Results

Alternative Decarbonization

AESO 2024 Long-Term Outlook

MAY 2024

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Overview

- Compared to the Reference Case, the Alternative Decarbonization scenario assumes a conservative outlook on cost declines over the forecast for emerging baseload technologies (e.g., nuclear small modular reactors [SMRs] and carbon capture, utilization and storage [CCUS]). The scenario also incorporates decreased costs for battery energy storage and increased intertie capacity.
- The Alternative Decarbonization scenario sees the least long-term capacity built of all *2024 Long-term Outlook* (LTO) scenarios. In contrast to the other 2024 LTO scenarios, the Alternative Decarbonization scenario forecasts no nuclear SMR additions and the fewest CCUS retrofits. This highlights the importance of reaching commercial maturity in the development and manufacturing process for emerging baseload technologies.
- The assumptions in the Alternative Decarbonization scenario result in more wind and solar generation and delayed CCUS deployment supported by imports, rather than early CCUS retrofits and late-term nuclear SMR additions as seen in the Reference Case.
- In the Alternative Decarbonization scenario, greater intertie utilization after the assumed intertie expansion results in fewer peaking and baseload capacity additions post-2035 compared to the Reference Case. Greater intertie capacity may improve system flexibility by allowing for greater exports during high supply and greater imports during low supply.

Alternative Decarbonization Scenario

The Alternative Decarbonization scenario builds on the Reference Case but assumes that capital costs associated with emerging dispatchable generation technologies follow a more conservative outlook over the forecast horizon. The Alternative Decarbonization scenario assumes nuclear SMR capital costs remain at their current first-of-a-kind estimates and, compared to the Reference Case values, capital costs for CCUS are doubled, the rate and magnitude of battery energy storage cost declines are doubled and capacity for the British Columbia (BC) intertie is doubled. These assumptions reflect possible technological development timelines of generation types that may one day make up a significant portion of the supply mix but are currently unproven at utility scale. Adjusting these cost profiles to reflect a slower adoption rate of emerging low- and non-emitting generation technologies results in a vastly different long-term build forecast for the Alternate Decarbonization scenario.

Table 1: Alternative Decarbonization – Capital Cost Assumptions for Select Generation Technologies ($/kW, 2022 dollars)

	Nuclear SMR		Combined-Cycle with CCUS		CCUS Retrofit		Battery Energy Storage	
	Ref. Case	Alt. Decarb	Ref. Case	Alt. Decarb	Ref. Case	Alt. Decarb	Ref. Case	Alt. Decarb
2028	6,207	8,867	2,080	3,430	760	1,521	1,015	557
2033	5,056	8,867	2,580	4,819	1,261	2,521	964	479
2038	5,589	8,867	3,053	5,486	1,501	3,001	1,377	685
2043	4,324	8,867	3,554	7,107	2,001	4,002	1,377	685

The Reference Case load forecast is used as the input for the Alternative Decarbonization scenario. Load growth in the Reference Case is modest in the 2020s as it is driven by oil sands production and macroeconomic variables including gross domestic product (GDP) and population. Later in the forecast horizon, following the 2030s, load is anticipated to experience an increased rate of growth and intraday variability mainly driven by charging of electric vehicles (EVs) and electrification of building heating and cooling, among other factors.[1]

