying new technologies need to accommodate uncertainty over future technology costs, suggesting a

[33] For discussions see Newell (2015) and Dechezleprêtre and Popp (2014).

[34] For example, the U.S. Department of Energy has provided prizes for rooftop solar photovoltaic, energy-efficient lighting, and software to promote energy savings for utility consumers (Newell 2015). Incentives for demonstration projects (seeking to prove the viability of major new technologies at a commercial scale) are more contentious as they can absorb a large share of R&D budgets.

preference for adoption subsidies over regulations (the latter may force a new technology even if its costs are higher than expected) and incentives need to phase out as technologies mature.[35]

36. Under-investment in low-emission technologies may be especially severe in LICs with capital shortages. This is the basic reason for donor contributions supporting other investments (for example, infrastructure projects), and partly rationalizes the mobilization of climate finance.

Addressing Burdens on Vulnerable Households

37. Energy price burdens on low income households have been a major obstacle to carbon pricing—but can be largely overcome. Carbon pricing is mostly passed forward in higher consumer prices for energy, but the impacts may be less regressive than commonly supposed—for EU countries, carbon tax incidence can be moderately regressive, to proportional, to moderately progressive, when energy price burdens are compared with household consumption (Figure 9).[36] Distributional concerns warrant targeted relief rather than undercharging for carbon damages—the latter is highly inefficient as typically about 90 percent or more of benefits leak away to higher income groups (for example, Clements and others 2013, Figure 3.12). The focus should be on the distributional impact of the whole policy package not just the component that raises energy prices.

38. Compensating low-income households may require only a fraction of carbon pricing revenues[37] and should be practical for advanced economies through adjustments to existing tax and benefit systems. However, there are trade-offs in targeting, economic efficiency, and administration. For example, payroll tax rebates and earned income tax credits disproportionately benefit low-income households while also promoting labor force participation, but they do not reach the non-working poor. Transfer payments can reach the latter but do not provide extra incentives for work effort and may increase administrative burdens.

39. Factoring environmental impacts into energy prices makes sense for low-income countries, despite 'fuel poverty'. Efficient allocation of a country's resources implies that energy prices should cover supply and environmental costs. And energy taxes may be less regressive in countries where the poor lack vehicles and power grid access. Where low-income households are not formally registered as taxpayers or benefit recipients, they might be compensated by spending

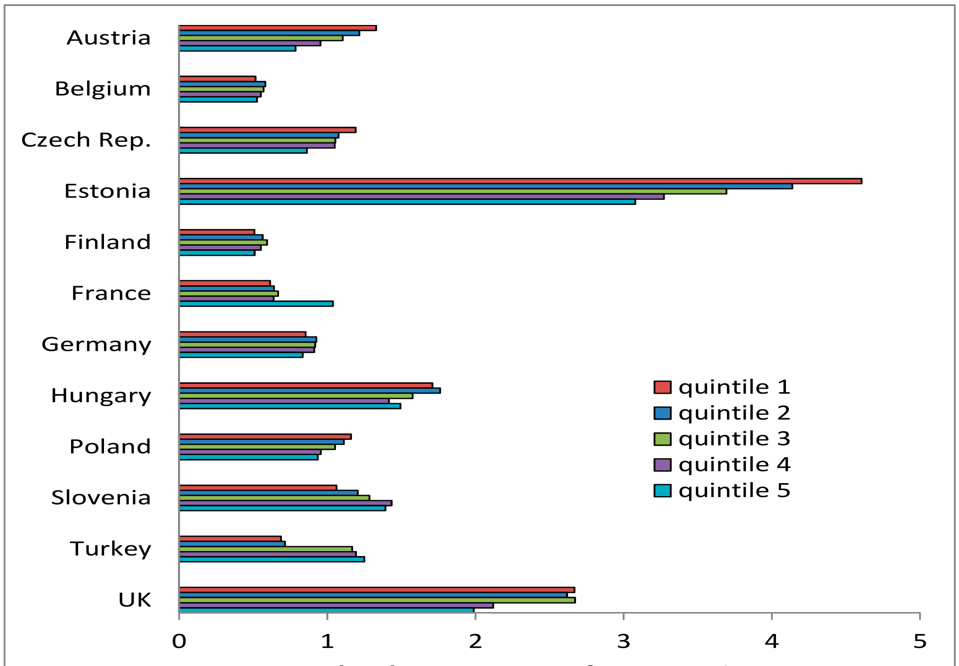
[35] Subsidies for renewables deployment totaled $121 billion worldwide in 2013 (IEA 2014), although nearly 70 percent of renewable electricity subsidies were provided by just five countries: Germany ($22 billion), United States ($15 billion), Italy ($14 billion), Spain ($8 billion), and China ($7 billion). Often these subsidies take the form of feed-in-tariffs, which provide guaranteed prices for renewables—in contrast, fixed subsidies per unit of renewable generation are more flexible as they allow prices to vary with changing economic conditions (Löschel and Schenker 2014). Subsidies for fossil fuel energy (including undercharging for climate and other environmental costs) are much larger and estimated at $5.3 trillion in 2015 or 6.5 percent of global GDP (Coady et al. 2015).

[36] Although the poor tend to allocate a greater share of their consumption to electricity than wealthier households, this is less true for transportation and heating fuels, as well as other consumer products whose prices increase indirectly as a result of higher energy costs.

[37] About 10 percent for the United States (for example, Dinan 2015).

on education, health, housing, job programs, clean fuel alternatives, and so on, though this can involve greater leakage of benefits to the non-poor.[38]

Figure 9. CO_2 Price Impact by Income Quintile Prior to Revenue Use, Selected Countries, 2012



Source. Parry (2015).

Note: Quintile 1 refers to the bottom income quintile, and quintile 5 to the top.

Addressing Burdens on Vulnerable Firms

40. The impact of carbon charges on energy prices causes "emissions leakage"—partially offsetting increases in other country emissions[39]—and harms the competitiveness of energy-intensive, trade-exposed firms. Leakage rates are not that substantial however, typically about 5–20 percent of the first-round emissions reduction from carbon pricing if a sizeable coalition of countries price carbon (Fischer, Morgenstern, and Richardson 2015, pp. 163), and the problem is confined to a limited number of industries (for example, chemicals, plastics, primary metals, petroleum refining).[40] Efficient resource allocation generally implies that industries unable to

[38] One caveat is that higher electricity prices from charging for polluting generation fuels may encourage household burning of (unpriced) biomass, with higher environmental costs. A possible interim response is to use feebates that can promote use of cleaner generation fuels but with limited effects on electricity prices.

[39] Leakage results from migration of firms away from countries with mitigation policies to countries without these policies, as well as increasing fuel use in those countries as mitigation elsewhere puts downward pressure on international fuel prices.

[40] For the United States, industries with energy expenditures in excess of 5 percent of the value of their output account for less than 2 percent of GDP (Fischer and others 2015). However, the carbon intensity of industries in

compete when energy is properly priced should ultimately cease operation (with programs to ease transitions), though policy adjustment should be gradual. Using carbon pricing revenues for labor and capital tax reductions provides offsetting improvements in general competitiveness.

41. Border tax adjustments (BTAs) could reduce leakage concerns, and encourage participation in carbon pricing schemes—but raise serious legal and practical concerns. BTAs would levy (or remit) charges on imports and exports to ensure a level playing field given carbon prices levied elsewhere. This can in principle have beneficial efficiency effects,[41] but there are challenging practical issues (in measuring embodied carbon), uncertainties (on compatibility with World Trade Organization obligations) and risks of abuse. In the absence of strong evidence that the benefits would be significant, the case for carbon BTAs will be weak[42]—and is lessened by the generality of commitments to implement INDCs.

C. Experience to Date

42. Increasingly, policymakers are relying on pricing instruments to reduce emissions. As of mid-2015, about 40 national governments and more than 20 sub-national governments have implemented, or are implementing, some form of carbon pricing (WBG 2014 2015). Most of these schemes are ETSs, for example, in the EU scheme covering 31 countries, Korea (introduced in 2015), California, and some provinces in China. But 15 national and sub-national governments now have explicit carbon taxes (Table 2); recent examples include Chile, France, Mexico, and the United Kingdom.

43. But these programs just scratch the surface. Only 12 percent of global GHGs are currently priced, reflecting the lack of national schemes in many large emitters, and limited sectoral coverage of existing schemes.[43] And current prices—often below \$10 per ton of CO_2—are below those consistent with environmental objectives. Besides price volatility, and in contrast to carbon taxes (which are often explicitly paired with reductions in broader taxes), ETSs have generally not formed part of a broader fiscal reform.[44] British Columbia's carbon tax (CAN \$30/ton and covering all fossil fuels) is viewed as a poster child, though political economy factors were favorable.[45]

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developing economies tends to be about 2–3 times as high on average (Böhringer, Carbone, and Rutherford 2013, Figure 2).

[41] Keen and Kotsogiannis (2014).

[42] Burniaux, Chateau, and Duval (2013).

[43] Coverage will roughly double, however, when China introduces pricing on industrial sources in 2017.

[44] One exception was the—now defunct—ETS in Australia (introduced in 2012 but repealed in 2014). The majority of allowances were auctioned, raising revenues of approximately 1 percent of GDP, about half of which were used for progressive personal income tax reductions.

[45] For example, British Columbia has no reliance on coal.

D. International Coordination of Fiscal Policy

44. International cooperation, which would enhance mitigation efforts, is challenging because of "free riding"—the reluctance of any country to mitigate unilaterally, since it bears the costs, while the climate benefits accrue to all countries. The 1997 Kyoto Protocol, which set emission reduction targets for individual countries in 2008–12 relative to 1990 levels, was largely ineffective. Key problems included lack of coverage (developing countries were not included and the United States did not ratify), the differing burdens of mitigation (depending partly on a country's emissions growth from 1990 to 2008), and the lack of enforcement (there were no penalties for non-compliant countries). The first problem at least has been addressed, as advanced and developing economies alike submitted INDCs for the Paris Agreement.

Table 2. Carbon Taxes Around the World

Government	Year adopted	Tax rate in 2015, US$/ton CO2	Coverage rate, % of GHGs
Br. Columbia	2008	25	70
Chile	2014	5	55
Denmark	1992	31	45
Finland	1990	40	15
France	2014	16	35
Iceland	2010	10	50
Ireland	2010	23	40
Japan	2012	2	70
Mexico	2014	1-4	40
Norway	1991	50	50
Portugal	2015	5	25
South Africa	2016	10	80
Sweden	1991	168	25
Switzerland	2008	62	30
UK	2013	16	25

Source. WBG (2014, 2015).

45. Underpricing from an international perspective is familiar from situations where countries compete for mobile tax bases, in which context some progress has been made through tax floor agreements. The climate analog would be a coordinated CO_2 price floor among a coalition of willing countries, which could be pursued alongside the INDC process and would represent a natural extension of existing fuel tax policy. This arrangement would provide some degree of protection against competiveness concerns and cross-border fuel smuggling. Individual countries could set prices exceeding the floor, which they may wish to do for domestic environmental or fiscal reasons, or because carbon pricing is more politically acceptable than elsewhere. Previous experience (for example, with EU value added taxes and excises for alcohol, tobacco, and energy products) suggests it is easier to agree over tax floors than tax rates—and a single minima itself should be easier to negotiate than numerous country-level emissions targets.[46]

46. Monitoring carbon price floor arrangements should be feasible. Taxes or subsidies for road fuels, electricity consumption, natural gas, and so on, are pervasive and a price agreement should account for future adjustments in these provisions, as they offset or enhance the emissions impact of formal carbon pricing. Allowance could also be made for country-specific special needs (for example, influential lobby groups may prevent higher energy prices for particular sectors). But conventions can be agreed for measuring, and accounting for, fiscal provisions, exemptions, etc.

47. International coordination could occur through linked ETSs. A difficulty, however, is that countries then lose control over their domestic emissions prices, as these depend on energy and policy developments (for example, cap adjustments) in all countries within the emissions trading bloc. Countries can retain control over their emissions price through price floors (as in the United Kingdom), but if one cap applies to the trading bloc these floors (or other domestic mitigation efforts) have no impact on aggregate emissions.

48. Enforcement remains a key concern in ensuring an effective international agreement, though for now countries acting in their own self-interest can make significant progress. Mitigation costs need not be large if recycling of carbon pricing revenues is done well, and, accounting for domestic environmental benefits, many countries are better off, on net, from carbon pricing. The priority is to start the process—implement carbon pricing domestically and work out coordination practicalities later as a coalition of the willing emerges.

IV. CLIMATE FINANCE

49. The climate finance issue is that of meeting the advanced economies' pledge to mobilize—from public and private sources—$100 billion a year by 2020 for mitigation and adaptation in developing economies. There are concerns on the spending side about the balance between mitigation and adaptation (currently most is on the former), allocating funding across countries and projects accounting for efficiency and equity, and avoiding paying for projects that would have gone ahead without funding. The most pressing challenge, however, is achieving the $100 billion goal.

50. Climate finance in 2014 has been estimated at $62 billion (Table 3). About a third of this was from multilateral sources and this funding is likely to increase in future as multilateral

[46] See for example Weitzman (2014).

development banks strengthen their climate action plans. Bilateral contributions were slightly larger, and the rest was largely made up of private flows co-financing bilateral and multilateral sources (private flows in particular are difficult to measure).

51. The Green Climate Fund (GCF) was established in 2013 to help manage public contributions. The GCF raised $10 billion in pledges from 35 countries in 2014,[47] though it will take time achieve more substantial funding levels.

Table 3. Climate Finance

Targets and (Actual and Potential) Sources of Climate Finance		
Goals for 2020	Mobilize from advanced economies $100 billion per year for climate mitigation and adaptation in developing countries by 2020.	
Actual flows in 2014	$23.1 bn	Bilateral (e.g., Overseas Development Assistance).
	$20.4 bn	Multilateral (mostly Multilateral Development Banks).
	$16.7 bn	Private finance (leveraged from public sources).
	$1.6 bn	Export credits (mainly for renewable energy).
	$61.8 bn	Total flows.
Potential extra revenues	$25 bn	$30/ton CO_2 charge, advanced economy domestic fuels (7% apportioned).
	$25 bn	$30/ton CO_2 charge, international aviation/maritime fuels.[a]

Source. OECD (2015), authors' calculations updating Keen and others (2013).
Note. [a] Includes revenues from advanced economies only.

52. The use of carbon pricing in developing countries would catalyze, and efficiently allocate, private sector climate finance. Carbon pricing promotes across-the-board incentives for clean energy projects (renewables, energy efficiency, etc.) and the efficient ordering of these projects. Under top-down finance, on the other hand, there is no automatic mechanism for ensuring that the most cost-effective projects are selected first and high transactions costs prevent funding for numerous small-scale opportunities (for example, people switching to energy efficient vehicles, appliances, or lighting).

53. Additional climate finance from donor countries need not come from innovative sources. To date, bilateral contributions have typically come from general government budgets. There may be some natural appeal in using carbon pricing as a direct source of climate finance. A charge of $30 per ton of CO_2 in advanced economies would have raised about $25 billion for climate finance in 2014 with 7 percent of revenues apportioned. Indirectly, carbon pricing in

[47] Statement by Héla Cheikhrouhou, Executive Director of the GCF, Financing for Development Conference, Addis Ababa, July 2015.

advanced economies leverages private flows to developing economies through offset markets (but there are problems—see below).

54. Charges on international aviation and maritime emissions (about 4 percent of global CO_2 emissions, but rising rapidly) are promising. National governments have a weaker claim on these tax bases than they do for domestic fuels, making them appealing as a possible source of climate finance. There are challenges, including the need for international coordination (especially important for maritime, given the mobility of the tax base) and legal issues (especially for aviation, due to treaties and bilateral air service agreements limiting fuel taxes) but the practicalities should be manageable. A global $30 per ton CO_2 charge on these fuels could have raised about $25 billion for climate finance in 2014, even after compensation for developing countries (see Table 3).[48]

55. Carbon offset markets remain depressed. Offset markets through the Clean Development Mechanism resulted in a cumulative $28 billion of flows to developing countries up to 2012 (WBG 2014, pp. 44–45). However, transaction value in the primary offset market fell sharply in 2009 and has stayed low since then, amid uncertainties about the scale and stringency of carbon pricing in advanced economies and concerns over the validity of offsets. Depending on the level of ambition, offset market flows could range from $5–40 billion per year in 2020 (World Bank 2011). Given that offset flows so far have largely gone to a relatively small set of middle income countries, broadening access among developing countries is a priority.

V. ADAPTATION

56. Adaptation policies complement mitigation and are largely in countries' own interests, but design specifics are highly dependent on national circumstances. Adaptation refers to deliberate adjustments in ecological, social, and economic systems to moderate adverse impacts of climate change and harness any beneficial opportunities (Agrawala and others 2011). Adaptation includes "hard" policy measures (for example dyke construction, changing crop varieties, adapting infrastructure) and "soft" measures (for example early warning systems, building codes, insurance). These measures might reduce the urgency of mitigation—but only moderately (for example, there are limits to how far one can protect against extreme climate outcomes). The benefits of adaptation are largely domestic, though there are potential cases of cross-border spillovers.[49] Preventive actions are typically more cost effective, and more common, than reactive actions, but are hindered by uncertainties and, for developing economies, funding constraints.[50] Economic aspects of adaptation

[48] The International Civil Aviation Organization (ICAO) Assembly agreed in October 2013 to implement, by 2020, a market-based mechanism to stabilize industry CO_2 emissions, but envisaged that any revenues would be retained by the industry.

[49] For example, diversion of water systems to counteract drier climates, and efforts to stem climate-induced population migration may have spillover effects on neighboring countries.

[50] Bosello,, Carrano, and De Cian (2010) estimate that about 88 percent of adaptation measures in OECD countries are preventative, compared with 43 percent in non-OECD countries.

policy have received much less attention from analysts than has mitigation, reflecting their strong dependency on country-specific circumstances and uncertainty over local climate impacts.

57. In developing countries, adaptation and development strategies are closely interlinked. Many aspects of development (for example, better education, healthcare, and infrastructure) facilitate adaptation, while some adaptation strategies (for example, efficient water use, climate-resilient housing, robust crops) facilitate development even without climate change—these complementarities are likely to rise with increasing urbanization (Margulis and Narain 2010, Khan and others 2009). Maximizing synergies between adaptation and development requires close policy integration and evaluation of climate impacts.

58. Some adaptation will occur privately and governments should support, not discourage, these adjustments. For example, measures encouraging urban development away from vulnerable coastlines, or requirements for flood insurance, reduce exposure to sea level rises, while automatic compensation payments for the failure of traditional crops might discourage a shift towards varieties more suitable to a changing climate.

59. But governments have a key role, and external finance for developing countries is needed. Policy intervention can help overcome market failures (for example, where private agents are imperfectly informed about adaptation benefits, or where measures, like soil retention, by one actor benefit others) and promote private sector adaptation (for example, through information provision, regulations, and institution-building). Governments also provide public goods and services, including resilient infrastructure (for example, paving roads in response to more intense precipitation),[51] and are better positioned to internalize long-term consequences of investment projects.

60. Public adaptation costs are potentially significant, and more so for LICs. Assessments of adaptation costs aggregated across developing countries are conservatively estimated at $80–100 billion annually out to 2050 (Figure 10).[52] These costs average about 0.1–0.2 percent of GDP for most regions, but are substantially higher (0.6 percent) in sub-Saharan Africa and dramatically higher—more than 5 percent of GDP for some small Pacific islands (for example, Margulis and Narain 2010).

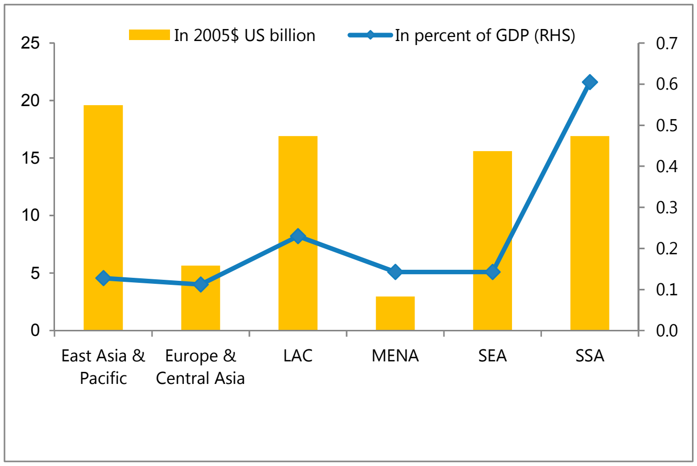
61. Infrastructure spending accounts for the largest share of adaptation costs. The main sectoral components of adaptation costs are related to infrastructure, coastal zones, water supply, agriculture, human health, and extreme weather events (Figure 11). While the share of these

[51] See for example Jones, Keen, and Strand (2013); Osberghaus and others (2010). National governments are beginning to promote local adaptation initiatives through sub-national grants (for example, the U.S. Environmental Protection Agency's Local Climate and Energy Program, Bhutan's LoCAL program). See World Bank (2014).

[52] Estimates in Figure 10 exclude, for example, adaptation costs related to ecosystem services, energy, manufacturing, retailing, and tourism. Adaptation costs for advanced economies are more modest, for example, equivalent to about $17 billion in Europe according to Osberghaus and Reif (2010).

components varies across regions,[53] infrastructure spending is the highest, and is expected to increase over time with urbanization (Margulis and Narain, 2010, Figure 10). East Asia and the Pacific and South Asia currently face the highest costs owing to their population size and density, while SSA is expected to see the largest increase over time (from $1.1 billion to $6.1 billion for 2040–50 under the "wettest scenario" for climate change).

Figure 10. Annual Adaptation Costs, 2010–50



Source. Margulis and Narain (2010).

62. Fiscal responses need to account for the uncertainties and wider fiscal risks from climate change. Government policies, programs, and projects need to be flexible—meaning they are warranted on cost-benefit grounds across a range of climate scenarios,[54] and that they can be adjusted as climate impacts materialize. Governments would benefit from developing frameworks to reflect the fiscal risks from climate change, account for climate change-related public expenditures, and for strategic resource allocation, efficiency of spending, institutional capacity and fiscal sustainability. Adaptation strategies should also ensure that public policy complements rather than substitutes for private sector actions in generating desired social outcomes.

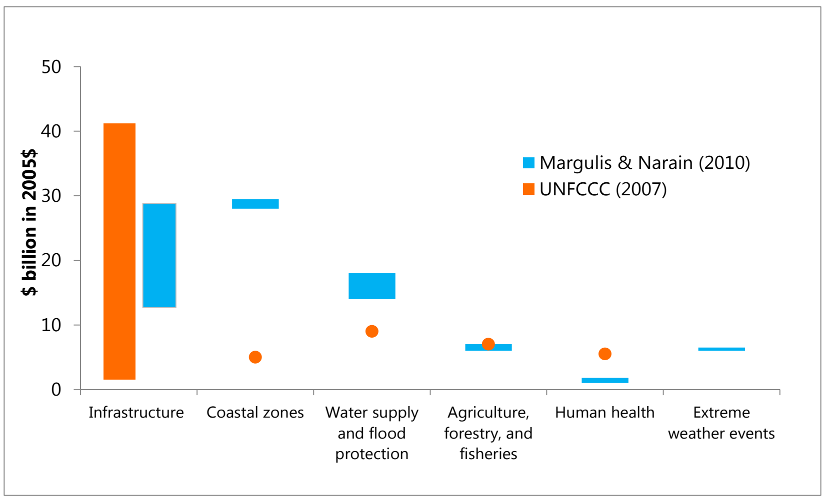
63. Many countries are beginning to develop integrated climate strategies and incorporate climate adaptation into medium-term budget frameworks. A number of countries (for example, Brazil, China, India, and Mexico), have developed climate change strategies setting broad directions for government policy (World Bank 2014). These strategies, however, often address climate change in isolation, without reconciling it with other objectives such as growth and poverty

[53] The highest costs for East Asia and the Pacific are in infrastructure and coastal zones; for SSA, water supply and food protection and agriculture; and for LAC, water supply and flood protection and costal zones (Margulis and Narain, 2010).

[54] For example, investments in hydroelectric plants may be worthwhile across a variety of wet and dry scenarios (Margulis and Narain, 2010).

reduction. In some cases, environmental, climate, and growth objectives are combined through "green growth" strategies to account for synergies (for example, National Strategy for Green Growth in Korea), although often they remain general and not integrated with the budget framework. Some countries that are highly vulnerable to climate change (for example, Bangladesh, Cambodia, Indonesia, Morocco, and Nepal) attempt to classify all climate-related expenditures in their budgets.[55] These initial steps provide important lessons (such as addressing difficulties in comparing programs across sectors, or accounting for off-budget climate expenditures). Further internalizing climate-related expenditures into fiscal frameworks can help in assessing fiscal sustainability, measuring adaptation gaps, and identifying the extent of additional financing needed to combat the negative impact of climate change.

Figure 11. Annual Adaptation Costs by Sector



Note: Rectangles indicate range estimates and dots point estimates.

64. Enhancing resilience to natural disasters and climate change requires a comprehensive, multi-pillar risk management framework. Key elements include: (1) identifying and assessing climate-related risks and integrating them into budget planning; (2) self insurance through fiscal and external buffers; (3) risk reduction through structural reforms and targeted investments in infrastructure; and; (4) risk transfer through disaster risk insurance, multilateral risk-sharing mechanisms (for example, the Caribbean Catastrophe Risk Insurance Facility) and precautionary instruments. Ex post disaster risk management entails resilient recovery through emergency

[55] SEEA System of Environmental Accounting provides a statistical framework for the classification and reporting of environmental activities, expenditures, and other transactions. Nepal's 2013/14 budget statement indicated that 10 percent of total government expenditures were climate related. The analysis allowed government to improve the allocation of resources. Tagging climate expenditure in Morocco helped to reveal considerable differences among sectors in accounting for climate-related spending and lack of appropriate performance indicators for climate change programs. See World Bank (2014).

response and reconstruction efforts (such as resettlement away from coastlines) that also reduce future risks.

VI. THE FINANCIAL SECTOR AND CLIMATE CHANGE

65. Climate change entails potential risks to macro-financial stability. This section outlines (1) the nature of these risks, (2) the role of the financial sector in reducing them, and (3) financial-sector policies facilitating those roles.[56]

A. Financial Sector Risks

66. Climate-related risks affecting financial stability are broadly categorized as physical and transition risks. Physical risks include those to insurance and reinsurance sectors from increased costs and frequency of climate-related natural disasters, on both the liability (increasing property and casualty claims) and asset (losses on investments in real estate or equity of firms affected by climate-change-related events) sides. These risks are relatively well recognized, though more quantification is needed. Transition risks are 'stranded assets', or potential financial losses from investments losing value (for example, coal reserves) as a result of climate mitigation, or shifting consumer and investor preferences to greener products and technologies.[57]

67. To minimize repercussions for financial stability, changing physical risks should be reflected in the financial sector's risk modeling. Increased physical risks could present major challenges to insurance business models, altering the balance between premiums and claims and leaving insurance companies exposed to uncovered losses. Adjusting premiums could also pose financial stability challenges through reduced ability of policyholders to get private insurance cover, which may contract mortgage lending and lower property values (Carney 2015).

68. Few investors are aware of the carbon footprint of companies in their portfolios, while companies holding potentially stranded assets may be overvalued. Many institutional investors' asset allocation decisions do not take into consideration the carbon content of eligible securities. The perceived long-term nature of stranded asset risks also makes investors hesitant to incorporate them in portfolio investment and risk management frameworks. A cycle of fire sales and asset price declines could affect even seemingly unrelated institutions and asset classes, exacerbating investors' concerns, and leading to sizeable market fluctuations and further asset portfolio losses. Modeling these systemic risks still has a long way to go.

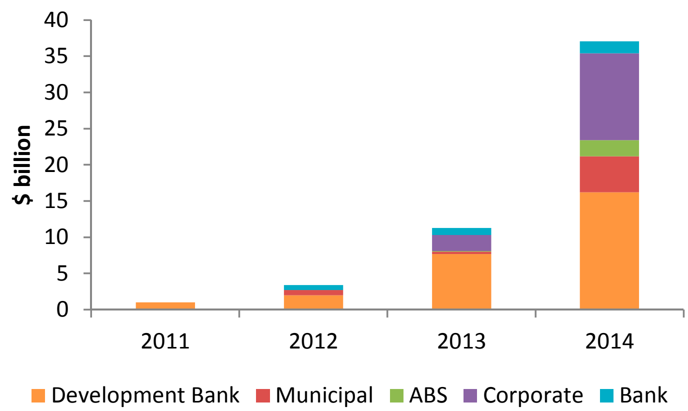
[56] For further discussion see UNEP (2014).

[57] The stranding of assets can also be a concern to countries richly endowed in fossil fuels.

B. Role of the Financial Sector

69. The green bond market, facilitating low-carbon investment, has expanded rapidly since its inception in 2007. Green bonds satisfy investors' demand for bonds that integrate environmental factors into their investment practices and help asset-management firms boost their public image with investors. Investors range from green-dedicated funds to asset managers, banks, corporations, pensions, and insurance and re-insurance companies. With the AAA investment-grade issuances from the European Investment Bank and the World Bank, total green bond issuance reached $37 billion in 2014 (Figure 12). A typical strict transparency requirement may increase financing costs, while a key challenge to a sustained development of the market is a lack of strict standards for green bonds.

Figure 12. Green Bond Market: Size and Compositions, 2011–14



Source. Olsen-Rong (2015).

70. Green stock indexes facilitate environmentally-minded investors' decisions, but their use by institutional investors has been relatively limited. The performance of some green indexes—which include green technology companies, along with investment vehicles that track these indices—has not been significantly different from that of major financial indexes (for example, S&P U.S. Carbon Efficient vs. S&P 500) in recent years. But their use may have been hindered by limited climate mitigation policies, investor expectations of delays in emissions reduction policies given sluggish global economic growth and slow political progress, and the sharp oil price decline that has shaken investors' confidence in profitability of green technology companies.

71. The private sector is decarbonizing its investment portfolios on a voluntary basis. A prominent initiative is the Portfolio Decarbonization Coalition, a group of long-term institutional investors seeking voluntary commitments to move institutional investments to low-carbon-exposure firms (commitments have exceeded $230 billion at end-2015). This shift will require information on carbon footprints, and how these might respond to future mitigation policies. Firms are increasingly requested to provide better carbon footprint disclosure,[58] though a key concern is the lack of consistent standards for measuring footprints and effective disclosure schemes.[59]

72. Investors also use other financial policies and instruments to lower carbon risk. These include restraining capital spending of high carbon footprint companies through dividend policies, or requiring them (as BP, Shell, and Statoil shareholders did in 2015) to publish stress tests of their current and future investment opportunities against climate policy scenarios.

73. Disaster-risk insurance and related weather hedging instruments transfer climate damage risks to those more willing to bear it. For example, catastrophe bonds were first issued (by insurers, reinsurers, corporations, and government agencies) in the mid-1990s, as the insurance industry looked for alternative methods to hedge catastrophe-related risks. Pension funds and other large institutional investors bought about four-fifths of issued catastrophe bonds in 2014—returns are generally higher than, and largely uncorrelated with, returns on other fixed income or equity investments. More than $40 billion of catastrophe bonds have been issued in the past decade, with new issuance in 2014 reaching $8.8 billion and an outstanding amount of about $25 billion.[60] Obstacles to wider private investor involvement in these and related instruments include their very long maturity, a risk-return profile that may not satisfy private investors' objectives and risk mandates, and difficulties in estimating potential losses given the newness of the markets.

C. Financial Sector Policies and Regulations

74. Financial sector regulators and central banks can help identify climate change risks for the financial sector. For example, the Financial Stability Board (which monitors and makes recommendations about the global financial system) is considering the implications of climate change for the financial sector and financial stability.[61] The Bank of England recently prepared a Climate Change Adaptation Report focused on the insurance sector, and the People's Bank of China has undertaken similar analysis. Financial sector regulation and supervision should support market development and protect financial stability, while ensuring affordable, sufficient and sustainable insurability. Proper implementation of the International Association of Insurance Supervisors (IAIS)

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[58] This requires, for example, assessing emissions from a company's electricity use, from direct fuel combustion, and from other sources (such as the transportation of inputs and finished products, and upstream emissions associated with extraction of raw materials it uses).

[59] There are some 400 different initiatives underway, underscoring the lack of consensus on standards for effective disclosure.

[60] Over the last two decades, several countries—for example, Caribbean and Pacific islands, Ethiopia, and Mexico—have used catastrophe bonds.

[61] It recently recommended establishment of an industry-led task force to develop consistent climate-related disclosures. Adequate disclosure is a prerequisite for the private and public sectors to understand and measure the potential effects of climate change on the financial sector. The proposal envisages that (1) firms regularly disclose information on the size of their carbon footprint and strategies to manage their transition to a lower-carbon business model, (2) higher-quality corporate information be available to help financial institutions better assess firms' climate risk management and transition plans, and (3) financial institutions be encouraged to disclose their carbon footprints and the management of their exposures to climate risks, including by running suitable stress tests.

Insurance Core Principles (including Valuation, Enterprise Risk Management for Solvency Purpose, and Capital Adequacy) will encourage insurers to take appropriate actions, such as proper pricing, and ensuring sufficient reserves and capital in a forward looking manner.

75. More work on stress-testing of climate-related risks for the financial sector is needed. While insurers conduct stress-tests of physical risks, climate change scenarios are not typically considered. Also, corporate and financial sector stress testing of transition risks is not common, and enhanced risk management tools are needed for evaluating stranded asset risks. Official and private sectors are considering issues such as how to incorporate climate change stress-testing in corporate and financial sector risk management practices and potential roles for supervisors and financial authorities in market-wide tests to assess systemic level risk.

76. Altering prudential regulations may not be the best way to address climate risks. There have been proposals to adapt capital risk weights, liquidity standards, and other prudential regulations to provide incentives for low-carbon investment. However, alterations to prudential rules seem far less suited as a tool to address climate-related externalities and would hamper their effectiveness at achieving their primary goal of maintaining the resilience of financial firms. The focus of financial regulation should remain on building resilience to shocks, with a systemic approach accounting for all material risks to the financial system, including from climate events, and ensure adequate capitalization, risk management, and disclosure.

VII. ROLE OF THE IMF[62]

77. On mitigation, the IMF is continuing its analytical agenda and stands ready to offer technical assistance. Besides providing practical guidance on the design of fiscal policy for climate mitigation and finance, the IMF has developed spreadsheet tools to quantify, for more than 150 countries, the efficient level of energy taxes to address climate and other environmental costs, and the carbon, fiscal, economic, and broader environmental benefits of price reform. Ongoing work is quantifying carbon pricing consistent with country-level mitigation pledges and the trade-offs across a broad range of fiscal and regulatory mitigation instruments. Working with other international organizations, the IMF promotes dialogue on these issues among policymakers.[63] The IMF regularly provides technical assistance to member countries on energy pricing reform, and carbon taxation is a natural extension.

78. On climate finance, the IMF emphasizes the attractiveness of carbon pricing instruments. Applied to developing countries these instruments attract private flows, and applying them to fuels used in international aviation and maritime transport can raise significant public sources.

[62] See also IMF (2015b).

[63] See www.imf.org/environment for details on recent events.

79. On adaptation, the IMF will assist countries, particularly small states, facing increasing natural disaster risks. In partnership with other stakeholders, the objective is to help countries enhance disaster risk management frameworks, determine the appropriate combination of building buffers and risk transfer through insurance or financial market instruments, and tailor investment and growth policies to building resilience. IMF policy advice for vulnerable countries will integrate the implications of these policies into country macroeconomic frameworks by incorporating the likely costs of natural disasters into medium-term macroeconomic projections, ensuring that fiscal and monetary strategies build and maintain adequate buffers, and balancing the need for infrastructure spending to enhance natural disaster and climate change resilience with debt sustainability (Box 2). The IMF has recently strengthened the financial safety net for developing countries faced with pressing balance of payments needs, including those resulting from natural disasters (IMF 2015c). These efforts could help ensure existing and potential financing is prioritized within a comprehensive strategy and sustainable macroeconomic framework that appropriately takes account of natural disaster risks. In other countries vulnerable to climate change where the issues are macro-critical, the fiscal costs of adaptation, and the effective use of climate-related financial flows will need to be integrated in sustainable, medium-term fiscal frameworks.

80. On financial sector resilience, IMF staff will work with member countries and other partners to support initiatives encouraging consistent climate-related disclosures, prudential requirements, and stress testing. This will focus on aspects that are macro-financially critical including: (1) enhancing understanding of the transmission mechanisms between climate risks and macro-financial stability; (2) helping to design disclosure rules for climate risk exposure; (3) developing best practices for stress-testing climate risks; (4) supporting work on globally consistent prudential requirements for the insurance sector, including on a Global Insurance Capital Standard allowing for catastrophe risk; and (5) capacity building to promote development of markets and instruments for managing climate-related risks. The latter will include support for countries strengthening their regulatory oversight to ensure sound and resilient institutions and assisting in developing well-functioning financial markets providing instruments for managing climate risks.

Box 2: Climate Change, Natural Disasters, and Debt Sustainability

Climate change can affect debt sustainability through different channels. Extreme weather conditions could severely reduce output and increase fiscal spending in the short term, generating borrowing needs while eroding the public sector's capacity for debt repayment. The macroeconomic shock from natural disasters, including balance of payment pressures and currency depreciations, could also intensify external debt vulnerabilities. Climate change could also negatively affect countries' debt sustainability over the medium to long term, as it could reduce long term growth potential and the equilibrium exchange rate, and fiscal spending may have to increase to adapt to the impact of climate change.

Debt sustainability analysis (DSA) can be a useful tool to help countries assess both the short-term and long-term debt sustainability implications of natural disasters and climate change.[1] This can be done by 1) incorporating the growth implications and fiscal costs of climate change in the macroframework underlying the DSA, and 2) including in the DSA a customized scenario to evaluate the impact of natural disasters on debt. A few countries have already started to do so: the Kiribati 2015 DSA incorporated conservative long-term growth assumptions and a 3½ percent-per-annum fiscal cost of adapting to climate change. The Samoa 2015 DSA included a natural disaster shock scenario, calibrated using historical natural disasters, which would increase public external debt by 10 percent of GDP at its peak. The St. Kitts and Nevis 2015 (market access country) DSA also included a natural disaster shock, under which public debt in 2020 would be 13 percent of GDP higher than baseline owing to lower growth and high fiscal deficits. While these issues are particularly relevant for the long term projection horizon in the LIC Debt Sustainability Framework (LIC DSF), they are also applicable for a 5–year horizon in the DSA framework for market access countries.

The upcoming joint IMF-World Bank review of the LIC DSF will explore ways to strengthen the DSF framework—while not undermining its usability and versatility—to address debt challenges arising from natural disasters and climate change. While it is premature to commit to any particular area that will be integrated in the DSF, some of the following areas could be explored in the underlying work for the DSF review:

- The link between natural disasters and debt distress could be further examined. Empirical work could test whether countries that are more vulnerable to natural disaster shocks tend to have higher probability of debt distress. If significant links are found, the results could inform the debt sustainability framework when assessing debt vulnerabilities in this country group.
- A "severe natural disaster" scenario could be applied for countries that are vulnerable to natural disasters. The design of this shock scenario, including the magnitude and duration of the macroeconomic impact, could draw on recent empirical work (for example, Laframboise and Loko 2012, Acevedo 2014, Cabezon and others 2015).
- While this issue goes beyond the LIC DSF, the long-term impact of climate change on growth, and fiscal and external balances needs to be considered when developing medium- and long-term projections. An important element is to account for adaptation efforts, which would increase public expenditure (including investment) and debt in the short run but could support growth and resilience to future climate change and natural disasters in the long run. Estimating such impacts can be challenging but can help improve long-term macroeconomic frameworks as an input to debt sustainability analyses.
- This work could draw on the World Bank's expertise and past work in this area, including in the assessment of country-specific vulnerabilities to climate change, costs of adaptation measures, and damage and reconstruction costs from severe natural disasters.

[1] The IMF assesses public debt sustainability in all member countries using two distinct frameworks; one for LICs (that generally rely on concessional financing), and another for countries that have market access.

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This is **Exhibit O** referred to in the

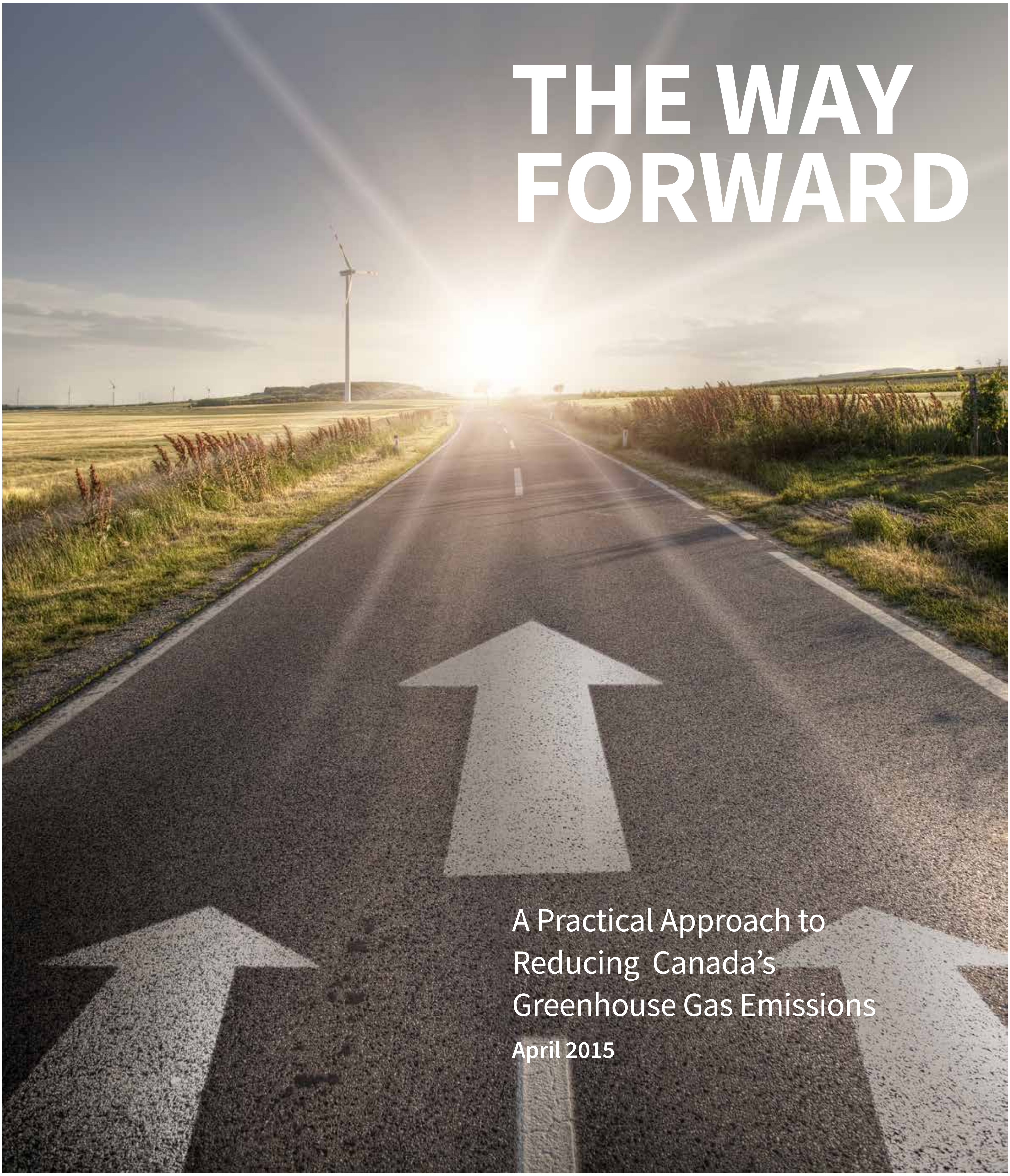
affidavit of **John Moffet**

affirmed before me on **January 29, 2019**

Commissioner for Oaths for Québec

#224458

CANADA'S **ECOFISCAL** COMMISSION
Practical solutions for growing prosperity



THE WAY FORWARD

A Practical Approach to Reducing Canada's Greenhouse Gas Emissions

April 2015

CANADA'S ECOFISCAL COMMISSION

WHO WE ARE

A group of independent, policy-minded Canadian economists working together to align Canada's economic and environmental aspirations. We believe this is both possible and critical for our country's continuing prosperity. Our Advisory Board comprises prominent Canadian leaders from across the political spectrum.

We represent different regions, philosophies, and perspectives from across the country. But on this we agree: ecofiscal solutions are essential to Canada's future.

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A thriving economy underpinned by clean air, land, and water for the benefit of all Canadians, now and in the future.

OUR MISSION

To identify and promote practical fiscal solutions for Canada that spark the innovation required for increased economic and environmental prosperity.

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EXECUTIVE SUMMARY

For most Canadians, "doing nothing" in response to climate change is simply not an option. Canadians already bear significant economic costs associated with the climate impacts from rising greenhouse gas (GHG) emissions; almost all regions and economic sectors are vulnerable. However, most provinces and the country as a whole are not on track to achieving existing emissions-reductions targets for 2020, let alone the deeper reductions required over the longer term. Achieving meaningful reductions will require the design and implementation of more-stringent policies.

Delaying such policy actions will mean higher future costs for Canadians. Getting moving now allows policy to begin reducing GHG emissions and then ramping up to yield more significant reductions over time. In this way, households will have the ability to adapt their behaviour, and businesses will have the flexibility to adopt and develop technologies required to transform our energy system. Falling behind the rest of the world can lead to competitiveness challenges in a global economy that increasingly recognizes the economic value of low-carbon activities.

The question we now face in Canada is *how* to move ahead in the most practical and cost-effective way. This report offers a clear way forward—through provincial carbon pricing.

The report explores two central issues. First, why provincial carbon pricing is the most practical way to move forward on achieving meaningful, low-cost reductions in GHG emissions. Second, which details and fundamentals of policy design need to be considered as provinces take their next steps.

These ideas are explored by drawing on analysis and evidence from economic theory, from policy experience both internationally and in Canada, and from new economic modelling. Three key policy criteria are emphasized throughout the report: (1) policies are *effective* if they achieve the required level of emissions reductions; (2) policies are *practical* if their designs reflect local economic contexts and priorities; and (3) policies are *cost-effective* if emissions reductions are achieved at least cost.

The report concludes with four recommendations for Canadian policymakers.

Recommendation 1:
All provincial governments should move forward by implementing carbon-pricing policies.

Making national progress on reducing GHG emissions is necessary, and the longer progress is delayed, the more it will cost Canadians. Provinces have the jurisdictional authority and policy momentum to make important headway on this issue now by adopting carbon-pricing policies, which achieve emissions reductions at the lowest cost.

Carbon pricing is increasingly emerging as a central policy instrument for reducing GHG emissions, with support from a broad range of influential entities, such as the World Bank, the Organisation for Economic Co-operation and Development, the International Monetary Fund, and the Canadian Council of Chief Executives. The analysis presented in this report demonstrates the considerable economic benefits of carbon pricing relative to other policies in every Canadian province. Carbon pricing provides emitters with the flexibility to identify least-cost ways to reduce emissions. It also generates revenue that governments can use to drive additional environmental or economic benefits. And, over time, carbon pricing will also drive more innovation, further reducing costs.

Independent provincial carbon-pricing policies offer a practical way forward. Coordination of these policies may be desirable down the road, and different paths to that coordination, including a role for the federal government, are possible. However, it makes good sense to lead action from the provinces. These policies already exist in some provinces and there is momentum building in other provinces to follow suit. The Council of the Federation has now signalled that provincial carbon pricing has a role to play in a provincially led national energy strategy. Furthermore, provinces have unique economic structures, emissions profiles, and political contexts, to which carbon-pricing policies can be customized. Using provincial policies can ensure that carbon-pricing revenues remain within the province in which they are generated, avoiding both real and perceived challenges of a centralized system. Moving forward with provincial policies now allows Canada to make crucial progress on the necessary and inevitable transition toward a cleaner, lower-emissions economy.

Recommendation 2:
Provincial carbon-pricing policies—existing and new—should increase in stringency over time.

Carbon-pricing policies are not automatically environmentally effective; stringency is essential. A more stringent policy has a higher carbon price. A carbon tax with a very low price is weak policy, as is a cap-and-trade system with a very high cap. Similarly, a policy with a high carbon price that covers only a small fraction of emissions is weak policy. To achieve the required economy-wide emissions reductions at least cost, and to produce the necessary incentives for innovation, any carbon-pricing policy needs to be stringent.

What is the "right" level of stringency? Our modelling analysis uses the provinces' current 2020 targets as a convenient, though arbitrary, benchmark. With the exceptions of Nova Scotia and Newfoundland and Labrador, no Canadian province is projected to meet its emissions-reductions targets for 2020; in this sense, current policies are insufficiently stringent. These targets, in any event, are only relevant for the short term. Much deeper reductions will be required over the next few decades. Even those provinces now pricing carbon lack policies stringent enough to achieve their stated targets.

The dynamics of stringency are also important. Ramping up the stringency of policies over time will avoid unnecessary shocks to the economy, but will nonetheless encourage households and businesses to change their behaviours. The sooner policies are put in place, the more time is available for the carbon price to increase smoothly, rather than abruptly. An economic environment with a predictable escalation in price is conducive to long-range planning.

Existing provincial policies vary in terms of stringency. British Columbia's carbon tax is the most stringent, and appears to have driven notable emissions reductions. The price of carbon in B.C. is now static at $30 per tonne, however, with no increases since 2012. Quebec's comparatively new cap-and-trade system has a lower carbon price, but its cap on emissions is scheduled to decrease steadily each year. Alberta's system with flexible regulations has led to minimal emissions reductions, partly due to its limited stringency.

Recommendation 3:
Provincial carbon-pricing policies should be designed to broaden coverage to the extent practically possible.

Broad coverage creates incentives for emissions reductions throughout the economy. Coverage also matters for minimizing the costs of any given amount of emissions reduction. The more emitters (and emissions) are covered by the policy, the more incentives exist to realize all available low-cost reductions. Carbon-pricing policies should thus be as broad as possible. The most cost-effective policy would impose a uniform price on all GHG emissions, irrespective of their source. Specific sectoral exemptions not only introduce inequities, but also raise the overall cost of the policy.

The British Columbia carbon tax and the Quebec cap-and-trade system both have reasonably broad coverage. Alberta's flexible regulation, however, creates no incentives for emissions reductions from small emitters, including buildings, vehicles, and small industrial sources. And only a very small fraction of emitters actually pays the price on carbon. This narrow coverage contributes to the limited effectiveness of Alberta's existing policy.

Recommendation 4:
Provinces should customize details of policy design based on their unique economic contexts and priorities; they should also plan for longer-term coordination.

While consistency of provincial carbon prices is a desirable goal, other dimensions of policy design can remain customized to provincial contexts.

Revenue recycling, in particular, provides an opportunity for diverse provincial policy choices. Some provinces may choose to reduce existing business or personal income taxes, as in British Columbia. Others may prefer to use the revenue to invest in the development of new technology, as in Quebec and, to some extent, Alberta. Carbon-pricing revenue could also be used to finance investments in critical public infrastructure, to address competitiveness risks for exposed industrial sectors or to ensure fairness for low-income households. Different provinces with different contexts and priorities are likely to make different choices. This flexibility is a key strength of the provincial approach to carbon pricing.

Over the longer term, consistency of the carbon price across provinces is desirable for two reasons. First, such consistency improves overall cost-effectiveness by ensuring incentives exist for realizing all potential low-cost emissions reductions, whatever their location. Second, a common price avoids policy-induced challenges of interprovincial competitiveness. When policy is equally stringent across provinces, all firms face a level playing field.

While a consistent carbon price across Canada is eventually desirable, it is not critical in the short term. Nor should the pursuit of such a common price be an obstacle to effective and timely provincial action. Canadian provinces have a long history of differential policies. By developing effective provincial policies now, and thereby beginning to mobilize markets toward low-carbon innovation, provinces can make crucial headway on an important challenge.

CONTENTS

1 INTRODUCTION

Climate change presents an urgent policy challenge for Canadians, as it does for people all over the globe. Economic costs associated with the gradual but inexorable rise in Earth's average temperature are occurring now, and they will escalate unless significant actions are taken to reduce our greenhouse gas (GHG) emissions. While there is no longer any serious debate about the science of climate change, there is continuing debate about which policies can most effectively address the problem. Further delays in effective policy action will increase the costs of achieving meaningful emissions reductions. Canadians and their governments need to build on existing momentum by implementing smart climate policies.

At the meeting of the Council of the Federation in August 2014, Canada's provincial premiers explicitly recognized the importance of using carbon-pricing policies to help drive a transition to a low-carbon economy. Their conclusion makes sense. Though British Columbia, Alberta, and Quebec have already begun to address GHG emissions by putting a price on carbon, other provinces could follow suit.

This report explores the opportunity for building on these early provincial policies. It has two main objectives: First, it makes the case that Canada needs to reduce its aggregate GHG emissions, and that a practical method for doing so are for provincially designed and implemented carbon-pricing policies that reflect the essential economic contexts within the respective province. Second, it provides an overview and preliminary guide to key issues of policy design, and sets the stage for a deeper discussion on design details that will appear in future reports from Canada's Ecofiscal Commission.

The central case for implementing well-designed provincial carbon pricing is threefold.

First, carbon-pricing policies are *effective* in driving the needed reductions in GHG emissions. Evidence both here at home and internationally strongly supports the effectiveness of carbon pricing. Canada needs more stringent carbon policy to drive reductions both in the short and longer term. As the world moves toward a new global agreement in 2015, insufficient policy action at home will cost Canada in terms of international reputation and may result in our products being denied the market access we desire. As Canada's trading partners move forward with their own policies, Canada risks putting its industries at a competitive disadvantage in a global economy that values emissions reductions.

Second, provincial carbon pricing offers a *practical* path forward for Canadian policy. Canada's existing federal structure is not a barrier; it is an opportunity for smart and effective policy. Building on existing momentum, provincial governments can design ecofiscal carbon policies based on their own economic and policy contexts. Governments can move forward with policies now, beginning the needed transition and avoiding the costs of delay. Any revenues generated by the policies would be retained within the province, available for provincial priorities. This approach does not preclude a future role for the federal government, but instead provides a practical path forward for crucial new policies.

Third, well-designed carbon-pricing policies are *cost-effective*. They help achieve emissions reductions at the lowest possible costs because they allow emitters to find the most efficient methods to reduce emissions. Other policies—such as building and vehicle regulations, subsidies, and investment in research and development—may also be useful components of a comprehensive policy package, but their effectiveness is significantly diminished in the absence of a carbon price. Given the benefits of carbon pricing in terms of policy flexibility, the economic gains from revenue recycling, and the incentives for clean innovation, carbon pricing is an essential foundation of any cost-effective approach to reducing GHG emissions.

For an effective, practical, and cost-effective policy, smart design is essential. This report provides a starting point for a more comprehensive discussion of the details of policy design. It lays out a framework based around five central issues: What policy instruments can be used to price carbon? How stringent is policy in terms of the price of carbon? How broad is the coverage of the policy? What is done with the revenues obtained? How can competitiveness risks be addressed?

The stringency and coverage of a policy matter a great deal. A carbon-pricing policy that applies a low carbon price to a small share of overall emissions is neither effective nor cost-effective and not much better than no policy at all. Other design choices have more complex trade-offs. The unique characteristics of each province may lead to different design choices; but all can achieve the desired goals of efficient and effective emissions reductions.

This is the first of several reports on carbon pricing from Canada's Ecofiscal Commission. The analysis presented here will be a starting point for the Commission's regional engagement on carbon-pricing policy through 2015, which will in turn inform the Commission's future research and policy recommendations on these critical design issues.

The remainder of this report is structured as follows. Section 2 reviews the need for new policies in Canada to reduce GHG emissions. It lays out the fundamentals of Canada's emissions challenges and the rationale underpinning a need for policy action. Section 3 considers the economic and policy contexts of the different provinces, making the case that the provinces offer a practical path forward for new carbon-pricing policies. Section 4 uses economic modelling to illustrate how ecofiscal carbon pricing is the most cost-effective approach to achieving each province's existing GHG emissions-reductions targets. Section 5 provides a framework for comparing provincial policies. Finally, Section 6 makes clear policy recommendations based on the analysis and findings from this report.

Note two important things this report does not attempt to do. It does not lay out a comprehensive climate policy for Canada. Without dismissing the need for selected regulations, subsidies, or clean-tech investments, the focus here is to explore the important role that can be played by carbon-pricing policies. Nor does this report provide detailed design recommendations for carbon-pricing policies within each province. Instead, it creates a framework for analysis of the various objectives and constraints that could inform policy design in each region. These design details will be considered extensively in future Commission reports.

2 THE NEED FOR NEW CARBON POLICIES

Why are new climate policies needed in Canada? This section summarizes the broad global consensus around climate science, and surveys some of the economic costs of climate change for Canada. It then assesses the progress of Canadian governments in implementing policies to reduce GHG emissions, and reviews the main options for further policy actions.

2.1 CLIMATE CHANGE IS REAL AND COSTLY

The science is clear: GHG emissions are inexorably changing Earth's climate. It is also becoming increasingly clear that these changes pose significant economic risks for Canada and for the world.

The growing atmospheric concentration of GHGs contributes to climate change

A clear consensus has emerged regarding the core science of climate change (Intergovernmental Panel on Climate Change [IPCC], 2013, 2014a; Wolff et al., 2014). A survey of climate science research finds that 97% of scientific studies supports the hypothesis that climate change is driven by human actions (Cook et al., 2013, 2014). The members of Canada's Ecofiscal Commission are not climate scientists, but we defer to the best available evidence from the scientific community. The most recent report from the International Panel on Climate Change—which brings together diverse scientific research on climate change—indicates there is more than a 95% probability that human activity is responsible for climate change (IPCC, 2014a).

