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Sustainable Energy Solutions

Future Financial Liability for Greenhouse Gas Emissions from New Large Industrial Facilities in Canada

1st Edition: October 2005

Matthew Bramley

REPORT

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Future Financial Liability for Greenhouse Gas Emissions from New Large Industrial Facilities in Canada

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0. Abstract

- This paper will assess the future financial liability that could plausibly accrue to the owners or operators of new large industrial facilities in Canada as a result of the regulation of the greenhouse gas (GHG) emissions of such facilities during their expected operational life, which is typically at least 25 years and commonly much longer.
- It is argued that such facilities will very likely be subject to a regulated GHG emissions targets-and-trading system for decades to come, in light of (i) the implementation and/or anticipated implementation of such systems not only in Canada but also in the European Union, the United States and elsewhere; and (ii) fundamental international drivers of increasingly severe legal limits on GHG emissions, notably strong scientific concern.
- By considering the need to stabilize atmospheric GHG concentrations, commitments already being made by some industrialized-country governments and the views of business organizations, it is further argued that over the next 50 years, national emissions targets are likely to become increasingly stringent, that free allocations of emission rights to industrial emitters will correspondingly fall, and that GHG prices, i.e., prices of tradeable GHG emission units, are likely to rise.
- Accordingly, six plausible scenarios are constructed for allocations of emission rights to new large industrial facilities in Canada and GHG prices between 2008 and 2057, and the resulting financial liabilities are calculated. The results show that the liabilities are potentially very large, and that when evaluating them it is essential to focus on the post-2012 period up to the full extent of a facility's expected operational life.
- For oil sands extraction and upgrading, liabilities[1] rise over time to $3.90 per barrel in modest-price scenarios and to $11.70 per barrel in high-price scenarios. For electricity generation, liabilities rise over time to 4.9 ¢/kWh (coal-fired) or 2.4 ¢/kWh (gas-fired) in modest-price scenarios and to 14.8 ¢/kWh (coal-fired) or $7.2 ¢/kWh (gas-fired) in high-price scenarios.
- Even if governments remove liabilities from industry, these liabilities will simply be transferred to governments (i.e., taxpayers) or to other economic sectors, assuming that Canada remains bound by the levels of national emissions targets that underlie the scenarios. In other words, national financial liability arises from national emissions targets; the share of that liability assigned to industrial GHG emitters is ultimately a secondary issue.

1. Purpose of this paper

This paper will assess the future financial liability that could plausibly accrue to the owners or operators of new large industrial facilities in Canada as a result of the regulation of the greenhouse gas (GHG) emissions of such facilities during their expected operational life, which is typically at least 25 years and commonly much longer. This assessment is made in the context of

- international action to address climate change;
- the Government of Canada's participation in such international action; and
- provincial/territorial governments' climate change policies.

[1] In constant 2010 dollars.

The financial liability stems from the expected imposition by governments of legal limits on large industrial facilities' GHG emissions, combined with emissions trading. Such limits are expected to start to apply in Canada in 2008. While their severity during subsequent decades is uncertain, this paper argues that they are likely to become increasingly severe, translating into an increasing financial liability to the owners or operators of these facilities.

This paper has been written with the fossil-fuelled electricity generation, oil sands extraction and upgrading, and natural gas transmission sectors particularly in mind, but it also applies to other heavy industry sectors. In all cases, it is assumed that the facilities in question do not fall below size thresholds that governments may use to exclude smaller facilities from legal limits on GHG emissions.

All dollar amounts in this paper are in Canadian dollars unless otherwise specified. They have not been adjusted for inflation except where it is specified that constant dollars are used.

2. Drivers of increasingly severe GHG emission limits

There are three fundamental international drivers of increasingly severe legal limits on GHG emissions over the long term, elaborated in the following subsections:

- strong scientific concern;
- a global political consensus and legal framework for action; and
- the development of legally binding instruments, starting with the Kyoto Protocol.

2.1 Scientific concern

National governments, in partnership with the professional scientific community, formed the Intergovernmental Panel on Climate Change (IPCC) to advise them on the scientific basis, past and projected future impacts, and means of adapting to and mitigating (i.e., preventing)[2] global climate change caused by GHG emissions from human activities. The formal reports of the IPCC beginning in 1990 show that

- a large and steadily accumulating body of scientific evidence has resulted in increasing and now high confidence that GHG emissions from human activities are now the dominant cause of global climate change;[3] and
- this climate change, if allowed to proceed unchecked, will have profound adverse impacts on people, economies and ecosystems worldwide by the end of this century.[4]

Review of the scholarly scientific literature[5] and public statements by numerous professional scientific societies indicate that the vast majority of professional climate scientists concur with the IPCC position. The resulting concern is now being clearly articulated by the most authoritative and broadly based scientific institutions. In June 2005, the national science academies of all the G8 countries (including Canada and the United States) plus China, India and Brazil stated: "… there is now strong evidence that significant global warming is occurring. … It

[2] In climate change discussions, "mitigation" means reduction of GHG emissions or enhancement of GHG "sinks" that absorb carbon dioxide from the atmosphere.

[3] See especially Intergovernmental Panel on Climate Change. 2001. *Summary for Policymakers — A Report of Working Group I of the Intergovernmental Panel on Climate Change*; http://www.ipcc.ch/pub/reports.htm.

[4] See especially Intergovernmental Panel on Climate Change. 2001. *Summary for Policymakers — Climate Change 2001: Impacts, Adaptation and Vulnerability*; http://www.ipcc.ch/pub/reports.htm.

[5] See, for example, Oreskes, N. "The Scientific Consensus on Climate Change," *Science* vol. 306, December 3, 2004, p.1686.

is likely that most of the warming in recent decades can be attributed to human activities. … The scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action. It is vital that all nations identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions."[6]

It should be stressed that this scientific concern has been deepening and broadening steadily for more than 15 years. In other words, as research results have accumulated, confidence that GHG emissions from "business-as-usual" scenarios of human activities will cause major damage worldwide this century has been steadily increasing. Expression of that confidence, which has now reached a high level, has been coming from an increasingly numerous, authoritative and broad-based set of scientific institutions. It therefore seems very unlikely that this concern will disappear or even decline in the coming decades.

2.2 Global political consensus and legal framework for action

One hundred and eighty-eight countries (including Canada and the United States) — virtually the entire international community — have ratified the United Nations Framework Convention on Climate Change (UNFCCC), which entered into legal force in March 1994.[7] The UNFCCC's "ultimate objective" is "to achieve … stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[8] The IPCC has shown that to stabilize GHG *concentrations* in the atmosphere at any level, it will be necessary to reduce global GHG *emissions* from human activities to a small fraction of their current level; and that the longer it takes to achieve those reductions, the higher the level at which GHG concentrations will stabilize.[9,10] The higher the stabilization level, the more global warming and the larger the likely environmental impacts.

Delays in reducing emissions by only a few years will dramatically increase the rate of emission reduction needed later on to achieve a given target for stabilizing GHG concentrations.[11] As a result, practicable trajectories of global annual emissions over time, calculated to result in stabilization of atmospheric concentrations at low enough levels and quickly enough to avoid the most damaging environmental impacts, tend to depart significantly from "business-as-usual" emissions trajectories around 2010–20.[12] The urgency of initiating major emission reductions immediately is a theme that has now emerged strongly in the professional climate science community. The national science academies, in their statement cited in Section 2.1, noted: "Failure to implement significant reductions in net greenhouse gas emissions now will make the job much harder in the future."

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[6] The Royal Society. 2005. *Joint science academies' statement: Global response to climate change;* http://www.royalsoc.ac.uk/document.asp?id=3222.

[7] See http://unfccc.int/essential_background/convention/status_of_ratification/items/2631.php.

[8] Article 2; see http://unfccc.int/essential_background/convention/background/items/1349.php.

[9] Intergovernmental Panel on Climate Change. 2001. *Climate Change 2001: Synthesis Report*, p.90; http://www.ipcc.ch/pub/syreng.htm.

[10] Intergovernmental Panel on Climate Change. 2001. *Climate Change 2001 — The Scientific Basis*, Technical Summary, p.75–76. Available at http://www.ipcc.ch/pub/wg1TARtechsum.pdf.

[11] See, for example, *Avoiding Dangerous Climate Change, International Symposium on the Stabilisation of greenhouse gas concentrations, Hadley Centre, Met Office, Exeter, UK, 1-3 February 2005, Report of the International Scientific Steering Committee*, p.7; http://www.stabilisation2005.com/Steering_Commitee_Report.pdf.

[12] See, for example, World Business Council for Sustainable Development. 2004. *Facts and trends to 2050 — Energy and Climate Change*, p.5; http://www.wbcsd.ch/web/publications/Basic-Facts-Trends-2050.pdf.

A few governments continue on occasion to raise doubts about the legitimacy of the scientific concern described above; this has most notably been true of the current United States administration. However, shortly before the July 2005 G8 Summit, President George W. Bush made this statement: "I recognize that the surface of the earth is warmer and that an increase in greenhouse gases caused by humans is contributing to the problem."[13] In the subsequent G8 Gleneagles Communiqué, the United States administration "reaffirm[ed] our commitment to the UNFCCC and to its ultimate objective to stabilise greenhouse gas concentrations … We reaffirm the importance of the work of the Intergovernmental Panel on Climate Change…"[14]

In summary, it can be said that the UNFCCC represents a global consensus, more than a decade old, that deep, sustained cuts in global GHG emissions are needed.

2.3 Legally binding instruments

While the UNFCCC provides a legal framework for global action to cut GHG emissions, it does not legally require emission reductions except in the most general way. The Parties to the UNFCCC (i.e., the countries that had ratified it) therefore agreed, in a 1995 decision known as the "Berlin Mandate," on the need for "a protocol or another legal instrument" that would "set quantified limitation and reduction objectives within specified time-frames, such as 2005, 2010 and 2020," for the GHG emissions of industrialized countries.[15]

The result was the negotiation, in December 1997, of the first such instrument, the Kyoto Protocol to the UNFCCC. The protocol is akin to a detailed regulation adopted under a general law (the UNFCCC). The protocol sets national GHG emissions targets for the "commitment period" 2008–12 for industrialized countries including Canada. Canada ratified the protocol in December 2002, thereby agreeing to be legally bound to meet its target of reducing its GHG emissions, net of credits for forestry and agricultural "sinks"[16] and purchases of international emission credits, to 6% below the 1990 level during 2008–2012. The protocol entered into force as international law on February 16, 2005.

Two of the countries for which the protocol sets emissions targets, the United States and Australia, have refused to ratify the protocol (despite having both previously signed[17] it) and thereby be legally bound to meet their targets. Indeed, the current United States administration has made clear that it has no intention of meeting its Kyoto target. This significantly reduces the effectiveness of the Kyoto Protocol given that the United States accounted for 29% of industrialized countries' GHG emissions in 2002.[18]

The Kyoto Protocol represents only a small first step towards the UNFCCC's ultimate objective of stabilizing atmospheric GHG concentrations at a level that would prevent dangerous human interference with the climate. The protocol requires only relatively small emission reductions, does not limit emissions beyond 2012, and limits the emissions of industrialized countries only. A series either of amendments to the protocol or successor treaties, setting increasingly severe

[13] This statement was widely reported and is quoted on the websites of several news organizations.

[14] Paragraph 4; see http://www.g8.utoronto.ca/summit/2005gleneagles/communique.pdf.

[15] See http://unfccc.int/resource/docs/cop1/07a01.pdf#page=4.

[16] "Sinks" are biological processes that absorb carbon dioxide from the atmosphere, notably in forests and soils.

[17] Signature of a treaty signals an intention to ratify.

[18] This figure was calculated from the database available at http://ghg.unfccc.int/default.htf. Data for 2001 was used for Poland, and for 1999 for Russia and Liechtenstein.

emissions targets for an increasing number of countries, will be needed over several decades post-2012 to reach the UNFCCC's ultimate objective. The Kyoto Protocol itself foresees such amendments and requires the Parties to "initiate the consideration of" post-2012 targets by the end of 2005 at the latest.[19] This implies that such "consideration" must begin at the United Nations Climate Change Conference to be held in Montreal from November 28 to December 9, 2005.

3. Adoption of regulated GHG emissions targets-and-trading systems for large industry

Section 2 summarized the fundamental drivers of increasingly severe legal limits on GHG emissions at the national level. How are such limits likely to be expressed at the level of large industrial facilities within countries?

The answer is that governments throughout the industrialized world are settling on regulated emissions targets-and-trading systems[20] as the method of choice to limit GHG emissions from large industrial facilities. Under these systems, industrial facilities are subject to mandatory emissions targets that can be met by combining on-site emission reductions with purchases of tradeable emission rights or units, variously referred to as permits, allowances, credits or offsets.[21] A facility whose emissions are reduced beyond its target generally earns a commensurate amount of emission units that it can sell.[22] In many systems, emission units can also be earned by emission reduction projects undertaken outside the industrial sectors that are subject to mandatory targets; such units can then be purchased by companies subject to targets. Emission units are generally denominated in tonnes of carbon dioxide or carbon dioxide equivalent (CO_2e).[23]

Under these systems, the portion of an industrial facility's emissions that is in excess of its target represents a financial liability, because, to be in legal compliance with the system, the facility must purchase emission units equal to that excess portion. The liability is equal to the amount of tonnes of emissions in excess of the target, multiplied by the price per tonne of the tradeable units. The price is set by the market, although in some cases governments may set a ceiling price by offering additional units at that price.

There are several key reasons why governments tend to prefer regulated emissions targets-and-trading systems, as opposed to some other means, to address GHG emissions from large industrial facilities:

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[19] Article 3.9; see http://unfccc.int/essential_background/kyoto_protocol/items/1678.php.

[20] A subset of such systems are the commonly referred-to "cap-and-trade" systems.

[21] Generally, tradeable units are rights to release emissions on a one-time basis. A company owning or operating a facility that is expected to release more emissions than its target for a number of years will therefore need to have at its disposal a stream of units over time.

[22] Regulated emissions targets-and-trading systems generally impose targets not at the company level, but at the facility level, or possibly the sub-facility level for facilities that involve more than one distinct activity. This is, notably, the case for the systems for GHG emissions proposed in Canada (Section 3.1) and those that have been implemented in the European Union (Section 3.2) and the United States (Section 3.3). It is, of course, possible for a company that owns or operates several facilities to transfer tradeable emission units internally. For instance, a company might use surplus units, earned by a first facility whose emissions had been reduced beyond its target, to meet the target of a second facility whose emissions remained above its target. However, the targets remain facility-level targets that must be met for each facility. See also the discussion in Section 5.3.2.

