

Eastern Canadian crude oil supply and its implications for regional energy security

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Abstract

Canada has been blessed with immense energy resources; however, their distribution is not uniform. One such example is crude oil, which is found primarily in western Canada. Eastern Canada, consisting of the six eastern-most provinces (Newfoundland and Labrador, New Brunswick, Nova Scotia, Ontario, Prince Edward Island, and Quebec), produce limited quantities of crude oil, most of which is exported to the United States. Ideally, western Canadian crude oil would meet the demands of eastern Canada; however, the North American Free Trade Agreement (NAFTA) and the absence of oil pipelines means that eastern Canada increasingly relies on supplies of crude oil from a small number of oil exporting countries, many with declining production.

This paper examines crude oil production, supply, and its refining in eastern Canada. It shows that crude production in the region has reached its peak and that increasing global competition for crude oil will affect energy security in eastern Canada, either through price increases or supply shortages, or both.

Keywords: Energy security, NAFTA, Canadian crude oil production

1 Introduction

In 2007, Canada produced about 1,014 million barrels of crude oil and condensate, while consuming about 676 million barrels in its refineries (Statistics Canada 2009b), making it one of a limited number of countries producing more crude oil than it consumes (BP 2009). However, such numbers can be misleading; by exporting 658 million barrels to the United States, Canada was required to import about 313 million barrels of crude oil (Statistics Canada 2009b).

Prior to the 1980s, western Canadian crude was shipped by pipeline to Ontario and Quebec where it met most of crude oil demand in these provinces (Statistics Canada 2009e). The introduction of the Free Trade Agreement (FTA) and subsequently the North American Free Trade Agreement (NAFTA), has resulted in western Canadian crude oil shifting from a west-to-east flow (to eastern Canada) to a north-south flow (to the United States) (Pratt 2007).

The energy export provisions in NAFTA have encouraged the development of the tar sands (Watkins 2003) and the rapid growth in the export of energy (notably crude oil and natural gas) to the United States (exports of crude oil have grown from 241.7 million barrels in 1990 to 658.6 million barrels in 2007 (Statistics Canada 2009b)). It has also resulted in the gradual reduction of inter-provincial crude oil shipments, first to Quebec (which has ceased entirely)

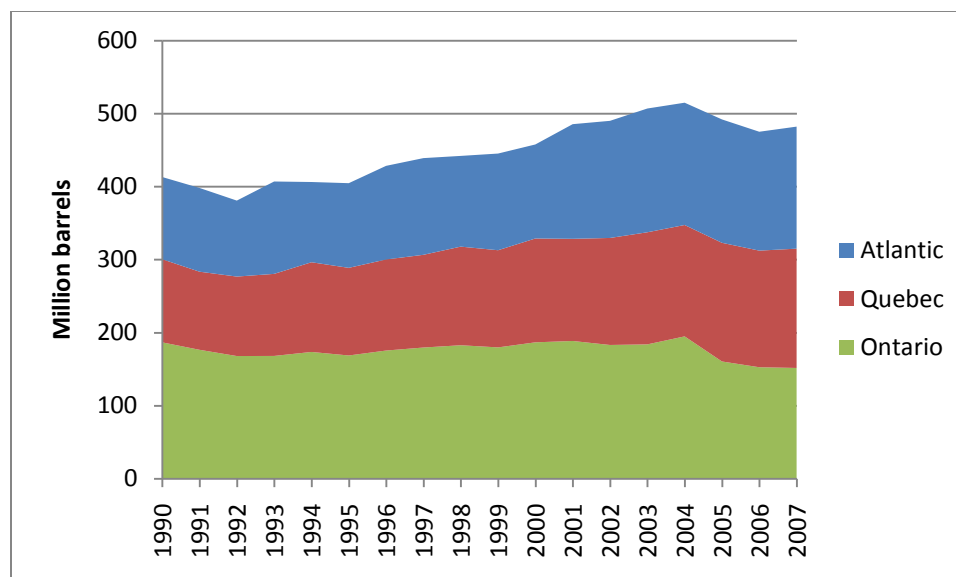
and then to Ontario. Although some provinces in eastern Canada (Canada's six most-easterly Canadian provinces: Ontario, Quebec, and Atlantic Canada, consisting of Newfoundland and Labrador, New Brunswick, Nova Scotia, and Prince Edward Island) have always relied on imports of crude oil, the increase in exports to the United States has seen a concomitant increase in imports to eastern Canada.

