7

Energy

Energy trade is an important component of the North American economy. Each NAFTA country relies importantly on its neighbors to buy or sell energy resources to fuel regional economic growth. Though each of them produces substantial amounts of oil and gas, the region as a whole is a small net energy importer—primarily due to large-scale US oil imports. Canada and Mexico together supply about one-third of total US oil imports. Canada also accounts for the bulk of US imports of natural gas and electricity.

Yet, despite this natural interdependence, bilateral energy relations have had a stormy past, and NAFTA disciplines left substantial aspects of the energy economy untouched. Why?

Historically, political considerations strongly color energy policies in North America—reflecting both economic and sovereignty concerns:

- In the 1980s, Canada experimented with energy independence in its National Energy Program (NEP). Even after that initiative fell flat, Canadian opponents of North American integration frequently cited sovereign control over energy resources as a reason to oppose the Canada-US Free Trade Agreement (CUSFTA). While muted today, such sentiments make some Canadian politicians reluctant to embrace the concept of a "continental energy policy," a term President George W. Bush introduced in his 2000 election campaign that has drawn more attention in Canada than the United States.
- In Mexico, sovereignty concerns are even more extreme. The Mexican Constitution reserves to the state the exclusive right to exploit subsoil resources, creating barriers to both energy integration and market-

oriented reforms. Equally troubling, Mexican policymakers have abetted the Organization of Petroleum Exporting Countries (OPEC) cartel on numerous occasions over the past decade to restrict exports and manipulate world oil prices—actions that are antithetical to North American economic integration.

- In the United States, which accounts for a quarter of world energy consumption, politicians call for the end of US dependence on foreign energy sources whenever there is an energy price spike. Such demands have intensified since the terrorist attacks of September 2001, prompting new subsidy-laden energy legislation that Congress finally passed in July 2005. At the same time, US politicians give short shrift to conservation policies—including energy taxes—that could constrain the vast appetite of US consumers for their gas-guzzling sport utility vehicles (SUVs).[1]

Political sensitivities notwithstanding, economic forces are driving the energy sector toward integration. Since the 1980s, deregulation of the energy sector in the United States and Canada has fostered strong growth in energy trade. The CUSFTA and NAFTA have facilitated bilateral trade but have been less influential in harmonizing energy policies and prices, which are still set within national and subnational borders.

Can the North American energy sector become as integrated as the auto sector, which is widely considered the most integrated industry in North America? Integration in the auto sector accelerated in the 1960s after the negotiation of the bilateral Canada–United States Automotive Agreement (commonly known as the 1965 Auto Pact). In contrast, economic integration of the energy sector is fairly recent. Efforts to advance the concept of a North American energy market will clearly take time, especially considering the political dimension. This chapter examines the energy policy framework in North America, and what can be done to promote investment, production, and trade in the region.

Energy Policies in North America

Energy policies in North America are made at both the national and subnational levels in each country. The CUSFTA and NAFTA have facilitated integration of the US and Canadian energy markets, though differences in regulatory policies significantly hinder market integration in the electricity sector. Despite these differences, policy coordination is advancing inter

1. While driving habits are conventionally viewed as inelastic to price signals, automakers are concerned that the recent decline in SUV sales is an indicator of the high long-term elasticity of vehicle choice to gas prices ("Rising Gasoline Prices Threaten Viability of Biggest SUVs," *Wall Street Journal*, March 22, 2005, B1).

alia through the work of the North American Electric Reliability Council (NERC), which is charged with developing, promoting, and enforcing standards for competition in the electricity sector and ensuring that differences in transmission systems and regulation do not impede the flow of electricity. NERC is primarily an exercise between the United States and Canada; broad based, Mexico's constitutional ban constrains cooperation on energy policy with its neighbors. Nonetheless, the experience of NERC illustrates that energy policy can converge in North America, although the convergence will probably be slow and incomplete. This section summarizes how energy policy has evolved in each of the three countries over the past few decades.

Canada

Between 1950 and 1973, Canada's energy sector was loosely regulated and largely geared toward producer interests. During the 1970s and early 1980s, the Canadian government turned interventionist in response to higher energy prices. In 1975, the Canadian government established Petro-Canada as a public energy company; it received federal subsidies and enjoyed special exploration rights. The government also instituted a "made in Canada" price for oil, which was substantially below prevailing world prices. Canadian oil exports were taxed to absorb the difference between the "made in Canada" price and the world price.

In 1980, Prime Minister Pierre Trudeau initiated the National Energy Program, which had three objectives: energy independence, a strong Canadian petroleum industry, and energy price fairness throughout Canada.[2] To achieve these goals, the Canadian federal government blocked or delayed foreign purchases of Canadian companies through investment restrictions enforced by the Foreign Investment Review Agency and pressured US firms to sell their Canadian assets to Canadian firms.[3] The NEP also put price ceilings on oil and natural gas and subsidized oil exploration based on how much of the operation was owned by Canadians. The government also taxed oil and gas exports. These policies evoked strong US opposition, especially regarding the forced divestment of Canadian holdings.

The NEP was controversial and failed to achieve its objectives.[4] Starting in 1984 with the election of a new Progressive Conservative government

2. This section draws on Watkins (1991).

3. In a much-heralded case, Conoco was pressured to sell its stake in Hudson Bay Oil and Gas to Dome Petroleum (Verleger 1988).

4. The National Energy Program prompted strong opposition from Alberta (and other provinces), which challenged the constitutionality of the export tax. The Canadian Supreme Court ruled in Alberta's favor, spurring important changes in the NEP. We are grateful to Helmut Mach of the government of Alberta for this point and other comments on an earlier draft of this chapter.

in Ottawa, privatization and deregulation became the themes of Canadian energy policy. In 1985, the Canadian government signed the Agreement on Natural Gas Prices and Markets with British Columbia, Alberta, and Saskatchewan, which allowed for competitive pricing (OECD 2000). This agreement was the first of a series of federal-provincial agreements that removed price controls and export restrictions on oil and natural gas. Real gas prices in the industrial sector in Canada fell by more than a third and remained constant for the household sector between 1985 and 1997. In 1991, the government began divesting its stake in shares of Petro-Canada; over the years, sales continued, and the government sold its final 19 percent stake in the company in 2004. Today, Canada's federal government advocates a "market-based" energy policy and tries to minimize government intervention.

The provinces have jurisdiction over resource management (except in frontier and offshore areas), intraprovincial commerce, and environmental issues; they also own all subsoil resources. The federal government has jurisdiction over nuclear power, interprovincial commerce, and international trade. The federal government attempts to direct research on energy-related issues. Provincial power over energy resources poses an additional hurdle to integration of the North American energy market, because different provinces have somewhat different energy strategies. By comparison, while individual states within the United States have some say over electric power management, their influence is much less than that of the Canadian provinces.

One example of divergent provincial practices is deregulation. Across Canada, oil, coal, and upstream natural gas markets are market-oriented. The downstream gas market has been completely deregulated in Ontario but is only slowly being deregulated in other provinces. The same is true with electricity generation: Some provinces are deregulating faster than others. Despite the slow pace of deregulation in some sectors and provinces, Canada's overall energy policy is market-oriented. Natural Resources Canada runs federal policy with a mandate to build on market-oriented policy in support of sustainable energy development and to strengthen and expand Canada's commitment to energy efficiency.

United States

US energy policy over the past few decades has featured bouts of government intervention with subsequent deregulation.[5] President Richard Nixon introduced price controls on crude oil in 1971; following the oil shock of 1973–74, the administration announced the improbable goal of achieving energy independence by 1980. President Gerald Ford's ill-starred Whip Inflation Now program continued price controls on oil. These

5. This section draws on Joskow (2001).

failed, but Ford successfully pushed new fuel efficiency standards for automobiles and created the Strategic Petroleum Reserve. President Jimmy Carter then created the US Department of Energy (DOE) to coordinate the various elements of US energy policy. During his tenure, the government implemented both price controls and quantitative limits on using natural gas and oil to generate electricity, which boosted reliance on coal for US electricity generation. Carter also signed the Natural Gas Policy Act in 1978, which deregulated natural gas prices for new supplies.[6] In 1979, following the fall of the Shah of Iran, the Carter administration replaced price controls with a tax on windfall profits generated from prices above those that earlier controls mandated. Although the tax ceased to collect revenue after the fall in oil prices in the early 1980s, it remained on the books until 1988. In addition to selective price controls and energy taxes, Carter announced proposals to reduce energy consumption, promote energy efficiency, and expand domestic production.

Under the promarket philosophy of the Reagan administration, the federal government took a hands-off attitude toward energy policy, and the states were allowed more room to determine their own energy initiatives. Several states gave large subsidies for "clean" energy production (e.g., solar, wind, and hydropower) to promote environmental objectives. In the early 1990s, President George H. W. Bush pursued further deregulation to combat the high prices charged by vertically integrated electricity monopolies. The goal was to separate generation from distribution. To that end, Bush signed the Energy Policy Act of 1992, which created standards for renewable energy, promoted energy efficiency, and encouraged energy development.

The reforms produced mixed results. States still control the electric transmission lines; local politics often impedes the efficient distribution of power within and between states. The business of generating electricity has become more competitive with deregulation, but retail distribution and sale are still subject to patchwork state regulation and local monopolies. More recently, fraud—and the widespread perception of fraud—by Enron and other companies has created a public backlash against deregulation.[7]

The United States has made halting attempts at reforming its much-criticized electricity transmission system. In December 1999, the Federal Energy Regulatory Commission (FERC) proposed that transmission providers should be organized into regional transmission organizations (RTOs). These groups (FERC initially envisioned 4 or 5) would combine a region's providers into a single operating entity.[8] In addition to managing

6. In the 1980s, prices were deregulated for natural gas supplies that the Natural Gas Policy Act had grandfathered.

7. See "US Energy Policy Back in the Spotlight," *Financial Times,* March 8, 2002.

8. When the RTO system was proposed, roughly 130 operators controlled sections of the US electricity transmission system.

transmission within the region, each RTO would be responsible for negotiating interregional exchanges with other RTOs. Although not subject to FERC orders, Canadian operators can join RTOs and thereby receive equal access to US transmission systems.[9]

Participation in an RTO was initially voluntary, but only two had been created (in the midwest and northeast) by June 2002. In 2003, FERC attempted to make RTO participation mandatory, but southern and northwestern utilities and their state regulators opposed the proposal. They feared that increased integration would result in higher prices in these traditionally energy-rich regions and that a surrender of the local utility monopoly on transmission lines would make it impossible to profit from past and future infrastructure investment.[10] The coalition has significant clout in Washington and managed to include a provision in the Energy Policy Act of 2005 that legislates a delay in mandatory RTO participation until 2007.[11] White House support for the "voluntary approach" to grid reform has effectively stalled the FERC initiative to make RTOs mandatory. As of 2005, six RTOs—including independent system operators (ISOs), which are very similar—were operating. However several of these operate over significantly smaller geographic areas than FERC initially envisioned. Three RTOs are confined to operations within a single state (California, New York, and Texas).[12]

In contrast to his father's Energy Policy Act, President Bush's 2001 National Energy Policy has been criticized for emphasizing energy development much more than conservation. The stated purpose of the National Energy Policy is to "help the private sector, and, as necessary and appropriate, State and local governments, promote dependable, affordable, and environmentally sound production and distribution of energy for the future" (NEPD 2001, xviii). This mission statement recognizes the leading role of the private sector in energy development and the roles of state and local governments in energy regulation. In this sense, the US and Canadian approaches to energy policy are similar. There are, however, two major differences. First, Canadian provinces own subsoil resources, while

9. For example, B. C. Hydro has been actively involved in the creation of RTO-West.

10. The southeast and northwest enjoy surplus energy as a result of depression-era development projects (the most famous being the Tennessee Valley Authority) and low production costs relative to other regions.

11. For example, Southern Co., a major power utility, has given $481,500 in campaign contributions to members of the House Energy and Commerce Committee, and $105,000 to Senator Richard C. Shelby (R-AL) since 1989. Senator Shelby was instrumental in the delay of FERC's plan to make RTO participation mandatory ("Short-Circuited: How Unlikely Coalition Scuttled Plan to Remake Electrical Grid," *Wall Street Journal,* November 4, 2003, A1).

12. For RTO boundaries and regulations, see www.ferc.gov/industries/electric/indus-act/rto.asp (accessed on May 25, 2005).

most subsoil resources in the United States are privately owned. Second, US federal agencies that oversee interstate gas and electricity markets have more clout than Canadian federal agencies. But "states' rights" concerns still constrain the ambition of federal regulators.

