An IHS CERA Special Report

Growth in the Canadian Oil Sands:

Finding the New Balance

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EXECUTIVE SUMMARY

The world is searching for the right balance between increasing oil supply to meet aspirations for higher living standards and greater energy security, while at the same time protecting the environment, particularly in the face of concern about climate change. How this mix of interests evolves will be a defining feature of the early twenty-first century.

Development of the Canadian oil sands encapsulates the complexities the world faces on energy, environmental, and security issues. The oil sands are an immense resource—second only to Saudi Arabia in recoverable oil reserves. They are the sixth largest source of new supply additions in the world since 2000—ahead of Iran, Kuwait, and China. Further development offers Canada the potential to become one of the largest oil producers in the world and to continue to expand its position as the number one foreign supplier of oil to the United States. Furthermore, the oil sands are part of the dense network of economic, political, and energy relations between the United States and Canada. The oil sands themselves are a key element in the vital trade link between the countries: Canada is the largest trading partner of the United States. The two-way trade between the countries reached $597 billion in 2008, and Canada ranks by far as the largest market for American exports of goods and services.

The future of oil sands development is of great importance to Canada's overall economy. Major US interests are at stake, and there will be a significant global impact as well. The world's demand for energy will rise over the next several decades. CERA projects that total world energy demand in 2035 could as much as double from where it is today. Alternative forms of energy, such as biofuels, wind, and solar power, will play a growing role in satisfying higher demand, but so will fossil fuels, including oil. Indeed, all forms of energy—as well as greater efficiency—will be needed to deliver and support higher living standards around the world.

Will there be sufficient future investment in innovation, energy production, and efficiency to meet the energy needs of consumers around the world? If one or more of these factors falls short, energy could constrain economic growth instead of serving as an engine of development and rising living standards. There are no easy answers to the world's energy, environment, and security challenges.

Oil today accounts for 35 percent of global energy supply—the largest share of any form of energy. In 2035 oil will still play a central role in world energy supply. CERA's estimates of global oil demand in 2035 range from 97 million barrels per day (mbd) to 113 mbd. In 2008 world oil demand was 85.2 mbd.* Even in a world of relatively slow demand growth, new supplies of oil will be needed, especially to meet demand for greater mobility among those entering middle income levels around the world and to offset declining production in existing oil fields. The size and location of the oil sands resource means it has the potential to play an increasingly important role in satisfying oil demand—especially in North America.

*The 2008 figures include 1.2 mbd of global biofuels demand.

From the economic and energy security points of view there are compelling arguments in favor of strong expansion of the oil sands. Yet, at the same time, as with any form of energy, development has an impact on the environment. The production and processing of oil sands are among the more carbon-intensive when compared to other liquid fuels. Also, the cumulative impact of development on Alberta's water and land resources and on local and Aboriginal residents is not yet fully assessed.

The recognition of the significance of oil sands provides the motivation for this CERA study. The study has three objectives:

- first, to provide local, regional, and global contexts on the oil sands and explain why issues surrounding their development matter
- second, to identify and assess issues that will affect oil sands development—with a particular focus on those that generate debate or face uncertainty
- third, using our scenario framework, to illustrate how the future could unfold under three different sets of assumptions about oil sands development, economics, politics, and technology

THE KEY INSIGHTS

What factors will have a major impact on oil sands development? What issues are the focus of debate or face an uncertain future? A central element of this report is assessment of questions that will be critical for development but lack a shared understanding among stakeholders.

The issues surrounding future oil sands development do not necessarily lend themselves to clear-cut answers. The evolution of a number of critical issues, ranging from climate change regulation to Aboriginal rights, is uncertain. Views on the benefits and impacts of oil sands development span a wide spectrum.

CERA has identified key insights about the oil sands that illuminate issues that are uncertain or a focus of debate. These insights are informed by CERA's own research over the past eight months, combined with the results of a series of workshops in Calgary; Washington, DC; and Fort McMurray, Alberta, as well as the insights gained from the development of our three oil sands scenarios.