The objectives of this paper are threefold. First, to show that the evolution of eastern Canada's crude oil supply and growing reliance on imports from countries with declining production will influence the region's energy security. Second, to consider the possibility of meeting eastern Canada's crude oil needs from supplies of crude oil and condensates from the region's two producers. And third, to propose a means whereby eastern Canada could resume its reliance on western Canada to meet its crude oil demand.

The paper examines the changes in the crude oil market in eastern Canada between 1990 and 2007, inclusive. By starting in 1990, the paper captures all production from two new producers in eastern Canada, shows the impact of changing North American oil markets on crude oil imports into the region, covers the period of Asia's rapid increase in demand, and includes the start of the Kyoto Protocol.

2 Crude supply

Eastern Canadian crude oil comes from three sources: western Canada, eastern Canada, and international suppliers. With two notable exceptions, the volume of crude oil has risen steadily, from 413 million barrels in 1990 to 482 million barrels in 2007; changes in crude demand are shown in Figure 1. The first of the two downturns in demand occurred in the early 1990s during an economic recession, while the second began in 2005 with the closure of an 83,000 barrels per day refinery in Ontario (CAPP n.d., CBC 2003). By 2007, through refinery expansion and some excess capacity, the growth in demand resumed.



**Figure 1: Growth in crude oil demand in eastern Canada
(Statistics Canada 2007, Statistics Canada 2009c)**

2.1 Transporting crude

Table 1, which shows the methods of transporting crude to eastern Canadian refineries, reflects both the location of the refineries and Canada's changing supply picture: Ontario, which is effectively landlocked, gets almost all of its crude via pipeline; Quebec's refineries receive crude from tankers sailing up the Saint Lawrence River (Industry Canada 2009) and from the Portland-Montreal pipeline (PMPL 2006); and refineries in Atlantic Canada obtain crude exclusively by tanker (Statistics Canada 2009e).

Table 1: Crude transportation methods (Statistics Canada 2009e)

Region	1990		2007	
	Pipeline	Tanker	Pipeline	Tanker
Ontario	99.1%	0.9%	99.5%	0.5%
Quebec	61.6%	38.4%	52.2%	47.8%
Atlantic	0.0%	100.0%	0.0%	100.0%

Table 1 also highlights Canada's changing supply picture. In 1990, Quebec received over 60% of its crude via the Montreal-Sarnia pipeline between Ontario and Quebec (about 25% of its supply from western Canada via Ontario). By the late-1990s, growing demand for western Canadian crude oil in the United States as a result of NAFTA and the availability of eastern Canadian crude oil meant that Quebec could reduce its reliance on western Canadian crude. The Montreal-Sarnia pipeline Quebec was subsequently reversed (CEPA 2007), allowing more crude from international suppliers to reach Ontario (while freeing up increased western Canadian crude for export to the United States). By 2007, Quebec's reliance on crude oil from pipelines had decreased to the point where supply from pipelines and tankers were approaching parity.

There are no pipelines between Atlantic Canada and Quebec or Ontario as demand in Atlantic Canada was never considered large enough to justify their construction.

2.2 Refineries

There are ten refineries in eastern Canada, with a combined capacity of over 1.35 million barrels per day, or about 65% of Canada's total refining capacity. Although the greatest regional demand for refined products is in Ontario and Quebec, the largest refinery in Canada is found in Atlantic Canada (Irving in Saint John). Most of the product from the Saint John refinery is intended to meet demand on the east coast of the United States (NRCan 2009b). The list of refineries and their capacities are shown in Table 2.