[23] Carbon dioxide equivalent is a summation of emissions of multiple GHGs converted into units of carbon dioxide by multiplying the amount of each gas by its "global warming potential," which measures the strength with which a gas contributes towards the greenhouse effect.

- Regulated targets provide governments with certainty about the level of emissions from sources that commonly represent close to 50% of national emissions. This certainty is desirable in the context of a requirement to meet a national emission target.
- Emissions trading maximizes economic efficiency and minimizes costs for industry, by encouraging emission reductions to occur only where they can be achieved least expensively.
- These systems allow industry great flexibility in deciding how to meet targets. Both this and the previous point facilitate acceptance by industry.
- In choosing the level at which to set the targets, governments retain full flexibility in the amount of responsibility for emission reduction and associated costs that are allocated to industry sectors.
- Emissions trading for GHGs is easily justified by the fact environmental impacts of GHGs (which are global) are unrelated to the locations where they are emitted.
- The Kyoto Protocol itself has created a global GHG emissions targets-and-trading system, in which countries are allowed to use three international emissions trading mechanisms to meet their national targets.

Beyond these theoretical reasons why governments tend to prefer regulated emissions targets-and-trading systems over other means of addressing GHG emissions from large industrial facilities, the following subsections elaborate six lines of evidence, drawn from the actions of governments and business to date, that support the strong likelihood that large industrial facilities in Canada will be subject to a regulated GHG emissions targets-and-trading system for decades to come, as the Government of Canada responds to the three fundamental drivers of increasingly severe legal limits on GHG emissions identified in Section 2. In short form, these lines of evidence are as follows:

- The Government of Canada has formally announced its intent to use existing legislation to implement such a system beginning in 2008, with a view to it remaining in place indefinitely, and it seems unlikely that provincial governments have the ability or intent to stand in the way.
- The European Union has already begun operating a regulated GHG emissions targets-and-trading system covering more than 11,000 industrial facilities in 25 countries, with a view to it remaining in place indefinitely. This initiative by the majority of the other industrialized countries that have ratified the Kyoto Protocol can be expected to have a significant influence on Canada.
- In the United States, 4 states have already enacted regulated GHG emissions targets-and-trading systems, several others are seriously considering doing so, and 15 states have formally challenged the federal government to do so. There is also now in Congress strong interest in and support for legislation to implement nationally regulated GHG emissions targets and trading. The close integration and unequal size of the economies of Canada and the United States means that choices made in the United States are highly influential on Canada.
- Regulated GHG emissions targets-and-trading systems have also begun operating in Australia and Norway, and are under serious consideration in Switzerland, Japan and possibly Russia.
- There is now broad recognition in the business community that regulated GHG emissions targets-and-trading systems are a long-term reality for them. Several major GHG-emitting companies, including some in the United States, have gone so far as to publicly

support the establishment and/or long-term continuation of regulated GHG emissions targets-and-trading systems. Almost half of United States utilities surveyed in early 2004 expected Congress to enact mandatory regulation of CO_2 emissions within five years.

- There is now also a broad-based recognition within the investment community that climate change, and regulated limits on GHG emissions in particular, represent a serious financial risk for companies and those investing in them.

The six lines of evidence presented below will also serve as the basis for assessing, in Sections 4 and 5, the likely evolution of Canada's regulated GHG emissions targets-and-trading system for large industrial facilities post-2012.

3.1 The Government of Canada's plans for Large Final Emitters

The Government of Canada has been preparing a regulated GHG emissions targets-and-trading system for large industrial facilities since the end of 2002, following the publication of the *Climate Change Plan for Canada* (November 2002), according to which nine energy-intense sectors[24] would be subject to "targets for emissions reductions established through covenants with a regulatory or financial backstop," combined with emissions trading.[25] Throughout 2003 and 2004, Natural Resources Canada published some 30 discussion papers elaborating the details of what it came to refer to as the "Large Final Emitters" (LFE) system, including proposals for new legislation to authorize the setting of GHG targets in regulations.[26] Natural Resources Canada also engaged in detailed analysis and extensive discussion with industry sector associations and, in the case of electricity generation, with provincial governments, as to the numerical value of targets. Natural Resources Canada published proposed targets only for electricity generation and not for any other sector.

In April 2005, the government replaced the *Climate Change Plan for Canada* by a new plan, *Moving Forward on Climate Change — A Plan for Honouring Our Kyoto Commitment.* The 2005 plan also includes an LFE system that implicitly covers the same sectors as before but no longer follows all the details previously elaborated by Natural Resources Canada. Environment Canada is now in charge of implementing the system and on July 16, 2005 published in the Canada Gazette Part I[27] a *Notice of intent to regulate greenhouse gas emissions by Large Final Emitters*. According to the 2005 plan[28] and notice of intent, the system will have the following key features, "with detailed implementation … to be carried out in partnership with provinces, territories, Aboriginal peoples, industry and environmental groups." In what follows, unattributed quotes are from the 2005 plan; the notice of intent is cited only where it provides additional or significantly different information.

- An LFE regulation or regulations will set sectoral targets, beginning in 2008, in terms of GHG emissions intensity (emissions per unit of production). "It is expected that the draft

[24] "Thermal electricity generation (coal, oil and gas), oil and gas (upstream extraction, oil and gas pipelines, gas utilities, petroleum refining), mining (both metal and non-metal), pulp and paper production, chemical production (industrial inorganic chemicals, industrial organic chemicals and chemical fertilizers and fertilizer materials), iron and steel production, smelting and refining, cement and lime production, glass and glass container production."

[25] Government of Canada. 2002. *Climate Change Plan for Canada*, p.29–32; http://www.climatechange.gc.ca/english/publications/plan_for_canada/plan/.

[26] The discussion papers are not publicly available at the time of writing. They can be obtained from the author on request.

[27] P.2489.

[28] Government of Canada. 2005. *Moving Forward on Climate Change — A Plan for Honouring Our Kyoto Commitment*, p.14–18, 40–41; http://www.climatechange.gc.ca/kyoto_commitments/.

LFE regulation will be published for public review and comment in fall 2005." (plan) "Elements of the proposed regulatory framework could be published in fall 2005. … It is envisaged that at least part of the regulatory package would be recommended no later than early 2006 for publication in the Canada Gazette, Part I …" (notice)

- The government's "preferred option" and "working assumption" for legislation authorizing the LFE regulation is the Canadian Environmental Protection Act, 1999 (CEPA), which requires that "GHGs must first be added to the list of substances in Schedule 1 to the Act."[29] The government will "make maximum possible use" of equivalency agreements under CEPA, allowing provincial/territorial legislation to replace CEPA in enforcing the LFE system when it "delivers the performance of the national LFE regulation."
- Targets will be set for existing facilities during 2008–12 at 15% below projected business-as-usual (BAU) emissions intensity for all emissions except "fixed process emissions" (those for which there is no technical way of changing the emissions intensity), for which targets will be set at BAU levels. Further adjustments will then be made to ensure that no sectoral target is set at more than 12% below BAU levels.
- Targets for new facilities and "facilities undergoing major transformations" will be "based on" (which we understand to mean "set at the level of") "best available technology economically achievable" (BATEA), although the interpretation to be given to this term has not yet been specified. The date of first production after which a facility will be considered "new" has not yet been decided, although the notice of intent mentions as possible years 2000 and 2002 (Canada's ratification of the Kyoto Protocol). It has also not yet been decided for how long a facility will be considered "new," although the 2005 plan refers to the government's previous commitment that targets for new facilities "will be locked in for up to ten years from first production," while according to the notice of intent "it is proposed that BATEA-based targets be made applicable for at least 10 years."
- Companies will be able to combine five options for meeting targets applying to their facilities:
    - in-house emission reductions;
    - purchase of emission units earned by LFE companies whose facilities have surpassed their targets;
    - purchase of "domestic offset credits" earned by emission reduction projects in Canada that fall outside the LFE system;[30]
    - purchase of international units recognized under the emissions trading mechanisms of the Kyoto Protocol; and
    - payments into a Technology Investment Fund (created by Bill C-43, passed by the House of Commons in June 2005) or other "qualifying technology investment vehicle" (notice), up to a maximum of nine megatonnes CO_2e for all LFE companies combined.
- The government will implement mechanisms to limit the cost of compliance to $15/tonne CO_2e. For instance, payments into the Technology Investment Fund will be capped at this

[29] On September 3, 2005, Environment Canada published in the Canada Gazette Part I (p.2870) a draft order to add GHGs to Schedule 1 to CEPA.

[30] The government is proposing, inter alia, that: "Electricity saving, non-emitting energy production and non-LFE cogeneration projects that result in indirect emission reductions from fossil fuel electricity production are eligible to create offset credits." See Government of Canada. 2005. *Offset System for Greenhouse Gases Technical Background Document*, p.32; http://www.climatechange.gc.ca/english/publications/offset_gg_tech/.

price. However, according to the notice of intent, the penalty for non-compliance could be set at $200/tonne.

- Targets for post-2012 will be set after consultations, but "possible criteria that could be used to determine specific longer-term targets include:
  - the most current scientific evidence;
  - consistency with long-term climate change objectives and energy policy;
  - [the] aim to make Canadian industry best-in-class;
  - Canada's international obligations; and
  - recognition of sectoral capabilities, relative compliance costs and other competitiveness considerations." (notice)

The financial liability to LFE companies resulting from this system depends on the market price of emission units as well as on the targets. Between January 2004 and April 2005 inclusive, the prices paid for the two types of international emission units recognized under the Kyoto Protocol (and under Canada's proposed LFE system) for which there is significant forward trading activity — CERs[31] and ERUs[32] — were respectively in the range of $3.75 to $8.93 per tonne CO_2e (weighted average $7.04) and $5.71 to $9.00 (weighted average $7.55).[33,34] Average prices were slightly lower for units where the buyer assumes the risk that the units not be issued.[35] In July 2005, CER prices were reported to be in the range of about $8.82 to $14.70.[36,37] Many factors could influence future prices up to 2012, although a common belief is that they will tend to rise with the approach of the Kyoto deadline. Post-2012 prices will be discussed in Section 4.3.

There appears to be a high likelihood that the government will implement the LFE system very much as planned, given

- the entry into force of the Kyoto Protocol;
- the clarity and formality with which the government has expressed its plans as detailed above;
- the decision to use existing legislation to underpin the system; and
- the significant concessions already made to industry (notably, the use of emissions intensity targets, the modest level of the targets, the Technology Investment Fund and the $15/tonne price ceiling).

The biggest threat to implementation would appear to be the formation of a Conservative government following the federal election expected in 2006, as the Conservative Party of Canada has given many indications that it is opposed to the Kyoto Protocol and to the regulation of

[31] Certified Emission Reductions.

[32] Emission Reduction Units.

[33] Lecocq, F. and K. Capoor. 2005. *State and Trends of the Carbon Market 2005*, p. 27. Washington D.C.: World Bank; http://carbonfinance.org/docs/CarbonMarketStudy2005.pdf.

[34] The prices cited in the source document are as follows. CERs: $US3.00 to $US7.15 (weighted average $US5.63). ERUs: $US4.57 to $US7.20 (weighted average $US6.04). These prices have been converted to Canadian dollars using an exchange rate of $US1=$1.25.

[35] The prices cited are for forward trading, i.e., trading of units that have not yet actually been issued. Units are only issued when projects have been registered and emission reductions have occurred. There are therefore various risks that could result in units not being issued.

[36] Consultants call for bigger bundles of small-scale CDM projects. *Carbon Finance*, July 2005; http://www.carbon-financeonline.com/issue/19/story/676.html (subscription required).

[37] The prices cited in the source document are €6 to €8. These prices have been converted to Canadian dollars using an exchange rate of €1=$1.47.

GHGs. However, the Conservative position can be expected to change at some point in response to the international drivers discussed in Section 2 and the significant moves to implement regulated GHG emissions targets-and-trading systems in the United States (Section 3.3).

3.1.1 Provincial/territorial government policies and attitudes

Although the federal government strongly believes that it has clear constitutional authority to implement the LFE system, it is relevant to take account of provincial/territorial government policies and attitudes to the establishment of a national regulated GHG emissions targets-and-trading system in Canada. This is especially so since the recent *Notice of intent to regulate greenhouse gas emissions by Large Final Emitters* stated that "partnership between the federal government and provinces and territories on (a) the broad policy outcomes and objectives of the LFE system; (b) the detailed design of the system …; and (c) longer-term LFE targets (beyond 2012)" is one of the "key elements of the proposed regulatory approach."

Provincial/territorial governments have generally been strongly in favour of developing GHG emissions trading:

- The governments of Alberta, British Columbia, Manitoba, Nova Scotia, Québec and Saskatchewan were members of the Greenhouse Gas Emission Reduction Trading (GERT) Pilot (1998–2002),[38] while the Ontario government was an active partner in the Pilot Emission Reduction Trading (PERT) Project (1996–2000).[39]
- The Alberta government's climate change action plan (October 2002)[40] and Climate Change and Emissions Management Act (CCEMA, in force since November 2004)[41] both provide for negotiated agreements regarding GHG emissions with key sectors, notably industry sectors, and for the use of emissions trading to fulfill the sectoral agreements. In the summer of 2005, the Alberta government began informal consultations on a new regulation under the CCEMA that appears designed to enforce the LFE system for the purposes of concluding an equivalency agreement with the federal government under CEPA.
- Provincially owned BC Hydro intends to use GHG offsets (i.e., emissions trading) to meet its "no net incremental environmental impact" objective.[42]
- Provincially owned Ontario Power Generation previously purchased very large quantities of offsets to meet its voluntary GHG emission targets.[43]
- In 2001, Québec modified its main environmental statute to authorize the use of tradeable emission units to achieve environmental objectives.[44]
- In the same year the Conference of New England Governors and Eastern Canadian Premiers (of Québec and the four Atlantic provinces) adopted a recommendation to

[38] See http://www.gert.org.

[39] See http://www.cleanaircanada.org/bghistory.htm.

[40] Government of Alberta. 2002. *Albertans & Climate Change: Taking Action*; http://www3.gov.ab.ca/env/climate/plan.html.

[41] See http://www.qp.gov.ab.ca/documents/Acts/C16P7.cfm?frm_isbn=0779733363.