While much of the administration's National Energy Policy can be implemented without congressional input, there has been a five-year battle over legislation relating to the plan. Box 7.1 presents highlights of the Energy Policy Act of 2005 (HR 6), which passed Congress in late July 2005. The bill promotes US energy production but does not significantly reduce imports or shift US energy purchases toward Canada and Mexico. Similar legislation was introduced in the previous session of Congress but was successfully filibustered in the Senate in November 2003 (receiving only 57 of the required 60 votes for cloture).[13]

In essence, the 2003 US energy bill failed under the weight of excessive public subsidies to energy producers, lack of concrete incentives for energy conservation, and the strong opposition of Democratic members to the provision on MTBE liability protection.[14] MTBE protection was dropped from the 2005 bill in order to secure passage. Both bills focused on subsidies for expanding US production of traditional energy sources—oil, coal, and natural gas.[15] The bill also included subsidies for nontraditional sources—ethanol, biodiesel, hybrid cars and hydrogen fuel cells—in hopes that they would become commercially viable in the future. It is worth noting that ethanol production has been subsidized as an "infant industry" since 1978. Only domestically produced ethanol (mostly from corn) is eligible for the tax credit; in contrast, foreign ethanol is subject to a tariff of over 50 cents a gallon.[16]

The energy bill sought to ensure that America had secure sources of energy to meet growing demand. Provisions that would limit consumption, such as a more efficient corporate average fuel economy (CAFE) standard,

13. The *Wall Street Journal* called that bill "a 1,700-page monstrosity" that "may not have all that much to do with energy any more" ("The Grassley Rainforest Act," November 18, 2003, A20). The editorial criticized the pork barrel legislative process and the "GOP leadership [that] greased more wheels than a Nascar pit crew."

14. MTBE, a gasoline additive and suspected carcinogen, was banned in California in 1999, sparking the famed Methanex dispute under NAFTA Chapter 11 (see chapter 4 on dispute settlement). Several other states have followed California's lead, and the MTBE provisions in the energy bill were motivated by fears of defective product lawsuits against MTBE producers.

15. The nonpartisan Congressional Budget Office (CBO) projected that the tax incentives in the Energy Policy Act of 2005 conference report would reduce revenue by $12.5 billion, while the legislation would increase outlays by $1.6 billion (CBO 2005). The Bush administration had requested that the tax incentives be confined to $8 billion.

16. This tariff is intended to protect the US industry from Brazil, the world's leading ethanol producer. As NAFTA members, Canada and Mexico are exempted.

Box 7.1 Key provisions of the Energy Policy Act of 2005

Electricity reliability organization (ERO)	Allows FERC to participate in the creation of an ERO that will be able to enforce mandatory electricity reliability standards throughout North America.
Regional transmission organizations (RTOs)	New reliability standards for the energy transmission system. Implementation of FERC's Standard Market Design (SMD) plan, which would make operator participation in a regional transmission organization (RTO) mandatory to restructure grid, is delayed until 2007.
"Native load" requirement	Requires that utilities reserve space on transmission grids to meet local needs. In essence, gives local utilities priority on transmission use over other customers.
Ethanol subsidies	Replaces 5.2-cent per gallon tax break on ethanol with tax credit for ethanol-based fuel producers. Money for credit would no longer come from the highway trust fund. Aims to double ethanol use by 2012.
Bio-diesel	Penny tax credit for each percentage point of bio-diesel in blended diesel fuel. Bio-diesel is made from soybeans and other oilseed crops.
Repeal of Public Utilities Holding Company Act (PUHCA)	Repeal of 1930s consumer protection act that limits outside ownership of public utilities by geography and industry. Repeal is intended to spur investment in electricity transmission system.
Oil royalties	New royalty relief in the event of low oil prices for small shallow-water operations in the Gulf of Mexico. Increased royalty relief for deep-water oil and natural gas drilling in the gulf.
Permit streamlining	Streamlined system for obtaining permits to drill for oil and natural gas, as well as changes to expedite the creation of "energy corridors" for pipelines and high-voltage wires through the use of eminent domain on behalf of private utilities.
Permanent reauthorization of Price-Anderson	Government insurance of liability for all nuclear power operations in the country.

(box continues next page)

were viewed with suspicion.[17] Provisions that might raise the price of energy (in economic terms the surest way to promote conservation) were rejected outright. Conservation was an afterthought in the bill, though it does contain boutique programs, notably the $1.7 billion program to help automakers develop—within 20 years—a "freedom car" that runs on hydrogen fuel cells.

17. The CAFE standard regulates fuel economy in automobiles sold in the United States by setting a corporate sales-weighted standard for two categories. To avoid fines, the average fuel economy of a firm's passenger cars must be at least 27.5 miles per gallon (mpg), and light trucks—including pickups, minivans, and SUVs—must be at least 20.7 mpg.

Box 7.1 *(continued)*

Nuclear loan guarantees	For the construction of 8,400 megawatts of new nuclear plants, subject to approval by the secretary of energy.
Clean coal	$2 billion incentive program for deployment of "clean coal" technology; labeled the "highest and largest" tax incentives in the bill by Senate Energy and Natural Resources Committee Chairman Pete Domenici.
Strategic Petroleum Reserve	To be permanently authorized and increased in size to 1 billion barrels from 700 million barrels.
Renewable energy	Increase in tax credits for wind, solar, geothermal, biomass, and other renewable energy sources.
Hydrogen fuel cells	Authorizes $1.7 billion for research and development of fuel cell technology.
Combined heat and power programs	To receive a 10 percent investment tax credit and accelerated depreciation rates.
MTBE phase out	Phases out the use of MTBE, a gasoline additive that had been found to contaminate groundwater. Liability protection to MTBE producers (included in the 2003 bill) was dropped from the 2005 act to secure the support of Senate Democrats.
Liquefied natural gas (LNG) terminals	Gives FERC the final authority to approve sites of onshore LNG terminals, eliminating the ability of states and localities to veto proposed onshore LNG sites.
North American Energy Freedom	Embraces the goal of energy self sufficiency for the North American continent by 2025 and establishes the United States Commission on North American Energy Freedom to give recommendations to Congress and the President on creating a coordinated and comprehensive energy policy for the continent.

Source: Thomas Legislative Database, Library of Congress, thomas.loc.gov (accessed on August 2, 2005).

The US energy bill would only slightly affect NAFTA partners. Improvements in the natural gas infrastructure within the United States will provide incentives for both Mexico and Canada to expand exports to supply what promises to be a growing demand for clean energy. Canada will be disappointed about the lack of a mandate for the RTO system. However, Canadian firms are allowed to join RTOs as equal partners, and several, including B. C. Hydro, have already joined or are involved in talks. The specter of large energy subsidies has not upset NAFTA members as much as one might think. Canadian firms stand to profit from subsidies for hydrogen fuel cell research, alternative energy sources, and hydro-

electric power.[18] While Canada generally opposes farm subsidies, the Canadian corn lobby sees ethanol support as something to imitate rather than complain about.

Mexico

Articles 27 and 28 of the 1917 Mexican Constitution declared subsoil minerals the property of the people and prohibited foreign activity in strategic energy sectors. These provisions of the Mexican Constitution were given teeth in 1938 when President Lázaro Cárdenas nationalized the oil industry and expropriated all foreign oil assets—an extremely popular action in Mexico. In 1958, Mexico passed a law giving the national oil company, Petróleos Mexicanos (Pemex), control over downstream oil operations such as transportation and marketing (Hufbauer and Schott 1992).

Mexico benefited in the 1970s as high oil prices coincided with the discovery of offshore oil reserves, enabling the country to dramatically increase its oil production and exports. Mexico sought to leverage its newfound oil wealth to develop an integrated oil industry. Extensive debt-financed investments were approved for exploration and development of crude oil and products, natural gas, and petrochemicals. Pemex employment grew rapidly. Mexico's luck ran out in the early 1980s when oil prices fell in response to global recession, making it impossible to service the country's burgeoning debt.

During the late 1980s and 1990s, the Mexican energy policy refocused on the exploitation of crude oil and gas. In 1995, the natural gas sector was opened to foreign investment in downstream operations such as transportation and storage. However, drilling for natural gas is still reserved for nationals. There has been much less reform in the oil sector. Foreign interests can contract their services to Pemex for exploration and extraction of oil reserves but cannot own any of the oil produced. This constraint all but eliminates the potential for substantial foreign participation in the oil sector.[19]

Today, Pemex remains a powerful force in Mexico as a symbol of national sovereignty, the cash cow of public finance, and an employer of about 140,000 people. Pemex seeks to maintain its oversized workforce and minimize domestic oil prices—goals that make Pemex economically inefficient and difficult to reform.[20] About 60 percent of Pemex's revenues

18. See "Canada Plugs into US Energy Bill," *Gas & Oil Connections* 8, no. 18, September 19, 2003.

19. The energy sector accounts for 57 percent of Mexican public-sector investment. Most of the public energy investment is in oil.

20. Whereas Pemex employs almost 140,000 people, by contrast the Venezuelan state oil company (PDVSA)—not a bastion of efficiency—has about 40,000 employees (EIA 2003b).

are diverted to the Mexican treasury, contributing about one-third of federal revenues but draining the company of needed investment funds. Indeed, in 2000 the money diverted to the federal budget was more than five times the amount spent on investment (WTO 2002). The 2002 budget tried to correct this imbalance by providing almost $15 billion for new energy investment. Most of this money has gone into existing fields, rather than new exploration.[21]

Mexico's Constitution mandates state control of electricity generation, transmission, and distribution. The state monopoly, Comisión Federal de Electricidad (CFE), maintains a legal monopoly on the sale of electricity to Mexican consumers.[22] This system is to blame for severe inefficiencies and underinvestment, which threatens the Mexican economy with high-energy costs today and chronic blackouts in the medium term.

To be sure, the Mexican Constitution has been reinterpreted several times in recent years to permit private activity in some aspects of the energy sector. In response to escalating costs, the Salinas administration reinterpreted the Constitution in 1991 to allow private companies to produce power for their own use, for sale to CFE, or for export. These companies subsequently have grown to account for a significant share of Mexican generation capacity. In an attempt to increase private-sector activity in the electricity sector, President Vicente Fox decreed in 2001 that CFE and Luz y Fuerza del Centro could buy increased amounts of electricity from "self-supplying" private firms that generated their own electricity and had been able to sell no more than 20 megawatts of excess to the Mexican government at marginal cost. However, the Mexican Supreme Court ruled in April 2002 that the Fox decree was unconstitutional.[23] In response, the Fox administration presented new energy reform proposals to the Mexican Congress in August 2002 that would amend Articles 27 and 28 of the Mexican Constitution to allow private electricity generators to sell directly to other large industrial consumers of the CFE. In an attempt to avoid the red-hot sovereignty issue, these proposals did not call for the privatization of existing CFE assets but instead fostered reforms that would encourage new investment because the firms could serve a larger and more competitive market. The case for reform was persuasive: Mexico already suffers frequent power outages; it will need much more en-

21. Between 2000 and 2004, Pemex invested a total of $40 billion. Less than $5 billion was spent on exploration ("Mexican Oil Chief Seeks Expansion," *New York Times,* March 3, 2005, 8).

22. There is one exception: Luz y Fuerza del Centro, a separate wholly owned government monopoly, has the exclusive rights to sell electricity to consumers in and around Mexico City. However, CFE and Luz y Fuerza are not allowed to compete, and Luz y Fuerza purchases much of its power from CFE.

