Electricity Sector Analysis | Stakeholder Feedback and Integration

Background

The AESO intends to analyze potential pathways to net-zero emissions from the Alberta electricity sector by 2035 and produce a written report of our analysis and findings. The analysis intends to forecast the potential dynamics in the electricity sector that could result from technological advancements and changing consumer behavior as well as from responses to potential government policy targets. Given significant interest in decarbonizing the electricity sector, forecasting potential pathways to net-zero carbon emissions from the Alberta electric system will provide insights to the opportunities and challenges associated with emerging and advancing technologies and consumer trends. The net-zero pathways analysis will inform and influence AESO analysis such as future long-term outlooks.

Introduction

On Dec. 16, 2021, the AESO provided notice and sought written feedback from interested stakeholders on their perspectives regarding the scope and input assumptions of the proposed net-zero emissions pathways analysis. The comment period ran from Dec. 16, 2021, to Jan. 31, 2022, to accommodate the holiday season and to afford stakeholders an opportunity to prepare a comprehensive submission.

The primary intent to solicit stakeholder feedback was to enhance modeling that the AESO will complete for the study. The AESO posed several questions seeking stakeholder perspectives regarding the driving factors of government policy, economic prospects, electric load, and generation supply that may direct pathways to a net-zero carbon electricity system by 2035.

Participating stakeholders

We value stakeholder feedback, and we thank you for sharing your insightful perspectives with us. The AESO received 47 responses from stakeholders representing electricity generators, electric load representatives, distribution and transmission facility owners, academic experts, non-governmental organizations, and interested citizens. We reviewed the submissions in detail and summarized the feedback and insights into three categories; scope of analysis and government policy, electric load forecast and macroeconomic drivers, and generation forecast drivers. The depth of responses provided several insights and identified opportunities for modeling enhancements and modifications to the AESO's net-zero analysis.

The following stakeholders provided submissions:

1. Acciona Energy Canada Global
2. ADC – Alberta Direct Connect Consumer Association
3. AEEA – Alberta Energy Efficiency Alliance
4. Alberta Innovates
5. AltaLink Management Ltd.
6. AREA – Alberta Renewable Energy Alliance
7. ATCO Electric Ltd.
8. Big Spruce Law
9. BluEarth Renewables
10. BRC Canada – Business Renewable Center Canada
11. Calgary Climate Hub
12. Campus Energy
13. Canadian Nuclear Association
14. CanREA – Canadian Renewable Energy Association
15. Capital Power Corporation
16. COG – CANDU Owners Group Small & Medium Size Reactor Technology Forum
17. Direct Energy
18. Enbridge Inc.
19. Enfinite
20. ENMAX Corporation
21. EPCOR Distribution & Transmission Inc.
22. ESC – Energy Storage Canada
23. FortisAlberta Inc.

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24. Friends of Science Society
25. FutEra Power
26. Greengate Power Corporation
27. Heartland Generation Ltd.
28. IPCAA – Industrial Power Consumers Association of Alberta
29. IPPSA – Independent Power Producers Society of Alberta
30. Ivan Purdy
31. Kineticor Resource Corporation
32. Montem Resources
33. MSA – Market Surveillance Administrator
34. Pembina Institute
35. PWX – Powerex Corporation
36. QUEST Canada
37. RMP Energy Storage
38. Shaffer Hastings Simon – University of Calgary
39. Solar Alberta
40. Solas Energy Consulting Inc.
41. Suncor Energy Inc.
42. TCE - TC Energy Ltd.
43. Technical Integration Ltd.
44. TransAlta Corporation
45. UCA – The Office of the Utilities Consumer Advocate
46. Voltus Energy Canada, Ltd.
47. WaterPower Canada

View stakeholder comments here or visit the AESO website at www.aeso.ca and follow the path: Market > Net-Zero Emissions Pathways.

Key themes

Scope of analysis and government policy

Stakeholders generally supported the AESO's plans to undertake net-zero carbon emissions pathways analysis, although some respondents sought clarification of the AESO's role in exploration of net-zero policy. Many stakeholders expressed openness to assisting the AESO with the net-zero modeling efforts, including rationalizing inputs and assumptions, and forecasts. There was general agreement on the need to clearly articulate the assumptions around the definition of net-zero and the treatment of offsets and how they can be utilized. Respondents had a range of views regarding their expectations regarding the outputs, deliverables, and the scope of the AESO's net-zero electricity forecasting exercise. Some stakeholders expect a fulsome evaluation of reliability impacts, tariff implications, transmission requirements, and system costs, while other respondents anticipated a high-level evaluation of specific potential net-zero carbon emissions pathways.

Government policy was front of mind for stakeholders. Many respondents commented that there was significant uncertainty in the emissions regulatory framework and government policy that would complicate net-zero analysis. Details around policy assumptions can have a material impact on the resulting analysis and stakeholders expressed that federal carbon prices, federal clean electricity standards, federal clean fuel standards, federal targets for zero-emission vehicles, federal-provincial-municipal partnerships to promote energy efficiency and/or net-zero ready building standards, changes to provincial regulations, subsidies, and grants could all impact supply, demand, and cost of electricity. Due to the uncertainty around policy assumptions stakeholders strongly support the AESO clearly articulating its assumptions regarding net-zero policy and drivers within the analysis.