[42] BC Hydro. 2004. Greenhouse Gas Report 2004, p.2,5; http://www.bchydro.com/environment/reports/reports1776.html.

[43] Bramley, M. 2002. *The Case for Kyoto: The Failure of Voluntary Corporate Action*, p.20. Drayton Valley: Pembina Institute; http://www.pembina.org/publications_item.asp?id=140.

[44] Bill 25, 36th legislature; http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=5&file=2001C59F.PDF.

"develop [a GHG] Emissions Trading Registry, and methods for baseline creation and credit generation."[45]

- In 2004, a Task Force on Emissions Trading established by the Government of Manitoba provided an enthusiastic endorsement of GHG emissions trading and recommended that Canada's LFE system start up in 2006 instead of 2008.[46]

Some provincial governments, most notably Alberta's, have long been opposed to the Kyoto Protocol and may, as a result, want to weaken the LFE system targets. Other provincial governments, notably Québec's, have consistently supported the Kyoto Protocol but may want to contest the LFE system targets on the grounds that they do not treat certain industry sectors fairly. Whether provincial/territorial governments will have any scope to vary particular sectors' LFE targets within their jurisdictions while meeting the federal government's requirement that equivalency agreements "deliver the performance of the national LFE regulation" (see above) will depend on whether that requirement is interpreted on a sector-by-sector or jurisdictional basis. At the time of writing, this is unclear, with no guidance provided by the federal notice of intent. Natural Resources Canada, when it was still leading the development of the LFE system in 2004, floated the possibility of different LFE targets for electricity generation in different provinces.[47] Now that "best available technology economically achievable" (BATEA) is to be the basis for setting targets for new facilities, it is questionable whether a reasonable case can be made that BATEA varies from one province to another.

3.1.2 Application to electricity generation

At the time of writing it is unclear how targets will be set for new fossil-fuelled electricity generation facilities, except that they will be at BATEA levels. It seems quite likely that BATEA will be interpreted as a combined cycle natural gas turbine, since this is generally regarded as current best practice in fossil-fuelled electricity generation. Another possibility is to set different BATEA targets for coal-, gas- and oil-fired facilities, although this would represent a departure from Natural Resources Canada's previous approach of setting a single target irrespective of fuel. Natural Resources Canada's proposed targets for electricity generation, published in 2003,[48] likely give little indication of the targets that Environment Canada will now set.

3.1.3 Application to oil sands

At the time of writing it is unclear how targets will be set for new oil sands facilities, except that they will be at BATEA levels. It is quite unclear how BATEA will be interpreted, although it is predictable that industry and the Government of Alberta will argue that new facilities themselves represent BATEA.

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[45] The Committee on the Environment and the Northeast International Committee on Energy of the Conference of New England Governors and Eastern Canadian Premiers. 2001. *Climate Change Action Plan 2001*, Recommendation 33. http://www.negc.org/documents/NEG-ECP%20CCAP.PDF.

[46] International Institute for Sustainable Development. 2004. *Realizing Opportunities: Emissions Trading in Manitoba*, p.15; http://www.iisd.org/publications/pub.aspx?pno=605.

[47] Natural Resources Canada. 2004. *Allocation of Greenhouse Gas Emission Reductions in the Electricity Sector* (presentation at Federal/Provincial/Territorial Meeting, Toronto, November 20, 2003).

[48] *Ibid.*

3.1.4 Application to natural gas transmission

At the time of writing it is unclear how targets will be set for new natural gas pipelines, except that they will be at BATEA levels. It is quite unclear how BATEA will be interpreted, although it is predictable that industry will argue that new facilities themselves represent BATEA. It is also unclear to what extent fugitive emissions (leaks of methane), which are significant for this sector relative to emissions from fuel combustion, will be covered by targets. If fugitive emissions can be reasonably reliably quantified, it will be difficult to justify their exclusion.

3.2 The European Union's emissions trading scheme

The European Union (EU) and its member states have become the world's leaders in the implementation of regulated GHG emissions targets and trading. The EU Greenhouse Gas Emissions Trading Scheme (ETS), which began operation on January 1, 2005, enforces GHG targets for more than 11,000[49] industrial facilities throughout the 25 EU member states and by July 2005 was regularly seeing half a million allowances (emission units worth one tonne CO_2e each) traded in a day.[50] Based on two EU Directives (2003/87/EC and 2004/101/EC) that each member state must translate into national law, the ETS includes the following key features:[51]

- In Phase I, from 2005–07, emissions (not emissions intensity) targets for CO_2 (but no other GHGs) apply to all combustion facilities (including fossil-fuelled electricity generation but also many other industry sectors) exceeding 20 megawatts (MW), all oil refineries, coke ovens, metal ore roasting or sintering facilities and pulp mills, and, with size thresholds, facilities for the production of iron and steel, cement, lime, glass, ceramics and paper/board. In Phase II, from 2008–12, it is possible that additional industry sectors and additional GHGs may be added, although the European Commission recently cast doubt on whether this is feasible.[52] After 2012, the ETS will continue in an unlimited series of five-year phases.
- Targets are set at the facility level by each national government in a "national allocation plan" for each phase. In Phase I, targets have been set in total at about 70 to 110 Mt, or 3.5 to 5.5%,[53] below the BAU level. National allocation plans generally provide for targets to be set for new facilities (i.e., those beginning operations after the national plan has been finalized) by setting aside a "new entrant reserve" of allowances, but new facility targets can vary greatly from one country to another.[54] Targets for Phase II are not yet known; they will be set in national allocation plans that must be submitted by June 30, 2006. Phase II targets can be expected to be significantly tougher than Phase I targets, at least in those countries that are far from their national Kyoto targets, because facility-level targets in the ETS are required to be consistent with national Kyoto targets.

[49] Record EU ETS prices, NAPs saga continues. *Carbon Finance*, July 2005; http://www.carbon-financeonline.com/issue/18/story/655.html (subscription required).

[50] ECX boosts exchange traded volume in EU ETS. *Carbon Finance*, June 2005; http://www.carbon-financeonline.com/issue/17/story/619.html (subscription required).

[51] Except where otherwise noted, this information can be found in the two Directives, which are available at http://europa.eu.int/comm/environment/climat/emission.htm and http://europa.eu.int/comm/environment/climat/emission/linking_en.htm.

[52] Looking beyond 2007. *Carbon Finance*, June 2005; http://www.carbon-financeonline.com/issue/18/feature/87.html (subscription required).

[53] EU ETS driving power prices in Europe – UBS. *Carbon Finance*, August 2005; http://www.carbon-financeonline.com/issue/19/story/700.html (subscription required).

[54] Looking beyond 2007. *Carbon Finance*, June 2005; http://www.carbon-financeonline.com/issue/18/feature/87.html (subscription required).

- National governments are allowed to auction up to 5% of the total supply of allowances in Phase I and up to 10% in Phase II. It is not clear what degree of auctioning might be allowed in subsequent phases.
- As in Canada's proposed LFE system, companies have multiple options for meeting targets: in-house emission reductions, purchase of excess allowances from companies that have surpassed their targets, and purchase (with restrictions) of international units recognized under the emissions trading mechanisms of the Kyoto Protocol. Use of credits from emission reduction projects undertaken in the EU but outside the ETS system is not possible in Phase I but will be possible in Phase II. Canada's proposed compliance option of payments into "technology investment vehicles" is not available.
- There is no price ceiling on the cost of compliance; penalties for non-compliance are €40 per tonne CO_2e in Phase I and €100 per tonne in subsequent phases.

The price of 2005-vintage allowances in the EU ETS between January and August 2005 has varied between about $10 and $43 (€7 to €29) per tonne CO_2e.[55] Prices for 2007- and 2008-vintage allowances reached €30 ($44) on July 11, 2005.[56] According to investment bank UBS, the price of CO_2 in the EU ETS has become the "key driver" of electricity prices in continental Europe, with the increase in the price of 2006 German baseload power from €33/MWh in February 2005 to €45/MWh in July 2005 fully attributable to the corresponding increase in the price of ETS allowances.[57]

Before implementation of the EU ETS, Denmark implemented in 1999 a pilot regulated GHG emissions targets-and-trading system for the country's electricity sector, which has now been superceded by the EU ETS; in April 2002 the United Kingdom launched a system covering multiple industry sectors.[58] This system is still in operation, and 63 participating facilities have been granted a temporary exclusion from the EU ETS until the end of 2006, when the UK system will end.[59]

3.3 Regulated GHG emissions targets and trading in the United States

Before the advent of the EU ETS, the United States had made more use of regulated emissions targets-and-trading systems than any other country, although mainly for pollutants other than GHGs. The largest and best known example, operating since 1995, is the Acid Rain Program that limits sulphur dioxide emissions from virtually all fossil-fuelled electricity generating units nationwide.[60] While the United States' current federal administration has withdrawn from the Kyoto Protocol, many states are going far beyond the federal government to implement policies addressing GHG emissions.[61] In particular, some have implemented regulated GHG emissions

[55] *Carbon Finance*, July 2005, p.16. A variation between €7 to €30 has been converted to Canadian dollars using an exchange rate of €1=$1.47.

[56] Prices slide in the EU ETS. *Carbon Finance*, July 2005; http://www.carbon-financeonline.com/issue/19/story/668.html (subscription required).

[57] EU ETS driving power prices in Europe – UBS. *Carbon Finance*, July 2005; http://www.carbon-financeonline.com/issue/19/story/700.html (subscription required).

[58] Rosenzweig, R., M. Varilek and J. Jannsen. 2002. *The Emerging International Greenhouse Gas Market*, p.57–58. Pew Center on Global Climate Change; http://www.pewclimate.org/global-warming-in-depth/all_reports/international_greenhouse_gas_/index.cfm.

[59] See http://www.defra.gov.uk/environment/climatechange/trading/uk/pdf/uk-optout.pdf.

[60] Ellerman, A., P. Joskow and D. Harrison. 2003. *Emissions Trading in the US: Experience, Lessons and Considerations for Greenhouse Gases*, p. 11–20. Pew Center on Global Climate Change; http://www.pewclimate.org/global-warming-in-depth/all_reports/emissions_trading/index.cfm.

[61] A very useful overview is provided at http://www.pewclimate.org/what_s_being_done/in_the_states/.

targets-and-trading systems, several others are seriously considering doing so, and 15 states have formally challenged the federal government to do so:

- The states of Oregon,[62] Massachusetts,[63] New Hampshire[64] and Washington[65] have enacted regulated GHG emissions targets-and-trading systems that limit CO_2 emissions from fossil-fuelled electricity generation beginning in 1997, 2006–08, 2006 and 2004 respectively.
- In 2003, the governors of Connecticut, Delaware, Massachusetts, New Hampshire, New Jersey, New York, Maine, Rhode Island and Vermont (with Maryland and Pennsylvania also participating as observers) formed the Regional Greenhouse Gas Initiative to develop a regional CO_2 emissions targets-and-trading system for the electricity generation sector.[66] Details of the proposed system are expected to be published in the fall of 2005.[67] According to a draft leaked in August 2005, the system is to start in 2009, cover more than 600 facilities, and the governments are considering auctioning a portion of the total supply of allowances (tradeable emission units).[68]
- On June 1, 2005, California governor Schwarzenegger issued an Executive Order setting targets to limit state-wide GHG emissions to the 2000 level in 2010, the 1990 level in 2020, and 80% below the 1990 level by 2050. As part of the announcement, the governor asked the state Environmental Protection Agency to report on "options for a GHG emission cap and trade system," i.e., targets-and-trading system.[69] The report to the governor and legislature is due in January 2006.[70]
- Earlier, in November 2004, the governors of California, Oregon and Washington agreed to explore the development of a regional "market-based carbon allowance program," i.e., a CO_2 emissions targets-and-trading system.[71]
- In July 2002, the attorneys general of Alaska, California, Connecticut, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont wrote to President Bush urging "prompt implementation" of a mandatory federal "market-based approach that caps greenhouse gas emissions."[72] Then in October 2003, California, Connecticut, the District of Columbia, Illinois, Maine, Massachusetts, New Jersey, New Mexico, New York, Oregon, Rhode Island, Vermont and Washington launched a legal challenge to the federal Environmental Protection Agency's refusal to

[62] See http://www.pewclimate.org/states.cfm?ID=17; http://www.oregon.gov/ENERGY/SITING/standards.shtml#Carbon_Dioxide_Emissions.

[63] See http://www.pewclimate.org/states.cfm?ID=40; http://www.mass.gov/dep/bwp/daqc/files/regs/729final.doc.

[64] See http://www.pewclimate.org/states.cfm?ID=53; http://www.gencourt.state.nh.us/legislation/2002/hb0284.html.

[65] See http://www.leg.wa.gov/RCW/index.cfm?fuseaction=chapterdigest&chapter=80.70.

[66] Pew Center on Global Climate Change. 2004. *Climate Change Activities in the U.S.: 2004 Update*, p.10–11; http://www.pewclimate.org/what_s_being_done/us_activities_2004.cfm.

[67] RGGI delays but hopes of national impact. *Carbon Finance*, June 2005; http://www.carbon-financeonline.com/issue/18/story/628.html (subscription required).

[68] DePalma, A. 2005. 9 States in Plan to Cut Emissions by Power Plants. *New York Times*, August 24.

[69] See http://www.governor.ca.gov/state/govsite/gov_pressroom_main.jsp.

[70] California evaluating 'cap-and-trade' options. *Carbon Finance*, September 2005; http://www.carbon-financeonline.com/issue/20/story/738.html (subscription required).

[71] See http://www.ef.org/westcoastclimate/.

