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APPrO
ASSOCIATION OF POWER PRODUCERS OF ONTARIO

April 25, 2016

Mike Lyle
Vice-President Planning, Law and Aboriginal Affairs
Independent Electricity System Operator
120 Adelaide Street West – Suite 1600
Toronto, Ontario, M5H 1T1

Re: Stakeholder feedback on the Ontario Planning Outlook 2016

Dear Mike,

Attached please find comments from APPrO on the Ontario Planning Outlook 2016 as part of the SAC stakeholder feedback process.

I would be happy to meet with you to discuss these comments and how they relate to the planning process and market renewal in Ontario.

Sincerely,

David Butters
President and CEO

Cc:
Terry Young, Vice-President, Conservation and Corporate Relations
Susan Harrison, Senior Stakeholder Relations Advisor
Andrew Pietrewicz, Director, Resource Integration, Power System Planning

APPrO comments on the Ontario Planning Outlook 2016

Introduction

The Association of Power Producers of Ontario (APPrO) is a non-profit organization representing more than 100 companies involved in the generation of electricity in Ontario, including generators and suppliers of services, equipment and consulting services. APPrO members produce power from co-generation, hydro-electric, gas, nuclear, wind energy, solar energy, waste wood and other sources. APPrO focuses 100% on the commercial, regulatory and economic issues of power producers in Ontario.

APPrO is pleased at the opportunity to provide feedback to the Independent Electricity System Operator (IESO) on the future of Ontario's power system. As stated on March 23, 2016 at the Stakeholder Advisory Committee meeting, the IESO is seeking feedback on the material in its slide deck *Ontario Planning Outlook 2016: Ontario Supply/Demand Balance to 2035* as it develops its technical report (OPO 2016) for the Ministry of Energy. This submission summarizes the feedback from APPrO and our members on the information and process outlined in the slide deck.

Bill 135: A New Three-Step Planning Process

On October 28, 2015, the Ontario government tabled Bill 135, the *Energy Statute Law Amendment Act, 2015*. This Bill has been ordered for Third Reading and is expected to be passed into law shortly. Once Bill 135 receives Royal Assent, a new three-step planning process will guide the electricity sector in Ontario. The new planning process starts with the IESO developing a technical report on Ontario's electricity system needs. The government then uses the IESO's technical report as input into development of a Long-Term Energy Plan (LTEP). Finally, government direction is given to the IESO to develop an IESO Implementation Plan to describe how the LTEP objectives will be achieved. The OPO 2016 is the IESO's technical report and the first stage of the new planning process.

The OPO 2016 Requires Stress-Testing

As the initial planning step for Ontario's electricity system, it is important that the OPO 2016 establishes a strong technical framework for assessing possibile future outcomes and a proven process to support the recommended plan. A strong technical framework requires comprehensive data collection, robust analysis and adequate stress-testing to ensure that risks in the plan are understood with as much clarity as possible. In other jurisdictions, electric utilities and central planning authorities complete detailed Integrated Resource Plans (or Resource Adequacy Assessments) to assess the uncertainty of an electricity system's future. APPrO believes that the OPO 2016 should strive for similar rigor and depth of analysis in developing OPA 2016. The conclusions of the OPO 2016 will be the foundation for the next LTEP on which the government

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will include asssessment of non-electricity policy objectives such as social and economic factors. If the OPO 2016 assessment and conclusions are not adequately developed and stress-tested by realistic scenarios then policy makers will not be properly informed as they attempt to balance broader government objectives in the LTEP.

Stress-testing of the OPO 2016 with industry stakeholders will lead to a resilient electricity system plan. The information provided by the IESO thus far with respect to OPO 2016 provides a simple summary of historical data and a forecast of future trends without clearly articulating a specific plan. APPrO believes there are several risk factors that could significantly influence the possible future needs and timelines for investment in Ontario's electricity system. These risk factors should be transparently assessed to determine the potential impact on the planning outlook presented in the OPO 2016 and to clearly describe to government and the electricity industry the range of realistic possible future outcomes. The investigation of key risk factors and determination of the likely impact on the planning outlook can lead to broad support from electricity industry for the OPO 2016. Stress-testing of risk factors provides each stakeholder a clear view on how the planning outlook may impact their investment and policy goals. As the Reliability Coordinator for the province, one of the core mandates of the IESO is ensuring grid resilience and maintaining reliability. Performing stress-tests and producing a robust OPO 2016 will align with the IESO's vision and mission, and best serve the interests of public policy.

Primary Risk Factors for OPO 2016

The following are key risk factors that APPrO believes should be assessed as part of the OPO 2016.

Regulatory Risks for End-of-Life Extension at Pickering Generation Station

The information provided in the presentation material for OPO 2016 shows the Pickering Generating Station (GS) with a life extension to permit operation of units 1 and 4 until 2022 and units 5, 6, 7, and 8 until 2024. The Pickering GS must obtain two primary regulatory approvals to operate to this schedule. Ontario Power Generation (OPG), the nuclear generation facility owner/operator, must receive permission from the Canadian Nuclear Safety Commission (CNSC) to operate beyond the current operating licence expiry of 2018. OPG must also receive regulatory approval from the Ontario Energy Board (OEB) for generation rates that will fund the end-of-life extension. Both regulatory approvals require submission of detailed evidence that will be vetted by regulators and concerned stakeholders. Success in both regulatory proceedings is not guaranteed and the OPO 2016 technical report should consider a scenario with a shorter operating life for Pickering GS to reflect the regulatory risk in these proceedings. The IESO should present an estimate for the cost of extending the life of Pickering GS to help quantify the regulatory risk.

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Delays in Refurbishment Schedule

The nuclear refurbishment plan in the presentation material for OPO 2016 shows the refurbishment schedule of the Bruce and Darlington nuclear stations as currently planned. Nuclear refurbishment is a complex and costly endeavour that will require significant numbers of skilled nuclear professionals and tradespeople. The availability of both labour resources is limited and may impact the ability to meet the schedule as currently planned. Previous refurbishments of CANDU technology generating units has resulted in challenges. The refurbishment plan involves tight coordination between ten nuclear generating units, any delays at one unit would impact the schedule and cost of other units. The refurbishment schedule should be stress-tested in the OPO 2016 technical report by considering reasonable scenarios where refurbishment is delayed to identify the potential impact on Ontario's supply need. The IESO should also provide a plan in the OPO 2016 technical report to describe how delays will be managed if they do occur in the future along with an estimate of the cost of delays in the refurbishment schedule.