23. In its deliberations, the Supreme Court questioned whether private generation was legal at all, but it was not asked to decide this question. See "Meeting Mexico's Electricity Needs," *North American Free Trade and Investment Report* 14, no. 2, January 31, 2004.

ergy investment to keep pace with the expected growth in energy demand over the next decade (EIA 2005b). Nonetheless, the energy reforms have been blocked in the Mexican Congress.[24]

While reforms are urgently needed, they would provide only a small portion of the resources that Mexico needs to upgrade its energy sector. Between 1994 and 2002, $5.3 billion of foreign direct investment had gone into the Mexican energy sector. Some $1.5 billion of this total had been directed toward small-scale electricity generation and international trade infrastructure, with about 60 percent of the investment coming from the United States and slightly less than 40 percent from France. The remaining $3.8 billion had gone to build-lease-transfer power-generating projects, with Europe providing 60 percent, the United States 20 percent, Japan 13 percent, and Canada 7 percent of the funding (Barnés de Castro 2002). Even taking these new investments into account, as of 2003, private entities own only around 30 percent of generating capacity.[25]

In 1999, the Mexican government estimated that $59 billion of investment in electricity generation and infrastructure improvements, through 2009, would be required to keep pace with demand. By this metric, the government is well behind.[26] Due to political and constitutional constraints, liberalization or privatization of the electricity industry is unlikely. The Partido Revolucionario Institucional (PRI), with the strong support of labor unions, has vowed to use its control of the Mexican Congress to block any attempt to increase foreign participation in the industry. Instead, these allies propose to force Pemex to invest in the creation of 4,000 MW of generating capacity over the next eight years.[27]

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24. Some Congressional leaders would like to eliminate private generation entirely. In 2003, a group of PRI Congressmen asked the Auditoría Superior de la Federacíon (ASF), the auditing entity of the Mexican Congress, to review the procedures that allow private parties to sell electricity under its authority to review the government's use of the federal budget. The ASF determined that all generation permits granted between 1996 and 2002 were in violation of the Constitution. The Energy Ministry challenged the ASF finding in the Mexican Supreme Court. In April 2005, the Court ruled in a 6-5 decision that ASF had exceeded its authority by reviewing legal matters outside its scope. A definitive ruling in favor of ASF and against the permits would have had an immediate effect on the electricity industry. "Mexico Court Decision Eases Restrictions on Private Power Generation," *North American Free Trade and Investment Report* 15, no. 9, May 15, 2005.

25. CFE reported a generating capacity of 40,354 MW in March 2003. The Comisión Reguladora de Energia (CRE), the regulatory agency for energy generators, listed 235 permits for private generation with a total capacity of 19,443 MW in October 2003. However, included in this total are 29 permits (totaling 1,091 MW) owned by Pemex, the state oil firm. See "Meeting Mexico's Electricity Needs," *North American Free Trade and Investment Report* 14, no. 2, January 31, 2004.

26. See "Mexico's Power Generation Sector: Constitutional Challenge Against Permits Granted to Private Parties," *North American Free Trade and Investment Report* 14, no. 13, July 15, 2004.

27. Ibid. and "Meeting Mexico's Electricity Needs," *North American Free Trade and Investment Report* 14, no. 2, January 31, 2004.

Overall, the Pemex and CFE monopolies impose significant constraints on the development of Mexican energy resources and on Mexican economic growth. Pemex's political status as a symbol of Mexican sovereignty makes reform extremely difficult, and Mexico's energy policies remain the least market-oriented in North America.

Medium-Term Energy Outlook

This section examines supply of and demand for energy in North America. It discusses how much energy North America will need and what energy sources will fill this need.

Energy Balances

Tables 7.1a and 7.1b show energy production, imports, exports, and consumption of various energy sources for the three countries in North America in 2002. The United States accounted for almost a quarter of the world's energy consumption, and the share for North America as a whole was 29 percent. The US and North American shares in world consumption are fairly constant across the different sources of energy. Canada and Mexico currently produce more energy than they consume, but the large energy deficit of the United States overwhelms their relatively small surpluses. Thus, North America as a whole consumes 18 percent more energy than it produces.

Turning to oil, the United States imports more than it produces domestically and claims 83 percent of North American oil consumption. In 2002, net imports accounted for 53 percent of US oil consumption. In contrast, Canada and Mexico are net exporters of oil. Mexico has large reserves but actually produces little more oil than Canada and much less than the United States, reflecting the underachievement of Mexico in exploiting its own oil resources.[28] Still, Mexico is a net exporter: In 2002, Mexico consumed 55 percent of its own oil, while net exports accounted for 45 percent of production.[29]

As in the oil market, the United States accounts for a very large share of total North American natural gas consumption and production. It accounts for 71 percent of total North American gas production, but 83 percent of North American consumption—leading to net imports of 3.5 billion cubic feet (Bcf) in 2002 (or 16 percent of consumption). Here again, Canada produces much more natural gas than it consumes and exports

28. Mexico's oil reserves are much smaller than Canada's. However, most of Canada's reserves are in the form of oilsands, which are only in the early stages of being exploited. In contrast, Mexico's reserves are mostly mature.

29. Stock changes in 2002 were approximately zero.

Table 7.1a Energy production and consumption, 2002 (in quadrillion BTUs)

Product	North America	United States	Canada	Mexico	World
Total energy					
Production	99	71	18	10	405
Consumption	117	98	13	7	405
Oil[a]					
Production	30	17	5	8	157
Consumption	45	38	4	4	159
Dry natural gas[b]					
Production	28	20	7	1	99
Consumption	28	23	3	2	93
Coal[c]					
Production	24	23	2	0	97
Consumption	24	22	2	0	98
Electricity[d]					
Production	16	12	4	0	57
Consumption	16	12	4	0	57

more than half of its production, primarily to the United States. Mexico produces very little natural gas, flares a relatively large portion of its associated gas, and is not active in natural gas trade, despite Mexico's acute need for natural gas to generate electricity.

Coal is the only fossil fuel where the United States is self-sufficient. Canada is very active in coal trade, although only little of this trade is with the United States. Mexico imports a significant share of its total coal consumption, much of it from the United States, to supplement its relatively meager domestic coal production.

Electricity can be generated from a number of sources, including oil, natural gas, and coal. About two-thirds of North American electricity comes from these fossil fuels. The remaining third comes from nuclear and renewable sources. In the United States, 17 percent of electricity comes from nuclear power, and 12 percent from other renewable sources. In Canada, over half of electricity production comes from hydroelectric power, while a full 70 percent comes from nonfossil fuels (nuclear is 13 percent of the total). Mexico is most reliant on fossil fuels for electricity, since only 20 percent of its electricity comes from other sources.

Only a small share of total production is traded. The United States makes up the largest share of North American electricity consumption; net imports, however, account for less than 1 percent of total US electricity consumption. Canada is a small net exporter of electricity to the United States but hopes to increase exports in the future. Mexico lacks

Table 7.1b Energy production, trade, and consumption, 2002

Product/country	Production	Imports	Exports	Consumption
Oil (thousand barrels per day)				
North America	15,542	12,956	5,024	23,835
United States	9,000	11,530	984	19,761
Canada	2,949	1,088	2,079	2,093
Mexico	3,593	338	1,961	1,981
World	76,858			78,206
Dry natural gas (billion cubic feet)				
North America	27,014	4,352	4,322	26,991
United States	19,047	4,008	516	22,534
Canada	6,633	131	3,804	2,959
Mexico	1,334	213	2	1,498
World	90,717			90,270
Coal (million short tons)				
North America	1,179	47	40	1,152
United States	1,094	17	40	1,066
Canada	73	29	0	72
Mexico	12	2	0	14
World	5,252			5,262
Electricity (billion kilowatt hours)[e]				
North America	4,592	49	49	5,014
United States	3,839	36	13	4,337
Canada	549	13	36	487
Mexico	204	0	0	190
World	15,290			14,284

BTUs = British thermal units

a. 1 quadrillion BTUs is equal to about 180 million barrels of oil or 500,000 barrels per day for one year.
b. 1 quadrillion BTUs is equal to about 1 trillion cubic feet of natural gas.
c. 1 quadrillion BTUs is equal to about 50 million short tons of coal.
d. To avoid double counting total energy production, this table includes electricity generated only from primary sources that are not counted elsewhere (nuclear, hydroelectric, geothermal, wind, etc.). 1 quadrillion BTUs is equal to about 100 billion kilowatt hours.
e. Total electricity generation includes secondary production from plants that consume fossil fuels (oil, natural gas, and coal) and primary production from nuclear and renewable sources.

Note: Sums may not add up due to rounding.

Source: EIA (2004b).

both the investment to generate electricity at home and the infrastructure necessary to import sufficient power from the United States.

Overall, the United States is driving North American energy consumption, but Mexico has the most acute energy needs relative to the size of its economy. While energy is traded within North America, in most sectors the scope of trade is well short of levels that would confer maximum mu-

tual benefits on the NAFTA partners. We now turn to some of the projections for energy consumption and production over the next 25 years.

Demand

In 2002, North America consumed 117 quadrillion British thermal units (BTUs) of energy, with the United States accounting for 83.7 percent of this total, Canada 11.1 percent, and Mexico 5.9 percent (table 7.1). These shares of energy consumption are roughly in line with the respective shares of North American GDP. At market exchange rates, the United States made up 88.4 percent of North America's GDP in 2002, Canada accounted for 6.1 percent, and Mexico 5.5 percent.[30]

Based on projections for real GDP growth and a number of other factors, the DOE projects how much energy the countries of North America will need in the future. These projections are displayed along with recent consumption history in table 7.2. The demand for energy is projected to grow relatively slowly in the United States and Canada during the next 20 years—about half the rate of real GDP growth. Mexico's demand for energy, however, may grow only moderately less than the growth of real Mexican GDP and more than twice that in the United States. Overall, energy consumption in North America is projected to be almost 50 percent greater in 2025 than in 2000. As explained later, the principal difficulty will be meeting the Mexican demand for energy, which might double by 2025.

Although the total demand for energy in North America is projected to increase substantially, the share of each type of energy in total demand will likely remain about the same. According to DOE projections, renewable energy will likely experience the fastest growth rate (albeit from a low base), followed by oil and natural gas, which will remain the largest sources of North America's energy. Under current policies, reflected in DOE projections, the use of nuclear power is projected to grow slowly; if so, it will continue to lose market share through 2025. Renewable energy is projected to grow at an average of 1.8 percent through 2025, which is slightly higher than the growth rate for North American energy consumption as a whole—1.5 percent (table 7.2). Coal is projected to grow at 1.5 percent per year, in line with the overall growth rate. In making these projections, the Energy Information Administration (EIA) assumed that oil prices would decline through 2006 and then remain in the range of $27/bbl (the OPEC basket price, in 2002 dollars) through 2025. But prices have been rising rather than

30. GDP data are from the International Monetary Fund's *World Economic Outlook* database, April 2003. Energy intensity can be expressed as the ratio of a country's physical energy consumption to its GDP. On this measure, Canada is the highest of the three countries in North America, and the United States and Mexico are virtually tied.

Table 7.2 Demand for energy in North America, 1990–2025

	1990	2000	2005	2010	2015	2020	2025	Average annual change 2001–25 (percent)
Total energy consumption (quadrillion BTUs)								
North America	100.6	118.7	124.6	134.5	144.6	155.0	166.6	1.5
United States	84.6	99.3	103.2	111.8	119.7	127.9	136.5	1.4
Canada	11.0	13.2	14.2	15.4	16.5	17.5	18.4	1.6
Mexico	5.0	6.2	7.2	7.3	8.3	9.6	11.6	2.8
World	348.4	398.9	433.3	470.8	517.3	567.8	622.9	1.8
Energy consumption by source (quadrillion BTUs)								
Total (North America)	100.6	118.7	124.6	134.5	144.6	155.0	166.6	1.5
Oil	40.4	46.3	48.3	53.3	58.3	62.1	67.3	1.6
Natural gas	23.1	28.8	30.6	32.6	35.3	38.7	40.9	1.6
Coal	20.7	24.5	24.9	27.4	28.6	30.7	34.2	1.5
Nuclear	6.9	8.7	9.4	9.6	9.8	10.0	9.7	0.4
Renewable	9.5	10.6	11.3	11.6	12.7	13.5	14.4	1.8
Net electricity consumption (billion kilowatt hours)								
North America	3,369	4,297	4,422	4,839	5,306	5,792	6,314	1.9
United States	2,827	3,605	3,684	4,055	4,429	4,811	5,207	1.8
Canada	435	510	539	578	630	680	728	1.6
Mexico	107	182	198	206	247	301	379	3.9
World	10,546	13,629	14,960	16,358	18,453	20,688	23,072	2.3

Notes: Data for 1990 and 2000 are historical as reported in EIA (2004a). Data for 2005 and beyond are projected based on the EIA reference case for income and population growth. 2005 projections are from EIA (2003a); 2010–25 projections are from EIA (2004a). The reference case assumes income and population growth of 3.1 and 0.9 percent, respectively, for North America, 3 and 0.8 percent for the United States, 2.7 and 0.6 percent for Canada, 3.9 and 1.1 percent for Mexico, and 3 and 1 percent for the world.

