Pembina Institute response on development of a net-zero scenario in the next Canada's Energy Future report

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The Canada Energy Regulator (CER) has announced that its next Canada's Energy Future report — an annual report which explores possible future energy scenarios in Canada over the long term — will include modelling consistent with Canada's commitment to achieve net-zero emissions by 2050.

According to the CER, the report and net-zero scenario analysis will have the following parameters:

- Consistent with Canada achieving net-zero emissions by 2050;
- Inclusion of fully modelled scenarios of supply and demand for all energy commodities in Canada;
- Consistent with a global context in which the world achieves its Paris Accord goal of limiting warming to 1.5 degrees Celsius; and
- Inclusion of relevant uncertainties, including future trends in low-carbon technology and energy markets.

In June 2022, the CER requested feedback on this proposed change to its modelling. This document comprises Pembina Institute's response to the CER's feedback questions.

Summary of response

- Canada has committed to achieving economy-wide net-zero emissions by 2050, but does not yet have an energy scenario that is aligned with achieving that goal domestically and globally. A net-zero energy scenario is needed.
- Canada's climate and energy transition policies will only be effective if they are grounded in credible and transparent scenarios that model the energy future Canada is seeking to achieve. The Canada Energy Regulator's mandate to fully model a net-zero scenario for Canada is an opportunity to align with the International Energy Agency's landmark *Net Zero by 2050* report,

which lays out a roadmap for the global energy sector to meet the goal of limiting global warming to less than 1.5 degrees Celsius.

- A net-zero scenario for Canada will provide a foundational tool that can be used to assess government spending, policies, and programs along with proposed infrastructure projects to ensure that the decisions being made today are consistent with a climate-safe world. This scenario can also provide a credible basis for developing sector-specific targets and net-zero pathways.
- Similarly, a Paris Accord-compliant energy scenario will provide essential data for Canadian businesses and investors seeking to assess climate risk, help plan for a just transition, and educate Canadians about the scale and nature of the energy transition.

CER Discussion Questions

1. For discussion: Are there other factors that the CER should scope in (or scope out) of our net-zero analysis? What are they?

The Pembina Institute recommends that the CER net-zero scenario align with the Emissions Reductions Plan target of reducing emissions by 40-45% below 2005 levels by 2030, as stated in Canada's Nationally Determined Contribution.

In addition, existing intermediate commitments should also be taken into account. For example, Canada has a commitment of a 90% non-emitting grid by 2030; however, the net-zero electricity modelling released previously does not reflect this commitment. These intermediate steps are important given that GHGs have a cumulative impact on climate (and hence early reductions in GHGs are impactful) and given the need to provide clear signals to industry.

International Assumptions for Net-zero Scenarios

2. What is your perspective on relying on the IEA's NZE Scenario as a source for assumptions on international energy outcomes in the next Energy Future report? Are there any caveats to consider when relying on the IEA's NZE Scenario?

The Pembina Institute strongly supports the use of the IEA NZE Scenario as a source of assumptions on international energy outcomes, and the use of global commodity price assumptions (including oil and gas) aligned with this scenario. The IEA NZE scenario is credible and well-respected, and provides a fully modelled pathway to global net-zero by 2050.

This analysis back-casts from the goal of limiting global warming to 1.5°C temperature change and reaching net-zero emissions by 2050. In doing so, it illustrates one possible global pathway for oil, gas, coal, and renewables over the next 28 years, acknowledging the uncertainties inherent in the pace of technological innovation and behavioural change. The IEA's scenario demonstrates that net-zero by 2050 is a narrow—but achievable—goal.

Canadian oilsands are relatively high-cost and carbon-intensive compared to international sources.[1] Since one starting assumption is that the world collectively meets its Paris Agreement goals, a decline in demand is expected for such high-cost resources.[2]

The IEA recommendation for 100% clean power in OECD countries by 2035 and a phase-out of coal power by 2030 are both aligned with Canada's commitments and should be reflected in the modelling. The IEA however lags behind other comparative models on the long-term growth of electrification of end uses.[3] The IEA also relies more on CCS and bioenergy than other models. The role for both these technologies in the electricity sector in Canada should be determined based on how they compete on the basis of costs and GHG emission impacts/uncertainties with alternative non-emitting technologies such as renewables, storage and demand-side measures. Similarly, the potential for growth of nuclear power in Canada depends on addressing the significant stakeholder opposition it currently faces and on how rapidly it is able to become cost competitive.

