OPG 2017 LTEP Contribution
Near-Term Hydroelectric Opportunities:
Development and Fleet Optimization Through Market Renewal

Briefing to the Deputy Minister of Energy
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Outline

- OPG's Key Public Messages for 2017 LTEP
- Near-Term Hydroelectric Considerations for 2017 LTEP
  - Reinvesting for Future Generations
  - Optimizing Operations
- Market Renewal
- Near-Term Recommendations for 2017 LTEP

OPG's Key Public Messages for 2017 LTEP

1. OPG operates a clean, safe, reliable, cost-effective generation portfolio with strong Indigenous and local community partnerships
2. OPG's nuclear assets provide cost, reliability and carbon benefits to Ontario
3. OPG will leverage and optimize existing assets including its hydro fleet to cost effectively reduce emissions while providing increased flexibility to the IESO
4. OPG is prepared to support the government's longer-term electrification goals through development of additional hydroelectric assets
5. OPG is actively engaged in innovation through initiatives such as Nanticoke Solar, Atikokan and Thunder Bay biomass, micro grid development, exporting our nuclear expertise abroad, as well as continued support for Small Modular Reactors and deployment of electric vehicles

Near-Term Hydroelectric Considerations – 2017 LTEP

- OPG is committed to advancing near-term opportunities to add hydroelectric capacity and energy at OPG's existing facilities
- Preserving and/or optimizing OPG's existing hydroelectric infrastructure will drive significant system benefit for the long-term and further OPG's contribution to the government's long-term climate goals through maintaining (and often increasing) clean production from these valuable provincial resources
- OPG is committed to prudently reinvesting in its infrastructure with cost recovery through the regulatory process:
  - Consistent with O Reg 53/05 section 6 (2) 4, "The Board shall ensure that OPG recovers capital and non-capital costs and firm financial commitments…incurred to increase the output of, refurbish or add operating capacity to a generation facility…(subsection ii) …if the Board is satisfied that the costs were prudently incurred…"

Near-Term Hydroelectric Considerations - 2017 LTEP (cont'd)

- Leveraging OPG's existing hydro assets ensures emission reduction and grid flexibility benefits can be extended and expanded upon into the future
- OPG will reinvest in aging assets
  - Some units reaching end-of-life will become unavailable to the system if reinvestment does not occur
- OPG will continue to work with the IESO to address market inefficiencies and increase system flexibility to achieve further value from existing assets
- OPG will continue to look for opportunities for technology or operational process innovations

For Consideration in the 2017 LTEP

- **"Supporting Provincial Climate Change Goals"** – support hydroelectricity as a dependable, long-lived, cost-effective electricity source that is integral to Ontario's green supply mix of the future
- **"Leverage Existing Assets Effectively"** – showcase the reliability of Ontario's hydroelectric fleet as well as notable opportunities for reinvestment at existing sites for future generations

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Ranney Falls GS

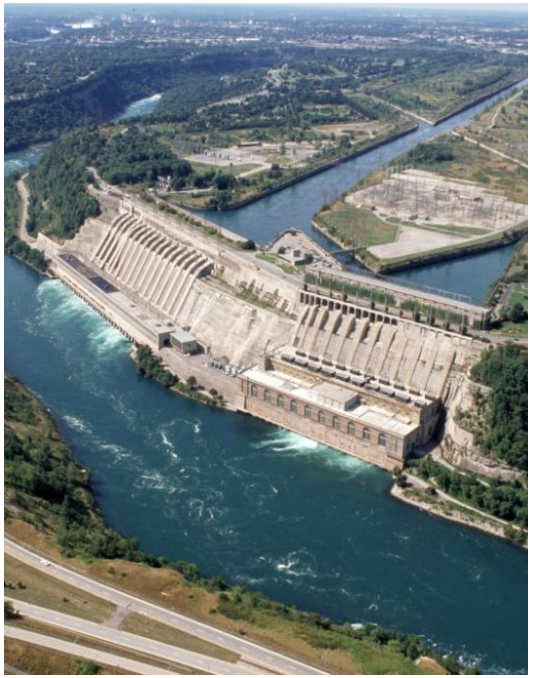
- Located on the Trent-Severn Waterway near Campbellford, Ranney Falls GS was placed in service between 1922-1926
- Unit 3 (0.8 MW 'Pup unit') reached its end of life in 2014 and was taken out of service
- Project includes replacement of the Pup unit with a new single unit powerhouse adjacent to the existing 10 MW, two unit station, adding an incremental 10 MW (33 GWh) of clean hydropower
    - Utilizes existing excess water in the Trent River to better optimize available water resource
    - Distribution connection has been secured and no new distribution line required
    - Parks Canada environmental assessment complete
    - Construction planned to commence as early as Q2, 2017
- Project has established a solid social licence with strong municipal support and support of area Indigenous communities