Energy Security and US-Canada Relations

The oil sands resource offers North America the possibility of further increasing continental oil supply security. Significant growth in oil sands imports into the United States will reduce the required volume of oil imports from elsewhere in the world. The oil sands are sourced from a politically stable and secure country adjacent to the United States. The United States is a natural market for Canadian oil, since the neighboring markets are connected by pipelines. Often unrecognized is Canada's position as the number one foreign supplier of oil to the United States. Canada's share of US oil imports rose from 15 percent in 1998 to 19 percent in 2008, underscoring the deep economic and trading relationship between the two neighbors as well as the critical role of energy in that bond (see Table ES-1). In our high growth scenario the oil sands would supply 37 percent of US oil imports by 2035—far more than any other foreign supplier. Greater Canadian oil exports to the United States result in fewer imports from elsewhere in the world than would otherwise be the case—shortening supply lines, among other advantages.

Canada and the United States have a long history of cooperation on energy issues, particularly on oil matters, although there have also been periods of significant contention. Cooperation is in the interests of both countries. A key challenge for continued cooperation is the development of a common framework for regulating greenhouse gas (GHG) emissions. A common Canadian-US framework for regulating GHG emissions would provide a more clear and solid climate for energy investments—including oil sands—compared with a world in which conflicting regulatory schemes emerge. An integrated approach would help to reduce market distortions and trade conflicts. The challenge of developing a shared set of policies should not be taken lightly, however. Developing a truly integrated approach between the United States and Canada for regulating GHG emissions would be a major milestone in international cooperation to combat climate change.

Greenhouse Gas Emissions

Comparisons of the GHG emissions of oil sands to other sources of crude oil are a source of great confusion. The confusion stems from using different boundaries to measure GHG emissions. The most comprehensive measurement of GHG emissions is on

Table ES-1

Top Five Sources of Crude Oil and Petroleum Product Imports to the United States, 1998 and 2008

(million barrels per day and share of total US imports)

1998

		Volume (mbd)	Share of Total US Imports (percent)
1	Venezuela	1.72	16
2	Canada	1.60	15
3	Saudi Arabia	1.49	14
4	Mexico	1.35	13
5	Nigeria	0.70	6

2008

		Volume (mbd)	Share of Total US Imports (percent)
1	Canada	2.46	19
2	Saudi Arabia	1.53	12
3	Mexico	1.30	10
4	Venezuela	1.19	9
5	Nigeria	0.99	8

Sources: US Energy Information Administration, Cambridge Energy Research Associates.

a life-cycle, *well-to-wheels* basis. The *well-to-wheels* basis includes GHG emissions from oil extraction, processing, distribution, through to the combustion of the refined products, such as gasoline and the resulting emissions that exit through the tailpipe. On this basis total GHG emissions from oil sands are approximately 5 to 15 percent higher than the average crude oil consumed in the United States. That is, about 5 to 15 percent more carbon dioxide (CO_2) in total is released into the atmosphere as a result of using oil sands instead of an "average" crude oil. Measuring GHG emissions in only part of the life cycle—the extraction, processing, and distribution part, or what is called *well-to–retail pump* or *well-to-pump*—can yield larger differences between oil sands and the average crude oil processed in the United States.

GHG emissions released during the combustion of refined products, such as gasoline, account for 70 to 80 percent of total life-cycle, well-to-wheels emissions. The well-to-retail pump portion of GHG emissions accounts for 20 to 30 percent of total life-cycle GHG emissions. GHG emissions from combustion of gasoline in an automobile will be the same regardless of the crude oil from which the gasoline is derived. Variability in GHG emissions from different sources of crude oil occurs mainly in the well-to–retail pump portion of the value chain.

Life-cycle GHG emissions from oil sands can be higher, lower, or on par with conventional crude oils since both oil sands and conventional crude have a wide range of emissions. This is why the very notion of comparing oil sands to an "average" barrel of crude oil is an additional source of confusion in considering GHG emissions. The United States consumes crude oils with a wide range of GHG emissions, some with emissions higher than those from the oil sands. The picture becomes even more complex since the carbon footprint of crude oil consumed in the United States is likely to change over time. First, over the life of a conventional oil field, the energy consumed to extract a barrel of oil can increase significantly because of the need for more energy-intensive extraction techniques. Second, the "average" conventional barrel imported into the United States may become heavier over time as high-quality light crude oil becomes scarcer. These issues highlight the critical importance of obtaining accurate and verifiable GHG life-cycle data from all sources of crude.