Source: EIA (2003a, 2004a).

falling, and continued high oil prices could affect both the total energy consumption and the composition energy sources.[31]

Much of the growth in demand for natural gas will reflect the increased consumption of electricity. While the growth of electricity consumption is projected to be slightly higher than the growth in total energy consumption for the United States and Canada, Mexico's growth of electricity consumption will likely average 3.9 percent annually, which is about 1.1 percentage points greater than its projected growth in total energy consumption (table 7.2). Mexico will need additional electricity as it con-

31. On April 4, 2005, the OPEC basket price stood at $53/bbl. It has been above the announced OPEC target price band (a maximum price of $28/bbl) since December 2, 2003 (EIA 2005d).

nects rural areas to electricity grids and as current customers demand more electricity to fuel economic expansion.

Supply

Table 7.3 shows the annual growth rate of production and consumption of various energy sources in each of the three countries from 1990 to 2001, as well as the projected annual growth rate of consumption through 2025. These projections assume that renewable energy and nuclear power remain minimal sources of supply. They may or may not be compatible with radical new CO_2 capture and sequestration technologies that could reduce greenhouse emissions from oil, coal, and natural gas. In the DOE scenario of "steady as she goes," as the North American economy integrates and as the demand for energy increases in Mexico, trade will become an increasingly important aspect of energy supply.

Oil

The United States needs to import substantial amounts of oil in order to meet its energy needs. Crude oil production in the United States declined 2.2 percent annually from 1990 to 2001, while consumption increased 1.2 percent annually. If the growth of oil consumption remains at about the same rate (or increases) in the United States through 2025, and if production remains relatively static, the United States will need substantially greater oil imports.

Concerns about US dependence on foreign oil often overlook the fact that the United States gets 40 percent of its imported oil from Canada, Mexico, and Venezuela; in fact, the United States now imports more oil from Canada than from any other country. The growth in Canadian oil production was double the growth in its consumption during 1990–2001, and much of the excess went to the United States. Canada's consumption of oil is projected to increase at about the same rate through 2025. While Canada's production of oil from conventional sources is expected to remain constant and eventually decline, technological innovations will allow further development of the oilsands in northern Alberta, so Canada will continue to be an important exporter of oil.

At the beginning of 2005, the EIA recorded that Canada had 178 billion barrels of proven oil reserves—that is, economically viable for exploitation (EIA 2005a).[32] The United States stood at 21.5 billion barrels (EIA 2005c). Mexico has fewer *proven* oil reserves (18.9 billion barrels),

32. In 2003, the EIA decided to classify the nearly 180 billion barrels of oil reserves in the form of oilsands as "conventional" or commercially viable ("There's Oil in Them Thar Sands!" *The Economist*, June 28, 2003, 75).

Table 7.3 Average annual growth rates of energy production and consumption (percent)

Product/country	Production 1990–2001	Consumption 1990–2001	Consumption 2001–25
Oil			
North America	–0.4	1.2	1.6
United States	–2.2	1.2	1.5
Canada	2.4	1.0	1.6
Mexico	1.9	0.8	2.5
Dry natural gas			
North America	0.0	1.6	1.6
United States	0.7	1.5	1.4
Canada	4.9	1.8	2.2
Mexico	2.9	3.2	3.9
Coal			
North America	0.4	1.6	1.6
United States	0.4	2.0	1.6
Canada	0.8	2.1	0.8
Mexico	2.5	3.7	2.4
Nuclear			
North America	2.3	2.3	0.4
United States	2.5	2.5	0.3
Canada	0.3	0.3	1.2
Mexico	9.7	9.7	1.1
Renewable			
North America	–0.2	–0.2	1.8
United States	–1.7	–1.6	2.1
Canada	1.1	1.1	1.3
Mexico	1.7	1.6	1.7

Sources: For 1990–2001 production and consumption: EIA (2003b); for 2001–25 consumption: EIA (2004a).

although it is thought to have substantially more reserves (some 54 billion barrels) that are not considered as there is no plan to explore them in the short term (EIA 2005b).[33] At current rates of production (3.8 million barrels per day), Mexico's proven reserves will last roughly 13 years. However, Mexico's annual demand for oil in physical terms is projected to grow about three times faster from 2001 to 2025 than from 1990 to 2001. This means that Mexico will need to substantially increase both its proven reserves and its production just to meet its own demand, much less continue to supply the United States with 1.4 million barrels per day of profitable oil exports.

Based on these projections for oil demand and supply, trade will become an even more important vehicle for meeting energy needs. One op-

33. Most of these are deep-water reserves in the Gulf of Mexico.

tion for reducing US dependence on Middle Eastern and West African oil is to increase energy imports from NAFTA members. However, in 2001, North America as a whole imported 13 million barrels of petroleum per day. By 2025, the EIA predicts that North America will import 21.4 million barrels per day—about 65 percent higher than the 2001 figure (EIA 2004a, 40).[34] Unless North America sharply increases its rate of oil production, the United States will increasingly depend on oil from regions marked by either political fragility or outright instability: the Middle East, Russia, and West Africa. Hence, the United States will likely become even more dependent on foreign oil; the question is whether it draws substantially more of this oil from Canada and Mexico—and, to a lesser extent, from regional suppliers such as Venezuela and Colombia.

Natural Gas

The natural gas market in North America is similar to the market for oil in many respects. In the United States, consumption of natural gas increased between 1990 and 2001 at double the rate of production, necessitating substantial imports.

Canada increased its production of natural gas by almost 5 percent annually between 1990 and 2001, while consumption increased 1.8 percent annually. Canada's excess production makes it the primary supplier of natural gas to the United States. While Canada is expected to continue to be a major natural gas exporter, level production and rising domestic consumption will keep exports from growing significantly over the next decade. Indeed, the DOE projects that US imports by ship of liquefied natural gas (LNG) will exceed imports from Canada by 2015 (EIA 2004a).

Mexico experienced the highest rates of growth in consumption of natural gas in 1990–2001, primarily due to electricity generation. Mexican natural gas consumption is projected to double by 2025. However, Mexico's proven natural gas reserves are relatively small (15 trillion cubic feet, or Tcf) compared with the United States (187 Tcf) and Canada (56 Tcf) and need to be substantially augmented as demand increases over the next decade (EIA 2005a, 2005b, 2005c). Mexico's existing proven reserves will be exhausted by 2025.

One way of supplementing output is to reduce flaring. Mexico flares 11.7 percent of its gross production of natural gas (Rosellón and Halpern 2001). If Mexico's flaring rate were reduced to that of the United States (0.5 percent), Mexico would have 146 Bcf more gas annually. Another possibility for Mexico is to increase net natural gas imports from southwest United States. Doing so will require major investments in pipeline infra-

34. As mentioned above, the EIA projects oil prices in the range of $27/bbl in 2025 (in 2002 dollars). If oil prices are substantially higher, as seems likely, imports will possibly be less, depending on production within North America.

structure. By 2025, the United States is projected to supply about 40 percent of Mexico's natural gas needs, compared with 7 percent in 2001 and around 15 percent in 2003 (EIA 2004a).

Several projects have been proposed to supply California and northern Mexico with natural gas imported from Asia, Australia, and even New Zealand. These projects contemplate the importation of LNG to regasification terminals in Mexico and then piping the gas to western United States. Locating the terminals in Mexico avoids certification and public relations problems that would arise in California. One such project, backed by ChevronTexaco, plans to begin operation in 2007, eventually processing 1.4 Bcf of natural gas a day.[35] In Canada, one LNG terminal is scheduled to begin operation in Nova Scotia in 2007, with two others proposed; there is also interest in building Pacific terminals in British Columbia ("Canada Offers Fertile Ground for LNG Terminal Developers," *Natural Gas Week,* January 3, 2005). A large portion of the LNG received at Canadian terminals would be gasified and exported to the United States via pipelines. However, concerns about the vulnerability of regasification terminals and LNG tankers to accidents and terrorist attacks have provoked strong community resistance to such projects, both in Mexico and Canada, as well as in the United States.[36]

Coal

Coal is another fuel that North America may be required to import in the future. Between 1990 and 2001, consumption of coal in all three countries grew faster than production, although both Canada and the United States were small net coal exporters in 2001. While coal resources are abundant, coal mining takes a heavy toll on the environment. Environmental restrictions, not reserves, will limit the expansion of production. However, the Bush administration has proposed the "Clear Skies" legislation, which would ease some of the current coal regulations, and recent legislative proposals would subsidize "clean coal" technology. Both programs have drawn the ire of environmental groups—indeed, "Clear Skies" was not

35. See "Baja Natural Gas Plant Proposed, ChevronTexaco Hoping to Pipe Fuel from Australia," *San Francisco Chronicle,* October 31, 2003, B3.

36. Plans for LNG terminals have been abandoned in Eureka, California, and were voted down by city councils in Fall River, Massachusetts, and Harpswell, Maine, due to terror concerns. FERC has the final decision on locating terminals in the United States, but local council decisions carry significant weight. In Mexico, a project in Baja California proposed by Marathon Oil has been abandoned, although other terminals are still planned. While government and industry officials assert that the risks of LNG are small, it is currently imported to only four locations in the United States, including Boston Harbor. James A. Fey of MIT has posited that an LNG spill and explosion could incinerate a 5 square mile area surrounding the point of ignition ("Fears of Terrorism Crush Plans for Liquefied-Gas Terminals," *Wall Street Journal,* May 14, 2004, A1).

included in the 2003 Energy Act for fear the provision would sink the entire bill.

In Canada, the government of Ontario has announced the goal of shutting down all coal-fired generators, which currently supply one quarter of Ontario's electricity, by 2007. However, the plan has been criticized as too costly and scientifically unjustified (McKitrick, Green, and Schwartz 2005). Others have suggested the regulation may run afoul of World Trade Organization (WTO) and NAFTA trade obligations, since much of Ontario's coal supply is imported from the United States (John Spears, "Electricity Laws May Break Trade Rules, Lawyer Says," *Toronto Star,* February 15, 2005, D6).

Mexico has a century of coal reserves at current production levels but remains a net importer of coal for two reasons. First, coal mining in Mexico is relatively costly, and second, Mexico's coal is of low quality, meaning it must be mixed with higher-quality coal from the United States and other countries before it can be utilized for energy production.

Nuclear and Renewable Energy

Public opinion in North America vehemently opposes nuclear energy. This could change but probably only in the wake of severe oil shortages or the stark impact of global warming. Although production and consumption of nuclear energy in Mexico grew substantially (from small bases) between 1990 and 2001, the DOE projects future growth through 2025 to do no more than maintain the current proportion of nuclear power in the total energy picture, as in the United States and Canada. Highly emotional political opposition—centered on meltdown and terrorist scenarios—diminishes the prospects for building nuclear power plants for cross-border electricity transmission in North America. This is a political fact, notwithstanding the emphasis on nuclear power expressed in the Report of the National Energy Policy Development Group (NEPD 2001) and despite the highly adverse climatic consequences of carbon dioxide emissions.

In the United States, consumption of renewable energy declined from 1990 to 2001 but is projected to turn around through 2025. Canada and Mexico are projected to increase their consumption of renewable energy through 2025 at the same annual rates as in 1990–2001. Although the volume of renewable energy usage is currently small, the prospects for the United States importing renewable energy from Canada could be improved if state regulations regarding renewable energy portfolios could be clarified and harmonized. We return to this topic in our recommendations.

Greenhouse Emissions

Despite the increased use of natural gas, carbon dioxide emissions will increase in step with total energy consumption, because (under DOE pro-

Table 7.4 Carbon dioxide emissions (billion metric tons)

Region/country	1990	2000	2010	2015	2020	2025	Average annual change 2001–25 (percent)
North America	5.8	6.7	7.7	8.3	8.9	9.7	1.6
United States	5.0	5.8	6.6	7.0	7.5	8.1	1.5
Canada	.5	.6	.7	.7	.8	.8	1.6
Mexico	.3	.4	.4	.5	.6	.7	2.8
World	21.6	23.5	27.7	30.4	33.5	37.1	1.9

Notes: Data for 1990 and 2000 are historical. 2010–25 projections are from EIA (2004a). The reference case assumes, for income and population growth respectively, 3.1 and 0.9 percent for North America, 3 and 0.8 percent for the United States, 2.7 and 0.6 percent for Canada, 3.9 and 1.1 percent for Mexico, and 3 and 1 percent for the world.

