

Converting Energy and Natural Resources into Manufactured Products Adding Value to Natural Gas

Prepared by the Chemistry Industry Association of Canada
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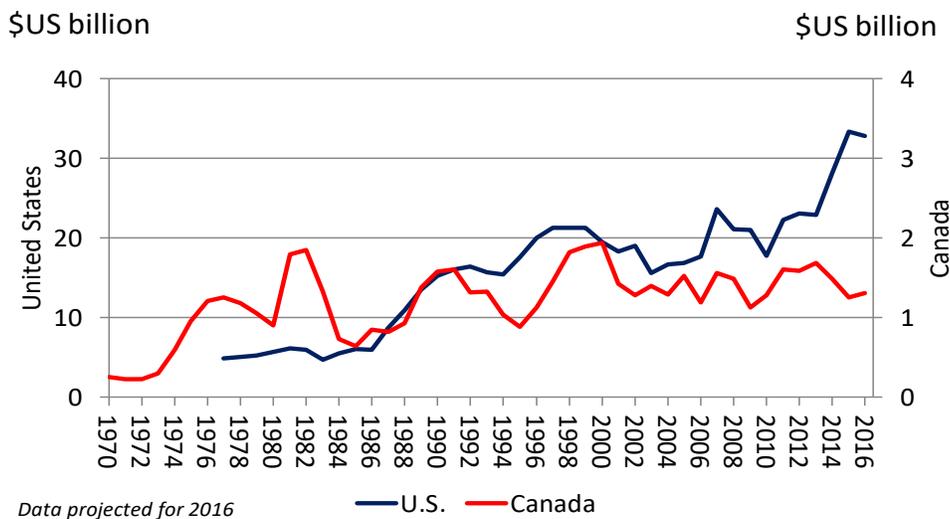
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Introduction

Energy comes from many sources, including hydro, wind, solar, oceans (tidal and wave), biomass, uranium, crude oil, natural gas, coal, oil sands – bitumen, and coal bed methane; all are in abundance and all offer opportunities for development and growth. This assessment is focused on the opportunity provided by natural gas and natural gas liquids, but applies to all unconventional gas, oil and liquids.¹ Energy resources offer a portfolio of opportunities in North America and responsibly optimizing these opportunities is a good goal for all Canadians. Resource basins may be located in Western Canada but the opportunity for upgrading and adding value to energy resources is not limited to this region alone. The shale gas revolution has been most dramatic in the Northeastern United States, in states such as Pennsylvania and Ohio, these resource basins are now being connected to major demand centers in Central Canada at this very minute, which goes to show that this is a continental opportunity! Indeed, the scale of the opportunity, is generational in scope and Canada cannot sit idle, there is competition across North America for these resources and Canada is in global competition for these investment dollars.

A recent Canadian Energy Research Institute (CERI) study “[Competition Analysis of the Canadian Petrochemical Sector](#)” has direct bearing on the opportunity available for the chemistry sector in Canada. It should be used to illustrate how other jurisdictions analyzed the situation and assisted in developing plans and policies to realize goals. At this point in the development of unconventional oil and gas, most upgrading and petrochemical development is happening in the U.S. but is not happening here on nearly the same scale (see Figure 1). It is the purpose of this report to show how some of that development can and should in fact happen here in Canada. Fundamentally, the energy and natural resource renaissance in North America, has opened a window for the chemistry sector to expand, and investors are eager to put these resources to work.

Figure 1: Chemical investment trends – Canada v. U.S.



¹ Natural gas liquids are a component part of raw natural gas and associated gas is often found in the same reservoirs as unconventional oil.

