



CANADA'S NEW energy capital

Laura
Severs,
Edmonton
Economic
Development
Corporation,
Canada, discusses
the Edmonton service
area and its growing
status as the world's most
politically stable oil reserves.



Poised to take up the mantle of Canada's new energy capital, Edmonton is strategically located between the world's second largest oil reserves and the US, one of the planet's largest energy consumers. As the largest urban centre closest to the province's vast oil supply in Northern Alberta (the oilsands' reserves are only eclipsed by oil deposits in Saudi Arabia), Edmonton is both the transportation and logistics hub for Alberta's highly active oilfield servicing, gas and mining sectors.

In addition to being the provincial capital, this bustling city with a metropolitan region population of more than one million is closer than other major centres to more than half of the top 100 population centres in North America, including Toronto, as well as key US cities such as New York and Chicago. This is an important factor, considering that Canada exports more than 1 million bpd of oil to US markets.

Alberta and Edmonton sit at the heart of Canada's conventional oil industry and the country's natural gas sector, which is the third largest in the world. The role of the province is certain to expand in

coming years, with oilsands production expected to more than double by 2025, rising from 1.5 million bpd in 2010 to 3.5 million bpd by 2025.

Oilsands investment alone is expected to generate CAN\$ 1.7 trillion in economic activity across Canada over the next 25 years. For each permanent oilsands related job created, an additional nine direct, indirect or induced jobs are generated in Canada.

In addition to the oilsands, Edmonton holds an important strategic position as the gateway to the north. There are a number of major projects on the drawing board, including the Mackenzie and Alaska gas pipelines, as well as Northern Gateway: a twin pipeline system running from near Edmonton to a new marine terminal in Kitimat, British Columbia, for exporting petroleum and importing condensate. These activities presage an even larger and logistically central role for Canada's new energy capital.

The bigger oil picture

The vast majority of Canada's oil reserves are found to the north, northeast and northwest of Edmonton, primarily in the Athabasca and Cold Lake regions. These 170 billion bbl oilsands reserves (based on reserves recoverable using current technology) represent 97% of Canada's total oil reserves. To put it into perspective, the largest portion of the oilsands are located below ground in an area covering 140 200 km² of land, equivalent to just 4.5% of Canada's total boreal forest. The mineable portion, as opposed to drilling (in situ), only exists under 4802 km², representing just 0.1% of the country's total boreal forest. Current production estimates from the oilsands show that operating projects are capable of producing 1.89 million bpd,



Figure 1. Syncrude is one of the largest producers of crude oil from Canada's oilsands.



Figure 2. Edmonton energy and technology park, located in northeast Edmonton, provides a vision for a new industrial area for the city. The primary land uses include: petrochemical cluster precinct, logistics precinct, manufacturing precinct and research and development park precinct.

with another 647 000 bpd worth of production now under construction. Add to this an additional 1.821 million bpd for oilsands projects with regulatory approval and a further 1.27 million bpd for projects under regulatory review and the potential is self evident.

Combine this abundance with the ability to provide a safe, secure source of energy and the motivation driving projects such as Imperial Oil's Kearl project, jointly owned between Imperial and ExxonMobil Canada, is clear. Initially, Kearl will produce 110 000 bpd, while startup is expected in 2012. The project has regulatory approval to increase production to 345 000 bpd, through a phased in development approach.

Another example of oilsands growth will see Suncor Energy Inc. and Total E&P Canada Ltd. proceed with the Voyageur upgrade, which Suncor will operate. This 200 000 bpd project is expected to come onstream in 2016.

The Edmonton factor

Translated into raw capital, Alberta's oilsands will bring an economic injection of over CAN\$ 100 billion to the Edmonton service region in 2010 - 2020 alone, thus making the area one of few places in the world where oil production is growing. Much of this CAN\$ 100 billion of planned investments will be centred in or around greater Edmonton.

Alberta's Industrial Heartland (AIH), directly adjacent to Edmonton, is one of the places where the benefits will be reaped. AIH is a non-profit cooperative group of five neighbouring municipalities (Edmonton, Fort Saskatchewan, Lamont County, Strathcona County and Sturgeon County) dedicated to sustainable ecoindustrial development. At 582 km², it is Canada's largest hydrocarbon processing region and a large scale producer of chemicals derived from petroleum. The region is home to more than 40 companies with a combined investment value in excess of CAN\$ 25 billion.