Calabogie GS Redevelopment

- Located ~100 km east of Ottawa, Calabogie GS was constructed in 1917
- Current facility is undersized for available water resource and is reaching the end of its service life
- Redevelopment opportunity to replace existing 4-MW end-of-life station with approximately 10-13 MW of clean and efficient capacity
  - Optimizes site power generation approximately doubling annual energy to ~44 GWh
  - Leverages existing civil and transmission infrastructure
- 2021 earliest in-service

Sir Adam Beck 1 G1/G2 Frequency Conversion and Runner Upgrade

- Sir Adam Beck 1 GS (SAB1) G1/G2 are 25 Hz generating units that were decommissioned in 2009; the remaining units of SAB1 generate at 60 Hz
- The SAB1 G1/G2 frequency conversion project will convert these units to 60 Hz, while also overhauling the units and completing runner upgrades
- The project will provide the following benefits:
  - Adds an estimated 100 MW of low cost capacity at system peak
  - Increases the supply of operating reserve, which is desired by the IESO for the Ontario market
  - Shifts off-peak energy generation at the Sir Adam Beck Complex to on-peak hours
  - Higher total annual energy generation (an additional 50-100 GWh per year)



Runner Upgrades

- A runner is the rotating part of the turbine that converts the energy of falling water into mechanical energy
- Runner upgrades are a cost effective method of extracting additional capacity and energy generation from existing generating stations, by taking advantage of more efficient runner designs currently available
- Runner upgrades have negligible impact on the external environment and existing flow regimes of the stations
- ~100 MW of additional capacity and ~340 GWh of additional energy generation can be obtained through runner upgrades at OPG's existing facilities
- OPG has currently included ~50 MW (~125 GWh) of runner upgrades in its internal 2017-2019 business plan:
  - Beck - SAB1 G5 and G10
  - Harmon G1 (G2 runner upgrade was completed in 2016)
  - Little Long G1 and G2
  - Silver Falls G1
  - Saunders G10

Pump Generating Station (PGS)

- OPG and the IESO are currently working together to pursue opportunities to optimize OPG's PGS and increase system value from Canada's largest and most flexible energy storage asset.

- The Beck Complex provides significant dispatchable energy (close to southern Ontario load centers), regulation service, operating reserve, ancillary services, and energy storage.

- The PGS facilitates time shifting at the Beck Complex, which can reduce the commitment of non-renewable facilities during on-peak periods and reduce the amount of Surplus Baseload Generation.

- Despite the benefits of PGS, it has operated less frequently over the last few years than in the past. OPG and the IESO collaborated on a pilot project to find a solution to increase utilization of the PGS through operational changes within existing market rules. The team determined that changes to the market rules and structure were needed to provide increased opportunities for PGS.

- OPG is continuing to advance increased utilization of PGS through the IESO's Market Renewal initiatives. Market enhancements could result in the reduction of Ontario ratepayer costs.

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Other OPG Site Opportunities

- Several other OPG sites also provide opportunities for near-term, cost-effective reinvestments at end-of-life facilities or existing infrastructure:
  - Mattagami Lake
    - South of Timmins, Mattagami Lake Control Dam was constructed in 1921
    - OPG has proposed developing a run-of-the-river, 5-6 MW generating station and an associated ~3 km connection line in the immediate vicinity of the dam
    - OPG and Mattagami First Nation would develop the project under partnership terms already established
    - Engineering and design work has been substantially completed and an environmental assessment has been completed
  - Coniston GS
    - East of Sudbury, Coniston GS was constructed in 1905
    - 3 unit station, approximate total capacity of 4.75 MW
    - Unit 1 shutdown in 2013; Units 2 and 3 are reaching the end of their service life
    - Opportunity to replace the station with approximately 6 MW (27 GWh) of clean and efficient capacity
  - Other small stations reaching end-of-life (e.g. Hagues Reach GS, Frankford GS)
  - Development of the Allanburg Intake #2 (Lake Gibson) near OPG's Decew GS
  - Various opportunities at OPG existing control dams
- Further economic and environmental investigations are required

Market Renewal

- OPG is supportive of the IESO's efforts to address market inefficiencies, and further encourages expediting certain market evolution initiatives to enable system flexibility, optimize the use of existing assets and reduce costs for the ratepayer

