Power Advisory LLC

September 9, 2016

To: Power Advisory LLC Clients and Contacts

From: Jason Chee-Aloy, Power Advisory LLC

RE: Summary and Commentary on IESO's Ontario Planning Outlook

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On September 1, 2016, the Independent Electricity System Operator (IESO) released the Ontario Planning Outlook (OPO) serving as the IESO's technical report on Ontario's power system. The OPO represents the IESO's planning outlook for the 2016 through 2035 period.

The OPO was developed in response to the June 10, 2016 request from the Ontario Minister of Energy for a technical report from the IESO pursuant to Section 25.29 (3) of the Electricity Act, 1998 on the adequacy and reliability of Ontario's electricity resources in support of the Ontario Government's development of the Long-Term Energy Plan (LTEP). Plans for the Ontario Government to engage stakeholders on development of the LTEP are expected to be announced in the coming weeks, with the new LTEP (LTEP 2017) likely finalized during the first half of 2017.

Our summary and commentary is divided into two main sections. First, the key components of the OPO are listed along with Power Advisory LLC's commentary in order of the main sub-sections of Section 3 (Electricity System 20-Year Outlook) contained within the OPO. Second, we draw a high-level general summary and conclusion of the OPO.

I. OPO KEY COMPONENTS AND COMMENTARY

From the outset of the OPO, it states that Ontario's power system is well positioned to continue to meet Ontario's future needs, while at the same time adapting to significant change across the sector. Over the past decade, the coal-fired generation fleet has been retired and replaced with wind, solar, bioenergy, waterpower, refurbished nuclear, and gas-fired generation. These resources, combined with investments in conservation and demand management (CDM) and transmission, have addressed the reliability concerns from a decade ago, have reduced greenhouse gas (GHG) emissions in Ontario's electricity sector by more than 80%, and with current planned investments will help to meet the province's needs well into this planning period (i.e., 2016 to 2035).

The figures below show changes to Ontario's installed generation capacity and energy production from 2005 to 2015.

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Figure 1: Ontario Installed Supply Mix in 2005 and 2015

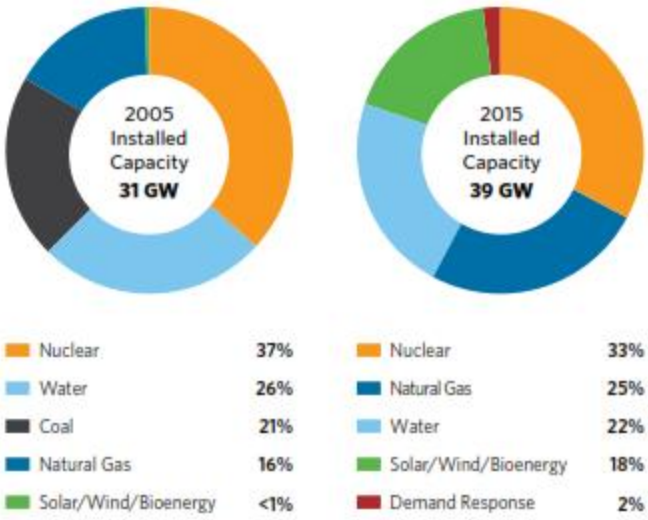
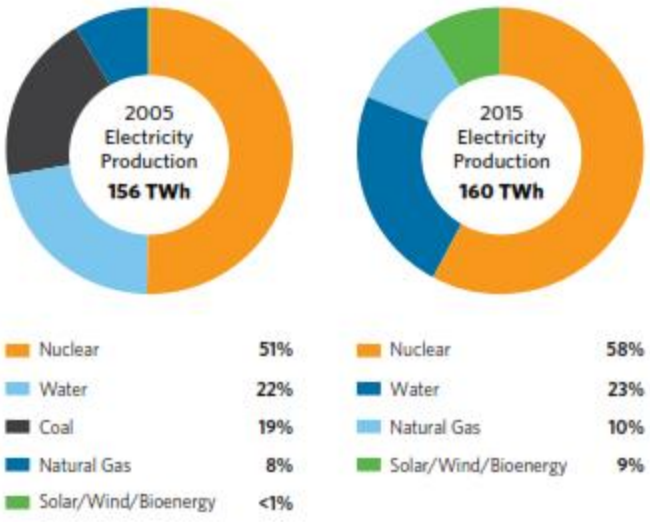


Figure 2: Ontario Electricity Production in 2005 and 2015[1]

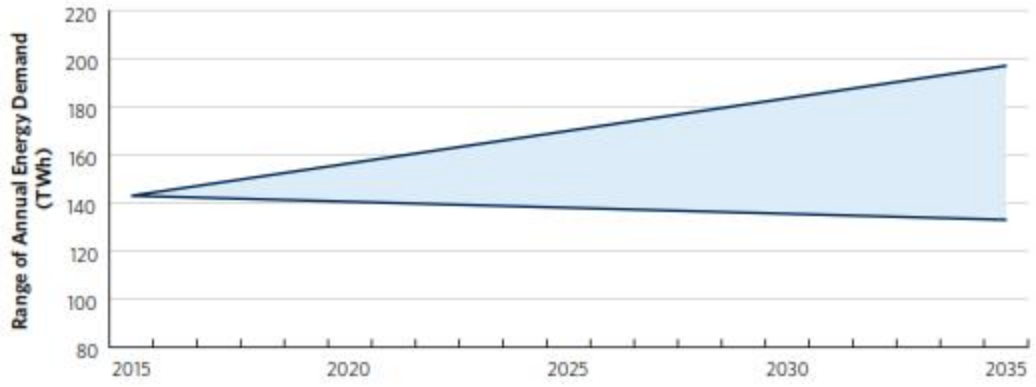


1. Demand Outlook

- The IESO acknowledges that much uncertainty exists with Ontario's electricity demand outlook due to factors such as economic growth, demographics, energy and environmental policies, etc.

