

Alberta Industrial Sector Market Opportunities Report

June 2010

**Government
of Alberta ■**

Summary

As part of its role in identifying and fostering economic opportunities, Alberta Finance and Enterprise engaged McKinsey & Company¹ to develop a fact-based assessment of significant economic growth opportunities in Alberta. This report reviews the options for growth in nine of Alberta's leading industrial sectors - identified by Alberta Finance and Enterprise - as well as the roles that industry and government could play in helping to capture these opportunities.

To meet these objectives, each sector was put through a series of review screens that assessed opportunities on existing sectoral strengths, global market potential, and significant competitive opportunities and challenges. The industries assessed in this report are:

- Refined petroleum products and petrochemicals (RPPP) – specifically bitumen upgrading, refined petroleum products, and petrochemicals
- Architecture, engineering, and construction (AEC)
- Metal fabrication and machinery manufacturing
- Environmental products and services
- Financial services
- Aerospace and defence
- Forest products
- Building products
- Alternative energy

The opportunities identified are based on existing or potential competitive advantages that Alberta could leverage to pursue incremental (i.e., more than organic) growth. The scope of this effort was to identify and assess the largest opportunities within each sector. There are other smaller opportunities which may be worth pursuing but have not been included in this study.

In most cases, the time frame under consideration was the near to medium term (0 to 10 years), with the exception of the RPPP sector which, based on the nature of the industry, has a longer term view.

¹ This report was prepared by McKinsey & Company based on publicly available information and information provided by Alberta Finance and Enterprise. The information was evaluated, but was not independently verified by McKinsey & Company

OPPORTUNITIES OVERVIEW

Given the scale of the planned activity in Alberta's oil sands (over \$165 billion of projects over the next 10 to 15 years), and the associated spend along the value chain, it is unsurprising that the largest growth opportunities are within the RPPP sectors and directly associated industries, such as AEC and metal fabrication.

However, growth in non-energy-related sectors offers the prospect of increased economic diversification and, in sectors like unmanned vehicle systems, an opportunity to leverage domestic competitive advantages to take a leading role in an emerging global industry.

The following table summarizes the opportunities identified across each sector.

SECTOR OPPORTUNITIES SUMMARY

Sector	Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe
Refined petroleum products and petrochemicals	<ul style="list-style-type: none"> ■ Expand domestic value add by building 2 to 3 upgraders (increase total upgrading in Alberta by 40% to 1.7 million barrels per day) ■ Build world-scale petrochemical facilities (13 million tonnes per year by 2020 and 33 million tonnes by 2040) based on upgrader off-gases and – potentially in the long term – petroleum coke 	<ul style="list-style-type: none"> ■ Construction: \$13 billion to \$18 billion and 130,000 to 170,000 person-years ■ Operations and Maintenance: \$1.6 billion to \$1.8 billion per year and 8,000 to 12,000 jobs ■ For an industry producing 13 million tonnes per year: ■ Construction: \$13 billion to \$19 billion and 115,000 to 175,000 person years ■ Operations and Maintenance: \$3.0 to \$4.6 billion and 13,000 to 19,000 jobs per year 	<ul style="list-style-type: none"> ■ Light-heavy differentials return to levels similar to 2004-2007 period and construction costs can be competitive (e.g., comparable to US Gulf Coast levels) ■ Existing refineries in the US Midwest will reach maximum capacity for accepting Alberta bitumen within the next few years ■ Upgrader capacity expands in line with current estimates of the Energy Resources Conservation Board ■ Off-gases are collected and provided to producers cost-effectively from existing and future upgraders ■ Alberta and British Columbia shale gas and, long term, northern gas could provide adequate volume of ethane to offset declining volumes from conventional gas ■ Market prices will continue to provide high margins for Alberta producers based on North American demand

Sector	Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe
Architecture, engineering, and construction	<ul style="list-style-type: none"> ■ Capture a greater portion of domestic engineering activity, particularly in the oil sands ■ Longer term – export engineering and design work outside Alberta 	<ul style="list-style-type: none"> ■ \$580 million per year and 6,300 jobs at stake ■ Every 1 percent of global market share is equal to \$80 million and 900 jobs 	<ul style="list-style-type: none"> ■ Domestic oil sands and international planned mega capital projects are commissioned ■ Alberta firms could: <ul style="list-style-type: none"> – Develop the expertise, capacity and cost competitiveness to retain the ~20 percent of engineering spend that could leave the province; and – Leverage domestic expertise to successfully capture a portion of the global engineering spend planned for energy related capital projects
Metal fabrication	<ul style="list-style-type: none"> ■ Retain 50 percent of oil sands metal fabrication and 75 percent of machinery demand domestically ■ Expand share of US oil and gas field equipment and machinery imports by an additional 10 percent ■ In the long term, increase domestic industry capability to serve a greater portion of the oil sands 	<ul style="list-style-type: none"> ■ \$1.25 billion per year and 12,000 jobs per year ■ \$150 million per year and 1,350 jobs per year 	<ul style="list-style-type: none"> ■ \$165 billion in oil sands projects in the next 10-15 years are commissioned ■ Productivity gains in technology adoption and processes and labour performance improvement increases cost-competitiveness ■ Alberta firms aggressively engage in the more competitive and complex oil sands global supply chains ■ Innovation leads to the development of new machinery products

Sector	Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe
Environmental products and services	<ul style="list-style-type: none"> ■ Capture large share of Carbon Capture, Transport and Storage equipment and service needs ■ Maintain a high share of long-term growth in oil sands reclamation ■ Longer term – aim to capture more reclamation services beyond Alberta 	<ul style="list-style-type: none"> ■ Construction: \$12.4 billion in GDP and 140,000 person-years ■ Operations and Maintenance: \$830 million in GDP and 2,600 jobs ■ \$100 million in GDP and 1,100 jobs per year ■ Not sized 	<ul style="list-style-type: none"> ■ Alberta can reach its goal of capturing 25 to 30 million tonnes of carbon annually ■ Industry growth will be based upon: clear regulations, higher price of carbon and technology investment ■ Oil sands operators aggressively invest in innovative reclamation efforts ■ Oil sands-related reclamation technology and processes can be applied to situations and industries outside of Alberta
Financial services	<ul style="list-style-type: none"> ■ Expand Alberta's institutional investment capacity ■ Position Alberta as a centre of expertise in energy infrastructure financing to serve the domestic and global markets 	<ul style="list-style-type: none"> ■ 1 percent capture of Canadian addressable market would provide \$10 to \$20 million in GDP and 70 to 140 jobs per year ■ 1 percent capture of global energy infrastructure market would provide \$40 to \$115 million in GDP and 260 to 770 jobs per year 	<ul style="list-style-type: none"> ■ Alberta financial institutions can establish themselves as leaders in alternative asset classes and manage some of the \$50 billion in unmet Canadian demand ■ Alberta financial institutions can lever their proximity to energy infrastructure assets to develop best in class knowledge of infrastructure finance

Sector	Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe
Aerospace	<ul style="list-style-type: none"> ■ Establish Alberta as a major centre of unmanned vehicle systems (UVS) manufacturing and operations ■ Capture industry growth in the maintenance, repair and overhaul (MRO), and geomatics technology sectors 	<ul style="list-style-type: none"> ■ \$350 million in GDP and 1,800 jobs per year ■ \$100 million in GDP and 1,000 to 1,100 jobs per year 	<ul style="list-style-type: none"> ■ Provision of significant incentives to a major UVS manufacturer to locate operations in the province supports the growth of a cluster of related activity; ■ Transportation regulations allow civilian use in Alberta earlier than in the US ■ Segments within the domestic air transportation sector drive a better than North American industry-wide annual growth rate of between 1.5 and 3.5 percent for the MRO sector through 2018 ■ Geomatics technology sector maintains recent annual growth rates of between 5 and 10 percent
Forest products	<ul style="list-style-type: none"> ■ Leverage forestry bio-mass products to generate an additional 350 MW of additional power 	<ul style="list-style-type: none"> ■ Construction: \$570 million in GDP and 5,300 person-years ■ Operations and Maintenance: \$180 million in GDP and 1,700 jobs per year 	<ul style="list-style-type: none"> ■ Alberta's market power rates provide sufficient return to incent new investment in biomass power generation ■ Biomass can be collected and transported at economical rates ■ Capital costs in remote AB locations do not escalate ■ Biomass owners (holders of existing Forest Managements Agreements) can access sufficient financing to build generating capacity

Sector	Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe
Building products	<ul style="list-style-type: none"> ■ Expand Alberta industry to capture a greater portion of domestic market (approximately 50 percent of cabinets and countertop; 50 percent of heating, ventilating, and air conditioning and insulation; and 100 percent of prefabricated structures) 	<ul style="list-style-type: none"> ■ \$350 million in GDP and 3,300 jobs per year 	<ul style="list-style-type: none"> ■ Building products sector can engage in productivity improvements in order to effectively compete for market share ■ Sector is able to compete/attract employees with required skill sets ■ Alberta's residential, commercial and industrial construction activity remains at approximately 2008 levels
Alternative energy	<ul style="list-style-type: none"> ■ Meet short- to mid-term local demand for wind and biofuel energy ■ In the longer term (2020), potentially export second-generation biofuels 	<ul style="list-style-type: none"> ■ Construction: \$600 million to \$1.4 billion in GDP and 6,000 to 13,000 person-years ■ Operations and Maintenance: \$375 million to \$465 million in GDP and 1,250 to 1,550 jobs per year ■ Not sized 	<ul style="list-style-type: none"> ■ Between 2010 and 2017, installed wind power increases between 1000 and 3000 MW, requiring a total capital investment of approximately \$1.9 billion to \$5.8 billion ■ In the near term (0-5 years), biofuel production remains constrained to first generation technologies ■ Longer term (5+ years), economics of second generation technologies improve

CHALLENGES AND THE ROLE OF GOVERNMENT

In determining what it would take to realize these opportunities, some common obstacles to growth across these sectors emerged. Although the scope of this effort did not include creating a detailed action plan, a number of key levers that government and industry could use to mitigate these issues were also identified.

Alberta's cross-cutting challenges to growth are:

- Relatively high construction costs
- Limited scale within some industries
- Need for innovation.

Construction costs

Construction costs are a key factor in assessing the business case for expansion in any capital intensive industry. This is particularly true of the RPPP sectors, which have a direct impact on the AEC and metal fabrication industries. Early indications suggest that current Alberta construction costs in February 2010 were as much as 30 percent lower than they were at their peak in 2008.² Since this decline is likely a combination of both improved practices and an economic slowdown, it will be important to ensure that costs do not rise again with a return of activity. The government could play a role in helping to constrain costs in two key ways:

- Improving productivity and project management by providing dedicated education and training and sharing of best practices
- Increasing the supply of skilled labour through training and targeted immigration.

Limited scale within some industries

- Industries such as metal fabrication, building products, and aerospace and defence are all characterized by a large number of small firms. This fragmentation can limit the industries' competitiveness. For example, the manufacturers of building products are unable to harness the scale economies necessary to be cost effective and many metal fabrication shops lack the capacity required to be tier one suppliers to oil sand projects. The government could support scale development in the industry by:
 - Facilitating the building of management and commercial capacity through education and training

² When AFE internal estimates suggest rates were as much as 1.6 times higher than those of the US Gulf Coast.

