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Canada as an emerging energy superproducer

by Gerry Angevine and Kenneth P. Green

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Executive summary

Since 2006, the Prime Minister and his colleagues have been suggesting that Canada is on the verge of becoming an "energy superpower" without explaining what they mean other than to indicate that Canada's energy commodity production is poised to increase considerably. Historically, the term "energy superpower" has meant major oil companies and OPEC (a cartel of oil-producing countries), which at times used their control over much of the world's oil production to influence the price of oil. For a *country* to be an energy superpower in the political sense—that is, to be able to use its status as a major energy producer to achieve political objectives—Russian experience has indicated that a country must be able to control access to supplies sufficiently to be a price setter. Canada, without ownership and therefore control of its energy resources, or the ability or the mandate to exercise market power for economic advantage in our principal export markets for these resources, is not in a position to become an energy superpower. However, Canada's position as a major producer of petroleum, electricity, and uranium, along with developments underway or planned and large undeveloped energy resources, suggests that Canada is becoming a "superproducer" of energy.

Primarily because of the huge volumes of bitumen deposited in Alberta's oil sands, Canada has proved crude-oil reserves of 173.6 billion barrels and ranks third in the world by this measure, behind only Saudi Arabia and Venezuela. Among the world's top ten crude-oil producers, Canada ranks sixth, well behind Russia, Saudi Arabia, the United States, China, and Iran. But Canadian oil production is poised to increase substantially as a result of continuing investment in facilities to produce bitumen from the oil sands and crude oil from shale formations. The most recent long-term projection by the National Energy Board suggests that Canadian oil production could reach 4.5 million barrels per day by 2020 compared with 3.0 million barrels per day in 2010—an increase of 50%. But these are conservative estimates because the NEB did not recognize the potential for growth in oil production from shale formations. In any case, it appears likely that Canada is on course to become the fourth-largest—possibly even the third-largest—oil-producing country.

Canada's proved reserves of natural gas rank 20th in the world according to the US Energy Information Administration, but this ranking is based only on resources that are recoverable via conventional technologies (i.e., vertical well drilling). If gas from unconventional sources were included, Canada would rank considerably higher because of the enormous volumes of gas that have been identified as recoverable from tight sand and shale rock formations in British Columbia. Canada currently ranks as the fourth-largest producer of natural gas in the world, although we produce less than one quarter as much gas as Russia and the United States. However, Canada has the potential to increase gas production considerably, especially in British Columbia where numerous LNG export project applications have been approved, filed with the National Energy Board, or are being developed.

Canada is already a major exporter of electricity largely because of its large capacity for hydroelectric power generation and proximity to major electricity markets in the United States. But the country has the technical potential to more than double hydroelectric capacity from approximately 75,000 MW (megawatts) to 163,000 MW in the future. While the economic potential for expansion of hydroelectric capacity is lower, primarily because of the remoteness of the many of the technically feasible sites, 25,000 MW of that potential capacity includes "planned" hydroelectric projects that are either already under construction or under review for likely development. As the new hydroelectric facilities being planned for Newfoundland & Labrador, Quebec, Manitoba, British Columbia, and other provinces come on line, they will further strengthen Canada's position as a superproducer of energy and one of the world's largest net exporters of energy.

Australia, according to the World Nuclear Association, holds 31% of the world's recoverable uranium resources, followed by Kazakhstan with 12%. Canada and Russia each have about 9% and Niger, 8%. Canada was the world's largest uranium producer for many years but was surpassed by Kazakhstan in 2009; by 2011, Kazakhstan's production was more than twice that of Canada. However Cameco, Areva, and their joint venture partners are set to commence operations at the Cigar Lake mine in Saskatchewan this year, which will double Canadian production. The Cigar Lake mine, development of additional properties in northern Saskatchewan, and further exploration both there and in other parts of the country indicate that Canadian uranium production is poised for considerable growth.

Because Canada is self-sufficient in energy, most of the increase in oil, gas, uranium, and hydroelectric production will be bound for export markets. Canada was the fifth largest net exporter of oil, natural gas, oil products, and electricity combined in 2009, accounting for almost 133 million tonnes of oil equivalent, surpassed only by Russia, Saudi Arabia, Norway, and Iran. Canada was also a major exporter of uranium. As the capacity to produce conventional crude oil, bitumen, natural gas, uranium, and electricity production increases, Canada is on course to become an even more significant energy commodity exporter.

The impact of becoming an energy superproducer

If Canada becomes an energy superproducer and net exporter, will this be in Canadians' best interest? Energy commodity production already has a considerable impact on Canada's Gross Domestic Product (GDP). For example, oil and gas extraction contributed approximately $94 billion to GDP in 2011. A study of the impact on Canada's economy of natural gas extraction alone, including drilling and support services, indicated that these activities contributed $9.8 billion to labour income and $64 billion to GDP in 2008. Electric utilities (including generation, transmission, and distribution) contributed approximately $33 billion to GDP in 2011. The uranium industry purchased goods and services valued at $1.1 billion in 2011.

Canada's energy sector—even without service stations and wholesale trade in petroleum products—provided direct employment to 264,000 people in 2010.[1] When indirect employment is included, it is estimated that the Canadian petroleum industry employs close to 500,000 persons. Adding total employment in uranium mining (≈ 15,500 persons) and direct employment in the electricity sector (≈ 97,000 workers), and assuming that 50,000 persons are employed indirectly by the electricity sector, suggests that the energy sector as a whole accounts for at least 663,000 jobs, or approximately 4.4% of total Canadian payroll employment in 2012.

Clearly, oil and gas production, uranium mining, and electricity generation, transmission, and distribution are important elements of the Canadian economy. The recurring, annual benefits from economic activity in the energy sector, including interprovincial energy trade involving transportation and storage, will increase if, as expected, further development of our petroleum, uranium, and hydroelectric resources leads to sufficient new production that more than offsets declines in output from maturing oil and gas fields, depleting uranium mines, and decommissioned hydroelectric facilities. Construction of expanded and new production facilities, and the infrastructure that will be required in order to transport the additional oil, natural gas, uranium, and electricity, will also boost interprovincial energy trade and employment and contribute to GDP.

Royalties and related payments from energy commodity producers also contribute substantial amounts to governments. Canada's oil and gas producers alone contribute between $17 billion and $20 billion to the provincial and territorial governments every year in the form of royalties, land-lease payments, and licenses. Hydroelectric generators pay approximately $1.5 billion dollars to provincial and territorial governments via water rental

1 This includes direct coal mining employment of approximately 25,000 workers (Coal Association of Canada, 2012).

fees. Uranium producers currently pay approximately $170 million per year to the government of Saskatchewan as royalties, the resource surcharge, and lease payments and fees.

In total, the Canada's energy resource producers make annual contributions of at least $19 billion to governments in the form of royalties, lease payments, and fees. These payments will become greater as petroleum and uranium production increases and new hydroelectric facilities are built. Growth in the production of oil sands bitumen alone could be contributing $50 billion per year in royalties by 2033 (current dollars) compared with $4.5 billion in 2011.

Is there a risk of contracting the "Dutch Disease"?

It is clear that further energy resource development would boost the economy and add significantly to government revenues but there could be risks to other sectors of the economy. Because of the impact that development and export of Holland's North Sea natural gas resources had on the value of its currency and the ability of its manufacturing sector to compete, the economic literature warns of the perils of becoming overly dependent on the resource sector, often called "Dutch Disease" or the "resource curse". It is argued that this occurs when a resource boom leads to substantial growth in resource exports and that growth, in turn, leads to both appreciation of the exchange rate and higher labour and materials costs in the manufacturing and other sectors of the economy, which can reduce both output and income.

Recent evidence, including Norway's experience, suggests that even though the Canadian dollar has appreciated along with (and in part because of) increased net exports of oil and gas, with appropriate policies and institutional arrangements Canada should be able to enjoy the economic benefits from becoming a superproducer and exporter of energy while holding its own as an exporter of manufactured goods compared with the other advanced economies.

Policy considerations

While, on balance, becoming an energy superproducer and net exporter appears to be a worthy objective, it is important to ensure that the Canadian economy benefits as much as possible from further development of our energy resource sector. Below are some suggestions for federal, provincial, and territorial governments faced with this situation.

1 Avoid intervention in decisions about energy investments since the allocation of funds is best left to those who are motivated by market forces, have

in-depth knowledge of the technologies involved, and are prepared to take risks based on their understanding of the outlook for various energy commodities in markets around the world.

2 Avoid the temptation to increase government expenditures in step with growth in energy resource revenues because such revenues typically decline as energy prices and/or production fall, creating considerable financial difficulties for governments that become overly dependent on them.

3 Invest non-renewable-resource royalty revenues in excess of specified target amounts to prevent growing expenditures during good times and the consequent pain of retrenchment when revenues from royalties on energy resource production, which tend to fluctuate with economic conditions, falter. For example, the accumulated funds can be used to offset declines in royalty revenues during periods when resource output is flagging unexpectedly on account of slowing economic growth or recession.

4 Assist Canadian energy commodity producers to gain entry to markets in foreign countries by negotiating trade treaties and agreements, working to remove regulatory barriers that impede energy imports from Canada, and by using on-site experts (e.g., trade commissioners in the federal Department of Foreign Affairs and International Trade) to provide insight with regard to local market developments and prospects.

5 Help Canada's manufacturing sector to remain competitive with the other advanced economies by encouraging investment in state-of-the-art technologies and by ensuring that there is a continuing stream of new engineering, science, and technology graduates to assist in their use. In this regard, it is recommended that: [a] the existing two-year write-off of expenditures on manufacturing and processing machinery and equipment be declared a "permanent" feature of the tax system in order to remove uncertainty with regard to its continuation and extend this policy to all sectors; and [b] an accelerated depreciation program be implemented with respect to capital expenditures associated with research and development.

6 Strive to ensure that resource and manufacturing sector development is not constrained by insufficient workers with skilled trades by making young Canadians aware of the rewarding careers that are available through enrolment in training programs, facilitating the mobility of Canadian skilled workers, and streamlining the processing of applications by skilled workers from other countries wishing to emigrate to Canada.

7 Improve the capacity of government departments and regulatory agencies to review and make decisions on applications to develop, produce, and transport energy commodities as quickly as possible in order to ensure that energy resource development is not unnecessarily delayed.

8 Ensure that oil, gas, and uranium royalties are competitive with those in foreign jurisdictions seeking exploration and development investment.

9 Remove moratoria on offshore oil and gas exploration and development if it is clear that the environmental risks can be managed in a manner that is acceptable.

Introduction

In a speech to the Canada-UK Chamber of Commerce in London on July 14, 2006 Prime Minister Harper referred to Canada as the emerging "energy superpower" that his government "intends to build". From his remarks, it appears that his claim regarding Canada being or about to become an energy superpower was based on Canada's growing importance as an energy commodity producer:

> We are currently the fifth largest energy producer in the world. We rank 3rd and 7th in global gas and oil production respectively. We generate more hydro-electric power than any other country on earth. And we are the world's largest supplier of uranium.
>
> But that's just the beginning. Our government is making new investments in renewable energy sources such as biofuels. And an ocean of oil-soaked sand lies under the muskeg of northern Alberta—my home province. The oil sands are the second largest oil deposit in the world, bigger than Iraq, Iran, or Russia; exceeded only by Saudi Arabia. (Harper, 2006a)

The Prime Minister and the Minister of Natural Resources, the Hon. Joe Oliver, have repeated this claim on various occasions since then (Harper, 2006b, 2006c, 2007; Oliver, 2012). More recently, speaking to the World Economic Forum in New Delhi, Mr. Harper referred to Canada as a "natural resources powerhouse" (Harper, 2012).

Canada—An Emerging Superproducer of Energy explores the meaning of the term "energy superpower" and whether, and in what sense, Canada is or could become an energy superpower or a superproducer of energy. It also examines how Canada's energy resources, production, and net exports rank from a global perspective and provides an overview of the economic benefits flowing from energy resource production, including the royalty payments that flow to governments, and interprovincial energy trade. Finally, it examines the economic challenges that Canada faces in embracing the goal of becoming a "superproducer" of energy, including potential risks to other sectors and to the economy as a whole.

These considerations lead to the premise that further growth in energy production would be of net benefit for Canadians as long as the risks associated with becoming a superproducer of energy and a major net energy exporter can be managed in a manner which avoids, or at least minimizes, the negative impacts that energy sector growth could have on other sectors of the economy. To this end a set of policy recommendations is put forward for the federal and provincial governments to pursue in order to successfully manage greater reliance on energy resource development and production. It is assumed that further development of energy resources will rely on private investment in energy resource production and transportation facilities in accordance with market conditions, knowledge and expectations while ensuring that all Canadians have the freedom to choose the kind of work that they do and that their property rights are upheld. The suggested policy reforms would help to ensure that the potential employment, income and social benefits from becoming a superproducer of energy and a leading net exporter of energy are achieved. The Appendix gives an overview of recent development in Canada of energy resource commodities.