One such company is Dow Chemical Canada ULC, whose AIH plant forms one of the largest petrochemical facilities in Canada. The plant produces hydrocarbons, ethylene, polyethylene and electricity. Another company is Praxair Inc., the largest industrial gases company in North and South America, whose AIH operations include the Heartland hydrogen pipeline network; two air separation units; carbon dioxide purification facilities; and oxygen and nitrogen pipelines. A third is Shell Canada Ltd. (Scotford), who operate a chemicals plant, a refinery and an upgrader.

In Edmonton's northeast sector, the 49 km² Edmonton Energy and Technology Park (EETP), which also constitutes part of the AIH, is in its formative stages. Expected to be built out over the next 30 years, the complex will refine chemical products left over from oilsands production, transforming them into higher value industrial and consumer items worth an estimated CAN\$ 18.4 billion/y. The EETP is already attracting industry interest and will include:

- ▶ A petrochemical cluster.
- ▶ A logistics precinct (to provide the means for chemical products to be shipped to local or international markets).
- ▶ A manufacturing precinct geared to using material from petrochemical plants (e.g. plastics and oils) to create finished goods.
- ▶ A research and development precinct.

The EETP is expected to compound Edmonton's role as the major supply and manufacturing centre supporting growth in the oilsands.

GREENER BY THE DAY

- ▶ Oilsands production accounts for 5% of Canada's GHG emissions.
- ▶ Canada accounts for 2% of global GHGs.
- ▶ In total, oilsands production constitutes 0.1% of GHGs produced globally.
- ▶ Approximately 80% of the GHGs from the oilsands are created inside the internal combustion engine of the end consumer.
- ▶ GHGs per barrel of synthetic crude produced have been cut by more than 39% since 1990.
- ▶ By 2016, more than half of Alberta's bitumen will be produced by being liquefied underground and piped to the surface.
- ▶ In situ extraction methods leave a much smaller footprint than the first generation oilsands surface mines.

Figure 3. Oil dig: Alberta's oilsands are the third largest proven crude oil reserves in the world, next to Saudi Arabia and Venezuela.



Figure 4. Edmonton's Shaw conference centre encourages environmental and social sustainability practices throughout the facility and the city.

Edmonton is also the educational and training centre for energy development. The University of Alberta, located in Edmonton, houses highly successful mining engineering faculties, specialising in mineral and energy extraction. The Northern Alberta Institute of Technology (NAIT), also based out of Edmonton, helped to develop and educate skilled tradespeople

and is the largest such training institute in Canada, based upon number of successful graduates.

Building brick by BRIK

The world's first bitumen refinery to combine gasification technology with an integrated carbon capture and storage (CCS) solution will be built just 45 km northeast of Edmonton in the AIH. The CAN\$ 15 billion joint North West project (an equal partnership between North West Upgrading and Canadian Natural Resources Ltd. (CNRL) subsidiary, Canadian Natural Upgrading Ltd.), is also the first to use its CO₂ for the purposes of enhanced oil recovery. The refinery will have a total processing capacity of 150 000 bpd of bitumen feedstock over three equal phases. Construction is to begin in late 2011 or early 2012, with the start up of phase one set for 2014.

North West's first phase will process 37 500 bpd of Crown royalty bitumen and 12 500 bpd of bitumen supplied by CNRL, totalling 50 000 bpd. While the

new facility will combine advance upgrading and refining of bitumen in Alberta, it was conceived partly because of the provincial government's new bitumen royalty in kind (BRIK) program. In 2008, the Government of Alberta announced its intention to collect oilsands bitumen royalty volumes in kind to encourage upgrading, refining and petrochemical development in Alberta. The province expects it could have 400 000 bpd of bitumen royalty in kind to market by 2020. Once the three phases of the North West upgrade are completed, up to 75 000 bpd of royalty in kind bitumen will be supplied by the province for refining.