- Evaluating and removing any barriers to collaboration and consolidation (e.g., reduce any friction to change in ownership)
- Attracting investment to facilitate development of large-scale firms.

Targeted innovation

Finally, in a number of industries, such as aerospace, machinery manufacturing, alternative energy, and environmental services, the key to unlocking growth is continued innovation. The Alberta government has a track record of promoting innovation and some high-profile successes like the Alberta Oil Sands Technology and Research Authority (AOSTRA) program. Going forward, *targeted support* of opportunities that build on a competitive advantage (e.g., proximity to demand in the case of environmental services) could play a critical role in unlocking growth. Mechanisms that government could use include:

- Sponsorship of research, technology development and demonstration
- Providing incentives for investment in technology
- Establishing regulatory regimes that support accelerated innovation

Alberta Upgrading, Refined Petroleum Products, and Petrochemicals

Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe	Challenges
<p>Expand domestic value add by building 2 to 3 upgraders (increase total upgrading in Alberta by 40% to 1.7 million barrels per day)</p>	<ul style="list-style-type: none"> ■ Construction: \$13 billion to \$18 billion and 130,000 to 170,000 person-years ■ Operations and Maintenance: \$1.6 billion to \$1.8 billion per year and 8,000 to 12,000 jobs 	<ul style="list-style-type: none"> ■ Light-heavy differentials return to levels similar to 2004-2007 period or construction costs can be competitive (e.g., comparable to US Gulf Coast levels) ■ Existing refineries in the US Midwest will reach maximum capacity for accepting Alberta bitumen within the next few years 	<ul style="list-style-type: none"> ■ Capital constraints due to tighter credit capital markets, allowing fewer funds available overall, placing projects with higher absolute capital requirements at a disadvantage ■ Companies focused on upgrading have different cost of capital requirements ■ Companies with multiple assets will also consider the impact of any new project – and its market impact – on their existing assets
<p>Build world-scale petrochemical facilities (13 million tonnes per year by 2020 and 33 tonnes by 2040) based on upgrader off-gas and – in the long term – petroleum coke</p>	<ul style="list-style-type: none"> ■ For an industry producing 13 million tonnes per year: <ul style="list-style-type: none"> – Construction: \$13 billion to \$19 billion and 115,000 to 175,000 person-years – Operations and Maintenance: \$3.0 to \$4.6 billion and 13,000 to 19,000 jobs per year 	<ul style="list-style-type: none"> ■ Upgrader capacity expands in line with current estimates of the Energy Resources Conservation Board ■ Off-gases are collected and provided to producers cost-effectively from existing and future upgraders ■ Alberta and British Columbia shale gas and, long term, northern gas gas could provide adequate volume of ethane to offset declining volumes from conventional gas ■ Market prices will continue to provide high margins for Alberta producers based on North 	<ul style="list-style-type: none"> ■ The cost of feedstock is the largest contributor to the ongoing costs of operation ■ The cost of feedstocks: feedstocks based on off-gases from bitumen upgrading are a more complex and expensive source than those from natural gas wells ■ Petrochemical production using petcoke is strongly dependent on capital investment levels and the costs of chemical production from competing feedstocks



Overview

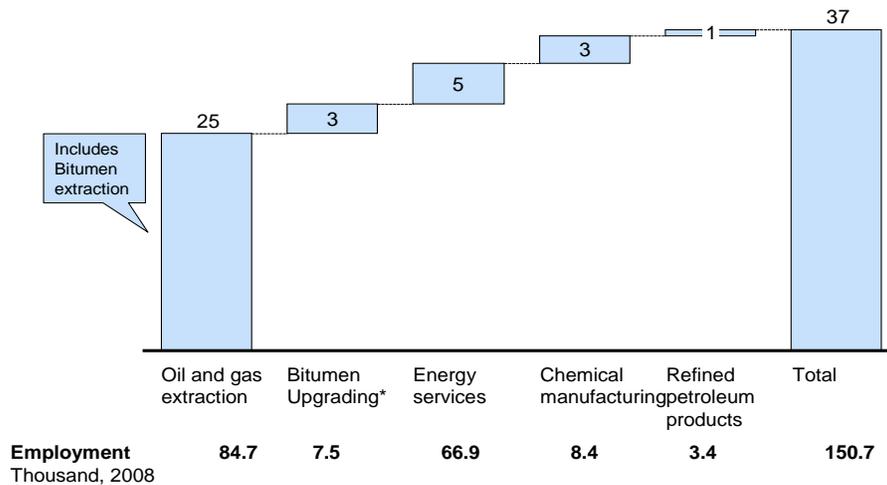
The domestic oil and gas industry is the single largest contributor to the Alberta economy. The value chain for this industry includes oil and gas extraction, energy services, chemical manufacturing, and refined petroleum products. In total, these industries provided over \$37 billion in GDP contribution in 2008 and supported 150,000 direct jobs in Alberta (exhibit 1).

With \$140 billion in potential oil sands spend on the horizon,³ the focus of this report is on the oil sands value-added industry that comprises upgrading, refining, and petrochemicals. Currently, over half the total economic value of the oil and gas industry in Alberta is tied to bitumen extraction, about 41 percent of which is exported in raw form. As bitumen production increases, this presents an opportunity to increase the amount of value-added activity conducted within the province to capture more economic growth in Alberta.

This opportunity intersects with the government's aspiration of developing a balanced portfolio of economic activity across the energy value chain. Although there are potentially many opportunities to leverage Alberta's competitive advantages within the industry, this report considers three specific opportunities being considered by Alberta Finance and Enterprise (AFE) as part of its value-added strategy. They are the construction of new bitumen upgraders, bitumen refineries, and petrochemical facilities.

In this chapter, we examine the attractiveness of each of these opportunities, assess the circumstances in which they could be realized, and explore whether the province could play a role in encouraging the investments. In addition to assessing the stand-alone business case, we also consider how it compares to alternative investments in that space. In reality, of course, several strategic considerations influence a company's decision to pursue an opportunity beyond its stand-alone value. Such considerations include: the company's ability to acquire capital and how it would carry that investment within its portfolio of projects; the impact the project could have on its existing operations; and the impact on partnerships and alliances with other companies – and the alternative investment paths these may provide. (Please see the following section on bitumen upgrading for more detail.)

³ Alberta Finance and Enterprise, *Inventory of Major Alberta Projects*, December 2009.

Exhibit 1: Alberta GDP contribution from energy sectors

* Bitumen upgrading split out of Oil and gas extraction using estimates based on CERI's "Economic Impact of Alberta's Oil Sands, 2005". Average 2008 monetary value for Bitumen upgrading (gross margins); 2008 total SCO production

Source: Statistics Canada – Alberta 2008 GDP by NAICS codes

In each of the next three sections, we elaborate on the following key messages:

- Upgrading in Alberta is a competitive option for monetizing bitumen relative to other alternatives, such as the Gulf Coast, once the Mid West opportunities are exhausted.
- Full conversion petroleum refining in Alberta will require gross margins to return to near the average levels of the past 10 years and additional conversion capacity to be driven out of the market. However, more complex upgrading to create high demand products (e.g. diesel) may be attractive.
- Petrochemical production in Alberta is an attractive proposition when using natural gas liquid feedstocks or off-gases from upgrading.

Although there are varying degrees of challenge in realizing these opportunities, the single most important factor in all three is managing construction costs relative to those in competing jurisdictions.

In early 2010, Alberta's construction costs were estimated to be up to 30 percent lower than their peak in 2008, when rates were as high as 1.6 times the US Gulf Coast (USGC). This decline is undoubtedly a mixture of both economic slowdown (and the associated abatement of pressure on wages and material costs) and improved practices. While costs may again increase with renewed capital project activity, the province can play a meaningful role in cost control using two key levers:

- Improving productivity and project management through proactive education, training, and the sharing of best practices
- Increasing the supply of skilled labour through training and targeted immigration.

In addition, by taking an integrated view of these opportunities, the government should be able to maximize the value of any support offered to industry by taking advantage of the natural synergies among these opportunities. This integrated view can take two forms: strategic or logistical.

A strategic view takes into account the interconnections between opportunities. For example, the attractiveness of additional petrochemical production is dependent on low-cost feedstock. More bitumen upgraders in the province would generate off-gases that are an ideal feedstock to support a petrochemical plant. In turn, increased demand for the off-gases by the petrochemical industry would benefit the upgraders by providing an alternative revenue stream and/or an environmental benefit from reduced emissions. In this case, government support to expand upgrading in the province would also benefit the petrochemical industry – and, as such, both benefits should be considered in valuing the return on the support provided.

A logistical view takes into account the benefits of the co-location of several value-added facilities in a geographic cluster. By creating these clusters, government has the ability to create scale economies for any support across multiple players. For example, if government support entails providing infrastructure for waste water treatment, one larger plant could be built to support the entire cluster at less than it would cost to provide support across dispersed plants. A cluster has the added advantage of enabling companies, through a coordinating role played by government or a government agency, to optimize schedules and flows within the cluster. Finally, co-location would minimize the environmental footprint of multiple facilities.

ALBERTA BITUMEN UPGRADING

Bitumen upgrading plays a significant role in Alberta's economy, contributing approximately \$3.4 billion to provincial GDP⁴ and supporting between 6,000 and 9,000 direct jobs.⁵ Five⁶ major bitumen upgrading complexes in the province are converting bitumen into synthetic crude oil (SCO) and other products, with a total capacity of 1.2 million barrels per day (mmbbl/d). This is up from 400,000 mmbbl/d of capacity in 2000.

The Energy Resource Conservation Board (ERCB) expects robust growth in total oil production (conventional and heavy) and forecasts that production will increase from 1.9 mmbbl/d today to 3.0 mmbbl/d by 2018 (exhibit 2).⁷ By 2017, 88 percent of total oil extraction is anticipated to be derived from bitumen instead of

⁴ Calculated using GDP multipliers and methodology from CERI's report, *Economic Impact of Alberta's Oil Sands*, 2005; December 2009 monetary value for bitumen upgrading (gross margins); 2009 average SCO production.

⁵ CERI, *Economic Impact of Alberta's Oil Sands*, 2005; company websites.