3. Are there any other sources the CER should consider for international assumptions in its net-zero scenarios? What would be the purpose and benefit(s) of relying on those other sources?

The CER net-zero scenario should refer to the IPCC Sixth Assessment Report for current emissions trajectories, mitigation pathways, and estimates of the remaining global carbon budget (the amount of carbon that the world can emit while limiting global temperature rise to 1.5 degrees Celsius). A robust net-zero scenario will stay within the limits of this carbon budget.

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[1] M.S. Masnadi, G. Benini, H.M. El-Houjeiri et al., "Carbon implications of marginal oils from market-derived demand shocks," *Nature* 599 (2021). https://doi.org/10.1038/s41586-021-03932-2

[2] G. Semieniuk, P.B. Holden, J.F. Mercure et al., "Stranded fossil-fuel assets translate to major losses for investors in advanced economies," *Nature Climate Change* 12, (2022). https://doi.org/10.1038/s41558-022-01356-y

[3] Dave Jones, "IEA's Net Zero by 2050", *Ember*, https://ember-climate.org/insights/commentary/ieas-net-zero-by-2050/

The Pembina Institute recommends that the action table from the UN Climate Action Pathways report for the energy sector be considered for policy adjustments to get to net-zero.[4] Additionally, the Bloomberg NEF Electric Vehicle Outlook should be referenced for trends in EV demand.[5]

It is also important to note that since IEA's NZE is only one possible global pathway to net-zero 2050, it is worthwhile to use the model in an exploratory way. Many other scenarios can lead to the same outcome and understanding those can minimize bias and uncover policy-relevant insights about assumptions and uncertainties. An example is the net-zero pathways report from the Canadian Climate Institute which examined 62 different pathways to achieve net-zero targets. Examining multiple pathways can also increase the robustness of policy insights discovered through the model.[6]

Additional Net-zero Analysis

The CER will develop additional modelling analysis in which Canada achieves its net-zero goals under different assumptions about the future. The purpose of this analysis is to address the uncertainty of what a net-zero future could look like for Canada by analyzing different pathways to 2050.

Themes for this analysis could include:

- *The rest of the world does not act as quickly as Canada to reduce GHG emissions;*
- *Variations to the costs and effectiveness of different emerging energy production and end-use technologies, including:*
  - *Hydrogen*
  - *Biofuels*
  - *Carbon capture and storage*
  - *Negative emissions technologies, such as:*
    - *Direct air capture*
    - *Bioenergy with carbon capture and storage*
    - *Nature-based solutions*
  - *Nuclear power, including small modular reactors (SMRs)*

[4] UNFCCC, "Action Table for Climate Action Pathway 2021." https://unfccc.int/climate-action/marrakech-partnership/reporting-tracking/pathways/energy-climate-action-pathway#eq-1

[5] Bloomberg, *Electric Vehicle Outlook 2022*. https://about.bnef.com/electric-vehicle-outlook/

[6] C. P. Weaver, R. J. Lempert, C. Brown et al., "Improving the contribution of climate model information to decision making: the value and demands of robust decision frameworks," *Wiley Interdisciplinary Reviews: Climate Change*, 4(1), (2013). https://doi.org/10.1002/WCC.202

    - *Renewables like wind and solar*
    - *Batteries (for utility-scale electricity storage and electric vehicles)*
- *Different expectations about behavioral and societal changes regarding energy use;*
- *Higher or lower economic activity;*
- *Different global oil and natural gas price assumptions than in the scenario described in topic 3, and;*
- *An international context that limits the global temperature rise to 1.5 °C, but a different pathway than described in the IEA NZE Scenario*

4. Of the potential themes for additional net-zero modelling analysis mentioned above, which do you think are most important to model and analyze? If so, why?

