THE ALBERTA OIL SANDS FROM BOTH SIDES OF THE BORDER*

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ABSTRACT. The United States produces less than half of the oil it consumes, a dependence unlikely to subside without drastic improvements in domestic production, development of renewable resources, and greater energy efficiency. All three of these actions, even if ultimately meaningful, will take time to produce results, so the United States is likely to continue to depend on outside suppliers. The most tempting of these suppliers is Canada, especially its massive oil sands in northeastern Alberta Province. In this article I ask why that is true and, more important whether the arrangement is mutually beneficial. The answers are strongly related to location; that is, the location of supply and the location of demand. The view from the south favors Canada above all other countries as a likely source for meeting the growing U.S. oil needs, yet not without accompanying unintended consequences. When viewed from the north, the monetary attraction of the oil sands is weakened by the environmental costs that are likely if their development expands as expected. Weighing these perspectives, the question is whether the combination of demand and environmental concerns leads to, accelerates, or discourages development. Viewing such a prospect from both sides of the border challenges the view that development of natural resources is always inevitable or wise, regardless of apparent profitability and need. Much depends on location. Keywords: Alberta, Canada, natural resources, oil sands.

Unconventional fuels are strategically important... resources that should be developed to reduce the growing dependence of the United States on foreign oil imports.

—Energy Policy Act of 2005

After more than a century of temptation, setbacks, anticipation, and challenge, one of the world’s great storehouses of energy finally appears ready to give up its treasure. Thousands of workers and their families, plus billions in capital investment from the United States and many other countries, have poured into northeastern Alberta Province, especially in the past several years, in the hope that the oil-rich sands there will turn an often-slighted “back of beyond” into a modern bonanza (Figure 1). Governments and corporations around the world, but especially in the United States and Canada, recognize the advantages of developing such huge reserves. The Alberta oil sands, for so long little more than an enticing possibility, today are being prepared for continued large-scale expansion, even as oil prices fluctuate.

Many circumstances, including the demand for oil on the world stage, are inciting this change from promise to reality, but the most important factor is geographi-

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* This work was completed with the assistance of the government of Canada. Thanks are also due to the anonymous reviewers and the people who graciously agreed to interviews: Brad Anderson, Soheil Asgarpour, Melissa Blake, Jim Boucher, Paul Chastko, Les Diachinsky, Simon Dyer, Bruce Friesen, Mary Griffths, Aaron Sellick, Chris Severson-Baker, Brad Stelfox, Greg Stringham, Steve Tuttle, Dan Woynilowicz, and David Woynorowski.

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The View from South of the Border

To view the Alberta oil sands from south of the U.S.-Canada border one must start by examining the American demand for oil in the context of conventional crude-oil supplies, both present and future. The daily world demand for crude oil is expected to reach close to 96 million barrels by 2015 and 113 million barrels by 2030 (EIA 2008b). With 21 percent of that thirst coming from the United States, additional supplies seem critical for the continued national and political stature of a country able to produce only about 40 percent of its own needs. The prospect for lowering this dependence is slim. For example, Prudhoe Bay, once able to push more than 2 million barrels southward every day, now sends less than half that amount. Production has also faded dramatically in Texas, Oklahoma, California, and most other places under U.S. authority, despite a record number of drilled wells. Even in the prolific Gulf of Mexico, production declined from about 1.6 million barrels per day off Louisiana and Texas in 2003 to about 1.27 million barrels per day in 2007 (EIA 2008a).

Making conditions worse, production of some of the most traditional foreign suppliers is also down sharply. For example, Mexico’s great Cantarell oil field, originally 15–20 billion barrels in reserves, is in quick decline, having dropped in total production from more than 2 million barrels per day in 2004 to an average of 1.46 million per day through the first ten months of 2007 (Harrup 2006; Bermer 2007; Morton 2007). Oil-rich Venezuela, with reserves that exceed 30 billion barrels, is becoming unstable as a supplier and is having to adjust to its own production problems. Farther away, production in the North Sea fields that have been supplying oil to the United States for more than thirty years are also in virtual free fall. Indonesia, long a supplier of low-sulfur crude to the western United States, is suffering from such large production shortfalls that it is contemplating withdrawing from the Organization of Petroleum Exporting Countries. Adding to the worries of falling supply, demand for oil is rising elsewhere, particularly in China and India. All of these events are reflected in global oil statistics: In 2006 surplus production capacity was approximately 1.3 million barrels per day, down from 1.6 million barrels per day in 2005 and 3.0 million barrels per day in 2003 (EIA 2007a). By 2008 that surplus had largely disappeared.

