

2017 Long-term Outlook

Information Session

July 25, 2017

- 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

- 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

- 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)

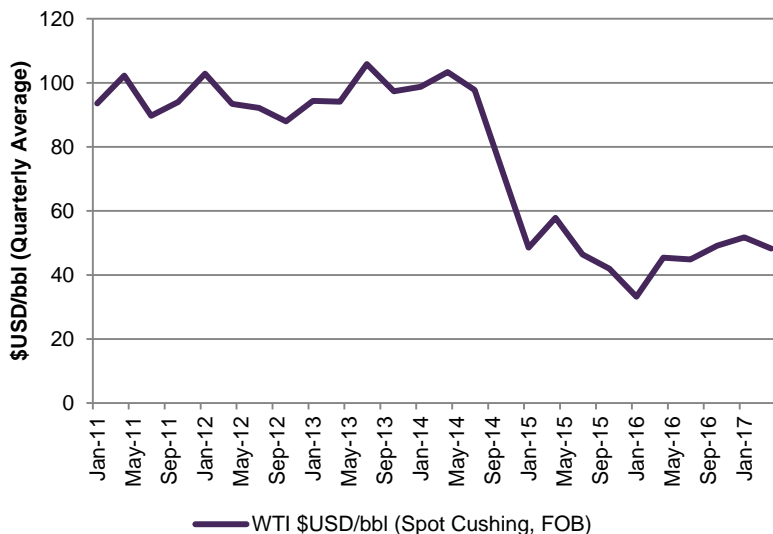
2017 LTO Reference Case Load Growth

- 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

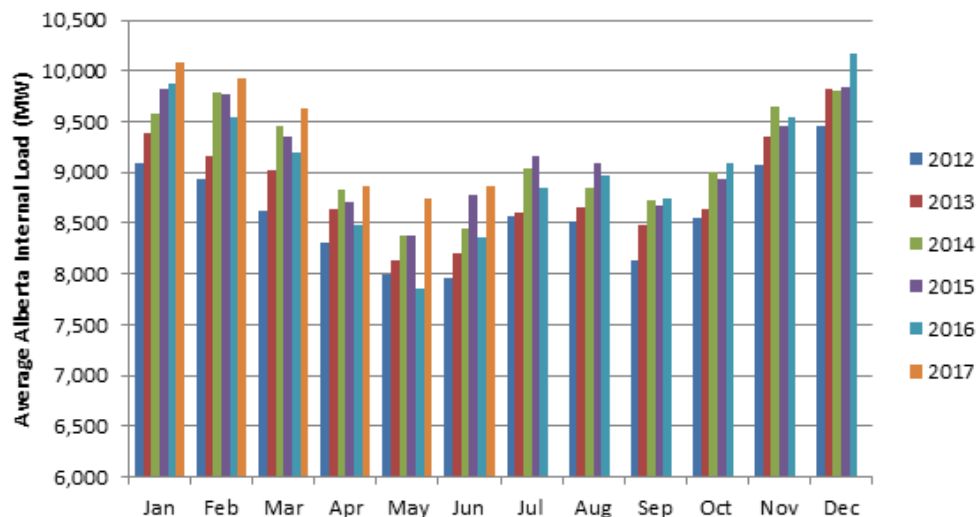
- Background and context

- 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

Historic Oil Prices



