

# Forecasting matters for grid planning

Poor forecasting in AESO's 2024 Long-Term Outlook puts cost-effective grid at risk

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## Poor forecasting in AESO's 2024 Long-Term Outlook puts cost-effective grid at risk

### Summary

The Alberta Electric System Operator's (AESO) biennial 2024 Long-term Outlook (LTO) released in May 2024 substantially **underestimates the growth of renewable energy** and thus the need for transmission infrastructure to support further growth and investment. To-date, underbuilding transmission has already cost Albertans \$10.6 million by creating barriers for getting the lowest-cost energy to market. This will **lead to a more expensive, less reliable, and higher-emitting electricity system**. At the same time, the LTO does not sufficiently consider demand-side management opportunities, which in a modern grid help to cost-effectively reduce electricity demand and shift it from peak times. Also notably, the LTO reference case projects 6-9 GW of Alberta's gas assets to become abated with carbon capture and storage (CCS) by 2030 despite only 0.1 GW in development. This report provides context of how this LTO compares to previous editions, to projects in development, and to fully operational projects in Alberta's electricity system.

Additionally, recent provincial government policies on renewable energy and the ongoing AESO market restructuring have created uncertainty in Alberta's electricity market. Policy certainty needs to be reestablished to rejuvenate investment in low-carbon electricity generation.

### Background

The Alberta Electric System Operator (AESO) forecasts energy supply and demand in the province through its Long-term Outlook (LTO), publishing its results every two years. The LTO sets the basis on which important planning decisions are made, making it an important part of

operating and planning for an affordable and reliable electricity system. It also provides industrial consumers, investors and other stakeholders an indication of the trajectory of the electricity system.

Historically, the growth of wind, solar and energy storage in Alberta consistently exceeds AESO's forecasts. For example, current installations have already surpassed previous AESO projections for 2040. Similar to previous LTOs (2017, 2019 and 2021), the 2024 LTO underestimates the potential of renewable energy projects. The most recent LTO differs from previous iterations, however, with its new consideration of projects based on projected corporate interest in power purchase agreements (PPAs), which reduces the volume of underestimation.<sup>1</sup> But it also overestimates the speed and potentially the size of the role that less mature electricity generation technologies will play, such as its expectation that most gas-fired power plants will be retrofitted with carbon capture and storage (CCS) projects.

The AESO's continued underestimating of renewables and overestimating of the pace of CCS projections in its LTO contributes to poor planning of the grid and puts an affordable, reliable and clean electricity system in jeopardy. The 2024 assessment in particular is based on a misleading reference scenario and does not appear to be technology agnostic.

## Methodology

We examine the AESO's forecasted generation capacities in its four most recent LTOs (2024, 2021, 2019 and 2017) in comparison with projects already operating and projects in development.

The capacities of operational projects are determined from AESO data.<sup>2</sup> Projects "In Development" are based on the anticipated commissioning dates reported through the AESO project queue.<sup>3</sup> We have taken a similar approach as the AESO and only included projects that are mature in the development queue and considered sufficiently advanced to satisfy the AESO's inclusion criteria. Thus, we only include projects in stages 3 (seeking approval) through 6 (recently commissioned) in the AESO's development queue.

It is important to note that estimating the buildout of renewables using the AESO criteria for projects in development and focusing solely on those in stages 3 through 6 – totalling 86

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<sup>1</sup> AESO, *2024 LTO Generation Forecast Methodology* (2024), 8.

<https://www.aeso.ca/assets/Uploads/grid/lto/2024/2024-LTO-Generation-Forecast-Methodology.pdf>

<sup>2</sup> AESO, "Current Supply Demand Report," July 10, 2024.

[http://ets.aeso.ca/ets\\_web/ip/Market/Reports/CSDReportServlet](http://ets.aeso.ca/ets_web/ip/Market/Reports/CSDReportServlet)

<sup>3</sup> AESO, "Connection Project Reporting May 2024." <https://www.aeso.ca/grid/transmission-projects/connection-project-reporting/>

projects – is likely also underestimating growth of renewables. Another 104 projects are in the pipeline between stages 0 (initial application noting project intent) and 2 (engineering and design), many of which would advance to stages 3 through 6 if they found supportive investment conditions in the province.