[72] See http://www.ago.state.ma.us/sp.cfm?pageid=1234.

regulate GHG emissions under the Clean Air Act.[73] The challenge was turned down by a panel of judges in July 2005, but five of the states and the District of Columbia have formally appealed the decision.[74]

- In July 2004, state governments also signalled their willingness to confront major GHG-emitting companies directly with a lawsuit to require CO_2 emission reductions. The suit was brought by California, Connecticut, Iowa, New Jersey, New York, Rhode Island, Vermont and Wisconsin against the United States' five largest GHG emitters (all electricity generators).[75] It was dismissed by a federal court in September 2005, but Connecticut and New York said they will appeal.[76]

There is also now in Congress strong interest in and support for legislation to address climate change, and in particular to implement nationally regulated GHG emissions targets and trading:

- The numbers of climate-change-related legislative proposals introduced increased from 7 in the 105th Congress (1997–1998), to 25 in the 106th Congress (1999–2000), to over 80 in the 107th Congress (2001–2002),[77] to nearly 100 in the 108th Congress (2003–2004) up to August 2004.[78] Of the latter, four proposed mandatory CO_2 emissions targets for electricity generation facilities and three proposed mandatory GHG emissions targets for a broader set of sources.[79] In these proposals, targets are generally accompanied by emissions trading provisions.
- The Senate has twice voted on a bill sponsored by senators McCain (Republican) and Lieberman (Democrat) to establish a regulated GHG emissions targets-and-trading system that would cap the GHG emissions of the electricity, manufacturing, commercial and transportation sectors (representing 85% of national emissions) at their 2000 level by 2010[80] (a significant constraint given that the United States' total emissions are projected to be 16–21% higher in 2010 than in 2000[81]). The first version of the bill (S.139, S.Amdt.2028) was defeated by 55 votes to 43 in October 2003,[82] and a second version (H.R.6, S.Amdt.826) was defeated by 60 votes to 38 in June 2005.[83] The loss of five yes votes reflects a net electoral gain of one seat by Republican opponents to the bill, plus a switch by four senators who voted for the first version but against the second one because

[73] Office of New York State Attorney General. 2003. *States, Cities, Environmental Groups Sue Bush Administration on Global Warming, Challenge EPA's Refusal to Reduce Greenhouse Gas Pollution.* News release, 23 October; http://www.oag.state.ny.us/press/2003/oct/oct23a_03.html.

[74] US States fight back on climate change. *Carbon Finance*, September 2005; http://www.carbon-financeonline.com/issue/20/story/739.html (subscription required).

[75] Office of New York State Attorney General. 2004. *Eight States & NYC Sue Top Five U.S. Global Warming Polluters*. News release, 21 July; http://www.oag.state.ny.us/press/2004/jul/jul21a_04.html.

[76] U.S. judge dismisses states' global warming suit. *Reuters*, September 16, 2005.

[77] Pew Center on Global Climate Change. 2004. *Climate Change Activities in the U.S.: 2004 Update*, p.4; http://www.pewclimate.org/what_s_being_done/us_activities_2004.cfm.

[78] See http://www.pewclimate.org/what_s_being_done/in_the_congress/108th.cfm.

[79] *Ibid.*

[80] *Ibid.*

[81] US Department of State. 2002. *US Climate Action Report 2002*, p. 73; http://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/1395.php. The figure is 16% for gross emissions and 21% for emissions net of carbon sequestration.

[82] See http://thomas.loc.gov/cgi-bin/bdquery/z?d108:SP02028:.

[83] See http://thomas.loc.gov/cgi-bin/bdquery/z?d109:SP00826:.

of the addition of provisions to support nuclear power, not because of any change of mind about the need for a regulated targets-and-trading system.[84]

- In June 2005, although it rejected the McCain-Lieberman bill, the Senate did express majority support for regulated GHG emissions targets by voting 53 to 44 in favour of a non-binding resolution[85] expressing "the sense of the Senate that Congress should enact a comprehensive and effective national program of mandatory, market-based limits and incentives on emissions of greenhouse gases that slow, stop, and reverse the growth of such emissions at a rate and in a manner that (1) will not significantly harm the United States economy; and (2) will encourage comparable action by other nations that are major trading partners and key contributors to global emissions."

3.4 Regulated GHG emissions targets-and-trading systems in other countries and states

Apart from the EU as a whole, Denmark, the United Kingdom and the U.S. states mentioned above, the Australian state of New South Wales and Norway appear to be the only other jurisdictions to date to have enacted regulated GHG emissions targets-and-trading systems. However, implementation of such systems is under consideration elsewhere, including other Australian states, Switzerland, Japan and Russia.

3.4.1 Australia

The New South Wales system, which applies to the state's electricity sector, began operation on January 1, 2003 and remains in force until 2012.[86] The average price of tradeable emission units in 2004 and the first three months of 2005 was about $10/tonne CO_2e.[87]

In March 2005, the governments of all the Australian states and territories announced,[88] "in the absence of national leadership on greenhouse policy," their intention to jointly establish a national GHG emissions targets-and-trading system. A working group has already developed design principles, including that the system will "initially cover the stationary energy sector (including electricity, gas and coal)" and that a portion of emission units will be auctioned by governments. The working group will report further to First Ministers "in the second half of 2005."

In August 2005, the International Energy Agency, in its review of the country's energy policies, warned the Australian government that GHG-reducing technologies "would most likely require a carbon price signal to facilitate their implementation. An emission trading system can be an effective means of introducing a price signal and the government is encouraged to re-appraise as required the costs and benefits of a national emissions trading scheme …"[89]

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[84] Annie Petsonk, Environmental Defense, personal communication, July 27, 2005.

[85] See http://thomas.loc.gov/cgi-bin/bdquery/z?d109:SP866:.

[86] An overview of the system is provided in State of the nation. *Carbon Finance*, March 2004; http://www.carbon-financeonline.com/issue/4/feature/23.html (subscription required).

[87] Lecocq, F. and K. Capoor. 2005. *State and Trends of the Carbon Market 2005*, p. 35. Washington D.C.: World Bank; http://carbonfinance.org/docs/CarbonMarketStudy2005.pdf. The price of $US8.10 cited in this document has been converted to Canadian dollars using an exchange rate of $US1=$1.25.

[88] Government of South Australia. 2005. *States Lead the Way on Cutting Greenhouse Gases*. News release, 31 March; http://www.ministers.sa.gov.au/minister.asp?mId=3&pId=6&sId=4331.

[89] International Energy Agency. 2005. *IEA Commends the Efficiency and Security of the Australian Energy Market But Cautions on Environmental Sustainability*. News release, 9 August; http://www.iea.org/Textbase/press/pressdetail.asp?PRESS_REL_ID=154.

3.4.2 Norway[90,91]

Norway has enacted a GHG emissions targets-and-trading system that is modelled closely on the EU ETS and like the latter sets targets for the period 2005–07. One major difference is that Norway's system only covers 15% of national emissions because it exempts emissions sources that are already covered by the country's carbon tax, which covers about 50% of national emissions. Another difference is that Norway's system will not continue beyond 2007 unless new legislation is enacted.

3.4.3 Switzerland[92]

In June 2005, the Swiss government published a regulation introducing a carbon tax for all facilities using fossil fuels to produce electricity and heat. Under the regulation, which still awaits parliamentary approval, companies can apply for exemption from the tax in exchange for accepting GHG emission reduction targets for 2008–12. Targets have already been agreed for more than 300 companies. Companies will be allowed to use emissions trading to meet their targets, and the government's intention is that this targets-and-trading system will be linked to the EU ETS starting in 2008.

3.4.4 Japan

Japan's government is divided over the desirability of a regulated GHG emissions targets-and-trading system. In August 2004, the Ministry of the Environment proposed a voluntary system to run between 2005 and 2007, seen as a precursor to a mandatory system beginning in 2008.[93] But later the same month the Ministry of Economy, Trade and Industry issued a report that was "negative" about domestic emissions trading.[94] Finally, in June 2005, the Ministry of the Environment announced a voluntary system to run between April 2006 and March 2007 in which 34 participants have taken on GHG targets in exchange for a total of $30 million in incentive money. The system does not, however, include any of the country's major GHG emitters, who are opposed to domestic emissions trading.[95] Japan's "Kyoto Protocol Target Achievement Plan," finalized on April 28, 2005, does assign a significant emission reduction to industry (in comparison to the Japan Business Federation's voluntary commitment merely to stabilize emissions) but does not clarify what policies will be implemented to achieve it.[96]

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[90] Prestrud, P., A. Torvanger and J. Vevatne, 2005. Opinion: Emissions trading and Norwegian climate policy. *Cicerone*, 2005 (1); http://www.cicero.uio.no/fulltext.asp?id=3492.

[91] Rosland, A., 2005. Fifteen percent of Norway's emissions in emissions trading. *Cicerone*, 2005 (3); http://www.cicero.uio.no/fulltext.asp?id=3628.

[92] Office fédéral de l'environnement, des forêts et du paysage. 2005. *Le Conseil fédéral concrétise l'introduction de la taxe sur le CO_2 sur les combustibles*. News release, 22 June; http://www.umwelt-schweiz.ch/buwal/fr/medien/presse/artikel/20050622/01172/.

[93] Japan's MoE proposes domestic emissions trading scheme. *Carbon Finance*, August 2004; http://www.carbon-financeonline.com/issue/9/story/289.html (subscription required).

[94] METI issues climate change report. *Carbon Finance*, September 2004; http://www.carbon-financeonline.com/issue/10/story/339.html (subscription required).

[95] Japan announces voluntary ETS for 2006. *Carbon Finance*, June 2005; http://www.carbon-financeonline.com/issue/18/story/629.html (subscription required).

[96] Planning for Kyoto. *Carbon Finance*, June 2005; http://www.carbon-financeonline.com/issue/18/feature/88.html (subscription required).

3.4.5 Russia

Sources in Russia's Economic Development and Trade Ministry[97] and one of Russia's largest energy companies[98] have stated that Russia is considering setting up a domestic emissions trading system that would complement the EU ETS. Russia's prime minister approved a Kyoto Protocol implementation plan in March 2005,[99] but the plan posted on the Economic Development and Trade Ministry's website[100] does not refer to such a system.

3.5 Anticipation of and support for regulated GHG emissions targets-and-trading systems by major GHG-emitting companies

There is now broad recognition in the business community that regulated GHG emissions targets-and-trading systems and the consequent financial liability are a long-term reality for them. This is evident in the practice, now widespread among large companies in the electricity and oil and gas sectors, of building a GHG price into investment decision making. It is also evident when companies purchase emission units valid for compliance with regulated targets before such targets have been set. While this is to be expected in jurisdictions that have either implemented or, like Canada, announced an intention to implement regulated targets-and-trading systems, it is also occurring elsewhere, notably in the United States. This lends weight to the view that it is only a matter of time before such a system is implemented nationally in the United States.

Several major GHG-emitting companies have gone so far as to publicly support the establishment and/or long-term continuation of regulated GHG emissions targets-and-trading systems, seeing them as being in the public interest environmentally, and/or as conferring an advantage relative to competitors, and/or to reduce regulatory uncertainty for business.

Key details of these developments include the following:

- Major American GHG emitters Cinergy,[101] Duke Energy,[102] Exelon[103] and PG&E[104] have all stated that they support federal regulation of CO_2 emissions. Cinergy advocates an economy-wide targets-and-trading system; Duke a "broad-based, mandatory approach," preferably a carbon tax; Exelon an economy-wide targets-and-trading system or a carbon tax; and PG&E a targets-and-trading system for the electricity sector.
- According to a survey of 19 United States utilities undertaken in early 2004, 70% of coal-fired electricity generators surveyed said they "factored carbon constraints into their

[97] Russia considers setting up EU-style emissions trading scheme. *EUobserver.com*, 4 November 2004.

[98] Russia examines domestic ETS. *Carbon Finance*, June 2004; http://www.carbon-financeonline.com/issue/7/story/235.html (subscription required).

[99] Russia approves Kyoto action plan. *Carbon Finance*, March 2005; http://www.carbon-financeonline.com/issue/15/story/540.html (subscription required).

[100] See the item dated May 16, 2005 under "Current Information" at http://www.economy.gov.ru/wps/portal/english.

[101] Cinergy readies for carbon constrained world. *Carbon Finance*, December 2004; http://www.carbon-financeonline.com/issue/12/story/419.html (subscription required).

[102] Duke Energy CEO calls for carbon tax in US. *Carbon Finance*, April 2005; http://www.carbon-financeonline.com/issue/16/story/575.html (subscription required).

[103] RGGI delays but hopes of national impact. *Carbon Finance*, June 2005; http://www.carbon-financeonline.com/issue/18/story/628.html (subscription required).

[104] California first to force utility greenhouse gas disclosure. *Carbon Finance*, July 2004; http://www.carbon-financeonline.com/issue/8/story/272.html (subscription required).

business planning," 47% of respondents expected Congress to enact mandatory regulation of CO_2 emissions within five years and 58% expected it within ten years.[105]

- ChevronTexaco is a prominent American oil company that now factors a GHG price into its investment decisions.[106] Mining companies BHP Billiton and Anglo American are also doing so.[107]
- Oil companies BP and Shell operated full-scale internal GHG emissions trading systems during 1999–2001 and 2000–2002 respectively as a way to build a GHG price into decision making and help meet voluntary corporate GHG targets. BP's system covered operations worldwide while Shell's system covered facilities accounting for one third of global corporate emissions.[108,109] Japanese electronics manufacturer Matsushita (Panasonic) is now considering implementing an internal CO_2 emissions trading scheme.[110]
- Oil company Canadian Natural Resources Limited stated in 2003 its agreement "that the management of GHG emissions and the financial liabilities resulting from those emissions are an integral component of project development, design and implementation, and are important for the determination of the public interest, and should be addressed in detail in Alberta's regulatory approvals process. Further, Canadian Natural recognizes that the development of GHG reduction targets, offset criteria and a detailed plan for GHG emission reductions, including the use of offsets, are critical components of project Applications, and commits to including these in future Applications."[111]
- In August 2004, electricity generator TransAlta bought 1.75 Mt CO_2e of CERs[112] from an agricultural methane emission reduction project in Chile.[113] TransAlta will be able to use these units in complying with the proposed Canadian Large Final Emitter system (see Section 3.1) beginning in 2008. TransAlta and other major Canadian GHG-emitting companies were already making large purchases of "GHG offsets" (emission reductions physically realized outside a company's own operations) as long ago as 2000,[114] but the August 2004 deal was the first reported Canadian private sector purchase of emission units recognized under the Kyoto Protocol.

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[105] GHGs a political problem not scientific — US utilities. *Carbon Finance*, November 2004; http://www.carbon-financeonline.com/issue/15/story/540.html (subscription required).

[106] Resolutions force change in climate at oil companies. *Carbon Finance*, May 2004; http://www.carbon-financeonline.com/issue/6/story/207.html (subscription required).

[107] Innovest Strategic Value Advisors. 2004. *Carbon Disclosure Project — Climate Change and Shareholder Value in 2004*, p.66; http://www.cdproject.net/report.asp.

[108] Pew Center on Global Climate Change. 2004. *Climate Change Activities in the U.S.: 2004 Update*, p.47–48; http://www.pewclimate.org/what_s_being_done/us_activities_2004.cfm.