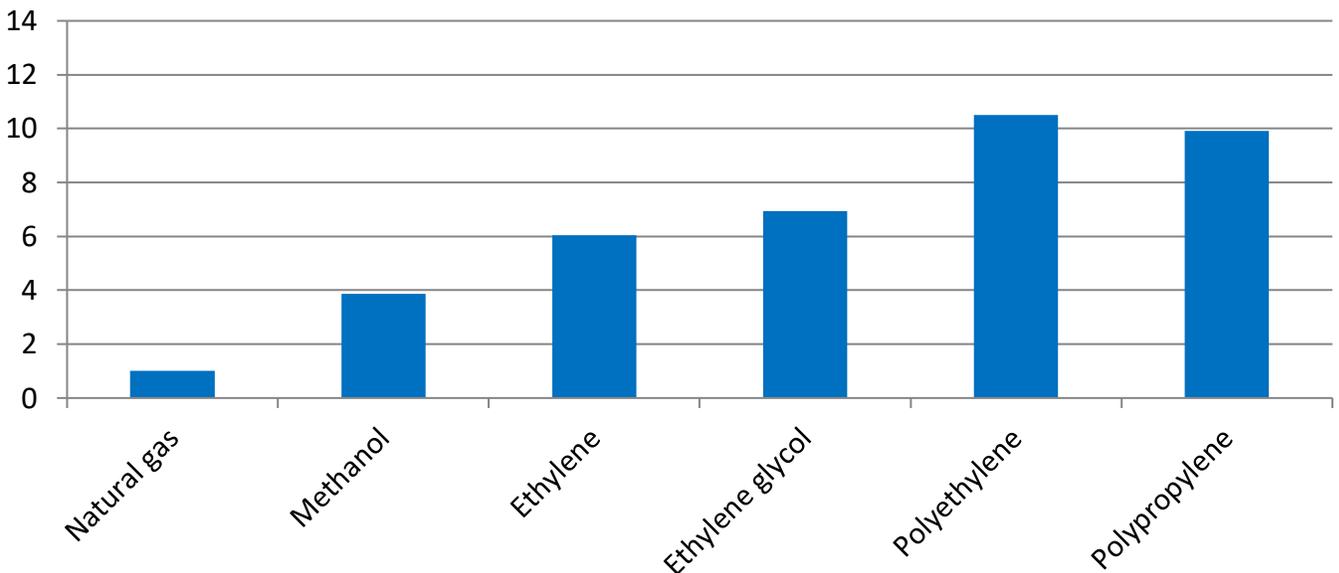
The chemical industry is already a key contributor to Canada’s value-add energy strategy. Natural gas liquids, in particular ethane, and natural gas itself (methane) are converted into high value chemicals and synthetic resins (plastics), \$26 billion in sales this past year, with over \$19 billion in exports. These are sub-sectors of the larger chemical sector with sales in 2016 of \$53 billion and exports of \$39 billion. The major centres of chemical production in Canada at industrial cluster sites in Joffrey, Ft. Saskatchewan, Sarnia and around Montreal but more broadly our sector is everywhere (Figure 2). Moreover, those that work in the chemical sector have high value jobs; over 1/3 of our employees have university degrees (Figure 6) and provide an average salary of \$62,500. Again, for the industrial chemicals and synthetic resins sub sector, those numbers jump to \$81,500 per employee. Chemical facilities and the required direct jobs have important multiplier effects within local economies – each chemical job results in another five in related sectors and services (source: Statistics Canada).

Figure 2: The Chemical Sector Across Canada



Feedstock (or raw materials) are core to the competitiveness of chemical producers, and their capacity to move along value chains (see Figure 3). Canada has the opportunity to move along energy value chains and provide a significant added value to the resource products Canada produces and imports to the benefit of the Canadian economy.

Figure 3: Energy Value Chain Multipliers



Source: Chemistry Industry Association of Canada (CIAC)

A new world-scale integrated petrochemical complex is a 30- 50-year investment. Using recent United States Gulf Coast (USCG) expansions and investment in new facilities as examples, a greenfield petrochemical complex, including infrastructure and derivative facilities, can cost in excess of US\$ 8 billion. Even an investment on an existing site with infrastructure already in place can approach the US \$5 billion range. Similarly, such a facility will require approximately 80,000-100,000 barrels per day of feedstock (in this case ethane) which accounts for 70% or more of operating costs. Clearly a reliable supply of feedstock is the first and most essential consideration of the investor while other examples are provided later in this document.

Canada is heavily reliant on its natural gas industry to market its output but the major export pipelines are operating at only a fraction of their capacity. The problem is market access – Canada’s pipelines deliver to locations that are now better served by the explosive growth in U.S. production. Increasing the capacity to convert the components of natural gas, specifically methane, ethane and propane, into higher-value products can in turn provide market diversity and incentivize further demand for these raw resources. Products produced by the chemical industry do not suffer from lack of market access, nor do they move by pipeline, these products are moved; first via freight rail and then by marine transport to global markets, and many of them are sold based on oil-related pricing instead of the very much lower gas prices providing stable returns for North America investors. It is clear to CIAC that investing in the chemical industry is investing in value creation!

One final “opportunity” is the global challenge of climate change. Canada’s chemical producers consume energy and produce carbon dioxide in their processes, this is a fact. Indeed, life cycle analysis of the products produced by the chemical sector globally show that it is the most energy intensive sector of all manufacturing sectors. But these same products also capture and

sequester carbon in their chemical products (e.g., insulation, car parts, counter tops, medical equipment, solar panels). In turn, the products, over their respective life cycles reduce carbon dioxide consumption/release. Overall, global chemical products reduce carbon emissions (CO₂) by three metric tonnes for every tonne emitted during chemical production. As Canada devises and implements its policies to address climate change, we need to take advantage and invest in a sector that prides itself on being a solutions provider. From insulation, to light-weighting of auto, to specialty lubricants, the chemistry sector is about providing solutions. While the sector is very energy intensive and is the most traded sector globally, there is opportunity to make products right across Canada from natural gas, rather than elsewhere in the world from oil or coal which might result in a larger global carbon footprint. One example is methane (natural gas) conversion to methanol. If the same methanol is produced in China from coal, it will have a carbon footprint that is six to eight times larger than doing it here! CIAC urges doing it here with the best technologies and the lowest emitting feedstock, rather than elsewhere – that is responsible resource development.