Table 2: Refineries in Eastern Canada (Industry Canada 2009)

Region	Refinery	Capacity bbl/day
Ontario	Imperial (Sarnia)	121,000
	Shell (Corunna)	69,900
	Sunoco (Sarnia)	85,100
	Imperial (Nanticoke)	118,000
	<i>Capacity</i>	394,000
Quebec	Ultramar (Montreal)	215,000
	Petro-Canada (Montreal)	130,200
	Shell (Montreal)	130,400
	<i>Capacity</i>	475,600
Atlantic	Irving (Saint John, NB)	280,300
	North Atlantic Refining (Come-by Chance, NL)	115,000
	Imperial (Dartmouth, NS)	89,000
	<i>Capacity</i>	484,300

2.3 Western Canadian crude

Western Canadian crude oil is transported to eastern Canada by pipeline. Prior to the mid-1990s, crude oil was delivered to refineries in both Ontario and Quebec; today it supplies only refineries in Ontario. The total volume of crude from western Canada has declined dramatically since 1990, from 190 million barrels to 83.5 million in 2007. By 2007, only Ontario was receiving a supply, about half its 1990 total (see Table 3).

Table 3: Western Canadian crude supply (Statistics Canada 2009e)

Region	1990 (MMbbl)	2007 (MMbbl)
Ontario	162.9	83.5
Quebec	26.7	0.0
Atlantic	0.0	0.0

In 2007, eastern Canada (i.e., Ontario) acquired western Canadian crude from three provinces, Alberta (65.7%), Saskatchewan (20.0%), and Manitoba (7.3%) and the Northwest Territories (7.1%) (Statistics Canada 2009d).

2.4 Eastern Canadian crude

Eastern Canadian crude oil comes from the two extremes of crude oil production history. In Ontario, crude oil was first discovered in 1858 and went into commercial production in 1861 (Gray 2008), while off the east coast of Canada in the Atlantic Ocean, Nova Scotia began producing crude in 1991 and Newfoundland and Labrador in 1996. In addition to crude oil from Ontario and Newfoundland and Labrador, condensates are obtained from Nova Scotia's offshore natural gas fields.

The evolution of eastern Canadian crude production since 1990 is shown in Figure 2. Throughout this period, Ontario's limited supply of crude oil declined by more than half to 0.688 million barrels by 2008. Nova Scotia's offshore produced crude oil only between 1991 and 1999, peaking in 1994 at 8.3 million barrels, while its production of condensates began in 2000 and peaked at 4.7 million barrels in 2005. The most significant supplier of crude oil in eastern Canada is Newfoundland and Labrador, beginning in 1997 and exhibiting incremental increases in production as more fields are brought into play.

