



2018-2019 Research Projects

February 20, 2018

1. ECONOMIC IMPACTS OF OIL SANDS PRODUCTION IN CANADA AND THE US

- As part of an annual update, a forecast of the production of oil sands bitumen and Synthetic Crude Oil will be conducted for 2017-2037. In addition, to updating the production costs in oil sands and production forecast, economic impact analysis will be developed using CERI's Input/Output model for Canadian and U.S. impacts. GHG emissions will also be forecast as will Canadian and US job impacts.

2. ECONOMIC IMPACTS OF CANADIAN CONVENTIONAL OIL AND GAS SUPPLY IN CANADA AND THE US

- As part of an annual update, a forecast of the production of conventional oil and gas production will be conducted for 2017-2037. This will include onshore and offshore activities as well as emerging oil and gas plays. In addition, to updating the production costs and production forecast, economic impact analysis will be developed using CERI's Input/Output model for Canadian and U.S. impacts. GHG emissions will also be forecast as will Canadian and US job impacts.

ECONOMIC IMPACTS AND EMISSIONS PROFILES OF THE PETROCHEMICAL INDUSTRY IN CANADA

This project will consider the economic impacts of the petrochemical industry in Canada. It will also assess the emissions profiles of the various sub-sectors in Canada, the US and Qatar. In assessing the emissions profiles, CERI will examine government emissions policies and potential technologies to reduce emissions.

ECONOMIC AND ENVIRONMENTAL IMPACTS OF METHANE EMISSIONS REDUCTION IN THE NATURAL GAS SUPPLY CHAIN

The production process for natural gas results in venting and flaring activities. Natural gas processing also creates emissions, including those from consumption. This study will quantify the economic and environmental impacts of methane emissions reduction throughout the full supply chain of natural gas. The study will also include a consideration of hydrogen additions to the natural gas stream and methane release and capture from municipal solid waste facilities and other similar locations.

MARKET REVIEW OF NATURAL GAS LIQUIDS EXPORTS

This research will provide an update of NGLs production and assess foreign investment attraction of Western Canadian NGL's for liquids exports to Asia, determine pricing mechanisms and in some cases the lack of transparency in pricing of NGLs. The project will also consider the availability and opportunity of NGLs in Atlantic Canada.

ECONOMIC AND ENVIRONMENTAL IMPACTS OF ELECTRIC VEHICLE TRANSPORTATION SCENARIOS

Fuel sales for passenger and freight vehicles are underpinned by wholesale and retail infrastructure. This investment plus commodity sales has a major impact on the Canadian economy. Without the sale of transportation fuels, these investment costs, commodity sales and tax revenues will have no value. However, changing the transportation system to reduce GHG emissions through new technology adaptation is being proposed as a major mechanism to achieve climate change mitigation goals. Some common examples are fuel switching and electrification of transportation. This study will develop several future transportation scenarios for Canada and provide economic and environmental analyses of them considering factors such as macroeconomic impacts, R&D needs, and infrastructure inertia.

The project will consider two or three jurisdictions including Ontario and Quebec.

AN ECONOMIC ASSESSMENT OF A CLEAN FUEL STANDARD IN CANADA

This research will focus on the economic and environmental impacts of moving to a clean fuel standard in Canada. It will consider the impacts on the agriculture, oil and retail gasoline sub-sectors. The project will document the emissions reduction expected from such a standard and what the impact might be when the implementation of this standard is compared to electrification of the transportation sector.

MULTI ATTRIBUTE EVALUATION OF ELECTRICITY STORAGE SYSTEMS

Electric energy storage (EES) systems are in a rapid development phase. They are considered as critical to enable transitioning to a cleaner a more versatile electric power system. The most commonly cited application of EES is arbitraging variable generating sources such as solar and wind matching them with the demand. However, there are numerous other applications of EES in traditional and modern grids, such as ramping, black start, demand response, voltage support etc. The perceived benefits of EES has led to new EES technology developments, demonstration projects, and research projects that quantify the benefits of EES systems. Despite these developments, implementations of EES systems have been limited to few demonstration projects and a significant uptake of EES has not been observed. The high capital costs of EES systems have been identified as one main barrier for deployment. In addition to the capital costs, other non-technical barriers include some regulatory treatments of EES that may prevent them from tapping into multiple revenue streams and limitations of evaluation methods utilized to quantify benefits of EES.

