April 15th, 2022

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Environment and Climate Change Canada

Submitted via Email: ECD DEC@ec.gc.ca

Re: Clean Electricity Standard

The Power Workers' Union ("PWU") represents a large portion of the employees working in Ontario's electricity industry. Attached please find a list of PWU employers.

The PWU appreciates the opportunity to provide input on the Clean Electricity Standard Discussion Paper. The PWU is a strong supporter and advocate for emission reduction strategies and climate change initiatives and recognizes that the Clean Electricity Standard will be an important part of Canada's climate plan. The PWU has engaged in several federal consultations that support the prudent and rational reform of the electricity sector and the importance of low-cost, low-carbon energy to the competitiveness of Ontario's economic sectors.

The PWU believes that deploying new, low-carbon electricity infrastructure is the best way to help advance Canada's NZ objectives by 2050 in a way that supports workers, communities and the competitiveness of our economy.

We hope you will find the PWU's comments useful.

Yours very truly,

Jeff Parnell
President

Encl.

Power Workers' Union Submission on Canada's Clean Electricity Standard Discussion Paper
April 2022

The Power Workers' Union (PWU) is pleased to submit comments and make recommendations to Environment and Climate Change Canada (ECCC) regarding the development of the Clean Electricity Standard (CES) and to help reach Canada's 2035 climate targets in a way that supports workers, communities, and the competitiveness of our economy. The PWU is a strong advocate of emission reduction strategies and has engaged in several federal consultations, including the SMR Action Plan, Hydrogen Strategy, National Infrastructure Plan, Clean Fuel Standard (CFS), Carbon Capture Utilization and Sequestration (CCUS) tax credit, and the 2030 Emission Reduction Plan.

The federal government has released a discussion paper on a proposed Clean Electricity Standard (CES) and is seeking comments from Canadians on its scope and design. The treatment of electricity within the Output Based Pricing System (OBPS) is also under review. The objective of the CES is to support the federal government's goal of establishing a net-zero emissions electricity system by 2035 and prevent the use of carbon-emitting electricity generating sources to meet demand growth created by decarbonizing the rest of the economy.

The proposed CES is intended to support the provinces and territories with their decisions regarding the:

1) Integration of wind and solar generation while de-risking the intermittency challenges;
2) Management of increased demand from electrification e.g., the transportation sector;
3) Deployment of emerging non-emitting options e.g., energy storage, geothermal and SMRs; and,
4) Promotion of energy efficiency and demand-side management to minimize demand and rate impacts.

The discussion paper requested feedback in several areas: Stranding of new emitting assets; CES as an incentive to deploy non-emitting sources, such as nuclear and storage; accelerating the development of the electricity system; resource availability and interconnections with neighboring jurisdictions; continued flexible use of natural gas; and, the CES's technology neutral objective.

The PWU provides the following recommendations in response to the discussion paper.

Context for and Viability of the CES's 2035 goals

1) The CES objectives should reflect that it is not possible to achieve net zero electricity emissions by 2035 and instead identify alternative pathways to achieve the desired outcomes as soon as possible.

Treatment of gas-fired generation and carbon pricing

2) The CES should allow for an ongoing role for gas-fired generation to provide peak and reserve capacity.
3) The OBPS should be modified to render the use of gas-fired generation for baseload and intermediate demand uneconomic.

Benefits and challenges of alternatives to continued gas-fired generation

4) The CES should support the use of biomass fueled generation.
5) The CES treatment of renewables should clearly recognize the challenges of relying on renewables to achieve its goals.

6) The CES should be technology agnostic, recognizing that the options for developing significant, new non-emitting generating assets are limited and affected by regional economics.
7) The CES should support the deployment of emerging technologies that mitigate the need for gas-fired generation during the transition and for the long-term.

Provincial and Territorial Considerations

8) The CES should be focused on policy drivers that can be used by the provinces and territories to develop the desired net zero emissions electricity system.
9) Regional interprovincial Tx Interconnections are dependent upon the type and location of new non-emitting supplies.
10) The CES should objectively communicate meaningful cost references regarding the available emission reduction options to support discussion and decision-making.

Relationships to other Federal Initiatives

11) Federal tax credits should be available to all low-carbon, baseload, and intermediate resource options to support the CES's technology agnostic objective.
12) The federal Green Bonds Framework (GBF) should be technology agnostic and include nuclear.

<u>Context for PWU Recommendations</u>

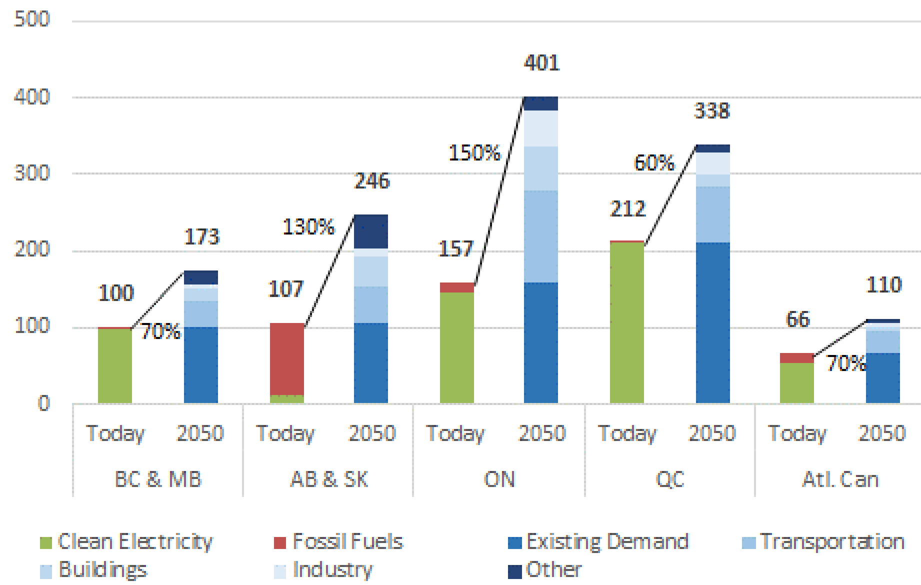
A stated objective of the CES is to reduce gas-fired generation emissions as soon as practically possible. Unfortunately, achieving this objective is complicated by the anticipated growth in demand for low-carbon electricity resulting from electrification of the economy.[1]