Global and comprehensive action is required to reduce the annual flow of GHG emissions so as to stabilize their accumulated atmospheric concentrations (e.g., Hoffert et al., 1998; Peters et al., 2013). Stabilizing atmospheric GHG concentrations at levels sufficient to slow current warming trends requires a fundamental shift in the way the world's economies produce and use energy.

Since climate change is a global phenomenon, policies in any one country are insufficient for addressing the challenge (Auditor General of Canada, 2014). As part of the international Copenhagen Accord, however, the Government of Canada adopted a target for emissions reductions by 2020, and has committed to achieving this target (Canada, 2013). As discussed below, all Canadian provinces have adopted similar emissions-reductions targets.

The full range of GHGs matters for policymakers. The release of carbon dioxide from burning fossil fuels is the largest source of GHG emissions—76% of total human-related GHGs, accounting for both volume and global warming potential—and is rightfully a priority for policy (Global Carbon Project, 2014). Sensible policy, however, must be comprehensive and focus on all types of GHGs, including methane, nitrous oxide, and sulphur hexafluoride, and all sources of these emissions. In the rest of this report, we refer to GHGs more generally, measured in terms of "equivalent" tonnes of carbon dioxide (CO_2e).

Climate change is costly for Canada

The economic costs of *not* reducing GHG emissions are potentially very large, though notoriously difficult to estimate with precision. Nordhaus (2010) estimates annual global damages by 2095 at $12 trillion, and den Elzen et al. (2014) estimate potential annual damages of approximately 4% of global GDP by 2100. A recent commentary in *Nature* notes that the impacts of methane released from thawing Arctic permafrost could have global costs of $60 trillion in net present value—a value almost as large as today's entire global GDP (Whiteman et al., 2013).

While these estimates are large, they likely understate the economic risks of climate change for two main reasons. First, the models used to generate the estimates tend to have limited representation of catastrophic events. Weitzman (2009) argues that better incorporating low probability but catastrophic outcomes into estimates would substantially raise the projected economic costs of climate change. The standard models tend to ignore, for example, impacts of climate change from increased conflicts and illnesses from mass migration, impacts on ocean ecosystems, food security, or energy supply disruptions (Pindyck, 2013; Howard, 2014). Second, many potential impacts are not easily quantified in terms of GDP. How should mass extinctions or catastrophic impact on ecosystems be valued? Both factors suggest that estimates of the GDP costs of climate change should be seen as illustrative, and probably as lower bounds of the full costs.

Canada's economy is not immune to these global costs. Rising sea levels and extreme weather events can threaten coastal cities and infrastructure. Industrial sectors such as forestry, mining, and energy face risks from permafrost degradation and the migration of plant species. Invasive species and diseases threaten food production in some Canadian regions (Warren & Lemmen, 2014). The National Round Table on the Environment and the Economy (2011) estimates that the economic costs of climate change in Canada (in 2006 dollars) would rise from around $5 billion annually in 2020 to between $21 billion and $43 billion annually by 2050.

The scale of potential threats is very large, though often expressed only in abstract, statistical terms. At a more local scale, however, the impacts become much more concrete. Almost all regions and economic sectors of Canada are vulnerable.

Extreme Weather. The increasing intensity and frequency of extreme weather events, such as wildfires and storms, are leading to large financial losses for Canadian insurers. Kovacs and Thistlethwaite (2014) note that the Canadian insurance industry paid out a record $1.7 billion in 2011 for property damage from extreme weather events. This record was broken in 2013, however, which saw major flooding in Calgary and a particularly costly storm in Toronto. The southern Alberta floods in 2013 alone are estimated to have led to $4.7 billion in damages, including large-scale damage to Calgary's electrical network, the shuttering of many businesses, and the associated losses in income and production (Swiss Re, 2014).

Forestry Products. Climate change has already had major impacts on Canada's forest-products sector, an industry critical for the prosperity of over 190 Canadian communities (Forest Product Association of Canada, 2014). Warmer winter temperatures driven by climate change is the major factor contributing to the outbreak of the mountain pine beetle in Western Canada, which has reduced the economic value of over 18 million hectares of Canadian forest (Warren & Lemmen, 2014). These impacts contributed to mill closures and lost jobs. Similarly, climate change has altered the frequency and distribution of fire cycles, in some cases bringing new threats to communities that previously never experienced the risk of wildfires. The most common deciduous tree in our boreal forests—the trembling aspen, which has high ecological and commercial value—has been experiencing more severe dieback in recent years (Warren & Lemmen, 2014).

Freshwater Levels. A warmer climate brings with it the risk of reduced water levels in Canada's lakes and rivers, which could have major implications for a range of sectors. One estimate suggests that moderate climate change could increase annual shipping costs in the Great Lakes – St. Lawrence system by 13%, while more extreme changes could increase costs by 29% (Millerd, 2005). Lower water levels due to climate change could also lead to reduced tourism, lower hydroelectric capacity, and decreased property values (Shlozberg et al., 2014).

The North. The Canadian Arctic faces both more severe threats and greater likelihood of further impacts. The most recent report from Working Group II of the IPCC identifies the dire impacts of such changes on Arctic communities (many of which are highly reliant on their surrounding ecosystem) as one of the key climate-change risks to humans (IPCC, 2014b). Arctic First Nations and Inuit people, for example, face major disruptions to their way of life with loss of ice cover and threats to Arctic fisheries.

Sea Level. The melting of glaciers and ice sheets from warming in both the Arctic and Antarctic, along with thermal expansion from warming ocean water, contributes to global sea-level rise and poses huge threats to urban residents and infrastructure on both the Pacific and Atlantic coasts of Canada (IPCC, 2013). Sea-level rise leads to greater risks of coastal erosion, flooding from storm surges, and submergence (Andrey et al., 2014). Coastal British Columbia is particularly threatened, where sea-level rise could flood airports, roads, homes, and more; one analysis indicates that approximately $25 billion of Vancouver's real estate could be heavily impacted by unmitigated sea-level rise (Keenan & Yan, 2011).

Agriculture. A warming climate can have both positive and negative economic effects on Canadian agriculture. On the positive side, for example, climate change may increase income from the production of winter wheat (Environment Canada, 2014c). Yet the increased frequency of droughts and pest infestations due to climate change is expected to increase the vulnerability of Canada's overall agricultural sector (Environment Canada, 2014c; Warren & Lemmen, 2014). Stewart et al, (2011) note that the prairie drought of 2001—the driest year in the region in hundreds of years—led to an estimated $5.8 billion in financial losses, largely due to the reduction in agricultural production.

Fisheries. Another impact of global climate change falls on Canada's fisheries. The rising atmospheric concentration of GHGs is leading to rising ocean acidification, which is expected to have far-reaching effects on marine ecosystems along all three of Canada's coastlines (Nantel et al., 2014). An estimate prepared for Fisheries and Oceans Canada puts the value of the threatened fish harvest in the Northwest Territories and Nunavut at $3.4 million annually (G.S. Gislason & Associates Ltd. and Outcrop Ltd., 2002). Similar threats exist for elements of Canada's Pacific fisheries.

Mining and Exploration. Even Canadian mining, exploration, and oil sands operations bear economic costs associated with the changing climate—especially in the North, where operations often rely on ice roads for the transportation of both inputs and outputs. With recent changes in climate, there is a smaller window of time in which the ground remains frozen and road transport is possible. For example, in 2006, the shortened winter season forced the Diavik diamond mine in the Northwest Territories to incur extra air-transport costs of over $11 million (Ford et al., 2010).

2.2 CANADIAN OPPORTUNITIES FROM POLICY ACTION

As other countries adopt and expand their efforts to reduce GHG emissions, Canada can seize economic opportunities by being at the leading edge of these policy initiatives. Canadian opportunities come in four forms.

First, there are significant costs associated with delayed policy action. The Organisation for Economic Co-operation and Development (OECD) estimates that for every $1 of clean energy investment *not made* in the electricity sector before 2020, expenditures of $4.3 would be required between 2021 and 2035 to make up for increased emissions (OECD, 2011). In the United States, each decade of climate policy delay is estimated to increase the costs of the eventual policy actions by 40% (Council of Economic Advisers, 2014). In Canada, the National Round Table on the Environment and the Economy (2012a) suggests that waiting until 2020 to implement policies sufficient to achieve deep emissions reductions by 2050 (65% below 2005 levels) would cost Canadians $87 billion more than taking equivalent action now. In short, delay is very costly.

Second, implementing effective Canadian policies to reduce GHG emissions can create social licence and help secure global market access for Canadian natural resources. Some suggest that had more effective Canadian policies been in place over the past few years, we might not have witnessed the extensive international and American criticism regarding the oil sands, with the associated obstacles to the approval of the Keystone XL pipeline (e.g., Panetta, 2014; Cleland, 2014). We can only speculate as to what would have occurred had a more stringent policy been in place, yet clearly environmental performance matters. Alberta Premier Jim Prentice recently said that the solution to the province's biggest challenge of finding new markets for its oil is to redefine Alberta "as an environmental leader" (*Globe and Mail*, 2014). Indeed, as our trading partners implement their own climate policies, Canadian firms could even face more explicit threats to competitiveness in the form of trade measures such as border carbon adjustments or low-carbon fuel standards.

Third, actions to reduce GHG emissions also reduce air pollutants—such as particulate, nitrogen oxides, and sulphur dioxide—that threaten our health and raise our health-care costs. A recent study from the International Monetary Fund (IMF) shows that Canada could see net benefits from carbon pricing, especially given the significant benefits from reducing air pollutants and avoiding costly health impacts (Parry et al., 2014).

Fourth, Canadian businesses and workers can benefit from actively participating in the global shift toward a cleaner economy. As major economies such as China, India, and the United States implement more thorough carbon-reduction policies, global demand for cleaner technologies will naturally increase. McKinsey & Company (2012) suggests that under the right policy conditions, Canada could have comparative advantages in sustainable resource development, carbon capture and storage, uranium mining, and hydroelectricity expertise. Canada could be a leader in nascent markets such as off-grid solar photovoltaic power, biomass energy, conventional hydro and marine power, and energy-efficient buildings. In short, Canada can benefit by supplying the world's increasing demands for cleaner technologies and the associated expertise.

2.3 CANADIAN GOVERNMENTS ARE UNLIKELY TO ACHIEVE THEIR GHG OBJECTIVES

Canadian federal and provincial governments have established formal targets for reducing GHG emissions. This report does not assess their appropriateness in terms of stringency (see Box 1 on page 6). In Canada and elsewhere, such targets are often set for political and diplomatic reasons, rather than as the result of a coherent weighing of costs and benefits. In addition, targets of any stringency will not achieve emissions reductions unless they are coupled with effective policies.

Box 1: On Targets and Stringency

How can policymakers know the appropriate stringency of any given carbon-pricing policy?

The answer is not necessarily clear-cut. Three different approaches for defining stringency are discussed below.

A cost-based approach. One approach to defining stringency is to align the price of carbon embodied in the policy with the social cost of carbon (SCC). The SCC is an estimate of the damages from emitting an extra tonne of CO_2e today. Aligning carbon prices with the SCC is economically efficient, because it fully internalizes the external costs associated with GHG emissions. The key challenge, however, is to estimate the SCC. Updated estimates based on the analysis from the well-known Stern review, for example, place the SCC at roughly $100 per tonne of CO_2e . But other credible estimates place the number much lower, while still others estimate the number to be much higher (Nordhaus, 2011; Ackerman & Stanton, 2012; Hope, 2013). A recurring theme in these studies is that the inclusion of uncertainty increases the estimated SCC; analyses that do not consider low probability but catastrophic events of climate change tend to produce estimates of the SCC that are biased downward (Heyes et al., 2013).

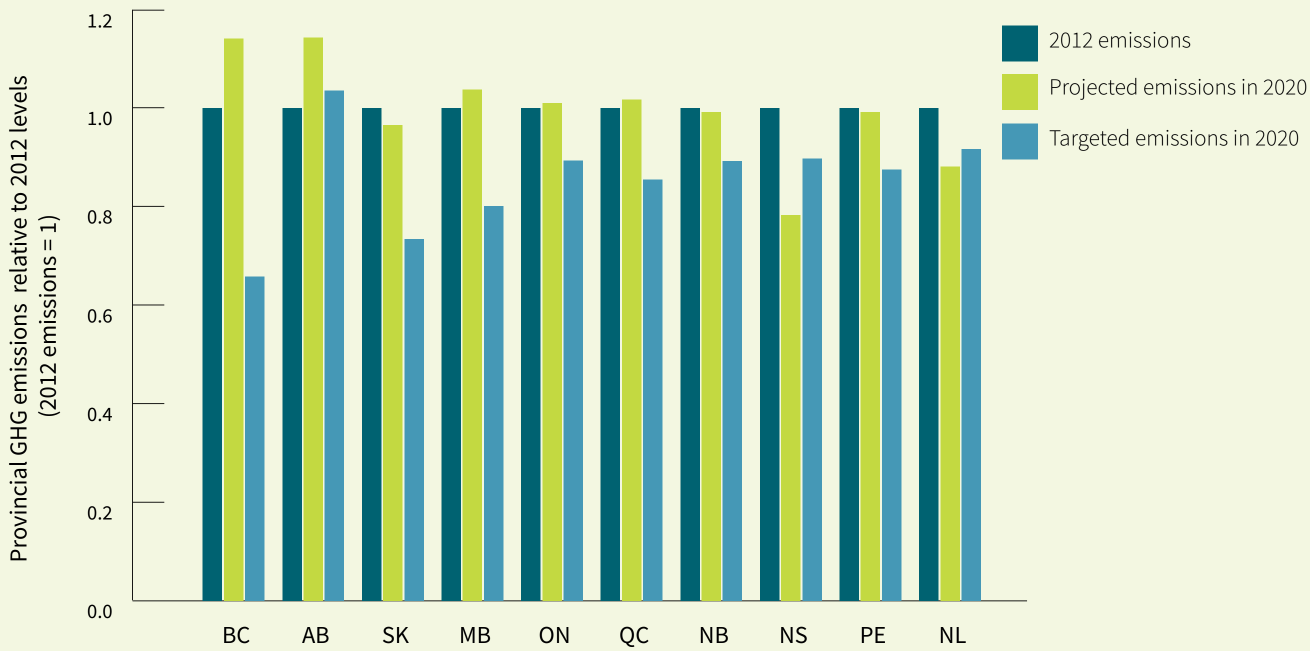
A quantity-based approach. An alternative approach to defining policy stringency starts from an estimate of the necessary long-run global emissions reductions. To reduce the likelihood of dangerous and irreversible climate change, for example, the IPCC estimates that global GHG emissions must fall to the level necessary to stabilize the global atmospheric concentration of CO_2e at 450 parts per million. An economic model can then be used to estimate the carbon price required to generate this reduced level of GHG emissions. The most recent estimates by the IPCC suggest that such a global carbon price would start below $100 per tonne and ramp up to about $200 per tonne by 2050.

A target-based approach. Finally, any individual jurisdiction could measure the stringency of its policy in terms of the policy's ability to achieve a stated target for GHG emissions. However, since the target may itself be chosen arbitrarily, with little regard for the details of climate science, this approach is more about the effectiveness of a policy in achieving its stated goals, rather than about whether the stated goals are themselves appropriate.

Canadian policy stringency? In the case of existing Canadian policies designed to reduce GHG emissions, any of these approaches would conclude that our current policies are insufficiently stringent. Existing Canadian policies do not price carbon as highly as the lower estimates of the SCC; they are certainly insufficient to achieve the much deeper reductions necessary over the longer term; and they are even unlikely to achieve the provinces' stated emissions targets for 2020.

The need to ascertain the "right" stringency of policy is not a task that should distract Canadian policymakers today. The practical path forward is to put smart policies in place as soon as possible, and then gradually increase their stringency to levels that can better be determined with further study.

FIGURE 1: Current, Projected, and Targeted GHG Emissions for Canadian Provinces



The figure shows actual GHG emissions in 2012, projected emissions in 2020, and targeted emissions in 2020 in each province, normalized by 2012 emissions to allow for comparisons between provinces. The gaps between the 2020 targets (blue bars) and the projected 2020 emissions (green bars) show the need for new emissions-reductions policies. Note that given a lack of data on projections for the individual territories, we cannot project their emissions gap. However, their relatively low emissions do not significantly impact countrywide measures.

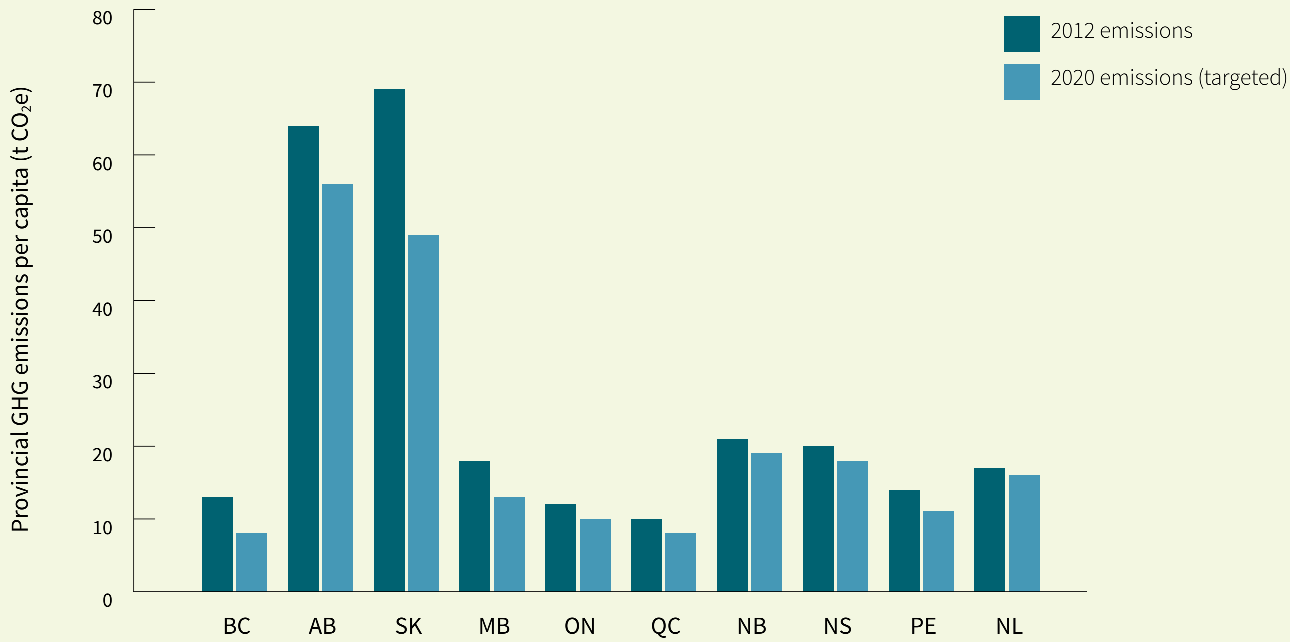
Sources: Auditor General of Canada (2014); Environment Canada (2014a); Environment Canada (2014b); and Alberta Environment (2014).

Whatever the underlying logic of any individual emissions-reduction target, the data show that most of Canada's provinces are unlikely to achieve them. Figure 1 shows that the provincial targets for 2020 vary considerably in their ambition, ranging from 4% above current emissions in Alberta to 34% below current emissions in British Columbia. Achieving the targeted reductions is made more difficult by ongoing economic growth and the associated rise in emissions; for many provinces, such growth makes the "business as usual" projected emissions for 2020 even higher than current emissions.

The gaps between projected and targeted emissions clearly show that current policies are insufficient to achieve stated goals. This conclusion is consistent with the findings of other analyses (Environment Canada, 2014c; Auditor General of Alberta, 2014; Auditor General of Canada, 2014; Environmental Commission of Ontario, 2013; NRTEE, 2011). Only Nova Scotia and Newfoundland and Labrador are on track to achieve their emissions-reductions targets for 2020. British Columbia has established a relatively aggressive target, but is still projected to have emissions in 2020 well above that level.

How deep are the various provincial targets? To put them in context, Figure 2 shows both current per capita GHG emissions and the projected per capita emissions in 2020, based on each province's stated target and Statistics Canada's population projections. The figure illustrates that Alberta's and Saskatchewan's targets could result in the largest absolute improvements in terms of per capita emissions. Yet it also shows that even if they achieved their targets, they would continue to produce far more emissions per capita than the other provinces.

FIGURE 2: Provincial GHG Emissions Per Capita (2012 and targeted for 2020)



The figure shows provincial GHG emissions per capita for each province based on actual emissions and population in 2012 and projected emissions and population in 2020, assuming that each province achieves its own stated target.

Sources: Environment Canada (2014a); and Statistics Canada (2014c, 2014d).

The sum of the provincial targets is very close to the federal government's national target. If all provinces were to achieve their individual targets, total Canadian GHG emissions would fall from their 2012 level of 699 Mt to 632 Mt by 2020. The federal government's national target is slightly more ambitious, requiring total emissions to fall to 626 Mt by 2020, 19 Mt of which are projected to come from credits due to land use, land-use change, and forestry (Environment Canada, 2014a).

In either case, however, deeper reductions in Canadian emissions will be needed over the longer term, assuming the world as a whole strives to reduce annual GHG emissions to stabilize the global climate by 2050. In 2008, for example, Canada specified a non-binding target of 60-70% below 2006 levels by 2050 (Environment Canada, 2008).

Whether we consider provincial or federal targets, or the 2020 targets, or probable ones for 2050, it is clear that a policy of business as usual will not be sufficient to achieve them. Getting new policies firmly in place, and then ramping up their stringency over time, can position Canadian provinces to contribute meaningfully to required long-run global reductions.

2.4 GOVERNMENTS CAN USE DIFFERENT POLICY APPROACHES

Achieving both the necessary short-term and long-term emissions reductions requires that broad actions be taken throughout the economy. Government policy can create the incentives needed to drive these actions.

Government policy is needed to align economic and environmental objectives

Climate solutions should not be expected from the market alone. In the absence of government policy, households and businesses do not bear the costs they impose on others through their own emissions of GHGs. Producing GHGs is free for the individual emitters, even though climate change imposes broad, wide-ranging costs on the economy. This *market failure* underpins the challenge of GHG emissions. As a result, it will fall on our governments to implement policies to ensure that private incentives are aligned with society's environmental objectives.

A variety of policies can correct this misalignment. Whichever policy is used, the nature of the problem suggests that Canadian policies should be comprehensive, aimed at all major types of GHG emissions, and thus all major emitters. Policy aimed too narrowly at specific technologies and/or sectors can delay the pace of emissions reductions, increase the costs of achieving them, and permit "free riding" by some while others face a greater adjustment burden.

Various policy instruments can drive emissions reductions

Three major types of policy instruments are available: regulations, subsidies, and ecofiscal policies. Each type can play a useful role in an overall comprehensive approach to reducing GHG emissions, but some important trade-offs exist.

Regulations typically set mandatory limits on GHG emissions, define standards for emissions performance, or mandate the use of low-carbon technologies. Designing regulations requires detailed information on the firms being regulated as well as their production processes. Since different companies often face different costs in meeting the regulatory requirements, the regulatory approach often leads to a higher overall cost for a given amount of emissions reductions. The prescriptive nature of regulations can also reduce the incentive to innovate beyond the regulation's specific requirements.

Regulations can nonetheless be quite effective in certain circumstances (Moxnes, 2004; Murphy et al., 2007). Regulations requiring more fuel-efficient vehicles to be produced by automotive manufacturers, for example, can ensure that drivers have the option to purchase lower-emission vehicles. Given the relatively small number of vehicle manufacturers, these regulations can be applied relatively cost-effectively, and can help to drive the decarbonization of the transportation sector. Federal fuel-efficiency standards for light- and heavy-duty vehicles are forecast to drive emissions reductions of approximately 14 Mt in 2020 (NRTEE, 2012).

Regulations can improve their cost-effectiveness by being specifically designed for flexibility. Renewable electricity standards, for example, such as the one implemented in Nova Scotia, require utilities to use a given level of renewable or low-carbon energy, but are not prescriptive as to the specific technologies to be used. If such "smart" regulations also allow energy providers to trade compliance permits, the overall costs can be further reduced (Murphy et al., 2007).

For the economy as whole, however, cost-effectiveness requires that sector-specific regulations be carefully aligned. This design process requires detailed information about the firms' abatement costs, which government generally does not have and the private sector is averse to providing. The ensuing negotiations with industry are often quite complex, time-consuming, and costly. Moreover, as technology changes at different rates in different sectors, regulations must continually be adapted to remain cost-effective. Even smart regulations designed today are likely to lose their intelligence over time (Popp, 2003).

Subsidies use public funds to support technologies or behaviours that reduce GHG emissions. Many subsidy programs are plagued by free-ridership challenges; if subsidized activities would occur even in the absence of the subsidy, the policy is not cost-effective in terms of reducing emissions, and may even be ineffective at generating any emissions reductions. Subsidies can make sense in some contexts, however. Public financing may be required for public-transit infrastructure, for example, and this could help achieve reductions in GHG emissions. Public funds are also usually required to support basic research, which for well-established reasons tends to be underprovided by the private sector (Jaffe et al., 2005).

The third major policy approach is to use *ecofiscal* policies, which establish a price on carbon emissions and generate revenues that can be returned back to the economy. The main advantage of carbon pricing is its cost-effectiveness. Carbon pricing can drive emissions reductions at lowest cost. Three main factors underpin this advantage. Because carbon pricing relies on the market, emitters have flexibility in how they reduce emissions, based on their unique costs of abatement. Carbon-pricing policies also generate revenue that can be used to achieve other economic and environmental objectives. Finally, carbon-pricing policies create stronger incentives for innovation than do regulatory approaches;

when carbon has a price, there is always value to be gained through innovations that reduce emissions.

A carbon price can be established in two different ways: *cap-and-trade systems* and *carbon taxes*. Cap-and-trade systems set a limit on the total allowable level of emissions, allocating permits equal to this level, and then creating an active market in which firms can trade the permits at a market-determined price. Carbon taxes directly establish a price that must be paid by emitters of GHGs. Both approaches create incentives for firms and households to reduce their emissions, and both systems create incentives to adopt and develop cleaner technologies. We return to policy instruments and design details for carbon-pricing policies in Section 5.

Experience suggests that carbon pricing is an essential policy tool

The focus of this report is on carbon pricing. Such ecofiscal policies are unlikely to be the only element in a comprehensive policy package that is effective at achieving emissions reductions while doing so in a cost-minimizing manner. In some situations, regulations and subsidies may play an important complementary role (Bramley et al., 2009; NRTEE, 2009). But carbon pricing is an essential element, and one that is currently underused in Canada.

Across the world, governments are increasingly implementing carbon pricing (World Bank, 2014a). In its report *State and Trends of Carbon Pricing 2014*, the World Bank notes that 39 national and 23 sub-national jurisdictions have put a price on GHG emissions or have stated their intention to do so in the near future. In addition, 74 countries and more than 1,000 companies and major investors have expressed support for a carbon price (World Bank, 2014b). See Box 2 for additional details.

The growing prominence of these policies reflects a practicality that is well known in the economics literature. Economists have long recognized that market-based policies can be used successfully to reduce pollution—including the emission of GHGs—at the lowest possible cost. Putting a price on emissions creates market incentives for innovation and for emitters to identify and implement the lowest-cost reductions.

The possibility of generating revenue that can be used to advance economic and environmental goals is an important part of ecofiscal policies. Such *revenue recycling* can add further economic benefits to carbon pricing (e.g., Jorgensen et al., 2013; Carbone et al., 2013). Revenues raised through carbon pricing can be used to finance reductions in existing taxes on labour and capital. Alternatively, governments can use the revenues to support the development of environmental technologies, invest in critical public infrastructure, protect vulnerable segments of the population, or reduce existing budget deficits.

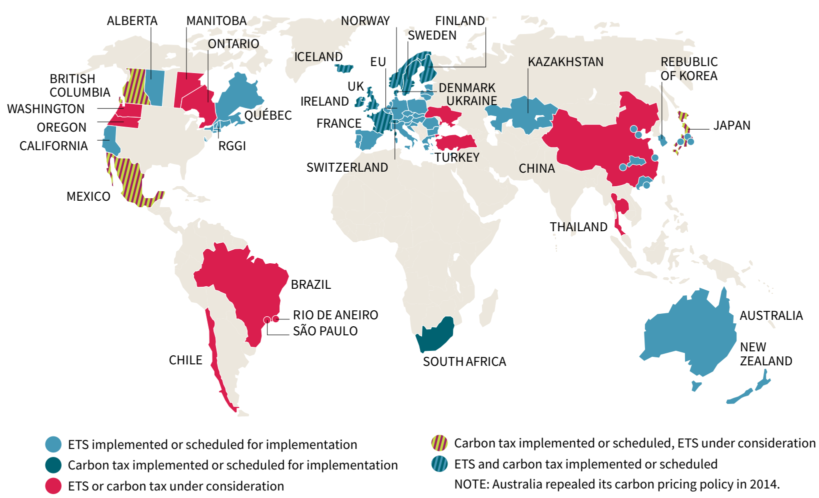
Real-world policy experience also suggests that carbon pricing is quite effective at reducing GHG emissions without negatively affecting the economy. Based on data from the first six years of British Columbia's carbon tax, per capita use of fuels subject to the tax decreased by 16%, but increased by 3% over the same period in the rest of Canada, while B.C. slightly outperformed the rest of the country in terms of GDP growth (Elgie, 2014). An assessment of carbon-pricing policies in six European nations finds that emissions were reduced and that GDP slightly increased (Barker et al., 2009). Murray et al. (2014) also find that the U.S. states that are part of the Regional Greenhouse Gas Initiative (RGGI) achieved proportionally greater emissions reductions compared with the rest of the United States. Similarly, the price incentive created by the UK carbon levy reduced energy intensity by 18.1% and electricity use by 22.6%, with no evidence of negative effects on employment or plant closures (Martin et al., 2014).

Box 2: From Economics 101 to Mainstream Policy

Increasingly, carbon-pricing policies are widely accepted by governments and businesses as an essential policy tool.

National and sub-national governments all over the world have implemented or are planning to implement carbon pricing. And a wide chorus of mainstream economic voices including world leaders, international institutions, investors, and businesses are promoting the use of carbon taxes or cap-and-trade systems.

As the figure below illustrates, the World Bank counts 39 countries and 23 sub-national jurisdictions that have implemented or are considering implementing carbon-pricing policies. The cumulative GHG emissions of these jurisdictions accounts for about a quarter of global emissions. The World Bank notes that 2013 saw the addition of 10 carbon-pricing initiatives and one in early 2014. The beginning of 2015 marked the opening of South Korea's cap-and-trade system also known as an emissions trading sytem or ETS, the world's second-largest carbon market after Europe's.



Source: World Bank (2014a).

This growth in carbon pricing coincides with a growing support base of important political and economic actors, which includes the following:

- The **World Business Council for Sustainable Development (WBCSD)** identifies carbon pricing as being a must-have for a sustainable future (WBCSD, 2011).
- Here in Canada, the **Canadian Council of Chief Executives (CCCE)** supports putting a price on GHG emissions and says carbon pricing can "lead to innovation and new technologies that have positive outcomes for consumers" and improve the competitive position of Canadian firms (CCCE, 2010).
- The former **U.S. Secretary of the Treasury** recently stated, "[W]e must not lose sight of the profound economic risks of doing nothing. The solution can be a fundamentally conservative one that will empower the marketplace to find the most efficient response. We can do this by putting a price on emissions of carbon dioxide"(Paulson, 2014).
- The **OECD** calls carbon pricing a key element of fiscal policy and calls for faster progress (OECD, 2014).
- The **IMF** suggests that all countries should implement carbon pricing and urges them not to wait for a formal international agreement (CBC News, 2014).

3 THE PRACTICALITY OF PROVINCIAL CARBON PRICING

As discussed in the previous section, Canada needs new, more stringent, cost-effective climate policies in order to achieve stated objectives. And there is a strong argument for filling the current policy gap with pan-Canadian carbon pricing. The broader and more consistent the price across Canada, the more emissions will be reduced in a cost-effective way. Moreover, the costs of delay underline the urgency of policy action. While all levels of government can play a useful role in climate policies, provincial action on carbon pricing is a practical path forward for reducing Canadian GHG emissions.

This section briefly reviews the new initiative of Canada's provincial premiers and the specific progress already made by some provinces. It explores key differences between provinces in terms of their emissions and economic structures. It recognizes the practicality of continuing this provincial momentum, but also the desirability of longer-term coordination in order to produce an efficient system across the country.

3.1 PROVINCES CAN TAKE THE INITIATIVE—AND ALREADY ARE

Canadian provincial premiers have clearly expressed their support for carbon pricing. Since August of 2014, all provinces and territories are now participating in the development of a national energy strategy, and addressing climate change is a key part of this strategy. Critically, the premiers explicitly recognize carbon pricing as a valuable policy instrument for transitioning to a lower-carbon economy (Council of the Federation, 2014). This momentum shows that the provinces are moving on carbon pricing, and that such actions offer a practical path forward—politically, legally, and economically—toward a pan-Canadian approach.

Some provinces are already pricing carbon, in different ways

Three provinces have already implemented policies that put a price on GHG emissions. While the design and stringency of these policies vary widely, these policies highlight the potential for implementing ecofiscal policies at a provincial level. Section 5 revisits the design of these policies in detail.

British Columbia implemented its carbon tax in 2008. The tax applies to GHG emissions associated with the combustion of fossil fuels; it was introduced at a rate of \$10 per tonne CO_2e and has gradually increased to its current level of \$30 per tonne. The tax applies to approximately 70% of B.C.'s GHG emissions.

In 2007, Quebec applied a small carbon tax on fossil fuels equivalent to about \$3.50 per tonne CO_2e. It then moved forward with a cap-and-trade system in 2013, which superseded the tax. The policy sets a limit on emissions from regulated sectors, but allows emitters to trade emissions permits. Quebec's cap-and-trade system is linking with a similar system in California, under the Western Climate Initiative. As of February 2015, the cap-and-trade system has a minimum permit price of \$15 per tonne CO_2e.

The Alberta Specified Gas Emitters Regulation (SGER), implemented in 2007, is a regulation with elements of carbon pricing. It requires regulated emitters to reduce their emissions intensity (emissions per unit of output) relative to a stated benchmark by 12%, but allows them to comply with the policy by trading permits with other regulated emitters, purchasing credits for other emissions reductions within Alberta, or contributing to a technology fund at a cost of $15 per tonne CO_2e.

Other provinces have implemented policies to reduce GHG emissions, although generally not based on carbon pricing. Ontario, for example, has entirely phased out its use of coal-fired electricity plants. Nova Scotia has implemented a renewable energy standard. Manitoba has implemented a narrow emissions tax, applied only to coal. Overall, provincial policies are a key driver of emissions reductions. Analysis from the National Round Table on the Environment and the Economy (2012b) finds that provincial policies were projected to drive more than two-thirds of Canada's total expected emissions reductions in 2020.

Provinces share constitutional authority to price carbon with the federal government

While Canada's Constitution is not explicit and the courts have not ruled on the issue, British Columbia and Quebec have demonstrated that provinces can use either carbon taxes or cap-and-trade systems to price GHG emissions. The federal government also has a clear legal ability to price carbon, although exclusive provincial jurisdiction over natural resources and electricity generation likely puts the provinces at the centre of any carbon-pricing policy. Provincial authority may nonetheless have limits, particularly in terms of interprovincial trading, trade measures such as border carbon adjustments, and compliance with international treaties, all of which may require some involvement of the federal government (Courchene & Allan, 2008; Elgie, 2008). In the short term, however, the provinces clearly have considerable room to manoeuvre.

A province-driven approach is practical

Many people argue that a global problem requires a global solution. GHG emissions from any individual location in the world contribute to global climate change. A uniform carbon price, applied equally in all countries, would create equivalent incentives for all emissions reductions and ensure that no one jurisdiction was competitively disadvantaged. Not surprisingly, however, the multilateral approach to climate policy has proved to be very challenging. A "top-down" agreement that sets binding national targets has not yet emerged, even after many years of international discussion and negotiation. Perhaps in response to these difficulties, as negotiators move toward a potential new global agreement in Paris at the end of 2015, focus has shifted toward a more practical "bottom-up" approach, with nations taking on voluntary commitments (Flannery, 2014). How the recent bilateral agreements involving China, India, and the United States alter this dynamic remains to be seen.

The emergence of different provincial policies in Canada parallels developments in international climate policy. Previous research highlighted uniform, Canada-wide carbon pricing as economically ideal in principle (NRTEE, 2009). Yet important differences across the provinces—which are often underappreciated and even ignored—present challenges for any federal carbon-pricing policy. In particular, the perceived risks of financial redistributions among provinces can be politically divisive (Gibbons, 2009). Inside Canada, as with the multilateral efforts, a bottom-up approach driven by the provinces offers a practical path forward.

3.2 PROVINCES HAVE UNIQUE ECONOMIC AND EMISSIONS PROFILES

Provincial differences pose a challenge for many pan-Canadian policy discussions, and climate policy is no exception. A range of local factors can drive regional climate policy choices (Harrison, 2013). Given different emissions profiles and economic structures, the nature of the emissions-reduction challenge varies widely from province to province. Practical and successful policy must take into account these important differences, no matter which level of government is implementing the policy.

How then, are the provinces different? To set the stage, we explore provincial contexts through emissions and economic data.

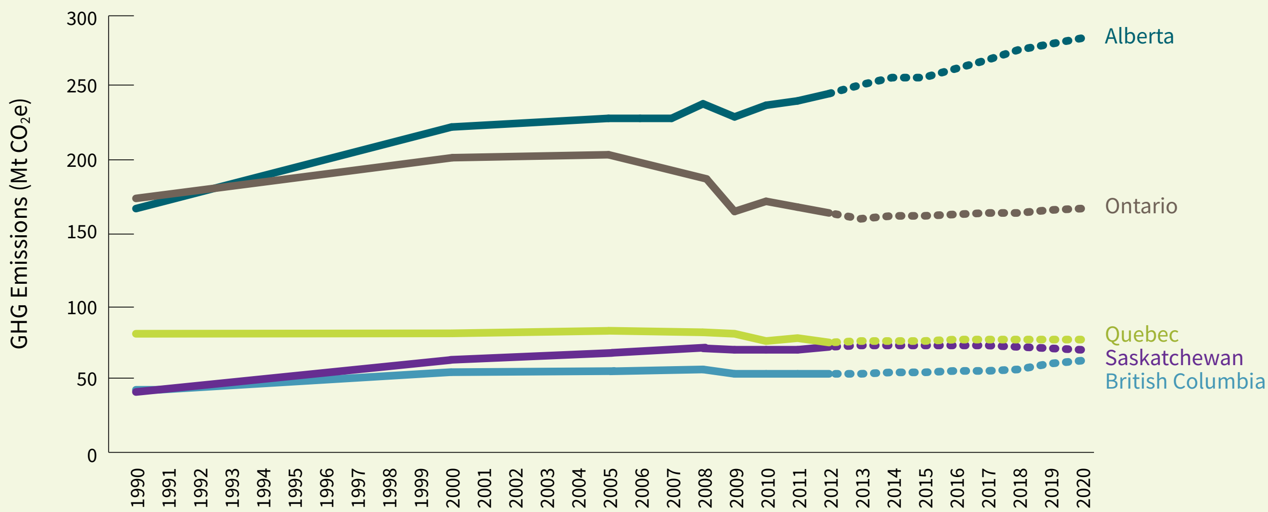
Provinces have different emissions profiles

Reducing GHG emissions is already a stated objective for each province. Yet the nature of this challenge is unique to the circumstances of each province, in terms of the levels of provincial GHG emissions, the rate at which emissions are changing over time, and the costs of abatement. Figure 3 draws on Environment Canada (2014a, 2014b, 2014c) data and analyses to show actual and projected emissions trends from 1990 to 2020.

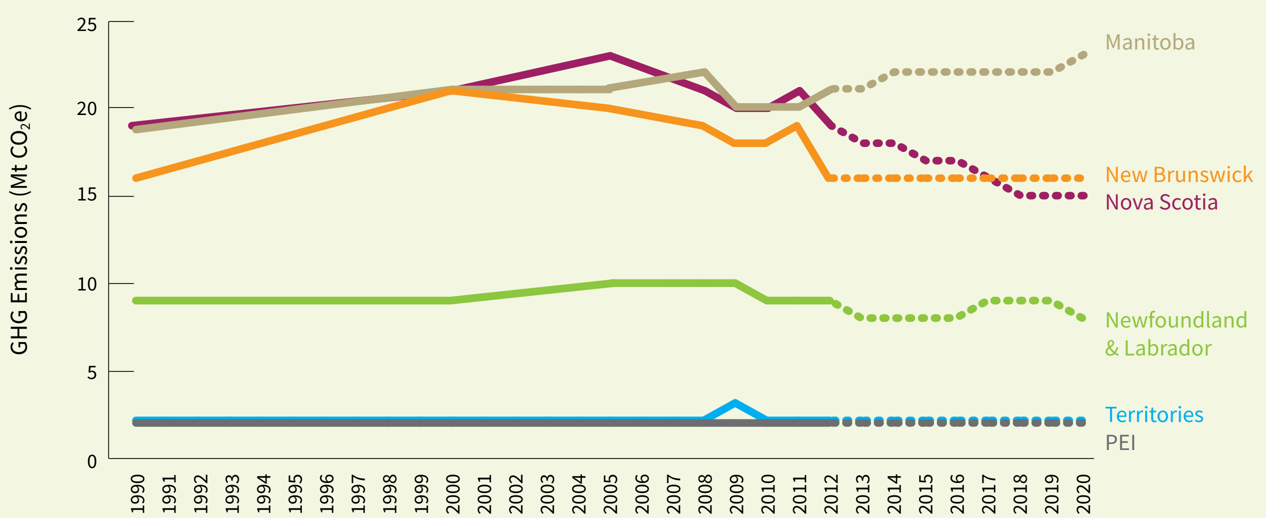
Emissions are attributed to the province in which they are created based on well-established accounting rules. Alberta's emissions, for example, include those associated with the production of oil and gas, but not the emissions associated with the consumption of its fossil-fuel exports to other jurisdictions. Similarly, Prince Edward Island consumes emissions-intensive electricity generated outside the province; yet these emissions are attributed to the site of generation, not to P.E.I.

FIGURE 3: Historical and Projected GHG Emissions by Province

Historical and projected GHG emissions for highest-emitting provinces



Historical and projected GHG emissions for smallest-emitting provinces and territories

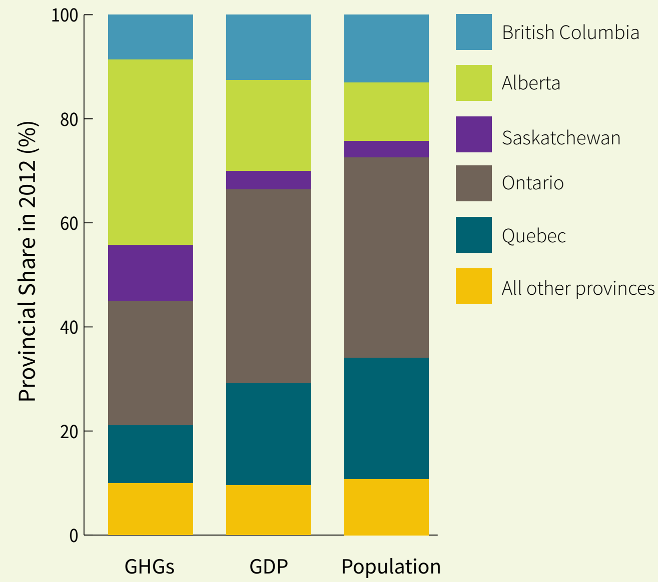


Five provinces made up 90% of Canada's GHG emissions in 2012. Alberta's emissions are projected to grow by 20% from 2012 to 2020, while other provinces have generally flat or declining projected trends. These data exclude international credits from land use, land-use change, and forestry.

Sources: Environment Canada (2014a, 2014c).

Table 1: Provincial Shares of GHG Emissions, GDP, and Population in 2012

Province	GHGs	GDP	Population
BC	8.6%	12.6%	13.1%
AB	35.7%	17.5%	11.2%
SK	10.7%	3.6%	3.1%
MB	3.0%	3.3%	3.6%
ON	23.9%	37.3%	38.6%
QC	11.2%	19.6%	23.3%
NB	2.3%	1.7%	2.2%
NS	2.7%	2.1%	2.7%
PE	0.3%	0.3%	0.4%
NL	1.2%	1.6%	1.5%
Terr	0.3%	0.5%	0.3%
Canada	100%	100%	100%



Sources: Environment Canada (2014b); Statistics Canada (2014b, 2014c).

The projected emissions paths to 2020, based on policies currently in place, are relatively flat in most provinces. As we will explore below, these trends suggest that even though the economies are growing, emissions per unit of GDP are actually falling. Part of this trend comes from ongoing improvements in technology and energy efficiency. Another part is due to policy: British Columbia's carbon tax, Ontario's phase-out of coal-fired plants, and federal vehicle regulations are examples of policies helping to reduce GHG emissions.

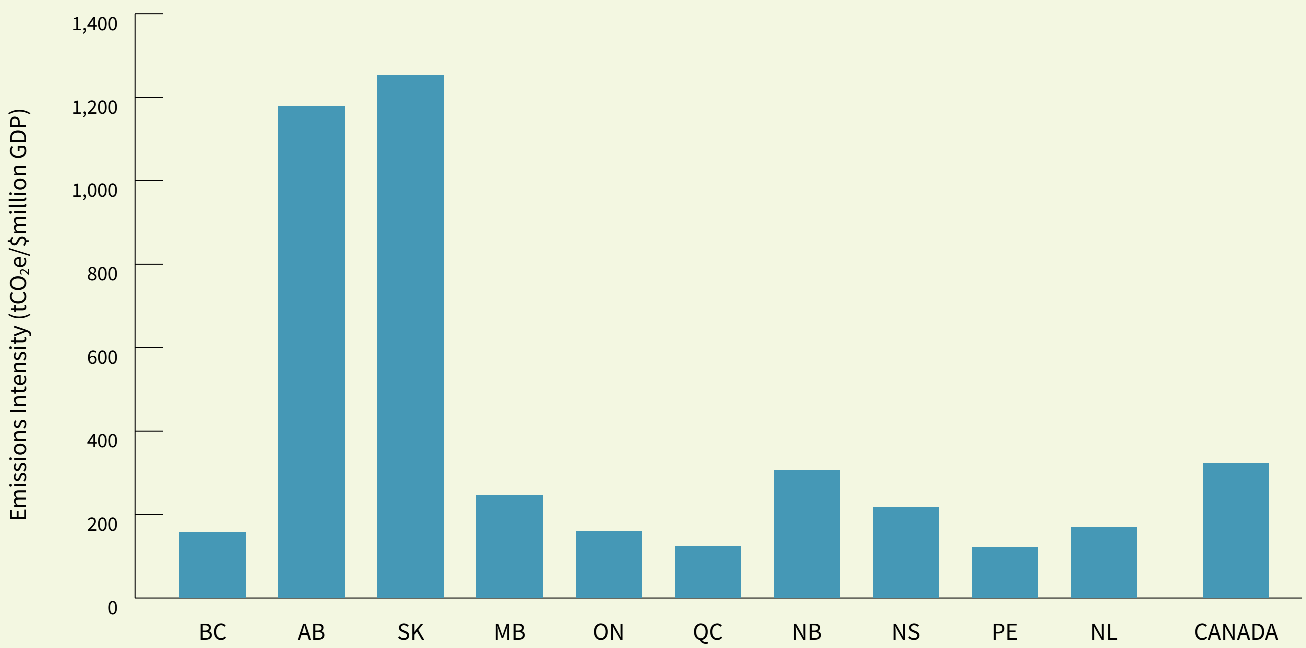
Alberta's GHG emissions, projected to grow by 20% from 2012 to 2020, are the one major exception. Projected growth in the oil sands is a key driver of the province's rising emissions, though this would likely change if oil prices persist at their current low level. While emissions from coal-fired electricity plants remain an important source of Alberta's emissions (approximately 14% of its total in 2012), the province's emissions growth to 2020 is largely due to the predicted expansion of its oil and gas sector.

About 90% of Canadian GHG emissions comes from five provinces: British Columbia, Alberta, Saskatchewan, Ontario, and Quebec; about 60% comes from Alberta and Ontario alone. While emissions in the smaller provinces matter, the five largest provinces are fundamental to the country's overall emissions and will therefore be the focus of the remainder of this section.

As shown in Table 1, provincial emissions are not necessarily proportional to population or economic size. Alberta and Saskatchewan stand out as the only two provinces with shares of national GHG emissions significantly larger than their shares of total population or GDP.

The distribution of emissions, GDP, and population across the provinces is central to the potential challenges of any centralized, federal approach to carbon pricing. Revenues generated from any federally imposed carbon-pricing policy would be proportional to the levels of GHG emissions. Approximately 36% of revenues would therefore be generated from Alberta, yet that province has only 18% of Canada's GDP and 11% of its population. Depending on the mechanisms by which revenues would be recycled back to the economy, Alberta and Saskatchewan would potentially contribute far more financially than they would receive through recycling. We return to this potential challenge below.

FIGURE 4: Provincial Emissions Intensity (GHGs per unit of GDP) in 2012



Provincial emissions intensity varies widely, with Saskatchewan having more than three times the emissions per dollar of GDP than the national average.

Sources: Statistics Canada (2014a, 2014b); Environment Canada (2014b).

Provinces have different emissions intensities

Emissions intensity, or the emissions produced per dollar of provincial GDP, is also quite different across the provinces. Figure 4 shows overall provincial emissions intensities in 2012, and displays their considerable variation across provinces. Alberta and Saskatchewan are the clear outliers, with emissions intensities more than three times the national average.

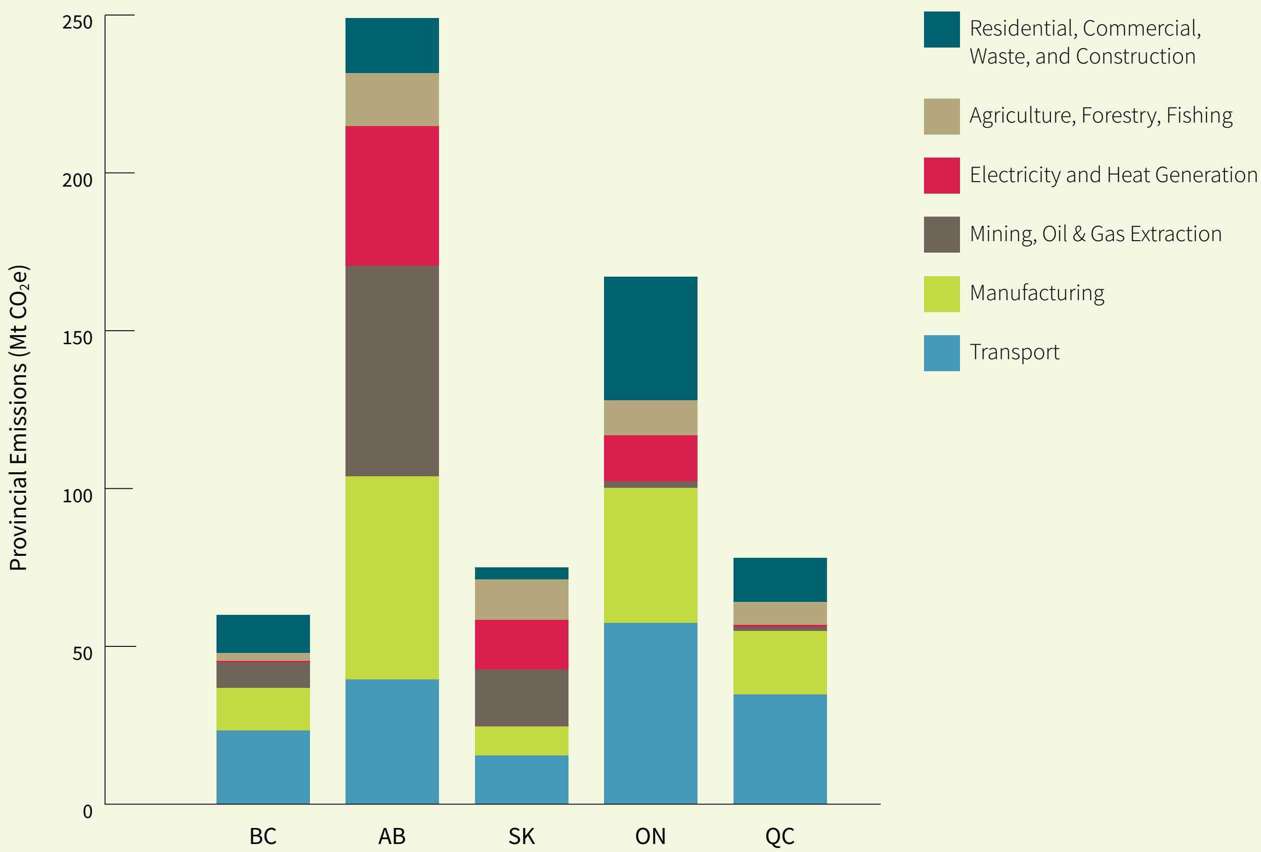
Structural differences between provincial economies are a key factor underpinning these differences in emissions intensity. Different sectors—with different emissions intensities—differ in their relative importance in different provinces. Figure 5 breaks down GHG emissions by sector for the five largest-emitting provinces in 2012. Four main differences between the provinces emerge from the data.

First, key emissions-intensive sectors, such as resource extraction (dark brown bars) and agriculture (beige bars), are concentrated in Alberta and Saskatchewan. Resource extraction makes up 27% and 24% of Alberta's and Saskatchewan's emissions, respectively, but less than 2% of Ontario's and Quebec's. Agriculture makes up 17% of Saskatchewan's emissions.

Second, there are important differences in the nature of manufacturing emissions (green bars). While some specific manufacturing sectors (such as cement) are emissions-intensive, much manufacturing is relatively non-intensive. Ontario's large and relatively non-intensive manufacturing sector contributes to its relatively small emissions profile, even though its manufacturing sector is the country's largest. On the other hand, manufacturing in Alberta includes emissions-intensive petroleum refining and bitumen upgrading. As a result, overall manufacturing emissions are larger in Alberta than in Ontario, even though Alberta's manufacturing sector is smaller in terms of economic output.

Third, transportation emissions by province have both similarities and key differences (light blue bars). On the one hand,

FIGURE 5: Provincial GHG Emissions by Sector in 2012



Composition of provincial GHG emissions varies widely, and helps explain differences in overall emissions intensity.

Source: Environment Canada (2014a).

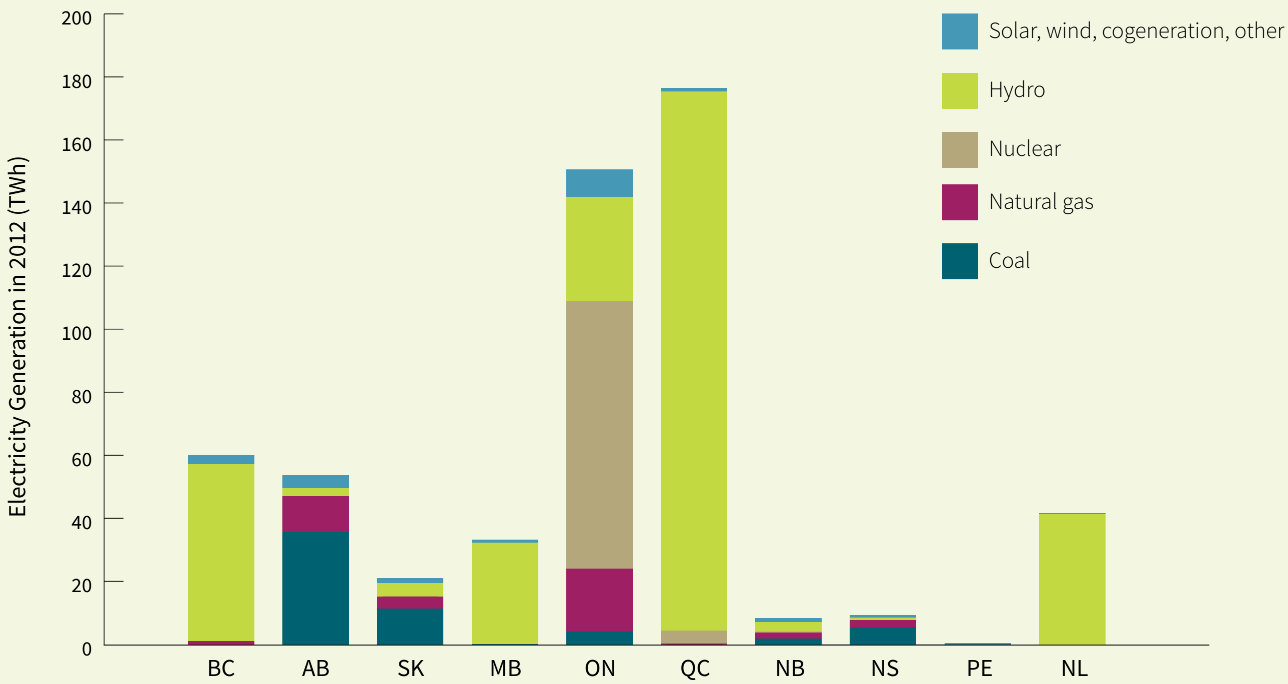
transportation is a major source of emissions for all provinces. Dependence on gasoline-consuming vehicles is common to all provinces, as is the general makeup of the fleet of passenger vehicles. As a result, national vehicle fuel-efficiency standards such as those imposed by the federal government can be both effective and cost-effective. On the other hand, Alberta's transportation emissions are disproportionately large, around twice those of Ontario on a per capita basis. Transportation emissions also include heavy-duty commercial vehicles; in Alberta, the use of these vehicles for transporting goods to the oil sands is a notable contribution to that province's total emissions (Environment Canada, 2014a).

Finally, different electricity systems are a crucial driver of the differences in provincial emissions intensities. Figure 6 shows electricity generation by province in 2012, but also breaks out the different sources of electricity.