In the near to medium term reducing GHG emissions from oil sands production through efficiency improvements is likely to prove more cost effective and technologically feasible than carbon capture and storage (CCS) technology. In oil sands mining operations, improved process reliability can lower energy consumption per unit of oil sands processed, thereby reducing life-cycle GHG emissions. For in-situ operations, reducing the amount of steam required to produce each barrel of oil sands reaps rewards in decreased energy use and decreased life-cycle GHG emissions. This objective is consistent with advances in technology and efficiency achieved in recent years. The average amount of steam used today per unit of output is half what it was in 2000. The technology is expected to continue improving. In contrast, CCS is a longer-term option because widespread commercialization of CCS is expected to be years away, and CCS would substantially increase capital and operating costs. An additional challenge in implementing CCS for oil sands is the need to develop CO_2 pipelines to an appropriate storage area.

Local Environmental Issues

Water availability is unlikely to constrain oil sands development, but improvements in water management are necessary. Oil sands mining operations rely on the Athabasca River for water. The water issues rise and fall with the river itself, for the river is seasonal, with much lower flow in winter than in summer. Thus, water issues are more significant in the winter. For all scenarios, water storage will be needed to meet the needs of oil sands mines during the winter months, when withdrawal limits from the river are lower. Technological improvements in the management of mining waste will also allow more water recycling and reduce the amount of water needed from the Athabasca River.

Regulations that govern water use, waste management, and site reclamation in the Alberta oil sands will need to address the cumulative impact of the industry's growth, not just individual projects. At the project level, government regulation of oil sands activities is stronger than in many other oil-producing regions in the world. However, given the potential scale of future activity, the cumulative impact of development could become increasingly significant. Regulatory bodies are now working to manage and provide regional standards for air quality, land impact, and water quality and consumption, in addition to the existing project-level regulations. Such cumulative regulations will be important for public acceptance of further oil sands development, as land impacts and water consumption are some of the most visible environmental aspects of these projects.

Research and technology improvement are needed to treat oil sands mining waste and reclaim tailings ponds. The tailings ponds store water and waste material (the tailings) from the oil sands extraction process. They currently cover an area equal to Staten Island, New York. Water from the ponds is recycled back into the process. The ponds also contain a layer of *fluid fine tailings,* a mixture of water and fine clay and silt that is the consistency of pudding or yogurt. Water does not separate naturally from this material. Removing enough water to turn fluid fine tailings into a firm surface that can support equipment traffic is one pathway for land reclamation. Technology for removing water from fluid fine tailings is advancing, and trials of several technologies are under way. End-pit lakes (EPLs) are a second method for incorporating fluid fine tailings into the landscape during land reclamation. EPLs consist of mining waste capped with a layer of fresh water. These lakes are designed to become permanent features in the landscape. No EPLs have yet been constructed, and research is needed to determine whether these lakes can become active ecosystems that support plant and animal life.

Impact on Aboriginal and Local Communities

The exercise of First Nations community rights could affect the pace and scope of oil sands development.* People of First Nations heritage make up approximately 2.8 percent of Alberta's 3.6 million population, totaling approximately 100,000 people. By law, First Nations groups must be consulted by government and industry on all development within the oil sands area that affects their traditional way of life, but the nature and process of this

*First Nations groups are indigenous Canadians that live south of the territory occupied by the Inuit people, a culturally and linguistically separate group of indigenous Canadians. Métis are people of mixed indigenous and European heritage. These three groups together constitute Canada's Aboriginal population.

consultation is under debate. Lawsuits by some First Nations groups currently in the courts challenge the way they are consulted prior to oil sands projects. In addition some First Nations groups downstream from oil sands developments have particular concerns about the health effects that some assert may be caused by the leakage of industry waste. However, the oil sands also represent a growing economic opportunity for Aboriginal communities, with long-term job opportunities and potential equity partnership in some projects.

Infrastructure constraints and cost inflation of goods, services, and labor will affect the pace and cost of oil sands investment. The rapid growth over the past several years has increased strains on housing, infrastructure, and community services in the oil sands region and resulted in a high cost of living. If these pressures are not alleviated, the region will have difficulty attracting people needed for essential services. All of this ultimately could slow long-term growth in the oil sands industry. The sudden slowing of industry investment in the wake of the recent oil price slump could give the region a chance to catch up with the population growth that occurred over the past several years. The region's dependence on the cycles of one industry complicates planning and underscores the need for industry and government innovation to address these "boom and bust" issues.