## AESO forecasts compared to operating projects and projects in development

The AESO is again heavily underestimating renewable energy buildout in its 2024 LTO. By next year (2025), solar energy projects in development in Alberta will already be more than double the 2024 LTO forecast for that year (Figure 1), unless there is a wave of cancellations or prohibitions of mature projects due to Alberta’s draft new solar development restrictions on certain types of agricultural land.<sup>4</sup>

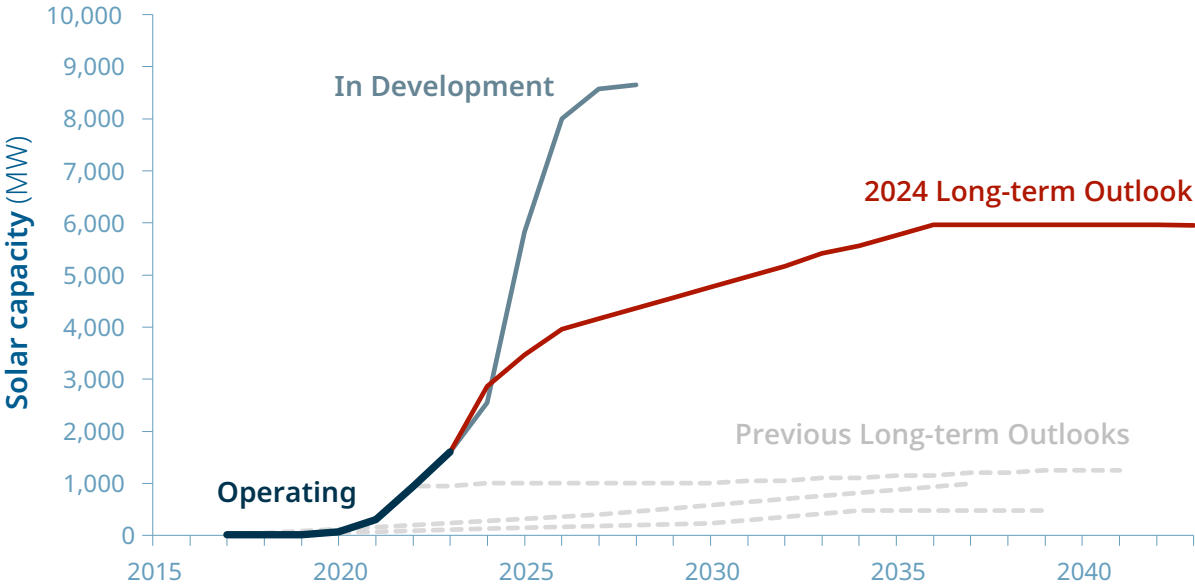


Figure 1. Actual solar energy projects in development greatly exceed AESO 2024 Long-term Outlook and previous forecasts

Wind energy projects in development will hit AESO’s 2024 LTO peak estimate seven years earlier than forecasted (Figure 2), unless they face similar developmental caveats as solar. For example, the government has yet to finalize the no-go wind development areas announced in February 2024.<sup>5</sup>

<sup>4</sup> Government of Alberta, “Renewed path forward for renewable energy,” media release, February 28, 2024. <https://www.alberta.ca/release.cfm?xID=898196983DoFA-AECA-5F92-FF655CE1369C4E28>

<sup>5</sup> Government of Alberta, “Renewed path forward for renewable energy.”