Source: EIA (2004a).

jections) North America will continue to rely primarily on oil to meet its energy needs (table 7.4). Only in Canada is the ratio of carbon dioxide emissions to energy consumption likely to decline.[37] It remains to be seen how Canada will live up to its Kyoto Protocol obligations, and what effect this will have on the North American energy market. In order for the greenhouse pollution outlook to change, natural gas, renewable energy, and nuclear power would have to be substituted for oil and coal on a much faster trajectory than is currently predicted by the DOE. Alternatively, radical new technologies will need to be developed that cheaply capture carbon dioxide (CO_2) from the exhaust of oil and coal combustion and pump the greenhouse substance deep into the earth. In addition, it may become economically feasible to capture and sequester the CO_2 byproduct from the generation of hydrogen (H_2) from natural gas (CH_4). Clean-burning hydrogen might then be used to fuel hydrogen fuel cells in automobiles. This new source of energy—which emits only water as a byproduct—would eliminate automotive greenhouse emissions.

NAFTA and Energy Trade

The NAFTA Text

Chapter 6 of NAFTA, which addresses "energy and basic petrochemicals," for the most part extended to Mexico the energy trade provisions that were established by the United States and Canada in their 1988 free

37. However, some analysts argue that even Canada's greenhouse gas emissions will get worse for three reasons: greater reliance on higher-polluting oil production from the oil-sands, more coal-fired electric power plants to replace nuclear facilities, and higher Canadian demand for SUVs. See Rubin and Buchanan (2002).

trade agreement. The accord, however, does not create an integrated energy market in North America.

NAFTA liberalized energy trade much more than energy investment. NAFTA eliminates tariffs and quantitative restrictions on trade in energy products, although Mexico was allowed to keep its licensing system, which reserves petroleum trade to Pemex and electricity trade to the CFE. To maintain Pemex's monopoly on oil and gas exploration and development, as well as distribution of electricity and petroleum products, Mexico insisted on an exemption from most of the investment provisions and various other portions of the energy chapter.[38] However, Mexico did agree to gradually open purchase contracts issued by Pemex and CFE to US and Canadian bidders and to allow performance contracts for oilfield service firms (Hufbauer and Schott 1992). Also, Mexico agreed to liberalize foreign investment in coal and some basic and secondary petrochemicals.

Importantly, NAFTA Article 609 clarified that federal and subfederal energy regulations affecting "the transportation, transmission or distribution, purchase or sale of an energy or basic petrochemical is explicitly covered by NAFTA's national treatment obligations." Each NAFTA country is allowed to restrict energy exports for reasons of conservation, supply shortages, price volatility, and national security. However, these criteria are narrowly defined, and the "emergency clause" has not yet been invoked. NAFTA also prohibits minimum and maximum import and export prices, although it does not prohibit Mexico's public energy monopolies from setting the prices charged to business firms and individual households. These small inroads into Mexico's public energy monopoly provide a foundation for future reforms.

Energy Trade

Energy trade is an important element of North American commerce. Based on US imports from NAFTA countries in 2002, disaggregated by two-digit SITC categories, the top six traded sectors were road vehicles, petroleum, electrical machinery, telecommunications/sound recording, miscellaneous products under special tariff headings, and gas. When coal and electricity are thrown in the mix, energy accounts for 12 percent of total US imports from NAFTA countries.

Tables 7.5 and 7.6 show US energy trade (both volume and value) with Mexico and Canada between 1989 and 2004. Since energy trade between Canada and Mexico is very small, as is Mexican and Canadian energy trade with the rest of the world, we focus on their trade with the United States. Since energy prices are volatile, it is useful to focus on the volume

38. Petrochemicals are listed in NAFTA Chapter 6 (the exemption chapter) at the insistence of Mexico, which wanted the broadest definition of energy-related products so that certain petrochemicals would be exempt from NAFTA obligations.

of energy trade in North America rather than the value to get a handle on underlying trends (although fluctuations in energy prices obviously affect the volume to some extent). The volume of US energy imports from Canada has doubled for many products since 1989, although the two trade agreements are not responsible for most of this increase. US energy imports from Mexico have increased in some sectors but not in others. Natural gas is the only sector where US exports to both Canada and Mexico have grown substantially.

Coal

Coal is not an actively traded commodity in North America because each country has large domestic supplies. However, it is the one energy commodity where the United States enjoyed an overall trade surplus of some $285 million in 2004. Trade in coal between the United States and Mexico has generally been 2 million metric tons or less annually in each direction. Canada usually exports 2 million to 3 million metric tons to the United States but imports close to 20 million metric tons from the United States. US exports of coal to Canada have remained fairly constant in the past few years while total US coal exports have declined substantially.

Crude Oil, Refined Oil, and Liquefied Propane and Butane

The United States exports very little crude oil, and most US exports of crude go to Canada. In contrast, US imports of crude are substantial. Canada has usually sold a slightly greater volume of crude to the United States than Mexico has, but together Canada and Mexico averaged a little less than a third of total US imports of crude between 1989 and 2004.

The United States supplements its oil supply with imports of refined as well as crude oil, although US imports of refined oil are much lower than that of crude. Canada provides a substantial amount of refined oil to the United States (although the Canadian share is only about 10 percent of total US refined oil imports). Mexico has inadequate refining capacity so it is not surprising that the United States buys very little refined oil from Mexico. Indeed, due to the difficulty of obtaining sufficient funding for building refineries in Mexico, Pemex looked to the United States for some of its refined products. For example, Pemex and Shell each own 50 percent of the refinery in Deer Park, Texas, which is the sixth largest refinery in the United States. About 70 percent of the crude oil refined at Deer Park is imported from Mexico, and the refinery exports a significant amount back to Mexico.[39] As the demand for oil in Mexico will likely grow at a faster rate than Mexican refining capacity (currently estimated at 1.7 million barrels

39. Deer Park is one of the few refineries in the world that can convert very heavy crude into light products, such as gasoline. Mexican refineries are not capable of processing some of the heavy crudes pumped from Mexican oilfields. See Shell Deer Park (2003).

Table 7.5a US energy import values, 1989–2004 (in millions of dollars)

Product/country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Coal (SITC 32X)																
Canada	112	131	128	154	166	184	187	193	195	204	203	253	281	252	263	342
Mexico	2	1	0	0	0	0	0	0	0	0	2	0	0	1	0	0
Non-NAFTA	301	156	181	265	346	462	515	413	459	522	461	551	740	739	915	2,076
Total	415	288	309	419	513	646	703	606	654	726	665	805	1,023	993	1,178	2,418
Crude oil (SITC 333)																
Canada	3,133	4,414	4,643	4,814	4,999	4,917	6,139	7,367	7,424	5,560	6,552	12,654	10,048	11,077	13,964	18,702
Mexico	3,999	4,821	4,341	4,272	4,185	4,594	5,682	7,033	6,565	3,819	5,265	9,838	7,953	10,464	13,614	17,172
Non-NAFTA	27,909	34,598	28,390	29,018	29,063	29,019	30,256	30,449	24,405	16,088	19,825	34,054	31,376	32,543	45,188	63,069
Total	35,041	43,833	37,374	38,104	38,247	38,530	42,077	44,849	38,394	25,467	31,642	56,546	49,378	54,084	72,766	98,943
Refined oil (SITC 334)																
Canada	1,555	1,990	1,858	1,599	1,661	1,571	1,676	2,478	2,383	1,725	2,141	3,628	4,109	4,075	5,255	6,499
Mexico	121	205	164	222	478	267	216	368	430	439	375	660	587	571	978	1,591
Non-NAFTA	11,115	13,562	10,169	9,077	8,424	8,109	7,059	13,317	14,707	12,078	15,558	28,359	24,655	21,140	25,620	36,281
Total	12,792	15,757	12,191	10,898	10,563	9,948	8,951	16,163	17,520	14,243	18,074	32,647	29,351	25,786	31,853	44,371
Propane and butane (SITC 342)																
Canada	336	479	583	528	631	533	605	817	812	555	629	1,132	1,263	992	1,505	1,619
Mexico	45	121	93	37	45	47	39	124	105	82	74	93	70	73	22	17
Non-NAFTA	102	207	187	141	275	293	292	932	1,181	1,067	1,115	1,885	1,800	1,607	2,515	3,403
Total	483	807	863	706	952	873	936	1,872	2,098	1,705	1,818	3,110	3,134	2,672	4,042	5,039
Natural gas (SITC 343)																
Canada	1,695	2,012	2,334	2,729	3,245	3,903	3,246	3,915	5,069	5,184	6,070	10,361	15,355	11,428	18,249	19,481
Mexico	0	0	0	0	0	15	1	5	3	7	31	45	16	27	1	1
Non-NAFTA	66	137	93	79	146	97	27	84	154	154	304	611	954	900	2,510	3,881
Total	1,761	2,149	2,427	2,808	3,391	4,014	3,275	4,004	5,226	5,345	6,404	11,017	16,325	12,355	20,760	23,363
Electricity (SITC 351)																
Canada	558	463	487	590	662	960	856	902	978	1,039	1,334	2,711	2,681	1,160	1,382	1,261
Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-NAFTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	558	463	487	590	662	960	856	902	978	1,039	1,334	2,711	2,681	1,160	1,382	1,261
Total																
Canada	7,388	9,488	10,034	10,414	11,365	12,068	12,709	15,671	16,861	14,268	16,928	30,738	33,737	28,985	40,618	47,904
Mexico	4,167	5,148	4,597	4,531	4,708	4,923	5,938	7,529	7,103	4,347	5,747	10,637	8,627	11,136	14,615	18,781
Non-NAFTA	39,493	48,661	39,019	38,580	38,255	37,980	38,149	45,195	40,906	29,909	37,263	65,460	59,525	56,929	76,748	108,710
Total	51,049	63,298	53,650	53,525	54,329	54,971	56,797	68,396	64,871	48,525	59,938	106,835	101,891	97,050	131,981	175,395

Table 7.5b US energy import volume, 1989–2004

Product/country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Coal (million metric tons)																
Canada	2	2	1	2	2	2	2	2	2	2	2	3	3	3	3	3
Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-NAFTA	4	2	3	4	8	9	9	7	9	10	10	13	18	16	24	29
Total	5	4	5	6	9	11	11	10	11	12	12	16	21	19	27	32
Crude oil (million barrels)																
Canada	196	217	267	291	328	348	379	396	424	459	422	499	484	515	543	575
Mexico	255	254	275	281	301	339	367	386	392	364	364	396	424	491	535	545
Non-NAFTA	1,678	1,751	1,588	1,694	1,897	2,021	1,914	1,605	1,363	1,378	1,291	1,286	1,394	1,412	1,628	1,764
Total	2,128	2,222	2,130	2,266	2,527	2,708	2,660	2,387	2,179	2,202	2,078	2,181	2,302	2,418	2,706	2,884
Refined oil (million barrels)[a]																
Canada	75	76	77	70	77	78	77	96	96	93	98	103	132	133	140	138
Mexico	8	9	9	13	34	20	14	17	22	31	24	23	21	25	34	42
Non-NAFTA	614	614	547	495	519	523	411	637	726	858	896	944	947	823	817	924
Total	697	698	633	578	629	621	501	750	844	982	1,017	1,069	1,100	981	991	1,104
Propane and butane (million barrels)																
Canada	32	33	41	42	48	49	57	52	48	57	53	58	57	71	67	58
Mexico	5	9	7	3	4	4	3	10	9	12	9	6	6	6	1	0
Non-NAFTA	12	17	14	11	24	26	24	67	96	120	111	115	112	114	137	158
Total	48	58	62	55	76	78	84	129	153	188	172	179	175	191	205	216
Natural gas (billion cubic meters)																
Canada	31	36	45	57	64	72	81	82	84	88	94	97	109	110	108	108
Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-NAFTA	2	3	2	2	4	2	1	2	3	3	6	11	12	13	27	38
Total	33	39	47	58	67	75	81	84	87	90	101	109	121	123	135	146
Electricity (thousand megawatt hours)																
Canada	18	16	20	26	29	44	40	42	43	39	45	47	38	38	31	27
Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-NAFTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	18	16	20	26	29	44	40	42	43	39	45	47	38	38	31	27

a. Refined oil (SITC 334) excludes some quantity where the quantity was measured in kilograms rather than in barrels.

Note: US imports for consumption, does not include trans-shipments.

Source: USITC Interactive Tariff and Trade Dataweb (2005).