- For the 2016 to 2035 planning period, the IESO derived a range of electricity demand outlooks from 133 TWh to 197 TWh in 2035 compared to 143 TWh in 2015. This obviously represents a very wide range of potential electricity demand levels over the next twenty years. It is noted that all IESO demand outlooks account for the Ontario Government's Climate Change Action Plan (CCAP).

Figure 7: Demand Uncertainty



- Because of the very uncertain outlook for electricity demand, IESO utilized four different outlooks attempting to capture different future demand scenarios. Listed below is a brief description of the four demand outlooks.
    - Outlook A represents declining demand from 2015;
    - Outlook B represent a flat demand outlook essentially maintaining 2015 demand levels; and
    - Outlooks C and D are higher demand outlooks driven by different levels of electrification mainly associated with the CCAP.

Figure 8: Ontario Net Energy Demand across Demand Outlooks

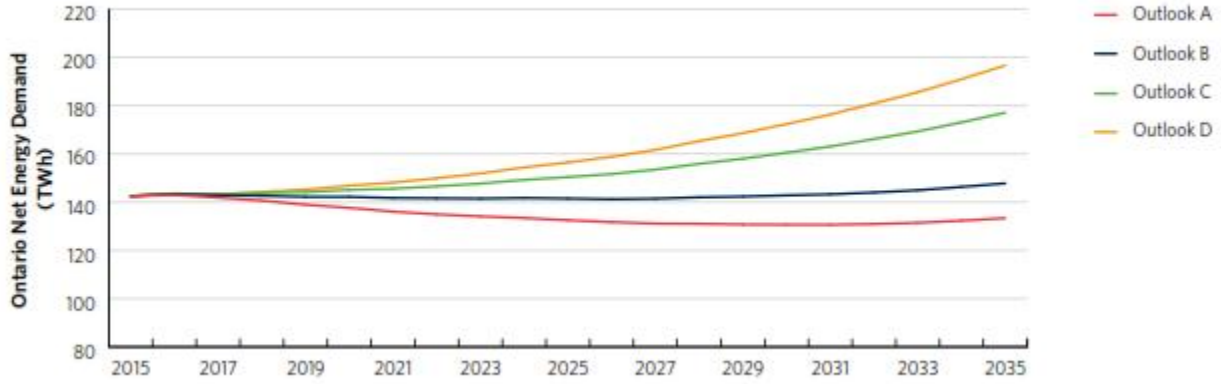


Figure 9: Ontario Net Summer Peak Demand across Demand Outlooks

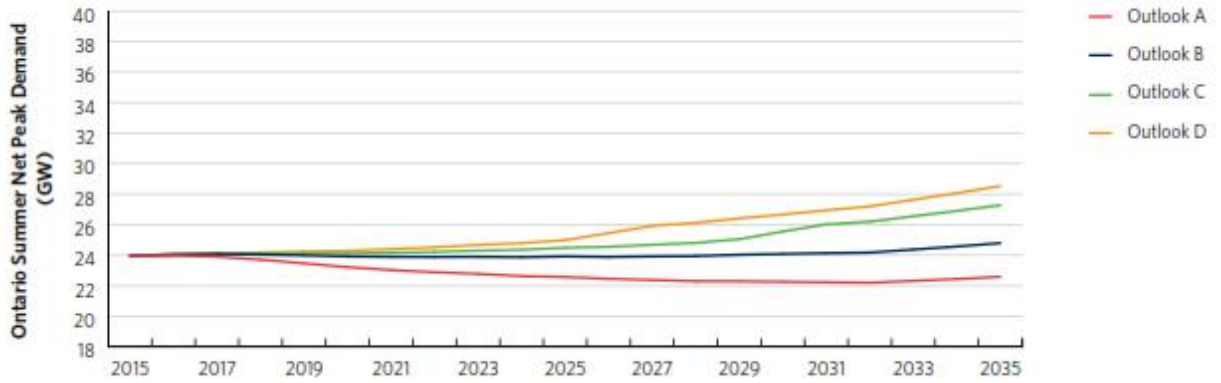
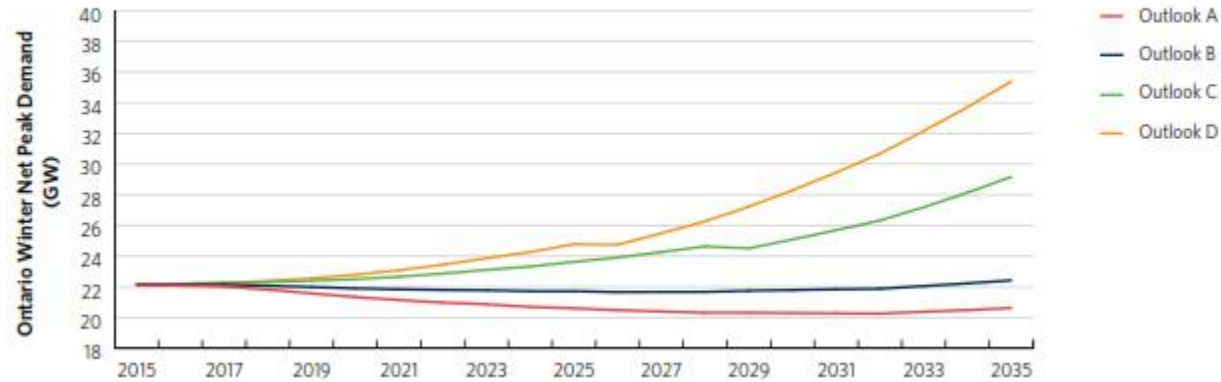


Figure 10: Ontario Net Winter Peak Demand across Demand Outlooks



- As expected, Outlooks C and D show electricity demand increasing over time resulting from the impacts of increased electrification. Due to the potential future impacts of electrification, Ontario could once again become a winter peaking jurisdiction (i.e., prior to

the early 2000s, Ontario was historically winter peaking but has been summer peaking since the early 2000s to the present).