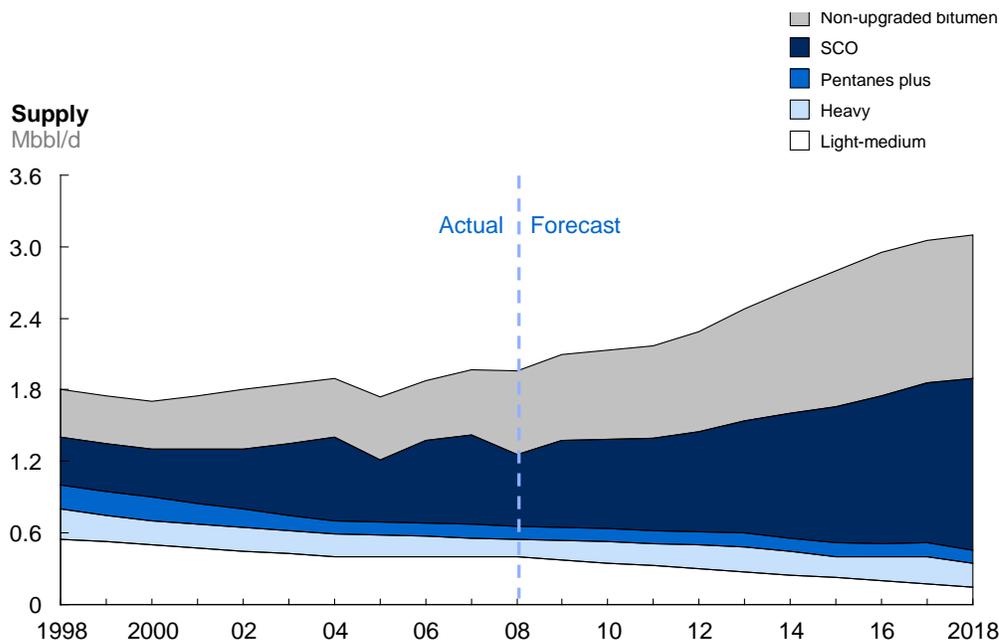
⁶ Includes Suncor, Syncrude, Shell, CNRL, and Opti-Nexen

⁷ ERCB ST98-2009, *Alberta's Energy Reserves 2008 and Supply/Demand Outlook 2009-2018*.

conventional sources. Approximately 65 percent of bitumen production is upgraded in Alberta, while the remainder is exported for processing out of the province.

The Canadian Energy Research Institute (CERI) forecasts that, subject to global economic conditions, total bitumen extraction could increase to between 4.3 and 5.0 mbbbl/d by 2030,⁸ with the potential for even longer-term investments in this sector.

Exhibit 2: Alberta supply of crude oil and equivalent



SOURCE: ERCB ST98-2009, Alberta's Energy Reserves 2008 and Supply/Demand Outlook 2009-2018

REFINED PETROLEUM PRODUCTS

Alberta is home to a significant petroleum refining industry that has been built around the conventional oil extraction business. The province's five refineries have a total capacity of approximately 450,000 barrels per day (bbl/d) and are currently operating at 390,000 bbl/d.⁹ Petroleum refining is a stable contributor to the economy, contributing approximately \$750 million to the GDP annually since 2000.¹⁰ This industry employed 3,400 people in 2008,¹¹ and mostly serves

⁸ CERI, Economic Impact of the Petroleum Industry in Canada, July 2009.

⁹ ERCB ST98-2009, Alberta's Reserves 2008 and Supply/Demand Outlook 2009/2018.

¹⁰ Statistics Canada, 2002 dollars (large swings in commodity price changes may prevent an accurate representation of GDP using multipliers).

the domestic market. International exports account for less than 10 percent of revenues, while one-third of production is exported to other provinces.¹²

Refining markets are typically regional in nature for several reasons. The first is the relative transportation costs of inputs and products. Since refined product is more complex and expensive to move than crude, refineries tend to be located close to demand centres where the products will be consumed to reduce shipping costs. Second, economies of scale diminish when refineries reach a certain size. And, third, as differences in transportation costs are of relatively greater importance to project economics than differences in construction or operating costs, refineries have little incentive to move away from demand centres to pursue opex or capex savings. However, recent developments by Saudi-based refineries, for example, have demonstrated that scale together with a sufficient enough cost advantage – e.g., low delivered crude costs – can create opportunities to export the refined product further afield.

PETROCHEMICAL MANUFACTURING

Petrochemical manufacturing is a major industry in Alberta, producing over 4.5 million tonnes per year (mta) of chemicals,¹³ with a value of shipments in 2008 of \$13.3 billion.¹⁴ This world-scale level of activity is anchored by some of the world's largest ethylene plants in Joffre and Fort Saskatchewan with a combined capacity of over 4.5 mta, nearly 15 percent of North American capacity and 3 percent of global capacity. The industry is a significant contributor to the province's economy. In 2008, it accounted for \$3.2 billion in GDP contribution and employed 7,500 people. From 2002 to 2008,¹⁵ it grew an average of 6.1 percent per year, and its international exports represent an important share of output accounting for almost 60 percent of revenues in 2008.¹⁶

The domestic petrochemical industry is highly competitive because of the limited availability of low-cost feedstocks within North America. The primary feedstocks are natural gas liquids (NGLs) like ethane, which is derived from the large volume of conventional natural gas produced in Alberta. As a result, Alberta's ethylene plants (ethane crackers) are among the most cost-competitive operations on the continent (exhibit 3). Their cash costs are far below those of the typical North American plants. Moreover, Alberta's ethylene plants will be cost-competitive with potential imports from low-cost locations like the Middle East.

¹¹ AFE-provided estimates from Statistics Canada's *Survey of Employment, Payrolls, and Hours*.

¹² AFE-provided estimate from Statistics Canada.

¹³ AFE industry presentation, *Oil Sands to Petrochemicals – Alberta's Value-added Strategy*, January 2010.

¹⁴ AFE-provided estimates from Statistics Canada's *Survey of Employment, Payrolls, and Hours*.

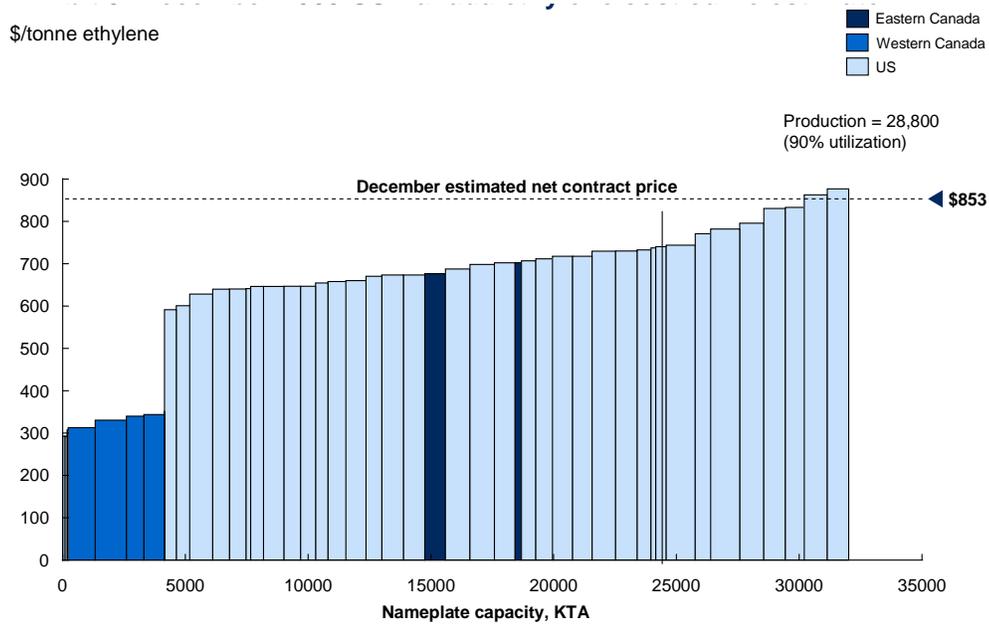
¹⁵ Statistics Canada NAICS classification 325 Chemical manufacturing, in 2002 dollars.

¹⁶ AFE-adjusted from Statistics Canada's *Survey of Employment, Payrolls, and Hours*.

A stable supply of low-cost feedstock is key to sustaining the industry’s competitiveness – and to expanding it. In addition to the existing NGLs, two potential sources of feedstock could competitively support the expansion of Alberta’s petrochemical industry. These are ethane from shale gas deposits and off-gases from current and planned bitumen upgraders.

If the anticipated shale gas materializes and is suitable in terms of liquid content, the volumes may be sufficient to sustain the existing petrochemical industry (which faces declining conventional gas production) – and the off-gases from upgraders could be used to support its expansion. If, however, shale gas liquids turn out to be insufficient, the off-gases could be used to supply the existing domestic industry’s needs. Under either scenario, capturing the off-gases will be essential.

Exhibit 3: December 2009 US/Canada ethylene cost curve estimate



SOURCE: Hodson; McKinsey margin models

Alberta Architecture, Engineering, and Construction

Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe	Challenges
<p>Capture a greater portion of domestic engineering activity, particularly in the oil sands</p>	<p>\$580 million per year and 6,300 jobs at stake</p>	<p>Domestic oil sands and international planned mega capital projects are commissioned</p>	<p>Competition from low-cost international jurisdictions for engineering work. Global companies acquiring Alberta companies to reduce competition.</p>
<p>Longer term - export engineering and design work outside Alberta</p>	<p>Every 1 percent of global market share is equal to \$80 million per year and 900 jobs</p>	<p>Alberta firms could:</p> <ul style="list-style-type: none"> ■ Develop the expertise, capacity and cost competitiveness to retain the ~20 percent of engineering spend that could leave the province ■ And leverage domestic expertise to successfully capture a portion of the global engineering spend planned for energy related capital projects 	<p>Limited exportable experience of Alberta firms serving as lead Engineering, Procurement, Construction (EPC) contractors</p>

Overview

The Alberta architecture, engineering, and construction (AEC) industries comprise one of the largest segments of the provincial economy, with revenues of almost \$75 billion in 2008, GDP contribution of almost \$20 billion¹⁷ (11 percent of the total economy), and total direct employment estimated at over 264,000 (12 percent of the provincial total) (exhibit 4).¹⁸ The industry is largely domestic with exports accounting for less than 1 percent of total revenues. AEC, particularly construction, has a large number of small firms – over 80 percent of the 25,000 construction companies in the province have less than 10 employees.¹⁹ This report focuses primarily on opportunity identification within the engineering and construction (E&C) sub-sectors because they generate over 96% of the revenue in the AEC sector.

ENGINEERING AND CONSTRUCTION

Since 2000, the combined E&C sectors have been among the fastest growing in the province, with an annual growth of 12 percent driven largely by growth in the oil and gas industry. Oil and gas construction alone accounts for 35 percent of the sector's total GDP contribution. Residential construction, the next largest GDP contributor at 15 percent, is also heavily linked to the oil and gas expansion that attracted a large number of workers to Alberta.

While sector revenue and GDP data for 2009 are not yet available, the economic slowdown, and specifically the decline in oil and gas development activity will result in significantly lower revenues than those in 2008. Market reports also suggest that many E&C firms had significantly reduced staffing levels staff during the past 18 months (some reported staff reductions of over 50%).

Fortunately, there are early signs of a recovery in oil sands project development, and with a robust pipeline of planned activity estimated at over \$140 billion, there is clearly substantial domestic demand over the next decade to be captured by Alberta E&C companies. There is also potential to further develop Alberta's major capital project engineering expertise that could be leveraged for export.

Engineering and Construction sector opportunities include:

- Maximize cost competitiveness to help encourage major capital project development in Alberta
- Capture a significant share of engineering and construction work for Alberta-based projects

¹⁷ 2002 dollars.