Possible Execution of Nuclear Refurbishment Off-Ramps

While the current refurbishment plan for both Darlington GS and Bruce GS is based on the complete refurbishment of all applicable generating units there is no commitment by the Ontario government to complete the plan as stated. The Amended and Restated Bruce Power Refurbishment Implementation Agreement (ARBPRIA) includes off-ramp provisions for the termination of the refurbishment of applicable units if costs exceed specific thresholds or if the refurbishment schedule is delayed. The off-ramp provisions include the assessment of alternate supply resources that are determined to be economic compared to the cost of nuclear refurbishment. For Darlington GS, the Minister of Energy has only committed to commencing refurbishment of the first unit in 2016 and will subsequently assess each remaining unit before granting commitments to move forward with refurbishment. Therefore, these publically disclosed off-ramps indicate uncertainty regarding the efficacy of the planned refurbishments. The OPO 2016 should explore alternate scenarios where applicable off-ramps are exercised and provide guidance on how the IESO expects to manage the resulting supply deficit.

Probability of Continued Operation after Contract Expiry

The IESO expects over 25 GW of installed generation capacity in Ontario to reach end-of-life, either due to contact expiry or service life, by 2035. In the presentation material for OPO 2016, the assumption is that this generation will continue to operate beyond the end of life and provide capacity to Ontario for the life of the plan.

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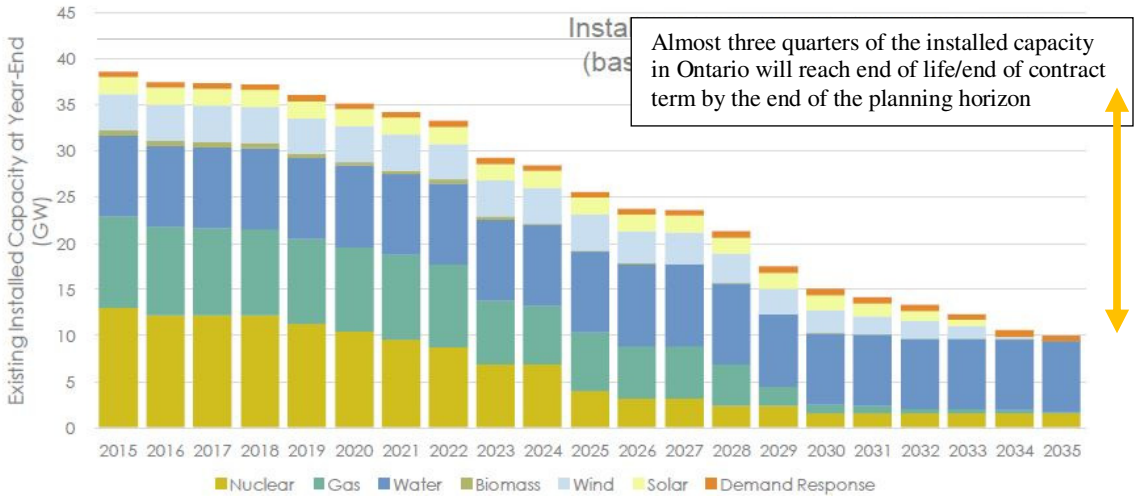


Ontario Installed Capacity under Contract – Source: IESO

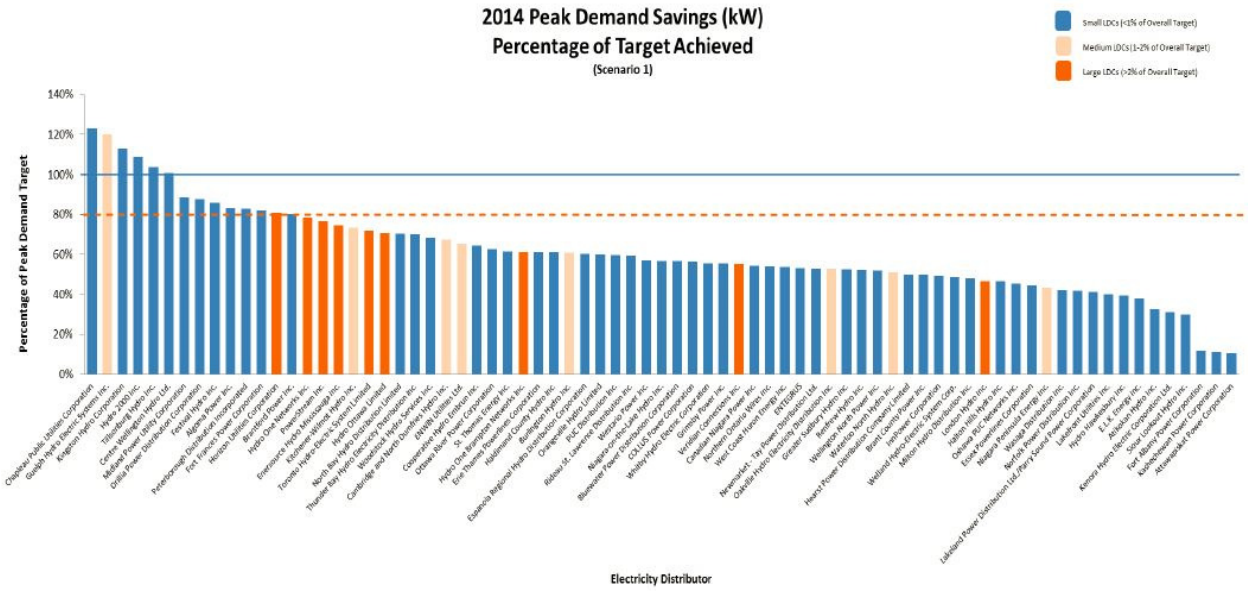
Continued operation of these generation assets will depend on a variety of factors including generating asset health, financial market conditions, power system needs, project return expectations, and government policy. Some of these factors can be influenced directly by the IESO and government policy (e.g., electricity market design), while other factors are outside the control of the electricity industry (e.g., conditions of financial markets). At this time, there is increased uncertainty in Ontario's electricity market due to the recent Market Renewal initiative launched by the IESO. Potential market design changes include: two-schedule pricing; day-ahead market; real-time unit commitment; intertie scheduling; capacity market and intertie capacity transactions; and demand-response auction.

In addition, on September 1, 2015 the IESO presented the Non-Utility Generation (NUG) framework assessment to government. In the document the IESO clearly indicated a preference for the use of a capacity market to meet future resource requirements. The OPO 2016 is largely silent on capacity markets and it is not clear if the IESO preference for capacity markets has waned. Further, the IESO recommended in the NUG framework that no more negotiations for re-contracting of existing generation reaching contract term continue and therefore existing asset owners have been left in limbo with respect to future investment options.