These profiles highlight three main types of supply mixes. British Columbia, Manitoba, Quebec, and Newfoundland and Labrador rely almost exclusively on low-carbon hydroelectric power (green bars). Alberta, Saskatchewan, and Nova Scotia, meanwhile, continue to rely on emissions-intensive coal-fired plants (teal bars). Ontario and New Brunswick have a mix of natural gas, nuclear, cogeneration, hydro, and renewables. Since 2012, Ontario has completed its coal phase-out, and added additional renewable capacity.

Note that trade in electricity is not captured in Figure 6. Quebec, for example, exports substantial electricity to the United States, and so does not consume as much as it produces. In contrast, while all

FIGURE 6: Sources of Provincial Electricity Generation



Provinces have vastly different energy systems, with different levels and sources of electricity generation. British Columbia, Manitoba, Quebec, and Newfoundland and Labrador rely almost exclusively on hydroelectricity. Alberta, Saskatchewan, and Nova Scotia continue to rely on coal-fired combustion plants, while Ontario has a mix of gas, nuclear, cogeneration, hydro, and renewables. (Since 2012, Ontario has completed its coal phase-out, and added additional renewable capacity.)

Source: Environment Canada (2014a).

electricity produced in Prince Edward Island is generated through renewable wind power, it also consumes imported power from the United States, and so consumes much more than it generates.

Taken together, these provincial differences in economic structure, emissions intensities, and energy mixes naturally contribute to differences in political context and policy priorities. As a result, practical carbon-pricing policies would likely be designed within each province to reflect these differences. Box 3 considers how provincial economies respond differently to changes in important market prices, using the recent collapse in the world oil price as a particularly timely example.

3.3 PROVINCIAL CARBON PRICING OFFERS A PRACTICAL WAY FORWARD

The provincial differences above frame the challenges for Canadian climate policy. Although differences between provinces suggest that a uniform, countrywide carbon-pricing policy could reduce emissions at lowest cost, those same differences pose two main challenges for any federal approach to carbon pricing. First, a centralized approach, with carbon-pricing revenues accruing to the federal government, could create significant financial redistributions among provinces. Second, different economic contexts and policy priorities suggest that different policy designs and revenue recycling options could make sense in different provinces. Any practical approach to carbon pricing—whether provincial or federal—would need to seriously consider these issues.

Box 3: World Oil Prices and Canada's Provincial Economies

Major fluctuations in world commodity prices and exchange rates have diverse impacts in different parts of the Canadian economy.

The per-barrel price of West Texas Intermediate (WTI), a common North American benchmark, fell from US$105 in July of 2014 to below US$50 in February of 2015. This massive decline in the world oil price creates both losers and winners in Canada, with implications for income, government budgets, and GHG emissions.

Income

For firms and workers directly involved in the production of oil—concentrated in Alberta, Saskatchewan, and Newfoundland and Labrador—the price decline leads to an immediate and large reduction in income. As oil companies reduce their production, lay off workers, and scale back investment, the negative economic impact spreads to the many industries supplying Canada's oil sector.

In contrast, for consumers across the country and for businesses that use oil intensively, the decline in the world price is a significant financial windfall. Consumers find that heating their homes and filling their gas tanks is cheaper than before, and more money is thus available for other uses. Firms that use oil-based products as inputs find the decline in costs improves their competitiveness, fuelling an expansion in sales and employment. For consumers, these gains occur across the country; this is also true for firms, but their largest concentration occurs in Ontario and Quebec—still the heart of Canadian manufacturing.

The decline in the world oil price also leads to a depreciation of the Canadian dollar, which stimulates exports of a wide range of Canadian products, thereby dampening the direct negative impact on the country's economy. In the oil-importing provinces, which suffer little or no direct reduction in activity from the declining oil price, the weaker currency has an important expansionary effect.

For Canada as a whole, which is a significant net exporter of crude oil, the decline in the world oil price leads to a decline in overall economic activity. The economic decline in the oil-exporting provinces offsets the expansions in the oil-importing provinces. The Bank of Canada's estimate for overall GDP growth in 2015 was adjusted downward from 2.4% to 2.1%, largely as a result of the decline in the world price of oil (Bank of Canada, 2015).

Government budgets

Changes in the world price of oil also have important implications for the fiscal situations of provincial governments. In each of Alberta, Saskatchewan, and Newfoundland and Labrador, earnings from natural resources in 2014 represented between one-quarter and one-third of its government's annual program spending. The decline in the world oil price significantly reduces these revenues and forces the governments into cutting spending, raising taxes, or increasing their budget deficits.

For the non-oil-producing provinces, the reduction in the price of oil, combined with the depreciation of the Canadian dollar, works to stimulate economic growth. Along with the higher growth, the government's tax base also expands. Governments in these provinces with existing budget deficits may therefore find a return to a budget balance easier in a world of low oil prices.

The decline in expected Canadian GDP growth caused by the oil-price decline also affects the fiscal situation of the federal government. TD Economics (2015) estimates that the federal budget, which in early 2014 was expected to have a small surplus in each of the 2015 and 2016 fiscal years, is now expected to remain in deficit until 2017.

Box 3 continued

Greenhouse gas emissions

Sustained low oil prices will lead to less production of oil and other petroleum products, and as a result, fewer emissions of GHGs. Any decline in investment in oil sands projects will result in slower growth of Alberta's emissions. Alberta and Saskatchewan might therefore come closer to achieving their existing GHG emissions targets, and Newfoundland and Labrador may achieve its current target by a larger margin.

Emissions associated with energy consumption, on the other hand, are likely to be higher, as firms and households consume more petroleum products. (The magnitude of this effect depends on how sensitive petroleum demand is to changes in its price.) Drivers may drive more, and even choose less-efficient vehicles. Manufacturing sectors will produce more output and also more GHG emissions. Consequently, Ontario and Quebec will likely face greater challenges in achieving their targeted emissions reductions.

Whatever changes are created in Canada's economy as a result of fluctuations in the world price of oil, such changes do not affect the underlying case for carbon pricing as a means of addressing climate change. Whether oil prices are high or low, carbon-pricing policies create powerful market incentives for reducing GHG emissions.

A decentralized approach—with carbon-pricing policies designed and implemented by each province—is a practical and expedient way to move forward. The practicality of this approach is explained below.

Provincial policies can sidestep the difficult issue of burden sharing

Not stated in the federal government's current target for Canada's emissions reductions (17% below 2005 levels by 2020) is the issue of how the required reductions are to be distributed among the provinces. As discussed above, provincial emissions and emissions intensities are far from uniform. The distribution of provincial emissions reductions, therefore, has significant implications for the distribution of the associated burden.

As noted in Section 2, however, the provinces have also established their own emissions-reductions targets. If each province were to successfully achieve its own target, and Canada received the expected credits for emissions reductions from land use, land-use changes, and forestry, Canada would come very close to complying with the current federal target under the Copenhagen Accord.

Provincial policies can avoid financial redistributions among provinces

Just as burden sharing affects the regional distribution of the *costs* of policy, the allocation of carbon-pricing revenue affects the distribution of *benefits*. A decentralized approach to carbon pricing could ensure that all carbon revenue would be recycled inside the province in which it is generated. For example, even though more total revenue might be generated in Alberta (given its larger emissions), the primary benefits of recycling this revenue would similarly be experienced within Alberta. Revenue generated in one province would not be recycled to another.

In principle, a federal policy could be designed to prevent interprovincial redistributions, with all revenues returned to the province in which they were generated (Snoddon & Wigle, 2009; Snoddon, 2010). Given the scale of the potential revenues and the relationship between these revenues and the existing federal equalization program, many details would need to be studied thoroughly. As a result, some provinces might understandably be concerned about how such a policy would be implemented in practice. In contrast, a policy approach based on provincial action avoids this important complication in a simple and transparent manner.

Provincial policies can be designed to suit provincial priorities

A provincial approach to carbon pricing would not only ensure that each province kept its own carbon revenue, it would also allow each province to determine *how* its carbon revenue would be recycled. Different approaches to revenue recycling—reducing other taxes, investing in technology or infrastructure, protecting vulnerable Canadians or sectors, or some combination of these approaches—have different benefits and costs. Any government's chosen approach would naturally reflect its provincial priorities. Just as provinces have different economies and emissions profiles, so too do they have different political and policy priorities. Province-led carbon-pricing policies would also allow for other policy details to be customized to each province. British Columbia and Quebec, for example, have implemented different policy instruments to price carbon. Each has advantages and disadvantages, but these trade-offs may play out in different ways in different provinces. We return to this issue in Section 5.

Provinces can serve as laboratories for learning about best practices

As carbon pricing continues to evolve in Canada, it is hardly surprising that we observe a considerable *range* of policy designs. Such diversity can provide important benefits for policymakers, especially over time. Competing policy ideas can allow us to learn about the strengths and limitations of different options (The Climate Group, 2014). Provincial approaches can be monitored to draw lessons for policy improvement, leading to the diffusion of the most effective policy ideas (Sawyer et al., 2013; Belanger, 2011). Such "policy diffusion" can be an important pathway for better policy in the longer term (Aulisi et al., 2007; Jänicke, 2005). Indeed, lessons are already beginning to emerge from the policy experiences in British Columbia and Alberta, as discussed in Box 4.

Our shared history has shown that pan-Canadian policy need not be the creation of the federal government. Education at all levels, publicly financed health care, and labour-market training are just three spheres of many in which broadly similar policies exist across the country, even though individual provinces operate their own systems in their own ways. Furthermore, provincial policies have often been the source of policy innovations that have also spread across the country. Saskatchewan led in the creation of public health care, while both Alberta and Saskatchewan led the fight against public budget deficits. In both cases, what started as unique provincial priorities have become entrenched as pan-Canadian economic values.

3.4 POLICY CAN BECOME MORE COORDINATED AND COMPREHENSIVE OVER TIME

This section has laid out a practical path forward for Canadian carbon pricing. Yet in the end, a comprehensive and coordinated system is desirable across the country. Despite the significant benefits of provincial carbon pricing, such an approach has one key disadvantage: the possibility that different provincial systems will lead to a range of carbon prices across the country—and perhaps to some provinces having no price at all. Over time, a more comprehensive and coordinated policy can be achieved in several ways.

Over time, coordination of provincial policies is desirable

The coordination of provincial policies is desirable for four reasons. First, strong policy in some provinces and weak policy in others, reflected in differentials in carbon prices, could result in inexpensive emissions reductions being left unrealized. The most cost-effective approach to pan-Canadian policy is to have a single carbon price applied to as large a share of national emissions as possible.

Second, provincial differences in policy introduce the possibility of interprovincial competitiveness issues that benefit neither the economy nor the environment. Firms in emissions-intensive industries could face incentives to move their facilities to jurisdictions with weaker policies, thereby relocating an unchanged level of GHG emissions and increasing the economic costs for those provinces with more ambitious policies.

Third, a decentralized approach can lead to insufficiently stringent policy. While setting targets is politically easy, implementing effective policy comes with clear challenges. If implementing policy is perceived to be costly, individual provinces would have an incentive to avoid using strong policies, hoping the other provinces will make the tough choices. As in the case of international climate politics, individual provinces may tend to free-ride on the policy actions of others. And provinces with more expensive emissions reductions may be particularly less inclined to take action (Harrison, 2013).

Box 4: Policy Lessons from British Columbia and Alberta

British Columbia's revenue-neutral carbon tax has been in place since 2008, and Alberta's Specified Gas Emitters Regulation (SGER) since 2007.

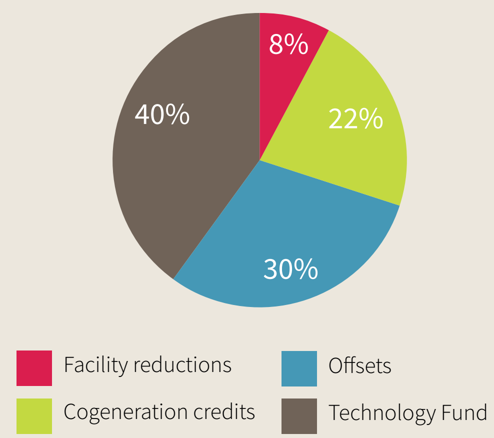
The evidence so far suggests that the impacts of the two policies are quite different. As we discuss in Section 5, differences in the *stringency* of the policies are a key explanatory factor.

Trends in B.C. relative to the rest of Canada provide preliminary evidence as to the effect of B.C.'s carbon tax. Fuel use per capita declined by 16% in the first six years, but increased by 3% over the same period in the rest of Canada. These provincial differences cannot be explained by differences in economic growth: over the same period, B.C.'s economy grew by 1.8%, as opposed to 1.3% in the rest of the country (Elgie, 2014).

Econometric analysis supports this preliminary finding. Rivers and Schaufele (2012) estimate that the tax led to a reduction of more than 3 Mt of gasoline-related GHG emissions. They reject alternative explanations such as cross-border shopping and other vehicle-efficiency policies as likely explanations of the emissions reductions.

Additional research is beginning to emerge on other impacts of B.C.'s policy. Preliminary analysis, for example, suggests that the combination of the carbon tax and the corresponding reductions in other taxes has led to an increase in aggregate employment within the province (Yamazaki, 2014).

Alberta's SGER policy appears to be much less effective. The share of total emissions priced by the policy was only about 3% in 2012. Specific design details dilute the policy's effectiveness in reducing GHG emissions. For example, in lieu of reducing emissions, emitters can comply with the policy by purchasing offsets, receiving credits for cogeneration, or by contributing to the province's Technology Fund. The figure at right shows the breakdown of actual compliance from 2007 to 2012, cumulatively. The significant fraction (52%) of compliance obligations satisfied through credits and offsets is a source of some concern. Given that some of these offsets and cogeneration projects were in place before the regulation, concerns exist over the policy's genuine contribution to *marginal* emissions reductions (Horne & Sauve, 2014).



Source: Alberta Environment (2014).

Statistical analysis provides further evidence on the limited effectiveness of Alberta's SGER. Preliminary analysis from Rajagopal (2014) finds that the regulation had no significant impact on annual GHG emissions or even emissions intensity for average facilities in all sectors.

Fourth, a diverse patchwork of policies can be complex and expensive for businesses with operations in multiple provinces. Different compliance and reporting rules can increase transaction costs for firms. The harmonization of procedures for measurement and verification between provincial policies can address this problem.

A range of different mechanisms for more coordinated and comprehensive policy could be part of a pan-Canadian provincial approach to carbon pricing. Either provincial or federal approaches to coordination can be effective; a future report from Canada's Ecofiscal Commission will explore options in more detail.

Provincial governments could coordinate their policies

Coordination could emerge from continued provincial cooperation. For example, the Council of the Federation (2014) suggests provincial carbon-pricing policies could be part of a coordinated, province-led national energy strategy.

One possible method of coordination is *linkage*, which allows for the trading of emissions permits between regional cap-and-trade markets. The result is a consistent carbon price, and more cost-effective policy overall (Jaffe & Stavins, 2008). Linkage allows regions with higher abatement costs to reduce fewer emissions, and regions with lower costs to reduce more. As a result of a joint market, emitters in both jurisdictions can benefit. Quebec and California, for example, are currently linking their permit markets as part of the Western Climate Initiative.

Other mechanisms for linkage also exist, including access to a common offset market (Jaffe & Stavins, 2008; Aldy & Stavins, 2011; Ranson & Stavins, 2012).[1] Prices in different cap-and-trade systems would converge to the market price of offsets, thereby leading to a consistent carbon price. Even carbon taxes could be linked with other carbon-pricing instruments via shared offset markets.

Provinces could also align their carbon-pricing policies without formal linkage. By aligning policy design elements with other provinces, such "linking by degrees" would allow the provinces to share best practices and reduce the administrative costs of implementing policies (Burtraw et al., 2013).

The federal government could help the provinces coordinate

Alternatively, the federal government could play a useful role in provincial coordination. To be effective, federal coordination would need to focus on two main elements of the provincial policies: *stringency* and *revenue recycling*.

The most centralized approach to coordination would involve an eventual shift toward a uniform federal policy. Under this approach, such a nationwide policy would eventually replace provincial policy. The most economically efficient federal approach would involve a consistent carbon price across the country. Yet, if federally implemented, this approach would encounter a significant hurdle. All revenues generated by the federal carbon price would naturally flow to Ottawa—unless some element of the policy design prevented such financial flows.

Snoddon and Wigle (2009) and Snoddon (2010) propose a revenue recycling approach to address this problem. They suggest that the federal government could set the overall stringency of policy but decentralize revenue recycling by sharing the revenue with provincial governments. Similarly, Peters et al. (2010) argue that recycling all revenue back to the province in which it was generated could ameliorate distributional impacts between regions.

Alternatively, equivalency agreements between federal and provincial governments could provide a mechanism for the coordination of provincial policies. Federal policy could establish a minimum standard (e.g., a minimum carbon price), but allow provinces to implement provincial policies to match or exceed this level. Nova Scotia, for example, has signed an equivalency agreement with the federal government that exempts it from the federal coal-fired electricity GHG regulations (Canada, 2013). The Nova Scotia renewable energy standard achieves equivalent emissions reductions. In the face of potential federal oil and gas regulations, various provinces have explored the potential of equivalency agreements that would allow them to implement provincial policies (including carbon-pricing options) and thereby be exempted from the federal regulations. No policies have been finalized, however, since the federal regulations were put on hold (Sawyer et al., 2013).

[1] Offsets are credits for emissions reductions that can be purchased by regulated emitters from emitters not regulated under a carbon-pricing policy (e.g., forestry, waste, agriculture).

International experience highlights a range of approaches to coordination

International examples illustrate both more and less centralized approaches to coordination. The European Union's Emissions Trading System (ETS) is a continent-wide cap-and-trade system. In the early phases of the ETS, individual EU states made their own design decisions about the stringency of their caps and how permits were allocated, with some guidance and approval from the European Commission. Over time, the policy has become more centralized, with the Commission setting overall continental emissions caps and increased permit auctioning (Ellerman, 2008; and International Carbon Action Partnership [ICAP], 2015).

An overall approach in which policy stringency is set centrally, but all other details of policy design are decentralized, is now emerging in the United States. Regulations from the U.S. Environmental Protection Agency (EPA) essentially require states to implement state-level policies no less stringent than the EPA's emissions guidelines. States can use existing policies or craft new ones, customized to the unique elements of their own economies and energy systems (Konshnik & Peskoe, 2014). This emerging approach builds on pre-existing policy leadership at the state-level (Rabe, 2008).

Similarly, China has been moving forward with a more decentralized approach, involving seven provincial and municipal pilot cap-and-trade systems. China's National Development and Reform Commission announced these initiatives in 2011. As of June 2014, all seven are in operation, with local governments managing the design and implementation of the pilot programs. As a result, design choices such as sector coverage, auctioning, allowance schedules, and other details are specific to each system. These differences allow China to accumulate experience and inform the development of its national cap-and-trade system, planned to start between 2016 and 2020. While it is still too early to know how the pilot programs will link to the national program, the most successful pilot programs will likely be used as models (World Bank, 2014a; Munnings et al., 2014).

4 THE COST-EFFECTIVENESS OF CARBON PRICING

The previous section made the case that provincially led carbon-pricing policies are a practical path forward for achieving greater emissions reductions in Canada. But why the focus on carbon pricing, rather than on other policy approaches?

Carbon pricing's big advantage is that it can drive a given amount of emissions reduction at lower cost than alternative policies. Firms and households facing a carbon price have the flexibility to choose how best to reduce their emissions and avoid paying the carbon price—whether by reducing their emitting activities or by investing in low-carbon processes and technologies. The result of this flexibility is that emissions reductions throughout the economy are achieved at lowest cost. A carbon price also generates revenue that, if used wisely by government, can create additional economic benefits.

This section uses a formal macroeconomic model to demonstrate the benefits of using carbon pricing for reducing GHG emissions relative to a less flexible regulatory approach.

4.1 ECONOMIC MODELLING OF GHG EMISSIONS REDUCTIONS

Though economic models are necessarily a simplification of the actual economy, they are invaluable for illustrating key insights and for comparing the effects of alternative policies.

The modelling framework is well suited to cost-effectiveness analysis

Analysis in this section applies a "computable general equilibrium" model of the Canadian economy to explore provincial policy options.[2] This model simulates the pattern of production and trade throughout the economy and is particularly useful for comparing alternative policy options in terms of likely macroeconomic outcomes. For technical details, see the description in Böhringer et al. (2015).

The model used here has several key features:

- It includes explicit representation of each province (given their size, Prince Edward Island and the territories are combined), showing the unique patterns of production and consumption in each province as well as the trade flows between them. This representation is based on input-output tables from Statistics Canada.
- The model includes rich detail on energy use and GHG emissions, but also includes non-energy emissions from industrial processes and agriculture.
- Canada is modelled as a "small open economy," which trades goods and services with the rest of the world, but does not influence international terms of trade.
- The model includes 17 industrial sectors within each province, representing a wide range of emissions profiles and abatement costs.
- By representing the full Canadian economy, the model can capture the implications of climate policies for production, consumption, prices, and both international and interprovincial trade.

[2] Computable general equilibrium (CGE) models are a type of analytical tool used to assess the impacts of policy changes on the economy. Such models are "computable" in that they are solved numerically; they are "general" in that the model considers all sectors of the economy; and they solve for an "equilibrium" in which all markets clear simultaneously. CGE models are commonly used in macroeconomic analyses.

- The model has been developed by top modelling experts in Canada and internationally, and has been used in an academic setting (e.g., Böhringer et al., 2015), but also in applied policy contexts by Environment Canada.

The model's rich detail on industrial sectors, energy, and GHG emissions allows for a thorough assessment of distinct provincial carbon-pricing policies. And because the model represents the full Canadian economy and is grounded in economic theory, it is well suited to consider the relative costs of different policy options.

As with all economic models, however, there are limitations. The complexity of the model in terms of its regional and sectoral detail comes at some cost. In particular, the model is based on assumptions around existing technologies, and does not allow for the possibility that new technologies and processes might be developed in response to carbon pricing. While the model is very useful in comparing different scenarios, it is less well suited to predicting specific future outcomes; more can be learned from the relative changes in GDP between scenarios, for example, than from the levels within any one scenario. Finally, the model is static and therefore does not consider important dynamics, such as the process of capital accumulation. We return to these limitations later in this section.

Four modelling scenarios illustrate the range of policy options

The analysis in this section considers four policy scenarios, described in Table 2. These scenarios are defined in terms of the policy's stringency, flexibility, and revenue recycling. Comparing model outcomes under these scenarios allows us to better understand the benefits of the various aspects of carbon pricing.

Table 2: Modelling scenarios

Scenario	Stringency sufficient to achieve provincial targets	Flexibility within provinces	Revenue recycling	Flexibility between provinces
1. Inflexible regulations	✓			
2. Flexible policies	✓	✓		
3. Ecofiscal policies	✓	✓	✓	
4. Linked ecofiscal policies	✓	✓	✓	✓

All four scenarios assume that each province implements a policy sufficiently stringent to achieve its own provincial target for GHG emissions. With stringency held constant across all scenarios, we can then compare the cost-effectiveness of various policies. The analysis uses the provinces' existing stated targets as a benchmark. (This approach does not endorse these existing targets; it simply uses them as a means of comparing alternative policy approaches.)

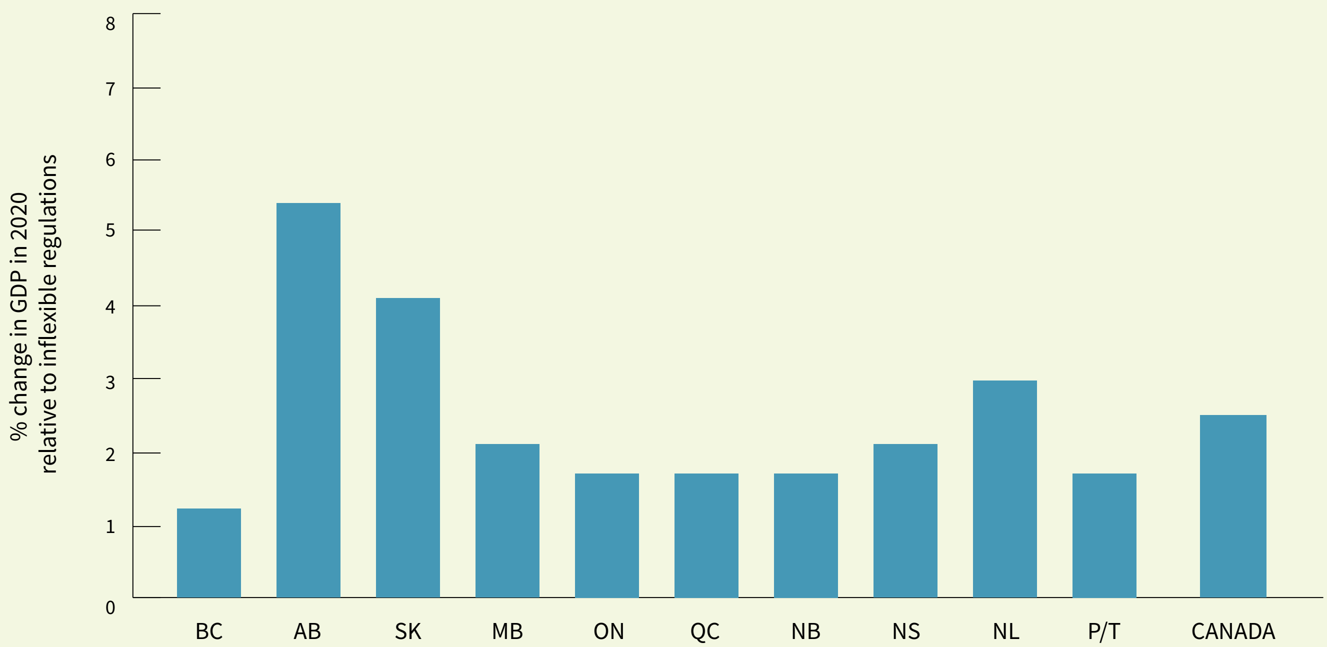
Scenario 1: Inflexible Regulations. This scenario assumes that the provinces achieve their emissions targets using inflexible regulations; each sector within the province reduces its emissions by the same percentage amount, whatever its relative abatement costs. In addition, the policy does not generate revenue to be recycled back to the economy. Scenario 1 approximates an inflexible regulatory policy in which emitters bear the costs of their emissions reductions, but pay no price on their remaining GHG emissions.

Scenario 2: Flexible Policies. This scenario introduces flexibility within each province. Each province still achieves the required reductions as a whole, but the contributions of different sectors vary according to their relative costs of abatement. This scenario replicates the effect of a carbon-pricing policy in one important way: the marginal abatement costs of all emitters are equated (and so total provincial emissions reduction is achieved at least cost). However, unlike a genuine carbon price, this scenario generates no revenue to be recycled.[3] Scenario 2 could represent provincial cap-and-trade systems with permits allocated for free, or a set of "smart" regulations designed to maximize flexibility between sectors.

Scenario 3: Ecofiscal Policies. This scenario represents a set of independent provincial ecofiscal policies. Full flexibility exists within each province, as in Scenario 2. As a result, a single carbon price exists within each province. But the policy also generates revenue,

[3] Scenario 2 is modelled using a provincial carbon price with revenue recycled back to the economy via lump sum payments. This approach is a non-distortionary approach to revenue recycling; it results in no substitution effects, other than those induced by the price of carbon.

FIGURE 7: Benefits of Policy Flexibility



The figure shows the benefits of using flexible (rather than inflexible regulatory) policy to achieve provincial GHG emissions-reduction targets. Flexibility improves cost-effectiveness of carbon policy for all provinces (P.E.I. and the territories are combined as P/T). For the country as a whole, flexibility can increase GDP by 2.5% relative to inflexible regulations.

Source: Ecofiscal Commission modelling.

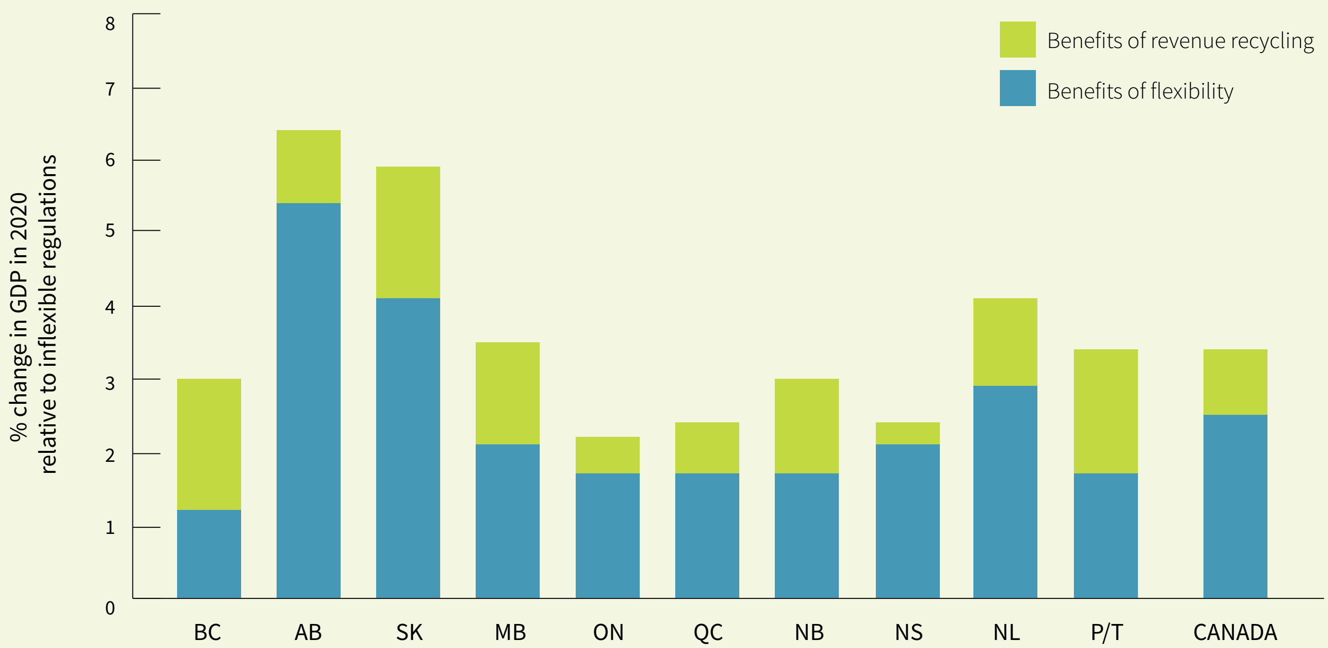
which in this case is used to reduce personal income taxes in each province. Each provincial policy is independent: so all revenue stays within provincial borders. Note that only one option for revenue recycling—reducing personal income taxes—is considered. The analysis is meant to be illustrative and not to preclude other options for revenue recycling. Future research from the Ecofiscal Commission will explore alternative recycling options.

Scenario 4: Linked Ecofiscal Policies. In this scenario, provincial governments are assumed to implement the same policies as in Scenario 3, but now allow for permit trading between provinces. As a result, emitters in provinces with higher marginal abatement costs can purchase emissions permits from provinces with lower marginal abatement costs. The result is the same total amount of emissions reduction for Canada, but a single carbon price across all provinces.

Modelling shows benefits of policies relative to inflexible regulations

The objective of the modelling analysis is to assess the cost-effectiveness of different policy approaches to achieving a given level of emissions reduction. We use Scenario 1 (inflexible regulations) as the benchmark, against which we compare the benefits of the other three policy scenarios. This approach reflects the Commission's view that the relevant policy question is not about *whether* to achieve a given level of emissions reductions, but rather *how* best to achieve such reductions. The analysis measures these benefits in terms of improvements in provincial GDP relative to the benchmark (where GDP is the total value of income and production generated within each province).

FIGURE 8: Benefits of Policy Flexibility and Revenue Recycling



The figure shows the economic benefits of policy flexibility (blue) and of revenue recycling (green) relative to inflexible regulations. Revenue recycling can generate benefits for all provinces; for Canada as a whole, it can improve an already-flexible policy by 0.9% of GDP.

Source: Ecofiscal Commission modelling.

4.2 BENEFITS OF POLICY FLEXIBILITY

One of the key benefits of ecofiscal policy is its flexibility. Ecofiscal policies work through increasing the economic incentives for emitters to reduce their emissions, who then respond by seeking out the most cost-effective emissions reductions. To assess the magnitude of these benefits, we compare scenarios with and without flexibility (Scenarios 1 and 2). Figure 7 shows the percentage change in GDP from introducing policy flexibility.

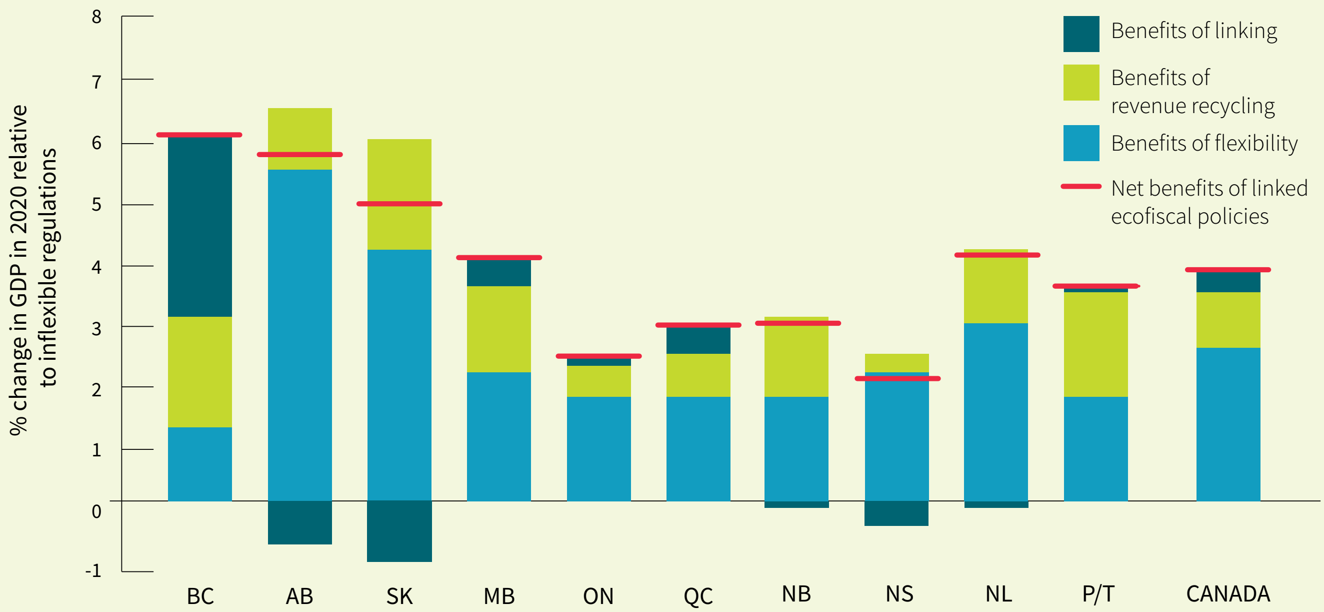
Relative to the use of inflexible regulations, flexible policy increases GDP in all provinces, by an average of 2.5%. As should be expected, these benefits are larger for provinces in which the costs of abatement vary widely within the province: flexibility allows for fewer emissions reductions in sectors with high costs of abatement, but more reductions in sectors with lower abatement costs.

In Alberta, for example, electricity generation with coal-fired plants is highly emissions-intensive. Yet emissions reductions from switching to alternative sources (such as high-efficiency natural gas) can occur at relatively low cost. Gas power is only slightly more expensive than coal without a carbon price, and has a cost advantage even at relatively low carbon prices. As a result, policy flexibility allows electricity generation to contribute more emissions reductions, while sectors with limited options for abatement, such as cement manufacturing, contribute fewer.

In contrast, the benefits of flexibility for British Columbia are relatively modest. With no production of coal-fired electricity, B.C. has fewer lower-cost emissions reductions available. Further, given B.C.'s very ambitious target, deep reductions are required throughout the economy, limiting the benefits of flexibility in this case.

Nova Scotia is a special case, as it is on track to achieve its currently stated provincial target even without new policies; unfortunately, it will achieve its target mostly through the ongoing decline of its industrial base and its associated emissions. (The developments in offshore natural gas and oil could change the province's emissions and economic trends.) As a result, no

FIGURE 9: Benefits of Policy Flexibility, Revenue Recycling, and Linking



Interprovincial linking (with a single Canada-wide carbon price) can slightly improve cost-effectiveness of carbon policy for Canada overall, with some mixed impacts for individual provinces. It can increase Canadian GDP relative to inflexible regulations by about 0.4% in addition to the benefits of flexibility discussed above.

Source: Ecofiscal Commission modelling.

additional provincial policy is required for Nova Scotia. Yet, given provincial trade, Nova Scotia experiences secondary impacts of carbon policies implemented in *other* provinces. A key factor in this result is interprovincial linkage: Nova Scotia can increase its emissions and *still* achieve its target. Consequently, emitters in Nova Scotia have an advantage over others in Canada, and so produce a greater number of emissions-intensive products, such as cement, while provinces with more aggressive policies produce fewer.

4.3 BENEFITS OF REVENUE RECYCLING

Unlike regulations, ecofiscal policies generate revenue for the government that can be recycled back to the economy in a variety of ways, further improving the cost-effectiveness of policy. This *revenue recycling* is the second key advantage of ecofiscal policies.

Modelling results, shown in Figure 8, illustrate these provincial benefits. In addition to providing flexibility from carbon pricing within the province, the policies also generate revenue, which in this modelling exercise is used to reduce personal income taxes. Each provincial policy is independent, with all revenue staying within the province. In reality, several approaches to revenue recycling are available, and we explore this further in Section 5. The purpose of this modelling exercise is simply to illustrate the benefits of revenue recycling relative to a regulatory approach. It is not to suggest that reducing personal income taxes is the preferred way of recycling.

Revenue recycling leads to benefits for all provinces and for the country as a whole. In this scenario, the benefits come from reducing existing income taxes; as is usually the case in computable general equilibrium models, income taxes reduce both work effort and GDP. The modelling suggests that revenue recycling can improve cost-effectiveness for Canada by 0.9% in terms of GDP—over and above the benefits from policy flexibility. Combining both benefits, provincial ecofiscal policies are more cost-effective than inflexible regulations by 3.4% of GDP in 2020.

Note the variation across provinces in terms of the benefits from revenue recycling. This variation is partly explained by the existing variation in provincial income tax rates. Manitoba, New Brunswick, and Quebec, for example, have relatively high personal income tax rates, and so experience greater benefits than other provinces from reductions in these taxes.

4.4 BENEFITS OF INTERPROVINCIAL LINKAGE

The analysis has so far considered policy in each province independently. Flexibility *between* provinces can further improve cost-effectiveness of Canada's overall emissions reductions. Scenario 4 represents the case of *linked* provincial ecofiscal policies.

The first three modelling scenarios require each province to achieve its own emissions target in 2020, independent of the policies in other provinces. Yet considering each province's target in isolation may result in one province incurring relatively costly emissions reductions, while another leaves lower-cost reductions unrealized. Such an outcome would not be cost-effective for the country as a whole, but would occur if the carbon prices were not equalized across the provinces.

With the modelling assumptions of Scenario 3, provincial carbon prices vary notably across the provinces. British Columbia's ambitious emissions-reduction target, for example, requires a higher price than in other provinces. In contrast, Alberta's less stringent target requires only a low carbon price.

The benefits of linking provincial policies emerge because, for the country as a whole, the most cost-effective approach occurs when the carbon price is equalized across provinces. Figure 9 shows the benefits of linking the provincial systems through permit trading (light blue bars), a process that produces a consistent Canada-wide carbon price. Similar to the agreement between Quebec and California, linked cap-and-trade systems allow permit trade between emitters in different provinces.[4] Firms with lower abatement costs in one province reduce more emissions, and sell permits to firms in other provinces with higher abatement costs. The result is a consistent carbon price across all provinces.

Two key findings emerge from this analysis, each with implications for Canadian policy. First, the benefits of linking are not distributed evenly across the provinces, and linking even leads to decreases in GDP in some provinces. Second, the overall benefits of linking are generally modest relative to the benefits of flexibility and revenue recycling. We discuss each finding in more detail below.

Uneven benefits of interprovincial linkage

Simple models of linkage suggest permit trading should benefit both buyers and sellers. Buyers purchase low-cost reductions from other provinces, avoiding higher-cost reductions at home. Sellers implement additional emissions reductions at lower cost than the value of the permit they sell. The results for British Columbia, for example, illustrate these benefits. B.C. has deep provincial targets and has higher abatement costs given the low carbon intensity of it hydro-based electricity system. Under linking, B.C.'s firms therefore purchase a large number of permits from other provinces, and avoid higher-cost emissions reductions at home. Other provinces, such as Manitoba, Ontario, and Quebec, see similar benefits, leading to an overall benefit of linkage for Canada.

In terms of the overall impact on provincial GDP, however, the model's general equilibrium results are more complex than this simple intuition. This complexity highlights the potential challenges of linking, particularly for net permit sellers. Saskatchewan, for example, sees a small decrease in its GDP. Saskatchewan has a relatively shallow target, but also has access to relatively low-cost emissions reductions, particularly from its coal-fired electricity plants. Saskatchewan's firms therefore sell a large number of permits to other provinces and achieve benefits by earning more on their permit sales than they incur in costs from their emissions reductions. While this transaction makes sense for the individual emitters selling permits, it leads to an increase in the price of carbon in Saskatchewan, increased costs for other emitters in the province, and a small net decrease in provincial GDP. Saskatchewan, Nova Scotia, New Brunswick, and Newfoundland and Labrador see similar increases in the price of carbon under linkage.

The costs and benefits from interprovincial linkage illustrated in Figure 9 apply to a modelling scenario in which each province is assumed to implement policy sufficient to achieve its own stated objective. It is worth noting that a different allocation of provincial targets—with the same aggregate emissions reductions for the country overall, but distributed among the provinces differently—could lead to different distribution of costs and benefits.

Benefits from interprovincial linkage are relatively modest

The second key takeaway from the analysis is that the overall benefits of linkage—for Canada and for most provinces separately—are relatively modest compared with benefits from revenue recycling and policy flexibility. Again, a key driver of the size of these benefits is the level of policy ambition embodied within the various provincial emissions-reduction targets. The finding that the overall benefits from interprovincial linkage are modest is driven by the fact

[4] Other approaches to price harmonization are possible. Any province with a carbon tax could peg its carbon price to the market price in other jurisdictions, or the purchase of permits from other jurisdictions could allow for exemptions from the tax. Provincial systems could also be indirectly linked through access to a common offset market. Future Commission research will explore these issues in more detail.

that the various province-specific carbon prices (in Scenario 3) are broadly similar. British Columbia, with its very aggressive target, and Alberta, with its relatively shallow target, are the two outliers from this general pattern. If the provincial targets used in this modelling exercise are to be taken at face value, the analysis here suggests that a significant share of the benefits of carbon-pricing policies can be achieved through provincial action, without interprovincial linkages.

4.5 IMPORTANT LIMITATIONS OF THE MODEL

As discussed, all economic models have limitations. In terms of assessing the relative benefits of ecofiscal policies, three key limitations of the model are relevant. Two suggest the actual cost-effectiveness benefits will be larger than what is suggested by the model. One suggests they could be smaller.

First, the model does not capture the innovation benefits of ecofiscal policy. Over time, carbon pricing creates incentives to adopt and develop new technologies that can reduce emissions at lower costs. A carbon price makes these innovations valuable no matter what, while an inflexible regulation provides incentives to reduce emissions only to the level required by the regulation (Köhler et al., 2006). Furthermore, economic opportunities for Canadian firms would be created as other countries implement their own carbon-pricing policies, thus increasing the global demand for such innovations. Though the model does not consider these benefits, they remain an important consideration for Canada and its provinces.

Second, additional benefits of flexibility may exist given variation between individual firms. The modelling analysis illustrates the cost-effectiveness benefits only of flexibility between different *sectors* of the economy. That is, it reflects the fact that some sectors have lower abatement costs than others. Yet the model does not capture the benefits of flexibility owing to differences *within* sectors but *between* firms. In any given sector, different firms will also face different technologies and thus different abatement costs. On this front, the model clearly underestimates the benefits of policy flexibility.

The third factor goes in the other direction. Realistically, regulatory policies will rarely be as costly as the inflexible regulations depicted in this analysis. Scenario 1 is based on the strong assumption that all sectors are required to achieve the same percentage level of reductions. In reality, government would often consider differences in sectoral abatement costs and negotiate with the sectors directly. In addition, regulations can be designed with some flexibility. The federal government, for example, has built some flexibility into its regulations for GHG emissions for vehicles (Sawyer & Beugin, 2012).

This third argument should not be pushed too far, however, given the important and practical limitations to smart regulations. Real-world regulations cannot be as cost-effective as the flexible-policy scenario. Designing smart regulations that truly replicate the efficiency of a market-based instrument requires policymakers to have detailed information on the abatement costs in each sector—information that governments simply do not have. The stringency of regulation is usually designed after analyzing sectoral abatement costs and consulting with firms in the industry. Yet the challenge of determining the “right” level of stringency in a regulation is precisely the advantage of ecofiscal policies. Rather than having to predetermine the source of low-cost emissions through analysis or negotiations, ecofiscal policies use market forces to seek out the lowest-cost reductions. Given these challenges, prescriptive regulations cannot be as flexible or cost-effective as ecofiscal policies.

4.6 POLICY LESSONS FROM THE MODELLING EXERCISE

Three main lessons can be drawn from this modelling exercise. Figure 9 shows the GDP benefits for each province from the combination of policy flexibility, revenue recycling, and interprovincial linking. The main lesson is that each province would benefit considerably by achieving its current emissions-reduction target through the use of carbon-pricing policies, rather than some form of prescriptive regulations. Given the practical limitations to policy design and access to information, even smart regulations would be significantly less cost-effective than a carbon-pricing policy.

A second lesson is that the benefits of revenue recycling are considerable, and also point to the value of the ecofiscal approach. Since carbon pricing generates revenues for governments, economic benefits can be achieved by using these revenues to reduce existing taxes. Regulatory policies do not generate revenues, and hence are denied this potential benefit. While the modelling only illustrates one approach to revenue recycling, other approaches can also create economic benefits, if designed well.

The third lesson relates to the benefits of interprovincial linkages. Most provinces benefit from linking their policies to those in other provinces, but some do not. In any event, the benefits or costs are generally quite small relative to the benefits from flexibility and revenue recycling. It therefore makes sense for the provinces to implement carbon-pricing policies independently, and then work over time toward coordinating their respective policies. Timely provincial action is the practical path forward.

5 A FRAMEWORK FOR POLICY DESIGN

This section is a starting point for examining the design of carbon-pricing policies. Though the focus here is on provincial policies, the framework would also be relevant in a federal context. Smart policies are both effective at driving emissions reductions and cost-effective in doing so. In addition, they need to reflect local circumstances, and should be designed to permit a transition toward nationwide coordination over time. Our purpose here is to develop a general framework for examining the design details that will ultimately be determined by the provinces. Future reports by the Ecofiscal Commission will use this framework to explore design choices in greater detail.

The framework developed here is based around five central design issues:

1. Which different policy instruments can be used to price carbon?
2. How stringent is the policy, and what is the price of carbon?
3. How broad is the policy coverage?
4. How is revenue recycled back to the economy?
5. How can competitiveness risks be addressed?

To make the discussion concrete, the various issues are illustrated by examining the existing provincial carbon-pricing policies, including British Columbia's carbon tax, Quebec's cap-and-trade system, and Alberta's Specified Gas Emitters Regulation (SGER). We conclude with a high-level evaluation of these existing provincial policies.

5.1 CARBON-PRICING INSTRUMENTS CONSTRAIN PRICES, QUANTITIES, OR BOTH

GHG emissions can be priced using different policy instruments. Though implemented differently, each instrument can be used to establish a price on GHG emissions, and each can generate revenue to be recycled back to the economy.

A carbon tax directly sets the price of carbon

A *carbon tax*, such as the policy used in British Columbia, directly sets a price on GHG emissions. The government sets the level of the tax; in B.C., it is currently \$30 per tonne of CO_2e. Faced with a clear carbon tax, individual emitters are led to reduce emissions whenever the cost of doing so is less than the tax; if the abatement cost is higher than the tax, the emitter will not reduce emissions, and will instead pay the tax.

While the price of emissions is set clearly by the policy, and is thus certain at any given time, the level of the resulting total emissions can only be estimated, as it depends on the specific behaviours and abatement costs of firms and households, neither of which are known with precision to the government.

A cap-and-trade system directly sets the quantity of emissions

The opposite logic is true for a *cap-and-trade system*. In such systems, as currently used in Quebec, the government caps the aggregate allowable emissions and then distributes emissions permits among the covered entities. Permits can be issued for free, auctioned, or some combination thereof. Whether auctioned or not, the permits can be traded in a market that determines the price of GHG emissions. Faced with a clear market price for permits, individual emitters will reduce emissions when the cost of doing so is less than the permit price; they will buy permits (and avoid making reductions) when their price is lower than abatement costs.

By setting the aggregate cap, the total level of GHG emissions is known. The resulting market price of carbon, however, can only be estimated, as it depends on the emitters' abatement costs, technologies, and the general level of economic activity.

Other mechanisms can blend price and quantity constraints

Alternative, more complex policy instruments can also be used to establish a price on GHG emissions. Alberta's SGER, for example, is a flexible performance standard with some similarities to both cap-and-trade systems and carbon taxes, but also has some unique elements (discussed below in the context of other design choices). The SGER requires improvements in emissions intensity of covered entities from a baseline level of emissions specific to each emitter.

The SGER provides firms with some flexibility in how they comply with the performance requirements. Emitters can choose to improve emissions intensity by reducing emissions (for a given level of output). Or, as in a cap-and-trade system, they can purchase credits from other regulated emitters that have reduced beyond the required intensity standard. Alternatively, similar to a carbon tax, firms can comply with the policy by purchasing offset credits or by paying $15 per tonne of emissions into a technology fund.

The Alberta policy provides greater price certainty than would be the case with a conventional cap-and-trade system. The Technology Fund protects emitters from high carbon prices by setting a maximum permit price. However, the contributions to the Fund (which are then reinvested by government in technology projects) may or may not lead directly to emissions reductions. While a maximum price clearly increases price certainty by preventing unexpected price spikes, it reduces certainty with respect to the quantity of emissions reduced.

Other policies include similar design elements that can blend carbon taxes and cap-and-trade systems. Floor prices guarantee a minimum carbon price. If emitters achieve reductions more easily than expected—for example, because of depressed economic conditions—a minimum price maintains incentives for long-run innovation and emissions reductions.[5] The Quebec cap-and-trade system, for example, has a minimum auction price of $15 per tonne CO_2e as of February 2015. (It also has a "soft" price ceiling: If the price rises above $40, the government will hold extra auctions to distribute new permits, thus providing downward pressure on prices.)

Carbon taxes can also be designed to provide some of the quantity certainty normally provided by a cap-and-trade system. Government could commit to adjusting the tax rate over time, partly based on emissions levels. If total emissions are not on track to achieve stated objectives, the carbon price could be increased; conversely, if emissions unexpectedly decreased rapidly, the carbon price could in turn be decreased. The disadvantage of such a scheme is that the greater quantity certainty comes at some cost; the reduced certainty regarding the carbon price is likely to diminish the ability of firms to make long-run investment decisions. See Box 5 for a brief summary of the main trade-offs regarding instrument choice.

[5] One disadvantage of the European Emissions Trading System is that it lacks a price floor. The market price for permits dropped sharply during the global financial and economic crisis, and remains low today; as a result, the incentives for innovation in that system are currently quite limited.

Box 5: Trade-offs in Instrument Choice

Different policy instruments, including a carbon tax, a cap-and-trade system, and a range of hybrids, can create a price on GHG emissions.

Future research from the Ecofiscal Commission will explore in detail the trade-offs between these instruments. The table below highlights potential advantages and disadvantages of each at a very high level.

	Key Advantages	Key Disadvantages
Cap-and-trade	• Drives cost-effective emissions reductions • Provides certainty as to the quantity of emissions reduced • Creates opportunities for linkage with other systems, broadening scope and harmonizing prices	• More administratively complex to implement and manage • Allows for price volatility, because the carbon price fluctuates over time • In practice, most cap-and-trade systems have initially not auctioned all permits, reducing the scope for revenue recycling
Carbon tax	• Drives cost-effective emissions reductions • Provides certainty as to the carbon price • Simple and transparent; easy to administer	• Perceived as having greater public opposition • Does not provide certainty as to the quantity of emissions reductions to be achieved

Sources: Goulder & Schein, 2013; Stavins, 2008; Parry & Pizer, 2007.

In addition to pure cap-and-trade systems and carbon taxes, a wide variety of hybrid instruments can also be designed that blend elements of both instruments, or even add additional dimensions of complexity. The Specified Gas Emitter Regulation in Alberta, for example, is neither a carbon tax nor a cap-and-trade system, but has elements of both. In terms of comparing instruments, several points are worth noting.

1. Cap-and-trade systems and carbon taxes are fundamentally more similar than different. Both put a price on carbon, both create market-based incentives for emissions reductions and innovation, both can generate revenue that can be recycled back to the economy. Most importantly, both are more cost-effective than inflexible regulations.

2. The core advantage of a carbon tax is its simplicity. A carbon tax on fuels can be easily and quickly implemented, as the example in British Columbia illustrates. It is transparent for all emitters and has limited administrative costs. It is also simple for businesses to plan in response to the tax, since it creates a clear, predictable price on carbon. Cap-and-trade systems, in contrast, generally require more institutional capacity to handle permit trading, and monitoring of transactions and ownership of permits. In practice, free allocation of permits tends to be politically popular, but reduces the cost-effectiveness of the policy.

3. The core advantage of a cap-and-trade system is that it is easier to harmonize with other cap-and-trade systems. Linking two cap-and-trade systems allows permit flows between emitters in each jurisdiction, leading to a common permit market and a harmonized price. Linking systems—as Quebec and California have done—can therefore be one effective path from a patchwork of separate systems toward a broader, more unified policy.

Box 5 continued

4. Differences between systems often get blurred by practical details. While a carbon tax creates certainty about the price of carbon, making planning easier for businesses, a cap-and-trade system provides greater certainty as to the emissions reductions to be achieved. In practice, most policies have hybrid characteristics that blend the two instruments. For example, price floors and price ceilings protect against price volatility in cap-and-trade systems, though at the cost of losing certainty regarding the levels of emissions reductions to be achieved.

5. The details of design are extremely important. Tax, cap-and-trade, and hybrid systems can all achieve cost-effective emissions reductions if designed and implemented well. But comparing the instruments in the abstract is challenging, given the extent to which different design elements can affect performance. Future research from the Ecofiscal Commission will evaluate carbon-pricing instruments in greater detail.

5.2 MORE-STRINGENT POLICY DRIVES GREATER EMISSIONS REDUCTIONS

Carbon pricing sets a crucial constraint: depending on instrument choice, the constraint is either the carbon price or the maximum level of emissions. The stringency of the policy depends on the extent to which the constraint is binding, and thus requires action from emitters.

Two main metrics can be used to compare the stringency of different policies. The *carbon price* measures emitters' marginal incentive for reducing GHG emissions. Carbon prices change relative prices of goods and services: they make carbon-intensive activities relatively more expensive and carbon-reducing activities relatively less expensive. The higher the carbon price, the more firms and individuals are induced to change their behaviour.

The *average carbon cost* reflects the costs of policy across emitters' total emissions. The average carbon cost (per tonne of CO_2e emitted) can differ from the carbon price if permits are given away for free or if the carbon price does not apply to all emissions. A firm's decision to build a new facility is partly based on the firm's return on investment, which is affected by the average carbon cost (Leach, 2012).

In the case of a carbon tax, the carbon price is set directly by the policy. In contrast, a cap-and-trade system or an intensity-based regulation imposes some form of *quantity constraint* on emitters, which applies to either the allowable level of emissions or emissions intensity. A lower permitted level of emissions is a more stringent policy, because it requires more action by emitters. A carbon price then emerges from the market created by the presence of the quantity constraint. A lower permitted quantity generates a higher carbon price.

Table 3 compares current levels of stringency for existing provincial carbon-pricing policies, based on the most recently available data. British Columbia's carbon tax, set directly at $30 per tonne, has the highest carbon price of any Canadian policy. Indeed, it is currently the most stringent carbon-pricing policy in North America. Emitters pay the carbon price on their regulated emissions (i.e., those share of emissions covered by the policy), so the average carbon cost in B.C. is also $30 per tonne.

The price of carbon in Quebec's cap-and-trade system currently emerges from a combination of the cap and the price floor. As of February, 2015, the price of permits in the joint California-Quebec auction was $15.14 per tonne CO_2e. This price was slightly above the price floor of $15, unlike earlier Quebec auctions, in which the cap was not binding.[6] Quebec is initially providing some permits for free, so the average carbon charge is lower than the carbon price. Quebec's floor price will rise by 5% (plus inflation) per year, and the emissions cap will fall by 3-4% annually. The policy will thus become more stringent over time (Dumont, 2013).

The stringency of Alberta's SGER system emerges from a combination of the 12% required improvement in emissions intensity and the $15 price ceiling (created by the Technology Fund). The price ceiling defines the maximum cost per tonne of compliance, setting the marginal carbon price for emitters, and providing incentives for existing firms to take actions to reduce emissions if those actions cost less than $15 per tonne. The 12% intensity standard defines the compliance obligation for emitters. In 2012, total compliance obligations amounted to about 13 Mt, or slightly less than 5% of total emissions (Alberta Environment, 2014).

[6] Emissions by covered entities in 2012 and 2013 were slightly above 18 Mt CO_2e, while the 2013 cap was at 23.2 Mt. See Ministère du développement durable, Environnement et Lutte contre les changements climatiques (MDDELCC) (2014b) and Gouvernement du Québec (2012).