Four responses to oil shortfalls come to mind: to increase domestic production, to develop alternative energy resources, to decrease demand, or to increase imports. The first option is the most difficult, especially when it comes to conventional oil,
because U.S. proven reserves total only about 20 billion barrels and new discoveries are increasingly rare. Some attempt has been made at the second option—for example, increasing the production of ethanol—but the social costs may be too high (Edwards 2007).

The third option—lowering demand—might succeed in the shortest amount of time because both the United States and Canada are inefficient consumers. Already, the efficiency strategy has produced substantial progress, especially in California, in use of electricity and natural gas (Rosenfeld 2003; WR1 2007). Even applying all practicable saving strategies as quickly and successfully as possible, the absolute U.S.
demand continues to climb as domestic production continues to drop. This means that oil shortages will increase and that prices will rise. This leads us to consider the fourth option.

Option four—increasing imports—seems inevitable, at least over the next fifteen to twenty years. Recognizing this, the U.S. Department of Energy forecasts that U.S. imports will increase by 30 percent between 2006 and 2030 (Foreso 2007). Such an increase will affect the entire economy, because energy presently amounts to almost 18 percent of the value of everything the U.S. imports (PPI 2008).

In response to the anticipated oil-supply deficit and the need for increased imports, those people tasked with finding future supplies for the United States face three interrelated geographical questions: Where are additional reserves available? Which routes between the areas of supply and the United States are most secure and reliable? And which reserves would produce the lowest environmental and social costs of production, transportation, and delivery?

One of the most noteworthy realities of the countries that currently provide oil to the United States is reliability. Identifying countries with large oil reserves is no longer sufficient; now their ability and willingness to provide their oil to U.S. markets must also be considered. The Persian Gulf attracts the majority of concern because most of the world’s reserves are there—on the order of 725 billion barrels, if internal national reports are to be believed. Several factors, however, including political stability, supplier policies, and the cost in U.S. lives and money, cast doubt on how much of these reserves will actually be available to the United States. For example, apart from the direct energy needs to pursue the war in Iraq, the cost for military protection of Persian Gulf oil destined for the United States was $50 billion in 2003, about $139 billion by 2006, and even more in 2008. If these costs were included, it would raise the price of gasoline at least 73 percent (NDRC 2007). Moreover, with the oil infrastructure concentrated in relatively few pockets around the Persian Gulf, the majority of world’s oil-supply apparatus is vulnerable to damage, sabotage, change in economic condition, and shift in government outlook.

Even where oil is available, supply routes are a concern. Transportation out of the Persian Gulf must negotiate the most critical choke point in the world, the Strait of Hormuz, a constriction scarcely more than 32 kilometers wide that has been mined in the past and could be rendered impassable with the sinking of a single tanker (EIA 2007b). Considerations of economic cost, military threat, and political dependence have prompted the United States to reduce its reliance on oil from this region, a policy that has had some success, but only because of the timely development of the large fields in Alaska, Mexico, and the North Sea, all of which are now well past their peak. The question is, where will the United States turn for oil in the future, amid increasing worldwide competition for available supplies?

One source of supply could be Russia, where reported reserves of 60 billion barrels have been attracting renewed attention since production rebounded, placing the country back in its former position as the largest oil supplier, with more than 10 million barrels per day (EIA 2008c). Of this, 70 percent is exported, but only
a meager 108,000 barrels per day reached the United States in 2006 (EIA 2008c). More Russian oil may end up in U.S. pipelines, but such hope is dampened by several factors, including continued technical difficulties in developing oil fields in Siberia, long transportation distances to U.S. markets, and the propinquity of closer markets.

A second location of increased interest to the United States is the resurgent Caspian Basin. One of the earliest major producers of oil, Azerbaijan and the other countries surrounding the sea are considered to have among the greatest reserves of oil in the world. Output just from the Caspian countries should more than double to 4.3 million barrels per day by 2015 and increase steadily thereafter (EIA 2007a). Azerbaijan and Kazakhstan are the most promising of these countries, with an estimated 47 billion barrels of reserves.

