



Hydrocarbon Processing Sector

Energy drives Alberta's economy and its feedstocks drive a globally recognized and competitive petrochemical processing sector.

With massive reserves of conventional and shale oil and gas as well as bitumen, a highly skilled technical workforce and the pipeline, road and rail capacity needed to move feedstock and product to major North American and Asian markets, the Greater Edmonton area is both connected and competitive for petrochemical processing or the supply and servicing of this key sector.

Sector snapshot

Edmonton is a member municipality of Alberta's Industrial Heartland, home to global leaders in petroleum and petrochemical processing and Alberta's largest petrochemical processing cluster. Its strategic location between major resource extraction areas, natural storage capacity and ready access to a skilled and educated workforce have contributed to the area's reputation as the primary petrochemical and hydrocarbon processing centre for Alberta and Canada. This region is responsible for a significant portion of the \$31 billion (2012)¹ earned from Alberta's chemicals and petroleum refining sector. Revenue is earned from the following subsectors:²

- \$20 billion refined petroleum products
- \$11 billion chemical products including
 - 43% from synthetic resins
 - 33% from basic chemicals
 - 23% from fertilizers and other chemicals

The sector employs nearly 14,000 people in Alberta.³ The Greater Edmonton area represents approximately one-third of Alberta's overall labour force and its well-established role in this sector means local availability of a skilled and experienced workforce.

Edmonton's industry has ready access to primary petrochemical feedstocks of petroleum, hydrocarbon liquids, natural gas and natural gas liquids – as well as other agriculture-based feedstock important for fertilizer production. The area is at the centre of a comprehensive rail and pipeline network that moves goods in and around the region, and from the region to all key North American markets and west coast ports serving Asian markets.

The following summarizes the petrochemical product slate available and produced within the Greater Edmonton area.

- | | | |
|--------------------------------------|------------------------------|----------------------------|
| • Agricultural chemicals | • Heating fuels | • Petroleum coke |
| • Anhydrous ammonia and aqua ammonia | • Hydrogen peroxide | • Polyethylene |
| • Butane | • Industrial gases and steam | • Propane |
| • Carbon dioxide | • Iso-octane | • Propylene |
| • Condensates and heavy distillates | • Molybdenum and Vanadium | • Resins |
| • Ethane | • Monoethylene glycol | • Styrene monomer |
| • Ethylene | • Natural gas liquids | • Sulphur-related products |
| • Granular urea | • Oilseed-based products | • Synthetic crude oil |
| | | • Transportation fuels |

Power is generated by co-generation within the region or supplied through a power provider such as EPCOR and delivered through the region's transmission and distribution network. The transmission system serving the Heartland area is currently being expanded to include a new overhead double circuit 500kV transmission line,⁴ ensuring plenty of capacity for future growth.

The Edmonton Energy and Technology Park's petrochemical zone is well connected to the major highways to move goods and services east/west (Highway 16), north to key resource areas (Highway 63) and south (Anthony Henday Drive to Highway 2) to U.S. markets.

¹ Highlights of the Alberta Economy 2013, Government of Alberta

² Alberta's International Exports by Industry – A 10-Year Review, May 2013

³ Government of Alberta, Economic Commentary, Which Sector is Alberta's Largest Manufacturing Sector, Jan. 29, 2013

⁴ Heartland Transmission Project, 2013



Petrochemical sector workforce, training and R & D

Current labour rates are generally 2-6% lower than the Alberta average for a range of occupations relating to this sector. The following illustrates sample wages:¹

	EDMONTON HOURLY
Industrial instrument technician	\$34.11
Industrial engineer	\$36.44
Chemical engineer	\$49.68

University of Alberta

- Home to a dozen key centres of research excellence in resource and processing-related fields
- School of Business – Natural Resources and Energy MBA
- Faculty of Engineering – top 5% of North American engineering faculties and top 5% in chemical engineering
 - features over 5,500 students, over 200 professors and 50 research chairs
 - attracts over \$50 million annually from external sources for sponsored research funding
 - offers specialized degree programs including a Bachelor of Science in Petroleum Engineering