Generation Outlook

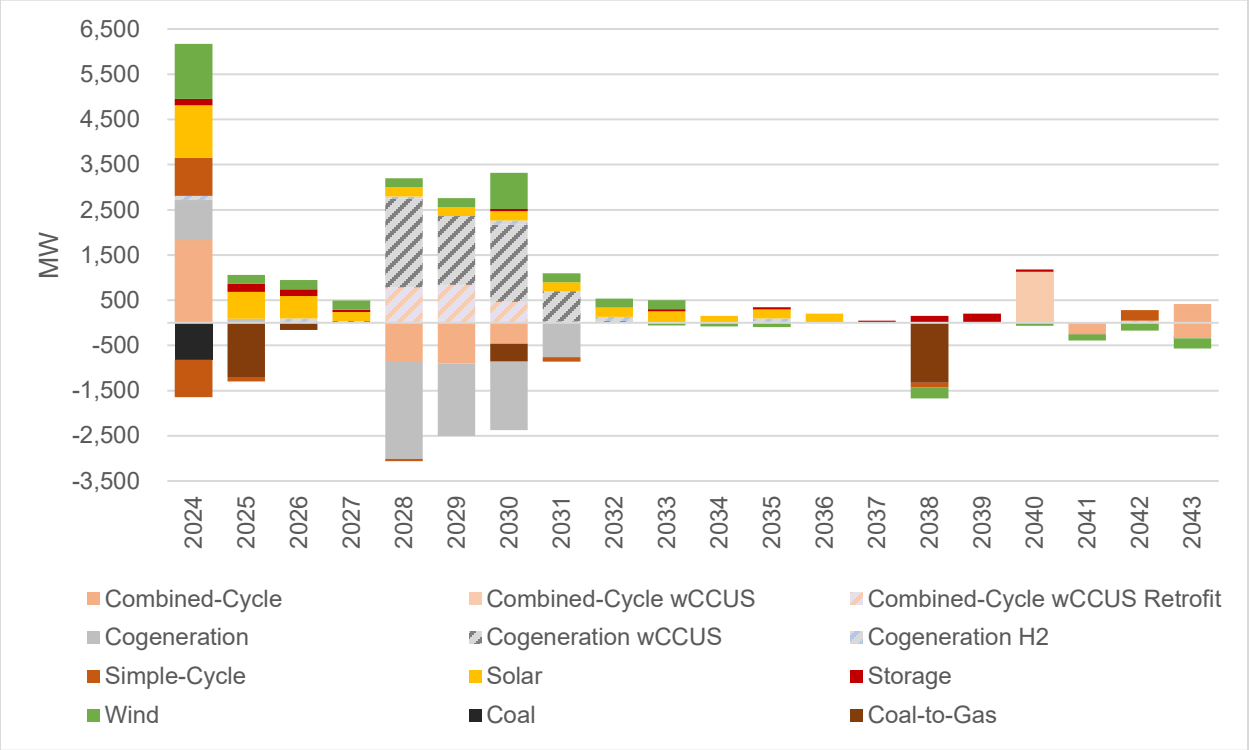
The Alternative Decarbonization scenario results in approximately 23,000 megawatts (MW) of capacity additions and retrofits between 2024 and 2043. For the purposes of the 2024 LTO, retrofits are counted as a retirement of an existing facility and an addition of a retrofitted facility. Importantly, the capacity additions may not match the capacity retirements, as CCUS decreases the output of a facility.[2] Most of these additions and retrofits are cogeneration with CCUS (5,944 MW), solar (4,260 MW) and wind (3,618 MW). Additions predominantly occur between 2024 and 2030, including all combined-cycle CCUS retrofits and the majority of cogeneration CCUS retrofits, wind and solar additions, coinciding with investment tax credits available until 2031.[3] In this scenario, 1,113 MW of battery energy storage is added, incrementally, by 2040. With increasing demand entering the 2040s, the Alternative Decarbonization scenario adds 1,130 MW of combined-cycle with CCUS as a lump-sum build in 2040. An unabated natural gas-fired simple-cycle and combined-cycle unit are built in 2042 and 2043, respectively.

[1] For more information about the Reference Case load profile in the 2024 LTO, see the Reference Case results and Load Methodology sections.

[2] For more information about CCUS additions and retrofits in the 2024 LTO, see the Emerging Technology Drivers section.

[3] For more information on investment tax credits in the 2024 LTO, see the Policy and Regulatory Drivers section.

