

Paper for discussion

North American Energy Relationships



By Doug Russell



**Clean Energy
and Climate Action:**
A North American Collaboration

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Clean Energy and Climate Action: A North American Collaboration

Draft Paper for Discussion

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Clean Energy and Climate Action: A North American Collaboration

The International Institute for Sustainable Development and the Pembina Institute have partnered in a multi-year project entitled **Clean Energy and Climate Action: A North American Collaboration**. This project is committed to the creation of an ambitious and coherent policy approach to climate change and energy issues in North America.

Three policy papers are being prepared under the project. The goal of this paper, *North American Energy Relationships*, is to provide a picture of how energy production and the use of energy in North America will impact the design of policy responses to climate change and the development of clean energy technologies. The paper provides context for the companion papers on carbon capture and storage and cap-and-trade systems in North America.

This version of the paper is a draft for review. Comments and input are welcome, and can be provided to Jessica Boyle, jboyle@iisd.ca.

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North American Energy Relationships

Clean Energy and Climate Action: A North American Collaboration

Contents

| | |
|---|-----------|
| 1. Introduction | 1 |
| 2. Energy profiles and energy regulation | 2 |
| 2.1 Energy profiles | 2 |
| 2.2 Energy regulation | 7 |
| 3. Energy infrastructure and interconnectedness of energy systems in North America ... | 13 |
| 3.1 Oil infrastructure | 13 |
| 3.2 Electricity infrastructure | 16 |
| 4. Energy security in North America | 26 |
| 4.1 Defining energy security: Importers and exporters..... | 26 |
| 4.2 Energy security and climate change | 27 |
| 4.3 Energy security: A U.S. perspective | 28 |
| 4.4 Energy security: A Canadian perspective | 32 |
| 4.5 Energy security: A Mexican perspective | 34 |
| 5. North American energy and climate change relationships | 36 |
| 5.1 Tri-national relationships..... | 36 |
| 5.2 Bilateral relationships | 40 |
| 5.3 Regional initiatives (sub-national) | 42 |
| 5.4 Multinational initiatives..... | 43 |

| | |
|--|-----------|
| 5.5 Assessment of relationships in the context of North American energy and climate policy | 45 |
| 6. Areas for climate change and energy collaboration..... | 47 |
| 6.1 Policy collaboration..... | 47 |
| 6.2 Technology research, development and deployment..... | 48 |
| 6.3 Capacity building | 49 |
| 7. Potential trade irritants | 50 |
| 7.1 Border adjustments | 50 |
| 7.2 Energy Independence and Security Act of 2007 and California’s low-carbon fuel standard | 51 |
| 7.3 “Buy American” provisions of the U.S. stimulus package | 54 |
| 8. Boundary climate regime scenarios | 55 |
| 8.1 Boundary Scenario 1: “Bottom-up” national plans..... | 55 |
| 8.2 Boundary Scenario 2: A North American emissions bubble | 56 |
| 8.3 Energy implications of each scenario | 57 |
| 8.4 Most likely policy scenario | 58 |
| 9. Canadian considerations and conclusions | 60 |
| Bibliography..... | 62 |

List of Figures

| | |
|--|----|
| Figure 1. Annual U.S. Imports from Canada, 1973 to 2008..... | 3 |
| Figure 2. Annual U.S. Imports from Mexico, 1973 to 2008..... | 4 |
| Figure 3. U.S. Imports of Natural Gas from Canada, 1973 to 2008..... | 5 |
| Figure 4. Composition of Electric Power Generation in Canada, the United States and Mexico, 2008 | 7 |
| Figure 5. Crude Oil Exports from Canada to the United States..... | 16 |
| Figure 6. International and Interprovincial Transfers of Electricity, 2008 (Gigawatt Hours)..... | 18 |
| Figure 7. Flow of Natural Gas Imports and Exports, 2008 (billion cubic feet)..... | 24 |

List of Tables

| | |
|--|----|
| Table 1. Total Primary Energy Production and Consumption- Quadrillion BTUs, 2007..... | 2 |
| Table 2. Petroleum Statistics for Canada, the United States and Mexico, 2008..... | 3 |
| Table 3. Natural Gas Statistics for Canada, United States and Mexico, 2008..... | 4 |
| Table 4. Coal Statistics for Canada, the United States, and Mexico, 2008..... | 5 |
| Table 5. Electricity Statistics for Canada, the United States and Mexico, 2008..... | 6 |
| Table 6. Renewables Statistics for Canada, the United States and Mexico, 2008..... | 6 |
| Table 7. Carbon Dioxide Emissions and Carbon and Energy Intensity Statistics, 2007..... | 7 |
| Table 8. Canadian Oil Pipeline Projects..... | 15 |
| Table 9. Imports and Exports of Natural Gas and LNG for the United States, First Quarters of 2008 and 2009..... | 22 |
| Table 10. Crude Oil Imports: Top 15 Countries, Year-to-date as of July 2008 and 2009 (thousands of barrels per day)..... | 31 |
| Table 11. Average Per-Barrel Emissions Relative to the Average Barrel Consumed in the United States (%)..... | 62 |

Abbreviations and Acronyms

| | |
|-------|--|
| ARRA | American Recovery and Reinvestment Act |
| BTU | British thermal unit |
| CEC | North American Commission on Environmental Cooperation |
| COP | Conference of the Parties |
| EIA | Energy Information Agency |
| FERC | Federal Energy Regulatory Commission |
| G-20 | Group of 20 |
| IEA | International Energy Agency |
| IGCC | integrated gasification combined cycle |
| LCFS | low carbon fuel standard |
| LNG | liquefied natural gas |
| MGGRA | Midwestern Greenhouse Gas Reduction Accord |
| MRV | measurement, reporting and verification |
| NAFTA | North American Free Trade Agreement |

| | |
|--------|---|
| NAMA | Nationally Appropriate Mitigation Action |
| NEB | National Energy Board |
| NERC | North American Electricity Reliability Corporation |
| NRCan | Natural Resources Canada |
| Pemex | Petróleos Mexicanos |
| RGGI | Regional Greenhouse Gas Initiative |
| RD&D | research, development and deployment |
| SPP | Security and Prosperity Partnership |
| NRCan | Natural Resources Canada |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WCI | Western Climate Initiative |

1. Introduction

Energy and climate policy are inextricably linked, as rational policies and programs aimed at reducing greenhouse gas emissions require accounting for how energy is produced, consumed and traded. Doing otherwise will result in unintended consequences in the economy and will introduce trade distortions. This paper explores the energy relationships in North America and the implications for action on clean energy and climate change. It is intended to provide a picture of how the production and use of energy in North America will impact the design of policy responses to climate change and the development of clean energy technologies. In so doing, the paper provides context for accompanying papers on carbon capture and storage (CCS) and linking of cap-and-trade systems in North America developed under the IISD-Pembina project, *Clean Energy and Climate Action: A North American Collaboration*.

The paper first summarizes the energy sectors for each of Canada, the United States and Mexico. It then explores how the energy systems of the three countries are interrelated and describes energy policy drivers and energy infrastructure in each of the three countries. Because climate change policies are in a state of flux in North America at the time of writing, references are made as appropriate to specific aspects of draft legislation or programs, with the understanding that these initiatives may change substantially in the coming months. Taking into account the most applicable interpretation of energy security for each country, the next section of the paper discusses the influence that energy security considerations could have on energy trading relationships, clean energy technology development and climate change policy. Then, North American energy and climate change relationships are described, and strengths and weakness of each are analyzed with a view to identifying building blocks for future cooperation.

The rest of the paper looks at possibilities for developing linkages and common approaches within North America, including identification of emerging areas of cooperation as well as potential irritants that may arise, such as border adjustments related to the carbon content of imports and exports and other protectionist measures that may be applied in climate policy design. Two possible “boundary “climate change policy scenarios to 2020 are described and the impacts of each scenario on energy trade and economic competitiveness are discussed. A most likely policy scenario is then posited for consideration. The paper concludes by outlining the implications for Canada of a more highly integrated North American energy and climate policy, including identification of particular opportunities and constraints that may arise.

2. Energy profiles and energy regulation

North America is one of the world's most important regions for energy—producing about one-quarter of global energy supply and consuming about one-third of the world's commercial energy.¹ National markets have grown over the years in both magnitude and complexity. Today, North America must concern itself with a range of energy issues including energy resources, reserves, technologies, infrastructure, trade, investment, laws, regulations, the environment, employment, security, and other factors affecting the development of the energy market's performance. In addition to energy, North America has a broad range of other important economic, social, technological, and environmental issues that require cross-border communication and cooperation. This chapter provides statistics on the composition of the energy profile for North America and describes the regulatory regime that oversees the energy sector in each country.

2.1 Energy profiles

This section provides basic energy data for each of Canada, Mexico and the United States. Unless otherwise noted, all data is for 2008 and the source is the U.S. Energy Information Agency (EIA). Table 1 presents the total primary energy production and consumption for each country for 2007.

Table 1. Total Primary Energy Production and Consumption, 2007 (quadrillion BTUs)

| | Canada | United States | Mexico |
|----------------------------------|--------|---------------|--------|
| Total primary energy production | 19,422 | 71,504 | 9,920 |
| Total primary energy consumption | 13,753 | 101,554 | 7,588 |

Source: Data from the EIA.

Table 2 presents the key petroleum statistics for each country.

¹ North American Energy Working Group, *North America – The Energy Picture II*, prepared by Energy Picture Experts Group, Security and Prosperity Partnership, 2006.

Table 2. Petroleum Statistics for Canada, the United States and Mexico, 2008

| Petroleum (thousand barrels/day) | Canada | United States | Mexico |
|--|---------|---------------|--------|
| Total oil production ¹ | 3,350 | 8,514 | 3,185 |
| Crude oil production ² | 2,596 | 4,950 | 2,791 |
| Consumption ³ | 2,261 | 19,498 | 2,128 |
| Net exports/imports (-) | 1,089 | -10,983 | 1,057 |
| Exports to the United States | 2,493 | N/A | 1,302 |
| Refinery capacity | 1,969 | 17,594 | 1,540 |
| Proven reserves (billion barrels) ⁴ | 178.092 | 21.317 | 10.501 |

¹ Includes lease condensate, natural gas plant liquids and other liquids, and refinery processing gains or losses.

² Includes lease condensate.

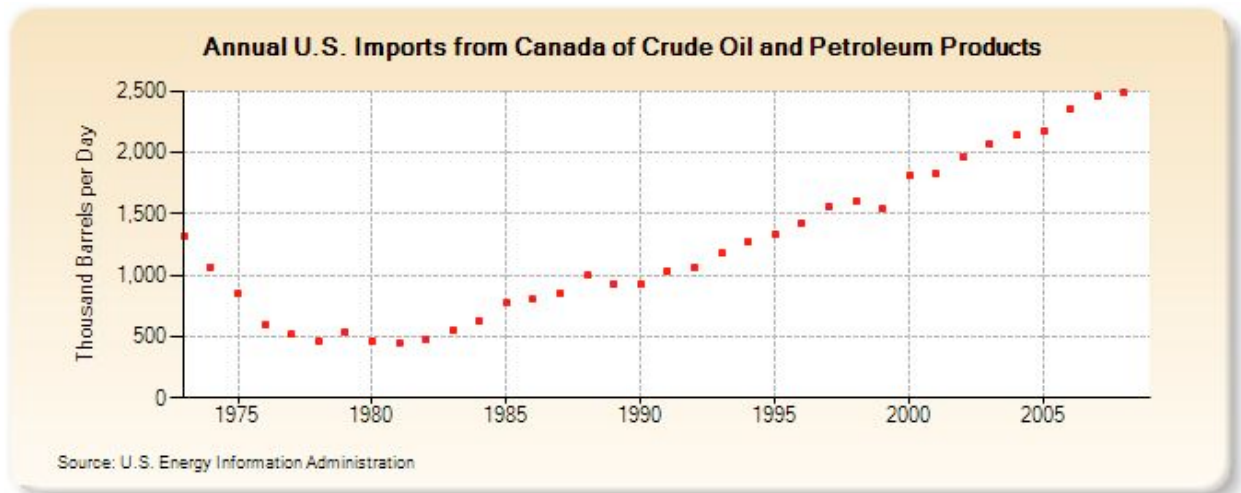
³ Includes consumption of petroleum products and direct combustion of crude oil.

⁴ As of January 1, 2009.

Sources: U.S. data from the EIA, Canada and Mexico from Oil and Gas Journal.

Figure 1 shows the steady rise of imports of crude oil and petroleum products into the United States from Canada from 1973 to 2008.

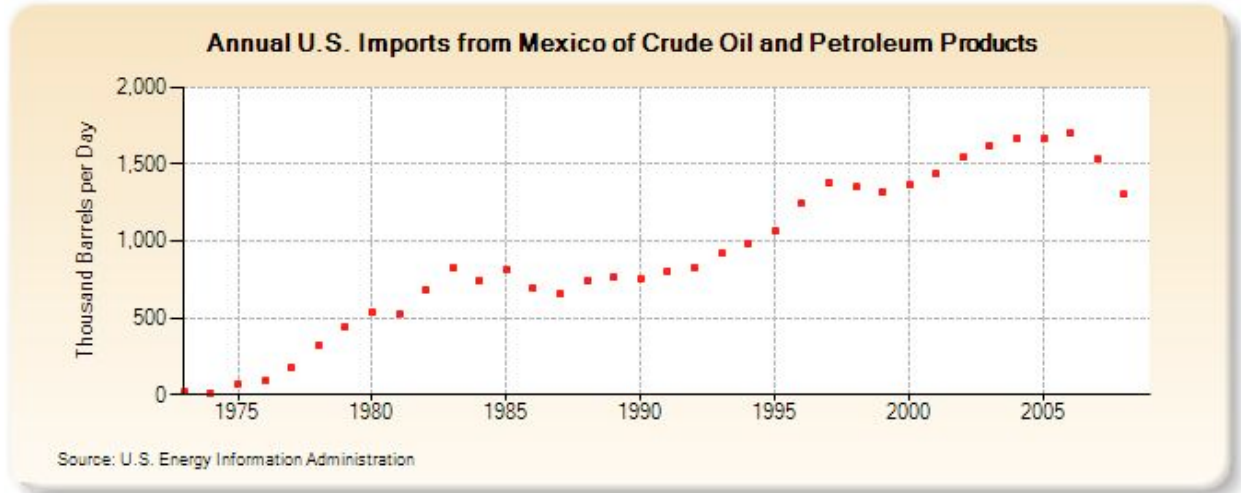
Figure 1. Annual U.S. Imports from Canada, 1973 to 2008



Source: Data from the EIA.

During the same period, as shown in Figure 2, U.S. imports from Mexico peaked in 2006 at 1,705 barrels per day and have been falling since due to the depletion of Mexico’s largest oil field, Catteral.

Figure 2. Annual U.S. Imports from Mexico, 1973 to 2008



Source: Data from the EIA.

Table 3 provides statistics for natural gas for each country.

Table 3. 2008 Natural Gas Statistics for Canada, the United States and Mexico, 2008

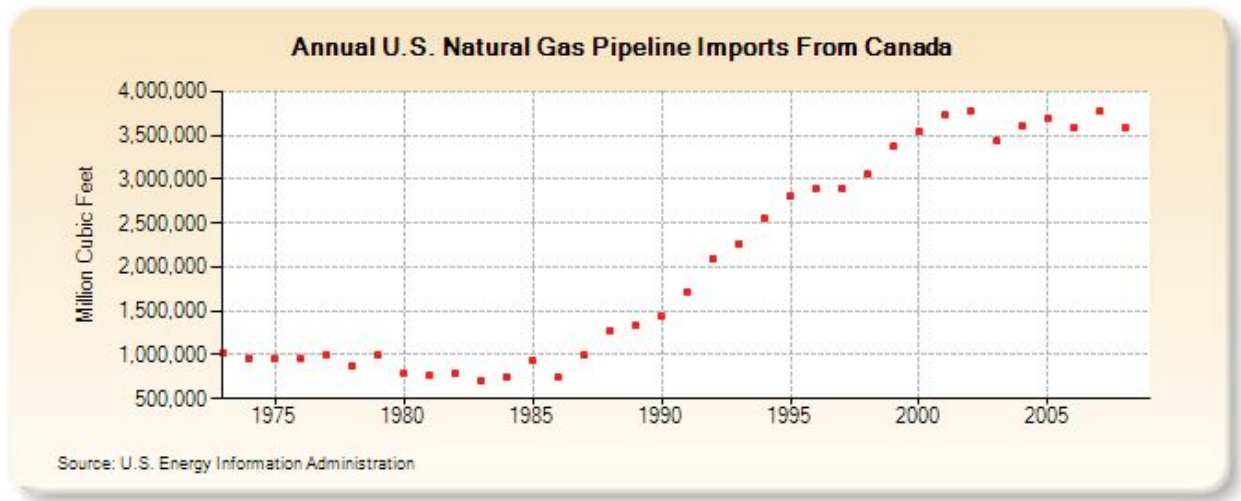
| Natural gas (billion cubic feet) | Canada | United States | Mexico |
|----------------------------------|--------|---------------|--------|
| Production (dry natural gas) | 6,037 | 20,561 | 1,842 |
| Consumption (dry natural gas) | 2,929 | 23,208 | 2,362 |
| Net exports/imports (-) | 3,108 | -2,975 | -405 |
| Proven reserves ¹ | 57,906 | 237,726 | 13,162 |

¹ As of January 1, 2009.

Sources: U.S. data from the EIA; Canada and Mexico from *Oil and Gas Journal*.

Figure 3 shows the dramatic rise of Canadian natural gas exports to the United States from 1986 to 2000.

Figure 3. U.S. Imports of Natural Gas from Canada, 1973 to 2008



Source: Data from the EIA.

Table 4 presents coal statistics for each of Canada, United States and Mexico for 2008.

Table 4. Coal Statistics for Canada, the United States, and Mexico, 2008

| Coal (thousands of short tons) | Canada | United States | Mexico |
|--------------------------------|-----------|---------------|-----------|
| Production ¹ | 75,074 | 1,171,483 | 12,652 |
| Consumption ² | 62,376 | 1,121,714 | 16,693 |
| Net exports/imports (-) | 12,238 | 45,667 | -5,052 |
| Proven Reserves (as of 2005) | 7,251,000 | 263,781,000 | 1,335,000 |

¹ Includes anthracite, bituminous, and lignite.

² Includes anthracite, bituminous, and lignite and net imports of metallurgical coke.

Source: Data from the EIA.