"Energy superpower" or "superproducer of energy"?

In 2007, after the Prime Minister had made his initial "energy superpower" claims, Annette Hester (then Senior Associate with the Center for Strategic and International Studies in Washington, DC), was asked by the Canadian Defence and Foreign Affairs Institute to "test the case" for Canada as an energy superpower (Hester, 2007). In her report, Ms. Hester noted that the term "energy superpower" has different connotations. During much of the twentieth century, major oil companies and then OPEC (a cartel of oil-producing countries) at times used their control over much of the world's oil production to influence the price of oil and, for that reason, were regarded as oil or energy superpowers. But, she went on to point out that in order for a *country* to be an energy superpower in the political sense—that is, to be able to use its status as a major energy producer to achieve political objectives—Russian experience has indicated that a country must be able to control access to supplies—both reserves and transport in the case of oil and natural gas—sufficiently to be a price setter. In addition, in contrast to the traditional use of market power by energy producers, in order to qualify as an energy superpower a country must be bent on leveraging its energy resources to extend its sphere of political influence beyond its regional markets.

Ms. Hester concluded, and we agree, that Canada is not, nor is it about to become, an energy superpower. One reason is that the federal government does not have the required control over Canadian production and shipments of oil, gas, and uranium because the production and transportation facilities are privately owned and Canada's oil, gas, uranium, and hydroelectric resources for the most part fall under provincial jurisdiction. Further, the government does not have a mandate or the desire to leverage Canadian energy commodity exports in markets in the United States, Mexico, and other world regions (for example, the Asia-Pacific region) in order to influence their prices. Moreover, Canada is committed to the principle of free trade in accordance with open market conditions.

The Prime Minister and his colleagues do not appear to contemplate Canada becoming an energy superpower in the political sense, in the manner, for example, that Russia has managed its natural gas exports to Europe. But they clearly do envisage the country becoming a greater producer and net exporter of oil, natural gas, uranium, and hydropower and believe that fostering Canada's emergence as a *superproducer* of energy is appropriate given the anticipated economic benefits.

It is clear that Canada is poised to experience considerable growth in energy resource production and export capacity and to join the ranks of the world's major net exporters of energy. Canadian oil production and net exports will increase through at least the next quarter-century as the result of continued expansion in the capacity to produce bitumen from the oil sands and oil from shale formations such as the Bakken formation in Saskatchewan and the Canol formation in the vicinity of Norman Wells in the Northwest Territories. While conventional natural-gas production is declining as existing fields mature, there is considerable potential to grow gas production from tight sand and shale rock formations in British Columbia, Alberta, and elsewhere, much of which will likely be exported to Asia. Further, Canada's production and exports of uranium and electricity are poised to increase as the result of projects that are already being developed or planned.

As discussed in the following sections, Canada's emergence as a superproducer and a leading net exporter of energy commodities will bring considerable economic benefits and, on balance, appears to be in Canadians' best interest. However, government leaders must be mindful of the challenges that rapid resource development could bring to other sectors of the economy and make appropriate adjustments to the policy framework in order to maximize the benefits from increased oil, natural gas, uranium, and electricity production and exports.

How Canada's energy resources, production, and net exports rank

If Canada is to become a superproducer of energy and rank among the top net exporters of energy, what is the country's current status and why and how could it change? This section provides a brief discussion of how Canada compares with other energy resource rich countries, both as a resource and reserve holder and as a producer—by commodity. Also Canada's status as a net energy exporter is reviewed.

Crude oil

According to the US Energy Information Administration (EIA), Canada ranks third among the ten countries with the most potential for future oil production as measured by proved reserves, surpassed only by Saudi Arabia and Venezuela (table 1) (US EIA, 2012). The reason for Canada's high rank in this regard is that approximately 170 billion barrels of oil are considered to be recoverable from the Alberta oil sands.

Among the world's top ten crude-oil *producers*, Canada ranks sixth, well behind Russia, Saudi Arabia, the United States, China, and Iran (table 2). However, Canadian oil production is poised to grow as further development of bitumen production from the oil sands and recovery of oil from shale formations using horizontal drilling and hydraulic fracturing technologies more than offset the decline in production from maturing fields.

The most recent long-term projection by the National Energy Board (NEB) suggests that Canadian oil production could reach 4.5 million barrels per day by 2020 compared with 3.0 million barrels per day in 2010—an increase of 50% (National Energy Board, 2011). But these are conservative estimates because the NEB did not recognize the potential for growth in oil production from shale formations. Compared with other leading oil producers, other things being equal, Canada will surely rank as a superproducer of oil as soon as 2020, most likely at least the fourth largest producer in the world. Most of the incremental production will be for the export market since,

Table 1: Countries ranked as top 10 for proved oil reserves (billions of barrels), 2012

	Reserves		Reserves
1. Saudi Arabia	267.0	6. Kuwait	104.0
2. Venezuela	211.2	7. United Arab Emirates	97.8
3. Canada	173.6	8. Russian Federation	60.0
4. Iran	151.2	9. Libya	47.1
5. Iraq	143.1	10. Nigeria	37.2

Source: US Energy Information Administration, 2012: Petroleum, Reserves, 2012, <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=57&aid=6&cid=all,&syid=2008&eyid=2012&unit=BB>.

Table 2: Crude oil production by country* (000's of barrels per day), 2011

	Production		Production
1. Russia	9,774	6. Canada	2,904
2. Saudi Arabia	9,458	7. United Arab Emirates	2,688
3. United States	5,658	8. Iraq	2,626
4. China	4,069	9. Mexico	2,596
5. Iran	4,054	10. Kuwait	2,530

Note *: Includes lease condensate.

Source: US Energy Information Administration, 2012: Petroleum, Production, 2011, <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=57&aid=1&cid=all,&syid=2010&eyid=2011&unit=TBPD>.

except for relatively small amounts of crude oil imported to supply refineries in Quebec, New Brunswick, and Nova Scotia, Canada is self-sufficient in oil.[1] Canada's role as supplier of crude oil to the United States, as well as to markets in Asia once pipeline access to the British Columbian coast and/or the US west coast is put in place, is therefore bound to increase.

1 Conversion of a portion of TransCanada Corporation's Mainline natural-gas pipeline capacity to transport crude oil, and re-direction of flow in the crude oil pipeline running from Sarnia to Montreal will allow refineries in Montreal to be supplied with oil from western Canada, supplanting imports. Western Canadian supplies could be shipped by tanker from Montreal to supply the refineries in Saint John, New Brunswick and Dartmouth, Nova Scotia or, possibly, a pipeline will be built from Montreal to Saint John.

Natural gas

According to the data for proved reserves of natural gas that is limited to gas that is recoverable via conventional vertical-well-only technology, Canada ranks 20th in the world, far below Russia, Iran, and Qatar (table 3). Canada already is one of the world's top natural-gas producers, although production in 2011 was less than one quarter that of either Russia or the United States (table 4).

Table 3: Countries ranked as top 20 for proved natural gas reserves (trillions of cubic feet), 2012

	Reserves		Reserves
1. Russia	1,680.0	11. Indonesia	141.1
2. Iran	1,168.0	12. Iraq	111.5
3. Qatar	890.0	13. China	107.0
4. Saudi Arabia	283.5	14. Kazakhstan	85.0
5. United States	272.5	15. Malaysia	83.0
6. Turkmenistan	265.0	16. Egypt	77.2
7. United Arab Emirates	215.0	17. Norway	70.9
8. Venezuela	195.0	18. Uzbekistan	65.0
9. Nigeria	180.5	19. Kuwait	63.5
10. Algeria	159.0	20. Canada	61.0

Source: US Energy Information Administration, 2012: Natural Gas, Reserves, 2012, <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=3&pid=3&aid=6&cid=all,&syid=2008&eyid=2012&unit=TCF>.

Table 4: Production of dry natural gas (billions of cubic feet), 2011

	Production		Production
1. Russia	23,685.8	6. China	3,628.7
2. United States	23,000.0	7. Norway	3,581.6
3. Iran	5,360.8	8. Saudi Arabia	3,258.2
4. Canada	5,218.1	9. Algeria	2,922.9
5. Qatar	4,121.3	10. Netherlands	2,851.1

Source: US Energy Information Administration, 2012: Natural Gas, Production, 2011, <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=3&pid=26&aid=1&cid=all,&syid=2007&eyid=2011&unit=BCF>.

More importantly, however, is that Canada has enormous quantities of natural gas recoverable from shale and tight sand formations, especially in British Columbia and Alberta. These resources are not included in the data on proved natural-gas reserves because their production is generally only feasible through the application of advanced technologies. These so-called unconventional supplies have the potential to allow Canada to become a superproducer of natural gas and a significant exporter of liquefied natural gas (LNG) to markets in the Asia-Pacific region and, possibly, other regions including Europe (Angevine and Oviedo, 2012).[2]

Electricity

Canada is one of the world's largest producers of power from hydroelectric generation facilities (International Energy Agency, 2012a). Largely because the supply of electricity sourced from hydroelectric generation capacity exceeds demand in the hydro-capacity-rich provinces of Quebec, Manitoba, British Columbia, and Newfoundland & Labrador, Canada is a major exporter of electricity to markets in the United States. According to the International Energy Agency, Canada is one of the largest electricity exporters in the world.

Canada has the technical potential to more than double its hydro capacity from approximately 75,000 MW (megawatts) to 163,000 MW (Canadian Hydropower Association, 2012). However, the economic potential is considerably less primarily because of the remoteness of the many of the technically potential sites. 25,000 MW of the identified technical potential capacity consists of "planned" hydro projects that are either under construction or under review for possible development in order to meet anticipated growth in domestic demand or in both Canada and the United States.[3] As the new hydroelectric facilities being planned for Newfoundland & Labrador, Quebec, Manitoba, British Columbia, and other provinces come on line they will strengthen Canada's position as a superproducer and exporter of energy.

Energy balance comparisons

Canada's emergence as a superproducer of energy as outlined above positions Canada to soon become a very significant net exporter of energy on the world stage. The International Energy Agency's "energy balance" statistics provide

2 As indicated in table 5, Canada is already a significant net exporter of gas but all of these exports flow to American market regions.

3 In its most recent long-term projection, undertaken in 2011, the National Energy Board predicted that Canada's hydroelectric generation capacity, including wave and tidal energy facilities, would increase by 9,330 MW during the decade ending in 2020 (National Energy Board, 2011).

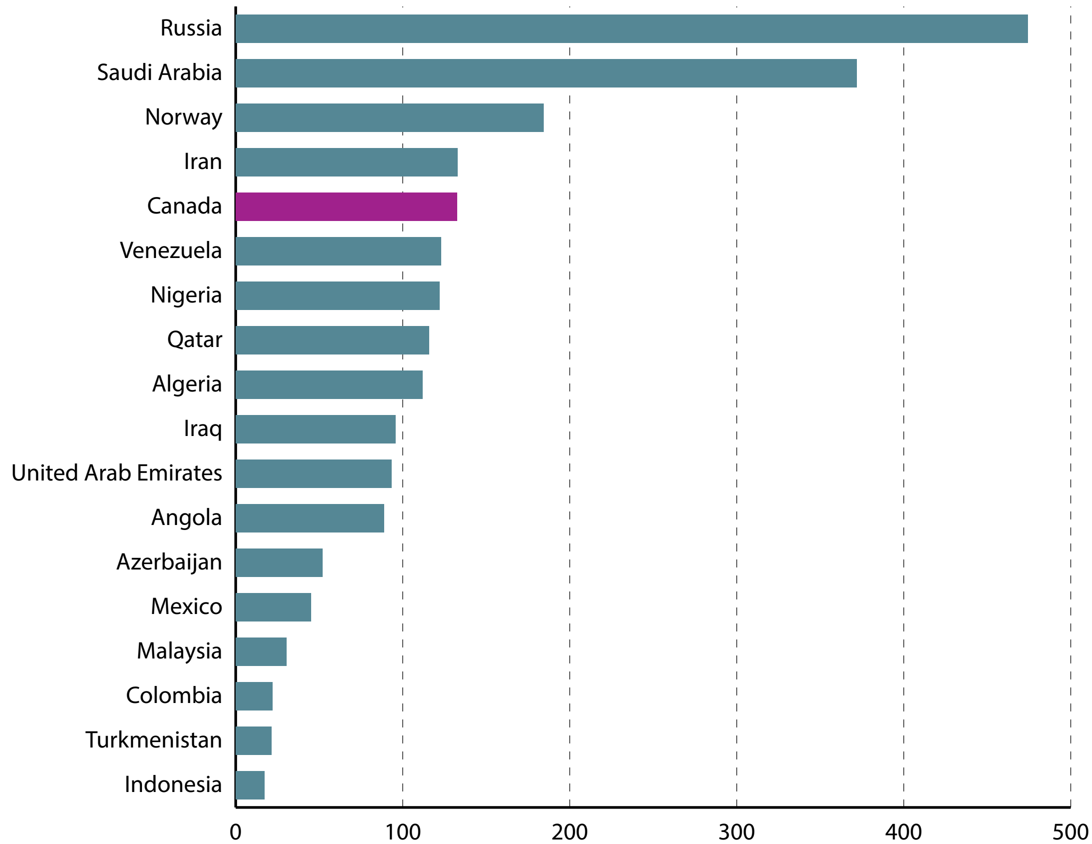
Table 5: Net energy exports (million tonnes of oil equivalent), 2009

