

## Engagement Session | March 28, 2022 – Stakeholder Comments

Posted: April 21, 2022

1. ADC and IPCAA – Alberta Direct Connect Consumer Association and Industrial Power Consumers Association of Alberta
2. AEEA – Alberta Energy Efficiency Alliance
3. AltaLink Management Ltd.
4. ATCO Electric Ltd.
5. BluEarth Renewables
6. Calgary Climate Hub
7. CANDU Owners Group (COG) Small & Medium Size Reactor Technology Forum
8. CanREA – Canadian Renewable Energy Association
9. Capital Power Corporation
10. Direct Energy
11. Enfinite
12. ENMAX Corporation
13. EPCOR Distribution & Transmission Inc.
14. ESC – Energy Storage Canada
15. Heartland Generation Ltd.
16. Maxim Power
17. Pembina Institute
18. Powerex Corporation
19. RMP Energy Storage
20. RNG Coalition – Renewable Natural Gas Coalition
21. TCE - TC Energy Ltd.
22. TransAlta Corporation
23. UCA – The Office of the Utilities Consumer Advocate
24. Voltus Energy Canada, Ltd.

# Stakeholder Comment Matrix – March 22, 2022

Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	<b>March 22, 2022 to April 19, 2022</b>	Contact:	Vittoria Bellissimo
Comments from:	Alberta Direct Connect Consumer Association (ADC) and Industrial Power Consumers Association of Alberta (IPCAA)	Phone:	403 966 2700
Date:	2022/04/19	Email:	Vittoria.Bellissimo@IPCAA.ca

## Instructions

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2. Please respond to the questions below and provide your specific comments.
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## Introduction

On Dec. 16, 2021, the AESO provided notice that it was commencing examination of potential pathways to a net-zero electricity system in Alberta. As an initial step, the AESO sought, and has received written feedback from interested stakeholders on their perspectives regarding the scope and input assumptions of the proposed net-zero emissions pathways analysis<sup>i</sup>. 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. The AESO has reviewed and incorporated several of the suggested changes<sup>ii</sup> and has completed its initial modelling using the revised assumptions.

The intent of the Mar. 28, 2022, engagement session is to present these preliminary modelling results to stakeholders for input and discussion. This comment matrix is intended as a follow-up and seeks any additional stakeholder insights and comments that the AESO will consider prior to the completion of our analysis and final publication of a report by the end of June. Stakeholder feedback received will similarly be compiled and posted and the AESO will subsequently provide a summary directional update.

## Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO’s analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022.</p> <p>Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>ADC and IPCAA appreciate the AESO’s on-going analysis of net-zero impacts on the Alberta grid.</p> <p>The session was valuable. Going forward, it would be helpful to understand how this work impacts the other undertakings the AESO has in its Business Plan. A planning exercise in isolation is not as valuable as a study that looks at the problem (and the possible solutions) holistically.</p> <p>The AESO has established scenarios; however, it has not reviewed the market implications of the scenarios nor actions the AESO and the electricity market in general can take to help mitigate significant costs to consumers and potential reliability concerns. ADC and IPCAA recommend that the AESO commit to this as part of the next steps of this engagement.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis?</p> <p>What areas would benefit with further clarification from the AESO?</p>	<p>With regard to the overall purpose of the analysis, the AESO states: “The analysis is intended to highlight the potential high-level reliability, cost and market implications of a range of plausible potential net-zero outcomes.” ADC and IPCAA note that none of the scenarios achieve net-zero by 2035 as per the Federal Government’s planned Clean Electricity Standard. It would be useful to have an actual net-zero scenario – particularly for analysis of costs.</p> <p>The AESO’s scope is reasonable, but the timing is problematic. The June Report should include recommendations to policy makers. This work needs to be informative to policy makers who are making decisions now. This is particularly relevant to transmission policy and the Output-Based Allocation (OBA) level established as part of TIER.</p> <p>ADC and IPCAA submit that the scope should be expanded to include analysis by the AESO of measures that the electricity market can</p>

	Questions	Stakeholder Comments
		<p>undertake to promote net-zero. Measures such as implementing interval pricing to promote demand response should be considered.</p> <p>With regard to areas that would benefit from further clarification, ADC and IPCAA have the following comments:</p> <ul style="list-style-type: none"> <li>• Has the AESO reviewed the proposed bulk and regional rate design’s impact on achieving net-zero by 2035? ADC and IPCAA are concerned that the AESO’s proposed rate design might impede Alberta’s path towards net-zero by 2035.</li> <li>• The AESO has acknowledged that its proposed rate design will incent behind-the-fence (BTF) generation. ADC and IPCAA are concerned that the proposed design will promote small, inefficient BTF generation that cannot capture its carbon. Conceptually, in Alberta “large” efficient generation sources, in combination with CCUS, will be able to capture their carbon emissions and provide near net-zero electricity to the grid.</li> </ul>
3	Do you have any feedback or observations with regards to the Load forecast and associated load factors?	<p>The AESO’s load forecast continues to focus on Alberta Internal Load (AIL). This is a concern because major changes in future load growth due to electrification will be on the Demand Transmission Service (DTS) load. DTS load forecasts are critical in order to understand future distribution and transmission costs. DTS load pays wires costs in Alberta, therefore a forecast of future DTS load increases should be analyzed carefully.</p> <p>The Base Load forecast with energy efficiency based on historical trend is problematic. Energy efficiency investments in low pool price years would have been much more limited than the higher pricing we can expect going forward.</p> <p>Under electrification of buildings, the AESO states: “electrification of space and water heating systems in buildings is expected to be modest in the lead up to 2035 due to lack of policy support.” It would be useful to re-examine this assumption and run sensitivities on it.</p>

Questions	Stakeholder Comments
	<p>On the “Electrification of heating systems in buildings” (Slide 20) forecast, does the AESO recognize and take into account that as carbon price rises to \$170/T, natural gas prices will be rising at a faster rate than electricity prices? At the same time, the carbon content and impact on electricity pricing will be falling towards zero. Is this incorporated into the analysis?</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>The energy efficiency signpost sensitivity seems low. See comments above as well as the Potential Study completed for Energy Efficiency Alberta several years ago.</p>
<p><b>4</b> Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>Co-generation with CCUS would likely produce extra energy that is exported to the grid. This extra electricity will likely be near net-zero.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>No comments at this time.</p>
<p><b>5</b> Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.</p>	<p>As renewables increase on the grid and electrification intensifies (as per the 2035 Peaking Conditions graph), it is apparent that there will be rapid changes in both generation and load at times (for example the “duck curve”).</p> <p>As electrification occurs, there will be large stresses and the resultant increased costs on the distribution system.</p> <p>In many jurisdictions, demand response is viewed as a credible option to mediate these changes. Demand response requires price signals to loads and / or their retailers. To help mediate these large load changes via demand response, will the AESO consider interval pricing for all Alberta consumers?</p> <p>In addition, would the AESO consider working with the AUC and Distribution Facility Owners (DFOs) to ensure that:</p> <ol style="list-style-type: none"> <li>1. Retail-level internal pricing be implemented; and</li> </ol>

	Questions	Stakeholder Comments
		<p>2. All loads receive the same transmission price signal, whether they connect at distribution or transmission voltage.</p> <p>Thank you for the opportunity to comment. This work is important to ADC and IPCAA members. If the AESO requires additional input from industrial loads directly, ADC and IPCAA would be happy to facilitate the discussion.</p>

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

<sup>i</sup> <https://www.aeso.ca/assets/Uploads/net-zero/net-zero-dec-16-jan31-2022-comments.pdf>

<sup>ii</sup> <https://www.aeso.ca/assets/Uploads/net-zero/03MAR2022-Summary-Net-Zero-Emissions-Pathways-Stakeholder-Comments.pdf>

# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Jesse Row
Comments from:	Alberta Energy Efficiency Alliance	Phone:	403-483-4810
Date:	2022/04/14	Email:	Jesse.Row@aeaa.ca

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### Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO’s analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>Yes, the session was valuable in learning more about the preliminary modelling results.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p>It would be good to know why the Load Sensitivities will not be modelled to identify their potential impact on the cost of meeting a net zero emission target.</p>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>We appreciate the energy efficiency signpost, but suggest it be broadened to a DSM signpost as policy changes related to other technologies such as demand response would also have an impact on peak demand levels both regionally and provincially.</p> <p>As shared previously, the current sensitivity related to changes in energy efficiency is well below potential uptake levels. We acknowledge that the policy environment is not currently in place to achieve these higher levels (as the AESO stated in the recent engagement session), but a similar situation exists for the various generation scenarios being modelled (e.g., the policy environment does not enable all 3 equally). One of the primary values of a modelling exercise such as this is the ability to compare scenarios to one another. Modelling a range of demand scenarios would provide valuable information on the potential impact of changes to the demand side of the system and total costs to consumers of reaching net zero emissions under a wider range of potential future scenarios.</p>



Questions		Stakeholder Comments
4	Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?	
	a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?	
5	Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.	

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	<b>March 22, 2022 to April 19, 2022</b>	Contact:	Richard Boulton
Comments from:	AltaLink	Phone:	403-267-2198
Date:	2022/04/19	Email:	

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Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>The session was valuable in providing stakeholders an overview of the AESO’s preliminary analysis on net-zero pathways with respect to load growth and generation scenarios.</p> <p>AltaLink appreciates the AESO sharing this valuable work and providing the opportunity to provide comments.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p>AltaLink recommends the AESO include emissions associated with cogeneration in the total emission calculation as a sensitivity. Also see our comments regarding Question #4.</p>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	<p>Overall, AltaLink believes the AESO’s load forecast looks reasonable. AltaLink believes load is much more certain than generation over the next 10 years. Load growth uncertainty, however, is expected to increase dramatically through the later 2030s and 2040s as we approach 2050 when the entire economy is targeted to be net zero.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>AltaLink recommends the AESO consider two additional signposts and develop corresponding sensitivity analysis:</p> <ul style="list-style-type: none"> <li>• Industrial electrification (driven by corporate ESG requirements or carbon policies), especially the conversion of gas drives to electric, could quickly add substantial load.</li> <li>• DER Solar. The AESO analysis anticipates more than 2,000 MW &lt;5 MW DER solar in its preliminary results. We believe that this penetration of small DER solar would be heavily dependent on government policy support. If these subsidies do not materialize, we expect this penetration of small scale solar will not occur.</li> </ul>

Questions	Stakeholder Comments
<p>4 Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<ul style="list-style-type: none"> <li>• It would be helpful for the AESO to share more information on its analysis on DER Solar (&lt; 5 MW) versus grid solar. It is AltaLink’s understanding that there remain economies of scale which would drive most solar to be no smaller than 10-20 MW size. This could change if there were specific policies to encourage roof-top solar. See AltaLink’s comments regarding Question #3</li> <li>• Recommend that a sensitivity be performed to see how results are impacted if Cogen is subject to similar emissions requirements as grid connected generation. i.e. Although the AESO’s current assumption is reasonable (as it is aligned with current federal methodology for allocating Cogen emissions to a host’s industry), by not accounting for the performance/cost impact of mitigating Cogen, the energy output appears to have been maximized in all scenarios. AltaLink believes it would be prudent to perform additional sensitivity analysis to understand the implications in a scenario where either the federal practice changes or host industries use third-party electricity suppliers instead of engaging in cogeneration themselves. AltaLink also recommends the total emissions from Cogen be tracked so, users of the report can choose to include them or not.</li> <li>• Recommend a sensitivity analysis be performed under the Renewable and Storage Rush scenario to better understand the potential impact of new interties in optimizing renewables and reducing the need of energy storage. Also see AltaLink’s comments regarding Question 4(a).</li> </ul>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<ul style="list-style-type: none"> <li>• Believe a significant signpost will center around carbon policy/requirements for other industry segments particularly the oil &amp; gas segment. This could dramatically shift economics of Cogen.</li> <li>• Policies for interties. The Federal government is actively promoting regional interconnections as part of the solutions for achieving a net-zero electricity grid. Although major interties may not be built in time, if new intertie development is underway supported by new policies, such a development will clearly influence generation development before 2035.</li> </ul>

5	Questions	Stakeholder Comments
	<p>Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.</p>	<ul style="list-style-type: none"> <li>As each scenario ends up with different emissions, AltaLink recommends viewing them as an all-in total cost including the likely cost of emission offsets. Otherwise, it becomes very difficult to compare different scenarios.</li> </ul>

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Dale Friesen
Comments from:	ATCO	Phone:	403-461-9440
Date:	[2022/04/19]	Email:	Dale.Friesen@atco.com

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Questions	Stakeholder Comments
<p><b>1</b></p>	<p>Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p> <p>We appreciate the AESO's early action around net-zero emissions pathways. The AESO team initiated this work even prior to the Federal government's recently published "Clean Electricity Standard Discussion Paper" on the topic of Net-Zero Electricity Grid by 2035 (NZ2035). The engagement hosted in March was useful however more work will be needed to help understand the viability of the various pathways to NZ2035.</p>
<p><b>2</b></p>	<p>Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p> <p><b>Purpose and Scope</b></p> <p>We understand that the AESO's Net-Zero Pathways Analysis (ANZPA) is a planning exercise and not a policy or market design recommendation document. However, given the latest federal policy direction of NZ2035, and the potential market design changes that may be required, any results that come out of this analysis may influence the thinking of and understanding in the ability to achieve this target by various parties.</p> <p>While the AESO has done a good job stating the initial scope of the net-zero report, in the final version of the report it will also be important to state how practical it is to build out the scenarios that the AESO has modelled. Given the time frame of the proposed federal regulation, (approximately 10 years to reach NZ2035 once enacted), it will be important that the AESO include thoughts on whether there is sufficient time or resources to build/retrofit the necessary generation, transmission and distribution infrastructure, and supporting market systems while maintaining reliability. This could include – depending on the pathway – hydrogen or CCUS infrastructure, transmission lines, and sufficient ramping or firming generation.</p> <p>Reliability and affordability are key requirements in reaching the federal NZ2035 target. Although the ANZPA was not intended to answer how these will be achieved, the outcome/results may be relied upon in future</p>

	Questions	Stakeholder Comments
		<p>discussions on pathways. A broader discussion should be initiated to understand the full impacts to Albertans from the federal NZ2035 in terms of reliability, affordability, industry competitiveness and public safety</p> <p><b>Clarification on Electrification of Heating; Space and Water</b></p> <p>The introduction of electric space and water heating will not reduce the energy demands associated with space and water heating in Alberta during cold winter weather. With a peak demand of approximately 32 GW on the ATCO Gas System alone, electrification of space and water heating in Alberta would require roughly a tripling of Alberta's electric generation. We have based this on the following:</p> <p>Cold climate heat pump manufacturers claim that their products remain operational down to -25° C whereas testing by NRCAN has validated operation down to -21° C. While air source heat pumps can have a Coefficient of Performance (COP), which is defined as the heating energy delivered divided by the electrical energy input. With a COP value as high as 4, performance begins to degrade at approximately 10° C, reaching a COP of approximately 1.5 at -20° C. Below -20° C, electric resistance (fan coil or baseboard) heating becomes necessary. With a COP of 1 or less, electric resistance heating is approximately equal in efficiency to heating with natural gas using a high efficiency furnace.</p> <p>As a result of this quantum of required peak demand to support electrification of heating; space and water the additional reliable generation needed at peak is significant, and likely not practical and does not include the added transmission and distribution cost associated with the grid required to support this level of generation and the further impact to consumers for all of the required home retrofit costs.</p>
3	Do you have any feedback or observations with regards to the Load forecast and associated load factors?	N/A