Table 5 presents electricity statistics for each of Canada, the United States and Mexico for 2008.

Table 5. Electricity Statistics for Canada, the United States and Mexico, 2008

| Electricity (billion kilowatt hours) | Canada | United States | Mexico |
|--|--------|---------------|--------|
| Total net generation ¹ | 614.23 | 4,110.26 | 244.95 |
| Consumption ^{2,3} | 536.05 | 3,872.60 | 200.95 |
| Total electricity capacity (million kilowatts — 2007 data) | 124.70 | 994.89 | 56.25 |
| Net exports/imports (–) | 32.23 | –32.93 | 0.70 |
| Distribution losses ⁴ | 54.10 | 270.60 | 41.94 |

¹ Conventional thermal electricity, hydroelectric power, nuclear electric power, and geothermal, solar, wind and wood and waste electric power generation.

² Net generation plus electricity imports minus electricity exports minus electricity distribution losses.

³ Consumption data for Canada and Mexico are for 2007; for the United States, data is from 2008.

⁴ Distribution losses for Canada and Mexico are for 2007; for the United States, data is from 2008.

Source: Data from the EIA.

Table 6 presents statistics on renewables for each of Canada, the United States and Mexico for 2008.

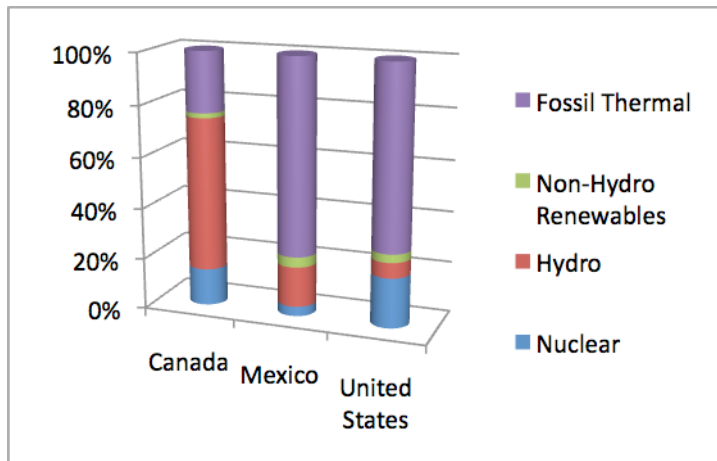
Table 6. Renewables Statistics for Canada, the United States and Mexico, 2008

| | Canada | United States | Mexico |
|--|--------|---------------|--------|
| Total renewables electricity generation (billion kilowatt hours) | 380.14 | 382.06 | 48.34 |
| Total net generation from renewables (per centage) | 61.9 | 9.3 | 19.7 |
| Total biofuels production (thousands of barrels per day) | 17.2 | 656.0 | 0.1 |

Source: Data from the EIA.

Figure 4 presents the relative share of total power generation of fossil-fired thermal generation, hydroelectric, nuclear and other renewables.

Figure 4. Composition of Electric Power Generation in Canada, the United States and Mexico, 2008



Source: Data from the EIA.

Table 7 presents carbon dioxide emissions data and carbon- and energy-intensity statistics for 2007.

Table 7. Carbon Dioxide Emissions and Carbon and Energy Intensity Statistics, 2007

| | Canada | United States | Mexico |
|---|-----------|---------------|----------|
| Total carbon dioxide emissions from consumption of energy (million tonnes) ¹ | 589.90 | 6,006.71 | 452.96 |
| Carbon intensity using market exchange rates (tonnes per thousand 2005 U.S. dollars) | 0.493 | 0.461 | 0.491 |
| Energy intensity using market exchange rates (BTU per 2005 U.S. dollars) | 11,498.95 | 7,796.29 | 8,224.43 |

¹ International data for carbon dioxide emissions from the consumption of energy include emissions due to the consumption of petroleum, natural gas, and coal, and also from natural gas flaring.

Source: Data from the EIA.

2.2 Energy regulation

Jurisdiction for energy regulation is shared among federal and provincial and state governments in each of the three North American countries. Significant regulations and policies for each of Canada, the United States and Mexico are described in this section.

Canada

In Canada, jurisdiction over energy is divided among the federal and provincial and territorial governments. Provincial governments have jurisdictional responsibilities over the exploration, development, conservation and management of non-renewable natural resources, as well as over sites and facilities for the generation and production of electrical energy within provincial borders. Federal jurisdiction in energy is primarily associated with regulation of interprovincial and international trade and commerce, and the conservation and management of non-renewable resources on federal lands.

Canada's energy policy is guided by a series of principles, agreements and accords. The main principles are:

1. *A market orientation.* Markets are the most efficient means of determining supply, demand, prices and trade while ensuring an efficient, competitive and innovative energy system that is responsive to Canada's energy needs.
2. *Respect for jurisdictional authority and the role of the provinces.* Provincial governments are the direct managers of most of Canada's resources and have responsibilities for resource management within their borders.
3. *Where necessary, targeted intervention in the market process to achieve specific policy objectives through regulation or other means.* These policy objectives include issues of health and safety (such as pipeline regulation) and environmental sustainability.²

Federal regulation

The National Energy Board (NEB) is an independent federal agency that regulates the Canadian energy industry in the public interest. The board was created in 1959 and is governed by the National Energy Board Act. The board reports through the minister of natural resources to the Parliament of Canada. It holds either written or oral public hearings where applicants and interested parties can participate. Its main responsibilities include:

- *Pipelines and power lines.* Interprovincial and international oil and gas pipelines and additions to existing pipeline systems, under federal jurisdiction, require the NEB's approval before they may be built or expanded. Public oral or written hearings are held for applications to construct pipelines exceeding 40 kilometres in length, and for any other applications at the discretion of the NEB. The NEB is also responsible for ensuring that companies comply with regulations concerning the safety of employees, the public and the environment as they might be affected by the design, construction, operation, maintenance or abandonment of a pipeline.
- *Frontier lands and offshore areas:* The NEB regulates frontier lands and offshore areas that are not covered by provincial-federal management agreements. Its responsibilities

² Natural Resources Canada (NRCan), *Overview of Canada's Energy Policy* (2009). Available online at: <http://nrcan.gc.ca/eneene/polpol/owevue-eng.php>.

include the regulation of oil and gas exploration, development and production; enhancing worker safety and protecting the environment.

- *Environmental assessment.* In addition to its responsibilities under the National Energy Board Act, the board has responsibilities under the Canadian Environmental Assessment Act, and the Northern Pipeline Act. Under the Canadian Environmental Assessment Act the board ensures that appropriate environmental assessments are conducted for projects under its jurisdiction. The NEB provides technical and administrative assistance to the Northern Pipeline Agency, which, under the Northern Pipeline Act, would oversee the planning and construction of any Canadian portion of the proposed Alaska pipeline.

Joint federal/provincial regulation

Offshore regulation in Atlantic Canada comes under joint federal and provincial responsibility through the Canada–Nova Scotia Offshore Petroleum Board in Nova Scotia and the Canada–Newfoundland & Labrador Offshore Petroleum Board in Newfoundland. The two boards are independent joint agencies of the Government of Canada and the governments of Nova Scotia and Newfoundland and Labrador, respectively. They have the authority and the responsibility to make all the decisions necessary to permit exploration, development and production of offshore oil and gas in an efficient, fair and competent manner. These boards issue licenses for offshore exploration, development and production.

Provincial regulation

Provincial regulation of oil and natural gas activities, pipelines and distribution systems is administered by provincial utility boards. These regulatory bodies review applications related to oil and natural gas activities and pipelines to ensure that they are in the public interest, having regard to environmental, economic and social effects. The producing provinces may impose royalties and taxes on oil and natural gas production; provide drilling incentives; and grant permits, approvals and licenses to construct and operate facilities. The consuming provinces regulate distribution systems, including the tariffs. The provinces also oversee the retail cost of natural gas to consumers, who purchase gas directly from the distribution company.

While the federal government in Canada has interests in a number of aspects of electricity sector regulation, the key initiatives with respect to the restructuring of both wholesale and retail electricity competition have been taken at the provincial level. The key factors affecting decisions in this regard include regional costs, supply and social considerations. To date, two provinces, Alberta and Ontario, have initiated retail competition. The electricity markets in these two provinces account for nearly half the Canadian total.

United States

U.S. energy policy is complex and fluid, with numerous federal and state laws in place to govern routine operations of the energy system and new legislation being drafted to enact policy changes to respond to political, environmental and economic priorities. At the federal level the Energy Policy Act of 2005, administered in part by the Federal Energy Regulatory Commission (FERC), emphasises nuclear and renewable energy, efficiency and conservation. In 2009, U.S. Congress

worked on a series of bills to address climate change, energy security and job creation. On June 26, 2009, the House of Representatives passed the American Clean Energy and Security Act of 2009 (H.R. 2454). This comprehensive national climate and energy legislation would establish an economy-wide greenhouse gas cap-and-trade system and contains critical complementary measures to help address climate change and build a clean energy economy. Similar Senate legislation, the Clean Energy Jobs and America's Power Act, introduced by senators Kerry and Boxer, is currently being considered in Senate committees. Relevant sections of each act are described more fully later in this paper.

Jurisdictionally, in relation to energy regulations, FERC is an independent agency that regulates the interstate transmission of electricity, natural gas and oil. FERC also reviews proposals to build liquefied natural gas (LNG) terminals and interstate natural gas pipelines, as well as licensing hydropower projects. The commission:

- Regulates the transmission and wholesale sales of electricity in interstate commerce.
- Reviews certain mergers and acquisitions and corporate transactions by electricity companies.
- Regulates the transmission and sale of natural gas for resale in interstate commerce.
- Regulates the transportation of oil by pipeline in interstate commerce.
- Approves the siting and abandonment of interstate natural gas pipelines and storage facilities.
- Reviews the siting application for electric transmission projects under limited circumstances.
- Ensures the safe operation and reliability of proposed and operating LNG terminals.
- Licenses and inspects private, municipal, and state hydroelectric projects.
- Protects the reliability of the high voltage interstate transmission system through mandatory reliability standards.
- Monitors and investigates energy markets.
- Enforces FERC regulatory requirements through imposition of civil penalties and other means.
- Oversees environmental matters related to natural gas and hydroelectricity projects and other matters.
- Administers accounting and financial reporting regulations and conduct of regulated companies.³

Many areas outside of FERC's jurisdictional responsibility are dealt with by state utility commissions and other regulatory bodies such as the Nuclear Regulatory Commission. Areas considered outside of FERC's responsibility include, among others:

- Regulation of retail electricity and natural gas sales to consumers.

³ FERC, *What FERC does* (2009). Available online at: <http://www.ferc.gov/about/ferc-does.asp>.

- Approval for the physical construction of electric generation facilities.
- Regulation of activities of the municipal power systems, federal power marketing agencies such as the Tennessee Valley Authority , and most rural electric cooperatives.
- Regulation of nuclear power plants by the Nuclear Regulatory Commission.
- Issuance of state water quality certificates.
- Oversight for the construction of oil pipelines.
- Abandonment of service as related to oil facilities.
- Mergers and acquisitions as related to natural gas and oil companies.
- Responsibility for pipeline safety or for pipeline transportation on or across the outer continental shelf.
- Regulation of local distribution pipelines of natural gas.⁴

Mexico

In Mexico⁵, the legal framework for the oil and gas sector is spelled out in Article 27 of the constitution in the Regulatory Law of Constitutional Article 27 on Petroleum. For electricity, Articles 25, 27 and 28 of the constitution include the Law of the Electric Power Utility and the Law of the Energy Regulatory Commission.

Petroleum sector

The Regulatory Act of the Constitutional Article 27 on Petroleum defines the oil industry and establishes the regulatory industry structure. Furthermore, this act determines the activities defined as strategic and reserved only to the government (exploration, extraction, production and “first-hand sales”) and those activities open to private participation (construction, operation, transportation, storage, and distribution, including international and domestic commercialization).

Electricity sector

Constitutional Article 27 establishes that generation, transmission, distribution and supply of electricity to be used as public service is exclusively the federal government’s responsibility. Article 28 further establishes that all strategic activities carried out by the federal government shall not be considered a monopoly. Article 25 empowers the federal government to own and operate public companies with the exclusive purpose of implementing identified strategic activities, such as in the electricity sector.

⁴ FERC, *What FERC does*.

⁵ Information on Mexico has been derived primarily from NAEWG, *North America - Energy Picture II* (2006).

Energy Regulatory Commission Act

The Energy Regulatory Commission Act established the Comisión Reguladora de Energía as an autonomous agency that regulates the electricity and natural gas industries. Regulated activities in the natural gas sector include:

- Natural gas first-hand sales.
- Liquefied petroleum processing.
- Natural gas transportation, distribution and storage.

Exploration and production. The state-owned company, Petróleos Mexicanos (Pemex), legally has the natural gas and oil production monopoly. Also, Pemex maintains the natural gas “firsthand sales” monopoly.

Transportation. Transportation of natural gas and oil is a regulated activity with public and private participation. Pemex controls 85 per cent of the installed capacity.

Distribution. The Comisión Reguladora de Energía has granted 21 local private distribution companies permits to operate the natural gas distribution system.

Regulated activities in the electricity sector include:

- Public service electricity supply.
- Electricity generation by private parties.
- Exports and imports between private parties.
- Electricity acquisitions for public service.
- Transmission services between the supplier and private-generation permit holders.

3. Energy infrastructure and interconnectedness of energy systems in North America

North America's energy infrastructure and energy flows are complex, closely integrated and growing to meet increased demand. Cross-border oil flows are very important to the region's economies with Canada and Mexico key suppliers of crude oil to the United States. Electricity connections across the borders of each of the three countries help offset the need for expansion of national capacity. Canada moves major quantities of its natural gas output to the United States through several pipeline connections, and Mexico is a net importer of natural gas from the United States. Both Canada and the United States are net exporters of coal, and Mexico imports small amounts of coal from the United States.

This chapter describes the oil, electricity, coal, natural gas and LNG infrastructure that is in place and planned to connect the energy systems in each of the three countries. An assessment is made of the implications of this interconnectedness for future cooperation within North America on issues such as climate change and technology development.

3.1 Oil infrastructure

As noted in Chapter 2, the North American oil industry works within an array of different national, state and provincial laws and associated regulations. In Canada, although the federal government has jurisdiction over interprovincial and international trade, the provinces preside over most natural resources and the associated infrastructure. In Mexico, Pemex controls the infrastructure for most of Mexico's petroleum industry including exploration, development, production and refining. In the United States, infrastructure and resources on federally controlled public land (including offshore areas) are under the control of the federal government, while infrastructure development, production and refining are mostly privately owned, with businesses engaged in interstate commerce subject to federal laws.

North America has a relatively modern and adequate oil infrastructure compared with many regions of the world.⁶ Nevertheless, the requirement for development and upgrades is ongoing. Technical and transport factors are particularly important to infrastructure development in the

⁶ NAEWG, p. 22.

petroleum industry. For example, the physical characteristics of crude oil play an important role in cross-border cooperation and infrastructure development. Some of North America's key oil resources require extensive processing before they are ready for market (for example, Canada's oil sands require large commitments of infrastructure for their development, upgrading, transport and processing; and Mexico's heavy crude oils require significant development, transport and refinery operations). There are some examples of cross-border cooperation that have helped address the regional needs. Pemex is working with a variety of U.S. companies that develop refinery-coking capabilities in return for Pemex providing longer-term supplies of heavy Maya crude oil. Shell Oil (U.S.) at Deer Park, Texas is an example. Another example is the sharing agreement between ConocoPhillips and EnCana.⁷ Under the arrangement, EnCana's steam-assisted, gravity driven upstream oil operations Foster Creek and Christina Lake (both in east-central Alberta) are paired with two of ConocoPhillips downstream refineries in Wood River, Illinois and Borger, Texas. This venture provides EnCana with a 50 per cent interest in the U.S. refineries; in return, ConocoPhillips acquired a 50 per cent interest in the Canadian steam-assisted, gravity driven operations.

Another challenge is the long distances over which oil must be transported. Canada's western crude oil in Alberta and sweet crude from Newfoundland are both far from the key markets in Ontario, Quebec and the United States. Mexico's oil production requires transport both inland and across the Caribbean,⁸ while the United States transports oil great distances from its fields in Alaska.

In 2008 Canada was the largest exporter of crude oil to the United States, moving a total of 716 million barrels, primarily from Alberta and Saskatchewan.⁹ According to the NEB, while there was some spare capacity on some oil pipeline systems in 2008, there were periods of apportionment as incremental capacity additions were largely offset by increasing oil sands supply. The board approved a number of pipeline applications in 2007 and 2008: that infrastructure is now being built and additional capacity is expected as early as the fourth quarter of 2009. Table 8 provides the NEB's 2009 summary of specific Canadian oil pipeline projects scheduled to come on-stream in the coming years. The additional pipeline capacity will provide the infrastructure needed to increase market penetration of Canadian crude oil to the United States.

⁷ EnCana, *EnCanada and ConocoPhillips close transaction to create integrated North American heavy oil business* (News Release, 4 December 2007). Available online at: <http://www.encana.com/news/newsreleases/2007/P1167773154300.html>.

⁸ Pemex operates an extensive oil pipeline network in Mexico that connects major production centers with domestic refineries and export terminals. This network consists of over 453 pipelines spanning 2,900 miles, with the largest concentration in the southern part of the country. Mexico does not have any international pipeline connections, with most exports leaving the country via tanker from three export terminals in the southern part of the country: Cayo Arcas, Dos Bocas and Coatzacoalcos.

⁹ EIA, *U.S. Imports by Country of Origin* (U.S. Department of Energy, 2009). Available online at: http://tonto.eia.doe.gov/dnav/pet/pet_move_impcus_a2_nus_epc0_im0_mbb1_a.htm.