¹⁸ Alberta Finance and Enterprise, Statistics Canada.

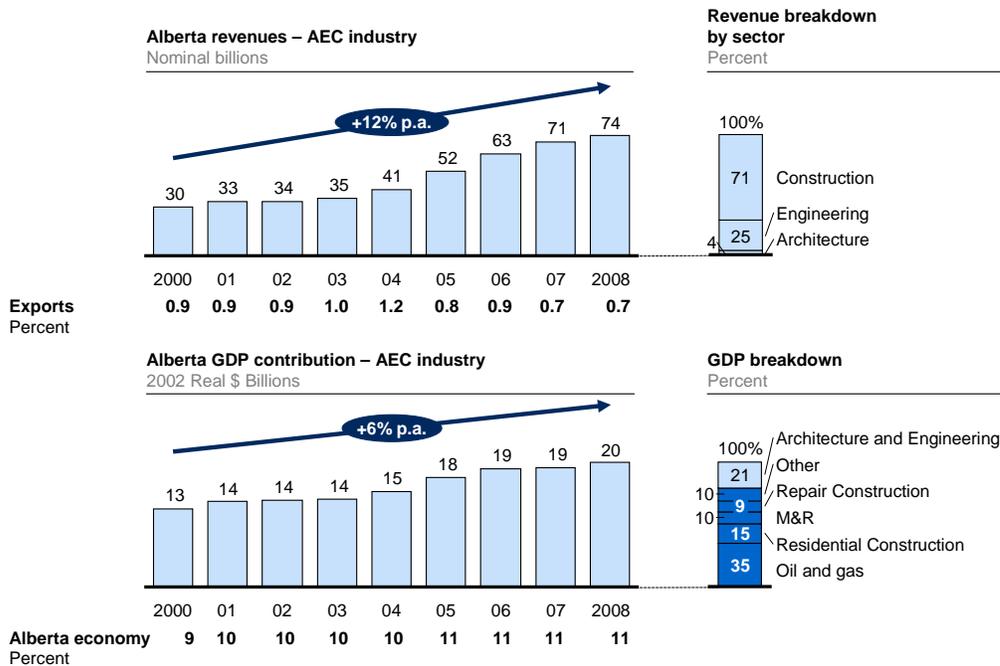
¹⁹ PwC, Alberta Industry Sector Performance and Prospects, May 2009.

■ Increase export of engineering services.

In facilitating domestic industry growth, Alberta has an opportunity to ensure that the maximum possible value of engineering work taking place on domestic projects is captured locally. This would generate not only the value from the initial project, but it would also lead to a stable source of revenue from ongoing maintenance work that is more likely to be awarded to firms that did the initial project.

Cost pressures are compelling firms to outsource engineering for Alberta projects to low-cost jurisdictions. Recent consolidation in the E&C sector, with global firms acquiring Alberta companies, eases the ability to source engineering work for Alberta projects to offices in other countries.

Exhibit 4: Architecture, Engineering and Construction overview



SOURCE: Statistics Canada, PwC Alberta Industry Sector Performance and Prospects 2009; Alberta Industrial Outlook: Non-residential and engineering construction segments

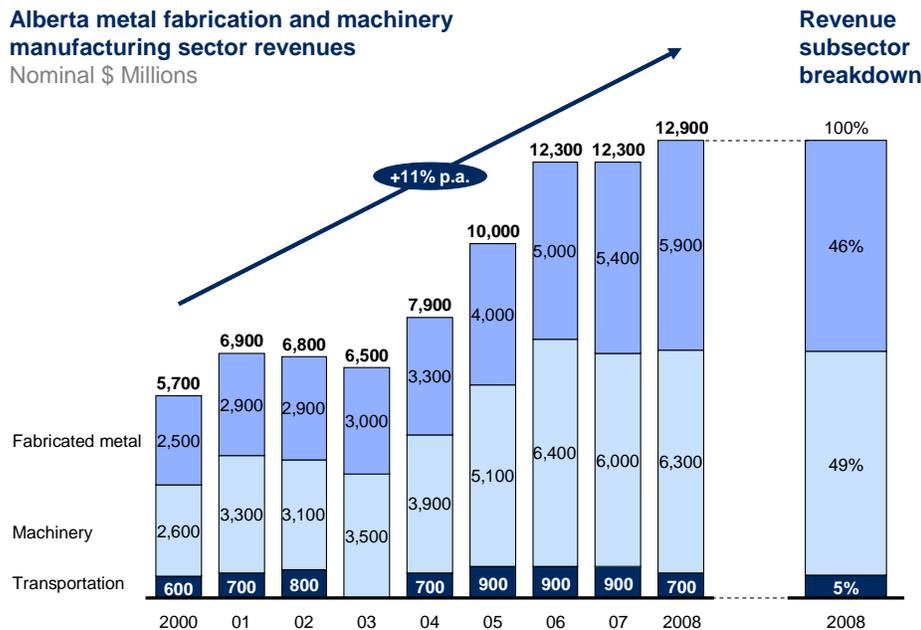
Alberta Metal Fabrication and Machinery Manufacturing

Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe	Challenges
<ul style="list-style-type: none"> ■ Retain 50 percent of oil sands metal fabrication and 75 percent of machinery demand domestically ■ Expand share of US oil and gas field equipment and machinery imports by an additional 10 percent ■ In the long term, increase domestic industry capability to serve a greater portion of the oil sands 	<ul style="list-style-type: none"> ■ \$1.25 billion per year and 12,000 jobs per year ■ \$150 million per year and 1,350 jobs per year 	<ul style="list-style-type: none"> ■ \$140 billion in oil sands projects in the 10-12 years are commissioned ■ Productivity gains in technology adoption and processes and labour performance improvement increases cost-competitiveness ■ Alberta firms aggressively engage in the more competitive and complex oil sands global supply chains ■ Innovation leads to the development of new machinery products and keeps Alberta ahead of global commoditization cycles 	<ul style="list-style-type: none"> ■ Ensuring domestic production and labour capacity is sufficient to meet market demand ■ Improving management structures to compete effectively with other jurisdictions ■ Managing domestic costs in the face of labour availability pressure

Overview

The metal fabrication and machinery manufacturing industry is an important and fast growing segment of the Alberta economy. In 2008, it had revenues of over \$12 billion and contributed almost \$5 billion²⁰ to provincial GDP (2 percent of the total economy). It directly employed an estimated 46,000 people (exhibit 5).²¹

Exhibit 5: Metal fabrication and Machinery manufacturing overview



The industry is largely driven by oil and gas activity: in a recent survey of 50 firms, 87 percent indicated that they actively served the oil and gas sector and 42.6 percent said that they did so exclusively. The industry mostly consists of a large number of small businesses, with 85 percent of firms in the industry employing fewer than 50 people.²²

For the purposes of this report, we have disaggregated the industry into three sectors:

- Metal fabrication²³ – 46 percent of revenue

²⁰ 2002 dollars.

²¹ Alberta Finance and Enterprise; Statistics Canada.

²² GTS, Alberta Metal Fabrication and Machinery Manufacturing: Sector Overview, August 2008.

²³ NAICS 332.

- Machinery manufacturing²⁴ – 49 percent of revenue
- Primary metals and transportation equipment manufacturing²⁵ – 5 percent of revenue.

The most current available data, from 2008, reflects the peak of activity in both the metal fabrication and machinery manufacturing sectors. At that time, the two sectors accounted for about 1 percent of the Alberta economy each, with revenue having grown at an impressive 7 percent and 12 percent respectively per year since 2000. While 2009 data is not yet available, the economic slowdown has taken its toll on these sectors as well and revenues are expected to be lower.

The metal fabrication sector is largely domestic. Exports account for only 10 percent of revenue, although they have grown steadily from \$300 million in 2000 to \$800 million in 2008. Of this, 75 percent went to the US oil and gas sector. Machinery manufacturing is a more export-oriented sector, with exports growing steadily at 20 percent per year since 2000, mostly driven by price increases, to reach \$3 billion, or 35 percent of the sector's revenue, in 2008. Exports are also heavily – 60 percent – oriented toward the US oil and gas industry.

The impressive growth of these sectors has not been without challenges. Reacting to demand from a heated oil and gas industry, the metal fabrication and machinery manufacturing sectors rapidly expanded capacity, causing a shortage of skilled labour and pushing up wages. The strong demand has also limited productivity improvements or diversification of its customer base beyond the energy sector and its local markets, leaving it highly dependent on energy-related activity.

The Alberta metal fabrication sector faces two major growth opportunities:

- In the shorter term, Alberta firms should make sure that they, and not offshore producers, supply as much of the oil sands fabricated metal spend as possible (current estimates suggest domestic producers have the capability to supply 50 percent of the total demand for fabricated metal, worth approximately \$14 billion over the next 10 years²⁶)
- Over the longer term, the sector should expand its capabilities so that it can supply more than its current 50 percent share of what the oil sands industry spends on fabricated metal products.

With an estimated pipeline of almost \$240 billion in major (over \$5 million) construction and maintenance projects over the next 10 years in Alberta,²⁷ the biggest opportunity for the metal fabrication sector is to capture local demand.

²⁴ NAICS 333.

²⁵ NAICS 336.

²⁶ IMAP.

²⁷ About \$80 billion on hold.

While Alberta firms have proved themselves adept at meeting the fabricated metal needs of most of the economy, including conventional oil and gas, the challenge will be to capture the demand for fabricated metal from the estimated \$140 billion of oil sands projects. Since fabricated metal accounts for 15 to 20 percent of a typical oil sands project, this represents over \$20 billion in revenue for the sector.

In addition, the 2- to 3-year construction phase of these projects is followed by more than 15 years of ongoing maintenance, repair, and operations (MRO) work which represents significant value to the industry.

Alberta firms have the technology and scale to supply about half the fabricated metal required by the oil sands industry.²⁸ However, the sheer scale of the activity and the opportunity it presents to foreign suppliers, coupled with the international reach of the owners and EPC firms that select suppliers, increase the likelihood that fabricated metal products will be procured from outside the province. Data over the past 10 years confirm that this is already taking place, as imports have been growing steadily in the sector.

The two main growth opportunities for Alberta's machinery manufacturing sector are:

- Capturing a greater share of the US oil and gas field equipment market
- Diversifying and expanding capabilities to supply a greater portion of the domestic demand from the oil sands.

The machinery manufacturing sector is dominated by oil and gas field equipment and services, which accounts for almost 50 percent of revenues.²⁹ The sector has been thriving by serving the domestic conventional oil and gas industry and has been successfully exporting 35 percent of its output, with the United States accounting for 60 percent of those exports.

Alberta's current export niche to the United States is in innovative field machinery and equipment for the conventional oil and gas industry. Representing over 30 percent of the import market, Alberta is currently the largest supplier of oil and gas machinery to a US market that appears to be splitting into two distinct segments: imports of innovative products from higher-cost jurisdictions and imports of basic or "cloned" products from low-cost jurisdictions.

²⁸ Industry expert interviews.

²⁹ Dun and Bradstreet.