Table 3: Carbon Prices and Quantity Constraints in Provincial Carbon-Pricing Policies

Province	Instrument	Carbon price (per tonne CO_2e)	Average carbon cost (per tonne CO_2e)*	Quantity constraint
British Columbia (2014)	Carbon tax	$30	$30	None
Alberta (2012)	Flexible intensity standard	$15	~$1.14**	None***
Quebec (2015, projected)	Cap-and-trade	$15.14****	$11.41*****	Cap is set at 2014 emissions, and will decline 3-4% annually from 2016 to 2020

Sources: Alberta Environment (2014); California Air Resource Board (2014); Sawyer (2014); Government of British Columbia (2014b); Régie de l'énergie (2013); Purdon et al. (2014).
*This calculation represents a slight overestimate of average carbon cost because all abatement is assumed to occur at the price of carbon. This difference is small because so far, abatement levels are relatively low.
**Based on data in Alberta Environment (2014) for compliance in 2012. As Leach (2012) notes, the average cost depends on changes in output and emissions intensity relative to the benchmark.
***The SGER sets a compliance obligation based on required improvements relative to a 2003-05 average intensity. This requirement does not place a constraint on the absolute quantity of emissions, but instead defines the share of emissions on which emitters pay the carbon price.
****Based on settlement price for February 2015 auction (California Air Resource Board, 2015).
*****This price represents the maximum possible average carbon cost given that Quebec may auction up to 23% downstream permits.

As a result, Alberta's average carbon cost is vastly lower than its carbon price—estimated at $1.14 per tonne by Alberta for 2012—and thus the policy plays only a slight role in affecting firms' investment decisions. Bošković and Leach (2014) find that the SGER imposes compliance costs on a typical oil sands facility of around $0.03 per barrel of oil, averaged over the project's life, with negligible impact on expected rates of return. These very low costs are a function of both low policy stringency and Alberta's royalty regime. As the carbon-pricing policy reduces firms' revenues, a significant share of the reduction is absorbed by the government's loss of royalty earnings. This finding supports the evidence presented in Box 4 that the SGER has not been effective in reducing GHGs.

Finally, the carbon price in Alberta established by the Technology Fund merits comment. As discussed below, revenue from the Technology Fund is used to invest in development and deployment of technologies to reduce additional GHG emissions. Yet because it does so by funding projects by the same firms that contribute to the fund, its effects may be to reduce the effective carbon price. If contributing firms can reasonably expect to receive money back from the fund, then contributions may not be viewed as a cost, and their incentives to reduce emissions will likely be diminished.

5.3 COVERAGE DETERMINES WHICH GHG EMISSIONS ARE PRICED

The *coverage* of a policy, which defines the emissions subject to the carbon-pricing policy, has major implications both for the extent to which policy drives emissions reductions and the costs at which it does so. Covering more emissions means broader incentives for emissions reductions. Together, the level of the carbon price and the breadth of coverage of a policy define the policy's overall stringency. Broader coverage also reduces costs: as is true with various forms of taxation, a broader base enables a lower rate (i.e., carbon price) to achieve the same levels of overall emissions reductions.

Pricing policies can be designed with different levels of coverage

Two different metrics of coverage are relevant for comparing carbon-pricing policies. *Regulated emissions* are those to which the marginal incentive for reduction applies. *Priced emissions* are those on which emitters actually pay a carbon price. The difference between the two metrics relates to the difference in average and marginal carbon prices discussed above. We discuss each in turn with respect to the B.C., Alberta, and Quebec systems, illustrating the different coverage choices available.

Upstream and Downstream. In practical terms, where in the life cycle of carbon emissions the carbon price is applied—what is known as the *point of regulation*—is a key determinant of which emissions are regulated.

Applying the carbon price to fuel distributers and importers based on the carbon content of the fuels they sell is an *upstream* policy. Final consumers, however, still see the effects of the policy, because fuel distributers pass these costs on to consumers, who then face the appropriate price incentives. In British Columbia's upstream policy, for example, the carbon tax is clearly shown on households' bills for natural gas for home heating and gasoline for vehicles.

Non-combustion industrial process emissions (such as those in cement manufacturing processes, or venting and flaring emissions from oil and gas production) will not be covered when carbon pricing is applied only to fuel, since these emissions are not the result of fossil fuel consumption; for broader coverage, these additional emissions can be priced separately.

Alternatively, a *downstream* policy applies the carbon price at the point where the GHG emissions actually occur. Downstream approaches, however, must also define a threshold for the size of emitter covered by the policy. Including a very large number of small final emitters creates a significant administrative burden for governments.

To avoid such a burden, downstream systems tend to include only large industrial emitters and, critically, to exclude small emitters—including vehicles, buildings, and small businesses—which make up a large share of total emissions. Alberta's SGER, for example, is a downstream policy that covers facilities with annual emissions greater than 100 kt CO_2e. The threshold is pragmatic, because Alberta has a small number of extremely large emitters—power plants, oil sands facilities, and refineries (Leach, 2012). If Alberta reduced its threshold by half, to 50 kt CO_2e, it would need to monitor 40% more facilities in order to expand covered emissions by only 3% (Alberta Environment, 2014). Given the policy's exclusive focus on large emitters, however, it effectively ignores half the province's emissions.

Policies can also be designed with multiple points of regulation to enable broad coverage. For example, Quebec's system has both downstream and upstream pricing. It covers upstream carbon content of fuels and electricity, as well as downstream industrial process and electricity generation emissions with a 25-kt CO_2e threshold (more details below). Quebec is also the only jurisdiction in Canada that covers non-combustion process emissions. Given this combination, the province's cap-and-trade system achieves the highest coverage of the three Canadian carbon-pricing policies.

Regulated vs. Priced Emissions. The effective coverage of a policy is reduced if emitters are required to pay a price on only a small share of regulated emissions. The difference between regulated emissions and priced emissions for each of the three provincial carbon-pricing policies reflects differences between marginal and average carbon prices.

Under the B.C. carbon tax, all regulated emissions face the same price (the marginal price is equal to the average price). As a result, the share of priced emissions is the same as the share of regulated emissions, or about 70% of B.C.'s total GHG emissions.

Under the Alberta SGER, by contrast, while approximately 50% of emissions are regulated by the policy, emitters pay the carbon price on only 3% of total emissions. Regulated emitters must only reduce emissions that exceed the emissions-intensity threshold defined by the policy. Only these marginal emissions are priced; no payments are required for the remaining emissions. This discrepancy again highlights the large difference in marginal and average costs under the Alberta system.

Under Quebec's cap-and-trade system, around 27% of emissions permits are allocated for free. Similar to the Alberta system, these free permits reduce the share of emissions for which emitters pay the marginal price of carbon.

The share of priced emissions matters in measuring the stringency of policy, because it affects the materiality of the policy for major emitters. When emitters pay a carbon price on a very small share of their emissions, the total cost of policy is small relative to the size of projects and overall profits. As a result, firms may not spend the time or money to optimize their costs perfectly based on marginal costs and benefits. In other words, smaller effective coverage given a lower share of priced emissions can reduce the effectiveness of the policy in creating incentives for emissions reductions. This issue is particularly significant in Alberta.

Table 4 summarizes the coverage of policies in B.C., Alberta, and Quebec. It describes the point of regulation for each system, identifies thresholds for emitters, and estimates the share of provincial emissions covered by the respective policy in terms of both regulated emissions and priced emissions. It also identifies key sources of GHG emissions *not* covered by the policy.

Table 4: Coverage of Provincial Carbon-Pricing Policies

Province	Instrument	Points of regulation	Non-covered emissions	Threshold for industrial facilities	Regulated emissions	Priced emissions
British Columbia (2014)	Carbon tax	• Distributors and importers of fossil fuels	• Non-combustion industrial processes • Agricultural • Waste management	N/A	~70%	~70%
Alberta (2012)	Flexible intensity standard	• Industrial combustion (including oil and gas) • Electricity generation	• Fuel combustion (non-major emitters) • Non-combustion industrial processes • Agricultural • Waste management • Aviation and shipping	100 kt CO_2e per year	~50%	~3%
Quebec (2015, projected)	Cap-and-trade	• Industrial combustion and process emissions • Distributors and importers of fossil fuels • Generators and importers of electricity	• Agricultural • Waste management • Aviation and shipping	25 kt CO_2e per year (both upstream and downstream)	~85%	~62%

Sources: Dumont (2013); Gouvernement du Québec (2013); Horne & Sauve (2014); ICAP (2014); Leach (2012); MDDELCC (2014a); LiveSmart BC (2012); McMillian LLP (2008); Picard (2000).

Carbon offsets can broaden policy coverage, though could pose practical problems

Allowing the purchase of carbon offsets as a means of compliance can provide covered entities with lower-cost possibilities, and increase coverage by including activities that would otherwise be difficult to include directly in the carbon-pricing policy. In theory, if offsets are genuinely additional—that is, they represent emissions reductions that would not have occurred in the absence of the offset purchase—they will not undermine the overall effectiveness of the policy. In practice, however, ensuring the credibility of offsets can be challenging; future reports of the Ecofiscal Commission will evaluate trade-offs with respect to allowing offsets in carbon-pricing policies.

Table 5 presents the role of carbon offsets within the three different provincial policies. Given the concerns over whether carbon offsets represent genuine emissions reductions, Quebec only allows up to 8% of an entity's compliance obligation to be covered by offset purchases (Purdon et al., 2014). Alberta has the most extensive offsetting system, which allows the policy to extend to a larger share of its economy. From 2007 to 2012, over 20% of SGER compliance consisted of offset purchases (Sawyer, 2014).

5.4 CHOICES FOR REVENUE RECYCLING DEPEND ON PRIORITIES

A carbon tax generates revenue, as does a cap-and-trade system, if the emissions permits are auctioned. How this revenue is recycled back to the economy has major implications for the economic impacts of a carbon-pricing policy. Revenue can be recycled in many ways, including reducing corporate or personal income taxes, public investments in critical infrastructure, or directly supporting technology. Governments could alternatively choose to forgo revenue from a cap-and-trade system by allocating permits for free; in this case, the monetary value of the permits is transferred to the emitters.

Table 6 summarizes the current provincial approaches to revenue recycling, identifying the most recent (or forecasted) levels of carbon-pricing revenue, the extent to which revenue is generated (as opposed to forwent through free permits), and how the revenue is recycled.

Table 5: Offset Markets in Provincial Carbon-Pricing Policies

Province	Instrument	Limits on compliance via offsets	Eligible projects for offsets
British Columbia (2014)	Carbon tax	Offsets not permitted as compliance	• None
Alberta (2012)	Flexible intensity standard	Only in-province offsets accepted	• Waste management • Agricultural • Renewable energy & energy efficiency • Industrial • Others
Quebec (2015, projected)	Cap-and-trade	Only offsets from California or Quebec accepted, to a maximum of 8% of compliance	• Manure storage facilities (methane) • Waste disposal sites • Ozone-depleting substances projects

Sources: Alberta Environment (2008); Government of Alberta (2013); Government of British Columbia (2014a, 2014b); Purdon et al. (2014).

The total revenue generated by the various provincial policies results from a combination of policy stringency and coverage. With the highest carbon price and broad coverage, British Columbia generates by far the most revenue. As Quebec includes fuel distributors and importers in its cap-and-trade auctioning process beginning in 2015, that province will increase its carbon revenue from $56 million in 2013 to a forecasted $425 million annually. Alberta's revenue of $55 million, generated only through its price-ceiling mechanism, is the lowest of the three provincial systems.

Under Alberta's intensity-based system, emitters pay a price only on emissions above the benchmark intensity standard. As a result, the system is analogous to a cap-and-trade system in which permits are provided for free; it *forgoes* additional revenue generation. This explains the small revenues from the Alberta system. Because the system is based on emissions intensity (i.e., emissions per unit of output), the system creates stronger incentives to reduce emissions intensity than to reduce the absolute level of GHG emissions (Fischer & Fox, 2004).

Revenue generated from carbon-pricing policies can be used to reduce existing taxes and maximize the cost-effectiveness of policy. In British Columbia, for example, revenue from carbon taxes enables reductions in personal and corporate income taxes, as well as other tax measures to address fairness. Reducing existing taxes helps achieve the policy's objective at least cost, because such taxes impose costs on the economy; personal income taxes discourage working, while corporate income taxes discourage investment and innovation.

Recent studies in the United States and Europe have considered how carbon-pricing revenues can be used to address fiscal challenges (e.g., Ramseur et al., 2012; Marron & Toder, 2013; Vivid Economics, 2012). If governments face a need for greater revenues, revenue from carbon pricing could represent an efficient alternative to increasing other taxes, such as corporate or personal income taxes, which tend to retard economic growth.

Alternatively, using revenue to support innovation and clean technology could facilitate greater long-run emissions reductions. Revenue generated from Alberta's Technology Fund, for example, supports the development and deployment of technologies to further reduce GHG emissions. Quebec's carbon revenues are used mostly to support emissions reductions in the transportation sector—a key source of Quebec's emissions—but also to support technology and other emissions-reducing projects.

5.5 POLICY DESIGN CAN ADDRESS RISKS TO COMPETITIVENESS

Unilateral carbon pricing by a province can create competitiveness risks for firms within the province. If the policy makes firms less competitive than rivals in jurisdictions with less-stringent policies, domestic firms could lose market share and reduce production or profits.

At current low carbon prices, such competitiveness risks are likely to be small, and measures to manage them may be unnecessary. In addition, the most vulnerable sectors are those that are emissions-intensive and that engage actively in trade with other jurisdictions; this is a minority of sectors in most provinces.

Table 6: Revenue Recycling from Provincial Carbon-Pricing Policies

Province	Instrument	Revenue (millions)	Effective free allocations	Uses of revenue*	Allocation of revenue
British Columbia (2014)	Carbon tax	$1,212	0% of eligible emissions unpriced	Personal income tax reduction	16%
				Other personal tax measures	23%
				Corporate income tax reduction	51%
				Other business tax measures	9%
Alberta (2012)	Flexible intensity standard	$55	~95% of eligible emissions unpriced Revenue generated only through Technology Fund compliance	Investments in innovation and research and development for GHG emissions reduction and adaptation	8%
				Market demonstration for GHG-emissions-reducing technologies and adaptation	42%
				Projects that reduce GHG emissions or support adaptation	51%
Quebec (2015, projected)	Cap-and-trade	$425	~At least 25% of eligible emissions unpriced in 2015	Development and use of public and alternative modes of transportation	59%
				Green-energy substitution and energy efficiency	17%
				Innovation, research and development, and market demonstration for GHG emissions reductions	5%
				Other projects for GHG emissions reduction and climate change adaptation	19%

Sources: Ministry of Finance of Quebec (2012); Climate Change and Emissions Management Corporation (2013); Government of British Columbia (2014b); MDDELCC (2014); Ecofiscal Commission calculations.
*The data for Quebec's use of revenues represent the total funding since the inception of its Green Fund in 2007, which was previously funded with revenues from the province's carbon tax.

The issue of competitiveness would become more important, however, if provinces increase carbon prices significantly and unilaterally. In that case, design elements to manage these risks will be more important (Stopler, 2014). While competitiveness risks remain a concern, various design choices can address these challenges. Table 7 summarizes how current provincial carbon-pricing policies have been designed to manage such risks. Each of these options is discussed in more detail below.

Border adjustments could level the playing field

Border adjustments can ensure that domestic firms are not disadvantaged relative to competitors in jurisdictions with less-stringent policies. Tariffs could be applied, for example, to imports from other jurisdictions based on the carbon content of the imported products. Given Canada's constitutional division of power, such border adjustments could not be implemented by a single province, but would require involvement by the federal government.

In practice, border adjustments could invite reciprocating taxes from other jurisdictions or challenges under international trade law (McAusland & Najjar, 2014). Even if successfully implemented, they could be costly for Canada in terms of reduced trade (NRTEE, 2009).

For specific emissions that fall under provincial jurisdiction, some form of border adjustment could nonetheless be practical. Imports of electricity into Quebec, for example, are subject to that province's cap-and-trade system, thus ensuring that coal-fired electricity generation outside the province is not advantaged relative to cleaner generation within Quebec. If Hydro Quebec imports such electricity from other provinces or U.S. states, it must have sufficient permits to account for the associated GHG emissions. The measure is constitutionally possible because of pre-existing provincial regulatory authority over imported electricity (Parlar et al., 2012).

Table 7: Competitiveness Measures in Current Provincial Carbon-Pricing Policies

Province	Instrument	Addressing competitiveness risks by:		
		Price levels	Coverage	Revenue recycling
British Columbia	Carbon Tax	Phase-in of tax at $10 per tonne, with $5 increase per year	Refund program for greenhouse growers and exemptions for agricultural fuel use	Corporate tax cuts
Alberta	Flexible intensity standard	Gradual phase-in of intensity standard Low average carbon cost, given intensity standard and royalty interactions $15 price ceiling	Exemption for small commercial emitters Low share of priced emissions, given intensity standard Offsets	Free allocation of permits to covered entities
Quebec	Cap-and-trade	Allowance price containment reserve (“soft” price ceiling)	Point of regulation for imported electricity	Free allocation of permits to vulnerable industrial facilities

Sources: Hydro-Québec (2014); Horne & Sauve (2014); Sawyer (2014); Government of British Columbia (2013).

Partial permit rebates could address competitiveness risks

Central to competiveness risks is the concern that domestic industry will respond to carbon prices by reducing production and losing market share to foreign competitors, with no overall change in global emissions. Carbon-pricing policies can be designed to address this concern directly by using free permits or rebates. Full or partial rebates in a cap-and-trade system can reduce the total cost of compliance for firms while maintaining a carbon price that creates the incentive to reduce emissions.

For example, recall from Table 6 that Quebec’s cap-and-trade system provides free permits for process emissions from industrial firms. Allocation is based on the level of production and emissions intensity of each sector. In 2013, a minimum of 75% of permits were freely allocated, but the number of free permits is scheduled to decline by 1 to 2% annually (Dumont, 2013).

Alberta’s SGER is similar to a cap-and-trade system with free permits. Emitters only pay for emissions exceeding the benchmark emissions intensity. The intensity standard forgoes revenue generation, and provides incentives for firms to improve emissions *per unit of output*, but not to reduce the absolute level of emissions. The policy’s design moderates competitiveness risks, but allows for increases in the overall level of GHG emissions. In Alberta’s case, the costs to oil and gas producers are further reduced because of interactions with the royalty regime, which imply that producers pay only about half the costs imposed by the policy, the remainder being borne by the provincial government (Bošković & Leach, 2014).

Sectoral exemptions could address competitiveness concerns, but increase costs

An alternative approach to protecting vulnerable sectors is to exempt them from the carbon price. For example, to address concerns from British Columbia’s greenhouse growers and other parts of its agricultural sector, the province effectively exempted these firms from the carbon tax. While exemptions reduce the burden for these businesses, they do so at the expense of raising the total cost of the policy. Limiting the policy coverage reduces its ability to drive least-cost reductions, and simply requires greater emissions reductions from firms in the covered sectors. As noted, the lower coverage of the Alberta system undermines both its effectiveness and cost-effectiveness relative to the systems in B.C. and Quebec.

5.6 SUMMARY: HOW DO EXISTING CANADIAN POLICIES COMPARE?

As discussed in this section, current provincial carbon-pricing policies illustrate a range of potential design choices. Table 8 summarizes the key differences between British Columbia’s carbon tax, Alberta’s SGER, and Quebec’s cap-and-trade system.

How do these three systems compare overall? In terms of the type of policy instrument, carbon taxes, cap-and-trade systems, and even hybrid options can be designed to be effective. Yet, as this section has made clear, there is much devil in the details of policy design.

The essentials of smart policy design begin with stringency and coverage. A more stringent policy is based on a higher price

Table 8: Summary of Provincial Design Choices

Province	Instrument	Stringency		Coverage		Main revenue recycling	Addressing Competitiveness
		Carbon price (per tonne)	Average carbon charge (per tonne)	Regulated emissions	Priced emissions		
British Columbia (2014)	Carbon tax	$30	$30	~70%	70%	Business and personal income tax cuts	Phase-in of the carbon tax
Alberta (2012)	Flexible intensity standard	$15	~$1.14	~50%	~3%	Forgone revenue (intensity standard) Some technology support	Low stringency Effective free permits
Quebec (2015, projected)	Cap-and-trade	$14.03	$10.24	~85%	62%	Some forgone revenue GHG-emissions-reducing measures	Soft price ceiling Border adjustment on imported electricity Some free permits

of carbon, and the higher price drives more emissions reductions. A policy with more coverage means that this price is applied to a broader base of emissions, and this broader base improves the cost-effectiveness of emissions reductions.

In terms of stringency, the three policies are clearly not equivalent. The B.C. carbon tax is the most stringent, with both the highest price of carbon and the highest average carbon cost. While the price of carbon in Quebec is currently relatively low, the emissions caps in both Quebec and California are scheduled to decline steadily over time, thus increasing the stringency of the policy. Alberta's policy, on the other hand, has low stringency, particularly in terms of the associated average carbon cost. In addition, given that Alberta's total emissions are projected to rise over time along with planned expansion of the oil sands, average costs matter a great deal in terms of affecting investment decisions. New facilities are a major source of emissions growth.

As for coverage, both the B.C. carbon tax and the Quebec cap-and-trade system apply to the majority of emissions in the two economies. Quebec's system, which includes industrial process emissions, is the broadest of the three systems (that province has relatively few fugitive emissions, such as methane leaks, and venting and flaring in upstream oil and gas). Alberta's system has far narrower coverage than the other two. For regulated emissions, no small emitters (e.g., vehicles, buildings, and smaller industrial facilities) face financial incentives to reduce emissions, as they do in B.C. and Quebec. In addition, given the very small share of priced emissions in Alberta, total costs to firms are relatively low, and are thus not likely to be material to their investment decisions.

The next element to consider when comparing systems is the overall performance in terms of emissions reductions. Not surprisingly, the systems' differences in performance reflect their underlying differences in stringency in coverage. As discussed in Box 4, B.C.'s carbon tax appears to have successfully driven emissions reductions. In Alberta, however, compliance data from the government suggests that emissions reductions from the SGER have been minimal. Quebec's system has not been in place long enough to determine its effectiveness in this regard.

Unlike stringency and coverage, other elements of policy design are less clear-cut; different choices could nonetheless result in a coherent and effective system. Future research from the Ecofiscal Commission will explore issues such as revenue recycling and business competitiveness in more detail. Trade-offs exist between different choices for revenue recycling and addressing competitiveness, and different design choices across provinces partly reflect different economic realities and political priorities.

6 RECOMMENDATIONS: THE WAY FORWARD

This report began with two main objectives: first, to identify a practical policy approach for achieving meaningful, least-cost reductions in Canadian GHG emissions; and second, to begin a discussion about the details of policy design that recognize key differences across the provinces.

Three key concepts are embedded in both objectives. Policies are effective if they achieve the required level of emissions reductions. Policies are practical if their design details reflect local economic contexts and priorities. And policies are cost-effective if emissions reductions are achieved at least cost.

Based on these criteria, and on the findings from this report, this section provides recommendations for Canadian policymakers. Our recommendations relate to an overall approach, but also begin to provide guidance on the details of policy design.

RECOMMENDATION 1:
Provincial governments should move forward by implementing carbon-pricing policies.

The case for continuing with provincial carbon pricing is as follows:

First, more-stringent GHG policies are needed—and delay is costly. Climate change is a pressing issue for Canada, with significant economic costs associated with policy inaction. Canadian mitigation is also a necessary part of a global effort toward reducing GHG emissions—an effort that is gaining urgency in light of recent agreements involving the United States, China, and India. Yet most provinces and the country as a whole are not on track to achieving existing targets for 2020, let alone the deeper reductions required in the longer term. Whatever the benchmark—achieving domestic targets, aligning with current climate science, driving deep long-term reductions—more-stringent policies are required.

Delaying policy actions will increase costs for Canadian governments. Getting moving now allows policy to begin modestly and then ramp up over time. In this way, households will have the time to gradually adapt their behaviours, and businesses will have the flexibility to adopt and develop technologies required to reduce GHG emissions and transform the energy system. Falling too far behind the rest of the world can lead to competitiveness challenges in a global economy that increasingly recognizes the need to decarbonize.

Second, carbon-pricing policies achieve emissions reductions at lowest cost. Carbon-pricing policies should be a central element of each province's climate change strategy. Relative to inflexible regulatory approaches, ecofiscal policies have multiple advantages. The analysis here, based on economic modelling, demonstrates the considerable relative benefits of ecofiscal policy in terms of both flexibility and revenue recycling. Over time, carbon pricing will also drive more innovation, further reducing costs.

Third, provincial policies offer a practical path forward, even if coordination is desired in the longer term. The provinces have unique economies, emissions profiles, and political contexts to which carbon-pricing policies can be customized. These policies already exist in some provinces; and the Council of the Federation has now signalled that provincial carbon pricing has a role to play in a provincially led national energy strategy. Using provincial policies can ensure that carbon-pricing revenues remain within the province in which they are generated. While a federal policy could conceivably be designed to achieve this outcome, starting with the provinces sidesteps the real and perceived challenges in doing so. As a result, the province-first approach allows Canada to continue its current provincial momentum in making the inevitable transition toward a cleaner, lower-emissions economy.

RECOMMENDATION 2:
Provincial carbon-pricing policies—existing and new—should increase in stringency over time.

Ecofiscal policies are not automatically environmentally effective; stringency is essential. A more stringent policy has a higher carbon price covering a broader base of emissions. A carbon tax with a very low price is weak policy, as is a cap-and-trade system with a very high cap. Similarly, a policy with a high carbon price that covers only a small fraction of emissions is weak. To achieve the required economy-wide emissions reductions at least cost, and to produce the necessary incentives for innovation, any carbon-pricing policy needs to be stringent.

What is the "right" level of stringency? Our modelling analysis uses the provinces' current 2020 targets as a convenient, though arbitrary, benchmark. With the exceptions of Nova Scotia and Newfoundland and Labrador, no province is projected to meet its emissions targets for 2020; in this sense, current policies are insufficiently stringent. And these targets, in any event, are only relevant for the short term. Much deeper reductions will be required over the next few decades. Even those provinces that now price carbon do not have policies stringent enough to achieve their stated targets.

The dynamics of stringency are also important. Ramping up the stringency of policies over time will avoid unnecessary shocks to the economy, but will nonetheless encourage households and firms to slowly change their behaviours. The accumulation of small changes over many years can generate dramatic changes over the long term. The sooner policies are put in place, the more time is available for the carbon price to increase gradually, rather than abruptly. An economic environment with a gradual and predictable escalation in price is conducive to long-range planning.

RECOMMENDATION 3:
Provincial carbon-pricing policies should be designed to broaden coverage, to the extent practically possible.

Broad coverage creates incentives for emissions reductions throughout the economy. But it also matters for minimizing the costs of any given amount of emissions reduction. The more emitters (and emissions) are covered by the policy, the more it creates incentives to realize all available low-cost reductions. Ecofiscal policy should thus be as broad as possible without unduly increasing administrative costs. The most cost-effective policy would impose a uniform price on all GHG emissions, irrespective of their source. Specific sectoral exemptions not only introduce perceived inequities, but also raise the overall cost of the policy.

RECOMMENDATION 4:
Provinces should customize details of policy design based on their unique economic contexts and priorities; they should also plan for longer-term coordination.

While eventual consistency of provincial carbon prices is desirable, other dimensions of policy design can remain customized to the unique provincial context.

Revenue recycling, in particular, provides an opportunity for diverse provincial policy choices. Some provinces may choose to reduce existing corporate or personal income taxes, as in British Columbia. Others may prefer to use the revenue to invest in the development of new technology, as in Quebec and, to some extent, Alberta. Carbon-pricing revenue could also be used to finance investments in critical infrastructure, to address competitiveness risks for exposed sectors, or to ensure fairness for low-income households. Different provinces with different contexts and priorities are likely to make different choices. This flexibility is a key strength of the provincial approach to carbon pricing.

Over the longer term, coordination across provinces (and indeed, across international jurisdictions) is an issue for both the cost-effectiveness and the effectiveness of carbon-pricing policies. Overall, consistency of carbon prices matters most, for two reasons.

First, consistency of carbon prices across provinces improves overall cost-effectiveness by ensuring incentives exist for realizing all potential low-cost emissions reductions, whatever their location. Second, a common price avoids policy-induced challenges of interprovincial competitiveness. When policy is equally stringent across the provinces, all firms face a level playing field. Such coordination can thus improve the overall effectiveness of the policy by ensuring that firms do not avoid reducing emissions by simply relocating to provinces with less-stringent policies.

Although a consistent carbon price across Canada is eventually desirable, it is not critical in the short term. Nor should the pursuit of such a common price be viewed as an obstacle to effective and timely provincial action. The provinces have a long history of differential policies. By developing effective policies now, and thereby beginning to mobilize markets toward low-carbon innovation, the provinces can make crucial headway on an important challenge. The coordination of different provincial policies can wait.

7 NEXT STEPS

The Ecofiscal Commission will use the framework developed in this report as a foundation for conversations with regional leaders and policy experts about how policies can best be customized to meet provincial interests while ensuring they are part of a cost-effective pan-Canadian system. This report is a starting point for broader research on policy design and coordination.

The Commission's future work on carbon pricing will explore the central policy design choices in greater detail. Drawing on input from regional outreach meetings to identify policy priorities, future reports will explore trade-offs between design options, particularly in terms of choosing policy instruments and revenue-recycling approaches. Future reports will also assess the competitiveness risks for different provinces and explore policy options to mitigate these risks. The Commission will also explore approaches to the coordination of various provincial policies within the context of fiscal federalism.

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This is **Exhibit P** referred to in the

affidavit of **John Moffet**

affirmed before me on **January 29, 2019**

Commissioner for Oaths for Québec

#224458

CANADA'S **ECOFISCAL** COMMISSION
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CLEARING THE AIR: HOW CARBON PRICING HELPS CANADA FIGHT CLIMATE CHANGE

April 2018

Dale Beugin
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Glen Hodgson
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Nancy Olewiler
Chris Ragan

EXECUTIVE SUMMARY

We've come a long way in Canada. We have real, working examples of both carbon taxes and cap-and-trade systems that are reducing GHG emissions while maintaining strong economies.

Yet the growing consensus around carbon pricing is not yet universal. Some voices have questioned the extent to which carbon pricing will affect GHG emissions. And elections are on the horizon, both nationally and in several provinces, in which carbon pricing could be a source of debate and even a key issue.

Such policy debates are healthy and necessary. But debates will support good policy decisions only if they are based on facts and evidence. And there is strong evidence, grounded in solid economics and policy experience, that carbon pricing works.

Part of the problem is communication. Governments and policy analysts (including here at the Ecofiscal Commission) haven't always done a good enough job explaining carbon pricing to Canadians. This really matters because carbon pricing affects us all. How we design these policies will influence how we live and how we do business. We all want better understanding.

In short, we need a more informed conversation about carbon pricing. So let's have that conversation. Let's clear the air.

Done right, carbon pricing changes household and business behaviour, reduces GHG emissions, and provides an incentive for the development and adoption of the technologies that can play a key role in a low-carbon economy.

In addition (and this point is also often overlooked), carbon pricing will achieve these outcomes at a lower economic cost than other policies. Together, this means that carbon pricing can support both a clean economy *and* a prosperous economy. It achieves these goals by changing incentives and unleashing market forces. It lets businesses and individuals identify the best ways to reduce their GHG emissions and at the times and places that are right for them. And it doesn't require governments to identify and enforce specific ways to reduce GHG emissions.

This essay unpacks the overall story. *What* does "working" mean for carbon pricing? *Where* has carbon pricing worked? *Why* does carbon pricing work? *When* does carbon pricing work? *Who* supports carbon pricing? *How* do policies put a price on carbon? We provide clear answers to these questions in (mostly) jargon-free language. Just the facts.

CONTENTS

CLEARING THE AIR: HOW CARBON PRICING HELPS CANADA FIGHT CLIMATE CHANGE

Dale Beugin, Executive Director, Canada's Ecofiscal Commission
Brendan Frank, Research Analyst, Canada's Ecofiscal Commission
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1. Introduction

Canadians increasingly agree that climate change requires action. Evidence continues to mount that melting ice packs and extreme weather events pose serious risks to Canadians and their economy. Other climate impacts, such as sea level rise and warmer temperatures, are of particular concern to Canada's coastal and Arctic communities. The risks are even worse for other, more vulnerable countries.

Despite its relatively small population, Canada has a role to play in the global efforts to reduce greenhouse gas (GHG) emissions to avoid the worst of these risks. Canadians do not want to "free ride" on the actions of others. They want to do their part and contribute to these efforts.

Canadians are also moving closer to agreement on *how* we should tackle these challenges. Several large provinces have already introduced well-designed carbon-pricing policies. And the federal government is now committed to filling in the remaining policy gaps — by requiring every Canadian province and territory to put a price on carbon by the end of 2018.

That growing consensus around carbon pricing, however, is not yet universal. Various economists and policy experts have made the case for carbon pricing as the best way to reduce GHG emissions while maintaining a strong economy. Yet recently, others have questioned the extent to which carbon pricing will affect GHG emissions. And elections are on the horizon, both nationally and in several provinces, in which carbon pricing could be a source of debate and even a key issue.

Such policy debates are healthy and necessary. Historically, significant shifts in the consensus around policy emerged only after vigorous public discussion. While free trade and balanced budgets might now be broadly accepted, they were once controversial ideas.

But debates will support good policy decisions only if they are based on facts and evidence. And there is strong evidence, grounded in solid economics and policy experience, that carbon pricing works.

Part of the problem is communication. Governments and policy analysts (including here at the Ecofiscal Commission) haven't always done a good enough job explaining carbon pricing to Canadians. This really matters because carbon pricing affects us all. How we design these policies will influence how we live and how we do business. We all want better understanding.

In short, we need a more informed conversation about carbon pricing. So let's have that conversation. Let's clear the air.

The many details of carbon pricing are important for governments to consider when they design good policy. The Ecofiscal Commission has undertaken extensive economic research exploring these details, some of it fairly technical. We've explored how to design policy for fairness, and how to design it to ensure Canadian businesses remain competitive. We've considered the best ways for governments to recycle revenues generated from carbon pricing. And we've looked at the *other* climate policies that work best with carbon pricing.

Amidst all these details, however, the most important finding of the Ecofiscal Commission's work often gets lost: *Carbon pricing works*.

Done right, carbon pricing changes household and business behaviour, reduces GHG emissions, and drives the development and adoption of the technologies that will play a key role in a low-carbon economy.

The evidence is clear: carbon pricing shifts us away from "business as usual," changing our emissions trajectory. And higher carbon prices drive deeper emissions reduction.

In addition (and this point is also often overlooked), carbon pricing will achieve these outcomes at a lower economic cost than other policies.

Together, this means carbon pricing can support both a clean economy *and* a prosperous one. It achieves these goals by changing incentives and unleashing market forces. It lets businesses and individuals identify the best ways to reduce their GHG emissions and at the times and places that are right for them. And it doesn't require governments to identify specific ways to reduce GHG emissions.

This essay unpacks the overall story. *What* does "working" mean for carbon pricing? Where has carbon pricing worked? *Why* does carbon pricing work? *When* does carbon pricing work? *Who* supports carbon pricing? *How* do policies put a price on carbon? We provide clear answers to these questions in simple, (mostly) jargon-free language.

2. What does "working" mean for carbon pricing?

We focus on two key outcomes that should drive Canada's climate policy.

First, we should be aiming to reduce our annual greenhouse gas (GHG) emissions. Not just this year but every year going forward. Moving Canada toward deep emissions reductions over time contributes to global efforts to avoid some of the costliest and most uncertain impacts of climate change.

Note that GHGs aren't just about carbon dioxide. They also include methane, nitrous oxide, and many other gases that collect in Earth's atmosphere and act like the walls of a greenhouse to lock in heat, raising average global temperatures. Policies that "put a price on carbon" are really designed to put a price on *all the major GHGs*, wherever feasible.

Second, we should be striving to sustain a strong economy — with the good jobs and incomes that come with it. We can choose to reduce our GHG emissions by having a weak economy, with little production and income, but this is a very costly way to clean up the environment. Far better alternatives are available. Our objective should be to reduce GHG emissions significantly but do so at the *lowest possible economic cost*.

Can carbon pricing achieve these dual objectives? Yes. We'll show how throughout this essay.

Q&A: Why is carbon pricing better for the economy than regulations?

Carbon pricing isn't the only option available to policy makers committed to reducing GHG emissions. In particular, **command-and-control regulations** are an alternative. This kind of policy requires businesses or individuals to adopt specific technologies or achieve certain levels of emissions performance.

For example, Canada has mandatory vehicle efficiency standards for cars and light trucks. These standards require car manufacturers to produce vehicles with a given average level of fuel economy for the vehicles they make, which lowers emissions per kilometre driven.

> **A central advantage of carbon pricing is that it works with market incentives by encouraging businesses and households to seek out the lowest-cost way to reduce emissions. Emitters are not all the same, and carbon pricing takes advantage of these differences to minimize the cost of reducing emissions.**

In contrast, command-and-control regulations generally cost more than carbon pricing because they provide far less **flexibility** to businesses and households, and they typically ignore the important differences between them. Such regulations require specific actions or outcomes from specific firms or groups, regardless of their different abilities to achieve these outcomes.

Some carefully designed regulations might come close to carbon pricing by building in market mechanisms. For example, Quebec requires that automakers produce a certain number of zeroemissions vehicles (ZEVs). Car manufacturers receive tradeable credits for each ZEV they produce and need a certain number of credits to meet their quota. Firms that produce ZEVs costeffectively can produce more than what is required by their quota to receive additional credits. They can sell these credits to other firms that cannot manufacture ZEVs as cheaply and are better off buying more credits than making more ZEVs.

3. Where has carbon pricing worked?

Carbon pricing has a track record of success. There are two basic approaches to carbon pricing: carbon taxes and cap-and-trade. It's also possible to combine them. We'll get to the details of *how* they work later. The bottom line is that they all put a price on GHG emissions, which creates an incentive to produce fewer of them.

Here, we'll explore outcomes in three different jurisdictions that have implemented different types of carbon pricing. None of these policies are perfect, but they all illustrate that carbon pricing works.

Isolating the impact of carbon pricing is critical. Changes in emissions that happen to coincide with new policy aren't *necessarily* the result of that policy. In statistics jargon: correlation isn't the same as causation.

Below, we focus on studies that explicitly isolate the impacts of carbon pricing. Using statistical or modelling analysis, these studies aim to answer the question: how would emissions or economic growth be different if carbon pricing policies hadn't been put into place?

BC's carbon tax has reduced GHG emissions by between 5% and 15%

British Columbia's carbon tax started in 2008 at $10 per tonne of carbon emissions, rose by $5 a year, and then paused at $30 in 2012. The tax applied to the burning of fossil fuels, or about 70% of the province's GHG emissions. Initially, all revenues were used to finance income-tax cuts and selected tax credits — the carbon tax was "revenue neutral" for the government.

Starting in April 2018, BC's carbon tax will start rising again by $5 per tonne every year until it hits $50 in 2021. The BC government will use the new revenues to finance initiatives such as public transit and home retrofits to drive further emissions reductions. It will therefore no longer be revenue neutral.

As a result of the carbon tax, annual emissions in BC are 5% to 15% lower than they would otherwise have been. This estimate draws from several analyses (see References for details) each of which isolates the impacts of the carbon tax from other factors.

Those reductions in GHG emissions were the result of various shifts, including:

- The fuel efficiency of BC's entire vehicle fleet improved by 4% more than it would have without the tax. In other words, people *invested* in vehicles that would reduce their emissions and thereby allow them to pay less carbon tax by purchasing less gasoline.
- People also changed their gasoline consumption. Per-capita demand for gasoline would be between 7%-17% higher without the carbon tax by 2011. The carbon tax changed the way people drive.
- The carbon tax also affected natural gas use. One analysis suggests that tax reduced residential natural gas demand by 15% and commercial natural gas demand by 65%.

Box 1: Fast Facts About BC's Carbon Tax

- Implemented in 2008, BC's carbon tax was the first in North America.
- The tax is currently set at $35 per tonne and will rise by $5 a year until 2021.
- Economic analysis shows that annual GHG emissions in BC would be between 5% and 15% higher if it had not put its carbon tax in place.
- Economic analysis suggests the carbon tax had only a very small impact on the BC economy.

Q&A: Why have BC's emissions continued to go up if the carbon price is working?

Still, the emissions news from BC isn't completely rosy. In recent years, BC's total GHG emissions have actually *increased*. Two main factors are at work.

First, the tax was "frozen" at $30 per tonne in 2012 after steady increases for the previous few years. As a result, businesses and individuals had a weaker incentive to make long-term investments to reduce emissions than they would have had with a slowly rising carbon price. For example, gasoline consumption fell between 2008 and 2013 when the carbon price was rising but rose by 7% between 2013 and 2016 when the price was frozen.

Second, even though BC's total GHG emissions have increased in recent years, they are almost certainly lower than they would have been *in the absence of the tax*. BC's strong economic (and population) growth has contributed to more overall energy use and therefore GHG emissions.

Similarly, declines in energy prices over time encouraged energy use, partially offsetting emissions reductions from the carbon tax.

The $30 per tonne tax caused emissions to grow less quickly than they otherwise would have. But a higher carbon price will be required to drive deeper emissions reductions in the future.

Q&A: What were the economic impacts of BC's carbon tax?

The BC carbon tax appears to have had at most a very small impact on economic growth. Some analysis finds no significant economic impact, while other studies suggest that the economy grew only slightly more slowly as a result of the carbon tax than it otherwise would have.

Growth nonetheless remained strong. Indeed, since 2008, British Columbia's economy has outperformed the rest of Canada. This difference doesn't mean that the carbon tax is the *reason* for BC's higher growth — indeed, it almost certainly isn't — but it does reinforce that the tax likely wasn't a significant barrier to BC having a strong economy.

In addition to relatively strong economic growth, BC's carbon tax has not negatively affected its overall job market. One economic analysis (again, a study that carefully isolated the effects of the carbon tax) found that while some emissions-intensive industries did see job losses between 2007 and 2013, the carbon tax also led to the creation of 10,000 jobs in less emissions-intensive industries (for example, service industries) that would not have otherwise existed.

> **In other words, BC's carbon tax didn't lead to fewer jobs—it shifted jobs to different industries, with a slight overall increase. As part of a necessary long-term transition away from carbon-intensive energy systems, this shift is exactly the pattern that carbon pricing is designed to produce.**

California's cap-and-trade system is reducing emissions — and the economy is thriving

Box 2: Fast Facts About California's Cap-and-Trade System

- California implemented a cap-and-trade program in 2012.
- Emissions are falling in California and will fall faster as the program ramps up.
- California is projected to reduce its GHG emissions to 1990 levels by 2020.
- There is no indication that the cap-and-trade system has hindered economic growth in California.

California introduced a cap-and-trade system in 2012. Under the program, the state sets a cap on how many GHGs its largest industrial emitters can produce and gives them permits, or "allocations," that allow them to produce GHG emissions.

The minimum price for emissions permits started at $10 per tonne (around $13 Canadian) and will increase at a rate of 5% per year until 2020. Over time, the emissions cap, and therefore the number of permits, will decline, so permit prices will likely increase. The carbon price (permit price) is currently just over $15 per tonne (around $19 Canadian).

The cap initially applied only to electricity producers and manufacturers. In 2015, the cap-and-trade system expanded to include fuels like gasoline and diesel and now applies to 85% of California's GHG emissions.

> **The cap falls every year, as required by legislation. From 2015 to 2020, the cap fell just fast enough to allow California to meet its target of reducing GHG emissions to 1990 levels by 2020.**

In 2014, California linked its cap-and-trade program with Quebec's, so companies in the two jurisdictions can trade permits with each other. In 2018, Ontario joined this linked cap-and-trade system.

Q&A: What can Quebec and Ontario learn from California's experience?

Is the system working? Yes, but modestly, at least in the short term. From 2012 to 2015, California's emissions fell by only 2%. A few factors help explain this outcome. First, the cap initially applied to only a few sectors. Second, the cap did not initially need to fall very fast for California to meet its 2020 emissions targets. Starting in 2020, however, the cap will start to fall faster, so we expect that GHG emissions will also start to fall more quickly.

The system's challenges have offered lessons. Some observers worry, for example, that there are too many permits in the system, especially in the longer term. But the design of the California system at least partially addresses this concern by establishing a minimum permit price. Even if there is a glut of permits in the market, the price of carbon won't fall below this threshold, thus maintaining the economic incentive for households and businesses to reduce their emissions.

Q&A: How about California's economic performance?

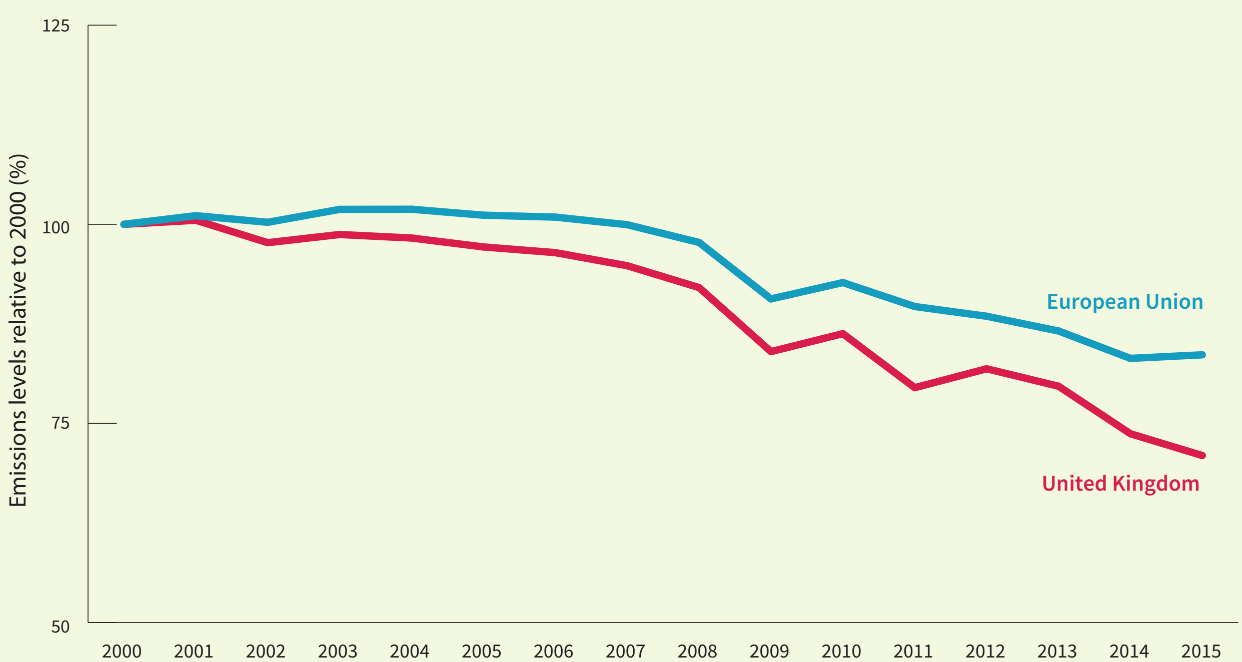
Again, there is no evidence that cap-and-trade has harmed growth in the Sunshine State, which has remained robust. Since the 2008 global economic crisis, California's economy has consistently outperformed the rest of the American economy, a trend that continued after 2012, when the cap-and-trade system was implemented.

The UK has rapidly reduced its emissions with a hybrid carbon-pricing system

The United Kingdom uses a hybrid carbon-pricing system, with elements of both cap-and-trade and a carbon tax.

Since 2005, the UK has participated in the European Union's cap-and-trade system, which has a current permit price of less than £10 per tonne (about $18 Canadian). Since 2001, the UK has also had a domestic "Climate Change Levy," which is a tax on electricity, gasoline, and other fuels supplied to firms. In 2013, the UK started increasing its domestic carbon tax to support the EU's cap-and-trade system. The UK's carbon tax differs from BC's in a few key ways. For example, different sectors in the UK pay different levels of carbon taxes, whereas BC's carbon tax is economy-wide.

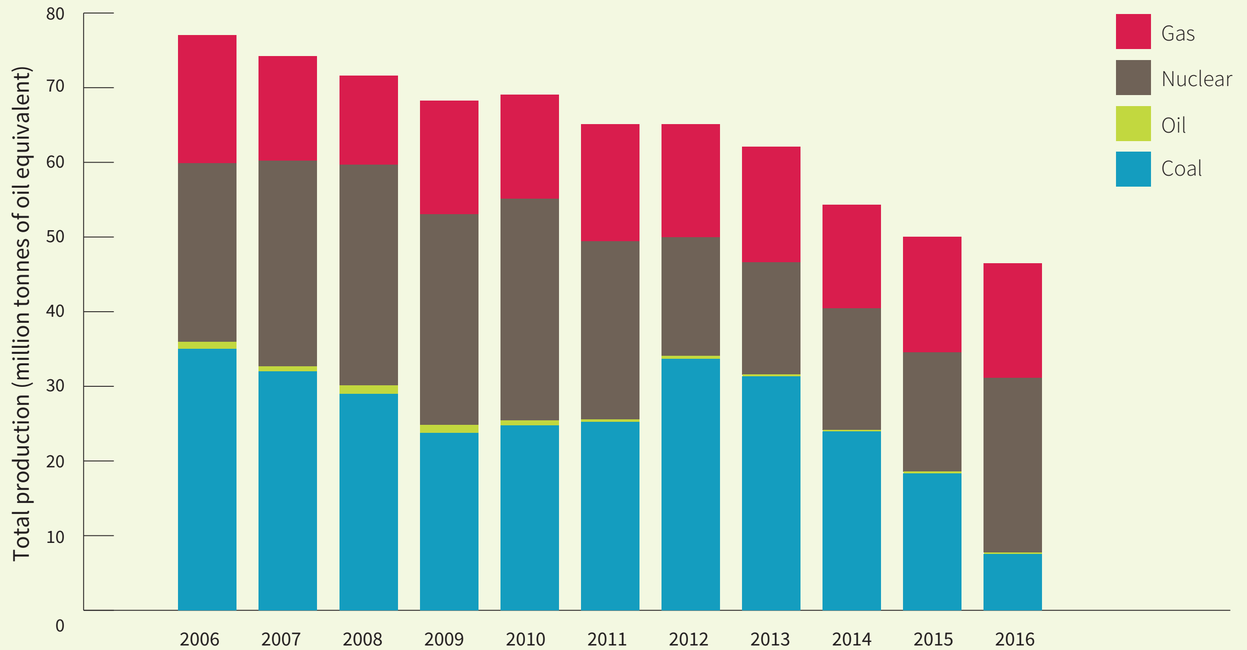
Figure 1: GHG Emissions Trends in the UK and the EU (2000 levels = 1.00)



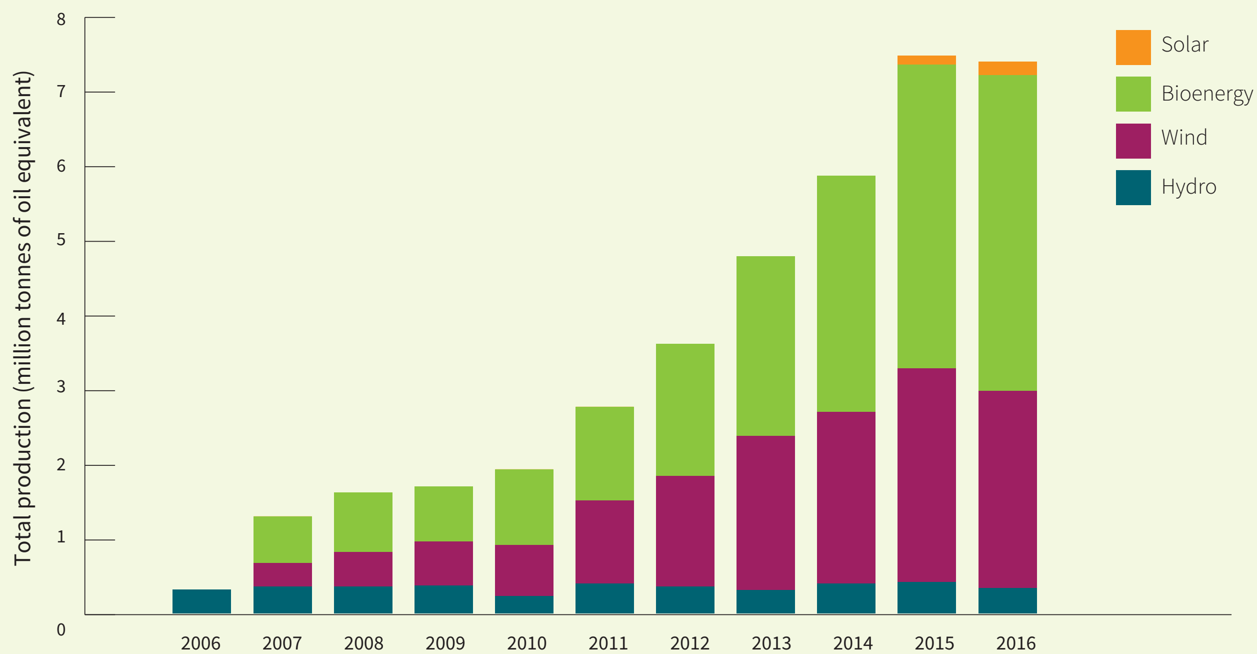
Source: Eurostat, 2017

Figure 2: Electricity Production by Source for Large UK Producers

Non-renewable electricity production by large UK producers



Renewable Electricity Production by Large UK Producers



Source: UK Government, 2017

Box 3: Fact Facts About the United Kingdom's Hybrid System

- The UK uses a hybrid system combining a carbon tax with cap-and-trade.
- UK industries pay over £20 per tonne for GHG emissions; households are exempt.
- Emissions in the UK have fallen sharply over the last several years, particularly in the electricity sector.
- The UK's economy has grown at a comparable rate to the EU's economy.

The UK's domestic carbon tax is now £18 (around $33 Canadian) per tonne, and creates incentives additional to those created by the EU's cap-and-trade system. In other words, domestic industries pay both carbon prices. For example, if the EU permit price were £8 per tonne, UK industries would pay a total carbon price of £26 per tonne (around $47 Canadian). If the EU permit price were to fall to zero, UK industries would still pay £18 per tonne for their GHG emissions.

Since 2000, the UK has seen a sharp decline in its total GHG emissions, and the drop has become steeper over the last few years. As Figure 1 illustrates, the UK's emissions have fallen faster than those in the rest of the EU, which has a cap-and-trade system but (for most countries) no additional carbon tax.

Q&A: How did carbon pricing affect how the UK produced and used electricity?

One sector in which the UK's climate policies, including the carbon tax, have been particularly noticeable is large-scale electricity generation.

> **Electricity emissions have fallen by more than 30% over the last ten years. The carbon tax has played a key role.**

According to one estimate (which isolates the effect of the carbon tax), production facilities that paid the UK's Climate Change Levy reduced their electricity consumption by 23%. In addition, the tax was far more effective at reducing emissions than other programs that companies had the option to adopt instead of paying the carbon tax.

Carbon taxes also affected the *way* in which electricity is generated in the UK. Though other policies have also affected these outcomes, several recent studies cite carbon pricing as the main cause for the rapid decline of coal-fired electricity. Figure 2 shows the data: faced with a carbon tax, large electricity producers have begun producing more electricity from renewables and less from fossil fuels. As a result, the UK is producing fewer GHG emissions from electricity (and also less electricity overall).

The UK case also highlights some challenges. The UK is slowly decarbonizing its electricity sector but is now more reliant on imported electricity. In 2016, 5.8% of the UK's electricity was imported, mostly from France and the Netherlands. While France uses mostly nuclear power, the Netherlands is still largely reliant on fossil fuels. Therefore, while the UK has reduced emissions significantly from its electricity sector, some of these emissions simply shifted to the Netherlands as a result of their weaker climate policies.

Q&A: How did the hybrid system impact the UK's economy?

In the years following implementation of its carbon tax, the UK's economy performed very well by current European standards. In per capita terms, the country's economy grew faster than in similarly sized European countries, including France, Italy, Germany, and Spain. In the last decade, however, the UK's economic growth has been slower than in many of its neighbours, due in large part to the financial crisis of 2008, and more recently, to the economic uncertainty created by the prospect of the UK's exit from the European Union.

4. Why does carbon pricing work?

Why do higher carbon prices lead to lower GHG emissions? The underlying logic is based on an essential economic truth: *prices influence behaviour*.

Prices affect choices throughout the economy

First, think about prices of *other* goods and services. If the price of cauliflower increases, many people choose broccoli instead. If the price of parking increases, many people choose instead to take the bus or subway to work. If the price of winter beach vacations increases, many people choose instead to have local holidays. An increase in cigarette taxes helped to reduce the number of smokers. The same kind of response holds for choices all through the economy.

Here's a specific example from history: in the 1970s, the world price of oil spiked significantly on two occasions, both of which led to sharp increases in gasoline prices in Canada. In response, drivers' choices changed. In the short term, people drove less. In the medium term, fuel-efficient vehicles became more popular, so people might have driven the same amount, but they used less gasoline while doing so. The reason was simple: buying a more fuel-efficient car meant saving money. People (and businesses) like to save money when they can and when they have options to do so. Prices influenced behaviour.

> **Carbon pricing affects *many* different choices. It increases the costs of any activity (driving, flying, heating, etc.) based on how much carbon dioxide it produces. But that doesn't mean that anyone and everyone simply pay a higher cost. After all, individuals and businesses have choices. Those choices give them ways to *avoid* paying the carbon price. And in fact, that's exactly the point.**

An example: carbon prices affect driving choices

To illustrate why carbon pricing works, let's consider our choices around driving and how carbon pricing can affect them. The carbon price will make gasoline a little more expensive. How might *your* driving behaviour change as a result?

Most drivers have options in how they respond. Some seek opportunities to carpool. Others take the bus or train to work instead of driving. Others take more dramatic action like buying a smaller car — some even get rid of their car altogether (thus saving money on fuel plus many other car-related expenses). Others move closer to work. Some people might not change their behaviour at all, choosing instead simply to pay the carbon price on their unchanged gasoline usage.