Questions	Stakeholder Comments
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p><b>Sensitivity Signpost to Consider</b></p> <p>We understand that ANZPA represents only preliminary impacts to Alberta’s electricity system. However, we believe with the federal Net Zero by 2035 proposed regulation that it would be useful to also create a bookend around full/ambitious electrification (including heating) as politicians, academics and industry groups have suggested this as a distinct “Net-Zero” policy. This significant increase in electric load would change the overall demand (and supply) of the electric system. Creating this bookend scenario may be important in informing both the public and governments of what would be required (electrification of heating) to get to full/ambitious electrification.</p>
<p>4 Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p><b>Results and Outcomes</b></p> <p>We are pleased to hear that the AESO will further evaluate resource adequacy utilizing its electric system risk model. Looking at the initial results, we believe that at least one and possibly two of the proposed scenarios raise reliability concerns, especially for meeting longer duration cold weather conditions (1 to 4 weeks). It will be critical to maintain reliability and we trust that the AESO will continue to understand the dynamics of the changing variables going forward and help reduce risks of unforeseen events. One recent example was the December 2021 three-week cold spell during which renewable energy output was between 0 and less than 10% of its capacity.</p> <p><b>Assumptions</b></p> <p>Given the latest impacts on commodity pricing, it was useful to see assumptions on carbon pricing however assumptions on fuel input pricing were absent. Based on the technologies being selected in the results such as renewables, natural gas combined cycle with CCUS, hydrogen using ATR or SMR, and battery storage, it would be useful to see what natural gas pricing assumptions were used as these will directly impact the</p>

	Questions	Stakeholder Comments
		<p>capture prices of various technologies and the types of emerging technologies that could be selected.</p> <p>In addition, more detailed assumptions on hydrogen generation be provided. ATCO suggests that combined cycle with hydrogen may be underestimated (as is shown as providing no capacity) and it may be more practical and effective than some other options in providing new baseload and mid-merit generation to meet NZ2035.</p>
	<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p><b>Additional Sensitivity Signpost</b></p> <p>Another sensitivity signpost that the AESO may want to consider is the impact/variability of fuel pricing. Given recent impacts on commodity prices, from global demand of preferred sources to more stringent environmental policies continuing to put pressure on oil and gas investments, there could be scenarios where higher sustained natural gas prices occur going forward. As inputs for combined cycle with CCUS and hydrogen generation, higher natural gas prices could increase the capture prices for renewables, creating an alternative build scenario using other emerging technologies.</p>
<p>5</p>	<p>Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.</p>	<p>To summarize ATCO's main comments following the Net Zero Emissions Pathways Engagement Sessions, the following is provided:</p> <ul style="list-style-type: none"> <li>• Greater analysis on the practicality of the scenarios that the AESO has modelled including the costs and market and reliability implications.</li> <li>• More modelling on electrification of building heating given that electrification of space and water heating in Alberta would require roughly a tripling of Alberta's electricity generation.</li> <li>• Greater consideration of natural gas pricing in sensitivity analyses given its impact on technology choice in a net zero future.</li> </ul>

	Questions	Stakeholder Comments
		<ul style="list-style-type: none"> <li>• More detail in assumptions for not considering combined cycle hydrogen generation for baseload and mid-merit generation or a scenario in which these provide more significant capacity.</li> <li>• Beyond ANZPA, a broader discussion will need to be initiated around consumer price impacts and industry competitiveness for the different scenario analyzed.</li> </ul>

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

<sup>i</sup> <https://www.aeso.ca/assets/Uploads/net-zero/net-zero-dec-16-jan31-2022-comments.pdf>

<sup>ii</sup> <https://www.aeso.ca/assets/Uploads/net-zero/03MAR2022-Summary-Net-Zero-Emissions-Pathways-Stakeholder-Comments.pdf>

# Stakeholder Comment Matrix – March 22, 2022

Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	R. McMann
Comments from:	BluEarth Renewables	Phone:	Contact Phone Number
Date:	2022/04/19	Email:	<a href="mailto:roslyn@bluearth.ca">roslyn@bluearth.ca</a>

## Instructions

1. Please fill out the section above as indicated.
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## Introduction

On Dec. 16, 2021, the AESO provided notice that it was commencing examination of potential pathways to a net-zero electricity system in Alberta. As an initial step, the AESO sought, and has received written feedback from interested stakeholders on their perspectives regarding the scope and input assumptions of the proposed net-zero emissions pathways analysis<sup>i</sup>. 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. The AESO has reviewed and incorporated several of the suggested changes<sup>ii</sup> and has completed its initial modelling using the revised assumptions.

The intent of the Mar. 28, 2022, engagement session is to present these preliminary modelling results to stakeholders for input and discussion. This comment matrix is intended as a follow-up and seeks any additional stakeholder insights and comments that the AESO will consider prior to the completion of our analysis and final publication of a report by the end of June. Stakeholder feedback received will similarly be compiled and posted and the AESO will subsequently provide a summary directional update.

## Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO’s analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions		Stakeholder Comments
1	<p>Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022.</p> <p>Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	
2	<p>Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis?</p> <p>What areas would benefit with further clarification from the AESO?</p>	<p>BluEarth continues to be supportive of the AESO’s Net-Zero analysis an important input to the modernization and decarbonization of the electricity sector. As Alberta works towards aligning with the Federal Clean Electricity standard and the next phase of the TIER program, this report can be an important consideration.</p> <p>Although the AESO analysis considers EV penetration, it would be interesting to further understand the impacts of two-way flow EVs (acting as storage and generators) as we look to 2035.</p>
3	<p>Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	
	<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	
4	<p>Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>While we support the move to look at various percentages of renewable and storage penetration (vs. the one 100% renewables and storage scenario), we are concerned that the proposed high renewables scenario “Renewables Storage Rush,” which shows zero emissions renewables accounting for 45% of provincial generation by 2035, may not provide a high enough upper limit to consider by 2035. This is especially given the low cost advantage of renewables, the rapid cost declines of storage and the continued increasing carbon and natural gas fuel prices.</p>
	<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	

Questions	Stakeholder Comments
<b>5</b> Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.	We request AESO provide the background assumptions for technology costs and the further analysis items on slide 42 in order to allow stakeholders to review as part of the mid May direction update (and before the June report).

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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DRAFT

# Stakeholder Comment Matrix – March 22, 2022

Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Robert Tremblay Dr. Joe Vipon
Comments from:	Calgary Climate Hub	Phone:	1-403-903-6234
Date:	2021/04/20	Email:	<a href="mailto:rob.tremblay@hotmail.ca">rob.tremblay@hotmail.ca</a> ; <a href="mailto:jvipond@gmail.com">jvipond@gmail.com</a> ; <a href="mailto:robert@calgaryclimatehub.ca">robert@calgaryclimatehub.ca</a>

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The intent of the Mar. 28, 2022, engagement session is to present these preliminary modelling results to stakeholders for input and discussion. This comment matrix is intended as a follow-up and seeks any additional stakeholder insights and comments that the AESO will consider prior to the completion of our analysis and final publication of a report by the end of June. Stakeholder feedback received will similarly be compiled and posted and the AESO will subsequently provide a summary directional update.

## Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO's analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>The session was valuable and the AESO made an exceptional effort to answer all questions in the session.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<ul style="list-style-type: none"> <li>- The scope of the analysis should include new interties in all scenarios</li> <li>- The scenarios should better represent macro conditions carbon pricing, intertie capacity, and renewable price as opposed to different visions of what the grid could look like</li> <li>-</li> </ul>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors? a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<ul style="list-style-type: none"> <li>- Solar and wind pricing should be part of the sensitivity analysis</li> </ul>
<p><b>4</b> Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<ul style="list-style-type: none"> <li>- Cogeneration derived from unabated fossil fuel combustions is <i>*not*</i> a valid source of net-zero electricity</li> <li>- Upstream methane emissions and the regulatory response to mitigating fugitive emissions must be considered as an impact in the forecasts</li> <li>- The cost of assumed CCS subsidies must be included in the costs for gas with CCS. These subsidies are ultimately paid by ratepayers or taxpayers</li> <li>- Given national interest in new interties, such as with the Pan Canadian Grid Council, model cases with new interties <i>*must*</i> be considered to have a complete range of forecasts for what a net-zero grid will look like in Alberta</li> <li>- Climate policy <i>*beyond*</i> the currently stated policy should be used as a bookend case representing what extreme action on climate mitigation would mean for the Alberta grid. In the absence of this</li> </ul>



	Questions	Stakeholder Comments
		<p>case, the AESO is presenting an incomplete range of scenarios. In the past (such as with the “Clean Tech” scenario in the 2021 LTO), the AESO has missed emerging policies, such as the 2035 CES, and thus failed to provide reasonably accurate forecasting for Albertans</p> <ul style="list-style-type: none"> <li>- The effects of uncertainty in the price of wind and solar must be explore more</li> <li>- A scenario with no CCS (and by extension no blue hydrogen) should be done</li> <li>- A model with a theoretical “infinite intertie” with neighboring jurisdictions should be done to show what a 2035 net-zero grid should</li> </ul>
	<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<ul style="list-style-type: none"> <li>- Air sourced heat pump adoption absolutely needs to be included</li> </ul>
<p><b>5</b></p>	<p>Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.</p>	<ul style="list-style-type: none"> <li>- The AESO modelling needs to better include a range of policy scenarios reflecting both failure of the current climate policy to materialize *and* acceleration of climate policy beyond the currently stated goals. Currently the AESO only considers policy failure and therefore misses forecasting climate policy acceleration (which has been the case over the past two LTO cycles)</li> </ul>

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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# Stakeholder Comment Matrix – March 22, 2022

Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	<b>March 22, 2022 to April 19, 2022</b>	Contact:	Robin Manley, COG SMRTF Chair
Comments from:	CANDU Owners Group (COG) Small & Medium Size Reactor Technology Forum (SMRTF)	Phone:	416-705-1393
Date:	2022/04/14	Email:	<a href="mailto:robin.manley@opg.com">robin.manley@opg.com</a> or <a href="mailto:sonia.iqbal@candu.org">sonia.iqbal@candu.org</a>

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The intent of the Mar. 28, 2022, engagement session is to present these preliminary modelling results to stakeholders for input and discussion. This comment matrix is intended as a follow-up and seeks any additional stakeholder insights and comments that the AESO will consider prior to the completion of our analysis and final publication of a report by the end of June. Stakeholder feedback received will similarly be compiled and posted and the AESO will subsequently provide a summary directional update.

## Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO's analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>The session was valuable to understand the preliminary analysis results. Even better understanding could have been achieved by providing in advance more information on the assumptions used, and why they were used.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p>The purpose and scope are reasonably clear except with respect to how far out the analysis is meant to look. The presentation variously uses 2035, 2040, 2041, and 2042.</p> <p>Generally, it would be valuable to know how the AESO assumptions on electrification of vehicles, home heating, DER use and annual/peak load growth compare to those of similar organizations in other Canadian jurisdictions (e.g. IESO in Ontario). Not that they should be identical necessarily, but if significantly different it would generate the question “why?”, which could be used to test and validate assumptions.</p> <p>It seems that a forecasted load growth of 1% average is very conservative and does not appear to consider increased demand from electrification. Did the sensitivity case analysis on “what if” it were substantially higher identify serious challenges which should require some mitigation actions?</p>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	<p>The load forecast assumes use of blue hydrogen. However, blue hydrogen production requires high GHG emissions (in fact, more than the equivalent energy value of natural gas, due to efficiency losses). Utilization of blue hydrogen will only be acceptable (from an ESG and climate perspective) in the 2030's if CCS (CCUS) is proven to reduce blue H<sub>2</sub> generation emissions substantially (and long-term), cost-effectively and at scale. At this time all three of these things are unknown. New facilities built to produce hydrogen as a mass-market fuel will need to adopt the best available technology and achieve carbon capture rates over 95% to provide return on investment with a net climate benefit by significantly lowering the carbon intensity for blue hydrogen, see e.g. <a href="https://www.pembina.org/en/2022/03/22/carbon-intensity-of-blue-hydrogen-accounting-for-technology-and-upstream-emissions/">Carbon intensity of blue hydrogen: Accounting for technology and upstream emissions (pembina.org)</a>.</p>

Questions	Stakeholder Comments
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>We think 2 key additional signposts are:</p> <ul style="list-style-type: none"> <li>(i) successful adoption of CCS/CCUS (demonstration of GHG reduction long-term; cost effectiveness; deployed at scale), and</li> <li>(ii) policy wrt acceptability of use of blue hydrogen.</li> </ul>
<p>4 Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>The assumption that carbon price increases will slow to an inflationary rate after they reach the current planned level of \$170/tonne may be conservative. Urgent action is required to address the accelerating impacts of climate change. The Government of Canada has committed to achieve net zero emissions from power generation by 2035 which suggests the carbon price will accelerate at a rate much higher than inflation after 2030. Given the federal government's aggressive approach, it is not unreasonable to expect carbon penalties to double by 2040, meaning that other technologies become cost-competitive and drive GHG emitters off the electricity table.</p> <p>The models assume a continued reduction of costs for wind, solar and batteries. However, what if geopolitical concerns drive production of components for these away from China, to Western suppliers (e.g. Canada) – resulting in cost increases? What if concerns about toxic waste generation in China drive higher environmental standards there (and thus cost increases)? What if toxic waste disposal of solar panels and batteries must be factored into costs, or large volume waste disposal costs for wind turbine blades and solar panels (with the 20-30 year lifetime) are added to the lifecycle costs (currently they are not)?</p> <p>The Dispatchable Dominant scenario is highly reliant on the success of CCS/CCUS. CCS/CCUS is a promising technology but has not yet been proven at a commercial scale. SMRs are also a promising zero emissions generation technology that will be commercially deployed in Canada by 2030 and should be considered in the sensitivity analysis. Certainly it is correct to identify that nuclear deployment in Alberta would take about 11 years from project start. However, we know nuclear reactors work very well to reduce carbon emissions (nuclear has been powering Canadian grids since the 1960s). Slide 38 refers to alternative technologies like nuclear and hydro requiring government support (it is assumed here this</p>

Questions	Stakeholder Comments
	<p>means “subsidies”) yet it is a fact that renewables in Canada have been heavily subsidized for many years, and government financial and policy support for CCS/CCUS in Alberta is considered critical. This seems to demonstrate an inconsistent application of criteria in the built-in assumptions.</p> <p>Given that the “First Mover Advantage” and “Renewable and Storage Rush” scenarios equally rely on some pretty liberal assumptions (i.e. speculative and unproven – no jurisdiction <i>in the world</i> has successfully decarbonized using wind and solar), it seems that in fact all 3 base scenarios rely on untested assumptions. Would it not make sense to include a scenario that incorporates only technologies that we actually know work?</p> <p>It is not clear why co-generation is not incorporated in the total emissions graphs. While a verbal explanation was provided that these are outside of scope for AESO, outside the grid, “inside the industry fence”, this seems an overly limited perspective which does not get to the true problem. CO<sub>2</sub> does not know about fences. Projections occurring in silos miss the greater opportunity.</p> <p>It is not clear if the “First Mover Advantage” assumptions on duration of storage (4, 19 and 60 hours) are referring all to batteries, or if these are variously batteries, compressed air, and pumped storage.</p> <p>It is not clear if the transmission build-out necessary to support the huge and necessary spatial distribution of wind and solar, is incorporated in the cost assumptions.</p> <p>It is not clear if the overbuild (above nameplate capacity) necessary for wind and solar to provide reliable supply – on the order of a factor of 4 to 12 depending on environmental/weather/geography conditions in our experience – has been factored into the costs and timelines to build.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>The signpost on CCUS, as noted previously, needs to incorporate evidence of large scale effectiveness.</p> <p>A signpost on blue hydrogen acceptability needs to be added, as noted previously.</p>

	Questions	Stakeholder Comments
		For the First Mover Advantage scenario, the battery life assumptions are unproven at scale. 4 hours will certainly work, but for 19 and 60 hour batteries, we do not know the practicality or the cost, at scale.
5	Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.	The CANDU Owners Group (COG), Small & Medium Size Reactor Technology Forum (SMRTF) stands ready to provide any additional information on nuclear power opportunities for clean energy (both electricity and heat/steam) on request. Please reach out to <a href="mailto:robin.manley@opg.com">robin.manley@opg.com</a> , or <a href="mailto:sonia.iqbal@candu.org">sonia.iqbal@candu.org</a>

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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# Stakeholder Comment Matrix – March 22, 2022

Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Evan Wilson
Comments from:	Canadian Renewable Energy Association	Phone:	
Date:	2022/04/19	Email:	ewilson@renewablesassociation.ca

## Instructions

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Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p>We appreciate the efforts that the AESO is making to prepare this analysis, as it will provide critical context to support efforts to decarbonize the grid in Alberta, in order to support a net zero economy. We expect that the project’s findings will be beneficial both to policy makers and market participants wishing to understand the efforts and programs required to support grid decarbonization with minimal impacts to cost and reliability.</p>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	
<p><b>4</b> Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>We are pleased that the AESO has decided to move forward with a range of different options for the deployment of renewable energy to support net zero, rather than one single “100% renewable and storage” option, as originally presented.</p> <p>In addition to the scenarios that are provided in the preliminary results, we would recommend an additional sensitivity analysis that provides some further context on the impacts of reduced penetration of cogeneration. While we understand the AESO’s reasoning that cogeneration would be excluded from the Clean Electricity Standard, it is likely unrealistic to assume that recent Federal government climate announcements would not have some impact on cogeneration in the province. As a result, it would be helpful to understand the impact of changes to the level of cogeneration to the supply mix.</p>



Questions	Stakeholder Comments
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>Overall, the signposts for the “First Mover Advantage” scenario and the “Renewables Rush” scenario seem appropriate, though we would request more explanation of the treatment of energy storage in both scenarios, in order to better understand the impacts on the economics of solar energy after the late 2020s, which were highlighted in the webinar presentation.</p>
<p>5 Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.</p>	<p>Since the development of these scenarios, the federal government has released its Emissions Reduction Plan (ERP) and consultation papers relating to both the Output Based Pricing System (OPBS) and Clean Electricity Standard (CES). These announcements bring increased clarity on various policies impacting inputs into the scenarios shared in the stakeholder session. As a result, it is recommended that AESO provide some updated analysis regarding the impacts of these policies on the scenarios, and on the load profiles that informs them.</p> <p>On slide 42, there is a review of the tasks required to inform further analysis on cost estimates. Prior to finalizing any of these estimates, it will be critical for the AESO to share them with industry subject matter experts in order to confirm their accuracy. This review could be done either via written submission or in another stakeholder webinar.</p> <p>Furthermore, the slide outlining the plan for cost estimation includes a plan for estimates of system integration costs and transmission costs for each scenario. We recommend that the AESO also provide an estimate of the transmission cost reductions that could result from the use of distributed energy resources, energy storage and other non-wires alternatives.</p>

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Matthew Davis
Comments from:	Capital Power	Phone:	403.540.6087
Date:	April 19, 2022	Email:	<a href="mailto:mdavis@capitalpower.com">mdavis@capitalpower.com</a>

### Instructions

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2. Please respond to the questions below and provide your specific comments.
3. **Please submit one completed comment matrix per organization.**
4. **Stakeholder comment matrices will be published on [aeso.ca](http://aeso.ca), in their original state.**
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### Introduction

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The intent of the Mar. 28, 2022, engagement session is to present these preliminary modelling results to stakeholders for input and discussion. This comment matrix is intended as a follow-up and seeks any additional stakeholder insights and comments that the AESO will consider prior to the completion of our analysis and final publication of a report by the end of June. Stakeholder feedback received will similarly be compiled and posted and the AESO will subsequently provide a summary directional update.

### Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO's analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>Capital Power appreciated the AESO's March 28<sup>th</sup> session. It is valuable that the AESO has been open and transparent in its development of the Net-Zero Emissions Pathways report.</p> <p>However, the amount of time allotted to Q&amp;A and discussion was insufficient given the broad amount of interest in the topic. Additionally, noting that the presenters tended to read what was on the slides provided, we would submit that for future sessions that additional information/insight/commentary from the presenters would be more valuable.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p>Capital Power believes that this work will be critical in informing a range of how the supply/demand mix will evolve over the next 20 years. Given the focus of the Federal Government's policy objectives are 2030 and 2035, some of the AESO's findings in the later part of the study period (2036 to 2041) may have to be accelerated, particularly with respect to the timing of potential new supply. Capital Power encourages the AESO to consider the relative misalignment between this study's timeframe and key policy dates and add some discussion on this as part of its final analysis.</p> <p>As raised by Capital Power and others in the stakeholder session, there is a strong need to clearly identify the amount of load served on the AIES by cogeneration given that the AESO has elected to exclude cogeneration from the electricity sector net-zero pathways analysis but does appear to rely on it to serve what appears to be nearly 50% of total energy demand in the future.</p>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	<p>On average the EV assumptions appear reasonable, but there may be further opportunities to optimize the charging profile, particularly if considering the opportunity to optimize in conjunction with periods where there is substantial wind and solar production.</p> <p>Capital Power believes that the electrification of heating may occur faster and may be more significant than the AESO's assumptions. Capital Power appreciates that the AESO has run some sensitivities around the impact of earlier adoption and would appreciate the AESO providing more details</p>

Questions	Stakeholder Comments
	<p>around the signposts and assumptions that would lead to the outcomes presented in the tornado chart on slide 23.</p> <p>As commented on in the session, the AESO has not identified the loading levels associated with storage in its presentation. As this is an important consideration, particularly in the Renewables and Storage Rush scenario, Capital Power submits that the AESO should include storage loading in its results.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>While the AESO may include data services loading under its general growth signpost, it would be useful for the AESO to also include it as a specific example of sizable opportunities to grow demand in the province.</p> <p>The AESO should also be considering the potential for exacerbated self-supply as a result of high wires costs, as behind the meter developments will impact the amount of load served by the market.</p>
<p>4 Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>The three scenarios appear to cover a range of potential outcomes, though none stand out as particularly realistic on their own.</p> <p>There are some inconsistencies in the AESO's narrative for each scenario that challenge the overall perception of their viability. For example:</p> <ul style="list-style-type: none"> <li>• The credibility of the premise of near cessation of wind and solar generation development in the dispatchable dominant scenario is challenging given current interest (from both developers and corporate PPA buyers), along with technology costs.</li> <li>• The first mover advantage scenario raises a similar concern as above in respect of its position to cease solar developments in 2028, but overall appears more plausible.</li> <li>• The renewables and storage rush scenario appears to exclude some thermal projects that are actively under development. While the AESO has stated that they are using its project inclusion criteria as its basis for including projects, the AESO should also look to ensure that their assumptions are aligned with active construction projects.</li> </ul>

Questions	Stakeholder Comments
	<p>It would be helpful for the AESO to provide additional discussion regarding the rationale for the scenarios to articulate how the key assumptions are consistent with the overall scenario.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>Capital Power understands the AESO’s signposts in both the dispatchable dominant and first mover scenarios. In the last scenario, Capital Power believes that the AESO needs to provide more context around how this type of future may arise, particularly with respect to the challenges that it would face in ensuring there is sufficient transmission capacity on the system to connect the various wind, solar, and storage projects.</p>
<p>5 Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.</p>	<p>Given the level of interest in this work, Capital Power strongly encourages the AESO to be as transparent as possible with the results. This would align with the AESO’s objectives to increase transparency and provide more useful data to industry and stakeholders.<sup>1</sup></p> <p>To further provide value, in addition to the report, access to the quantitative results in the form of excel tables will be of great use to market participants who may wish to leverage the AESO’s work in further analyses. Specific quantitative results that would be useful would include:</p> <ul style="list-style-type: none"> <li>• System and delivered costs to customers are critical to understanding the affordability aspect of the net zero pathways. To fully assess this, the AESO should publish its system costs methodology so that participants can understand how the AESO is approaching this critical aspect of the modelling. It is noted that the AESO’s delivered cost of electricity assessment, which would be most reflective of customer cost impacts is not expected as part of the June report (slide 12). The AESO should reconsider this timeline given the expedited pace of broader net-zero policy-</li> </ul>

<sup>1</sup> As the AESO presented in its March 2022 presentation on Data Strategy, the AESO will apply principles of open data (including accessible / machine processable data) and will reduce barriers to data access including potential proactive release for certain data sets. <https://www.aeso.ca/assets/AESO-Data-Strategy-Engagement-March-2022.pdf>

Questions	Stakeholder Comments
	<p>related discussions, particularly at the Federal level, but in any event should confirm when it will publish that critical analysis.</p> <ul style="list-style-type: none"> <li>Information regarding peak and average/total demand along with representative load shapes. Making this information available would align with the AESO’s approach to publishing its load forecast in its long-term outlook. The load shapes (particularly net of DER) would be very valuable in assisting in understanding some of the potential operability challenges – this would further be aided if the AESO published the wind and solar profiles that they are using in the analysis.</li> <li>Generation information by asset class including capacity, energy, and capacity factor. While the AESO’s charts provide this information, it is very useful to have the information in an accessible format. With respect to capacity factor, given the role that peaking capacity has in the market acting as backup capacity, it would be very useful to understand what level of asset utilization is necessary to ensure reliability. In addition, this type of information would be helpful to informing policy discussions regarding a potential Clean Electricity Standard and physical emissions performance standards for thermal generating units.</li> <li>Emissions by asset class are very useful, as mentioned above, the AESO should also include an assessment on the emission from cogeneration that serve electric load, particularly load on the AIES. If the AESO is in a position to publish the results, it may also be of interest to stakeholders the emissions saved through electrification of heating systems and transportation in this study.</li> </ul>

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

<sup>i</sup> <https://www.aeso.ca/assets/Uploads/net-zero/net-zero-dec-16-jan31-2022-comments.pdf>

<sup>ii</sup> <https://www.aeso.ca/assets/Uploads/net-zero/03MAR2022-Summary-Net-Zero-Emissions-Pathways-Stakeholder-Comments.pdf>

# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Nicole Black
Comments from:	Direct Energy/NRG Curtailment Solutions	Phone:	(403) 463-3520
Date:	2022/04/19	Email:	nicole.black@nrg.com

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	Questions	Stakeholder Comments
1	<p>Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022.</p> <p>Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>The session was quite valuable. We suggest that, prior to future sessions, AESO provide easier access to materials that will be referenced during the session. For example, references to the relevant sections of the Dunskey analysis on electric vehicles would have been helpful.</p>
2	<p>Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis?</p> <p>What areas would benefit with further clarification from the AESO?</p>	<p>The purpose and scope were clear. It would be helpful to know the extent to which AESO anticipates its involvement in developing policy and regulation (energy and environmental), rather than monitoring and analyzing given sets of policies and regulations.</p>
3	<p>Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	<p>The load forecast focuses primarily on the impacts of beneficial electrification, with much less focus on the potential impact of demand response, demand-side management and energy efficiency initiatives. While AESO does not have specific demand response products, and energy efficiency has been de-prioritized as a policy issue, we recommend that AESO allows for the possibility of such products in the future. In developing its load forecasts, AESO should use a holistic approach to beneficial electrification and flexible demand initiatives. Moreover, AESO should consider the opportunities for flexible demand in forecasts of oil sands and hydrogen production growth. With regard to electric vehicles, AESO should consider the impacts of changes in utilities' retail EV rate design and potential arbitrage opportunities in AESO's markets on EV charging profiles; we are unclear whether the Dunskey analysis on EV addresses these issues.</p>
	<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>We agree with these signposts. We also urge AESO to provide more detail regarding how it plans to track them and consider additional signposts.</p>
4	<p>Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>We would like to know if AESO is modeling correlated unit outages in its Monte Carlo assumptions, especially for natural gas-fired units that face common fuel availability risks. AESO should also consider the</p>



	Questions	Stakeholder Comments
		opportunities of interties with MISO and the Western energy imbalance markets, which are projected to reduce their carbon emissions significantly.
	a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?	Yes.
5	Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.	

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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# Stakeholder Comment Matrix – March 22, 2022

Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	<b>April 19, 2022</b>	Contact:	Jessica Halland
Comments from:	Enfinite	Phone:	403-615-7594
Date:	2022/04/19	Email:	jhalland@enfinite.com

## Instructions

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Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>Enfinite attended the March 28 session and would like to thank the AESO for the opportunity to learn more about the assumptions that will be applied to drive the pathway to net-zero recommendations. Enfinite appreciates the complexities of making these assumptions and forecasting load given the frequently shifting variables and is aware that this is not meant to drive policy or market design. The session was clear and concise in this regard.</p> <p>The session was valuable, but more collaboration between all stakeholders is necessary to generate the most reasonable forecast. Further, Enfinite suggests that the AESO consider methods to track changes to assumptions based on current information, such as regulatory changes, as these changes will have a significant impact on market behavior and effect electricity consumption patterns.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p>Enfinite is supportive of the purpose and scope of the analysis. Enfinite would like to understand what measures the AESO is taking to ensure that simultaneous clean energy consultations and initiatives, and their outcomes, are factored into the analysis and updated as needed. As new information becomes available, it should further inform the overall analysis to ensure the data is relevant and takes into account the numerous federal and jurisdictional consultations.</p> <p>The AESO's willingness to collaborate with industry to obtain forecasting and modelling data to advise a more robust forecast is the most effective way to achieve the desired outcome.</p>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	<p>Enfinite is supportive of the driving factors used to support the net-zero load forecast. As the push for decarbonization continues, it is difficult to make the assumption that electrification of space and water heating systems in buildings is expected to be modest in the lead up to 2035 due to lack of policy support. As we have seen from the roll out of recent</p>

Questions	Stakeholder Comments
	<p>mandates to decarbonize the electricity sector, it is clear that there is an aggressive target and the processes to implement these changes are happening in an expedited manner.</p> <p>Enfinite agrees that increased electrification and adoption of net zero technologies will change daily energy profiles and affect typical peaking conditions and submits that the adoption of energy storage on a larger scale will ensure reliability during this transition.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>Enfinite agrees with the signposts that the AESO has identified and recommends that the AESO regularly review these to ensure that the assumptions made as a result of the identified indicators remain up to date and relevant as there remains uncertainty, particularly in the regulatory space.</p>
<p>4 Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>The generation assumptions made in the engagement session are reasonable overall. These assumptions are likely to change due to several factors, including commercial acceptance, and should be assessed regularly to ensure the outcome of forecasting and modelling are based on relevant information.</p> <p>The Dispatchable Dominant scenario assumes that carbon captured technologies become more cost effective. This is the least cost-effective scenario and will likely result in energy costs increasing. As CCUS is a new technology, concerns around market risk and environmental impact remain an issue. Further, this scenario sees the lowest increase in renewable technologies which is in direct conflict with forecasted growth of storage, wind and solar.</p> <p>The First-Mover Advantage scenario forecasts a more realistic view of the growth of solar and wind but does not factor in energy storage to the degree necessary to ensure the reliability of these technologies. Solar and wind will remain intermittent without the large-scale development of energy storage.</p>

Questions	Stakeholder Comments
	<p>Enfinite submits that the Renewable and Storage Rush scenario is the most likely scenario given the current trends, signals from the proposed clean electricity standards and growth of storage in jurisdictions that have had similar mandates and constraints.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>Enfinite agrees with the signposts that the AESO has identified but suggests that the first two generation assumptions need to take into consideration the growth of energy storage and its impact on these assumptions.</p> <p>Enfinite submits that energy storage is a vital component of a net-zero grid and, as such, needs to be factored in to the Dispatchable Dominant and First-Mover Advantage scenarios on a larger scale.</p>
<p><b>5</b> Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.</p>	<p>Enfinite is generally supportive of the preliminary results the AESO has presented but reiterates that energy storage is key to a successful transition.</p> <p>Efforts need to be made by all levels of government to ensure that revenue streams for clean energy generation are well defined and implemented. The lack of policy signals, particularly in defining storage, is causing further delays to the approval and construction of large-scale energy storage. These signals are necessary to ensure the electricity system is prepared for the transition to decarbonization while maintaining reliability of the grid in the most cost-effective way.</p>

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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Comment period:	<b>March 22, 2022 to April 19, 2022</b>	Contact:	Mark McGillivray
Comments from:	ENMAX Corporation	Phone:	
Date:	2022/04/19	Email:	<a href="mailto:MMcGillivray@enmax.com">MMcGillivray@enmax.com</a>