Generation asset owners will need to understand the results of the Market Renewal initiative before they can make investment decisions related to continued operation. There is also no certainty that existing assets will be confident in the future market framework in Ontario to continue operation or will be the best option to meet Ontario's electricity system needs in the future. The OPO 2016 should consider scenarios where some of the existing generation assets do not continue operation beyond the end of their contract term.

Long-term Cost-Effectiveness of Conservation Activities

Conservation and Demand Management (CDM) activities are expected to play a key role in offsetting future gross electricity demand growth over the planning horizon. The information provided to date by the IESO with respect to OPO 2016 lacks details regarding future CDM activities and programs, including the potential efficacy of future codes and standards that are projected to provide contributions to meeting overall CDM targets post 2015. Almost half of the future savings in the long-term come from new programs yet to be planned. It is not clear how the IESO has considered the continued expectation of long-term success of CDM activities/programs for OPO 2016. The IESO should consider the risk of existing and future CDM activities/programs not being cost-effective in meeting future demand growth and other power system needs relative to other resource options (e.g., generation, emerging technologies, etc.). Many of the CDM programs are expected to be delivered by local distribution companies (LDCs) and the recent results appear to indicate some difficulty in achieving CDM program targets for many LDCs.



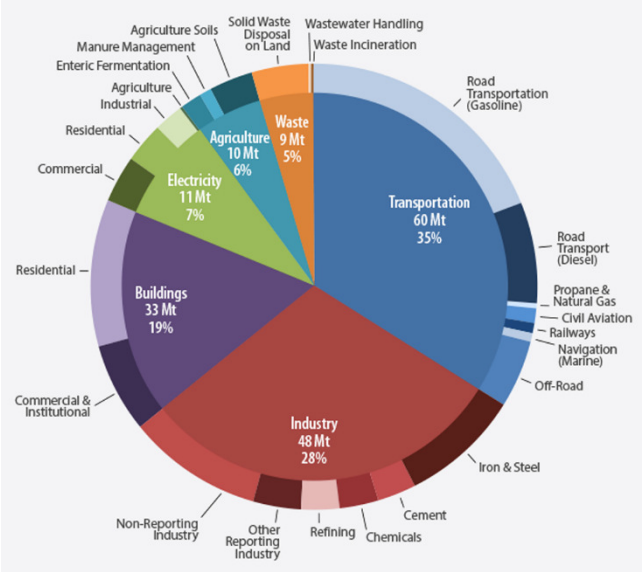
CDM Achievement by LDC – Source: OEB CDM Report 2011-2014

The conservation targets in LTEP 2013 are aggressive and the IESO notes that effort will be required to meet those CDM targets. If the CDM targets are not met or if CDM activities cease to be the most cost-effect option for meeting electricity demand growth, additional supply resources will be required. The OPO 2016 should determine a realistic lower CDM result to understand the amount of additional supply resources that may be needed. The cost of achieving the CDM targets should be estimated by the IESO and presented in the OPO 2016.

Influence of Ontario's Climate Change Strategy

One of the primary objectives of the current government is the implementation of the Ontario Climate Change Strategy (OCCS). The OCCS was published in late 2015 and outlines the

government's actions to combat climate change including a target of 37% reduction of greenhouse gas (GHG) emissions from 1990 levels by 2030. Based on recent GHG emission reporting, the 2030 GHG emissions reduction target requires a 25% decrease from today[1], a commendable, but ambitious objective.



Source: Ontario Climate Strategy – 2013 GHG Emissions by sector

The OCCS includes the adoption of a cap-and-trade regime and establishment of a carbon price in Ontario. Over 50% of GHG emissions are produced by the transportation and buildings sectors and both are likely to consider electrification (e.g., electric vehicles for transportation, heat pumps and high-efficiency electric space heating for buildings, etc.) to meet the 2030 GHG emissions reduction target. Adequate stress-testing of OPO 2016 should include the short-term and long-term possible influence of the OCCS on Ontario's electricity system.

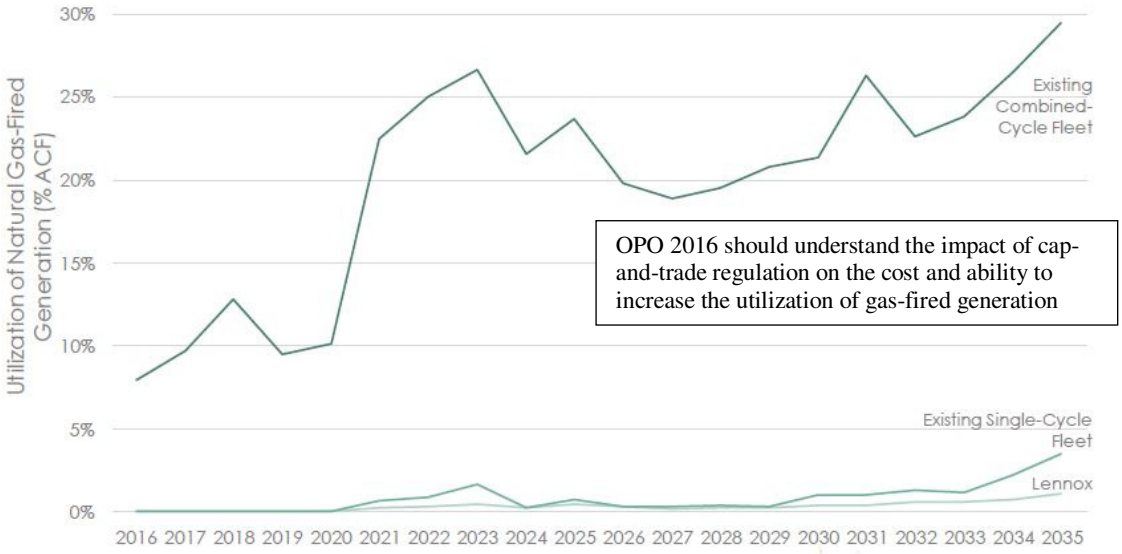
Impact of Cap-and-Trade Regulation

On March 3, 2016, the IESO hosted a consultation webinar on cap-and-trade regulation with IESO-contracted gas-fired generators[2], of which most are APPrO members. Virtually all emissions generated from the electricity sector are currently related to natural-gas fired generation. The IESO expects that the upstream compliance obligation cost for domestic electricity will ultimately make its way into the electricity market. Carbon pricing should result in an increase in the Market Clearing Price within Ontario's wholesale electricity market when gas-fired generation is on the margin, as the cost of carbon is embedded into the offer prices of