Figure 1: Alternative Decarbonization – Capacity Additions and Retirements



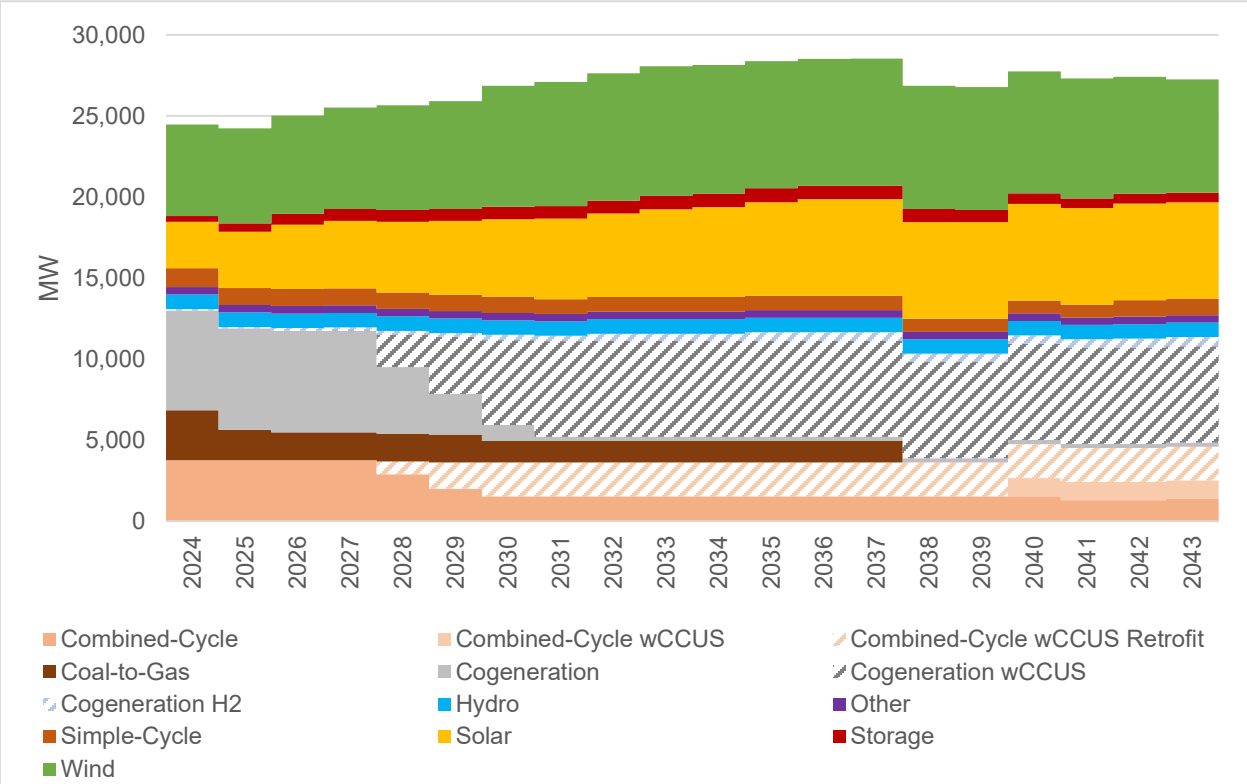
The Alternative Decarbonization scenario results in 2,590 MW fewer capacity additions as compared to the Reference Case. This decrease is largely attributable to differences in combined-cycle with CCUS retrofits and capacity additions post-2035. Instead, the Alternative Decarbonization scenario utilizes greater imports, particularly after intertie capacity is increased in 2035. In the Alternative Decarbonization scenario, increased CCUS cost assumption results in three fewer combined-cycle retrofits as compared to the Reference Case. Without any assumed cost declines from next-of-a-kind installations no nuclear SMR units are built over the forecast period. This is a significant difference from the Reference Case, in which six nuclear SMR units are built in 2042 and 2043. This contrast demonstrates the importance of reaching commercial maturity in the development and manufacturing process, as well as the impact of other supply considerations, such as intertie capacity and system flexibility, on the deployment of nuclear SMRs. The Alternative Decarbonization scenario utilizes greater imports than the Reference Case facilitated by greater intertie capacity, supporting system flexibility and reducing late-term baseload capacity additions like those in the other 2024 LTO scenarios. Imports and exports in the Alternative Decarbonization scenario are further discussed in the Intertie Utilization section below.

Wind and solar capacity in the Alternative Decarbonization scenario are similar to the Reference Case, with 100 MW less wind and an equivalent amount of solar. Notably, forecast storage capacity is not significantly different from the Reference Case, despite assumed cost reductions. By the end of the forecast timeline, the Alternative Decarbonization scenario expects 600 MW of storage capacity, 100 MW greater than the Reference Case.

Like capacity additions, capacity retirements in the Alternative Decarbonization scenario occur predominantly between 2024 and 2030, coinciding with most of the combined-cycle and cogeneration CCUS retrofits. In this scenario, approximately half of the coal-to-gas retirements (1,746 MW) occur by

2030, with the remainder (1,329 MW) retiring in 2038. Between 2033 and 2043, some wind (1,070 MW), solar (15 MW) and storage (723 MW) retire as they reach their end of life.