	Crude oil	Oil products	Natural gas	Electricity	Total
1. Russia	248.3	100.3	124.5	1.3	474.4
2. Saudi Arabia	318.5	53.3	0.0	0.0	371.8
3. Norway	87.1	11.4	85.2	0.8	184.5
4. Iran	126.4	5.3	0.8	0.4	132.9
5. Canada	59.3	8.8	61.6	2.9	132.6
6. Venezuela	90.4	34.4	−1.7	0.0	123.1
7. Nigeria	116.0	−7.0	13.1	0.0	122.1
8. Qatar	43.1	12.7	60.0	0.0	115.8
9. Algeria	47.3	17.7	46.9	0.0	111.9
10. Iraq	95.7	0.0	0.0	0.0	95.7
11. United Arab Emirates	101.6	−0.2	−8.2	0.0	93.2
12. Angola	90.4	−1.6	0.0	0.0	88.8
13. Azerbaijan	44.6	2.4	4.9	0.0	51.9
14. Mexico	69.7	−14.3	−10.2	0.0	45.2
15. Malaysia	6.4	2.8	21.3	0.0	30.5
16. Colombia	18.3	2.4	1.4	0.0	22.1
17. Turkmenistan	2.0	3.3	16.0	0.1	21.4
18. Indonesia	−0.5	−14.4	32.0	0.0	17.1
19. Australia	−4.5	−14.6	12.9	0.0	−6.2

Source: International Energy Agency, 2012b.

the basis for net export comparisons, by country, for crude oil, oil products, natural gas, and electricity on a combined basis for 2009 (table 5, figure 1) (International Energy Agency, 2012b). Canada, virtually tied with fourth-place Iran, ranked fifth among the world's net energy exporters, well below first- and second-place Russia and Saudi Arabia but within striking distance of third-ranked Norway. Given the prospect of continued expansion of oil sands production, and the development of LNG exports and additional hydro capacity, Canada could move up the ladder and, conceivably, soon be among the world's top three net energy resource exporting countries. No doubt this is one of the outcomes that the Harper government has in mind when it implies that Canada is on the verge of becoming a superproducer of energy.

Figure 1: Total of net energy exports of crude oil, oil products, natural gas, and electricity (million tonnes of oil equivalent), 2009



Source: International Energy Agency, 2012b.

Uranium

In their remarks about Canada being in a position to become a super-producer of energy, the Prime Minister and his colleagues have frequently referred to Canada's potential to become a leading producer and exporter of uranium as well as oil, gas, and electricity. According to the World Nuclear Association, Australia holds 31% of the world's recoverable uranium resources, followed by Kazakhstan with 12%. Canada and Russia each have about 9%, and Niger 8%. South Africa, Namibia, and Brazil each have approximately 5%, followed by the United States with about 4%. Uzbekistan is estimated to hold about 2% (World Nuclear Association, 2012b). On this basis, Canada appears to have sufficient resources to become a more significant, although not dominant, uranium producer. In fact, Canada was the world's largest uranium producer for many years but was surpassed by Kazakhstan in 2009. In 2011, Kazakhstan's production of mined uranium was more than double Canada's (table 6).

Table 6: Mined uranium production by country (tonnes of U), 2011

	Production		Production
1. Kazakhstan	19,451	5. Namibia	3,258
2. Canada	9,145	6. Russia	2,993
3. Australia	5,983	7. Uzbekistan	3,000
4. Niger	4,351	8. United States	1,537

Source: World Nuclear Association, 2012b, *World Uranium Mining*, <http://www.world-nuclear.org/info/inf23.html>.

All of Canada's current uranium production is in northern Saskatchewan where the main producers are Cameco and Areva Resources Canada (formerly Cogema Resources, now part of France's Areva Group).[4] In 2011, 84% of Canada's uranium production came from the Cameco McArthur River mine, the largest operating uranium mine in the world. The balance came from the company's Rabbit Lake mine, where production is now in significant decline. About 83% of Canadian uranium production— 8,111 of 9,786 tonnes—was exported in 2010 (World Nuclear Association, 2012a).

This year, Cameco, Areva and their joint venture partners expect to commence operations at the Cigar Lake mine. This is anticipated to boost total Canadian production by about 9,000 tonnes per year, thereby doubling our output (Cameco, 2012a). The development of additional properties in northern Saskatchewan and further exploration both there and in other parts of the country indicate that Canadian uranium production is poised for considerable growth. Because domestic uranium requirements are not expected to increase much in the coming decade (no new nuclear power plants are on the horizon), most of the increase in production will be exported. Including uranium with oil, natural gas, and electricity therefore strengthens the government's claim that Canada is on the brink of becoming a superproducer of energy and a leading net exporter of energy commodities.

4 Cameco was formed in the 1988 merger of Saskatchewan Mining Development Corporation and the government-owned Eldorado Nuclear Ltd. The company issued its first public shares in 1991 and was fully privatized in 2002.

Economic benefits from energy resource production

Becoming a superproducer of energy and one of the world's largest net exporters of energy would result in economic benefits that would flow from further development and increased production of our energy resources, including the increased royalty revenues that Canadian governments would collect from the added production, and greater security of the energy supply to meet Canada's own requirements via robust interprovincial energy trade. Here, the focus is on the economic benefits that flow to Canadians from oil and gas production, uranium mining, and electric power generation, transmission, and distribution in terms of employment and Gross Domestic Product (GDP).

Crude oil and natural gas

Statistics Canada's estimates indicate that 54,070 persons were directly employed in the extraction of oil and gas during 2011. This represented 0.4% of total payroll employment in that year but 2% of employment in the goods-producing industries. However, this does not include workers who were engaged via contracts or fees to provide drilling and other support services. An estimated 95,928 workers were directly engaged in the provision of support services to the mining, quarrying, and oil and gas extraction sectors, many of whom were involved in oil and gas extraction (Statistics Canada, 2012e).

While no recent estimate of employment attributable to the oil and gas services sector is available, a 2010 Canadian Energy Research Institute (CERI) study indicates that the sector was responsible for as many as 798,333 jobs in 2006, of which 46% (367,233 jobs) involved workers engaged at locations where oil and gas field activities take place, involving all includes all aspects of drilling, completion, gathering, processing, and construction (CERI, 2010).

Oil and gas extraction (excluding support services) contributed $87.0 billion to GDP in 2011 (constant 2007 dollars, approximately $94 billion in nominal terms) (Statistics Canada, 2012a; author's est.). This accounted for about 6% of total GDP but 19% of the GDP of the goods-producing sector. As noted earlier, however, this does not take account of the contribution made by the oil and gas services sector. According to the CERI study cited above, the oil and gas services sector directly and indirectly contributed $65 billion (current dollars) to GDP in 2006.

Natural gas

An indication of the economic importance of the Canadian natural gas industry alone is provided in the December 2009 study *The Contributions of the Natural Gas Industry to the Canadian National and Provincial Economies*, which IHS Global Insight (Canada) Limited prepared for America's Natural Gas Alliance (IHS Global Insight, 2009). The study used input-output analysis to estimate employment, value added, and labor income arising from the production and processing of natural gas (including drilling and related support services), gas transmission and distribution, and engineering construction encompassing upstream, midstream, and downstream natural gas operations. Because the focus of this study is on energy resource production, only the findings with respect to extraction, processing, drilling, and related support services are summarized in table 7.

Direct employment in natural gas production totaled 84,461 workers, of which 87% were in Alberta. Total employment exceeded total direct employment by 32,383 jobs as a result of indirect employment of 28,029 persons and induced employment of 4,354 persons.

Value added directly in the natural gas industry as a consequence of gas production and processing activities amounted to $58.5 billion (nominal or current dollars) with another $5.8 billion added as a result of indirect and induced effects. $9.8 billion of labor income was generated, of which $2.1 billion was the consequence of indirect and induced effects. As with employment, the lion's share of the value added and labor income occurred in Alberta.

Electricity

Construction of every new hydroelectric power facility, nuclear plant, or thermal power plant gives rise to economic benefits through employment, labour income, and contributions to the GDP. Operation of electric generation facilities provide continuing streams of economic benefits throughout the country. The employment and GDP impacts from electricity generation alone were not publicly available. However, according to Statistics Canada 96,680 persons were directly employed in the operation of electric utilities (including generation, transmission, and distribution) in 2011, accounting for 0.6% of total payroll employment yet 3.6% of jobs in the goods-producing sector. These activities contributed $30.5 billion to Canada's GDP in 2011 (constant 2007 dollars, approximately $33 billion in nominal terms) (Statistics Canada, 2012a, e). This accounted for 2.0% of total GDP but 6.7% of the GDP of the goods-producing group of industries.

Table 7: Summary of economic impacts from natural gas production, drilling, and related support services, 2008

	Employment (number of workers)		Value added ($ millions)		Labour income ($ millions)	
	Direct	Total	Direct	Total	Direct	Total
British Columbia	6,172	7,982	3,381	3,471	534	620
Alberta	73,457	99,064	52,990	57,847	6,821	8,455
Saskatchewan	2,560	3,699	1,177	1,344	213	313
Manitoba	39	240	4	14	3	14
Ontario	567	2,935	499	1,142	56	256
Quebec	0	574	0	15	0	2
Atlantic	1,205	1,786	420	451	95	132
Territories*	461	564	58	59	33	38
Total	**84,461**	**116,844**	**58,529**	**64,343**	**7,755**	**9,830**

Note *: In this table, "Territories" refers to Yukon and the Northwest Territories.

Source: IHS Global Insight (Canada) Limited, 2009.

Uranium

According to the Saskatchewan Mining Association, the Saskatchewan uranium industry directly employs about 2,595 people while contractors to the industry employ an additional 2,567 workers. In addition to direct employment, the industry is responsible for 10,324 spin-off jobs—that is, persons employed by the industry indirectly and via induced effects (Saskatchewan Mining Association, 2012). The industry and contractors paid $600 million in salaries, wages, and benefits to their employees in 2011. Assuming that the earnings (including benefits) of the average spin-off employee were two thirds those of the average directly employed person, total labor income generated by the industry in the province would have been approximately $1.4 billion. The value of goods and services purchased by the uranium industry in 2011 was $1.1 billion, of which $814 million was spent in Saskatchewan.

According to Natural Resources Canada, excluding service stations and wholesale trade in petroleum products, the energy sector provided direct employment to 264,000 people in 2010 (Natural Resources Canada, 2012).[5] It is important to note, however, that this does not include persons who are employed indirectly by the energy sector, such as those engaged in manufacturing equipment and materials used in oil and gas production or providing services. Including indirect employment, it is estimated that the Canadian

5 This includes direct employment in coal mining of approximately 25,000 workers (Coal Association of Canada, 2012).

petroleum industry employs close to 500,000 persons (Petroleum Services Association of Canada, 2012). Considering total uranium mining employment of approximately 15,500 persons and direct electricity-sector employment of about 97,000 (both estimates based on data presented earlier in this section), and assuming that 50,000 persons are indirectly employed by the electricity sector, suggests that the energy sector accounts for at least 663,000 jobs or approximately 4.4% of average payroll employment in 2012 (Statistics Canada, 2013).

This brief examination of the economic benefits from oil and gas production, uranium mining, and electricity generation, transmission, and distribution indicates that the energy sector makes an important contribution to the Canadian economy in terms of GDP and employment. The recurring, annual benefits of these kinds will increase if, as expected, further development of our petroleum, uranium, and hydroelectric resources leads to sufficient new production that more than offsets declines in output from maturing oil and gas fields, depleting uranium mines, and decommissioned hydroelectric facilities. Construction of expanded and new production facilities, and the infrastructure that will be required in order to transport the additional oil, natural gas, uranium, and electricity, will also boost employment and contribute to GDP.