> **Evidence shows that these kinds of decisions actually happen. Two UBC economists found that BC's carbon tax reduced demand for fuel by 7%, and that a little less than half of those reductions were from changes in driving habits.**

Similarly, evidence from Denmark finds that a 10% increase in the price of fuel causes the average driver to reduce driving by 3%. In other words: prices influence behaviour.

Why do drivers make these choices? Because of the relative costs of the various options available. If making a different choice is easy (perhaps because a driver lives close to public transit) then it has low costs (for example, in terms of the time required). By letting drivers choose how to respond (or not), a carbon-pricing policy lets individuals — rather than governments — identify the most preferred approaches to reducing GHG emissions.

Carbon prices can also affect vehicle choices

Changes in driving behaviour probably aren't the only — or even the most important — way drivers respond to a higher carbon price. Over time, the policy will also affect the vehicles they purchase.

Let's consider four Canadians in very different circumstances who share the need to buy a new car:

Alex

My gas costs are really high, since I commute daily from my home in the suburbs to work downtown. I don't have good public transport options.

A

Barbara

I use my car all of the time, including for work, which takes me out of the city and onto bumpy, snowy roads.

B

Charlotte

I mostly use my car for running errands. I prefer to cycle when I can. I like having the latest technologies.

C

Derek

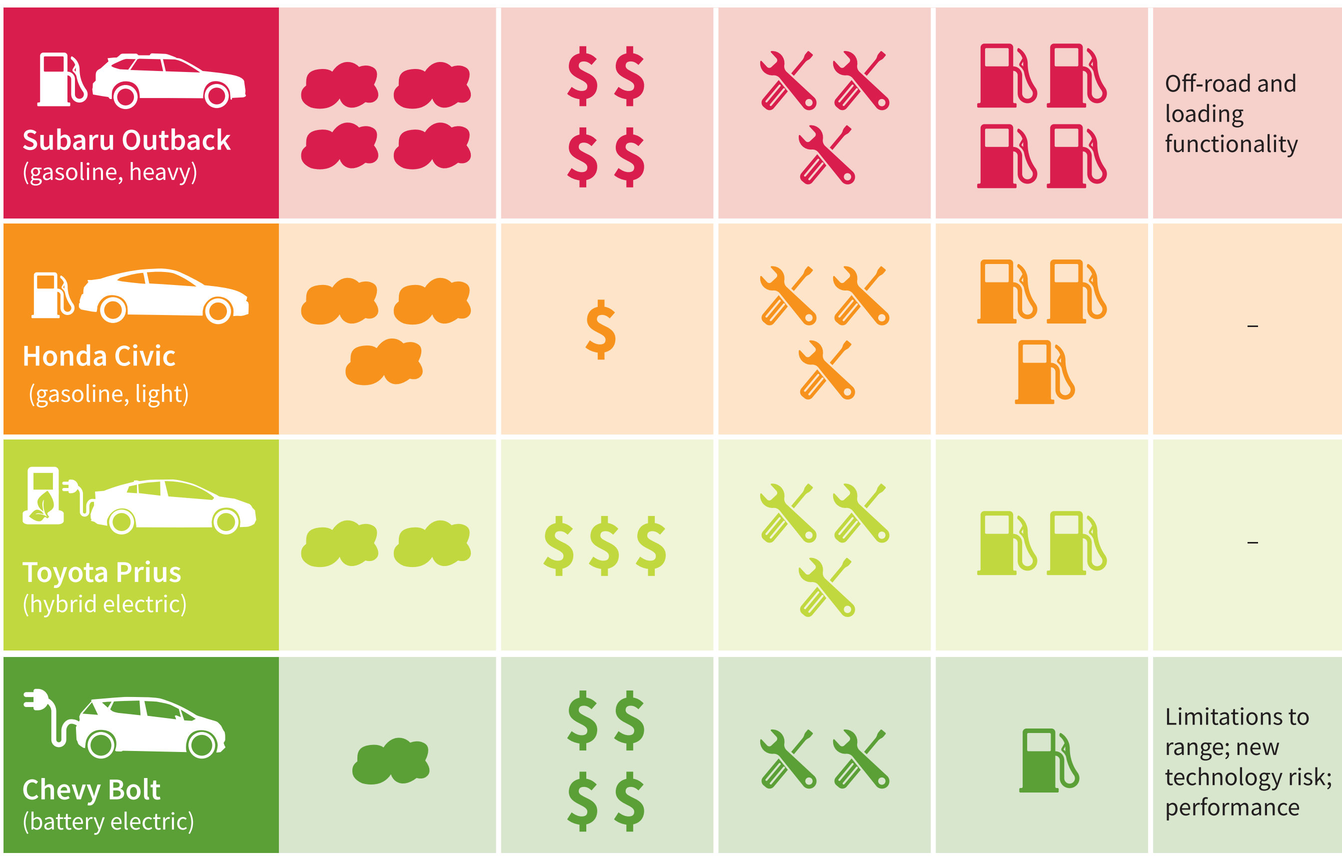
Every weekend I drive long distances to visit my partner who lives 3 hours away.

D

Different vehicles have different fuel economies. This means they produce different amounts of GHG emissions, so they also have different carbon costs under a carbon price. Our four individuals have choices when it comes to buying a new vehicle. The carbon price can affect which vehicle they choose and thus the GHG emissions they ultimately create while driving that vehicle.

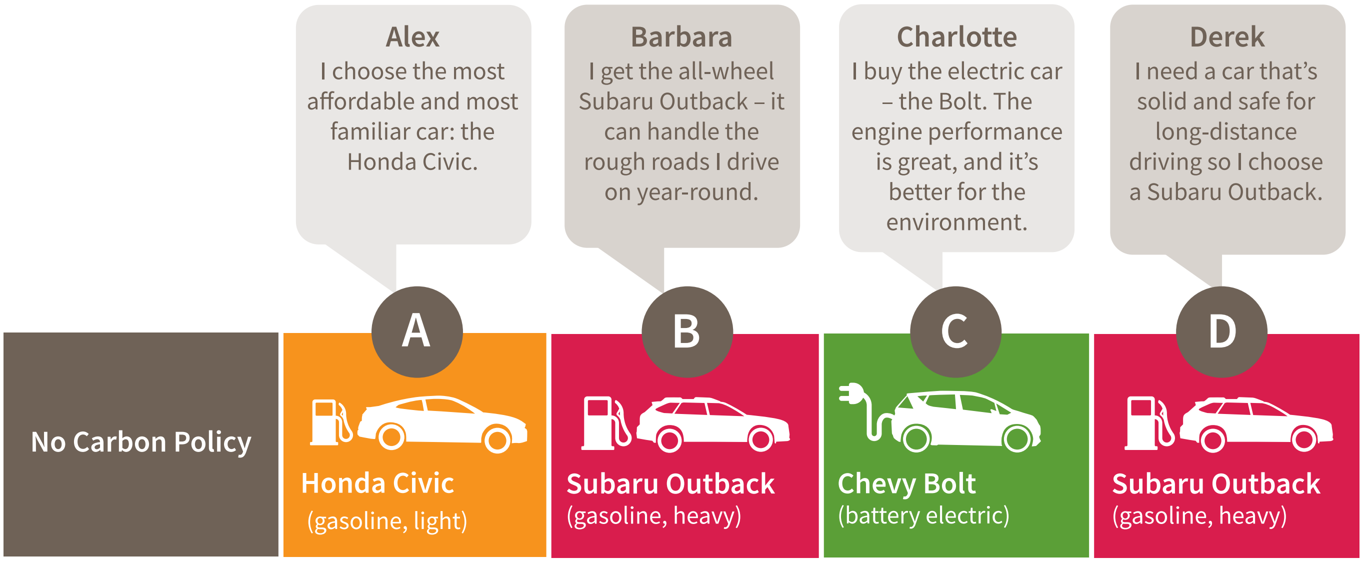
To unpack these vehicle choices, let's consider the four options for a new vehicle in Table 1. We can see that different vehicles have their own advantages and disadvantages, both financial and non-financial (precise numbers will vary; think of these rankings as illustrative).

Table 1: Characteristics of Vehicles

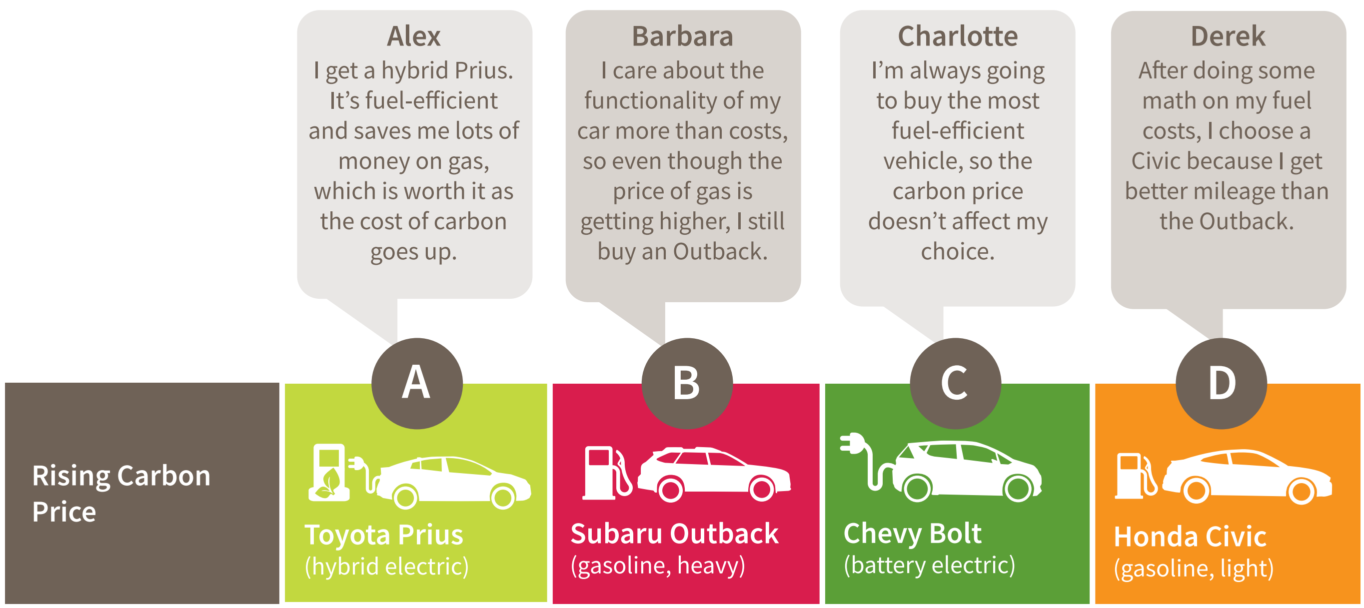


	GHG Emissions/km	Purchase Cost	Maintenance Costs	Fuel Costs	Intangibles
Subaru Outback (gasoline, heavy)		\$\$\$\$			Off-road and loading functionality
Honda Civic (gasoline, light)		\$			–
Toyota Prius (hybrid electric)		\$\$\$			–
Chevy Bolt (battery electric)		\$\$\$\$			Limitations to range; new technology risk; performance

Which vehicles do our four drivers prefer? Let's think about that question in three different contexts. Begin in the situation *without* carbon pricing, in which case producing GHG emissions is costless to the individual. In this case:



Now consider the choices under a carbon price that rises over time. Emitters will therefore pay for the carbon emissions they produce. In this case:

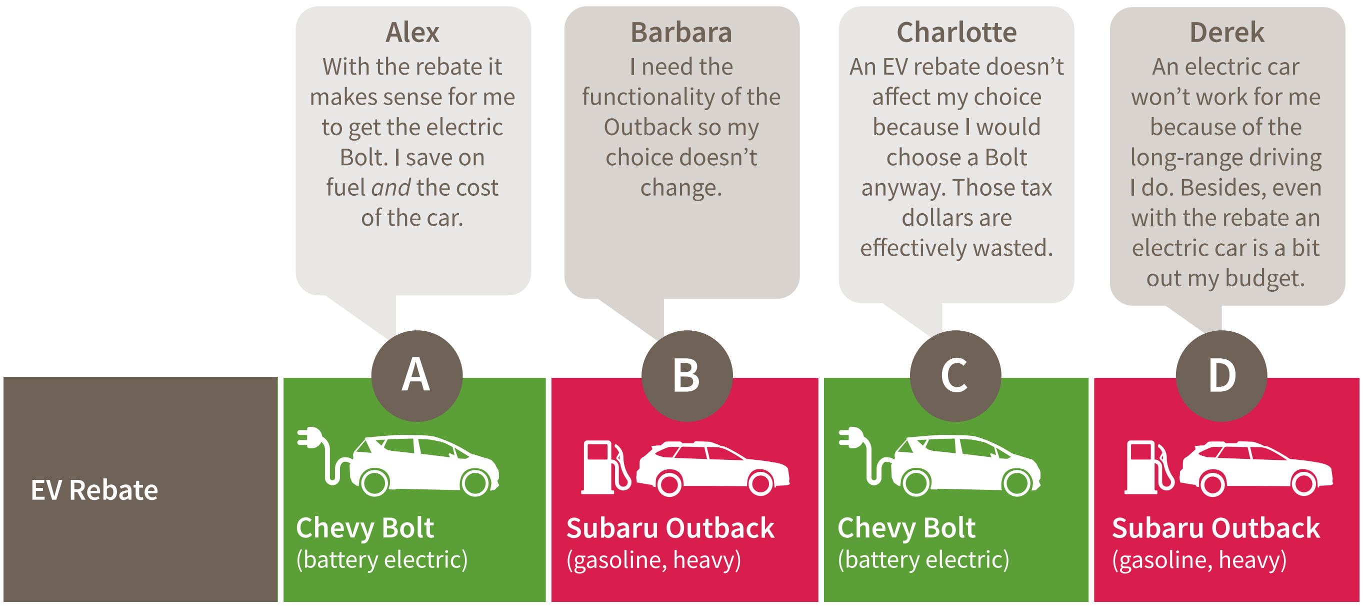


In our example, the carbon price affects vehicle choices of two of the four drivers. It causes them to choose more fuel-efficient vehicles to save money on gasoline. It also therefore reduces GHG emissions, relative to the scenario without the carbon price.

While our example here is illustrative, it's not far from reality. Those same UBC economists, for example, found that on average, the mix of vehicles driven in BC would have been 4% less fuel-efficient had BC not implemented its carbon tax. The carbon price will not affect every vehicle purchase, but it *will* affect some. Over time those choices that reduce emissions add up. In other words: carbon pricing works because *prices influence behaviour*.

The great advantage of a carbon-pricing policy is the flexibility it provides. It lets individual Canadians or businesses make their own choices about how to respond — or not — to the price, based on the costs of doing so. That flexibility keeps the costs of those emissions reductions low.

In contrast, consider a third policy scenario. Governments sometimes try to reduce GHG emissions by providing cash rebates for consumers' purchases of low-emission, electric vehicles. Let's see our four drivers' vehicle choices in this case:



We compare the outcomes across the three policy scenarios in Table 2. The EV rebate does lead to some emissions reductions because it causes Alex to buy the Bolt. But because it promotes a *specific* technology, the rebate has narrower impacts than the carbon price: Derek has no incentive to buy the Outback instead of the Civic, so the EV rebate does not affect his behaviour at all.

Furthermore, the EV rebate has costs that the carbon price doesn't. Charlotte, for example, gets the rebate *even though she would have purchased the Bolt anyway*. Those taxpayer dollars are effectively wasted. The result? The rebate reduces GHG emissions at a higher cost than putting a price on carbon. Recent analysis from the Ecofiscal Commission found that EV rebates in Quebec reduce GHG emissions at a cost around $400 per tonne, while BC's carbon tax is currently reducing emissions at less than $35 per tonne.

Table 2: Comparing Vehicle Choices Under Three Alternative Policies

	1. No climate policies	2. Rising carbon price	3. EV rebates
A Alex	Honda Civic	Toyota Prius	Chevy Bolt
B Barbara	Subaru Outback	Subaru Outback	Subaru Outback
C Charlotte	Chevy Bolt	Chevy Bolt	Chevy Bolt
D Derek	Subaru Outback	Honda Civic	Subaru Outback

Carbon prices drive innovation

The story of why carbon pricing works still isn't done. Carbon pricing will have another lasting effect: it will create long-term incentives for the innovation of low-emissions technologies.

A good carbon-pricing policy doesn't just price emissions in the present and drive emissions reductions today, it also creates expectations for higher carbon prices in the future. In response, innovative engineers and entrepreneurs have strong and rising incentives to develop technologies that reduce GHG emissions even further.

> **As new technologies emerge, additional options for reducing emissions become available. As a result, the costs of reducing emissions gets lower and lower over time. As an additional benefit, those innovators might be able to sell their products and ideas internationally, helping to reduce emissions elsewhere.**

In the context of our vehicle example, as the costs of batteries decline, so too will the costs of electric vehicles. That means a steadily rising carbon price will shift more vehicle choices. In the future, carbon pricing is likely to cause Alex and Derek to choose electric vehicles rather than gas-powered or hybrid options. Similarly, electric trucks and Sport Utility Vehicles will become available, and at more affordable prices, which means a carbon price might also affect Barbara's choices.

Carbon prices affect choices all across the economy

To be clear, our vehicle example is just a parable. It considers four hypothetical individuals in the context of a single choice. But the lessons from this simple example have general implications for carbon pricing.

First, the choice of vehicle is only one of thousands of choices that businesses and individuals will make about their behaviour, purchases, and investments. Just as a carbon price will change the trade-offs around vehicles, it will affect choices around home insulation, fuel use in industrial processes, and investments in pension plans.

Some methods of reducing GHG emissions will help businesses or households save money by allowing them to avoid paying the carbon price. Just as importantly, some decisions won't be affected by the price. If an action to reduce emissions is very expensive, the carbon price will not require businesses or individuals to take that action. And that's OK: the idea is not to force anyone to take specific actions (like some regulations might do) but rather to let prices change incentives and let incentives affect choices. *Households and businesses always face choices*.

> **The idea is not to force anyone to take specific actions. Rather, it's to let businesses and individuals choose options that work for them.**

Over time, we need deeper emissions reductions. That's why a rising carbon price is so important. As the carbon price increases, it will affect more decisions, resulting in more emissions reductions. But even a carbon price of $100 per tonne won't force actions that cost $200 or even thousands of dollars per tonne. A predictable and gradually rising path for the carbon price will let individuals and businesses plan for the future, again keeping costs down.

Second, millions of other Canadian consumers and businesses will also face that same choice. Every one of them will have their own context and preferences. Some will have more opportunities to reduce GHG emissions inexpensively. Others might have different opportunities, or fewer opportunities. And that's exactly the point: those that have low-cost alternatives will respond to a carbon price in the way that makes most sense for them. As a whole, this means we can realize the lowest-cost ways to reduce GHG emissions throughout the economy, without forcing anyone to take the high-cost actions.

> **When designed well, carbon pricing applies to all emissions in the economy and all emitters — individuals as well as businesses. This broad coverage creates a common incentive for everyone to reduce emissions in low-cost ways.**

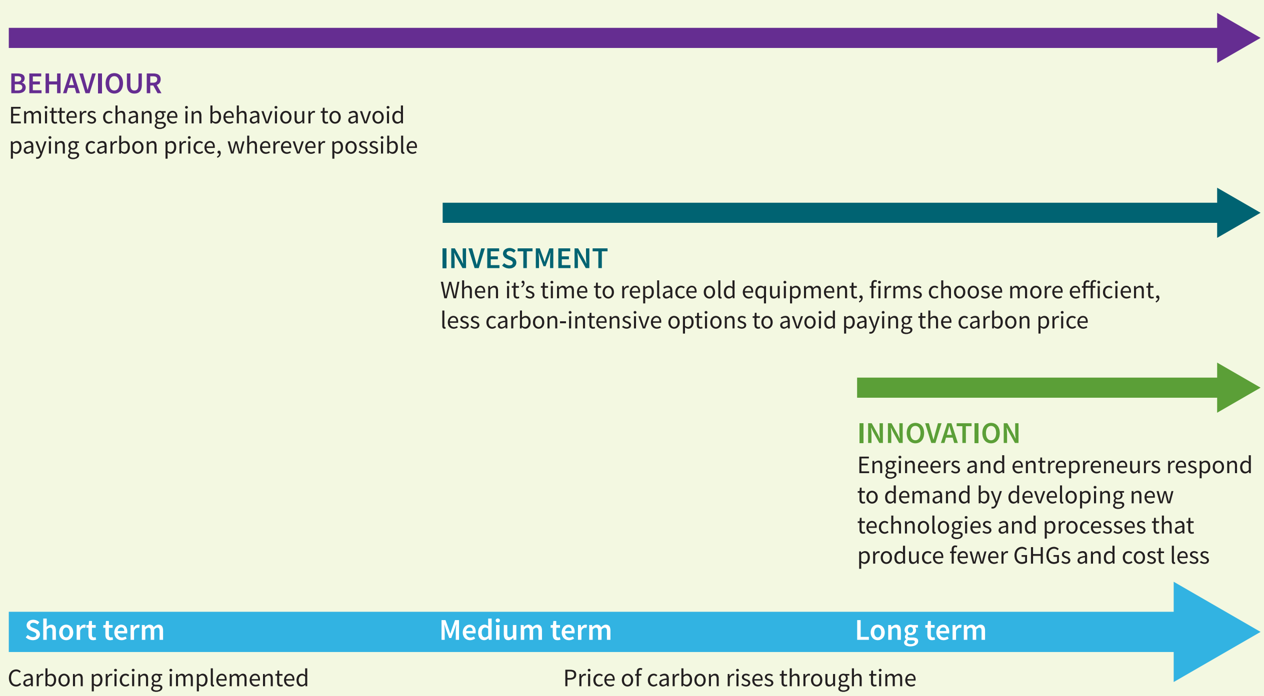
In short, we can extrapolate our example across all GHG emissions in Canada. Carbon prices affect choices. That's why a price on carbon can efficiently drive emissions reductions, and why it already has done so in British Columbia, California, the UK, and elsewhere, as we saw in Section 3.

5. When does carbon pricing work?

The impacts of carbon pricing aren't instantaneous, and we shouldn't expect immediate results. But nobody should conclude that carbon pricing doesn't work just because things don't change dramatically in the short term. Monitoring the GHG impact of carbon pricing is like watching paint dry.

Our story of driving and vehicles illustrates why carbon pricing works. But it also illustrates *when*. Figure 3 sketches a timeline for when businesses and individuals respond to carbon pricing.

Figure 3: Timeline for Responding to Carbon Pricing

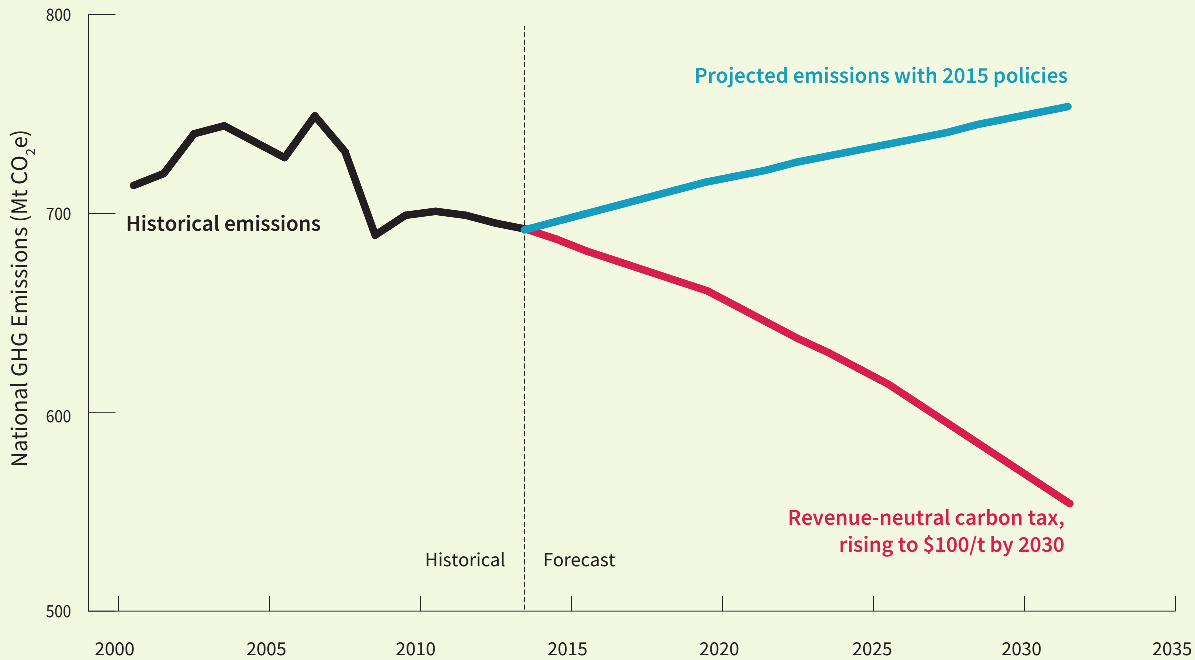


The gradual impact of a steadily rising carbon price helps to keep adjustment costs low. Replacing old equipment before it is necessary can be expensive. Carbon pricing gives businesses and individuals choices as to when to make these investments. The gradual transition gives everyone time to respond to the policy and plan their investments accordingly.

> **All these gradual changes add up across the economy and over time.**

Achieving deep GHG reductions at lowest cost is a long-run objective. Carbon-pricing policies in Canada are still young, with modest impacts so far. But gradual impacts from actions taken now accumulate into enormous impacts over time. And as carbon prices steadily increase, emissions levels will decrease, and cumulative emissions reductions will continue to grow. Our analysis from a previous report, shown in Figure 4, shows how a rising carbon price can drive large GHG reductions over time. Notice that, in this example, all the revenues raised by the carbon tax are used to finance cuts in other taxes — which makes the carbon tax revenue neutral.

Figure 4: Projected Emissions Reductions from a Pan-Canadian Carbon Price Rising to $100 per tonne



Source: Economic modelling from Navius Research, 2015

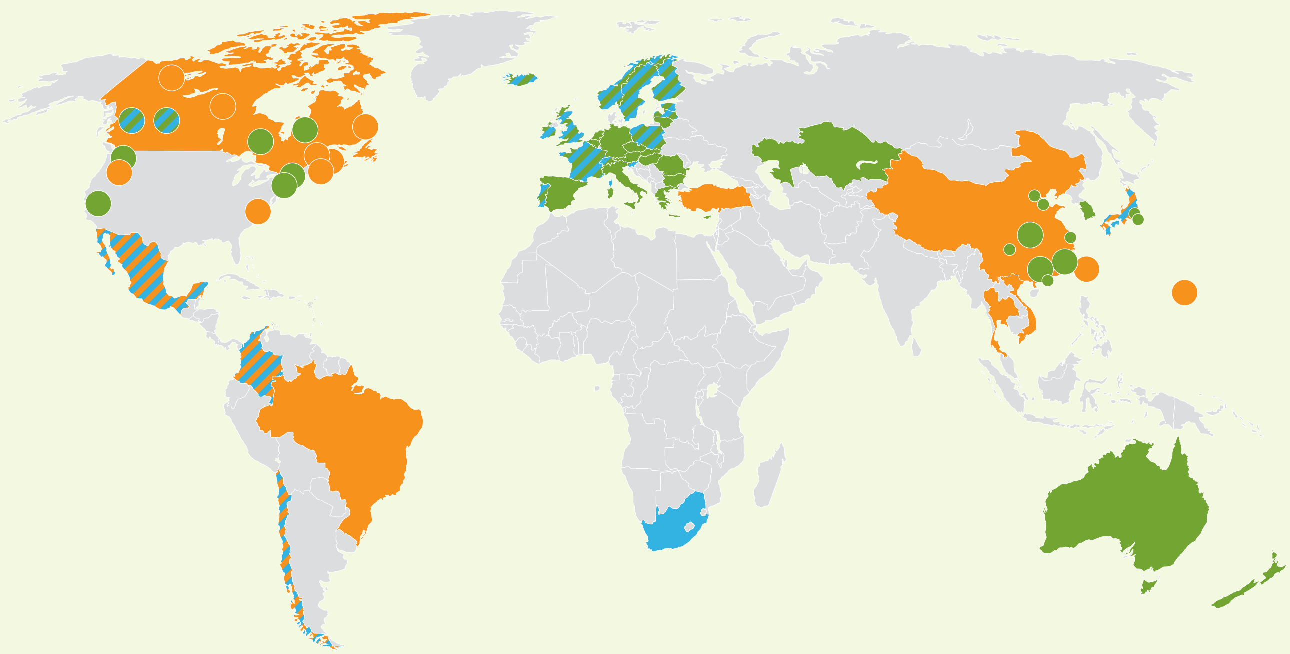
6. Who supports carbon pricing?

Support for carbon pricing comes from a remarkable range of perspectives.

Carbon pricing is spreading across the world

Many jurisdictions are implementing various kinds of carbon-pricing policies. Carbon pricing has spread to every continent, as Figure 5 illustrates. Countries, provinces, and states are choosing the type of carbon pricing that suits their unique circumstances — and learning and improving as they go. China is one of the latest countries to get on board. It launched its first cap-and-trade system in late 2017.

Figure 5: State of Carbon Pricing Around the World, 2017



- ETS implemented or scheduled for implementation
- Carbon tax implemented or scheduled for implementation
- ETS or carbon tax under consideration
- ETS and carbon tax implemented or scheduled
- ETS implemented or scheduled, tax under consideration
- Carbon tax implemented or scheduled, ETS under consideration

Note: An Emissions Trading System (ETS) is another term for a cap-and-trade system.

Source: World Bank, Ecofys and Vivid Economics. 2017. State and Trends of Carbon Pricing 2017. Washington D.C.

Carbon pricing has some unexpected advocates

Support for carbon pricing is broader than you might expect. Here is a sample of the kinds of people that have advocated carbon pricing as the best way to reduce GHG emissions *and maintain a strong economy at the same time*.

Henry Paulson

A tax on carbon emissions will unleash a wave of innovation to develop technologies, lower the costs of clean energy and create jobs.

Henry Paulson is a former CEO of Goldman Sachs and served as Secretary of the Treasury under President George W. Bush from 2006 to 2009.

Christine Lagarde

The transition to a cleaner future will require both government action and the right incentives for the private sector. At the centre should be a strong public policy that puts a price on carbon pollution.

Christine Lagarde has been Managing Director of the International Monetary Fund since 2011. She has also served as France's Minister of Economic Affairs and Minister of Finance.

Greg Mankiw

I view [a carbon tax] as a conservative approach to dealing with climate change. The alternative to giving the people the right incentives and letting them make free choices is to regulate their behavior… If we give people the right incentive with the carbon tax, then a lot of those regulations will become unnecessary.

Greg Mankiw is an economics professor at Harvard University. He was the Chair of George W. Bush's Council of Economic Advisors from 2003 to 2005, and later an advisor to presidential candidate Mitt Romney.

Jerry Brown

You have an incredible mechanism that protects our economy and reduces greenhouse gases... cap-and-trade is the way forward.

Jerry Brown is the Governor of California, having served from 1975 to 1983 and again from 2011 to the present.

Preston Manning

"For any economic activity, especially the production of energy, we should identify its negative environmental impacts, devise measures to avoid, mitigate or adapt to those impacts, and include the costs of those measures in the price of the product. It's the idea behind using carbon pricing to reduce greenhouse gas emissions."

Preston Manning founded both the Reform Party of Canada and the Canadian Reform Conservative Alliance. He served as Leader of the Official Opposition in the House of Commons from 1997 to 2000.

Steve Williams

"Climate change is happening. We think a broad-based carbon price is the answer."

Steve Williams is the CEO of Suncor, Canada's largest oil producer.

Angela Merkel

"It would be best if damaging emissions had a price worldwide. A global carbon market would be an incentive for the most efficient production possible, while ruling out a distortion of competition."

Angela Merkel has served as the Chancellor of Germany since 2005 as leader of the country's centre-right Christian Democratic Union.

Bernie Sanders

"A carbon tax must be a central part of our strategy for dramatically reducing carbon pollution, a view shared by economists on both ends of the political spectrum."

Bernie Sanders is a United States Senator. He was a Democratic Candidate in the 2016 presidential primaries.

Catherine McKenna

It is no longer acceptable to pollute for free and pass the bill to future generations. Putting a price on carbon is the most efficient way to reduce global emissions while encouraging sustainable and robust economic growth.

Catherine McKenna is a federal Member of Parliament and Canada's Minister of Environment and Climate Change.

Megan Leslie

Carbon pricing is needed to help reduce carbon emissions damaging our environment and contributing to wildlife declines across Canada and around the world.

Megan Leslie is the President and CEO, WWF-Canada.

Jim Yong Kim

The world's top priority must be to get finance flowing and get prices right on all aspects of energy costs to support low-carbon growth. Achieving a predictable price on carbon that accurately reflects real environmental costs is key to delivering emission reductions at scale.

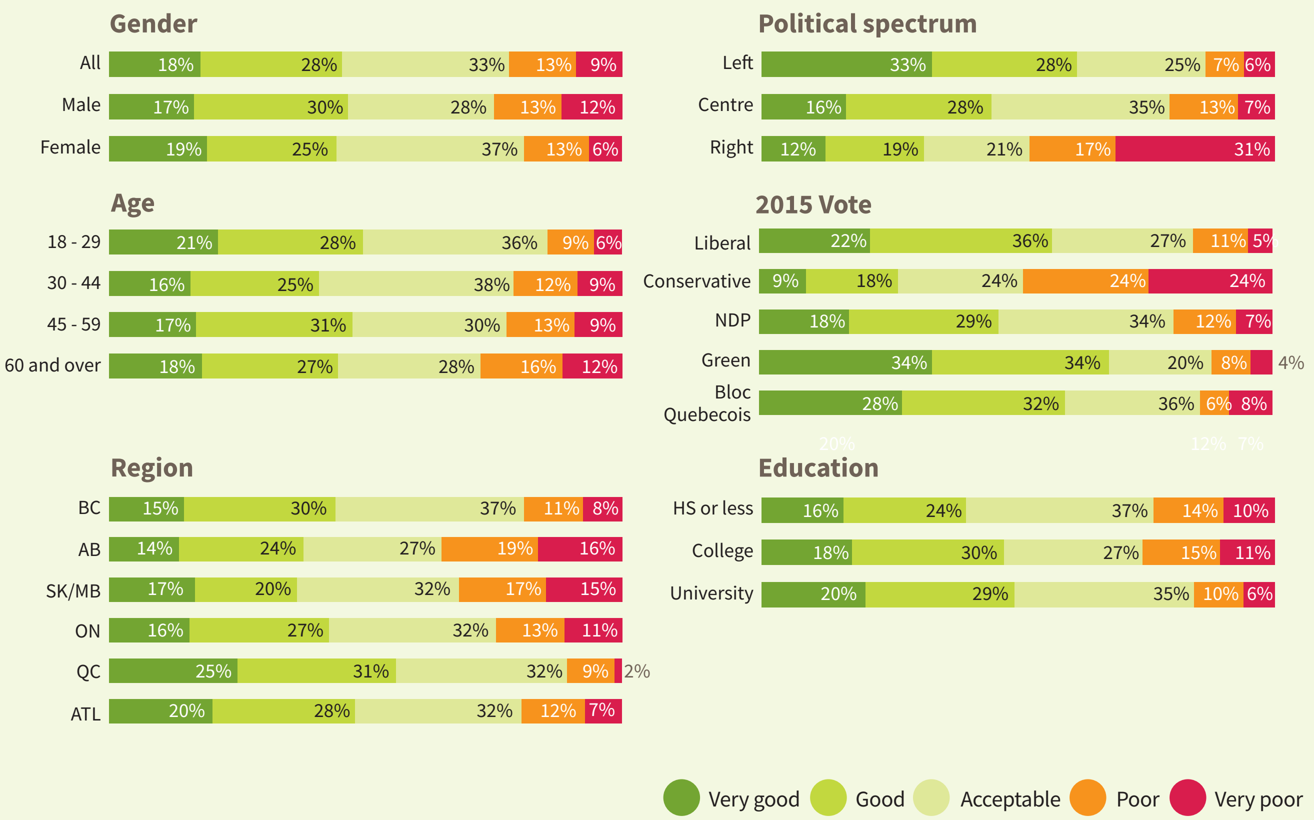
Jim Yong Kim has been the President of the World Bank since 2012. Previously, he was a physician, an advisor at the World Health Organization, and professor at Harvard Medical School.

Elon Musk

The fundamental problem is the rules today incent people to create carbon… So what can you do? Whenever you have the opportunity, talk to your politicians, ask them to enact a carbon tax.

Elon Musk is an investor and entrepreneur. He is the founder or cofounder of several companies, including Tesla, SpaceX, and SolarCity.

Figure 6: Canadians' Reaction to Carbon Pricing



Source: Abacus Data, 2018

Carbon pricing has support from Canadians

What about support among Canadians? Earlier this year, we commissioned polling on Canadians' attitudes toward carbon pricing. The results are instructive.

Despite some occasionally heated rhetoric, most Canadians support carbon pricing. Almost four out of five of those surveyed thought that carbon pricing was at least an "acceptable" idea, and 46% thought it was a good or very good idea. As Figure 6 illustrates, results vary somewhat by region. Opposition is strongest in Alberta, but 65% of Albertans surveyed still thought carbon pricing was at least an acceptable idea.

In addition, Canadian attitudes toward carbon pricing are slowly shifting. Compared to 2015, more Canadians think carbon pricing is a good or very good idea, and more people support it as a way to reduce emissions.

Not everyone who learns about carbon pricing will end up supporting it. And perhaps those who care about the environment are more likely to expend the effort to learn about carbon prices. At the very least, these results suggest that it might be a good idea for Canadians to learn a little more about carbon pricing and how it works.

7. How do policies put a price on carbon?

So how *does* carbon pricing work? How do policies put a price on carbon? Carbon pricing looks very different in the three jurisdictions we discussed in Section 3, but they're all based on the same idea. There are two basic approaches: carbon taxes and cap-and-trade systems. Variations of these two policies (and even hybrids) exist, but our focus here is on the basics of the policies, not their many details. We will look at carbon taxes and cap-and-trade systems in their simplest forms.

Carbon taxes *directly* set a price on carbon

A carbon tax sets the price on carbon directly. It applies to specific fuels based on how many GHGs are emitted when they are burned. Emitters pay a fixed fee to the government for every tonne of GHG emissions.

With this design, more carbon-intensive fuels have a higher carbon tax. In British Columbia, for example, the tax is currently set at $35 per tonne of GHGs. This translates to a little under 8 cents per litre of gasoline, a little over 9 cents per litre of diesel, and $1.77 per GJ (gigajoules) of natural gas. (One litre of diesel produces slightly more GHGs than one litre of gasoline, which explains why the tax per litre is slightly higher for diesel, but the tax per tonne of GHGs is identical for the two fuels.)

> **Businesses and individuals can choose to change their behaviour to reduce their GHG emissions, thus reducing the amount of carbon tax they pay. In extreme cases they can avoid paying the tax entirely if they can get to zero emissions. Leaving these decisions to businesses and individuals is exactly what makes carbon pricing work.**

Q&A: How are carbon taxes and cap-and-trade different?

What is the bottom line? Carbon taxes and cap-and-trade systems have more similarities than differences. Both policies put a price on carbon. Both create an incentive to reduce GHG emissions. Both provide incentives for the development and adoption of low-carbon technologies over time. Both policies can generate revenue that can be used to create other economic benefits, but there are also two important differences between the policy approaches.

First, carbon taxes and cap-and-trade systems provide certainty about different outcomes.

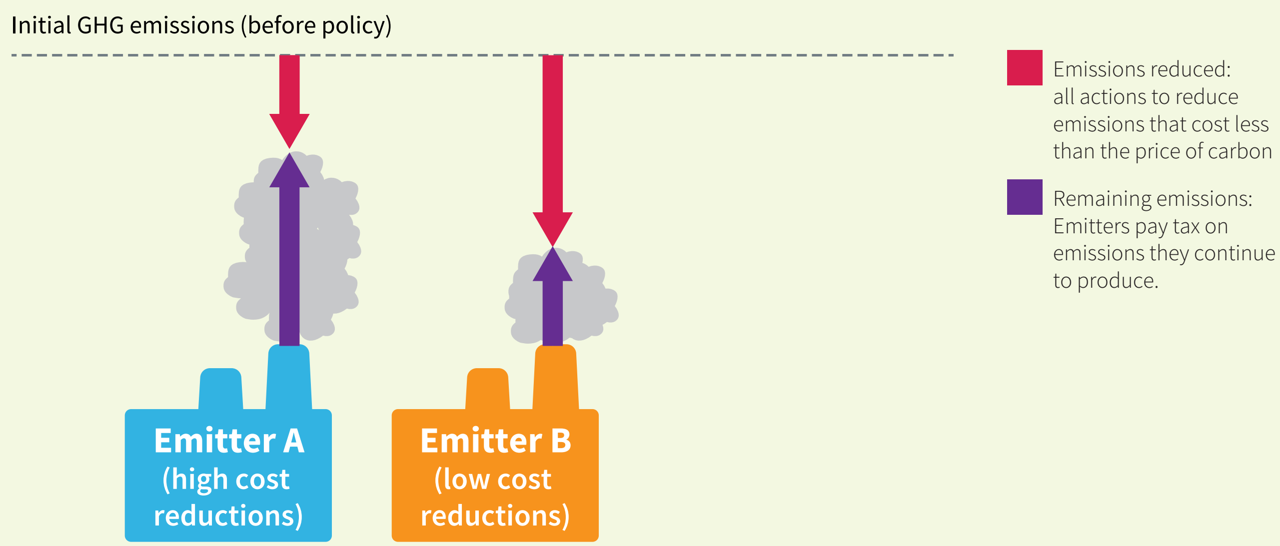
Under a carbon tax, we know what the price of carbon will be. But we don't know precisely how businesses and individuals will respond to the policy, what new technologies to reduce emissions might emerge, or how the economy will perform (independent of carbon pricing). As a result, a carbon tax doesn't guarantee a specific amount of emissions reductions. Modelling can be used to project GHG reductions these estimates cannot be certain.

In contrast, with a cap-and-trade system, the cap provides a clear regulatory limit on the total amount of emissions. So emissions are known. But the market for permits — not a policy decision — determines the carbon price; it varies with changes in supply and demand. Modelling can be used to project how the carbon price will evolve over time but, again, these estimates cannot be certain.

Many cap-and-trade systems — for example, those in Ontario, Quebec, and California — reduce the uncertainty in the carbon price by establishing upper and lower limits for the price. Such limits make a cap-and-trade system more like a carbon tax.

Linking cap-and-trade systems across jurisdictions can yield additional benefits. GHG emitters covered by the cap-and-trade systems in Ontario and Quebec, for example, can buy and sell emissions permits among each other *and* from emitters in California. The result is that the permit market is larger than it would be if each jurisdiction prohibited trades with emitters in other jurisdictions. The bigger market provides more opportunities to adopt low-cost ways to reduce emissions. Current estimates indicate that if the Ontario and Quebec cap-and-trade systems had no access to the California system, the carbon price in the two Canadian provinces would be significantly higher than it now is.

Figure 7: How a Carbon Tax Works



The example here illustrates how it works:

1. Consider two emitters, **Emitter A** and **Emitter B**. Without a carbon tax, each produces the same amount of GHG Emissions each year.
2. Now, consider those same emitters under a carbon tax. **Emitter A** knows that it will pay the carbon tax on its emissions. But it also has choices: it can take actions to *avoid* those emissions by (for example) installing more efficient equipment or switching from diesel to electricity. **Emitter A** therefore takes every action to **reduce emissions** that cost less than simply paying the tax. In other words, **Emitter A** would rather pay $10 for an action that reduces a tonne of carbon dioxide than $30 in taxes on that tonne.
3. **Emitter B** is in the same situation. But every emitter has different context with different costs. Even though it started out with the same level of emissions, it has more options for low-cost emission reductions (perhaps it is an older facility; perhaps it still uses different technologies that are easier to upgrade). As a result, it **reduces emissions** even more than **Emitter A** to avoid paying as much of the carbon tax as possible.
4. This flexibility of when and how to reduce emissions means that total costs to the economy are lower than they would be under a regulation that simply required both firms to use specific technologies or achieve a specific level of emissions performance. By giving emitters choice, the carbon price lowers overall costs.
5. Finally, both emitters pay the carbon tax on their **remaining emissions**. Governments can choose to recycle this revenue back to the economy in various ways. They might reduce other taxes such as corporate or personal income taxes. They might invest in green technologies. Or they might give money to low-income households.

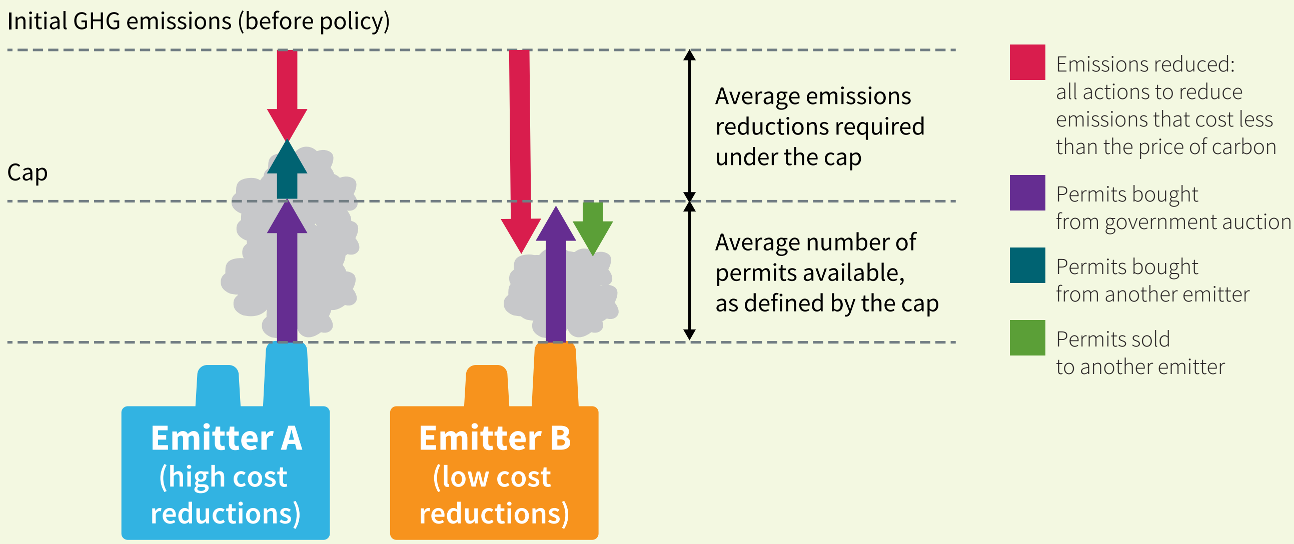
Cap-and-trade systems *create a market* that establishes a price on carbon

Cap-and-trade systems *also* create a carbon price but in an indirect way.

A government begins by establishing a maximum allowable level of GHG emissions in its jurisdiction; this is the **cap** on emissions. It then allocates emissions permits to industrial facilities, fuel distributors, and other large emitters, either by selling them or providing them for free. These businesses can emit GHGs only up to their total number of permits. The difference between the total amount of current emissions (without the policy) and the emissions “cap” determines the size of the reduction in GHG emissions.

Where is the carbon price in this picture? The key point is that businesses are allowed to buy and sell emission permits among themselves; this is the **trade** part of cap-and-trade. Firms that need more permits (so that they don’t have to reduce their emissions as much) will demand them and purchase them from the market. Other firms that don’t need all their permits (because they plan

Figure 8: How a Cap-and-Trade System Works



to cut their emissions) will supply and sell them to the market. This supply and demand for permits determines the market price of carbon. Trading in this market determines who will reduce emissions (and sell permits) and who will increase emissions (and buy permits).

The net effect of this pattern of emissions and trading is that GHG emissions get reduced by the required amount and at the lowest possible cost. Why? Because the firms that are able to reduce emissions at the lowest cost are the ones that will realize the most reductions; the firms that are able to reduce emissions only at a higher cost cut their emissions by less or not at all. All emitters in a cap-and-trade system have a profit-driven incentive to reduce their emissions, but they respond differently because of their different costs and technologies.

This example illustrates how it works:

1. Again, we consider two emitters, **Emitter A** and **Emitter B**. Each produces the same amount of GHG Emissions each year.
2. Now, consider those emitters under a cap-and-trade system. The **cap** is defined by the **total number of permits** available in the system: each emitter needs a permit for every tonne of GHG it produces. The cap is smaller than total current emissions, which requires the average emissions from our emitters to fall. Available permits can be sold or distributed for free. For the sake of this analysis, let's assume that both **Emitter A** and **Emitter B** get the same number of permits to start (**the average**).
3. **Emitter A** wants to avoid having to buy **additional permits**, so it **takes action to reduce its own emissions**. But it has only a few low-cost opportunities to do so. To minimize its costs, **Emitter A** reduces some emissions but also **buys some additional permits** from other emitters on the permit market.
4. **Emitter B** has more options for low-cost emissions reductions. In fact, given that the permits it holds are valuable (i.e., can be sold on the market), it makes sense for **Emitter B** to **reduce even more** and **sell additional permits for cash**.
5. Because our simple example only has two emitters, the permits sold by **Emitter B** are equal to the permits purchased by **Emitter A**. This is how larger markets work as well: the *price* of those permits will adjust such that the supply of permits is equal to the demand. The result: a price on carbon.
6. The outcome is the same as the carbon tax. Each emitter reduces emissions by taking all actions that cost less than the price of carbon. They hold permits for all remaining emissions, thus collectively meeting the **cap on emissions** for the economy as a whole.

These ideas bring us back to the purpose of this essay: our goal is to explain where and why carbon pricing *has* worked, and *how*. Before we get to our conclusions and recommendations, we'll address a few questions that may have popped up along the way.

8. Other FAQs about carbon pricing

Our focus has been the "who, what, when, where, why, and how" of carbon pricing, which reduces GHG emissions while supporting a strong economy. But other more detailed questions about carbon pricing also frequently arise. We address these questions (briefly) here, with links to deeper analysis.

Q&A: Does carbon pricing undercut business competitiveness?

Short answer: No. Well-designed carbon pricing can create incentives to reduce GHG emissions without damaging the international competitiveness of Canadian businesses.

What do we mean by competitiveness? It's the ability of a business to compete successfully against its domestic and foreign rivals. Regulations, wages, working rules, income-tax rates, the quality of workers, and market access are just a few of the many factors that affect competitiveness. Carbon pricing adds one more element to the mix. In Canada, carbon pricing only affects business competitiveness if the carbon price at home is higher than the one faced by rivals from other jurisdictions.

Competitiveness is a legitimate and important issue. But it's *not* a reason to avoid pricing carbon, for three reasons.

First, competitiveness pressures *created by carbon pricing* affect a relatively narrow part of the aggregate Canadian economy. Only sectors that both produce lots of emissions and compete in global markets are affected. They make up about 5% of GDP nationally, though this is not evenly spread across the country. In Ontario and BC, for example, less than 2% of GDP comes from such "exposed" sectors; in Alberta and Saskatchewan, however, the number is more like 18%.

Second, this "carbon competitiveness" issue is relevant only if Canada is way ahead of the pack internationally, meaning that we have carbon prices well above those in our trading partners. But we aren't way ahead: over 40 countries have some form of carbon pricing, and the number is growing every year. However, *some* foreign firms *do* compete with this 5% of the Canadian economy and come from jurisdictions with *lower* carbon prices. This is a problem we need to address. What should we do? This brings us to our final point.

Third, well-designed carbon pricing *can* effectively address the issue of business competitiveness. When competitiveness *is* an issue, recycling the revenues from carbon pricing can ensure that firms remain competitive and continue to thrive in their Canadian location. Carbon pricing can be (and should be) designed to provide *targeted*, *transparent*, and *temporary* support to "carbon-exposed" sectors. Several of these policies are already in place across Canada, including corporate income-tax cuts and emissions-performance standards.

Q&A: Is carbon pricing unfair for low-income households?

Short answer: No. Well-designed carbon pricing won't disproportionately affect low-income households.

Here's the concern: compared to higher-income households, energy tends to make up a larger share of lower-income households' total expenditures. Carbon pricing makes (fossil-fuel-based) energy more expensive. All else being equal, this would imply that those households are disproportionately affected by the carbon price, relative to high-income households. That's a legitimate concern, but good policy design can provide the solution.

Smart recycling of revenues can address these fairness concerns. For example, BC and Alberta mail rebate cheques to lower-income households. The combination of carbon pricing *and* the cheques ensures that low-income households aren't unduly affected relative to high-income households. (It actually makes them better off while still giving them an incentive to reduce their emissions.) In short, fairness concerns should not be an obstacle to implementing carbon pricing, as long as the policy is designed well.

Q&A: Can revenue recycling undermine carbon pricing?

Short answer: No. The primary objective of carbon pricing is to reduce GHG emissions, but it can also raise substantial revenues for the government. Once a carbon price is in place, the decision of what to do with the revenues is a related but separate issue. Revenue-recycling choices are a key part of designing smart carbon-pricing policies, and they have implications for the overall environmental and economic performance of a carbon-pricing policy. Done right, they will not undermine incentives to reduce emissions.

Let's work through a simple example to explain why. Rebate cheques to households are one way to ensure carbon pricing is fair for low-income earners. Here's the most important part: those rebate cheques don't depend on each earner's emissions levels at all. Let's assume that a carbon tax raises $100 million in a province with one million households. If all the revenue is rebated to households, each household would get a rebate cheque for $100. It doesn't matter how much carbon tax any one household pays — it still gets the same rebate. So, if the household were to reduce its carbon consumption, it would pay less in carbon taxes a*nd still get the $100 rebate*.

In other words, the household's incentive to reduce carbon emissions is not affected by the rebate as long as the rebate is not related to the household's own emissions. Even if the cheque is larger than a household's carbon costs, it can save *even more* by reducing emissions. For each individual household, the credit and the carbon tax are independent of each other. The logic is exactly the same for supporting emissions-intensive industries to protect competitiveness and maintain incentives for these industries to reduce GHG emissions.

Q&A: What is the role of other policies? Can carbon pricing do it all?

Short answer: No. Carbon pricing is the simplest and most cost-effective way to reduce GHG emissions. But it can't do it all. Governments should consider three types of "non-pricing" policies as complements to carbon pricing: gap-filling, signal-boosting, and benefit-expanding.

Although carbon pricing can cover *most* of an economy's emissions, it is difficult to attach a price to *some* types of emissions. For example, emissions from forestry, agriculture, and waste come from many sources and can be tough to measure. Because of these gaps, relying on pricing alone will leave cost-effective emissions reduction opportunities unrealized. "Gap-filling" policies target these opportunities *and* can lower the overall cost of reducing emissions.

Sometimes carbon pricing doesn't work as well as it could because the price signal it sends is too weak to change household or business decisions. There are several reasons this might happen. One is that consumers don't always have all the information they need. "Signal-boosting" policies can help carbon pricing work better by addressing these other problems. For example, programs like *Energy Star* can help consumers identify which appliances use less electricity and produce fewer emissions. This makes it easier for consumers to follow the logic of the carbon price and make low-carbon decisions that will save them money for the many years they will own the appliances.

Other times, climate policy isn't just for the climate. Some policies might offer more than GHG mitigation. Better cycling paths and public transit can reduce car use *and* improve urban mobility. Shifting away from coal-fired electricity can reduce GHG emissions *and* improve local air quality. These "benefit-expanding" policies may be cost-effective when we consider positive outcomes *other* than reducing GHG emissions.

9. Conclusions

Well-designed policies that put a price on carbon can reduce GHG emissions and can do so in a way that doesn't undermine our economic prosperity.

Carbon pricing works. We have shown *where* carbon pricing has worked — in terms of both environmental and economic outcomes — in provinces, states, and countries that have implemented carbon-pricing policies. Experience in British Columbia, California and the United Kingdom provide real-world evidence of successful carbon pricing.

We have shown *why* carbon pricing works—using a simple example of how a carbon price might affect the vehicles we purchase, and why. Carbon pricing is all about incentives and flexibility. It reduces costs by preserving choice for individuals and businesses.

> **Carbon pricing is all about incentives and flexibility. It reduces costs by preserving choice for individuals and businesses.**

We have shown *when* carbon pricing works by considering impacts in the short, medium, and long terms. Carbon pricing works gradually and incrementally over time. But over the long term, these effects accumulate enormously.

We have shown *who* accepts that carbon pricing works by looking at the breadth of jurisdictions across the globe moving forward with policies, as well as the support from a broad cross-section of individual policy voices.

Finally, we have shown *how* policies put a price on carbon by explaining cap-and-trade systems and carbon taxes. Both systems can work and are actually more similar than they are different.

Carbon pricing is about the "rules of the market," not specific outcomes

Our findings might be a little unexpected, and perhaps contrary to some of the many carbon-pricing myths floating around. The point of carbon pricing *isn't* to punish polluters. It is *not* to generate revenue (though it does do that). And it's definitely *not* about promoting specific "green" technologies.

> **Market prices should tell the truth about what carbon really costs us. Carbon pricing does that. And then it lets individuals and businesses respond in ways that work for them.**

Instead, carbon pricing is about making the "rules of the market" work better, and letting individual producers and consumers make their own choices within that context. Market prices should tell the truth about what carbon really costs us. Carbon pricing does that. And then it lets individuals and businesses respond in ways that work for them. The overall result is that we get lower GHG emissions without harming the overall performance of the economy.

10. Recommendations

Canada has made enormous progress on carbon pricing over the last several years, but there is more to be done. We close off this essay with three recommendations.

RECOMMENDATION #1:
Canadian provinces should rely on increasingly stringent carbon pricing policies to reduce GHG emissions

Carbon pricing already covers the majority of GHG emissions in Canada. Governments should continue to make carbon pricing the central plank of their climate policy, and they should add well-designed non-pricing policies only when carbon pricing alone can't do the job. This will ensure that Canada reduces GHG emissions at the lowest possible economic cost.