While the CES sets out a strategy for the transition towards 2035 and beyond, the viability of the pathways is influenced by the challenges existent in each provincial and territorial jurisdiction. Reducing Canada's dependence on natural gas will require new electricity infrastructure that depends on regional incremental demand and supply conditions, as shown in Figure 1. For example, significant low-carbon hydroelectric generation already exists in Quebec which has already addressed the building heat challenge and, as a result is forecasting modest demand growth by 2050. On the other hand, Alberta and Saskatchewan must convert their predominantly fossil fuel-fired generation and concurrently address the forecasted, second largest increase in electricity demand.

Ontario's electrification-driven electricity demand growth, the largest in Canada, will make its performance a critical factor for achieving the objectives of the CES.[2] The ECCC correctly acknowledges the pressing need for action given the significant amount of new, low-carbon energy infrastructure that is required by 2050.[3]

[1] Strategic Policy Economics, "Electrification Pathways for Ontario to Reduce Emissions", 2021; CCRE Commentary, "Toward a National Energy Vision: Canada's Low-Carbon Energy Infrastructure Opportunity in a Global Net Zero Future", 2021.
[2] PWU submission on the National Infrastructure consultation, regarding Government of Canada, "Building the Canada We Want in 2050", 2021.
[3] PWU submission to the 2030 emissions target consultation.

Figure 1 – Projected Growth in Needed Capacity to Achieve NZ2050 by Region in Canada



Source: Strapolec analysis

Context for and Viability of the CES's 2035 goals

Recommendation #1 – The CES objectives should reflect that it is not possible to achieve net zero electricity emissions by 2035 and instead identify alternative pathways to achieve the desired outcomes as soon as possible.

Ontario currently plans to meet its growing electricity demand by increasing its reliance on gas-fired generation. This will increase emissions from 4 Mt in 2017 to 17 Mt in 2042 [Figure 2], before considering the impacts of decarbonizing the economy.[4] Electrification of the economy will require even more capacity, potentially exposing Ontario to an unnecessary risk of brownouts in the late 2020s. Ontario is forecast to require 14 GW of new low-carbon supply by 2030.[5] This is equivalent to almost doubling Ontario's existing nuclear and hydro capacity in only 8 years. Ontario will need 20 GW by 2035. This is clearly not possible.

Analyses indicate that meeting the province's electrification demand will increase its' electricity sector emissions by an additional 35 Mt by 2042 as shown in Figure 2 – equivalent to a 25 percent increase in total overall provincial emissions. This will eradicate the emissions reductions achieved by Ontario's coal station closures over a decade ago. This will also set back Canada's overall 2030 national emission targets by 13 percent. In fact, without a change in strategy, Ontario's electricity sector emissions could increase to over 110 Mt by 2050. This equates to the total achievable forecast emission reductions from

[4] IESO, 2021 Annual Planning Outlook, Dec 2021

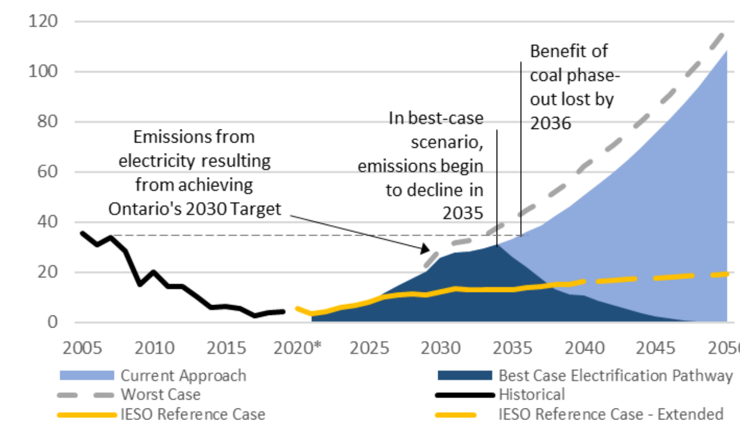
[5] Strategic Policy Economics, "Electrification Pathways for Ontario to Reduce Emissions", 2021; IESO, 2021 Annual Planning Outlook.

decarbonizing the electricity sector in all provinces that are still burning coal. This situation underscores the importance of the federal CES initiative.

Even under an aggressive build out of new low-carbon resources scenario, Ontario's emissions will not peak until 2035, well above the IESO's reference case, before dropping as shown in Figure 2. This will only be possible if Ontario starts immediately to build over 4000 MW of new baseload generation capability per year. However, even with such immediate and aggressive low-carbon capacity procurement, Ontario's electricity sector emissions will only be eliminated shortly before 2050. Such an aggressive procurement plan is not currently in play in Ontario. Over-reliance on natural gas-fired generation will persist for some time.