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Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022.</p> <p>Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>The session was helpful to learn more about the AESO's preliminary modelling results.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis?</p> <p>What areas would benefit with further clarification from the AESO?</p>	<p>ENMAX agrees with the intended purpose of the analysis, which is to highlight potential reliability, cost and market implications of a range of net-zero outcomes, and not present a specific policy or market design recommendation.</p> <p>As the AESO is aware, there are a number of key initiatives currently underway at both the federal and provincial levels. Among other announcements, the details and timelines laid out in the Clean Electricity Standard (which are not expected until the end of the year at the earliest) will be a foundational piece and will directly impact the AESO's inputs and assumptions.</p> <p>Given the potential rate impact on consumers, additional analysis on the amount of transmission and distribution builds, total cost of generation for the grid, and associated costs for each potential scenario is needed. ENMAX looks forward to seeing more details on the associated cost estimates (transmission, operating and new construction) for each of the pathways identified. It is important to recognize that the rate-impact/build analysis will be iterative because large increases in electricity costs would likely place downward pressure on electricity demand, and could even drive conversions from electricity to gas given that the target date for economy-wide net zero is 15 years later than the electricity target.</p>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	<p><b>Energy Efficiency and Demand Side Management</b></p> <p>Increased electricity demand due to EVs and building electrification, coupled with that demand's almost perfect negative correlation with residential solar energy production (residential electricity demand peaks in the winter and after sunset, while solar energy production peaks on summer afternoons) may actually make the management of transmission and distribution energy flows even more difficult.</p> <p>In the future, energy efficiency and demand side management programs and other non-wires solutions (such as energy storage) on the distribution system may play a greater role in helping to manage grid peak demand periods, which appear to have not been reflected in the AESO's current modelling results.</p> <p><b>Electric Vehicles</b></p> <p>While the AESO expressed that we may see EV targets and commitments move forward at the federal level regardless of economics or grid system</p>

	Questions	Stakeholder Comments
		<p>readiness, without alignment at the provincial level, the ability to support greater EV adoption will be challenged. Clear direction from the provincial government or AUC is needed on how DFOs are to proceed with electrification efforts.</p> <p>As a DFO, ENMAX Power is continually monitoring and evolving its forecasts to include electrification of transportation and DER deployment on its distribution system. ENMAX expects the AESO will collaborate with DFOs more closely in the future to further refine the load assumptions and anticipated DER deployment.</p> <p><b>Electrification of Buildings</b></p> <p>Given developers are already offering electric heating in new residential developments, the rate at which electrification of heating systems becomes significant may change.</p>
	<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>Since the net-zero space is evolving rapidly, the signposts and assumptions used will be further impacted by a number of different factors such as federal and provincial policies, pace at which new technologies are adopted and electricity costs. That said, the signposts identified appear to be a reasonable starting point.</p>
4	<p>Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>Slide 39 of the AESO's presentation – It would be helpful to provide more visibility on the assumptions the AESO used with respect to energy storage &amp; solar PV growth under the three scenarios.</p>
	<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>See ENMAX's response to question 3a). Providing clarity around H2 fired generation assumptions would also be helpful. For instance, is this assumed to be 100% H2 fired or a NG/H2 blend? A 30% H2/NG blend results in ~10% reduction in CO2 compared to 100% NG burn.</p>
5	<p>Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.</p>	<p>None.</p>

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# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Lisa Lemish
Comments from:	EPCOR Distribution & Transmission Inc.	Phone:	780 969 8210
Date:	2022/04/19	Email:	<a href="mailto:Llemish@epcor.com">Llemish@epcor.com</a>

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On Dec. 16, 2021, the AESO provided notice that it was commencing examination of potential pathways to a net-zero electricity system in Alberta. As an initial step, the AESO sought, and has received written feedback from interested stakeholders on their perspectives regarding the scope and input assumptions of the proposed net-zero emissions pathways analysis<sup>i</sup>. 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. The AESO has reviewed and incorporated several of the suggested changes<sup>ii</sup> and has completed its initial modelling using the revised assumptions.

The intent of the Mar. 28, 2022, engagement session is to present these preliminary modelling results to stakeholders for input and discussion. This comment matrix is intended as a follow-up and seeks any additional stakeholder insights and comments that the AESO will consider prior to the completion of our analysis and final publication of a report by the end of June. Stakeholder feedback received will similarly be compiled and posted and the AESO will subsequently provide a summary directional update.

### Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO's analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>EDTI supports the AESO's initiative to incorporate stakeholder feedback and allow stakeholders to understand the underlying assumptions in the new long term transmission outlook process. As the process develops, EDTI would like to understand the cost impact of the transmission system long term has on customer rates.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<ul style="list-style-type: none"> <li>• How do the following sensitivities impact the AESO's pathway to net zero analysis? <ul style="list-style-type: none"> <li>○ Application of demand side management technologies</li> <li>○ Rate structure</li> <li>○ Energy efficiency, and,</li> <li>○ Known customer owned battery storage projects.</li> </ul> </li> <li>• What analysis has been completed to understand the financial cost impacts of potential transmission projects?</li> <li>• Due to the long lead time required to build and construct transmission facilities, how will this report be used in the short term to identify need for new transmission infrastructure?</li> </ul>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p> <p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>EDTI does not have any feedback or further comments regarding the load forecast and associated load factors.</p> <p>A potential driver that the AESO may want to consider in their load forecast are anticipated regulatory/legislative changes.</p>
<p><b>4</b> Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p> <p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>EDTI does not have any feedback or further comments regarding the generation forecast scenarios.</p> <p>EDTI does not have any feedback or further comments regarding the sign posts used in the generation forecast.</p>

Questions	Stakeholder Comments
<b>5</b> Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.	EDTI does not have any additional information to provide at this time.

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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<sup>i</sup> <https://www.aeso.ca/assets/Uploads/net-zero/net-zero-dec-16-jan31-2022-comments.pdf>

<sup>ii</sup> <https://www.aeso.ca/assets/Uploads/net-zero/03MAR2022-Summary-Net-Zero-Emissions-Pathways-Stakeholder-Comments.pdf>

# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Justin W Rangooni
Comments from:	Energy Storage Canada	Phone:	647 627 1815
Date:	2022/04/19	Email:	jrangeoni@energystoragecanada.org

### Instructions

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### Request for feedback

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Stakeholder engagement, dialogue, and feedback will be key to framing the AESO’s analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>Energy Storage Canada (ESC) was pleased at the opportunity to attend the session. ESC found the session valuable, with particular support for:</p> <ul style="list-style-type: none"> <li>- Concise overview of Net-Zero report scope</li> <li>- Adjustments and response to stakeholder comments</li> <li>- Sensitivities for load forecast and scenarios for supply resources</li> </ul>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p>ESC believes the scope is reasonable for this planning exercise.</p> <p>Further clarification is required on the transmission cost estimates and whether they will include Storage as a Transmission Asset. Details on how storage may be used in a scenario to support resource integration would be helpful</p>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p> <p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>AESO states for EVs “Vehicle adoption based on policy drivers, not economics.” This approach does not align with many outlooks that view economics of EVs to be economics in the next 3 to 7 years. Further, the economics of EVs for use in fleet vehicles is even closer. The AESO should consider reviewing the economics of EVs, specifically with respect to current short-term gasoline pricing.</p> <p>ESC believes the signposts should include economics of EVs, in particular medium-duty vehicles used in fleet services and utility vehicles. Higher electrification of this vehicle segment may have a significant impact on future loading.</p>
<p><b>4</b> Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>ESC believes that the Renewable &amp; Storage rush scenario should include the TIER High-Performance-Benchmark being lowered to zero prior to 2035. A Renewable &amp; Storage rush would likely be tied to the full cost of carbon being passed through to electricity offer prices from thermal resources. The higher electricity price is a key support for the economics of energy storage that cycle from low price periods to high price periods.</p>

Questions	Stakeholder Comments
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>ESC generally supports the signposts described by the AESO; however, further information and clarity is required. For example, under the First-mover advantage scenario, is there not a potential for more storage penetration beyond 4-hour batteries? Would a limited amount of pumped storage or compressed air energy storage be appropriate</p>
<p>5 Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.</p>	<p>While Renewable Corporate PPAs may continue to add to supply, customer’s ESG requirements may begin to evolve to seek greater refinement in the delivery of emission-free electricity (e.g., 8760-hour retail product for consumption). This requirement would profoundly impact retail options and generation supply mix.</p> <p>Understanding the integrated role of transmission and storage to enable new renewable generation development should be an important outcome of this planning exercise given the long development time of new transmission.</p> <p>The load pattern changes from electrification and net-zero policies could have a profound impact on the electricity system. For example, EV charging and space heating conversions could result in significantly greater consumption during the time period of 5am – 8am, creating new stresses and value for different generation suppliers. Further, as adoption of EVs and other net-zero investments grow, the capability to shift consumption will diminish since there is a limit to how much demand response can be effective before the peak is just pushed around.</p>

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Kurtis Glasier
Comments from:	Heartland Generation Ltd. (“Heartland Generation”)	Phone:	(587) 228-9617
Date:	[2022/04/19]	Email:	Kurtis.Glasier@heartlandgeneration.com

### Instructions

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### Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO’s analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>Heartland Generation has concerns with the stated purpose and pending reliability assessment of the proposed scenarios, as detailed below. Respectfully, assessing the implied reliability prior to examining hypothetical scenarios may provide a more representative outcome. Presenting the reliability outcomes of the proposed scenarios would allow the discussion of the scenarios to be more grounded. The scenarios do not indicate what supply additions will be made in order to achieve the necessary reliability outcome (e.g., the marginal unit is Hydrogen-peaking, therefore, Hydrogen peaking units will be added to the supply mix until an allowable resource adequacy is met).</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p>The stated purpose of this analysis and how it could be used may not be aligned. The AESO, in the session, indicated that this report is “a planning exercise, not a policy or market design recommendation document.” However, on the AESO’s website under purpose it includes that this initiative will “provide insight to government and industry.” An analysis document produced and published by the independent system operator will inform policy or market design, as shown by participation in this initiative from various levels of government and public interest stakeholders. Heartland Generation has concerns that the AESO’s analysis could form a policy recommendation even if it that was not its intent. A planning exercise without the intent of informing policy, could very well misinform policy makers and lead to less desirable market design outcomes.</p> <p>As the AESO is well aware the analysis presented regarding net-zero pathways will not be presented in a vacuum, and that conclusions from this “planning exercise” may very well be taken as implied policy or market design recommendations. Therefore, given the ongoing government policy discussions that are, or will be, taking place (e.g., CES, TIER, etc.) it may be more meaningful as a “planning exercise” for the AESO to defer a decarbonization pathways report until the foundational policies have stabilized. Otherwise, there is a risk that a hypothetical planning exercise could be potentially misconstrued and used to inform a policy</p>



Questions	Stakeholder Comments
	<p>recommendation in a way that was not intended and for which it was ill-fitted to provide.</p> <p>AESO's primary objective should be reliability, the analysis on any of the net zero pathways should start there. Absent any evidence to the contrary, it is hard to see how any of the three scenarios would meet the AESO's reliability mandate to operate a safe and reliable grid. The AESO should use the resource adequacy model to add supply under different circumstances (i.e., the cost and policy assumptions of the three proposed scenarios). This would ensure that across the three scenarios the same level of reliability (e.g., same level of normalized expected unserved energy) is being compared. Once the same level of reliability is achieved, the cost comparisons for integration and transmission costs become more meaningful. It is not worthwhile for the AESO to present cost estimates for scenarios that do not provide for a reliable grid as their own mandate would prevent them from operating an unreliable grid.</p>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	<p>Heartland Generation does not have any direct feedback regarding the load factors.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>See above comment.</p>
<p><b>4</b> Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>The AESO has stated that it will share “capital costs associated with new generation construction.” Heartland Generation agrees with this proposal. The capital cost assumptions would be helpful in the form of levelized capital costs for all generation, including the Cost of New Entry (CONE), for each of the three scenarios assuming costs will vary between them.</p> <p>For each scenario, this information could be presented in three tables similar to the one provided as part of question 6 of the January comment matrix, including: the generation type, plant capacity, capital cost, etc. This would allow clear insight into the AESO's modelling assumptions and how the generator cost estimates are affected by each of the scenarios.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>Heartland Generation does not have any direct feedback regarding the appropriateness of the selected signposts. It remains hard to make comments under the proposed scenarios without knowing the explicit</p>

Questions	Stakeholder Comments
	changes to capital costs under each of the three proposed scenarios and the implied reliability of each scenario.
5	Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.
	Heartland Generation is concerned that the reliability of the three proposed scenarios would not be permitted under the current legislation; to say this another way, that the three scenarios would not meet the minimum long-term adequacy metrics required by the legislation. This would invalidate any cost and operation assumptions based off of these proposed scenarios.

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Rob Watson
Comments from:	Maxim Power Corp.	Phone:	403-750-9317
Date:	2022/04/19	Email:	rwatson@maximpowercorp.com

### Instructions

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### Introduction

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### Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO's analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>Maxim found the session valuable, and our multiple attendees appreciated the AESO sharing their knowledge and path forward as part of the engagement session.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p>Maxim is of the opinion that the scope is appropriately broad to accomplish the goals of the Net-Zero Analysis. We would however like to encourage the AESO to ensure that their analysis considers the specific requirements faced by Alberta's deregulated electricity market as compared to other regulated jurisdictions within Canada.</p>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	<p>Maxim believes the considerations brought up with the load forecast are reasonable, although we would suggest that the high case of EV adoption could be increased to a higher level.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>Maxim is fine with the signposts as proposed.</p>
<p><b>4</b> Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>Maxim would like to see TIER treated as the baseline for the sake of forecasting generation, with consideration given to a case where the carbon intensity baseline instead follows OBPS. Additionally, we believe that the continued use of natural gas simple cycle units in place of hydrogen should be considered, especially with the speculative nature of hydrogen technology and the potential the technology may not develop to a utility scale level by the proposed time period.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>Maxim suggests that the signposts that largely consider the end of the decade should instead look to the middle of the 2020's as an intermediary period. If the technological evolutions that are suggested as part of this analysis do not see significant progress within the next 5 years, it seems unlikely that they will suddenly become readily available and deployed in the 2030's.</p>

Questions	Stakeholder Comments
<b>5</b> Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.	Maxim has no additional information to add at this time.