[1] The OCCS 2030 target is 37% reduction from 1990 levels, which is a target of annual emissions of 127 Mt CO_2. Based on 2014 emissions levels of 171 Mt CO_2 and, emissions would need to drop by 25% over the next 15 years. - Ontario's Climate Strategy – Ministry of Environment and Climate Change - https://dr6j45jk9xcmk.cloudfront.net/documents/4928/climate-change-strategy-en.pdf

[2] IESO Cap-and-Trade Outreach - http://www.ieso.ca/Pages/Participate/cap-and-trade-outreach.aspx

carbon emitting generators (this is expected to also result in a decrease in the Global Adjustment). The installed capacity potentially impacted by cap-and-trade represents almost 25% of the total installed capacity in Ontario[3]. The possibility of changes (or lack of changes) to existing gas-fired generation contracts to potentially compensate for increased compliance costs could have an impact on the availability and dispatch actions of gas-fired generation facilities in the future. Possible electricity market adjustments from cap-and-trade regulations should be assessed as part of the OPO 2016 conclusions, especially given the current expectation of increased utilization of gas-fired generation. The cost impact of cap-and-trade on gas-fired generation should be calculated and presented in the OPO 2016



Future Utilization of Natural Gas-Fired Generation - Source: IESO

Structure of Import Agreements

The Ontario and Quebec governments agreed to seasonal exchange of electricity capacity in late 2014. Based on direction from the Minister of Energy in April 2015[4], the IESO has negotiated and executed a capacity sharing agreement with Hydro Quebec Energy Marketing (HQEM) for 500 MW of seasonal peak capacity over a 10 year term. The IESO is continuing discussions with HQEM and NALCOR (representing Newfoundland and Labrador) for further capacity agreement opportunities[5]. The structure of future import agreements and the potential impact on supply need is important information for market participants in Ontario. The OPO 2016 does not discuss imports or capacity agreements in detail. The IESO should provide details on the range of contemplated arrangements, if any, and expected benefits and cost of imports from neighbouring jurisdictions.

[3] The IESO identified 9,309 MW of capacity from 51 contracts which may be impacted by cap-and-trade.
[4] Directive to the IESO – Minister of Energy - http://www.ieso.ca/Documents/Ministerial-Directives/MC-2015-904-Outgoing-IESO-Letter-of-Direction-1.pdf
[5] Quebec and Newfoundland & Labrador Trade Discussions – IESO SAC Meeting October 1, 2015 - http://www.ieso.ca/Documents/consult/sac/SAC-20151001-Ontario-Quebec-Capacity-Sharing.pdf

Clarity Required for Adequate Stakeholder Engagement of OPO 2016

Engagement with electricity industry representatives on the details of the OPO 2016 is an important component in developing a resilient planning outlook. Adequate engagement with stakeholders regarding the OPO 2016 is extremely beneficial to the IESO, government policy makers and ultimately Ontario's rate-payers. By allowing stakeholders to review and debate assumptions, calculations, and conclusions of the OPO 2016, the electricity industry together can ensure that the results and technical input to the LTEP are accurate and represent the best estimation of the future of the electricity system.

Adequate engagement of OPO 2016 will require further stakeholder consultation. To ensure that the consultation is effective and focused information and clarity on certain issues is required from the IESO. The following table outlines what APPrO believes are primary issues that require further information or clarity from the IESO.

Issues Requiring Information or Clarity from IESO	**Description of Requirements**
Background data, assumptions and key calculations	• Information used in the OPO 2016 should be vetted by stakeholders to ensure accuracy and build industry support for the plan. • Assumptions and calculations should be assessed and debated with stakeholders to ensure reasonableness.
Forecast ranges	• Probability distribution of forecasts, or provision of an upper or lower bounds, used in OPO 2016 is needed to clarify realistic boundaries for stress-testing.
OCCS considerations	• A description of how the OCCS has been considered in the OPO 2016 is required to understand the depth of impact on current results.
Post-contract market design concepts	• A high-level concept of market design considerations for assets reaching the end of their contract term is required.
Alternative scenario factors	• The IESO should identify what factors they consider will have a major impact on the future of the Ontario electricity system to provide focus to future engagement with stakeholders on the OPO 2016.
Forum for future OPO 2016 stakeholder engagement	• A description of how further stakeholder engagement will be organized and focused is needed.

Possible Alternative Supply Scenario Components for OPO 2016

APPrO agrees with the IESO assessment that Ontario's electricity sector is entering a period of significant uncertainty. A large portion of the existing supply resources are reaching end of life/end of contract terms while over the same period electricity demand expectations will likely be influenced by new climate change initiatives. To plan for uncertainty, the OPO 2016 should define an expected case and assess realistic alternative planning scenarios to determine what additional resources may be required should certain events or changes to the electricity market

occur. The OPO 2016 should attempt to clearly articulate risk factors and identify possible contingency actions to mitigate their impact on Ontario's electricity sector.

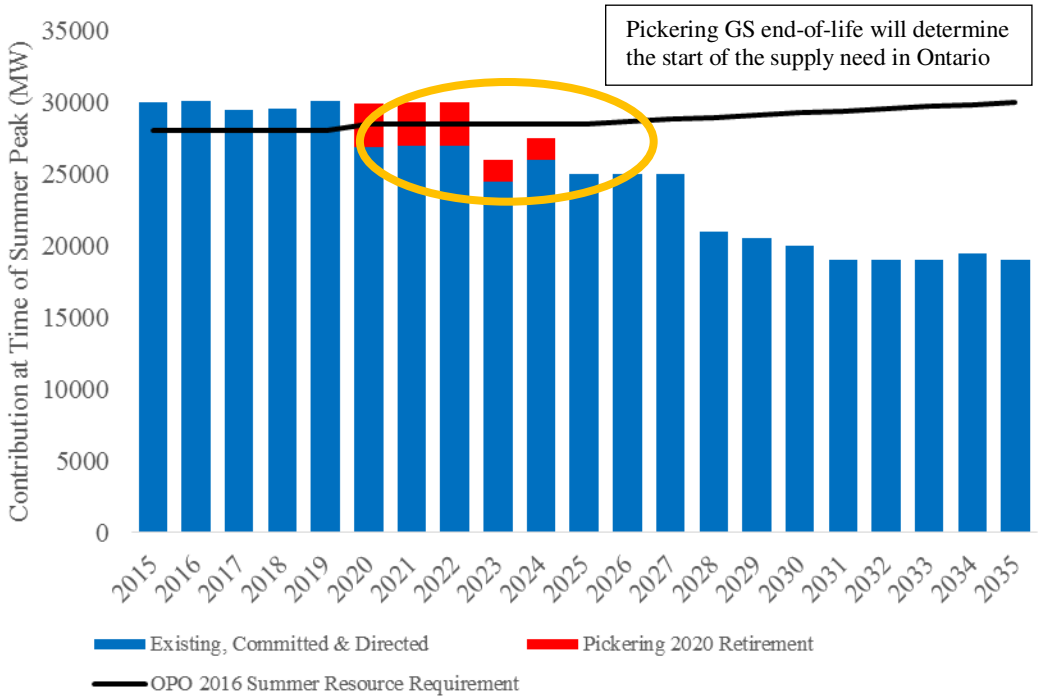
An alternative scenario considered in an updated OPO 2016 should at a minimum attempt to quantify the risk factors identified by APPrO. To assist the IESO, APPrO has performed a high-level analysis of six risk factors and identified a rough estimation of the impacts on the current planning outlook presented in the OPO 2016. Combining the impacts of the risk factors creates an alternative planning outlook to initiate discussion and debate. A brief summary of each risk factor and the estimation of impacts on the OPO 2016 are provided below.