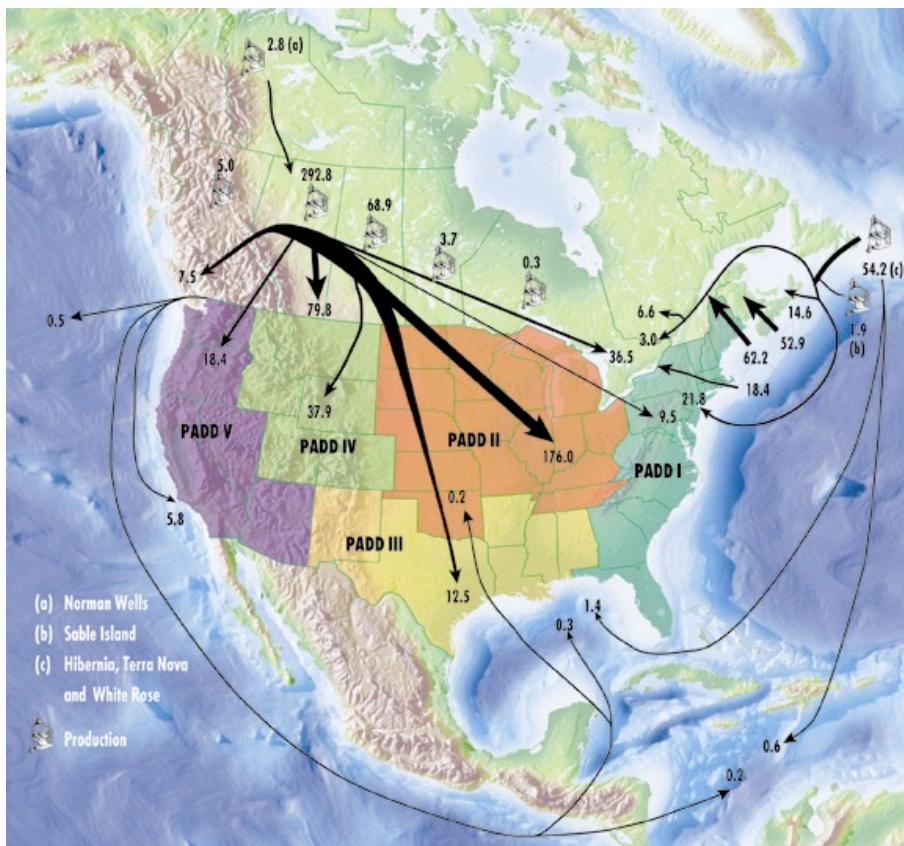
Table 8. Canadian Oil Pipeline Projects

| Pipeline | NEB filing date/ NEB approval date | Capacity increase cubic metres/day (million barrels/day) | Proponent estimated completion date | Market |
|---------------------------------------|---|---|--|----------------------------------|
| TCPL Keystone Pipeline | Certificate approved November 2007 | 69,000 (435) | Q4 2009 | Southern PADD II and PADD III |
| Enbridge Clipper | Certificate approved May 2008 | 71,500 (450) | Q2 2010 | PADD II |
| TCPL Keystone Cushing Expansion | Approved July 2008 | 24,800 (155) | Q4 2010 | Cushing, Oklahoma |
| TCPL Keystone XL | Filed February 2009 | 111,300 (700) | Q4 2012 | U.S. Gulf Coast (PADD III) |

Source: Date from NEB, *Canadian Pipeline Transportation System – Transportation Assessment - July 2009*, p. 21.

Figure 5 provides a picture of Canadian crude oil production and equivalent supply and distribution for 2008, demonstrating clearly how interconnected Canadian pipeline infrastructure is with that of the United States.

Figure 5. Crude Oil Exports from Canada to the United States



Source: Reprinted from NEB, *Canadian Pipeline Transportation System – Transportation Assessment – July 2009*, p. 4.

3.2 Electricity infrastructure

As economies grow, the need for electricity grows. There is a continual need for investment in new power plants, transmission and distribution. Emerging regulations related to climate change and renewable energy add more challenges, particularly related to how best to improve energy efficiency and how to accommodate higher levels of variable generation.¹⁰ And the development of economical clean coal technology could accommodate continued coal use in electricity generation.

¹⁰ Variable generation resources differ from conventional and fossil-fired resources in that their fuel source (wind, sunlight and moving water) cannot presently be controlled or stored. Unlike coal, oil and natural gas, which can be stockpiled for the most part, with the notable exception of pumped hydro, variable fuel resources must be used where and when they are available.

Canada, Mexico and the United States are active electricity traders. Canada is the world's second largest exporter of electricity with Quebec the major exporter to the northeast United States. Most electricity generation in Mexico comes from thermal power plants—many in the Mexico City area. Mexico is a net importer of electricity from the United States. In 2007, the United States imported a total of 51.4 billion kilowatt hours (Bkhw) of electricity from Canada and Mexico, and exported a total of 20.1 Bkhw to Canada and Mexico.¹¹ The forecast for 2020 is for U.S. electricity imports to decrease by about one third while exports are projected to remain constant.¹² In its *2009 Annual Energy Outlook to 2030*, the EIA noted that over the long term, electricity demand growth in the United States has slowed progressively each decade since 1950, from 9 per cent per year in the 1950s to less than 2.5 per cent per year in the 1990s. From 2000 to 2007, increases in electricity demand averaged 1.1 per cent per year. The slowdown in demand growth is projected to continue over the next 23 years, as a result of efficiency gains in response to rising energy prices and new efficiency standards for lighting, heating and cooling, and other appliances.¹³

Most of Canada's provinces and territories are part of interconnected electricity grids of power plants, substations and transmission lines that cross international, provincial and territorial borders. These networks provide electric utilities with alternative power paths in emergencies, and allow them to buy and sell power from each other and from other power suppliers.

Canada has three power grids: the western grid, eastern grid and Quebec grid, which includes Atlantic Canada. The dividing line between the eastern and western grids is the Alberta-Saskatchewan border. Canadian grids are also tied into the U.S. grids (the Western Interconnection, the Eastern Interconnection and the Texas Interconnection).

Canada's electricity transmission lines have a predominant north-south orientation, due to northern hydropower development in James Bay, Churchill Falls, Nelson River in Manitoba, and other northern development in British Columbia and Ontario. All provinces are interconnected with neighbouring provinces, allowing them to import and export power. However, east-west transmission is less common than north-south transmission. To date, most of the inter-provincial exchange of power has occurred in eastern Canada, with the largest transfers between Quebec and Newfoundland and Labrador. Canadian utilities and government leaders are currently exploring ways to increase and improve east-west electricity flow, especially between Ontario and Manitoba and Ontario and Quebec. The territories are not connected to other territories, the provinces or the United States.

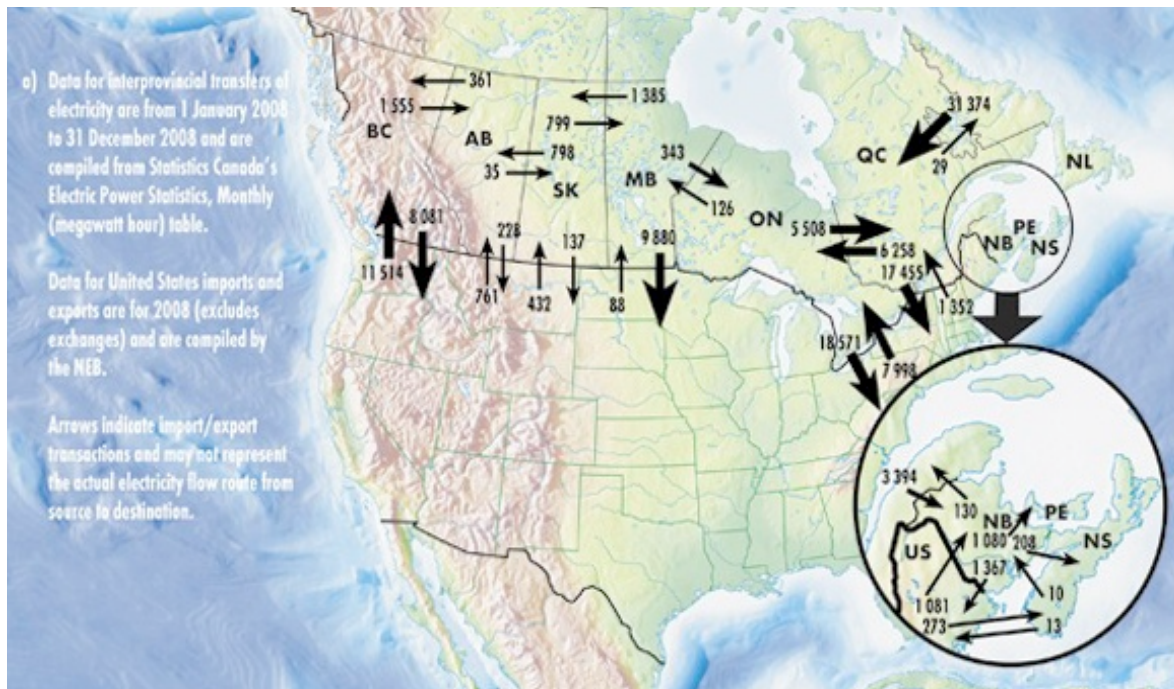
¹¹ EIA, *Electric Power Industry – U.S. Electricity Imports from and Electricity Exports to Canada and Mexico* (Washington, D.C.: U.S. Department of Energy, 2009). Available online at: <http://www.eia.doe.gov/cneaf/electricity/epa/epat6p3.html>.

¹² EIA, *Updated Annual Energy Outlook 2009 Reference Case Service Report* (Washington, D.C.: U.S. Department of Energy, 2009). Available online at: [http://www.eia.doe.gov/oiaf/servicerpt/stimulus/pdf/sroiaf\(2009\)03.pdf](http://www.eia.doe.gov/oiaf/servicerpt/stimulus/pdf/sroiaf(2009)03.pdf).

¹³ EIA, *Rate of Electricity Demand Growth Slows, Following the Historical Trend* (Washington, D.C.: U.S. Department of Energy, 2009). Available online at: <http://www.eia.doe.gov/oiaf/aeo/electricity.html>.

Figure 6 shows the 2008 international and interprovincial transfers of electricity between Canada and the United States and among Canadian provinces.

Figure 6. International and Interprovincial Transfers of Electricity, 2008 (Gigawatt Hours)



Source: Reprinted from NEB, *Canadian Energy Overview 2008: An Energy Market Assessment May 2009*, p. 46.

Mexico exported 1.3 billion kilowatt hours of electricity to the United States in 2007 while importing 0.6 billion kilowatt hours. Companies have built power plants near the U.S.-Mexico border with the aim of exporting generation to the United States. There are plans to connect Mexico with Guatemala and Belize as part of the Sistema de Interconexión Eléctrica para América Central. The plan is part of a larger effort, the Plan Puebla-Panama, to create an integrated electric power market in Central America. According to media reports, the section of Sistema de Interconexión Eléctrica that will link Mexico and Guatemala is expected to come online shortly.¹⁴

In the United States, the FERC has mandated that regional transmission organizations oversee the administration of transmission systems in competitive electricity markets. Given the international nature of the transmission grid, FERC has encouraged Canadian and Mexican participation and, in some cases, has directed the regional transmission organizations to indicate how foreign transmission entities would be represented.

¹⁴ EIA, *Mexico: Country Analysis Brief* (Washington, D.C.: Department of Energy, 2009), p. 10.

Accommodating renewable energy in the electricity grid

The *2009 Long-Term Reliability Assessment* by the North American Electricity Reliability Corporation's (NERC) estimates that approximately 260,000 megawatts of new renewable “nameplate” capacity (biomass, geothermal, hydro, solar and wind) is projected over the coming ten years. Roughly 96 per cent of this total is composed of wind (229,000 megawatts) and solar (20,000 megawatts). Wind power alone is projected to account for 18 per cent of the total resource mix by 2018. Due to its limited availability during times of peak demand, however, wind power accounts for only about 3 per cent (38,000 megawatts) of the peak resource mix. Though not all of the projects may come to fruition, the integration of this volume of resources will require significant changes to traditional planning and operating techniques to ensure reliability.¹⁵

Today's bulk power system is designed to meet customer demand in real time—meaning that supply and demand must be constantly and precisely balanced. As electricity itself cannot be stored on a large scale, changes in customer demand throughout the day and over the seasons are met by controlling conventional generation, using stored fuels to fire generation plants when needed. As the electric industry in North America seeks to reliably integrate large amounts of variable generation (primarily from renewable sources) into the bulk power system, considerable effort will be needed to accommodate and effectively manage their unique operating and planning characteristics. In particular, significant transmission additions and reinforcements will be needed to move solar, wind and ocean power from their source points to demand centres. NERC is encouraging policy makers and government entities to work together to remove obstacles to transmission development, accelerate siting and approve needed permits.¹⁶ In addition to expansion of transmission facilities, the NERC is also recommending that significant attention be paid to adding more sources of flexibility (such as demand response, the operation of structured markets, shorter scheduling intervals, gas and energy storage), to developing more comprehensive planning approaches, and providing greater access to larger pools of available generation and demand.

One area that has received significant interest in recent years is the development of smart grids.¹⁷ A smart grid can be defined as a power system, from generation source to end user, that

¹⁵ NREC, *2009 Long-Term Reliability Assessment* (Princeton: NERC, 2009), p. 3. Available online at: http://www.nerc.com/files/2009_LTRA.pdf.

¹⁶ NERC, *Accommodating High Levels of Variable Generation* (Princeton: NERC, 2008). In addition, in November 2008, the Institute for Energy for the 21st Century called on the incoming U.S. administration to streamline existing regulations that limit permitting for energy infrastructure systems, recognizing that “energy infrastructure systems [will] require massive amounts of new investment in the face of rising difficulty in locating, permitting and building new infrastructure... Construction of numerous electricity transmission lines, natural gas terminals, and wind projects have been abandoned as a result of frustration and the inability to get siting approval.” See Institute for 21st Century Energy and U.S. Chamber of Commerce, *A Transition Plan for Securing America's Energy Future* (Washington, D. C. U.S. Chamber of Commerce, 2009). Available online at: http://energyxxi.org/reports/Transition_Plan.pdf.

¹⁷ The U.S. administration announced on October 27, 2009 the investment of US\$3.4 billion in the country's electric transmission grid, which Carol Browner, director of the White House Office of Energy and Climate Change Policy in the Obama administration, said is the “largest-ever investment in the smart grid.”

integrates a two-way flow of communication and energy as application of existing and new technologies enable new forms of supply, delivery and consumption.¹⁸ A number of developments under the “smart grid” moniker may assist in the integration of variable resources. These include deployment of smart meters to facilitate more demand response programs, incentives to promote the installation of stationary and mobile (such as plug-in vehicles) storage facilities and variable generation in the distribution system. All of these technology developments need to be considered in planning an integrated system.

Energy storage technologies also have the potential to assist the large-scale integration of variable generation.¹⁹ Pumped hydro composes the vast majority of energy storage used today, though numerous storage technologies, in various stages of development and commercialization, can provide added flexibility. Technologies such as battery energy storage, flywheel energy storage and compressed air energy storage are rapidly becoming commercially viable. However, the cost of storage devices compared with other methods of flexibility currently has limited their applicability to specific and limited situations. The U.S. Department of Energy’s *20% Wind Energy by 2030* report indicates that sourcing 20 per cent of annual energy needs from wind resources in the United States would not require storage resources assuming that sufficient transmission exists for distribution.²⁰

Coal infrastructure

Coal is cheap and plentiful in Canada and the United States but can face constraints due to insufficient access to infrastructure for handling and delivery.²¹ Accessing coal supplies requires structures for mining, preparation, delivery and storage. Most coal is shipped via rail, barge and ship. Its primary uses are for electricity generation and steel production.

In Canada, coal is used primarily for electricity production in Alberta and Saskatchewan. Some thermal coal is transported to Ontario, Mexico and the United States. In Mexico about 10 per cent of electricity generation comes from coal. The United States, on the other hand, is a major international coal producer and consumer. Consequently the United States has major infrastructure requirements in every phase of coal production and use.

Infrastructure for coal-fired power generation in North America has been relatively stagnant over the past 30 years, with many of the existing power plants currently in line for replacement or phase-out. Clean coal technology, which embraces a variety of technological advances, is

¹⁸ Ontario Smart Grid Forum, *Enabling Tomorrow’s Electricity System* (Toronto: Independent Electricity System Operator, 2009) Available online at: www.ieso.ca/smartgridreport.

¹⁹ KEMA, *White Paper: Benefits of Fast Response Storage Devices for System Regulation in ISO Markets* (November 2008).

²⁰ U.S. Department of Energy, *20% Wind Energy by 2030 – Increasing Wind Energy’s Contribution to US Electricity Supply* (Washington, D.C.: U.S. Department of Energy, 2008). Available online at <http://www.20percentwind.org>.

²¹ The coal infrastructure section refers only to Canada and the United States, given that coal in Mexico comprises only 5 per cent of its total energy consumption.

receiving significant attention from U.S. and Canadian policymakers. In the United States, for example, the draft Clean Energy Jobs and American Power Act, introduced by senators Kerry and Boxer, would amend the Clean Air Act to establish performance standards for coal-fired power plants permitted in 2009 or thereafter.²² The Canadian government is planning to introduce measures that “effectively ban the construction of new dirty coal plants starting in 2012.”²³

The next-generation coal-fired power generation infrastructure include: low-nitrogen oxide burners, selective catalytic reduction, flue-gas desulphurization, fluidized bed combustion and integrated gasification combined cycle (IGCC). IGCC technology involves the production of hydrogen and carbon dioxide from coal and then usually the combustion of the resulting hydrogen. The carbon dioxide produced is separated from the hydrogen prior to combustion, making IGCC plants prime candidates for CCS. IGCC is in a very early stage, with capacity from IGCC power plants projected to be 7.5 gigawatts by 2020.²⁴

CCS is the subject of a separate paper in this Clean Energy and Climate Action series. The U.S. Department of Energy has invested more than US\$3 billion since 2001 to fund multiple CCS projects being conducted by seven regional partnerships. The department has offered at least US\$8 billion in loan guarantees for coal-fired power plants with CCS, and the Obama Administration has deemed CCS technology important for “energy independence” and included US\$3.4 billion for “clean coal” power in the US\$787 billion American Recovery and Reinvestment Act. Section 125 of the draft Kerry-Boxer sponsored Clean Energy Jobs and American Power Act would establish a program for the demonstration and early deployment of CCS technologies. The act would authorize fossil fuel-based electricity distribution facilities to hold a referendum on the establishment of a carbon storage research corporation. If the referendum were to be approved by entities representing two-thirds of the nation’s fossil fuel-based electricity, the corporation would assess fees totalling US\$10 billion over 10 years to be used by the corporation to fund large-scale demonstration projects of CCS technologies in order to accelerate their commercial availability.

In Canada, the Alberta government is committing C\$2 billion to CCS and announced its intention to proceed with three projects on June 30, 2009:

- *Alberta Carbon Trunk Line*. To be constructed and operated by Enhance Energy and North West Upgrading, the project will incorporate gasification, carbon capture, transportation, enhanced oil recovery and storage in the Alberta industrial heartland and

²² “Title 1—Greenhouse Gas Reduction Programs”, “Subtitle B—Carbon Capture and Sequestration” and “Section 124 Performance Standards for Coal-Fired Power Plants”, *Clean Energy Jobs and American Power Act* (S.1733) as introduced on September 30, 2009.

