2017 Long-term Outlook

Information Session

July 25, 2017
Welcome

• Overview of 2017 Long-term Outlook (2017 LTO)
• Questions will be answered at the end of the presentation
  – Please use microphone when asking questions so webinar participants can hear discussion
• Today’s presentation will be published on AESO.ca by end of day
Overview

• 2017 LTO is the AESO’s view of load and generation over 20 years within Alberta
  – Used as one of many inputs to guide the AESO in planning Alberta’s transmission system including the Long-term Plan

• The AESO has done a prudent job of developing the 2017 LTO
  – Takes Alberta’s economy and policy announcements into account
  – Uses scenarios to test potential future outcomes
Key Highlights

• Load is forecast to grow at an average annual rate of 0.9% until 2037
  – Downward revision from the 2016 LTO due to revised economic growth expectations, modelling adjustments, and energy efficiency assumptions

• Key generation assumptions include
  – All coal-fired generation will retire by the end of 2030
  – The Renewable Electricity Program (REP) will support approximately 5,000 MW of renewable generation development, 400 MW of which will be energized and operational by Dec. 1, 2019
  – Additional renewables will develop outside of the REP
  – By 2030, 30% of electricity produced in Alberta will come from renewable sources
  – Approximately 2,400 MW of coal-fired generation will convert to natural gas-fired units in the early 2020s

• 13,900 MW of new capacity is forecast to be developed by 2037 (this excludes coal-to-gas conversions)
2017 LTO Reference Case Load Growth
2017 LTO Load Scenarios

• Reference Case Scenario
  – Will be the basis for several AESO functions

• Low Load Growth Scenario
  – Tests lower load growth
  – Assumes only under-construction oilsands projects are completed
Economic and Load Outlook

• Background and context
  – Alberta’s economy is linked to global oil prices
  – Oil prices have come down since mid-2014 due to global over supply
  – Alberta economy is coming out of a recession
  – Record high loads since late 2016 due to weather and recently completed oilsands projects ramping up

Source: U.S. Energy Information Administration
Economic and Load Outlook

• Reference case economic outlook assumptions
  – Oil price forecasts less optimistic than before
    • Gradual ramp to ~$80/bbl long-run
  – Oilsands economics
    • Incremental expansions expected to be economic under current price outlooks
    • Large greenfield projects are generally not economic
  – Alberta’s economy will grow modestly over next 20 years
Economic and Load Outlook

• Reference Case load outlook assumptions
  – Next 5 years
    • Under-construction and recently-completed oilsands projects will contribute to near-term load growth
  – Beyond 5 years
    • Incremental expansions at oilsands sites will drive modest economic and load growth
  – Efficiency
    • Demand across Alberta will be impacted by energy efficiency
2017 LTO Load Forecast

Historical
2016 LTO Reference Case
2017 LTO Reference Case
2017 LTO Low Growth

Alberta Internal Load Winter Peak (MW)

Year | 2016 LTO RC | 2017 LTO RC | 2017 LTO LG
--- | --- | --- | ---
2022 | 13,701 | 12,260 | 11,847
2027 | 14,702 | 12,814 | 12,025
2032 | 15,593 | 13,486 | 12,277
2037 | 16,496 | 13,947 | 12,484

Compound Annual Growth Rates (CAGR)

<table>
<thead>
<tr>
<th>Growth Period</th>
<th>Historical</th>
<th>2016 LTO RC</th>
<th>2017 LTO RC</th>
<th>2017 LTO LG</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-2016</td>
<td>1.7%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2011-2016</td>
<td>1.6%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2016-2022</td>
<td>-</td>
<td>3.0%</td>
<td>1.1%</td>
<td>0.6%</td>
</tr>
<tr>
<td>2016-2027</td>
<td>-</td>
<td>2.3%</td>
<td>1.0%</td>
<td>0.4%</td>
</tr>
<tr>
<td>2016-2032</td>
<td>-</td>
<td>1.9%</td>
<td>1.0%</td>
<td>0.4%</td>
</tr>
<tr>
<td>2016-2037</td>
<td>-</td>
<td>1.8%</td>
<td>0.9%</td>
<td>0.4%</td>
</tr>
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</table>
2017 LTO Generation Forecasts
2017 LTO Generation Forecast Principles

• Generation forecast key assumptions
  – Reliability maintained (no unserved load)
  – At least 30% of electricity produced in Alberta comes from renewables by 2030 (Renewable Electricity Act – Bill 27)
  – 15% reserve margin level assumed
  – Payments from the market support new firm generation capacity

• Methodology considers the economics, characteristics and drivers for each technology type
  – Some technologies are primarily driven by policy and some are driven by opportunities in the electricity market
  – Market simulations and reserve margin calculate firm capacity additions
  – Scenarios are used to test alternate potential outcomes
2017 LTO Scenario Structure

<table>
<thead>
<tr>
<th>Load</th>
<th>Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-growth</td>
<td>Low-growth</td>
</tr>
<tr>
<td>Reference Case</td>
<td>Reference Case, High Coal-to-gas, No Coal-to-gas, Large-hydro Addition, Western Integration, High Cogeneration</td>
</tr>
</tbody>
</table>
2017 LTO Reference Case Generation Assumptions

• Renewable additions
  – Wind: 5,000 MW by 2030
  – Solar: 500 MW by 2030 plus 500 MW after 2030
  – Hydro: 350 MW by 2030