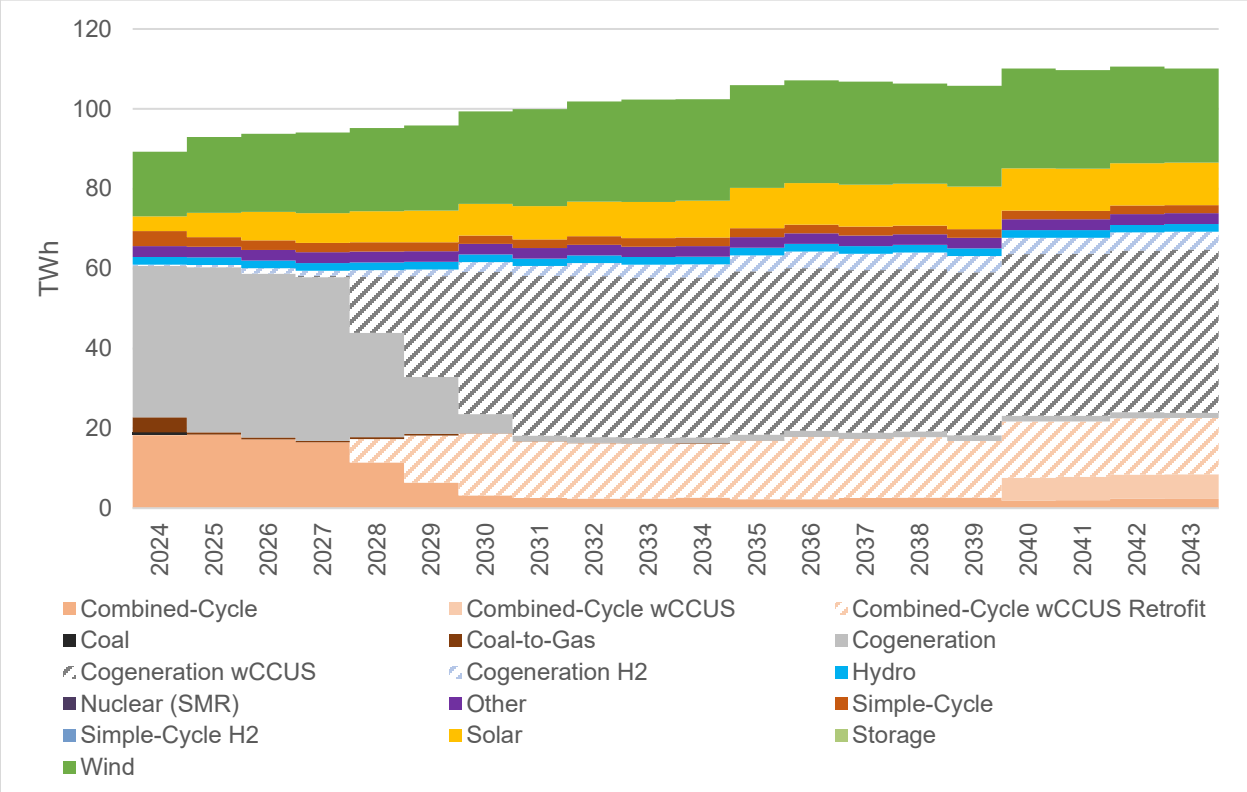
Figure 2: Alternative Decarbonization – Total Capacity



Total Energy Production and Sources

Wind, solar and cogeneration with CCUS comprise most of the generation in the Alternative Decarbonization scenario. Wind and solar generation in the Alternative Decarbonization scenario reach a maximum of 34 per cent in 2033 through 2039, declining to 31 per cent by 2043. Natural gas-fired generation, both abated and unabated, provides approximately 60 to 70 per cent of generation throughout the forecast timeline. By 2030, 10 per cent of natural gas-fired generation is unabated, decreasing to five-to-six per cent through the remainder of the forecast horizon.

Figure 3: Alternative Decarbonization Scenario – Alberta Annual Energy



The assumptions for the Alternative Decarbonization scenario change the overall energy as compared to the Reference Case. In the first 10 years, the Alternative Decarbonization has less generation from natural gas-fired generators, more generation from renewables like wind and solar, and more reliance on the intertie with greater imports and exports. In the latter 10 years, the Alternative Decarbonization scenario has no nuclear SMR generation, instead, there is more energy from new combined-cycle with CCUS units, wind and solar, as well as greater imports from the assumed expanded intertie.