²³ Environment Canada, *Government Delivers Details of Greenhouse Gas Regulatory Framework* (News Release, Ottawa, March 10, 2008). Available online at: <http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=B2B42466-B768-424C-9A5B-6D59C2AE1C36>.

²⁴ EIA, *Annual Energy Outlook 2007 with Projections to 2030* (Washington, D.C.: U.S. Department of Energy 2008); and U.S. Department of Energy, *Gasification Technology R&D* (2008). Available online at <http://www.fossil.energy.gov/programs/powersystems/gasification/index.html>.

central Alberta. It will capture carbon dioxide from the Agrium fertilizer plant and North West Upgrading Inc.

- *Integrated gasification combined-cycle carbon capture power generation facility.* EPCOR and Enbridge will construct and operate this facility adjacent to EPCOR'S existing Genesee power plant, west of Edmonton.
- *Integrated CCS project.* Shell Canada Energy, Chevron Canada and Marathon Oil Sands will operate this project at the Scotford Upgrader in the Alberta industrial heartland. The C\$1.35 billion project will receive C\$865 million of public funds (C\$745 million from Alberta).

At the federal level in Canada, the government has invested C\$240 million in commercial demonstrations of CCS at Boundary Dam, a coal-fired electricity plant in Estevan, Saskatchewan, and has announced investments of over C\$340 million for TransAlta's Keephills 3 plant outside Edmonton and C\$120 million for the Scotford Upgrader.

Natural gas infrastructure (including liquefied natural gas)

The natural gas infrastructure in North America has grown to meet what—until 2008—was an ever increasing demand for natural gas. Table 9 summarizes the North American import/export activities for natural gas and LNG for the United States for the first quarter of 2009.

Table 9. Imports and Exports of Natural Gas and LNG for the United States, First Quarters of 2008 and 2009

| | First quarter 2009 | | First quarter 2008 | | Change (%) | |
|----------------------|-----------------------------|--|-----------------------------|--|--------------|---------------|
| | Volume (billion cubic feet) | Average price (\$US per 1 million BTU) | Volume (billion cubic feet) | Average price (\$US per 1 million BTU) | Volume | Price |
| Imports | | | | | | |
| Canada | 928.3 | \$5.03 | 1,044.4 | \$8.13 | -11.1% | -38.1% |
| Mexico | 6.6 | \$4.62 | 2.6 | \$8.04 | +156.4% | -42.5% |
| LNG by vessel | 86.4 | \$6.56 | 75.7 | \$8.57 | +14.1% | -23.5% |
| Total Imports | 1,021.2 | \$5.16 | 1,122.7 | \$8.16 | -9.0% | -36.8% |
| Exports | | | | | | |
| Canada | 244.5 | \$5.36 | 202.7 | \$8.40 | +20.7% | -36.2% |
| Mexico | 77.1 | \$4.10 | 108.4 | \$8.29 | -28.9% | -50.5% |
| LNG by vessel | 9.8 | \$6.52 | 9.5 | \$6.81 | +3.5% | -4.3% |
| Total Exports | 331.5 | \$5.10 | 320.6 | \$8.32 | +3.4% | -38.7% |

Source: Reprinted from the Office of Natural Gas Regulatory Activities, U.S. Department of Energy, *Natural Gas Imports and Exports First Quarter Report 2009*, p. 3.

The combination of the economic downturn of 2008, the surge of unconventional gas discoveries such as shale, and an excess of LNG imports are pressuring an already flooded North American gas market. U.S. imports from Canada have grown every year since 1986 with the exception of 2009. In the first quarter of 2009, exports of natural gas from Canada to the United States were down by 11.1 per cent and prices for natural gas had plummeted by over 35 per cent from the same quarter in 2008.

Canada remains the largest supplier of natural gas to the United States, with exports in 2008 of 3,589 billion cubic feet.²⁵ In 2008 Canada represented 90.9 per cent of U.S. imports of natural gas, while Mexico supplied only 1.1 per cent of U.S. total natural gas imports. There are numerous entry points via pipelines into the United States from Canada, with over 73 per cent of natural gas entering from Alberta and Saskatchewan into the border states of Washington, Idaho, Montana, North Dakota and Minnesota. Figure 7 shows the flow of natural gas imports and exports to and from the United States in 2008.

On the export side, nearly 75 per cent of U.S. exports during the first quarter of 2009 were sent to Canada, while 23 per cent went to Mexico. St. Clair, Michigan was the dominant exit point for 90 per cent of U.S. natural gas exports to Canada.

Key functions of natural gas infrastructure include production, liquefaction or regasification for LNG, storage and transport (pipelines and tankers). The gas pipeline infrastructure is more developed between Canada and the United States than between the United States and Mexico.²⁶ The NEB's 2009 assessment of Canadian natural gas pipeline infrastructure concluded that "pipeline capacity is adequate across the country, although there may be occasions of short-term limitation at some points depending upon markets, storage and seasonal shifts."²⁷

The assessment further observed that "utilization declined for most natural gas pipelines in 2008 as a result of declining conventional supply from the Western Canadian Sedimentary Basin, growing demand within western Canada, and competition from other supply basins, particularly in the western and southern U.S." As a result of these and other market factors, the number of pipeline applications for new or expanded natural gas pipelines was lower in 2008 than in previous years.²⁸

Canada does not yet import LNG, although there are seven proposals to construct LNG import facilities in Atlantic Canada (three projects), Quebec (three projects) and British Columbia (one project), many of which are in the environmental assessment or regulatory review process.²⁹ In

²⁵EIA, *U.S. Natural Gas Imports by Country* (Washington, D.C.: Department of Energy, November 2009). Available online at: http://tonto.eia.doe.gov/dnav/ng/ng_move_imp_csl_a.htm.

²⁶NAEWG, *The Energy Picture II – January 2006*, pp. 28-36.

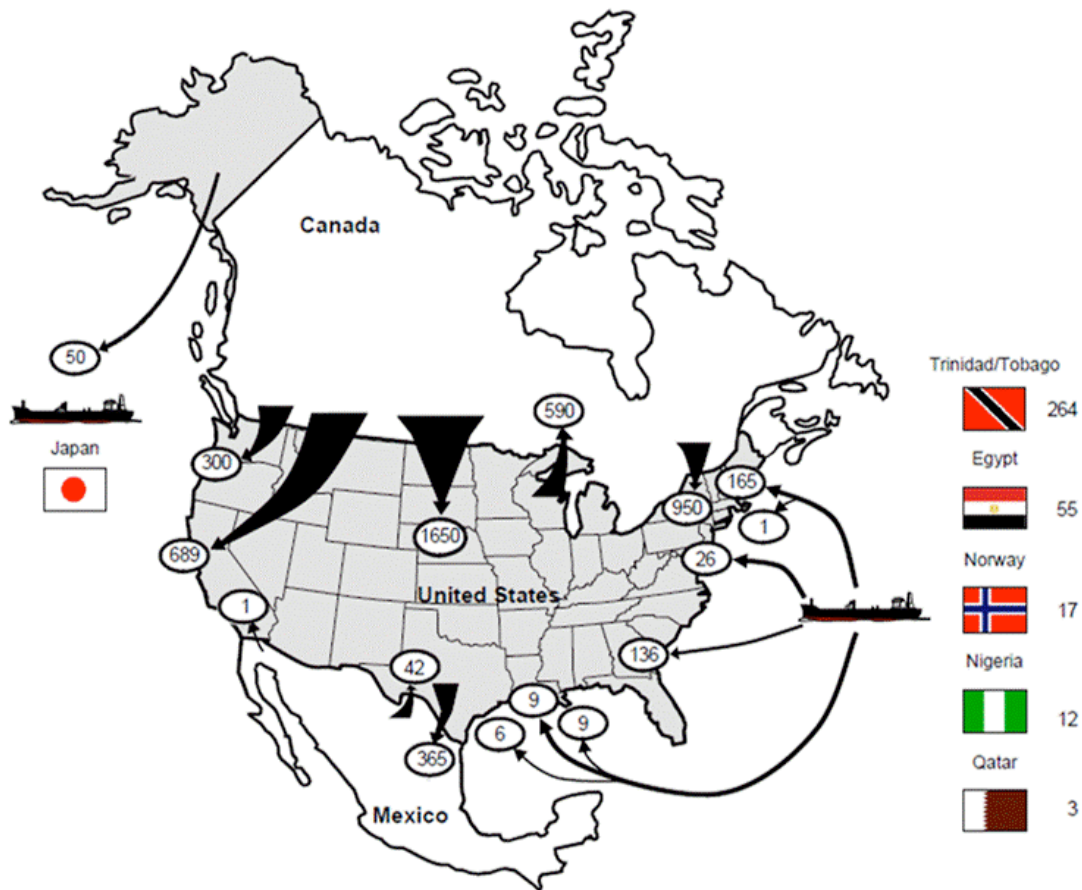
²⁷NEB, *Canadian Pipeline Transportation System Assessment*, p. 23.

²⁸NEB, *Canadian Pipeline Transportation System Assessment*, Section 2.5.

²⁹NRCAN, *Canadian LNG Import/Export Projects: Status as of May 2009* (Ottawa: Natural Gas Division, Petroleum Resources Branch, NRCAN, 2009). Available online at: <http://www.nrcan.gc.ca/eneene/pdf/imppro-eng.pdf>.

Figure 7. Flow of Natural Gas Imports and Exports, 2008 (billion cubic feet)

Figure SR1. Flow of Natural Gas Imports and Exports, 2008
(Billion Cubic Feet)



Source: Energy Information Administration, U.S. Natural Gas Imports and Exports: 2008, Tables SR6 and SR8

Source: Reprinted from EIA, U.S. Natural Gas Imports and Exports, 2008, Figure SR1.

Mexico, as of 2006, eight LNG projects were in various stages of advanced consideration. The projects are mainly associated with the power sector's expansion plans which involve natural gas-fired combined-cycle plants. In the United States in the first eight months of 2009, LNG imports amounted to 320.8 billion cubic feet, with Trinidad and Tobago and Egypt the prime sources. Of the nine LNG-receiving facilities in the United States, those in Everett, Massachusetts and Elba Island, Georgia handled nearly two-thirds of LNG imports. As in the rest of North America, expansion and development of LNG facilities is complex. Federal agency approvals of LNG terminals can be overridden by state decisions or other state permits (such as shoreline management and zoning) can be used to delay LNG project developments.

Significant technological progress has been made in reducing liquefaction, shipping and regasification costs. These efficiency improvements now make LNG a potentially viable option for North American markets. However, in order to access LNG in any significant way, North America will need to develop receiving capability in Canada and Mexico, as well as expand existing capacity in the United States. This will require the construction of docking facilities, LNG storage and regasification facilities, and associated pipelines. In addition, the existing pipeline grid and natural gas storage capabilities may have to be expanded to transport this supply to market areas. LNG expansion, however, faces two major challenges. First, the current glut of natural gas on the North American market that has resulted from improvements in horizontal drilling and multi-fracturing of unconventional gas makes short-term LNG expansion uneconomical. Second, LNG import terminal projects have met with significant public concerns, including environmental and safety issues, and potentially decreased local property values.

4. Energy security in North America

One of the prominent influences on energy policy and, by extension, climate policy, is the concept of energy security. There are many interpretations of what “energy security” means, depending on the country or region being considered. Energy security has evolved from a focus on maintaining or securing cost-effective supplies of energy and reducing vulnerabilities to foreign threats to a concept that includes environmental, economic, social, cultural and technological elements.

4.1 Defining energy security: Importers and exporters

In large measure, how a nation defines energy security (or insecurity) depends on the degree to which it relies on importing or exporting energy. In its simplest form, energy insecurity stems from “either the physical unavailability of energy, or prices that are not competitive or are overly volatile.”³⁰ The way in which nations choose to interpret the threat that energy insecurity poses to their economy is often less than objective and has become increasingly politicized. To understand how energy insecurity is perceived, it is necessary to consider the factors that influence it. Among others, these include:

- Access to or control of energy resources.
- Energy disruptions resulting from natural disasters or geopolitical events.
- Energy market structure and regulatory oversight.
- State of energy infrastructure, including extraction, transportation, refining, power generation and transmission.
- Concentration of fossil fuel resources and associated infrastructure in a limited number of countries or regions of the world.
- Availability and cost of alternative energy sources—the ability to diversify.
- Progress in technology to affordable energy resource diversification.
- Policy responses to social and environmental pressures.

Energy-importing countries are generally concerned with security of supply, price stability, and efficiency of use. Energy importers view energy security as necessary of achieving social and development goals because of potential restrictions on energy availability, the economic impact

³⁰ International Energy Agency (IEA), *Energy Security and Climate Policy: Assessing Interactions* (Paris: IEA, 2007), p. 12. Available online at: (http://www.iea.org/textbase/nppdf/free/2007/energy_security_climate_policy.pdf).

of high-cost energy imports or both. Major energy-importing countries or regions include the United States, European Union, Japan, China and India.

Energy-exporting countries or regions are concerned with the viability of export flows, their competitive position in the global energy markets, and commodity prices. Important factors include adequacy of energy reserves; infrastructure and technology for production, transport and export; adequate foreign demand, and security of trade and transport links. Canada, Russia, West Africa, Venezuela and the Middle East are the major fossil fuel-exporting countries or regions.³¹

4.2 Energy security and climate change

The International Energy Agency (IEA) cites four types of policy responses that address root causes of energy insecurity among importing nations:

- *Energy system disruptions linked to extreme weather conditions or accidents.* Government responses are precautionary in nature and include preparing contingency arrangements for the management of and recovery from such incidents after they happen;
- *Short-term balancing of supply and demand in electricity markets.* This is most often performed by government-appointed, independent transmission system operators;
- *Regulatory failures.* Governments monitor effectiveness of the regulations affecting energy markets and make adjustments in response to inefficiencies; and
- *Concentration of fossil fuel resources.* Government responses aim to minimize the exposure to resource concentration risks including switching to non-fossil fuel sources, diversifying supply routes, maximizing efficiency and developing domestic resources.

Of these four policy responses, the IEA concludes that it is the last—dealing with concentration of fossil fuel resources—that has the closest relationship with climate change policies.³² In the first case the goal is to move away from risk-prone fuel, while in the second case (climate change) it is to reduce the carbon intensity of the fuel mix.

Two large energy security issues are related to concentration of fossil fuel resources. The first concerns price. While oil and coal prices are basically world prices (and natural gas is often indexed to world oil prices), a concern exists over the market power of a few oil producers to harm competition in its broadest sense and impede the economic development of importing countries. The second involves the risks of physical unavailability. These risks are of greatest concern where prices do not reflect market fundamentals, because in such cases the price effect is unable to contribute to balance demand and supply in response to a supply shortfall. An example is Mexico, where the domestic price of energy is controlled by the government, and hence supply adequacy becomes an issue.

³¹ International Institute for Sustainable Development, *Energy Security in Selected Countries – A Companion Document to IISD and Energy for Sustainable Development* (Unpublished document, December 2006).

³² IEA, *Energy Security and Climate Policy: Assessing Interactions*, pp. 12-14 and pp. 38-44.

Making the long-term adjustments to compensate for energy insecurity arising from resource concentration involves a suite of policy actions very similar to those needed to deal with energy system transformations aimed at significantly reducing greenhouse gas emissions. In most cases, the policies and programs required to solve both issues are mutually reinforcing, creating synergies that may provide common ground and opportunities for enhanced cross-border cooperation. In North America, some examples include:

- Establishing policies that result in a price on carbon either through cap-and-trade systems or carbon taxes or a mixture of both.
- Developing a smart grid to improve energy efficiency, hence reducing energy security risks associated with resource availability and reducing emissions associated with the use of fossil fuels for peak power generation.
- Providing greater interconnectivity of electricity transmission infrastructure among provinces and states to allow for increased penetration of non-fossil power generation, thereby reducing reliance on fossil fuel imports on the one hand and reducing greenhouse gas emissions on the other.
- Reducing barriers to siting of LNG terminals to allow for larger supplies of natural gas in the fuel mix, thereby reducing potential for price volatility and providing a higher penetration of a lower-carbon content fuel in the U.S. energy mix.
- Developing CCS technologies, to allow for significantly reduced greenhouse gas emissions from both new and retrofitted coal-fired power plants, which contribute to climate change goals while promoting increased domestic production of power and less reliance on imports.
- Engaging in infrastructure investment and policy intervention aimed at increasing the use of vehicles powered by alternative forms of energy to petroleum, since increased penetration of such vehicles into the national fleet will lower reliance on oil imports while reducing emissions from the transportation sector. Low carbon fuel standards and corporate average fuel economy standards are two examples of such policy interventions.

4.3 Energy security: A U.S. perspective

U.S. president Barack Obama provided perspectives on energy security on the White House website:

Our reliance on oil poses a threat to our economic security. Over the last few decades, we have watched our economy rise and fall along with the price of a barrel of oil. We must commit ourselves to an economic future in which the strength of our economy is not tied to the unpredictability of oil markets. We must make the investments in clean energy sources that will curb our dependence on fossil fuels and make America energy independent [including:]

- B
reaking Dependence on Oil. Promote the next generation of cars and trucks and the fuels they run on.
- P
roducing More Energy at Home. Enhance U.S. energy supplies through

responsible development of domestic renewable energy, fossil fuels, advanced biofuels and nuclear energy.

- Promoting Energy Efficiency. Promote investments in the transportation, electricity, industrial, building and agricultural sectors that reduce energy bills. P

So we have a choice to make. We can remain one of the world's leading importers of foreign oil, or we can make the investments that would allow us to become the world's leading exporter of renewable energy. We can let climate change continue to go unchecked, or we can help stop it. We can let the jobs of tomorrow be created abroad, or we can create those jobs right here in America and lay the foundation for lasting prosperity.³³

In 2008, the United States imported 3.58 billion barrels of crude oil³⁴ (the most of any country in the world), and 3,984 billion cubic feet of natural gas³⁵ (number two in the world behind Japan). In 2007, the United States imported 31 terawatt hours of electricity (number three in the world behind Italy and Brazil).³⁶ In addition to its imports, the United States is the number-one producer and consumer of electricity, number-three producer of natural gas and number-three producer of crude oil. In 2007 it generated 2,118 terawatt hours of electricity from coal, second only to China.