Alberta Environmental Products and Services

Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe	Challenges
Capture large domestic share of Alberta's Carbon Capture, Transport and Storage equipment and service needs	<ul style="list-style-type: none"> ■ Construction: \$12.4 billion in GDP and 140,000 person-years ■ Operations and Maintenance: \$830 million in GDP and 2,600 jobs 	<ul style="list-style-type: none"> ■ Alberta can reach its goal of capturing 25 to 30 million tonnes of carbon annually ■ Industry growth will be based upon: clear regulations, higher price of carbon and technology investment 	<ul style="list-style-type: none"> ■ Identification of the optimal capture technology early in the industry's development ■ Making premature investments could put the project at a cost disadvantage for its entire lifetime
Maintain a high share of long-term growth in oil sands reclamation	<ul style="list-style-type: none"> ■ \$100 million in GDP and 1,100 jobs per year 	<ul style="list-style-type: none"> ■ Oil sands operators aggressively invest in innovative reclamation efforts 	<ul style="list-style-type: none"> ■ Developing a cost-effective technology for addressing tailings treatment ■ Government regulation creates certain requirements but, as long as the cost of treatment remains high, little incentive exists for companies to accelerate reclamation
Longer term – aim to capture more reclamation services beyond Alberta	<ul style="list-style-type: none"> ■ Not sized 	<ul style="list-style-type: none"> ■ Oil sands-related reclamation technology and processes can be applied to situations and industries outside of Alberta 	<ul style="list-style-type: none"> ■ New market capture entails a significant commitment from Alberta firms

Overview

Broadly defined, environmental products and services include services and equipment to prevent, measure, test, treat, and dispose of waste and other environmental hazards. Alberta has a robust environmental products and services industry that includes almost 1,330 companies, employs 28,000 Albertans, generates more than \$4.4 billion in revenues, and has a well-earned international reputation.³⁰ It serves the needs of several major industries in Alberta, including municipal services, power generation, pulp and paper, petrochemicals, and oil and gas. The province is estimated to have as many as 7,000 non-federal contamination sites (e.g., manufacturing sites and gas stations) that will eventually require remediation and reclamation services.³¹

The most prominent sources of growth in environmental products and services will continue to be driven by opportunities in the oil and gas industry, both in conventional and non-conventional extraction. The current inventory of abandoned wells is over 45,000, worth more than \$2.4 billion in reclamation liabilities.³² With over 200,000 active and inactive wells in the province and an average of 16,000 new wells drilled every year, significant opportunities will exist for years to come.

In addition, reclamation opportunities exist along the oil sands value chain, with a focus on the major issues created by the unique challenges of oil sands extraction and its impact on the environment. Two opportunities in particular will generate significant economic activity:

- Carbon emissions, addressed through carbon capture and sequestration
- Land reclamation, including tailing ponds.

Because these environmental services take place at the site of waste or emission generation, the vast majority of economic activity remains local. While some specialized services and equipment may be imported, the capital work and the ongoing operations are labour and commodity material intensive. Therefore, this industry will grow primarily to meet domestic needs, with an opportunity to export some knowledge as some of the unique challenges faced in Alberta may become applicable elsewhere.

³⁰ Intro from AFE's, *Industry at a glance* for Environmental Products and Services.

³¹ ECO Canada 2007, *Who Will Do The Cleanup?* Canadian Labour Requirements for Remediation and Reclamation of Contaminated Sites; Environmental Labour Market Research; Environmental Careers Organization of Canada.

³² Tashi Sheka (ERCB), *Licensee Liability Rating (LLR) Program*, Alberta Energy Information Exchange, April 2009.

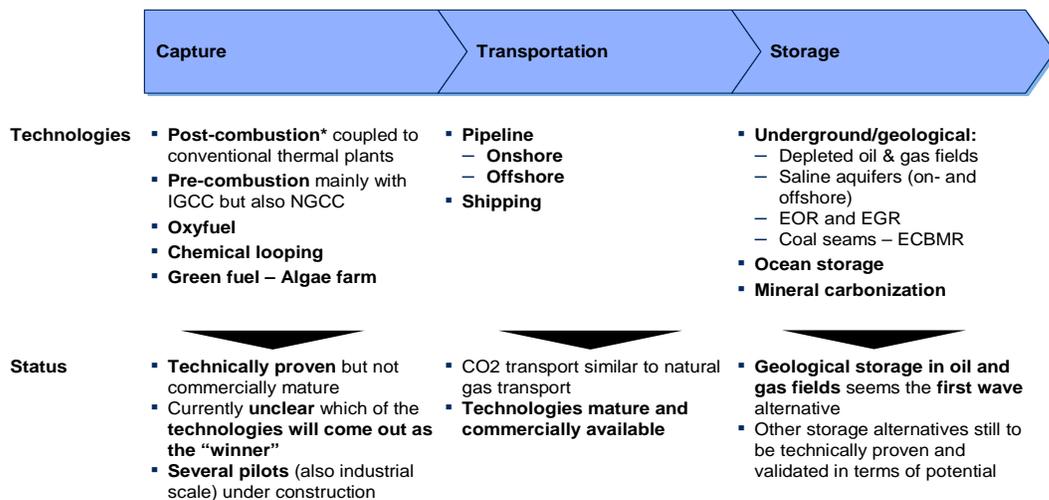
CARBON CAPTURE AND SEQUESTRATION

To combat the impact of carbon emissions, significant research and investment is being made into carbon capture and sequestration (CCS). CCS is a process that enables CO₂ to be captured, transported, and sequestered during the process of creating power to prevent its release into the environment (exhibit 6).

To address growing concerns about carbon emissions, the Alberta government has a stated goal of capturing 25 to 30 Mt of carbon annually through CCS by 2020.³³ It has also provided \$2 billion in funding aimed at developing CCS technology that generates useful solutions to ensure the long-term viability of Alberta's significant energy resources.

In total, building capacity to capture, transport, and store the 25 million to 30 million tonnes of carbon annually targeted by the Government of Alberta will require approximately \$10.0 billion to \$12.5 billion in upfront capital expenditure and \$750 million to \$850 million in annual operating expenditure over the estimated 40-year life of the carbon capture assets.³⁴

Exhibit 6: Carbon capture and storage technology



Sources: MIT; IEA; expert interviews; team analysis

³³ Alberta Carbon Capture and Storage Development Council.

³⁴ The costs are defined as the additional full cost (including initial investments and ongoing operational expenditures) of a CCS hard coal power plant with pre-combustion capture compared to the development of a state-of-the-art non-CCS plant with the same net electricity capacity and using the same fuel (European example); Transportation costs are assumed to be approximately 200 km with no additional booster facility required. Storage is assumed to be in a 1,500 m deep depleted oil field.

Alberta Financial Services Industry

Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe	Challenges
<p>Expand Alberta's institutional investment activity. Expansion will generate increased revenue through management fees and carried interest.</p>	<ul style="list-style-type: none"> ■ 1 percent capture of Canadian addressable market would provide \$10 to 20 million in GDP and 70 to 140 jobs per year ■ International market offers additional opportunities 	<ul style="list-style-type: none"> ■ Potential for management of third-party capital among public sector pension and endowment funds in Canada is \$40 to \$50 billion (\$10 to \$15 billion provided by private equity, \$30 to \$35 billion provided by infrastructure) ■ Management fees are between 1 and 2 percent ■ Carried interest is between 10 and 20 percent ■ Annual rate of return is 8.4 percent (S&P 500 20-year average) 	<ul style="list-style-type: none"> ■ Growing competition within alternative asset classes.
<p>Strengthen and expand the sector's expertise in energy infrastructure debt and equity financing. Expansion will generate increased revenue through debt and equity issuing fees.</p>	<ul style="list-style-type: none"> ■ 1 percent capture of global energy infrastructure market would provide \$40 to \$115 million in GDP and 260 to 770 jobs per year 	<ul style="list-style-type: none"> ■ Between 2010 and 2020, global infrastructure investment in the downstream oil & gas and power generation sectors is in average \$335 billion per year ■ Fees associated with raising capital are between 1 and 3 percent 	<ul style="list-style-type: none"> ■ Traditional wholesale banks often prefer proximity to large capital markets over proximity to infrastructure development location ■ Current lack of mechanisms in Alberta to encourage knowledge-sharing and collaboration among stakeholders

Overview

Financial services represents one of the largest industries in Alberta. In 2008, it had revenues of over \$17 billion,³⁵ contributed \$8.3 billion to provincial GDP (4.6 percent of the total economy), and directly employed approximately 73,000 people (exhibit 7).³⁶

Between 2002 and 2008, financial services' GDP growth was 7.7 percent per year.³⁷ During this time Calgary has increasingly attracted investment banking and asset management activity focusing on the oil and gas sector, while Edmonton has developed a wealth management and pension management industry to support growing provincial prosperity.

The industry is led by a small number of large firms, with many operating corporate head offices in other financial jurisdictions. In total, Alberta is home to over 5,000 financial services businesses,³⁸ with more than 60 percent of firms employing fewer than 10 people.³⁹

The industry in Alberta can be disaggregated into three sectors:

- Retail and commercial banking, lending, and processing⁴⁰ – 60 percent of GDP
- Wholesale banking and asset management⁴¹ – 27 percent of GDP
- Insurance⁴² – 13 percent of GDP

As long as Alberta's economy continues to experience strong growth driven by the energy sector, it is reasonable to assume the financial services industry will continue to grow proportionally. To unlock growth beyond this organic pace, Alberta must critically assess the financial sectors' capabilities and identify potential niche opportunities where it has a distinct advantage and can compete nationally or globally.

³⁵ Statistics Canada, AFE estimate

³⁶ Statistics Canada, Table 381-0015; Alberta Economic Development Authority (AEDA), *Envision Alberta*, March 2010.

³⁷ In real terms, Alberta Industry and Sector Performance Reports.

³⁸ Alberta Business Monitor Reports, 2008.

³⁹ Alberta Finance & Enterprise.

⁴⁰ NAICS 521, 5221 (monetary authorities, local credit unions, banking, and other depository credit intermediation).

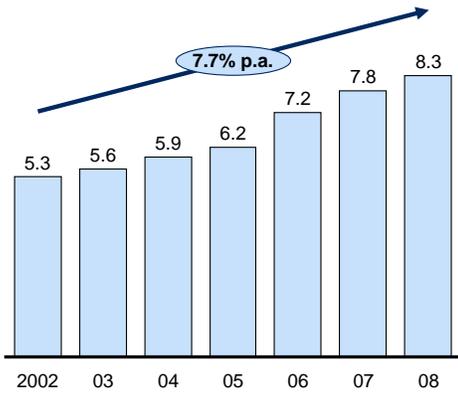
⁴¹ NAICS 5222, 5223, 5242, 523, 526 (non-depository credit intermediation and activities related to credit intermediation, agencies, brokerages, securities, commodity contracts, funds, and other financial investment and financial vehicles).

⁴² NAICS 5241 (insurance carriers).