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# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Binnu Jeyakumar
Comments from:	Pembina Institute	Phone:	587-436-3667
Date:	2022/04/19	Email:	Binnuj@pembina.org

### Instructions

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Questions	Stakeholder Comments
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<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p>AESO’s undertaking of the Net-Zero Analysis is very timely from a climate, economy, and energy perspective. Canada has a commitment for a net-zero grid by 2035, our largest trading partner US has a similar commitment, and developed countries need to achieve a net-zero grid by 2035 to keep global temperature increase to under 1.5C (as per the International Energy Agency). In addition, as the cost of renewables, batteries, and electric vehicles continue to plummet, these technologies will be deployed at an exponential rate. Finally, as Alberta undergoes an accelerated transition away from coal-fired generation, critical infrastructure decisions are being made right now and in the next couple of years that will determine the composition of our electricity system for decades to come.</p> <p>The inclusion of carbon output, certain costs, and various generation mixes are helpful in the scope of the Net-Zero analysis. However, the presented scenarios do not sufficiently explore the full range of pathways for Alberta and therefore restrict the scope and robustness of the analysis. Adding the following information will help assess the impacts of the net zero pathways:</p> <ul style="list-style-type: none"> <li>• Net cost analysis that includes an estimate of the system benefits, cost reductions, and deferrals in addition to the costs of various investments.</li> <li>• More comprehensive sensitivity analyses for various key assumptions, particularly around technology costs and deployment rates.</li> <li>• Impact of cogeneration and potential alternatives. Cogeneration is a significant contributor to emissions in Alberta’s electricity sector,</li> </ul>

Questions	Stakeholder Comments
	<p>and excluding them from any modelling of a net zero grid will impact the credibility of the results when examined by the global climate community, the investor community, and companies with ESG goals.</p> <ul style="list-style-type: none"> <li>• Impact of interprovincial transmission interties. Interties have been well documented to reduce the total system cost of grid decarbonization efforts in multiple jurisdictions.</li> </ul> <p><b>Modelling an evolving landscape</b></p> <p>There are parameters that seem to be held constant in the AESO's analysis that will evolve and respond dynamically to the development of a net-zero grid and economy.</p> <ul style="list-style-type: none"> <li>• For example, while demand response facilitated by EVs is only somewhat incorporated to aid grid operations and mitigate wires needs because it is not presently deployed, the trajectory toward net-zero grids will advance the development of this technology globally and in Canada and Alberta. There is a high probability that the amount of demand response will be much higher than that modelled.</li> <li>• Failing to acknowledge and incorporate the correlation of net-zero enabling technologies with the development of net-zero grids will result in overly pessimistic reliability and cost results.</li> <li>• Electricity technology cost decline and capacity growth forecasts are consistently underestimated in analyses across the world, lagging reality<sup>1,2</sup>.</li> <li>• At the very least, the scope of results of the analysis should clearly and explicitly acknowledge the potential for new technologies to mitigate the challenges of net-zero.</li> </ul>

<sup>1</sup> Xiao et al., "Plummeting Costs of Renewables - Are Energy Scenarios Lagging?" (2021). *Energy Strategy Reviews* 35. <https://doi.org/10.1016/j.esr.2021.100636>

<sup>2</sup> <https://qz.com/2049805/is-solar-power-getting-cheaper/>



Questions	Stakeholder Comments
	<ul style="list-style-type: none"> <li>The final report should be very clear around these assumptions and where technology and market efficiencies could mitigate challenges but were not factored into the analysis. This is not only an issue around characterizing the assumptions and inputs – it speaks to a directional bias in the entire analysis that requires diligent mention in all communications around the analysis to avoid misuse of the outputs and conclusions.</li> </ul>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	<p>Methodologically, the growth rates of technologies should be based on plausibility, and not just extrapolations of historical trends. As the grid transforms, so will markets. From the preliminary results, we noted several areas where growth parameters should be adjusted.</p> <ul style="list-style-type: none"> <li>AESO noted that energy efficiency changes are based on historical trends, but the industry is expected to grow with policy support incoming nationally. Ideally, the forecasts for energy efficiency growth should be used instead of the historical trend as a baseline. Additionally, deeper reductions in demand from energy efficiency can be run as a sensitivity. The ~200 MWA sensitivity may not sufficiently capture the entire range of opportunity. The 2018 Energy Efficiency Alberta study<sup>3</sup> estimated reductions can reach much as 13.3% of Alberta’s electricity demand, or 919 MW, in 2038.</li> <li>Electric vehicle adoption is based on Healthy Environment, Healthy Economy targets, not the most recent ERP. The federal government may tighten these targets even further; modelling for scenarios should account for further increased ambitions or achievements as a sensitivity.             <ul style="list-style-type: none"> <li>Over half of Albertans (54%) say the next car they purchase in the next one to five years will be an electric vehicle.<sup>4</sup></li> </ul> </li> </ul>

<sup>3</sup> Page 32, <https://open.alberta.ca/publications/energy-efficiency-alberta-2019-2038-energy-efficiency-and-small-scale-renewables-potential-study>

<sup>4</sup> <https://www.newswire.ca/news-releases/the-next-new-vehicle-purchase-for-nearly-70-per-cent-of-canadians-will-be-an-electric-model-kpmg-in-canada-survey-889637501.html>

Questions	Stakeholder Comments
	<ul style="list-style-type: none"> <li>○ Regarding electric bus adoption, Edmonton already has 60 electric Proterra ZX5 busses and the Bow Valley Region transit authority expects to have nine in 2023. ZX5 busses have 450 kWh capacity each. The figure on page 18 of the March 28 presentation is small, but it appears to underestimate relative to these busses already.</li> <li>• As of the 2022 Emission Reduction Plan, the federal government has committed almost \$1 bn across Canada to support building heating electrification, including a Deep Retrofit Accelerator. The expectation for “modest” support until 2035 is too conservative.</li> </ul> <p>With each of the technologies above (EE, EVs, electrified heating), the analysis should acknowledge not only the potential for changes in electricity demand growth, but also the opportunity for these technologies to offer reliability and grid services through demand response, and the resulting cost savings. Assuming that these technologies are limited to their present role in our grid as largely non-responsive demand is not realistic in a net-zero grid and net-zero economy.</p> <ul style="list-style-type: none"> <li>• The EV charging behaviour results for LDV and MHDV on slide 49 do not appear to match the qualitative statements that suggest the onset of managed charging, which would shift charging to off-peak.</li> <li>• AESO noted vehicle-grid integration (VGI) technologies are excluded from this modelling because of their nascency and lack of policies and standards. However, as AESO noted, Ford’s F-150 Lightning will include V2B capabilities. Tesla vehicles have the hardware to support the same, and Hyundai, Kia, Genesis, Toyota, and Ford have all announced their support for at least V2L. With net-zero 2035 as a target, it is highly likely – and necessary – for further policies and standards to be established that enable greater grid flexibility and integration of electrification technologies. These policies and continuing technology development will create a high probability for VGI capabilities to</li> </ul>

Questions	Stakeholder Comments
	<p>become a reality. The Dunskey post AESO cited<sup>5</sup> states, “Utilities and regulators in Canada should start thinking now how best to incentivize V2G to meet grid objectives” – we see this as support for AESO to consider VGI in its net-zero modelling, not as a reason for excluding it.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>This is a good list of the key variable determinants that can affect load growth over this timeframe. As noted above, there is reason to believe that EE, EV adoption, and heating electrification are likely to proceed more quickly than assumed in the base case and – if implemented concertedly – can help to cost-effectively integrate non-emitting generation.</p> <p>Greater clarity is also needed on how these signposts will be used in subsequent analyses.</p>
<p>4 Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p><b>Scenario definitions</b></p> <p>We appreciate that the AESO has considered the feedback on the limited value of a 100% renewable scenario and has removed that scenario from analysis. However, it is not clear what common set of principles and decision factors were used to determine the three scenarios modeled.</p> <ul style="list-style-type: none"> <li>• It is not clear why the higher renewable and storage scenario is labelled as a “Rush”, which implies haste and unpreparedness. Given that these are the only non-emitting or even low-emitting technologies that have achieved commercial deployment in Alberta, this scenario would be better characterized as a continuation or acceleration of recent market trends using readily available technologies instead of subsidized new and emerging technologies (the “first-mover advantage” is actually a better label for a renewable-heavy outcome). Moreover, the “Dispatchable Dominant” label implies that other scenarios do not have dispatchable generation, which is not the case, given storage’s deployment.</li> </ul>

<sup>5</sup> <https://www.dunskey.com/scaling-vehicle-to-grid-v2g-technology-benefits-and-considerations/>

Questions	Stakeholder Comments
	<ul style="list-style-type: none"> <li>• It should be recognized that the Dispatchable Dominant scenario is not market-driven. The statement “[CCUS] cost declines enabled by government support for carbon capture technologies” implies subsidies for specific technologies. Hence the scenario is not technology-neutral. In any treatment of cost impacts in the final report, it should be acknowledged that this scenario relies on technologies to be subsidized by taxpayers.               <ul style="list-style-type: none"> <li>○ On the other hand, renewable deployment in the other scenarios is driven by market economics, including “renewable cost declines” and private sector procurement of renewable energy.</li> </ul> </li> <li>• It should also be recognized in the cost analysis that the additional 2 Mt of emissions in the first two scenarios will cost at least \$340 M in 2035 (assuming \$170/tCO<sub>2e</sub>). Furthermore, the risk of the carbon price increasing through policy at \$15/tCO<sub>2e</sub> – not just inflation – after 2030 should be included in the model.</li> </ul> <p><b>Investment flexibility</b></p> <p>It should be recognized that the different reliance on generation types in the scenarios have very different implications for capital investment responding to unexpected changes in supply-demand dynamics, which are very common in Alberta’s electricity market. A scenario that relies predominantly on NGCC CCUS investments, which are typically above 500 MW, will lead to grid investments and energy price outcomes that are much less flexible than the smaller, scalable investments in renewable energy and battery storage. The modelling does not seem to include these differences in assessing cost and grid reliability outcomes, and this needs to be acknowledged as a downside to very heavy reliance on very lumpy generation options.</p> <p><b>CES treatment of cogeneration</b></p> <p>The most significant risk that the AESO invites in relying on this analysis in planning for 2035 net-zero electricity is the potential for the federal government’s CES to treat cogeneration differently than is assumed in this</p>

Questions	Stakeholder Comments
	<p>analysis, and the potential for Alberta’s grid in 2035 to not be credibly net-zero for investors. It appears that all three scenarios rely on cogeneration for well over half of total generation in 2035. These scenarios would need to change dramatically if these emissions are not entirely omitted from the federal CES, severely undermining the utility of this analysis. Canada’s National Inventory Report (NIR) includes cogeneration emissions in the calculation of the province’s electricity emissions intensity, so omitting cogeneration emissions altogether would be a significant departure from current practice.</p> <p>Similarly, all three scenarios in the preliminary results show the use of hydrogen in simple cycle units after 2030. It is important for the cost analysis and carbon output results to consider the sources of hydrogen that might be used. In the context of a net-zero economy and the oil and gas emissions cap, only blue and green hydrogen may be possible.</p> <p><b>Interties</b></p> <p>The scenarios exclude what is likely to be the most cost-effective option: a mix of predominantly renewable energy with some domestic energy storage and substantial new intertie capacity. There is growing evidence that transmission to integrate geographically diverse renewable energy supply is often the most cost-effective option to realize both reliability and deep decarbonization outcomes<sup>6</sup>.</p> <ul style="list-style-type: none"> <li>Given the strong prospects for interties to enable the most cost-effective, reliable net-zero grid outcome, including this as an “alternative approach” rather than a feature of at least one of the scenarios undermines the utility and robustness of the analysis.</li> </ul>

<sup>6</sup> <https://www.nrel.gov/analysis/naris.html>

Questions	Stakeholder Comments
	<ul style="list-style-type: none"> <li>• While interties are identified as an alternative approach, it is distinct from the other alternatives identified in that it is both economic, feasible, and readily available<sup>7</sup>.</li> <li>• There are already explicit policy commitments to interties like the formation of the Pan-Canadian Grid Council and federal funding for preliminary development work related to interties.</li> <li>• Excluding interties from the scenarios will increase total system cost outcomes and undermine reliability, particularly for the renewable energy and storage scenario<sup>8</sup>.</li> <li>• According to industry experts, including an ATCO representative, interties could represent export opportunities for Canada, avoiding building stranded assets, and reduce electricity costs for consumers<sup>9</sup>.</li> </ul> <p><b>Generation cost forecasts</b></p> <p>It is unclear what AESO’s cost estimates are for all generation technology types are, but forecasts for renewables and storage cost declines are consistently underestimated<sup>1,2</sup> (e.g. solar PV in International Energy Agency World Energy Outlooks between 2009 and 2020<sup>10,11</sup>)</p> <ul style="list-style-type: none"> <li>• Battery storage costs in electric vehicles are below \$100 USD/kWh<sup>12,13</sup></li> <li>• There are already as much or more battery storage projects announced or with AUC applications in Alberta as the “Renewables and storage rush” scenario. From a preliminary</li> </ul>

<sup>7</sup> <https://davidsuzuki.org/wp-content/uploads/2020/08/DSF-Talking-Transition-2020-Appendix-3.pdf>

<sup>8</sup> Brett Dolter, G. Kent Fellows, and Nicholas Rivers, “The Economics of the Site C Hydroelectric Project in British Columbia” (2021). SSRN. <http://dx.doi.org/10.2139/ssrn.3742136>

<sup>9</sup> <https://www.ourcommons.ca/Content/Committee/421/RNNR/Reports/RP9335660/mnrrp07/mnrrp07-e.pdf>

<sup>10</sup> <https://www.carbonbrief.org/guest-post-why-solar-keeps-being-underestimated>

<sup>11</sup> Figure titled “The main IEA scenario sees much faster global solar capacity growth than in previous years”, <https://www.carbonbrief.org/solar-is-now-cheapest-electricity-in-history-confirms-iea>

<sup>12</sup> Figure ES1, <https://eta-publications.lbl.gov/publications/why-regional-and-long-haul-trucks-are>

<sup>13</sup> <https://about.bnef.com/blog/battery-pack-prices-cited-below-100-kwh-for-the-first-time-in-2020-while-market-average-sits-at-137-kwh/>

Questions	Stakeholder Comments
	<p>count, there may be more than 600 MW by 2025, not 2028. Though not all of these projects may pass AESO's threshold to be included in modelling, what has already been announced should be viewed as closer to a reference case used in all the scenarios rather than a "rush" scenario.</p> <ul style="list-style-type: none"> <li>• Pembina compiled price BNEF and Lazard price forecasts for solar PV, wind, and batteries in 2019<sup>14</sup> and encourages AESO to include even more rapid cost declines as a sensitivity.</li> </ul>

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<sup>14</sup> Page 12, <https://www.pembina.org/reports/reliable-affordable.pdf>

Questions Stakeholder Comments

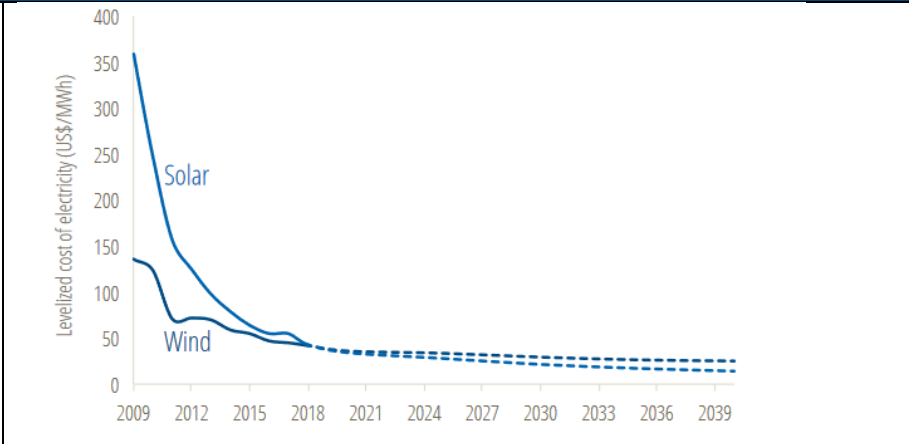


Figure 2. Historical and forecast cost decline for wind and solar

Data source: Lazard and BloombergNEF<sup>3</sup>

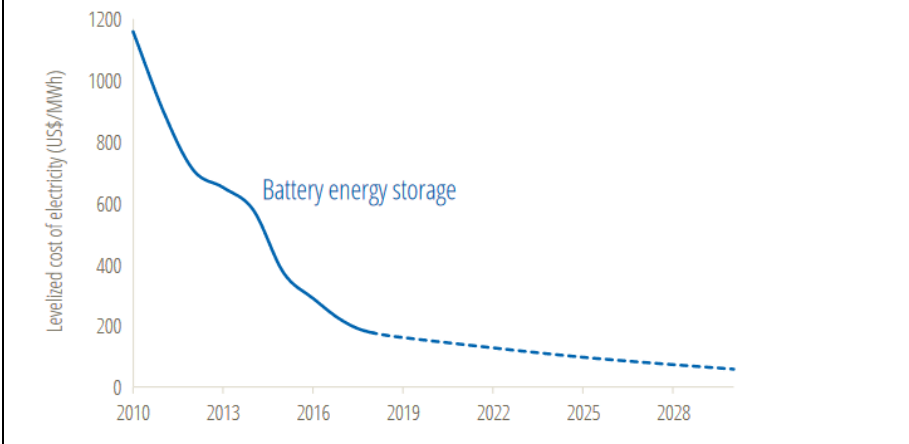


Figure 3. Historical and forecast cost decline for battery energy storage

Data source: Lazard and BloombergNEF<sup>4</sup>

a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?