The two major pieces of energy legislation in the United States in 2009 signal the concerns of American policymakers regarding energy security and climate change. The Waxman-Markey bill, which passed the House of Representatives in June 2009 (*American Clean Energy and Security Act of 2009: A bill to create clean energy jobs, achieve energy independence, reduce global warming pollution and transition to a clean energy economy*) and the Kerry-Boxer senate bill (S.1733) both seek to alleviate energy insecurity and deal with climate change through clean energy initiatives, restrictions on greenhouse gas emissions and longer-term transformation to a clean energy future. Goals include an 83 per cent cut in greenhouse gas emissions from 2005 levels by 2050, with a 43 per cent cut achieved by 2030 and 17 to 20 per cent by 2020. Incentives for CCS include over US\$1 billion annually for 10 years for demonstration and early deployment, and a commercial deployment program funded by a share of the allowances in the cap-and-trade system (5 per cent from 2020 to 2050), covering a period of 10 years for each qualifying plant. To qualify, the plants in question must derive at least 50 per cent of their annual

³³ The White House, President Barack Obama, *Energy and Environment*, (2009). Available online at: <http://www.whitehouse.gov/issues/energy-and-environment>.

³⁴ EIA, *U.S. Imports by Country of Origin* (Washington, D.C.: Department of Energy, 2009). Available online at: http://tonto.eia.doe.gov/dnav/pet/pet_move_impcus_a2_nus_epc0_im0_mbbl_a.htm.

³⁵ IEA, *U.S. Natural Gas Imports by Country* (Washington, D.C.: Department of Energy, 2009). Available online at: http://tonto.eia.doe.gov/dnav/ng/ng_move_imp_c_s1_a.htm.

³⁶ IEA, *Key World Energy Statistics: 2009* (Paris: IEA, 2009). Available online at: http://www.iea.org/Textbase/nppdf/free/2009/key_stats_2009.pdf.

fuel from coal and petroleum coke (30 per cent in the case of the Kerry-Boxer bill) and must capture at least 50 per cent of their carbon dioxide emissions by 2020 (65 per cent in Kerry-Boxer). Both bills would establish performance standards for any new coal-fired electric generation facilities. Waxman-Markey establishes a renewable electricity standard of 20 per cent (5 per cent of which may be met through energy efficiency).

Both the Energy Policy Act of 2005 and the American Recovery and Reinvestment Act of 2009 (the stimulus bill) include major incentives for renewable energy and energy efficiency, both key elements in the pursuit of energy security and climate change goals. The stimulus bill contains US\$71 billion for clean energy and energy efficiency programs and another US\$20 billion in clean energy tax incentives. In addition to the provisions of the stimulus bill, the Department of Energy's Loan Guarantee Program³⁷ has issued seven solicitations for applications that include projects with "innovative technologies" (US\$2 billion); nuclear power facilities and research (US\$20.5 billion); CCS (US\$8 billion); energy efficiency, renewable energy, advanced transmission and some biofuels (US\$43.5 billion); and "quick start"³⁸ commercial transmission projects (US\$7.5 billion).

The updated 2009 U.S. energy reference case that takes into account the provision of the stimulus package forecasts an increase of 13 per cent in total U.S. domestic energy production from 72.5 quadrillion BTUs per year in 2007 to 81.9 in 2020, and a 27 per cent increase from 2007 levels by 2030. Imports are forecast to decrease from 34 per cent of total consumption in 2007 to 26.9 per cent in 2020 and 22.5 per cent in 2030.³⁹

On the international front, the United States is taking steps to shore up its energy-importing relationships with Canada and Mexico and decrease its reliance on imports from the Gulf States. Table 10 shows the year-to-date imports from the top 15 exporters of crude oil to the United States for 2008 and 2009.

Canada and Mexico are the number-one and number-two suppliers of crude oil to the United States, supplying 39.1 per cent of the total volume of the top 15 suppliers for year to date as of July 2009, up 3.5 per cent from 2008. For the same period, imports from the Gulf States declined by 3.9 per cent, while imports decreased dramatically from volatile countries (for example Iraq was down 32 per cent, Nigeria almost 33 per cent).⁴⁰ Imports from Latin America increased by 3.8 per cent. How noteworthy these trends are is difficult to say. The overall decrease in imports has more to do with the U.S. economic recession than anything else. Clearly, the United States would prefer to source all of its crude oil from stable nations to ensure supply security; however,

³⁷ Section 1703 established under Title XVII of the Energy Policy Act of 2005 and Section 1705 established under the Recovery Act of 2009.

³⁸ Projects that start prior to September 30, 2011.

³⁹ EIA, *An Updated Annual Energy Outlook 2009 Reference Case April 2009* (Washington, D.C.: Department of Energy, 2009). Available online at: <http://www.eia.doe.gov/oiaf/servicerpt/stimulus/pdf/stimulus.pdf>.

⁴⁰ This decline was in part due to production issues in Nigeria, where crude production in 2008 averaged 1.94 million barrels per day versus its estimated capacity of 2.7 million barrels per day.

a significant amount of crude oil is sourced by companies through the spot market where the focus is on cost, crude type and logistics (mainly transport distances). Thus, the extent to which the data in Table 10 reflects a trend away from more volatile regions of the world is unclear.

Table 10. Crude Oil Imports: Top 15 Countries, Year-to-date as of July 2008 and 2009 (thousands of barrels per day)

| Country | Year to date as of July 2008 | Year to date as of July 2009 | Change (%) |
|-----------------------|---------------------------------|---------------------------------|-------------|
| Canada | 1,934 | 1,916 | -0.9 |
| Mexico | 1,136 | 1,197 | +5.4 |
| Saudi Arabia | 1,538 | 1,063 | -30.9 |
| Venezuela | 1,035 | 1,015 | -1.9 |
| Nigeria | 992 | 668 | -32.7 |
| Iraq | 667 | 453 | -32.1 |
| Brazil | 224 | 342 | 52.7 |
| Russia | 127 | 272 | 114.2 |
| Colombia | 182 | 261 | 43.4 |
| Algeria | 308 | 231 | -25.0 |
| Ecuador | 197 | 201 | 2.0 |
| Kuwait | 205 | 183 | -10.7 |
| Equatorial Guinea | 60 | 91 | 51.7 |
| United Arab Emirates | 7 | 62 | 785.7 |
| Total (top 15) | 8,612 | 7,955 | -7.6 |

Source: EIA, *Crude Oil and Total Petroleum Imports Top 15 Countries* (Washington, D.C.: DOE, 2009).

The fact that the energy infrastructure of both Canada and Mexico are highly interconnected with U.S. markets (particularly so for Canada) makes each country a sort of extension of the U.S. homeland, at least insofar as energy security is concerned. The United States is interested not only in the steady evolution of both conventional and non-conventional sources of oil and gas in each of its North American partners, but also in the safety, integrity and efficiency of any critical infrastructure. In this regard, the projected rapid decline of Mexican crude oil production (described more fully later in this chapter) may impact the U.S. energy supply. Potential

impediments to the import of Canadian crude from the oil sands due to environmental considerations may also create some energy security concerns in the United States.

4.4 Energy security: A Canadian perspective

As noted earlier, Canada is a significant producer of energy and, based on future reserves and its trading relationship with the United States, is poised to remain a significant energy exporter for many years to come. Over the past 30 years, Canada's total energy production has increased by 87 per cent while its total energy consumption has increased by only 44 per cent. With 99 per cent of its energy exports going south of the border, Canada is the largest single supplier of energy to the United States.⁴¹ Canada is the world's largest producer of uranium, third-largest producer of natural gas, fifth-largest producer of crude oil, seventh in electricity and thirteenth in coal.⁴² In 2008, Canada realized C\$ 73 billion in revenue from net energy exports.⁴³

Both federal and provincial governments have used energy development as a means for economic growth, with the result that Canada plays a vital role in the North American energy marketplace. Because Canada will remain an energy exporter for the foreseeable future, it could be argued that it already has energy security in the traditional definition. But the reality is that Canada and the United States form a hugely interdependent energy marketplace for products like oil, natural gas and electricity, and without access to this market—and to global markets for uranium and coal—the energy industry would be a fraction of its current size. Moreover, as a significant importer of oil and oil products from the Atlantic Basin and an importer of various energy commodities from the United States, Canada has a stake in the other side of the energy security equation.

Although the Canadian resource base is huge, most of the easily accessed, low-cost resources have been developed. The result is that, particularly for oil and natural gas, the future for fossil fuels lies in unconventional resources such as oil sands and shale gas, or in remote Arctic and offshore supplies—all of which present challenges. These include the need to bring the products long distances to markets, and to import significant amounts of equipment and expertise. All these activities require capital, thus making the availability of capital a potential threat to energy security.

Perhaps the largest threat to Canada's energy security will be how the environment is factored into public policy decisions in Canada and in its biggest market, the United States. The prime target of such policies is the oil sands, although new coal-fired power plants could also be considered. A number of studies have estimated that oil sands-derived products involve a 10 per cent to 30 per cent increase in emissions relative to conventional gasoline and diesel on a well-

⁴¹ EIA, *Country Analysis Brief: Canada* (Washington, D.C.: DOE, 2009).

⁴² IEA, *Key World Energy Statistics: 2009* (Paris: IEA, 2009).

⁴³ National Energy Board, *Canadian Energy Overview 2008* (Calgary: NEB, 2009), p. 3. Available online at: <http://www.neb.gc.ca/clf-nsi/rmgynfmtn/nrgvrprt/nrgyvrvw/cndnrgyvrvw2008/cndnrgyvrvw2008-eng.html>.

to-wheel basis.^{44,45} In the context of advocating a low carbon standard for fuels in California, Mui notes that increased development of marginal, unconventional sources of crude oil (such as tar sands, oil shale and coal to liquids) threatens to offset the benefits of clean energy efforts.⁴⁶ Introduction of market distortions based on environmental concerns is one of the main fears of the oil sands proponents in Canada. In addition, Alvarez, Cleland and Gibbons argued that the continued policy uncertainty in Canada surrounding the issue of climate change will eventually affect investment prospects for oil sands projects coming on stream post-2012, as well as for heavy oil upgraders and new coal-fired electricity generation.⁴⁷

Domestically, although numerous provincial-federal demand-side management programs are in place or planned, to date they have not delivered serious results. Canada remains one of the biggest global energy consumers and carbon dioxide emitters, both on a per capita and per unit of GDP basis.⁴⁸ Over time, in the face of increasing stringency of carbon-reduction policies and the need to reduce imports in some regions of the country, Canada will need to launch a more concerted effort to bring itself in line with other developed countries and major trading partners.

Another potential threat to Canada's energy security arises because its energy resources are unevenly distributed across the country. Different resources are found in different regions, and as a consequence, it is very difficult to articulate a truly national vision when it comes to energy development or policy. Energy resources that are viewed by importing countries as national endowments are more commonly seen in Canada as regional or provincial endowments. The difficulty in articulating a truly national perspective on energy or climate policy leads to further uncertainty in investment circles, which in turn may make raising capital for national energy priorities difficult. In addition, this regional perspective creates interprovincial tensions further hindering progress toward national approaches to energy and environment policy.

Finally, Canadian energy exports rely almost exclusively on one trading partner—the United States. This has served Canada well because the United States is a stable market for Canada's products and significant revenue has been generated. But Canada could be subject to market pressures as a result of environmental issues (such as the passage of low carbon fuel standards or eventual border adjustments on high-carbon-content fuels). As a hedge against these circumstances, many feel that to alleviate future budget security threats, it is now time for

⁴⁴ S. Mui *et al.*, *White Paper: Life Cycle Analysis of Greenhouse Gas Emissions from Tar Sands* (Washington, D.C. Natural Resources Defense Council [NRDC], 2008).

⁴⁵ “Well-to-wheel” refers to a total life cycle assessment of emissions and/or energy associated with all aspects of vehicular transportation, from the point of extraction of the fuel to the point it is used by the car. This takes into account factors such as the impact of extraction and processing of the fuel, transportation of the fuel from the producer to the consumer, vehicle design and efficiency of use.

⁴⁶ S. Mui, *Tar Sands: Risks, Opportunities, and Barriers to Greening the North American Energy Relationship* (Natural Resources Defense Council presentation to UCLA School of Public Affairs, October 22, 2009).

⁴⁷ P. Alvarez, M. Cleland and R. Gibbons, *National Energy Security from an Exporter's Perspective: The Canadian Experience* (prepared for the North Pacific Energy Security Conference, Honolulu December 15-16, 2008). Available online at: <http://www.cwf.ca/V2/files/NationalEnergySecurityJan26.pdf>.

⁴⁸ IEA, *Key World Energy Statistics: 2009*.

Canada to actively look west across the Pacific to pursue trading relationships with some of the world's other top energy consumers—China, Japan, India and the Republic of Korea.

4.5 Energy security: A Mexican perspective

The pivotal problems of the Mexican energy sector are associated with the decline in oil reserves and production, the financial standing of its state-owned oil company, Pemex, and growing dependence on imported fuels.⁴⁹ Proven hydrocarbon reserves have been decreasing in recent years, down to a level equal to 9.3 years of production for petroleum and 9.7 years for natural gas.⁵⁰ Although the government and others persist in officially denying that Mexico has reached the peak of its oil production career, the shrinking of the principal deposit, Cantarell, demonstrates the opposite. The *International Energy Outlook 2009* forecasts that Mexico could become a net oil importer by 2020, with net imports reaching 300,000 barrels per day in 2030. As one of the largest oil exporters to the United States, this has important implications for future U.S. energy supplies. From Mexico's perspective, changing into a net oil importer would have important repercussions upon its economy, due to the federal government's dependence on Pemex for a sizable share of its revenues.^{51,52}

A looming problem relates to the country's high consumption of natural gas across all sectors of the economy, but especially in the power sector. The production of natural gas increased at the rate of 6 per cent a year from 1999 to 2007 to reach 1,976 billion cubic feet in 2007. This has not been enough to cope with the rise in domestic demand, which grew at an average annual rate of 9.7 per cent during the same period. This has led to Mexico moving from being a near-zero natural gas importer in 1999 to having to import 307.7 billion cubic feet in 2007.⁵³

In terms of energy security, Mexico faces issues as a country that is transiting from being an exporter to an importer. As this transition takes place, the federal treasury will continue to shrink because of decreased oil export revenues, with less money available for future energy exploration or improvements to the energy infrastructure⁵⁴—let alone what the revenue drop will mean to social programs and government operations.

⁴⁹ R. Vargas, *Energy Security in Mexico: An Evaluation in Light of St. Petersburg* (Berlin: Freidrich Ebert Stiftung, 2007). Available online at: <http://library.fes.de/pdf-files/iez/global/04690.pdf>.

⁵⁰ Pemex, Annual Statistics, several years; in R. Vargas, p. 2.

⁵¹ EIA, *International Energy Outlook 2009* (Washington, D.C.: Department of Energy, 2009).

⁵² Oil has rapidly become Mexico's most precious natural resource, accounting for about 27 per cent of total exports in 2006, compared with only 8 per cent in 2000, and for upwards of 40 per cent of the revenue side of the federal government's budget. According to Pemex financial statements for 2008, the corporation paid US\$57 billion in taxes and duties. See Pemex, *Pemex Audited Financial Results Report as of December 31, 2008* (Mexico City: Pemex, 2009). Available online at: <http://www.ri.pemex.com/index.cfm?action=content§ionID=19&catID=12168>.

⁵³ EIA, *Mexico Country Analysis Brief*; and EIA, *Mexico Energy Profile: Energy Data Series*. Available online at: http://tonto.eia.doe.gov/country/country_time_series.cfm?fips=MX#ng.

⁵⁴ The country's energy infrastructure needs a desperate upgrade. Over the past decade, Pemex has slashed its maintenance expenditures throughout the country. In 1997 the company had a budget of US\$2.7 billion for

Despite the modest liberalization in Mexico's electricity and gas sectors resulting from the North American Free Trade Agreement (NAFTA), a large question mark remains over whether such liberalization will be extended to the oil sector because of Mexico's insistence on a prominent role for government in energy markets. From a U.S. and Canadian perspective, enhanced participation by private companies, particularly in the exploration and production stages, is desirable if Mexico's oil exports are to be sustained.⁵⁵

As noted earlier, a significant vulnerability facing Mexico comes from threats to its existing infrastructure. Pemex energy facilities are targets for domestic terrorist groups that have already attacked them, as well as international terrorist networks that have threatened to attack the facilities. As the relatively concentrated 70-square-mile Cantarell oil field falls into terminal decline, the country will rely on energy systems that are more geographically dispersed and more susceptible to attack, namely the Chicotepec Basin to compensate. This onshore oil region, northeast of Mexico City, holds about 54 per cent of Mexico's non-Cantarell known reserves. The area will be difficult to protect because it stretches over more than 2,400 square miles. Further, because of complex geology, production projects at the basin will need to be especially infrastructure intensive. Overall, the task of building and protecting an entire network of pipelines and processing facilities appears overwhelming for a nation without a coherent energy security plan.⁵⁶

As Mexico prepares to make the transition from exporter to importer, energy security has become a pressing issue. Mexico's questionable energy security threatens to compound the country's problems with oil production. This interaction will further erode the country's ability to reverse the downhill slide of the oil sector. Mexico faces internal and external threats to energy infrastructure, but has no effective plan to counter such risks. In fact, securing infrastructure is becoming even less of a priority because Pemex's whole focus has shifted entirely to finding more oil and increasing overall production.⁵⁷

maintenance; in 2007 the budget was only US\$1 billion. Funding decreases have become the norm at Pemex because the federal government increasingly siphons off energy revenues to support social programs.

⁵⁵ I. Morales, *Mexico's Energy Policy Options in North America's Continental Energy Markets* (Puebla: American University Center for North American Studies, 2006). Available online at: http://www1.american.edu/ia/cnas/pdfs/workingpaper3_energy.pdf.

⁵⁶ On other fronts of vulnerability: 1) it is likely that the same corruption that has prevented the country from controlling the drug violence within its borders will continue to prevent it from effectively protecting its energy infrastructure; 2) the financial crisis that Pemex currently faces (over US\$111 billion in debt as of April 2008) will further degrade Mexico's ability to protect its energy infrastructure; and 3) state-owned Pemex makes an attractive target for a wide range of dissatisfied Mexicans because damage to the state monopoly directly affects the federal government. See J. Clement, *Energy Security In Mexico: Problems and Implications* (Petroleumworld, 2008). Available online at: <http://www.petroleumworld.com/sati08101801.htm>.

⁵⁷ J. Clemente, 2008.