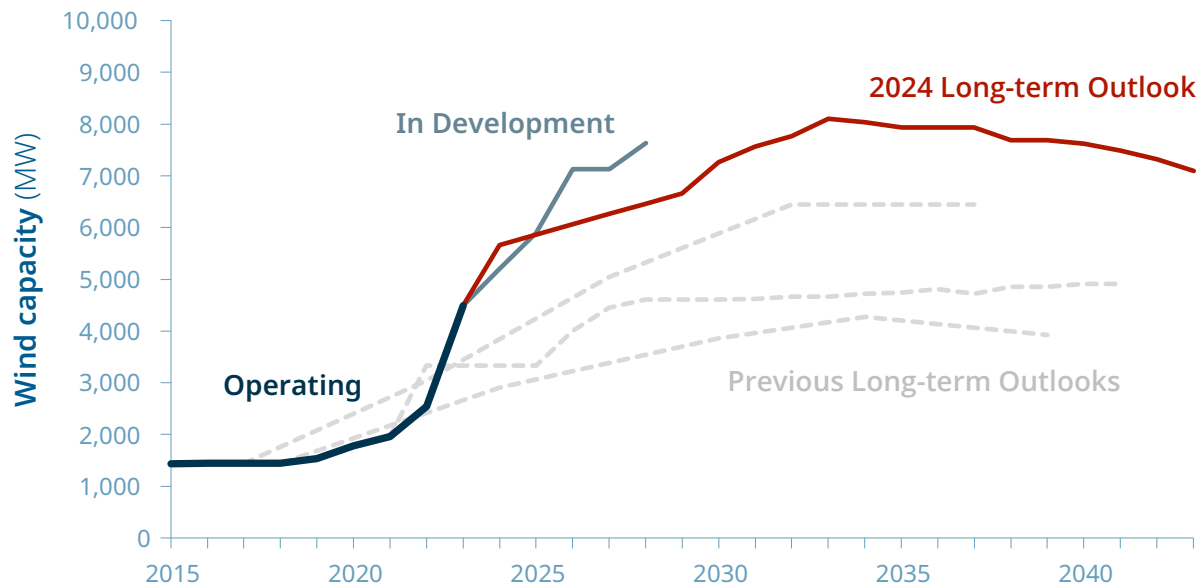


Figure 2. Actual wind energy projects in development exceed AESO 2024 Long-term Outlook and previous forecasts

Energy storage projects (both grid-tied and solar-battery hybrid) are also undergoing incredible growth as they become increasingly more cost-effective to deploy. Storage projects identified as in development via the AESO project queue will be more than double the system operator’s 2024 LTO forecast by 2026 (Figure 3).