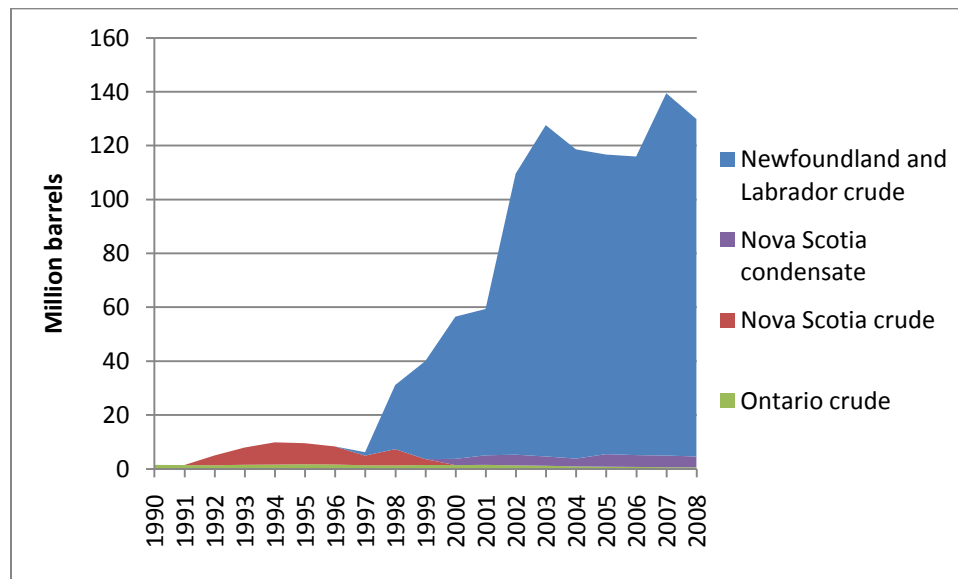


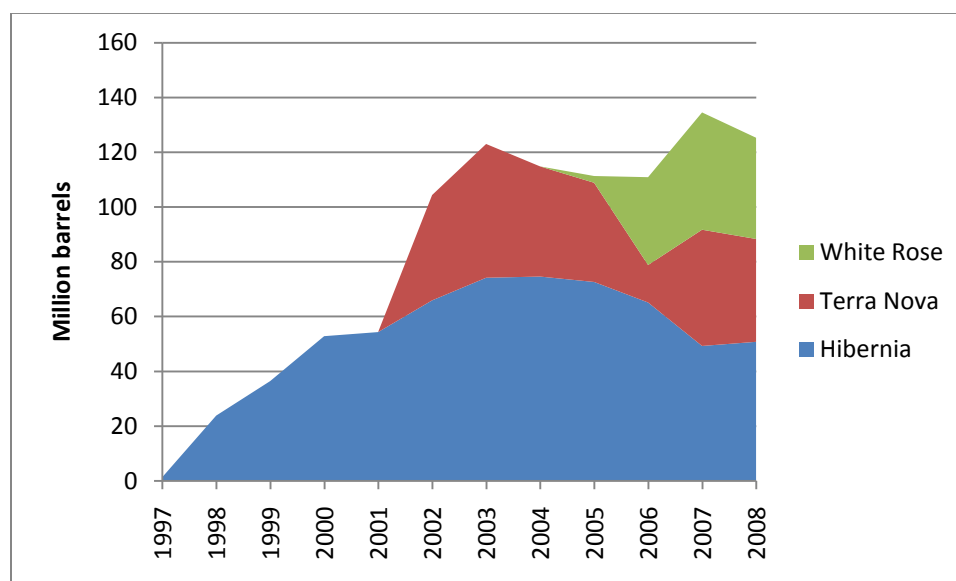
Figure 2: Eastern Canadian production (Statistics Canada 2009b)

In 2007, 139.5 million barrels of crude and condensates were produced in eastern Canada: Newfoundland and Labrador (134.5 million barrels of light and medium crude), Nova Scotia (4.3 million barrels of condensates), and Ontario (0.688 million barrels of light and medium crude). Over half was exported to the United States, with lesser amounts used in eastern Canada, as shown in Table 4.

Table 4: Disposition of eastern Canadian crude (MMbbl) (Statistics Canada 2009b)

To:	From:	
	Atlantic	Ontario
Ontario	6.21	0.69
Quebec	12.74	0.00
Atlantic	34.49	0.00
United States	73.27	0.00
Other countries	1.43	0.00
Inventory changes	1.15	0.00

There have also been offshore discoveries of oil and natural gas in Newfoundland and Labrador. The Grand Banks has an estimated 2,840 million barrels of crude oil, and including the Labrador Shelf, has quantities of exploitable natural gas and natural gas liquids (CNLOPB 2009). Since 1997, production has focused on extracting crude oil and some natural gas liquids from three fields in the Grand Banks: Hibernia, Terra Nova, and White Rose (see Figure 3). About 1,022 million barrels of crude oil have been extracted to date.