Power Advisory LLC Commentary

Considering that the range of electricity demand outlooks is very wide, the IESO should provide additional data and information relating to the inputs used to derive the demand outlooks. This will provide stakeholders with much more insight that can be used towards planning their business decisions and strategies and help them determine the plausibility of each demand outlook.

While this point may be on surface semantic in nature, we believe the IESO has purposely used the term 'outlook' regarding future electricity demand and therefore made conscious decisions not to use terms like demand 'forecasts'. We believe this suggests that the IESO may have used some qualitative judgements regarding inputs and/or results of the demand outlooks in order to more clearly show four distinct future demand scenarios and their potential outcomes.

The IESO only conveyed net electricity demand outlooks within the OPO's main sections and not conveyed or performed any analysis regarding gross demand outlooks (i.e., not taking into account impacts of CDM, distributed energy resources (DERs), etc.). Perhaps this was done to support the IESO's foundational position that 30 TWh of CDM is being planned to be achieved by 2032. Gross demand outlooks should have been factored into the OPO so as to better assess risks to meeting Ontario's future demand requirements.

The IESO only assessed global electricity demand outlooks for the entire province and did not assess any local or regional future electricity demand and applicable needs or requirements. Considering the distinct electrical characteristics of specific regions within Ontario's power system (e.g., Greater Toronto Area, etc.) future local or regional power system needs will on balance be relatively specific when compared to the global needs for all of Ontario. Perhaps the IESO's regional planning exercises will address local and regional needs, but it is not clear how the OPO or the forthcoming LTEP 2017 will integrate with regional planning exercises.

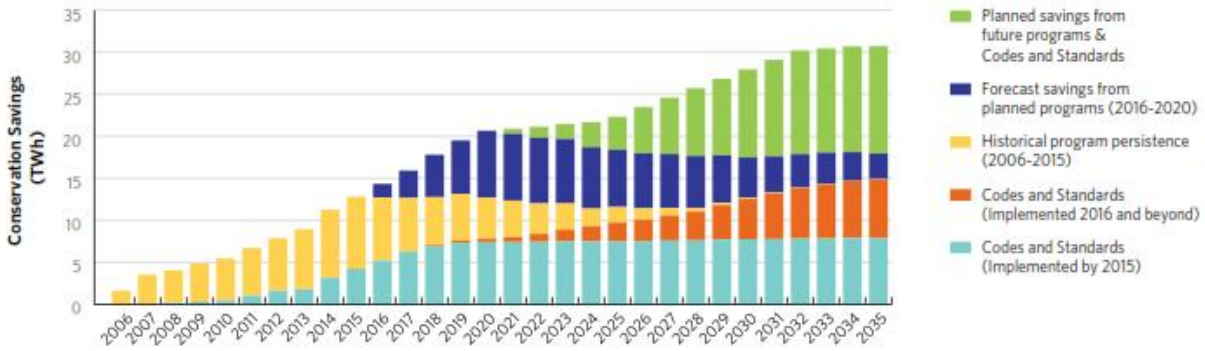
Moving forward, LTEP 2017 should define a base case demand forecast that conveys the most likely future electricity demand scenario based on what is presently known and projected. If done, this should provide a stronger basis for stakeholders to assess potential future electricity demand in Ontario. Along with a base case, LTEP 2017 should provide alternate demand forecast scenarios.

2. CDM Outlook

- The electricity demand outlooks above are all net demand outlooks and not gross outlooks. That is, the IESO has accounted for the impacts of CDM and DERs on gross demand.

Therefore, the IESO's planning assumption is that the LTEP 2013 CDM target of 30 TWh by 2032 and the near-term target set in the Conservation First Framework and Industrial Accelerator Program of 8.7 TWh by 2020 are both accounted for within all four demand outlooks. The figure below shows that IESO's future breakdown of how these CDM targets are planned to be achieved.

Figure 11: Conservation Achievement and Outlook to Meet the 2013 LTEP Target



- In June 2016, the IESO completed an Achievable Potential Study (APS) to assess CDM potential in Ontario. The APS concluded that within current budget assumptions, approximately 7.4 TWh of CDM can be achieved by local distribution companies (LDCs) by 2020, and in the longer term about 19 TWh can be achieved by distribution- and transmission-connected customers by 2035. The APS also acknowledged that incremental CDM could be achieved above these projections with a higher budget.

Power Advisory LLC Commentary

In order for the OPO to be a true technical report, the IESO should more rigorously assess the likelihood of meeting planned CDM targets. The CDM target of 30 TWh represents is aggressive and it appears that the APS supports this point. Therefore, if the CDM target for 2032 is not met, the IESO's net electricity demand within all outlooks will be higher than what's been conveyed in the OPO.