[109] Rosenzweig, R., M. Varilek and J. Jannsen. 2002. *The Emerging International Greenhouse Gas Market*, p.52. Pew Center on Global Climate Change; http://www.pewclimate.org/global-warming-in-depth/all_reports/international_greenhouse_gas_/index.cfm.

[110] Matsushita considers in-house emissions trading. *Carbon Finance*, August 2005; http://www.carbon-financeonline.com/issue/20/story/706.html (subscription required).

[111] Canadian Natural Resources Limited and Oil Sands Environmental Coalition. 2003. *Oil Sands Environmental Coalition and Canadian Natural Resources Limited Principles of Cooperation*. Agreement, 14 September; available from the author on request.

[112] Certified Emission Reductions.

[113] TransAlta. 2004. *TransAlta completes first Canadian Certified Emission Reduction purchase under Kyoto*. News release, 24 August; http://www.transalta.com.

[114] Bramley, M. 2002. *The Case for Kyoto: The Failure of Voluntary Corporate Action*, p.6. Drayton Valley: Pembina Institute; http://www.pembina.org/publications_item.asp?id=140.

- Japanese private sector companies made up most of Japan's 21% share of total worldwide purchases of project-based GHG emission units between January 2004 and April 2005 inclusive. More than 96% of the project-based GHG emission units purchased worldwide during that period (150 Mt CO_2e in total) were intended for compliance with the Kyoto Protocol or other regulatory requirements.[115]
- John Browne, CEO of BP, wrote in July 2004 in *Foreign Affairs*: "Recent experience suggests that emissions trading regimes — whereby government sets a binding cap on total emissions … are the best policy for encouraging business … A well-designed trading regime would include a strictly enforced cap …"[116]
- In May 2005, the leaders of 13 major British-based companies, including BP and Shell, wrote to Prime Minister Tony Blair about the need to develop long-term policies to achieve the government's goal of reducing CO_2 emissions by 60% by 2050 (see Section 4.1.2), a goal for which they expressed support.[117] According to the companies, "we need a strong policy framework that creates a long-term value for carbon emissions reductions …"; "we welcome the use that has been made of market-based policies such as the EU Emissions Trading Scheme …"; "climate change policy needs to … create greater certainty about the long-term value of emissions reductions by setting targets for emissions trading and other related policies … now for the year 2025"; "Members of our group are directly involved in the development of international carbon markets, and believe that the value of these markets could be in the order of tens of billions of Euros."
- In July 2005, the leaders of seven large companies in the electricity sector and of British Gas wrote to the United Kingdom government on "priority areas for tackling climate change."[118] In the letter, co-signed by two leading NGOs, the companies wrote: "We believe that in the long term, a global cap-and-trade mechanism will be the most cost-effective way for reducing greenhouse gas emissions globally. The development of such a mechanism should be based on a successful EU Emissions Trading Scheme (ETS). During the UK Presidency of the EU, a clear political commitment by Government to the scheme beyond 2012 would send strong positive signals across the world."

3.6 Recognition of financial liability for GHG emissions by the investment community

At the same time as many major GHG-emitting companies have accepted the implementation of regulated GHG emissions targets-and-trading systems as a long-term reality and, in some cases, view this as a desired outcome, there is now also a broad-based recognition within the investment community that climate change, and regulated limits on GHG emissions in particular, represent a serious financial risk for companies and those investing in them. Key indications of this are as follows.

- The Carbon Disclosure Project, which currently represents 155 institutional investors with combined assets of $US21 trillion, has sent three questionnaires to each of the

[115] Lecocq, F. and K. Capoor. 2005. *State and Trends of the Carbon Market 2005*, p. 20–21. Washington D.C.: World Bank; http://carbonfinance.org/docs/CarbonMarketStudy2005.pdf.

[116] See http://www.foreignaffairs.org/20040701faessay83404/john-browne/beyond-kyoto.html.

[117] HRH The Prince of Wales's Business & the Environment Programme. 2005. *Corporate Leaders Call for UK Leadership on Climate Change*. News release, 27 May; http://www.cpi.cam.ac.uk/bep/downloads/CLG_pressrelease_letter.pdf.

[118] See http://www.bcse.org.uk/ukbcse/docs/2005/CEOs%20&%20NGOs%20%20to%20Margaret%20Beckett%20MP%20290705.pdf.

world's 500 largest companies since 2000.[119] In sending the latest questionnaire, sent on February 1, 2005, the investors expressed their desire "to improve our understanding of possible material impacts on the value of our investments driven by the following factors connected with climate change: *taxation and regulation*, technological innovations, shifts in consumer attitude and demand, [and] changes in weather patterns" (our emphasis). One of the questions posed was "Do you have a strategy regarding emerging greenhouse gas emissions regulation and trading initiatives such as the EU Emissions Trading Scheme and the Chicago Climate Exchange?[120] If yes, specify the implications, detail the strategies adopted and actions taken to date. If no, are you planning on doing so, and if so when?" A similar question posed in the previous questionnaire (sent November 1, 2003) was "Have you considered scenarios involving reductions in GHG emissions *beyond existing national, regional and international targets*? If yes please detail these scenarios, and your estimated costs or savings associated with each one. If no, are you planning on doing so, and if so when?" (our emphasis).

- Innovest Strategic Value Advisors, an investment research and advisory firm that analyzes the questionnaire responses for the Carbon Disclosure Project, concluded from the previous set of responses: "Mainstream pension trustees, analysts, bankers, insurers and fund managers have begun to appreciate the implications of climate change and greenhouse gas (GHG) policies in financial terms. No longer can fiduciaries claim to be unaware of what is at stake. Taking climate risks into account is now becoming part of smart financial management. Failure to do so may well be tantamount to an abdication of fiduciary responsibility."[121] Innovest states, with particular reference to electricity generation and to metals and mining: "… we believe that the inclusion of carbon shadow prices into liquidity, valuation and balance sheet calculations is a prudent step towards managing carbon risks."[122]
- At an Institutional Investor Summit on Climate Risk, held at the United Nations in New York in May 2005, a group of investors managing over $US3 trillion in assets, including the treasurers of the states of California, Connecticut, Maine, Maryland, New Mexico, Oregon and Vermont, as well as several public and labour pension funds, issued a ten-point "call for action" including these points:[123]
    - "All publicly-held companies in the auto, electric power, and oil and gas sectors should follow the lead of some companies and report within a year how likely scenarios for climate change, future greenhouse gas limits, and dwindling access to inexpensive energy will affect their businesses and competitiveness, and to identify steps they are taking to reduce those financial impacts and seize new emerging market opportunities."
    - "The Securities and Exchange Commission (SEC) to require that companies disclose the risk associated with climate change as part of their securities filings."

[119] See http://www.cdproject.net/about.asp.

[120] The Chicago Climate Exchange is a voluntary United States-based GHG emissions targets-and-trading initiative.

[121] Innovest Strategic Value Advisors. 2004. *Carbon Disclosure Project — Climate Change and Shareholder Value in 2004*, p.1; http://www.cdproject.net/report.asp.

[122] *Ibid.*, p.56,66.

[123] See http://incr.com/05investorsummit/; http://incr.com/05investorsummit/pdf/INCR_05_call_for_action.pdf.

- In August 2005, the chairman of the Institutional Investors Group on Climate Change, which comprises 28 British pension funds and other large investors,[124] stated: "Pension funds can no longer afford to ignore the impact of climate change on their investments: the clear warnings both from the scientific community and policy makers, and from recent empirical evidence, demonstrate that climate change is an issue that needs to be at the forefront of investment decision making."[125]
- In April 2005, JPMorgan Chase, the United States' second largest financial services group, made commitments to quantify the financial cost of GHG emissions in project finance transactions in the electricity sector, and to publicly advocate the adoption of either an economy-wide GHG emissions targets-and-trading system or a carbon tax. These and other climate-change-related commitments were announced as part of the company's new environmental policy.[126]

4. GHG emissions targets and prices post-2012

In Section 3, it was argued that large industrial facilities in Canada will very likely be subject to a regulated GHG emissions targets-and-trading system for decades to come, in light of

- the implementation and/or planned implementation of such systems in various jurisdictions in the near term, for the most part up to 2012, and related views in the business and investment communities; and
- the influence on the Government of Canada of the three fundamental drivers of increasingly severe legal limits on GHG emissions identified in Section 2.

To assess the future financial liability for GHG emissions of new large industrial facilities in Canada, it is necessary to consider the likely evolution of Canada's targets-and-trading system much further into the future, since the expected operational life of such facilities is typically at least 25 years and commonly much longer. Specifically, it is necessary to consider the possible long-term evolution of:

- national emissions targets;
- the resulting facility-level targets;
- GHG prices, i.e., the prices of tradeable emission units.

These three topics are addressed in the following subsections.

It cannot be stressed too much how important it is to look beyond 2012. Asserting that government policy in the post-2012 period is too uncertain, and that therefore no assessment of financial liability can be made, leads to a serious analytical error, that of inserting zero in place of a number — financial liability post-2012 — that is highly uncertain but, as we shall see below, likely to be large. Any analysis in which a large number is replaced by zero risks producing dramatically wrong results. For example, a company contemplating beginning operation in 2008 of a large GHG-emitting facility with an operational life of 25 years, but without considering any explicit scenarios for GHG prices post-2012, is effectively assuming a GHG price of zero for the latter 80% of the facility's life. Such an assumption would likely be

[124] See http://www.iigcc.org/membership.aspx.

[125] The Carbon Trust. 2005. *New Report Urges Pension Trustees To Address Climate Risk*. News release, 8 August; http://www.thecarbontrust.co.uk/carbontrust/about/press_releases/pension_trustees_to_address_climate_risk.pdf.

[126] JPMorgan Chase to push on climate. *Carbon Finance*, May 2005; http://www.carbon-financeonline.com/issue/16/story/581.html (subscription required).

highly unrealistic given the discussion below besides running counter to the suggestion by institutional investors, cited in Section 3.6, to consider "scenarios involving reductions in GHG emissions beyond existing national, regional and international targets."

4.1 Increasingly stringent national emissions targets

Increasingly severe legal limits on GHG emissions over the long term, resulting from the three fundamental drivers identified in Section 2, are likely to manifest themselves, in the first instance, in the form of increasingly stringent national emissions targets. It was noted in Section 2.3 that the Kyoto Protocol falls very far short of the UNFCCC's ultimate objective of stabilizing atmospheric GHG concentrations at a safe level, and that a series of amendments to the protocol or successor treaties, setting increasingly severe emissions targets for an increasing number of countries, will be needed over several decades post-2012 to reach the UNFCCC's stabilization objective.

Admittedly, in the discussions now underway about addressing climate change post-2012 there is a view that a set of national emissions targets does not represent the most appropriate international regime, or that countries will not be able to reach agreement on such targets.[127] For example, the International Chamber of Commerce recently commented: "Deep differences exist among countries and regions about the most effective ways to address climate change — and clearly call into question whether an international framework based on a progression of national, binding, differentiated, absolute emission reduction targets can effectively marshal a sustained and global response to concerns about climate change."[128]

However, an international regime post-2012 based on a set of national emissions targets (with some likely set in terms of emissions intensity) remains prominent among the proposals being discussed. Given the urgency of initiating major emission reductions immediately (see Section 2.2) and the depth of the reductions needed as early as 2020 (see Section 4.1.1 below), governments are likely to require a degree of certainty about reductions that will require the international regime post-2012 either to continue to be based on national emissions targets or to be translatable with a reasonable degree of precision into those terms.

To get an idea of the level at which national emissions targets post-2012 might be set, it is important to examine

- scientific analysis of trajectories of future annual emissions calculated to result in stabilization of atmospheric GHG concentrations at various levels;
- commitments already being made by some industrialized-country governments; and
- the views of business organizations.

4.1.1 Scientific analysis of emissions trajectories

It is beyond the scope of this paper to undertake a comprehensive review of the scientific analysis of future emissions trajectories. Much of this analysis focuses on stabilization of the atmospheric concentration of CO_2, or of GHGs collectively expressed as CO_2e, in the range of

[127] For a survey of different possible international regimes, see Bondansky, D. 2004. *International Climate Efforts Beyond 2012: a Suvery of Approaches*. Pew Center on Global Climate Change; http://www.pewclimate.org/global-warming-in-depth/all_reports/international_climate_efforts/.

[128] International Chamber of Commerce. 2005. *Business and the global economy, ICC statement on behalf of world business to the Heads of State and Government attending the Gleneagles Summit, 6–8 July 2005*; http://www.iccwbo.org/home/statements_rules/statements/2005/G8_statement.asp.

400 to 550 parts per million (ppm). This is related to a widely held view that the increase in global average temperature above pre-industrial levels must be limited to 2°C, or at least not allowed to go much beyond that, to avoid the worst adverse impacts. Analysis of the outputs of multiple computer models of the climate system suggests that there is a relatively high risk of exceeding a warming of 2°C when stabilizing the CO_2e concentration at 550 ppm, and even significant risk at 400 ppm.[129,130]

Two recent examples of analysis of future global emissions trajectories and the implications for industrialized countries[131] follow:

- A report by the Netherlands Environmental Assessment Agency (MNP) reached the following conclusions regarding the reductions needed in industrialized countries' (United States, Canada, enlarged EU, former Soviet Union and Japan) GHG emissions to stabilize atmospheric concentrations between 400 and 550 ppm CO_2e. For example, to eventually stabilize the concentration at 450 ppm CO_2e, emissions would have to be cut to 10–20% of the 1990 level by 2020 and to 75–85% of the 1990 level by 2050: [132]

	400 ppm CO_2e	450 ppm CO_2e	500 ppm CO_2e	550 ppm CO_2e
Reduction below 1990 level by 2020	25–30%	10–20%	5–15%	0–15%
Reduction below 1990 level by 2050	85–90%	75–85%	65–70%	55–60%

- Using different assumptions, a report by the German Federal Environmental Agency (Umweltbundesamt) reached even harsher conclusions regarding the reductions needed in industrialized countries' CO_2 emissions to stabilize atmospheric concentrations between 400 and 550 ppm CO_2 (roughly equivalent to between 450 and 650 ppm CO_2e):[133]

	400 ppm CO_2 (c. 450 ppm CO_2e)	450 ppm CO_2 (c. 550 ppm CO_2e)	550 ppm CO_2 (c. 650 ppm CO_2e)
Reduction below 1990 level by 2020	25–50%	10–30%	5–25%
Reduction below 1990 level by 2050	80–90%	70–90%	40–80%

4.1.2 Government commitments regarding post-2012 targets

The following commitments regarding post-2012 GHG emissions targets have been made by industrialized-country governments:

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[129] Hare, B. and M. Meinshausen. 2004. *How Much Warming Are We Committed To and How Much Can Be Avoided?*, p.26. Potsdam Institute for Climate Impact Research; http://www.pik-potsdam.de/pik_web/publications/pik_reports/reports/pr.93/pr93.pdf.