**Figure 3: Newfoundland and Labrador production (CNLOPB 2008)**

Hibernia is the largest of the offshore oil fields (1,244 million barrels or about 44% of the reserves) and has been responsible for most of Newfoundland and Labrador's production (633 million barrels) (CNLOPB 2009). The Hibernia field is accessed by the world's largest gravity base structure platform and sits in about 80 metres of water. Terra Nova and White Rose are smaller fields (354 and 305 million barrels, respectively) accessed by two FPSO (Floating Production, Storage, and Offloading) ships. The Terra Nova FPSO experienced production problems in 2004 (a mechanical failure and two spills) and had a temporary shutdown between June and September 2006, when it was sent back to Rotterdam for repairs (NRCan 2009c).

Together, these three fields account for about two-thirds of Newfoundland and Labrador’s offshore oil reserves (CNLOPB 2009).

2.5 Imported crude

The difference between the total demand for crude in eastern Canada and the available supply from both eastern and western Canada is made up by imports from a variety of producing countries. Table 5 shows that the reliance on imports varies by region, with most imports being consumed in Quebec.

Table 5: Crude suppliers for the three regions (Statistics Canada 2009e)

Region	Canada (MMbbl)	Imports (MMbbl)
Ontario	91.09	43.30
Quebec	12.93	143.05
Atlantic	34.49	123.38

Between 1990 and 2007, ten countries (Algeria, United Kingdom, Norway, Saudi Arabia, Iraq, Venezuela, Mexico, Nigeria, United States, and Russia) supplied approximately 95% of eastern Canada’s imported crude oil (see Figure 4). During this time, the average, annual volume of crude oil per supplier increased from 17.8 million barrels (from 11 suppliers) to 24 million barrels (from 13 suppliers). Despite a seemingly large number of producers and the importance of diversity of supply (Yergin 2006), almost 60% of the region’s crude oil imports came from three producers in 2007 (Algeria, Norway, and the United Kingdom); although this would appear to be somewhat of an improvement from 1990, when 63% came from two suppliers (Norway and the United Kingdom).

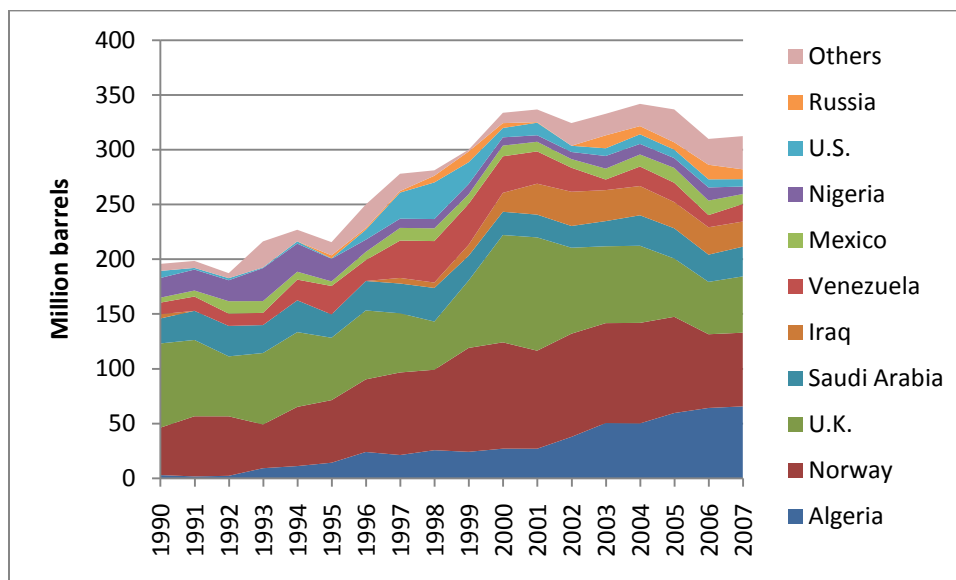


Figure 4: Changes in eastern Canadian crude oil suppliers (1990-2007) (Statistics Canada 2009e)

The distribution of imports is not uniform throughout eastern Canada. Ontario's principal suppliers are the United Kingdom, Algeria, and the United States; Quebec receives most of its crude oil from Algeria, the United Kingdom, and Angola; while Atlantic Canada imports from Norway, Saudi Arabia, and Iraq.

