Enhancing Canada's Energy Endowments with Interties:

A National Competitive Advantage in a Decarbonizing World

Statements Provided to NRCan Standing Committee on Strategic Electricity Interties

Marc Brouillette

October 2, 2017

STRATEGIC POLICY ECONOMICS

Overview

In making investment decisions on energy interties, the main consideration is whether or not electricity will flow through the intertie, and how much of the intertie's capacity will be used.

This is essentially a demand and supply question. In the context of this committee, the demand question entails crystal ball gazing to the future, a future where we expect decarbonization and fuel switching to impact the demand for electricity. The supply question is what kind of generation should or will get built and where.

The concept I bring to the committee is that Eastern Canada (including Manitoba) has three distinct energy endowments. These endowments could represent a national competitive advantage for this country. Interties could augment this competitive advantage.

The opportunity is predicated on three factors:

1. DEMAND AND INTERTIE ECONOMICS: Today, demand for electricity has a daily and seasonal profile that inherently reduces transmission and distribution asset utilization and hence their economic use. Today, interprovincial intertie investments are not warranted for Ontario. However, in the future, demand will not only grow but will also change the daily and seasonal load profile presented to transmission assets and the requirements on new supply.
2. ENERGY ASSETS: Eastern Canada's hydro and natural gas storage capacities are both akin to grid scale seasonal batteries. Ontario's nuclear advantage could be the generation that supplies the batteries and cost effectively optimizes the development and/or leverage of the batteries.
3. THE U.S.: Demand in the northeastern U.S. will rise with emission reduction, much like Ontario's will, and the U.S. has fewer supply options.

Collectively viewing the requirements for new supply, transmission asset optimization, and the U.S. need for clean energy could enable a unique low-cost source of electricity for domestic use in Canada and for exporting electricity and gas-from-electricity to the U.S., if Canada is smart about it.

Demand and Intertie Economics

The nature of the existent demand and supply balance can dramatically shape whether or not an investment in interties makes economic sense. My studies show that for the next 8 years, due to surpluses in both Ontario and Quebec, there is no domestic energy cost advantage for intertie development or even enhancing any trade agreements between Ontario and Quebec [Strapolec, August 2017].

I agree with Climate analysts that fuel switching will lead to electrification. Meeting Ontario's 2030 emission targets will require 60% more electricity than used today, even while taking advantage of energy efficiency innovations [Strapolec November 2016]. Much of this demand will be in winter.

Demand for electricity has two inherent characteristics that are counter to a goal of optimizing the economic value of an intertie:

1) Daily Demand – Challenge #1:
    a. The IESO has stated that because of the daily demand profile, the value of interties for emission reduction purposes is limited to only a few hours a day, [IESO May 2017]. The net effect is less than 25% of the intertie capacity is productively used.
    b. At such low utilization rates, interties could add over $60/MWh to the cost of electricity, almost doubling the cost of the delivered power [Strapolec, June 2016].

2) Seasonal demand – Challenge #2:
    a. In an electrified world, seasonal variation in demand for electricity is significant.
        i. In Quebec where most buildings are electrically heated, winter demand for electricity is approximately 65 percent higher than it is in the summer.
    b. The only clean electricity supply that matches the electrified winter heating seasonal profile is large reservoir hydro, such as what Quebec has.
        i. However, Quebec does not currently have the generation capacity in winter to serve even its own needs [CCRE May 2017].
        ii. To supply the expected Ontario winter growth in demand requires new capacity to be built either in Ontario or elsewhere.
    c. If the new supply is built in Quebec, for example, new interties would be needed to get the electricity to Ontario.
        i. However, the seasonal demand profile suggests these new interties will only be utilized to capacity for three months of the year.
        ii. Under an energy independence framework, if the new supply were to be built in Ontario, the need for interties could be annulled.

Supply Choices can Hurt or Help

Whether or not interties make sense in the future depends on whether there will be sufficient new demand on the "grid" to justify an acceptable utilization of the intertie assets. This outcome is a function of the nature of the new demand and where the new generation is built.

Two of the most talked about clean energy alternatives have opposing benefits regarding the implications on interties: Wind and Solar/Battery Distributed Energy Resources (DER).

Intermittent supplies that have been and are being built are counter to an efficient use of intertie capacity. For example, wind generated electricity output is not aligned with demand.

- Wind generation needs a backup capacity. This need for backup applies equally to interties. Wind generation in Ontario has reduced the utilization of the interties for importing electricity to Ontario from Quebec by 15% to 20% -- but without reducing the needed intertie capacity [Strapolec June 2016]. Wind depletes the pipe.

Distributed Energy Resources (DER) may alter the daily demand profile.

- The most significant advantage of distributed energy resources, such as the solar-battery combination, is the ability to couple them with distribution company controllers to effect

> demand side management. The outcome of these "optimizing technologies" is to effectively flatten demand from the grid across the daily cycle. This flattening of demand leads to a higher utilization of the distribution and transmission assets. [Strapolec, December 2016].