Questions	Stakeholder Comments
<p>5 Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.</p>	<p><b>Clean Energy Portfolio approach</b></p> <p>The Pembina Institute conducted an illustrative analysis<sup>15</sup> comparing the costs and energy services provided by a natural gas plant and a clean energy portfolio comprising of renewables, storage, energy efficiency, and demand side management. While the analysis was limited in nature and did not include grid-wide modelling, it shows how various clean energy solutions could be leveraged to provide reliable and cost-effective electricity.</p> <p><b>Sensitivity Analysis</b></p> <p>Assumptions we need to make today – particularly regarding prices, technology deployment, and policies – may drastically change in just a few years. Incorporating uncertainties in the modelling approach provides robust insights that are not misleading to policymakers and stakeholders<sup>16</sup>. The following “deep uncertainty” principles will improve the quality of analysis:</p> <ul style="list-style-type: none"> <li>• Whereas running a model under a few archetypical scenarios can show some plausible future outcomes and implications, it would be more useful to run the model across many scenarios to understand which factors will have the most impact on outcomes of interest.</li> <li>• When running sensitivities, it should be through a Global Sensitivity Analysis approach with permutations of sensitivities and their values, not one-by-one assuming all other factors remain the same.</li> </ul>

<sup>15</sup> Jan Gorski and Binu Jeyakumar. Reliable, affordable: *The economic case for scaling up clean energy portfolios: A study comparing clean energy portfolios and natural gas for electricity generation* (2019). <https://www.pembina.org/pub/reliable-affordable-economic-case-scaling-clean-energy-portfolios>

<sup>16</sup> Yue et al., “A Review of Approaches to Uncertainty Assessment in Energy System Optimization Models” (2018). *Energy Strategy Reviews* 21. <https://doi.org/10.1016/j.esr.2018.06.003>

	Questions	Stakeholder Comments
		<ul style="list-style-type: none"> <li>Many (at least more than 30) scenarios should be run to discover important factors rather than restricting the factors to create three possible scenarios. These multiple scenarios can then be narrowed to the most plausible and useful scenarios for enabling understanding of the transition.</li> </ul>

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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<sup>i</sup> <https://www.aeso.ca/assets/Uploads/net-zero/net-zero-dec-16-jan31-2022-comments.pdf>

<sup>ii</sup> <https://www.aeso.ca/assets/Uploads/net-zero/03MAR2022-Summary-Net-Zero-Emissions-Pathways-Stakeholder-Comments.pdf>

# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Connor Curson
Comments from:	Powerex Corp.	Phone:	604-891-6028
Date:	2022/04/19	Email:	connor.curson@powerex.com

### Instructions

1. Please fill out the section above as indicated.
2. Please respond to the questions below and provide your specific comments.
3. **Please submit one completed comment matrix per organization.**
4. **Stakeholder comment matrices will be published on [aeso.ca](https://aeso.ca), in their original state.**
5. Email your completed comment matrix to [forecast@aeso.ca](mailto:forecast@aeso.ca) by **April 19, 2022**.

### Introduction

On Dec. 16, 2021, the AESO provided notice that it was commencing examination of potential pathways to a net-zero electricity system in Alberta. As an initial step, the AESO sought, and has received written feedback from interested stakeholders on their perspectives regarding the scope and input assumptions of the proposed net-zero emissions pathways analysis<sup>i</sup>. 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. The AESO has reviewed and incorporated several of the suggested changes<sup>ii</sup> and has completed its initial modelling using the revised assumptions.

The intent of the Mar. 28, 2022, engagement session is to present these preliminary modelling results to stakeholders for input and discussion. This comment matrix is intended as a follow-up and seeks any additional stakeholder insights and comments that the AESO will consider prior to the completion of our analysis and final publication of a report by the end of June. Stakeholder feedback received will similarly be compiled and posted and the AESO will subsequently provide a summary directional update.

### Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO’s analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p>Powerex appreciates the opportunity to comment on the AESO’s NetZero Pathways analysis effort.</p> <p>In the March 28, 2022 engagement session, the AESO noted on Slide 38 that the initial Net-Zero Pathways quantitative analysis does not include alternative approaches that could achieve decarbonization policy objectives, including interties that may also help support decarbonization. Powerex provides the following comments on the treatment of interties in the AESO’s analysis.</p> <p>Electric utilities across the western interconnection are currently grappling with the issue of achieving decarbonization while retaining reliability at affordable costs. Many western states have adopted Clean Energy Standards with similar compliance timelines to those being proposed in Canada. Most jurisdictions and utilities have recognized that broader regional integration—to take advantage of the geographic diversity of load and resources—is an important component of meeting these objectives.</p> <p>In the context of Alberta’s electricity market and the decarbonization of Alberta’s electricity sector, Powerex believes that failing to recognize and leverage regional diversity would be a lost opportunity. The existing interties (1200 MW BC-AB Intertie, 310 MW MATL Intertie, and 153 MW SK-AB Intertie) bring current and potential benefits with respect to the long-term achievement of the NetZero objective, while continuing to assist with reliability and affordability.</p>

Questions	Stakeholder Comments
	<p>For this purpose, it would be helpful for the AESO to provide a baseline that identifies the detailed assumptions in their NetZero analysis with respect to how the current interties are utilized, not just in terms of commercial energy transfers, but also the reliability services that are derived. Once these are identified, this can be used as a foundation for discussions about whether the status quo intertie framework remains the best overall framework, or whether a different framework, or different balance of services on the interties, should be considered in light of the challenges of a NetZero grid. This question is important in the context of considering the current capabilities of the interties, separate and distinct from any consideration of increasing intertie capacity.</p> <p>As it has been recognized in the rest of the western interconnection, broader regional discussions on the uses and benefits that are derived from the interconnection of electrical systems is both necessary and beneficial to developing a mutual understanding of, and agreement upon, the commercial and operational framework that best supports unlocking the full potential benefits of those facilities in the context of a changing electricity grid.</p> <p>Powerex looks forward with working with the AESO and other stakeholders on this initiative.</p>
<b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?	
a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?	
<b>4</b> Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?	Please see Powerex’s response to Question 2, above.

	Questions	Stakeholder Comments
	a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?	
5	Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.	Please see Powerex's response to Question 2, above.

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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<sup>i</sup> <https://www.aeso.ca/assets/Uploads/net-zero/net-zero-dec-16-jan31-2022-comments.pdf>

<sup>ii</sup> <https://www.aeso.ca/assets/Uploads/net-zero/03MAR2022-Summary-Net-Zero-Emissions-Pathways-Stakeholder-Comments.pdf>

# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Robert Stewart
Comments from:	RMP Energy Storage	Phone:	587-920-4833
Date:	[2022/04/12]	Email:	Robert.stewart@rockymountainpower.ca

### Instructions

1. Please fill out the section above as indicated.
2. Please respond to the questions below and provide your specific comments.
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### Introduction

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The intent of the Mar. 28, 2022, engagement session is to present these preliminary modelling results to stakeholders for input and discussion. This comment matrix is intended as a follow-up and seeks any additional stakeholder insights and comments that the AESO will consider prior to the completion of our analysis and final publication of a report by the end of June. Stakeholder feedback received will similarly be compiled and posted and the AESO will subsequently provide a summary directional update.

### Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

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Questions		Stakeholder Comments
1	<p>Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022.</p> <p>Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	
2	<p>Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis?</p> <p>What areas would benefit with further clarification from the AESO?</p>	
3	<p>Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	
	<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	
4	<p>Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>In the Renewables and Storage Rush scenario, it is unclear why there are H2SC units added in 2028 when CAES assets could provide additional benefit. CAES should be considered instead of these H2SC assets.</p>
	<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	
5	<p>Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.</p>	<p>Specifically related to the CAES technology assumptions it is unclear whether an Adiabatic CAES (ACAES) or Diabatic CAES (DCAES) technology are proposed. The efficiency, operational parameters and cost of these units is different. Additionally, there are no technology limitations for keeping CAES at 60 hours of duration where additional cavern capacity (duration) can be built for very little additional capital cost.</p>



Questions	Stakeholder Comments
	<p>Pg. 53 the CAES is marked as 19 hours duration and PSH 60 hours, please confirm this was a typo. Additionally, the cost for the CAES unit seems low (USD?).</p> <p>Pg. 54 The stated efficiency of the CAES is not clearly defined. If this is a DCAES then there needs to be cost allocation of natural gas/H2 and the output is higher (1.3 units electricity out to unit of electricity in). ACAES should be considered at higher efficiencies (60-65% range).</p> <p>I would be happy to discuss this in detail to ensure CAES assets are modeled correctly.</p>

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

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# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Vincent Morales, Manager of Legislative and Regulatory Affairs
Comments from:	Coalition for Renewable Natural Gas	Phone:	+1 916.588.3033
Date:	2022/04/19	Email:	vincent@rngcoalition.com

### Instructions

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Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022.</p> <p>Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>The session was valuable and helped stakeholders understand the assumptions the AESO chose within their modelling.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis?</p> <p>What areas would benefit with further clarification from the AESO?</p>	
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	
<p><b>4</b> Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated</p>	<p>The AESO should include the use of renewable natural gas (RNG) in its generation assumptions for all its scenarios. As described in question 5 below, the climate benefits of RNG are clear. In addition, as a clean drop-in fuel, RNG can decarbonize any application that currently uses natural gas. This means that RNG</p>

Questions	Stakeholder Comments
<p>regulatory and generation assumptions?</p>	<p>can decarbonize any existing natural gas-fired power station<sup>1</sup> that is connected to the North American gas pipeline network without requiring any power station refurbishment. As Alberta installs more variable renewable electricity, RNG can be used to decarbonize the grid balancing services that are currently offered by natural gas-fired power stations. This would also allow existing natural gas-fired power stations to partially or fully decarbonize depending on the share of RNG they procure in their gas blend.</p> <p>Hydrogen can be produced at an ultra-low carbon intensity by converting RNG feedstock to hydrogen.<sup>2</sup> Low carbon intensity hydrogen can also be produced by gasification or pyrolysis of wood waste. Those hydrogen conversions can be combined with CCS to produce hydrogen with a net-negative carbon intensity. Several existing gas turbines have the capability to use a blend of hydrogen and natural gas. For example, Capital Power ordered gas turbines that can operate on a mixture of natural gas and up to 30 percent hydrogen to refurbish its Genesee Units 1 and 2 from coal to gas.<sup>3</sup> Those gas-fired power stations could use a portion of low carbon hydrogen to lower their carbon intensity.</p> <p>The biggest barrier to achieving a zero-carbon electricity sector in Alberta is the decarbonization of seasonal storage. The use of RNG and hydrogen as a dispatchable, storable resource can tackle that barrier.</p> <p>The AESO should weigh the implications of a Canada Clean Electricity Standard more carefully in at least one of the proposed scenarios. The Government of Canada just completed the first step in its public consultation on the Clean Electricity Standard.<sup>4</sup> It is reasonable to expect that new regulations will be designed at the federal level that will impact Alberta’s electricity generation portfolio in the medium term.</p>

<sup>1</sup> Or any natural gas-fired power station that is currently under construction or that is about to break ground.

<sup>2</sup> For example, hydrogen can be produced from steam methane reforming as well as auto-thermal reforming of RNG.

<sup>3</sup> Mitsubishi Power America, “Capital Power Orders Two Mitsubishi Power JAC Gas Turbines to Help Achieve Net Carbon Neutral Goal,” press release, December 23, 2020. <https://power.mhi.com/regions/amer/news/20201223.html>

<sup>4</sup> Environment and Climate Change Canada, *A clean electricity standard in support of a net-zero electricity sector: discussion paper* (2022). <https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/achieving-net-zero-emissions-electricity-generation-discussion-paper.html>

Questions	Stakeholder Comments
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>Post 2030, existing combined-cycle and simple-cycle gas turbines should be assumed to procure RNG to decarbonize their electricity output in all scenarios.</p>
<p><b>5</b> Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.</p>	<p><b>About the RNG Coalition and the RNG Industry</b></p> <p>The Coalition for Renewable Natural Gas (RNG Coalition) is the trade association for the RNG industry in North America. Our diverse membership is comprised of leading companies across the RNG supply chain, including waste collection, recycling and waste management companies, renewable energy project developers, engineers, financiers, investors, organized labour, manufacturers, technology and service providers, gas and power marketers, gas and power transporters, transportation fleets, fueling stations, law firms, environmental advocates, research organizations, municipalities, universities, and utilities. Together we advocate for the sustainable development, deployment, and utilization of RNG, so that present and future generations have access to domestic, renewable, clean fuel and energy in Alberta and across North America.</p> <p>The RNG industry is nascent relative to other renewables industries but has shown extraordinary recent growth driven by policies designed to promote environmental and economic goals—including but not limited to clean air, improved waste management, increased job development, energy independence, and resource diversity. Between 1982 and 2011, only 30 RNG projects were developed—most of which were incentivized by various U.S. state’s Renewable Portfolio Standard Programs (RPS) and underwritten by the monetization of Renewable Energy Credits (RECs) that RNG-sourced electricity generated under such programs. Expanding rapidly throughout the last decade, there are now 250 operational RNG facilities in North America with 237 under construction or in substantial development.<sup>5</sup> Most of the RNG projects developed since 2011 have been incentivized by transportation decarbonization programs, including the Unites States</p>

<sup>5</sup> RNG Coalition, RNG Facilities Database (as of April 1, 2022, accessible from [www.rngcoalition.com](https://docs.google.com/spreadsheets/d/1CpLTd1Yva4qQzUjWYtKMUGW1BIMmn-Jri3uErd8IJ7A/edit#gid=0)): <https://docs.google.com/spreadsheets/d/1CpLTd1Yva4qQzUjWYtKMUGW1BIMmn-Jri3uErd8IJ7A/edit#gid=0>

Questions	Stakeholder Comments
	<p>Environmental Protection Agency’s (U.S. EPA) Renewable Fuel Standard Program<sup>6</sup> and California, Oregon, and British Columbia’s Low Carbon Fuel Standards (LCFS).</p> <p><i>Carbon Intensity of RNG</i></p> <p>All commercially available methods of producing RNG from organic waste feedstocks have excellent greenhouse gas performance, exemplified by carbon intensity (CI) modeling employed by California’s LCFS program.<sup>7</sup> Moreover, some RNG projects capture and destroy a greater amount of GHG (as measured on a tonnes of carbon dioxide equivalency basis) than are emitted during the fuel’s combustion, making it one of the few fuels available commercially today with a carbon-negative impact (i.e., better than carbon-neutral), in some cases.</p> <p>This breadth of technological options for producing RNG (and green hydrogen) means that the GHG impact of resources can vary substantially. For this reason, the RNG industry has long advocated for employing metrics to assess the GHG emissions from each energy production pathway. We believe that a lifecycle analysis (LCA) is the most appropriate method of doing so because it accounts for all greenhouse gas emissions benefits and disbenefits<sup>8</sup> from a given RNG production pathway. These various emissions steps are then combined to produce a CI score for each production pathway. A common tool for calculating RNG CI scores is the GREET model<sup>9</sup> created by Argonne National Lab, which is widely accepted among both</p>

<sup>6</sup> RNG has grown substantially thanks to the RFS program, making up over 95 percent of the lowest-GHG-emission cellulosic biofuel production category and generation of D3 RINs (Renewable Identification Numbers; credits given for fuels that create at least a 60% reduction in lifecycle greenhouse gases). <https://www.epa.gov/renewable-fuel-standard-program/renewable-fuel-annual-standards>

<sup>7</sup> See information on LCFS Pathway Certified Carbon Intensities: <https://ww2.arb.ca.gov/resources/documents/lcfs-pathway-certified-carbon-intensities>

<sup>8</sup> For example, benefits may include avoidance of upstream emissions while disbenefits may include leakage, energy usage, and non-CO<sub>2</sub> combustion emissions.