1) Pickering GS Reaches End-of-Life in 2020

In the previous LTEP and in the NUG framework assessment, Pickering GS was expected to operate to 2020 before reaching end of life. The Minister of Energy approved OPG to investigate extending Pickering GS life beyond the current 2020 planned retirement in an announcement on Jan 11, 2016. To achieve that capability, OPG must receive regulatory approval from the OEB and the CNSC which is not guaranteed to be granted. Pickering GS has a relatively poor operational performance compare to other nuclear generation facilities within the World Association of Nuclear Operators (WANO) and the Electric Utility Cost Group[6]. Lower operational performance results in higher total generation costs for ratepayers where analysis of Pickering A and B units compared to the WANO Nuclear Performance Index shows that Pickering GS units are within the bottom quartile in total generation costs. In addition, the CNSC until recently had installed a hold point of 210,000 full power hours on the operation of Pickering GS[7]. There is a risk that higher costs or safety concerns could limit the life extension for Pickering GS back to the original 2020 timeline. With an installed capacity of 3,000 MW, the end-of-life timeline for Pickering GS will determine the start of the future supply need in Ontario. The OPO 2016 should consider a scenario where the operating life of Pickering GS is not extended beyond 2020.

[6] Incentive Regulation Options for OPG's Prescribed Generation Assets – OEB - http://www.ontarioenergyboard.ca/OEB/_Documents/Decisions/Power_advisory_report_OPG_20120511.pdf

[7] CNSC approves OPG's request to remove Pickering hold point on June 3, 2014 – CNSC - http://news.gc.ca/web/article-en.do?nid=853339



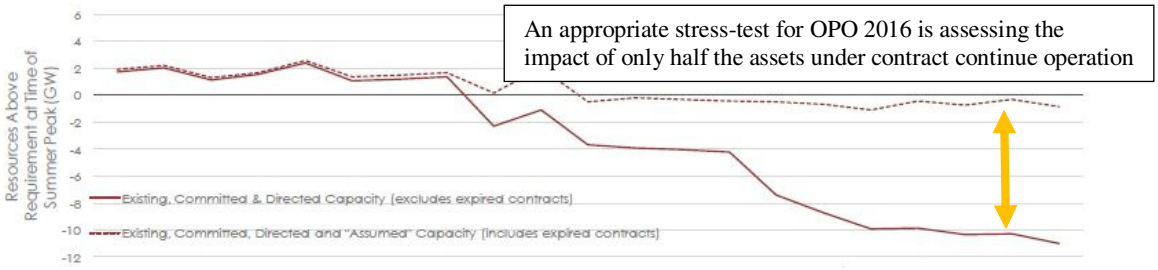
2) Guidelines For Execution of Refurbishment Off-Ramps

The current assumption in the presentation material for OPO 2016 is for the refurbishment of six Bruce units and all four Darlington units in accordance with the recently released schedule. A decision by the government to not proceed with a refurbishment of a generating unit at Bruce GS or Darlington GS would be a significant shift in Ontario's electricity sector future. The government has reserved the right with both Darlington GS and Bruce GS to determine if refurbishments for each generating unit should commence. The IESO should provide a high-level plan of action, including timelines and critical milestones, on how it will react should the government exercises the off-ramp. A description of the actions and timelines of the IESO would provide guidance to the industry on how the IESO plans to remove the units and address subsequent adjustments to the supply need. The guidelines would help ensure that removal of the units would be orderly which would minimize risk. The guidelines could also identify which generation units are currently most likely to be removed.

3) Repowering expectations of end of contract generation

The decision to continue operation by a generation asset owner after contract term expiration or end of service life depends on many factors (e.g., health of the generation asset, the investment needs to continue operation, the electricity market framework, government policy and investment return expectations, etc.). Guidance on the Market Renewal initiative from the IESO will help guide generation owners to which investment option is best suited for the existing generator. For Ontario's supply resources, the range of possible continued operation could on one hand have all existing generation continuing to operate and on the other hand

have all units retired at the end of their contract term. Given the high-level of uncertainty due to multiple issues already discussed, it is difficult to determine how much of the generation units reaching end of life over the planning horizon would continue operation. To stress-test the system need, it would be reasonable at this time to assess the impact of mid-point between the ranges of future status of supply resources. In other words, the OPO 2016 should consider a scenario where only half of the generation continues operation after the end of contract term.



Resources above Requirement of Time of Summer Peak (GW) – Source: IESO

4) Higher Gross Demand from Electrification of Transportation and Buildings

The OPO 2016 discusses possible impacts of electrification of transportation on the gross electricity demand in Ontario, but it is not clear whether that impact has been included in the gross electricity demand forecast presented in the planning outlook. By 2030, the OSSC is targeting a 25% reduction of GHG emissions from 2014 emission levels.