Although the Caspian Basin, like Russia and the Persian Gulf, has huge reserves, significant geopolitical obstacles hinder its becoming a meaningful supplier to U.S. markets. The entire area is landlocked, so exports require construction, maintenance, and military protection of long, expensive, and vulnerable pipelines through unstable and even hostile territory; the recent upheavals in Georgia offer one recent example of the problem. Even when oil does reach the Black Sea, any of it that is bound for U.S. markets must pass through one or more choke points, such as the Dardanelles and the Bosporus. In contrast, delivery to other buyers, among them countries of the European Union, is generally simpler and less expensive because distances are shorter and transportation by pipeline costs less (Huber 2001). These factors, plus investment risk and the possibility of supply interruptions, limit the degree to which the United States might be able to rely on the Caspian Basin to satisfy future needs.

A third place that holds promise for U.S. markets is the Barents Sea, north of Norway, an area that has gained interest because global warming has been lengthening the ice-free periods in the area. Currently Sweden, Norway, Russia, France, and Italy all maintain a strong presence in the Barents Sea, and the region may hold several billion barrels of reserves. Diminishing the promise of such development for benefit of the United States, European countries are closer and thus more likely destinations. In addition, environmental costs of development there may be uncomfortably high: The World Wildlife Fund considers the Barents "Europe's last wild sea," and has warned that increasing oil activity there poses serious threats to marine ecosystems and biodiversity. Other organizations with similar views have recommended establishing oil-free areas there (UNEP 2007).

West Africa is a fourth source of supply that could help satisfy the increasing U.S. needs. The great reserves of this region, particularly on or near the Gulf of Guinea, are geographically alluring to the United States The more important of these countries are Nigeria (36 billion barrels), Angola (8 billion barrels), and Gabon (2.5 billion barrels). Even Chad, with an estimated 1.5 billion barrels, has U.S. attention now that a pipeline through Cameroon is operating. Access to the Atlantic Ocean is an important attraction, because transportation routes to the United States
are direct, involving no choke points or unstable territories. As a measure of the vital importance of these reserves to the United States, in February 2007 the White House directed that a new combatant command, Africom, be established, with an area of responsibility dedicated solely to the African continent (excluding Egypt) to protect oil fields, supply lines, and shipping lanes, especially those from the Gulf of Guinea (Ghazvinian 2007, real 2007; Shaxson 2007). That command is now in effect.

Three remaining areas of oil supply are closer to U.S. markets. Two of them are in Alaska: the Arctic National Wildlife Refuge, slightly more than 97 kilometers east of Prudhoe Bay, with perhaps 16 billion barrels, and the 95,000-square-kilometer National Petroleum Reserve to the west, which may hold billions more. Both areas are the more tempting because of the precedent of oil development on the Northern Slope. Discord as to the wisdom of developing these areas remains, of course (Bass 2004). The third nearby prospect for new oil development, also close to existing oil infrastructure, is the Gulf of Mexico. The gulf probably holds additional, untapped reserves that may become accessible as recovery technology improves. Hope is riding on the deep waters in the middle of the gulf—the so-called hole—although the recoverable volume is not yet certain (Mufson 2006). The gulf may supply about 2.1 million barrels per day by 2012 (Karl and others 2007).

Taken together, every likely source of conventional oil supply—whether in the Persian Gulf, the Barents Sea, the Caspian Basin, West Africa, South America, Alaska, or the Gulf of Mexico—carries its own spatial, logistical, and political yoke, and none can alone provide the United States with the security and sufficiency of supply it needs when measured against anticipated increases in demand. The prospect of obtaining future supplies from these areas, singly or in groups, is pockmarked with the uncertainties of access, competing markets, transportation costs, environmental concerns, political instability, and the weight of socioeconomic disparities in many regions that increasingly trouble any sense of moral decency.

One other large future source of oil, in most ways the most attractive source, remains: the oil sands of Canada. Already the United States receives more oil imports from Canada than from any other country. Moreover, Canada offers the most complete list of criteria—not just its reserves and proximity but also its security of availability and supply, as well as a multitude of practical, economic, cultural, and political accommodations—that are favorable for expanding that arrangement. In the event that other supply streams are interrupted, terminated, or become unreliable, Canada could be at least part of the safety net the United States needs.