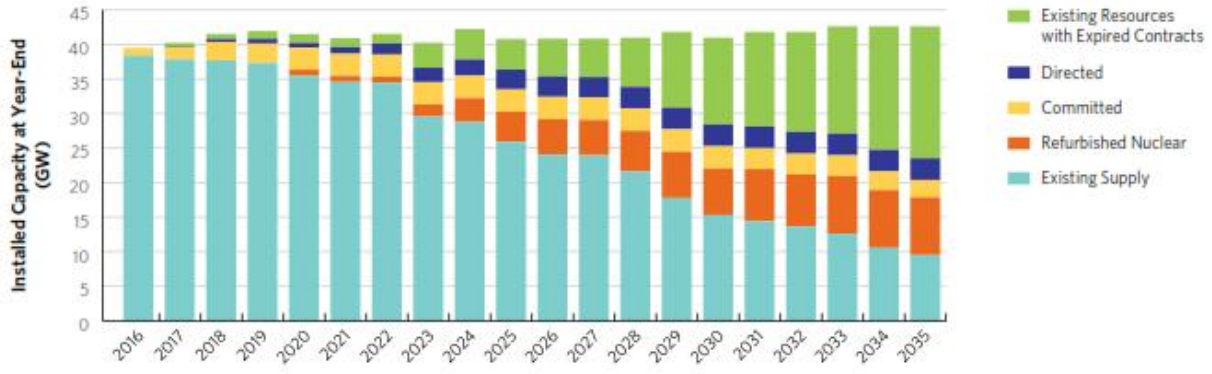
The components projected to comprise the CDM target of 30 TWh by 2032 should be more rigorously assessed in order to provide stakeholders with a better understanding of CDM's efficacy and therefore any potential for CDM policies and/or targets to be modified in the future.

Overall, the efficacy of CDM will impact future net electricity demand, which could then impact the resources that may be needed to meet Ontario's power system needs (both in timing and quantity regarding system needs).

3. Supply Outlook

- From the present time and at least until the retirements and refurbishments of applicable nuclear generating units begin, the IESO states that Ontario is in a strong position to reliably address any of the demand outlooks presented in the OPO, and this starting position is shaped by three factors:
    - The combined capability of resources that exist today ("existing resources") (i.e., resources presently in commercial operation);
    - Resources that have been procured but are not yet in-service ("committed resources") (e.g., generation projects under IESO contracts, still in development, and have not yet reached commercial operation); and
    - Resources not yet procured or acquired but have been directed to meet Ontario Government policy objectives outlined in the LTEP 2013 and elsewhere ("directed resources") (i.e., generation projects not yet procured (e.g., under contracts) but have been identified for future development (e.g., as indicated within LTEP 2013, applicable Ministerial Directives to IESO, etc.)).

Figure 12: Outlook for Installed Capacity to 2035



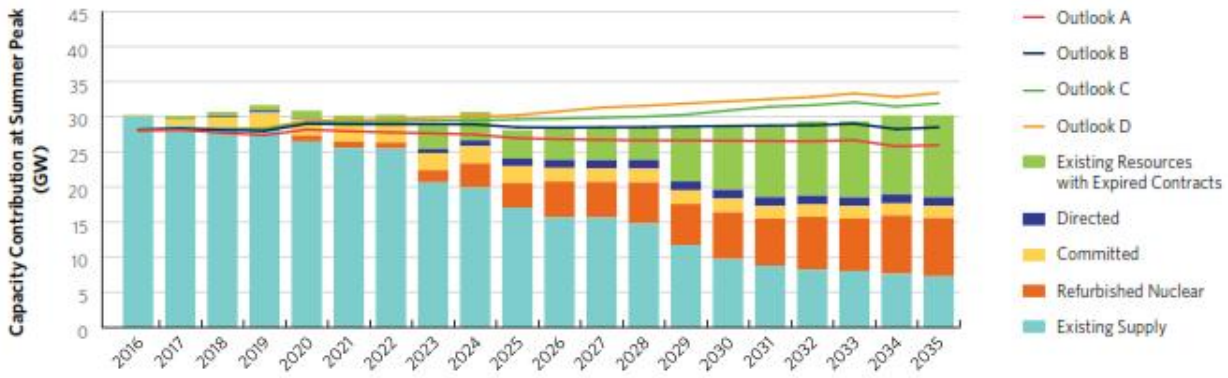
- As indicated in the figure above, if all existing generation resources were to continue to operate after the expiry of their contracts (i.e., contracts with the IESO and contracts with the Ontario Electricity Financial Corporation (OEFC)), and if refurbishments of applicable nuclear generating units at Bruce generating station (GS) and Darlington GS along with committed resources and directed resources come into service as scheduled, Ontario will have a total installed capacity of nearly 43 GW by 2035.

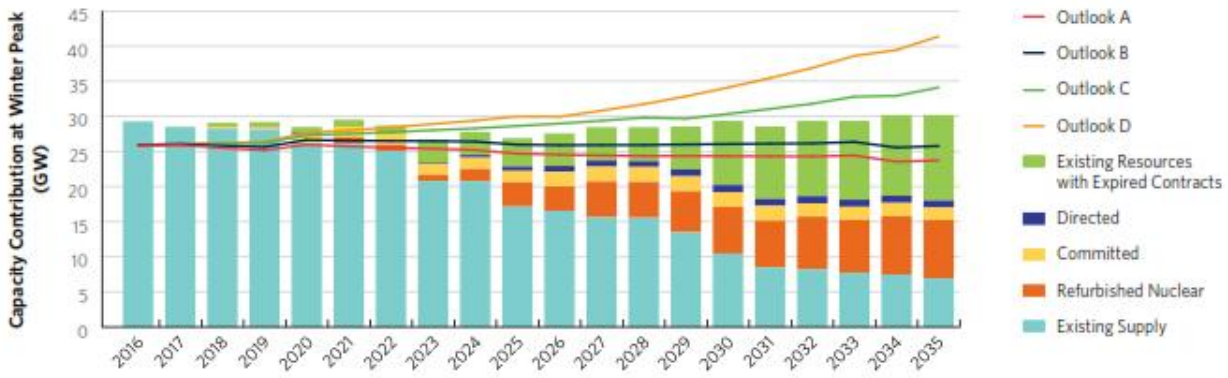
- However, in contrast, if all existing generation resources are removed from service after contract expiry, Ontario will have a total installed capacity of approximately 25 GW by 2035.