3 Refined petroleum products

The ten eastern refineries each receive about the same amount of crude, although the range of refined petroleum products varies depending upon the product and its associated volumetric expansion. These differences are shown in Table 6.

**Table 6: 2007 data for refined petroleum products (MMbbl)
(Statistics Canada 2009c, Statistics Canada 2007)**

Supply parameter	Ontario	Quebec	Atlantic
Crude oil Availability	151.8	163.4	167.1
RPP Production	177.7	169.9	175.0
RPP Exports	-12.2	-18.1	-115.9
RPP Imports	10.8	46.6	21.1
RPP Inter-regional transfers ('-' means export)	55.7	-55.3	1.9
RPP Availability	231.0	144.1	74.7

More significant are the exports, with the refineries in Atlantic Canada exporting over two-thirds of their refined product. Like the crude oil produced in Atlantic Canada, most of the refined product is sent to the east coast of the United States (PAD District I), very little is shipped to other eastern Canadian provinces. Quebec imports a significant quantity of refined petroleum, exporting considerably more, primarily to Ontario. The final distribution of the available refined petroleum products is 51% (Ontario), 32% (Quebec), and 17% (Atlantic Canada).

4 Refined product demand

Eastern Canadian demand for refined petroleum products has not abated between 1990 and 2007, increasing by over 15%, from 392 million barrels to over 451 million barrels; the changes and end-uses are shown in Figure 5. Most of this increase has occurred in the transportation sector (31%) and in non-energy and producer consumption (29%). There have also been declines in consumption; for example, refined petroleum products used for space heating decreased by 6%, while for electricity and steam generated from refined petroleum and stock changes, demand fell by 60%.

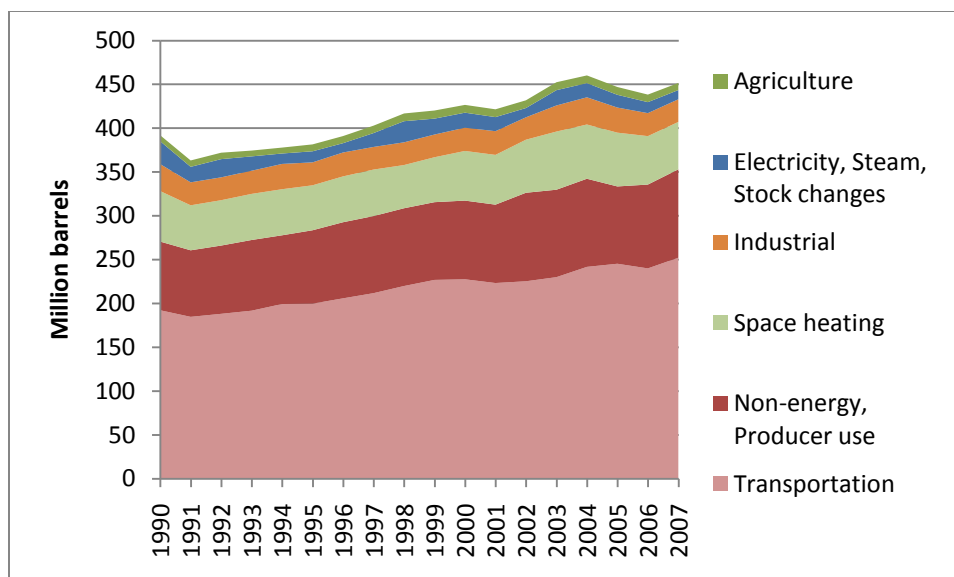


Figure 5: Annual RPP demand (Statistics Canada 2009c, Statistics Canada 2007)