Many reasons favor greater U.S. dependence on Canadian oil. Most fundamental, Canada has more oil than it needs, and the United States is happy to buy all that Canada is willing to sell. The two countries share much more than a convenient overlap of supply and demand, however: Americans and Canadians are nearest neighbors, are economically interdependent, speak a common language, and travel easily and frequently between the two nations with little suspicion or difficulty. In addition, Canada and the United States share several rivers and the largest system of lakes in the world. Climate, topography, fauna, ground cover, and urban life are
so similar on both sides of the border that they blur the crisp cartographic line that divides the two countries. Benefited by the North American Free Trade Agreement, commercial exchange between the United States and Canada is now the largest it has ever been. In short, they depend on one another—willingly, to their mutual benefit, and with increasing enthusiasm. Within this atmosphere the two countries are eagerly moving closer to each other when it comes to energy, one of the most valuable commodities they trade.

Such energy trade is robust. Canada supplies around 18 percent of the U.S. oil imports and about 90 percent of its imported natural gas, and it is the biggest seller of electricity to the U.S. Northeast. In total, about one-fourth of the energy used in the United States comes from Canada, and the proportion is going up. U.S. imports of energy products from Canada increased to $73.7 billion in 2006, and about one-half of the $15.5 billion increase in U.S. merchandise imports from Canada between 2005 and 2006 resulted from higher energy imports. The volume of U.S. imports of crude petroleum from Canada increased by 12 percent to 1.8 million barrels per day in 2006 (Reeder 2007).

Even after centuries of extraction and use, a large portion of the original storehouse of fossil fuels in the United States and Canada remains in place, including billions of cubic meters of gas, centuries' worth of coal, and billions of barrels of conventional oil (NAEWG 2006). Add in the oil sands, and the available reserves bulge. Already, oil-sands development is approaching half of Canada's total national oil production, amounting to 1,157,325 barrels a day, roughly 44 percent of Canada's total crude-oil production. By 2010, oil-sands production is forecast to surpass 3,000,240 barrels of oil a day, or 67 percent of total Canadian crude-oil production (Statistics Canada 2007).

To U.S. consumers, Canada is the best source for oil in every way. Compared with reserves anywhere else, Canadian oil is closer, costs less to transport, requires no tankers or deep ports, and is comparatively free of the risks of hostile actions or interdiction. Political, legal, financial, regulatory, and technical requirements for enhanced flow to the United States are already largely in place, and many of the companies that handle the product operate within the binational arena routinely. Given the continuing rapid rise of U.S. spending on oil—from about $55 billion in 2002 to $171 billion in 2006—and the expected leakage back to the United States of some of the revenues paid Canada for more oil, the case for expanded reliance is strong (Forbes 2007).

The great interest in obtaining more oil from Canada is driven by location. The United States needs more oil, and Canada has a surplus it is willing to sell to its southern neighbor. But the favorable relationship between the United States and Canada involves more than just proximity and lower transport cost. Business, history, politics, and issues of mutual national security all favor the arrangement, with the balance of benefits overwhelmingly weighted on the U.S. side of the border. Even from the environmental perspective, the United States would come out far ahead by any measure, despite some indications that it is beginning to consider oil
sands as more than just a commodity. The primary example of this recent shift has been the reaction to BP's proposal to modernize and expand its refining facilities at Whiting, in northwestern Indiana. By completing the planned project, BP aims to increase use of Canadian crude from oil sands. Public protests over the expansion have centered on increased air and water pollution (Hawthorne 2007). They may be a harbinger of more opposition, if not to the needed expansion and upgrading of U.S. processing facilities, then to the idea that U.S. demand is harming the environment in other countries. Addressing this point, the 2008 annual meeting of American mayors adopted a resolution that "supports federal legislation that prohibits government use of unconventional or synthetic fuels" derived from carbon dioxide-intensive sources such as oil sands (Yoney 2008). In other words, consumers in the United States are starting to recognize that their demand for oil has repercussions elsewhere; in this case, Canada.

The View from North of the Border

At first glance, enhanced oil-sands development seems appealing. By the end of 2000 there had not been a major oil discovery—that is, more than 1 billion barrels—in thirty years, and by 2006 the world was pumping 31 billion barrels of oil each year but discovering fewer than 9 billion barrels of new oil to offset them. Today all the fields in the lower forty-eight states are in decline, and the era of "easy oil" is over; even oil production in the Persian Gulf may have passed its peak.