Table 7.6a US energy export values, 1989–2004 (in millions of dollars)

Product/country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Coal (SITC 32X)																
Canada	763	592	432	560	376	386	457	514	564	688	665	657	648	651	627	708
Mexico	24	25	22	20	29	28	50	88	123	106	92	62	53	50	65	85
Non-NAFTA	3,600	3,991	4,266	3,745	2,793	2,548	3,205	3,248	2,878	2,397	1,503	1,454	1,211	966	929	1,910
Total	4,387	4,608	4,720	4,325	3,198	2,962	3,713	3,849	3,565	3,191	2,259	2,174	1,912	1,670	1,621	2,703
Crude oil (SITC 333)																
Canada	49	171	34	22	15	43	1	166	303	417	271	154	176	87	124	218
Mexico	0	0	0	1	0	0	0	4	0	0	0	1	0	1	0	0
Non-NAFTA	13	12	2	3	5	2	0	290	477	253	501	289	1	0	0	28
Total	62	183	35	27	20	44	1	460	780	670	772	444	177	88	124	246
Refined oil (SITC 334)																
Canada	434	594	446	395	422	429	492	560	651	561	626	886	905	797	986	1,255
Mexico	431	529	612	791	670	672	739	952	1,365	1,304	1,729	3,183	2,400	2,190	2,149	2,606
Non-NAFTA	2,308	3,546	3,927	3,349	3,405	2,685	2,733	3,251	2,719	1,723	2,114	2,881	2,910	3,027	3,943	5,864
Total	3,173	4,669	4,984	4,535	4,497	3,785	3,964	4,763	4,736	3,588	4,469	6,950	6,215	6,014	7,078	9,725
Propane and butane (SITC 342)																
Canada	14	27	31	22	32	27	55	51	41	39	48	97	57	45	72	102
Mexico	84	101	77	114	114	114	139	146	180	125	164	444	214	259	230	208
Non-NAFTA	14	32	148	121	82	54	122	105	76	40	87	122	67	166	169	114
Total	112	160	256	258	229	195	316	302	297	204	299	663	338	470	471	424
Natural gas (SITC 343)																
Canada	11	0	10	40	37	62	33	80	143	71	58	153	189	382	1,078	1,933
Mexico	56	41	41	191	80	44	87	33	35	30	18	111	201	471	73	13
Non-NAFTA	160	158	242	121	127	147	146	148	142	142	142	148	146	141	149	140
Total	227	199	293	351	244	254	266	261	320	243	218	411	536	994	1,300	2,086
Electricity (SITC 351)																
Canada	180	491	54	64	61	30	47	69	124	185	206	398	1,258	304	716	829
Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-NAFTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	180	491	54	64	61	30	47	69	124	185	206	398	1,258	304	716	829
Total																
Canada	1,451	1,876	1,006	1,102	943	977	1,085	1,439	1,826	1,960	1,874	2,344	3,234	2,265	3,603	5,045
Mexico	595	695	752	1,118	893	859	1,016	1,223	1,704	1,566	2,003	3,800	2,869	2,972	2,517	2,912
Non-NAFTA	6,095	7,738	8,585	7,339	6,413	5,435	6,205	7,042	6,292	4,555	4,346	4,895	4,335	4,303	5,190	8,056
Total	8,141	10,309	10,343	9,559	8,249	7,271	8,307	9,704	9,822	8,080	8,223	11,039	10,437	9,540	11,310	16,013

Table 7.6b US energy export volume, 1989–2004

Product/country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Coal (million metric tons)																
Canada	16	15	11	14	9	9	10	12	15	20	19	18	17	16	19	17
Mexico	0	0	0	0	0	0	1	2	2	2	1	1	1	1	1	1
Non-NAFTA	77	82	89	80	60	56	71	70	61	51	34	35	28	20	20	26
Total	93	97	100	94	69	66	82	84	78	72	54	54	45	37	40	44
Crude oil (million barrels)																
Canada	3	6	1	1	1	2	0	6	10	21	15	6	5	3	5	7
Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-NAFTA	1	1	0	0	0	0	0	13	24	19	28	11	0	0	0	1
Total	4	7	2	1	1	2	0	19	34	40	42	17	5	3	5	8
Refined oil (million barrels)																
Canada	21	19	15	14	16	15	15	16	20	19	150	19	19	24	30	31
Mexico	26	24	29	36	32	34	34	40	58	69	77	99	79	67	56	54
Non-NAFTA	116	137	175	166	168	140	131	129	110	86	88	85	107	112	118	151
Total	162	180	219	216	216	189	179	184	187	174	315	203	205	203	204	236
Propane and butane (million barrels)																
Canada	2	2	2	2	2	2	4	3	2	3	3	4	3	3	3	4
Mexico	5	5	4	8	6	7	9	8	11	8	9	17	9	12	9	8
Non-NAFTA	1	2	8	7	6	4	8	7	4	3	4	5	3	7	7	3
Total	8	9	14	17	14	14	20	18	17	15	17	26	15	22	19	15
Natural gas (billion cubic meters)																
Canada	0	0	0	1	1	1	1	1	1	1	1	1	2	4	6	11
Mexico	1	1	1	3	1	1	1	1	1	1	1	1	2	4	1	0
Non-NAFTA	3	2	2	2	2	2	2	2	3	2	2	2	3	2	2	3
Total	4	2	2	6	3	3	4	4	6	4	3	4	7	11	9	14
Electricity (thousand megawatt hours)																
Canada	9	16	2	2	3	1	2	2	5	9	11	12	19	12	22	22
Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-NAFTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	9	16	2	2	3	1	2	2	5	9	11	12	19	12	22	22

Note: Refined oil (SITC 334) excludes some quantity where the quantity was measured in kilograms rather than barrels.

Source: USITC Interative Tariff and Trade Dataweb (2005).

per day), Mexico will probably continue to be a net importer of refined oil from the United States (EIA 2005b).

North American trade in liquefied propane and butane is small. The United States exports a few million barrels annually to both Canada and Mexico and receives a few million barrels annually from Mexico. Canada accounts for the dominant portion of total US imports of liquefied propane and butane, but the total is not large.

Natural Gas

The growth in natural gas trade in North America is the fastest of any energy commodity. The United States is a net importer of natural gas but at times during the 1990s has provided a significant amount of natural gas to Mexico. Mexican consumption of natural gas is expected to increase steeply in the future, at an annual rate of 6.2 percent from 2001 to 2025. While some of this gas will have to come from overseas, if greater pipeline capacity existed along the US-Mexico border, the United States could expand exports of natural gas to Mexico.

US natural gas imports have grown more than tenfold in value terms (and almost fivefold in quantity terms) since 1989, and most of the new supply has come from Canada. Natural gas trade between the United States and Canada is two-way; however, a significant amount of US exports represents Canadian gas transported from west to east that crosses the US border as it flows from Canadian gas wells to Canadian customers. While deregulation has boosted natural gas trade, and while pipeline capacity has increased, more pipeline construction will be necessary to create an integrated natural gas market between the United States and Canada.[40] Eventually, reserves in Alaska's North Slope and Canada's Mackenzie Delta may be tapped to supply natural gas across the continent.

Electricity

Almost all US trade in electricity is with Canada, and the United States is a net importer. However, electricity trade is two-way, due to shifting seasonal demand (north to Canada in the winter, south to US cities in the summer). Canada has a comparative advantage in electricity generation due to its many fast-flowing rivers that provide hydroelectric power. Mexico, which is plagued by frequent power outages, does not currently have adequate transmission infrastructure to import heavily from the United States. Likewise, Mexico lacks the infrastructure to export a significant volume of electricity to the United States. However, some private

40. The challenge is not only cross-border but also between regions of each country. As evidence of market segmentation, Bradley and Watkins (2003) cite significant price differences between natural gas sold at high prices in the Pacific northwest (where prices were very high during the 2001 energy crisis) compared with the slack market in the US mountain states during the same period.

companies, such as California-based Sempra Energy, have started producing electricity in Mexico for the US market.[41] Better transmission infrastructure would promote electricity trade between the United States and Mexico, but it is not clear that new transmission lines will be built anytime soon.

North American Policy Cooperation: Recent Initiatives

The Energy Consultative Mechanism (ECM) between the United States and Canada, which has been in existence since 1980, provides a formal mechanism for the two countries to discuss developments in the energy sector and to facilitate cooperation in research and development. The group, which comprises senior staff of Natural Resources Canada, the Canadian Department of Foreign Affairs, and the US Departments of Energy and State, meets once a year but publishes no proceedings or reports.

In April 2001, the three NAFTA countries created the North American Energy Working Group (NAEWG) to collaborate on energy policy issues and to enhance North American energy trade and interconnections consistent with sustainable development.[42] The high political profile soon faded, however. The NAEWG's work has focused on sharing information on technical standards and regulations rather than on big-picture infrastructure projects or energy security issues.

As of March 2005, the NAEWG had issued four major reports,[43] focusing on North America's energy supply, demand, infrastructure, electricity regulation, and energy efficiency. The first report, "North America: The Energy Picture," provides basic statistics and discusses the legal and policy regulatory frameworks in each of the three countries. The second, "North America: Regulation of International Electricity Trade," expands on the previous report's section on electricity regulation. The third report, "North American Energy Efficiency Standards and Labeling," documents North American attempts to harmonize efficiency standards by 2003. The most recent report, "North American Natural Gas Vision," was released in January 2005.

While NAEWG's level of activity is an improvement over the ECM, much more could be done. The flavor of this working group is that of a

41. The Termoeléctrica de Mexicali natural gas power plant in Baja California Norte has a capacity of 600MW and can supply both Mexico and southern California. Environmental groups have challenged the plant, along with similar projects, but it has been approved in court and is currently operating ("Judge Lets Power Flow from Mexico," *Los Angeles Times,* July 10, 2003, C2).

42. See NAEWG (2002a) for details.

43. In addition to these four, NAEWG released "Guide to Federal Regulation of Sales of Imported Electricity in Canada, Mexico, and the United States" in January 2005 as a follow-up publication to its earlier work on electricity trade.

talkfest—long on discussion, short on recommendations. We suggest that the NAEWG be given a higher profile, hold public meetings, and issue clear recommendations, even if the parties agree only on narrow issues.

By necessity, cooperation has been strongest in the area of electricity regulation. NERC, founded in 1968, develops voluntary reliability standards, relying on peer pressure and mutual self-interest to see that its regulations are followed. NERC itself has taken the position that voluntary standards are no longer adequate and advocates legislative changes to create a mandatory set of electric reliability standards across North America.[44]

In response to the northeast blackout of August 14, 2003, Ottawa and Washington sprang into action, establishing the US-Canada Power System Outage Task Force. This group was charged with determining the root causes of the blackout and developing a plan to prevent any recurrence of regionwide power outages. Box 7.2 summarizes the final report from the task force, which addresses the causes of the northeast blackout. The emphasis on preventing mass outages is clearly appropriate. To this end, a bilateral electricity reliability organization (ERO) to develop and enforce mandatory electric reliability rules throughout the United States and Canada was first suggested in 1997 as a successor organization to NERC. The ERO would be an important step forward. This step would require that the US Congress grant FERC power to delegate some of its regulatory authority to an international body. The concept of an ERO has sufficient promise and salience that it should become the top item on the agenda of energy cooperation.

Recommendations

What the August 2003 blackout proved for electricity—that effective policy and regulation on one side of the border is a national security priority on both sides—is also true in the oil, natural gas, nuclear, and other energy sectors. However, while more integrated North American energy policies may be in the best interests of all involved, getting from here to there is no small task.

NAFTA solidified already extensive energy relationships between the United States and Canada, which operate through physical and regulatory interconnections. The agreement also made tentative steps toward bringing Mexico into the market for trade and procurement of energy-related goods. However, private investment in Mexican hydrocarbons or electricity remains largely off-limits. NAFTA did not create the uneven nature of

44. NERC operates primarily in the United States and Canada, although its members also include energy suppliers to a portion of Baja California Norte, Mexico. NERC's position with respect to mandatory reliability standards is explained on its Web site, www.nerc.com (accessed on March 1, 2005).