5. North American energy and climate change relationships

A number of clean energy and climate relationships exist that involve either two or all of the three NAFTA partners. This chapter outlines the most prominent initiatives, describes their mandates and assesses their potential ongoing role in delivery of a North American approach to climate change and energy policy.

5.1 Tri-national relationships

North American Free Trade Agreement

NAFTA has a stand-alone side agreement that relates to environmental matters: the North American Agreement on Environmental Cooperation. It also has a Secretariat charged with administering the agreement: the North American Commission on Environmental Cooperation (CEC). In July 2009 the CEC was given a priority mandate to work on climate change in North America as part of its strategic direction for 2010 through 2015,⁵⁸ but it is unclear what the focus of their work will be. It might provide analysis and a consultation mechanism aimed at policy coordination across the three countries, but to date the CEC has not been particularly prolific on issues related to climate change and energy policy, despite some analytic work in the late 1990's and the early part of this decade on technical issues surrounding development of a North American emission trading system. This may be due to the fact that climate change as an issue has been seen to straddle the mandates of both environment and energy ministries, making it difficult for an environment-led organization to receive sufficient clearance to take on meaningful policy work.

On the energy side, NAFTA's Chapter 6, "Energy and Basic Petrochemicals," includes virtually all forms of energy, ranging from uranium to fossil fuels to electricity. From the Canadian perspective, NAFTA's Chapter 6 prohibits government intervention in the normal operation of North American energy markets, whether in the form of price discrimination (such as through the imposition of export taxes) or direct disruption of supply channels. Mexico has reserved the right to control its own energy resources and has opted out of two articles related to energy:

⁵⁸ CEC, *Commission for Environmental Cooperation (CEC) Ministerial Statement* (Sixteenth Regular Session of the CEC Council, Denver, Colorado, June 24, 2009). Available online at: http://www.cec.org/files/PDF/ABOUTUS/Trilateral%20Ministerial%20Statement%20June%202009_en.pdf.

Article 605 discussed below and Article 607 that deals with energy flows in the face of threats to national security-related scenarios, such as armed conflict.

Article 605 of NAFTA has been interpreted by some to mean that Canada is required to sell a certain percentage of its energy output to the United States, even in the face of a severe domestic shortage. Moreover, such critics argue that NAFTA prevents this percentage from falling over time. Neither of these statements is exactly true. Canadian producers can sell oil to whomever they wish, including, for example, overseas customers. As a result, the share of total output exported to the United States can rise or fall according to the normal forces of supply and demand. The main conditions that NAFTA imposes on Canadian energy products is that all buyers in North America must have equal rights to buy those products and that the Canadian government cannot restrict exports to the United States to the extent that they fall below a rolling three-year historical average.⁵⁹ In essence, the agreement exists between Canada and the United States so that both countries have the security of knowing that their trade in oil, refined petroleum products, natural gas, uranium and electricity cannot be easily blindsided by the other government acting arbitrarily. Policy options for addressing climate change in all North American countries will need to take NAFTA's provisions into account.

Security and Prosperity Partnership of North America

The Security and Prosperity Partnership (SPP) was launched in March 2005 by the leaders of Canada, the United States and Mexico. The SPP aims to, among other things, foster cooperation and information sharing, improve productivity, reduce the costs of trade, increase energy security and enhance joint stewardship of the environment. In 2006 the SPP included in its agenda a two-pronged energy security initiative. The first prong of the initiative aims to diversify energy resources through increased collaboration on research, development and commercialization of clean energy technologies. The second stream involves strengthening the North American energy market by improving transparency and regulatory compatibility, promoting the development of infrastructure, increasing cooperation on energy efficiency standards, and supporting other efforts aimed at addressing challenges on the demand side. The SPP has also brought under its wing the North American Energy Working Group (NAEWG), which began in 2001 and is led by the three energy ministers of Canada, the United States and Mexico. The NAEWG has produced a number of studies, including two editions of the *North American Energy Picture*, the first in 2002 and the second in 2006. While trilateral cooperation on energy science and technology was increased under the NAEWG, its members agreed a more formal framework for collaboration was needed in order to address issues such as ownership of intellectual property rights and to provide the proper legal foundation for funding joint, mutually beneficial projects in science and technology.

In 2007 the countries agreed to the new Trilateral Agreement for Cooperation in Energy Science and Technology to address these issues. The agreement allows for bilateral and trilateral cooperation in mutually beneficial research, development and deployment of a wide range of

⁵⁹ M. Holden. *Canadian Oil Exports to the United States under NAFTA*. Library of Parliament In Brief, 16 November 2006). Available online at: <http://www.parl.gc.ca/information/library/PRBpubs/prb0633-e.pdf>.

energy technologies for peaceful uses, including renewable energy, energy efficiency, nuclear energy, fossil fuels and electricity. Among other areas, this could include advancing the science and technology of low- or zero-emission energy production and end-use technologies, low-carbon fuels, CCS, hydrogen and fuel cell technologies, and technologies to enhance the security of energy infrastructure.

The agreement envisions numerous potential areas of cooperation, including joint studies and projects; the exchange of information on scientific and technical activities and developments; and the exchange of scientific and technical personnel in order to participate in joint studies and projects. Possible cooperative efforts include collaboration among government agencies, universities and other research institutions, private sector firms and others in order to advance science and technology development in all three nations.⁶⁰

The Obama administration appears to have downplayed the SPP. For example, the U.S. SPP website notes, “This website is an archive for SPP documents and will not be updated.”⁶¹ However, the SPP has fostered the annual meetings of leaders of Mexico, the United States and Canada, so the opportunity for leader-level coordination will remain within whatever forum emerges.

The August 2009 *North American Leaders’ Declaration on Climate Change and Clean Energy* outlined a vision for a low-carbon North America and endorsed the need for a global goal of a 50 per cent emission reduction by 2050, including recognition that developed countries should reduce emissions by 80 per cent or more from 1990 or later years by 2050.⁶² Leaders underscored the importance of developing and strengthening financial instruments, involving both public and private sector funding, to support mitigation and adaptation actions. They pledged to communicate and work together on mid- and long-term goals to reduce national and North American emissions, but made it equally clear that each nation would “set and implement [its] own ambitious mid-term and long-term goal.” Other pledges included:

- Developing comparable approaches to measuring, reporting and verifying emission reductions, including cooperating in implementing facility-level greenhouse gas reporting throughout the region.
- Building capacity and infrastructure with a view to facilitate future cooperation in emission trading systems.
- Collaborating on climate-friendly and low-carbon technologies, including building a smart grid in North America for more efficient and reliable electricity inter-connections, as well as regional cooperation on CCS.

⁶⁰ NRCan, *Trilateral Agreement for Cooperation in Energy Science and Technology: Backgrounder* (Ottawa: NRCan, 2007). Available online at: <http://www.nrcan-rncan.gc.ca/media/newcom/2007/200766a-eng.php>.

⁶¹ Spp.gov, *Security and Prosperity Partnership of North America*. Available online at <http://www.spp.gov/>.

⁶² *North American Leaders’ Declaration on Climate Change and Clean Energy*. 10 August 2009, Guadalajara, Mexico. Available online at: <http://pm.gc.ca/eng/media.asp?category=5&id=2724>.

- Working together under the Montreal Protocol to phase down the use of hydrofluorocarbons.
- Cooperating in protecting and enhancing forests, wetlands, croplands and other carbon sinks, as well as developing appropriate methodologies to quantify, manage and implement programs for emission reductions in this sector.
- Reducing transportation emissions by striving to achieve carbon-neutral growth in the North American aviation sector in the context of global action.
- Pursuing a framework to align energy efficiency standards in the three countries in support of improved national energy efficiency and environmental objectives.
- Working to reduce greenhouse gas emissions in the oil and gas sector, including promoting best practices in reducing fugitive emissions and the venting and flaring of natural gas.

A report on progress will be made in 2010.

North American Electricity Reliability Corporation

Since 1968, NERC⁶³ has been committed to ensuring the reliability of the bulk power system in North America.⁶⁴ To achieve that, NERC develops and enforces reliability standards that are the planning and operating rules that electric utilities follow to ensure the maintenance and improvement of the electric power system in North America. NERC also assesses the adequacy of the power system's reliability and capacity annually via a 10-year forecast and winter and summer forecasts. It also monitors the bulk power system on an ongoing basis and educates, trains, and certifies industry personnel. NERC is a self-regulatory organization, subject to oversight by the U.S. Federal Energy Regulatory Commission and governmental authorities in Canada.

As of June 18, 2007, the U.S. Federal Energy Regulatory Commission (FERC) granted NERC the legal authority to enforce reliability standards with all U.S. users, owners and operators of the bulk power system, and it made compliance with those standards mandatory and enforceable. Reliability standards are also mandatory and enforceable in Ontario and New Brunswick, and NERC is seeking to achieve comparable results in the other Canadian provinces. NERC has also indicated its intent to seek recognition in Mexico.

⁶³ NERC was originally constituted as a "council" but recently changed to a "corporation".

⁶⁴ NERC defines a reliable bulk power system as one that is able to meet the electricity needs of end-use customers even when unexpected equipment failures or other factors reduce the amount of available electricity. NERC divides reliability into two categories: 1) adequacy: having sufficient resources to provide customers with a continuous supply of electricity at the proper voltage and frequency virtually all of the time; and 2) security: having the ability to withstand sudden, unexpected disturbances such as short circuits or unanticipated loss of system elements due to natural causes. In today's world, the security focus of NERC and the industry has expanded to include withstanding disturbances caused by man-made physical or cyber attacks. See NERC, *Company Overview: FAQ* (2009). Available online at: <http://www.nerc.com/page.php?cid=17|114>.

NERC's status as a self-regulatory organization means that it is a non-governmental organization that has statutory responsibility to regulate users, owners and operators of the bulk power system through the adoption and enforcement of standards for fair, ethical and efficient practices.

One of NERC's key contributions to the overall clean energy and climate change agenda is the early identification of infrastructure improvements that will be needed to meet future energy needs—in particular, how to integrate substantial new amounts of renewable energy into the North American grid.

5.2 Bilateral relationships

U.S.-Mexico Bilateral Framework on Clean Energy and Climate Change

The U.S.-Mexico Bilateral Framework on Clean Energy and Climate Change was established by the leaders of the United States and Mexico in April 2009 to elaborate joint efforts required to achieve a low-carbon future and a clean energy economy. The bilateral framework establishes a mechanism for political and technical cooperation and information exchange, and facilitates common efforts to develop clean energy economies.

The bilateral framework focuses on renewable energy, energy efficiency, adaptation, market mechanisms, forestry and land use, green jobs, low-carbon energy technology development and capacity building. The framework will also build upon cooperation in the border region to promote efforts to reduce greenhouse gas emissions, adapt to the local impacts of climate change in the region, and strengthen the reliability and flow of cross-border electricity grids. The framework will also facilitate the ability of neighbouring border states to work together to strengthen energy trade. The framework makes specific mention of the need to build capacity in Mexico and to exchange expertise in technology, policy and market design.⁶⁵

U.S.-Canada Clean Energy Dialogue

The Clean Energy Dialogue was established between the leaders of the United States and Canada in February 2009 to enhance joint collaboration on the development of clean energy science and technologies to reduce greenhouse gas emissions and combat climate change. The three focal areas are developing and deploying clean energy technology, building a more efficient energy grid based on clean and renewable generation, and expanding research and development in clean energy.

The first report of the Clean Energy Dialogue was presented in September 2009 to Prime Minister Harper and President Obama.⁶⁶ On CCS, the report states that the countries will expand

⁶⁵ America.gov, *U.S., Mexico Announce Agreement on Energy, Climate Change* (April 16, 2009). Available online at: <http://www.america.gov/st/texttrans-english/2009/April/20090417095126eafas0.7790949.html>.

⁶⁶ U.S. - Canada Clean Energy Dialogue, *First Report to the Prime Minister of Canada and the President of the United States of America* (September 16, 2009, Ottawa, Ontario). Available online at: <http://www.pm.gc.ca/eng/media.asp?id=2822>.

on existing collaboration in carbon dioxide injection and storage testing, share information from large-scale CCS demonstration projects, and work together to map carbon dioxide sources and geological storage opportunities. The report commits Canada and the United States to working toward a consistent regulatory framework between the countries, which would include compatible CCS project rules, standards and monitoring, as well as verification and accounting principles. Bilateral meetings between Canadian and American CCS experts are planned in mid-2010 and in 2011 to share best practices and provide updates on joint activities. The two nations intend to form the "Canada-U.S. CCS Collaboration" under the existing Trilateral Energy Science and Technology Agreement, which also includes Mexico, and hope to formalize the arrangement through an implementation agreement by the end of 2009.

As a result of the continued growth in electricity demand, collaboration between the two nations regarding the North American power grid will focus on the open exchange of information and electricity research, development and deployment (RD&D), reliability standards, cyber security and interoperability guidelines. Upgrades to the electric power grid will aim to increase its efficiency and promote connection to clean energy sources, as well to increase the use of clean energy technologies.

Joint commitments regarding clean energy RD&D are meant to boost economic opportunities for the Clean Energy Dialogue partners. The two are to develop a clean energy RD&D collaboration framework and a technology roadmap which would allow both nations to meet their respective 2050 greenhouse gas reduction targets. The framework and roadmap would foster a unique North American market through common codes, standards and incentives, along with collaborative research and development, and sharing of information, facilities and scientific infrastructure.

The Canada-Mexico Partnership

The Canada-Mexico Partnership was established in 2004. In 2007 new working groups on labour mobility and environmental and forestry cooperation were added to the existing working groups in the areas of agribusiness, energy, housing and community development, human capital, and trade, investment and innovation.⁶⁷ The energy working group is designed to enhance cooperation and technical strategic alliances in the energy field between the public and private sectors of Canada and Mexico through three technical committees: electricity, upstream hydrocarbons, and infrastructure and market development. In 2007 the energy working group meeting was the first to include the participation of Canadian provinces and Mexican states. The Alberta Department of Energy was represented, along with the states of Tamaulipas and Tabasco. Alberta continues to be represented in the upstream hydrocarbons technical committee through the Alberta Office in Mexico. The environment subgroup of the environment and forestry working group is pursuing an ongoing policy dialogue on Canada's and Mexico's respective domestic approaches to tackling climate change in the post-2012 era. In addition, the

⁶⁷ Canada-Mexico Partnership, *Annual Report 2007-08*. Available online at: <http://www.canadainternational.gc.ca/mexico-mexique/assets/pdfs/CMPreport-rappor08.pdf>.

working group is exploring opportunities and funding for cooperation on clean technology projects.

The Canada-Mexico Partnership is somewhat unique in that it involves active participation of members of the private sector as co-chairs of the working groups. Membership is fluid, with participation in the working groups subject to the invitation of the co-chairs. Participants are drawn from a wide variety of organizations and enterprises for each sector. The partnership meets annually to bring together all of the working groups to review progress and set the agenda for the following period. It last met in March 2009 in Mexico.

5.3 Regional initiatives (sub-national)

Provincial and state governments participate in a number of initiatives. Given that control over energy resources is constitutionally assigned to Canada's provincial governments and that approaches to climate change vary from province to province and from state to state in the United States, it is not surprising to have regional approaches to climate issues in the absence of agreed federal approaches. Three regional climate change initiatives currently operate in North America: the Western Climate Initiative (WCI), the Regional Greenhouse Gas Initiative (RGGI) and the Midwestern Greenhouse Gas Reduction Accord.

The Western Climate Initiative

Launched in 2007, the WCI includes British Columbia, Manitoba, Ontario and Quebec as participants along with Arizona, California, Montana, New Mexico, Oregon, Utah and Washington. Two provinces, Nova Scotia and Saskatchewan, are observers to the WCI. U.S. observers include Colorado, Idaho, Kansas, Nevada and Wyoming. The six Mexican states along the Mexican-U.S. border are also observers.⁶⁸ The WCI aims to cut emissions to 15 per cent below 2005 levels by 2020 and includes the development of a regional cap-and-trade system to help attain that goal. The recommended design will provide opportunities to obtain low-cost emission reductions through emission trading, allowance banking, and inclusion of an offsets component. The program can stand alone, provide a model for, be integrated into, or be implemented in conjunction with programs that might ultimately emerge from the federal governments of the United States and Canada.⁶⁹ The first compliance period is planned for 2012 to 2014 with two subsequent compliance periods, from 2015 to 2017 and from 2018 to 2020.⁷⁰

⁶⁸ From west to east: Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon and Tamaulipas.

⁶⁹ WCI, *Design Recommendations for the WCI Regional Cap-and-Trade Program* (23 September 2008). Available online at: <http://www.westernclimateinitiative.org/component/remository/general/design-recommendations/Design-Recommendations-Section-1/>.

⁷⁰ WCI, *Milestones* (2009). Available online at: <http://www.westernclimateinitiative.org/milestones>.

Midwestern Greenhouse Gas Reduction Accord

On November 15, 2007, the governors of Illinois, Iowa, Kansas, Michigan, Minnesota and Wisconsin and the premier of Manitoba entered into the *Midwestern Greenhouse Gas Reduction Accord*. The Accord calls for the establishment of targets for greenhouse gas emission reductions and timeframes consistent with states and provincial targets and for the development of a regional cap-and trade program design. In June 2009 a draft set of recommendations for the design of the system was presented with the intention of influencing debate on U.S. federal cap-and-trade legislation with a view to ensuring that “any future federal program recognizes the particular resources and special economic circumstances of the Midwestern region.”⁷¹

Regional Greenhouse Gas Initiative

The RGGI is a mandatory program designed to reduce carbon dioxide emissions from the power sector in 10 northeast and mid-Atlantic States by 10 per cent from 2009 levels by 2018. The states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont are signatory states to the RGGI agreement. Through independent rules and regulations, each state limits emissions of carbon dioxide from electric power plants, creates carbon dioxide allowances and establishes participation in carbon dioxide allowance auctions. Fossil fuel-fired electric power plants of 25 megawatts or greater are covered by the program (approximately 225 facilities among the 10 states). Auctions are scheduled on a quarterly basis. To date, five auctions have been held, with a total of over 134 million 2009 vintage allowances and 6.5 million 2012 vintage allowances raising over US\$432 million. Average clearing prices for 2009 vintage allowances in the first four auctions ranged from US\$3.07 to US\$3.51, while the last auction in September 2009 saw prices fall to US\$2.19.⁷²

5.4 Multinational initiatives

In addition to being members of the Organisation for Economic Co-operation and Development and the Group of 20 (G-20), Canada, Mexico and the United States are parties to or members of a number of energy and climate related initiatives. All are parties to the United Nations Framework Convention on Climate Change (UNFCCC) and Canada and Mexico are parties to the Kyoto Protocol.