And the stringency of carbon pricing policies across Canada should continue to increase gradually over time. Canadian provinces can achieve the deeper emissions reductions required by steadily increasing the rates of carbon taxes or steadily reducing the number of permits in cap-and-trade systems. Higher carbon prices and lower caps will lead to deeper emissions reductions.
The expectation of rising carbon prices will strengthen incentives for emitters to innovate and invest in low-carbon technologies. Steady, predictable increases in stringency will ensure that individuals and businesses have time to adjust and plan their long-term investments accordingly.

RECOMMENDATION #2:
Policy makers and analysts should work to better communicate the realities of carbon pricing

We've come a long way in Canada. We have real, working examples of both carbon taxes and cap-and-trade systems. But pervasive myths about carbon pricing still cause too much of the debate to be based on poor information.

We appreciate that carbon pricing isn't always simple, especially when it comes to the important details of policy design. It is incumbent on all of us engaged in climate policy to communicate beyond a narrow group of technical policy experts. Carbon pricing affects all Canadians, so we need to help all Canadians understand the basics. That's why we wrote this essay — so please pass it on.

We can't afford to base important policy decisions on myths and misunderstandings; critics of carbon pricing ought to base their arguments on evidence. There is plenty of room to debate the different methods of carbon pricing, various approaches to revenue recycling, how fast the carbon price should rise, or what other climate policies may be necessary. But arguing that prices don't affect decisions is arguing against a large body of economic theory, against an enormous amount of empirical evidence, and most importantly, against most people's own experiences.

Having a better public conversation about carbon pricing can help us move forward.

RECOMMENDATION #3:
Governments should carefully evaluate their carbon-pricing policies over time, especially in the medium term.

Nothing is more convincing than hard data. To *show* that carbon pricing works, governments should undertake careful, detailed analysis of how carbon pricing has performed in their jurisdictions. That analysis should isolate the effects of carbon pricing from other factors. It should explicitly show the impacts of the policy on GHG emissions and the economy by estimating what environmental and economic outcomes would have been in the absence of the carbon price. This robust data and analysis should be clearly communicated to the public.

And if, over time, evidence accumulates that existing carbon-pricing policies haven't worked as theory — and experience — suggests they will, governments should be prepared to revisit or redesign these policies as necessary.

Carbon pricing will be most effective *over time*. Our transition to a low-carbon economy will not occur overnight, but instead gradually, as firms and individuals develop and adopt new technologies. Evaluation and adjustment over time are important, but must also be tempered by patience.

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This is **Exhibit Q** referred to in the

affidavit of **John Moffet**

affirmed before me on **January 29, 2019**

Commissioner for Oaths for Québec

#224458

VANCOUVER DECLARATION
ON CLEAN GROWTH AND CLIMATE CHANGE

March 3, 2016

Canada stands at the threshold of building our clean growth economy. This transition will create a strong and diverse economy, create new jobs and improve our quality of life, as innovations in steam power, electricity and computing have done before. We will grow our economy while reducing emissions. We will capitalize on the opportunity of a low-carbon and climate-resilient economy to create good-paying and long-term jobs. We will do this in partnership with Indigenous peoples based on recognition of rights, respect and cooperation.

We will build on the leadership shown and actions taken by the provinces and territories, as exemplified by the 2015 Quebec Declaration and Canadian Energy Strategy, by working together and including federal action. We will build on the momentum of the Paris Agreement by developing a concrete plan to achieve Canada's international commitments through a pan-Canadian framework for clean growth and climate change. Together, we will leverage technology and innovation to seize the opportunity for Canada to contribute global solutions and become a leader in the global clean growth economy.

To that end, First Ministers agree to the following:

1. Increase the Level of Ambition

Recognizing the Paris Agreement which calls for significant reductions in global greenhouse gas (GHG) emissions to limit global warming to less than 2˚C and to pursue efforts to limit it to 1.5˚C above preindustrial levels;

Recognizing that the level of ambition set by the Paris Agreement will require global emissions to approach zero by the second half of the century and that all governments, Indigenous peoples, as well as civil society, business and individual Canadians , should be mobilized in order to face this challenge, bringing their respective strengths and capabilities to enable Canada to maximize the economic growth and middle class job opportunities of a cleaner, more resilient future**;**

First Ministers **commit to**:

- **Implement** GHG mitigation policies in support of meeting or exceeding Canada's 2030 target of a 30% reduction below 2005 levels of emissions, including specific provincial and territorial targets and objectives;

- **Increase** the level of ambition of environmental policies over time in order to drive greater GHG emissions reductions, consistent with the Paris Agreement;

- **Better coordinate** GHG emissions reporting systems among jurisdictions to accurately and transparently assess the progress and the impact of our climate actions towards our respective and collective targets.

2. Promote Clean Economic Growth to Create Jobs

Recognizing that the cost of inaction is greater than the cost of action with regard to GHG emissions mitigation and adaptation to the impacts of climate change;

Recognizing that clean growth which supports the transition to a climate-resilient and low carbon economy by 2050 is necessary to ensure the future prosperity of Canada and Canadians;

Recognizing the diversity of provincial and territorial economies, and the need for fair and flexible approaches to ensure international competitiveness and a business environment that enables firms to capitalize on opportunities related to the transition to a low carbon economy in each jurisdiction;

Recognizing the economic importance of Canada's energy and resource sectors, and their sustainable development as Canada transitions to a low carbon economy;

Recognizing that growing our economy and achieving our GHG emissions targets will require an integrated, economy-wide approach that includes all sectors, creates jobs and promotes innovation;

Recognizing that investing in clean technology solutions, especially in areas such as renewable energy, energy efficiency and cleaner energy production and use, holds great promise for sustainable economic development and long-term job creation;

First Ministers **commit to**:

- **Ensure** deep reductions in GHG emissions and a competitive economy, provide certainty to business, and contribute global solutions to a global issue;
- **Foster and encourage** investment in clean technology solutions for Canada and the world that hold great promise for economic growth and long-term job creation;
- **Implement** measures grounded in the view that clean growth and climate change policies are of net economic, environmental and social benefit to Canadians.

3. Deliver Mitigation Actions

Recognizing that a collaborative approach between provincial, territorial and federal governments is important to reduce GHG emissions and enable sustainable economic growth;

Recognizing the important role all governments have in the global effort to reduce

GHG emissions, and that a number of provinces and territories have already joined or are exploring entry into regional and international efforts to reduce GHG emissions;

Recognizing that development of new technologies and deployment of existing technologies and innovations in areas such as cleaner energy production and use, renewable and alternative energy, energy efficiency and innovative financial instruments will create new and competitive economic opportunities, domestically and abroad, that can facilitate the transition to a more resilient, low carbon economy;

Recognizing that carbon pricing mechanisms are being used by governments in Canada and globally to address climate change and drive the transition to a low carbon economy;

Recognizing that provinces and territories have been early leaders in the fight against climate change and have taken proactive steps, such as adopting carbon pricing mechanisms, placing caps on emissions, involvement in international partnerships with other states and regions, closing coal plants, carbon capture and storage projects, renewable energy production (including hydroelectric developments) and targets, and investments in energy efficiency;

Recognizing that the federal government has committed to ensuring that the provinces and territories have the flexibility to design their own policies to meet emission reductions targets, including their own carbon pricing mechanisms, supported by federal investments in infrastructure, specific emission reduction opportunities and clean technologies;

First Ministers **commit to**:

- **Transition** to a low carbon economy by adopting a broad range of domestic measures, including carbon pricing mechanisms, adapted to each province's and territory's specific circumstances, in particular the realities of Canada's Indigenous peoples and Arctic and sub-Arctic regions. The transition also requires that Canada engage internationally;

- **Foster** investments in clean technologies to reduce the GHG emissions associated with the production and consumption of energy, including renewable and alternative energy, energy efficiency and storage, and other technologies which may include carbon capture and storage;

- **Encourage** the sharing of information, expertise and best practices in order to foster a business environment that favours investments in innovative clean technologies related to climate change;

- **Work together** to enhance carbon sinks, including in agriculture and forestry, taking into account international best practices and accounting standards, to recognize their contribution to mitigating GHG emissions, and toward the establishment of a pan-Canadian offset protocols framework and verified carbon credits that can be traded internationally.

4. **Increase Action on Adaptation and Climate Resilience**

Recognizing that Canada has already experienced severe impacts of climate change, including forest fires, droughts, flooding, coastal erosion, thawing permafrost, invasive species, and the spread of diseases previously foreign to Canada;

Recognizing that the health and security of populations, as well as the economy, infrastructure, cultural heritage and ecosystems are being impacted by climate change, and that climate risks and inaction have significant implications for the economic and social development prospects of provinces, territories, Indigenous peoples and Canada as a whole;

Recognizing that Canada's northern and coastal regions are particularly vulnerable and disproportionately affected by the impacts of climate change;

Recognizing the importance of traditional ecological knowledge in regard to understanding climate impacts and adaptation measures;

Recognizing that comprehensive adaptation efforts must complement ambitious mitigation measures to address unavoidable climate change impacts;

First Ministers **commit to**:

- **Implement** strong, complementary adaptation policies within our respective jurisdictions to address climate risks facing our populations, infrastructures, economies and ecosystems, in particular in Canada's northern regions.

- **Support** climate resilient and green infrastructure, including disaster mitigation;

- **Strengthen** the collaboration between our governments and Indigenous peoples to support local adaptation efforts.

5. **Enhance Cooperation**

Recognizing that in the Paris Agreement, Parties agreed that they should, when taking action to address climate change, recognize and respect the rights of Indigenous peoples;

Recognizing that, in April 2015, Premiers concluded the Québec Summit on Climate Change with the Declaration of the Premiers of Canada by which they have agreed to act together in the fight against climate change;

Recognizing the leadership of the provinces and territories in developing the Canadian Energy Strategy, which was released in July 2015 and charts a path for shaping the sustainable development of Canada's energy future;

Recognizing the importance of provincial and territorial actions to enable the achievement of clean growth and climate change objectives and targets;

Recognizing the commitment of the federal government to work with the provinces and territories in order to complement and support their actions without duplicating them, including by promoting innovation and enabling clean growth across all sectors;

Recognizing that Canada cooperates with the United States and Mexico on energy and the environment, including through a recently signed Memorandum of Understanding on Climate Change and Energy Collaboration;

Recognizing the importance of public education, participation and access to information to increase climate change awareness and literacy;

First Ministers **commit to**:

- **Strengthen** the collaboration between our governments and Indigenous peoples on mitigation and adaptation actions, based on recognition of rights, respect, cooperation and partnership;

- **Strengthen** pan-Canadian intergovernmental cooperation and coordination on clean growth and climate change, including through mechanisms such as the Canadian Council of Ministers of the Environment, Ministers of Finance, Ministers of Innovation and Economic Development, and Energy Ministers, in collaboration with Indigenous peoples;

- **Implement** a collaborative, science-based approach to inform Canada's future targets that will increase in stringency as required by the Paris Agreement;

- **Enable** the participation of provinces and territories in cooperative activities related to their jurisdictions with the United States and Mexico on energy and climate change mitigation and adaptation;

- **Facilitate** cooperation to strengthen public communication and participation on climate change, improve public climate literacy, promote the actions taken by governments to reduce GHG emissions, and support international engagement.

Taking Action

- In order to achieve these commitments, First Ministers agree to work together to develop a pan-Canadian framework on clean growth and climate change, and implement it by early 2017. It will build on measures that the provinces and territories have taken, be supported by broad engagement with Indigenous peoples and all Canadians, and be informed by science and evidence. It will inform the development and submission of Canada's Nationally Determined Contribution and its long-term low greenhouse gas emission development strategy under the Paris Agreement as Canada's plan to achieve our international commitments. Specific actions include:

(1) Early actions by the Government of Canada:

a. Supporting climate change mitigation and adaptation through investments in green infrastructure, public transit infrastructure and energy efficient social infrastructure;

b. Investing in GHG emission reductions by working together on how best to lever federal investments in the Low Carbon Economy Fund to realize incremental reductions;

c. Fulfilling Canada's commitment to Mission Innovation, made in Paris in December 2015, by doubling government investment in clean energy research and development over the next five years, and spurring private sector investment in clean technology;

d. Advancing the electrification of vehicle transportation, in collaboration with provinces and territories;

e. Fostering dialogue and development of regional plans for clean electricity transmission; and

f. Investing in clean energy solutions to help get Indigenous, remote and northern communities off diesel.

(2) Working together to build on provincial and territorial actions by identifying measures that governments could take to reduce emissions and grow the economy in the longer term:

a. First Ministers direct that reports be developed by working groups to identify options for action in four areas: clean technology, innovation and jobs; carbon pricing mechanisms; specific mitigation opportunities; and adaptation and climate resilience. Each working group will assess impacts on economic and environmental outcomes. The reports will be provided to the ministerial tables charged with overseeing their work, as outlined below, by September 2016. Ministers will review these reports and provide their recommendations to First Ministers by October 2016, and make the working group reports public.

b. Working groups will be established in these four areas to prepare the reports. The working groups will be led by federal and provincial or territorial co-chairs, and will be composed of members from federal, provincial and territorial governments. Each of the groups will include Indigenous peoples in their work. The working groups will be encouraged to commission expert analysis and reports as necessary to support their work, and engage stakeholders.

c. The **Working Group on Clean Technology, Innovation and Jobs** will provide a report with options on how to stimulate economic growth, create jobs, and drive innovation across all sectors to transition to a low-carbon economy, leveraging regional strengths. This working group will consider a range of policy tools to bring new and emerging technology and innovations to market, sustain a competitive economy, reduce GHG emissions, encourage growth and investment, and increase exports of clean technologies, services and expertise. Their work will be overseen by Ministers of Innovation and Economic Development, who will receive their report.

d. The **Working Group on Carbon Pricing Mechanisms** will provide a report with options on the role of carbon pricing mechanisms in meeting Canada's emissions reduction targets, including different design options taking into consideration existing and planned provincial and territorial systems. It will consider various elements of carbon pricing policy, including coverage, comparability and stringency, as well as market transactions related to mitigation technologies and international trends in carbon pricing and markets. It will consider the effectiveness of various carbon pricing mechanisms to contribute to the certainty of emission reductions and their efficiency at achieving this objective at the lowest possible cost, and take account of particular challenges, such as those facing northern and remote communities. It will also address issues that are particularly important to industry and investors, such as predictability, and approaches to address interprovincial and international competitiveness, including carbon leakage. Their work will be jointly overseen by Ministers of Finance and the Canadian Council of Ministers of the Environment, who will both receive their report.

e. The **Working Group on Specific Mitigation Opportunities** will provide a report with options on how to promote clean growth and achieve a range of ambitious reductions in key sectors, including large industrial emitters, transportation, electricity generation and transmission, built environment, agriculture and forestry, and government operations as well as individual energy conservation actions. The working group will also look at approaches to internationally transferred mitigation outcomes, in the context of the Paris Agreement. The working group, supported by technical sub-groups, will consider various emissions reduction opportunities, taking into consideration existing and planned policies. Their work will be overseen by the Canadian Council of Ministers of the Environment, who will receive their report.

f. The **Working Group on Adaptation and Climate Resilience** will provide a report with options on a comprehensive approach to adapt to the impacts of climate change, support affected communities and build greater climate resilience. This working group will identify specific priorities in support of approaches to climate change adaptation, including disaster mitigation and conservation, and will consider a range of policy tools to foster research, innovation and investments in resilient infrastructure; integrate information, expertise and best practices from Indigenous peoples; and support the development of jurisdictional policies. This work will be overseen by the Canadian Council of Ministers of the Environment, who will receive their report.

(3) Working together on Energy Efficiency and Clean Energy Technology and Innovation:

a. Federal, provincial and territorial Energy Ministers will collaborate on specific actions being undertaken through the Canadian Energy Strategy, including energy conservation and efficiency, clean energy technology and innovation and delivering energy to people and global markets, in order to contribute to the pan-Canadian framework on clean growth and climate change.

b. The Government of Canada will advance the harmonization of energy efficiency standards and development of innovative approaches across Canada and with North American partners.

(4) Engage Indigenous peoples in the development of the pan-Canadian framework on clean growth and climate change

a. The working group process will be complemented by a broader engagement process with Indigenous peoples.

(5) Engage the public in the development of the pan-Canadian framework on clean growth and climate change

a. The public, including youth, will be engaged using online tools in particular to solicit input and to increase climate change awareness and literacy.

(6) First Ministers will meet in fall 2016 to finalize the pan-Canadian framework on clean growth and climate change, and review progress on the Canadian Energy Strategy.

This is **Exhibit R** referred to in the

affidavit of **John Moffet**

affirmed before me on **January 29, 2019**

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Commissioner for Oaths for Québec

#224458

WORKING GROUP ON CARBON PRICING MECHANISMS

FINAL REPORT

Aussi disponible en français

WORKING GROUP ON CARBON PRICING MECHANISMS

FINAL REPORT

CONTENTS

EXECUTIVE SUMMARY

On March 3, 2016, Canada's First Ministers, recognizing commitments and actions already taken by provinces and territories, released the Vancouver Declaration on clean growth and climate change which seeks to increase ambition and enhance cooperation in that regard. First Ministers agreed to work together to identify measures that governments could take to reduce emissions and grow the economy in the longer term by establishing working groups in four areas: clean technology, innovation and jobs; carbon pricing mechanisms; specific mitigation opportunities; and adaptation and climate resilience.

The Working Group on Carbon Pricing Mechanisms was tasked with providing this report, which includes options on the role that carbon pricing mechanisms could play in reducing Canada's greenhouse gas (GHG) emissions, including different design options taking into consideration existing and planned provincial and territorial systems.

Section II of the report provides a description of the mandate of the Working Group and the context for the discussion of carbon pricing. Many experts regard carbon pricing as one of the most efficient policy approaches to reduce GHG emissions as it provides flexibility to industry and consumers to identify the least-cost way to reduce their own emissions, and spurs innovation to find new opportunities for emissions reduction.

Section III reviews existing carbon pricing mechanisms and provides an overview of how carbon pricing works to reduce emissions by sending a price signal to the economy as a whole and to various economic actors. This section also looks at the various forms of broad-based carbon pricing mechanisms – carbon taxes, cap-and-trade systems, and performance standard or baseline-and-credit systems – and discusses other mechanisms and systems that reduce GHG emissions and impose an explicit price on carbon like fuel taxes or an implicit price on carbon, such as the closing of coal-fired plants. Finally, the section outlines some of the challenges related to introducing carbon pricing and the role complementary measures can play.

Section IV looks at the main design parameters for broad-based pricing mechanisms. While there are differences in the high level structure of carbon pricing systems, the detailed design of each system can have as much impact on the policy outcomes as the type of system chosen. Many of the same design decisions need to be made, whichever type of system is chosen, including: coverage of emissions, certainties regarding GHG emission reductions or the price signal, administration costs and the burden of compliance, efficiency and flexibility of approaches, related proceeds, and other design parameters. This section also provides an overview of what other countries are doing to price carbon.

Section V considers how carbon pricing can help Canada meet its GHG reduction targets by providing an overview of Canada's projected emissions profile based on the National Inventory Report. To better understand the implications that additional carbon pricing could have in Canada, Environment and Climate Change Canada's EC-Pro model was used to model three illustrative explicit carbon pricing scenarios that are presented in this section:

1. 15/30 price scenario would start at $15 in 2018 and rise to $30 in 2030 in nominal terms.
2. 30/40 price scenario would start at $30 in 2018 and rise to $40 in 2030 in nominal terms.
3. 30/90 price scenario would start at $30 in 2018 and rise to $90 in 2030 in nominal terms.

The model assumes that revenues generated by the carbon price are returned by direct transfer to the household sector in the province or territory where the carbon price was paid, which is not the current practice in any jurisdiction with carbon pricing. All three scenarios result in emissions reductions from the baseline scenario, although none of these scenarios are modelled to provide sufficient reductions to reach Canada's 2030 target of 524 Mt (a 30 per cent reduction below 2005 levels).

To do so, complementary mitigation measures will be required. Compared to the baseline scenario of 815 Mt, the 15/30 price scenario results in a level of GHG emissions in 2030 of 777 Mt (38 Mt below the baseline scenario). The 30/40 price scenario results in a level of emissions for 2030 of 764 Mt (50 Mt below the baseline scenario) and the 30/90 price scenario results in a level of emissions for 2030 of 720 Mt (95 Mt below the baseline scenario). As most computable general equilibrium models would predict, there is not a linear relationship between emissions reductions and the carbon price.

Section VI provides an overview of considerations in the implementation of carbon pricing in Canada. While carbon pricing leads to GHG reductions by internalizing the price of carbon into the cost of goods and services, it would also represent an increase in costs facing some producers and consumers. As such, carbon pricing presents several issues that need particular attention, namely: revenue recycling, impacts on Northern, remote and Indigenous communities, Indigenous Peoples, and competiveness and carbon leakage.

- A carbon pricing mechanism has the potential to raise significant revenues. Decisions around how that revenue is recycled back into the economy will be a central determinant of the overall economic and equity impacts of any policy and can have a significant impact on aggregate emissions outcome. There are three broad policy goals that governments might hope to address using recycled revenues: offset equity and competitiveness impacts created by the carbon price, facilitate the transition to a low-carbon economy, or boost sustainable growth and raise the long-run standard of living (or some mix of those options).

- Unless there are appropriate supporting measures, any carbon pricing mechanism could have disproportionate impacts on Northern, remote and Indigenous communities, as they face unique challenges compared to the rest of Canada. Given geographical realities, these communities could face additional burdens from carbon pricing mechanisms in the context of transportation costs, generation of electricity, heating costs, as well as impacts on local fuel-intensive industries, such as mining operations.

- Representatives from the Assembly of First Nations, the Inuit Tapiriit Kanatami and the Métis National Council highlighted the importance of strengthening the collaboration between government and Indigenous peoples in the development of all climate change-related policies, based on the recognition of rights, respect, cooperation and partnership, emphasizing that climate action should support, rather than jeopardize, the well-being of Indigenous communities, for example, in the areas of energy, food and water access and security.

- Increasing carbon prices to levels well beyond those of our trading partners could create competitiveness concerns in certain sectors. There are a variety of policy tools available to governments to address competitiveness pressures, which could be used in isolation or in conjunction with one another, including differential treatment for affected sectors, revenue recycling, and border tax adjustments.

Section VII evaluates carbon pricing in Canada by reviewing domestic experiences. Some provinces have already moved forward with their own explicit carbon pricing mechanisms, creating different regimes across Canada. Both carbon taxes and emission trading systems (cap-and-trade or performance standard / baseline-and-credit) have been implemented or announced by certain provinces. With existing and decided policies to be implemented, nearly 85 per cent of Canada's economy and population will be subject to broad-based carbon pricing mechanisms by 2017, covering a large share of emissions. All Canadian governments also have extensive experience with taxes on motive fuels that impose an explicit price on carbon, as well as other measures that impose an implicit carbon price.

This section also provides an evaluation of the current approach to carbon pricing in Canada, including a discussion on the similarities between the existing and planned broad-based carbon pricing mechanisms, as well as the existence of different regimes with different: carbon prices, coverage, GHG targets and access to foreign permits. The section concludes with a discussion on measures that could be used for comparing the price, coverage and GHG results of carbon pricing mechanisms, noting that there is no clear best option. Such measures could include a comparison of marginal prices, average effective carbon costs (revenues raised as a proportion of covered emissions), coverage-weighted marginal price (marginal price multiplied by the percentage of covered emissions in the jurisdiction), or trade-adjusted coverage-weighted marginal price (similar to coverage-weighted, but accounting for inter-jurisdictional permits). Alternatively, rather than using price, a comparison of emissions reductions could also be considered as reductions are the ultimate goal of carbon pricing. Comparing the stringency of different systems and the certainty they provide in reducing emissions at the lowest possible cost will be important in assessing the potential role of carbon pricing in a pan-Canadian framework.

Section VIII presents eight principles that need to be taken into account when designing carbon pricing policies:

- be flexible and support existing provincial and territorial actions;
- be considered as a central component of the pan-Canadian Framework;
- have broad coverage;
- be introduced in a timely manner;
- have price increases be predictable and implemented gradually;
- have regular and consistent reporting of emissions coverage;
- minimize international competitiveness impacts and carbon leakage; and
- take into consideration vulnerable groups (e.g., Northern and remote communities and low-income households).

Section IX presents three broad groups of options for carbon pricing, including a brief assessment in relation to the principles for a pan-Canadian approach: (1) a single form of broad-based carbon pricing mechanism that would apply across the country, (2) broad-based carbon pricing mechanisms in all jurisdictions but allowing for flexibility of instrument choice within each province and territory, and (3) broad-based carbon pricing mechanisms in some jurisdictions with the remaining jurisdictions instituting other mechanisms or policies to meet specific GHG reduction targets within their respective jurisdictions.

The options reflect different approaches to the implementation of carbon pricing in Canada. The choice of option should be guided by the commitments made by First Ministers in the Vancouver Declaration.

Regardless of which option is chosen, the working group heard from a number of stakeholders about the importance of two issues: harmonizing the recognition of offset credits and improving the reporting of emissions to ensure a good quality and a similarity between the federal and provincial/territorial emissions data. Harmonizing offset credits across Canada would generally require common standards and processes across jurisdictions. Further, harmonizing GHG measurement, reporting and verification requirements across jurisdictions implementing carbon pricing and other GHG reduction requirements would ease compliance burden and simplify administration (i.e., by being subject to a common set of measurement, reporting and verification requirements, rather than multiple sets of such requirements).

Section X concludes that, in examining the role that carbon pricing is playing and could further play in helping Canada reduce its GHG emissions, on the whole, carbon pricing is one of the more efficient tools available to governments to incent a transition to a low carbon economy. This section notes that carbon pricing could allow for an increase in the level of ambition in reducing GHGs, promotes clean economic growth, and facilitates the possibility for enhanced cooperation among jurisdictions – but would depend on the tool chosen, the price, the coverage, etc.

1 INTRODUCTION

1.1 Vancouver Declaration

On March 3, 2016, Canada's First Ministers released the Vancouver Declaration on clean growth and climate change. Broadly, the Vancouver Declaration seeks to build on commitments and actions already taken by provinces and territories and the momentum from the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) in Paris. The Declaration also seeks to move toward a pan-Canadian framework for clean growth and climate change that will meet or exceed Canada's international greenhouse gas (GHG) emissions targets, and transition to a stronger, more resilient, low-carbon economy – while also improving Canadians' quality of life.

In the Declaration, First Ministers agreed to the following:

- Increase the level of ambition (regarding GHG reductions);
- Promote clean economic growth to create jobs;
- Deliver mitigation actions;
- Increase action on adaptation and climate resilience; and
- Enhance cooperation, including with Indigenous peoples.

In the context of enhancing cooperation, First Ministers agreed to (i) strengthen the collaboration between government and Indigenous peoples on mitigation and adaptation actions, based on the recognition of rights, respect, cooperation and partnership; (ii) ensure flexibility for provinces and territories to design their own policies to meet emission reductions targets, including their own carbon pricing mechanisms, supported by federal investments in infrastructure, specific emission reduction opportunities and clean technology and (iii) work together to identify measures that governments could take to reduce emissions and grow the economy in the longer term by establishing working groups in four areas: clean technology, innovation and jobs; carbon pricing mechanisms; specific mitigation opportunities; and adaptation and climate resilience. Each working group was to assess impacts on economic and environmental outcomes.

1.2 Mandate of the Working Group on Carbon Pricing Mechanisms

The Working Group on Carbon Pricing Mechanisms was tasked with providing a report with options on the role of carbon pricing mechanisms in meeting Canada's emissions reduction targets, including different design options taking into consideration existing and planned provincial and territorial systems. It considered various elements of carbon pricing policy, including coverage, comparability and stringency, as well as market transactions related to mitigation technologies and international trends in carbon pricing and markets.

The Working Group's report also considered the effectiveness of various carbon pricing mechanisms in contributing to the certainty of emission reductions and their efficiency at achieving this objective at the lowest possible cost, and take account of particular challenges, such as those facing Northern, remote and Indigenous communities. Finally, it addressed issues that are particularly important to industry and investors, such as predictability, and approaches to address interprovincial and international competitiveness, including carbon leakage.

As part of its mandate, the Working Group also met with representatives of the Assembly of First Nations, the Inuit Tapiriit Kanatami and the Métis National Council, and received online input from various organizations and individuals who identified issues relevant to Indigenous interests. In addition, the Working Group co-chairs participated in a number of teleconferences with the co-chairs of the other three Working Groups (Specific Mitigation Measures; Jobs and Innovation, and Adaptation) and Indigenous representatives.

This work was jointly overseen by Ministers of Finance and the Canadian Council of Ministers of the Environment, who are both receiving this report.

1.3 Context

Many experts regard carbon pricing as a necessary policy tool for efficiently reducing GHG emissions, including the World Bank, the Organisation for Economic Cooperation and Development (OECD), the International Monetary Fund (IMF) and Canada's Ecofiscal Commission. Carbon pricing is generally considered to be one of the most efficient policy approaches as it provides flexibility to industry and consumers to identify the least-cost way to reduce their own emissions, and spurs innovation to find new opportunities for emissions reduction. Carbon pricing can also allow for alignment of efforts to reduce emissions across jurisdictions, reducing economic distortions and emissions leakage.

There is a widespread trend in favour of carbon pricing throughout the world's economies. An international movement has emerged in recent years, and is growing in strength. A September 2015 World Bank study concluded that more and more national and sub-national governments that are concerned about the increasing costs and risks associated with climate change have decided to take action and adopt carbon pricing.

The share of the world's GHG emissions that is subject to carbon pricing has tripled over the last decade, and, since January 2012, the number of carbon pricing instruments in operation has almost doubled from 20 to 38. Some 40 countries and 23 provinces, states, regions and/or cities on five continents have already implemented such instruments. Nearly 70 per cent have emissions trading systems (mostly cap-and-trade, but also performance standards systems), while 30 per cent or so use taxes and/or levies. Some governments (14) have combined these two broad families of instruments. Taken together, carbon pricing covers about half of GHG emissions in all these jurisdictions, representing around seven gigatonnes of carbon dioxide equivalent (CO_2e) or 12 per cent of worldwide emissions.[1]

In December 2015 in Paris, the World Bank officially launched the Carbon Pricing Leadership Coalition (CPLC), which has the mandate to study and share best carbon pricing practices. CPLC membership includes 20 national governments, including Canada, six subnational governments, including Alberta, British Columbia, Northwest Territories, Ontario and Quebec and numerous companies, including over two dozen Canadian companies representing a wide range of sectors. The CPLC was formed following the September 2014 United Nations Climate Summit, where 74 countries and 22 sub-national governments signed a statement entitled "Putting a Price on Carbon."

Earlier, in 2010, the World Bank had also launched the Partnership for Market Readiness (PMR), an initiative to provide funding and technical assistance to developing countries that have taken steps towards the establishment of carbon market mechanisms. Today, the PMR has 13 donor countries, 16 implementing countries and four technical partners, including Quebec and Alberta.

In addition, the IMF has started to place considerable emphasis on providing technical assistance to countries that are interested in pricing carbon in their economies and in reforming their energy and environmental tax systems. The IMF recently published a study affirming that carbon pricing should be at

1 World Bank, State and Trend of Carbon Pricing 2015.

the forefront of all plans aimed at reducing GHG emissions. The OECD, which brings together many of the world's largest economies, including Canada, came to the same conclusion in 2013, stating that carbon taxes and emissions trading systems are the most economical means of lowering GHG emissions and should become the cornerstone of governmental efforts in fighting climate change.

The private sector has also begun to advocate regarding the need to price carbon. In 2014, 350 institutional investors, managing assets worth more than US$ 24 trillion, asked governments to implement stable, reliable, ambitious and economically significant carbon pricing in order to redirect investments needed to overcome the challenges posed by climate change, which they perceive as a threat to their investments. More than 1,000 companies and investors, including major oil, gas and insurance companies, have signed the above-mentioned World Bank statement. Incidentally, the International Emissions Trading Association, which promotes carbon market mechanisms throughout the world, now includes 150 multinationals from developed countries and emerging economies, 17 years after its founding.

Taken together, the studies referenced above suggest that governments, businesses, and non-governmental organizations internationally are coalescing around two conclusions related to carbon pricing: (1) GHGs can no longer be released into the atmosphere on a large scale with impunity; and, (2) putting a price on emissions is an efficient and cost-effective way to create incentives to reduce their production as well as their consumption, and to reflect the value of the important and sometimes irreversible damage they inflict on the economy, human health and safety, infrastructure, and the environment and ecosystems.

2 REVIEW OF CARBON PRICING MECHANISMS

It is now established and recognized that GHG emissions are one of the main negative externalities arising from human economic activity, including both the production and the consumption of goods and services. In general, externalities refer to situations where the effect of production or consumption of goods and services imposes costs or benefits on others which are not reflected in the prices charged for the goods and services being provided. In other words, absent any other legal or regulatory requirements, the agent that causes negative externalities has no incentive to consider and integrate the impacts and costs it imposes on other agents in its business decisions or household's everyday life. This situation entices this agent to underestimate, or even ignore, the real costs of its actions to society, the economy and the environment.

2.1 How Does Carbon Pricing Work?

In order to allow the market to fully internalize negative externalities caused by pollutants and to overcome what he perceived as a market imperfection, the British economist Arthur Cecil Pigou proposed, nearly a century ago, to price these externalities. Since demand for a good is, in most cases, price sensitive, pricing externalities allows the economic agents to respond efficiently. For GHG emissions, this is typically referred to as a carbon price, reflecting the dominant role of carbon dioxide in total GHG effects and the practice of equating emissions of various GHGs on a CO_2e basis.

The main goal of carbon pricing is to reduce emissions by sending a price signal to the economy as a whole and to various economic actors, in particular, to reduce emissions. The clearer, more consistent, strong and predictable a price signal is in the medium and long term, the greater its efficiency will be as a driver of the change that is needed to transition to a low-carbon economy. By internalizing a carbon price in their daily decision making, this kind of signal incentivizes companies, investors and consumers to change their behaviour. Carbon pricing thus creates economic incentives for economic agents to make more environmentally sustainable strategic choices, to redirect their investments, and to reduce their emissions as well as their carbon footprint, notably by substituting carbon-intensive goods (such as fossil fuels), for goods that have a lower or no carbon content.

Properly quantifying the carbon price needed to reflect the scale of the negative externality is a significant challenge, given the complex global nature of the climate system and the long-term horizons over which emissions affect the system. This quantification is usually referred to as the social cost of carbon, and is typically estimated through economic models. Modelled results have significant uncertainty and variability, and are therefore not typically used directly in setting a carbon price. The price is more often set, either explicitly or through a market, based on the emissions target for a jurisdiction, and evaluation of the economic benefits and risks of policies in the context of policies present in other jurisdictions. Despite uncertainty in what the 'right' price is, carbon pricing is still seen as an efficient tool to encourage emissions reductions and spur innovation.

Raising the carbon-content price of goods and services used by companies encourages them to invest in reducing their carbon emissions by, for example: using renewable or low-GHG energy sources; improving their energy efficiency; upgrading their means of production to, among other things, eliminate energy loss; or, opting for less polluting alternative solutions. In so doing, carbon pricing can also make clean technology financially more attractive or even necessary, provide for the potential of new market opportunities, and stimulate innovation through green technology research, development, and marketing. In addition to encouraging established industries to seek less carbon-intensive methods of operating, carbon pricing can also create demand for low-carbon technologies, fostering new niche industries, start-ups and job creation, and creating new economic growth engines. In short, carbon pricing has the potential for encouraging companies to rethink their procedures and, if needed, reinvent themselves in the immediate and in the long term.

Carbon pricing also incentivizes consumers to make more environmentally friendly decisions. For example, higher gasoline prices encourage public transit and make electric or hybrid vehicles more attractive alternatives for travel and commuting. Households will also opt for low-carbon solutions for home heating or air conditioning and will consume less energy by improving the insulation of their residence. All of these actions, taken together, help reduce GHG emissions. It is important that governments enable consumers to make low carbon choices at an affordable cost.

For governments that are able to put a price on carbon, it can also represent a source of revenue that can be used in different ways according to the economic realities they face. These issues are discussed in detail later in this report.

Although it is generally considered to be one of the least-cost approaches to reducing GHG emissions, carbon pricing can still represent an additional cost to the economy that must either be absorbed or avoided by consumers and businesses, and which will invariably pose challenges, namely for Northern, remote and Indigenous communities. Thus, the introduction of carbon pricing generally leads to a period of transition that could be more or less long and laborious depending on the sectors covered, the presence or absence of similar policies among competitors, and the economic outlook. Governments that put in place carbon pricing must take these factors into account, recognizing that, since the economic, social and environmental costs of climate change impacts will inexorably rise over time if nothing is done to reverse the current trend, it will usually cost less to put a price on carbon now rather than later. In the long term, emissions reduction measures will help improve competitiveness and profitability for actors that take early action to reduce emissions in a global economy in which the prices of energy and carbon are expected to increase. These issues are further discussed later in the paper.

The speed with which the economic transformation necessary to shift to a low-carbon economy can be made, and therefore the length of the transition period necessary to achieve it, will largely depend on the carbon price level and design, and the reaction of the economy in the short, medium and long term. However, the broader the base (i.e., the more sectors and regions it covers) and the more flexibility in the design to respond to economic cycles, the more policy makers will succeed in calibrating the carbon price to achieve maximum success at the lowest possible cost, and the less its weight will be felt – even disproportionately felt – by the various economic actors.

If carbon pricing instruments are well designed and implemented, they can create opportunities to reduce GHG emissions at a lower cost to the community.

2.2 How Can Carbon Be Priced?

2.2.1 Broad-Based Carbon Pricing Mechanisms

There are three main mechanisms that can be used to explicitly apply a broad-based price to carbon: carbon taxes, cap-and-trade as well as performance standards systems.[2] Cap-and-trade systems and performance standard systems can both be considered emissions trading systems. In all systems, carbon is priced such that economic agents are incentivized to reduce emissions whenever the costs of doing so are less than the carbon price. Given the uncertainty in forecasting market responses, carbon pricing systems will differ in terms of the certainty of the emissions outcome and the certainty about the price signal. These uncertainties can be partially addressed through design considerations. Each carbon pricing system has advantages and disadvantages, strengths and weaknesses.

2 Hybrid approaches are also possible where different systems are used to cover different sectors or where systems overlap.

- Carbon taxes (such as the existing tax in British Columbia) put a price on GHG emissions and allow economic agents to change their behaviour in response to the price, thus determining which GHG reductions will take place. The regulated price creates certainty for actors deciding on whether to invest in emissions reduction technologies, meaning that all actors who are able to reduce emissions at a lower cost to avoid paying the tax are likely to do so. Because uncertainty exists about how economic agents will respond, to achieve a specific emissions reduction goal, governments may need to adjust the price (tax rate) over time.

  Carbon taxes can be applied to GHG emissions from fossil fuel combustion by taxing fuels based on their carbon intensity. A carbon tax could be designed to apply more broadly to also include non-combustion emissions (e.g., venting and industrial processes), which could increase administrative and compliance costs.

- Cap-and-trade systems (such as the existing systems in Quebec and Ontario) limit the total amount of GHG emissions by imposing a cap on emissions (both combustion and non-combustion) that is progressively lowered each year over a given period of time, thus providing certainty about the total emissions from a prescribed set of emitters. The broader the coverage, the more efficient cap-and-trade programs become. Emissions allowances are typically distributed to regulated/registered entities through a combination of auction, sales at a fixed floor price, and free allocation. Price controls and the ability to bank allowances can mean that emissions in a given year remain somewhat uncertain, although certainty remains over the different compliance periods.

- Performance standard systems or baseline-and-credit systems (such as the existing and proposed Alberta systems for major emitters) operate by applying intensity targets that set a limit on GHG emissions (both combustion and non-combustion) per production unit, which can be analogous to how allowances are freely allocated in a cap-and-trade system. Targets can be set at a facility or product level. Facilities that do not meet their emissions intensity standards can use a variety of compliance instruments, such as purchasing credits issued to more efficient facilities (i.e., that had emissions below the standard), purchasing offset credits, paying a fixed price to government, etc. Under a performance standard system, GHG emissions levels are largely dependent on changes in levels of production. Because uncertainty exists about how economic agents will respond, to achieve a specific emissions reduction goal, governments may need to adjust the price or standards over time.

Emissions trading systems, like cap-and-trade systems or performance standard systems, allow the price of GHG emissions to be determined by a market where entities can trade emissions allowances to find the most efficient reductions. Companies with the ability to reduce their emissions at lower cost can sell allowances to companies for whom the cost to reduce emissions is higher. Emissions trading allows for direct linkage with systems of similar design and stringency, which can provide access to lower cost emission reductions.

2.2.2 Other Mechanisms and Systems that Reduce GHG Emissions and Impose a Price on Carbon

Governments have developed many other mechanisms that help reduce GHG emissions and impose a price on carbon. These can include:

- Taxes on motive fuels that impose an explicit price on carbon; and

- Measures that impose an implicit price on carbon, like caps on emissions from the electricity sector or the closing of coal-fired power plants; renewable portfolio standards, feed-in tariffs and clean energy standards; new technology development and deployment of innovative technologies through research and development (R&D) programs; investment in infrastructure; vehicle efficiency standards; restrictions on land use planning and, building codes.

MOTIVE FUEL TAXES

Canadian governments have a long history of imposing taxes on the purchase of motive fuels. Although these fuel taxes have not always been imposed to serve environmental purposes and do not reflect the emission intensity of the various fuels, they share common features with a carbon content tax in that they influence behavioral changes in emissions-intensive activities. Table 1 illustrates that motive fuel taxes at both the federal and provincial/territorial levels impose a different price per tonne of CO_2e. These taxes generally only apply to commonly-used motive fuels and a number of exemptions/reduced rates apply to specific economic sectors.

Table 1: Motive Fuel Taxes and Implied CO_2e Prices Based on Global Warming Factors as Published in National Inventory

	Diesel		Gasoline	
	(cents/litre)	(implied $/tonne of CO_2e)	(cents/litre)	(implied $/tonne of CO_2e)
Newfoundland and Labrador	21.5	79.90	16.5*	70.48*
Prince Edward Island	20.2	75.07	13.1	55.96
Nova Scotia	15.4	57.23	15.5	66.21
New Brunswick	21.5	79.90	15.5	66.21
Quebec	20.2	75.07	19.2	82.01
Ontario	14.3	53.14	14.7	62.79
Manitoba	14.0	52.03	14.0	59.80
Saskatchewan	15.0	55.74	15.0	64.07
Alberta	13.0	48.31	13.0	55.53
British Columbia	15.0	55.74	14.5	61.94
Yukon	7.2	26.76	6.2	26.48
Northwest Territories	9.1	33.82	10.7	45.70
Nunavut	9.1	33.82	6.4	27.34
Federal	4.0	14.86	10.0	42.71

*Newfoundland and Labrador's gasoline tax was increased temporarily to 33 cents per litre (equivalent to $140.96 per tonne of CO_2e), effective June 2, 2016. The new rate on gasoline will be periodically reviewed.

Note: These rates do not include regional or city rate variations, which may provide for higher or lower rates than the general rate in each province. The rates also do not account for broad-based carbon prices that may apply in a province or territory.

2.2.3 Common Challenges for Carbon Pricing

Well-designed carbon pricing mechanisms can provide incentives for reducing emissions cost-effectively as well as for investments in low-carbon research and technological innovations. However, there are some issues for which broad-based carbon pricing mechanisms may not be sufficient on their own.

- **Lack of information.** Without sufficient information on low carbon alternatives, emitting sectors and consumers may not be able to respond to price incentives. For example, increased energy efficiency can be a cost-effective way to mitigate GHG emissions, but energy efficiency improvements can go untapped in the absence of relevant information. Labelling programs can help address this issue, for example by informing consumers about the level of energy consumption of appliances.

- **Benefits of an investment do not accrue wholly to the investor.** This is one reason to provide public support to certain types of research and development. Accordingly, there is a role for government investment in infrastructure that supports low-carbon decision-making, such as public transit and transmission networks to connect clean energy generators to the grid.

MEASURES WITH IMPLICIT CARBON PRICING

All Canadian jurisdictions are undertaking at least some initiatives to reduce GHG emissions. Some of these initiatives take the form of regulatory requirements, technology development and deployment, or voluntary actions that citizens and businesses are encouraged to pursue to reduce emissions.

In many cases, requirements to reduce GHG emissions lead to the imposition of higher costs on consumers. In this way, these mechanisms impose an implicit price on carbon. For example:

- Saskatchewan's Petroleum Research Incentive and Enhanced Oil Recovery Royalty encourage industry to develop technology that reduces the environmental footprint of the oil industry, including carbon dioxide enhanced oil recovery in heavy oil. As part of a carbon dioxide enhanced oil recovery project, carbon dioxide is being captured by an oil producer at a commercial ethanol facility and is being stored in a heavy oil reservoir.

- As part of its implicit carbon pricing approach, Nova Scotia has placed a hard cap on its electricity sector, reducing electricity emissions by 30 per cent to date, and which requires the achievement of a 55 per cent reduction in GHG emissions by 2030.

- In 2003 the Government of Ontario announced that it would close all coal-fired power plants in the province. In 2007, the *Cessation of Coal Use Regulations* came into effect, and the last coal-fired plant went offline in 2014.

- **The presence of monopolies and other forms of market power.** Economic actors who possess monopoly market power may impede the effectiveness of an explicit carbon price as a GHG emissions reduction tool, as they can simply pass on the additional carbon price to consumers, without fundamentally changing their processes. Consumers may, nonetheless, still react to the price increase by buying less of their products.

- **Disconnects between carbon price and energy use.** For example, increased electricity prices may not lead a landlord to invest in energy efficiency improvements in a rental property if the tenant pays the heating and power bills. Building codes or incentive measures for landlords to make energy-saving improvements in rental properties, such as the United Kingdom's Landlord's Energy Saving Allowance, can help address this disconnect.

- **Demand inelasticity.** Some activities may not respond to a carbon price in a timely enough manner unless the price is very high. Transportation is an example where emission standards for vehicles or low-carbon fuel standards can ensure emission reductions in the shorter term.

- **Need for certainty.** Regulations may be needed to ensure that certain types of investments are not made or to pursue a specific transformational path. For example, regulations requiring the phase-out of coal-fired electricity generation prevent investments in long-lasting capital stock, and help avoid investment lock-in and stranded assets.

- **No access to lower cost, cleaner alternatives.** Without access to alternatives, or reasonably-priced alternatives, increased carbon prices may lead to little or no reductions in GHG emissions regardless of the assigned carbon price (e.g., electricity generation, heating fuel, and transportation fuel in rural, remote and islanded regions).

- **Incomplete coverage.** It may be impractical to impose carbon pricing on some types of activities. This can be the case for emissions that are hard to quantify (e.g., fugitives) or for some types of diffuse activities for which there is not a practical point at which to impose the carbon price.

- **Lack of capital.** Some actors may not have access to sufficient capital to respond to the price signal that carbon pricing provides. This can be the case, for example, for low-income families that cannot afford to make improvements to vehicles or homes, and for Northern, remote and Indigenous communities that do not have access to alternatives to fossil fuels for heating or electricity.

In such cases, there may be a role for complementary measures. For example, targeted regulations, supported by an underlying carbon price, may be needed for activities that are not amenable to carbon pricing instruments, and to accelerate transformational changes in areas of high price inelasticity. Public investments in R&D and infrastructure, as well as in information programs, can also support transformative low-carbon innovations and enhance the effectiveness of carbon pricing.

Ideally, the resulting suite of policy measures chosen by governments will help ensure a comprehensive and coordinated approach to GHG reductions. As such, in establishing an explicit carbon pricing mechanism, it is important that taxes on motive fuels as well as the role of other existing explicit and implicit carbon pricings and other complementary measures for certain sectors be properly assessed and taken into consideration.

3 MAIN DESIGN PARAMETERS FOR BROAD-BASED PRICING MECHANISMS

While there are differences in the high level structure of carbon pricing systems, the detailed design of each system can have as much impact on the policy outcomes as the type of system chosen. Many of the same design decisions need to be made, whichever type of system is chosen.

3.1 Coverage of Emissions

Regardless of the broad-based carbon pricing mechanism used or whether the carbon price is determined by the market through an emissions trading system or set by government through a carbon tax, the same GHG emissions can be covered. Generally speaking, the main types of GHGs targeted by imposing a carbon price are those designated by the UNFCCC. Emissions are subsequently converted on the basis of their 100-year Global Warming Potential, in order to use CO_2e as a common accounting base. In this way, the price of carbon is applied uniformly and is based on one added tonne of CO_2e to the atmosphere.

- Both a carbon tax and an emissions trading system can be applied across the same economic sectors that are responsible for most GHG emissions (transportation, electricity production, industry, and buildings), so long as the necessary GHG measurement and reporting rules are in place.
- Performance standards with intensity targets are generally used for industrial resource extraction sectors, manufacturing installations and/or electrical production plants.
- Mechanisms such as fuel taxes, or carbon taxes that just apply to motive fuels, only allow for more limited coverage of the economy, usually emissions that are associated with burning gasoline and diesel.

Emissions trading systems normally extend coverage through enabling voluntary reductions in additional sectors not routinely required to measure and report GHGs under reporting rules. This can be the case, for example, in respect of the agriculture and residual materials (waste) sectors.

While emissions quantification is more challenging in these sectors, offset protocols, which should be meeting high environmental quality standards, may be applied to quantify and verify their emissions reductions. These sectors can voluntarily reduce their GHG emissions, quantify the emissions reductions using approved offset quantification protocols, have the reductions independently verified, and offer them, as offset credits, on the market to companies that are subject to these systems.

The cost of offset credits is generally lower than what the companies would need to spend to achieve comparable GHG emissions reductions at their own facilities and may be accepted by the system authority as an instrument that enables them to meet part of their regulatory obligations.

Carbon tax schemes could also include credible offset credits, although additional infrastructure would be needed for their issuance.

3.2 Certainties Regarding GHG Emission Reductions or the Price Signal

As previously mentioned, both a carbon tax and emissions trading systems provide the market with a carbon price that incentivises agents to reduce emissions whenever the costs of doing so are less than the carbon price.

Cap-and-trade systems provide the certainty of knowing that GHG emissions from covered sources will not exceed a threshold, the cap, in any given period of time. Market forces determine the price per tonne needed to achieve the desired emissions level. This price uncertainty can make it challenging for firms and individuals to choose which investments will be cost effective in the long-run, and for governments to forecast the proceeds such systems will generate.

In order to reduce price uncertainty, a floor price can be introduced in cap-and-trade systems for use during auctions, below which the government will decline to sell the available emissions allowances. This feature makes it possible to maintain a minimum carbon price, ensuring that the entities covered by the system remain incentivized to invest in greener technologies that emit fewer GHGs. Price spikes can also be controlled by creating a reserve of emissions allowances that the covered entities can access at a predetermined price, thereby offering a soft price ceiling if certain conditions are met.

While the underlying market price of fuels can fluctuate greatly, a carbon tax provides price certainty with respect to carbon pricing, as the additional cost to be paid for each tonne of emissions during a given time period is known; however, the level of GHG emissions achieved by the tax remains uncertain. To meet emissions targets, governments need to monitor the impact of the tax on carbon emissions and adjust the rates accordingly. As such, meeting specific short-term emissions targets through a carbon tax can be challenging. In addition, the need to adjust carbon tax rates in response to revealed emissions increases uncertainty about long-term prices.

Performance standard systems can provide some price certainty by allowing companies to purchase credits from the government at a set price per tonne. Performance standards can be stand alone or implemented with an emissions trading system. When implemented with an emissions trading system, facilities or firms would have the flexibility to pay the carbon price or purchase offset credits. Achieving a given emissions level, however, is difficult because the system focuses on attaining a given level of emissions intensity, rather than a given level of emissions. In a similar manner to carbon taxes, the price of the credits and the stringency of the standards can be adjusted over time to achieve a given emissions target.

3.3 Administration Costs and the Burden of Compliance

Broad-based carbon pricing mechanisms will impose administrative costs on both governments and regulated entities. Depending on the complexity of the pricing systems and the stringency of the quantification, reporting and verification requirements, these costs could be more or less burdensome. Implicit pricing mechanisms also have administrative costs for governments and regulated entities.

The administrative cost of implementing a carbon tax is typically low if the tax simply applies to fossil fuels at standard emissions factors. Historically, Canadian governments already have experience in applying this type of mechanism for motive fuels such as gasoline and diesel, but not for other fossil fuels such as natural gas and coal. In order to implement a carbon tax, governments need to determine the coverage, the rate of the tax and how to collect it. They may also need to calibrate the rate to the target emissions level or to align with other jurisdictions on a regular or periodic basis. Complexities may arise from design features such as tax credits or rebates aimed at addressing some competitiveness issues (e.g., for trade-exposed GHG emission intensive industries). If a carbon tax is expanded to include certain non-combustion emissions, administration costs could increase, depending on the coverage.

With respect to a carbon tax applied to fuel use emissions, fuel producers, distributors or end-users are required to pay to the government, at a pre-determined time and manner, the amount of tax that corresponds to their production, sales, purchases, or use of fuels, as the case may be. Depending on the stage at which the tax is imposed, a smaller number of entities being required to report information or remit money under the tax system will generally reduce the overall administrative cost and burden of compliance. However, if the carbon tax is also applied to industrial process, venting or fugitive emissions, companies operating in industrial sectors may also incur administrative expenses, since they may need to measure, verify, and report their emissions.

Implementing an emissions trading system generally requires a supporting administrative structure.

- A government must develop GHG reporting and audit requirements, its scope and its compliance rules; establish a coverage threshold; and set annual emission caps.
- The system must also be administered, which requires among other things an emissions allowances holding and monitoring register, participant registration, market supervision, and holding auctions. In the case of Ontario and Quebec, the administrative efficiency of certain key market functions (such as auction and market monitoring) is greatly enhanced by a common set of service providers that are part of the linkage with California through Western Climate Initiative (WCI) Inc.

Beyond administrative costs and independent of the selected mechanism, companies must meet their regulatory obligations by assuming the carbon cost for each tonne of emissions.

- For companies directly covered by carbon pricing measures issued under regulations, this usually involves a mandatory annual emissions declaration that generally includes a third-party audit to ensure accuracy. This would also apply to a carbon tax that included non-combustion GHG emissions in the tax base under its system.

3.4 Efficiency and Flexibility of Approaches

Optimal carbon pricing systems encourage emissions reductions from those for whom it is easiest and cheapest to reduce emissions. This is achieved by providing a mechanism where all emitters can choose the cheapest reduction opportunities available, even if that opportunity was not previously known to regulators, and high-cost emitters can choose not to reduce their own emissions – if it is more costly for them to do so than to buy surplus allowances from sources that have reduced their emissions, or pay a fixed price to the government.

Cap-and-trade systems can help ensure that a jurisdiction will not exceed a defined GHG emissions cap at the lowest cost – where the actual cost of remaining within that cap remains uncertain. Economic agents that are able to reduce their GHG emissions at low cost can sell unused allowances to others who need allowances and whose reduction costs are proportionately higher.

Emission trading systems, including cap-and-trade and performance standards, have the potential to include participation from more sectors of the economy by providing non-covered sectors with opportunities to sell reductions on the market by means of offset credits. This option is limited however, to sectors that can develop and apply rigorous quantification protocols at a scale to justify the administrative costs.

Carbon taxes generally apply uniformly to all targeted economic agents at a set point in time. They are visible and stable with respect to the price signal and enable companies to take the precise cost into account in decision making. Under a carbon tax, sectors do not have an incentive to reduce their non-taxed GHG emissions, unless offset credits generated by reductions in non-taxed emissions in these sectors are part of the design and accepted in lieu of paying the tax.

The process of price discovery that may be required to achieve a desired level of GHG emissions can be challenging because of the uncertainty of future activity levels and because governments and covered sectors possess asymmetric information, notably regarding the latter's marginal abatement costs and GHG emission reduction potential. In this context, it can be difficult to set a carbon tax to meet a specific emissions goal, or to predict emissions prices and economic impacts in a cap-and-trade system.

In terms of responsiveness to economic circumstances, cap-and-trade systems can be considered to be counter-cyclical. In other words, if the economy slows down and GHG emissions are falling, the carbon market can react and prices will decrease in response. When the economy improves, GHG emissions will generally rise and the price of carbon will automatically increase again. While this buffers the overall cost exposure of covered entities, it creates a risk to emissions reduction investments. The value of emissions reduction varies over time and actors will therefore have to incorporate the risk of price drops into their decisions, causing a lag or reduction in the activity taken at a given price – which however could be mitigated by the establishment of a floor price.

As noted above, carbon prices or price controls in all pricing systems ideally need to be designed to account for inflation to ensure they maintain the incentive to reduce emissions.

3.5 Related Proceeds

Both emissions trading systems and carbon taxes offer the potential for generating substantial proceeds for governments. Although it is relatively straight-forward to estimate revenues from a carbon tax, forecasting anticipated proceeds from an emissions trading system is more difficult (absent a floor price). The anticipated level of proceeds under an emissions trading system will then mainly depend on the scope of coverage, the stringency of the cap, the availability of banked credits or offsets, and the volume of emissions allowances freely allocated. Under a carbon tax, anticipated revenue essentially relies on the scope of coverage, the tax rate, the level of activity in emitting sectors, and the availability of low-cost reduction opportunities.

3.6 Other Design Parameters

Broad-based carbon pricing mechanisms can be designed with a number of other design parameters in mind, such as transparency and credibility, boundaries and linkages, and complementary policies.

- A transparent price will send a clear signal to the market and consumers, which is an important factor in ensuring that decisions efficiently internalize the impact of CO_2e emissions. Carbon taxes and trading systems provide a transparent price by having an explicit marginal price on one tonne of CO_2e emissions.
- The ability of carbon pricing mechanisms to allow the broadest participation possible helps to reduce the overall cost of emissions reductions. This can be achieved through a variety of means. For example, if other non-covered participants voluntarily reduce emissions and have the ability to trade those reductions as an offset in either a carbon tax system (i.e., an offset in lieu of paying the tax) or as an offset in a cap-and-trade system (i.e., in lieu of an allowance). The ability of carbon pricing mechanisms to link to other systems also helps to achieve this goal (e.g., the ability to trade offsets between jurisdictions for settlement purposes).
- The extent to which other complementary measures can be integrated into a broader carbon pricing mechanism should also be considered (as discussed above).