Figure 2: Emissions Implications Under Emitting and Clean Electricity Options

(Mt, 2005-2050)



Sources: IESO, APO, 2020; Source: IESO, 2021 APO, Chapter 7, Figure 42, 2021; Strapolec, Electrification Pathways for Ontario, 2021; Strapolec Analysis

Ontario's situation suggests that the ECCC should acknowledge achieving NZ by 2035 for the electricity sector is already impossible. The CES objectives should be refocused on the most effective policy options that can enable eliminating electricity sector emissions at the earliest date.

<u>Treatment of gas-fired generation and carbon pricing</u>

Recommendation #2 – The CES should allow for an ongoing role for gas-fired generation to provide peak and reserve capacity.

Natural gas-fired generation can cost-effectively provide peak and reserve capacity to the grid. Peak supplies are rarely used (<2% of the time) and produce negligible emissions over the year. Reserve capacity is almost never used, except under extreme emergency situations. The cost of mostly idle gas-fired capacity is much less than any other non-emitting option when its significant variable fuel cost is avoided. Considering the dispatch flexibility of natural gas-fired generation, it remains, at least for the short-term, an important asset for meeting peak and reserve needs. Forecasts suggest that Ontario will remain dependent upon gas-fired generation capacity for peak and reserve needs for a very long time. The most significant challenge for Ontario to 2035 is its need to meet baseload and intermediate demand with gas-fired generation.

Gas-fired generation is favoured by the electricity markets implemented in Ontario given its low capacity cost and how its low variable cost supply sets the energy market price. This inherent bias should be addressed by the CES to limit future participation in the energy market, as opposed to allowing payment of a carbon price as a permission to emit.

Recommendation #3 – The OBPS should be modified to render the use of gas-fired generation for baseload and intermediate demand uneconomic.

The need for new policy tools can be mitigated by modifying the OBPS to support the CES in the following ways:

1) Aggressively increase the application of the carbon price as a strong signal to investors;
2) The transition for consumers should be managed separately;
3) There should be no new provisions for credits or offsets;
4) Co-generation connected to the grid should be subject to the carbon price based on its efficiency; and,
5) Gas-fired generation based distributed energy resources (DERs) should be prohibited.

1) Aggressive carbon price

The Federal Output-Based Pricing System (OBPS) is inherently aggressive as the applicable carbon price for *new* generation transitions to fully expose all output by 2030. Unfortunately, the declining emission limits do not apply to existing generation. Furthermore, in Ontario, both existing and new generation will have negligible exposure to the carbon pricing under the province's Emissions Performance Standard (EPS) thereby eliminating any effective disincentives for natural gas-fired generation.

The treatment of natural gas-fired generation in both the OBPS and Ontario's EPS should be reviewed. The intent of these programs is to protect emission intensive trade exposed sectors from the competitive pressures associated with a carbon price on exported products. Gas-fired generation in Ontario, while it involves some electricity exports, is not trade exposed from a jobs perspective. Jobs in gas-fired plants are paid for by the province through fixed capacity payments. Applying the carbon price to natural gas-fired generation may limit the export of electricity to the U.S., but it will also save Ontario from the emissions associated with those exports. All gas-fired generation should be fully exposed to the carbon price and imports of electricity generated by gas-fired generation should be prohibited, as Ontario does with coal-fired generation.

The presence or absence of a carbon price will not affect the availability of natural gas-fired generation for peak or reserve purposes, but will dissuade its use for baseload and intermediate supply where the emissions do matter. Given the need for peaking and reserve capacity, the fact that fixed costs of the facilities are covered by capacity payments, and the significant growth in demand, there is no risk of stranding any existing gas-fired generation. By providing a strong price signal associated with emissions, investors will have the information they need to not expose ratepayers to the risk of stranding assets.

The CES should clearly signal the application of the full carbon price as soon as possible to incent new non-emitting supply.

2) Transition cost exposure to consumers

One clear drawback to a carbon price is that it increases the cost of electricity for consumers. This can be mitigated by rebating the carbon price to consumers via their electricity bills. These consumer rebates do not weaken the price signal for investors.

3) No need for additional credits or offsets

If the carbon price is fully applied to natural gas-fired generation, there is no need for any additional credits or offsets. Within the OBPS, the credit market allows for industry to find the cost-effective way to reduce emissions across the economy. This mechanism will be available if natural gas-fired generation remains within the OBPS. As mentioned above, there are no trade exposure risks requiring further action.

4) Output from Cogeneration facilities

The emissions from a Cogeneration facility are already addressed in the OBPS framework. However, any output from cogeneration facilities that is sold to the grid should be subject to the same carbon price formula that is applied to any other large, gas-fired generation facility. The OBPS already recognizes the efficiency benefit of Cogeneration facilities, which will continue to have an advantage over other gas-fired options when selling power to the grid. However, the limits should be decreased over time to fully expose generation sold to the grid by 2030, as recommended for all gas-fired generation.

5) Gas-fired DER should not be supported

Purpose built gas-fired DER generation should already be exposed to the carbon price under the Greenhouse Gas Pollution Pricing Act (GGPPA) as the emissions from these facilities would fall under the thresholds set for OBPS participation. Nevertheless, the final policy should ensure that these facilities are fully exposed to the carbon price and/or any future development is subject to an outright ban.