This study will evaluate the full value of EES by applying a techno economic modeling framework to electric power systems of Canadian provinces. The study intent to provide insights into market opportunities for different storage technologies, attributes of different technologies should carry to provide intended services, and contributions of EES to achieve energy, environmental, and economic goals set by different provinces.

Ongoing Research:

1. Maintenance of CERI Models and Programs

Ongoing maintenance and upgrading of CERI computer models and programs

2. Maintenance of CERI Databases

Ongoing maintenance and upgrading of CERI databases

3. Natural Gas Report

Research and updating of CERI's quarterly Natural Gas report, the results of which are used in other ongoing projects

4. Oil Report

Research and updating of CERI's quarterly Oil report, the results of which are used in other ongoing projects

5. Electricity Report

Research and updating of CERI's Quarterly Electricity report, the results of which are used in other ongoing projects

6. Geopolitics of Energy

Geopolitics of Energy (GOE) is the leading monthly journal on geopolitical developments affecting global energy markets. It provides analysis, information, perspectives and fresh ideas on the political and economic factors affecting energy and their impact on national energy policies, the international environment and prices.

Projects that may be considered in future years:

These projects could be considered in future years and are documented to allow for the topics and scope to continue to develop.

A. A competitive assessment of Innovation in the production processes of shale oil and off-shore deep water oil

- Unconventional oil mainly comes from three sources; Shale Oil, Off-shore Deep Water sources and Oil Sands. Building on the study “Economic and Environmental Potentials and Efficiencies of Oil Sands Operations: Processes and Technologies”, this project will assess the economic and technical potential of innovation in shale and offshore crude production to determine the long-term competitiveness of each.

B. Economic and Environmental Impacts of Value Added Uses of Oil and Natural Gas

- Value added activities for oil and natural gas are limited in Canada compared to other jurisdictions. This project will assess the economic and environmental impacts of different value-added products to the Canadian economy. The focus will be on those provincial economies where oil and gas represents greater than 10% of the economy (Alberta & Newfoundland).

C. Waste to Energy Potential in Canada

- This project will consider the waste to energy potential in Canada. Municipal solid waste and agriculture and forestry residue can be converted into liquid fuels and electricity. The economic and environmental impacts of these processes will be assessed.

D. Perspectives of Canadian Off-shore Oil and Gas Development

- This project will consider the offshore oil and gas reserves in Canada. These areas include the Pacific, Arctic and Atlantic coasts. In some cases, economics is a challenge, other areas have challenging weather conditions to contend with, and still others are challenged by concern over environmental impacts. This project will provide the current perspective of those potential opportunities and identify the major challenges of each. It will also consider how other

jurisdictions are overcoming those specific challenges to protect the environment while promoting economic development.

E. The State of Tidal Power Opportunities in Canada

- Tidal power can play an important role in electricity generation. This project will assess the economic and environmental impacts of expanded tidal power use.

F. Assessment of Future Electricity Transmission system needs in Canada

- This project will assess economics, land use impacts, and the major electricity transmission system requirements to facilitate reliable and efficient operations of Canadian electric power systems. The study will construct a spatially explicit database of electric power system assets—both existing and planned—and electricity demand centers to assess future transmission needs within Canadian provinces. Using this database, the intents to provide insights into investment needs, social and environmental impacts as well as economic development potential.

G. Economic and Environmental Impacts of Electricity Generation from nuclear reactors

- The use of nuclear power is controversial. From uranium mining, to processing through use and storage, stakeholders express concern along the production pathway. This study will assess the new types of reactors as well as the processing cycle to consider the economic and environmental costs and benefits of this electricity generating option.

H. Economic Impacts of Competitive versus regulated electricity markets

- This project will compare the economic benefits and costs of competitive versus regulated generation and transmission markets for electricity. Canada has several models operating that can provide insight into the effectiveness of investment in these different markets. With an increase in investment needed to address transition issues to a cleaner electricity system, decision makers will be interested in understanding how the different markets minimize cost and maximize benefits.

I. Economic benefits and costs of energy efficiency options in Canada

- This project will assess the economic impacts associated with energy efficiency projects as they relate to system planning requirements for electricity and natural gas generation, transmission and distribution systems. It will review the underlying principles of avoided cost, costing of externalities, free riders and free drivers. These concepts would benefit from an update to how they should be evaluated within the economic tests to screen energy efficiency programs. The analysis will also compare the cost effectiveness of energy efficiency

investments in producing employment in Canada compared to energy supply and infrastructure investments.