Exhibit 7: Financial Services overview

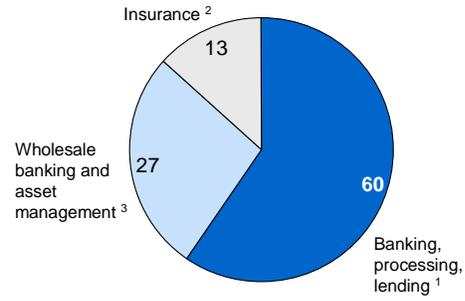
Financial service GDP contribution

Real 2002 \$ billions



GDP breakdown

Percent



1. NAICS code 521, 5221

2. NAICS code 5241

3. NAICS code 5222, 5223, 523, 5242, 526

SOURCE: Statistics Canada, Table 381-0015

Alberta Aerospace and Defence Industry

Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe	Challenges
Establish Alberta as a major centre of unmanned vehicle systems (UVS) manufacturing and operations	<ul style="list-style-type: none"> ■ \$350 million in GDP and 1,800 jobs per year 	<ul style="list-style-type: none"> ■ Provision of significant incentives to a major UVS manufacturer to locate operations in the province supports the growth of a cluster of related activity; Transportation regulations allow civilian use in Alberta earlier than in the U.S. 	<ul style="list-style-type: none"> ■ Ensuring that specialized skills exists along with increased productivity of an experienced workforce ■ Significant capital investments required to construct new or expand existing facilities and equipment
Capture industry growth in the maintenance, repair and overhaul (MRO), and geomatics technology sectors	<ul style="list-style-type: none"> ■ \$100 million in GDP and 1,000 to 1,100 jobs per year 	<ul style="list-style-type: none"> ■ Segments within the domestic air transportation sector drive a better than North American industry-wide annual growth rate of between 1.5 and 3.5 percent for the MRO sector through 2018 ■ Geomatics technology sector will maintain recent annual growth rates between 5 and 10 percent 	<ul style="list-style-type: none"> ■ Improving productivity and innovation within the industry ■ Ensuring a stable supply of skilled labour with specific high-end skills ■ Ensuring a stable and easily accessible research and development pipeline ■ Reducing the cost and risk of capital-intensive investments ■ Ensuring a position within the global supply chain that will create spinoff benefits

Overview

Alberta has a fast growing aerospace and defence industry, with annual revenues approaching \$1.6 billion, a GDP contribution of over \$900 million,⁴³ and employment of 6,500 to 7,000.

The aerospace and defence industry comprises several closely related sectors:

- Maintenance, repair, and overhaul⁴⁴ (MRO) – 32 percent of revenue
- Aerospace manufacturing⁴⁵ – 15 percent of revenue
- Geomatics technology and space sciences⁴⁶ – 27 percent of revenue
- Defence electronics⁴⁷ – 15 percent of revenue
- Other support for the military⁴⁸ – 6 percent of revenue
- Unmanned vehicle systems⁴⁹ – less than 5 percent of revenue.

MAINTENANCE, REPAIR, AND OVERHAUL

The province's MRO sector had approximately \$550 million in revenues in 2007⁵⁰ (more than \$400 million in GDP), with an annual growth rate for all air transport support of 8.4 percent from 2000 to 2007. The sector performs line maintenance on all fleets flying in the province, including major carriers and charter operators. It also competes regionally and nationally for component and airframe maintenance work but deals mainly with smaller aircraft such as business planes, small utility aircraft, and helicopters.

AEROSPACE MANUFACTURING

Alberta's aerospace manufacturing sector represents 1.3 percent (\$160 million in 2009) of Canada's \$12.8 billion in industry revenues. The sector consists of approximately 25 companies – a number of component manufacturers, some lower-tier suppliers, a single major engine OEM plant (Pratt and Whitney Canada), and a single major company assembling small utility craft (the Viking Aviation operation that recently began to build new Twin Otter aircraft).

⁴³ Based on best available data from 2005 to 2009 for each sector and applying best-fit NAICS codes and GDP revenue multipliers to each.

⁴⁴ PwC, Alberta Industry Sector Performance and Prospects; Hoover's company profiles.

⁴⁵ PwC, Alberta Industry Sector Performance and Prospects; StatsCan.

⁴⁶ Diane Loughheed-Keefe, *Assessment of Alberta's Geomatics Industry*, March, 2007; Canadian Space Agency; StatsCan.

⁴⁷ Industry interviews; Hoover's company profiles.

⁴⁸ Public Works and Government Services Canada.

⁴⁹ Industry interviews; Hoover's company profiles.

⁵⁰ PwC, Alberta Industry Sector Performance and Prospects; Hoover's company profiles.

GEOMATICS TECHNOLOGY AND SPACE SCIENCES

Alberta has substantial geomatics expertise, with a mix of reputable global positioning, sensing, and geospatial imaging companies. Combined, geomatics technology and space sciences companies design and manufacture hardware and software, perform data analysis, and represent over \$450 million in revenues within the province. Research efforts at the province's universities with specific geomatics programs are ongoing.

DEFENCE

The most recent available data suggest 2005 revenues of over \$264 million and employment of 1,200 people.⁵¹ This is estimated to have remained steady through 2008, with some significant contracts awarded in 2009. Alberta defence electronics companies include a few major defence integrators who design, manufacture, and support entire electronics systems almost exclusively for defence use. A series of smaller component manufacturers design and manufacture components for integrators. These smaller companies often leverage their defence-related work on commercial projects in other sectors.

MILITARY

As in the other manufacturing sectors, the industry is dominated by a few larger players, but many medium-sized companies successfully bid on government contracts. These companies provide a variety of logistics support and design, manufacturing, and equipment overhaul for land, aviation, and marine systems. Local companies also directly support military bases through local procurement programs.

The Government of Canada has recently committed to substantial increases in defence spending, including large capital renewal programs. Over \$550 million in Department of National Defence (DND) contracts have been awarded to Alberta companies over the past 3 years.⁵²

UNMANNED VEHICLE SYSTEMS

The unmanned vehicle systems (UVS) sector includes all unmanned aerial (UAV), ground, and marine vehicles. This emerging sector in Alberta had revenues of less than \$50 million in 2008⁵³ However, Alberta is in a leadership position within Canada as it is home to over half of the membership of Canada's UVS industry association. The province has several successful companies across the value chain providing control systems for large defence UAVs, subsystem

⁵¹ RP Erickson & Associates, *Alberta Aerospace Sector 2005*, May 3, 2006.

⁵² Public Works and Government Services Canada; includes defence-electronics-related contracts

⁵³ Estimated from industry interviews and Hoover's company profiles.

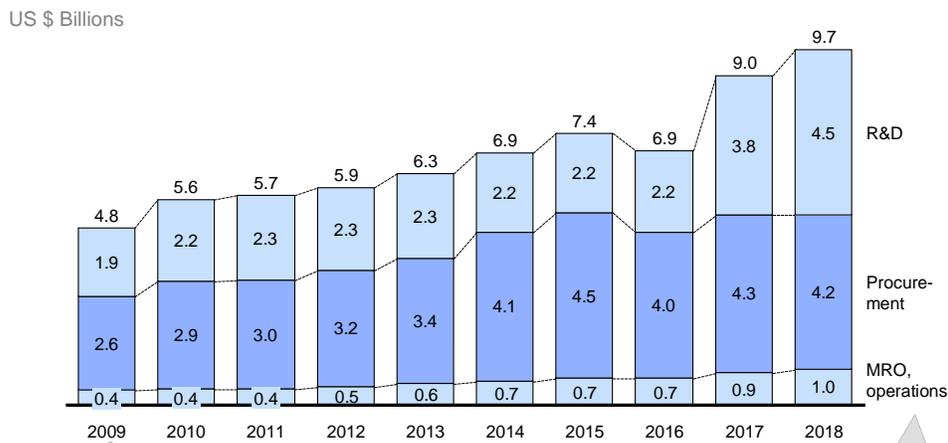
assembly, mini-UAV design, and training. Alberta is also home to the Canadian Centre for Unmanned Vehicle Systems, which is attempting to coordinate activity in the sector, as well as to support several pre-startup companies preparing to enter the UVS and components market and provide UVS-dependent services.

UAV is the fastest growing aerospace segment, with a predicted global growth of 11.6 percent versus 3.2 percent for manned aircraft through 2018.⁵⁴ Growth is expected to accelerate with pending regulatory changes to allow greater civilian use in the 2015-2020 timeframe. While ground and marine unmanned vehicles are behind UAV in development and use, they are also expected to grow quickly and more easily due to the simpler regulatory environment – the entire UVS market is forecasted to achieve cumulative revenues of over US \$70 billion between 2009 and 2019 (exhibit 8).

There are two significant paths to growth for the aerospace and defence industry:

- Capturing the forecasted growth of domestic sectors
- Capturing stepwise growth by attracting significant new aerospace and defence OEMs.

Exhibit 8: World UAV total expenditure forecast



Civilian use is less than 5% of today's UAV market but is expected to grow faster than the entire segment (17.5% versus 11.3%)

The service industry will accelerate once more craft with significant lifetimes are in operation

1 Excluding target drones and decoys

Sources: Teal Group, *UAV Market Study 2009*; team analysis

⁵⁴ Teal Group, *UAV Market Study 2009*; industry interviews.

Alberta Forestry Sector

Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe	Challenges
<p>Leverage forestry bio-mass products to generate an additional 350 MW of additional power</p>	<ul style="list-style-type: none"> ■ Construction: \$570 million in GDP and 5,300 person-years ■ Operations and Maintenance: \$180 million in GDP and 1,700 jobs per year 	<ul style="list-style-type: none"> ■ Alberta's market power rates provide sufficient return to incent new investment in biomass power generation ■ Biomass can be collected and transported at economical rates ■ Capital costs in remote AB locations do not escalate ■ Biomass owners (holders of existing Forest Management Agreements) can access sufficient financing to build generating capacity 	<ul style="list-style-type: none"> ■ In the absence of regulatory requirements, biomass power generation is driven by such factors as local power prices and the costs of production. ■ Raw wood, the most obvious source of forest biomass, is not an economical feedstock for power generation in Alberta.

Overview

Alberta's forest products industry is an important contributor to the province's rural economy. In 2008, it had revenues of over \$2.95 billion and contributed almost \$1.35 billion to provincial GDP (0.7 percent of the total economy). Traditionally a major source of employment in rural communities, it directly employed approximately 12,000 people. Alberta's timber production was the fourth largest in Canada, representing 10 percent of the total Canadian harvest.⁵⁵

However, the most recent assessments of the industry show a significant decline in activity. Since its peak in 2005, its GDP contribution has declined by 12 percent.⁵⁶ This decline has been attributed to the collapse of the US economy and housing market – historically, the US has been the end market for approximately 74 percent of Alberta's forest products.⁵⁷

Alberta's forest products industry comprises three major sectors:

- Pulp⁵⁸ – 60 percent of revenue
- Lumber⁵⁹ – 25 percent of revenue
- Panelboard (oriented strand board)⁶⁰ – 15 percent of revenue.