Eco friendly

Yet, the city is not complacent regarding its newfound status of energy capital. Global demand for all forms of energy is forecast to double by 2050 and given the scarcity of resources globally, combined with the local workforce's inextricable link to the energy sector (one in 15 jobs in Alberta relates to energy), sustainability is paramount. One part of these sustainability measures is the development of carbon capture technology within Edmonton. Carbon capture and storage has the potential to be North America's largest single source of GHG emissions reductions. This CAN\$ 2 billion provincial government initiative is expected to store 4 million tpy of CO₂ underground by 2015. North West's bitumen refinery will capture approximately 1.2 million tpy of CO₂ per phase: the equivalent to taking almost 900 000 cars off the road. North West's CO₂ will be entrusted to Enhance Energy Inc., which is building Alberta's first CO₂ distribution pipeline.

Another carbon capture project, Quest, is still in the development stage but could begin by 2015. Shell Canada Energy, on behalf of the Athabasca Oil Sands Project, a joint venture of Shell Canada Energy (60%), Chevron Canada Ltd. (20%) and Marathon Oil Canada Corp (20%), is looking to capture CO₂ from Shell's Scotford Upgrader, located in the AIH. This would see over 1 million tpy of CO₂ captured.

Work being done by Williams Energy Canada, the only company in the world to process oilsands off gas, is also rich with eco benefits. Converting bitumen into oil produces off gas: a byproduct rich in natural gas liquids (NGLs) and olefins. Williams, through its operations in Fort McMurray and in the AIH, is

reducing GHG emissions by 219 000 tpy, while also reducing SO₂ emissions by more than 4200 tpy. Williams, the operator of the only olefinic fractionator in Western Canada, is also building a dedicated pipeline from Fort McMurray to Redwater in order to carry off gas liquids. The CAN\$ 340 million project is a third of the way to completion and expected to be operational by April 2012.

Elsewhere, Aux Sable Canada LP will become the first company in Alberta to extract ethane and hydrogen from a refinery or upgrader off gas stream. The plant, also located in the AIH, is expected to be in operation by summer 2011 and will handle off gas from Shell's nearby Scotford refinery. It will be licensed to process up to 20 million ft³/d of off gas and will produce hydrogen, ethane and a propane plus mix.

Furthermore, the aforementioned Edmonton Energy and Technology Park will use an eco industrial development model. In practice, this means that companies located in the park will share utilities, use cleaner alternative energy sources, reduce water use and waste, preserve natural areas and implement sustainable building practices. This ecoindustrial model will aim to emulate that which has been in place in the AIH since 1998, which was built using ecoindustrial principles and practices.

Finally, NAIT (a leader in technical training and applied education) is introducing a diploma program entitled Alternative Energy Technology this autumn. This program will focus on solar, geothermal, wind, bio fuel, fuel cell, carbon capture, small hydro and hybrid energy system applications.

Greener oil

Thomas Thundat, the Canada excellence research chair in oilsands molecular engineering at the University of Alberta, is working on developing new detection and extraction technologies to improve the overall efficiency of how Canada's oilsands are processed. It is hoped that this will eventually lead to extraction processes that are more energy efficient, use less water and reduce GHG emissions significantly more than current state of the industry practices. Thundat is a world leader in the study of molecules and nanoscale structures at interfaces, pioneering new techniques for detecting molecules on surfaces (even in trace quantities) and has developed new sensors that have tremendous potential applications for oilsands processing.

Furthermore, on top of the fact that Alberta was the first jurisdiction in North America to legislate industrial GHG emission reductions, EEDC vice chair and author Peter Silverstone says the potential exists to turn the oilsands into the world's greenest oil. In his 2010 book, *World's greenest oil, turning the oil sands from black to green*, Silverstone proposes modifying Alberta's royalty regime to take GHGs into account. The book proposes lower royalty rates (20%) for companies with the lowest GHG emissions and substantially higher rates (60%) for those with the highest GHG emissions. This, he says, would create multiple winners by significantly decreasing GHG emissions by up to 90 million tpy, while giving strong bottom line incentives to companies.

It is clear, therefore, that Edmonton itself is looking towards a bright, sustainable future both economically and