<sup>9</sup> See more information about Argonne National Lab’s GREET model: <https://greet.es.anl.gov/>

Questions	Stakeholder Comments
	<p>regulatory agencies and the scientific community, most notably by CARB in the LCFS.<sup>10,11</sup> While it would be technically possible to produce RNG with a higher CI than conventional natural gas—due to methane leakage, energy consumption, or other factors—the large RNG facility sample included under California’s LCFS illustrates that this is not the current practical reality at real-world RNG facilities in the U.S. today.<sup>12</sup></p> <p>It is important to recognize that as the country’s electricity grid sees an increased amount of zero-carbon electricity generation, the CI for all RNG pathways which utilize grid electricity as a primary input to gas cleanup will decrease.<sup>13</sup> This means that the RNG pathways which are currently low-carbon (due to the use of grid electricity and conventional natural gas in gas processing and transport) will move increasingly toward zero-carbon as their upstream energy inputs are derived from a greater and greater share of zero carbon electricity, and those which are currently carbon negative will produce even greater benefits.</p> <p>Moreover, the implementation of carbon capture and sequestration (CCS) in tandem with RNG to create biologically-derived green hydrogen creates the possibility of every production facility to serve as a carbon-negative emissions sink. Modeling CI based on these important interactions clearly illustrates both the immediate and long-term benefits of RNG deployment, and the use of such a framework in a consistent fashion across all policies promoting RNG will provide an incentive for RNG producers to maximize their greenhouse gas benefit.</p> <p>While we understand the AESO’s net-zero emissions pathways only include direct emissions and do not include lifecycle or upstream emissions, RNG Coalition believes the information above is worth considering to fully account for the cross-sectoral environmental benefits of RNG.</p>

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

<sup>10</sup> GREET can easily be modified to provide CI scores for stationary uses of RNG, as is required in other jurisdictions’ RNG utility procurement program. For example, the California Public Utilities Commission (CPUC) required Southern California Gas Company and San Diego Gas and Electric to use a modified version of GREET to measure the Carbon intensity of procured RNG. See CPUC Decision 20-12-022 dated December 17, 2020.

<sup>11</sup> Environment and Climate Change Canada also pre-published its Fuel Lifecycle Assessment model but details are missing about the quantification of avoided emissions in RNG pathways: <https://data-donnees.ec.gc.ca/data/regulatee/climateoutreach/government-of-canadas-fuel-life-cycle-assessment-model/en/?lang=en>

<sup>12</sup> RNG Coalition does not support the utilization of RNG produced through high-CI methods.

<sup>13</sup> In a similar fashion, electrolytic hydrogen production will continue to become cleaner over time.

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<sup>i</sup> <https://www.aeso.ca/assets/Uploads/net-zero/net-zero-dec-16-jan31-2022-comments.pdf>

<sup>ii</sup> <https://www.aeso.ca/assets/Uploads/net-zero/03MAR2022-Summary-Net-Zero-Emissions-Pathways-Stakeholder-Comments.pdf>



# Stakeholder Comment Matrix – March 22, 2022

Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Mark Thompson
Comments from:	TransCanada Energy Ltd. (“TCE”)	Phone:	403-589-7193
Date:	2022/04/19	Email:	markj_thompson@tcenergy.com

## Instructions

1. Please fill out the section above as indicated.
2. Please respond to the questions below and provide your specific comments.
3. **Please submit one completed comment matrix per organization.**
4. **Stakeholder comment matrices will be published on [aeso.ca](https://aeso.ca), in their original state.**
5. Email your completed comment matrix to [forecast@aeso.ca](mailto:forecast@aeso.ca) by April 19, 2022.

## Introduction

On Dec. 16, 2021, the AESO provided notice that it was commencing examination of potential pathways to a net-zero electricity system in Alberta. As an initial step, the AESO sought, and has received written feedback from interested stakeholders on their perspectives regarding the scope and input assumptions of the proposed net-zero emissions pathways analysis<sup>i</sup>. 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. The AESO has reviewed and incorporated several of the suggested changes<sup>ii</sup> and has completed its initial modelling using the revised assumptions.

The intent of the Mar. 28, 2022, engagement session is to present these preliminary modelling results to stakeholders for input and discussion. This comment matrix is intended as a follow-up and seeks any additional stakeholder insights and comments that the AESO will consider prior to the completion of our analysis and final publication of a report by the end of June. Stakeholder feedback received will similarly be compiled and posted and the AESO will subsequently provide a summary directional update.

## Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO’s analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>Yes, the latest session was valuable. The AESO’s Net-zero Pathways Report (the “Report”) will be of significant value to both the AESO and stakeholders. Engaging with stakeholders at key touchpoints throughout the analysis will allow the AESO to receive unique input from industry experts and will allow stakeholders to better understand the process used by the AESO to develop the report. Both will serve to increase the value of the final product.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p>TCE understands that the intent of the Report is to provide an initial assessment of the impact of a potential net-zero policy for Alberta’s electricity sector. As such, the purpose outlined by the AESO seems reasonable.</p> <p>Similarly, the proposed scope of the Report seems reasonable subject to the resolution of following concern. Resource adequacy (“RA”) assessments are considered within the scope of the Report, but flexibility and reliability assessments are not. While we acknowledge that detailed reliability assessments would be inconsistent with the intent of this Report, resource adequacy assessments on their own may be insufficient to identify operational challenges and may significantly under-estimate transmission cost impacts. This will depend on the granularity of the RA assessments. If the RA assessments are limited to a system-wide analysis, they may conclude that there is sufficient capacity to meet demand, but fail to identify where or when that capacity will be provided. An appropriate granularity for the assessments should be established.</p>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	<p>The factors the AESO identified as driving future load forecasts under a net-zero policy are reasonable. The primary challenge will be to determine appropriate timing and adoption rates, which will likely be driven by policy.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>Each of the signposts identified by the AESO are reasonable. TCE recommends that hydrogen production also be included as a signpost as it is the only “driving factor” identified by the AESO that is not included. If</p>

	Questions	Stakeholder Comments
		the Hydrogen Hub takes off in Alberta, its impact to load could be much more significant than heating system electrification.
4	<p>Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p> <p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>At this point in time and given the level of uncertainty, the AESO's generation forecast scenarios seem reasonable.</p> <p>The load forecast section of the presentation specifically outlines a reasonable set of signposts (although, could be improved by including a hydrogen hub development signpost as recommended above) on slide 23. The generation forecast scenarios section states the associated assumptions for each of the scenarios, but does not appear to list the associated signposts.</p> <p>Appropriate signposts for the generations forecast scenarios would include:</p> <ol style="list-style-type: none"> <li>1. Policy changes that impact the price and treatment of carbon emissions;</li> <li>2. Policy changes and subsidies to promote specific generation or carbon capture technologies; and</li> <li>3. Technological advances that impact the cost and performance of certain generation or carbon capture technologies.</li> </ol>
5	Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.	In the “Further analysis – Cost estimation” section of the presentation, the AESO specifies the types of costs that they will estimate in its analysis. TCE recommends that the AESO, in the Report, present these costs in a manner that is well understood by market participants that includes, at minimum, the impact to investment costs, transmission costs, and the resulting pool price and rate impact for system access service.

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

<sup>i</sup> <https://www.aeso.ca/assets/Uploads/net-zero/net-zero-dec-16-jan31-2022-comments.pdf>

<sup>ii</sup> <https://www.aeso.ca/assets/Uploads/net-zero/03MAR2022-Summary-Net-Zero-Emissions-Pathways-Stakeholder-Comments.pdf>

# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	March 22, 2022 to April 19, 2022	Contact:	Akira Yamamoto
Comments from:	TransAlta Corporation	Phone:	403-267-7304
Date:	2022/04/19	Email:	akira_yamamoto@transalta.com

### Instructions

1. Please fill out the section above as indicated.
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### Introduction

On Dec. 16, 2021, the AESO provided notice that it was commencing examination of potential pathways to a net-zero electricity system in Alberta. As an initial step, the AESO sought, and has received written feedback from interested stakeholders on their perspectives regarding the scope and input assumptions of the proposed net-zero emissions pathways analysis<sup>i</sup>. 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. The AESO has reviewed and incorporated several of the suggested changes<sup>ii</sup> and has completed its initial modelling using the revised assumptions.

The intent of the Mar. 28, 2022, engagement session is to present these preliminary modelling results to stakeholders for input and discussion. This comment matrix is intended as a follow-up and seeks any additional stakeholder insights and comments that the AESO will consider prior to the completion of our analysis and final publication of a report by the end of June. Stakeholder feedback received will similarly be compiled and posted and the AESO will subsequently provide a summary directional update.

### Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO’s analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p><b><i>The session was valuable as an update and first view of the AESO’s preliminary results; the session would have been more helpful if the datafiles of inputs and outputs were provided ahead of the session</i></b></p> <p>Yes, the engagement session hosted on March 28 was valuable. It provided an update on how the AESO was conducting its analysis, provided the preliminary results, and provides an opportunity for stakeholders to provide further input before it finalizes its analysis and begins report drafting.</p> <p>The engagement session would have been more helpful if we had received the data files associated with the analysis. While the presentation includes graphics that summarize the results, the ability to perform further analysis on the inputs and outputs of the AESO’s work aid in understanding the AESO’s approach better and provides an opportunity to do sense-checks and other validations that can make stakeholder feedback more specific. TransAlta asks the AESO to publish the associated data files to enable TransAlta to better understand the AESO’s analysis.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p><b><i>Excluding cogeneration emissions from the analysis is flawed and does not achieve net-zero</i></b></p> <p>The AESO’s approach with respect to excluding emissions from cogeneration is a serious, critical flaw. Under the AESO’s approach, cogeneration serves the vast majority of electricity needs and accounts for most of the electricity sector emissions by 2035. As conveyed in TransAlta’s first comment matrix, we anticipate that electricity sector emissions (including cogeneration) may require emissions to be as low as 2-5 MT CO<sub>2e</sub>/year – where the upper and lower bounds reflect differences in the stringency to meet reduction obligations through offsets and other compliance mechanisms. In fact, the AESO’s analysis not only ignores the emissions from existing cogeneration but goes even further by assuming that 1,500 MW+ of new greenhouse gas emitting cogeneration can be built without having those emissions counted towards Alberta electricity sector emissions. This approach is not consistent with the objective of the report</p>

Questions	Stakeholder Comments
	<p>and, consequently, the AESO is no longer truly performing a net-zero analysis.</p> <p>At a minimum, the AESO should be calculating the associated greenhouse gas emissions from cogeneration and presenting those in the analysis (even if it does not include those emissions as electricity sector emissions).</p> <p>The better approach is to consider how cogeneration would need to transition to lower emissions technologies assuming that those emissions will be regulated in a manner that effectively imposes the same emission reduction obligations on industrials as they would on electricity generators. In fact, industrial customers may be more likely to decarbonize sooner through efforts such as electrification and forgo cogeneration investment quicker if grid-backed generation is lower emitting, lower or comparable cost, and equally able to meet on-site requirements. This could result in higher electricity demand, a lower estimate of new cogeneration and a rapidly shrinking fleet of existing cogeneration.</p> <p>The AESO should also more clearly explain what its assumptions are in terms of subsidization under each scenario. At present, it is unclear how, if at all, the AESO's estimates of generation technology costs are reflected in the selection of resources to meet the forecasted demand and system requirements. Furthermore, we note that the Federal government's recent announcement on tax credits provides clarity that CCUS and energy storage will be eligible. It would be helpful to compare what the AESO's assumptions are with respect to subsidies and how they compare with the Federal Government's proposed program. TransAlta continues recommend that the AESO hold a technology agnostic view rather than developing scenarios where one technology is preferred over for reasons (that are not clearly explained) beyond economic cost.</p>
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	<p><b><i>A key assumption must be that rate designs will incentivize efficient electric charging load profiles that seek to minimize peak demand contributions and align charging with periods with high generation availability</i></b></p> <p>The AESO has identified that assumptions about electric charging profiles can have a significant impact on the load forecast. While the AESO has noted the unmanaged charging for light-duty vehicles is unlikely, we are concerned that the load forecast (more specifically, peak demand profile)</p>

Questions	Stakeholder Comments
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>does not reflect a very strong or effective consumer behavioural response with respect to rates for charging electric vehicles. Rate design and providing strong incentives through transparent rates can change consumer behaviour and we believe that it is more appropriate to assume that a rate design will be implemented that helps to reduce peak demand contributions from electric vehicle charging.</p> <p><b>Industrial load forecasts should consider load growth associated with electrification and test whether current self-supply will revert to grid-supplied power</b></p> <p>As suggested in response to question (2) above, the AESO may be underestimating early adoption of electrification in the area of industrial thermal (steam) requirements. The AESO should consider scenarios where industrial load shifts from self-supply to grid-backed supply and sensitivities where there are electricity demand increases associated with the replacement of gas boilers and cogeneration with electric boilers.</p>
<p>4 Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>As conveyed in our response to question (2) above, the most significant issue with the AESO’s analysis is the lack of consideration for how cogeneration will attain net zero by 2035. Our further comments, beyond the critical issue of cogeneration transition and emissions, with each generation forecast scenario are as follows:</p> <p><b>Dispatchable Dominant Scenario</b></p> <p>The dispatchable dominant scenario contains unrealistic assumptions about generation development including an assumption that there is limited renewable development despite the clear fact that renewable projects continue to be brought online and the pace of development is accelerating not declining.</p> <p>The scenario appears to be driven by the desire to largely maintain the electric system in a “frozen in time”, or worse a “look back in time” state, where thermal resources that will struggle with running economically at high capacity factors are replaced with baseload thermal resources that apparently do not face that same challenge – despite the fact that those resources have even higher capital and variable costs. Under all scenarios, low cost, economic renewable generation will be developed and their</p>



Questions	Stakeholder Comments
	<p>advantages in low/no variable cost will displace higher cost thermal generation including new combined cycle with Carbon Capture, Utilization and Storage (CCUS) and existing thermal resources.</p> <p>The appeal of this scenario from a system control perspective is that it presents a net-zero scenario that largely appears like the status quo. It assumes that the electric system reverts back to a profile that it would have exhibited when the system was dominated by thermal generation with a static level of renewables and the conclusions would be reliability and resource adequacy would look like it did historically. However, this scenario does not achieve net-zero and is not a realistic scenario into the future.</p> <p>The AESO should be considering whether it is reasonable to assume that generation investment into CCUS at the high levels anticipated in this scenario are unlikely to occur under the energy-only market. Investors into combined cycle with CCUS will be cautious about their ability to meet emissions performance requirements – despite the appeal of CCUS in Alberta and the existence of operating facilities we note that we don’t have a combined cycle with CCUS and even the performance of CCUS operations with more concentrated streams of carbon emissions will be challenged to meet an 90% carbon capture rate.<sup>1</sup> Additionally, the AESO should not assume that combined cycle with CCUS will perform the same as a combined cycle plant. More specifically, combined cycle with CCUS will be even more limited in its ability to ramp up and down (and changing output levels can significantly impact potential capture rates). This ramping constraint could make combined cycle with CCUS a poor fit with an electric system that is converting to intermittent, renewable generation with higher variability and ramping requirements. The AESO should provide its performance assumptions on new technologies as those assumptions could lead to misleading conclusions about the reliability and carbon emission reductions assumption associated with this scenario.</p>

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<sup>1</sup> The Clean Electricity Standard discussion paper suggests a standard of 50 tonnes CO<sub>2</sub>/GWh for low-emitting generation, which implies a capture rate of 90% or more.