Most studies on deep decarbonization in Canada include a significant amount of new hydro and nuclear in the supply mix [Canada, 2016]. As an example, the Trottier report considered the lowest cost alternatives for each jurisdiction. Most of the Trottier report simulations assumed that all economically feasible hydro will be developed in the next 20 years, and then identified a significant amount of new nuclear generation to complete the electrification required. Whether hydro is a lower cost alternative than nuclear remains to be seen. While the current HQ project at LaRomaine appears to be on track, the experiences at Site C, Muskrat Falls, and the Keeyask dam have led to higher than expected costs.

Canada's Energy Infrastructure advantage

Canada's endowments of hydro, public acceptance of nuclear power, and natural gas storage systems are a potential competitive advantage to Canada's economy.

HYDRO: It is well understood that potential remains for further development of hydro capacity in eastern Canada. Large hydro's ability to respond to both daily demand with fast ramping as well as the winter season peak makes it a highly desirable supply type.

NUCLEAR: Canada's nuclear advantage includes two significant factors: (1) the generally high level of public acceptance that could allow Canada to pursue nuclear rollout sooner than other jurisdictions; and (2) Canada's nuclear supply chain is large and actively engaged in the western world's largest nuclear investment suggesting a higher likelihood of nuclear project success → it is a well oiled machine.

NATURAL GAS STORAGE: Less widely discussed is the important role that Ontario's natural gas storage capacity can play in decarbonization. The large storage caverns accumulate natural gas when heating is not required and then provide the natural gas in winter. Those storage assets also provide natural gas to neighboring jurisdictions such as Michigan. These storage assets can be used to collect renewable natural gas and hydrogen to blend down the carbon content of natural gas. Electricity is required for the clean production of both.

Combined, these hydro, nuclear, and natural gas assets are a unique capability. Hydro is a battery that provides daily and seasonal flexibility. Natural gas storage is a battery to address the winter season. Nuclear is a baseload supply that can be constantly filling up these "batteries" when they are not needed. With a future flattened demand profile from DER, these assets can further flatten the seasonal demand requirements on the grid and providing significant economies to eastern Canada's energy system by increasing the utilization of existing transmission, distribution, and storage assets [Strapolec, December 2016].

The U.S.

I believe the topic relevant to informing intertie investment decisions is the clean energy situation south of the border. The U.S. will be challenged to find supply options to meet the long-term emission reduction objectives.

The north-eastern U.S. and great lakes region have far fewer energy options at their disposal than does eastern Canada. The options available to the north-eastern U.S. for meeting a significant clean electricity demand growth are limited to such things as wind, solar, and batteries. The high latitude climate of these regions inhibits reliance on solar that other jurisdictions may capture. To meet climate objectives in the north-eastern U.S., baseload solutions are needed -- baseload solution that fill up the transmission pipes.

Canada's hydro/nuclear/gas advantage is likely a lower cost and perhaps even the only option for these U.S. jurisdictions. How Canada's assets may get developed to provide a competitive advantage for exporting energy to the U.S. should be a key consideration in decisions regarding the development of intertie capacity.

For example, it may make sense to build a large capacity of baseload nuclear power that can:

(1) be wheeled through Quebec to maximize the benefit of Quebec's vast hydro storage capacities; and

(2) be used to generate hydrogen, support renewable natural gas production, and store clean fuel for building heating using Ontario's vast natural gas storage capacities.

Closing

Eastern Canada has a unique triad of energy endowments that if planned in a holistic manner to optimize demand on the grid can create an energy advantage to Canada's economy and an export of energy.

A note on wind as a generator to support the hydro battery

Wind energy can also act to charge the hydro battery by filling up the hydro reservoirs. To effect intertie efficiencies, the wind supplies would need to be collocated within the same jurisdiction as the hydro. When this can be done, such as in Quebec, this is a great solution. In general, however, wind located remotely from the hydro assets reduces the utilization of the transmission/distribution infrastructure that would connect them. The wind intermittency deficiency could be overcome with a co-located storage. The storage, however, would need to have at least seven days of storage capacity and would still require a backup for reliability reasons. The closest candidate today is pumped storage. Given the sheer magnitude of capacity that is required, land use, siting, and cost implications should be considered. I don't address wind here as it provides no competitive advantage to Canada as all jurisdictions have access to the same options.

Appendix A - References and Bibliography

Canada: Canada's Mid-Century Long-term Low Greenhouse Gas Development Strategy. 2016

CCRE: CCRE Commentary, Buying Electricity from Quebec, M.Brouillette, April 2017

IESO: Ontario-Quebec Interconnection Capability, A TECHNICAL REVIEW, May 2017

Strapolec: Renewables and Ontario/Quebec Transmission System Interties, June 2016

Strapolec: Ontario's Emissions and the Long-Term Energy Plan: Phase 1, November 2016

Strapolec: Ontario's Emissions and the Long-Term Energy Plan: Phase 2, December 2016

Strapolec: Ontario/Quebec Electricity Trade Agreement: An Implications Assessment, August 2017

Contact Information

Strategic Policy Economics

Marc Brouillette
Principal Consultant
(416) 564 - 4185
marc@strapolec.ca
www.strapolec.ca