The chemical industry, through the application of chemistry is already adding value to natural resources, producing jobs, creating wealth, and provides a highly innovate anchor to the Canadian economy. CIAC recommends a policy approach that recognizes the importance of responsible natural resource and energy conversion in creating value-added products. Essentially, CIAC is recommending an “all of the above” approach to economic development which can be applied to shale gas resources, as well as to conventional, associated gas and other types of energy resource developments. While it is imperative that the owners and developers of resources have, in a responsible manner, the ability and right to maximize the value of what they produce it is also important for government to create an environment that advances economically competitive opportunities for the upgrading, conversion and manufacturing of these resources into value-added products. Government initiatives and policies directed at this end enable both producers and downstream industry to thrive and benefit the entire Canadian economy so that both advance in a sustainable manner.

Overall, it is our view that Canadians need to broaden the dialogue around energy resources and development and consider options to further integrate North American energy resources to maximize the benefits of all stakeholders. This includes moving energy resources up the value chain, where values is enhanced by conversion into chemical and derivative products and not exclusively through consumption of energy content purposes. Canada’s future should involve different pathways for hydrocarbons, not eliminating their use entirely.

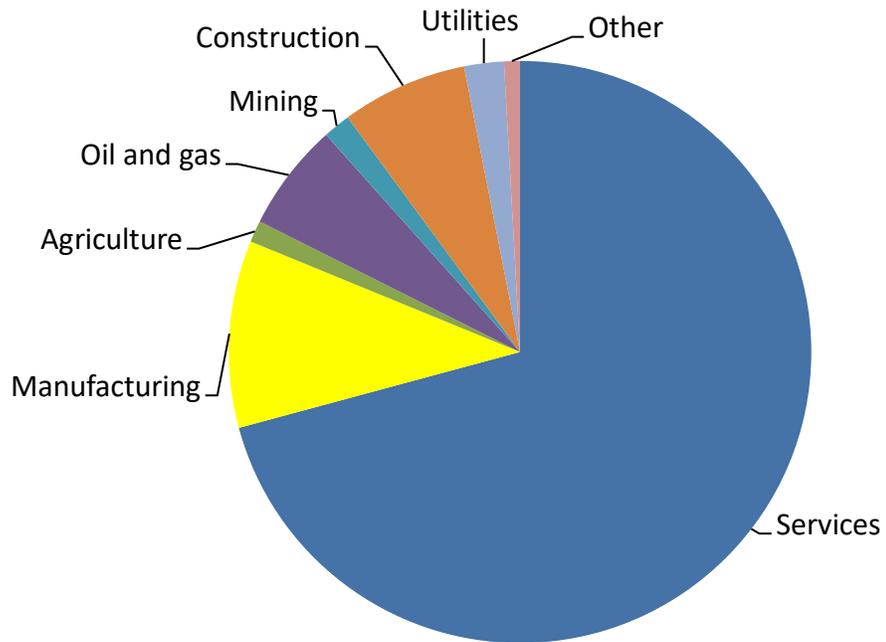
Background: Canada's Chemical Sector-energy intensive, energy efficient and providing sustainable solutions.

This section describes the Canadian chemical industry and how it puts technical knowledge and highly innovative processes to work to create new products and add value to raw natural resources to the benefit of Canada's economy.

Canada's Economy is Closely Linked to Natural Resources

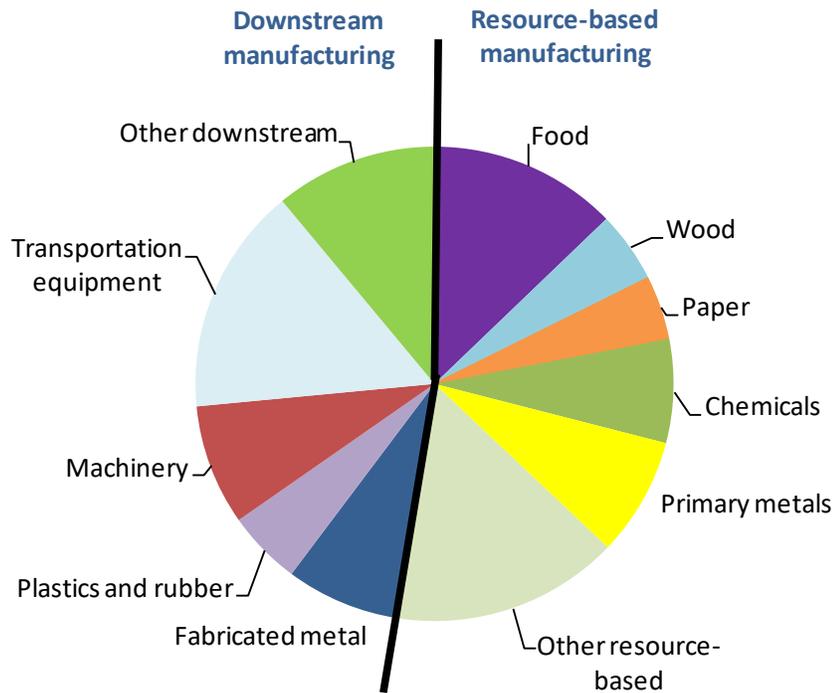
While the Canadian economy is mature, and appears to be dominated by the service sector (Figure 4) many of these services are related to manufacturing and resource development. Manufacturing is a very important component of our economy and Figure 5 further breaks down manufacturing into industries based directly on resource upgrading and other further-downstream industries.