3.7 Considerations for Choosing a Carbon Pricing Mechanism

Each carbon pricing mechanism has its advantages and disadvantages. The mechanisms and the design of the system details chosen by a government will depend mainly on its objectives in the following areas:

- The desired level of certainty around reduction in GHG emissions in a given time frame;
- The desired clarity and strength of the carbon price signal over time, both for covered sectors and companies and for the economy as a whole;
- The desire to provide GHG reduction opportunities at the lowest cost in order to limit the impact on covered sectors and low-income households, while achieving GHG reduction objectives;
- The desired level of compliance flexibility for covered sectors and companies;
- The interaction with other climate change policies and regulations; and
- The risks to competitiveness of trade-exposed sectors and desired mitigation approaches.

3.8 What Are Other Countries Doing to Price Carbon?

A number of Canada's largest trading partners are using some form of carbon pricing mechanism, the most common of which are carbon taxes and cap-and-trade systems.

- In the absence of support for new legislation, the United States (U.S.) government is relying on the authorities in the *Clean Air Act* to regulate GHG emissions via, notably, the Clean Power Plan, which sets standards for emissions from power plants, and establishes state-by-state emissions reductions goals, and enables compliance by using a cap-and-trade system through a proposed "Model Trading Rule" to guide state-level compliance options. Independent of federal actions, various sub-national governments in the U.S. have established emissions trading requirements. Under the WCI, California has an economy-wide cap-and-trade system that is linked with Quebec and soon with Ontario (expected by 2018). In addition, a number of northeastern states regulate CO_2 emissions from electricity generation under the Regional Greenhouse Gas Initiative which is also a cap-and-trade system.
- Mexico introduced a carbon tax in 2014 and recently announced that it would launch a 12-month pilot program of a cap-and-trade system in November 2016 which will include voluntary participation by up to 60 companies. The cap-and-trade system is to be administered by research firm MexiCO_2 which will verify reported emission levels. It is expected that a full program will be in operation in 2018.
- China, the world's biggest GHG emitter, has announced that, as of 2017, its seven regional GHG cap-and-trade pilot systems currently in operation will give way to a nationwide system.

Annex 1 provides a listing of international carbon pricing mechanisms, as well as some basic parameters of each system. This sample shows considerable variation in how these policies are implemented, with coverage ranging from 8 per cent of total emissions in Japan to 85 per cent of total emissions in California. The price on carbon also varies across jurisdictions, from between US $1 and US $4 per tonne of carbon dioxide in Mexico to as high as US $168 per tonne of carbon dioxide in Sweden.

The international experience shows that tax and emissions trading systems, as well as overlapping trading systems, can and do co-exist in the same jurisdiction. Many European countries use a combination of both tax and cap-and-trade systems.

- France and Ireland introduced a carbon tax, while also participating in the European Union Emissions Trading System (EU ETS) in order to increase the carbon emission coverage.
- The United Kingdom introduced a carbon price floor on fossil fuels used in electricity generation to complement its Climate Change Levy on industry, agriculture and the public sector. The United Kingdom also participates in the EU ETS.
- Norwegian GHG mitigation policies include a carbon dioxide tax, the *Pollution Control Act*, the *Petroleum Act*, and the *Greenhouse Gas Emissions Trading Act*, which collectively cover more than 70 per cent of Norwegian domestic GHGs.

The Paris Agreement, reached in December 2015, recognizes the importance of carbon pricing and market mechanisms to combat climate change. A whole article, Article 6, is dedicated to this in the Agreement. Of the 188 countries that had submitted their intended nationally determined contributions prior to the Conference, 90 mentioned that they intended to use market mechanisms.[3]

As described further below, in 2017, jurisdictions representing nearly 85 per cent of Canada's economy and population will have broad-based carbon pricing mechanisms in place.[4]

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3 For more information, see: http://www.ieta.org/resources/Resources/Reports/Carbon_Pricing_The_Paris_Agreements_Key_Ingredient.pdf

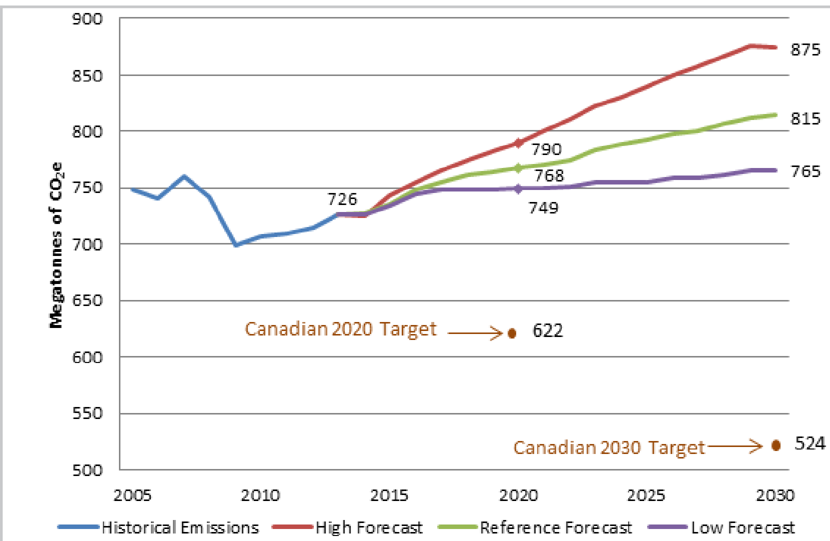
4 Broad-based carbon pricing will not apply to 100 per cent of GHG emissions in any of the provinces with a carbon pricing system. For example, Québec's and Ontario's cap and trade programs cover between 80 and 85 per cent of their overall emissions.

4 HOW CAN CARBON PRICING HELP CANADA MEETS ITS GHG REDUCTION TARGETS?

4.1 Overview of Canada's Emissions Profile

Through the Vancouver Declaration, First Ministers agreed to "implement GHG mitigation policies in support of meeting or exceeding Canada's 2030 target of a 30 per cent reduction below 2005 levels of emissions, including specific provincial and territorial targets and objectives". Figure 1 presents Canada's projected emissions[5] – with three possible scenarios – based on the National Inventory Report. The range in the figure highlights the sensitivity of emissions to broader economic factors – especially the price of oil. The 2030 target would see Canada's emissions reduced to 524 Mt of CO_2e.

Figure 1 – Canada's Projected Emission Profile



Based on projections from Canada's Second Biennial Report on Climate Change, which generally include policies in place prior to September 2015, Canada's emissions are projected to be 9 per cent above 2005 levels in 2030, meaning 291 Mt above Canada's target of 30 per cent below 2005 levels in 2030. Inclusion of other measures, including recently announced additional policy measures in Alberta, British Columbia, Ontario and Newfoundland and Labrador are expected to reduce the forecast emissions and gap to the 2030 target.

5 The data and projection used in this section do not necessarily correspond to those of provinces and territories who compile and produce inventories. There is nonetheless a general consensus that in order to ensure the comparison at the provincial and territorial scale, these data and projections are the only one that can be used at the moment. Work has been undertaken, in partnership, in order to improve the data and projection.

4.2 Illustrative Carbon Price Scenarios for Canada

Current provincial and territorial carbon pricing policies have a wide range of impacts across their respective economies and are contributing to GHG emission reductions in Canada. Increasing the overall level of ambition across the country in order to achieve Canada's GHG emissions targets may require implementing carbon prices where there is none, increasing existing carbon pricing mechanisms, developing additional mitigation measures, or implementing a combination of these approaches.

To better understand the implications that additional carbon pricing could have in Canada, Environment and Climate Change Canada's EC-Pro model was used to model three illustrative explicit carbon pricing scenarios that are presented in this section. These scenarios are meant to broadly illustrate the impacts on the economy of carbon pricing in general at various levels of ambition, rather than to reveal the impacts of any specific policy proposal.

EC-PRO MODEL

The EC-PRO model is a small open-economy recursive-dynamic computable general equilibrium (CGE) model of the Canadian economy. It captures characteristics of provincial production and consumption patterns through a detailed input-output table and links provinces via bilateral trade. Each province and territory is explicitly represented as a region. The representation of the rest of the world is reduced to imports and export flows to Canadian provinces which are assumed to be price takers in international markets. To accommodate analysis of energy and climate policies, the model incorporates information on energy use and GHG emissions related to the combustion of fossil fuels. It also tracks non-energy related GHG emissions. The EC-Pro model, being a CGE model, is an appropriate tool for modelling carbon pricing scenarios, since it allows the entire economy to respond as relative prices change throughout the economy. However, some significant caveats should be noted:

- Results from CGE models should always be interpreted as based on a certain set of assumptions. These assumptions typically vary from model to model, which can lead to different models producing differing results. Model results are therefore most useful when interpreted in relation to other scenarios of the same model, rather than as predictions on an absolute basis.
- CGE models do not typically capture the full range of positive impacts of climate change policies. These might include the development of new green technology sectors; direct benefits on public expenditure, such as those resulting from improved health; or the reductions of societal costs associated with GHG emissions, which are estimated to be $41 per tonne CO_2e on a global basis in 2016 by Environment and Climate Change Canada. In cost- benefit analysis, these positive societal impacts would offset some of the negative economic impacts typically predicted by CGE models.
- Calibrating the model to match the unique characteristics of each province and territory is a major endeavour and federal-provincial-territorial collaboration on modelling approaches is ongoing.[6] Modelling exercises undertaken by individual provinces and territories can focus specifically on these unique characteristics of their energy economy and may provide more robust results for individual regions. The EC-Pro model, on the other hand, has the advantage of explicitly modelling interactions between regions which provides a pan-Canadian perspective. This likely explains many of the differences regarding GHG inventories, projections and impacts which exist when comparing modelling analysis published by federal, provincial and territorial, and non-governmental institutions.
- Additionally, Quebec's and Ontario's participation in an international cap-and-trade system may generate GHG reductions within the system but outside of Canada. The potential GHG reductions realized internationally as a result of the trade of allowances between jurisdictions would not be accounted for by the model.
- The EC-Pro model does not attempt to predict which new technological breakthroughs will materialize in the future. As these new technologies become available, their cost will likely fall and their overall effectiveness improve, thereby leading to more emissions reductions at lower carbon prices than predicted by these models. While the available technologies in the model are limited to those that currently exist, associated performance characteristics (e.g., level of energy efficiency, operating costs and up-front capital costs) improve over the projection period.
- Global commodity prices and carbon policies are assumed to be static. This results in increased leakage and reduced positive technology spillover relative to a global increase in climate policy ambition.
- Provinces and territories may have put in place climate change policies that extend beyond the scenarios discussed below. Moreover, the modelling does not take into account the effect of mitigation policies that could be drawn from the work of the Mitigation Working Group or new provincial/territorial policies having an effect on carbon price or level, and which could also contribute to reaching Canada's GHG emissions reduction objectives

6 Matching the unique characteristics of smaller jurisdictions presents particular differences since some sectors may be comprised of a smaller number of firms. Results for smaller jurisdictions potentially have a large degree of error.

4.2.1 Baseline and Scenarios

The EC-PRO model was calibrated to create a baseline consistent with Canada's Second Biennial Report on Climate Change submitted in February 2016 to the UNFCCC. Apart from emissions data submitted to the UNFCCC, key information used for projecting emissions includes projections of energy demand and supply in line with the National Energy Board, gross domestic product (GDP) and population growth (from Department of Finance and Statistics Canada).

At the time of writing this report, the projected emissions are based on assumptions for 2015 – therefore only policies in place before September 2015 are currently captured in the baseline.[7] Because results are reported relative to a baseline that already contains broad-based carbon pricing actions in Quebec and British Columbia, it should be kept in mind when interpreting results that they do not represent the full effect of the broad-based mechanisms already in place, only the incremental impact from 2015 policies. In addition, the baseline does not capture the significant decline in oil prices, other recent changes to the energy market nor any policies which have been implemented, announced or changed since September 2015.[8] As such, recently announced climate policies, such as cap-and-trade in Ontario and carbon pricing, coal emissions phase-out, methane reduction commitment and oil sands limit in Alberta are not included in the baseline or illustrative scenarios for this modelling exercise. The model also assumes that no additional action on climate change is undertaken in other countries.[9]

Three illustrative carbon price scenarios are modelled with economic and emissions impacts reported in the following sections:

- 15/30 price scenario would start at $15 in 2018 and rise to $30 in 2030 in nominal terms.
- 30/40 price scenario would start at $30 in 2018 and rise to $40 in 2030 in nominal terms.
- 30/90 price scenario would start at $30 in 2018 and rise to $90 in 2030 in nominal terms.

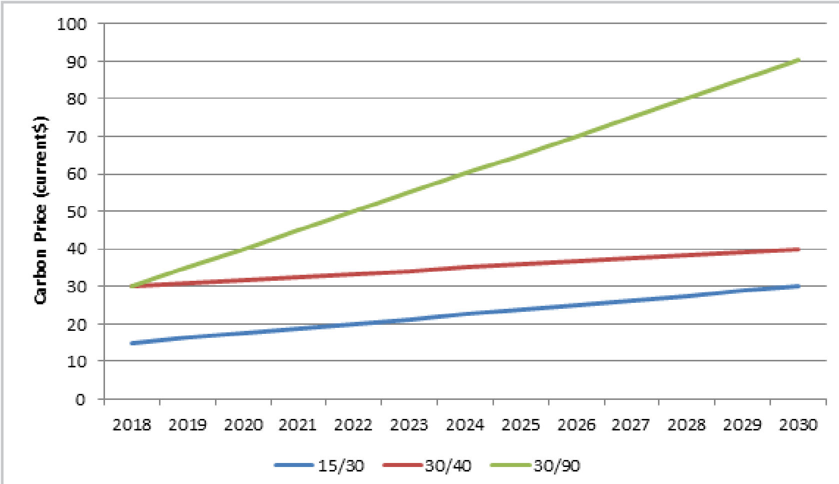
These scenarios are anchored by the highest level of carbon pricing currently in place in Canada - $30 per tonne in British Columbia. Scenario 1 illustrates the impact of carbon pricing in all provinces and territories gradually increasing to $30 by 2030. Scenarios 2 and 3 illustrate the impact of adopting carbon pricing in all provinces and territories at $30 per tonne and increasing this price to $40 and $90 per tonne respectively by 2030. Higher-price scenarios, such as a scenario that achieves Canada's targeted reduction of 30 per cent below 2005 levels by 2030, cannot be realistically illustrated with the simple treatment provided in this section. This is because the model represents the economy as it exists today. At higher carbon prices, the probability that a technological breakthrough or a significant structural change will occur increases; this reduces the value of the modelling results.

7 For example, the baseline for Quebec assumes that the carbon price remains at a price floor of about $20 per tonne in nominal terms in 2030 – although the price should be around $30 per tonne in nominal terms in 2030 with the regulation in place. Therefore, the baseline does not take into account any future increase in the carbon price in Quebec due either to increases in the price floor above what is included in the baseline or higher prices caused by scarcity of allowances in a cap-and-trade system. The baseline for British Columbia assumes that the carbon price remains at $30 per tonne in nominal terms throughout the projection period. The baseline scenario assumed an effective carbon price of $6/tonne ($30/tonne on 20% of emissions) in Alberta.

8 The baseline scenario assumes an oil price of $75/bbl in 2017 rising to $98/bbl (2015 US$) while Alberta's most recent forecast is substantially lower, projecting a price of $45/bbl in the 2016/17 fiscal year, and not hitting $75/bbl before 2020.

9 If other countries were to apply a broad-based price to carbon as modelled in these scenarios, the emissions reductions and economic impacts illustrated in these scenarios could be reduced because of reduced leakage, but emissions reductions could also improve due to increased technology improvement spillover.

Figure 2: Trajectory of the Carbon Price by Scenario



The scenarios assume that the price is applied in a manner that achieves a national price at the given level. In other words, where existing broad-based carbon pricing systems in a given province or territory were in place in 2014, the additional carbon price will be applied only to the extent that it brings the price to the national level.[10] For example, in scenario 15/30, British Columbia is exempted from an additional price since it already is at $30. However, in scenario 30/40, the difference between the national price and British Columbia carbon price is added (e.g., $0 in 2018 and $10 in 2030). For simplicity, this new carbon price is assumed not to interact with existing policies.[11]

For all scenarios, the carbon price is applied to cover all emissions from the combustion of fossil fuels that are relatively easy to price and emissions from industrial processes.[12] The emissions not covered by these scenarios include fugitive emissions, non-energy agricultural emissions (e.g., emissions from livestock, manure management, agricultural soils) and waste (landfills). In 2014, this would have covered over 80 per cent of total emissions in Canada, although coverage would have differed by province and territory based on their emission profile.[13]

In order to simplify the modelling work, no free allowances are issued and revenues generated by the carbon price are returned by direct transfer to the household sector in the province or territory where the carbon price was paid (other possible uses of revenues are discussed in following sections of the report related to revenue recycling and competitiveness). As discussed below, there are many potential policy priorities that governments could pursue in recycling carbon pricing revenue, which would have different emissions and economic impacts across sectors and regions from these illustrative scenarios. A policy that did not recycle revenue within the jurisdiction where it is collected could have substantial distributional and macroeconomic effects, negatively affecting jurisdictions that see a net loss of funds.

10 The new carbon price only tops up existing broad-based carbon prices. It does not take into account other taxes that price carbon, such as motive fuel taxes or other implicit measures.
11 In reality, policies could have important interactions. This will be especially important within cap-and-trade systems where prices adjust to clear the market.
12 Emissions from industrial processes are covered to be consistent with the approaches being taken by current provincial carbon pricing policies.
13 Under these coverage assumptions only 65 per cent of emissions are covered in Saskatchewan and Manitoba, while over 95 per cent of emissions are covered in Yukon, Northwest Territories, and Nunavut.

Finally, all results are presented as relative to the baseline projection rather than the economy as it exists today. For example, Yukon currently generates 95 per cent of its electricity using hydro and as demand has grown in previous years, the government has chosen to invest in new hydro capacity so that hydro's share of electricity generation has actually increased slightly. However, in the absence of any new projects, diesel power would be the least-cost alternative for new generation; modelling was done on the assumptions that no new policy decisions were made on new hydro or other generation projects and that all new generation capacity is met using diesel. As a result, the baseline has diesel accounting for 30 per cent of electricity generation in Yukon by 2030 (even though almost none exists today). In reality, the government of Yukon might choose new hydro builds for a variety of reasons, but those would be considered new policies that are not currently included in the baseline.

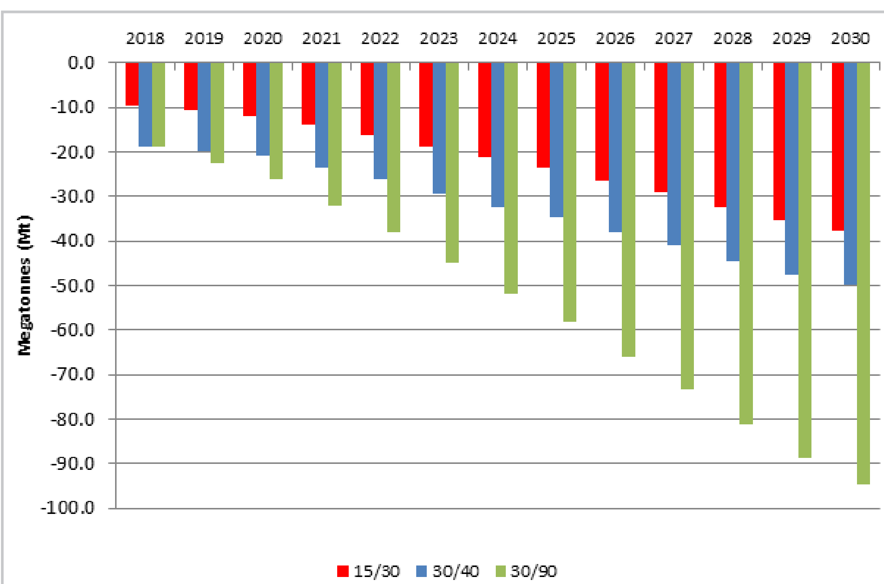
Although none of the scenarios lead to the necessary reductions to meet Canada's mitigation goals, as discussed in a following section, having a carbon price that is significantly higher than our trading partners could increase leakage and further the need to design policies to address competitiveness concerns in order to mitigate the leakage of emissions to other regions.

4.2.2 Estimated Impact on Emissions

Carbon pricing provides an incentive for firms and households to reduce emissions whenever and wherever the costs of emission reductions are less than the costs of paying the carbon price. The amount of emissions in a region will therefore decline as the carbon price rises.[14] As shown in Figure 3, all three scenarios result in reductions at the national level. Compared to the baseline scenario of 815 Mt, the 15/30 price scenario results in a level of GHG emissions in 2030 of 777 Mt (38 Mt below the baseline scenario). The 30/40 price scenario results in a level of emissions for 2030 of 764 Mt (50 Mt below the baseline scenario) and the 30/90 price scenario results in a level of emissions for 2030 of 720 Mt (95 Mt below the baseline scenario).

Importantly, as most CGE models would predict, there is not a linear relationship between emissions reductions and the carbon price. While the carbon price is 2.25 times higher in the 30/90 price scenario in 2030, emissions reductions are only 1.9 times larger than the 30/40 price scenario.

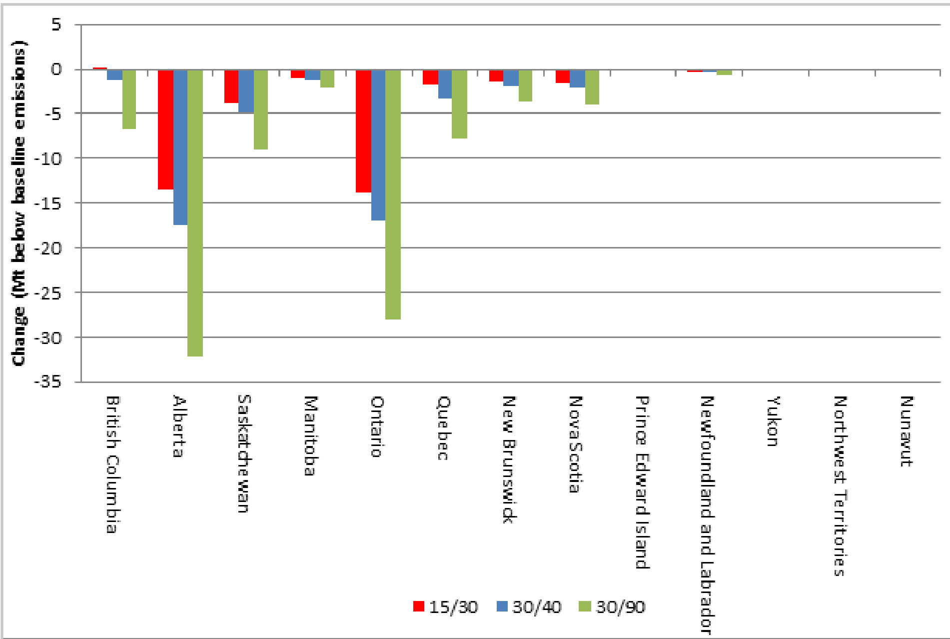
Figure 3: Estimated National Emissions Impacts



14 As discussed in a following section, because trade patterns will also change as a result of carbon pricing, emissions reductions in a specific region will not necessarily represent global emissions reductions.

As mentioned above, a carbon price will incentivize low-cost abatements. However, low-cost abatements opportunities are not necessarily located uniformly across regions. Figure 4 shows the estimated reductions in emissions in each of the provinces and territories (Figure 4a is expressed in megatonnes and Figure 4b is expressed as a percentage from baseline emissions). It is noteworthy that, in response to the 30/90 price scenario, reductions differ significantly from one province to another.[15] This highlights the fact that marginal reduction costs vary depending on many factors, including whether provinces and territories are currently engaged (or are planning to engage) in carbon pricing, and if consistent efforts have been undertaken to reduce emissions in the past.

Figure 4a: Estimated Emissions Impacts (Mt) by Jurisdiction in 2030[16]



15 The relatively large GHG reduction in Nova Scotia is largely attributable to decreased emissions intensity in the electricity sector. By lowering emissions, explicit carbon pricing will interact with Nova Scotia's existing implicit carbon pricing policies in this sector (as discussed above) . Because the model does not capture this interaction, the net effects reported for Nova Scotia in Figure 4 and Appendix 2 are likely overstated.

16 The carbon price applied in these scenarios is reduced in British Columbia (by $30) and in Quebec (by $20) to account for how existing policies were modelled in the baseline. Possible future increases in British Columbia's carbon tax or increases in allowances prices in Quebec above $20 are not included in this calculation. Allowance prices in Quebec will, at a minimum exceed $30 by 2030 given the expected trajectory of the regulation in place in Quebec. In addition, by 2030 scarcity of allowances could result in market prices above the price floor. No adjustment was made to account for Alberta's Specified Gas Emitters Regulation, despite it being included in the baseline scenario (at an assumed effective price of $6/tonne).

Figure 4b: Estimated Emissions Impacts (% of baseline emissions) by Jurisdiction in 2030

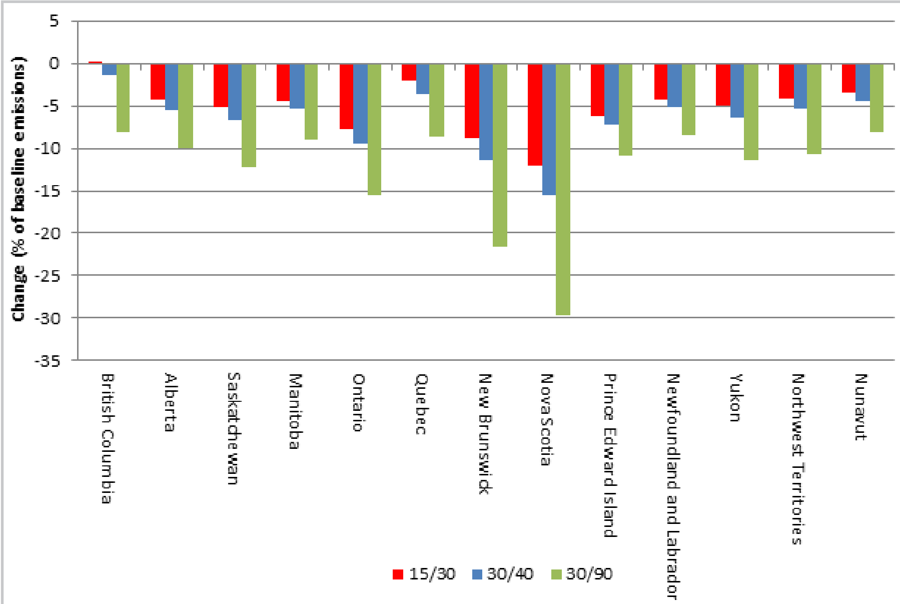
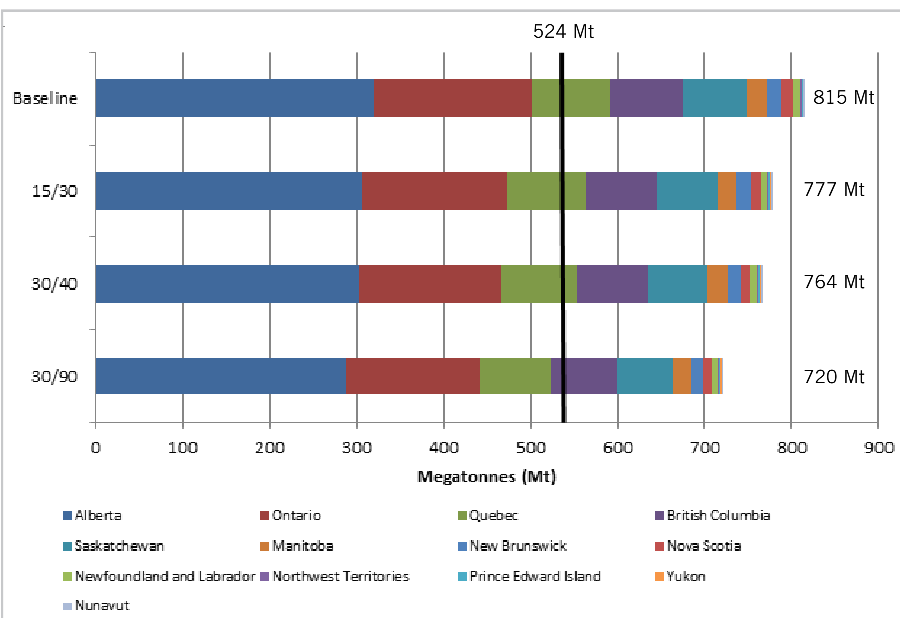


Figure 5 also breaks down emissions by province and territory to illustrate how the overall inventory of emissions changes in response to these scenarios, as well as the magnitude of additional reductions required to achieve Canada's emissions target of 524 Mt by 2030.

Assuming no additional mitigation actions other than those included in the baseline (i.e., in effect prior to 2014), it is estimated that by 2030, Alberta, Ontario, Quebec and British Columbia together would account for 83 per cent of total Canadian emissions. As noted previously, those four provinces will be subject to a broad-based carbon pricing mechanism by 2017. In that context, a large portion of the GHG emission reductions reported in this section would be achieved by the four existing systems if carbon were priced at levels consistent with the prices presented in the scenarios.

Figure 5: Estimated Emission Impacts in 2030



4.2.3 Estimated Economic Impacts

Fully assessing the economic impacts of carbon pricing is complicated. In addition to estimating the costs that pricing will impose on various parts of the economy, it is important to account for the benefits of reducing GHG emissions (including the avoided costs of climate change), certainty of cost of emission for businesses planning investment, long-term financial benefits of transitioning to a cleaner economy, and the potential benefits that may flow from innovations driven by carbon pricing.

Any assessment of the economic impacts of carbon pricing also needs to account for the uncertainties inherent in future economic projections and modelling. Model-based estimates depend on a wide range of assumptions, including a projection of the future economy. Thus, to the extent that underlying assumptions are uncertain or future economic performance differs from the projections embedded in the models used by the working group, the actual economic impacts of carbon pricing will differ from the estimated impacts presented in this section. In particular, while the economic growth projections in the working group's modelling are consistent with the integrated energy, emissions and economic baseline in Canada's Second Biennial Report on Climate Change, different economic assumptions, when projected out to 2030, can result in level values having significant variation (as shown by the range of Canada's projected emissions profile in Figure 1).

Each of the modelled scenarios outlined in this section projects that real GDP will continue to grow over the projection period, albeit at a slower pace than in the absence of carbon pricing. While GDP (in $2011) rises to about $2.6 trillion in 2030 in the baseline, the model estimates that carbon pricing could reduce that by about $7 billion (at $30/tonne) to about $24 billion (at $90 per tonne). This translates into the average yearly growth rate between 2018 and 2030 slowing by 0.02, 0.03 and 0.08 per cent respectively for the different price scenarios. These estimated impacts are below the average revision to GDP growth year over year or the potential effect of fluctuations in world oil prices. Furthermore, these impacts are small compared to the alternative economic assumptions consistent with the high and low emissions scenarios from Figure 1 (where GDP ranges from $2.4 to $2.9 trillion).

Actual economic impacts will be sensitive to the design of the policy. For example, impacts will vary depending on how revenues are recycled. The illustrative carbon pricing scenarios described above assume that revenues are recycled to the household as lump-sum transfers in the jurisdiction where the revenues were collected. If revenues were instead recycled such that 1/3 are used to reduce labour taxes, 1/3 are used to reduce capital taxes and the remaining 1/3 are transferred to households, real GDP impacts from the 30/90 scenario would fall from $24 billion to $17 billion in 2030.

The estimated economic impacts do not take into account the benefits that will result from clean growth policies, including through investments in infrastructure and the development of new green technology sectors. As well, carbon pricing will provide business certainty and help create and attract investment opportunities in Canada and enable export growth of clean tech and services solutions. These positive impacts are not addressed in our models, but can be expected to sustain growth.

Finally, these estimates do not consider the cost of global inaction on climate change. The National Roundtable of Energy and the Environment in its 2011 "Paying the Price" report[17] found that global failure to address climate change could have significant economic impacts for Canada. Its analysis showed that impacts "could range from $21 billion to $43 billion per year by 2050, equivalent to 0.8% to 1% of GDP, depending upon what future global emissions occur and how Canada grows in the meantime."

Economic impacts will likely differ across regions just as differences in the economic structure of jurisdictions led to emissions impacts differing across jurisdictions. Jurisdictions with a relatively large amount of emissions-intensive industries or relatively emission-intensive household sectors will tend to have relatively larger economic impacts than other jurisdictions or ones that already have carbon pricing systems in place.

17 For more information, see: http://nrt-trn.ca/climate/climate-prosperity/the-economic-impacts-of-climate-change-for-canada

5 CONSIDERATIONS IN THE IMPLEMENTATION OF CARBON PRICING IN CANADA

While carbon pricing would help meet GHG reduction targets by internalizing the price of carbon into the cost of goods and services, it would also represent an increase in costs facing some producers and consumers. As such, carbon pricing presents several issues that need particular attention.

5.1 Revenue Recycling

A carbon pricing mechanism has the potential to raise significant revenues.[18] The design decisions around coverage, price and mitigation goal in any system will have a significant impact on the revenue collected. In addition, decisions around how that revenue is recycled back into the economy will be a central determinant of the overall economic and equity impacts of any policy and can have a significant impact on aggregate emissions outcome.

There are three broad policy goals that governments might hope to address using recycled revenues. When comparing various recycling options, it is important to consider them in the context of the policy goal they are meant to address. Governments might choose to recycle revenues to:

- Offset equity and competitiveness impacts created by the carbon price;
- Facilitate the transition to a low-carbon and resilient economy;
- Boost sustainable growth and raise the long-run standard of living of households, including in Northern, remote and Indigenous communities; or
- A mix of those options.

5.1.1 Recycling Options to Address Equity Impacts of Carbon Pricing

Because carbon pricing works by changing the relative price of goods in the economy, firms and households that rely more on carbon intensive goods will face greater impacts than those that rely less on carbon intensive goods.[19] This creates the incentive for firms and households to internalize the cost of carbon into their decisions and reduce their use of carbon intensive goods. However, carbon pricing will systematically impact some subgroups, such as Northern, remote and Indigenous communities, more than others and while the incentives to reduce emissions should be maintained, there exists a rationale to use recycled revenues to limit the impacts on subgroups that are impacted more, not because of their choices but because of their circumstances. These subgroups could be defined based on income, access to lower-cost options, dependence on emissions-intensive industries, or other metrics.

5.1.2 Household Equity Impacts

The level of CO_2e emissions generated by $1,000 of consumption spending does not differ significantly across income quintiles, suggesting that the carbon intensity of the consumption basket does not significantly vary with income. However, lower income households consume a greater share of their income and are therefore disproportionately affected by carbon pricing. A carbon price and a sales tax (including fuel and excise taxes) will thus exhibit a similar degree of regressivity across income groups. The regressivity does

18 Revenue generation from carbon pricing is one component that a government can use in its overall fiscal management. To the extent that carbon pricing will have an impact on other parts of the economy, or revenues from other sources, it may result in reduced revenues elsewhere during the transition to a low carbon economy.

19 The embedded costs in goods and services such as food, water and clothing, as well as motive fuels that could be used, for example, in traditional hunting/fishing activities, could be significantly impacted, which could disproportionally affect Northern, remote and Indigenous communities and increase their dependence on southern imports.

not come from low-income earners consuming relatively more high-carbon content goods but for the same reason as for a sales tax: since the consumption-income ratio is higher for lower income households (as they save less), taxes paid on consumption will necessarily represent a higher proportion of these households' income.

Generally, sales tax regressivity is addressed through exempting some goods (e.g., basic groceries) and through direct transfers to low income households (e.g., Goods and Services Tax (GST) credit). Another possibility would be to means-test subsidies for abatement actions, recognizing that lower income households have less disposable income to invest in energy efficient technology. The need to recycle revenues toward lower income households would be structural rather than transitional.

Furthermore, the recycling of revenues to address equity issues could be implemented though programs specifically designed and focused toward low-income households, including Northern, remote and Indigenous communities, in order to reduce the proportion of the revenue spent on carbon-intensive goods and services. Alberta's planned carbon levy rebates to low- and middle-income households and British Columbia's low income climate action tax credit are two examples of this type of policy.

5.1.3 Sectoral Impacts and Revenue Recycling

Carbon pricing works by making carbon-intensive goods more expensive and carbon-intensive firms less competitive. For this reason, many of the competitive and equity impacts across sectors are a necessary product of a functioning carbon pricing system. As the market adjusts to the reality of carbon pricing, the overall make-up of the economy will change. This will create a period of transition where some firms will need to change production processes and some individuals may need to change employment.

By investing in this transition to address the financial constraints of individuals and firms, governments could potentially limit impacts and speed up the transition to a sustainable low carbon economy. Transitional assistance could include support to adopt lower emitting or energy efficient technology or retraining programs for displaced workers. This will be especially important in communities which are dependent on carbon intensive firms/sectors, such as diesel-dependent communities in Northern and remote contexts.

Special consideration could also be given to the competitiveness impacts of carbon pricing on emissions-intensive sectors with limited ability to pass on increased costs related to carbon prices. (See further discussion below.)

Carbon pricing may result in domestic firms with low emissions intensity losing market share to firms in low carbon price jurisdictions with high emissions intensity, thereby reducing the environmental benefit of the carbon price. Recycling revenues to reduce the competitiveness impacts can potentially improve global climate outcomes. However, any initiative that increases production by emissions intensive domestic firms will make achieving national targets more difficult.

As such, it is important to take considerable care in identifying sectors that may be subject to lost opportunities to foreign competitors as a result of carbon pricing. In addition, policies to help alleviate these impacts should either be transitional in nature or related to the carbon pricing policies of our trading partners.

5.1.4 Recycling Options that Help Transition to a Low Carbon and Resilient Economy

The overall goal of carbon pricing is to reduce emissions. As such, proponents sometimes discuss the virtuous cycle of reinvesting revenues collected by carbon pricing into areas that further reduce emissions or to ensure adaptation and increase resiliency.

That said, carbon pricing itself should provide a robust economic signal that creates the incentives to undertake any abatements that are economical. The impacts of additional incentives to reduce emissions could be less than expected in the cases where: individuals and firms receive incentives for actions they were already going to make because of the price signal; incentives target additional reductions in areas with inefficiently high costs; and, the incentives interact with the carbon pricing mechanism leading to higher emissions elsewhere in the system.

However:

- In practice, it is only possible to price things that are measurable with some degree of certainty. For this reason, it is difficult to price the emissions associated with some sectors of the economy. Despite this fact, these sectors sometimes have many low cost opportunities to reduce emissions. Recycling revenues to incentivize emissions reductions in these sectors could be justified, although complementary regulations that mandate best practices are a potentially more cost-effective way to incentivize emissions reductions in parts of the economy that are not subject to carbon prices.
- Fighting climate change can be considered a technological problem. The world needs new technologies to be developed in order to maintain (and improve) living standards while reducing the amount of GHGs emitted. Unfortunately, two main market failures lead to an inefficiently small amount of green innovation. The first is the knowledge spillover market failure, where innovators are unable to monetize the full value of their innovation. By making incremental improvements, future innovators benefit from having access to existing innovations but also steal market share from the original product. The second market failure is that the benefits to some types of relevant innovation will be global while a carbon pricing instrument will only change demand within the domestic market. Because Canada is a relatively small market, carbon pricing in Canada would have only a modest impact on global green innovation. To incentivize more green innovation, governments could further fund basic research and/or provide additional support for research and development, subject to the availability of appropriate human resources.
- Certain goods in the economy have a public nature and will not be efficiently provided by the market. Governments generally take it upon themselves to provide these goods (e.g., public transit, parks, police and military). Carbon pricing has the potential to increase expenditures associated with providing these goods both by increasing their demand and increasing their costs. For instance, governments may be required to expand the public transit system or the electricity grid to extend these services to a larger part of the population. Some public infrastructure may no longer be consistent with a low carbon economy and may require replacement before the end of its useful life. Alternatively, the costs of governments might increase with the need to reduce emissions in their buildings, vehicle fleets and military. Recycled revenues could potentially be used to offset the costs associated with these expenses.

Recycling revenues to accelerate the transition to a low-carbon economy can provide various benefits. Measures that assist firms to increase energy efficiency could help reduce production costs, make firms more competitive, and improve the overall energy security of the jurisdiction. Programs aimed at fostering green innovation could also contribute to the creation of new technology clusters and green jobs. Recycling revenues into measures that reduce fossil fuel combustion will also have a positive effect on air quality and on public health care expenditures, not to mention the numerous co-benefits on the security and quality of life that stems from actions aimed at improving active and sustainable means of transportation.

5.1.5 Recycling Options that Achieve Stronger, More Inclusive and Resilient Long-term Economic Growth

Given that governments have many competing policy priorities, revenues from carbon pricing could potentially be directed towards areas that are not directly related to climate change. Directing funds towards policies that achieve stronger, more inclusive and resilient long-term economic growth could be justified regardless of the source of the revenues. Because emissions are partly a function of economic activity, recycling revenues in a way that promotes economic growth will increase the carbon price necessary to achieve a given emissions reduction. However, higher incomes will also have an impact on the ability of households to make investments that lower their emissions.

Economic impacts of carbon pricing are difficult to estimate, as modelling does not take into account uncertainty in economic projections, benefits to the economy, and the cost of not taking climate action. Estimates vary widely, with one of the main factors being how revenues are recycled. In general, the projections showing the smallest impacts on GDP are the ones in which the revenues from carbon pricing are used to reduce distortionary taxes.[20] Generating revenues through a price on carbon provides the opportunity to adjust the overall tax mix in the economy to increase overall tax competitiveness or make the system more equitable. Tax mix changes could be an efficient way to deal with many of the equity issues above.

Other priorities might include stimulating the economy and promoting long-term sustainable growth through targeted investments in infrastructure or improving the current or future fiscal balance of governments.

5.1.6 Considerations

To ensure transparency about the use of the proceeds from carbon pricing, governments could choose to direct all carbon revenues to:

- Revenue neutrality (all revenue from the carbon price is used to lower other sources of revenues, such as in British Columbia); or
- Fiscal neutrality (all revenue from the carbon price is used to either lower other sources of revenue and/or reinvested in new spending associated with climate change, such as in Alberta, Quebec and Ontario).

Revenue recycling could offset much of the economic cost, correct equity impacts or increase emission reductions and help pay for public infrastructure to support mitigation activities and adaptation to climate change impacts, or a mix of these approaches. However, the choice between recycling options requires weighing trade-offs. Different governments at different periods may choose to recycle differently and there may not be one optimal choice.

5.2 Northern and Remote Communities

Unless there are appropriate supporting measures, any carbon pricing mechanism could have disproportional impacts on Northern and remote communities, as they face unique challenges compared to the rest of Canada. Northern and remote communities are generally characterized as permanent or long-term settlements that are not connected to the North American electrical grid or natural gas network.

According to the Natural Resources Canada Remote Communities Database, there are roughly 284 remote communities in Canada. These include communities, settlements, villages or cities, as well as long-term commercial outposts and camps for mining, fishing and forestry activities. Approximately 60 per cent are considered to be Indigenous communities (First Nations, Innu, Inuit, Métis).

Given geographical realities, these communities could face additional burdens from carbon pricing mechanisms in the context of transportation costs, generation of electricity, heating costs, as well as impacts on local fuel-intensive industries, such as mining operations.

20 Recycling revenues to decrease other taxes is a straightforward exercise in CGE modelling. Recycling revenues in ways that promote technology or incentivize additional emissions reductions are computationally more difficult since the effectiveness of these actions depends largely on their design.

5.2.1 Transportation

The vast transportation distances and geographical remoteness of Northern and remote communities necessitates a heavy reliance on air travel and other motive-fuel vehicles and is the major driver of emissions in the transportation sector. Long-distance medical travel is also a necessity for residents living in small, remote communities with limited health care services, as well as for hospital patients requiring medical procedures that are not available locally.

5.2.2 Generation of Electricity

With the exception of a few local hydro grid-tied communities in Yukon, Northwest Territories and Quebec, the vast majority of remote communities across Canada rely on diesel generation for the production of electricity, and there are currently few options for renewable technology substitution (e.g., electricity consumption is far too small to integrate wind energy cost effectively and the technical maximum solar penetration may only displace 2-10 per cent of the annual diesel use). Thus, most of these communities are characterized by a high degree of dependence on imported fuel and high energy costs, which can inhibit the localization of goods and services.

Community isolation also affects the energy source mix for electricity. Interconnecting most communities to a transmission grid is cost prohibitive due to the sheer distance between them and the small population size also prohibits investment into alternatives due to technical and economic challenges of integrating complex multi-source systems into remote communities. [21]

5.2.3 Heating

The majority of homes and buildings in the Territories are heated by diesel or other liquid fuels. In general, reliance on diesel fuel is due to less viable options to ship/transport and consume fuels with lower carbon content (e.g., natural gas, propane, wood pellets). This reliance on diesel is exacerbated by the fact that winters are generally longer and colder in the northern communities, resulting in more days requiring space heating than the average Canadian household. For example, winter temperatures can remain below -40°C for prolonged periods in the Territories, and in other northern communities.

5.2.4 Impacts on Fuel-Intensive Industries

The Northern economy is less diversified than Canada's national economy and the industries that are prevalent are fuel-intensive. For example, mining, quarrying and oil and gas extraction and public administration, accounted for over 40 per cent of the North's GDP in 2011. Further, the transportation and electrical needs for mining can push energy costs to 30 per cent of total operations expenses at a northern mine. While the industrial sector in the Yukon is powered by hydro or diesel, depending on the size of the operation and proximity to the grid, industries in Northwest Territories and Nunavut rely almost exclusively on diesel electricity generation.

21 The establishment of mini and micro grids for remote electrification has been identified as a possible means to facilitate the localization of goods and services.

5.2.5 Considerations for Northern and Remote Communities

These challenges that Northern and remote communities may face do not necessarily preclude the use of carbon pricing mechanisms, however, it will be important to take into account certain considerations in contemplating carbon pricing mechanisms and the recycling of revenues.

- Remote communities that are heavily reliant on carbon-based fuels would be disproportionally burdened by a carbon pricing. Further, these communities, particularly those above the tree line, currently have limited opportunities to reduce their consumption of carbon-based fuels by making use of alternative fuels.
- The embedded costs in goods and services such as food and clothing could be as significant as the direct costs from carbon pricing on energy.
- Inadequate access to capital, low on-reserve investment, and low employment rates impede the ability of vulnerable groups to diversify economies or invest in new infrastructure, which makes it harder to address the increased resources needs associated with mitigating the impacts of climate change.
- Carbon pricing raises the cost of operations and reduces the competitiveness of fuel intensive industries, such as exploration for, and extraction of minerals, oil and gas, which operate in a global economy. (This factor is not limited to Northern or remote communities.)
- Carbon pricing mechanisms could significantly affect the budgets of governments in Northern and remote communities.

Islands and islanded communities, which are not necessarily considered to be Northern or remote, may face similar challenges depending on their isolation relative to the mainland. For example, there may be limited access to alternative fuels or other electrical grids. Further, these communities may face higher transportation costs, and this could have an impact on the cost of all goods and services in those communities.

5.3 Indigenous Peoples

Throughout the engagement process, representatives from Indigenous organizations welcomed the commitment by governments to engage Indigenous peoples in the development of the pan-Canadian framework and supported the goal of building a strong economy while protecting the environment for future generations.

As a guiding principle, Indigenous representatives explained the need for governments to respect the principles of the United Nations Declaration on the Rights of Indigenous peoples, and to take into account Indigenous rights and interests in the development of all climate change-related policies. The importance of establishing "Free, Prior, and Informed Consent" (FPIC) was particularly highlighted for guiding all local, provincial, and national interactions with Indigenous peoples.

Representatives were encouraged that carbon pricing schemes offer Indigenous communities the potential for economic development and also create new opportunities for the deployment and development of green technologies. That being said, representatives emphasized the critical need to work collaboratively to address climate change and its associated impacts on health, wellbeing, and cultural traditions. Indigenous peoples and their traditional practices and cultures are on the front lines in terms of their exposure to the changing climate and should actively participate in a pan-Canadian effort to reduce GHG emissions and adapt to the impacts of climate change. The point was also made that climate action should support, rather than jeopardize, the well-being of Indigenous communities, especially in the areas of energy, food and water access and security. They also suggested that carbon pricing must not be the only strategy for addressing climate change and should be considered one tool among many in developing a long-term strategy for reducing GHG emissions in Canada and transitioning toward a low-carbon economy.

On the design of carbon pricing in Canada, the following key considerations and opportunities were communicated:

- First, the importance of minimizing adverse impacts that carbon pricing could potentially have on the cost of energy in Northern and remote communities that have limited cost-effective options to enhance energy efficiency or switch fuel sources. Further, the recognition that embedded costs in goods and services such as food, water and clothing could also be significantly impacted for certain Indigenous communities.
    - » Fairness and equity should be a central consideration in carbon pricing design to ensure the welfare gap between Indigenous and non-Indigenous communities decreases. Similar to reducing household impacts, this could be done through the design of the carbon pricing mechanism.
    - » Revenues from carbon pricing could also be utilized within communities to subsidize investments such as increased building insulation or the installation of lower carbon or renewable energy sources and infrastructure to replace the diesel generation that presently supplies many Indigenous communities with electrical power, which could lessen the high costs of energy. Where investments cannot effectively be leveraged, revenues could be utilized to offset pricing impacts directly.
    - » The design of a carbon pricing mechanism should support Indigenous communities in the localization of goods and services through clean technology and energy development, which could ultimately lead to reducing or eliminating the reliance on imports and increasing food and water sovereignty.
    - » It was also noted that governments of all levels should be cognizant of the effect carbon pricing could have on operating budgets in order to minimize the impact on resources used to support Indigenous peoples.
- Second, many Indigenous people and communities are interested in the opportunities that carbon pricing may provide for them to benefit economically. This includes participating in emissions reductions activities, the creation of offsets or the recognition of the value of protecting carbon sinks, provided that Aboriginal title and rights and Treaty rights are respected and recognized.
    - » In order to help build capacity and consensus among communities regarding the involvement of Indigenous peoples in the carbon market, representatives identified the need to engage Indigenous peoples early and often in a manner consistent with the principles of "free, prior, and informed consent".
    - » When developing rules to guide the creation of those mechanisms, consideration needs to be given to the participation of Indigenous communities, including policies related to forestry management, biodiversity and other mitigation initiatives.
    - » With respect to potential offset credits, representatives also recommended additional support for corporations that have a revenue sharing agreement, impact benefit agreement or joint ownership arrangement with Indigenous peoples.
- Finally, the importance for all governments to maintain ongoing effective relationships with Indigenous peoples, in compliance with Canada's legal duties and responsibilities under domestic, constitutional, and international law, and for Indigenous peoples to be leaders in the Canadian effort to reduce GHG emissions and fight climate change.
    - » It is important that both Indigenous peoples and governments understand the potential impacts and opportunities that the many aspects of carbon pricing design and implementation may have on Indigenous people and their communities.
    - » To this end, representatives have encouraged governments to provide Indigenous peoples with the necessary information and resources for these communities to actively participate and make informed decisions consistent with FPIC principles.

5.4 Competitiveness and Carbon Leakage

Increasing carbon prices to levels well beyond those of our trading partners could create competitiveness concerns in certain sectors. In particular, certain industries in Canada would face higher direct and indirect production costs, not faced by their international competitors, which could reduce their price competitiveness in domestic and foreign markets. Alternatives to carbon pricing, such as carbon regulations, could also have similar impacts.

When their competitiveness is affected, Canadian firms may face pressure to reduce domestic production, or shift production/investment to a country that has not yet priced carbon at a comparable level (although firms consider many factors when making investment decisions).[22] This could impact jobs and economic activity in Canada, while undermining GHG reduction efforts on a global basis by shifting Canadian emissions to, or increasing emissions in, the other countries – a situation known as "carbon leakage".

The extent to which the competitiveness of a firm is negatively impacted by differential carbon pricing is largely determined by two factors:

- the carbon *emissions intensity* of the firm's production, which is representative of the cost exposure of the firm to carbon pricing; and
- the market power of the firm, or the ability of a firm to pass on increased costs to its buyers without significant loss of market share, which is often measured by the extent of the firm's *trade-exposure*.

Different governments apply different definitions and thresholds of emissions intensity and/or trade-exposure for identifying sectors at risk.[23] Generally speaking, the firms with the most potential for loss of competitiveness or carbon leakage are those in energy-intensive and/or trade-exposed industrial commodity and extractive sectors.

In the Canadian context, the scale of competitiveness impacts on particular sectors will depend on the type and degree of carbon pricing employed. Within an individual sector, impacts will also vary by firm and by province and territory. In considering measures to address the competitiveness impacts of carbon pricing in Canada, it will be important to establish clear criteria and thresholds based on emissions intensity and trade exposure to ensure that measures that address competitiveness are appropriately targeted at sectors subject to the greatest impact. At the same time, the substantial difference that exists across the country in economic and industrial structures will need to be reflected in the policy choices made.

5.4.1 Policy Tools

There are a variety of policy tools available to governments to address competitiveness pressures, which could be used in isolation or in conjunction with one another. Broadly speaking, there are three general approaches:

- Differential treatment for affected sectors;
- Revenue recycling; and
- Border tax adjustments.

22 Many factors can enter into decisions related to shifting of production/leakage, like differentials of labour and energy costs, availability of skilled labour, tax structures, access to markets, etc. Carbon pricing is thus one among many elements that can affect the decision making process of businesses.

23 As noted in a 2015 World Bank report on carbon pricing, while competitiveness pressures/leakage are a real concern for certain sectors, they have not materialized in a broad-based and significant way across jurisdictions that have some form of carbon pricing (for various reasons, including the fact that most of them have a price below $10 per tonne).

5.4.2 Differential Treatment for Affected Sectors

Differential treatment involves specific measures to reduce, eliminate, or offset the direct impact of carbon pricing on production costs for specific sectors. To date, most governments implementing carbon pricing mechanisms have dealt with competitiveness pressures through this approach.

For example, under a carbon tax system, a tax exemption could be fully or partially granted on fuels consumed in production domestically and/or on process emissions by vulnerable sectors (i.e., certain emission sources may have limited ability to reduce emissions without scaling back production). While this mitigates the impact of the carbon tax, the price signal to reduce emissions is effectively removed or weakened for those sectors.

Under a cap-and-trade or performance standard system, competitiveness pressures are addressed by excluding certain sectors from application of the system, or offering free emissions allowances as a design parameter. Further, free emissions allowances can be linked to specific product benchmarks to create a "race to the top" among firms by rewarding production efficiency and emission intensity performance. By granting such treatment, some of the competitiveness pressures in domestic and foreign markets of carbon pricing are mitigated.[24] These approaches both limit the cost impact of carbon pricing on sectors; however, freely allocating allowances offsets the cost impact of the carbon price, while maintaining the price signal and the incentive to reduce emissions. While firms do not incur the full cost of purchasing allowances, the price signal to reduce emissions could be maintained, provided there are incentives to reduce emissions over time (e.g., by reducing the number of free allowances or tying allowances to emissions benchmarks that reward efficiency).

5.4.3 Revenue Recycling

For the purposes of this section, revenue recycling refers to the use of revenues raised from a carbon pricing mechanism to fund measures aimed at offsetting the competitiveness impacts for specific sectors. This can take various forms, such as a reduction in corporate income taxes or funds to assist the transition to, and/or the development of, cleaner technology. Overall, such measures can be designed to further reduce GHG emissions, assist the transition to a low-carbon economy and/or improve the overall competitiveness of certain industries.

In general, economic modelling projections show that impacts of carbon pricing on GDP are smallest when the revenues from carbon pricing are used to reduce broad-based corporate and personal income taxes.[25] While this will improve the international competitiveness of all firms, those with low emissions-intensity will gain more, while tax reductions may not fully offset the competitiveness impacts for emissions-intensive firms or sectors. In addition, benefits can only be realised by those firms that pay corporate income tax (e.g., benefits would not accrue to unprofitable firms).

From an international perspective, targeted revenue recycling that provides a direct benefit to a specific industry or group of industries could be vulnerable to a trade challenge as a trade-distorting subsidy if it results in harm to foreign producers.

24 The choice of a linked system, with the implied lower emission reduction cost ($/t) can also narrow the "asymmetry" in policy conditions that might exist between a jurisdiction and its trading competitors.

25 Supporting studies for Canada include the Canada's Ecofiscal Commission report - CHOOSE WISELY: Options and Trade-offs in Recycling Carbon Pricing Revenues (2016), The David Suzuki Foundation report - Pricing Carbon: Saving Green, a carbon price to lower emissions, taxes and barriers to green technology (2008), and The Resources for the Future paper - Deficit Reduction and Carbon Taxes: Budgetary, Economic, and Distributional Impacts (2013).

5.4.4 Border Tax Adjustments

Border tax adjustments (BTAs) – also referred to as border carbon adjustments (BCAs) – consist of two components:

- "Carbon tariffs" applied on the embedded carbon content of imported GHG-intensive goods. Such carbon tariffs would be administered by the federal government given its jurisdiction for international commerce; and
- A full or partial rebate provided on the carbon price paid in the production of exported goods.

In theory, BTAs are intended to "level the playing field" between domestic producers, whose goods would have an embedded carbon cost, and international manufacturers, whose goods may have a lesser, if any, carbon cost. Specifically, carbon tariffs would ensure that all goods in the domestic market are subject to carbon pricing and mitigate the risk of carbon leakage. At the same time, while carbon tariffs and rebates for exported goods would be a means to limit competitiveness impacts on carbon-intensive sectors in Canada, they would not necessarily contribute to GHG reductions on a global basis.