Economics

Oil sands, like other complex oil projects around the world such as deepwater developments, face the challenge of high costs. The oil price collapse from $147 to the $40 to $60 range rendered many planned oil sands projects uneconomic. At the peak of oil industry capital cost inflation, in summer 2008, the threshold crude oil price for an oil sands project ranged from about $60 to $85 per barrel.* Since the oil price decline, more than 70 percent of proposed projects have been postponed. Although oil sands costs are roughly comparable to some other potential large new sources of supply, they are more expensive than many projects in the Middle East and other lower-cost producing regions. Oil industry costs have begun to ease, but unless major technological breakthroughs result in lower costs, the oil sands will remain among the higher cost oil supply options.

Natural Gas Demand

The oil sands are a major consumer of natural gas, today representing about 20 percent of Canadian demand. That could grow to 25 to 40 percent of Canadian demand by 2035. Even considering sizable new unconventional supply, Canadian domestic gas production is currently expected to peak around the middle of the next decade. Without the addition of new supply, such as from the Mackenzie Delta and Alaska, exports from Canada to the United States might decline in order to meet the needs of a rapidly expanding oil sands sector. However, improved efficiency can reduce oil sands demand for natural gas. Additionally, gasification of petroleum coke or asphaltenes, small nuclear facilities, and use of solvents are all technologies under development that could reduce natural gas demand, although they have yet to be demonstrated commercially in the oil sands.

*The crude oil prices are for West Texas Intermediate and assume a 10 percent rate of return. CERA's cost estimates are based on actual costs at the time and not future cost expectations. These cost estimates are based on a 20 percent per barrel light-heavy crude price differential, capital cost of $126,000 per flowing barrel for an integrated mine and upgrader, $30,000 per flowing barrel for steam-assisted gravity drainage (SAGD), and exchange rate parity.

The Innovation Challenge

The pace of technological innovation in the oil sands has been substantial, and further advances should be expected. However, cooperation between governments and the private sector is crucial for the advancement of certain technologies, which requires stepped-up government support of research and development (R&D). Since the inception of the first commercial oil sands facility in 1967, the industry has made major technological strides in optimizing resources, innovating new processes, reducing costs, increasing efficiency, and reducing its environmental impact. Advances in mining technology and the development of the SAGD technique for in-situ production have reduced costs and GHG emissions. Incremental improvements will continue; several new technologies in various stages of development have the potential to radically change oil sands production. All of these, however, must be proven effective and economically viable on a commercial scale. Many potential advances will require the kind of basic research and demonstration that individual companies do not have the resources or incentive to conduct. Government-private partnerships will be important in the advancement of technologies to address environmental and efficiency challenges. The environmental and efficiency challenges for oil sands are classic cases for consistent, long-term government R&D spending. The importance of oil sands establishes why stronger multiyear government support for R&D across a broad range of technologies, not just CCS, is vital.

CERA'S THREE OIL SANDS SCENARIOS

The complexity and uncertainty of the oil sands' future lends itself to application of CERA's scenario process. No one can accurately predict the future, but we can explore the key forces that will shape the future and assess the impact of different outcomes. Scenarios acknowledge uncertainty and illustrate how the future could evolve in different ways. They encourage people to think about the future in a flexible way by disengaging from their current point of view and interests—and the inevitable human tendency to simply extrapolate from what is happening today.

Growth in the Canadian Oil Sands: Finding the New Balance builds scenarios around issues specific to the Alberta oil sands. CERA's scenarios represent three different potential outcomes intended to explore the boundaries for oil sands development. They are by no means the only possible paths of development that could be envisioned. Indeed, it is possible that the future will ultimately contain elements of all three scenarios. CERA does not assign probability to any scenario, but encourages stakeholders, policymakers, and industry to use the scenarios to think as broadly as possible to understand the forces of change and how to adapt to them.

CERA's three oil sands scenarios are briefly summarized below. The full scenarios are in Chapter IV of this report.

New Social Order

New Social Order imagines a world in which governments attempt to remake their economies on a platform of clean energy. The global economic crisis that began in 2008 is followed by severe oil supply disruptions, leading to a multiyear spike in oil prices above $100 per barrel. An activist government role in the Canadian and US economies along with strong policies to limit GHG emissions encourages expansion of alternative forms of energy. Regulatory oversight of the oil sands tightens further, particularly to address the cumulative impacts on air and water quality and land use created by oil sands development.