Figure 4: Canadian Economy by Sector, 2016



Source: Statistics Canada

Figure 5: Canadian Manufacturing (GDP Comparison, 2016)



Source: Statistics Canada

A good illustration of the resource-manufacturing linkage is chemical manufacturing which purchases 18% of gas, 5% of oil and 3% of electricity consumed in Canada. Those numbers are higher for gas upgrading in Alberta, exceeding 21%. However, the broader manufacturing subsector, a key market for chemical sector output, is facing serious competitiveness concerns today. Over the last decade, facilities have been closing and to reverse this trend, we need to attract new investments. Adding value to resources is the essence of the manufacturing sector, which creates jobs and wealth across the country.

The Alberta chemistry industry consumes 21% of domestic gas, adding value here and across the Canadian economy.

In moving along resource value chains, Canada needs to consider factors that can enhance our global competitiveness. First, where there are duplicative and sometimes conflicting federal-provincial environmental regulations or significant incremental costs, this discourages potential investors. Regulatory streamlining must be a goal across all sectors of the economy. In particular, it must be facilitated where business is seeking to add value to resources, including energy and the chemistry industry's Responsible Care ethic will ensure we are doing the right thing as we undertake resource upgrading (see Appendix 1 and 2).

An earlier CERI petrochemical study (2015) confirms that North America has an abundant supply of competitively-priced raw materials (or feedstock) in the form of natural gas and natural gas liquids, to run chemical plants and provide for future demand growth. Adding value to natural resources creates jobs and wealth across the entire economy. In the U.S., both government and industry are aggressively pursuing these types of value added investment opportunities. Canada needs to focus its efforts if it wishes to participate in this natural gas renaissance. The CERI study, “Competitiveness Analysis of the Canadian Petrochemical Sector,” clearly pointed out that the government support on the USGC is on the order of 10%-15% of the capital cost of projects and has been sufficient to “win” virtually all of the 300 major projects announced in the past few years with an estimated value of over \$250 billion (62% of which is foreign direct investment) under consideration in North America.

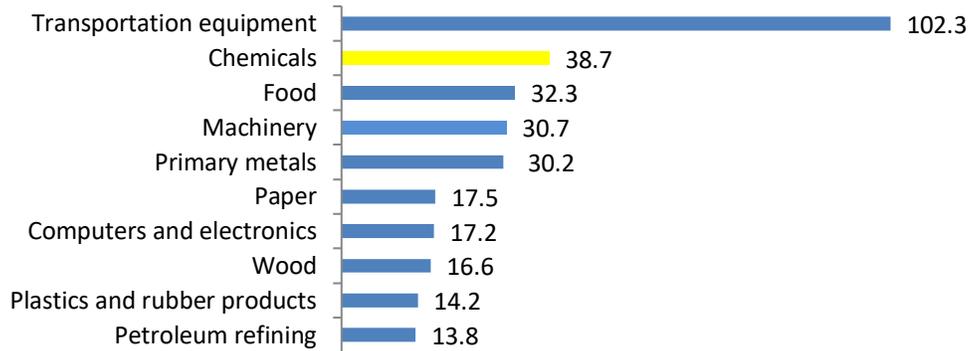
Competitiveness challenges here in Canada are being discussed by policy makers and industry and governments must continue to work together to remove unnecessary obstacles to investment, as well as on business and policy issues that will incentivize future growth in the chemical sector of our economy. Generation Energy needs to consider conversion of energy into manufactured goods as an option for the Canadian economy over the long term.

Each chemistry industry job results in 5 additional jobs across the Canadian economy.

Canada has all the necessary ingredients (energy, minerals, skilled workers, stable investment environment) to be an attractive destination for chemical sector investment. Canada also has the potential to become the world’s best upgrader of natural resources into value-added manufactured goods for domestic and global markets, but realizing this goal requires vision at the provincial as well as national level, and this starts with a dialogue around how we use energy and natural resources. In Canada, an energy dialogue must be more than a plan to facilitate energy export project approvals and increase the expeditious delivery of our energy to a broader suite of foreign markets.

The chemical industry is a key component in ensuring that we are using energy and natural resources in a productive way to add value to raw resources. The chemical industry already contributes to this goal and is a key exporter of its products to global markets (see Figure 6).

