Power Advisory LLC

September 18, 2015

To: Clients and Colleagues

From: Jason Chee-Aloy, Power Advisory LLC

RE: High-Level Commentary on IESO Planning Update: Preliminary Long-Term Outlook for Ontario Supply and Demand and Context for Planning

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At the August 13, 2015 Independent Electricity System Operator (IESO) Stakeholder Advisory Committee (SAC) meeting, the IESO presented a planning update, *IESO Planning Update: Preliminary Long-Term Outlook for Ontario Supply and Demand and Context for Planning*[1], that put into context future Ontario power system needs with respect to changes from the Government of Ontario's initial Long-Term Energy Plan (LTEP) (December 2013).

**Main IESO Planning Update Conclusions**

There were five main conclusions made by the IESO, as conveyed within their planning update.

1. Ontario will need additional capacity supply in the coming years.
2. The need for additional capacity supply grows when the Pickering nuclear generation station (GS) retires.
3. The need ranges in the ballpark of 2,000 MW to 3,000 MW.
4. The need is for capacity supply to meet peak energy demand needs in the summer and provide dispatchability/flexibility all year round.
5. The rate and pace of change in the coming decade will be significant.

The IESO stated that they have already commenced a more complete assessment of Ontario's future power system needs. Power Advisory believes this more complete assessment will be a key input to the Government of Ontario's next iteration of the LTEP. Power Advisory believes that the next iteration of the LTEP will be concluded by the end of 2016.

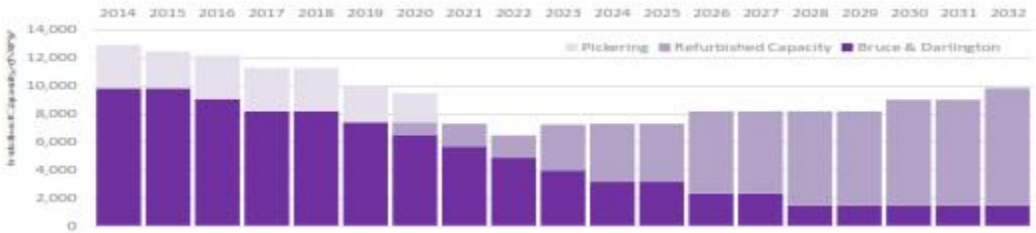
[1] See http://www.ieso.ca/Documents/consult/sac/sac-20150813-Planning-Update.pdf

**Ontario's Future Power System Needs Mainly Driven by Nuclear Generation Retirements and Refurbishments**

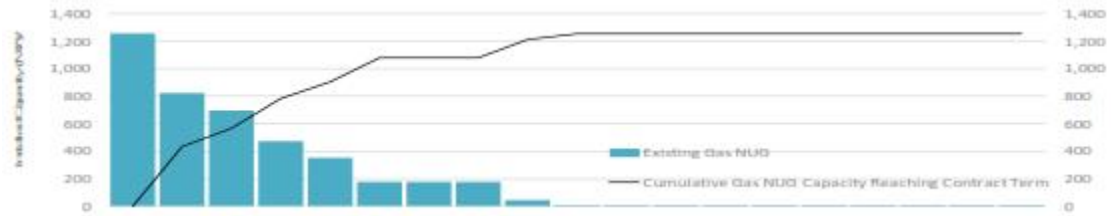
As shown in the graphic below, energy consumption and peak energy demand are projected to grow only moderately. Therefore, energy demand is not expected to drive future power system needs for increased capacity supply in Ontario.


The graphic below shows that the retirement of the Pickering GS along with refurbishments of applicable generating units and the Darlington GS and Bruce GS will mainly drive the projected capacity supply shortfall. The total nuclear generation capacity that will retire or undergo refurbishments is approximately 10,000 MW. From the graphic below, it appears that Pickering GS will be retired in 2020[2], and the refurbishments at Darlington and Bruce GS will commence around late 2016/early 2017. While Ontario Power Generation (OPG) has not made any formal announcements of when the Pickering GS will retire, a 2020 retirement date is a change from the 2018 retirement date indicated in the LTEP.