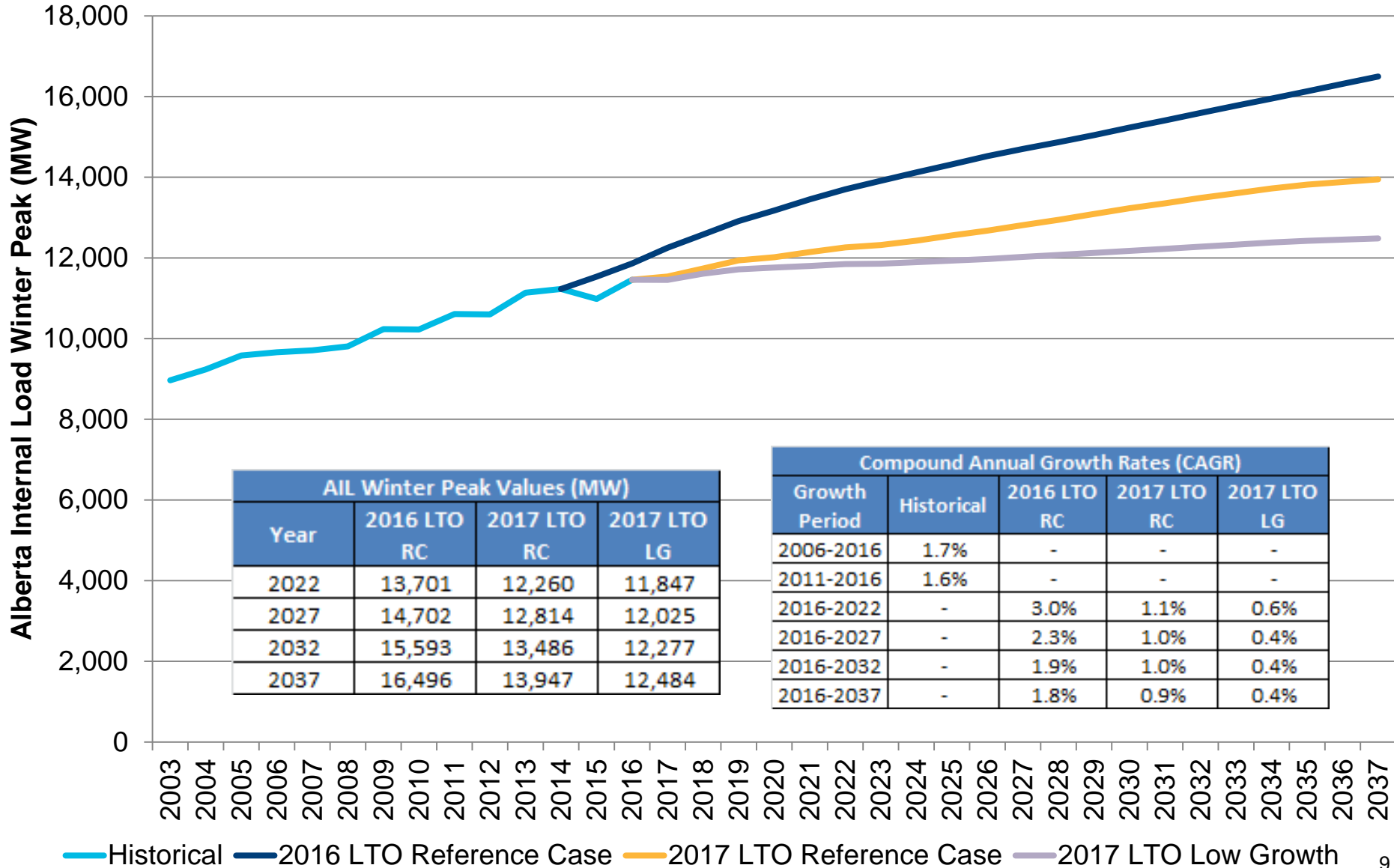
Average Alberta Internal Load by Month



- 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

- 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



2017 LTO Generation Forecasts

- 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

Load

Generation

Low-growth



Low-growth

Reference Case

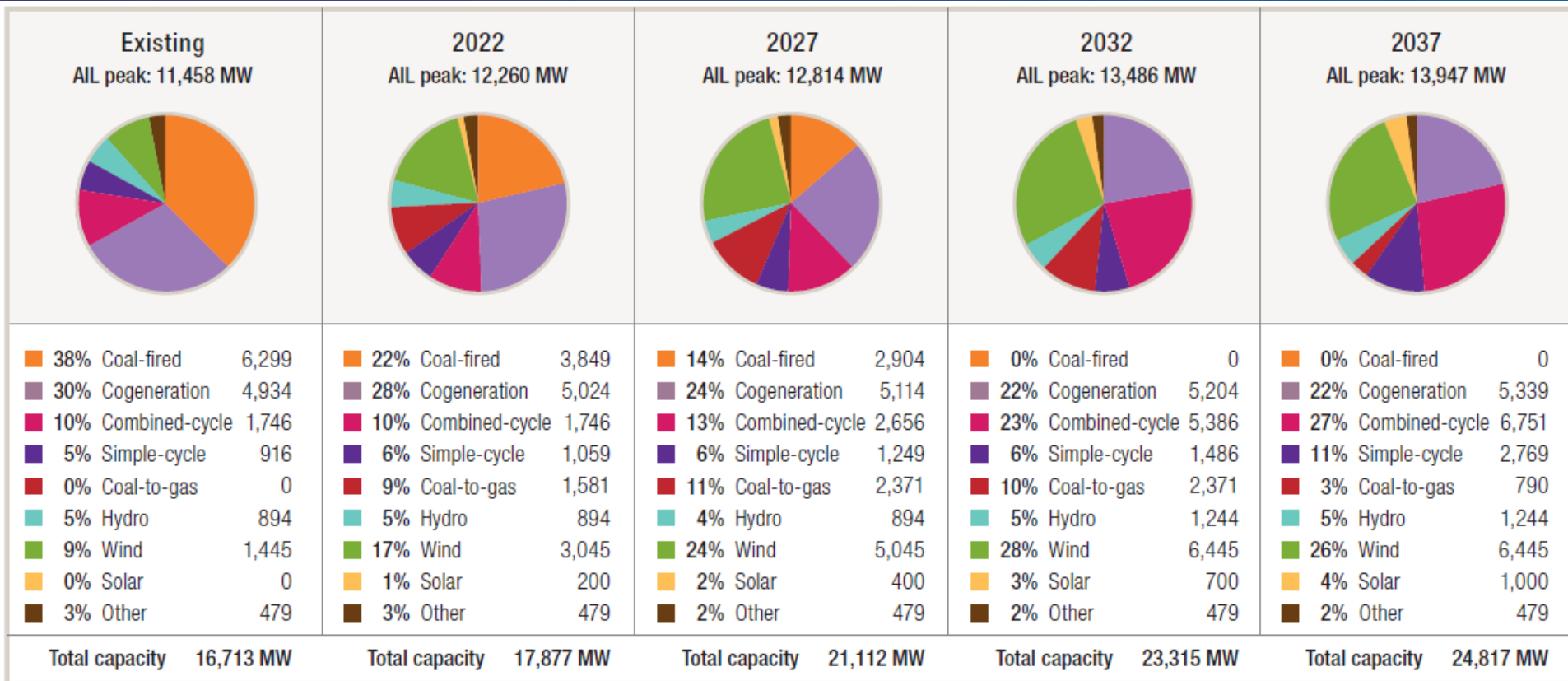


Reference Case
High Coal-to-gas
No Coal-to-gas
Large-hydro Addition
Western Integration
High Cogeneration