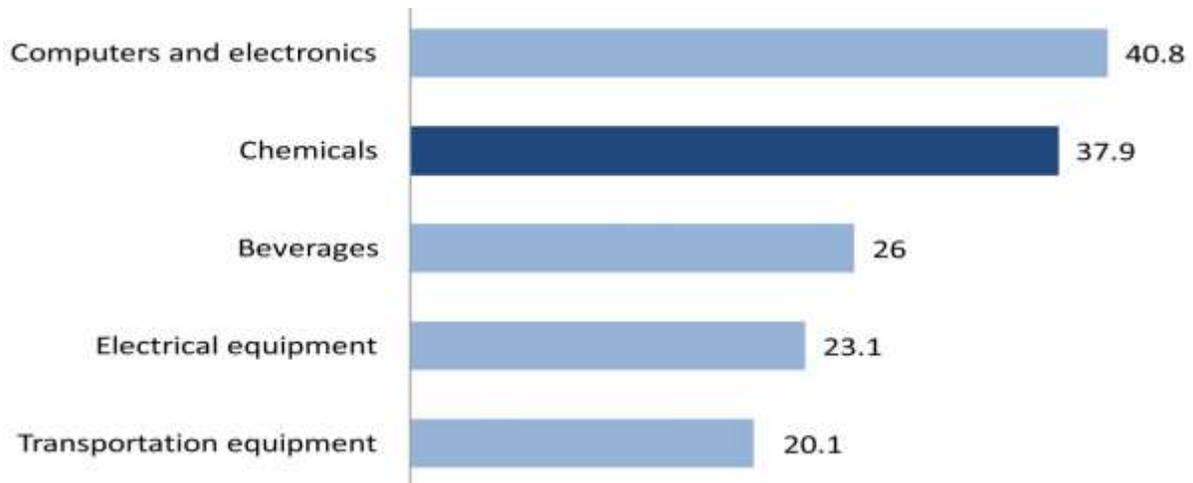
Figure 6: Canada Export Ranking - \$ Billion



Source: Statistics Canada

In addition, the chemistry sector is highly innovative and provides excellent career paths for highly skilled individuals (see Figure 7). Finally, as stated above in Figure 3, the chemical sector is a value “multiplier,” each step that raw natural resources take up the chemical sectors value chain equals a new and more valuable product, often worth several times the raw resource itself! The next section on page 11, discussing the petrochemical value chain, illustrates the impact of chemistry on raw natural resources.

Figure 7: Percentage of Employees with University Degrees

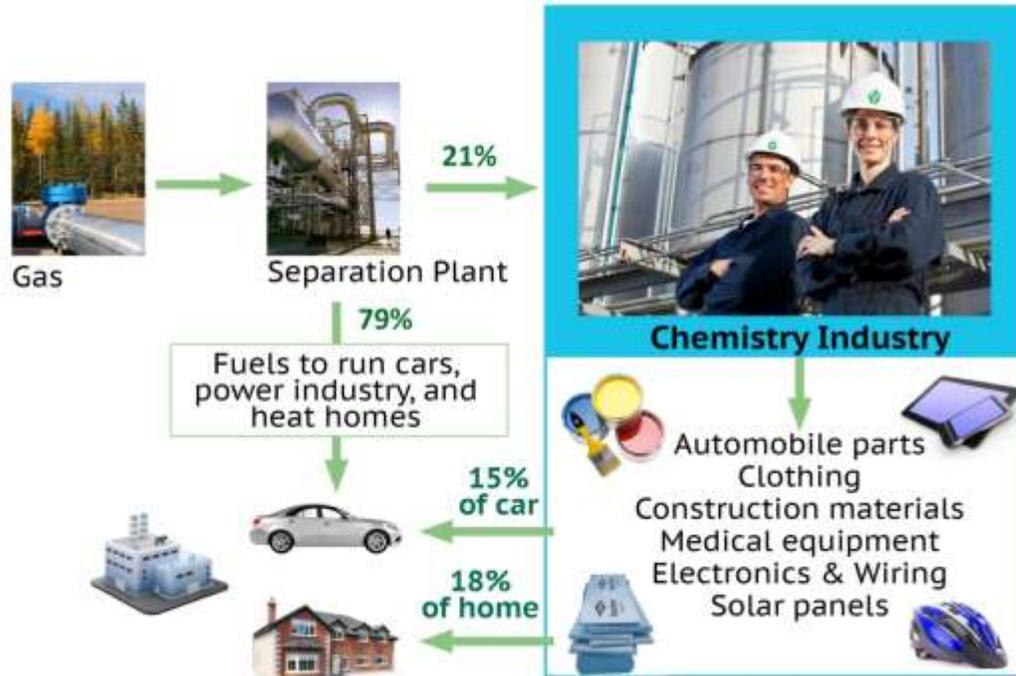


Source: Statistics Canada

Petrochemicals

Chemical companies use natural resources as both a fuel and as a raw material (or feedstock) for chemical production. The natural resource may be oil, gas, electricity or bio-based materials. In the case of natural gas, chemistry's impact is significant (see Illustration 1).