The transportation sector represents roughly 35% of GHG emissions of which a significant portion is road transportation (e.g., passenger cars, commercial trucks, semi-trucks, etc.). Statistics Canada estimates that there are over 8 million road motor vehicles registered in Ontario in 2014[8]. Even after assuming that motor vehicle registration growth is flat for the next 15 years, which is highly unlikely, the impact of a possible 25% transition to electric vehicles would have an impact on electricity demand forecast. The IESO estimates that each electric passenger vehicle would increase electricity consumption annually by 3.3 MWh and peak demand by 0.5 kW[9]. If 25% of the vehicle fleet were to transition to electric vehicles over the next 15 years, the result would be an extra 6.6 TWh of energy consumption and almost 1 GW increase in peak demand. These estimates of potential impacts are rough approximations; however APPrO believes these estimates are a conservative representation of the possible impacts from the transportation and building sectors. These estimates do not account for motor vehicle registration growth or higher electrification impacts of different vehicle types (e.g., electric commercial trucks compared to passenger vehicles). Further, no analysis has been included for the building sector which represents almost 20% of GHG emissions currently. An alternative scenario analysis should consider higher gross demand

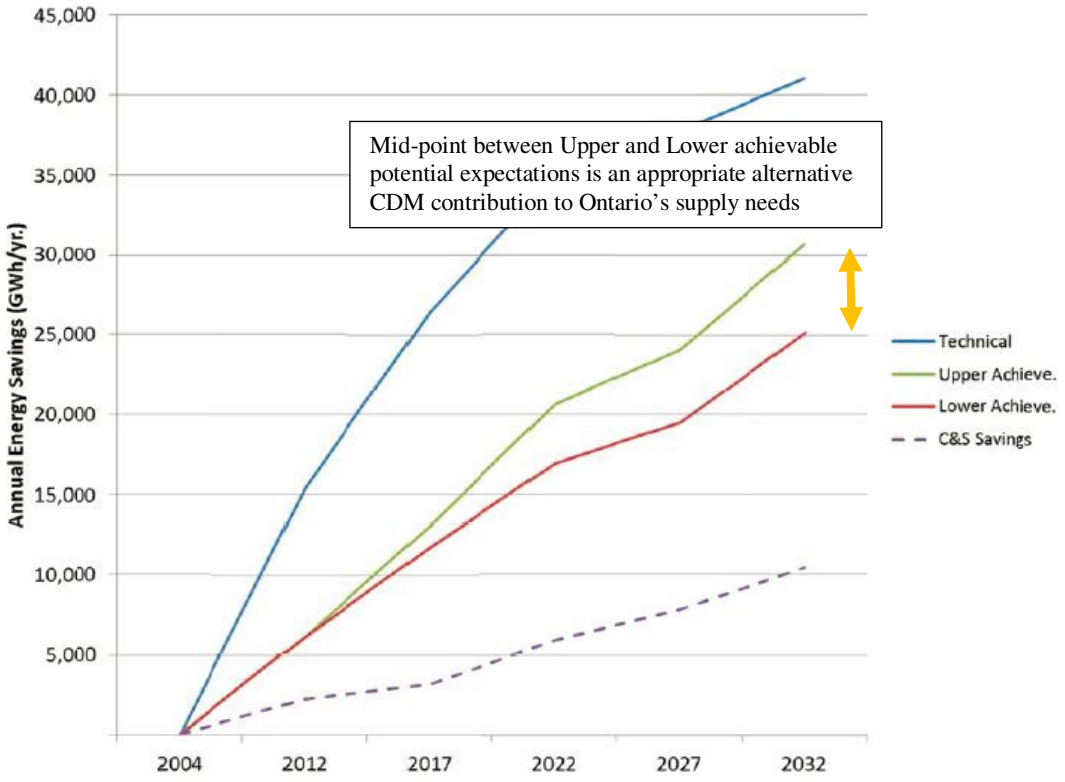
[8] Motor Vehicle Registrations, Statistics Canada – CANSIM Table 405-0004 - http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/trade14a-eng.htm

[9] Assumes that convenience of charging for electric vehicle owners is prioritized over smart controls to minimize costs

due to electrification in the building and transportation sector based on the current commitment to GHG emissions reduction.

5) Lower CDM Achievement

The IESO has stated that the 30 TWh CDM target to be achieved by 2032 is based on a current assessment of potential and does not represent a hard target[10]. As part of the LTEP 2013 development, an Achievable Potential study was completed to determine the amount of conservation potential that can be achieved by 2032. The Achievable Potential study determined an upper and lower achievable potential based on financial support for CDM programs. The upper achievable potential was based on programs with incentives sufficient to reduce customer payback to one year and aggressive outreach and support through education, training and marketing. The lower achievable potential was based on less aggressive programs with incentives sufficient to reduce customer payback to two years.



Achievable Potential Study for CDM – Source: ICF Marbek

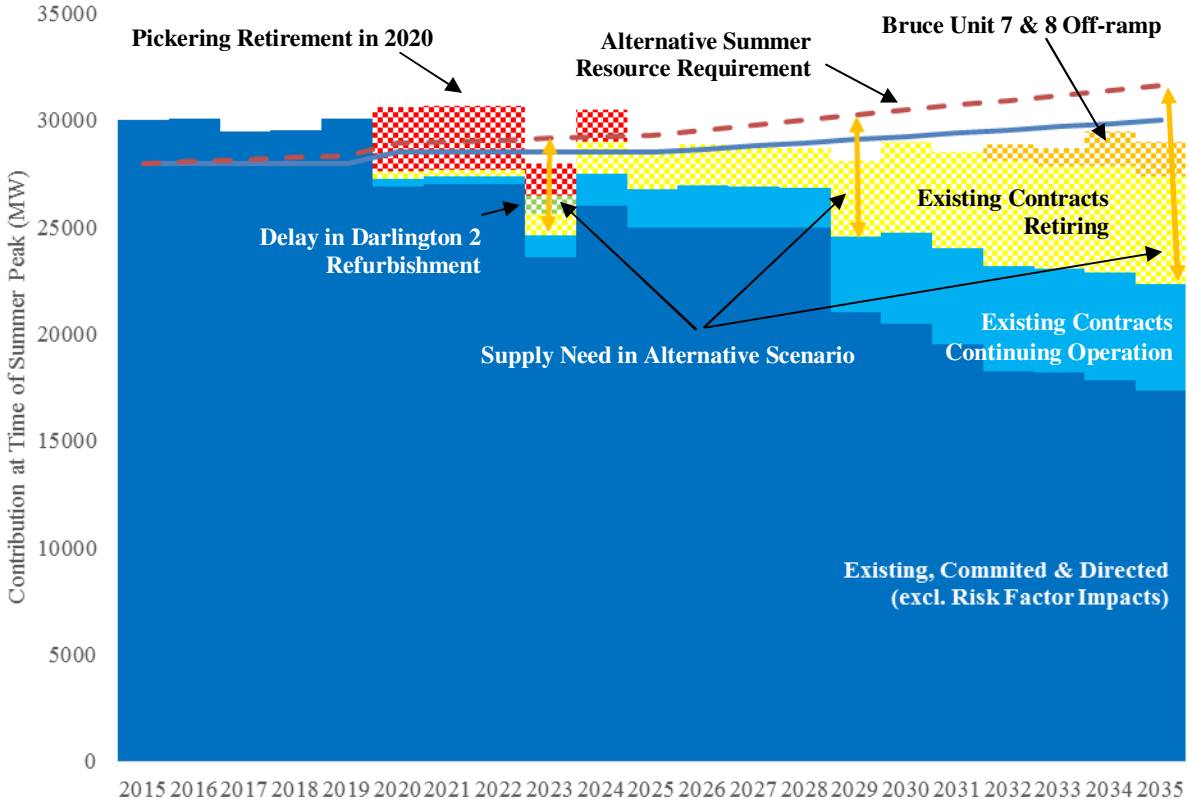
The results of the Achievable Potential study determined an upper achievable potential of over 30 TWh and a lower achievable potential of 25 TWh. This indicates that the 30 TWh LTEP target assumes strong financial commitment to conservation programs over the 20 year