[2] The 2020 Pickering GS projected retirement date was used by the IESO in *NUG Framework Assessment: Opportunities for Non-Utility Generators to Compete in Meeting Anticipated System Needs – Analysis and Recommendations* (September 1, 2015)

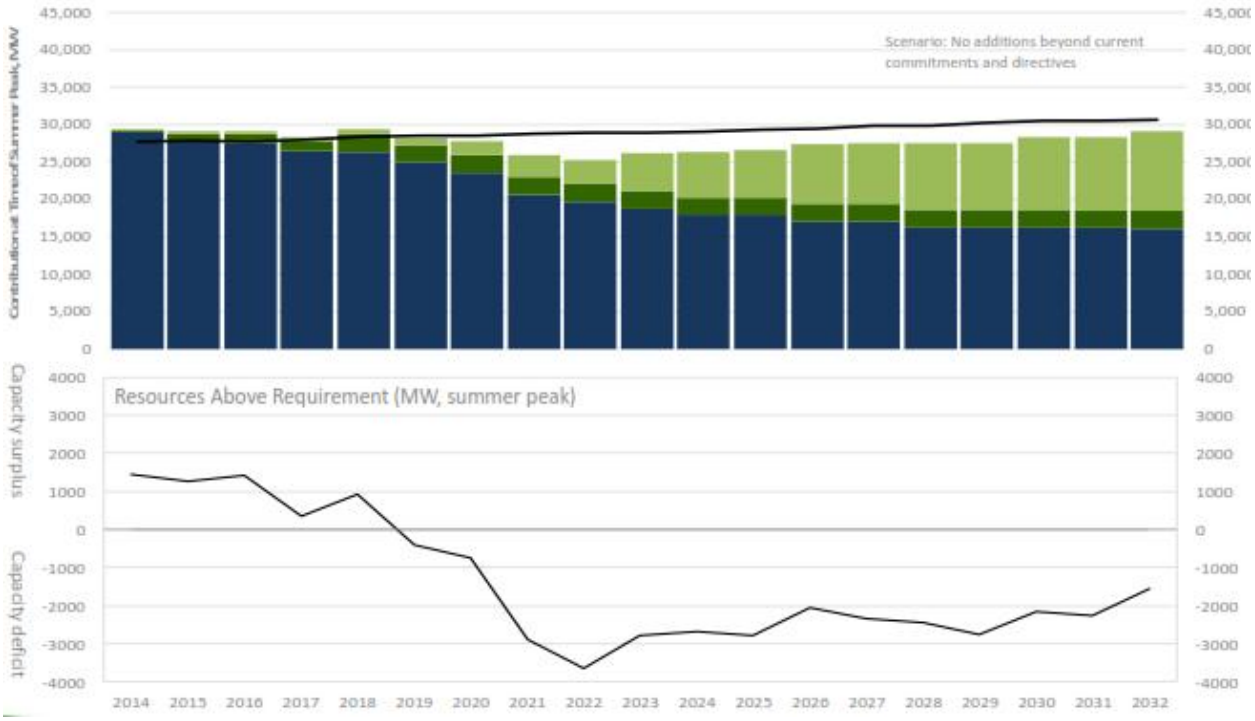



In addition to less nuclear generation capacity, in the graphic below, the IESO indicated that Non-Utility Generators (NUGs) (mostly gas-fired) could pose capacity supply risks as Power Purchase Agreements (PPAs) expire, which largely coincide with the timing of nuclear generation retirements and refurbishments. While future operation of NUGs with expired PPAs is unknown, Power Advisory believes that the IESO did not include NUGs with expired PPAs as available and operating capacity supply within their assessment of the Ontario's future capacity supply needs. This treatment of NUGs with expired PPAs is consistent with the treatment of NUGs within the LTEP (i.e., NUGs with expired PPAs were not counted as available and operating capacity within the LTEP).