- Therefore, there are a number of risks that could affect the availability of supply over the planning outlook.
    - Timing to retire the nuclear generating units at Pickering GS;
    - Cost overruns and delays to the refurbishment of the applicable generating units at Bruce GS and Darlington GS;
    - Availability and operation of generation post contract expiry; and
    - Overall general effects of aging on the performance of Ontario's present generation fleet.

- Despite the above noted risks, the IESO states that if the planned resources come into service and existing resources continue to operate, Ontario's existing, committed, and directed resources will be sufficient to meet demand Outlooks A and B. However, the IESO admits that additional supply resources will be required to meet any increased growth in demand such as the case within demand Outlooks C and D. The figures below show these points for the different demand outlooks given the projected generation fleet's capabilities to meet summer and winter peak electricity demand plus reserve requirements.

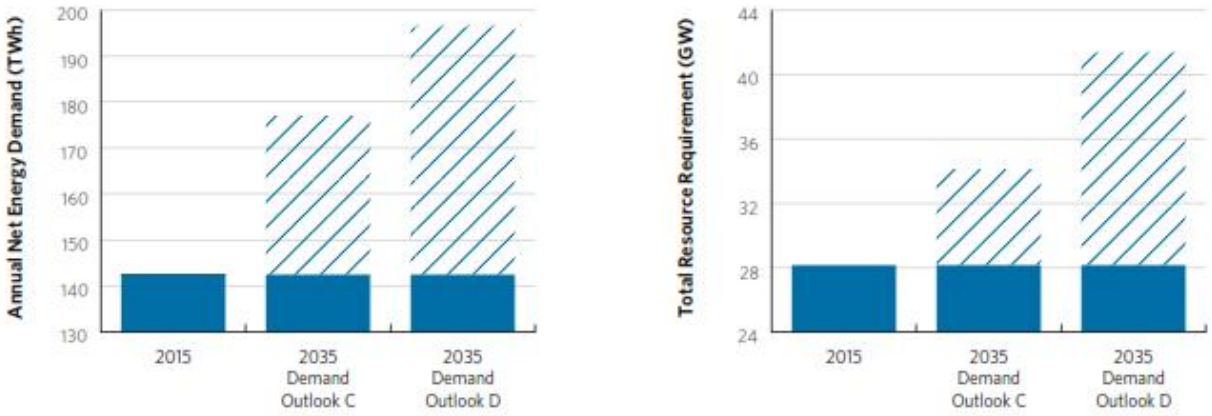
Figure 13: Available Supply at the Time of Peak Demand Relative to Total Resource Requirements*





- Leaving aside the risks to future operations of existing generation as described above, a closer look at the supply needs for energy and capacity resulting from demand Outlooks C and D are shown in the figures below.

Figure 15: Electricity Supply Requirements in Outlooks C and D



- While the IESO lists four demand outlooks, it does not provide any indication on what the supply needs may be in the future in terms of the types of supply resources that should be maintained and/or developed based on their attributes and system needs. That is, the IESO has not made any attempt to create different supply mix scenarios integrated with the four demand outlooks by meeting different future system needs. The IESO has only provided the table below that qualitatively lists different supply resource options along with their attributes and levelized unit energy costs (LUECs).

- What is also not clear in terms of future supply mix scenarios is how existing generation resources may be commercially maintained going forward and how needed generation may be developed going forward. In other words, the OPO does not provide strong indications as to mechanisms that may be required or developed to best ensure that generation adequacy is maintained in the future. While the IESO has started its Market Renewal Initiative which includes a capacity stream within the Initiative, it is not yet clear as to the degree to which contracting will continue or whether mechanisms like capacity markets will be developed in place of contracts or to complement of contracts. In part depending on future decisions as to what mechanism(s) may be used to help ensure future resource adequacy, this will partially drive Ontario's future supply mix (e.g., some generation projects are more challenged to be maintained or developed solely through combined energy and capacity market revenues, in absence of financeable contracts).

Table 2: Current Technology Characteristics

	Capacity	Energy	Operating Reserve	Load Following	Frequency Regulation	Capacity Factor	Contribution to Winter Peak	Contribution to Summer Peak	LUEC ($/MWh)
Conservation	Yes	Yes	No	No	No	Depends on Measure	Depends on Measure	Depends on Measure	$30-50
Demand Response	Yes	No	Yes	Yes	Limited	N/A	60%	85%	N/A
Solar PV	Limited	Yes	No	Limited	No	15%	5%	30%	$140-290
Wind	Limited	Yes	No	Limited	No	30%	30%	10%	$65-210
Bioenergy	Yes	Yes	Yes	Limited	No	40-80%	90%	90%	$160-260
Storage	Yes	No	Yes	Yes	Yes	Depends on technology/ application	Depends on technology/ application	Depends on technology/ application	Depends on technology/ application
Waterpower	Yes	Yes	Yes	Yes	Yes	30-70%	75%	71%	$120-240
Nuclear	Yes	Yes	No	Limited	No	85-95%	90-95%	95-99%	$120-290
Natural Gas	Yes	Yes	Yes	Yes	Yes	up to 65%	95%	89%	$80-310

Source: IESO. LUEC: Levelized Unit Energy Cost.