Since the population of eastern Canada increased from 19.7 million to 22.3 million between 1990 and 2007 (Statistics Canada 2009a), it is tempting to attribute the increase in transportation fuel demand to changes in population. However, as Table 7 shows, the energy for transportation has outstripped population growth in all regions, as has the sale of gasoline/petrol and diesel for the 1990 to 2007 period. Vehicle ownership data, which is only available until 2006, shows significant growth as well, exceeding the change in population in both Quebec and Atlantic Canada. This table illustrates that demand for refined petroleum products (notably gasoline/petrol and diesel) is increasing to meet both a growth in vehicle ownership (especially minivans, SUVs, and light trucks) and an increase in oil consumed per vehicle. This suggests that people are driving more or their vehicles are less fuel efficient, or both.

Table 7: Changes in population, transportation energy use, and vehicle ownership (Statistics Canada 2008, Statistics Canada 2007, Statistics Canada 2009c)

	Ontario	Quebec	Atlantic
Change in population (1990-2007)	24.2%	9.8%	-1.5%
Energy for transportation (1990-2007)	39.6%	25.1%	14.2%
Retail pump sales (1990-2007)	32.0%	27.4%	18.6%
Growth in vehicle numbers (1990-2006)	17.9%	24.8%	8.0%
Population per vehicle (2006)	1.92	1.79	1.73

5 Discussion

With two exceptions, demand for crude oil in eastern Canada grew between 1990 and 2007, meeting the demand for refined petroleum products in both eastern Canada and a growing export market in the United States. Eastern Canadian refineries rely on three sources for their crude oil supply: western Canada, eastern Canada, and imports.

Western Canadian production, which once supplied both the Ontario and Quebec markets with crude oil, has declined dramatically over the past 30 years, from a high of almost 300 million barrels in 1980 to Ontario's present 83.5 million barrels (Statistics Canada 2009e). Much of the reduction in Canadian consumption of Canadian crude oil can be attributed to the United States actively replacing Middle Eastern oil with suppliers it considers stable and more secure (MSNBC 2006). Canada is one such supplier; however, in order to meet the demand for Canadian crude in the United States (which has grown from 242 million barrels in 1990 to 658 million barrels in 2007 (Statistics Canada 2009b)), Canada is importing crude oil to meet its own needs.

Crude oil production in eastern Canada appears to have reached a plateau and is expected to decline without the addition of new fields. Ontario's production of crude oil has been in decline for several decades and, given its production volume, makes limited contributions to eastern Canadian crude supplies. Nova Scotia's condensates, again a minor contributor to eastern Canadian crude supplies, can be expected to decrease as offshore natural gas production continues to decline.

Production of crude oil from Newfoundland and Labrador has peaked and is in decline due to natural declines (Oil Production Bulletin 2009), although this may be slowed because of reservoirs in the White Rose field being brought on stream (Newfoundland and Labrador 2009). Existing fields are expected to be played-out by the early 2020s. A fourth field, Hebron, with an estimated 400 to 700 million barrels of recoverable heavy oil was to have been producing by 2013; however, disputes between the government of Newfoundland and Labrador and the developers of Hebron have pushed the startup date to 2017 (Canadian Press 2007). Production from the Hebron field will undoubtedly boost eastern Canadian crude oil production, but not to the current 125 million barrels per year (NEB 2009). If Newfoundland and Labrador are to return to existing production levels, a major exploration program will be needed that makes significant discoveries that are both economically viable and can be brought to market rapidly. This appears unlikely to happen, given that the available offshore oil reserves (excluding Hebron) amount to less than 360 million barrels and are spread across 13 fields (Newfoundland and Labrador 2009).