Therefore, the cumulative effects of the supply risks identified above are shown in the graphic below that conveys the projected 2,000 MW to 3,000 MW capacity supply need generally starting around 2020 and lasting until around 2032. Despite what the graphics show, in the IESO's *NUG Framework Assessment: Opportunities for Non-Utility Generators to Compete in Meeting Anticipated System Needs – Analysis and Recommendations* (September 1, 2015)[3], the capacity supply need date is stated to start in 2021.

[3] See http://www.ieso.ca/Documents/generation-procurement/NUG-Framework-Assessment-Report.pdf




The graphic below shows the changes from the LTEP to the IESO's recent planning update, where the changes effectively push the need date for capacity supply from 2018 to approximately 2020/2021 mainly driven by a later retirement of the Pickering GS, re-contracting of nine NUGs totaling approximately 550 MW, and the short-term supply arrangement contract for approximately 500 MW recently executed between Ontario and Quebec.

The IESO lists the following five factors that may change the projected Ontario capacity supply shortfall.

1. Outcomes of negotiations between the IESO and Bruce Power for the refurbishments of applicable generating units at the Bruce GS.
2. Outcomes of negotiations for re-contracting NUGs.
3. Policy decisions on as-yet uncommitted renewable generation resources.
4. Pace of growth in resource requirements shaped by energy demand growth and degree of conservation and demand management (CDM) target achievement.
5. Timing and duration of actual versus planned refurbishments regarding the applicable generating units at the Darlington GS and the Bruce GS.

In order to assist the more complete assessment of Ontario's future power system needs, the IESO posed the following questions to stakeholders at the August 13, 2015 SAC meeting.

- What are the key issues and themes of the day, of the future?
- How to incorporate analysis of uncertainty and risk into long-term planning?
- How can the IESO effectively solicit stakeholder input?
- Any other advice?

**Power Advisory Commentary**

- Overall, Ontario's capacity supply shortfall and therefore supply needs are inevitable due to future retirements and refurbishments of applicable nuclear generating units. Therefore, Ontario will require at least 2,000 MW to 3,000 MW of capacity supply between approximately 2020 and 2032.
- There have been no updates to the nuclear generation refurbishment schedules from the LTEP – now almost two years without any updates. Therefore, the chances of these refurbishment schedules being pushed out seems to be reasonable especially since OPG has not yet made any formal announcements regarding updates to the refurbishment schedule of the Darlington GS and no announcements of conclusion of a contract between Bruce Power and the IESO to define the parameters of the refurbishment of applicable generating units at the Bruce GS. Therefore, there seems to be some risks to refurbishments commencing later than planned in the LTEP. If this were the case, Ontario may not require additional supply capacity until after 2020/21.
- Considering the most recent refurbishments of CANDU nuclear generating units (e.g., Bruce GS, Point Lepreau in New Brunswick), there appears to be a strong likelihood that refurbishments of the applicable generating units at the Darlington GS and the Bruce GS will experience cost overruns and delays. If cost overruns and/or delays occur, there could

be less appetite to refurbish all generating units as planned. The LTEP listed a series of conditions the refurbishment program must meet in order to refurbish all generating units, including off-ramps. Therefore, if not all nuclear generating units are refurbished, the projected capacity supply needs of 2,000 MW to 3,000 MW will increase.