[130] *Avoiding Dangerous Climate Change, International Symposium on the Stabilisation of greenhouse gas concentrations, Hadley Centre, Met Office, Exeter, UK, 1-3 February 2005, Report of the International Scientific Steering Committee*, p.18; http://www.stabilisation2005.com/Steering_Commitee_Report.pdf.

[131] Studies such as the two cited necessarily make assumptions, usually with reference to what seems to be most politically feasible, about how the global emissions levels needed to stabilize concentrations at various levels will be allocated between industrialized and developing countries. Variations in those assumptions are one reason for variations in the results of such analysis.

[132] den Elzen, M. and Meinhausen, M. 2005. *Meeting the EU 2°C climate target: global and regional emission implications*, Figure 9a,c (p.24). Netherlands Environmental Assessment Agency; http://www.rivm.nl/bibliotheek/rapporten/728001031.pdf. The results presented are those for the "multi-stage approach" which assumes a gradual increase in the number of countries who adopt binding quantified emission intensity targets or absolute reduction objectives.

[133] Höhne, N. et al. 2005. *Options for the second commitment period of the Kyoto Protocol*, p.17-18. Umweltbundesamt; http://www.umweltbundesamt.org/fpdf-l/2847.pdf.

- In 2003, the government of the United Kingdom published its *Energy White Paper* that sets the goal of cutting the country's CO_2 emissions to 60% below the 1990 level by 2050, following the recommendation of the Royal Commission on Environmental Pollution.[134]
- The French government's Climate Plan (2004) states: "France considers that the atmospheric concentration of CO_2 should not exceed 450 ppm, in order to avoid an increase in global average temperature of more than 2°C, and that global GHG emissions should therefore be cut in half by 2050, which should lead industrialized countries to reduce their emissions by a factor of four to five over the same period. In this context, France's long-term objective is therefore to reduce its GHG emissions by 75–80% by 2050."[135]
- In March 2005, the European Council (comprising the heads of state or government of all EU member states) confirmed its position that "with a view to achieving the ultimate objective of the UN Framework Convention on Climate Change, the global annual mean surface temperature increase should not exceed 2°C above pre-industrial levels," and stated its belief that "reduction pathways for the group of developed countries in the order of 15–30% by 2020, compared to the baseline envisaged in the Kyoto Protocol … should be considered." [136] The Environment Council (comprising the environment ministers of all member states) had earlier recommended that "reduction pathways by the group of developed countries in the order of 15–30% by 2020 *and 60–80% by 2050* compared to the baseline envisaged in the Kyoto Protocol should be considered."[137] (our emphasis)
- As noted in Section 3.3, on June 1, 2005 California governor Schwarzenegger issued an Executive Order setting targets to limit state-wide GHG emissions to the 2000 level in 2010, the 1990 level in 2020 and 80% below the 1990 level by 2050.[138]
- In 2001, the Conference of New England Governors and Eastern Canadian Premiers (of Québec and the four Atlantic provinces) adopted a "mid-term goal [to] reduce regional GHG emissions by at least 10% below the 1990 level by 2020" and a "long-term goal [to] reduce regional GHG emissions sufficiently to eliminate any dangerous threat to the climate; current science suggests this will require reductions of 75–85% below current levels."[139]
- In Australia, the former premier of New South Wales, Bob Carr, recently committed the state to capping its emissions at 2000 levels by 2025 and achieving a 60% cut by 2050.[140]
- In 2001, the government of Sweden established the objective of reducing Sweden's per-capita GHG emissions to 43% below the current level by 2050.[141]

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[134] Department of Trade and Industry. *Our energy future – creating a low carbon economy*, p.8; http://www.dti.gov.uk/energy/whitepaper.

[135] Ministère de l'écologie et du développement durable. 2004. *Plan Climat 2004*, p.68; http://www.ecologie.gouv.fr/IMG/pdf/PLAN-CLIMAT-2004-2.pdf.

[136] Council of the European Union. 2005. *22 and 23 March 2005 Presidency Conclusions*. 7619/1/05 REV, p.15–16; http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/ec/84335.pdf.

[137] Council of the European Union. 2005. *2647th Council Meeting – Environment*. Press release, March 10; http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/envir/84322.pdf.

[138] See http://www.governor.ca.gov/state/govsite/gov_pressroom_main.jsp.

[139] The Committee on the Environment and the Northeast International Committee on Energy of the Conference of New England Governors and Eastern Canadian Premiers. 2001. *Climate Change Action Plan 2001*, p.7. http://www.negc.org/documents/NEG-ECP%20CCAP.PDF.

[140] Australia kicks off two major funding schemes for GHG abatement. *Carbon Finance*, June 2005; http://www.carbon-financeonline.com/issue/18/story/632.html (subscription required).

The Government of Canada has not yet made any commitments regarding post-2012 GHG emissions targets, but the Prime Minister recently mandated the National Round Table on the Environment and the Economy "to provide advice and recommendations on the development of a long-term energy and climate change strategy for Canada," including "options for post-2012 greenhouse gas reduction targets, including second commitment period [i.e., immediately post-2012] and 2050–2080 in keeping with objectives aimed at stabilizing concentrations of greenhouse gases in the atmosphere and minimizing temperature increases."[142]

4.1.3 Views of business organizations

Deep reductions of the same order as those to which governments are now committing are now finding support among business organizations, including some of the world's largest GHG-emitting companies:

- The CEO of the oil company BP, stated in 2003: "… we've come to the judgment that to avoid serious impact upon societies or the environment it is necessary to stabilise atmospheric concentrations of greenhouse gases at around 500–550 parts per million"; and that "stabilisation in the range 500–550 ppm is possible, and with care could be achieved without disrupting economic growth."[143] Shell has also put forward scenarios that allow the atmospheric CO_2 concentration to stabilize below 550 ppm.[144] According to the studies cited in Section 4.1.1, stabilization at these levels requires industrialized countries' GHG emissions to be reduced to 40–90% below 1990 levels by 2050 depending, among other things, on whether the stabilization levels apply to CO_2 or CO_2e.
- As noted in Section 3.5, in May 2005 the leaders of 13 major British-based companies, including BP and Shell, wrote to Prime Minister Tony Blair on the need to develop long-term policies to achieve the government's goal of reducing CO_2 emissions by 60% by 2050 (see Section 4.1.2). The companies wrote: "We welcome the UK Government's commitment to a reduction of this order of magnitude."[145]
- Insurance companies have often been prominent in expressions of concern about climate change. Australia's largest general insurer, Insurance Australia Group, recently joined calls for the country to adopt a target to reduce GHG emissions by 60% by 2050.[146]

4.2 Falling emissions allocations for industrial facilities

A useful way of viewing emissions targets is that they are equivalent to free allocations of emission rights. Indeed, in several emissions targets-and-trading systems, targets are explicitly implemented in this way: under the Kyoto Protocol, national targets are implemented as free

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[141] Swedish Ministry of the Environment. 2001. *The Swedish Climate Strategy, Summary Gov. Bill 2001/02:55*, p.15; http://www.sweden.gov.se/content/1/c6/02/05/22/bb5baf61.pdf.

[142] Government of Canada. 2005. *Prime Minister announces appointments to the National Round Table on the Environment and the Economy*. News release, February 16; http://www.pm.gc.ca/eng/news.asp?id=418.

[143] *Climate Change*, speech by Lord Browne to the Institutional Investors Group, London, November 26, 2003. Available at http://www.bp.com/genericarticle.do?categoryId=98&contentId=2015334.

[144] *Prudence pays – practical steps to bridge conflicting views on climate change*, speech by Sir Philip Watts at Rice University, Houston, March 12, 2003. Available at http://www.shell.com/static/media-en/downloads/speeches/pw_rice120303.pdf.

[145] HRH The Prince of Wales's Business & the Environment Programme. 2005. *Corporate Leaders Call for UK Leadership on Climate Change*. News release, 27 May; http://www.cpi.cam.ac.uk/bep/downloads/CLG_pressrelease_letter.pdf.

[146] Insurer joins call for Australia to make 60% GHG cut by 2050. *Carbon Finance*, July 2004; http://www.carbon-financeonline.com/issue/8/story/273.html (subscription required).

allocations to governments of tradeable emission units called AAUs,[147] and in the EU ETS, facility-level targets are implemented as free allocations to companies of tradeable emission units called allowances.

After 2012, as national GHG emissions targets become more stringent, i.e., allocations of emission rights to governments become smaller, it is very likely that the allocations of emission rights that governments are willing to pass on at no cost to industrial emitters in their countries will correspondingly fall. In other words, there is very likely to be a significant linkage between a country's national target and the facility-level targets in that country's regulated GHG emissions targets-and-trading system.

The fact allocation of emission rights contravenes the polluter-pays principle constitutes a second driver of reduced free allocations of emission rights to industrial emitters post-2012. Under the polluter-pays principle, all emission rights must be paid for, i.e., there is zero free allocation of emission rights. At an early stage in the development of its thinking behind Canada's LFE system, the Government of Canada subscribed to two justifications for providing exemptions to the polluter-pays principle in the form of free allocation of GHG emission rights: (i) preventing capital losses associated with the imposition of GHG constraints on capital stock existing before the introduction of the system; and (ii) protecting the competitiveness of Canadian facilities that compete with facilities in countries where there are no GHG emission targets applied to industry.[148] The first justification should gradually recede post-2012 as capital stock turns over. For sectors whose competitors are mainly limited to North America, the second justification should also recede if a national regulated GHG emissions targets-and-trading system is implemented nationally in the United States and includes targets consistent with scientific concerns (see Sections 2 and 4.1.1). The evidence presented in Sections 3.3 and 3.5 supports the likelihood of this occurring within a decade or so. For sectors with major competitors in developing countries, the second justification should recede if major developing countries begin to take on binding emissions limits, something that analysis of emissions trajectories (Section 4.1.1) shows will be necessary "within the near future (next two decades),"[149] and that many argue must happen as early as 2013.

Finally, governments are already interested in the concept of auctioning, as opposed to giving away for free, a portion of their allocations of GHG emission rights, as evidenced by the provision in the EU ETS for auctioning up to 10% of allowances during 2008–12 (see Section 3.2). In a consultation paper on the EU ETS issued in March 2005, the United Kingdom government indicated that it is indeed "considering the merits of auctioning up to 10% of allowances for Phase II" (2008–12), and "we have already stated it is our intention to make greater use of auctioning in future phases of the scheme."[150] The governments of nine northeastern states in the United States are also considering auctioning a portion of allowances in their proposed Regional Greenhouse Gas Initiative (see Section 3.3). Auctioning emission rights

[147] Assigned Amount Units.

[148] Tradeable Permits Working Group. 2000. *Using Tradeable Emissions Permits to Help Achieve Domestic Greenhouse Gas Objectives*, National Climate Change Process, p.42; http://www.nccp.ca/NCCP/national_process/issues/tradable_e.html#options. This report included the views of a multistakeholder group including, but not limited to, Government of Canada officials. However, it reflected government views at the time.

[149] den Elzen, M. and Meinhausen, M. 2005. *Meeting the EU 2°C climate target: global and regional emission implications*, p.30. Netherlands Environmental Assessment Agency; http://www.rivm.nl/bibliotheek/rapporten/728001031.pdf.

[150] Departement of Environment, Food and Rural Affairs. 2005. *UK Government approach to EU ETS Phase II*, p.12,19; http://www.defra.gov.uk/environment/climatechange/trading/eu/pdf/phase2-govapproach.pdf.

can be attractive to governments as it provides revenue that can be deployed to further accelerate the pace of GHG emission reduction in the economy. As the proportion of emission rights that are auctioned increases, so the free allocation of emission rights falls.

4.3 Rising GHG prices

Increasingly higher GHG prices, i.e., prices of tradeable GHG emission units, are another likely consequence of increasingly stringent national emissions targets during the decades post-2012. Assuming that they are not regulated (see Section 5.3.3) and that no one player exerts significant market power, GHG prices, like any market prices, depend on the interaction of supply and demand. The tightening of overall limits on emissions in the emissions trading market in question will increase demand for emission units while progress in lowering the costs of low-emission technologies will increase supply.

There is good reason to expect that the tightening of GHG emission targets in the range of those cited in Section 4.1 (40–90% reductions below 1990 levels by 2050) will outpace technological progress, leading to increasing GHG prices. The Intergovernmental Panel on Climate Change concluded: "Stabilization of atmospheric CO_2 concentration at levels below about 600 ppm is only possible with reductions in carbon intensity and/or energy intensity greater than have been achieved historically … The historically recorded annual rates of improvement of global energy intensity [energy use per unit of gross domestic product] (1 to 1.5% per year) would have to be increased and maintained over long time frames to achieve stabilization of CO_2 concentrations at about 600 ppm or below. Carbon intensity (carbon per unit energy produced) reduction rates would eventually have to change by even more (e.g., up to 1.5% per year (the historical baseline is 0.3 to 0.4% per year))."[151]

Natsource, the major GHG emissions broker and consultancy, has supported the likelihood of GHG prices rising in the decades post-2012 with a recent suggestion that GHG prices be assumed, as a "very rough proxy," to increase by 5% annually during the period 2015–40. Based on consideration of various levels of stringency of the targets-and-trading regime in place in Canada and the United States, combined with economic model results, Natsource suggests a range for the base price in 2015 of $19–50 per tonne of CO_2e.[152]

A further sense of the levels that GHG prices might reach post-2012 can be sought by examining:

- economic modelling results over a longer timescale;
- prices used for future planning by GHG-emitting companies; and
- prices that have been imposed, tolerated or contemplated by governments.

4.3.1 Economic modelling results

Economic models can be used to estimate the future GHG prices that would be needed to produce different amounts of emission reductions. Such models cannot "know" the availability and costs of technologies far in the future, they are therefore of questionable value in estimating a quantity that is highly dependent on the details of technological change, especially over a multi-decade time period.[153] Model results vary widely depending on the assumptions inherent in both the models

[151] Intergovernmental Panel on Climate Change. 2001. *Climate Change 2001: Synthesis Report*, p. 93; http://www.ipcc.ch/pub/syreng.htm.