Benefits and challenges of alternatives to continued gas-fired generation

Recommendation #4 – The CES should support the use of biomass fueled generation

Canada's significant renewable, farm and forest-sourced, carbon-neutral biomass wastes represent another opportunity to reduce carbon emissions while providing electricity, heat and biofibre-based alternatives to fossil fuels.[6] As well, the distributed availability of the biomass feedstocks makes it a flexible source of low-carbon energy at both the regional and provincial level.[7] For example, biomass generation in Northwest Ontario is a cost-effective alternative to natural gas-fired generation in the region while reducing natural gas imports from the U.S. at the provincial level.[8]

Furthermore, forestry waste biomass generation can provide the same flexibility offered by natural gas-fired generation. This form of generation produces minimal net emissions due to its renewable feedstock and when coupled with CCUS (e.g. Bioenergy Carbon Capture and Storage (BECCS)) offers a net carbon sink option. This can help the CES achieve NZ for the electricity sector by compensating for any natural gas-fired generation required to provide peak/reserve/emergency supply.

The Atikokan Generating Station (AGS) in Northwestern Ontario represents an important opportunity to continue and expand the use of waste forestry biomass to produce low-carbon electricity and heat.

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[6] PWU submission on the National Infrastructure consultation, regarding Government of Canada. "Building the Canada We Want in 2050." 2021.

[7] PWU, Submission to MNRF on ERO 019-3514, Ontario's Draft Forest Biomass Action Plan, 2021.

[8] M. Brouillette, CCRE Commentary – Toward a National Energy Vision: Canada's Low-Carbon Energy Infrastructure Opportunity in a Global Net Zero Future, 2021; PWU submission to Ontario's Forestry Biomass Action Plan, 2021

Analysis shows this is an economic alternative to gas-fired generation.[9] OPG considers sustainably managed biomass generation to be one of its low-carbon generation sources along with hydro and nuclear. OPG classifies the AGS as a low carbon emissions source of supply based on the sustainable forestry practices that provide the wood pellets.[10]

Ontario's sustainable forest management planning processes and practices enable OPG's biomass program to satisfy the United Nations Framework Convention on Climate Change (UNFCCC) definition of renewable biomass. Additionally, the proven, available biomass supplies in the Northwest make the AGS a strategic location for producing low-carbon hydrogen that could help decarbonize heavy duty vehicles in the forestry sector.

Recommendation #5 – The CES treatment of renewables should clearly recognize the challenges of relying on renewables to achieve its goals.

The CES discussion paper favours the use of renewables for achieving its goals. However, there are evident risks associated with the underlying assumptions of the CES: availability of the technologies; modelling limitations; the amount of back-up natural gas-fired generation that is required, and the cost competitiveness.

1) Technology Availability Constraints

   The CES discussion paper asserts that renewables are widely available. However, there are several evident factors that will limit the availability of the renewable capacity required to meet the magnitude of Canada's emerging needs. As the CES paper notes, Canada's demand for electricity will be significant - over twice today's available capacity.

   Supplying 1000 TWh of new demand would require 40,000 five-MW wind turbines and 17 million acres of land on which to site them.[11] It is also worth noting that wind output is low in the summer. Grid solar installations would need 2.5 million acres and do not produce much electricity in the winter. Most of the prime locations for wind resources in Ontario have already been developed, yet to meet the 2050 target using renewables could require over 200 times more than what is already installed in Ontario. – and that is if the renewables output could be aligned with demand.

2) Modelling Limitations

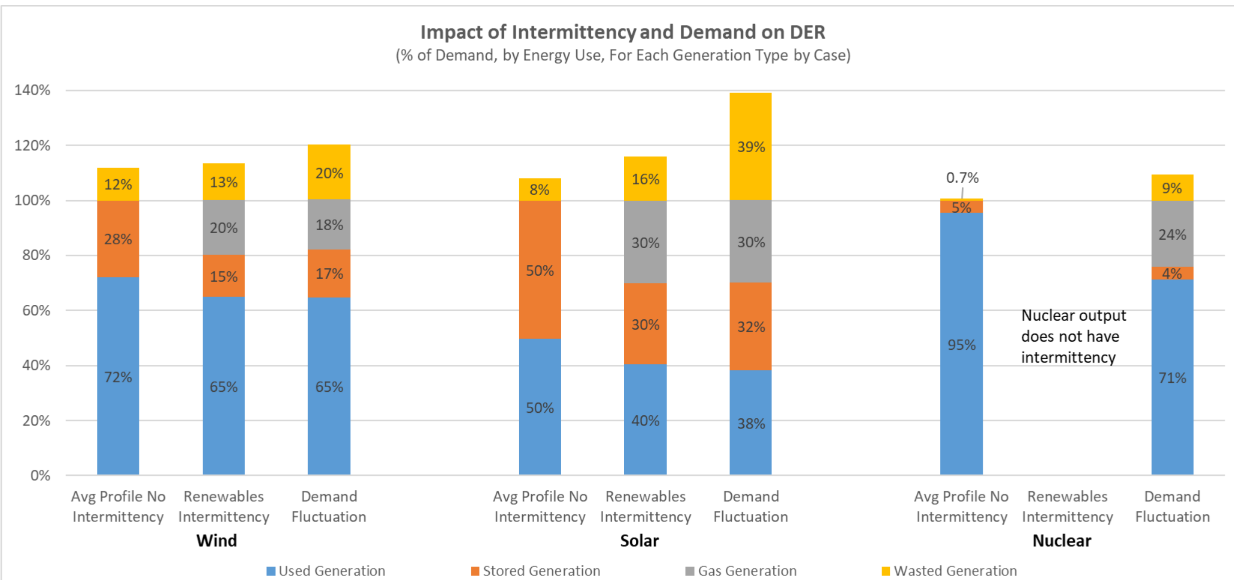
   Numerous modelling exercises have been undertaken around the world to assess the potential role for renewables in the future. However, studies of the reliability of these models suggests the