- Market solutions can address the system's immediate operability issues and OPG's existing assets are readily available to support

- Through the implementation of market changes, underutilized OPG assets can provide needed system value and cost savings

- OPG has submitted comments to support the IESO's Market Renewal initiative through the IESO's public consultation process, including:
  - Improve the day-ahead commitment process and / or develop a day-ahead market for hydroelectric and energy storage facilities; move to 15-minute scheduling of hydroelectric assets and interties, improving the efficiency of hydroelectric operation and increasing system flexibility; and
  - Encourage mechanisms for capacity trading, allowing generators to monetize capacity that is in excess of Ontario's needs and not required for Ontario reliability

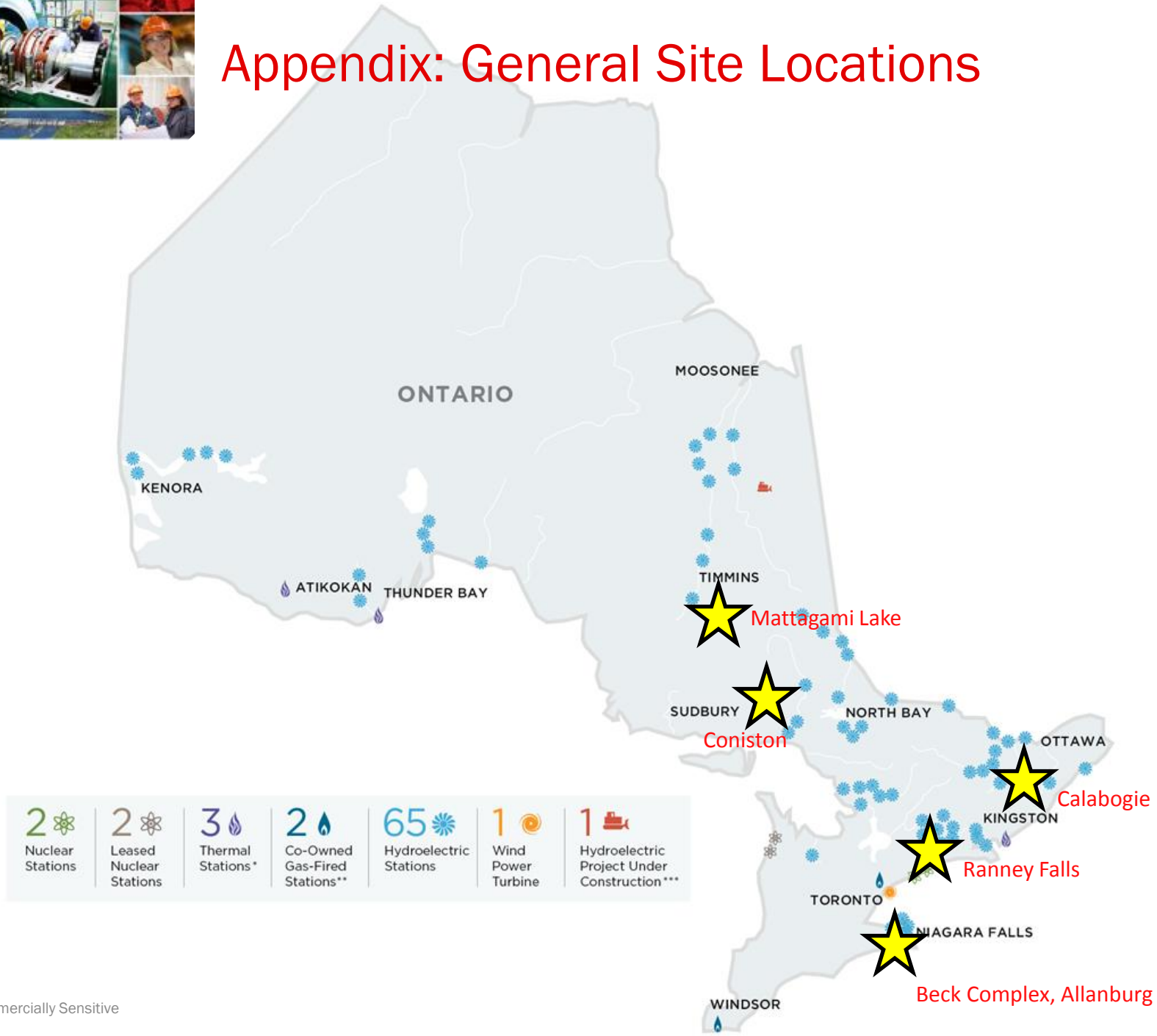
- Other opportunities to lower the overall cost of energy could also be obtained through a review and optimization of existing dispatch processes for hydroelectric facilities