Increased and more diversified energy commodity exports will bring other economic benefits that are more difficult to measure. For example, companies that become more heavily focused on expanding production in order to serve export markets typically develop commercial relationships with an increased number of valued clients in different parts of the world. This equips them to withstand downturns more easily in particular world regions or countries. Consequently, such companies not only become larger in size but more stable and, therefore, better positioned to provide long-term, secure employment to Canadian workers (Foreign Affairs and International Trade Canada, 2012). In turn, this provides greater economic security to individuals and households with ensuing socio-economic benefits.

Contributions to government revenues from energy resource production

Becoming a superproducer and a leading net exporter of energy commodities will also mean that governments will reap greater royalties from the production of crude oil, oil sands bitumen, natural gas and uranium, and increased revenues from the water rental fees that are levied on hydroelectric power generation facilities. For the most part, all of these revenues constitute a type of production tax that is collected on behalf of the owners of the resource, who, in most cases, are the citizens of the province or territory where the resource production occurs.[6] This section indicates just how important this form of government revenue has become.

Petroleum

Canadian oil and gas producers paid royalties of $161 billion to the governments of the provinces and territories during the twelve years from 2000 to 2011, inclusive (table 8). Of that amount, almost $115 billion (71.3%) was generated by production in Alberta (including oil sands), $17.4 billion (10.8%) in Saskatchewan, $13.5 billion (8.4%) in British Columbia, and $12.1 billion (7.5%) in the Newfoundland & Labrador offshore region. The remainder came from production in Manitoba, Ontario, the Yukon and Northwest Territories, onshore Atlantic provinces, and offshore Nova Scotia.

Almost $22 billion (19%) of Alberta's royalty income has come from oil-sands bitumen recovery operations, and almost 86% of that amount has been generated since 2005. As a consequence of changes to the royalty formula pertaining to oil sands, and growing oil -sands production, the oil sands now generate about as much royalty income for Alberta each year as all other petroleum (i.e., oil and gas) production. Looking ahead, Alberta royalties from oil-sands bitumen production are poised to increase remarkably as production increases. In a recent study of the outlook for oil-sands development by

6 Exceptions, for example, are where the Crown ceded mineral rights to railway developers in order to attract the development.

Table 8: Royalty payments by the petroleum industry ($ millions), 2000–2011

	British Columbia	Alberta	Alberta oil sands	Saskatchewan	Manitoba	Ontario	Territories	Atlantic Provinces	Newfoundland & Labrador offshore	Nova Scotia offshore	**Total**
2000	1,004	8,886	816	1,117	25	15	19	0	45	7	11,933
2001	1,246	9,795	265	938	24	12	43	0	31	11	12,365
2002	906	6,085	182	846	22	13	22	0	65	10	8,150
2003	1,413	7,758	274	1,122	23	20	30	0	115	23	10,777
2004	1,508	8,790	769	1,222	27	19	24	0	208	27	12,594
2005	1,967	11,796	819	1,474	42	19	20	1	410	94	16,641
2006	1,444	9,198	2,187	1,578	69	16	33	1	404	230	15,162
2007	1,255	8,071	2,716	1,434	86	15	34	6	1,224	264	15,105
2008	1,370	10,667	3,545	2,390	107	16	32	2	2,394	548	21,070
2009	500	3,885	2,110	1,468	100	8	19	3	1,857	151	10,101
2010	466	3,502	3,747	1,827	124	9	16	1	2,193	198	12,083
2011	444	4,546	4,467	1,933	246	12	12	1	3,246	167	15,074
Total	**13,522**	**92,979**	**21,897**	**17,348**	**894**	**175**	**305**	**15**	**12,190**	**1,729**	**161,055**

Source: Canadian Association of Petroleum Producers, 2012: section 4, various tables.

the Canadian Energy Research Institute (CERI), the reference case projection has bitumen production growing from 1.5 million barrels per day (MMbpd) in 2010 to 3.3 MMbpd in 2020, and to 5.4 MMbpd in 2045 (CERI, 2012). If that development path were achieved, royalties collected from the oil-sands industry (i.e., bitumen production) would exceed $10 billion by 2016 and reach about $50 billion per year by 2033. By way of comparison, oil sands royalties were $4.5 billion in 2011 (table 8).

In addition to royalties on their output, petroleum companies pay governments for the right to carry out exploration on specific tracts of land in the form of land leases and bonuses that are generally determined through auction processes. Further, the producers pay fees for licenses to produce oil and gas. Land lease payments vary according to the level of interest of would-be explorers, which varies with market conditions and expectations and the geological attributes of the land being offered by the government. By way of example, Alberta collected $2.6 billion in land bonuses and Crown lease sales during fiscal year 2010/11 and an estimated $3.3 billion during fiscal year 2011/12 (Alberta Finance and Treasury, 2012a). The government of Saskatchewan collected $222 million from land-lease sales in calendar year 2010 and $192 million in 2011 (Saskatchewan, Ministry of the Economy (Energy and Resources), 2012a).[7]

Table 8 shows petroleum producers' royalty payments to governments on a calendar-year basis net of special incentive payments paid to petroleum producers by governments. Information provided by Alberta Finance and Treasury shows that gross royalty receipts plus revenue from land lease sales declined during fiscal years 2009/10 and 2010/11 to $6.8 billion and $8.6 billion, respectively, but immediately prior to those years and more recently have been running close to $11 billion dollars per year (Alberta, Finance and Treasury, 2012b).

Saskatchewan received approximately $1.7 billion from oil and gas royalties and bonus bids during fiscal year 2011/12 (Saskatchewan, Ministry of the Economy (Energy and Resources), 2012b). In addition, Saskatchewan collected a resource surcharge of 1.7% of the value of oil and gas produced.[8]

Electricity

Electricity producers do not pay royalties but in most jurisdictions the owners of hydroelectric facilities pay water-rental fees for water use to the government of the province where the facilities are located. Generally, these fees are a function of the volume of production as measured in megawatt hours, but in some cases the formulas are more complex and partially based on the value of the electricity that is generated. Examples of the order of magnitude of this type of resource revenue in the case of the provinces with the largest hydroelectric generation capacity are provided below.

British Columbia The government of British Columbia included water-rental payments of $411 million in its 2012/13 budget (British Columbia, 2012);

Manitoba Water-power rental payments of $117.8 million are included in Manitoba's 2012/13 budget (Manitoba, Ministry of Finance, 2012).

Ontario Ontario's government received water-rental fee payments of $116.7 million in fiscal year 2010/11 and $111.7 million in 2011/12. These amounts were about 18 percent less than during fiscal years 2008/09 and 2009/10

7 Saskatchewan also received revenue from the sale of petroleum licenses of $240.8 million and $56.8 million in 2010 and 2011, respectively.

8 The surcharge rate varies according to when a producing well was drilled. In the case of older wells the rate is higher.

(Ontario Ministry of Finance, 2012). Because Ontario water-rental fees are a function of both the price of electricity and the volume of power that is generated, the total revenue from this item (also referred to as a "royalty" by the Ontario Ministry of Natural Resources) can fluctuate more than in most other provinces, where the fees are generally based solely on the volume of production.

Quebec Quebec has much more hydroelectric generation capacity in place than any other province. Most of that capacity is owned by Hydro Quebec. Until 2006, Quebec only levied water-rental fees on privately owned generators. However, in that year Hydro Quebec became subject to two water rental fees, statutory and contractual, as the result of amendments to the Loi sur le régime des eaux (Watercourse Act). Only municipally owned hydroelectric facilities remain exempt. According to information provided by officials with the Quebec Ministry of Natural Resources, the province received $696 million in water rental fees or royalties and related charges in fiscal year 2011/12. $718 million is included in the budget for 2012/13 (Quebec, Ministry of Natural Resources, 2012).

Newfoundland & Labrador Newfoundland & Labrador's 2012/13 budget projects water-rental payment revenues of almost $6 million (Newfoundland & Labrador, Dep't of Finance, 2012). That the indicated revenue is relatively small in spite of the large capacity (5,248 MW or 7.3 million horsepower) of the Churchill Falls hydroelectric station in Labrador is because the water-rental fee that applies to that facility, at $0.50 per horsepower per year, is very low.

This brief survey of revenue from water-rental fees in the provinces with the largest hydroelectric generation capacities suggests that the Canadian provinces and territories as a whole probably receive close to $1.5 billion dollars a year in this type of resource revenue.

Uranium

All of Canada's uranium production is currently in Saskatchewan. According to the annual report of the provincial Ministry of Energy Economy, the producers paid royalties of approximately $119 million to the government of Saskatchewan during fiscal year 2011/12. They also paid an estimated $33 million on account of the provincial resource surcharge (3% in the case of uranium) (Saskatchewan, Ministry of the Economy (Energy and Resources), 2012a), $6.3 million for licenses, and $12.1 million in surface-lease fees during 2011 (Saskatchewan Mining Association, 2012).

Summary

Canada's oil and gas producers contribute between $17 billion and $20 billion to the provincial and territorial governments each year in the form of royalties, land-lease fees, and licenses. These payments are difficult to predict because they fluctuate with production volumes and, in some cases, the prices of oil and gas. Similarly, land bonuses and lease payments fluctuate according to the geological attributes of the Crown lands that are released for bid and oil and gas market expectations.

Hydroelectric generators pay approximately $1.5 billion dollars to provincial and territorial governments via water-rental fees. Uranium producers currently pay approximately $170 million per year to the government of Saskatchewan, including royalties, the resource surcharge, and lease payments and fees.

In total, the Canada's energy resource producers contribute at least $19 billion to Canadian governments each year in the form of royalties, lease payments, and fees. Going forward these payments can be expected to increase as petroleum and uranium production increase and new hydroelectric facilities are built. Especially noteworthy is that growth in oil-sands bitumen production alone could be contributing an additional $45.5 billion per year in royalties to the Alberta government by 2033.

Interprovincial energy trade

An active trade in energy commodities among the various provinces is another important benefit that accrues to Canadians from the extraction and production of energy resources.

Crude oil

Some interprovincial trade in crude oil occurs as oil from western Canada or offshore Newfoundland & Labrador is shipped to oil refineries in Ontario or Atlantic Canada. There are 18 refineries operating in Canada with a total capacity of about two million barrels per day (National Energy Board, 2012b). Refineries in the Atlantic region and Quebec have almost 46% of Canada's crude-oil refining capacity. They presently import most of their own crude oil requirements from international sources including some from the United States, with the remainder being met by production from the East Coast offshore.

Ontario's oil refineries constitute approximately 23% of the country's oil-refining capacity. In 2010, about 20% of the crude oil that they processed was imported. All the rest, apart from a small amount of crude oil produced in Ontario, came from western Canada. Western Canadian refineries (in Alberta, Saskatchewan, and British Columbia), with 31% of total capacity, only process western Canadian crude oil. The two British Columbian refineries are generally supplied from oil produced in Alberta. The three Saskatchewan refineries are typically supplied by crude oil from Alberta and Saskatchewan (National Energy Board, 2012b).

Refined petroleum products

Basically, Canada's oil refineries were built to supply refined petroleum products to regional markets but some trade occurs between regions and with the United States and other countries. The Canadian Fuels Association describes Canada's fuel distribution system as one that operates according to several regions (called "supply orbits")—Western Canada, Ontario-Québec, and

Atlantic Canada—that generally operate independently from each other. Oil refineries in western Canada distribute gasoline, diesel fuel, and other refined petroleum products that they produce throughout the four western provinces, Yukon, and the Northwest Territories, and to Thunder Bay, Ontario (Canadian Fuels Association, 2012).

The refineries in southern Ontario distribute products to Sault Ste-Marie, northern Ontario, and as far to the east as Ottawa. Refineries in Montreal and Quebec City supply the St. Lawrence River corridor from Toronto to the Gaspé Peninsula, as well as the more remote areas of northern Quebec and, occasionally, parts of the Arctic. In addition to serving their own region, the oil refineries in the Atlantic Canada also supply the Arctic and Hudson Bay regions, as well as the US eastern seaboard.

Natural gas

British Columbia, Alberta, and Saskatchewan are self-sufficient in natural gas. Manitoba has no natural gas production; its requirements are met by natural gas shipped from Alberta and Saskatchewan on the TransCanada Pipeline. Ontario consumes a bit less than 3 Bcfd of gas but produces only about 0.02 Bcfd. Approximately 60% of the gas consumed in Ontario during 2009 was produced in western Canada (ICF International, 2010). The rest came from various regions in the United States, including the West, Midwest, Texas, Arkansas, and Louisiana. TransCanada Pipeline's main line, which supplies gas from western Canada, has a capacity of 4 Bcfd at the Manitoba-Ontario border. Gas also enters Ontario through three major US-Canada border crossings in southwestern Ontario with a total capacity of 3.9 bcfd.