[9] Strategic Policy Economics, "Atikokan GS Extended Operations", 2022.
[10] https://www.opg.com/powering-ontario/our-generation/biomass/; OPG Annual Report, 2019; World Resources Institute, INSIDER: Why Burning Trees for Energy Harms the Climate, Dec 2017; OPG, Ontario Power Generation's Biomass Journey, Sept 2017; FutureMetrics LLC, Biomass Carbon Capture and Sequestration, Dec 2020.
[11] SNC Lavalin, "Engineering Net Zero, March 2021; Nuclear Innovation Institute, "Nuclear Intelligence Report", September, 2021; Strapolec analysis.

contributions of renewables is overestimated and the associated costs underestimated.[12] These conclusions reflect the manner in which intermittency is addressed i.e., hourly, daily, weekly and seasonal variability of both output and demand.

Understanding these limitations is critical. For jurisdictions like Ontario, for example, the amount of sunshine is half that of Arizona and the consistency of wind is two thirds of that of the mid west U.S. Improving the reliability of these models would demonstrate how the need for, and use of, storage increases as does the need for backup gas generation and the amount of excess generation that is wasted, as illustrated in Figure 3 for Ontario.[13] These shortcomings should be addressed within the toolset used by the ECCC to ensure the appropriate information is available to support cost-effective decisions regarding ECCC policies and plans.

Figure 3 – Implications for Storage and Backup Supply for Renewables Scenarios



Note: The simulations modelled, including the nuclear scenario shows how the technology options could meet daily intermediate demand in the IESO's reference forecast for 2030 that exceeds what Ontario's existing baseload could supply after the Pickering Nuclear Generating Station retires.

3) Need for Backup Generation

The need for backup firm supply is higher than many assume. Analyses have clearly demonstrated that the renewables-based scenarios require significant flexible backup generation, even with the use of storage. This occurs due to intermittency—the days, and even weeks, when the output from renewables is negligible and/or insufficient to charge storage assets. Gas-fired generation will be needed to supply 20% to 30% of the energy output planned from renewables as illustrated in Figure 3 above. Simulations show that replacing natural gas-fired generation for meeting baseload and

[12] Hans-Kristian Ringkjøb∗, et al., "A review of modelling tools for energy and electricity systems with large shares of variable renewables", 2018, Renewable and Sustainable Energy Reviews; Miguel Chang a,*, et al., "Trends in tools and approaches for modelling the energy transition", 2021, Applied Energy.
[13] Strategic Policy Economics, "Renewables-Based Distributed Energy Resources in Ontario", 2018.

intermediate demand with 100% renewables and storage would cost four times as much as other low carbon alternatives.[14]

If a net zero emission electricity sector is the objective, the use of unconstrained natural gas to backup renewables is not the solution. Improved modelling would enable the ECCC to deliver better results. In the short-term renewables can help transition a decrease in the use of natural gas-fired generation. In the longer-term, renewables and natural gas will not help Canada achieve NZ by 2050.

4) Cost Competitiveness

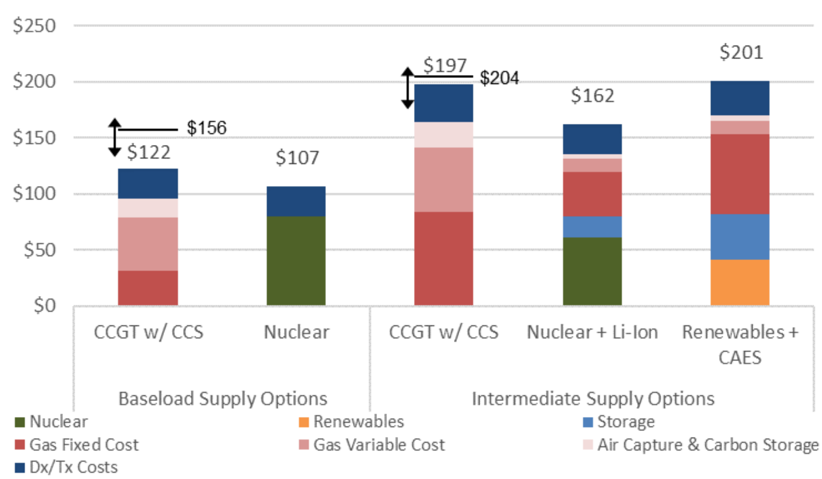
The CES discussion paper posits that renewables are becoming cost competitive as evidenced by their increased adoption across Canada. It is noteworthy to acknowledge that the vast majority of this adoption has been incented by substantial subsidies. For example, in Ontario these subsidies led to large cost increases and widespread consumer dissatisfaction.

The discussion paper correctly noted that the full cost of renewables is not clear as it includes expenditures for market and regulatory reforms, expansion and reinforcement of transmission and distribution infrastructure and for providing system flexibility. These costs all result from the intermittency and non-dispatchable nature of renewables.