[152] Rosenzweig, R., and D. Russell. 2005. Untitled report for BC Hydro, p.12. Washington, DC: Natsource; http://www.bcuc.com/Documents/Other/2005/DOC_7836_B-11%20Supplemntal%20F2006%20Call%20Evidence.pdf. (The document cited begins on p.150 of the pdf file.)

[153] For an account of the challenges of including technological change in economic models of climate policy, see:

themselves and the scenarios modelled. Relevant illustrative results obtained with models of the global[154] economy include the following:

- A recent review of modelling of the GHG prices (carbon tax levels) needed to reach a stabilized atmospheric concentration of 550 ppm (it is not clear whether this is CO_2 or CO_2e) using eight different models produced widely varying predictions of future prices: $1.40 to $34 per tonne CO_2 in 2020; $11 to $85 in 2040/2050 and $51 to almost $1200 in 2100 (in constant 2001 dollars).[155]
- Modelling of the stabilization of CO_2 concentrations at 400 to 450 ppm, commissioned by the German Advisory Council on Global Change (WBGU, an independent scientific body), projected GHG prices of about $12 to $45 per tonne CO_2 in 2020 and about $90 to $210 in 2050 (in constant 1990 dollars).[156]

4.3.2 Prices used for future planning by GHG-emitting companies

As noted in Section 3.5, the practice of building a GHG price into investment decision making is now widespread among large companies in the electricity and oil and gas sectors. GHG prices used by companies for investment decision making in Europe are generally considered to be commercially confidential. However, public information is available from the United States:

- Electricity generator Scottish Power was described in 2004 as the "leading practitioner" in this area.[157] The company's United States subsidiary Pacificorp has used a range of prices between zero and $55/tonne CO_2 in its Integrated Resource Planning process.[158]
- Several other United States electricity generators are building GHG prices into their planning and are beginning to be required to do so by regulators. Idaho Power Company has used a range of prices up to $67/tonne CO_2 for the period beginning in 2008, and the company has characterized these prices as representing reasonable estimates of the risk faced by the company and its customers due to potential future regulation of GHG emissions.[159]

- Weyant., J. 2000. *An Introduction to the economics of climate change policy*, p.21–24. Pew Center on Global Climate Change; http://www.pewclimate.org/global-warming-in-depth/all_reports/economics_of_climate_change/.
- Edmonds, J. et al. 2000. *Technology and the economics of climate change policy*, p.27–29. Pew Center on Global Climate Change; http://www.pewclimate.org/global-warming-in-depth/all_reports/technology_and_economics_/.

[154] If Canada's GHG emissions targets-and-trading system remains fully open to the international GHG emissions market, as is planned for 2008–12 (see Section 3.1), the relevant GHG price is the global price.

[155] Rosenzweig, R., and D. Russell. 2005. Untitled report for BC Hydro, p.11–12. Washington, DC: Natsource; http://www.bcuc.com/Documents/Other/2005/DOC_7836_B-11%20Supplemntal%20F2006%20Call%20Evidence.pdf. (The document cited begins on p.150 of the pdf file.)

[156] Nakicenovic, N. and K. Riahi. 2003. *Model Runs With MESSAGE in the Context of the Further Development of the Kyoto Protocol*, p.38; http://www.wbgu.de/wbgu_sn2003_ex03.pdf. These prices are presented graphically, which adds a degree of approximation to the numbers cited. They have been converted to Canadian dollars using an exchange rate of $US1=$1.25.

[157] Innovest Strategic Value Advisors. 2004. *Carbon Disclosure Project — Climate Change and Shareholder Value in 2004*, p.56; http://www.cdproject.net/report.asp. The price of $US40 cited in this document has been converted to Canadian dollars using an exchange rate of $US1=$1.25.

[158] Rosenzweig, R.. 2005. Testimony before British Columbia Utilities Commission, p.9–11; http://www.bcuc.com/Documents/Other/2005/DOC_7836_B-11%20Supplemntal%20F2006%20Call%20Evidence.pdf. (The document cited begins on p.135 of the pdf file.)

[159] *Ibid.*

4.3.3 Prices imposed, tolerated or contemplated by governments

There is significant evidence that governments are willing to impose, tolerate and/or contemplate GHG prices substantially higher than the $15/tonne CO_2e price cap that will be in place in Canada during 2008–2012 (see Section 3.1):

- As noted in Section 3.2, prices of allowances in the EU Emissions Trading Scheme (ETS) reached $44 per tonne CO_2 in July 2005. Although there are many views on future allowance prices in the EU ETS, investment bank UBS expects the price to rise further and suggests that it could reach $59/tonne later in 2005 or early 2006.[160]
- Norway has a CO_2 tax applied at an average rate of about $37 per tonne of CO_2, although it varies between about $16 and $62 per tonne depending on the sector and type of fuel. The tax, introduced in 1991, covers about two-thirds of the country's CO_2 emissions (half of the total GHG emissions), although several sectors are totally or partly exempted for competitiveness reasons.[161]
- In June 2005, the Swiss government published a regulation introducing a carbon tax of $33/tonne CO_2 for all facilities using fossil fuels to produce electricity and heat. Under the regulation, which awaits parliamentary approval, companies can apply for exemption from the tax in exchange for accepting GHG emission reduction targets for 2008–12 (see Section 3.4.3).[162]
- The Government of Canada's *Climate Change Plan for Canada* (November 2002), which was the basis for Canada's ratification of the Kyoto Protocol, envisaged the possibility that the international GHG price could be as high as $50 per tonne CO_2e during 2008–2012, while presenting economic modelling results showing only relatively modest macroeconomic impacts at that price.[163]
- Before the United States' withdrawal from the Kyoto Protocol in 2001, the Government of Canada was planning for the international GHG price during 2008–2012 to be in the range of $24–58 per tonne CO_2e.[164]

5. Scenarios for assessing financial liability and illustrative results

To assess the future financial liability for GHG emissions of a new large industrial facility in Canada, it is necessary to construct scenarios for the evolution of emissions allocations (Section 4.2) and GHG prices (Section 4.3) under Canada's GHG emissions targets-and-trading system over the expected operational life of the facility. The present value of financial liability can then

[160] EU ETS driving power prices in Europe – UBS. *Carbon Finance*, July 2005; http://www.carbon-financeonline.com/issue/19/story/700.html (subscription required). The price of €40 cited in this document has been converted to Canadian dollars using an exchange rate of €1=$1.47.

[161] Prestrud, P., A. Torvanger and J. Vevatne, 2005. Opinion: Emissions trading and Norwegian climate policy. *Cicerone*, 2005 (1); http://www.cicero.uio.no/fulltext.asp?id=3492. The prices cited in this document have been converted to Canadian dollars using an exchange rate of 1 krone = $0.1858.

[162] Office fédéral de l'environnement, des forêts et du paysage. 2005. *Le Conseil fédéral concrétise l'introduction de la taxe sur le CO_2 sur les combustibles*. News release, 22 June; http://www.umwelt-schweiz.ch/buwal/fr/medien/presse/artikel/20050622/01172/. The tax rate has been converted to Canadian dollars using an exchange rate of SFr 1 = $0.944.

[163] Government of Canada. 2002. *Climate Change Plan for Canada*, p.63–64; http://www.climatechange.gc.ca/english/publications/plan_for_canada/plan/.

[164] Analysis and Modelling Group. 2000. *An Assessment of the Economic and Environment Implications for Canada of the Kyoto Protocol*, p. 19–20. National Climate Change Process; http://www.nccp.ca/NCCP/national_process/issues/analysis_e.html#final.

be computed straightforwardly based on the facility's emissions, annual allocations and GHG prices,[165] taking into account an appropriate discount rate.

In Section 5.1, a range of plausible scenarios is suggested for the 50-year period 2008–57 based on the evidence and analysis presented in Sections 3 and 4. Illustrative results using these scenarios are presented and briefly discussed in Section 5.2. Other key considerations regarding financial liability for GHG emissions are raised in Section 5.3.

Given the large uncertainty as to governments' future policy choices, it is essential to test decisions regarding large GHG-emitting facilities using a range of scenarios. The probability distributions for future emissions allocations and GHG prices are wide. To use a single, mid-range scenario for decision making is therefore to run a considerable risk of making inappropriate decisions. A more prudent approach is to use a range of scenarios and make decisions that are robust across the range, rather than necessarily optimal for any one scenario.

It will be assumed in Section 5.2 that a facility's level of production and its emissions will not change over its operational life. The gap between a facility's actual emissions and its emissions allocation will therefore be closed most economically by the purchase of emission units. This is, of course, an approximation. First, routine maintenance and upgrades will tend to result in gradual improvements in efficiency, especially for complex facilities where there are many opportunities for such improvements. If this is expected with sufficient confidence, then the calculations can easily be adjusted by building in a gradual reduction in emissions over the years. If GHG prices become sufficiently high at some point in the future, it might also become economically preferable to make bigger changes leading to much larger reductions in a facility's emissions, rather than continuing to purchase emission units at the same level. One example is fuel-switching; another is retrofitting a facility to capture CO_2 and store it underground — an option currently under discussion for electricity generation and oil sands facilities in Western Canada. Presently, however, this option remains quite speculative, both from a technological and economic perspective, and is not expected to be used on a wide scale for these kinds of facilities for many years. Implementing CO_2 capture and storage or making other potential major transformations would also, of course, have their own considerable financial costs, for which a range of plausible scenarios would need to be included in any assessment of a facility's financial liability.

Only a facility's direct emissions, and the resulting financial liability accruing directly to the facility's owner or operator, will be considered in what follows. In reality, financial liability for GHG emissions elsewhere in a facility's lifecycle, e.g., electricity or natural gas production upstream, or fuel combustion downstream, can impinge indirectly on a facility's economic situation, because extra costs upstream may be passed on, and extra costs downstream will tend to reduce demand. Financial liability for indirect GHG emissions upstream and downstream should therefore be taken into account on a facility- or sector-specific basis.[166] Indirect GHG emissions induced by a facility elsewhere in its lifecycle should certainly be regarded as an essential consideration for purposes of environmental assessment, and there is no intention here to imply otherwise.

[165] Transaction costs for the purchase of emission units have been ignored in what follows.

[166] This is a particularly important consideration for facilities that are major electricity consumers. It was noted in Section 3.2 that the price of CO_2 in the EU ETS became the "key driver" of electricity prices in continental Europe in the first half of 2005.

5.1 Plausible scenarios

We suggest the following six scenarios for future emissions allocations and GHG prices under Canada's GHG emissions targets-and-trading system. Based on the evidence and analysis presented in Sections 3 and 4, the following scenarios can be considered to be roughly mid-range: plausible scenarios could be constructed that would represent both a somewhat greater and a somewhat lesser financial liability to the owners or operators of new large industrial facilities. "Alloc." in this table means the amount of emission rights allocated to a facility free of charge as a percentage of the facility's emissions. "Price" means the market price of emission rights per tonne of CO_2e in constant 2010 dollars.

Years	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5		Scenario 6	
	Alloc.	Price	Alloc.	Price	Alloc.	Price	Alloc.	Price	Alloc.	Price	Alloc.	Price
2008–12	100	15	88	15	88	15	88	15	100	15	88	15
2013–17	100	20	88	20	88	35	75	35	100	50	75	50
2018–22	80	25	70	25	70	50	50	50	80	75	50	75
2023–27	60	30	50	30	50	60	25	60	60	90	25	90
2028–37	40	40	25	40	25	80	0	80	40	120	0	120
2038–47	20	50	0	50	0	100	0	100	20	150	0	150
2048–57	0	60	0	60	0	120	0	120	0	180	0	180

The six scenarios are different combinations of three scenarios for the evolution of prices and three scenarios for the evolution of allocations. The rationale for the scenarios is as follows.

5.1.1 Prices

- In all six scenarios, during 2008–12 the price is set at $15, the cap promised by the Government of Canada (Section 3.1). Although prices could turn out to be lower during this period, international emission units recognized under the Kyoto Protocol are already trading almost up to this level (see Section 3.1), so it is probably prudent not to use a lower price.
- Scenarios 1 and 2 assume a modest price scenario. Prices rise slightly to $20 around 2015, which is at the lower end of the price range suggested by Natsource for that date (see Section 4.3). Prices then rise steadily until, around 2050, they have reached $60. This represents an average annual increment of just 3%, compared to the 5% annual increment suggested by Natsource. Sixty dollars is also less than one-third of the highest prices projected for 2050 by economic models (Section 4.3.1), within the range of prices already being used by companies for planning (Section 4.3.2), and also within the range of prices imposed, tolerated or contemplated by governments (Section 4.3.3) today or in the near term — as opposed to in 2050.
- Scenarios 5 and 6 assume a high price scenario. Prices rise sharply to $50 around 2015, which is at the higher end of the price range suggested by Natsource for that date (see Section 4.3), but within the range of prices already being used by companies for planning (Section 4.3.2), not much higher than the maximum price already recorded in the EU ETS and still within the range of prices that the Government of Canada earlier contemplated for 2008–12 (Section 4.3.3). Prices then rise steadily until, around 2050, they reach $180. This price might seem high from today's perspective, but it still represents only a 3% average annual increment starting from 2015, compared to the 5% annual increment suggested by Natsource. Also, $180 remains below the highest price projected for 2050 ($210) in the economic modelling results summarized in Section 4.3.1. This price scenario could be envisaged if relatively slow progress is made in lowering the costs of low-emission technologies (Section 4.3) and/or if national emission

targets are tightened rapidly in an attempt to stabilize GHG concentrations at lower levels (Section 4.1.1).