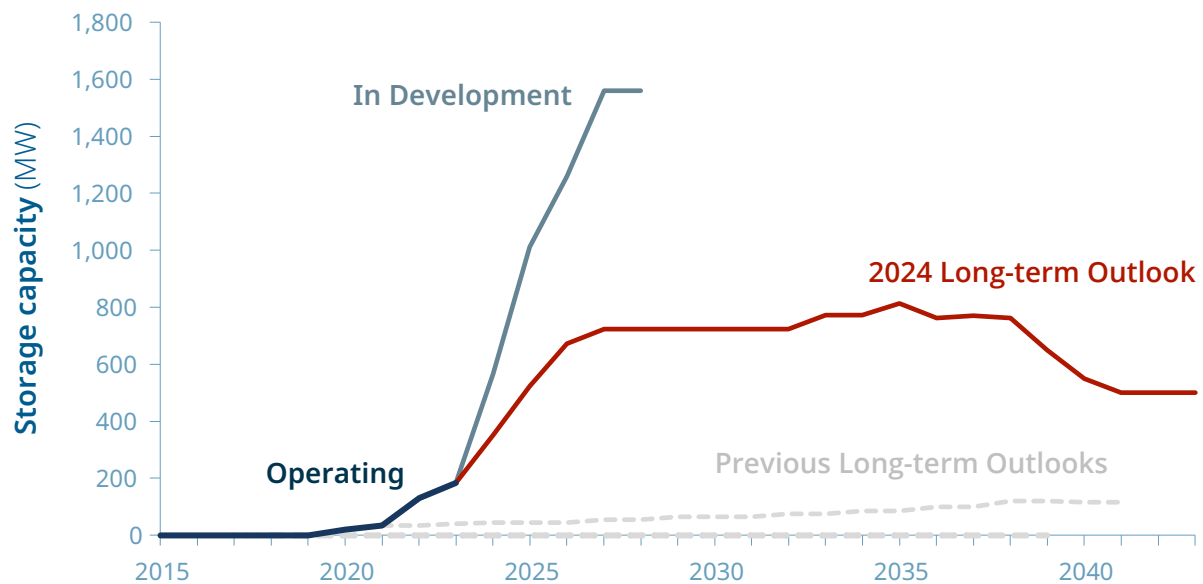


Figure 3. Actual energy storage projects (both grid-tied and solar-battery hybrid) in development greatly exceed AESO 2024 Long-term Outlook

However, the 2024 LTO forecast appears to vastly overestimate the buildout of gas projects abated with CCS or clean hydrogen (Figure 4). While abating existing gas-fired power emissions in the province is important, and existing gas plant operators have expressed an interest in doing so, there is currently only one abated gas project in development in the AESO queue – a new 100 MW hydrogen power plant under construction near Edmonton.<sup>6</sup> The AESO’s projected 9 GW of abated gas capacity by 2035 is 90 times the capacity of this single project. This vast overestimate of gas abatement is concerning, especially within the context of the 2024 LTO’s underestimation of wind, solar and storage.

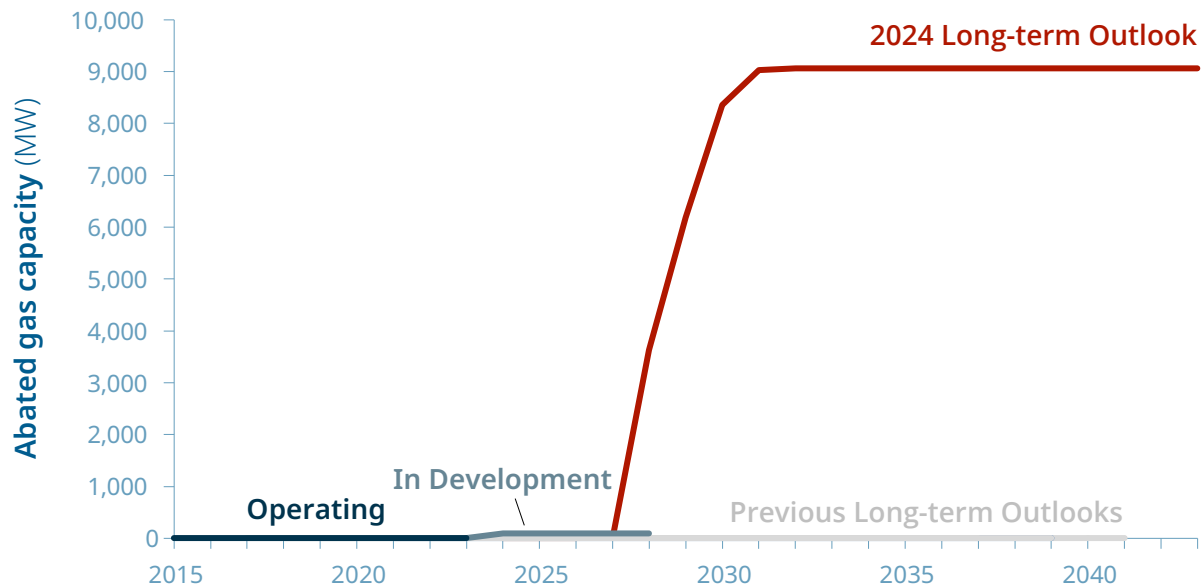


Figure 4. Actual abated gas capacity in development is significantly less than AESO 2024 Long-term Outlook

It is also worth noting that it can take eight to nine years to develop a CCS project from inception to start-up.<sup>7</sup> Given most of Alberta’s abated gas projects are in early stages, it seems unlikely that as many will be operating by 2031 as the AESO 2024 LTO forecasts. Furthermore, in May 2024 development on Alberta’s most advanced CCS gas project, which had conducted a front-end engineering and design study, was put on hold by the gas generator, citing poor economics.<sup>8</sup>

<sup>6</sup> Alberta Utilities Commission, Proceeding 27380.