The industry's long-term growth prospects appear to be limited. All but a small amount of the sustainable annual allowable cut (AAC) in Alberta has already been allocated to various producers of forest products – and they had been harvesting more than 98 percent of the available conifer AAC and 65 percent of the available deciduous resources before the 2009 slowdown. In addition, a dearth of excess feedstock is expected to curtail the expansion of the pulp and lumber sectors, both of which primarily consume the conifer resource.

Increasing global competition from low-cost pulp producers in the southern hemisphere and the declining demand for pulp in the US and Japan also limits growth of the pulp sector.

Alberta's lumber producers are highly dependent on the US housing market. As such, this sector will likely be limited to organic growth driven by a rebound in the US market. Even then – and for the foreseeable future – it is unlikely that the demand for lumber will return to the levels enjoyed during the housing boom.

⁵⁵ PwC Sector Performance and Prospects; figures exclude logging, hauling, and secondary manufacturing.

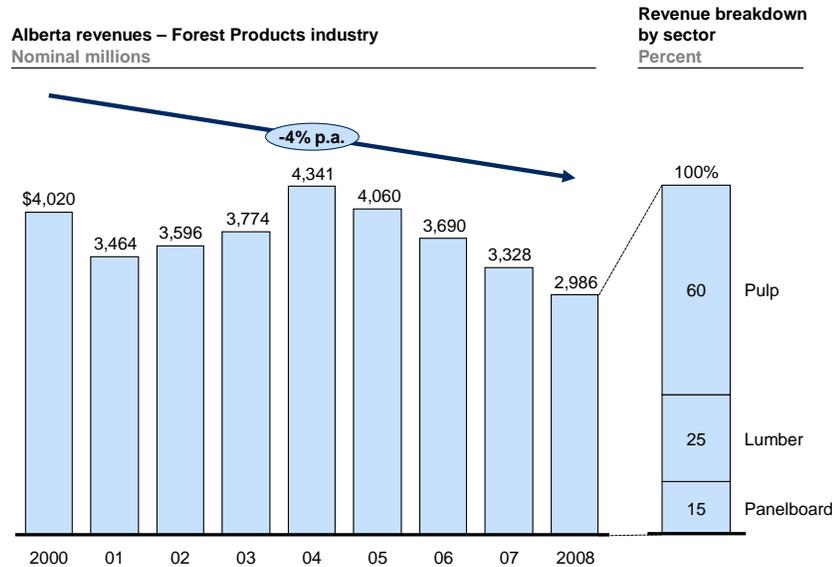
⁵⁶ PwC Sector Performance and Prospects; PwC Economic Impact of Forest Industry.

⁵⁷ PwC Sector Performance and Prospects.

⁵⁸ Alberta Forest Products Association; PwC Sector Performance and Prospects; figures exclude logging, hauling, and secondary manufacturing; NAICS 3221.

⁵⁹ Alberta Forest Products Association; PwC Sector Performance and Prospects; NAICS 3211.

⁶⁰ Alberta Forest Products Association; PwC Sector Performance and Prospects; NAICS 3212.

Exhibit 9: Alberta' Forest products sector overview

SOURCE: Alberta Forest Products Association; Jan Reurink, *Alberta GDP by Industry*; PwC Economic Impact of Forest Industry 2008

FOREST BIOMASS OPPORTUNITIES

As environmental concerns grow, energy producers are increasingly being asked to use green sources of energy – and forest biomass has been identified as a potentially low-carbon method of generating power.

In the absence of regulatory requirements, biomass power generation is driven by such factors as local power prices and the costs of generation.⁶¹ Alberta's power prices create a dynamic marketplace. Between 2004 and 2008, its prices averaged \$73 per MW.⁶² With levelized generation costs for a dedicated biomass steam plant at approximately \$57 per MW, and for a biomass gasifier at approximately \$67 per MW,⁶³ attractive economic returns are available for forest companies with access to fibre resources.

Raw wood, the most obvious source of forest biomass, is not an economical feedstock for power generation in Alberta. The delivered cost of a BDt (bone dry

⁶¹ An economic assessment of the cost of the system that includes all the costs over its lifetime – investment, operations and maintenance, fuel, and capital – to determine the minimum price at which the energy must be sold for the project to break even.

⁶² First Energy Capital.

⁶³ World Bank.

tonne) of raw wood alone (estimated at between \$60 and \$80)⁶⁴ would vastly exceed all commercially available power generation technologies' ability to pay.

In addition, unused forestry byproducts could provide feedstocks at sufficiently low cost making biomass power generation economical. Roadside residue, the unusable tree components unsuitable for existing lumber and pulp production, is currently left at the harvest site. Although the volume of roadside residue is difficult to measure accurately, estimates indicate that over 4.4 million dry tonnes⁶⁵ are left throughout Alberta each year.

The economics of consuming roadside residue are driven by transport costs, which mirror logging activity. Past estimates have indicated average Alberta log-haul distances in excess of 100 km.⁶⁶ Based on past estimates for the differing technologies' ability to pay for feedstock, it appears likely that greater than 50 percent of the roadside residue is located within an economically recoverable distance.

Consuming 2.2 million BDt, or 50 percent of the total 4.4 million BDt resource, in multiple modern gasifiers could support an installed electrical capacity of 350 MW,⁶⁷ generating \$200 million in annual electricity revenue. This revenue could support 1,700 jobs on an ongoing basis, contributing \$180 million in GDP⁶⁸. To facilitate this new electrical capacity, capital expenditures of \$675 million would be required.⁶⁹ Build out of this capacity would generate 5,300 employee years in construction employment and contribute \$570 million in construction-related GDP. Utilizing its existing transportation and site infrastructure, the forest products industry is best aligned to take advantage of this potential opportunity.⁷⁰

⁶⁴ CIFO; PwC; expert analysis.

⁶⁵ Alberta Energy Research Institute, Identifying Economic Opportunities for Bugwood and Other Biomass Resources in Alberta and BC, April 2008.

⁶⁶ Alberta Logging Cost Survey: data for 1996-1998.

⁶⁷ Alberta Finance and Enterprise.

⁶⁸ AFE forest products multipliers as proxy.

⁶⁹ World Bank.

⁷⁰ Forest Products Association of Canada, Transforming Canada Forest Products Industry.

Alberta Building Products

Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe	Challenges
<p>Expand Alberta industry ability to capture a greater portion of the domestic market (approximately 50 percent of cabinets and countertop; 50 percent of heating, ventilating, and air conditioning and insulation; and 100 percent of prefabricated structures)</p>	<ul style="list-style-type: none"> ■ \$350 million in GDP and 3,300 jobs per year 	<ul style="list-style-type: none"> ■ The Building products sector can engage in productivity improvements in order to effectively compete for market share ■ The sector is able to compete/attract employees with required skill sets ■ Alberta's residential, commercial and industrial construction activity remains at approximately 2008 levels 	<ul style="list-style-type: none"> ■ Cost-competitiveness of producers in other regions ■ Labour challenges due to a shortage of high-tech skilled labour and management ■ Further introduction of efficient manufacturing processes, improved management, and new technologies are needed in Alberta companies ■ Productivity improvements for Alberta's building products manufacturing companies are needed to alleviate labour competition from other low cost jurisdictions

Overview

Alberta's building products industry consists of diverse groups of products consumed throughout the commercial, industrial, institutional, and residential construction sectors. Apart from a few large international players, the industry is highly fragmented, consisting of many small and medium businesses. In 2008, the industry generated revenues in excess of \$8.6 billion⁷¹ and employed 40,000 Albertans.⁷²

The industry comprises three main sectors based on the revenue they generate:

- Non-wood products⁷³ – 62 percent
- Secondary wood products⁷⁴ – 21 percent
- Primary wood products⁷⁵ – 17 percent

Between 2000 and 2007, growth in the building products industry was fuelled by a boom in construction (exhibit 11). During 2004 and 2008, new home starts in Alberta increased from 26,000 units to 48,500 units per year, with new home construction activity increasing from \$8.1 billion to more than \$14.8 billion⁷⁶. Similar growth also occurred in the renovation, commercial, institutional, and government sectors, which increased by \$3 billion during that time.

Opportunities within each of the targeted sectors are spread across an array of products. Individually, many of the opportunities are small, but collectively the economic impact could be significant, with the potential for hundreds of millions of dollars in GDP contribution.

To grow, the building products industry would need to focus on capturing a greater portion of imports in the secondary wood and non-wood product markets, as well as capturing new opportunities arising from the sector's transition to green building products.

Alberta producers have been gradually increasing their share of the domestic market,⁷⁷ a trend that accelerated between 2007 and 2008. During this period, Alberta housing starts decreased from 48,500 to 30,000 units, while Alberta manufacturers increased sales from \$210 million to \$230 million.

Industry experts attribute Alberta's competitiveness to the introduction of technology-enabled manufacturing processes that let Alberta companies

⁷¹ Statistics Canada, *Monthly Survey of Manufacturing – 2101*, Table 304-0015.

⁷² Alberta Finance and Enterprise.

⁷³ NAICS 327, 3334.

⁷⁴ NAICS 32191, 32199, 33711, 33712, 3372, 3379.

⁷⁵ NAICS 3211, 3212.

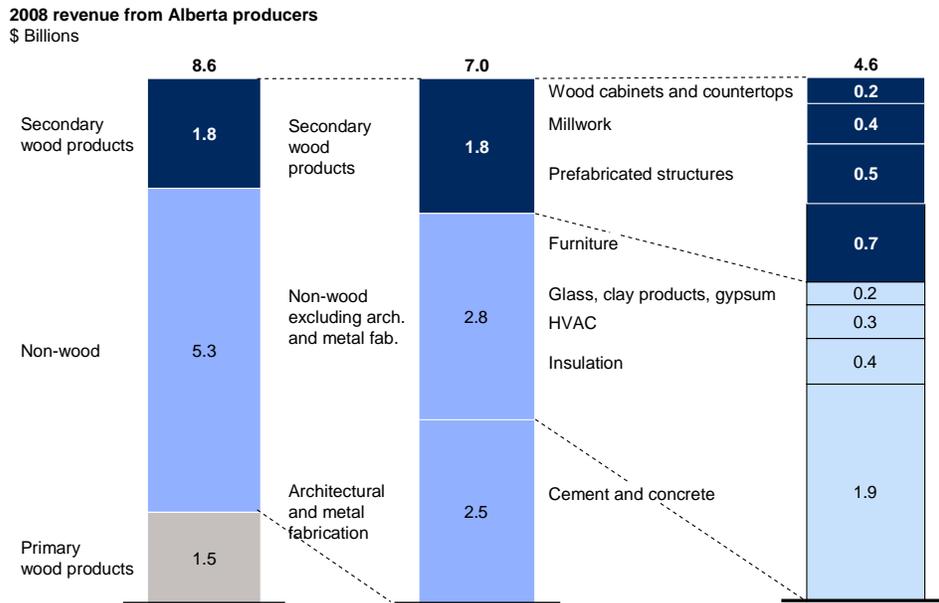
⁷⁶ Stats Canada.

⁷⁷ Industry expert interviews.

overcome higher labour costs, take advantage of geographic proximity to customers, and capture market share.