[10] Conservation Achievable Potential Study – OPA - http://www.powerauthority.on.ca/news/conservation-achievable-potential-study

timeline of the LTEP. While CDM activities may appear to be the most cost-effective options available to offset gross electricity demand, the difficulties that LDCs are having in meeting current CDM targets is a risk that CDM will not remain the most cost-effective option over the next 20 years. It is therefore reasonable to assume an average between the upper and lower achievable potential as an alternative scenario in the OPO 2016 to reflect a decrease in CDM activities.

Alternative Planning Outlook Scenario

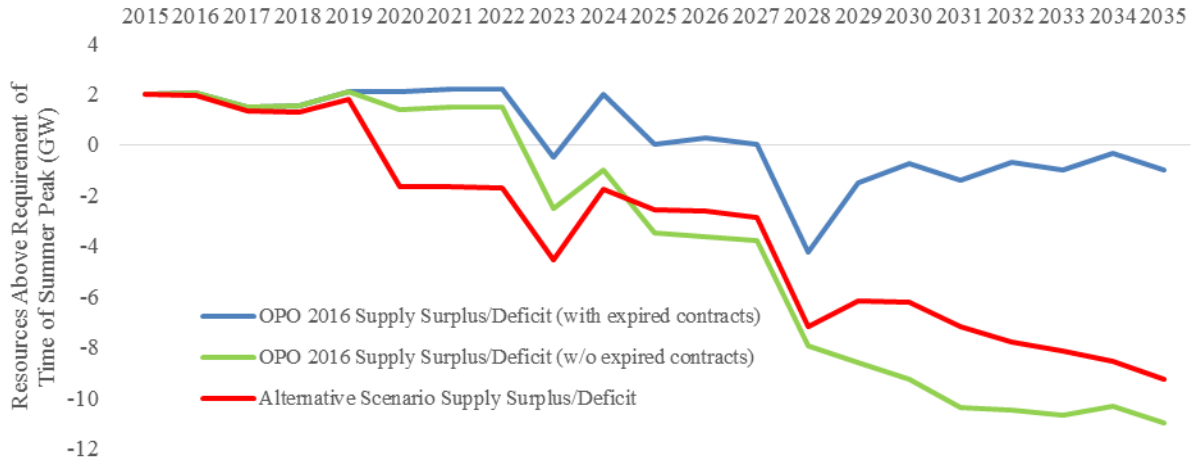
Based on APPrO's assessment of risk factors in the current planning outlook, the following charts represent a realistic high-level alternative scenario for Ontario's electricity system.



APPrO Risk Factor Impacts on OPO 2016 – Source: IESO & APPrO

The high-level alternative scenario prepared by APPrO provides some clarity on the risks facing the Ontario electricity system supply need over the next 20 years. In the short-term (to 2021) the primary impact on supply need is the risk of Pickering GS end of life occurring in 2020, resulting in the possibility of 1,600 MW of new supply being required. In the mid-term (2021 to 2026), scheduling risks in the nuclear refurbishment plan will increase uncertainty of supply need. The possible retirement of existing generation assets reaching end of contract term begins to impact supply need as well leading to a possible need of 2 GW to 4 GW of new supply. In the long-term (2026 to 2035), the actions of the Ontario economy to meet the OCCS GHG emissions target

reduction may begin to increase supply need due to higher than expected electricity demand. Difficulties in achieving the aggressive CDM targets will also increase the summer resource need in the alternative supply scenario. Finally, execution of the off-ramp from nuclear refurbishment and continued retirement of generation under contract could increase the supply need to as much as 9 GW.



Supply Need Surplus/Deficit – Source: IESO and APPrO

Potential Resource Options

The alternative planning scenario indicates that the supply need in Ontario could occur as soon as 2020 and be as large as 9 GW by 2035. There are a variety of potential resource options available to meet the supply need over the planning horizon. The following table summarizes the potential resource options and provides a summary of resource attributes and capabilities.