- Scenarios 3 and 4 assume a price scenario at the midpoint between those in scenarios 1–2 and 5-6.
- To keep suggested prices in perspective, it is worth noting that with a zero free allocation of emission rights, $25/tonne CO_2 corresponds to 6.1¢ per litre of gasoline, $50/tonne to 12.2¢ per litre, $100/tonne to 24.4¢ per litre, $150/tonne to 36.7¢ per litre and $200/tonne to 48.9¢ per litre.[167]

5.1.2 Allocations

- Scenarios 1 and 2 (modest price scenario) assume two different allocation scenarios. In scenario 1, BATEA (see Section 3.1) is interpreted generously, such that new facilities are considered already to be at the BATEA level. The allocation is therefore 100% during 2008–12, and this is locked in for 10 years, in accordance with the Government of Canada's commitment. It seems unlikely, however, that the government will be willing to lock BATEA-based targets in for more than 10 years in the context of an increasingly stringent national target. Nonetheless, in this scenario, the allocation only falls quite slowly after 2017 until it reaches zero by 2048 when a facility new in 2008 is 40 years old. This reflects a context of relatively modest tightening of Canada's national target, a gradually increasing reluctance on the part of government to provide free emission rights to an ageing facility and/or a gradually increasing use of auctioning of emission rights.
- In Scenario 2, BATEA is interpreted more stringently, such that during 2008–12 new facilities face, in proportional terms, the same emissions target as existing facilities: a 12% reduction below business-as-usual levels (see Section 3.1). As in scenario 1, the BATEA-based target is locked in for 10 years with the allocation subsequently falling steadily. However, in scenario 2 the allocation falls more rapidly, reaching zero by 2038 when a facility, new in 2008, is 30 years old. This reflects a more severe tightening of Canada's national target, a more rapidly increasing reluctance on the part of government to provide free emission rights to an ageing facility and/or a more rapidly increasing use of auctioning.
- Scenarios 5 and 6 (high price scenario) also assume two different allocation scenarios. Scenario 5 assumes the same relatively generous allocation scenario as scenario 1, the idea being that with GHG prices rising rapidly, governments choose to provide industry with some protection from the impact of those prices, at the expense of securing compensating emission reductions through mandatory requirements elsewhere in the economy or public spending. Scenario 6, in contrast, assumes a less generous allocation scenario than scenario 2. In scenario 6, in a context of severe tightening of Canada's national target, governments' willingness to provide free emission rights expires relatively quickly, and the allocation to a facility that is new in 2008 falls to zero by 2028, when it is 20 years old.
- Scenarios 3 and 4 (medium price scenario) use the same allocation scenarios as scenarios 2 and 6 respectively.

[167] These prices have been calculated using an emission factor of 2.443 kg CO_2e per litre of gasoline, which is consistent with the emission factors given for light-duty gasoline automobiles (tier 1, three-way catalyst) in Matin, A. et al. 2004. *Canada's Greenhouse Gas Inventory 1990–2002*, p.173. Environment Canada; http://www.ec.gc.ca/pdb/ghg/1990_02_report/toc_e.cfm.

- A consideration to bear in mind for these facility-level allocations is that there will be pressure for them to fall, overall, more quickly than the national allocations discussed in Section 4.1 or sectoral allocations, because the number of facilities (or volume of production) in each sector will tend to rise with economic growth. This needs to be balanced against the likelihood that governments will provide more generous allocations to facilities established in 2008 compared to those established later. An attempt has been made to take these considerations into account in these scenarios, although not with any pretence of precision.

5.2 Illustrative results

To illustrate the implications of the six scenarios for a facility's financial liability for GHG emissions, we will first consider a facility with annual emissions of 1 Mt CO_2e. The results can simply be scaled according to whether the actual emissions of a facility of interest are higher or lower. A scaling factor varying over time can also be applied if the facility's emissions are expected to change. Cumulative financial liabilities have been calculated using two different discount rates, 8% and 13.5%. The former is a rate commonly used in electricity sector analysis; the latter is based on the weighted average, pre-tax cost of capital varying from 12–15% for a private firm for non-discretionary investments of a large size and low to moderate risk for a large plant.[168] As both the 8% and 13.5% rates are nominal, they have been adjusted for a 2% annual rate of inflation for use in the calculations, because the latter use constant (real) dollars.

Resulting financial liabilities, in millions of dollars, are as follows for the generic facility with annual emissions of 1 Mt CO_2e. Cumulative totals are present values in 2008 but annual liabilities are undiscounted:

Years		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5		Scenario 6	
		8%	13.5%	8%	13.5%	8%	13.5%	8%	13.5%	8%	13.5%	8%	13.5%
2008–12	Annual	0.0		1.8		1.8		1.8		0.0		1.8	
	Cumulative	0.0	0.0	8.1	7.4	8.1	7.4	8.1	7.4	0.0	0.0	8.1	7.4
2013–17	Annual	0.0		2.4		4.2		8.8		0.0		12.5	
	Cumulative*	0.0	0.0	16.1	13.1	22.2	17.4	37.5	28.3	0.0	0.0	50.1	37.3
2018–22	Annual	5.0		7.5		15.0		25.0		15.0		37.5	
	Cumulative*	12.6	7.0	35.1	23.6	60.1	38.5	100.6	63.4	37.9	21.1	144.8	89.9
2023–27	Annual	12.0		15.0		30.0		45.0		36.0		67.5	
	Cumulative*	35.4	16.9	63.5	36.0	117.0	63.1	186.1	100.4	106.2	50.7	273.0	145.4
2028–37	Annual	24.0		30.0		60.0		80.0		72.0		120.0	
	Cumulative*	95.4	35.2	138.5	58.9	266.9	109.0	385.9	161.6	286.1	105.7	572.8	237.2
2038–47	Annual	40.0		50.0		100.0		100.0		120.0		150.0	
	Cumulative*	151.8	45.8	209.0	72.0	408.0	135.3	527.0	187.9	455.4	137.3	784.4	276.6
2048–57	Annual	60.0		60.0		120.0		120.0		180.0		180.0	
	Cumulative*	199.6	51.2	256.8	77.5	503.6	146.1	622.6	198.7	598.8	153.5	927.7	292.9

* from 2008 to the end of the period, inclusive

We can also calculate liabilities per unit of production from particular types of facilities. Undiscounted liabilities are presented below for oil sands extraction and upgrading, coal-fired electricity generation and natural gas-fired electricity generation:

[168] Mark Jaccard, Simon Fraser University, e-mail to the author, August 19, 2005.

- Financial liability for GHG emissions in $/barrel for oil sands extraction and upgrading at 65 kg CO_2e/barrel:[169]

Years	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
2008–12	0.00	0.12	0.12	0.12	0.00	0.12
2013–17	0.00	0.16	0.27	0.57	0.00	0.81
2018–22	0.33	0.49	0.98	1.63	0.98	2.44
2023–27	0.78	0.98	1.95	2.93	2.34	4.39
2028–37	1.56	1.95	3.90	5.20	4.68	7.80
2038–47	2.60	3.25	6.50	6.50	7.80	9.75
2048–57	3.90	3.90	7.80	7.80	11.70	11.70

- Financial liability for GHG emissions in ¢ per kilowatt-hour (kWh) for coal-fired electricity generation at 0.82 kg CO_2e/kWh:[170]

Years	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
2008–12	0.00	0.15	0.15	0.15	0.00	0.15
2013–17	0.00	0.20	0.34	0.72	0.00	1.03
2018–22	0.41	0.62	1.23	2.05	1.23	3.08
2023–27	0.98	1.23	2.46	3.69	2.95	5.54
2028–37	1.97	2.46	4.92	6.56	5.90	9.84
2038–47	3.28	4.10	8.20	8.20	9.84	12.30
2048–57	4.92	4.92	9.84	9.84	14.76	14.76

- Financial liability for GHG emissions in ¢/kWh for natural gas-fired electricity generation at 0.4 kg CO_2e/kWh:[171]

Years	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
2008–12	0.00	0.07	0.07	0.07	0.00	0.07
2013–17	0.00	0.10	0.17	0.35	0.00	0.50
2018–22	0.20	0.30	0.60	1.00	0.60	1.50
2023–27	0.48	0.60	1.20	1.80	1.44	2.70
2028–37	0.96	1.20	2.40	3.20	2.88	4.80
2038–47	1.60	2.00	4.00	4.00	4.80	6.00
2048–57	2.40	2.40	4.80	4.80	7.20	7.20

In short, these results show that financial liabilities for GHG emissions are potentially very large and that when evaluating them it is essential to focus on the post-2012 period up to the full extent of a facility's expected operational life.

In more detail, the first table above shows a total present value of financial liability, over 50 years, between $200 million and $928 million (8% discount rate) or between $51 million and $293 million (13.5% discount rate) for every 1 Mt CO_2e of annual GHG emissions. (Facilities in sectors such as oil sands and coal-fired electricity generation typically emit several Mt per year.) While the liabilities are relatively small or even zero in the early years, they can subsequently

[169] 65 kg CO_2e/barrel is the design emissions intensity of Shell Canada's Athabasca Oil Sands Project, including a mine, an upgrader and on-site electricity generation, which began operating in 2003. See Shell Canada Limited. 2005. *Managing GHG Emissions, Performance to the End of 2004 and Forecast to 2008*, p.11; http://www.shell.ca/code/values/climate/climate.html.

[170] 0.82 kg CO_2/kWh is a mid-range emissions intensity for supercritical pulverized coal combustion. See Pembina Institute. 2001. *A Comparison of Combustion Technologies for Electricity Generation*, p.5; http://www.pembina.org/pdf/news/appendix_2001-07-24.pdf.

[171] This is for a natural gas combined cycle facility. See Pembina Institute. 2001. *A Comparison of Combustion Technologies for Electricity Generation*, p.5; http://www.pembina.org/pdf/news/appendix_2001-07-24.pdf.

become large. In scenarios 1 and 6, respectively 52% and 38% of the present value of liability comes in the last 20 years out of 50 with a discount rate of 8%, and respectively 31% and 19% of liability comes in the last 20 years even with a discount rate of 13.5%.

Considering financial liabilities for GHG emissions as a cost per unit of production underlines how significant their impact could be. The results presented above for oil sands extraction and upgrading, showing liabilities rising to $3.90 per barrel in scenarios 1–2 and to $11.70 per barrel in scenarios 5–6, can be compared to current operating and supply costs of Canadian integrated oil sands mining/upgrading. In 2004, operating costs were estimated to be $12–18 per barrel of synthetic crude oil and full supply costs, including capital costs, taxes, royalties and a 10% real rate of return, were estimated to be $22–28 per barrel.[172] Similarly, the results presented above for electricity generation, showing liabilities rising to 4.9 ¢/kWh (coal) or 2.4 ¢/kWh (gas) in scenarios 1–2 and to 14.8 ¢/kWh (coal) or $7.2 ¢/kWh (gas) in scenarios 5–6, can be compared to current electricity prices. In 2003, average prices in Canada were 8.6 ¢/kWh (residential), 9.3 to 11.3 ¢/kWh (commercial/institutional) and 6.1 to 8.0 ¢/kWh (industrial).[173] Comparisons along these lines illustrate the seriousness of the risk that liability for GHG emissions will make facilities established in the next few years become uneconomic relative to alternatives long before the end of their planned operational lives.

5.3 Other key considerations regarding financial liability

5.3.1 Impact of other government policies

A regulated GHG emissions targets-and-trading system is not the only policy that governments are expected to deploy for reducing GHG emissions from large industrial facilities. Other policy options include financial incentives and/or quotas for the deployment of low-emission energy production technologies (e.g., electricity from renewable sources, CO_2 capture and storage), and financial incentives and/or standards to reduce energy consumption (e.g., building efficiency incentives and codes, demand side management programs, equipment and appliance standards, vehicle efficiency incentives and standards). Federal and provincial governments in Canada have already begun to implement several of these policies, and this can be expected to intensify in a context of increasingly stringent national emissions targets.

It is beyond the scope of this paper to consider any of these policies in detail. However, a comparison of a proposed investment in a large GHG-emitting industrial facility with alternative investments will need to take into account not only financial liability for GHG emissions but also the prospects of governments implementing any such policies during the facility's operational life. Nevertheless, the results presented in Section 5.2 clearly indicate that the financial liability for GHG emissions is a potentially very important factor that should always be included in any such comparison.

5.3.2 Liability to facilities versus liability to companies

It is important to be clear that when comparing the financial liability for GHG emissions from a large GHG-emitting industrial facility with the corresponding liability for alternative investments, the liability should be evaluated for each alternative alone. For example, supposing

[172] National Energy Board. 2004. *Canada's Oil Sands, Opportunities and Challenges to 2015*, p.7-8; http://www.neb.gc.ca/energy/EnergyReports/index_e.htm#OilSands.

[173] Natural Resources Canada. 2005. *Energy Use Data Handbook, 1990 and 1997 to 2003*, p.42,62,90; http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/home.cfm.

zero-emitting renewable electricity generation facilities were eligible for government-provided financial incentives, it would not be appropriate for a company to argue that the financial liability for GHG emissions from a proposed new fossil-fuelled electricity generation facility is reduced or offset by the company's ownership or simultaneous development of renewable generation capacity. This would be equivalent to arguing that low-emission facilities should subsidize, in emissions terms, high-emission facilities. It is not generally considered sound business practice for a company to include in the financial analysis of a proposed new project its indefinite subsidization by others of the company's activities.

5.3.3 Liability to industry versus liability to governments

It can of course be debated whether or not future allocations of GHG emission rights to, and GHG prices faced by, Canadian industrial facilities will fall within the six scenarios presented in Section 5.1. Even assuming Canada faces an increasingly stringent national emission target — for which considerable evidence was presented in Section 4.1 — it must be acknowledged that there are a number of reasons why governments might want to protect industry from the consequences of correspondingly stringent facility-level emission targets. This could be done in one or both of two ways:

- by "grandfathering" the generous free allocations of emission rights that characterize a facility's early years in all the scenarios in Section 5.1 well into the latter years of its life; and
- by limiting the cost of compliance to a ceiling price set below international GHG prices (i.e., by implementing a subsidized GHG price).

The purpose of this paper is to assess the financial liability for GHG emissions that could plausibly accrue to the *owners or operators* of new large industrial facilities (see Section 1). While the two options mentioned above would reduce the financial liability defined in this relatively narrow sense, it is important to note that neither of them would affect the financial liability accruing to society as a whole. Instead, still assuming that Canada remained bound by the levels of national emissions targets that underlie our six scenarios, liabilities removed from industry would simply be transferred to governments (i.e., taxpayers) or to other economic sectors, such as individuals' transportation and residential energy use. In other words, national financial liability arises from national emissions targets; the share of that liability assigned to industrial GHG emitters is ultimately a secondary issue.

A transfer of burgeoning financial liability for GHG-intensive industrial activities to all taxpayers/individuals, or to other business sectors, could be quite politically challenging. It is questionable whether governments would be willing either to shoulder indefinitely the bulk of the financial liability for an industry sector's GHG emissions — a form of subsidy that could be very large in dollar terms (see Section 5.2) — or to transfer that liability to others. The political feasibility is particularly questionable for an industry sector in robust financial health or where the transfer of liability is a net transfer between regions.