Illustration 1: Gas-Based Chemistry Value-Chain



In the petrochemical sub-sector, CIAC members take components of natural gas and convert them into a broad range of basic chemicals such as methanol, ethylene, ethylene glycol, styrene and polyethylene and often go beyond and create fabricated products and unique chemical formulations. After these basic building blocks are produced locally, there is opportunity to either export these goods to consumer markets or to further upgrade a portion of these goods into consumer products for use right here in Canada. As Illustration 1 above shows, chemistry solutions can create an endless number of finished goods!

Enhancing Canada's Chemistry Sector

Developing A Broader Dialogue

CIAC believes that energy development, natural resource development and value-added processing must remain a matter of priority, purpose and policy for Canada. We need to bring together the federal and provincial governments and all energy stakeholders, with one clear purpose - to competitively add value to energy and natural resources in the most sustainable way possible to create Canadian wealth, jobs, products that improve everyday living, and to help reduce our environmental footprint. A second goal is to purposefully bring long-term balance and opportunity for sustained growth to Canadian energy markets.

CIAC supports policy initiatives that promote sustainable development of diverse energy supplies, energy conservation, and the concept of using some energy as a feedstock or raw material to be converted into high value-added chemical products. At the same time, energy development, environmental improvements and societal expectations should advance cooperatively and not in conflict. Canada's energy, environmental and societal goals can be mutually reinforcing; industrial competitiveness, value-added upgrading and sustainability can and should be pursued together. The chemistry industry is actively engaged in finding solutions; our members are working with partners in the energy sector to address emissions, water use and site remediation.

Energy is a key component of economic well-being and an essential input into an economy. The CIAC agrees that Canada needs to develop access to markets for its natural resources, but we argue Canada should also utilize the bounty of natural resources in North America and develop markets for value added products in tandem with markets for raw resources. Adding value to natural gas and NGLs through the production of chemicals and polymers provides significant incremental value creation in Canada as well as providing access to incremental markets which are not, for example, constrained by inadequate transportation capacity. Adding value to natural resources helps Canada diversify its export markets since chemical and polymer products each have their own unique market dynamics, many of which run counter to the boom and bust cycle of basic resources such as oil and gas. Perhaps more significantly the application of chemistry to natural resources, transitions the raw product into goods that facilitate our continuously evolving economy and enhance our quality of life, goods such as automobile components and medical equipment.

Today, North America is experiencing a renaissance of investment in the chemical sector, a result of innovation in oil and natural gas extraction techniques. There are approximately, \$250 billion in new chemical sector investments underway, announced or anticipated in North America, virtually all of which is in the U.S. Attracting a share of new North American investments to Canada will involve hard-work by all of us; the competition is very good and competitors for investments are working hard to attract or keep these investments (Figure 1). The US Gulf Coast has the same raw materials, it is on tidewater, the construction costs are purported to be lower (though they have been rising recently) – we will have to work to win investment opportunity here. If this opportunity is to be realized in Canada it will be only because all levels of government and the investors are working together. In the end, it must be

evident that it is more profitable to add value to energy and natural resources in Canada than elsewhere.

Giving Investors Options

CIAC believes that the government can offer choices within the context of the business environment – choices in “letting the market decide.”

A fundamental principle is that ultimately decisions about how Canadian energy resources should be developed, produced and sold are best left to energy markets, both domestic and international, to resolve. Indeed, individual decisions about who and where to sell an individual firm’s energy production to and on what terms will continue to be made by the firms involved and different market participants will have different opportunities, with different views on which market opportunities are most favourable for them.

A critical role for governments in this is to ensure that markets are enabled to work efficiently, openly and fairly, while appropriately safeguarding the environment and the rights of all participants. This includes helping ensure that Western Canada’s energy supplies are open to global energy markets and open to value add opportunities in all of Canada. And that in turn means, among other elements, ensuring efficient, fair regulatory processes that can expeditiously provide necessary energy transportation infrastructure developed in a safe, environmentally and socially responsible manner.

This is a portfolio approach to energy development, a portfolio that sees some extraction and export, some upgrading and some further conversion or manufacturing into finished products being part of the conversation. Adding further value to basic resources optimizes opportunities for Canada, optimizes the usage of our resource endowment.

What does it take to win?

There are several angles that must be covered to win investment but in the end, Canada needs to be an economically competitive jurisdiction to build and operate value-add resource-based manufacturing facilities. There are many core factors to achieving global competitiveness and first is a willingness to compete.

As an example, in the past the incremental ethane extraction policy and program (IEEP) successfully leveraged \$350 million in forgone (immediate) revenues by Alberta in order to incentivize the extraction of 91,000 incremental barrels of ethane. This feedstock in turn resulted in \$1.8 billion in incremental investments in Alberta’s chemical sector while it was in place. The measure did not require upgrading, but it offered the choice to pursue upgrading and helped to offset some of the added costs or competitiveness factors Alberta faced at that time. Similarly, the Petroleum Diversification Program may well help leverage \$500 million in Royalty credits into over \$8 billion in advanced manufacturing facilities that turn propane feedstock into polypropylene. Indeed, the PDP helped spark interest in the chemical sector and led to far more applications and potential projects being identified than the original program was designed to handle. Redeveloping old policy tools and creating new concepts that can leverage natural gas and natural gas liquids into value added processes offer a real opportunity

to achieving further investment in the chemical sector. There are other regions, for example Ontario, where specific measures are in place to improve the attractiveness of these regions for foreign investors. Recent successes show that Canada is already on the radar screen of investors.