While carbon tariffs have been the subject of much international debate over the past decade, no country has yet implemented them, favouring rather the use of differential treatment for trade-exposed sectors. As such, there are a number of unsettled trade law and policy issues.[26] Ultimately, World Trade Organization (WTO) legality would depend on the specific design of the carbon tariff, though the WTO has been sensitive to the environmental goals of its member countries.

Carbon tariffs would have to be established at a level equivalent to a national carbon price or at the lowest carbon price of any province or territory in Canada in order to respect international trade (national treatment) obligations. If there is no carbon price in one or more provinces or territories, the carbon tariff would have to be zero.

5.4.5 Takeaway

Differential treatment and revenue recycling have the potential to address competitiveness pressures. In time, border tax adjustments may also prove to be an effective policy measure. The merit of each of these individual policy tools would need to be assessed against specific carbon pricing options and would involve trade-offs between different environmental and economic objectives.

It bears noting that any approach taken to address competitiveness issues that negates the incentive for certain sectors to reduce emissions will require higher carbon pricing across the rest of the economy to achieve the intended emissions outcome.

26 A number of these considerations have been reviewed and analysed in a Canadian context, including Maria Panezi "When CO_2 Goes to Geneva: Taxing Carbon across Borders — Without Violating WTO Obligations." CIGI Papers No. 83. Waterloo: Centre for International Governance Innovation (CIGI).

6 EVALUATING CARBON PRICING IN CANADA

6.1 Domestic Experiences in Carbon Pricing

Some provinces have already moved forward with their own explicit carbon pricing mechanisms, creating a variety of different regimes across Canada. In Canada, both carbon taxes and cap-and-trade systems have been implemented or announced by various provinces. All Canadian governments also have extensive experience with direct pricing of fuels or implicit carbon pricing mechanisms.

6.1.1 Carbon Taxes in Canada

British Columbia introduced a carbon tax in 2008 at a rate of $10 per tonne of CO_2e. This rate was increased by $5 per year up to 2012, reaching $30 per tonne of CO_2e. The tax is revenue neutral, as all the revenue it generates is returned to businesses and individuals in the province through other tax reductions and rebates. The tax applies to all fuel used in the province, covering about three-quarters of provincial GHG emissions. Specifically, the tax applies to all liquid, gaseous, and solid fuels, including gasoline, diesel, natural gas, coal, propane, home heating fuel, ethanol, and renewable diesel fuel purchases. As these fuels generate different amounts of GHG emissions, the carbon tax is applied at varying rates.

Alberta has also announced that it will be implementing a new carbon levy on transportation and heating fuels, including diesel, gasoline, natural gas and propane. The levy will apply as of January 1, 2017 at a rate of $20 per tonne, and will increase to $30 per tonne on January 1, 2018. The government has also indicated that the funds will be used to: diversify the economy by investing in renewable energy, bioenergy, and technology; spending on green infrastructure like transit; and improving energy efficiency of homes, communities, and businesses. Support will also be provided to households and businesses through lower-income rebates, a reduction in the small business tax rate, and funding to assist coal communities, indigenous communities, and other communities requiring adjustment assistance.

6.1.2 Cap-and-Trade Systems in Canada

Quebec introduced a cap-and-trade system in 2013, which covers business emitting 25,000 metric tonnes or more of CO_2e per year and fuel distributors selling more than 200 litres of fuel. The system covers about 85 per cent of Quebec's GHG emissions. Under the system, Quebec sets a cap on emission units that it will put in circulation each year, which will gradually decline over time. Trade-exposed industrial emitters receive most of their emission units free of charge, and the rest are sold at auction, which includes a price floor that increases annually by 5 per cent plus inflation – currently units are trading close to the floor price of about $16 per tonne of CO_2e. All proceeds from the auction go to the Quebec Green Fund and are earmarked for the financing of various initiatives contained in the 2013-2020 Climate Change Action Plan. Since January 1, 2014, Quebec's cap-and-trade system has been linked to California through the WCI. The linkage enables firms regulated by Quebec's system to purchase and use California's permits for compliance in Quebec, and vice versa.

Ontario' new cap-and-trade regulation – supported by its new *Climate Change Mitigation and Low Carbon Economy Act* – took effect on July 1, 2016. The first compliance period will begin on January 1, 2017. Similar to Quebec, the program will cover businesses emitting 25,000 tonnes of CO_2e per year, including distributors of heating fuels and suppliers of transportation fuels selling more than 200 litres of fuel. The program is expected to cover between 80 and 85 per cent of Ontario's emissions. Proceeds from the auctions are expected to go to investments to support GHG reduction initiatives, such as home and business energy efficiency, innovation funding, transit, and clean technology. Ontario has announced its intention to link with Quebec and California.

6.1.3 Performance Standard Systems in Canada

Alberta has priced GHG emissions since July 1, 2007 through the *Specified Gas Emitters Regulation*, which applies to all facilities that emitted more than 100,000 tonnes CO_2e in any year since 2003. This covered approximately 50 per cent of Alberta's emissions. This regulation includes compliance flexibility mechanisms for regulated facilities that enable Alberta's carbon offset and emissions performance credit markets, as well as an option to pay a fixed carbon price to government for emissions in excess of facility limits. The price per tonne of emissions started at $15/t CO_2e and was raised to $20/t for 2016 and $30/t for 2017, along with increases in the stringency of facility emissions limits. Revenue collected under the *Specified Gas Emitters Regulation* is all put into the Climate Change and Emissions Management fund which invests in emissions reduction and climate change adaptation measures. As of 2018, this will transition to a product-based performance standard system.

As of January 2016, British Columbia set a price on emissions from liquefied natural gas (LNG) facilities, in addition to carbon tax payable. Under the *Greenhouse Gas Industrial Reporting and Control Act*, LNG facilities are required to meet an emission limit of 0.16 tonnes of CO_2e per tonne of LNG produced (tCO_2e/tLNG). This includes emissions associated with the production of LNG and transmission of electricity used by an LNG facility. Facilities emitting below the emissions limit are eligible for credits which may be traded. Facilities emitting above the limit can achieve compliance through using credits, purchasing offsets or contributing $25 per tonne into a technology fund which will invest in emission reductions. Compliance costs may be partially offset for LNG facilities with emissions over 0.16 tCO_2e/tLNG but less than 0.23 tCO_2e/tLNG through the LNG Environmental Incentive Program. Modelling 2030 emissions indicates that the LNG benchmark would cover approximately 5 per cent of total British Columbia emissions in 2030 assuming no policy changes for the rest of the economy.

In June 2016, the Newfoundland and Labrador House of Assembly passed a bill that will regulate large industrial GHG emissions (i.e., industrial facilities that emit 25,000 tonnes of CO_2e or more). The legislation provides for at least two years of emissions monitoring to help form reduction targets. Industrial facilities are to achieve prescribed annual GHG emission reduction targets each year. Facilities may achieve the target by reducing emissions or using GHG reduction credits, which includes payment to a fund that supports emissions-reduction technology.

6.1.4 Other Carbon Pricing Systems in Canada

All Canadian governments have also made large-scale use of fuel taxes (see Table 1) or putting in place implicit carbon pricing mechanisms. For example, Nova Scotia has designed a set of implicit carbon pricing mechanisms which have reduced its total GHG emissions by almost 30 per cent since 2005. It imposed a hard cap on its electricity sector, to achieve 55 per cent reductions in GHG emissions by 2030. It also adopted a Renewable Portfolio Standard which has resulted in Canada's second highest level of wind power in its electricity mix (after Prince Edward Island), and it prescribed more electricity efficiency (now achieving 1 per cent/year load reductions); banned organics from landfills; and invested in Canada's largest expansion of the national grid in years.

Since 2010, British Columbia has imposed a price on GHG emissions from all provincial public sector organizations including ministries, school districts, post-secondary institutions, Crown corporations and health authorities. Provincial public sector organizations are required to have net-zero emissions, except for school buses and transit buses, through GHG emissions reductions and the purchase of offsets. The offset price for provincial public sector organizations is $25 per tonne of CO_2e. This price is in addition to the provincial carbon tax payable. However, school districts are eligible for a grant equal to the carbon taxes they paid directly. British Columbia has also established the Carbon Neutral Capital Program, which provides annual funding to school districts, health authorities, universities and colleges to improve the energy efficiency of their facilities. This funding is generally equal to or greater than the offset payments these public sector organizations make each year.

6.2 Evaluation of Current Carbon Pricing Approaches in the Pan-Canadian Context

A number of jurisdictions have introduced some form of carbon pricing, whether it is a carbon tax, a cap-and-trade, a performance based standards system, taxes on fuels or an implicit carbon pricing tool to reduce GHG emissions. Together, these actions are having an impact on Canada's GHG emissions reduction targets.

There are a number of similarities between the broad-based carbon pricing mechanisms that have been implemented or announced by provinces in Canada. For example, broad-based carbon pricing mechanisms in Canada:

- Attempt to correct a market failure by providing an incentive to businesses to develop and invest in technologies which save energy or reduce emissions, as well as providing an incentive to consumers to choose lower emissions goods and services.
- Take advantage of market efficiencies by providing flexibility on how to achieve emissions reductions.
- Generate revenues for government, which can be used to address potential adverse impacts on lower income individuals and families, including Northern, remote and Indigenous communities, and business competitiveness.

Those jurisdictions with broad based carbon pricing have designed their systems to meet environmental objectives while recognizing their own unique needs.

As a result, there are multiple regimes in Canada with multiple prices, minimal linkages among systems and a different scope of coverage among jurisdictions. Some jurisdictions have no broad-based carbon pricing regime. There is also access to foreign emissions permits in certain provinces.

6.2.1 Multiple Regimes

There is now a variety of carbon pricing mechanisms in Canada – both explicit and implicit. Each regime has its own set of criteria, including coverage, reporting requirements, timing of payments (e.g., embedded as a carbon tax or settled at the end of a multi-year compliance period using emissions allowances), the ability to use offset credits, etc. Other jurisdictions have no explicit carbon price, but in some cases have implemented measures that translate into an implicit carbon price.

The variety of approaches reflects the unique emissions profiles and unique economic structures of Canada's provinces and territories. Climate policy is not a one size fits all approach.

This multiplicity of regimes may not present concerns for some communities, households and businesses, including some of Canada's largest emitting industries. Indeed, in the electricity sector, provincial systems have minimal linkages and different administrative structures (crown corporations, markets, etc.) and power generating companies generally operate in a single province or territory and need only comply with a single regime.

However, for businesses that operate across the country, the existence of significantly different carbon pricing regimes (or none at all) across provinces and territories can increase their compliance costs.

6.2.2 Multiple Carbon Prices

The multitude of carbon pricing regimes also creates a range of effective carbon prices (both explicit and implicit) across the country, which impacts the incentive effects faced by businesses and consumers. In the absence of a comparable carbon price across Canada, some low-cost emission reduction opportunities may be missed. In their place, governments and industry may have to rely on higher-cost, less efficient reduction approaches.

Multiple prices (or no price in some cases) also impacts the ability of jurisdictions that have carbon pricing mechanisms to increase their price at a pace that exceeds others out of competitiveness concerns (i.e., if one province or territory chooses to significantly increase its carbon price vis-à-vis other jurisdictions, it could put certain firms at a competitive disadvantage within the country). To the extent that other jurisdictions' lack of similar pricing results in other jurisdictions not increasing their own rates more aggressively, this will have an impact on Canada's overall emissions reductions. In other words, lack of carbon pricing in some jurisdictions could actually impact other jurisdictions' emissions reductions, creating the same competitiveness concerns inside Canada that exist internationally.

6.2.3 Access to Foreign Permits in Certain Provinces

Some provinces have chosen to access international permits through trade, whereas other provinces have not. For example, Quebec's linkage to the California emissions permit market means that California emission permits can to be used to satisfy Quebec's annual cap-and-trade regulations, (and vice-versa). This linkage provides such provinces access to a broader pool of possibly lower-cost reductions but, as in any partnership, requires agreement among members before making any important changes like imposing a higher carbon price. This linkage will affect the flexibility of these two jurisdictions to unilaterally alter their carbon pricing mechanisms significantly.

6.3 Comparing the Stringency of Pricing Mechanisms

There are a number of ways to compare the stringency of carbon pricing mechanisms and no clear best option. While this report does not seek to recommend a measure for comparing stringency, this section provides a brief overview of some potential methods for making such a comparison. (These methods draw heavily on work done by Canada's Ecofiscal Commission.[27])

It should be noted that irrespective of the methodology preferred, some adjustments need to be considered to account for non-broad-based mechanisms that impose an explicit price on carbon – such as motive fuel taxes.

6.3.1 Marginal Price

The most straight-forward method to compare carbon pricing mechanisms is to consider the marginal price of carbon in that jurisdiction (i.e., the price that individuals/firms consider when buying or emitting their next unit of GHGs). This measure represents the marginal price to reduce one tonne of emissions as a result of the carbon pricing mechanism. For example, under a carbon tax, the marginal price would generally be the tax rate that applies, while under a trading system, the marginal price would generally be the market price for a compliance unit.[28] (Marginal price is different from average price, in that it does not take into account any exemptions from which some emitters may benefit).

27 Ecofiscal Commission, "Comparing Stringency of Carbon Pricing Policies", July 2016.

28 It is not an easy task to compare allowances prices to carbon tax rates, because the allowance price – if reflecting the market price of a larger market bringing together linked jurisdictions – will be different than a price applied only in the jurisdiction. Ontario recently undertook an evaluation of the tool to achieve its target. The analysis compared a linked cap-and-trade program with an unlinked cap-and-trade program and a carbon tax. According to that analysis, both the allowance price in an unlinked cap-and-trade and a carbon tax necessary to achieving Ontario's emission reduction commitments greatly exceeded the allowance price of a WCI-linked system.

While this method is simple, comparing on marginal price alone does not take into account the emissions covered by the carbon pricing mechanism (which also has an impact on overall reductions of emissions achieved). For example, under this approach, a carbon pricing mechanism with a marginal price of $40 per tonne of CO_2e that covers 75 per cent of emissions would be considered to be less stringent than a carbon pricing mechanism with a price of $100 per tonne of CO_2e that covers only 10 per cent of emissions, even though the total proceeds from the carbon price would be three times greater under the first system. Emissions reductions achieved will also be impacted by both price and coverage.

6.3.2 Average Effective Carbon Cost

Another way to easily compare carbon pricing and coverage across jurisdictions is to use a proxy by measuring the average effective carbon cost, which is the ratio of revenues from measures that put a price on carbon – therefore influencing the consumer's decision making process – to total emissions of GHG (i.e., average effective carbon cost = sum of all revenue derived from pricing GHG emitting products / GHG emissions of a jurisdiction). With this method of calculation, the effective carbon cost corresponds to an average economy wide price per tonne. The average effective carbon cost could be calculated just for regulated entities when considering competitiveness impacts on a sector or for the entire jurisdiction when considering cost to the economy.

Motive fuel taxes, sales taxes (federal and provincial) on fuels and revenues from a carbon tax, cap-and-trade or performance based system would be the main revenue sources to consider in calculating the effective carbon price. To this may be added revenue from various regulations that affect the consumer's decision to participate in producing GHG emissions. For example, additional registration fees for large cylinder capacity vehicles or additional taxes on fuel to fund local public transportation send a price signal on carbon pollution and could therefore be included in the calculation.

6.3.3 Coverage-Weighted Carbon Price

Another simple method to compare carbon pricing mechanisms could be to take into account coverage (i.e., emissions that face a price incentive for reduction) and marginal price by using a "coverage-weighted" carbon price. This could be calculated by taking the marginal price of carbon and multiplying it by the percentage of emissions that the carbon pricing mechanism covers. For example, a marginal carbon price of $40 per tonne of CO_2e that covers 75 per cent of emissions would have a coverage-weighted price of $30 per tonne of CO_2e ($40 X 0.75). This approach would take into account the coverage of a carbon pricing mechanism in addition to its price, thereby allowing some rough comparisons between systems.

Under this approach, a carbon pricing mechanism would be considered to have an increased stringency through an increase in either the marginal price per tonne of CO_2e or the coverage of the carbon pricing mechanism. Also, it is important to note that the coverage is not affected, under a cap-and-trade system or performance standard system, if an amount of carbon permits are freely allocated to emitters and the incentive to reduce emissions is maintained by the possibility to sell those permits.

6.3.4 Trade-Adjusted Coverage-Weighted Carbon Price

This approach would be similar to the coverage-weighted carbon price, but would also account for permits/reductions from other jurisdictions, in cases where a system has inter-jurisdictional linkages, such as Quebec's and Ontario's systems. Linked systems allow for inter-jurisdictional trade in permits, which essentially means that reductions made outside the system can be used for compliance purposes within that system.

Like the coverage-weighted carbon price, this approach could be calculated by multiplying the marginal carbon price by the domestic covered emissions plus inter-jurisdictional permits (including offsets) as a percentage of total domestic emissions (i.e., marginal price X (domestic covered emissions + inter-jurisdictional permits)/total domestic emissions). Under this approach, an assessment of stringency would include the impact of the systems on international emissions.

As climate change is a global issue, the objective with linked systems is to reduce emissions at the lowest cost wherever the emissions are. Not including inter-jurisdictional emissions reductions could understate the coverage and the stringency of linked systems.

6.3.5 Comparing Emission Reductions

Rather than using price as a metric for comparing stringency of systems, another approach could include comparing the amount of GHG emission reductions relative to a no policy scenario that resulted, or are expected to result, from a specific system. For example, this could include modelling the impacts (either ex-post or ex-ante) on GHG emissions of a carbon pricing mechanism in one jurisdiction against the impacts on GHG emissions of another mechanism in the same jurisdiction. This approach would rely on modelling, as it would require estimating the amount of GHG reductions associated with a given policy.

This approach could allow for a comparison of stringencies of a number of policies, rather than just explicit carbon pricing mechanisms (e.g., the impact of regulations and revenue recycling on GHG emission reductions), but is subject to the uncertainties and assumptions necessary to model.

6.3.6 Conclusion

As described above, comparing stringency is not straight-forward and it can be accomplished by using price metrics or emissions metrics. Other measures of stringency should also be further developed, which could take into account both pricing (implicit and explicit) and other policies that reduce emissions. In the end, all of these methods require careful interpretation and agreement on the underlying assumptions used in determining the measure of stringency of a given system. Nonetheless, being able to have a rough measure of the stringency of a system will be important in assessing the role of carbon pricing in the meeting Canada’s emission reductions targets as part of the broader pan-Canadian Framework, and the comparability between the different systems.

Comparisons of stringency should acknowledge the risk of leakage: one system might seem more stringent, but if it leads to an increase in emissions elsewhere because of businesses moving to a country where there is no or a lower price on carbon, then it could have less or a similar effect than a lower cost system.

7 PRINCIPLES FOR A PAN-CANADIAN APPROACH

First Ministers recognized that:

- all governments have an important role in the global effort to reduce GHG emissions, and that a number of provinces and territories have already joined or are exploring entry into regional and international efforts to reduce GHG emissions;
- carbon pricing mechanisms are being used by governments in Canada and globally to address climate change and drive the transition to a low carbon economy;
- provinces and territories have been early leaders in the fight against climate change and have taken proactive steps, such as adopting carbon pricing mechanisms, placing caps on emissions, involvement in international partnerships with other states and regions, closing coal plants, carbon capture and storage projects, renewable energy production (including hydroelectric developments) and targets, and investments in energy efficiency; and
- the federal government has committed to ensuring that the provinces and territories have the flexibility to design their own policies to meet emission reductions targets, including their own carbon pricing mechanisms, supported by federal investments in infrastructure, specific emission reduction opportunities and clean technologies;

and committed to transition to a low carbon economy by adopting a broad range of domestic measures, including carbon pricing mechanisms, adapted to each province's and territory's specific circumstances, in particular the realities of Canada's Indigenous peoples and Arctic and sub-Arctic regions.

In keeping with these commitments of the Vancouver Declaration, the following principles were used in guiding the development of options for the Working Group on Carbon Pricing Mechanisms:

- The pan-Canadian framework for Clean Growth and Climate Change should be flexible, and should recognize and further support existing carbon pricing policies already implemented or in development by provinces and territories.
- Carbon pricing, being widely recognized as an economically efficient policy tool, should be considered as a central component of the pan-Canadian Framework.
- Carbon pricing coverage should be applied broadly so that the incentive it provides to reduce GHG emissions is applied to as many goods and sectors in the economy as possible.
- Carbon pricing policies should be introduced in a timely manner in order to minimize new investment into assets that will become stranded and maximize cumulative emission reductions.
- Carbon price increases should occur in a predictable and gradual way to limit economic impacts and allow businesses and households time to plan and adjust with limited uncertainty.
- Reporting on carbon pricing policies, in terms of coverage, stringency and associated emissions reductions, should be consistent and made on a regular basis, and in a manner that is transparent and verifiable.
- Carbon pricing policies should minimize competitiveness impacts and carbon leakage. In this regard, carbon pricing policies in Canada, including explicit and implicit pricing mechanisms, should be reasonably comparable in price or stringency across the country to mitigate such impacts between provinces and territories. Those carbon pricing policies should also be designed to mitigate international competitiveness and carbon leakage pressures.
- Carbon pricing policies, including their revenue recycling components, should strike a balance between applying the polluter-pays principle and avoiding a disproportionate burden on vulnerable groups (i.e., emission-intensive/trade-exposed industries, northern and remote communities, and low income households).

8 OPTIONS

8.1 Role of Carbon Pricing Mechanisms in Pan-Canadian Framework

This report has examined carbon pricing and has identified various pricing mechanisms, including the major broad-based mechanisms: a carbon tax, a cap-and-trade system and a performance standard system. The report has also demonstrated that carbon pricing can lead to significant, economically efficient reductions in GHG emissions provided that the price signal is strong enough and the coverage is wide enough. As presented earlier, some provinces have already settled on a strong carbon price signal. With existing and decided policies to be implemented, nearly 85 per cent of Canada's economy and population will be subject to broad-based carbon pricing mechanisms by 2017.

As outlined in the previous section, the Vancouver Declaration indicates that "the provinces and territories have the flexibility to design their own policies to meet emission reductions targets, including their own carbon pricing mechanisms." In addition, First Ministers committed in the Vancouver Declaration "to transition to a low carbon economy by adopting a broad range of domestic measures, including carbon pricing mechanisms, adapted to each province's and territory's specific circumstances."

The working group has identified three broad groups of options for carbon pricing: (1) a single form of broad-based carbon pricing mechanism that would apply across the country, (2) broad-based carbon pricing mechanisms in all jurisdictions but allowing for flexibility of instrument choice, and (3) a range of broad-based carbon pricing mechanisms in some jurisdictions with the remaining jurisdictions instituting other mechanisms or policies to meet specific GHG reduction targets within their respective jurisdictions.

These options reflect different approaches to the implementation of carbon pricing in Canada. The choice of option should be guided by the commitments made by First Ministers in the Vancouver Declaration.

As per the design parameters and considerations above, a number of specific options would need to be considered within each of these broad groups of options, including the type of carbon pricing mechanism(s) to apply, the coverage and price/stringency of the metric, the level and certainty of mitigation that will be achieved by the option, how to address competitiveness and leakage risk, the use of revenue, and how to protect vulnerable groups and Northern, remote and Indigenous communities. Where the option includes the possibility that different jurisdictions will implement comparable pricing mechanisms, consideration will need to be given to adopting a measure to compare the stringency of all forms of carbon prices, including motive fuel taxes and implicit prices, and a system to ensure ongoing comparability. The implementation of any option should also reflect the commitments for a partnership with Indigenous peoples based on recognition of rights, respect and cooperation.

The broad groups of options are described below, including a brief assessment in relation to the principles for a pan-Canadian approach to carbon pricing (as discussed in the previous section), as well as potential considerations for provinces and territories with existing or planned carbon pricing mechanisms.

8.1.1 Single Type of Broad-Based Carbon Pricing Mechanism in All Jurisdictions

A single type of broad-based carbon pricing mechanism, such as a carbon tax or an emissions trading system, could be introduced throughout Canada.

- **Supportive of existing pricing policies:** Unless agreed to by provinces and territories with existing or planned mechanisms, by requiring that a single broad-based carbon pricing system apply in all jurisdictions across Canada, this option is not consistent with the principle of flexibility and support for existing or planned carbon pricing policies.

- **Central feature:** Under this option, the carbon pricing mechanism would apply across all jurisdictions. Whether it is a central component for increased ambition would still depend on the price level and coverage of the mechanism and the reductions achieved.[29] If applied to all sources whose emissions can be calculated using robust methods, such a mechanism could apply to between 70 and 80 per cent of total emissions in Canada. Application to such a wide range of goods and services could allow carbon pricing to function as a central component of the pan-Canadian Framework, depending on the level of the carbon price, the coverage and the emissions reduction over time.
- **Cost-effectiveness:** A single carbon pricing mechanism across Canada could be more efficient than having multiple regimes across provinces and territories. However, to be efficient, the regime would have to be flexible enough to accommodate for the variations among the provincial and territorial economies. As well, moving from multiple existing regimes to a single regime would impose significant costs on businesses and governments in some jurisdictions already active in carbon pricing during the transition. The choice of instrument could also provide for linkages to other systems outside of Canada.
- **Timely and predictable:** in order to minimize these transition costs, jurisdictions would need a reasonable period to transition into the single/harmonized regime. The system could then provide for carbon price increases that occur in a predictable and gradual way to limit economic impacts, either through agreement on price increases in each individual province and territory or through increases applied in a national mechanism that would apply to all provinces and territories. A transition period would also be required for provinces and territories to incorporate the single/harmonized regime into their plans for reducing GHG emissions and implement mechanisms for revenue recycling. Thus, this is likely the least timely option.
- **Clarity/transparency:** A single form of carbon pricing mechanism, in terms of coverage, stringency and associated emissions reductions, would provide greater clarity in terms of its application across Canada, as all provinces and territories would be using the same common elements. The clarity and transparency would depend somewhat on the pricing mechanism chosen and the complexity of design.
- **Competitiveness issues:** This approach could address potential domestic competitiveness issues, including through differential treatment, revenue recycling and/or potentially through border tax adjustments (BTAs). As explained above, to abide by international trade obligations, BTAs would not be possible for products that are exempted from coverage in any part of Canada. It may be more difficult to address local competitiveness issues through differential treatment under a single system than an option where provinces can have different systems that are tailored to their economies.
- **Vulnerable groups:** Revenue recycling decisions could be made by each jurisdiction, allowing each government to strike a balance between applying the polluter-pay principle and avoiding a disproportionate burden on vulnerable groups.

29 As this approach could replace some of the existing and planned provincial and territorial carbon pricing measures, the increase in ambition would need to be measured against existing or planned coverage and price in Canada. Furthermore, to the extent that this approach affected international linkages or the GHG results spurred by the tool, existing provincial emission reduction targets may be impacted.

8.1.2 Broad-Based Carbon Pricing in All Jurisdictions with Flexibility on Instrument Choice

Under this option, broad-based carbon pricing with a broadly comparable level of price, coverage, or emissions reduction would apply throughout Canada – but with flexibility on instrument choice within each province and territory.

- **Supportive of existing pricing policies:** By providing flexibility on instrument choice, this option is more flexible and would recognize and support existing or planned carbon pricing policies.
- **Central feature:** This option would ensure that carbon pricing is used throughout Canada, and could play a central role in the pan-Canadian Framework, as it is already doing or will do by 2017, when nearly 85 per cent of Canada's economy and population will be subject to broad-based carbon pricing mechanisms.
- **Cost-effectiveness:** Implementing carbon pricing regimes in provinces and territories that do not already have a mechanism would impose transition costs on businesses and governments. Multiple pricing regimes would not necessarily reduce the effectiveness of carbon pricing, and would preserve the instrument choice made by some provinces and territories based on the specificities of their economies. In addition, with comparable price and coverage, such an approach would ensure that carbon pricing would apply broadly to cover as many goods and services as possible and that emitters faced similar carbon costs, thereby favouring the efficiency of the various carbon pricing mechanisms. It could also allow for linkages between some or all jurisdictions. However, the existence of multiple carbon pricing mechanisms could increase administrative costs for businesses operating in multiple provinces or territories (and already facing diverse conditions across the country) compared to a single form of broad-based carbon pricing mechanism. For example, there could be differences in reporting requirements, timing of payments, refund mechanisms, registration requirement, etc. Therefore, under this option, federal, provincial and territorial governments should aim at minimizing the administrative cost on industry. As well, this option could also provide for linkages to other systems outside of Canada.
- **Timely and predictable:** As this option would build on existing systems, there would be no delay in introducing pricing and no impediment to timely, predictable and gradual increases in prices to limit economic impacts for those who already have a system.
- **Clarity/transparency:** The existence of multiple regimes would present challenges in terms of clarity's for Canada's approach as a whole. As discussed earlier in this report, there are also various metrics that can be used to compare the stringency of different carbon pricing mechanisms. If carbon pricing is to play a consistent role in GHG mitigation in all provinces and territories, governments may need to agree on common metrics to be able to compare their actions.
- **Competitiveness:** By enabling each jurisdiction to design its own carbon pricing mechanism, this option would give jurisdictions flexibility to address competitiveness issues through differential treatment and revenue recycling. To abide by international trade obligations, BTAs on imports would only be possible for products that had an explicit carbon price in all provinces and territories and would have to be set at the lowest carbon price across provinces and territories.
- **Vulnerable groups:** jurisdictions would have the flexibility to design their carbon pricing mechanisms, including their revenue recycling components, in a manner that strikes a balance between applying the polluter-pay principle and avoiding a disproportionate burden on vulnerable groups.

8.1.3 Broad-Based Carbon Pricing or Reductions Targets

Under this option, some jurisdictions would have a broad-based carbon pricing mechanism while the remaining jurisdictions would either choose to implement one or to use other policies or mechanisms, including implicit pricing mechanisms, to reach equivalent policy stringency or a specific GHG emissions target. Additional contributions to Canada's mitigation objectives would rest on existing carbon-pricing mechanisms where the price rises, on future mechanisms that could be added, as well as on current and future complementary mitigation measures.

- **Supportive of existing pricing policies** – By not imposing specific carbon pricing policies, this option is flexible and recognizes and supports existing carbon pricing mechanisms already implemented or in development by provinces and territories.
- **Central feature:** Given that this option would not lead to consistent pricing and coverage across provinces and territories, like the existing situation in Canada, emitters would face different carbon costs across jurisdictions, thereby potentially limiting the efficiency of carbon pricing systems for Canada as a whole. Further, carbon pricing may not be applied to as many goods and sectors as possible, which would decrease the effectiveness of carbon pricing in providing a similar incentive to reduce GHG emissions across Canada. Under this option, broad-based carbon pricing could continue to play an important role in the pan-Canadian Framework, but would not necessarily be the principal component for added GHG reductions.
- **Cost-effectiveness:** The existence of multiple carbon pricing mechanisms and other policies could increase administrative and compliance costs for businesses operating in multiple provinces or territories compared to a single form of broad-based carbon pricing mechanism, and could lead to higher cost reductions being pursued in some jurisdictions or sectors. To the extent that provinces and territories adopt approaches that are specifically tailored to their economic situations, overall efficiency could be improved. This option could provide for limited linkages to other systems outside of Canada.
- **Timely and predictable:** In provinces with carbon pricing mechanisms, increases in carbon prices could occur in a predictable and gradual way. Given the level of flexibility, this option may not be seen as predictable in jurisdictions that do not currently have commitments for how policies will evolve over time.
- **Clarity/transparency:** Having multiple ways to deal with climate change would result in a more complex set of tools to account for at the international level for Canada. Use of some implicit carbon pricing mechanisms could also add complexity to reporting on carbon pricing policies, in terms of coverage/stringency and associated emission reductions.
- **Competitiveness:** To abide by international trade obligations, BTAs on imports would not be possible if one province or territory does not assign an explicit carbon price to a given good. Under explicit carbon pricing schemes, provinces and territories would have full flexibility to use differential treatment and revenue recycling. In this scenario, this issue is mostly left to provinces and territories to resolve and use differential treatment and revenue recycling. As well, longer term interprovincial competitiveness issues will have to be monitored and potentially addressed if the stringency of carbon pricing measures diverge too greatly among provinces and territories. Furthermore, it may be difficult to address potential competitiveness issues arising from implicit pricing measures.
- **Vulnerable groups:** This approach reduces options for policy design to strike a balance between applying the polluter-pays principle and avoiding a disproportionate burden on vulnerable groups, as there may be no associated revenues with which to address these issues. That said, this approach allows provinces and territories, with the choice of tools that fits best their reality, to account for their vulnerable groups or to address specific issues.

8.2 Offset Credits, Common Reporting and Emissions Data Quality

Regardless of which option is chosen, the working group heard from a number of stakeholders about the importance of two issues: harmonizing the recognition of offset credits and improving the reporting of emissions to ensure a good quality and a similarity between federal, provincial and territorial emissions data.

An offset credit represents one tonne of GHG emission reductions generated from activities not covered by GHG regulations (approximately 80 per cent covered) and that would not have occurred without the incentive created by an offset system. In order to be considered valid, offsets must meet criteria set by a program authority, including the measurement and verification requirements. The quality of offsets is dependent on the criteria set by the program authority, which can vary from program to program. After they are issued by a program authority, offset credits can usually be purchased and submitted by entities to meet regulatory requirements under certain conditions.

Some offset programs already exist in Canada for regulatory compliance purposes (British Columbia, Alberta and Quebec) and others are being implemented (Ontario) or planned (Newfoundland and Labrador). These programs are not harmonized, with the important exception of Quebec and Ontario who are working to fully harmonize their offsets approach along with the more general system linkage. Due to the varying stringency and design of policies across jurisdictions, harmonization or linkage might be complicated. Common reporting requirements can be valuable, regardless of whether credits are traded.

The main benefit of allowing offsets to be traded across provincial boundaries is the potential increase in GHG reductions in sectors not covered by GHG regulations. Individual offset project proponents would have access to a broader potential market, thus giving them increased certainty of finding a buyer and reducing the risk of investing in an offset project. Offset project proponents and verification bodies would also benefit from a common set of offset rules and standards across the country.

Harmonizing offset credits across Canada would generally require common standards and processes across jurisdictions. Some jurisdictions may also require harmonized reporting of jurisdictional emissions to avoid double counting of reductions, and/or harmonized policy stringency prior to participating in offset trade. Harmonized criteria and processes would provide assurance to regulatory authorities that each offset generated by a Canadian system represents one tonne of GHG reductions or removals that is real, additional, permanent and verifiable, clearly owned and generated in adherence to approved protocols.

A harmonized offset system could be achieved by an agreement among provinces and territories for common rules and recognition, or by creating a centrally-administered system that would be run by one or more provinces or territories or by the federal government. These protocols should also be based on the best practices laid-out in scientific literature. To be valid in existing provincial or territorial systems, protocols as well as offsets credits mechanisms would need to abide by the definitions and criteria already developed.

In the course of our work, the Working Group heard from a number of businesses about the need to harmonize GHG measurement, reporting and verification requirements across jurisdictions implementing carbon pricing and other GHG reduction requirements in order to ease compliance burden and simplify administration (i.e., by being subject to a common set of measurement, reporting and verification requirements, rather than multiple sets of such requirements). Indeed, harmonizing these requirements would be advantageous for several reasons:

- First, it would assure comparability in the measurement and reporting of tonnes reduced for different carbon pricing and regulatory requirements.
- Second, such harmonization is a prerequisite for the linking of carbon pricing mechanisms across jurisdictions, given that units for a one tonne reduction would be understood to be equivalent, irrespective of the jurisdiction in which the reduction is generated.

- Finally, harmonized GHG measurement and reporting requirements would reduce the administrative burden on regulated entities and verification bodies, since the methodology and work done to measure and report GHG emissions for one jurisdiction could be replicated for purposes of reporting to another jurisdiction. For example, a natural gas distributor that operates in all provinces would be able to apply the same reporting rules, formulae and templates for the purposes of multiple reporting obligations.

This work has to be undertaken with respect of the roles and responsibilities of every jurisdiction, while being closely linked with the best practices at the international level which also aim to have worldwide comparable data.

9 CONCLUSION

The Working Group on Carbon Pricing Mechanisms has examined the role that carbon pricing is playing and could further play in helping Canada meet its GHG emissions targets. On the whole, carbon pricing is one of the more efficient tools available to governments to incent a transition to a low carbon economy, allowing for an increase in the level of ambition in reducing GHGs, promoting clean economic growth, and the possibility for enhanced cooperation among jurisdictions.

Nevertheless, an economic transition may impact parts of the economy and the country differently, so this report examines the potential impact of carbon pricing on households and business, and further considered the particular challenges facing Northern, remote and Indigenous communities. Some options have been described as to how these impacts may be addressed.

The working group has considered different design elements for a pan-Canadian framework for clean growth and climate change, and has identified eight principles for implementing carbon pricing, reflecting the commitments of the Vancouver Declaration. These principles should be key considerations moving forward, recognizing that there is a trade-off to be made between economic efficiency for Canada as a whole, reducing GHG emissions, and maintaining successful systems already in place in respect to roles and responsibilities of the federal, provincial and territorial governments. This is reflected in the three options presented by the group.

The Working Group on Carbon Pricing Mechanisms is pleased to present this report to the Ministers of Finance and the Canadian Council of Ministers of the Environment and trust that it will inform Ministers as they move towards an agreement on, and implementation of, a pan-Canadian framework for clean growth and climate change that will meet or exceed Canada's international GHG emissions targets, favour intergovernmental collaboration and ensure a transition to a stronger, more resilient, low-carbon economy – while also improving Canadians' quality of life.

10 ANNEX 1 – INTERNATIONAL CARBON PRICING MECHANISMS

Table A1: International Cap-and-Trade Systems

Systems	Jurisdictions	Year in Place	Coverage	Allocation
European Union Emissions Trading System	European Union	2005	45% of total emissions	100% auction for electricity production in utilities Some free allowances for heat production and for industrial participants through benchmarking
Swiss Emissions Trading Scheme	Switzerland	2008	10% of total emissions	Free allocation based on industry benchmarks Sectors at risk of carbon leakage receive 100% of the benchmark Other industry sectors receive a linearly decreasing share of free allowances (80% free in 2013, decreasing to 30% in 2020) No free allocation for power sector
California Cap-and-Trade Program	California	2012	85% of total emissions	Auctioning for electricity producers and fossil fuel distributors A portion of allowances, which declines annually, is freely allocated to aluminum, lime, cement, chemical, petrochemical, metallurgy, mining, pelletizing, pulp, paper, petroleum refining sectors
Regional Greenhouse Gas Initiative	North-East and Mid-Atlantic states in the U.S.	2009	20% of total emissions	Auctioning

Source: World Bank, State and Trends of Carbon Pricing 2014

Table A2: International Cap-and-Trade Systems (continued)

Systems	Jurisdictions	Year in Place	Coverage	Allocation
Kazakhstan Emissions Trading Scheme	Kazakhstan	2013	50% of total emissions	Free allocation based on grandfathering of historical emissions for the first three years (2013-2015)
New Zealand Emissions Trading Scheme	New Zealand	2008	50% of total emissions	Auctioning Free allowances provisions for pre-1990 forest landowners completed
Tokyo Cap-and-Trade Program	Tokyo (Japan)	2010	8% of total emissions	Auctioning
Target-Setting Emissions Trading Program in Saitama	Saitama (Japan)	2011		
Kyoto Emissions Trading System	Kyoto (Japan)	2011		
Guandong Pilot Emissions Trading System	Guandong (China)	2013	42% of total emissions	Auctioning
Shanghai Pilot Emissions Trading System	Shanghai (China)	2013	50% of total emissions	
Tianjin Pilot Emissions Trading System	Tianjin (China)	2013	60% of total emissions	
Beijing Pilot Emissions Trading System	Beijing (China)	2013	50% of total emissions	
Shenzhen Pilot Emissions Trading System	Shenzhen (China)	2013	38% of total emissions	
Hubei Pilot Emissions Trading System	Hubei (China)	2014	35% of total emissions	
Republic of Korea Emissions Trading Scheme	Republic of Korea	2015	60% of total emissions	Free allocation via grandfathering for existing facilities and benchmarking used for new entrants

Source: World Bank, State and Trends of Carbon Pricing 2014

Table A3: International Carbon Taxes

Jurisdictions	Year in Place	Coverage	Price
Australia[30]	2012-2014	60% of total emissions	About US$21.54 per tonne of CO_2e in 2013
Denmark	1992	45% of total emissions	About US$31 per tonne of CO_2 in 2014
Finland	1990	15% of total emissions	Heating fuels: €35 per tonne of CO_2 in 2013 Liquid traffic fuels: €60 per tonne of CO_2 in 2013
France[31]	2014	35% of total emissions	€14.5 per tonne in 2015
Iceland	2010	50% of total emissions	US$10 per tonne of CO_2 in 2014
Ireland	2010	40% of total emissions	€20 per tonne of CO_2 in 2014
Japan	2012	70% of total emissions	US$3 per tonne of CO_2 in 2014
Mexico	2014	40% of total emissions	Between US$1 and US$4 per tonne of CO_2 in 2014 (depends on the fuel type and usage)
Norway	1991	50% of total emissions	Between US$4 and US$69 per tonne of CO_2 in 2014 (depends on the fuel type and usage)
Sweden	1991	25% of total emissions	US$168 per tonne of CO_2 in 2014
Switzerland	2008	30% of total emissions	US$68 per tonne of CO_2 in 2014
United Kingdom	2013	25% of total emissions	£9.55 per tonne of CO_2 in 2014

Source: World Bank, State and Trends of Carbon Pricing 2014

30 On July 1, 2012, Australia introduced a cap-and-trade system for facilities that emitted 25,000 tonnes or more of carbon dioxide equivalent annually. The system was designed for a two-stage implementation, beginning with a fixed carbon price applying to units in the first years, then transitioning as of July 1, 2015 into a cap-and-trade system with unit prices to be set by the market. Before July 1, 2015, the system operated largely like a carbon tax on carbon emissions. However, the whole system was repealed effective July 1, 2014 and as such, units were never traded by the market or their amount capped by the government.

31 France's carbon tax, or Contribution Climat-Énergie, consists of a 3-year stage increase in existing taxes on fossil fuels. The first increase in 2014 was €7 per tonne of carbon dioxide equivalent but did not apply to motive fuels and heating oil. The second and third increase of €7.5 in 2015 and 2016 apply to all fuels, with the result that France will argue to have a €22 (about CND$31) carbon tax by 2016.

11 ANNEX 2 – SUMMARY OF PUBLIC SUBMISSIONS

As part of the process to develop a pan-Canadian Framework for Clean Growth and Climate Change, Canadians were invited to share their views on the issues being studied by the four working groups established by First Ministers. A public engagement was launched on April 22, 2016.[32] Submissions were received from a variety of stakeholders, including non-governmental organizations, business groups and academic researchers. However, the vast majority of submissions came from ordinary citizens seeking to play a role in the development of Canada's approach to clean growth and climate change.

Most of the submissions addressed mitigation issues but many submissions still addressed carbon pricing directly or indirectly.

11.1 Carbon Pricing

Overall, participants in the engagement process supported the idea of putting a price on carbon to reduce Canada's GHG emissions.

This said, concerns were raised about the impact of carbon pricing on low- and fixed-income Canadians and the need for carbon pricing to be fair for current and future generations. Equally, some participants questioned whether a carbon price would be sufficient to meaningfully reduce Canada's GHG emissions, suggesting that regulatory instruments should be considered instead. Still other interveners suggested that:

- a carbon tax of $50 per tonne of CO_2 would be damaging to the economy and would be too low to achieve any significant reduction in GHG emissions;
- burning fossil fuels is a necessity to maintain the standard of living of Canadians; and
- Canadians are already paying too many taxes.

Among the majority that supported the use of carbon pricing, there was backing for both a carbon tax and a cap-and-trade emissions allowance system. This said, a larger number of participants in the engagement process expressed a preference for some form of national carbon tax.

11.2 Carbon Tax

Those Canadians supporting a carbon tax suggested that it could:

- be less complex to implement and easier to administer on an ongoing basis, than a cap-and-trade system;
- have a wider scope of application than regulations which may not cover all emissions sources; and,
- be made revenue-neutral as is the case for the carbon tax in British Columbia.

On the issue of the rate of the carbon tax, there were a number of submissions that suggested that it be set at a starting rate of $30 per tonne of GHG emissions and increase over time according to a pre-determined schedule. Several submissions argue for the rate increases to be published in advance to allow purchasers of new products, such as vehicles, to know the expected operating costs of those products over their useful lives. It was also suggested that manufacturers should be required to indicate the amount of carbon emitted in producing and distributing their products as well as the associated carbon tax incurred though the production and distribution process.

32 http://letstalkclimateaction.ca/canada-s-approach-to-climate-change

11.3 Cap-and-Trade System

Those Canadians supporting a cap-and-trade emissions allowance system suggested that it could:

- directly cap Canada's GHG emissions and thus achieve some certainty with respect to the emission-reduction outcome; and,
- benefit from the European Union's experience with its Emissions Trading Scheme.

It was also suggested that the cap-and-trade system be implemented as far upstream as possible in order to capture large GHG emitters while minimizing the number of firms involved in the system. This, it was argued, could lower administrative costs for government and reduce the potential compliance burden for smaller businesses.

11.4 Use of Revenues from Carbon Pricing

A number of participants in the engagement process support using the revenues generated by carbon pricing to reduce other taxes (e.g., personal and corporate income taxes) and be revenue neutral as in British Columbia. Some argue, however, for using part of those revenues to assist low-income households who might be disproportionately impacted by the implementation of carbon pricing policies.

Other suggestions for using carbon pricing revenues include:

- financing "green" infrastructure investments (e.g., public transportation, building retrofits);
- providing financial incentives to consumers and businesses to implement renewable energy and energy efficiency technologies;
- retraining workers to integrate into the new, low-carbon economy; and
- undertaking research on emerging "green" technologies.

As a complement to the generation of revenues though carbon pricing, several submissions also argue for the elimination of subsidies and tax preferences provided to the fossil fuel industry.

11.5 Other Suggestions

It is worth noting that submissions on carbon pricing often included other tax and non-tax proposals for addressing GHG emissions.

Indeed, in general, there seemed to be recognition among participants in the engagement process that adopting a multi-pronged approach, involving a carbon pricing instrument and other policy instruments such as regulation, mitigation policies or elimination of some subsidies, may be needed to achieve green growth and climate change objectives.

12 ANNEX 3 – SUMMARY OF CONSULTATIONS WITH EXPERTS AND STAKEHOLDERS

12.1 Consultations with Invited Experts

The Carbon Pricing Mechanisms Working Group invited a number of experts (see table below) to meet with the working group to discuss issues and considerations related to the role that carbon pricing should play in the pan-Canadian Framework.

Invited Experts	
Stewart Elgie	University of Ottawa, Smart Prosperity
Nancy Olewiler (remote)	Simon Fraser University
Maria Panezi	Centre for International Governance Innovation
Mark Purdon (remote)	Institut québécois du carbone, Université de Montréal
Christopher Ragan	McGill University, Ecofiscal Commission
Nicholas Rivers	University of Ottawa
Dave Sawyer	EnviroEconomics

The experts were asked to consider the following questions:

- What are the most important issues that need to be taken into account when designing carbon pricing policy tools?
- Many factors affect the competitiveness of businesses across jurisdictions. In your opinion, how important a factor is "carbon pricing"? What are the best options to address competitiveness issues associated with carbon pricing?
- In your opinion, which kind of certainty – price or emissions – is most important? What is the appropriate trade-off between these two fundamental design elements?
- How much notice should governments reasonably give consumers and industry on the expected trajectory of a cap or tax rate in order to provide investment certainty?
- What is the most effective use (or mix of uses) of potential carbon pricing revenues? Should the priority be placed on minimizing the economic impacts for businesses and consumers, reducing distortionary taxes, or facilitating further emissions reductions?
- Should there be greater consistency across the different carbon pricing regimes in Canada – with varying coverage, reporting requirements, different GHG reduction targets and carbon prices (or no price nor target at all)? If so, what options are there to act without compromising actions already taken by provinces and territories?
- What role should carbon pricing play in Canadian efforts to reduce GHG emissions and to support a transition to a low-carbon economy compared to other targeted and focused mitigation approaches?

A summary of the main themes are presented below.

Carbon pricing should be a central component in reducing Canada's emissions

The experts generally agreed that, amongst all policy instruments, carbon pricing should play an important role in Canadian efforts to reduce GHG emissions, particularly as it would send a clear and ongoing price signal to reduce emissions.

Some experts argued that regulations can be a useful complementary tool to carbon pricing, while others cautioned against overuse of such measures, as regulations may not send a strong price signal to consumers and they would have little or no incentive to demand less of the regulated products. For example, if a performance standard was adopted for a particular industry, it would only affect the GHG intensity of that industry and the costs may not "trickle down" to consumers.

It was also noted that regulations may not create any incentive to reduce emissions beyond what is required. Further, regulations could actually, in some cases, have a limited, if not negative impact on GHG reductions. It was given as an example that adopting regulations requiring carmakers to manufacture more efficient cars could actually create an incentive to drive more as the result of the car's higher fuel efficiency.

Pricing should be consistent and coverage should be as broad as possible

It was argued that cost-effectiveness should in fact be a main objective in the design of carbon pricing tools. The experts generally agreed that, in theory, the best cost-effectiveness tool for Canada as a whole could be a single national carbon price managed by the federal government for it would guarantee price consistency. It was recognized, however, that many provinces and territories have had climate policies for years, including broad-based pricing mechanisms for British Columbia and Quebec, while Alberta and Ontario will in 2017.

The experts also generally agreed that broad-based carbon mechanisms that cover the largest range of emissions possible could result in effective policies that achieves GHG emission reductions at the lowest possible marginal cost of abatement, while recognizing that carbon tax, cap-and-trade and performance standard might have some different results depending on their design parameters.

It was asserted that a large carbon price on a small portion of the emissions would be far costlier for the economy than a small carbon price on the vast majority of emissions, thus identifying that price cannot be the sole policy consideration and that coverage and GHG reductions also need to be part of the equation in the design of the different tools.

Carbon prices should be predictable and timely

The experts agreed that predictability is a crucial element in the development of carbon pricing tools, and that it may be achieved by communicating clear policy objectives. Some viewed expectations of the carbon price, as well as planned increases in the carbon price, as being one of the most important elements of carbon pricing and that any system must be designed to anchor expectations. It was noted that clear expectations of the price of carbon would promote certainty and would therefore allow private sector investments to react to the future carbon price (e.g., emitters may be more inclined to make investments in cleaner technologies in the short-term if there is a greater level of certainty about future carbon prices in the long-term).

With respect to the trade-off between price and emissions certainty, there was a general consensus that as long as carbon pricing tools are broad-based, maintain marginal cost signals and are designed to efficiently achieve the lowest marginal cost of abatement, a carbon tax or cap-and-trade should have broadly similar effects on the economy.

There was also general agreement that governments should provide information on the expected trajectory of a cap or tax rate with as much notice as possible in order to provide investment certainty. The general consensus was that more time is always better, but that that should not delay the adoption and implementation of a carbon pricing mechanism. In fact, it was noted that the longer governments delay implementation of a carbon pricing tool, the costlier it could be to reach Canada's 2020 and 2030 GHG targets.

Overall, experts believed that implementing a carbon price as soon as possible, even if it were at a low price, is the optimal path forward. They argued that the price could then be ramped up over time and emphasized the importance of establishing a predictable price path that could be adjusted accordingly.

Carbon pricing should recognize competitiveness issues

The experts generally agreed that carbon pricing mechanisms should consider the impact on the competitiveness of businesses across jurisdictions, but that it was important to maintain the marginal cost on carbon emissions. It was noted that some emissions-intensive industries could be particularly impacted if measures are not taken to limit the distortion they may face when competing against foreign companies that may not be subject to the same carbon price signal. The extent to which they may be impacted would be dependent on the price level and their emissions intensity relative to their competitors. It was emphasized, however, that governments should not necessarily presume that there will be negative competitiveness impacts for any particular sector.

While revenue recycling was also proposed as a policy tool, BTAs[33], along with relief for exporters, were touted as important considerations for a carbon pricing strategy across Canada. It was noted that under the WTO, legality will depend on their specific design, though WTO has been sensitive to the environmental goals of its member countries in the past. For that reason, some argued that it would be easier to defend BTAs under a cap-and-trade system for they also directly serve the purpose as an environmental compliance tool to achieve GHG targets.

Nonetheless, BTAs were recognized as being complex and the experts suggested that BTA may not necessarily have to be implemented at the same time as the carbon price and worried that putting too much emphasis on BTAs could delay the adoption of carbon pricing. However, there was concern that providing relief to exporters would reduce the incentive for them to innovate and lower their carbon emissions.

It was also suggested that BTAs could first be adopted on only one or a few goods based on the ease with which it can be adopted as well as the magnitude of the domestic impact. Others disagreed with such an approach, arguing that adopting BTAs for the goods of only one or a few sectors at a time could create inequities between affected industries.

Use of revenues

In terms of the most effective use, or uses, of potential carbon pricing revenues, the general consensus seemed to be that the debate around how best to use the revenues should not be the central focus of carbon pricing.

It was noted that carbon pricing revenues are no different from any other government revenues, and there would be no advantage to earmarking these revenues. There was some concern that making revenue recycling decisions a part of the carbon pricing process would take the discussion away from carbon pricing's core purpose – to reduce GHG emissions.

However, it was also noted that, while the use of revenues is a secondary discussion, committing to revenue neutrality may be a powerful tool to ensure acceptability.

Some experts noted that governments should be careful with their use of carbon pricing revenues to avoid being offside with the WTO. To this end, revenues can be used to provide general tax relief, such as through reductions in corporate income taxes, but they cannot be directed at specific industries, as that may be considered a subsidy by the WTO.

33 During the session with the experts, border tax adjustments were referred to as border carbon adjustments. For consistency with the rest of this report, border tax adjustments is used here.

12.2 Stakeholder Engagement: Key Themes from Carbon Pricing / Mitigation Roundtables

The Working Group on Carbon Pricing Mechanisms, together with the Working Group on Specific Mitigation Opportunities hosted three roundtables with stakeholders and national Indigenous Organizations on June 7 (Montreal), June 8 (Ottawa) and June 21 (Vancouver), 2016. Participants at the roundtable sessions were highly engaged, and brought forward a wide variety of issues, considerations, and ideas. Some of the key messages that emerged from these sessions are summarized below.

- There was broad agreement on the need for ambitious climate change action, but a range of perspectives on priorities and next steps.
- Participants identified opportunities for emissions reductions across all sectors of the economy, and pointed to several cross-cutting enabling conditions – such as investment in clean electricity, inter-jurisdictional transmission grids and vehicle charging infrastructure to prepare for more electric vehicles, updated building codes and adequate access to capital to allow businesses to invest in new technologies.
- There are a number of emerging trends that could be accelerated to drive deeper emissions reductions. These include: urban densification; social innovation and the sharing economy; consideration of financial liabilities and investment risks related to climate change; and, changing business models, such as the move towards a circular economy.
- Individual Canadians can be agents of change. Public outreach and education efforts are needed to make people aware of the impacts of their choices and to build broad support and understanding of the actions being taken. Policies should avoid hidden costs in order to send clear signals to consumers; however, there is also a need to make low-carbon choices convenient and attractive. Governments have a responsibility to lead by example.
- Environmental, economic, and social criteria need to be balanced when evaluating policies. In addition to metrics, such as total costs and emissions reductions (e.g., cost per tonne), other considerations include potential for transformative change, competitiveness impacts, potential for job creation and skills development, social acceptability, and impacts on vulnerable populations. High-quality data and consistent reporting on progress is needed to develop and evaluate policies effectively and to inform data-driven decisions.
- Some key areas of potential partnership with Indigenous people include enhancing carbon sinks, electricity and distributed energy production, particularly in Northern and remote communities.
- Some participants suggested that Canada could consider purchasing internationally transferred mitigation outcomes (ITMOs) to help meets its climate change targets, provided that sufficient investments are also made in achieving domestic emissions reductions. Some participants suggested that there may also be potential for Canada to receive credit for exporting low-carbon technologies, products, or resources.
- Effective climate change policy requires a full suite of tools, including regulations, incentives, elimination of fossil fuel subsidies, outreach and education, and investment in research and development. Carbon pricing is a key tool, but complementary measures are also needed to reach emissions that are not effectively addressed through pricing. Rather than being prescriptive, governments should focus on achieving emissions reduction outcomes.
- When designing climate policies, governments can either choose to use carbon pricing as the main driver for GHG reduction (high carbon price, few complementary measures) or decide to rely on a wider array of measures (low carbon price, multiple complementary measures).
- There was broad agreement on: the need for a carbon price that is high enough and that increases over time to change behavior without decreasing public support; the importance of price foreseeability for business; the need to consider carbon leakage if Canada's prices are too high; the value of learning from international

experiences with different carbon pricing approaches; and, ultimately the need for the carbon pricing mechanism to deliver real emission reductions.

- Competitiveness needs to be carefully considered, both in terms of impacts of new costs on industry, as well as steps industry can take to enhance its competitiveness in a carbon-constrained world. Emissions-Intensive and Trade-Exposed sectors should be clearly defined and regularly reviewed.
- There is a need for policy coherence, including between carbon pricing and other mitigation policies, and between policies developed by different orders of government (federal, provincial, territorial). A patchwork of systems across the country can be difficult for business but can co-exist and might be a good way to evaluate down the road what would work best to achieve real GHG reductions. Identifying and addressing unintended barriers or areas of overlap between policies is a key challenge.
- A collection of approaches, including infrastructure spending, regulations, and carbon pricing are needed to achieve step changes, such as a transition to low-carbon fuels.

IN THE MATTER OF A REFERENCE to the Court of Appeal pursuant to section 8 of the *Courts of Justice Act*, RSO 1990, c. C.34, by Order-in-Council 1014/2018 respecting the constitutionality of the *Greenhouse Gas Pollution Pricing Act*, Part 5 of the *Budget Implementation Act, 2018, No. 1,* SC 2018, c. 12

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