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

Reference Case Generation Capacity

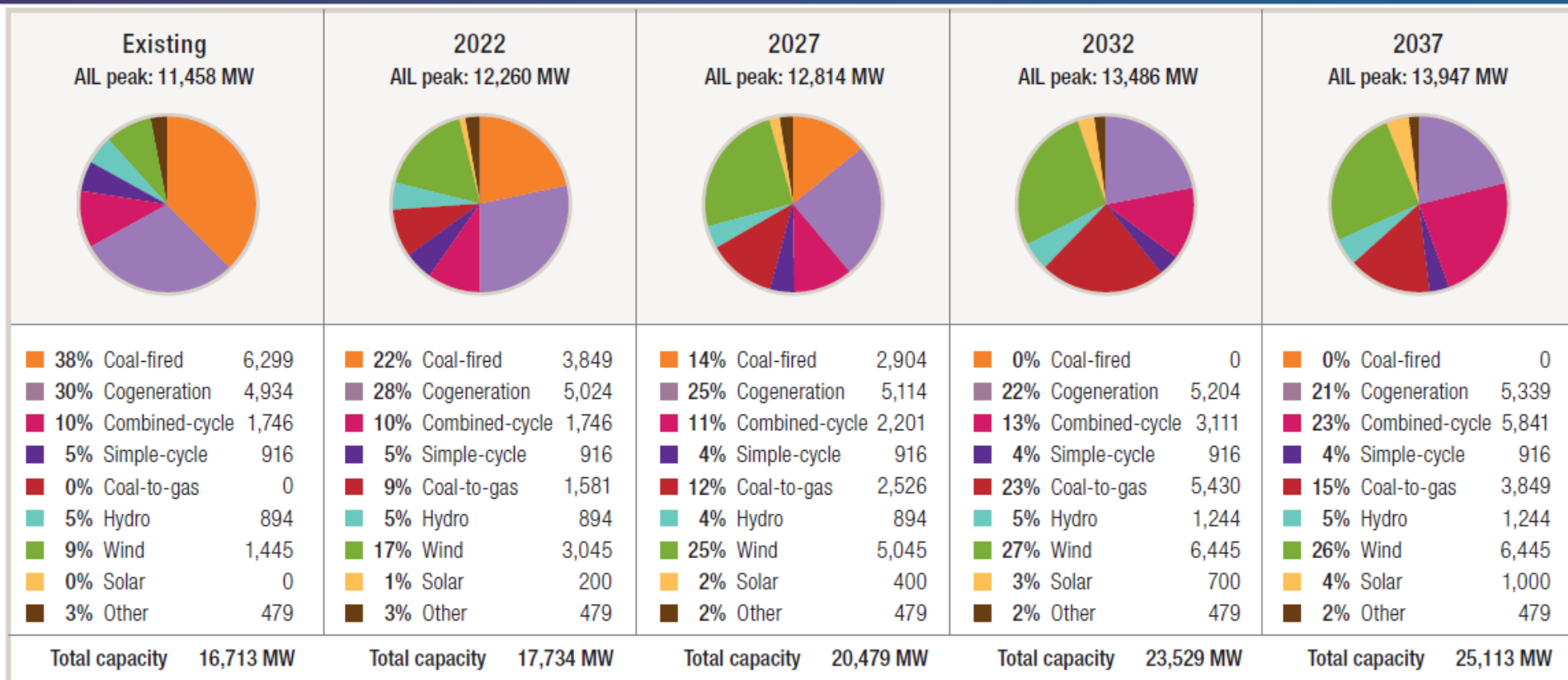


*Future capacity as of the end of year; existing capacity includes under-construction projects.