Northern Alberta Institute of Technology (NAIT)

- Largest apprenticeship training program in Canada with capacity to train 15,000 apprentices annually in 33 trades
- Certificate or diploma programs linked to the petrochemical industry include:
 - Chemical Engineering Technology
 - Engineering Design and Drafting Technology
 - Instrument Technician
 - Materials and Instrumentation Engineering Technology
 - Occupational Health and Safety

Local petrochemical support organizations:

- Alberta's Industrial Heartland Association
- Strathcona Industrial Association
- Northeast Capital Industrial Association

Highlights of the analysis showcase the opportunity.

	Propylene/ polypropylene*	Methanol*	Ammonia/urea*	Integrated Ethylene, Polyethylene and Monoethylene Glycol*
Total fixed investment assumptions	\$765 million (combined)	\$886 million	\$609 million (combined)	\$2.5 billion (Integrated Ethylene Complex)
Annual cash cost/ metric ton (MT) of output assumption	\$1,035/MT	\$182/MT	\$185/MT	LDPE - \$785/MT HDPE - \$703/MT MEG - \$420/MT
Annual global demand growth to 2025	5%	8%	2%	LDPE - 2.7% HDPE - 4 - 4.5% MEG - 1 - 1.5%
Primary growth markets for Edmonton-based plants	U.S., Mexico	Canada, U.S.	Canada, U.S.	North America
Price-competitive markets for Edmonton-based plants	South America China	China Indian Subcontinent	South America Indian Subcontinent	South America China

Source: Business Case for Methanol, Propylene/polypropylene, Ammonia/Urea, Polyethylene and Monoethylene Glycol, IHS Global, Inc., Alberta's Industrial Heartland 2013

*Note: All three project models assumed to start in 2018, with a capital cost of 10%, life span of 30 years, tax rate of 25% and operating costs as noted

Access to Alberta's liquid-rich shale gas reserves and the forecasted long-term attractive natural gas price contribute to very cost-competitive export netback pricing and a double digit internal rate of return for new plants processing any of these products.

Comparing Edmonton's and Alberta's competitive position with other producing markets, plants located here can effectively compete when shipping any of these product streams to North American markets – **especially polypropylene whose delivered cost to the U.S. is nearly \$100/MT lower than product shipped from the Middle East.**

Williams Energy's Edmonton-area plant expansion highlights growing interest in value-added processing in the Alberta Industrial Heartland area. Their new facility will be Canada's first propane dehydrogenation (PDH) facility and may be able to supply enough high quality propylene feedstock to support at least one new world-scale petrochemical plant.¹

To support value-added processing within Alberta, Alberta's Incremental Ethane Extraction Program provides an incentive through royalty credits to encourage greater production of ethane and promote value-added petrochemical production.²

With easy access to agricultural or forestry-based feedstock, new opportunities relating to bio-diesel, ethanol and plant-based pulp and plastics are emerging.

Alberta's deregulated energy market offers opportunities for merchant power generation using traditional fuel sources of coal or natural gas or converting excess heat or steam from industrial processes.

Proximity to feedstock and a significant research and development community rounds out the business case for producing these additives or products and positions Edmonton as the key location for processing.

More details are available on the compelling business case for these four streams by contacting Alberta's Industrial Heartland Association.