Each year since 1990, eastern Canadian refineries have had to rely upon a core of about ten international suppliers to make up the shortfall in domestic crude supply. The makeup of this core is effectively unchanged, although the average amount provided by each supplier has increased significantly to offset the production declines of the region's two principal suppliers (United Kingdom and Norway) and to meet the increasing regional demand for crude oil (BP 2009, Höök and Aleklett 2008, Gowdy and Julia 2007).

Eastern Canada's reliance on imported crude oil for its domestic and export requirements is putting the region at risk for a number of reasons. First, some of the region's international suppliers have reached production plateaus or are in decline, meaning that they may have difficulty in maintaining their levels of supply. Second, as international producers struggle to maintain production, the number of potential consuming countries has increased, creating more competition for crude oil; this can be expected to result in supply difficulties or price increases, or both. Third, although demand for crude oil in the United States is falling, there is still a demand for crude oil from secure sources, such as Canada, meaning that there may not

be a “crude dividend” for Canada. Fourth, despite having sufficient crude oil supplies to meet Canada’s internal needs, NAFTA’s proportionality clause means that, short of war, Canadian exports cannot be curtailed to the United States (Laxer and Dillon 2008, NAFTA 2002a, NAFTA 2002b).

If sufficient crude from western Canada were available to meet all of eastern Canada’s needs, thereby obviating the need for imports, there is still the question of how it could be distributed. The pipeline between the refineries in Ontario and Quebec could be reversed once again to take western Canadian crude to Quebec; one such proposal envisages moving tars-sands crude from Alberta through the Sarnia-Montreal pipeline and then to Portland, Maine through the Portland-Montreal pipeline for shipment to Gulf Coast refineries (Enbridge 2008).

This does not address the problem of meeting the crude oil needs of Atlantic Canada with Canadian supplies. The absence of an oil pipeline between Quebec and Atlantic Canada means that western Canadian crude would have to be supplied by other means, possibly by tanker from Montreal or by tanker from Portland, Maine, the terminus of the Portland-Montreal pipeline. Over the past few years, there has been talk of some form of strategic petroleum reserve in eastern Canada (Polaris Institute n.d.), but without supplies to fill it and scant government interest, there seems little chance of it being established (NRCan 2009a).

Ultimately, this is an energy security issue. Improving the region’s energy security will require a systematic set of policies based, for example, on the four ‘R’s of energy security (Hughes 2009). Eastern Canadians will have to reduce their reliance on oil products; replace insecure supplies of crude oil with ones that are secure; and restrict new demand to non-oil products. This is undoubtedly easier said than done because the principal use of refined petroleum products is transportation and many buildings, especially in Atlantic Canada, still rely on fuel oil for space heating; however, failure to do so will lead to severe economic and social hardships as oil becomes more expensive and competition for it becomes more intense.

6 Concluding remarks

Canada produces sufficient volumes of crude oil to meet its domestic demand; however, international agreements (such as NAFTA) and the lack of infrastructure means that much of eastern Canada is reliant on significant quantities of imported crude oil to meet its energy needs.

In itself, this is not an issue, as global trade in crude oil is an integral part of today’s globalized economy. However, world energy markets are changing, there are more countries demanding an increasing share of available crude oil, while a growing number of suppliers are struggling to maintain their prior levels of production. This puts pressures on all oil importing regions, including eastern Canada’s six provinces: Ontario, Quebec, and the Atlantic provinces (New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island).

Although parts of eastern Canada do produce crude oil, the quantities are not sufficient to meet the region’s demand, have reached a plateau or are in decline, and the bulk of the production is exported to the United States. Meeting eastern Canadian demand with western Canadian crude will require additional production to offset NAFTA limitations, changes to existing infrastructure, and possibly the addition of new pipelines or transportation facilities.

A volatile world oil market will affect eastern Canada, in part because of price, although Canadians already pay world prices for crude oil, but possibly more so when it comes to accessing supplies. Energy security policies that reduce consumption of oil products and replace or restrict consumption to sources that are secure, sustainable, and, preferably, environmentally benign, are needed to ensure the economic and social well-being of the region.

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