- 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

- 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

2017 LTO High Coal-to-Gas Scenario

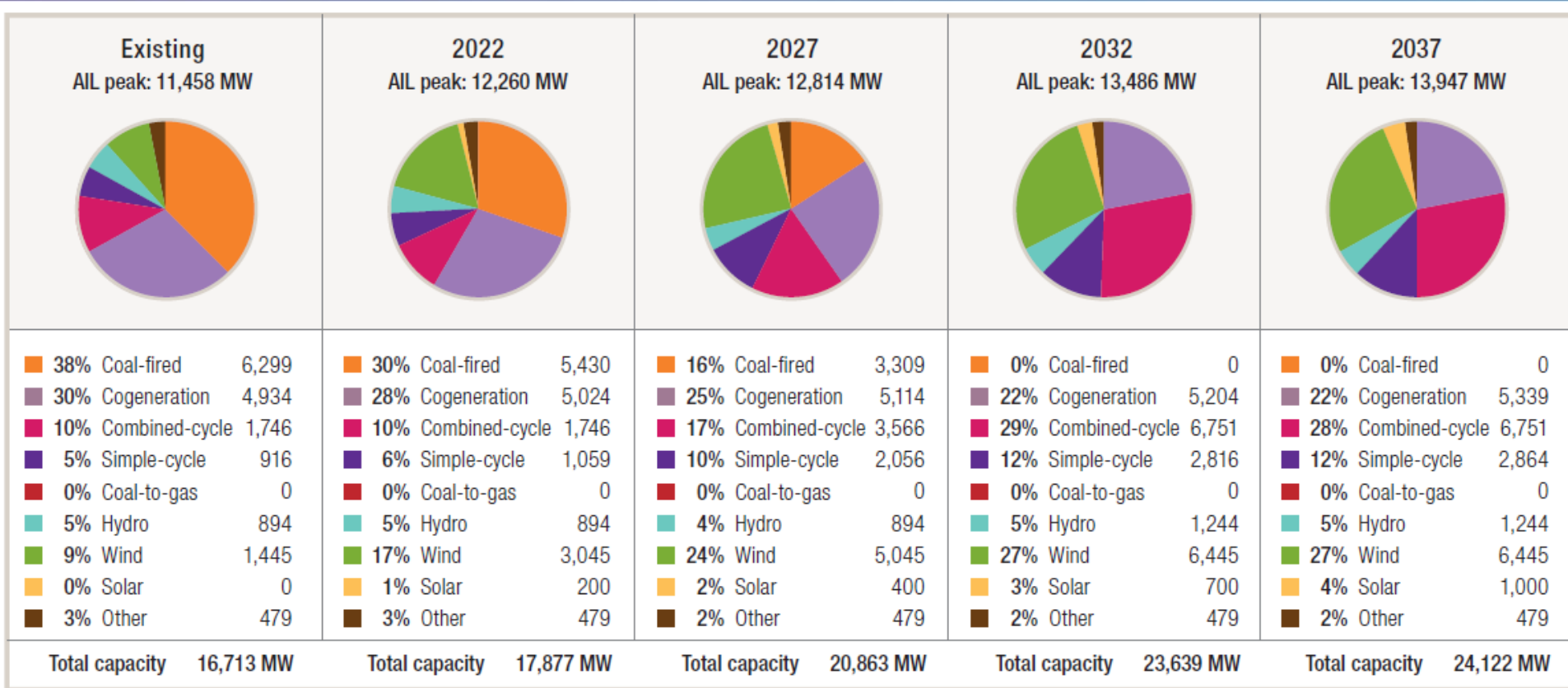


*Future capacity as of the end of year: existing capacity includes under-construction projects.