- Unlike previous IESO and Ontario Government power system planning documents, the OPO is much clearer and supportive regarding the potential role for intertie export and import transactions to help meet Ontario's future power system needs and enhance market efficiencies.

- Ontario currently has interconnections with Quebec, Manitoba, Minnesota, Michigan, and New York. These interconnections facilitate the import and export of electricity and can provide operational and planning flexibility while enhancing the reliability and cost-effectiveness of the Ontario's power system. The IESO states that interties can also be used to obtain firm capacity to support resource adequacy as well as energy to meet consumption where they can be pursued at costs below domestic resources (factoring in transmission).

Power Advisory LLC Commentary

Two fundamental issues exist within the OPO concerning the supply outlook. First, the IESO does not provide any risk assessments or contingency plans regarding components of the future supply mix. For example, the risks of refurbishing nuclear generating units have been well documented within and outside of Ontario, yet these risks are only briefly acknowledged within the OPO simply by noting the potential for off-ramps in the event of refurbishment issues. Second, the IESO does not provide any analysis regarding the potential for different supply mix scenarios and therefore

does not provide optimal future supply mix scenarios that could meet policy objectives while maintaining power system reliability in a cost effective manner.

After review of the demand and supply sections of the OPO, it is clear that the IESO has not undertaken any rigorous integration exercise towards optimally defining Ontario's future power system, its future needs, and which resources will be needed to meet these needs. As a consequence, it will be extremely difficult for any stakeholder to make business decisions regarding maintenance of existing assets or development of new assets due to the lack of information in the OPO.

While only briefly mentioned in the OPO, mechanisms to ensure future resource adequacy will significantly factor into the future composition of Ontario's supply mix. That is, Ontario's supply mix has been developed and maintained largely resulting from revenue certainty through long-term contracts (i.e., as is the case with most Independent Power Producers with Ontario generation assets) and in the case of most Ontario Power Generation (OPG) assets through rate regulation (where the remaining OPG generation assets are under IESO contracts). At present, it is not clear how existing generation will continue to commercially operate once contracts have expired and how needed generation may be developed in the future. Therefore, the mechanism(s) that will be used in the future to help ensure Ontario's resource adequacy is equally important as potentially pre-defining Ontario's future supply mix based on policy objectives (e.g., climate change, etc.) and other factors (e.g., cost effectiveness, etc.).

4. Market and System Operations Outlook

- The IESO states that over the planning period, a number of foreseeable changes are expected to result in a power system that is increasingly variable and complex to operate on a day-to-day basis. Changes such as increases in variable generation (i.e., wind and solar) and DERs, nuclear generation decommissioning and refurbishments, and changing customer demand patterns will change the electricity flow patterns on the bulk system. New facilities, tools and/or measures will need to be in place to help maintain system reliability and operability through this significant transition period.

- In order to meet these anticipated operational challenges, the IESO has implemented mechanisms (e.g., forecasting energy production from variable generation) and is working on other measures including additional frequency regulation, flexibility, control devices, and system automation. Overall, greater coordination between the grid operator and embedded resources, directly or through integrated operations with LDCs, could also improve visibility into the distribution system and enhance power system operations.

- With the uptake of CDM and DERs over the past several years, and continued uptake projected in the future, distribution systems are being utilized in ways that have not occurred in significant magnitudes before. Therefore, the outlook for market and system operations should not only be viewed as a challenge for the operations of the bulk transmission network through the IESO's wholesale electricity markets.

Power Advisory LLC Commentary

The IESO correctly points out growing challenges regarding market and system operations, however the OPO does not offer any potential recommendations and solutions to meet these challenges. Therefore, it is highly unlikely for the LTEP 2017 to address challenges regarding market and system operations.

5. Transmission and Distribution Outlook

- The IESO states that no significant new transmission investments will be required in an outlook of flat electricity demand served by existing and currently planned resources. However, additional transmission or local resources to address specific regional needs may be identified in the future through regional planning exercises.

- The need to replace aging transmission assets over coming years will also present opportunities to right-size investments in-line with evolving future circumstances. This could involve up-sizing equipment where needs exist such as in higher demand outlooks, or down-sizing to reduce the risk of underutilizing or stranding assets, or even removing equipment that is no longer required such as in the low demand outlook or in parts of the province that have seen reduced demand. Such instances may also present opportunities to enhance or reconfigure assets to improve system resilience and allow for the integration of variable generation and DERs.

- In higher demand outlooks, investments in transmission will be required to accommodate new resources. Transmission to integrate those resources will have significant lead time requirements of up to 10 years.

- In general, distribution systems stand to be impacted more than the bulk transmission system resulting from growing local electricity demand in certain areas of the province, increased uptake of CDM resources, and/or penetration of DERs and emerging technology resources (e.g., storage). Therefore, on balance, it appears that enhancements to distribution systems will be needed regardless of the demand outlook relative to enhancements that may not be required for transmission.

Power Advisory LLC Commentary

We concur with the IESO's positions and outlook for internal transmission and distribution.

However, we believe that given broader and regional policies, their objectives, and strategic opportunities (e.g., climate change with regional markets to facilitate carbon pricing, lowering of GHG emissions, and increased cross-border trade, etc.), the IESO and the Ontario Government should explore the potential to increase interconnections with neighbouring jurisdictions. Additional interconnection capability will increase the security and reliability of Ontario's power system, will also increase market efficiencies in Ontario and abroad, and open up new strategic trade opportunities that can benefit Ontario based resources and Ontario's electricity ratepayers.