Further introduction of efficient manufacturing processes with improved management and technology could help Alberta manufacturers continue to expand and capture some of the approximately \$300 million in imports. For each additional 1 percent capture of this import market, Alberta producers could generate \$3 million in revenue, 30 jobs, and \$2.7 million in GDP contribution.⁷⁸ The following tables offer a review of some of the key elements in the building products sector.

Exhibit 10: Sectors of the building products industry included in this assessment

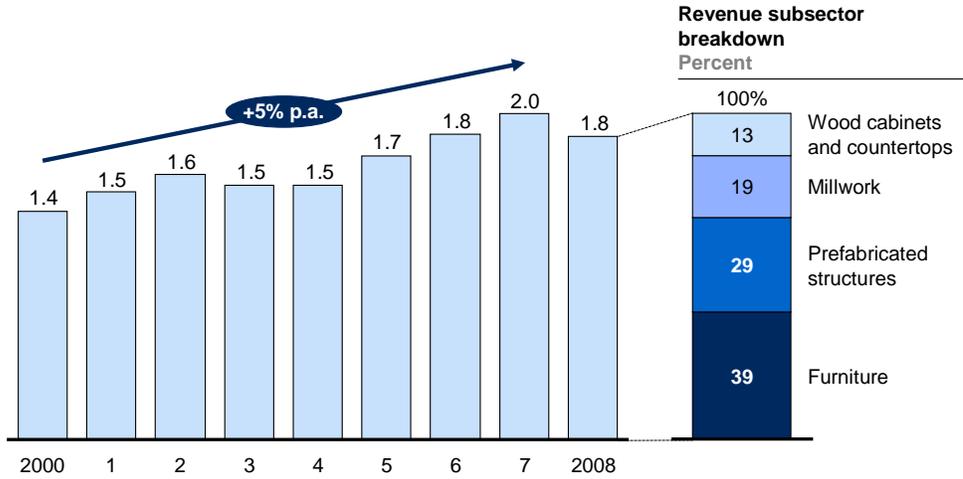


The subsectors of the building products industry were selected based on the availability of quality data and on the relative size of the revenue they generated.

⁷⁸ Alberta Finance and Enterprise furniture multipliers.

Exhibit 11: Alberta secondary wood products manufacturing revenue

Nominal \$ Billions



SOURCE: Statistics Canada

Alberta Alternative Energy

Opportunity Assessment	Size (GDP/Jobs)	What You Have to Believe	Challenges
<p>Meet short- to mid-term local demand for wind and biofuel energy</p>	<ul style="list-style-type: none"> ■ Construction: \$600 million to \$1.4 billion in GDP and 6,000 to 13,000 person-years ■ Operations and Maintenance: \$375 million to \$465 million in GDP and 1,250 to 1,550 jobs per year 	<ul style="list-style-type: none"> ■ Between 2010 and 2017, installed wind power increases between 1000 and 3000 MW, requiring a total capital investment of approximately \$1.9 billion to \$5.8 billion ■ In the near term (0-5 years), biofuel production remains constrained to first generation technologies 	<ul style="list-style-type: none"> ■ Four key variables directly influence the profitability and the growth opportunity for biofuels: government regulation, cost and availability of feedstock, competitive access to other markets, and conversion technologies ■ Biofuels: Feedstock price volatility; feedstock supply vulnerability to weather; strong dependence on government regulations and subsidies; growing competition from jurisdictions producing lower-cost, higher energy feedstocks; questionable environmental benefits ■ Wind: intermittency of energy generation; controversies related to noise, vibration, and property value
<p>In the longer term (2020), potentially export second-generation biofuels</p>	<ul style="list-style-type: none"> ■ Not sized 	<ul style="list-style-type: none"> ■ Longer term (5+ years), economics of second generation technologies improve 	<ul style="list-style-type: none"> ■ Securing adequate supply of the agricultural resource ■ Alberta's agricultural product is dispersed throughout the province but is most concentrated in the prairies, with 12 million bone dry tonnes dispersed across 140,000 km. This dispersion would contribute to higher transport costs and increased logistical challenges – for every 10 miles of transportation, the production cost of electricity increases \$3.90/MWh

Overview

With volatile global energy prices and mounting concerns about carbon emissions, governments and consumers are increasingly seeking clean and sustainable sources of energy to power our future.

In Alberta, the alternative energy industry is expanding, with significant growth in wind energy and electricity generation using biomass. Biofuels, ethanol and biodiesel are emerging opportunities, and may play an increasing role in Alberta's energy future.

There are four main sectors in the alternative energy industry:

- Wind – 560 MW of installed energy⁷⁹
- Solar – 1.5 MW of installed energy⁸⁰
- Biofuels – 40 million litres of ethanol, 19 million litres of biodiesel⁸¹
- Biomass power – 178 MW of installed capacity⁸²

It should be noted that the economic case for developing any of the alternative energy options is highly dependent on local energy prices. The data used to describe Alberta energy prices is based on energy prices during the period 2004-2008 when energy prices were high. If energy prices remain as low as they have been in 2009-2010, the case to invest in alternative energy source becomes more challenging.

THE WIND ENERGY SECTOR

In southern Alberta, wind energy has experienced significant growth, with an estimated 560 MW of power generation capacity, representing nearly 4 percent of Alberta's total installed power generation capacity.

With an average energy rate of \$73/MWh from 2004 to 2008,⁸³ Alberta electrical prices provide sufficient economic incentive to encourage the development of new wind resources, which are estimated to cost \$51/MWh.⁸⁴ Further support has been provided by the federal government through its ecoEnergy initiative which provides \$10/MWh for up to ten years, for projects constructed between April 1, 2007 and March 31 2011.⁸⁵

⁷⁹ Alberta Electric System Operator (AESO) Long-term transmission system plan 2009

⁸⁰ Industry Interview

⁸¹ Canada as an investment destination for biofuels, June 2009

⁸² Alberta Electric System Operator (AESO) Long-term transmission system plan 2009

⁸³ First Energy Capital.

⁸⁴ World Bank ESMAP Technical Paper December 2007, assumes a 100 MW wind farm

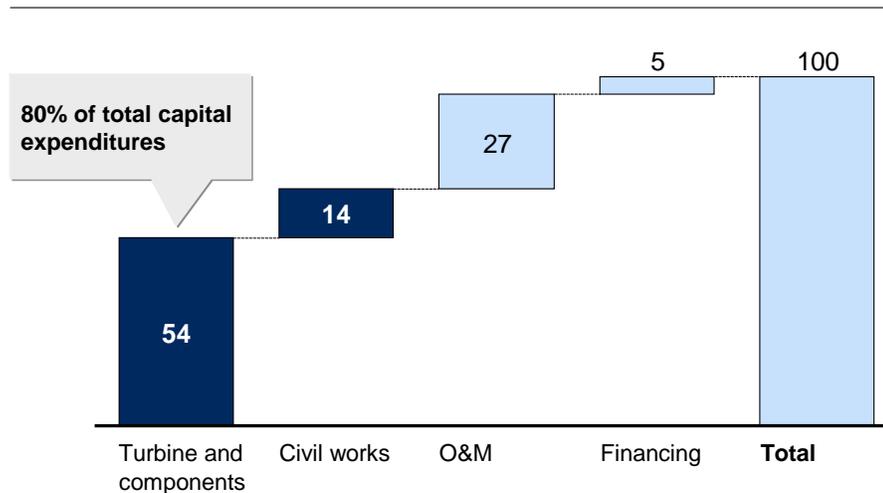
⁸⁵ Government of Canada, ecoEnergy for Renewable Power Program

Given the attractive economics, there are currently applications for an estimated 12,500 MW⁸⁶ of additional wind capacity in Alberta. Wind, however, is an intermittent energy source as it relies on the weather to produce power. For grid stability, most jurisdictions set an approximate limit of 20 percent⁸⁷ of intermittent installed capacity. Forecasts indicate Alberta will need approximately 15,000 MW⁸⁸ of installed electric generation capacity by 2017; a 20 percent threshold for intermittent power would indicate a maximum wind capacity of approximately 3,000 MW suggesting it is unlikely all of the proposed wind applications will be approved – unless viable export markets were found or significant advancements were made in wind storage technology that would allow planners to exceed the 20 percent cap on energy from wind.

The attractive economic fundamentals and the long queue of applicants suggest that Alberta is unlikely to require additional economic incentives to increase the amount of power generated by its wind resource.

Exhibit 13: Value generated during wind turbine life cycle

Life cycle cost of a wind park
Percent of total NPV



SOURCE: Expert Interviews

BIOMASS AND BIOFUELS

Globally, biomass is a growing source of power generation. Within the European Union, it is expected to contribute in excess of 50 percent of the total renewable

⁸⁶ AESO, 2009

⁸⁷ Industry Expert Interview

⁸⁸ AESO, 2009

base of 2,977 TWh by 2020. The development of the biomass resource has been driven by its competitive generation cost, environmental regulations, and its ability to provide baseload power. Unlike wind or solar, biomass has the ability to provide a non-interruptible source of power.

Alberta has five biomass facilities producing 178 MW, with a further 200 MW in plant capacity to be in service by 2011.⁸⁹ The current and proposed facilities primarily consume forestry residuals. However, Alberta has an abundant supply of other potential feedstock – non-merchant wood, forest plantations, agricultural biomass such as hay or straw, and municipal waste. Estimates for the total Alberta biomass resource exceed 30.2 million tonnes.⁹⁰

Canada's biofuels industry, consisting of ethanol and biodiesel, has grown rapidly over the past 5 years. Growth has been led by ethanol production, with Canadian production growing from 230 million litres in 2005 to 1,420 million litres in 2008; during these years, biodiesel production increased from 100 million litres to 115 million litres.⁹¹

Alberta's ethanol and biodiesel production remains small, but is expected to grow. In 2009, ethanol production was approximately 40 million litres, with biodiesel production of 19 million litres.⁹² This volume is anticipated to grow in the immediate future with the completion of new facilities. Revenues from this expanded biofuel production would be approximately \$40 million from ethanol⁹³ and \$250 million⁹⁴ from biodiesel.

Development of Alberta's biofuel sector is being promoted through Alberta's Nine-Point Bioenergy Plan. This \$239 million investment consists of three initiatives: a \$24 million commitment to commercialization and market development, a \$6 million commitment to infrastructure development, and \$209 million to renewable energy producer credits. The Producer Credit has been extended to 2016 with expansion of eligible production and some rate modifications. Starting in 2011, the rate will be 9 to 13 cents per litre for renewable diesel, 9 to 14 cents per litre for second generation ethanol, and 6 to 10 cents per litre for first generation grain-based ethanol.

⁸⁹ AESO

⁹⁰ Alberta Energy Research Institute, Identifying Economic Opportunities for Bugwood and Other Biomass Resources in Alberta and BC, April 2008

⁹¹ BCC Research, Liquid Biofuels: The North American Market

⁹² Canada as an investment destination for biofuels (June 2009)

⁹³ Assuming approximately \$0.50/litre delivered cost.

⁹⁴ Assuming approximately \$0.75/litre delivered cost.