J. Interprovincial trade in Hydroelectricity: Costs and Benefits

- This project will produce a market assessment of the costs and benefits of maximizing the hydroelectricity resources in Canada to support the decarbonization of Canada's energy systems. The report will assess the intra-provincial challenges to those provinces with sufficient hydro resources to move to a 100% hydro system. The second part of the analysis will consider the firm delivery of hydroelectricity to neighbouring provinces which currently have a significant percentage of fossil fuel generation. The review will also consider how load growth can be managed with these hydroelectricity options.

K. Market Designs for Grids with High Amount of Variable Power Generations

- Many Canadian provinces are setting renewable energy adaptation targets as a mechanism to achieve climate policy goals. Traditional electric power systems and markets are designed to operate with dispatchable generating units. Under such configurations, it is not clear whether the investors will see the certainty to invest on any generating source. This project will evaluate the structure and market designs Test of market designs to incentivize investments in an electric power system with high renewable penetration.

L. Lessons Learned in The Implementation of Renewable and Clean Power Options

- This project will consider the programs in Canada, the US and Germany used to promote the investment in renewable and clean power options. An assessment on the economic investment relative to the least expensive alternative will be calculated to determine the implied carbon price of these policies.

M. Development of a social impact assessment model for energy supply and demand investments in Canada

- This research will build on a socio-economic assessment tool developed by Statscan for use with their input-output model. The project will update the model built by StatsCan and specify relationships between supply and demand investment with respect to education, skills matching, cultural heritage, health, security, community development and affordability to name a few. The project will demonstrate the utility of the model by producing a social impact assessment of select energy infrastructure projects across the country.

N. Environmental and Economic Analysis of Energy Supply Options for Remote and Northern Communities

- Energy supply in Canada's Remote and Northern Communities is challenging. Territorial governments and some provinces face concerns related to supporting energy requirements for residential, and commercial use and to support industrial activities such as mining. This project assesses grid expansions, and local grid options. While, connecting to a transmission grid has clear advantages in terms of lower cost and reliability in supply, there may be missed opportunities in some cases such as remote communities, cases where significant grid enhancements are needed, etc. Local generation may also have job creation opportunities while connection to the grid doesn't really provide job creation long term. Furthermore, revenues stay in the community, if residents are paying their local utility. This study will conduct economic analysis of following case:
 - Connecting a currently off grid community to a grid system
 - Develop local generation in an off-grid community
 - Disconnecting a currently on-grid community and develop local generation

O. An economic potential and GHG emissions forecast of digital technology options and process efficiency for unconventional oil production

- Building on the research completed in 2015-16 and 2016-17, this paper will detail digital technology and process options that can be used in Oil Sands production to reduce energy use per barrel. The objective is to identify economic options that can be deployed to the sector and how those options may reduce overall emissions. Consideration will also be given to how these technologies can be employed in conventional oil and natural gas production.

P. Cost Benefit Analysis of Carbon Capture and Storage Options

- Carbon capture and storage is one approach to reducing carbon emissions of oil and natural gas use. This study will consider the economic and environmental impacts of repurposing carbon emissions to other products and services along with storage.

Q. Development of a clean electricity technology market assessment tool

- This project will produce a market assessment tool for clean technologies in Canada. It will provide analysis of financial benchmarking, economic impacts and market demand for technologies associated with climate change policies in the electricity supply and demand sectors.

R. Environmental Regulations of the Oil and Gas Sector in Canada

- Oil and gas production is a major consideration when determining how to combat climate change. It is also an important sector for the economy. This

study will consider the environmental regulations recently implemented as well as new regulations being discussed to assess their impacts on the economy and the environment. This project will review different climate change emissions reductions policies implemented federally and by provincial or territorial jurisdictions. It will consider the cumulative impact of different climate change management policies and how that would affect the competitive position of Canadian oil and gas industry. This study will compare Canadian regulations to the regulations of the US jurisdictions that have a significant oil and gas industry and assess how export exposed industries might be affected and whether “carbon leakage” should be a consideration.

S. An Economic Impact of Distribution Based Electricity Generation Options in Canada

- This project will consider the issue of distributed generation as it impacts on the operation of electricity grids and investment requirements for electricity distribution systems in Canada. Distributed options such as combined heat and power, self generation and energy cooperatives will be reviewed to determine how these technologies will impact the cost and reliability of grid operations. Different business models will also be considered including gross and net metering and how those models impact monopoly service providers.