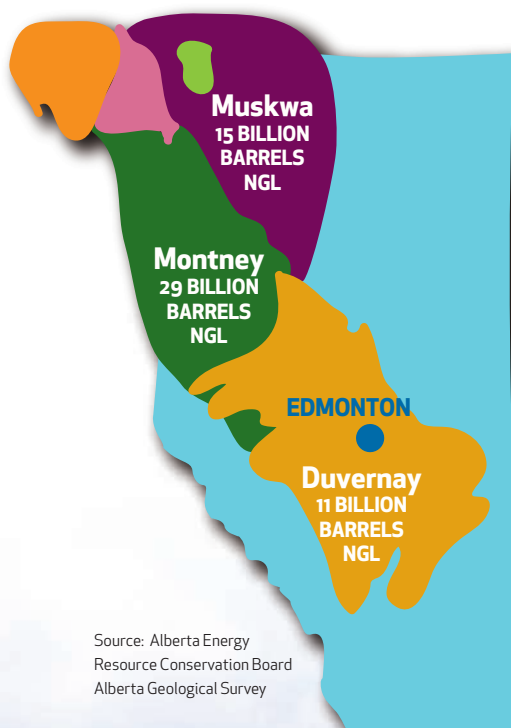
¹ Edmonton Journal, July 20, 2012
² Incremental Ethane Extraction Program Report to the Legislature, October 2012



Conventional natural gas and shale gas processing

Alberta's conventional and shale reserves offer producers both gas sales and value-added processing potential. Alberta's shale reserves are unique in that they have a higher-than-average percentage of natural gas liquids – key to processing derivatives.

Alberta's Shale Gas Play



Investment in Alberta's emerging shale gas play is becoming more attraction because of:

- improved extraction technologies, reducing production challenges,
- access to a strong domestic market with growth potential in targeted products,
- competitive export price potential for the near term,
- ready access to U.S. and Asian markets through current and proposed west coast shipping facilities and a North American-wide rail and pipeline network, and
- a political will encouraging local value-added processing.

This emerging area of development is well suited to build on the strength of the current sector capacities.

Petrochemical processing opportunities

Edmonton's future in the petrochemical sector and its related supply and service business is very bright. It builds on its proximity to low-cost energy and feedstock, world-class processing infrastructure, expertise and a competitive business climate. Abundant low-cost natural gas and increased bitumen production from the oil sands provides an extra advantage to processing this feedstock into higher value-added products.

An analysis was undertaken for AIHA in 2013 by IHS Global Inc. to assess the competitive opportunities around specific products. The results illustrate business potential in key sectors.

The detailed analysis was based on a generic business case for siting, building and operating petrochemical plants in the Edmonton area that process:

- propylene/polypropylene,
- methanol,
- ammonia/urea, or
- ethylene.

» We are pleased to add to our acreage in this play (Alberta's Duvernay shale gas field) as we advance our program to evaluate the potential for full-field commercial development.¹

Jeff Lehrmann, President, Chevron Canada Ltd., Aug. 1, 2013



Edmonton's Energy and Technology Park offers industrial development opportunities for greenfield petrochemical processing, industrial manufacturing, logistics, research and development, engineering and other businesses that support, supply and service the heavy industry located within Alberta's Industrial Heartland and resource companies located in the Edmonton service area covering central and Northern Alberta.

Alberta's Industrial Heartland (AIH) is Canada's largest hydrocarbon processing cluster.

World-class companies within or neighbouring AIH include:¹

- Agrium Inc.
- Air Liquide Canada Ltd.
- ATCO Energy Solutions
- Aux Sable Canada Ltd.
- Bunge Canada
- Chemtrade West Ltd.
- Dow Chemicals Canada ULC
- Dow Agro Science
- Evonik Degussa Canada
- Horton CBI
- Imperial Oil
- Keyera Energy
- ME Global
- North West Redwater Partnership
- Pembina Pipeline/Williams Energy Canada Ltd.
- Plains Midstream Canada
- Praxair Canada
- Sasol Canada Holdings Ltd.
- Shell Canada Ltd.
- Sherritt International Corporation
- Smith & Nephew (Alberta) Inc.
- Sulzer Metco (Canada) Inc.
- Suncor Energy
- Tervita Corporation
- Umicore Canada
- Univar
- Western Asphalt
- Western Hydrogen Ltd.
- Williams Energy Canada Ltd.