Stakeholders presented various perspectives regarding the market framework assumptions that should be made in net-zero modeling. Respondents also held varied views on the stress that the current energy-only framework and rules may experience in the context of a potential net-zero carbon electricity sector policy environment. Some respondents felt that the existing framework would be sustainable, while others expressed concerns about specific rules.

Some stakeholders questioned the viability of a net-zero electricity grid by 2035, suggesting the date may be too aggressive, and that a later date would be more prudent to analyze. Others suggested that 2035 may be possible with a concerted effort from the government and industry. Some proponents noted the

time range of the analysis should focus on the 2035 horizon while others noted there will still be significant transitions beyond 2035 and that 2050 should be explored.

Stakeholders expressed paramount concerns regarding electricity costs and reliability while describing multiple pathways that could lead to the decarbonization of the electricity grid in Alberta. Many stakeholders expressed an interest in the estimated costs that various net-zero carbon emissions pathways could pose for consumers, government, and the electricity industry, including the cost of stranded assets, the cost of new capital, transmission and distribution system costs, and operating costs. Multiple technological and policy pathways could lead to decarbonization of the electricity sector, but stakeholders expressed that a 100 per cent intermittent renewable grid backed by energy storage was not likely achievable nor a cost-effective route to net-zero by 2035. Respondents suggested that high levels of renewable penetration could be tested without focusing on an absolute renewable (solar/wind) energy target.

Macroeconomic drivers and electric load

Most stakeholders supported (or provided limited comments on) the approach proposed by the AESO to deal with economic and energy sector outlooks, which is methodologically like the 2021 Long-term Outlook (LTO). However, a significant group expressed the need to capture the impact of net-zero policies on the overall economic picture of the province, incorporating the impact to multiple sectors and the resulting behavioural changes that could be expected from net-zero policies. Stakeholder feedback reflected on the direct impact that global and continental changes in energy consumption could have on oil sands production and natural gas prices in Alberta.

In terms of load drivers, most stakeholders argued for the need to assume greater adoption of energy efficiency and demand response programs as a low-cost resource to handle increases from the electrification of other sectors. Stakeholders stressed the importance of testing federal targets for the electrification of the transportation sector as the adoption of this new technology is anticipated to occur at a rapid pace prior to 2035. There was consensus that the electrification of space heating/cooling and water heating will take longer due to economic considerations, technological readiness, lengthy lifecycle and stock turnover, and policy coordination; this electrification stream is expected to be more impactful after the 2030s. Feedback on the electrification of other sectors (i.e., heavy industries, crypto mining, data centers, etc.) was limited; yet the general theme is that each industry will have different drivers and sets of technologies that can help them de-carbonize via electrification.

There was no significant input into the treatment or expected adoption of distributed energy resources (DERs) beyond what's already done in the 2021 LTO. Stakeholders provided limited feedback on assessing the impact of climate change on Alberta's load or the economy in general.

Generation and technological forecast drivers

With regards to electricity supply options enabling a pathway to net-zero carbon emissions in Alberta's electricity sector, stakeholders shared several key themes with the AESO. Many stakeholders expect that a diverse suite of technologies would be viable on a pathway to net-zero carbon emissions. However, several stakeholders felt that few technologies could achieve the emissions reductions required to eliminate carbon from electricity supply by 2035.

Many stakeholders expect that wind and solar renewable technologies can provide a significant contribution to decarbonization efforts, while there are mixed expectations for carbon capture, utilization, and sequestration technologies. Post-combustion carbon capture, utilization and storage (CCUS) and hydrogen-fired generation were identified as potential pathways to decarbonization in the near term. Some stakeholders expressed that these technologies are not zero-emissions but could bridge a pathway to a zero-emissions future. Opinions on the viability of CCUS and hydrogen-fired retrofits to existing

infrastructure varied significantly between stakeholders. Several stakeholder responses demonstrated expectations that nuclear (i.e., conventional fission and small-modular-reactors) and hydroelectric generation options would be unlikely to develop by 2035, but that these technologies can provide significant contributions to longer-term zero-carbon-emissions electricity production. Many stakeholders suggested that nuclear and large hydroelectric assets would be unlikely to develop in the Alberta market due to the long development timeframes and regulatory burden associated with these generation types.

Although many stakeholders expressed expectations that energy storage technologies would decline significantly in cost, there were mixed expectations in terms of the contribution that these technologies could make to decarbonization by 2035. Conversely, several respondents anticipated that energy storage technologies could support renewable generation intermittency and supply volatility.

Similarly, opinions on the value and decarbonization potential of transmission interconnections with neighboring jurisdictions were varied. Some respondents expressed concerns about market fidelity with the prospect of increased transmission interconnections, while others reflected on the opportunity to both import and export low-carbon electricity as a resource with significant decarbonization potential. Regulatory mechanisms such as carbon offsets and emissions performance credits were viewed as low-cost compliance mechanisms to achieve decarbonization by some respondents, while others expressed that these mechanisms were likely to provide a limited contribution to a net-zero future.