Given that the recoverable oil-sands reserves measure 175 billion barrels and that the growth of American demand is unlikely to slow, ramping up production would seem beneficial to both Canada and the United States. Indeed, this hope informs the current planning strategy. If production capacity from the oil sands increases as expected, it will rise from its current 1.3 million barrels per day to more than 3.5 million barrels per day by 2018 and to 6 million barrels per day by 2040 (Söderbergh, Robelius, and Aleklett 2007). If it does, additional supplies will enter the pipeline just in time to help offset diminishing reserves in Mexico, growing supply insecurity in the Middle East, rising competition from developing countries, access and transportation bottlenecks in the Caspian Basin, and environmental concerns in places like the Barents Sea and northern Alaska. These expectations help explain the enthusiasm in most quarters over continuing the present trends toward expanding oil-sands development in Alberta. Even if just 20 percent of the reserves is recoverable, the long allure of the oil sands will seem vindicated, in no small part because the largest oil market in the world is right next door (Chastko 2005).

That oil is the most valuable commodity in world trade is well known. At the root of this situation is the spatial disequilibrium between locations of production and locations of consumption. Such geographical disparity, which has been widening each year since the mid-1980s, strongly influences economic and political decisions worldwide. As reserves shrink and demand grows, the craving for oil shifts political influence to countries with riches still in the ground, raises prices, stirs
political instability, tempts acts of terrorism, and increases open-sea piracy (ICC 2008). All of these arguments favor increasing investment in and enhancement of oil-sands production.

On the other hand, assuming that the only consequences of the United States' addiction to oil are economic and strategic would be a mistake. Environmental costs continue to rise as the search for new oil reaches farther and farther into virgin rain forests, trackless deserts, permanently frozen wilderness, and deeper water. As a result of new oil-field development, the environmental costs of the quest are shifting from worrisome to alarming, and no end to this trend is in sight; it will continue as long as oil remains tightly tied to economic prosperity, military power, national prestige, and global security.

So it is with the Alberta oil sands: As production increases, countries that long held only a superficial interest in oil sands are now focusing their attention on the prospects of receiving a share of the increasing production. None, however, competes well with the United States. Abutting the southern border of Alberta, the United States is the closest, most voracious, and politically friendliest market in the world for Canada's oil.¹ From the workers swarming into Fort McMurray, to the president of the Treasury Board in Ottawa, to the suburban commuters in Phoenix, to the secretary of defense in Washington—support for greater trade is enthusiastic. Given the geographical enticements of supply and demand, surplus and deficit, entrepreneur and consumer, one might expect all parties to be pleased. However, despite its many apparent attractions, we might ask whether the exchange of Canadian oil for U.S. dollars—when viewed evenly from both sides of the border—is as reasonable as it seems.

The rising standards of living in countries like India and China are also pushing up demand for natural resources. At the same time, decision makers are increasingly asking whether the mere existence of profitable and enviable natural resources should always, regardless of environmental changes, lead to their exploitation, ignoring such other considerations as price and national security. At what point should the environmental losses in the producing country be considered excessive? Should resource wealth always be considered a windfall or is it sometimes, in some places, a curse?

These question have wide resonance, from the rain forests of eastern Ecuador and deepwater drilling in the Gulf of Mexico to the damming of the Yangtze River and the prospects of oil development in the Arctic National Wildlife Refuge, from burying pipelines in pristine areas of Siberia to squeezing oil from the Green River Formation in western Colorado, the widening search for new sources of energy is emphasizing the dilemma of finding balance with the environmental damage it will inflict (Schneider and Dyer 2006).

Two factors influence environmental concern over the Alberta oil sands. The generic factor is the heavier environmental burden attached to producing a barrel of synthetic crude—that is, the output from a bitumen/extraheavy oil upgrader facility—than a barrel of conventional oil. The site-specific factor is linked to the
local environmental conditions of northeastern Alberta: Its harsh climate and sensitive ecology intensifies environmental vulnerability, while its relative isolation dampens public scrutiny and evaluation. Meanwhile, most residents are attracted by economic opportunities, not natural enticements. Together, these factors lead inevitably to changes not just in natural balances but in cultural ones as well. For example, First Nations people—who have occupied this territory for centuries—are finding it futile to resist changes that the oil-sands operations are bringing (Boucher 2006).