• Non-renewable additions
  – 2,400 MW of coal-to-gas conversion in early 2020s
  – Rest of coal retires in late 2020s
  – Combined cycle and simple cycle replace coal retirements and accommodate load growth – 7,000 MW of new capacity by 2037
  – Cogeneration: under-construction projects plus 400 MW by 2037

• Intertie
  – Capacity in line with intertie restoration
• Renewable capacity reaches approximately 36% of system in 2030
• Approximately 7,000 MW of new combined cycle and simple cycle capacity are built during the forecast horizon
• Approximately 2/3 of energy comes from renewables and cogeneration by 2037
2017 LTO High Coal-to-Gas Scenario

• Background
  – Uncertainty around future federal coal and gas regulations
  – This scenario tests what if there are significant coal-to-gas conversions

• Key Assumptions
  – 5,400 MW of coal capacity converts to natural gas in early 2020s
  – 900 MW of older capacity not assumed to convert
New gas units builds are later in forecast compared to the Reference Case

Approximately 4,000 MW of combined cycle gas generation is built, no new simple cycle is built

Coal, combined cycle, simple cycle, and coal-to-gas run with higher capacity factors than in the Reference Case
2017 LTO No Coal-to-Gas Scenario

• Background
  – Uncertainty around future federal coal and gas regulations
  – This scenario tests what if there are no coal-to-gas conversions

• Key Assumptions
  – No coal-to-gas conversions
  – Most coal capacity retires in the late 2020s
2017 LTO No Coal-to-Gas Scenario

- Similar to the Reference Case, 7,000 MW of new combined cycle and simple cycle are built during the forecast horizon.
- Earlier combined cycle and simple cycle builds to replace retiring coal, compared to Reference Case.

*Future capacity as of the end of year: existing capacity includes under-construction projects.*
• Background
  – Examines impact of large-scale new hydro development in Alberta
  – The Slave, Athabasca, and Peace river basins are all located in northern Alberta and contain 75% of estimated Alberta hydro potential

• Key Assumptions
  – 1,520 MW of Hydro is developed by 2037
    • Same 350 MW facility is built by 2030 as Reference Case (Peace River)
    • New 170 MW in 2028 on North Saskatchewan River
    • New 1,000 MW run-of-river hydro development in 2035 on Slave River

• Key Considerations
  – Run-of-river easier and less expensive to build but subject to river flow rates
  – Large-storage hydro is more expensive and challenging but can manage year-round flows and energy output
Non-hydro renewable development still required to reach 30 by 30 target

Less combined cycle and simple cycle develop over the forecast horizon compared to Reference Case (6,500 MW versus 7,000 MW)

Minimal differences compared to Reference Case before 2035

*Future capacity as of the end of year: existing capacity includes under-construction projects.*
2017 LTO Western Integration (new intertie) Scenario

• Background
  – This scenario considers the impacts of a new large interconnection with B.C.

• Key Assumptions
  – Up to 1,700 MW of imports/exports from/to BC (compared to 1,200 MW imports, 1,000 MW exports the Reference Case)
    • Total BC/Montana import/export capability increases to 2,000 MW
  – New intertie enters service in 2026
  – Opportunity service (similar to current intertie; no firm contract)

• Key Considerations
  – Type of contract (opportunity service versus firm contract)
  – B.C. capability to import/export
Western Integration (new intertie) Scenario

- Similar combined cycle and simple cycle development compared to Reference Case
- New intertie reduces the need for simple cycle compared with the Reference Case
- Minimal impacts due to opportunity service assumption – still need firm supply in Alberta

*Future capacity as of the end of year: existing capacity includes under-construction projects.*
2017 LTO High Cogeneration Scenario

• Background
  – Cogeneration incentives change under Climate Leadership Plan
  – The scenario tests more cogeneration development

• Key Assumptions
  – Additional 1,320 MW of additional cogeneration capacity above Reference Case (total of ~2,000 MW)
  – No additional load is assumed – all cogeneration is net-to-grid
2017 LTO High Cogeneration Scenario

- Less combined cycle and simple cycle development compared to Reference Case
- Approximately 3/4 of energy generated is from renewables and cogeneration by 2037

*Future capacity as of the end of year: existing capacity includes under-construction projects.
2017 LTO Low-Growth Scenario

• Background
  – Similar to the Reference Case
  – Low load growth load profile is used

• Key Assumptions
  – Only existing and under-construction cogeneration projects are included
  – Fewer renewables required to meet 30 by 30 target compared to Reference Case
    • 4,300 MW of wind developed by 2030 instead of 5,000 MW
2017 LTO Low-Growth Scenario

- Less combined cycle and simple cycle development compared to Reference Case
- New gas primarily required to replace coal-fired capacity
- Fewer MW of renewables required to achieve 30 by 30 target compared to Reference Case

*Future capacity as of the end of year: existing capacity includes under-construction projects.*
AESO Forecasting Future Steps

• Upgrading load modelling and processes
  – Hourly load forecasts by substation, regions, and Alberta Internal Load
  – Consideration for distribution-connected resources including photovoltaic solar and small-scale natural gas
  • Historical and forecast

• Capacity market load forecast development
  – Currently reviewing capacity market load forecasts from other jurisdictions
Questions?
Contact Us

• Visit AESO.ca to view today’s presentation
• Contact us at forecast@aeso.ca