Baker Hughes, “Baker Hughes Achieves New Hydrogen Milestones to Accelerate Transition to Hydrogen Economy,” media release, January 29, 2024. <https://investors.bakerhughes.com/news-releases/news-release-details/baker-hughes-achieves-new-hydrogen-milestones-accelerate>

<sup>7</sup> Global CCS Institute, *Global Status of CCS 2022* (2022), 47. [https://status22.globalccsinstitute.com/wp-content/uploads/2023/03/GCCSI\\_Global-Report-2022\\_PDF\\_FINAL-01-03-23.pdf](https://status22.globalccsinstitute.com/wp-content/uploads/2023/03/GCCSI_Global-Report-2022_PDF_FINAL-01-03-23.pdf)

<sup>8</sup> Capital Power, “Capital Power announces first quarter 2024 results,” media release, May 1, 2024. [https://www.capitalpower.com/media/media\\_releases/capital-power-announces-first-quarter-2024-results](https://www.capitalpower.com/media/media_releases/capital-power-announces-first-quarter-2024-results)

## Discussion

Basing Alberta's electric system planning on unrealistic projections creates many risks for Albertans. It jeopardizes the province's ability to meet current and future supply and demand needs, resulting in substantially higher system operating costs, unreliability and emissions. It is important to take a technology agnostic approach in forecasts and consider energy sources that support a clean, affordable and reliable grid. If Alberta does not create barriers to a free, efficient, open, competitive market, renewable electricity with energy storage will most often out-compete other forms of generation. Private sector investment is already willing to fully capitalize 12.3 GW of solar, wind and battery capacity, while abated gas projects are asking for significant public investment to proceed. System planning should recognize these economics accordingly. Unfortunately, this 2024 LTO does the opposite and seems to indicate Alberta will see more high-cost abated gas and less low-cost renewables. The relative difference in private sector investment dollars clearly demonstrates that investors are willing to fully capitalize 12.3 GW of solar, wind and battery capacity, while abated gas projects are asking for significant public investment to proceed.

Lastly, while the 2024 LTO acknowledges the potential for demand-side management, it only considers how newer appliances and electrical loads in buildings will improve their energy efficiency over time, using 3.8% less electricity by 2043 than without efficiency improvements. It does not account for the ability for electric vehicle charging or water tank heating to be shifted to times with lower electrical demand, reducing peak demand and increasing grid flexibility and reliability. This is an important consideration; Ontario's demand-side management programs have reduced peak load by 15% since they were first implemented in 2011.<sup>9</sup>

The most cost-effective pathway for Alberta to decarbonize its electricity system is to plan for and achieve a diverse mix of generation sources, energy storage, demand-side management and expanded interties to neighbouring provinces.<sup>10</sup> Overemphasizing the buildout of gas assets ignores lower-cost options for energy supply and reliability services.

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<sup>9</sup> Francis Bradley, "An Ontario Electricity System Primer with Lesley Gallinger," *Flux Capacitor*, March 26, 2024. <https://thefluxcapacitor.ca/episodes>

<sup>10</sup> Will Noel and Binu Jeyakumar, *Zeroing In* (Pembina Institute, 2023), 46. <https://www.pembina.org/pub/zeroing-in>

# Lessons for Alberta's grid

Underestimating the growth of renewable energy is common globally.<sup>11</sup> This is, in part, due to the faster-than-expected decline in costs of renewables and conservative modelling assumptions. However, this can leave electric system operators and planners unprepared and thus create social, economic and technical barriers to operating an affordable and reliable electricity system.