In 2009, given the publicity garnered by the scale and value of the oil sands in Alberta, coupled with modern capabilities to assess and publicize environmental changes, opportunities for more complete assessments of the impacts of oil sands have replaced the insulation and anonymity of distance. The most noticeable change to date is in the visible landscape. Already, oil-sands development has reshaped 420 square kilometers north of Fort McMurray, including the removal of more than 50 square kilometers of boreal forest (Woytillowicz and Severson-Baker 2006). Currently, about 2 million metric tons of oil sands are needed to produce 1 million barrels of synthetic crude oil.²

The Alberta oil-sands development is conflating geography and energy to produce an iconic “landscape of power” for all to see (Figure 2). But a different, if associated, landscape of power will be produced when recovery moves underground. Only about 22 percent of the oil in the Athabasca deposits can be removed using
surface-mining techniques (see Figure 1). Once underground—in situ—operations begin to dominate production, the surface-mining impacts we see today will spread more slowly. However, underground mining will require injecting substantial amounts of steam and drilling thousands of wells, not to mention providing roads, seismic lines, housing, and ancillary equipment. All things considered, landscape change, whether from surface or subsurface reserves, will be extensive. Already in place are approximately 3,224 scattered oil-sands lease agreements totaling 49,973 square kilometers, an area larger than Vancouver Island (Woynillowicz, Holroyd, and Dyer 2007).

The total impact of oil-sands development on the future appearance, function, and ecological balance of northeastern Alberta is only a little more than an educated guess, but it could be devastating. Government policy will be one of the influencing factors. For example, current policies do not call for reestablishing the land to "original condition," only to "equivalent land capability." Because the government considers agricultural land the equivalent of forest land, for example, oil-sands companies have reclaimed mined land to use as pasture for bison rather than restoring it to the original boreal forest and muskeg.

In addition to changes from oil production—which will be subjected to reclamation—additional landscape changes of a more permanent nature will continue to accumulate, including those from home building, road construction, provision of consumer and industrial services, pipeline placement, and generation and distribution of electricity necessary to service the growing needs of every aspect of the projects (Figures 3 and 4). Together, Alberta oil-sands development projects, already respon-
sible for some of the most striking energy landscapes on earth, will grow spatially and in intensity. In the end, because of the inherent nature of their development, the ecological sensitivities of northeastern Alberta, and the slow recovery rates in cold environments, one must expect landscape changes to become permanent.

As impressive as they will be, environmental changes from oil-sands production will not stop at the boundary of the resource. Some of these impacts, such as distribution rights-of-way, are easy to envision; others are less so. For example, the various methods of in situ development, such as steam-assisted gravity drainage, require massive volumes of hydrogen to upgrade the high-viscosity bitumen; production and upgrading will require almost 42.5 cubic meters per barrel produced in situ, double the amount of bitumen needed for the product from surface mining (ACR 2004; Reguly 2005). One place that is receiving great attention as a source of this hydrogen is the natural gas in the Mackenzie River delta, hundreds of kilometers to the northwest, where conditions are even colder and more fragile than areas near Fort McMurray. Nevertheless, plans for construction of a new pipeline to link the Mackenzie River gas fields with existing pipelines in northern Alberta are well advanced (Figure 5).

The impacts of developing and delivering natural gas are one illustration of environmental ripples that oil-sands recovery will generate. Another example reaches into the realm of nuclear power. Husky, Total, Shell, and other multinational corporations have been discussing the use of nuclear power to provide the steam needed
**The Proposed Mackenzie Valley Gas Pipeline, Canada**

![Map of the Mackenzie Valley Gas Pipeline](image)

**Fig. 5**—The Mackenzie Gas Project, a proposed 1,220-kilometer-long pipeline system along Canada's Mackenzie Valley that would link northern natural gas-producing wells to southern markets and be available for oil-sands recovery. *Source*: Adapted from Boreal Songbird Initiative 2007. (Cartography by Barbara Trapido-Lurie, School of Geographical Sciences, Arizona State University)

**Fig. 6**—Blocks of sulfur produced during processing, stored at a Syncrude upgrader site north of Fort McMurray, Alberta. No use has yet been found for this a by-product of the upgrading process. (Photograph by the author, June 2006)
to inject into the underground reserves for in situ recovery. Some politicians in Alberta have been vehemently against such expansion of nuclear power, but others strongly favor the idea (Polaris Institute 2007; Voutsinos 2007; WNN 2007).