- Variations to the costs and effectiveness of different emerging energy production and end-use technologies**:** IEA calls for "more than tripling the amount of public funds that are devoted to demonstration projects to show how new innovations in areas such as electrification, hydrogen and bioenergy can be deployed."
    - A scenario where such public investment is realized in Canada, to investigate key innovations that have gone under-addressed (especially hydrogen/bioenergy) but which are considered crucial to energy transition
    - A range of outcomes with regards to technology development/timelines for investment
- Different global oil and natural gas price assumptions: Recent volatility in oil prices indicates the need for a range of price assumptions. It can be assumed that periods of short-term energy price volatility will occur in the coming decades, and analysis is needed that supports long-term decarbonization and net-zero goals while still accounting for that shorter-term uncertainty.
- Different expectations about behavioral and societal changes regarding energy use: The IPCC Sixth Assessment Report Working Group III report expects that efficiency measures will offset any increase in electricity demand from electrifying all sectors.
- Impact of a potential global carbon price: Article 6 of the Paris Agreement provides a framework for international carbon pricing initiatives, an international carbon price floor (ICPF) has been proposed by the IMF, and the Net-Zero Asset Owner Alliance has called for a coordinated global price on carbon. Such international coordination would have an impact on many sectors, but oil production would be of specific interest to Canada given the comparatively high carbon intensity of our oil resources.

5. *Are there other areas of uncertainty that the CER should consider including in its analysis?*

The crisis in Ukraine and recent inflationary pressures increase short-term uncertainty and volatility in the energy sector. While some of this volatility can be accounted for in global price assumptions, the Pembina Institute recommends that the CER scenario consider updates from the IEA and other global net-zero pathways, while adhering to the outcome of net-zero by 2050. Short-term periods of energy insecurity may persist as we move to 2050, driving demand and prices higher. However, other regions, like the EU, are responding to this volatility by increasing investment in renewable energy, which may lead to a more rapid decline in global oil and gas demand in the longer term. Additionally, these higher energy prices may drive more rapid behavioural change domestically, as consumers opt for lower-carbon choices like electric vehicles or heat pumps. With many "black swan" factors that may be arise in the coming years, applying an exploratory approach to model analysis would reveal the robustness of policy approaches to uncertainties.

While there is some uncertainty regarding other countries' commitments to net-zero, an overall decline in fossil fuel demand is expected. Recent work from the Cambridge Centre for the Environment indicates that when and how quickly fossil fuel markets peak and decline is decided primarily by fossil fuel importers, as opposed to exporters like Canada.[7] Many of these importers have an economic incentive to decarbonize to reduce high-cost imports, especially in east Asia and the European Union.

Prices for renewable energy have decreased faster than expected in the last several years. BP's Statistical Review of World Energy for 2021 showed that the cost of onshore wind and solar power has decreased by 40% and 55% respectively since 2015—more than double the pace expected.[8] Researchers have found that assumptions surrounding renewables trends are biased by the type of organization, energy model, or policy assumptions used. The Pembina Institute suggests that clean energy costs should be grounded in available data from Canadian jurisdictions and that a range of scenarios be considered for the future cost of renewables and storage technologies, potentially leading to faster deployment of renewable energy technologies.[9]

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[7] J.F. Mercure, P. Salas, P. Vercoulen et al., "Reframing incentives for climate policy action," *Nature Energy* 6 (2021). https://doi.org/10.1038/s41560-021-00934-2

[8] BP, *Statistical Review of World Energy 2021*, https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html

[9] M. Jaxa-Rozen, E. Trutnevyte, "Sources of uncertainty in long-term global scenarios of solar photovoltaic technology," *Nature Climate Change* 11 (2021). https://doi.org/10.1038/s41558-021-00998-8

Methodology and Net-zero Analysis

6. Some regulations are still under consultation and development (such as the proposed Clean Electricity Standard or regulated sales mandate for zero emission vehicles). To what extent, and how, should these draft policies be included in the net-zero analysis assumptions?

The Pembina Institute recommends that targets and commitments announced in the 2030 Emissions Reduction Plan (ERP) should be included. These regulations have been identified as essential building blocks for Canada's path to net-zero by 2050. They should be included to the extent possible, so that we can better define the gap of where Canada stands and areas to improve.