As shown in Figure 4, detailed simulation models show that, even a decade from now, renewables solutions are expected to cost 25% more than other low-carbon generation options capable of meeting intermediate demand and almost twice as costly for baseload, reflecting the reliance on backup from gas-fired generation.

Figure 4: Integrated Low-emitting System Supply Cost Comparison

(LCOE $/MWh 2018CAD, NZ2050)



Note: Costs shown after conversion to Canadian context and include full life cycle costs, waste and decommissioning. Capital cost for CCGT w/o CC is based on IESO $140,000/MW/year, with CC adding $101,000/MW/year. Storage assumptions reflect lowest available cost, which is compressed air energy storage, co-located with wind farms. Source: Strapolec, 2021.

[14] CCRE Commentary, "Renewables-based Distributed Energy Resources in Ontario: A Three-Part Series of Unfortunate Truths, Part 2: Cost Implications", June 2019.

Recommendation #6 – The CES should be technology agnostic, recognizing that the options for developing significant, new non-emitting generating assets are limited and affected by regional economics.

Canada's significant low-carbon energy options – renewable biomass, hydroelectric, natural gas-fired generation with carbon capture and nuclear – can help Canada achieve its NZ targets. The latter three options are best suited for providing low-carbon baseload electricity, however, their potential availability is unequally distributed across the country.[15] Similarly, their respective roles in electrification of the economy and hydrogen deployment will vary by region.

Jurisdictions around the world are wrestling with the same challenges and are seeking low-carbon technological advantages in CCUS, new nuclear and small modular reactors (SMRs) and their roles in a hydrogen economy. Low-carbon nuclear and hydroelectric resources in Ontario and hydroelectric in Quebec could be key drivers for electrification and electrolytic hydrogen production while western Canada may be able to economically produce hydrogen from natural gas with carbon capture. All these potential solutions are not without challenges.

In Canada, recent major hydroelectric power developments outside of Ontario and Quebec have encountered significant issues – specifically Site C in BC, the Keeyask Dam in Manitoba, and Muskrat Falls in Labrador.[16] At the present time, Quebec is not planning for further investment in new hydroelectric plants.[17] While Ontario is exploring its remaining hydroelectric options, higher costs are anticipated. [18] Large-scale hydroelectric stations require extensive land. For example, meeting Canada's emerging electricity demand is expected to require 115 hydro reservoirs similar in capacity to BC's Site C project. Or alternatively, the required capacity is 15 times that of Quebec's James Bay complex and would require the flooding of up to 160,000 sq kms or 40 million acres of land.[19]

While significant economic and geological potential for CCUS exists in Alberta and Saskatchewan, its viability is less evident elsewhere in the country. Furthermore, natural gas-fired generation fitted with CCUS will not be a zero-emitter as it is only anticipated to be 90% efficient. However, the CCUS option could be integrated with renewables and/or direct air capture (DAC) to improve outcomes, but at some additional cost.[20]

Recently, the International Energy Association (IEA) noted the importance of nuclear energy for achieving Canada's Net Zero targets.[21] While the federal government and the western provinces are

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[15] Strategic Policy Economics, "Towards a National Energy Vision", 2021.
[16] Strategic Policy Economics, "Towards a National Energy Vision", 2021.
[17] CBC News, "Quebec looks beyond hydroelectricity as last planned megaproject set to wrap", December 2021.
[18] Ontario Newsroom, "Province Asking Ontario Power Generation to Investigate New Hydroelectric Opportunities", January 2022; Strategic Policy Economics, "Towards a National Energy Vision", December 2021.
[19] SNC Lavalin, "Engineering Net Zero", March 2021; Strategic Policy Economics, "Emissions and the LTEP", 2016; Strategic Policy Economics, "Towards a National Energy Vision", 2021; The Canadian Encyclopedia, James Bay Project, January 31, 2011.
[20] Strategic Policy Economics, "Electrification Pathways for Ontario to Reduce Emissions", 2021.
[21] IEA, Canada Energy Policy Review, 2021.

supportive of Canada's SMR action plan, there is no material funding.[22,23] Concurrently, Ontario, with its low emission electricity sector profile dependent upon nuclear, is only pursuing small scale pilots with foreign-based technologies.[24] Given Canada's established need for low-carbon generation and the societal benefits of nuclear energy, the absence of nuclear in Canada's NZ strategy is jarring.

Analyses show that building new nuclear in Ontario is the best long-term solution for reducing emissions in the province. From a land use perspective, meeting Canada's emerging demand will only require 19 nuclear sites equivalent in size to the Bruce Power Complex. These facilities could be sited on 40,000 acres or 0.04 million acres of land – an area that is less than 0.1% of the land required to support wind or hydro.[25]

If the full price of carbon is incorporated in the CES and OBPS frameworks, the aforenoted three options will emerge as appropriate to their inherent regional advantages.

Recommendation #7 – The CES should support the deployment of emerging technologies that mitigate the need for gas-fired generation during the transition and for the long-term.

The CES discussion paper posed the question of the role that Distributed Energy Resources (DERs) could play in helping achieve the NZ 2035 goals for the electricity system. Three types of DER could be considered:

- Small gas-fired distributed generation, often Cogeneration;
- Renewables, typically solar; and,
- Storage.

Gas-fired generation based DERs should not be supported by the CES framework. Currently in Ontario, this type of installation is proliferating behind the meter due to generous provincial rate programs. However, as discussed previously, these kinds of applications could become less economic with a broad application of the carbon price in the GGPPA and/or OBPS and through rate reform.