- In part based on the IESO's assessment of NUGs, *NUG Framework Assessment: Opportunities for Non-Utility Generators to Compete in Meeting Anticipated System Needs – Analysis and Recommendations* (September 1, 2015), it does not appear that the IESO will re-contract for many NUGs (if any) in the future especially considering projected oversupply until at least approximately 2020. Further, the IESO has slowed down stakeholder engagement regarding development and implementation of a Capacity Auction (i.e., Capacity Market) and defining 'capacity' for purposes of inter-jurisdictional trades. Therefore, there does not appear to be a clear path for NUGs whose PPAs are due to expire over the next few years to secure revenues outside of the wholesale energy market, where revenues from the wholesale energy market project to not be sufficient to cover operating and maintenance costs for NUGs no longer under PPAs over the next several years. If this situation arises, some NUGs whose PPAs expire may cease to operate[4].
- Given the retirement of all coal-fired generation in Ontario, coupled with the intermittency of energy output from wind and solar generation (i.e., variable generation) which has an increased share of Ontario's supply mix, most of the projected capacity supply needs should be met by generation and CDM resources that have dispatchability and flexibility attributes.
- Considering the future capacity supply needs, the timing to meet these needs, and the risks to meeting these needs, there appears to be only so many resource options to meet these needs. CDM, including demand-response, are already accounted for within the IESO's resource assessment and within the LTEP. Coal can no longer be used for the production of electricity due to Ontario law. The Ontario Government has declared a pause on any potential new nuclear generation development. However, the following resource options can be developed to help meet Ontario's future capacity supply needs but all have pros and cons for their future development and operations.
    - Gas-fired generation is probably the most cost effective supply option considering the price of natural gas and increased supply from shale gas, combined with its dispatchability/flexibility attributes. However, based on past Government actions to cancel contracted gas-fired generation projects there will likely be regulatory challenges to developing new gas-fired generation projects in the future. In addition, increases to the gas-fired generation capacity in Ontario will increase greenhouse gas

[4] Some NUGs have already ceased to operate following expiry of respective PPAs. For example, in October 2014 Brookfield Renewable Power announced plans to decommission its 110 MW gas-fired NUG facility (Lake Superior Power) in Sault Ste. Marie after failing to re-contract with the former Ontario Power Authority. Lake Superior Power has since mothballed.

emissions (GHG) which could run counter to some of Ontario's environment initiatives (e.g., a too be developed cap-and-trade system) and policy objectives.

- Due to specific Ontario Government policies (e.g., Green Energy and Green Economy Act (2009)) the uptake of variable generation has been significant over the last several years. As a result, many of the wind-rich locations have already been developed and land restrictions act to temper ground-mount solar generation development. Despite the IESO dispatching transmission-connected variable generation, their fuel sources are still intermittent therefore not affording relative flexibility when compared to other resource options. Further, the costs of variable generation are still relatively expensive. However, Ontario's renewable energy and environmental policies still provide rationale to pursue more variable generation and renewable generation from other sources (e.g., bio-energy, hydro, etc.).
- Despite its dispatchability and flexibility attributes, the potential to develop hydroelectric generation capacity is limited due to site feasibility and location. Regarding location, new transmission will need to be developed to accommodate energy demand in southern Ontario considering that the majority of untapped hydroelectric potential resides in northern Ontario. New hydroelectric generation coupled with new transmission likely results in relatively expensive projects with long lead and development timelines.
- Distributed generation (DG) utilizing various fuels (e.g., natural gas, solar, etc.) that may be coupled with various technologies (e.g., storage, etc.) continue to be developed but are relatively small in size. Technological advances continue resulting in declining costs to produce energy from many DG sources but many regulatory barriers still remain.
- The Ontario Government has begun discussion with Hydro Quebec for the potential to secure multi-year contractual arrangements for energy supply from Quebec and the same with Nalcor for energy supply from Newfoundland and Labrador. While both jurisdictions can provide hydroelectric energy (assuming sufficient generation capacity is exists in the future or is developed within Quebec and/or Newfoundland and Labrador), the cost to secure supply from these jurisdictions may be similar to forward electricity prices in New York and New England. That is, any contracted price for energy supply to Ontario will likely be priced based on U.S. northeast markets to which Hydro Quebec and Nalcor have experience exporting into. As a potential consequence, importing energy from Quebec and/or Newfoundland and Labrador under multi-year contractual arrangements may be relatively more costly than development of supply resources within Ontario.

- The IESO within their more complete assessment of Ontario's future power system needs and the Ontario Government through the next iteration of the LTEP must take into account

additional policies and markets within their planning models and policy choices. Climate change and technology are likely the main areas needing significant consideration. For example, Ontario's to be developed cap-and-trade system will effectively yield a carbon price which then changes the economics and costs of various resource options that could effectively meet Ontario's future power system needs and capacity supply needs. Other examples are the technological advances bringing new real-time products to energy consumers that help manage energy consumption either by lowering energy demand and/or self-supplying energy.