Each country participates in the Major Economies Forum on Energy and Climate that was announced in March 2009. The forum is intended to facilitate a candid dialogue among major developed and developing economies, help generate the political leadership necessary to achieve a successful international agreement, and advance the exploration of concrete initiatives and joint ventures that increase the supply of clean energy while cutting greenhouse gas emissions. In addition to Canada, Mexico and the United States, the other 14 participating countries/blocs are:

⁷¹MGGRA, *Draft Final Recommendations of the Advisory Group* (June 2009). Available online at: <http://www.midwesternaccord.org/GHG%20Draft%20Advisory%20Group%20Recommendations.pdf>.

⁷²RGGI, *Regional Greenhouse Gas Initiative: Welcome* (2009). Available online at: <http://www.rggi.org/>.

Australia, Brazil, China, the European Union, France, Germany, India, Indonesia, Italy, Japan, Korea, Russia, South Africa, and the United Kingdom.

Canada and the United States participate in the Asia-Pacific Partnership on Clean Development and Climate. The seven partners in this group have agreed to work together and with private sector partners to meet goals for energy security, national air pollution reduction and climate change in ways that promote sustainable economic growth and poverty reduction.⁷³ The partnership focuses on expanding investment and trade in cleaner energy technologies, goods and services in key market sectors. The partners have approved eight public-private sector task forces covering aluminum, buildings and appliances, cement, cleaner fossil energy, coal mining, power generation and transmission, renewable energy and distributed generation, and steel.

All three countries participate in the Carbon Sequestration Leadership Forum, a Ministerial-level international climate change initiative that is focused on the development of improved, cost-effective technologies for the separation and capture of carbon dioxide for its transport and long-term safe storage. The mission of the forum is to facilitate the development and deployment of such technologies via collaborative efforts that address key technical, economic and environmental obstacles. The Carbon Sequestration Leadership Forum also promotes awareness and champions legal, regulatory, financial and institutional environments conducive to such technologies. The forum is currently comprised of 24 members, including 23 countries and the European Commission.⁷⁴

Canada, Mexico and the United States participate in the Methane to Markets Partnership, an international initiative that advances cost-effective, near-term methane recovery and use as a clean energy source. The goal of the partnership is to reduce global methane emissions in order to enhance economic growth, strengthen energy security, improve air quality, improve industrial safety and reduce emissions of greenhouse gases.⁷⁵

Canada and the United States participate in the Global Nuclear Energy Partnership, which brings together 17 countries that share a common vision of the necessity of the expansion of nuclear energy in a safe and secure manner. The partnership aims to accelerate development and deployment of advanced fuel cycle technologies to encourage clean development and prosperity, improve the environment and reduce the risk of nuclear proliferation.⁷⁶

⁷³ Other members are Australia, China, India, Japan and Korea. Together the seven partner countries collectively account for more than half of the world's economy, population and energy use, and they produce about 65 per cent of the world's coal, 62 per cent of the world's cement, 52 per cent of world's aluminum, and more than 60 per cent of the world's steel.

⁷⁴ Carbon Sequestration Leadership Forum, *Home* (2009). Available online at: <http://www.cslforum.org>.

⁷⁵ Methane to Markets, *Home* (2009). Available online at: <http://www.methanetomarkets.org/>.

⁷⁶ Global Nuclear Energy Partnership, *Global Nuclear Energy partnership Statement of Principles* (September 16, 2007). Available online at: http://www.gneppartnership.org/docs/GNEP_SOP.pdf.

5.5 Assessment of relationships in the context of North American energy and climate policy

The aforementioned nineteen forums, agreements and partnerships all provide opportunities for the three countries to work toward common ground on clean energy, climate change, and the infrastructure and financing needed to implement a clean energy agenda. Each has its own specific purpose and operating culture. Each is at varying stages of implementing their work programs. Some have more momentum than others, and some are in the midst of rejuvenating their mandate to embrace emerging priorities in energy and climate change.

In the context of further bringing together Canada, Mexico and the United States to deal with energy and climate change, a number of observations can be made.

First, there is no one single forum in which an energy and climate pact for North America could be built. Rather, if one emerges, it will feature the pieces that have worked best in each of the arrangements described above.

Second, in the near term, the North American Leaders' Declaration on Climate Change and Clean Energy could provide a starting point for some of the supporting features required to more closely link the three countries in climate and energy. These include exploring ways to link carbon markets, moving toward common reporting systems for greenhouse gas emissions, and cooperating in the building of smart grids and in CCS technology deployment. Other concrete measures such as pursuing carbon neutrality in the aviation sector and the sharing of best practices in reducing fugitive emissions and reducing venting and flaring in oil and gas operations, have the potential to achieve early successes on which to continue building momentum.

With it looking unlikely now that President Obama will move to re-open NAFTA, there is an opportunity to explore ways to re-energize work under NAFTA. The CEC is a case in point. Up to now, the commission has not played a significant role in climate change. Yet, it has built considerable credibility in coordination of data, reporting and measuring pollutants, and measuring the effect of measures taken to improve the environment in NAFTA countries. With measurement, reporting and verification (MRV) emerging as a key theme going forward internationally from COP 15 in Copenhagen, it would seem a natural extension of the CEC mandate to support international MRV efforts in North America. Another role for NAFTA, at least in the short term, could be to help ease the tension surrounding measures that are being contemplated in the United States to address competitiveness concerns arising from taking action on climate change. Some sort of agreement among NAFTA countries to temporarily suspend border adjustment measures could be helpful until such time as the World Trade Organization can develop a framework to deal with these competitiveness issues.

Regional initiatives such as the WCI, the RGGI and the Midwestern Greenhouse Gas Reduction Accord have been very helpful in demonstrating the usefulness of carbon markets and providing guidance for the design of trading systems. As well, they serve as a backstop in case national cap-and-trade legislation is not possible in the short term. However, for carbon markets to function properly, and to avoid leakage from states and provinces not covered by a regional

program, the regional initiatives will need to be replaced by national programs administered at the federal level in both Canada and the United States.

The bilateral initiatives among the three countries will provide good opportunities for cooperation. In particular, the Canada-U.S. Clean Energy Dialogue could build on some early successes, perhaps in relation to smart grids and CCS, to help build its credibility. Both the U.S.-Mexico and Canada-Mexico bilateral agreements could provide the vehicle for capacity building efforts.

Finally, the participation of the leaders of each of Mexico, Canada and the United States in initiatives such as the G-20 and the Major Economies Forum on Energy and Climate provide important and frequent opportunities to find areas of common ground and to generate political momentum toward concrete measures to cooperate on energy and climate issues within North America.

6. Areas for climate change and energy collaboration

The preceding chapter demonstrated that many clean energy and climate change initiatives are underway or planned within a variety of institutional relationships among the NAFTA countries. In pursuing a low-carbon future, each of Canada, Mexico and the United States has indicated its intention to set its own medium- and long-term greenhouse gas emission targets and to develop and implement climate plans and programs account for national circumstances. However, the high degree of interconnectedness of the energy systems of each country makes it imperative that, at a minimum, national actions take into account NAFTA partners' energy needs and resources. Ideally, the three countries will consider areas for collaboration where common action may lead to more environmentally and economically effective approaches. These areas of cooperation can be grouped into three broad themes: policy, technology research and development, and capacity building. They could be pursued either bilaterally or trilaterally, as appropriate.

6.1 Policy collaboration

Opportunities exist to coordinate efforts, particularly between Canada and the United States, related to carbon pricing. Both countries have indicated their intention to pursue emission reduction targets in the most cost-effective manner possible.⁷⁷ The prominent policy tool at this stage in both countries is a cap-and-trade system that would cover a significant portion of industry and would allow for offset credits from a variety of both domestic and international actions. Finding means to link these national systems or even creating a common trading system would likely increase liquidity in the market and improve economic efficiency, and should be explored. Mexico can play an important role in this discussion as a potential source of offsets. Specific areas of collaboration could include addressing design issues such as the overall cap, scope of coverage, methods to reduce price volatility, means to harmonize a cap-and-trade system with carbon taxes, the role of domestic and international offsets, allocation methods, MRV methods and institutional arrangements.

The approaches that may be put in place in each country to deal with real or perceived competitiveness issues could become a trade irritant. Chapter 7 discusses in more detail the

⁷⁷ See for example, the November 13, 2009 speech by the Honorable Jim Prentice, Canadian minister of environment, to the Edmonton Chamber of Commerce. Available online at: <http://www.ec.gc.ca/default.asp?lang=En&n=6F2DE1CA-1&news=757C0154-3353-4BB4-B2F3-9E095A0DA33E>.

potential border adjustments contained in the Waxman-Markey and Kerry-Boxer bills, and the low-carbon fuel standard adopted in California. Collaborative action, perhaps under the umbrella of NAFTA, may be possible to at least temporarily reduce the tension that currently surrounds the potential future imposition of border adjustments.

Increasing energy efficiency will be a priority in the national plans of all three countries, motivated by energy security concerns as well as realizing the associated emissions reductions. One area of potential collaboration is to explore common energy efficiency standards and demand side management programs.

Sectoral approaches to dealing with climate change may offer an opportunity for coordinated action. The national leaders have already committed to exploring a North American approach to the aviation industry. Perhaps other sectors, such as cement manufacturing or steel making, are potential candidates for coordinated North America-wide approaches.

MRV will play an important role in the architecture of any agreement that will follow COP 15 in Copenhagen. Similarly, with all of the various North American dialogues, partnerships, and other approaches underway or contemplated, MRV will be an important part of any trilateral cooperation. In this regard, as already noted in Chapter 5, the CEC under NAFTA might be suitably experienced to support common approaches to MRV within the region.

Finally, the political direction that emerged from COP15 in Copenhagen will likely need to be elaborated and codified for inclusion in a future international climate change agreement. The G8/G20 meetings scheduled for 2010 in Canada and the COP 16 scheduled for Mexico in late 2010 both provide opportunities for continued North American cooperation and influence.

6.2 Technology research, development and deployment

CCS holds significant potential for future deployment to help offset emissions related to coal-fired power generation. Canada and the United States have each devoted significant funding to CCS demonstration projects and research. Further cooperation and research may be possible in addressing other issues related to CCS including determining the applicability of CCS to other activities (such as oil sands operations), assessment of environmental risks associated with CCS, building public awareness of CCS, and developing the regulatory framework needed to deal with liability, secure storage, and storage sites that cross international borders. As noted in Chapter 5, the Asia-Pacific Partnership on Clean Development and Climate and the Carbon Sequestration Leadership Forum might offer opportunities for increased collaboration on CCS.

Other areas where collaboration may be possible include development of enabling technology related to the building of smart grids, research and technology development related to climate change adaptation, research on methods to improve management of natural carbon sinks in the agricultural and forestry sectors, and development of innovative financing methods to encourage increased private sector investment in the low-carbon and clean energy technologies of the future.

6.3 Capacity building

Sharing experiences among all three countries affords the opportunity to help build the capacity needed to design national plans, policies and programs to reduce emissions and develop sustainable energy systems for the future. Numerous references to capacity building and transfer of know-how have been made in the context of separate U.S.-Mexico and Canada-Mexico bilateral arrangements.

7. Potential trade irritants

Climate change policy and regulation in one country have the potential to impact on trade relations between countries. Potential trade irritants in North America include protectionist policies, particularly on the part of the United States. The highly integrated nature of the energy sector means that potential border adjustments, low-carbon fuel standards and “buy American” provisions of the stimulus package are a concern in Canada and Mexico.

7.1 Border adjustments

The American Clean Energy and Security Act of 2009, which was passed by the U.S. House of Representatives on June 26, 2009, would open the door after 2020 for the United States to impose border adjustments to safeguard the competitiveness of U.S. manufacturing industries facing foreign competitors not subject to comparable emission reduction regulation. The Kerry-Boxer bill (*Clean Energy Jobs and American Power Act*) contains similar provisions.

The American Clean Energy and Security Act has a number of other provisions that are designed to protect U.S. industry before the president would be called upon to implement border adjustment measures. Up to 15 per cent of allowances will be given to energy-intensive industries beginning in 2014 and decreasing thereafter. Allocation is based on a formula that is designed to keep these industries competitive against imports from countries that do not impose mandatory emission reduction requirements. Although the bills do not list covered industries, they contain eligibility factors based on energy or greenhouse intensity and exposure to international trade.⁷⁸ If the 15 per cent does not provide enough allowances, then the allowances are distributed on a pro rata basis. Then if, by 2018, the United States is not a party to a multilateral agreement that binds all major emitting countries to contribute equitably to the reduction of greenhouse gas emissions and addresses competitive imbalances that lead to carbon leakage, and if the president makes various other findings, the president may install the equivalent of a border adjustment program for each eligible industrial sector. This represents a form of border tax, as it raises the cost of imported goods to a level similar to that of their domestically produced counterparts. This provision is set to take effect automatically in all eligible sectors, unless the president determines, and Congress agrees, that the adjustment is not

⁷⁸ The Pew Center on Global Climate Change identifies the main industries as steel, aluminum, pulp and paper, cement and some chemicals (particularly nitrogenous fertilizers). See Pew Center on Global Climate Change, *Addressing Competitiveness in U.S. Climate Change Policy* (Congressional Policy Brief, Fall 2008). Available online at: <http://www.pewclimate.org/acesa/addressing-competitiveness>.

necessary for a given sector. It would also not take effect in a given sector if at least 85 per cent of the sector's imports come from countries meeting one or more of the following criteria:

- The country is party to an international treaty and has agreed to emissions reductions at least as stringent as those in the United States.
- The country is party to an international sectoral agreement to which the United States is a party.
- The country has an energy or greenhouse gas intensity in that sector no higher than that those in the United States.

The border tax also does not apply to imports from least developed countries or nations that account for less than 0.5 per cent of global greenhouse gas emissions and less than 5 per cent of U.S. imports in a particular sector.⁷⁹

The legality in relation to trade law of such border adjustments applied to Canadian exports of crude oil derived from the oil sands is in question. NAFTA contains a number of obligations that limit the extent to which Parties can discriminate between like goods (for example, dirty and clean oil) at the border. Similarly, the World Trade Organization legality of the use of border adjustments is an issue.

While the intent of including the border adjustments as a backstop was to force countries like China and India to adopt similar emission reduction measures, there are legitimate concerns in Canada about the American Clean Energy and Security Act. If border adjustment measures are included and Canada is deemed to not be legally committed to taking sufficient action on climate change, Canadian exports in not only oil and gas, but other sectors, such as iron and steel, aluminum, cement, pulp and paper, and chemicals, could be affected as well. Of course, if Canada were to match the effort on climate change being made by the United States, then the border adjustments would not be necessary.

7.2 Energy Independence and Security Act of 2007 and California's low-carbon fuel standard

Under Section 526 of the Energy Independence and Security Act of 2007, U.S. federal agencies are restricted from entering into contracts to purchase synthetic, alternative or non-conventional fuels with higher emissions than their conventional counterparts, unless the life cycle of their greenhouse gas emissions are the same as or less than emissions from conventional petroleum sources. Table 11 shows clearly that crude from Canadian oil sands would fall under this restriction. Mexican imports would be far less affected.

Considerable discussion with respect to the interpretation and application of Section 526 has arisen in both Canada and the United States. The drafters of Section 526 have acknowledged that the section was originally intended to prevent the U.S. Air Force from procuring coal-to-liquid fuels, which are estimated to produce almost double the greenhouse gas emissions of

⁷⁹ Pew Center on Global Climate Change, *Addressing Competitiveness Issues in Climate Legislation*.

conventional fuels. Despite the original intent, the wording of Section 526 is of concern to oil sands producers, since oil sands crude is often referred to as non-conventional petroleum. However, no statement of purpose was included in the Energy Act to limit the scope of section 526 and preclude an expansive interpretation. In addition, on March 17, 2008, Representative

Table 11. Average Per-Barrel Emissions Relative to the Average Barrel Consumed in the United States (%)

| Source | Production, upgrading and transport to refinery | Refining and Finished Fuel Transport | Total well-to-tank | Total well-to-wheels |
|--------------------------|---|--------------------------------------|--------------------|----------------------|
| Canada (oil sands) | 252 | 135 | 185 | 117 |
| Venezuela (bitumen) | 221 | 129 | 168 | 114 |
| Nigeria | 300 | 57 | 162 | 113 |
| Mexico | 96 | 159 | 131 | 106 |
| Venezuela (conventional) | 66 | 129 | 101 | 100 |
| Canada (conventional) | 88 | 107 | 98 | 99 |
| Saudi Arabia | 63 | 119 | 95 | 99 |
| United States domestic | 62 | 82 | 73 | 94 |

Note: Figures are based on the average for U.S. imports from each source. Emissions in the first column normally occur in the country where the crude is produced; emissions in the second column are much more likely to occur in the United States. Higher figures indicate relatively dirtier sources.

Source: Based on numbers for diesel in K. J. Gerdes and T. J. Skone *Consideration of Crude Oil Source in Evaluating Transportation Fuel GHG Emissions* (Washington, D.C.: National Energy Technology Laboratory, 2009).

Harry Waxman, chair of the House oversight and government reform committee and an author of the legislation, wrote a letter to Representative Jeff Bingaman, chair of the Senate energy and natural resources committee clarifying the intention of Section 526, saying that it prohibits U.S.

government agencies, including the military, from purchasing “fuels derived from tar sands.”⁸⁰ This has resulted in ongoing confusion on both sides of the U.S.-Canada border.

But of more direct threat to Canada’s oil sands is the Low-Carbon Fuel Standard (LCFS) adopted by the California Air Resources Board on April 23, 2009. The LCFS will require fuel providers in California to ensure that by 2020 the mix of fuel they sell into the California market is reduced, on average, by 10 per cent from the carbon dioxide equivalent gram per unit of fuel energy sold in 2010. The standard will be measured on a life cycle basis in order to include all emissions from fuel consumption and production, including the “upstream” emissions that are major contributors to the global warming impact of transportation fuels.⁸¹

Under the LCFS, fuel providers will have at least three different options for compliance:

- Blend or sell an increasing amount of low-carbon fuels.
- Use previously banked credits.
- Purchase credits from fuel providers that have earned credits by exceeding the LCFS requirements.