Gas exits Ontario for the United States at Niagara, New York and Waddington, New York, and for Quebec via the TransCanada Pipeline that connects with the Trans-Quebec and Maritimes Pipeline (TQM). TQM supplies gas along the Montreal to Québec City corridor and to the Portland Natural Gas Transmission System at the Québec-New Hampshire border, feeding industrial and electric-power plant needs in the New England states (ICF International, 2010).

As demand in Ontario for natural gas increases, and conventional western Canadian gas production continues to decline, it is anticipated that Canadian gas will meet a smaller proportion of Ontario's requirements (ICF International, 2010; National Energy Board, 2011). This outlook could change, however, as shale-gas production is developed in British Columbia and Alberta.

Gas from the Sable Offshore Energy Project offshore Nova Scotia is transported by an underwater pipeline to Goldboro, Nova Scotia, where it enters the Maritimes & Northeast Pipeline for distribution to Nova Scotia, southern New Brunswick, and the American northeast.

EnCana Corporation's Deep Panuke facility 250 kilometres southeast of Halifax is slated to commence production sometime later this year. Production start-up has been delayed (a fire in a control panel in January and poor winter weather have added to the delay). All of the production has been sold to Repsol Inc. (Chafe, 2011). The gas will be brought ashore at Goldboro and distributed from there via the Maritimes & Northeast Pipeline. Gas imported in liquid form (LNG) at the Repsol Inc. re-gasification facility at Saint John, New Brunswick is available for consumption at Saint John and points west along the Maritimes & Northeast Pipeline. Prince Edward Island and Newfoundland & Labrador produce no natural gas and have no import facilities.

Electricity

Table 9 provides a summary of interprovincial electricity trade during 2011 in gigawatt hours. Negative numbers indicate that the province in question was a net receiver of electricity but only from other provinces. Trade in electricity between Canadian provinces and US states is not shown.

The province of Newfoundland & Labrador is a major provider of electricity to Quebec as a result of the agreement between the two provinces whereby Quebec agreed to purchase all of the output from the Churchill Falls hydroelectric facility. The other net providers of electricity to other provinces in 2011 were British Columbia, Quebec, New Brunswick, and Nova Scotia (Statistics Canada, 2012d). New Brunswick generally provides electricity to Prince Edward Island.

Quebec is a significant receiver of electricity from other provinces because of the Churchill Falls agreement. Prince Edward Island, Ontario, Manitoba, Saskatchewan, and Alberta all received more electricity from other provinces during 2011 than they provided (Statistics Canada, 2012d). Alberta typically imports power from British Columbia during on-peak hours. Electricity flows between Ontario and Manitoba, and between Ontario and Quebec, according to need and availability.

Uranium

Virtually all of Canada's uranium is used to generate electricity at nuclear power plants. Because all of Canada's uranium production occurs in Saskatchewan, most of the interprovincial trade in uranium is between Saskatchewan and the two remaining provinces with nuclear plants: Ontario and New Brunswick. Some uranium compounds are also shipped to research reactors in Ontario, Quebec, and Alberta that are used to produce radioactive materials for medical or scientific uses or for educational purposes.

Table 9: Interprovincial trade in electricity (gigawatt hours), 2011

	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL
Deliveries to other provinces	29,817	0	0	1,353	5,903	6,910	1,518	975	89	3,152
Receipts from other provinces	20	1,006	378	3,871	35,533	3,935	627	907	3,546	0
Net deliveries or, if negative, receipts	29,797	−1,006	−378	−2,518	−29,630	2,975	891	68	−3,457	3,152

Note: A gigawatt hour equals one billion watt hours or sufficient electricity to power 10 million 100-watt light bulbs for an hour.

Source: Derived from Statistics Canada, 2012d, CANSIM table 127-0003.

The bottom line

For the most part, the interprovincial trade in energy is the direct result of Canada's being a major producer of crude oil, natural gas, uranium, and electricity. As we become a superproducer of energy, the trade in energy and the economic benefits that flow from energy transportation and storage within Canada are bound to increase.

Challenges from strong growth in the energy sector—a reflection of success[9]

It appears from their comments (as noted earlier) about Canada as an emerging energy superpower that the Prime Minister and the Minister of Natural Resources would agree with Ms. Hester's conclusion that Canada is not about to become an energy superpower in the political sense. Rather, the Harper government appears focused on fostering Canada's emergence as a super-producer of oil, natural gas, hydroelectric power, and uranium to supply markets both at home and abroad in light of the anticipated economic benefits.

Relying on the expansion of energy-resource production and exports as the mainstay of economic growth appears at first glance to have merit. But experience with resource booms that have occurred in some other countries suggests that becoming an energy superproducer and major exporter could pose risks to other sectors of the economy.

An article in *The Economist* in 1977 argued that development of the Netherlands' offshore natural gas resources since 1959 had caused that country's manufacturing sector to shrink because inflated labour and other costs as a consequence of the resource boom, and appreciation in the value of the Dutch florin as the result of the gas exports, had made the manufacturing sector less competitive (*The Economist*, 1977, Nov. 26). The article referred to this phenomenon as "Dutch Disease", a term that has since frequently been used either as an explanation for slow economic growth in resource-rich countries following a run-up in the export of energy and/or other commodities such as minerals or agricultural products, or as a caveat of the potential undesirable consequences that export-geared resource-sector growth could have on the manufacturing sectors.

In the simple model that economists W.M. Corden and J.P. Neary used to describe the Dutch Disease, there is a booming traded resource commodity such as oil or gas, and a "lagging" sector built around a tradable commodity

9 Bank of Canada Governor, Mark Carney concluded in a speech in Calgary in September 2012 that the strength of the country's resource sector is a "reflection of success, not a harbinger of failure" (Carney, 2012).

such as manufactured goods. The remainder of the economy is assumed to consist of non-tradable goods and services. In this model, a boom in the tradable resource sector will increase the demand for labour and capital in that sector and cause production to shift toward that sector and away from the lagging sector, resulting in so-called "direct-deindustrialization" (Corden and Neary, 1982).

In the Corden-Neary model, there is also a "spending effect" as the extra revenue brought into the country by the resource export boom increases demand for labour in the non-tradable goods and services sector, shifting additional labour away from the lagging sector. As wages are bid up, the increase in unit labour costs in the lagging sector (e.g., manufacturing) make it more difficult for it to compete, resulting in "indirect-deindustrialization". Prices of non-tradable goods and services increase as a result of the increased demand yet prices in the traded good (boom) sector (such as oil) cannot change because they are determined in the world market. This causes appreciation of the real exchange rate that makes it even more difficult for the lagging sector to compete.

Whether and to what extent the Dutch Disease argument is applicable to any energy-rich country with a strong manufacturing sector is debatable. Certainly the degree to which this argument may be applicable to a particular country depends on the country's policy and institutional framework, including the size and composition of its manufacturing sector and the degree of synergy between, say, the oil-producing sector on the one hand, and manufacturing on the other. Canada is fortunate in this respect because the continuing development of oil-sands bitumen production capacity is providing a continuing stream of opportunities for manufacturers of machinery and equipment in Ontario and Quebec as well as other parts of the country.

It was generally taken for granted by economists that natural-resource development would contribute to economic growth because of the necessary project investment and as a consequence of spending of labour income generated by increased employment and investment in social infrastructure such as schools and hospitals. That view was cast in doubt in 1995 by D. Jeffrey Sachs and Andrew M. Warner, who claimed that natural resources can lead to decreasing economic growth, or what is termed the "resource curse". The mechanisms leading to this result were the characteristics of the Dutch Disease: higher labour and materials costs and exchange rate appreciation, and/or poor governance combined with an absence of essential institutional arrangements (Sachs and Warner, 1995).

The findings by Sachs and Warner led to a flurry of similar studies that generally supported their findings about the negative implications of resource dependence for economic growth and to a gathering consensus that natural resource exports "can damage institutions (including governance and the legal system) indirectly—by removing incentives to reform, improve infrastructure, or even establish a well-functioning bureaucracy—as well as directly—by provoking a fight to control resource rents" (Harford and Klein, 2005). However, these views were challenged by Christina N. Brunnschweiler and Erwin H. Butte in 2006, who found resource dependence (i.e., the ratio of the resource-exports-to-GDP variable in the Sachs-Warner analysis) to be insignificant in economic growth regressions where measures of resource abundance (i.e., stocks) were present and not a determinant of institutional quality. On the other hand, *resource abundance* was found to be a positively associated with both economic growth and institutional quality. These findings countered the "resource curse" argument as well as claims that resource development has a negative impact on institutional quality, therefore making it less likely that a resource-rich country will develop significant non-resource sectors (Brunnschweiler and Bulte, 2006).

Similarly, Louis-Philippe Béland, and Raaj Tiagi demonstrated, in a 2009 Fraser Institute study, that if one uses a more precise measure of natural resources, the "resource curse" may disappear, in which case it may be demonstrated that natural resources can lead to *positive* economic growth. This is especially likely to be the case in countries like Canada that have a high level of institutional quality as reflected in the index published in the Fraser Institute's *Economic Freedom of the World* (Beland and Tiagi, 2009).

Further, a review by economist Amela Karabegović found that recent research that takes advantage of newer data sets and more appropriate techniques of econometric analysis casts doubt on the argument that there is a "resource curse". Ms. Karabegović claimed that evidence from case studies suggests that countries are not necessarily doomed because they are rich in natural resources. While some countries have floundered, others have adopted appropriate policies and institutional arrangements and, as a result, been able to achieve economic growth and reduce poverty levels (Karabegović, 2009). The Norwegian experience provides an example of how prudent macroeconomic policies can help a country experiencing a boom in energy-resource development from suffering offsetting the negative economic effects of the "Dutch Disease" (Bergevin, 2006).

More recently, John R. Boyce and J.C. Herbert Emery argued that there can be a negative correlation between economic growth and natural resource abundance in the absence of market and institutional failures but that in such cases the implication that the "resource curse" is present can be overturned if there is a positive relationship between resource abundance and income levels (Boyce and Emery, 2011). Using panel data for US states for the period form 1970 to 2001, they demonstrated that resource abundance was negatively correlated with economic growth rates yet positively correlated with income levels.

Michael Beine and colleagues found a positive relationship between energy prices in Canada and the exchange rate from 1983 to 2007, which coincided with the period when Canada was becoming a significant net exporter of both oil and natural gas (Beine et al., 2009). They also found a negative relationship between Canadian manufacturing employment as a share of total employment and the appreciation that occurred in the real value of the Canada/US exchange rate other than that attributable to the weakening value of the US dollar in global markets. While these findings suggest that Canada may have some symptoms of Dutch Disease, the relationships between the key variables and sectors are far too complex to make a positive diagnosis on the basis of such skeletal evidence.

Another fragment of evidence of the possibility of Canada having Dutch Disease is that Ontario's manufacturing sector lost 290,000 full-time jobs during the decade ending in the summer of 2011 while the exchange rate appreciated by 40% from 2004, supposedly fueled by increased oil exports (Greenberg, 2011). However, it is not possible to conclude that the downturn in manufacturing was simply a consequence of the value of the Canadian/US dollar exchange rate possibly becoming more closely associated with the inflow of US funds needed to pay for Canadian oil. The appreciation in the Canada/US dollar exchange rate could have resulted in part from each of a number of things including productivity improvements, deterioration in the value of the US dollar on the world stage, or an increase in the world price of oil or of another resource commodity. Capital in-flows to finance government debt or private-sector construction may have also been a factor underlying the strengthening of the Canadian dollar. Moreover, it is not be at all clear what is driving the decline in the manufacturing sector: the stronger exchange rate may have been a factor, but a relatively small one.

In his presentation to the Spruce Meadows Roundtable in Calgary in September 2012, the Governor of the Bank of Canada, Mark Carney, said: "While the tidiness of the [Dutch Disease] argument is appealing and making commodities the scapegoat is tempting, the diagnosis is overly simplistic and, in the end, wrong". Mr. Carney acknowledged that the share of the manufacturing sector in Canada's GDP has declined in recent years while commodity prices, most importantly the price of oil, and the value of the Canadian dollar have been increasing. But he explained that the decline in the manufacturing sector has been underway for a much longer period and is part of "broad, secular trend … which has dispersed manufacturing activity across borders, increasingly concentrating the highest value-added stages of production in advanced economies", pointing out that Canada has not lost ground in this respect relative to other industrialized countries (Carney, 2012). Further, he noted that the rise in commodity prices explains only about half of the appreciation in our currency in terms of the US dollar over the past decade, about 40% being due to multilateral depreciation in the value of the US dollar and the balance a result of a variety of factors including capital in-flows.