Questions	Stakeholder Comments
	<p><b><i>First-Mover Advantage Scenario</i></b></p> <p>The first mover advantage scenario is more realistic than the dispatchable dominant scenario in that it assumes that renewable generation continues to grow in the supply mix. However, it is unclear how the AESO determined the levels of combined cycle with CCUS and hydrogen-fired simple cycle generation that are included in this scenario.</p> <p>We understand that the AESO's assumption is that combined cycle with CCUS is subsidized with government support and, given that this is not explicitly identified for technologies without CCUS, we presume that the hydrogen-fired simple cycle is not subsidized. For the first-mover advantage scenario to trigger 870 MW<sup>2</sup> more of hydrogen-fired simple cycle than the dispatchable dominant scenario, we assume that the AESO's price forecast shows higher prices in more hours and likely higher price volatility. We ask that the AESO confirm (at least directionally) if our assumptions are correct.</p> <p>Our concerns with the generation economics of baseload combined cycle with CCUS as expressed above under the dispatchable dominant scenario equally apply in the first mover advantage scenario. We see significant challenges with operating a baseload combined cycle with CCUS economically under the pressure of real-time market pricing that will be highly volatile with many hours that are well below the variable cost of a baseload natural gas facility. An additional complexity is that carbon capture rates for the CCUS will be optimized to a certain level of baseload operations, which will negatively impact the already limited ability for the combined cycle to match their output levels in response to market conditions.</p>

<sup>2</sup> The hydrogen-fired simple cycle additions in the dispatchable dominant and first mover advantage scenarios are 2,326 MW and 1,456 MW, respectively. The difference between these two numbers is 870 MW.

**Renewables & Storage Rush Scenario**

The renewables and storage rush scenario is unrealistic because very high levels of renewables penetration, such as when the amount of installed capacity of renewables is close to peak demand, would drive the need for additional export capability (or otherwise be driven by load consumption that could effectively utilize or match the renewable generation profile). The AESO's going in assumption that no new interties would be constructed (or load behaviours do not change in response to renewables) undermines this scenario and drives poor, unreasonable conclusions.

Renewables will not be built out in this volume unless they can be delivered to the grid. Even if we accept that renewable investment is driven largely by carbon offset or compliance or Environmental, Social and Governance (ESG) considerations, those benefits are not accrued if the renewables cannot generate (e.g., generation is curtailed from achieving its expected output). We expect that there could be considerable growth in newer types of customers (e.g., green hydrogen producers, crypto/data centres) or changes in consumer behaviours (e.g., electric vehicle charging, flexible demand response) that could emerge under a scenario of high renewables and take advantage of the profile low cost energy supply offered by wind and solar which would increase transmission system capacity utilization (lowering transmission charges) and promote better matching of generation and load profiles.

We also recognize and acknowledge that a key cornerstone of the Federal *2030 Emission Reduction Plan* for electricity is building regional interties.<sup>3</sup> The significant level of renewables and limited availability of long duration storage in Alberta under the renewables and storage scenario may drive the need for additional interconnections (and could also apply to the first movers advantage scenario but to a lesser extent) where Alberta surplus generation can be exported out of province and surplus capacity from adjoining jurisdictions can be used to imported electricity back into the province to meet provincial capacity and energy needs. Not only does this support the build out of renewables in Alberta but it also provides the benefit of increased interconnectivity and reliability associated with accessing capacity and energy from other electric systems. Storage that is built in Alberta is likely to be built out to meet specific reliability needs that cannot

Questions	Stakeholder Comments
	<p>be served by other technologies or otherwise where it is most competitive against other technologies or generation flowing from an intertie. We recognize that the significant challenge and barrier to interconnections is the lack of market mechanisms to ensure that significantly expanded interties result in fair competition, reciprocal trade opportunities, and open bidirectional market access.</p> <p>Moreover, the renewable and storage rush case as proposed is the only scenario that could address the question of whether cogeneration plus CCUS or hydrogen-cogeneration is more economic than industrial electrification using a portfolio approach to meet the electricity need. However, the fact that the AESO excludes consideration of how cogeneration will ultimately meet net zero ignores one of the most significant reasons that renewables and storage (including interties) is likely to be a strong long-term pathway to achieve 2035 and 2050 climate goals.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p><b><i>The signposts should consider how natural gas-fired cogeneration will transition to net zero technology and the development of regional interties</i></b></p> <p>The signposts need to consider how cogeneration, many of which are aging towards their end of life by 2035, will be transitioned to net zero technologies. This could include cogeneration seeking to electrify to meet thermal requirements and not replace existing cogeneration.</p> <p>The signposts should also consider that the federal <i>2030 Emission Reduction Plan</i> will be implemented including the implementation of additional regional interties. While we have noted above that there are significant challenges with intertie development and designing new markets/market interfaces, there may be paths in which new/expanded interties could be possible in the 2030-2035 timeframe.</p>

<sup>3</sup> <https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/erp/Canada-2030-Emissions-Reduction-Plan-eng.pdf>

Questions	Stakeholder Comments
<b>5</b> Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.	No additional comments at this time.

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

<sup>i</sup> <https://www.aeso.ca/assets/Uploads/net-zero/net-zero-dec-16-jan31-2022-comments.pdf>

<sup>ii</sup> <https://www.aeso.ca/assets/Uploads/net-zero/03MAR2022-Summary-Net-Zero-Emissions-Pathways-Stakeholder-Comments.pdf>

# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	<b>March 22, 2022 to April 19, 2022</b>	Contact:	Nola Ruzycki
Comments from:	The Office of the Utilities Consumer Advocate	Phone:	4035922723
Date:	[2022/04/19]	Email:	Nola.Ruzycki@gov.ab.ca

### Instructions

1. Please fill out the section above as indicated.
2. Please respond to the questions below and provide your specific comments.
3. **Please submit one completed comment matrix per organization.**
4. **Stakeholder comment matrices will be published on [aeso.ca](https://aeso.ca), in their original state.**
5. Email your completed comment matrix to [forecast@aeso.ca](mailto:forecast@aeso.ca) by **April 19, 2022**.

### Introduction

On Dec. 16, 2021, the AESO provided notice that it was commencing examination of potential pathways to a net-zero electricity system in Alberta. As an initial step, the AESO sought, and has received written feedback from interested stakeholders on their perspectives regarding the scope and input assumptions of the proposed net-zero emissions pathways analysis<sup>i</sup>. 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. The AESO has reviewed and incorporated several of the suggested changes<sup>ii</sup> and has completed its initial modelling using the revised assumptions.

The intent of the Mar. 28, 2022, engagement session is to present these preliminary modelling results to stakeholders for input and discussion. This comment matrix is intended as a follow-up and seeks any additional stakeholder insights and comments that the AESO will consider prior to the completion of our analysis and final publication of a report by the end of June. Stakeholder feedback received will similarly be compiled and posted and the AESO will subsequently provide a summary directional update.

### Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO’s analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022. Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>The session was valuable. Given the volume of information to digest and understand combined with the vast array of stakeholder interests it would have been helpful to see more time allocate to respond to stakeholder questions.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis? What areas would benefit with further clarification from the AESO?</p>	<p>Non wire alternatives are paramount to cost management, including, various load management programs, (e.g. smart charging, time of use rates, vehicle to grid technologies, dynamic pricing), that have the potential to alter consumption behavior and subsequently defer or eliminate the need for new infrastructure and optimally manage grid electrification caused by Electric Vehicle (EV) loads, grid modernization and decarbonization.</p> <p>Renewables paired with energy storage will play an important role in the net- zero emissions generation supply scenario.</p> <p>The AESO should remain open to including new and emerging technologies given these technologies are in varying states of maturity and as technologies evolve they may become more cost effective and suitable to meet the net-zero goal.</p> <p>The storage scenario, technologies, the incorporation of hydrogen-fired generation options, the revised nuclear and hydroelectric capital costs could benefit from further clarification from the AESO? There was discussion of various options which stakeholders would benefit from more clarity and greater detail.</p> <p>The introduction of Canada’s 2030 Emissions Reduction Plan and the 2022 Federal Budget places a colossal burden and role in emissions reduction on the electricity sector and the adoption of electric vehicles. The electricity and transportation sectors will play key roles in determining the successful outcome of the plan. Does the proposed AESO plan need to be modified to ensure it encapsulates the required initiatives to satisfy the ambitious electrification and decarbonization policies.</p>

Questions	Stakeholder Comments
<p><b>3</b> Do you have any feedback or observations with regards to the Load forecast and associated load factors?</p>	<p>The four net-zero load forecast driving factors (base load, DERS, EVs and hydrogen load and electrification of buildings) are all highly subjective to external factors such as the health of the economy, behavioural changes, the dominance of solar an intermittent supply source in the under 5 MW DERs category, the speed of adoption of EVs and the ramp up in hydrogen production and fuel switching building. The AESO states the impact of electrification due to the decarbonization efforts will translate to an increase of overall load; annual growth is forecast at 1%, while peak load growth is 1.4%, which is mainly driven by EV charging in the near term. Failing to select the most cost effective path by assessing the various net-zero carbon emissions pathways could pose a significant increase in cost for consumers which include the cost of stranded assets, the cost of new capital along with transmission, distribution and operating costs.</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>Energy storage and hydrogen/hydrogen blending are important and should be considered as supply drivers.</p>
<p><b>4</b> Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?</p>	<p>Under the renewables and storage rush scenario the AESO has provided assumptions for energy storage at 4 hour, 19 hour an 60 hour- does the AESO anticipate a need/stakeholder desire to utilize longer duration energy storage?</p>
<p>a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?</p>	<p>No comment</p>
<p><b>5</b> Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.</p>	<p>The AESO states that it will assume no changes to the electricity market structure, rules, or constraints within the context of the net-zero pathways analysis. It is critical to reach net-zero targets by leveraging lower cost approaches as much as possible while still ensuring that system reliability and safety are not compromised. The analysis should be as quantitative as possible relative to costs. The UCA supports regulatory and rate structure changes and believes them to be necessary to ensure price signals properly incent appropriate energy efficiency and demand</p>

Questions	Stakeholder Comments
	<p>response technologies. Tools such as access to real-time data could help better manage load and change customer behaviour.</p> <p>Many Alberta consumers are already finding the cost of electricity unaffordable; the AESO must ensure that the net-zero pathways assessment contemplates the affordability of the overall delivered cost of energy and does not exacerbate this concern. Alberta must remain cost-competitive with other provinces or risk losing industries to jurisdictions with lower energy costs.</p> <p>As such, non-wires alternatives are paramount to cost management (e.g., smart charging, time-of-use rates, vehicle-to-grid technologies, dynamic pricing, storage and DERs) as they have the potential to alter consumption behavior and subsequently defer or eliminate the need for new infrastructure and optimally manage grid electrification caused by Electric Vehicle (EV) loads, grid modernization and decarbonization. Renewables, green building standards and energy efficiency paired with energy storage will play an important role in the net- zero emissions generation supply scenario.</p> <p>The AESO's report should include the estimated economic efficiency of various CO<sub>2</sub> reduction technologies along with the impacts on affordability, and reliability.</p>

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)

<sup>i</sup> <https://www.aeso.ca/assets/Uploads/net-zero/net-zero-dec-16-jan31-2022-comments.pdf>

<sup>ii</sup> <https://www.aeso.ca/assets/Uploads/net-zero/03MAR2022-Summary-Net-Zero-Emissions-Pathways-Stakeholder-Comments.pdf>



# Stakeholder Comment Matrix – March 22, 2022

## Net-Zero Emissions Pathways | Engagement Session 1 – Preliminary Modeling Results



Comment period:	<b>March 22, 2022 to April 19, 2022</b>	Contact:	Nicole Irwin-Viet
Comments from:	Voltus, Inc.	Phone:	(857) 321-0314
Date:	2022/04/19	Email:	nirwin@voltus.co

### Instructions

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2. Please respond to the questions below and provide your specific comments.
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### Introduction

On Dec. 16, 2021, the AESO provided notice that it was commencing examination of potential pathways to a net-zero electricity system in Alberta. As an initial step, the AESO sought, and has received written feedback from interested stakeholders on their perspectives regarding the scope and input assumptions of the proposed net-zero emissions pathways analysis<sup>1</sup>. 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. The AESO has reviewed and incorporated several of the suggested changes<sup>2</sup> and has completed its initial modelling using the revised assumptions.

The intent of the Mar. 28, 2022, engagement session is to present these preliminary modelling results to stakeholders for input and discussion. This comment matrix is intended as a follow-up and seeks any additional stakeholder insights and comments that the AESO will consider prior to the completion of our analysis and final publication of a report by the end of June. Stakeholder feedback received will similarly be compiled and posted and the AESO will subsequently provide a summary directional update.

<sup>1</sup> <https://www.aeso.ca/assets/Uploads/net-zero/net-zero-dec-16-jan31-2022-comments.pdf>

<sup>2</sup> <https://www.aeso.ca/assets/Uploads/net-zero/03MAR2022-Summary-Net-Zero-Emissions-Pathways-Stakeholder-Comments.pdf>

## Request for feedback

The AESO is seeking feedback from interested stakeholders on their perspectives as it relates to the scope and development of the net-zero emissions pathways analysis. Please be as specific as possible with your responses. Thank you.

Stakeholder engagement, dialogue, and feedback will be key to framing the AESO's analysis and to ensure that the information provided to stakeholders via this analysis is valuable. The AESO would like to thank stakeholders in advance for their ideas, thoughts, and perspectives related to electric system decarbonization in Alberta.

Questions	Stakeholder Comments
<p><b>1</b> Please comment on Net-Zero Emissions Pathways Engagement Session hosted on March 28, 2022.</p> <p>Was the session valuable? Was there something the AESO could have done to make the session more helpful?</p>	<p>This session was valuable in clarifying the scope of the net-zero report. However, it is still unclear what this report will be used for in terms of guiding decisions made for the future of the Alberta electricity grid.</p>
<p><b>2</b> Is there any feedback that you would like to provide the AESO with respect to the purpose and scope of the Net-Zero Analysis?</p> <p>What areas would benefit with further clarification from the AESO?</p>	<p>The AESO has clarified that they have not yet looked in depth into how Demand Response (which is not included in the AESO's definition of Distributed Energy Resources) can help achieve net-zero in Alberta, citing the fact that some load already price responds independently. Price response is distinct from Demand Response. Demand Response resources participate in Operating Reserves in Alberta by reducing load rather than turning on generation in response to grid contingency events. This is just one example of how Demand Response can be leveraged to help the grid operate reliably with both lower emissions and lower cost than by calling upon traditional generators.</p> <p>Demand Response should be included among the resources in the net-zero emissions pathways analysis as a valuable, cost-effective resource to aid the Alberta electricity grid on the path to net-zero. In addition, Demand Response resources have the ability to aid the transition immediately: only Demand Response can stand up a new net-zero supply resource overnight, without the need for upfront capital and reliance supply chain constraints like other resources. For these reasons, the IEA has noted that Demand Response is a critical component of a Net Zero scenario, and concluded that more Demand Response efforts are needed. See <a href="https://www.iea.org/reports/demand-response">https://www.iea.org/reports/demand-response</a>, <a href="https://www.iea.org/data-and-statistics/charts/share-of-electricity-system-flexibility-from-demand-response-and-batteries-2020-and-2030-in-the-net-zero-scenario">https://www.iea.org/data-and-statistics/charts/share-of-electricity-system-flexibility-from-demand-response-and-batteries-2020-and-2030-in-the-net-zero-scenario</a> (asserting that Demand Response should be 16% of a net zero emissions scenario by 2030).</p>

Questions		Stakeholder Comments
3	Do you have any feedback or observations with regards to the Load forecast and associated load factors?	The AESO is currently predicting an increase in peak load by 1.4% annually, while annual growth is forecasted at 1.0%. This difference is attributed to the increase and timing of EV charging. Demand Response efforts often target peak load and can help slow this rapid peak increase, thereby reducing costs of procurement. The AESO should consider scenarios where Demand Response resources are leveraged to mitigate this increase in peak load.
	a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?	Voltus agrees with the signposts the AESO has identified. However, Voltus contends that Demand Response is an essential component of a Net Zero scenario and for combatting peak load growth.
4	Do you have any feedback or further comments with regards to the Generation forecast scenarios and associated regulatory and generation assumptions?	
	a) Do you agree with the signposts the AESO has identified? Do you have any suggestions for additional signposts?	
5	Please provide any additional information that you would like to share, which may contribute to the net-zero analysis development.	

Thank you for your input. Please email your completed matrix to: [forecast@aeso.ca](mailto:forecast@aeso.ca)