- 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

- 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

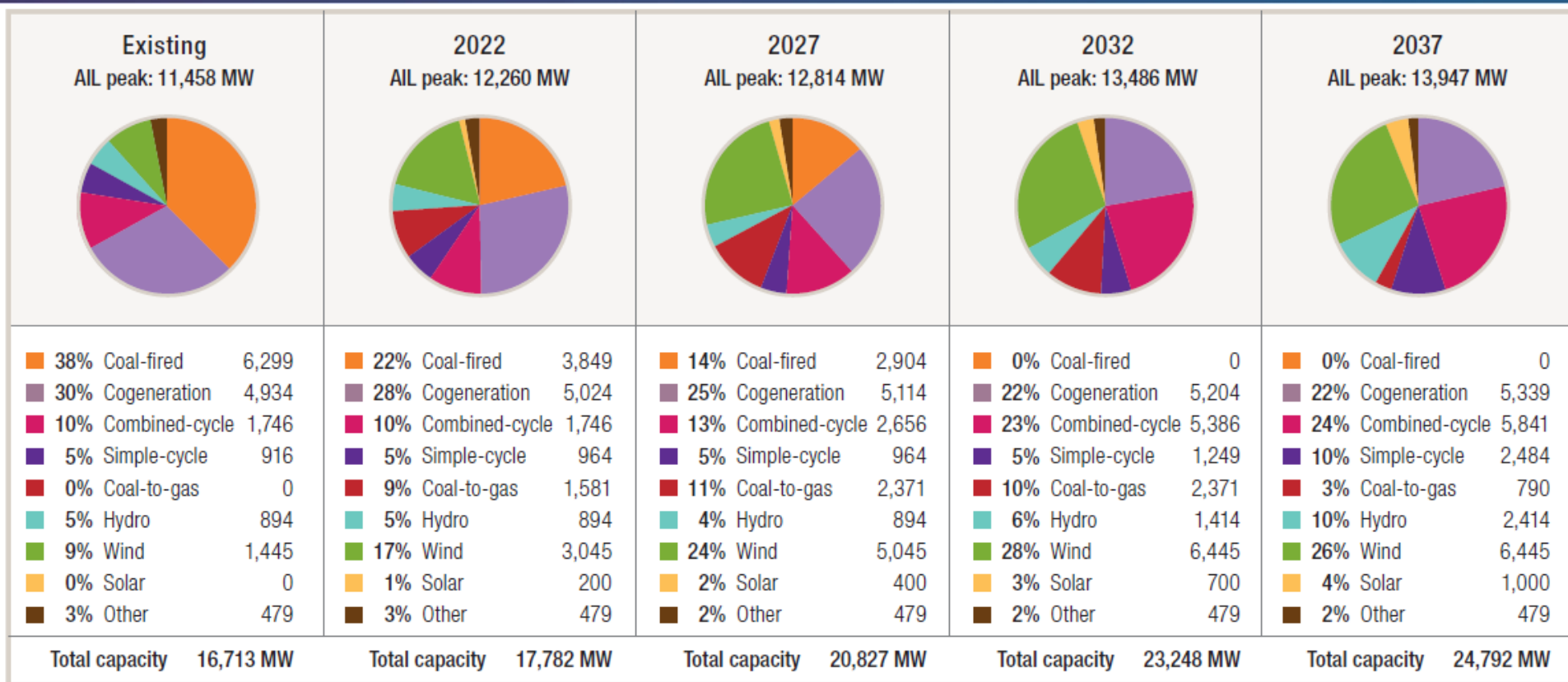


**Future capacity as of the end of year: existing capacity includes under-construction projects.*

- 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