6. Emissions Outlook

- With the phase-out of coal-fired generation, carbon emissions from Ontario's generation fleet now come primarily from gas-fired generation. Emissions are expected to continue to decline over the next five years as additional renewable generation comes into service. Beyond this period, emissions will depend on the level of electricity demand and the extent to which energy production from the existing gas-fired generation fleet may be displaced.

- When Ontario's cap-and-trade system takes effect in 2017, the electricity sector should see the cost of carbon reflected in the wholesale electricity price when gas-fired generation is on the margin and being dispatched. The Ontario market price for carbon will also be applied to electricity imports. The figures below show the level of GHG emissions and impacts on costs all for demand Outlook B (i.e., flat demand outlook).

Figure 18: Electricity Sector GHG Emissions in Outlook B

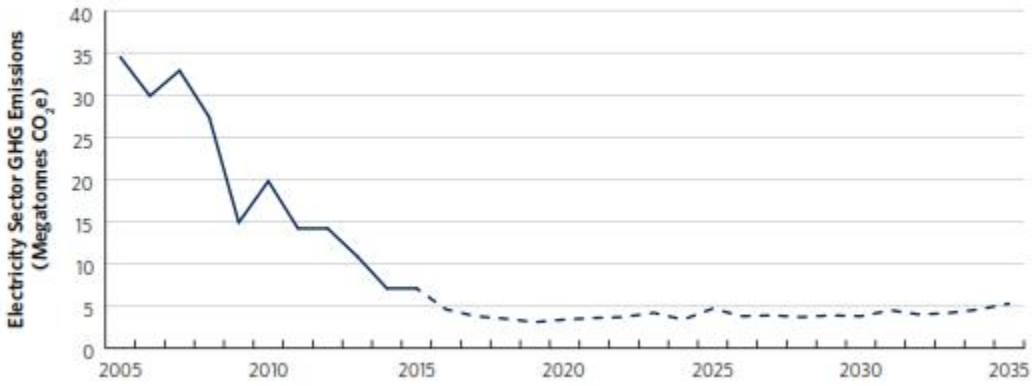


Figure 19: Total Cost of Electricity Service in Outlook B

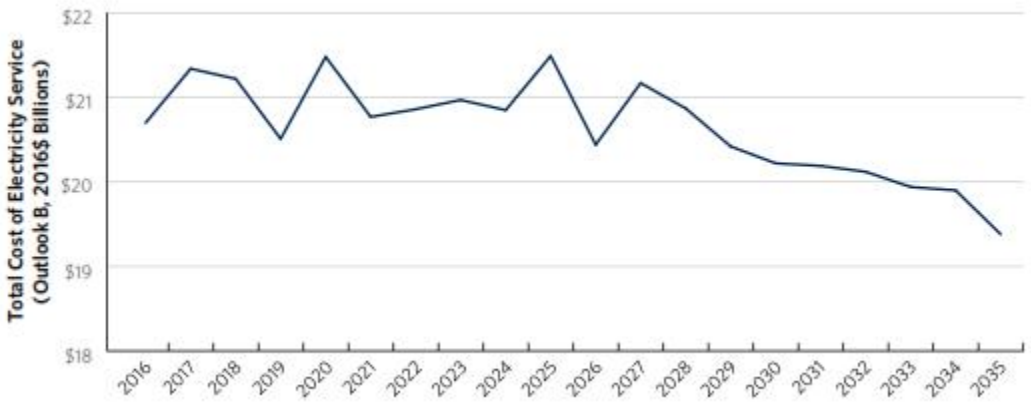
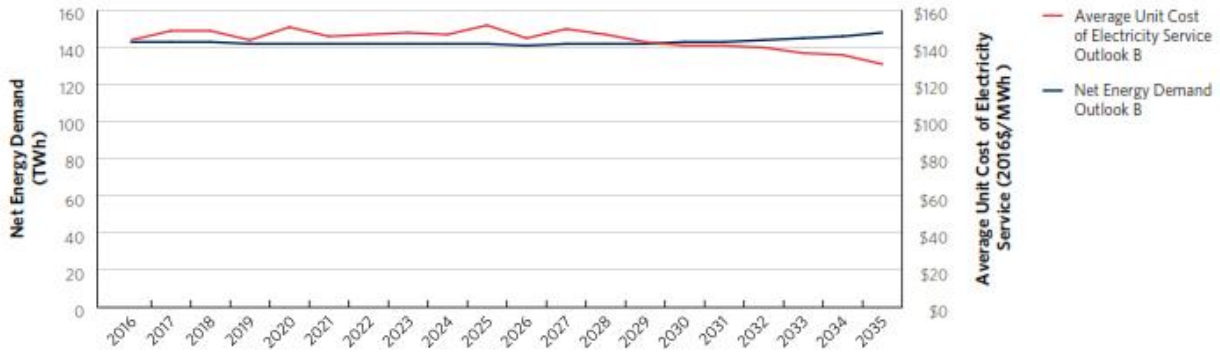


Figure 20: Average Unit Cost of Electricity Service in Outlook B



Power Advisory LLC Commentary

We concur that Ontario's electricity sector will continue to have relatively low GHG emissions into the future.