The Pembina Institute also recommends that the expected outcomes of these regulations be used as parameters for the model (for example, that the upcoming methane regulations do achieve at least 75% reduction in oil and gas methane emissions by 2030). In particular, the following announced policies should be included due to their significant impact:

- Oil and gas cap: The government has not yet set a firm target for a commitment to cap emissions from the oil and gas sector, but signaled in the ERP that their models show that a 31% reduction from 2005 levels is achievable. However, this reduction includes a growth in oil production from current levels. A proposal for the emissions cap and interim targets is expected this year, and modelling should be consistent with that level.
- Methane reductions: The federal government has committed to reducing methane emissions from oil and gas by at least 75% relative to 2012 levels by 2030.
- Carbon contracts for difference: These should be considered in this category of potential climate policies, but it is an open question whether they lead to incremental emission reductions, or simply increase the likelihood of expected pricing-driven reductions occurring. In reality, they will likely reduce the cost of capital for large decarbonization projects, which does reduce mitigation costs, but it is unclear if this constitutes a change in how these projects are modelled by the CER. These contracts will improve the longer-term certainty of policies, which can be used to adjust assumptions regarding the effectiveness of pricing levels to 2050.
- Carbon pricing: When adjusting inputs for industrial carbon pricing systems to get to net-zero, tightening rates should aligned with sector-level targets (i.e., net-zero by 2050, or the net-zero electricity grid by 2035) to ensure integrity of credit markets. This sends a clear signal to industry and investors that supply and demand in credit markets will be aligned with Canada's goals. For example, the Pembina Institute recommends

that provincial and federal benchmarks for oil and gas include an annual tightening rate of 3 to 4%, to achieve net-zero by 2050. This assumption aligns with federal government pricing benchmark criteria that the provinces must maintain marginal carbon prices aligned with the federal government's carbon price trajectory, and that Canada will meet its net-zero commitment.

- The carbon capture, utilization and storage investment tax credit (ITC) proposed in Budget 2022: The details of the tax credit have not yet been announced, but the parameters of the ITC in Budget 2022 are 60% for eligible capture equipment used in direct air capture projects; 50% for other eligible capture equipment; and 37.5% for eligible transportation, storage and use equipment. These levels are reduced by half from 2031-2040. When implemented, this credit will be essential to reduce technology costs and drive private sector investment in decarbonization initiatives.
- Clean electricity standard (CES): Include the stated outcome of a net-zero grid by 2035 as an input. The net emissions from the electricity sector should be 0 Mt CO_2e. The parameters of this policy should apply stringent rules for counting offsets or nature-based solutions. Cogeneration units, such as in the oilsands, should be considered included in the CES. Only offsets from direct air capture projects should be eligible in modelling the CES. The CES should also be modelled with interim targets to 2035.
- Clean fuel regulations: Assume the regulations achieve their target outcome (the carbon intensity of covered fuels is reduced, leading to a decrease of approximately 13% (below 2016 levels) in the carbon intensity of liquid fuels used in Canada by 2030).
- Zero emission vehicle (ZEV) sales mandate: Assume annually increasing requirements towards achieving 100% light duty vehicle (LDV) ZEV sales by 2035, including mandatory interim targets of at least 20% of all new LDVs offered for sale by 2026 and at least 60% by 2030. A linear approach to modelling these targets can be applied.
- Zero emission medium-and heavy-duty vehicles (MHDVs): Assume the target for MHDVs in the ERP are achieved (35% of total MHDV sales being ZEVs by 2030, and 100% MHDV sales to be ZEVs by 2040 for a subset of vehicle types based on feasibility, with interim 2030 regulated sales requirements that would vary for different vehicle categories based on feasibility, and explore interim targets for the mid-2020s). Specific policy has not been tabled but this target can be used as an input. A 'beachhead' approach to modelling targets across segments can be applied, such that vehicle types that are more suitable to transition in the near term have more stringent targets, and the heaviest classes (class 7 and 8) can be subject to delayed and/or less stringent targets.

7. *How should policy initiatives that are yet to be announced, but are necessary for Canada to reach net-zero emissions by 2050, be chosen and modelled?*

The Pembina Institute recommends that policies and assumptions from the IEA NZE Scenario be used.[10]

In particular, while the following policy initiatives may not have the detail necessary to include fully, they should be reviewed:

- Carbon border adjustment mechanisms (CBAMs): These policies may be used to mitigate carbon leakage in the model. However, there is still significant uncertainty regarding the parameters and deployment of CBAMs. CBAMs should not be modelled in conjunction with free allocations from industrial pricing systems, since they aim to accomplish similar outcomes.
- Internal combustion engine (ICE) vehicle phase-outs: The IEA NZE Scenario assumes that by 2030, ICE cars are phased out in the largest cities in Canada.
- Speed limits: Speed limits of 100 km/h are introduced on major highways across Canada by 2030. Such motorway speed limits are assumed to be adopted globally by 2030 in the IEA NZE.
- More stringent fuel economy and GHG standards for LDVs: Environment and Climate Change Canada has determined that current standards are not rigorous enough to allow Canada to meet its emission reduction objectives. As a starting point, revised emissions standards set in the United States for model year 2023-2026 can be modelled (Canada has committed to aligning with the most stringent standards in North America post-2025, but it could be modelled that such standards are adopted earlier).
- More stringent fuel economy and GHG standards for heavy duty vehicles (HDVs): The U.S. EPA proposed more stringent standards for HDVs on March 28, 2022, and while these have not yet been implemented, Canadian alignment with these U.S. standards could be modelled.
- Energy demand reduction: NZE modelling should include energy demand reduction pathways like demand-side management and less transportation demand due to Canadians working more from home (one behavioural change identified in the IEA NZE).
- Interprovincial transmission: The 2030 Emissions Reduction Plan and Budget 2022 have indicated strong support for developing interprovincial interties. The Pembina Institute

[10] IEA, *Net Zero by 2050 Assumptions*. https://www.iea.org/reports/world-energy-model/policies#net-zero-emissions-by-2050-assumptions

recommends that the NZE not constrain the maximum capacity of these interties below those in the results of the David Suzuki Foundation's Shifting Power report.

- Investment tax credits: Budget 2022 announced the development of a new investment tax credit of up to 30%, focused on net-zero technologies, battery storage solutions, and clean hydrogen. The design details of the investment tax credit will be provided in the 2022 fall economic and fiscal update.
- Electric vehicle to grid technologies: These can be modelled by assuming 75% of LDVs are available during peak hours and available in 2035.

8. Negative emissions are an important part of most net-zero scenarios. How should these be considered in the modelling process? Options could include allowing the model to determine the level of negative emissions based on costs and incentives for capturing emissions or fixing negative emissions to a certain level.

The Pembina Institute recommends following the IEA NZE, which includes a limited reliance on negative emissions, while allowing the model to determine the level of negative emissions based on costs and incentives. For example, in the IEA NZE, 30% of remaining fossil fuel use in 2050 does not result in carbon emissions, about half is in plants equipped with CCUS, and the remaining 20% of unabated fossil fuel use persists in hard-to-abate sectors (and is offset with BECCS and DACCS technologies).

The Institute also recommends focusing on technologies that are most feasible. The IPCC's Working Group III provides an assessment of the technological feasibility of negative emissions technologies.[11] The scenario should apply stringent rules for counting offsets or nature-based solutions as emissions reductions. The IEA NZE excludes offsets outside the energy sector.

This area would also benefit from additional modelling; for example, the IEA constructed a "Low CCUS Case" in which no new fossil fuel CCUS projects are developed beyond those already approved, to supplement its NZE scenario.

[11] See *Annex III: Scenarios and modelling methods*, Table II.1, in IPCC, *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (2022). doi: 10.1017/9781009157926.022

General Feedback

9. Is there anything else you can think of that could be relevant to the analysis or modelling of Canada's net-zero future?

N/A

10. What is the most meaningful way to reflect the interests of Indigenous peoples in this analysis?

The Canada Energy Regulator should engage with Indigenous groups as rights holders through this consultation.

11. How do you expect to use the next Canada's Energy Future report, including the net-zero analysis, for your own knowledge, research, or decision-making about energy in Canada?

The Institute expects to use this scenario for policy analysis and educational purposes. More broadly, the Energy Futures Report is an essential piece of modelling that contributes to Canada's climate goals, providing scenarios that assess existing climate ambition, government spending, and economy-wide policies that influence our energy decisions.

12. Do you have any other feedback or general comments?

While the Energy Futures report consists of scenarios, not projections, the report is relied upon by investors and policymakers to make decisions about the future. In the past, the central scenario has been the Reference Scenario, which is limited to announced or implemented policies and presents conservative estimates in the deployment of decarbonization technology. The Reference Scenario is inherently pessimistic about domestic and international climate action and therefore it is not representative of either national or global trends.

This net-zero scenario should be framed as the central scenario in this edition of Energy Futures. Setting Canada up for success in the clean energy transition requires reliable information on how to align energy production and consumption with Paris Agreement goals, which a credible net-zero scenario can provide.