In addition to the supply options identified by the AESO, stakeholders reflected on the potential inclusion of other technologies. Several respondents suggested that in addition to hydrogen-fired combined-cycle generation, the AESO should consider hydrogen-fired simple-cycle technologies. Green hydrogen was identified as a zero-carbon fuel type that could be included in the AESO's analysis. Similarly, several stakeholders invoked the potential of alternative storage technologies to batteries, such as pumped hydro energy storage and compressed air energy storage technologies. Although it is not an electricity supply alternative, some stakeholders expressed their expectations that demand-side management initiatives could provide low cost decarbonization potential.

Several stakeholders reflected that the 2035 timeline to achieve net-zero emissions in the electricity sector was aggressive. Concerns regarding stranded capital investments were expressed, and that investment uncertainty amidst fast regulatory change could be disruptive to the reliable supply of electricity.

Changes based on stakeholder feedback

Scope of analysis and government policy

The AESO would like to clarify that their net-zero emissions pathways work is not intended to represent a specific policy recommendation or reflect an expectation of, or full detailed analysis of, a particular government policy implementation. Rather, the analysis is intended to highlight the potential high-level reliability, cost and market implications of a range of plausible potential outcomes. The AESO acknowledges, amongst so much uncertainty, there are many potential pathways to net-zero and this analysis is intended to highlight only a few alternatives. Although certain assumptions regarding government policy are required in a forecast driving towards net-zero carbon emissions, the AESO intends to conduct the analysis assuming the existing electricity energy-only market framework and rules. Specifically, the AESO will assume no changes to the electricity market structure, rules, or constraints within the context of the net-zero pathways analysis. Rather, the analysis will explore the opportunities and challenges that changing electricity demand and evolving technology may introduce to the Alberta integrated electric system. The AESO's analysis will review various technological pathways that could lead to a net-zero carbon emissions electricity sector by 2035, with a focus on cost and reliability of the electric system. The AESO's analysis will assume that most electricity sector carbon emissions will need to be

mitigated by physical reductions, with a modest level of offsets and emissions performance credits accounting for the balance of emissions.

Several changing technological and policy elements could impact electricity supply and demand decisions in a decarbonizing market. Factors include technological advancements, technological cost declines, carbon price, government legislation and regulations, subsidies, grants, and investments in public infrastructure. Due to the multitude of unknown factors that could impact pathways to net-zero carbon emissions in the Alberta electricity sector, the AESO has decided to highlight multiple potential pathways to decarbonization within its net-zero analysis. The net-zero analysis will be an initial step in understanding decarbonization pathways and reflecting on their impact on the electricity system in Alberta.

The AESO's analysis will focus on potential changes to load profiles, generation supply sources, and resource adequacy. Although the AESO initially planned to provide quantitative information regarding two scenarios, it has decided to expand the net-zero analysis to incorporate three generation supply mixes that could present pathways to decarbonization of the electricity sector by 2035.

Macroeconomic drivers and electricity load

The load forecast for the net-zero analysis will factor the impact of electrification of different vehicle categories including light-duty, medium-duty, heavy-duty, and buses. Electric vehicle adoption rates will assume that federal targets are met in Alberta. The forecast will also incorporate the modest adoption of electrification in the building sector via space and water heating system technologies. Electrification of industrial sectors will also be incorporated including expected growth from hydrogen production. In addition to the main net-zero electricity demand forecast, the AESO will incorporate sensitivities based on economic growth, oil sands production, energy efficiency adoption, electric vehicle adoption rates, and electric vehicle charging profiles. The sensitivities will be used to provide directional insights to the key drivers of electricity demand.

Generation and technological forecast drivers

The net-zero electricity supply technology landscape could incorporate many existing generation and storage technologies. The AESO will expand its initial list of generation technologies to incorporate simple-cycle hydrogen-fired technologies. With respect to energy storage technologies, the AESO will also include pumped hydro energy storage and compressed air energy storage in the technological selections for review. Expectations of declining battery energy storage technology costs will also be factored into the AESO's analysis. Based on stakeholder feedback and responses, the AESO will increase the expected capital costs of nuclear and hydroelectric facilities to align with recently constructed projects.

Due to the diversity of stakeholder expectations regarding potential electricity supply mixes that could contribute to a net-zero grid by 2035, the AESO intends to quantify several potential future generation mix results that will focus on implementation of different combinations of technologies and levels of renewables and energy storage penetration including:

1. Zero emission dispatchable generation, moderate renewables growth
2. Renewable growth with dispatchable generation
3. High renewable growth, limited dispatchable growth, backed by storage

The AESO expects that these scenarios may demonstrate the implications of diverse pathways towards a net-zero carbon electricity sector by 2035.

Next steps

Incorporating the changes noted above, the AESO will complete their initial modeling using the revised assumptions. The preliminary modeling results will be brought to stakeholders for input and discussion at a session on March 28, 2022; click here to register. The AESO will then seek any additional stakeholder insights on the results by mid-April for consideration prior to the completion of our analysis and final publication of the report by the end of June. We look forward to your continued participation and engagement on this important initiative.