A consequence of heavy reliance on the development and production of resources as an engine of growth is that such reliance makes a resource-dependent economy prone to continuous boom-bust cycles that cause socioeconomic problems as resource-sector employment rises and falls. In Canada's favour in this regard as an emerging superproducer of energy is the immense array of the country's energy and non-energy resource endowment. While the Canadian economy may be alternately boosted and shaken by periods of rising and then falling oil and/or gas demand and prices, and similar cycles with regard to exports of mineral, forestry, agricultural, and other resource products, the cycles of the various resources are not in phase with one another. For example, when oil exports are rising, the demand for various minerals may be moving in the opposite direction. Moreover, Canada has a diversified economy with well-developed manufacturing and services sectors that provides additional protection from the boom-bust predicament that confounds economies that are heavily dependent on a single resource.

Managing economic pressures from growth of the energy resource sector

Though Canada may not have a pronounced case of Dutch Disease but merely "coincidental" symptoms, this does not mean that the government should be unprepared to address the possible negative economic consequences of becoming a superproducer and a leading net exporter of energy commodities. Mr. Carney, in his presentation to the Spruce Meadows Roundtable (2012), mentioned four tactics that could help minimize the risks to other sectors of the economy:

1. increased exports of manufactured goods and services to countries such as China, India, Thailand and Brazil that are driving the upward pressure on oil and metal prices;
2. greater value-added in commodity production here in Canada, as by producing more of the goods and services required by the petroleum production, refining/processing, and transportation sectors, thereby increasing the domestic demand for manufactured goods;
3. increased numbers of skilled workers and persons with science, technology, and engineering training so that Canada can successfully compete with other countries in manufacturing activities using advanced technologies (including the oil sands production)[10];
4. sustained business investment in state-of-the-art machinery and equipment at high levels.

In our opinion, outcomes such as these would undoubtedly help to ensure that Canada's manufacturing sector continues to prosper relative to those of the other advanced economies. But such outcomes may not be readily forthcoming without an appropriate economic policy framework.

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10 This is consistent with widespread concern about the increasing shortage of workers with engineering, technical, or skills training that is affecting many sectors and regions as the result of increasing demand, retirements, and difficulty attracting young people to the skilled trades (Canadian Chamber of Commerce, 2012).

Norway reportedly avoided Dutch Disease as a consequence of its oil boom largely by limiting wage increases and avoiding excessive government spending. Keeping wage increases from ballooning was likely achievable because of the centralized institutional arrangements by which such increases were normally determined.[11] Moreover, the technological challenges faced in the development of the offshore oil resource resulted in innovation that had positive effects for both the resource and non-resource sectors (Bergevin, 2006). By limiting wage increases to the rate of growth of productivity in the manufacturing sector, Norway avoided having wages in its growing resource sector lead to upward pressure on wages and salaries in the rest of the economy. Consequently, the manufacturing sector was not penalized by higher unit labor costs as in the Netherlands. Also, the Norwegian government prudently avoided spending much its oil revenues through debt reduction and the establishment of a petroleum fund.[12]

Controlling wage increases as the Norwegians did, however, can prevent labour markets from adjusting in response to demand and supply and such restrictions upon the economic freedom of workers and employers to respond to market conditions would impede efficient allocation of the available labour supply. Rather, it is possible to avoid undue pressure on wages in the energy-resource production sector, with the risk of spillover to other sectors, through policies that remove or at least minimize barriers to the inflow of skilled workers from other countries and improve the mobility of Canadian workers.

In Canada, the establishment of special funds to help manage large energy resource revenues would be up to those provinces benefitting from substantial increases in petroleum and uranium royalties and water rental fees. Alberta has a non-renewable resource fund, the Alberta Heritage Savings Trust Fund, which was established to facilitate investment of a portion of the government's revenue from non-renewable resources. It was intended that the Fund earnings be used for the benefit of current and future generations of Albertans (Alberta, Treasury Board and Finance, 2012). A portion of the large increase in oil-sands royalties that is anticipated to occur in coming years could be allocated to the Heritage Savings Trust Fund.[13] The Alberta Sustainability Fund, a sub-account of the General Revenue Fund, has been used as a depository for excess non-renewable resource revenues in recent

11 According to Bergevin (2006) the control of wages was facilitated by Norway's highly centralized union-employer interface. This is much different from the situation in Canada where the institutional arrangements pertaining to union-employer interface in the energy sector are generally on a provincial rather than national basis.

12 By denominating the petroleum fund in a foreign currency, the Norwegians were also able to curb some of the upward pressure on the Norwegian kroner.

13 The outlook for revenue from oil sands royalties is addressed on page 16.

years instead of the Heritage Savings Trust Fund. This is most likely because, once deposited, the Alberta Sustainability Fund balance is readily accessible. For example, if the government overestimates resource revenue (whether intentionally or not) it can rely on the Sustainability Fund to make up the shortfall. In fact, if actual General Revenue Fund expenses exceed revenues at the end of a fiscal year, the legislation stipulates that an amount equal to the difference "shall be allocated" to the General Revenue Fund from the Alberta Sustainability Fund (Alberta Finance and Treasury, 2009). Use of the Heritage Savings Trust Fund instead of the Sustainability Fund would therefore appear be preferable.

The development of the oil sands will continue to demand technological innovation to reduce natural gas requirements and the environmental impacts as well as to improve recovery rates and operating efficiencies. In turn, this is likely to provide business opportunities for segments of Canada's manufacturing industry.

The federal government could seek to curb growth of oil sands, natural gas, or uranium production because of concerns about Dutch Disease and the "resource curse" by, for example, not awarding export licenses. But given the economic benefits that accrue to Ontario and Quebec (where much of Canada's manufacturing industry is located) from energy resource development in other parts of the country, this would surely be unpalatable from a political perspective. Instead, the government should continue to foster Canada's development as a superproducer and leading net exporter of energy commodities but develop and implement policies designed to help to ensure that possible negative impacts on other sectors of the economy are avoided or at least minimized. As suggested by Mr. Carney (2012), this could include striving to ensure that Canada's manufacturing industries are in a position to compete with those in other advanced countries and to capture a share of the emerging economies' requirements for goods and services. One way of doing this is to ensure that investment in machinery and equipment that is necessary for research and development (R&D) is as attractive as in other countries which, according to at least one recent report, it is not (Deloitte, 2012). This is important because "machinery and equipment acquired for R&D purposes will, in many cases eventually end up in an enhanced manufacturing process, thereby closing the gap between invention and innovation" (Canadian Manufacturers & Exporters, 2012: 8).

Some might argue that Canada ought not to be—and cannot afford to be—indifferent as to how much of its energy resource endowment gets developed now rather than in the future, and that portions of our resources should therefore be put aside for future development. However, that argument makes little sense. First, Canada's oil, natural gas, uranium, and undeveloped hydroelectric resources are so large that under the best of circumstances only a small portion can be developed during the next 25 to 30, or even 50, years.

Further, if Canada does not respond to existing market opportunities—such as those for LNG and raw and upgraded bitumen exports to countries in the Asia-Pacific region—and establish a market niche now, it will be much more difficult to establish a commercial presence in such markets in the future. Finally, there is the possibility that new technologies (both discovered but not yet commercialized and as yet unknown) will sharply reduce global oil and gas demand at some point in the future, greatly reducing the value of our oil and natural gas resources. Examples include conversion of the enormous volumes of kerogen that are known to exist in Utah, Colorado, and neighbouring US states to crude oil (Angevine, 2010a), and the development of advanced nuclear technologies such as fusion that would lower the cost of electricity and potentially make the separation of hydrogen from water for use as fuel feasible.

Measures for facilitating Canadian energy resource development (without addressing the implications for other sectors) were discussed in several reports published during 2010 and 2011 as part of the Fraser Institute's "continental energy strategy" research initiative (Angevine, 2010a, 2010b, 2011). Although these studies were mainly focused on policies that would reduce barriers to oil, gas, and electricity investment, they equally apply to fostering Canada's emergence as a superproducer and exporter of oil, natural gas, electricity and uranium.

One important consideration is the need for the provinces and territories to ensure that royalties are competitive with foreign jurisdictions since oil, gas, and uranium are found in many places and countries, and states and provinces around the globe are competing for investment. Another is the need to remove uncertainty about environmental policy pertaining to atmospheric emissions in oil-sands bitumen production and upgrading in order that potential investors can more accurately evaluate the costs that they would face. Further, moratoria on oil and gas exploration and development off the shores of British Columbia should be removed if it is determined that the environmental risks can be adequately mitigated.[14] In addition, regulatory approval processes and procedures need to be streamlined wherever possible to ensure that proposed resource development projects that are triggered by export opportunities can be initiated and completed before those opportunities are diminished or foregone on account of more rapid development in other countries.[15]

14 See also Joel Wood, *Lifting the Moratorium: The Costs and Benefits of Offshore Oil Drilling in British Columbia* (2012).

15 This assumes, of course, that proposed Canadian developments are fully compliant with applicable laws and regulations, including those pertaining to environmental impacts.

Policy considerations

Facilitation of Canada's emergence as a superproducer and major net exporter of energy commodities is important because of the economic and social benefits that would flow from further development of our energy resources and related transportation infrastructure. Certainly, the increased employment and income would contribute to improvements in the quality of life for all Canadians. In order to ensure that the benefits of becoming a superproducer of energy can be realized to the greatest possible extent in the face of international competition and the need to address science-based environmental concerns, the governments of Canada and the energy-rich provinces and territories should consider the following policies:

1 Avoid intervention in decisions about energy investments since the allocation of funds is best left to those who are motivated by market forces, have in-depth knowledge of the technologies involved, and are prepared to take risks based on their understanding of the outlook for various energy commodities in markets around the world.

2 Avoid the temptation to increase government expenditures in step with growth in energy resource revenues because such revenues typically decline as energy prices and/or production fall, creating considerable financial difficulties for governments that become overly dependent on them.

3 Invest non-renewable-resource royalty revenues in excess of specified target amounts to prevent growing expenditures during good times and the consequent pain of retrenchment when revenues from royalties on energy resource production, which tend to fluctuate with economic conditions, falter. For example, the accumulated funds can be used to offset declines in royalty revenues during periods when resource output is flagging unexpectedly on account of slowing economic growth or recession.

4 Assist Canadian energy commodity producers to gain entry to markets in foreign countries by negotiating trade treaties and agreements, working to remove regulatory barriers that impede energy imports from Canada, and by

using on-site experts (e.g., trade commissioners in the federal Department of Foreign Affairs and International Trade) to provide insight with regard to local market developments and prospects.

5 Help Canada's manufacturing sector to remain competitive with the other advanced economies by encouraging investment in state-of-the-art technologies and by ensuring that there is a continuing stream of new engineering, science, and technology graduates to assist in their use. In this regard, it is recommended that: [a] the existing two-year write-off of expenditures on manufacturing and processing machinery and equipment be declared a "permanent" feature of the tax system in order to remove uncertainty with regard to its continuation and extend this policy to all sectors; and [b] an accelerated depreciation program be implemented with respect to capital expenditures associated with research and development.

6 Strive to ensure that resource and manufacturing sector development is not constrained by insufficient workers with skilled trades by making young Canadians aware of the rewarding careers that are available through enrolment in training programs, facilitating the mobility of Canadian skilled workers, and streamlining the processing of applications by skilled workers from other countries wishing to emigrate to Canada.

7 Improve the capacity of government departments and regulatory agencies to review and make decisions on applications to develop, produce, and transport energy commodities as quickly as possible in order to ensure that energy resource development is not unnecessarily delayed.

8 Ensure that oil, gas, and uranium royalties are competitive with those in foreign jurisdictions seeking exploration and development investment.

9 Remove moratoria on offshore oil and gas exploration and development if it is clear that the environmental risks can be managed in a manner that is acceptable.

Appendix—progress in energy resource development

This appendix provides a review of the progress that has occurred in both the production and trade of the key energy-resource commodities—crude oil, natural gas, electricity, and uranium—since 2000.