California’s move to reduce carbon dioxide emissions from transportation fuels could change the entire North American energy market, as fifteen other U.S. states and two Canadian provinces have pledged to follow suit. The fact that California is determined to diversify away from hydrocarbons worries those in the energy industry, particularly oil sands developers in Alberta. While current sales from Alberta to California represent less than 1 per cent of the state’s total supply, Alberta producers are counting on the future potential of that market. California is the largest gasoline consumer in the United States and the state’s own oil production, as well as that of Alaska, its other key domestic supplier, is in decline.

Equally troublesome for oil sands producers is the potential for an LCFS to be enshrined in federal legislation. In May 2007 then-senator Barack Obama introduced the Low-Carbon Fuel Standard Act of 2007, which made it to second reading and died following referral to the Senate committee on environment and public works.⁸² A LCFS that was contained in the original draft of the American Clean Energy and Security Act of 2009 was dropped from the final bill in the face of opposition from oil companies. The draft LCFS would have replaced the renewable fuels standard in 2023 and prevented total carbon emissions associated with fuel production and use from growing in the interim. Although the Kerry-Boxer bill does not include an LCFS, the U.S.

⁸⁰ C. Arsenault, “Oil Sands – Part 3: Biggest Customer has Second Thoughts,” *IPS* (20 October 2008). Available online at: <http://www.ipsnews.net/news.asp?idnews=44354>.

⁸¹ D. Crane and B. Prusnek, *The Role of a Low Carbon Fuel Standard in Reducing Greenhouse Gas Emissions and Protecting Our Economy* (Sacramento: Office of the Governor, Arnold Schwarzenegger, 2007) Available online at: <http://gov.ca.gov/index.php/?fact-sheet/5155/>.

⁸² Congressional Research Service, *S. 1324: National Low-Carbon Fuel Standard Act of 2007: Congressional Research Service Summary* (May 7, 2007). Available online at: <http://www.govtrack.us/congress/bill.xpd?bill=s110-1324&tab=summary>.

Environmental Protection Agency has waived its opposition to states' implementing fuel standards, thus opening the door for other states besides California to implement such standards.

As with the potential border adjustment provisions of the American Clean Energy and Security Act, California's Low-Carbon Fuel Standard and other similar provisions that make their way into U.S. domestic law will at least be a trade irritant, and may be the source of future trade challenges under NAFTA or through the World Trade Organization.

7.3 “Buy American” provisions of the U.S. stimulus package

In February 2009 Congress passed the American Recovery and Reinvestment Act (ARRA). The ARRA includes a large number of funding opportunities and tax incentives to support investment in clean energy at the local level. Among the more controversial portions of the ARRA are the “Buy American” provisions. Although the Obama administration has issued two sets of interim guidance for implementing the Buy American rules at the federal, state and local levels, many ambiguities remain that have the potential for delaying or scuttling renewable energy projects.

On July 29, 2009, the U.S. Department of Energy issued US\$30 billion in lending authority to support loan guarantees for renewable energy and transmission projects. Unlike the tax provisions, loan guarantees are in Division “A” of the ARRA. As members of this classification, recipients of ARRA funds must comply with the Buy American provisions. Because the Buy American provisions only apply to ARRA funds given for construction, repair, alteration and so on of public works or public buildings, by definition the Buy American provisions of ARRA should not apply to loan guarantees for private projects. However, in the case of renewable energy projects that are being developed by private entities for eventual operation under a power purchase agreement by a government entity, or where the option exists for a government entity to buy the facility, would there be a requirement to source all components using U.S. technology? These questions have not been addressed squarely in the interim guidance and will need to be resolved in the future.⁸³ How much of an issue this will be between Canada, Mexico and the United States is difficult to say at this stage. However, taken more broadly to the European Union and Chinese technology suppliers, how these provisions are resolved may slow the pace at which clean energy projects are deployed in the United States.

⁸³ D. J. Heffner, *Ambiguities in ‘Buy American’ rule hamper renewable energy projects* (Association of Corporate Council, September 30, 2009). Available online at: <http://www.lexology.com/library/detail.aspx?g=420a8379-631f-4f19-89a9-dc003f40cfb5>.

8. Boundary climate regime scenarios

This chapter outlines two hypothetical boundary climate policy scenarios that could occur in North America. Boundary scenarios take into account a range of possible policy outcomes, but are not a prediction of the future. Boundary scenarios are intended to cover either end of a range of plausible policy scenarios in which the most likely policy outcome falls. The scenarios have been constructed to provide a range of possible conditions that could impact broader North American energy issues, such as energy trade, competitiveness, energy infrastructure, and carbon pricing. Each scenario covers the period from now until 2020. Following the presentation of the boundary scenarios and associated implications on energy, a “most likely” policy scenario is posited for discussion.

8.1 Boundary Scenario 1: “Bottom-up” national plans

In this scenario, Canada, the United States and Mexico develop and implement nationally appropriate climate action plans. All countries agree individually to participate in an international post-2012 regime that is based on a principle of “pledge and review.”⁸⁴ Mid-term (to 2020) national targets with similar stringency are set in Canada and the United States at levels that will garner sufficient political support to pass implementing legislation and associated regulations. Both Canada and the United States choose a cap-and-trade approach for industrial sources. Caps would be hard caps and not intensity based. Domestic and international offsets, as approved by the UNFCCC post-2012 agreement, would be valid compliance units in each national system. Transportation emissions would be controlled by national standards, and national energy efficiency and renewable energy standards would be legislated. Each of Canada and the United States keep in place some of the unique elements that have characterized draft legislation and plans in each country to date. For Canada, contributions to a technology fund would be valid for compliance purposes, and one or more oil-exporting provinces would choose a different legislative path in their jurisdictions. In the United States, an LCFS would be legislated in a number of states, but border adjustment provisions under U.S. federal climate legislation are ruled out among NAFTA partners. Mexico agrees to develop nationally

⁸⁴ “Pledge and review” is a concept that was introduced by the Japanese in the early stages of the development of the 1992 UNFCCC. In a pledge and review system, each sovereign nation pledges to implement a series of policies, programs and laws, and agrees for the international community to review the progress that is being made in implementation. The United States supports a similar approach in the current round of negotiations for post-2012 commitments, with the concept of “internationalizing” national climate change programs.

appropriate mitigation actions (NAMAs) that comply with the post-2012 UNFCCC regime. These include expansion of renewable energy, legally-mandated energy efficiency standards, increased use of natural gas for power generation, reduction of deforestation, and development of sectoral plans capable of generating internationally approved credits (such as the cement sector). Under this scenario, Mexico's overall emissions by 2020 would be higher than 2009 but would represent a significant deviation from business as usual. Therefore, Mexico would be a potential source of credits to the United States and Canada, but would be able to sell to other countries.

Linkages among the three countries would be possible via the international carbon market. Canadian and U.S. allowances would not, however, be fungible, nor would the United States recognize Canadian offsets. Regional programs such as WCI and RGGI would be wound up.

8.2 Boundary Scenario 2: A North American emissions bubble

In this scenario, Canada, the United States and Mexico develop a North American emissions bubble, to be implemented in part by a continental cap-and-trade system.⁸⁵ Tripartite negotiations would establish the national allocations for each country. Valid compliance instruments in the continental cap and trade system would include North American allowance units; domestic offsets from each of Canada, the United States and Mexico; and internationally approved credits from other countries, thereby providing the link between the North American system and the international carbon market. Each nation would further allocate allowances to its covered industries. Regional programs such as the WCI and RGGI would be wound up. Compliance options such as the Canadian technology fund would not be allowed. All caps would be hard caps, not intensity based. Canada and the United States would likely take on similar, but not identical, targets that are more aggressive than the aggregate bubble target, with Canada's being slightly less stringent than that of the United States to account for continued oil sands development. Mexico's target would likely be less stringent than the aggregate bubble target, in line with the projected results of their NAMAs under the new post-2012 international climate agreement.

In addition to the cap-and-trade system, a number of other coordinated actions would be agreed upon and legislated in each country, including North American standards for energy efficiency, renewable energy standards, low-carbon fuels and vehicle emissions. All such initiatives would be found consistent with the principles of NAFTA.

⁸⁵ The European Union is an example of an emissions bubble. Member countries commit to an aggregate emission reduction target and negotiate among themselves individual member's targets that add up to the aggregate target.

8.3 Energy implications of each scenario

On energy trade:

Under Boundary Scenario 1, trade irritants would persist between Canada, the United States and, to a lesser extent, Mexico in relation to the U.S. LCFS. The tension in the United States between having a stable supply of crude from Canada and addressing the carbon content of its transportation sector would remain. Under this scenario, Canada might choose to increase crude oil exports to China and India and to increase its exports of cleaner natural gas to the United States to help meet its energy demand. This situation would be exacerbated by virtue of one or more oil-exporting provinces choosing a different climate change path with different targets and compliance options than those in the federal program.

Under Boundary Scenario 2, negotiations to determine the North American bubble and to determine North American LCFSs would necessarily take into account the concerns of Canadian oil producers, with an end result of less disruption to the volume of crude oil exports from Canada to the United States, but perhaps with the consequence that North American greenhouse gas emissions in 2020 would be higher than they would have been under Boundary Scenario 1.

On competitiveness:

Under Boundary Scenario 1, the possibility exists for a number of competitiveness issues to arise. Given that each country will be able to set their own target and introduce flexibility mechanisms for compliance as they see fit, one could foresee the possibility of competitiveness issues arising in energy-intensive sectors. For example, should Canada decide to peg the costs of compliance units from its technology fund at a level significantly lower than prices of allowances in the U.S. cap-and-trade system, the United States could claim that this would represent a subsidy and hence be challengeable under NAFTA. Similarly, Canadian oil exporters could consider a claim that the LCFS puts Canada at a competitive disadvantage for selling into the NAFTA-governed energy market.

Under Boundary Scenario 2, competitiveness issues would be dealt with in the negotiation of the bubble and the various North American standards, with the result that competitiveness impacts would be lessened, but with the consequence that North American greenhouse gas emissions in 2020 would be higher than they would have been under Boundary Scenario 1.

On energy infrastructure:

Both boundary scenarios would provide incentives for upgrading the energy infrastructure, in particular the refinement of the North American electrical grid, including the use of smart grid technology and accelerated development of CCS.

Under Boundary Scenario 1, Canada would likely export more of its oil sands crude to China and India, an activity that would require substantial investment in pipelines to the west coast of Canada and increased shipping capacity to deliver the product across the Pacific. Existing crude oil pipelines from Canada into the United States would be more than adequate for the reduced

level of Canadian crude being sold to the United States, while consideration would need to be given to increasing the capacity of natural gas pipelines in the United States.

On carbon prices:

Under Scenario 1, Mexico would be able to generate sectoral emission reduction credits from actions taken in energy-intensive sectors such as cement production. Mexico would also be able to sell these credits to any interested party to the post-2012 international climate agreement, so prices for these credits would follow global carbon prices. Depending on how Canada structures its technology fund pricing, some distortions could be introduced. Should it index the price of technology fund units to allowance prices in the U.S. cap-and-trade system, compliance costs in the Canadian and U.S. markets would be similar, and the United States would likely recognize Canadian offsets in its system. However, if the price of technology fund units is not indexed to the price of U.S. allowances and instead is fixed at a price less than U.S. allowances, competitiveness issues and associated trade irritants are likely to arise, as discussed earlier. In such an instance, it is unlikely that the United States would recognize Canadian offsets in its system and it would not allow export of U.S. offsets to Canada. In this case, Canadian compliance costs would be lower than those of the United States, but perhaps these lower costs would be offset by border tax adjustments on Canadian exports. As well, if technology fund units are priced lower than U.S. allowances, the value of Canadian offsets would be decreased.

Under Scenario 2, it is possible to foresee different prices for North American allowance units than for instruments sold in global carbon markets. This would depend in large part on the aggregate emission reduction target chosen by the NAFTA partners and the allocation room that is provided to Mexico from the outset. Lower prices would be associated with less stringent targets. On the other hand, depending on how widespread and stringent the provisions and standards are for energy efficiency, renewable energy and low-carbon fuels, offsets may be scarcer, tending to drive allowance prices higher.

8.4 Most likely policy scenario

The most likely North American policy scenario to 2020 is very close to Boundary Scenario 1, the “bottom-up” approach, with the exception that increased linkages between the Canadian and U.S. cap-and-trade systems are made in the last half of the period to 2020. Under this scenario, all three countries become parties to the post-2012 international climate agreement, with Canada and the United States taking on identical emission reduction targets for 2020. Mexico will implement NAMAs that result in a significant deviation from their business as usual, but their overall emissions will rise between now and 2020. The design of the U.S. cap-and-trade scheme will be similar to the system contained in the American Clean Energy and Security Act of 2009 (Waxman-Markey bill). Canada will implement a system with hard caps but with more free allowances provided to the oil and gas sectors. Contributions to a technology fund will be recognized as a valid Canadian compliance instrument until 2015, at which point the fund will be phased out. Until then, contribution rates to the technology fund will be allowed to float at a discounted index of the U.S. allowance price. The U.S. and Canadian systems will recognize offset projects from any NAFTA country as valid compliance instruments, but the Canadian and U.S. allowances will not be fungible until 2015, when the technology fund is phased out. In

addition to purchasing credits from Mexican offset projects, Canadian and U.S. linkages to Mexico will also be made through purchase of internationally validated sectoral credits. Greenhouse gas reporting requirements in both Canada and the United States will be the same for covered industries, and offset criteria for Canadian and U.S. projects will be similar. Regional trading programs such as the RGGI and WCI will be wound up, and provincial programs in Canada will be phased out by 2015 to allow for increased integration with the U.S. program.

Emissions from non-covered sectors in both Canada and the United States will be controlled by regulated standards in the areas of energy efficiency, buildings and vehicle emissions. The United States will introduce a federal LCFS after 2015 in response to the patchwork of state-legislated standards. Canada will be forced to move toward a LCFS by 2020. Mexico will continue to implement its NAMAs by adopting regulated standards that are similar to those in Canada and the United States, albeit possibly less stringent. The increased linkages between the Canadian and U.S. systems in the second half of the scenario period will also likely foster interest in Mexican participation in the trading programs, perhaps to the point of Mexico taking on a national cap. However, it is not likely that a North American bubble scenario will emerge until after 2020, if ever.

9. Canadian considerations and conclusions

Developing Canadian climate policy must take into account the existing energy relationships in North America. In 2008, Canadian net energy exports accounted for revenue of C\$73 Billion and contributed 7 per cent of Canadian GDP.⁸⁶ The extent to which Canada can achieve a climate change policy that can take advantage of emerging opportunities—development of clean technologies and cost-saving initiatives related to energy efficiency and the use of markets—will depend in part on how successful it is in ensuring that its policies are aligned with North American partners, in particular, the United States.

Canada's energy infrastructure is inextricably linked with that of the United States and Mexico. Meeting the challenges of supplying energy exports to the U.S. market requires that pipelines and electricity transmission grids be adequate to handle the volumes required. The oil and natural gas pipelines are sufficient to meet current demand and, depending on how the United States deals with crude oil extracted from the Canadian oil sands, may be sufficient for the future. Should Canada decide that the economic costs of meeting U.S. LCFSs are too punitive, and as a result, begin exporting increasing amounts of crude to Asia, enhanced pipeline capacity will be needed to bring the crude to the west coast for shipping across the Pacific. Should a more integrated approach be taken to Canadian and U.S. climate policy, there may be opportunities to lower the economic impacts of exporting crude oil from the oil sands to the United States while respecting the environmental intentions of an LCFS.

For electricity, a large increase is forecast for variable generation (in particular wind power) in response to emerging climate change and renewable energy policies and standards. This increased capacity will require significant changes to traditional planning and operating techniques to ensure reliability of the bulk power system in North America. These changes will require policymakers and government entities in Canada and the United States to work cooperatively to expand transmission facilities and add more sources of flexibility—such as the operation of structured markets, shorter scheduling intervals, development of new storage technologies and provision of greater access to larger pools of available generation and demand. Another opportunity for Canada to cooperate with the United States and Mexico is in the development of smart grids, including deployment of smart meters to facilitate more demand response programs and the provision of incentives to promote installation of stationary and mobile storage facilities (such as plug-in vehicles).

⁸⁶ National Energy Board, *Canadian Energy Overview*, p. 3.

Clean coal technology and the development of CCS will require significant investments to move to commercial scale. Canada and the United States are already cooperating in research and development programs with a view to making CCS and clean coal technologies a key part of both countries' climate change response.

Dealing with U.S. concerns over energy security related to its high reliance on foreign imports may open opportunities for increased North American cooperation in relation to programs aimed at reducing both energy demand and associated greenhouse gas emissions. These could include, in addition to some of the infrastructure investments noted above, establishment of policies that put a price on carbon such as cap-and-trade systems and LCFSSs. In Canada, however, with an economy highly dependent on net energy exports, energy security is linked to having unfettered access to its main market—the United States. Therefore, measures that may help relieve U.S. energy insecurity may have just the opposite effect on Canada's interpretation of its energy security.

From a process point of view, Canada will have many opportunities to explore enhanced cooperation with the United States and Mexico in relation to energy and climate change. In 2009 the annual meeting of North American leaders resulted in the *North American Leaders' Declaration on Climate Change and Clean Energy* and the U.S.-Canada Clean Energy dialogue was established. These initiatives provide a footing on which to continue building energy and climate partnerships.

At the provincial and state level, the groundwork laid by and the experience gained from the WCI and RGGI will be invaluable as Canada pursues a cap-and-trade system capable of linking with a federal U.S. program.

On the policy front, opportunities exist to coordinate efforts, particularly between the United States and Canada, related to carbon pricing. With cap-and-trade the most prominent tool at this stage in both countries, finding means to establish linkages between the two national systems will be an important contribution to increasing market liquidity and achieving environmental results in a cost effective manner. In the short to medium term, Mexico might have an important role as a supplier of offsets to both Canada and the United States. While resolving potential trade irritants such as future border adjustments on carbon-intensive imports may be possible within the parameters of NAFTA, a more likely resolution will come through Canada agreeing to implement an emission reduction program similar to that of the United States.

The most likely climate policy scenario to 2020, as described in Chapter 8, is one that evolves from the status quo and builds on the political, environmental and economic realities of the North American integrated energy system, while allowing for nationally appropriate provisions. It takes into account the energy security concerns of each country, fosters cooperation in the development of appropriate infrastructure, and is consistent with a post-2012 international climate change agreement. For Canada, it would mean having to significantly accelerate its efforts toward achieving its stated target of a 20 per cent reduction in greenhouse gas emissions from 2006 levels by 2020; but doing so with the knowledge that it would be moving in concert with its major trading partner.

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