Near-Term Hydro Recommendations for 2017 LTEP

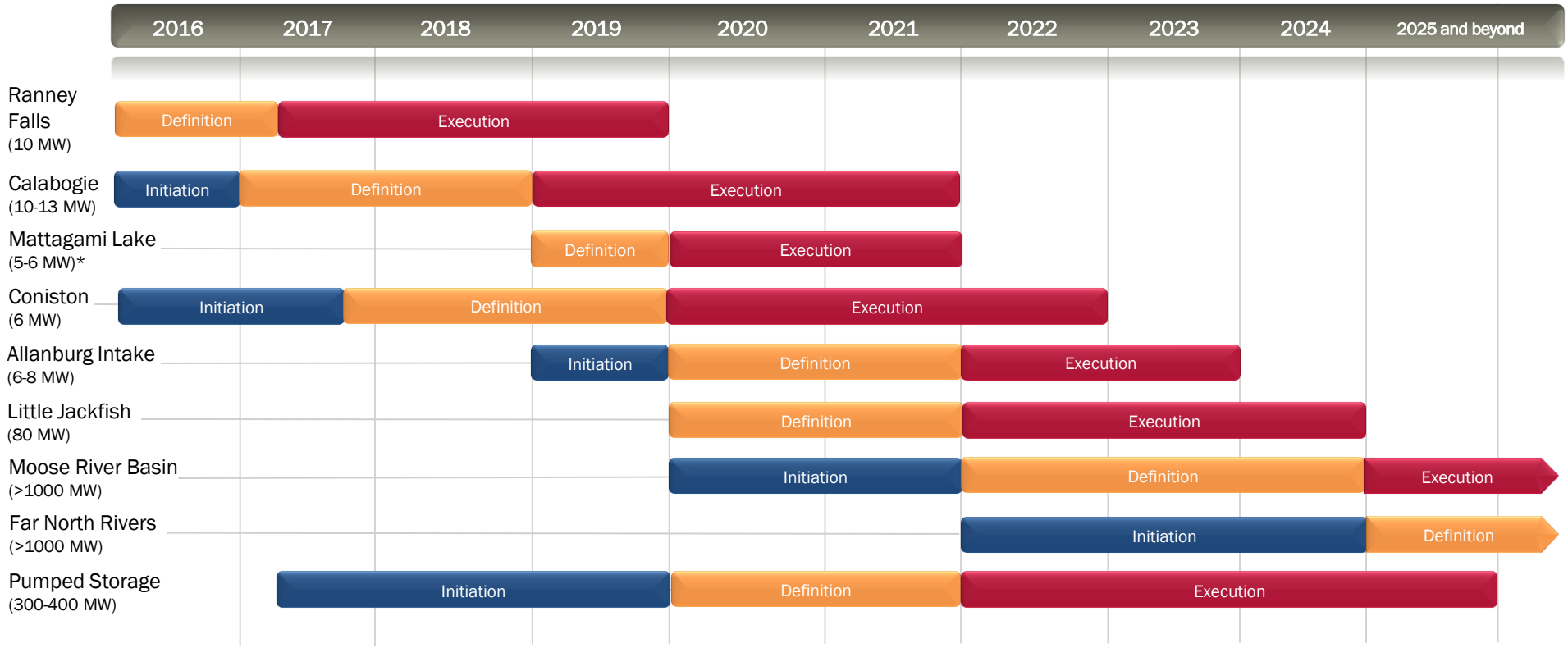
- Support hydroelectricity as a dependable, long-lived electricity source that is integral to Ontario's green supply mix of the future:
  - OPG to continue with initiatives to prudently invest in the retrofit, life extension, and development of hydroelectric facilities to optimize use of available water resources
  - OPG to implement options to upgrade and improve operational performance of existing hydro facilities in order to increase clean energy from its existing hydro fleet

- OPG to work with the IESO to increase market efficiency and flexibility:
  - Support the development of a more dynamic electricity market by implementing market improvements to take advantage of underutilized hydro assets
  - Given the benefits of existing bulk hydroelectric pumped storage, develop and implement near-term market mechanisms to facilitate optimization of energy storage facilities, specifically at the PGS and Beck Complex

Appendix: General Site Locations



Appendix: Current Timeline



**Assuming transmission constraints addressed*

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