Box 7.2 Causes of the August 2003 blackout

In April 2004, the US-Canada Power System Outage Task Force released its final report on the causes of the August 14, 2003 blackout, which affected 50 million people in the northeastern United States and Ontario. The report found that the blackout originated in Ohio. Three high-voltage transmission lines owned and operated by FirstEnergy (FE), a local utility company, failed after making contact with trees that had encroached into line easements. Due to computer failure, the line failures did not raise alarms, and FE controllers remained unaware of the problem. Since FE did not take action to rebalance the load on its system, the failures caused power to surge and overload other transmission lines in FE's control area, which in turn caused a cascade of failures throughout the region. The report faulted FE for not maintaining its transmission lines and for operating the transmission system in an insecure manner and the Midwest Independent System Operator (MISO), FE's RTO, for failing to provide effective diagnostic support and communicate the problem to other regional reliability coordinators.

To prevent future blackouts, the task force issued 46 specific recommendations. The first was to "make reliability standards mandatory, with penalties for noncompliance" (US-Canada Power System Outage Task Force 2004, 140). Second was to develop a regulator-approved independent funding mechanism for the North American Electric Reliability Council (NERC) to ensure its independence, and third was to strengthen the institutional framework for reliability management in North America. Most recommendations were far more technical in nature. The task force noted that "the August 14 blackout shared a number of contributing factors with prior large-scale blackouts, confirming that the lessons and recommendations from early blackouts had not been adequately implemented" (Task Force 2004, 147). This comment suggests systemic problems that require policy reform.

Previous blackouts have been caused by

- inadequate vegetation management (tree trimming);
- failure to ensure operation within secure limits;
- failure to identify emergency conditions and communicate that status to neighboring systems;
- inadequate operator training; and
- inadequate regional-scale visibility over the power system.

The new causes in the August 14 blackout were

- inadequate interregional visibility over the power system;
- dysfunction of a control area's System Control and Data Acquisition (SCADA) system and Emergency Management System (EMS); and
- lack of adequate backup capability to these systems.

North American energy integration, but it does institutionalize differences between the more market-oriented policies of Canada and the United States on one side and the more statist policies of Mexico on the other.

In our opinion, this bifurcation was an appropriate recognition of reality. The minimal steps taken by Mexico under NAFTA provide some small

precedent for liberalization, and the alternative—retarding integration between Canada and the United States in order to include Mexico—is undesirable. Today, tension remains between cohesion and progress in North American energy policy. Our view is that even though it is in the interest of all member countries to narrow the policy gap in the long term, future demands for energy are too pressing to hold US-Canada integration hostage to the Mexican political environment. Instead, we advocate continuing two-track integration and offer two sets of recommendations. The first concentrates on meeting the energy needs of Canada and the United States through enhanced cooperation. The second seeks politically viable ways that the three countries can help expand energy production in Mexico.

Furthering US-Canada Policy Cooperation

When the National Energy Policy Development Group, chaired by Vice President Dick Cheney, released its assessment of the US energy policy (NEPD 2001), its recommendation to create a "North American framework" provoked a great deal of discussion in Canada (although relatively little in the United States, where the hot issue of the report was the recommendation to allow oil drilling in the Arctic National Wildlife Refuge). Exactly what the framework would entail is ambiguous, and some Canadians are wary that a continental energy policy would undermine Canadian sovereignty. There is no reason for this to be the case. Canada's own energy policies, driven by the constitutional mandate that accords most direct responsibilities to the provinces, are an example of how to maintain local sway while ensuring interregional cooperation.

Enhanced cooperation can come from many sources, but we believe that an agreement has the best chance of being implemented if it comes from a bilateral cabinet-level initiative. The ECM—which involves the US Departments of State and Energy alongside Natural Resources Canada and the Canadian Department of Foreign Affairs—has up to this point distinguished itself primarily by its low profile; instead, ECM meetings should be used to provide public and political impetus to a series of initiatives to promote US-Canada energy linkages. Several items are ripe for cooperation, provided the two sides communicate with one another at a senior political level.

Joint Regulation of Electricity Reliability

The electricity grid connections between the United States and Canada are so tightly integrated that they constitute a single electricity infrastructure. In the post–September 11 environment, the United States has an obvious interest in ensuring the security of those portions of the grid in Canada. The August 2003 blackout showed Canadians by example that substandard operation of the grid in Ohio can turn the lights out in Ot-

tawa and Toronto.[45] Given the importance of electricity in the daily lives of Canadians and Americans, it is remarkable that grid reliability is regulated with only a voluntary set of standards (many of which were not followed in August 2003). There is broad support for developing mandatory reliability standards. NERC and FERC both agree that the creation of a bilateral ERO, mandated to develop and enforce reliability standards, would be desirable. Legislation enabling FERC to participate in the creation of an ERO was passed in July 2005 in the Energy Policy Act of 2005, and President Bush signed the measure into law in August. So the time is now right for an international initiative to establish joint regulation of the electricity grid.

If some level of joint regulation is successful in the realm of electricity management, the system could be expanded to other parts of the energy infrastructure, such as natural gas pipelines.

Renewable Portfolio Standards

Many US states have renewable portfolio standards (RPS), which either require the use of renewable energy or give incentives to use renewable energy. However, different states use different definitions of renewable energy. Some of these state definitions exclude particular types of energy-generating processes conventionally considered "renewable," particularly hydroelectric power in general or hydroelectric power from dams above a certain capacity. Also, some states have potentially abusive licensing standards or require the renewable energy be generated in-state.[46]

Canada's abundance of hydroelectric-generating capacity means it has much to gain from these emerging policies, but their potential use as trade barriers is a cause for concern.[47] In the United States, the federal government has already expressed some interest in developing a federal stan-

45. To be fair, equipment malfunction in Ontario caused the 1965 blackout, which affected much of the US northeast, including New York City.

46. NAFTA reiterates GATT language that trade-restrictive measures that attempt to protect the environment can be justified in some circumstances, but they cannot be applied in an arbitrary manner or function as a disguised restriction on trade.

47. Such "in-state" requirements are obviously a disguised restriction on extra-state commerce and thus a restriction on international trade. Licensing standards do not obviously violate NAFTA, but they could be used to restrict trade if states treated applications from Canada or Mexico less favorably. The definition of renewable energy is a tougher case. For example, New Jersey considers hydroelectric power generated by facilities with less than 30 megawatts of capacity to be renewable, but 96 percent of Canadian hydroelectric power is produced by facilities with more than 30 megawatts of capacity. Although there have been no legal cases on electricity issues to date, the 30-megawatt requirement could be considered "arbitrary" or a disguised restriction on trade, especially if most of New Jersey's hydroelectric power generators have less than 30 megawatts of capacity. Although the capacity of the plant has little to do with whether the energy is in fact renewable, some environmentalists fear that large dams adversely affect plants, animals, and fish.

dard, although a provision creating a federal RPS was removed from the Energy Policy Act of 2005 due to Republican objections an RPS would increase electricity costs ("Provisions to Curb Oil Use Fall Out of Energy Bill, *New York Times,* July 26, 2005, 14). If Canadian provinces are willing to adhere to an RPS—and there is no reason to believe they would not—expanding this to a binational standard should be relatively straightforward and would ensure that Canadian renewable energy is credited under the RPS. For the United States, an environment-friendly agreement with Canada would demonstrate its environmental credentials despite the US decision not to participate in the Kyoto Protocol.

Key Energy Projects

Both the United States and Canada should be more forthcoming about consultations over major energy projects than their record in the fractious deliberations over the Alaskan North Slope and Canadian Mackenzie Delta pipeline projects (box 7.3). It now appears that two pipelines will be constructed to bring natural gas from northern reserves to southern markets. Alaskan gas will take the "southern route" while a separate pipeline will connect the Mackenzie Delta to the existing Alberta gas pipeline infrastructure. While the pipeline routing dispute has subsided, it generated bilateral friction that contributed to unnecessary delays in infrastructure investments and set back the larger vision of energy security in North America.[48] We believe Dobson (2002) is correct in saying that infrastructure planning could and should be done within the context of existing regional mechanisms. The two governments should let private investors pursue their international energy projects, consistent with environmental, public safety, and security concerns.

Like the pipeline debate, most large energy projects in North America will have an international dimension. The next large projects on the horizon are the construction of LNG terminals in NAFTA countries (both to supply the local market and to import and regasify LNG for export via pipeline) and the exploitation of the oilsands in Alberta. Beyond LNG and the oilsands are nuclear power plants. While nuclear power currently dwells in the dark regions of political and environmental incorrectness, it could fast become more acceptable if atmospheric CO_2 concentrations rise and global warming becomes a political as well as a scientific fact.[49]

48. For a summary of Canadian concerns, see Paul Kergin, "Trust the Market (and Canada)," *Wall Street Journal,* May 15, 2002, A18.

49. Almost a quarter century since the partial meltdown at Three Mile Island, the de facto US freeze on building nuclear power capacity may be starting to thaw. Three operators have applied to the Nuclear Regulatory Commission for site approval to build additional reactors at existing plants in North Anna, VA, Clinton, IL, and Port Gibson, MS ("Nuclear Power Hopes to Find a Welcome Mat Again," *New York Times,* January 27, 2005, 16).

Box 7.3 Northern natural gas pipelines

In the United States, legislation attached to the Military Construction Appropriation Act of 2004 (PL 108-324) provides loan guarantees of roughly $18 billion to build a gas pipeline from northern Alaska to Chicago via the "southern route," which would run south across Alaska and then cut east through British Columbia and Alberta on its way to the Chicago hub.[1] An alternate "northern route" would have run southeast underwater into the northwestern territories and then through Alberta on its way to Chicago. The northern route is somewhat more direct and would cost $2 billion less to build than the southern route (Welch 2002).

The US Congress preferred the "southern route" both because it was thought to be more environment-friendly—much of this route parallels the Trans-Alaska oil pipeline or the Alaska-Canada Highway, so the construction infrastructure is already in place—and because a greater percentage of the line would go through the United States, thus creating more jobs for US union workers.

In addition to carrying gas from Alaska's North Slope, the "northern route" could have also been used to transport natural gas from Canada's Mackenzie Delta. Canadians initially feared that a standalone Mackenzie Delta pipeline might not be economically viable and that subsidies from the US government (at one point a guaranteed price floor for gas delivered via the North Slope pipeline was being considered) would price a private Canadian pipeline out of the market.[2] However, a private consortium has emerged to connect the Mackenzie Delta to Alberta's existing pipeline system. Notably, the Mackenzie pipeline consortium includes some Canadian aboriginal groups, who have joined with energy companies in support of a pipeline because they believe they have the political clout necessary to benefit from the extraction and transportation of natural resources on their lands.

1. This legislation, which also includes $400 million worth of tax breaks in the form of accelerated depreciation schedules and credits, was initially part of the Energy Policy Act of 2003 (HR 6) but was moved separately when the larger bill became bogged down in the Senate.

2. Jack Mintz of the C. D. Howe Institute pointed out that it was not just the potential for US subsidies but a more favorable tax system that advantaged US pipelines over Canadian ones. Canadian pipelines are depreciated for tax purposes at a rate of 4 percent per year using a declining balance method, resulting in a 50-year depreciation schedule, much longer than historical pipeline replacement life, even though the reserves in the Mackenzie Delta are expected to last only for 20 years. By contrast, the US tax depreciation schedule for pipelines is 15 years, and the Alaska pipeline will be allowed a special seven-year schedule (*National Post,* February 3, 2005).

Obviously, the home country will take the lead in developing LNG or nuclear projects on its territory or approving permits for infrastructure construction on its soil. The United States and Canada have differing philosophies regarding the level of government support for infrastructure projects and differing attitudes toward nuclear power. However, informal consultations can avoid misunderstandings on projects with cross-border dimensions and avoid duplication of efforts.

Currently, almost all of Canada's oil exports are destined for the United States and arrive through pipelines. Exploitation of the oilsands, now

technologically and commercially viable (with oil at $50/bbl), should significantly expand Canadian production and exports. Currently, Alberta oilsands yield more than 1 million barrels per day (bpd), and production is projected to double by 2010 (Alberta Department of Energy 2005). However, not all of the increased production may supply North American markets. In April 2005, the state-owned China National Offshore Oil Company (CNOOC) bought a 16.7 percent share in MEG Energy Corporation, a Calgary firm exploiting a 2-billion-barrel oilsands lease near Christina Lake, which hopes to produce 25,000 bpd by 2008. In addition, Canadian pipeline firm Enbridge and PetroChina, a division of China National Petroleum Company, agreed to cooperate on the construction of a 720-mile pipeline from the Alberta oilsands to the coast of British Columbia. This pipeline would cost $2 billion and have a planned capacity of 400,000 bpd or 20 percent of projected oilsands output by 2010. The deal depends importantly on agreement on long-term supply contracts with Chinese and other customers.[50]

Chinese investment plans in Canadian oil are only in an embryonic state, but because the Chinese companies are state-owned, commentators have already stirred concerns about Chinese government ownership of Canadian natural resources.[51] Speaking in Beijing, Canadian Prime Minster Paul Martin said he "shares those concerns" and that "the decision will be based on its benefits to Canada and the protections for Canada, and the nature of the owner and what the owner has to bring" ("Martin Echoes Takeover Concerns," *Toronto Star*, January 22, 2005, D1). The scene is thus set for a new bout of federal/provincial friction on energy policy if larger Chinese investments—with the approval of Alberta and British Columbia—provoke policy action from the federal government in Ottawa.