In addition to disruptions from mining and processing the fuel, developing natural gas, building nuclear power plants, plus the required improved network of pipes for oil and gas, pylons for electricity, and new roads for access, three more major environmental challenges present themselves. First is the accumulation of waste products from hydrotreatments. At present the primary waste product—sulfur stripped from the oil—is compressed into massive yellow blocks and stored on-site (Figure 6). This solution is presumably temporary, although a permanent remedy is not yet at hand. However, some innovators are proposing that sulfur might become valuable if it could be transported by pipeline and burned for its inherent energy.\(^3\)

The second additional impact, related to the first, is the augmented emission of greenhouse gases. Producing one barrel of oil from oil sands generates three times more greenhouse gases than does one barrel of conventional oil. Obtaining energy from oil sands instead of light crude means emitting 80 kilograms extra for every 400 kilograms normally emitted, or about 20 percent more carbon dioxide per unit of energy. The anticipated rise in production to 3 million barrels per day in 2020 will increase production of carbon dioxide from 30 million tons in 2004 to 95 million tons in 2020 (Asgarpour 2004). Already, greenhouse gas emissions from the Alberta oil sands are substantial. Currently the mining operations of Syncrude and Suncor are the third- and sixth-largest emitters of greenhouse gases in all of Canada.\(^4\)

The third concern is the resulting change in water quality and quantity. In Alberta, surface mining begins with removing the muskeg and other overburden as well as using multiple pumping wells to depressurize the basal aquifer in order to prevent groundwater from seeping into the mine pit (Griffiths, Taylor, and Woynillowicz 2006; Woynillowicz and Severson-Baker 2006). Transporting and processing the mined bitumen uses large volumes of water. In total, producing 1 cubic meter of synthetic crude oil requires an estimated 2–4.5 cubic meters of water (net figures), with additional water needed to upgrade the bitumen into lighter, crude synthetic oil, whether done on-site or elsewhere (Griffiths, Taylor, and Woynillowicz 2006, 1). Presumably recycling will help reduce this volume, but how much is uncertain. With in situ production, for example,

the volume of water needed to generate steam to recover a unit of bitumen from in situ production is about one-tenth of the volume withdrawn for oil sands mining. However, due to the location of in situ operations, the water is often withdrawn from the ground, rather than from rivers or lakes. This groundwater may be fresh or saline, depending on the depth from which it is withdrawn. It can be difficult to anticipate the long-term cumulative effects of such withdrawals on an aquifer. (Griffiths, Taylor, and Woynillowicz 2006, 1)

In addition to disturbance to groundwater and discharge of wastewater into open pits, a principal concern in northeastern Alberta is the impact on the Athabasca River and its delta. This river is already precariously oversubscribed by oil-sands
operations. In 2006, approved oil-sands mining operations held licenses to divert 359 million cubic meters from the river, or “more than twice the volume of water required to meet the annual municipal needs of the City of Calgary” (Griffiths, Taylor, and Woynillowicz 2006, 1). Such demand is a considerable impact of oil-sands development, especially if further growth proceeds as planned.

Assuming that the same recovery techniques are used in mining subsurface reserves, the demand for water will decrease somewhat, at least on a per-barrel-produced basis. However, the two most common in situ processes use freshwater, including fresh groundwater. Although some projects use saline water and almost all projects recycle water, all forms of water must be treated before they can be used to generate steam. The net amount of water required to produce 1 cubic meter of oil with in situ production may be as little as 0.2 cubic meter, the number of proposed projects has increased rapidly since the steam-assisted gravity-drainage process was developed. In other words, although in situ processing requires less water per unit produced, the expected increase in the scale of production of synthetic crude using such methods is likely to sustain or exacerbate the water burden.

Interest in how to discard wastewater is also rising. At present, producers send most of it to tailings ponds (Figure 7), which already cover more than 50 square kilometers and are therefore easily the largest single visible landscape signature. From the air, these ponds tempt migrating waterfowl, sometimes with deadly results. On 28 April 2008, hundreds of migratory birds landed on Syncrude’s ponds and died from contact with the contaminated water (Katinas 2008). A recent report by the Natural Resources Defense Council predicts an acceleration of the problem: “Annual bird mortality from landing and drowning in the oily water in current tar sands tailings ponds could range from more than 8,000 birds to well over 100,000. A doubling of tailings ponds—likely with proposed tar sands mining expansions—would increase projected annual bird deaths to between 17,000 and 300,000 individuals” (Wells and others 2008, v). The cumulative impact over the next thirty to fifty years ranges from a low of about 6 million birds lost to “as high as 166 million birds lost” (p. iv). Because these birds are migratory, such deaths in Canada will result in fewer birds in the United States. No practicable remedy for this problem exists at present.5

Weighing Oil—Sands Development

Weighing the pros and cons of oil-sands development depends largely on the vantage point of the observer. In the example of the Alberta oil sands, most vantage points are either north or south of the U.S.-Canada border. Canada has a surplus of oil, and the United States is desperate for greater security of supply. But more than simple resource trade—including, for example, investments already made by U.S. companies and the convenience of established arrangements—is tempting the two countries: a secure oil-delivery system, an array of accommodating financial instruments and legal structures, overlapping security concerns, years of precedents, and a similar cultural heritage. Using one’s ample natural resources to help meet
the needs of a friendly, oil-dependent neighbor would seem an ideal convergence in the world of energy commerce.