Crude oil

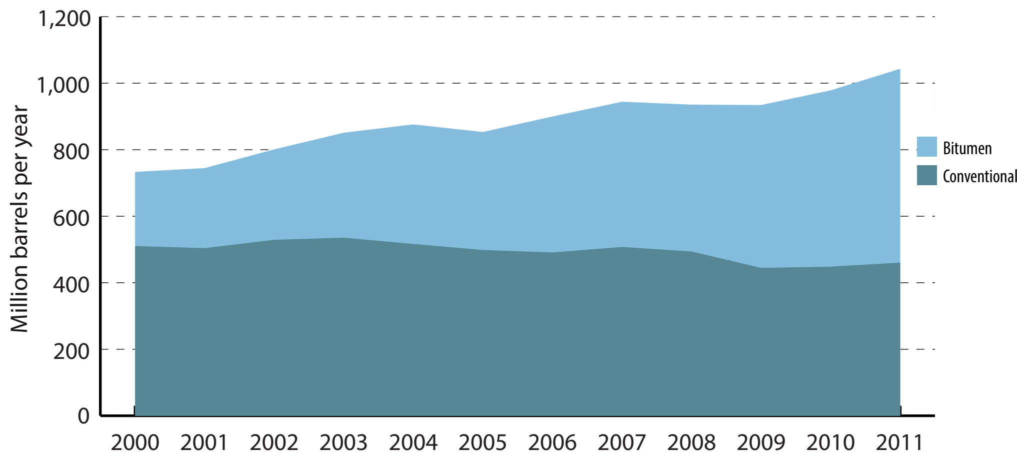
From 2000 to 2011, total Canadian crude oil production increased by more than 40%. As indicated by figure 2, the increase came solely from increased bitumen production, which grew about 2.6 times during this period as the result of further development of Alberta's oil-sands resources. At the same time, however, crude oil production from conventional wells fell by 10% as production from mature oil fields declined, but new discoveries were generally too small and less productive to make up the difference.

As indicated by figure 3, most of the decline in conventional crude oil production from 2000 to 2011 occurred in Alberta. However, in percentage terms, substantial drops also occurred in the Northwest Territories, British Columbia, and Ontario. Production increased slightly in Saskatchewan but, more significantly, off shore in the east coast offshore region (i.e., the Hibernia, Terra Nova, and White Rose projects offshore Newfoundland & Labrador) and in Manitoba.

Canadian net exports of light oil (all conventional) remained negative throughout the period from 2000 to 2011 as imports of feedstock for refineries in Ontario, Quebec, Nova Scotia, and New Brunswick more than offset exports to various US refineries. However, net exports of heavy oil (mostly bitumen from the oil sands) almost doubled, reaching 1,484 thousand barrels per day (Mbpd) in 2011 compared with 757 Mbpd in 2000 (National Energy Board, 2012a).

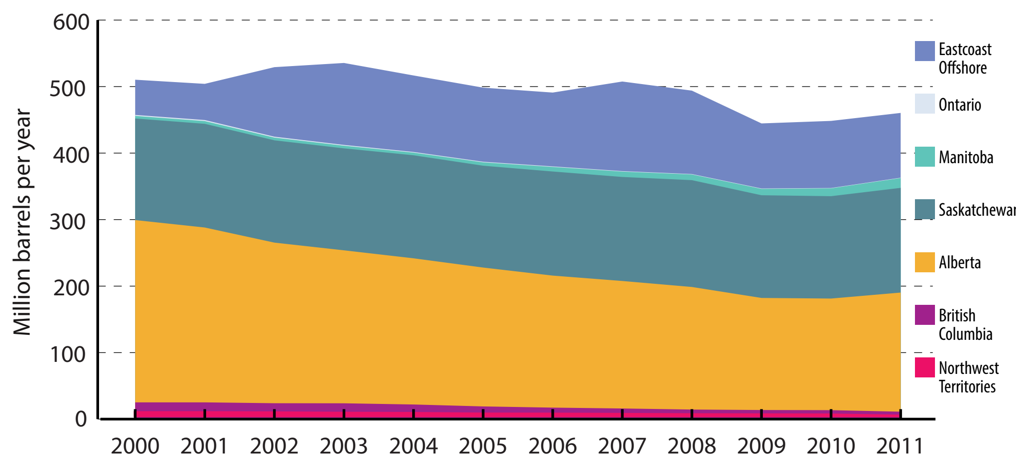
As illustrated by figure 4, Canadian net crude oil exports of light and heavy crude oils combined tripled during the period, benefitting from both increased exports and lower imports. Net exports reached 1,454 Mbpd in

Figure 2: Total Canadian production of crude oil, 2000–2011



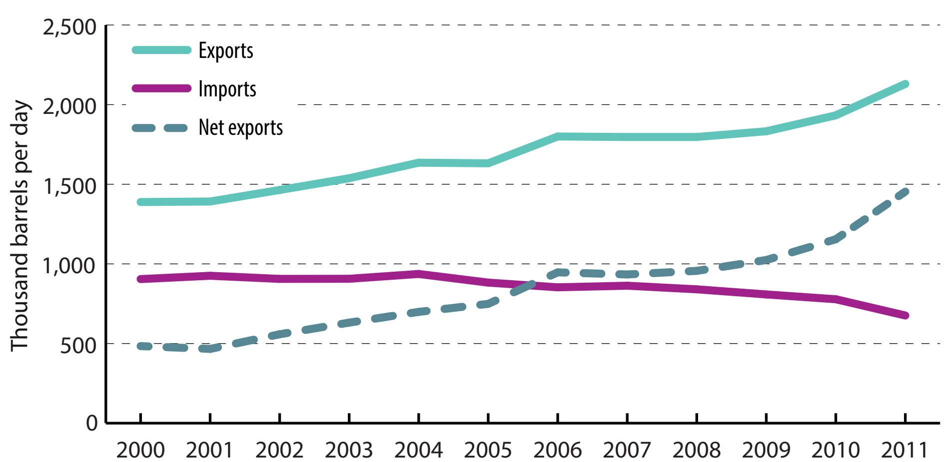
Source: Canadian Association of Petroleum Producers, 2012.

Figure 3: Canadian production of conventional crude oil, 2000–2011



Source: Canadian Association of Petroleum Producers, 2012.

Figure 4: Canadian trade in crude oil, 2000–2011



Source: National Energy Board, 2012a.

2011 compared with only 484 Mbpd in 2000. As in 2000, in 2011 virtually all of Canada's crude oil exports were to oil refiners in the United States. Oil import requirements continued to be met by various overseas suppliers (National Energy Board, 2012a).

Natural gas

Canadian natural gas production fell by 15% from 2000 to 2011, from 7.2 trillion cubic feet (Tcf) to 6.1 Tcf, led by a 26% drop in Alberta accompanied by similar rate of decline in Saskatchewan although the reduction there was much smaller in volume terms (table 10, figure 5). In both of those provinces, the drop reflects declines in production from maturing fields accompanied by insufficient production from newly connected wells to make up the difference.

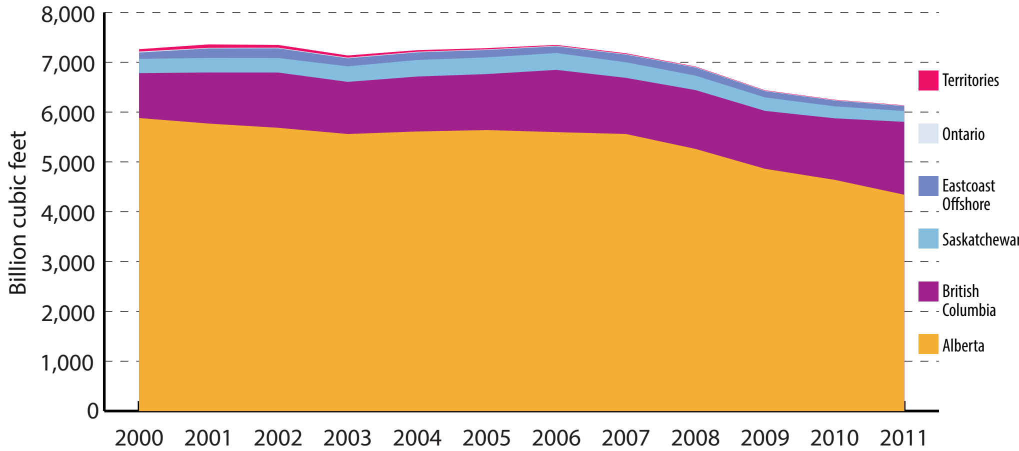
Natural gas production in the Eastcoast Offshore fields, Yukon, and Northwest Territories, and Ontario also declined. Gas production in those two Territories combined and Ontario is now virtually inconsequential from a national perspective.

Table 10: Canadian production of natural gas (billion cubic feet), 2000–2011

	British Columbia	Alberta	Saskatchewan	Ontario	Territories	Eastcoast offshore	**Canada**
2000	900.2	5,880.5	287.6	20.5	46.6	126.5	7,194.8
2001	1,025.7	5,769.2	292.4	12.5	68.7	189.6	7,277.0
2002	1,109.4	5,684.0	292.2	13.0	55.3	193.2	7,278.8
2003	1,046.2	5,559.5	312.2	13.6	43.6	160.8	7,078.6
2004	1,102.9	5,610.3	332.1	12.7	31.7	152.7	7,198.0
2005	1,123.6	5,638.8	335.2	12.2	24.7	148.9	7,246.5
2006	1,249.3	5,597.5	338.2	12.0	16.6	133.9	7,318.9
2007	1,126.6	5,559.7	312.9	10.3	15.0	155.3	7,154.6
2008	1,180.7	5,260.3	290.3	9.4	9.8	163.6	6,894.9
2009	1,161.8	4,861.2	270.6	8.4	8.9	126.4	6,420.0
2010	1,234.5	4,639.9	240.9	8.3	8.1	116.4	6,231.7
2011	1,462.1	4,341.3	217.6	7.9	7.4	99.8	6,120.8

Source: Canadian Association of Petroleum Producers, 2012: table 03-10A.

Figure 5: Canadian production of natural gas, 2000–2011



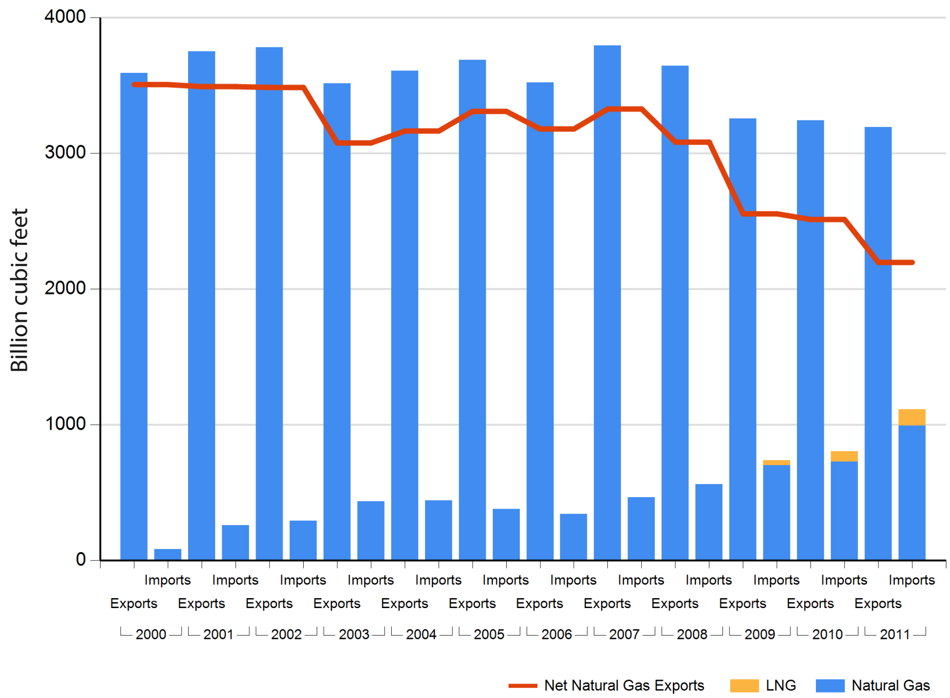
Source: Canadian Association of Petroleum Producers, 2012: table 03-10A.

The one bright spot in the country over the past decade with regard to natural gas production has been British Columbia, where annual production has increased by more than 0.5 Tcf. Much of the gain there has occurred during the past several years as the result of commencement of development of the Montney tight-sand and Horn River Basin shale-gas formations. Further development of those sources of supply and other shale formations is expected to give rise to sufficient growth in British Columbia natural gas production during the coming decade to supply LNG export facilities proposed for British Columbia's west coast (Angevine and Oviedo, 2012).