Oil sands production capacity initially grows rapidly in response to the rush of investment that follows the extended oil price spike. However, by 2020 industry costs have risen sharply, petroleum demand in North America is in permanent decline, and oil prices are in retreat. Environmental regulations are also significantly tighter. The intersection of increasing costs and declining oil prices squeezes producers' margins and deters significant oil sands developments after 2020. Having reached 2.9 mbd by 2020—which represents more than a doubling from current levels—oil sands capacity essentially stagnates for the rest of the scenario period. In 2035 production is 3 mbd.

A key feature of the New Social Order scenario is the rapid development of technology. Technology not only enables the scale-up of alternatives to petroleum, such as next generation biofuels and electric vehicles, it also allows the oil sands industry to reduce its environmental footprint. As a result of improved efficiency and advanced technologies, the GHG intensity of oil sands production improves by over 30 percent between 2008 and 2035.

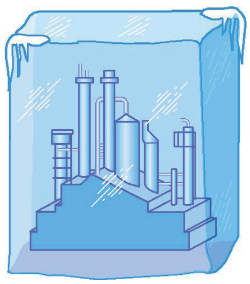
Barreling Ahead

The *Barreling Ahead* scenario illustrates conditions that allow Canada to become one of the biggest producers of petroleum in the world by 2035. The scenario explores the economic and energy security benefits, as well as the environmental impacts of such an expansion.

In this scenario the Canadian government plays a strong role in maximizing the development of Canada's vast energy resources, ranging from support for new infrastructure to stepped-up R&D funding (including establishment of the Research and Innovation Network). A "great recovery" follows the "great recession" of 2008 and 2009, leading to sustained strong oil demand growth and robust light, sweet crude oil prices. Strong oil prices and moderation of industry costs support continuous investment in both integrated and upstream-only oil sands projects. Ultimately oil sands production reaches 6.3 mbd in 2035. At this level of production Canada is by far the biggest source of oil for the US market, supplying 37 percent of US oil imports. Asia, with its rapid rise in oil consumption, becomes an important new market for oil sands products outside of North America.

Growing demand for natural gas and water, management of mining waste, and land reclamation are all challenges posed by the rapid rate of production growth in Barreling Ahead. Natural gas consumption by oil sands projects reaches 40 percent of total Canadian gas demand by 2035. Oil sands–related GHG emissions also rise sharply, ultimately representing about 20 percent of total Canadian GHG emissions.

Deep Freeze



In the *Deep Freeze* scenario the great recession of 2008 and 2009 is just the prelude to a "great stagnation," in which low rates of economic growth persist for years in both North America and the overall global economy. Globalization—the prevailing economic paradigm of the past several decades—loses ground to the forces of nationalism, insularity, and protectionism.

Oil demand growth is sluggish and oil prices are weak for most of the scenario. Without question the economic and oil price environment of Deep Freeze is the most challenging of the three scenarios for Canadian oil sands producers. The oil sands boom is followed by a great—and long—bust. Only new projects well into their construction phase proceed, leading to some continued growth in the early part of the scenario's first decade. By 2013 production has reached 1.8 mbd, 0.5 mbd higher than current levels, but the development process for new oil sands projects comes to a virtual halt.

Some moderate production growth occurs through the second decade of the scenario period, as oil demand growth gradually recovers, capital costs in the oil sands drop, and the pace of new environmental regulation slows. Owing to relatively favorable economics for incumbent oil sands producers, total industry capacity grows very gradually, through expansion of existing facilities. Ultimately oil sands capacity reaches 2.3 mbd by 2035, the weakest of the three scenarios.

CONCLUSION

The oil sands today have moved from the fringe of energy supply to the center. Their commercial development makes Canada the world's second largest holder of recoverable oil reserves and an increasingly important part of the fabric of hemispheric and global energy security.

But new challenges face the oil sands industry. The world's most severe economic downturn in decades has cast a chill on many investment plans. Also, like other energy sources, the oil sands will be affected by the future path of GHG regulation in Canada and the United States. Increasing effort will go into technological advances that help manage emissions in the production of oil sands. Locally, a growing focus on the cumulative environmental impacts could change future water and land use.

Recognizing the significance and impact of oil sands is very important, and approaching the questions about oil sands in a sound fashion is essential. To do otherwise is to risk wider disruption in US-Canadian relations and other negative consequences. This report combines

IHS CERA's research with the learning and insights from workshops involving a wide range of organizations and stakeholders. The objective is to contribute to finding that appropriate balance on oil sands development that meets economic and security needs and, at the same time, safeguards the environment.