Renewables-based DERs, typically defined as small, not grid scale installations e.g., rooftop solar, are high cost and largely non-dispatchable devices, even when coupled with storage. They add to the total system cost and require gas-fired back up as noted earlier. There are better alternatives. Programs such as Net Metering should be abandoned in jurisdictions with low fossil fuel supply mixes for these reasons. While these are provincial issues, the CES should provide clarity regarding the true costs, benefits and emission forecasts of DER.

Storage, although most often used to mitigate renewables intermittency, is the most attractive type of DER. The most valuable use of storage is for smoothing local demand. Locating storage as close as possible to the load provides flexible capacity that can reduce the need for gas-fired generation to meet

[22] NRCan, SMR Action Plan, 2021.
[23] NII, Nuclear Intelligence Report, "Why hydrogen needs nuclear", September 2021; Strategic Policy Economics, "Electrification Pathways for Ontario to Reduce Emissions:", 2021; Ontario Newsroom, "Small Nuclear Reactor Study Released, Alberta Signs SMR MOU", April 14, 2021.
[24] OPG, "OPG advances clean energy generation project", December 2, 2021.
[25] NII, Nuclear Intelligence Report, "Why hydrogen needs nuclear", September 2021.

peak, reserve and daily intermediate demands. Local community-scale storage may be the most cost-efficient as residential-scale storage costs are expected to remain high for some time.

Other emerging demand side management (DSM) technologies could potentially accelerate the transition to a NZ grid: electric vehicles (EVs); dual-fuel heat pumps; and, electrolytic hydrogen.

- EVs could effectively represent a subsidized form of small-scale storage directly available in homes and buildings.[26] Depending on the level of EV penetration, EV batteries could obviate the need for other forms of storage. Bidirectional EV chargers significantly enhances their utility.
- Dual-fuel heat pumps that operate off both electricity and natural gas could help mitigate the need for "peaking" gas-fired electricity generation in the winter. Producing heat from natural gas is far more energy efficient than generating electricity. Furthermore, blending renewable natural gas and hydrogen and then injecting it into the gas distribution system could reduce emissions during the transition to NZ.
- In the longer-term, as the hydrogen economy grows, electrolysers could meet most of the peak and reserve needs currently forecast for natural gas generation. [27]

A network of distributed hydrogen electrolysers integrated with the electricity system coupled with emerging DSM gas/electricity systems could achieve Canada's NZ objectives at a lower cost. These options reduce the use of natural gas and need for generation capacity while increasing the efficiency of the transmission and distribution system. When coupled with non-emitting baseload supplies, these technologies can effectively smooth local demand.[28]

Nuclear provides a well-suited foundation for an integrated low-carbon technology package that provides distributed storage capabilities and electrolytic hydrogen production. Accomplishing the CES NZ objectives can be accelerated by incenting new, low-carbon baseload generation. Storage and other DSM technologies will follow assuming the current biases favouring gas-fired generation are appropriately priced and regulated.

<u>Provincial and Territorial Considerations</u>

Recommendation #8 – The CES should be focused on policy drivers that can be used by the provinces and territories to develop the desired net zero emissions electricity system.

The CES discussion paper acknowledges that the provinces and territories have constitutional jurisdiction over electricity. However, the CES represents an opportunity to promote a national collaborative vision for electricity and other energy resources that benefit all of Canada. It can do so by establishing a common view on electricity system emissions, carbon pricing, the need for market reforms, and an end-point emissions standard to establish the conditions for regional investments in BECCS and DAC to support the CES NZ objective.

A Common View - The CES should define policy priorities to encourage provincial/territorial government accountability in providing a low-carbon electricity supply mix. The low carbon energy transition

[26] PlugNDrive, "EV Batteries Value Proposition for Ontario's Electricity Grid and EV Owners", 2020.
[27] PWU submission on the Natural Resources Canada (NRCan), "Hydrogen Strategy for Canada", 2020.
[28] Strategic Policy Economics, "Electrification Pathways for Ontario to Reduce Emissions", 2021.

exemplifies Canada's enduring policy dilemma – balancing the regional differences and disparities in resources and interests created by our vast geography. By focusing the CES on policy priorities, provincial/territorial governments are better able to optimize their own carbon footprint in support of achieving Canada's NZ goals.

Such an approach would provide government and private decision-makers with a framework to help balance and optimize the environmental, economic, and social benefits potentially achievable by building more low-carbon electricity, decarbonizing fossil fuels, and producing hydrogen. Maximizing the societal benefits from such investments would improve Canada's economic competitiveness while creating jobs and economic wealth. Governments could also work cooperatively to promote procurement criteria that further optimize these benefits.

Carbon Pricing - The OBPS and GGPPA rules for fossil fired-generation, consistent with the more aggressive approach recommended earlier, should be a sufficient federal tool to encourage the requisite decisions by regional governments and innovation by developers.

As previously noted, Ontario's emerging capacity gap and need for new gas-fired generation capacity in the near-term is a major challenge. The CES should encourage storage options that help avoid the need for new gas plants during the transition period and encourage investments in low-carbon baseload supply.

As well, these revenues should be invested to strategically optimize the cost effectiveness of carbon reductions and mitigate the impacts on Canada's trade exposed industries. Analysis shows that with a nuclear-based electricity system coupled with DSM and hydrogen and the smart re-investment of carbon price revenues, the requisite carbon price required to achieve Canada's 2050 targets could be as low as $106/tonne.[29] Keeping the carbon price low and implementing border adjustments could ensure low-carbon energy resources generate domestic economic growth and a competitive advantage in the global marketplace.