- 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

2017 LTO Large New Hydro Scenario



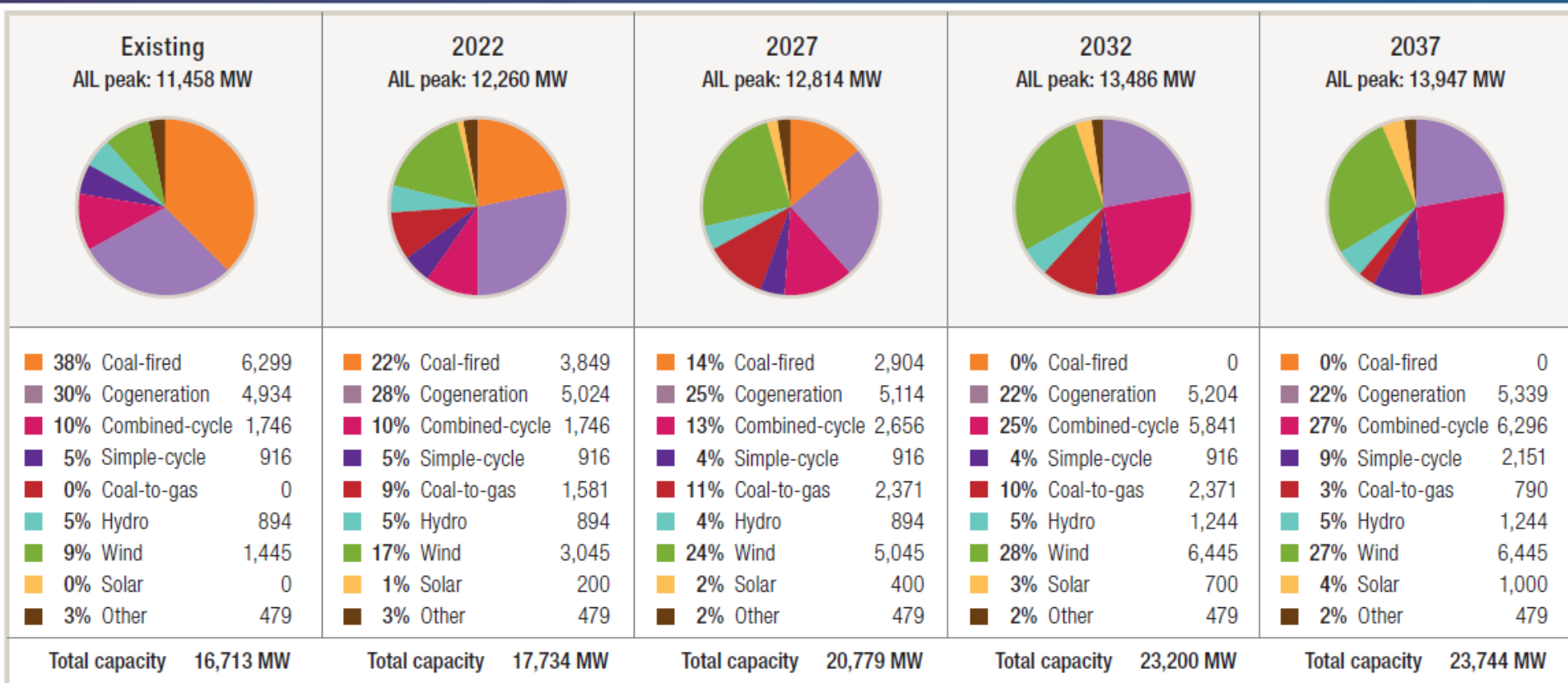
*Future capacity as of the end of year: existing capacity includes under-construction projects.