The costs of under-planning are high. In 2023, congestion<sup>12</sup> in transmission lines in Alberta resulted in 305 GWh of wind and solar energy being curtailed.<sup>13</sup> This amount of low-cost, fuel-saving electricity would power over 42,000 homes for a year.<sup>14</sup>

Alberta needs to maintain a diversified portfolio of generation and take steps to modernize the grid, like adding transmission, interties and demand-side management measures to maximize flexibility and maintain reliability. Continuing to plan the system for large, bulky generation, being overly reliant on CCS, and slowing renewable energy deployment puts Alberta at risk of operating the most expensive grid possible. To improve system planning and mitigate the risk of an expensive and emitting grid, we recommend:

- Electricity system planning **focus on the needs of a modernized electricity system**. For example, the AESO should account for the potential of demand-side management.
- The AESO and the Government of Alberta **use a technology agnostic view** in future analyses focusing on affordable, reliable and clean solutions — including while restructuring the energy market, planning electricity systems, and creating other policies.

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<sup>11</sup> Marc Jaxa-Rozen and Evelina Trutnevyte, “Sources of uncertainty in long-term global scenarios of solar photovoltaic technology,” *Nature Climate Change* 11.3. <https://doi.org/10.1038/s41558-021-00998-8>

Simon Evans, “‘Profound shifts’ underway in energy system, says IEA World Energy Outlook,” *Carbon Brief*, November 13, 2019. <https://www.carbonbrief.org/profound-shifts-underway-in-energy-system-says-iea-world-energy-outlook/>

Jason Wang and Patrick Steinmann, *Exploring a Simulation Model of Canadian Energy Policy* (2021), 6. [https://emi-ime.ca/wp-content/uploads/2021/03/EMI-2020-Wang\\_report\\_Exploring-a-Simulation-Model\\_Steinmann.pdf](https://emi-ime.ca/wp-content/uploads/2021/03/EMI-2020-Wang_report_Exploring-a-Simulation-Model_Steinmann.pdf)

<sup>12</sup> Congestion occurs when a lot of electricity is available but transmission lines do not have the capacity to get it to consumers, resulting in the surplus electricity being curtailed.

Curtailed is when renewable power plants adjust their operations so they are taking in less energy and thus reducing their output. For example, a wind plant can curtail electricity by adjusting the angle of turbine blades so they are catching less wind.

<sup>13</sup> Alberta Electric System Operator, *2023 Annual Market Statistics* (2024), 44.

[https://www.aeso.ca/assets/Uploads/market-and-system-reporting/Annual-Market-Stats-2023\\_Final.pdf](https://www.aeso.ca/assets/Uploads/market-and-system-reporting/Annual-Market-Stats-2023_Final.pdf)

<sup>14</sup> Assuming an average household uses 7.2 MWh per year. Carson Fong, *The Math on Renewable Energy* (Business Renewables Centre-Canada, 2023). <https://businessrenewables.ca/resource/math-renewable-energy>



- The Government of Alberta and the Alberta Utilities Commission **finalize Alberta’s new requirements and restrictions for renewable energy development** following the lifting of its seven-month moratorium on February 29, 2024.

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The Pembina Institute acknowledges that the work we steward and those we serve span across many Nations. We respectfully acknowledge the space our organization is headquartered in as the traditional and ancestral territories of the Blackfoot Confederacy, comprised of the bands Siksika, Piikani, and Kainai, the Îyârhe Nakoda Nations, including the bands of Goodstoney, Chiniki, and Bearspaw, and the Tsuut’ina Dené. These Lands are also home to the Métis Nation of Alberta — Region 3 whose Peoples have deep relationships with the Land.

These acknowledgements are some of the beginning steps on a journey of several generations. We share them in the spirit of truth, justice, reconciliation, and to contribute to a more equitable and inclusive future for all of society.

# Appendix A. Pembina Institute technical submissions to the AESO regarding the scope of the 2024 LTO

- LTO Preliminary Update – Consolidated Feedback (December 8, 2023).  
<https://www.aesoengage.aeso.ca/34307/widgets/143699/documents/122776>
- LTO Preliminary Results Engagement– Stakeholder Feedback (July 11, 2023).  
<https://www.aesoengage.aeso.ca/34307/widgets/143699/documents/108305>
- LTO Scope & Input Assumptions – Stakeholder Comments (February 8, 2023).  
<https://www.aesoengage.aeso.ca/34307/widgets/143699/documents/96605>