However, being on the radar screen and seeing a project through from conception to construction and operation, requires awareness of the competition Canada faces. A new petrochemical facility such as an ethane cracker requires an up-front investment on the order of \$8 - \$10 billion. A dedicated propane to propylene facility with polypropylene and related infrastructure has a capital cost of over \$4 billion and a methane to methanol facility can cost well over \$1 billion. Each of these facilities will operate for 30-50 years and provide high value products and well-paying careers for the company and Canadians who work there. An economic strategy that rewards value add choices and shares in the up-front risks may be necessary. Policy makers and investors need to ask themselves; what are competing capital costs in different jurisdictions, are logistics adequate to handle growth in Canada, do we offer competitive returns for investors, can we build new projects on time and on budget? To answer these questions industry and government need to work together.

Recommendations - Creating the Proper Conditions to Win Investment

Currently, Canada faces several headwinds in attracting new chemical sector investment such as the high-cost of construction in Canada, increases in corporate tax rates in some subnational jurisdictions, and a stricter climate change policy which has had a cascading effect on electricity rates. Individually, each of these issues are not cause for concern, but when considered in the aggregate it becomes clear that sometimes policies can hurt investor sentiment just as much as they can help.

We urge government and policy makers to consider, as fiscal conditions permit, providing choices for investors. Energy and natural resource products can be extracted and exported, but with the right conditions Canada can attract chemical sector investment and move up the resource value chain! CIAC recommends that policy makers consider ways to encourage investing in value add, for example:

- Programs could be designed to encourage the upgrading of energy materials such as methane and natural gas liquids through the use of the government's share of royalties and taxes (provincial & municipal). These programs could target to encourage new investments through improving availability of competitive valued feedstock. The PDP in Alberta was exactly this and the response of the investment community was very encouraging. Use of the Royalty system in this manner to further petrochemical investment in the province is not a subsidy - it is deliberately using a future revenue stream to incent development of value added products.
- Reduce the corporate tax rate if a company is part of the manufacturing and value adding sector. An example of such an arrangement is the special manufacturing and processing or M&P corporate tax rate in Ontario;
- Consider tax abatement measures at the provincial and municipal level for a set period on the incremental tax increase derived from new investment;
- Explore areas to expedite the regulatory approvals process and make a commitment to meet a scheduled timeline for such approvals;
- Find ways to work at both the local and provincial level to reduce construction costs and credit site-specific services which obviate the need to supply from the region, such as waste and water treatment, special fire-fighting and emergency response materials; and,
- Ensure that climate change policies take account of the holistic impact that the chemical industry has on carbon emissions and how similar production is treated in the U.S. and China, our direct and closest competition for new investments in energy value-add. Canada is a world leader in producing chemicals at low-greenhouse gas intensity; the same cannot be said for other jurisdictions.