- 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

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

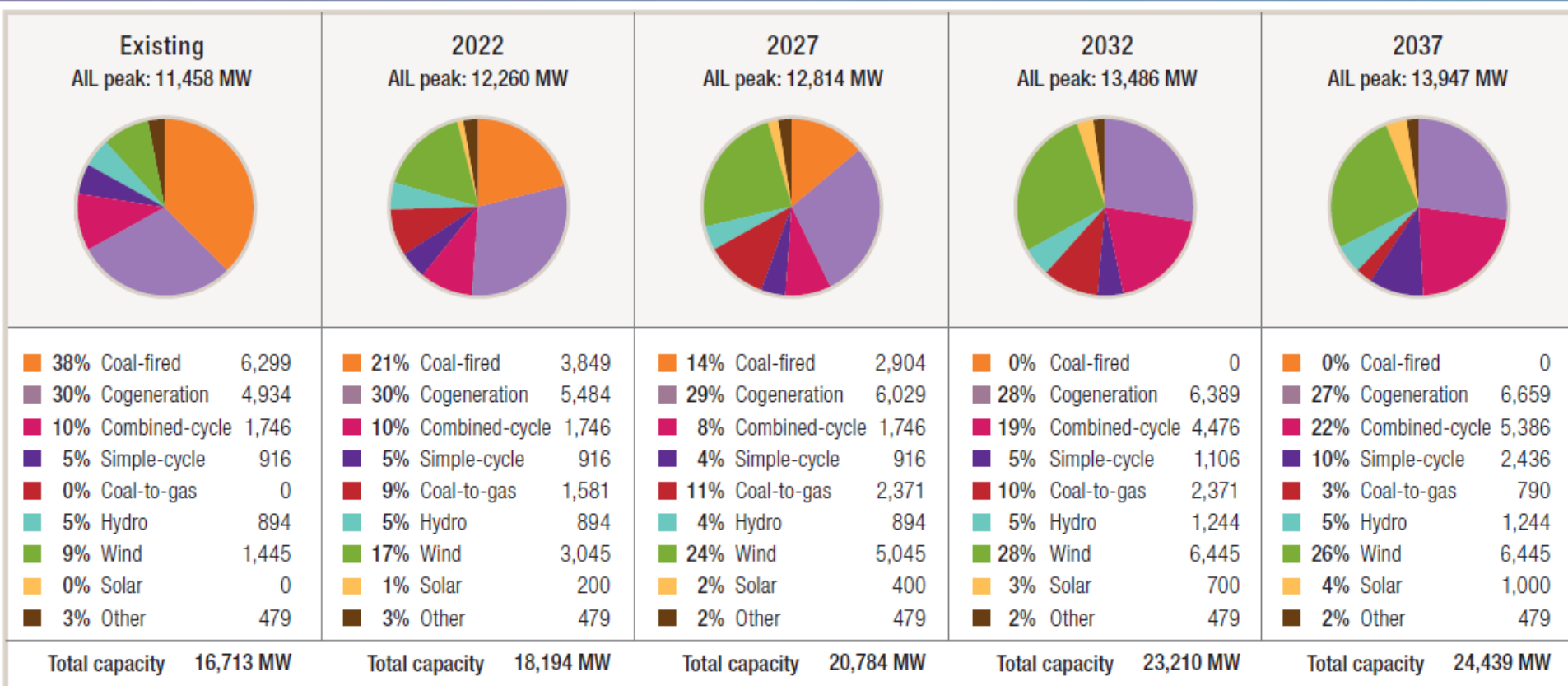


*Future capacity as of the end of year: existing capacity includes under-construction projects.