Observed at greater depth, however, the wisdom of wholesale resource development becomes increasingly complicated and more problematic, as attention tends to focus on benefits to individual countries. In Canada, private investors, public companies, and government tax collectors consider development of the Alberta oil sands a dream fulfilled, a financial bonanza. Others, especially many of the First Nations' people and members of the environmental community, consider such activities an inchoate disaster, one that not only affects Native cultures and threatens fragile ecosystems but also feeds further into unsustainable and wasteful systems of energy consumption.

Deciding on the proper role and contribution of the Alberta oil sands requires judging the economic benefits against its environmental costs. Will gaining the fruits of oil-sands development be later considered a devil's bargain? More broadly, must the mere existence of this massive and enticing natural resource necessarily prompt its development?

For the oil sands, these are questions of interest to people in both countries, but the decision falls predominantly on Canada's side of the border. After measuring gains and losses of expansion, those people in positions of responsibility need to decide whether Canada comes out ahead. It is not a new problem for the country: It has been selling its natural wealth—trees, uranium, hydroelectricity, and other
Riches—on the international market for decades, and in most ways these sales have been viewed as unremarkable transactions, business as usual. But at some point the exchange of natural bounty for the lucre it can provide may lose its appeal. Predicting when the accumulating toll will become excessive and knowing which factors to include in calculating the toll are no easy matters.

Questions of this sort are at the heart of all decisions about natural resources, regardless of their location. Even for Canada, a large and rich country, the accumulating environmental damage of such actions may come into play and drift across the border in a variety of forms. Moreover, given the relatively high and rather steady level of Canadian prosperity, promoting the quickest, most complete export of every form of its natural wealth may not always be necessary or sensible. Examined more closely, maximizing Alberta oil-sands development may not be in the broader interests of the United States, either, not just because some of the impacts may accumulate south of the border but also because such actions tend to forestall the increasingly clear imperative to look beyond oil.

A singular convergence of technology, history, and geography between the United States and Canada is propelling oil-sands development forward. Both countries see mutual benefits in such a trend because they are applying arguments that are weighted toward increasing supplies. Were either country to promote more vigorous integration of demand-side policies, the number of difficult choices about natural resource development would shrink, not just concerning oil sands in Alberta but also concerning other Canadian assets, such as the mighty rivers of Ontario and Quebec and the dense forests of British Columbia.

Regarding the case at hand, the question is whether it is wise to support the development of the oil sands to the scale contemplated, given the nature of the impacts of oil sand development on the quality and flow of the Athabasca River, the need to construct nuclear power plants, the Mackenzie River delta ecology, animal habitats, greenhouse gas emissions, landscape alterations, and the country's cultural heritage. When we conduct such an examination from the place of supply as well as the place of demand—in this case from opposite sides of a common border—we gain a more balanced, even more responsible, assessment of the costs and benefits of resource development than when we take a strictly nationalist view. This approach should be considered routine as demand for natural resources accelerates around the world. In this regard, many people in the United States and elsewhere are increasingly beginning to ask: What burden are some countries paying to meet rising resource demands? What responsibility should consuming countries accept for the damage their resource demand creates in supplying countries? These and many other related questions are at the heart of the human role in changing the face of the earth.

Notes

1. This juxtaposition is one of the major differences between the viability of oil sands in Alberta and oil sands found elsewhere, such as in the Venezuela's Faja de Orinoco. Venezuela is working to close the gap, but it cannot overcome the special—and spatial—advantages of Alberta's proximity to the United States.
2. This is equivalent to the energy in 285,223 tons of coal (at 24 gigajoules per metric ton) (Herweyer and Gupta 2008).

3. The trademarked name for this is “free-flowing sulfur” (PatentStorm 2006).

4. According to Environment Canada’s Facility GHG Reporting system, 2007 emissions from Syncrude’s Mildred Lake and Aurora Plant sites and Suncor Energy Inc. Oil Sands totaled 14.1 million and 8.8 million metric tons of carbon dioxide, respectively (Environment Canada 2009).

5. Noise mimicking the report of guns deters some birds from landing on the water.

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