Canadian net exports of natural gas have dropped by a third since 2000, from about 3.5 Tcf to approximately 2.2 Tcf (figure 6). This is the outcome of both weaker exports—reflecting the drop in Canadian natural gas production discussed earlier—and increased imports. Commencing in 2009, a portion of the increase in imports is a consequence of the commencement of LNG imports at the Irving Oil–Repsol LNG terminal and regasification facility in Saint John, New Brunswick. However, more importantly, the strength in imports reflects the fact that supplies have become available to the Ontario and Quebec market region from US sources as a consequence of the commencement of production from the large Marcellus shale-gas play in Appalachia and increased gas production in the US Rocky Mountain region.

All of Canada's natural gas exports are shipped via pipeline to the US Midwest, Northeast, and Pacific Northwest & California gas-market regions. The regional composition of these exports changed in some important respects from 2000 to 2011. The share flowing to the US Midwest region increased from 38% to 58% while the shares accounted for by the other US regions declined. The share of Canadian gas exports flowing to the US Northeast region dropped the most, from 29% to 15%. Flows to the West, including California, accounted for about 27% of Canadian gas exports in 2011 compared with 33% in 2000.

Figure 6: Canadian exports and imports of natural gas, 2000–2011



Source: National Energy Board, 2012a.

Electricity

Canadian electricity generation from utilities considered to be part of the electricity generation, transmission, and distribution industry declined slightly from 2005 to 2011. As indicated by the data presented in table 11 the drop was mostly in generation from the combustion of fossil fuels. The increase in hydroelectric generation was mainly the result of an 11% increase in Quebec that reflects additions to capacity there. Hydroelectric generation was marginally higher in Newfoundland & Labrador, British Columbia, and Saskatchewan in 2011 than in 2005, but a bit lower in Alberta, Manitoba, and Ontario.

Electricity from wind-power installations was more than three times greater in Alberta in 2011 than in 2005, reaching 2,697 gigawatt hours (GWhs) compared with 837 GWhs in 2005. Wind-power generation reached 1,775 GWhs in Ontario in 2011 compared with only 27 GWhs in 2005. This reflects the provincial government's generous incentives in the form of guaranteed feed-in-tariffs. A large increase in wind-power generation—from 92 GWhs to 742 GWhs—was also recorded in Saskatchewan.

Electricity generation in Ontario from the combustion of fossil fuels fell from 41,485 GWhs in 2005 to 15,273 GWhs in 2011. This reflects the government's policy of phasing out coal-fired generation capacity and accounts for most of the decline in Canadian electricity generation from combustion of fossil fuels over the period.

Table 11: Electricity generation by Canadian public and private utilities (gigawatt hours), 2005–2011

	2005	2006	2007	2008	2009	2010	2011
Hydroelectric	327,171	317,110	334,797	341,069	333,677	321,173	342,604
Tidal	28	19	23	15	30	28	26
Wind	1,551	2,447	2,976	3,750	6,573	9,460	7,563
Solar	0	0	0	0	5	156	55
Other	0	0	0	0	1,918	2,976	n.a.
Nuclear	86,830	92,419	88,190	90,585	84,992	85,527	90,034
Fossil fuels	140,938	129,187	142,617	131,617	118,506	123,572	101,957
Total	**556,517**	**541,181**	**568,603**	**567,036**	**545,701**	**542,891**	**542,240**

Note: A gigawatt hour equals one billion watt hours or sufficient electricity to power 10 million 100-watt light bulbs for an hour.

Source: Derived from Statistics Canada, 2012b, c, CANSIM tables 127-0002, 127-0007.

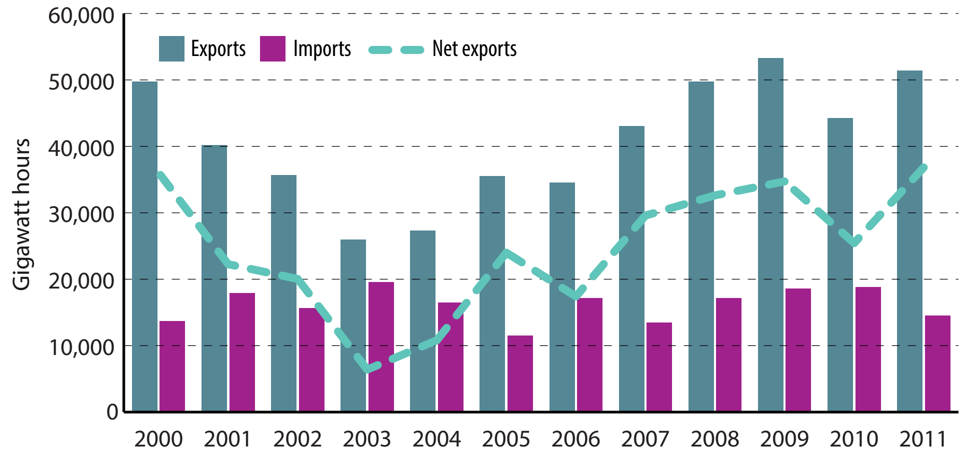
Electricity generation from nuclear power increased in 2011. Total generation from nuclear plants would have been greater had it not been for the lower output at the Gentilly II nuclear plant, which was shut down at the end of 2012 and the fact that units 1 and 2 at the Bruce nuclear plant A site were still out of service on account of refurbishment. If the 660 MW plant at Point Lepreau, New Brunswick had not been out of service for refurbishment since March 2008, total electricity generation from Canadian nuclear facilities would have been approximately 5,000 GWhs greater during each of the past several years. The Point Lepreau plant re-entered commercial service in November 2012.

Canada's international electricity trade is entirely with US market regions and generally in the north-south direction. Since 2000, electricity exports to the United States have fluctuated from as low as approximately 26,000 GWhs (in 2003) to as high as 53,000 GWhs (in 2009) (figure 7). Imports from the United States have also fluctuated, but in a much narrower band. Consequently, net exports have for the most part fluctuated in step with exports. Exports and net exports declined from 2000 to 2003 but since have trended upwards.

The value of net electricity exports fluctuates as a consequence of both volume and price changes. According to the National Energy Board, net exports were valued at $1.7 billion in 2011. This compares with $ 778 million in 2003 and $3.4 billion in 2000. The much lower value in 2011 than in 2000 in spite of net exports being marginally greater reflects the fact that the average price earned on exports in 2000 was almost double the average price realized in 2011 (National Energy Board, 2012a).

Opportunities for electricity trade are generally greater with respect to large hydroelectric facilities than with thermal power plants. One reason is that when a major new hydroelectric plant comes on stream, a large new

Figure 7: Canadian electricity trade, 2000–2011



Source: National Energy Board, 2012a.

block of capacity is suddenly made available that is often greater than the incremental capacity immediately required in the province where the plant is located. Another is that gas-fired power plants can be built on either side of the international boundary and in Canada and the United States the cost of fuel is generally much the same on either side because natural gas markets (and thus prices) are regional rather than national in scope.

Uranium

According to the World Nuclear Association, Canadian uranium production declined by 27% from the recent peak of 12, 501 tonnes in 2001 to 9,145 tonnes in 2011 (figure 8). All of the Canada's uranium mining production during this time has been in northern Saskatchewan. As indicated by table 12, the drop in production has resulted from cessation of output at the Key Lake, McClean Lake, and Cluff Lake mines and, more recently, declining output at the Rabbit Lake mine. Production has been increasing at the large McArthur River site.

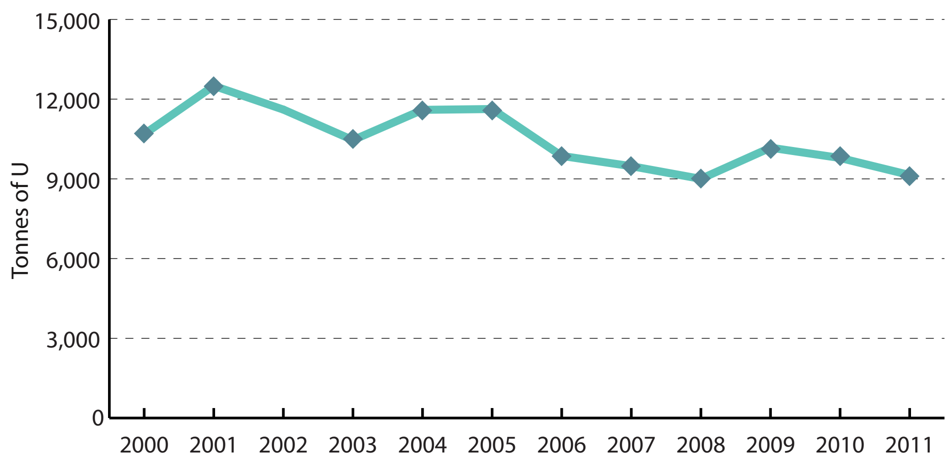
Canadian uranium is exported to the United States and to countries in Latin America, Europe, and the Far East. As illustrated by figure 9, Canadian uranium exports have typically absorbed about 82% of Canadian uranium production in recent years. Although there are numerous nuclear power plants in India and China, Canada has not exported uranium to those countries. India is one of the world's largest and fastest-growing consumers of nuclear energy. The recent conclusion of administrative arrangements to implement the 2010 nuclear co-operation agreement between Canada and India will allow Canada to commence exports to that country (Cameco, 2012b). Canada is also in the midst of negotiating a similar agreement and administrative arrangements with China which, if concluded, would provide Canadian access to another important market for Canadian uranium.

Table 12: Canadian uranium production (tonnes of U), 2000–2011

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
McArthur River	3,739	6,640	7,199	5,831	7,200	7,200	7,200	7,199	6,383	7,339	7,656	7,686
Key Lake	402	299	—	—	—	—	—	—	—	—	—	—
McClean Lake	2,308	2,539	2,342	2,318	2,310	2,112	690	734	1,249	1,388	666	—
Rabbit Lake	2,790	1,755	440	2,281	2,087	2,316	1,972	1,544	1,368	1,447	1,464	1,459
Cluff Lake	1,443	1,269	1,626	27	—	—	—	—	—	—	—	—
Total	**10,682**	**12,501**	**11,607**	**10,458**	**11,597**	**11,628**	**9,863**	**9,477**	**9,000**	**10,173**	**9,786**	**9,145**

Source: World Nuclear Organization, 2012a. <http://www.world-nuclear.org/info/inf49.html>.

Figure 8: Canadian uranium production, 2000–2011



Source: World Nuclear Association, 2012a.

Figure 9: Canadian uranium exports and share of domestic production exported, 2005–2010

Source: World Nuclear Association, 2012a.

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About the authors

Gerry Angevine

Gerry Angevine is a Senior Fellow of the Fraser Institute. In his former role as Senior Economist in the Institute's Global Resource Centre and, previously, as President and CEO of the Canadian Energy Research Institute and as a consultant with Navigant Consulting Ltd. and Angevine Economic Consulting Ltd., he has written, directed, and provided oversight to many research projects and studies in the field of energy economics, especially in relation to natural gas and electricity issues. Recent Fraser Institute studies that he has written include: *Towards North American Energy Security: Removing Barriers to Oil Industry Development* (2010); *North American Natural Gas: Reducing Investment Barriers* (2010); *North American Electricity: Escalating Prices Possible Unless Infrastructure Barriers Are Eased* (2011, with Carlos Murillo); *Ensuring Canadian Access to Oil Markets in the Asia-Pacific Region* (2012, with Vanadis Oviedo); and *Laying the Groundwork for BC LNG Exports to Asia* (2012, with Vanadis Oviedo). While with Navigant Consulting. he was co-author of a study of the impact of northern gas on North American gas markets for the Mackenzie Gas Project proponents. He has served as a witness before both the National Energy Board and the House of Commons Committee on National Energy Security. Dr. Angevine holds a Ph.D. degree in Economics from the University of Michigan, an M.A. (Economics) degree from Dalhousie University and a B.Com. degree from Mount Allison University.

Kenneth P. Green

Kenneth P. Green is Senior Director, Energy and Natural Resource Studies, at the Fraser Institute. He has studied environmental, energy, and natural resource policy for more than 20 years at think-tanks across North America, including the Reason Foundation in Los Angeles; the American Enterprise Institute in Washington, DC; and previously at the Fraser Institute, where he ran the Centre for Risk, Regulation, and the Environment. A frequent commentator in North American print and broadcast media, Dr. Green has testified before several state and federal legislative bodies in the United States including committees and subcommittees of the House of Representatives and Senate. He twice reviewed reports for the United Nations Intergovernmental Panel on Climate Change and is also the author of two textbooks: *Global Warming: Understanding the Debate*, for middle-school students studying climate change, and *Abundant Energy: The Fuel of Human Flourishing*, for post-secondary studies in energy policy. Dr. Green holds a Bachelor's degree in Biology from UCLA, a Master's in Molecular Genetics from San Diego State University, and a Doctorate in Environmental Science and Engineering, also from UCLA.

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