7. Electricity System Cost Outlook

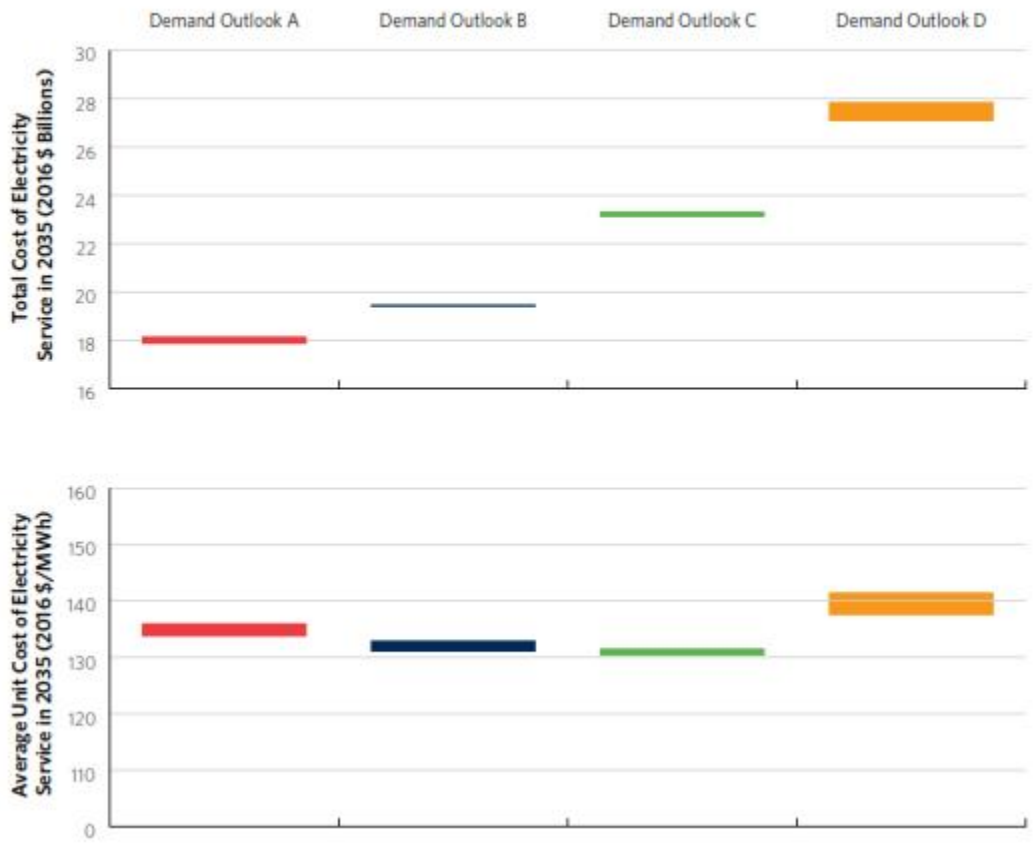
- The total cost of electricity service over the planning outlook will be a function of demand growth, cost of operating the existing system, and future investments.

- In the flat demand outlook (i.e., Outlook B), the total cost of electricity service is projected to average approximately $21B per year (2016$) over the next 10 years and is estimated to decrease to approximately $19B per year by 2035. The IESO goes on to state that any cost reductions are premised on expectations of lower revenue requirements among generators whose existing contracts have expired but continue to operate at costs below existing contract prices.

- The average unit cost of electricity service is projected to decrease by an average annual 0.3% per year (2016$) over the 20-year period. Ongoing investments lead to increases in the first 10 years of the outlook at an average annual rate of 0.4% per year. Unit rates are projected to decrease over the last 10 years of the outlook due to reduced investments in electricity resources (using the logic stated above regarding generation with expired contracts that continue to operate).

- In higher demand outlooks, additional investments in new resources (CDM, generation, transmission) will be required to meet increases in electricity demand (peak and energy requirements) and to keep emissions within the range of the flat demand outlook (consistent with Ontario Government climate change policies). The annual cost of electricity service is projected to rise by approximately $4B to $10B by 2035 (2016$). However, this will be associated with an increase in energy consumption in the province. As a result, the average unit cost of electricity service should be within the range of the flat demand outlook.

Figure 21: Cost of Electricity Service across Demand Outlooks



Power Advisory LLC Commentary

We concur with the IESO's projected cost estimates.

Considering the IESO did not undertake in a rigorous integration exercise within the OPO and therefore did not attempt to derive optimal future supply mix scenarios factoring in cost effectiveness, the LTEP 2017 should strive to account for minimizing future costs while meeting policy objectives (e.g., climate change) while maintain the reliability of Ontario's power system.

Overall, there needs to be stronger quantitative assessments of the impacts of rising costs to customers on CDM and DER uptake potential. That is, as costs to customers continue to rise, combined with declining CDM and DER costs, there appears to be a strong potential for the continual and maybe accelerated uptake of CDM and DER resources which will then more so impact Ontario's distribution systems (e.g., need for upgrades and expansions, regulatory reform through LDC cost recovery that will impact cost allocation and rate design, etc.).

II. SUMMARY AND CONCLUSIONS

The IESO's OPO only provides a forward view of potential demand outlooks with a single supply outlook that may or may not meet Ontario's future power system needs. Unfortunately, the OPO is not a rigorous Integrated Resource Plan (IRP) (i.e., unlike the Ontario Power Authority's 2007 Integrated Power System Plan filed with the OEB, unlike IRPs filed with utilities for regulatory approvals, etc.). Further, the OPO also does not utilize sophisticated methodologies and techniques used to determine power system needs along with the capabilities and cost effectiveness of resource options to potentially meet these needs, as is done within all of the U.S. wholesale capacity markets.

The OPO lacks sufficient assessment of future risks and accompanied contingencies to mitigate and address these risks. Perhaps the IESO is providing or will be providing such technical assessments to the Ontario Government for purposes of developing LTEP 2017. If this is the case, the forthcoming LTEP 2017 stakeholder consultations must be sufficiently transparent regarding analyses of risks, resource options, and measures to address these points.