Oil and bitumen-based processing

Alberta continues to develop its huge reserves of conventional oil and oil sands while capitalizing on processing these products and their by-products. Greater Edmonton's well-established refinery and upgrader base with industry leaders such as Imperial Oil, Suncor Energy and Shell continue to upgrade, produce and ship a range of petroleum products. These industries create significant supply and service opportunities from plant maintenance and turnaround to demand for critical ingredients such as the diluent needed to effectively pipe bitumen.

The North West Redwater Partnership's new refining facility will upgrade bitumen into high-demand products such as low carbon-standard diesel. It will also utilize gasification technology to capture pure CO₂ that will then be sold to enhance oil recovery prior to deep, safe underground storage.²

Improving access to current and new markets for petroleum products is a priority for both the public and private sector and a series of solutions are moving forward that will lead to a strengthened bottom line for years to come.

TransCanada's proposed gas pipeline conversion, Energy East Pipeline, will expand capacity to ship 1.1 million barrels/day of crude oil into Eastern Canadian and potentially European markets.³ This new service will expand both domestic and export market potential.

Keyera Corporation and Kinder Morgan Energy Partners L.P. have also announced the construction of the Alberta Crude Terminal, designed to ship 40,000 barrels/day by rail to any Canadian or U.S. market.⁴

Diversifying the transportation delivery system and increasing the market diversification contributes to optimizing the price secured for Alberta's hydrocarbon products and contributes towards a more favourable business environment for future production and processing.

» This is an historic opportunity to connect the oil resources of western Canada to the consumers of eastern Canada, creating jobs, tax revenue and energy security for all Canadians for decades to come.⁵

Russ Girling, President and CEO, TransCanada, Aug. 1, 2013

¹ Alberta's Industrial Heartland

² www.northwestupgrading.com

³ TransCanada News Release, Energy East Pipeline Project, Aug. 1, 2013

⁴ Keyera, News Release, July 30, 2013

⁵ TransCanada News Release, Aug. 1, 2013

Edmonton's competitive position

According to KPMG's Competitive Alternative 2012 report, Canada continues to rank well, offering a 3.4% cost advantage over the U.S. in overall specialty chemical manufacturing.

Edmonton mirrors this cost-competitive position with the following specific advantages:

- 2% - 3% cost advantage over key U.S. production hubs,
- lowest property taxes of 9 comparable locations including no machinery and equipment (M & E) taxes and no provincial sales tax,
- over 60 years of experience working with refining and petrochemical industries,
- an established and growing petrochemical production cluster – many major players are here,
- proximity to low-cost natural gas and oil sands-related feedstock,
- skilled, experienced and motivated workforce with very low work stoppage and unionization rates,
- outstanding pipeline and rail connections to multiple markets,
- ability to optimize utility investments through co-generation,
- readily available industrial land either zoned or designated for a range of industrial operations, and
- a municipal and government environment that is supportive of responsible industrial development.

Annual year-to-year property tax savings in Edmonton strengthen your bottom line

Siting industrial processing plants within the City of Edmonton offers equipment-intensive plants a significant annual tax cost advantage compared to neighbouring jurisdictions that levy a mechanical and equipment (M & E) tax.

Using 2012 tax bylaw figures from three neighbouring municipalities, the following shows the percentage tax increase over an Edmonton tax base for a \$5 billion project on a 100 acre site:¹

EDMONTON SCENARIO	NEIGHBOUR 1	NEIGHBOUR 2	NEIGHBOUR 3
75% M & E with 25% M & E removed because it is considered non-assessable	25% more	17% more	35% more



» Research illustrates that the Edmonton area can compete with global leaders in the processing of targeted derivatives such as propylene and polypropylene – with lowest delivery costs to North American markets.²

Couple this with potential local feedstock coming on stream from Williams Energy's new propane dehydrogenation (PDH) facility and you have a winning combination for business success.

¹ City of Edmonton Sustainable Development, 2013

² Business Model, IHS Global Inc., Alberta's Industrial Heartland Association, 2013