- 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

- 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

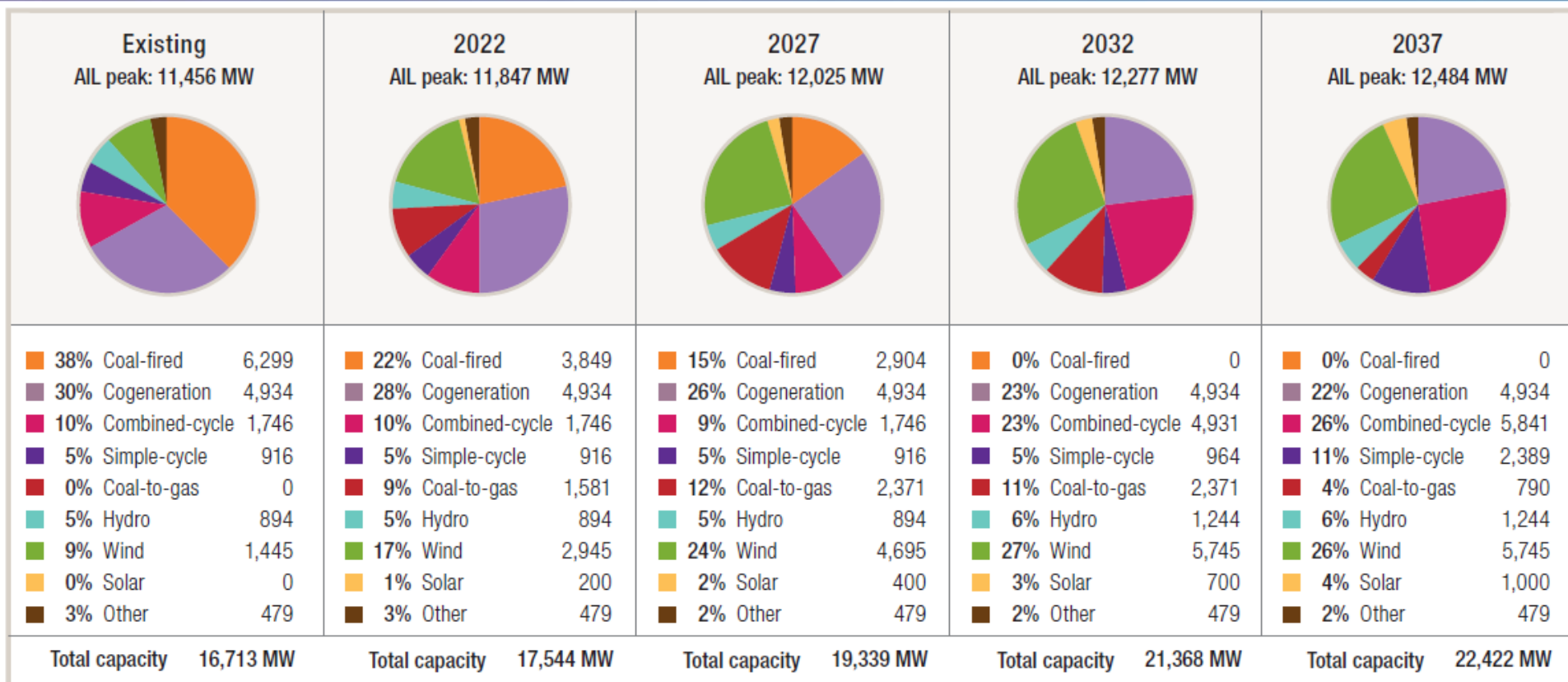


*Future capacity as of the end of year: existing capacity includes under-construction projects.

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

- 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



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

- 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

- 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](https://www.aeso.ca) to view today's presentation
- Contact us at forecast@aeso.ca