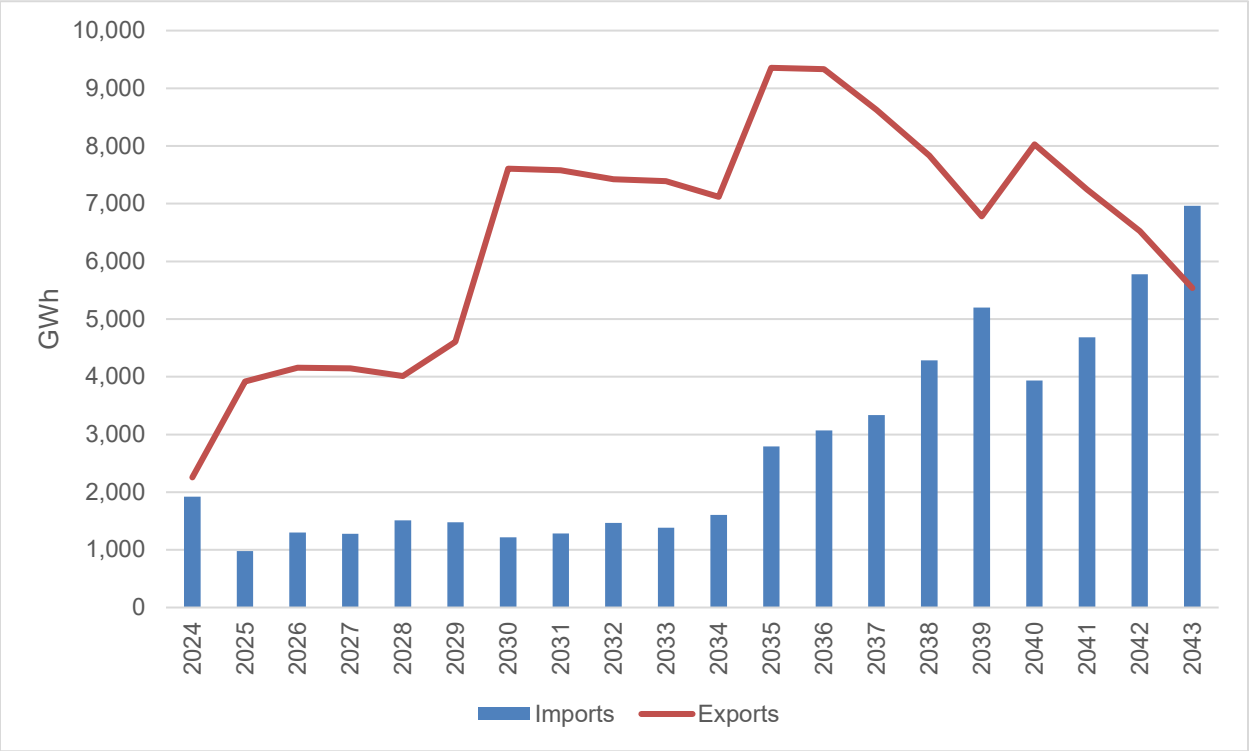
This energy forecast suggests that the assumptions in the Alternative Decarbonization scenario result in delayed CCUS deployment supported by imports, rather than early CCUS retrofits and late-term nuclear SMR additions as seen in the Reference Case.

Intertie Utilization

To serve increasing demand, the Alternative Decarbonization scenario relies on increased capacity and imports from the BC interties to meet energy needs. In the Alternative Decarbonization scenario, intertie capacity increases from 1,546 MW to 2,709 MW starting in 2035, resulting in a shift in intertie utilization over the rest of the forecast horizon in which exports begin to decrease and imports increase. After 2035, annual imports in the Alternative Decarbonization scenario are, on average, 2,212-gigawatt hour (GWh) greater than the Reference Case. By 2043, annual imports are forecast to reach over 6,900 GWh, a greater than 4,500 GWh increase compared to the Reference Case; this is in contrast to the Reference Case capacity additions, where baseload and peaking technologies are built in the interim years to meet increasing load. However, with the exception of 2043, Alberta is forecast to be a net exporter in the

Alternative Decarbonization scenario. Greater intertie capacity may improve system flexibility by allowing for greater exports during high supply and greater imports during low supply.[4]

Figure 4: Alternative Decarbonization – Average Annual Imports and Exports



Results Summary

The Alternative Decarbonization assumes a conservative outlook on emerging baseload technologies, decreased battery energy storage costs and increased intertie capacity. The Alternative Decarbonization scenario forecasts the smallest long-term capacity build and greatest utilization of the intertie. Compared to the Reference Case, deployment of CCUS is delayed in the Alternative Decarbonization scenario, with fewer CCUS retrofits but greater new combined-cycle with CCUS additions late in the forecast. Greater intertie utilization after the assumed intertie expansion results in fewer peaking and baseload capacity additions post-2035. Unlike the other 2024 LTO scenarios, there are no nuclear SMR additions in the Alternative Decarbonization scenario. This energy forecast suggests that the assumptions in the Alternative Decarbonization scenario result in delayed CCUS deployment supported by imports, rather than early CCUS retrofits and late-term nuclear SMR additions as seen in the Reference Case.

[4] The 2024 LTO assumes there will always be load for exports and supply for imports; however, imports and exports may be limited by factors other than intertie capacity (e.g., drought conditions impacting hydroelectric generation in BC). For more information on intertie methodology in the 2024 LTO, see the Generation Methodology section.

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