Finally, US-Canada cooperation could advance exploitation of another promising energy source: coalbed methane (CBM) gas. CBM is gas that eons ago was trapped during the conversion of plant material into coal. The presence of CBM gas has long been known (it is the primary cause of coal mine explosions), but commercial production has become feasible only in the past few decades. Unfortunately, CBM extraction also produces large amounts of water, often with a high saline content. Disposal of this water poses an environmental challenge.[52] In 2002, CBM production in the United States was 4.7 Bcf per day; it is projected to rise to 5.6 Bcf in 2025. Over the same period, Canadian production is expected to rise from 0.5

50. See "China Buys into Oilsands," *Edmonton Journal,* April 13, 2005, H1; "Enbridge, PetroChina Sign Oilsands Pipeline Deal," *Reuters,* April 14, 2005; and "China is Emerging as a Rival to US for Oil in Canada," *New York Times,* December 23, 2004, 1.

51. Similar concerns surfaced in the United States in mid-2005 when CNOOC sought to buy Unocal.

52. The leading technique is to inject the water back into the coalbed, which significantly raises production costs.

Bcf per day to 2.2 Bcf per day (NAEWG 2005a, 14). CBM and other "unconventional sources" will remain minor contributors to total production of natural gas. As a benchmark, in 2003, North America produced roughly 75 Bcf of natural gas per day. However, in a maturing industry, CBM gas could partially compensate for depleting oil and gas reserves. Both the United States and Canada should fund additional research on the recovery and development of CBM deposits.

Expanding Mexican Production and US-Mexico Energy Trade

The basic problem in Mexico is that the country will need much more energy in the near future but is unlikely to meet growing demand because of inadequate investment in oil and gas fields and electricity generation and distribution. The current tax system and constitutional constraints on energy-related private activity effectively deny the needed financial resources for energy investment in Mexico. Frequent electricity "brownouts," which disrupt industrial production throughout the country, underscore both the need for tax and energy reforms in Mexico and the cost of the long-standing political impasse over policy reforms in the Mexican Congress.[53] Supply shortfalls threaten to dampen economic growth, further limiting revenue available for new energy investment.

According to Luis Ramírez Corzo, the director general of Pemex, present levels of investment (about $10 billion a year) will allow the company only to maintain production levels and continue to export. Raising investment to $20 billion could boost exports in both oil and natural gas.[54] To do so, however, Pemex needs advanced oilfield technologies to exploit deepwater reserves in the Gulf of Mexico, which are not on offer from private companies under the limited fee-based service contracts permitted by Mexico's constitutional provisions. Avoiding the Constitution's "no-go" zone, Ramírez has set an ambitious agenda that includes rewriting the Pemex union contract, freeing Pemex finances from government management, creating an independent board of directors, creating "alliances" with foreign oil companies, and convincing the government to siphon less oil revenue to meet its fiscal targets.[55] The Pemex chief even suggested

53. One reason for the impasse is Pemex's status as a national symbol and cash cow of the Mexican treasury. Pemex made up 37 percent of federal budget revenues in 2000. If Pemex were privatized or partially privatized, alternative tax sources would be needed to compensate for the fiscal drain.

54. Much of the increase in investment would target 54 billion barrels of "possible" oil reserves in deepwater areas of the Gulf of Mexico. Mexico's proven reserves stand at 18.9 billion barrels in 2005, down from 28.4 billion barrels in 1999. See "Into Deep Water," *The Economist,* February 26, 2005, 36, and EIA (2005b).

55. See "Mexican Oil Chief Seeks Expansion," *New York Times,* March 3, 2005, 8.

that some natural gas resources should be open to exploitation by the private sector.[56]

Unfortunately, for a variety of political reasons, we do not believe that reforms to give private companies—Mexican or foreign—the requisite incentive to invest or operate in Mexico are likely in the near term.[57] There is an important qualification to this pessimistic prognosis: If world energy prices stay in the $40 to $60 per barrel range (presumably as a result of rapid demand growth in China and India and political tensions in the Middle East), and if energy demand greatly exceeds supply in Mexico, the Mexican people might become more willing to reconsider the utility of the energy provisions in their Constitution. In this case, Mexico may be able to implement a mix of job security arrangements (guaranteed employment of energy workers either with new foreign employers or in their current jobs) and wage insurance programs for displaced workers, which would make full-scale reform politically acceptable. The chances of this scenario seem small in the near future. But as time passes, and Mexico's energy problems and the associated drag on development become more severe, reforms will become unavoidable.

Meanwhile, the prognosis is slightly better for tax reform, which would allow Pemex to keep a larger share of its revenues. In 2003, the Chamber of Deputies passed a bill to reduce the government's take of Pemex revenues by as much as $2.5 billion in 2006; however, the legislation is stalled in the Mexican Senate.[58] In 2003, Pemex provided almost one-third of the Mexican government revenue (SHCP 2004, annex A), so any reduction in revenues from Pemex must be gradual and matched with painful increases in tax revenues from other sources.

In any case, the Mexican impasse is primarily an internal matter and is tightly interwoven with Mexican history and national identity. Any démarche from the United States as to Mexican subsoil resources is likely to be rebuffed as "neoimperialism."[59] North America, speaking through the NAEWG, will be better served by analyzing the international implications

56. Ramírez would allow mature natural gas fields that were unassociated with oil fields to be exploited by the private sector, so that Pemex could focus investment elsewhere. "Pemex Chief Calls for Opening Mexico's Energy Sector," *North American Free Trade and Investment Report* 15, no. 9, May 15, 2005.

57. Jorge Castaneda and Nathan Gardels have proposed a "North American Energy Security Fund" that would issue securities to finance oil exploration backed by future oil revenues rather than the oil itself ("How to Tap Mexico's Potential," *Financial Times,* March 8, 2005, 15). We doubt, however, that the potential return to investors would be sufficient to attract much private funding.

58. See "Mexican Oil Chief Seeks Expansion," *New York Times,* March 3, 2005, 8.

59. In May 2003, the US Congress passed a nonbinding resolution suggesting that any immigration agreement with Mexico be predicated on opening Pemex to US investment. While the resolution went virtually unnoticed in the United States, it caused outrage in Mexico. President Fox quickly responded that "Pemex forms not just a part of our economy but of

of substantial reform in the Mexican energy sector, and how best to manage a future energy crisis in Mexico, rather than trying to advocate Mexican policy adjustment from the perspective of Washington or Ottawa.

This is not to say that the United States and Canada should abandon Mexico to its present rigid energy policy. Through the NAEWG and other channels, the United States and Canada should make a concerted effort to build trust with Mexico on energy issues. Mexico should reciprocate by abandoning collusive dealings with OPEC.

LNG Terminals and Natural Gas Pipelines

As discussed earlier, several companies have expressed interest in locating LNG regasification terminals in Mexico. If built, the terminals would connect to pipelines to serve northern Mexico as well as to export to southwest United States. Unlike most portions of the energy sector, private investment in natural gas transportation was legalized in Mexico in 1995.[60] Since then, the number of interconnections between Mexico and the United States has increased from 7 to 15 (NAEWG 2005a, 67). Currently, Mexico is a net importer of natural gas from the United States, but the LNG terminals are expected to reduce Mexican imports from the United States after they open. (Mexico's first LNG terminal is expected to begin operation in 2007; others are in the planning stages.) The free flow of natural gas between the United States and Mexico is in the interest of both countries and requires cooperation on continuing to build interconnections and pipeline infrastructure. Private participation in LNG imports offers US companies an opportunity to gain a foothold in Mexico in an area where the government welcomes them. To the public at large, LNG can powerfully demonstrate the benefits of private investment in Mexico.

Streamlined Cross-Border Permits

Presidential permits—actually given by the DOE after receiving approvals from the State and Defense Departments—are required before a US firm can construct, connect, or operate an electricity transmission line across an international border. The Bush administration's National Energy Policy report (NEPD 2001), as well as a United States Energy Association report (USEA 2001), recommended that the US government accelerate the approval of presidential permits. Two executive orders have already attempted to implement this policy.[61] New permits should be particularly

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our history. . . . It has not been nor will be for sale" ("US Congressional Committee Sparks Controversy with Proposal that Immigration Accord with Mexico be Tied to Pemex Opening," SourceMex, May 21, 2003).

60. At present, Pemex still owns 84 percent of the natural gas transmission infrastructure (NAEWG 2005a, 17).

61. See Executive Order 13212 of May 18, 2001, *Federal Register* 66, no. 99, May 22, 2001, 28357; and Executive Order 13337 of April 20, 2004, *Federal Register* 69, no. 87, May 5, 2004, 25299.

helpful for future development along the southern border, which would enable the United States to export electricity (and natural gas) to Mexico.

Clean Energy Technology Exports to Mexico

The USEA (2001) has recommended that the United States "develop with the Mexican Government a coordinated plan of actions to foster the rapid development and introduction of clean energy systems in Mexico." The recommendation has its pros and cons. Encouraging the use of environment-friendly energy is a noble goal, but Mexico is primarily concerned with obtaining enough energy to meet its growing needs. Ensuring that the energy generation meets US environmental standards is a secondary concern. An aggressive US attempt to promote clean energy trade might be perceived by Mexican nationalists as a covert attempt to undermine Pemex and CFE, while hypocritically relying on environmentally questionable energy at home. On the other hand, "clean energy" systems can also increase production. For example, better equipment will reduce flaring in Mexican gasfields and pipelines, and antifraud mechanisms will eliminate waste.

To avoid a nationalist backlash, the United States should not deny imports of Mexican electricity that are generated in accordance with US environmental standards (even if those standards are below "best practice" methods), nor should the United States insist that Mexico meet "state of the art" environmental standards beyond those already widely applied in the United States. Meanwhile the NAEWG should undertake a project to study the ways of advancing clean energy technology trade in North America. The voice of Canada, an international leader in environment-friendly energy, should be prominent. Addressing these issues in a trilateral forum would put the focus on the shared goal of environmental protection rather than the narrower goal of US export promotion.

Energy Cooperation: Final Thoughts

To date, NAFTA has not played much more than a token role in trade and investment decisions in the energy sectors of the three countries. Trade is extensive, with Canadian and Mexican resources feeding the energy-hungry appetite of US consumers. NAFTA's modest approach to regional energy cooperation has had its downside; in particular, the trade pact has not spurred the efficiency gains that mark regional ties in other sectors. Because NAFTA sidestepped sensitive investment issues, trade in energy products has remained distorted and suboptimal.

Going forward, the short-term problems in North America are energy shortages in Mexico and to a lesser extent, localized energy shortages in the United States (e.g., California in 2001). Unless energy production in North America sharply increases, the long-term problem is that North America

will continue to be at risk of supply shortages originating in the Middle East, Russia, and West Africa—the three large oil- and gas-exporting regions. So long as the North American energy market remains integrated with the world energy market, world price volatility will inevitably spill over into North American price volatility.[62] However, increased North American production can reduce the region's vulnerability to external supply shocks.

Although the United States and Canada have largely integrated their energy markets, the ultimate goal of a unified North American energy market is still a long way off. The United States and Canada should continue to deepen cooperation in the areas of infrastructure planning and regulation. They should encourage Mexico to pursue tax and energy policies that will generate domestic revenues that can fund expansion of oil and gas production and electricity generation. Such reforms are needed first and foremost to provide a strong foundation for Mexican economic growth. In so doing, Mexico would also contribute to North American energy security and thus to the long-term health of the North American economy—on which Mexico is so dependent.

Exploiting the Canadian oilsands and expanding production of US and Mexican oil and gas should be cornerstones of a new and concerted North American energy security policy. We return to this crucial issue in our concluding chapter.

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