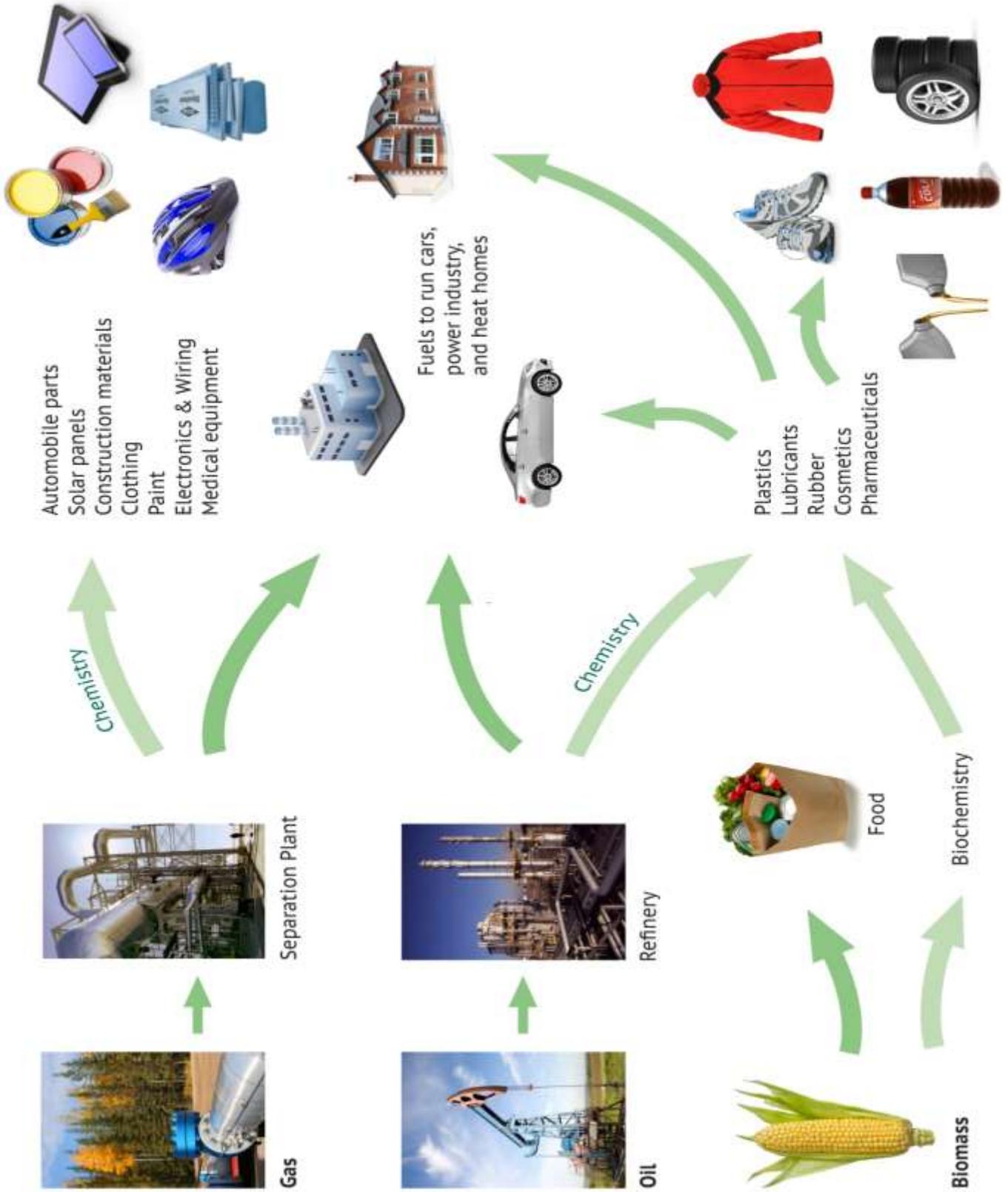
Conclusion

It is the view of CIAC that Canadians need to broaden the dialogue and consider options to further integrate and leverage our energy resources to maximize the benefits to all stakeholders. North America is in the midst of an energy and natural resources renaissance. Not since the early 20th century has such an incredible amount of raw natural resources being found and made their way to market. Innovation among producers has given us the shale oil and gas revolution and investors are keen not to waste this once in a generation opportunity to add value to our natural resources and the chemical sector is at the forefront. Right now, there is approximately \$250 billion worth of chemical projects in various stage of development in North America. Almost all of this investment is taking place in the United States but things do not have to be this way. Canada can attract some of this value-added investment, after all we have the skills, knowhow and the natural resources are at our fingertips, all that we need to do is create the right conditions for investors to choose us!

CIAC members are offering to work with municipal, provincial and the federal government to get the details right. We are prepared to have industry experts work with government experts, to offer choices to industry to realize more value-add resource upgrading and economic diversification in the province.

Natural gas and its associated liquids are the raw natural resources the chemical sector craves. These resources can be exported, consumed, converted or sequestered into a wide multitude of finished goods that enhance the quality of life for Canadians and others in distant markets. CIAC will speak out on behalf of market access diversity in all of its forms, but value added manufacturing should be made a priority and is a solid option for sustainable hydrocarbon development. This is about much more than market diversity; it is about how Canadians can optimize the value of energy and other natural resources. Moving along the energy and resource value chain by utilizing chemistry creates new products, increases wealth and provides opportunities for good careers – and the market diversity chemistry products provide enables sharing a bigger opportunity.

Appendix 1



Appendix 2

Responsible Care® - Our Commitment to Sustainability

CIAC is the national trade association of Canadian chemical manufacturers, representing companies that manufacture basic chemicals and resins. Members range from family-owned companies to affiliates of global enterprises. Together, these companies generate revenues of more than \$27 billion, representing over half of the total chemical sector which also includes fertilizers, pharmaceuticals and formulated products.

Responsible Care is the Association's commitment to sustainability – the betterment of society, the environment, and the economy. Our member operations are bound and guided by the ethics and principles of Responsible Care. A consequence of these ethics, our members constantly innovate for safer, more environmentally-friendly products and processes, and work cooperatively to identify and eliminate harm throughout the entire life cycle of their products. For a more complete description of the ethic and the membership commitment to sustainable development principles, visit www.canadianchemistry.ca.

For more information:

David Podruzny
Vice-President, Business and Economics
Chemistry Industry Association of Canada (CIAC)
350 Sparks Street, Suite 805
Ottawa, ON K1R 7S8
Tel: (613) 237-6215 ext. 229
e-mail: dpodruzny@canadianchemistry.ca

David Cherniak
Senior Policy Analyst, Business and Economics
Chemistry Industry Association of Canada (CIAC)
350 Sparks Street, Suite 805
Ottawa, ON K1R 7S8
Tel: (613) 237 – 6215 ext. 231
e-mail: dcherniak@canadianchemistry.ca