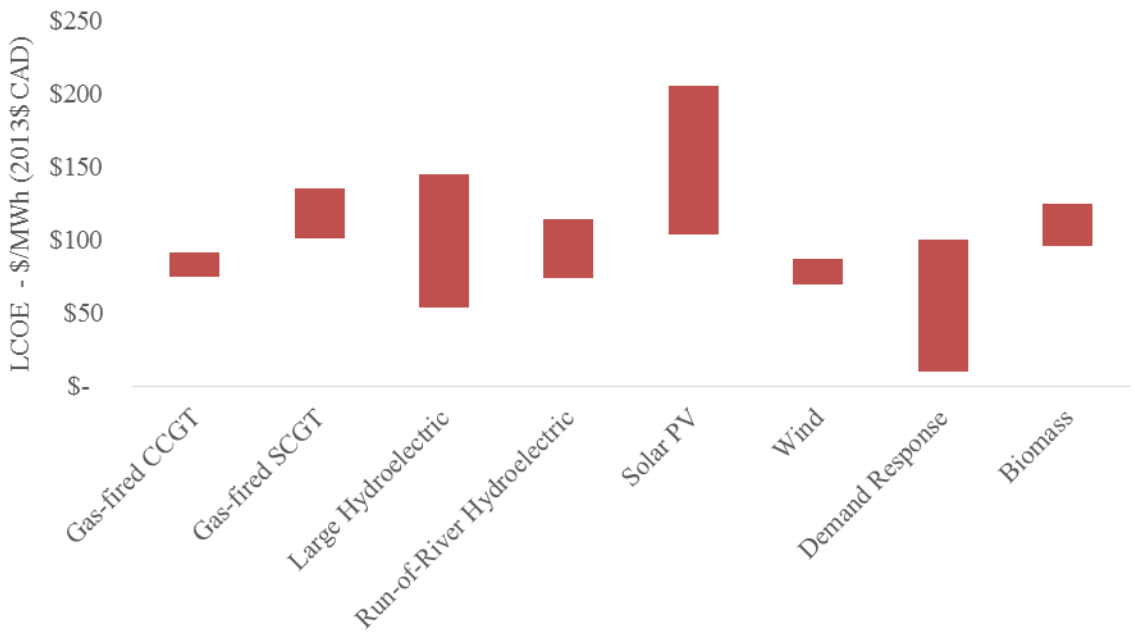
Resource Option	Siting Constraints	Development Time	Financial Commitment	Fuel Price Risk	GHG Contribution	Dispatchable
Natural Gas-fired	Can be sited close to load centers, requires access to gas pipelines	3-4 years	10 years +	High	High	Yes
Large Hydroelectric	Needs specific geographic attributes (i.e., Ontario far north)	8-10 years	40 years	Low	Low	Yes
Run-of-river Hydroelectric	Needs adequate river head	7-8 years	40 years	Low	Low	No
Solar PV	Highly flexible, can be sited on existing infrastructure	2-3 years	20 – 30 years	Low	Low	Partial
Wind	Needs adequate wind regime and transmission capacity	4-5 years	20-25 years	Low	Low	Partial
Demand Response	Requires available DR customers	1-2 years	1 year +	Moderate	Low	Partial

Biomass	Need security of fuel supply	3-5 years	20 - 30 years	High	Low	Yes

The optimal resource options will depend on the timing and characteristics of the power system need. For example, if Pickering GS is retired earlier than the current 2022/2024 timeline, there will be limited time available to procure and/or develop new supply resources. The limited time would restrict the supply options due to short development timelines. Alternatively, if the cost of continuing operation of existing assets is too high, resources with long development timelines could be available to meet long-term supply needs. For short supply need gaps, such as gaps created by nuclear refurbishment scheduling pinch points, supply resources with short financial commitment needs may be best suited. Other power system need attributes will also influence which supply resource is optimal (e.g., regional power system needs, ramping/load-following capability, GHG contribution, supply mix diversity, etc.). The OPO 2016 should summarize optimal resource attributes for different planning time periods (i.e., short-term, mid-term, and long-term) under different planning scenarios to guide government, policy makers, and electricity industry stakeholders.

The cost of each resource option is an important consideration in any resource selection decision. Levelized cost of electricity (LCOE) is commonly used to measure overall competitiveness of different generating technologies. The LCOE represents the cost to build and operate a generation facility over the financial life of the generation assets. Key inputs into the LCOE are capital cost, fixed operation and maintenance costs (O&M), variable O&M (including input fuel cost), financing costs, and expected utilization rate for the generation technology in a given electricity system. The key inputs and power system assumptions that influence LCOE calculations can change frequently. In many cases the realized cost of a resource option once constructed and operational can vary significantly from the LCOE calculation. For example, utilization rate for a resource option is driven by electricity demand characteristics and the future supply mix of a power system. In Ontario, utilization rates for certain resource options have been reduced due to surplus baseload generation events. The following chart provides a summary of LCOE ranges for different resource options based on the latest estimates from Annual Energy Outlook produced by the United States of America's Energy Information Administration (EIA)[11]. The IESO should produce similar analysis for Ontario's resource options to provide a clear understanding of each resource options cost-effectiveness and risk.

[11] Annual Energy Outlook 2015 – US EIA - http://www.eia.gov/forecasts/aeo/



Range of LCOE by Resource Option – Source: EIA, BC Hydro, Manitoba Hydro, IRENA, Lazard, & NREL

Summary

The future of Ontario's electricity sector is uncertain and supply needs will be determined by the impact of a wide variety of risk factors. The unknown impact of climate change initiatives on electricity demand combined with difficult existing supply resource decisions will require rigorous analysis to minimize risks. The OPO 2016 is an important first step in Ontario's new planning framework and, as the technical analysis supporting the development of the next LTEP, should be stress-tested to understand possible variation to the current planning outlook.

APPrO believes that further stakeholder engagement on the OPO 2016 is required. Stakeholder engagement regarding data, information, assumptions, and calculations within and driving the OPO 2016 is essential in order to best ensure accuracy of risk assessments. This will assist electricity stakeholders towards making sound business and investment decisions while gaining broad support for the OPO 2016 across the electricity sector. Stakeholder engagement sessions should also focus on understanding and assessing risk factors that could result in different supply needs. There are a large amount of generation assets that will be reaching end-of-life or end of contract term within the OPO 2016 planning horizon. Investment decisions required by generation owners to continue operations of their facilities will benefit from guidance on where the Ontario electricity system could evolve to.

There are four primary risk factors that will fundamentally influence the supply needs in OPO 2016.

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1. The capability to execute the current plan for Ontario's nuclear fleet will have the largest impact on supply needs.

2. The possibility of existing generation not continuing to operate after contract expiration/end-of-life could have a profound effect as well.

3. The impact of the OSSC may increase gross electricity demand.

4. Difficulties in achieving the aggressive CDM targets cost-effectively could further increase the resource requirement over the next 20 years.

There are many resource options available to Ontario to meet future supply needs. Each resource has benefits and drawbacks that will need to be considered at the time of supply need. Providing ample lead time to procure and construct new resources ensures that most resource options are available to Ontario. The current planning outlook does not expect any supply need until 2024/2025 and predicts this to be less than 1000 MW. As demonstrated by the alternative scenario analysis developed by APPrO, the supply need could be as early as 2020, which could limit the resource options available to meet a short-term supply need and could be much more than 1000 MW.

APPrO recommends that the IESO complete and publish analyses quantifying the full cost impacts of Pickering life extension not proceeding, and of CDM and other nuclear refurbishments not moving forward according to plan.

Overall, the uncertainty facing Ontario's electricity sector means that there will be critical milestones on the current plan that may result in significant divergences if primary risks occur. APPrO believes alternative planning scenarios should be considered to provide government policy makers and electricity industry representatives with a clear understanding of the possible future realities for the electricity sector.

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