Market reform - In order to move effectively forward to a decarbonized electricity system, some deregulated provinces, like Ontario, will require electricity market reform, specifically with respect to resource procurement.[30] Analyses show that Ontario's electricity market design will not successfully secure the low carbon resources needed to achieve NZ.[31] Furthermore, such market mechanisms do not encourage achieving broader societal benefits from these system investments.

End-Point Emissions Standard - Establishing an aggressive carbon price and goal to eliminate gas-fired generation precludes the need for a specific end-point emissions intensity standard and the associated compliance confirmation mechanisms. This end point efficiency standard should be zero or negative, as all of these technologies are forecasting lower costs than single cycle natural gas-fired generation with a fully applied federal carbon price.

Recognizing the inherent challenges in eliminating gas-fired generation, the CES should include mechanisms to encourage CCUS, Direct Air Capture (DAC) of carbon and BECCS technologies. It is worth noting that the BECCS has the advantage of producing negative emissions, a DAC requires significant

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[29] Strategic Policy Economics, "Emissions and the LTEP", 2016.
[30] Strategic Policy Economics, "Electrification Pathways for Ontario to Reduce Emissions", 2021.
[31] Strategic Policy Economics, "Electricity Markets in Ontario", 2020.

electricity to operate and CCUS technologies require a DAC to eliminate emissions that escape the CCUS systems. The end point zero emission standard may require an effectivity date beyond 2035 in order to provide a reasonable transition period as described earlier. It may only be achievable by 2050 and hence may not be relevant as part of a CES NZ 2035 objective.

Recommendation #9 – Regional interprovincial Tx Interconnections are dependent upon the type and location of new non-emitting supplies.

Investments in interprovincial interties come with very high costs. Canada's current interconnection infrastructure is focused on north-south electricity exchanges with the U.S. Currently, there are modest exchanges between provinces and territories given the large distances between Canada's urban centers and sources of supply. This may or may not change as demands for low-carbon electricity increase across the country.

For example, the Atlantic loop is currently being explored to facilitate the delivery of the region's low-carbon hydro resources to meet growing electricity demands in urban centers in eastern Canada. Other similar opportunities may exist—low-carbon electricity from BC to Alberta; from Manitoba to Saskatchewan; and, increased bilateral electricity trade between Quebec and Ontario.

However, forecasts indicate that all jurisdictions will experience significant demand growth that exceeds the capacity of their existing resources. The economics of new transmission investments will be driven by the type of new generation that is located in each jurisdiction and the emission reduction role it can play helping neighboring jurisdictions.

The uptake among the provinces of new hydro, CCU and nuclear technology may influence decisions on the need for long run transmission assets. While hydroelectric development has challenges as previously noted, if CCUS gains favourable economics, it could be a game changer. It is conceivable that successful CCUS implementation in Alberta and Saskatchewan may result in those provinces supplying BC and Manitoba instead. Alternatively, nuclear remains one of the most locationally flexible, low-carbon bulk generation options that any province could adopt.

Recommendation #10 – The CES should objectively communicate meaningful cost references regarding the available emission reduction options to support discussion and decision-making.

Annex A of the CES discussion paper provides a summary of the "cost and technological readiness of important technologies". The information is sourced from the Energy Information Agency (EIA) 2021 Annual Energy Outlook, which is a legitimate source for anchoring cost data. The U.S. National Renewables Energy Laboratory (NREL) also maintains an Advanced Technology Baseline that is drawn upon by the EIA. The NREL data provides more information. However, the cost information as presented in the Annex is misleading and incomplete and would lead to biased and ill-informed decision-making. Table 1 of the Annex, for example, provides overnight capital cost and variable O&M, but no fuel cost.

The information as presented incorrectly suggests the lowest cost option. For example, the overnight capital cost of a CCGT with 90% CCUS costs $3600/kw versus grid-scale solar at $1700/kw. However, if used for baseload, the CCGT may have a 90% capacity factor, i.e. it produces full output for 90% of the time in a year. By comparison, solar in Ontario has only a 19% capacity factor. This means that the relative cost for solar, based on per MWh of electricity produced, would be five times higher and the CCGT 10% higher, leaving the CCGT at only 45% of the cost of the solar (e.g. 5*1700 = 8500 vs 1.1* 3600 = 3960). The capacity factor is a significant determinant of what is commonly referred to as a levelized cost of electricity (LCOE), a better metric for comparing costs between generation types if assumptions are aligned.

Furthermore, the CCGT option would incur a variable cost of fuel that is not shown in Table 1 and hence there are no mechanisms to assess the relative merits of even gas vs solar options on a cost basis. Additionally, as the CCUS of the CCGT is assumed to be 90% efficient, there are additional carbon cost implications.

The CES should present more relevant cost comparators, specifically LCOEs and should do so for each province and territory. Relevant factors include:

1) Capacity factor that will be realized reflecting the useful energy produced. This must not only consider the weather determined factors (e.g., Ontario solar's 19% capacity factor which is much less than assumed by the EIA) – but also the operational capacity factor that considers wasted energy as a function of the supply mix of the jurisdiction in which it may be installed and the penetration of renewables in it.
2) Regional cost structures that consider local labour and other supply considerations that affect the capital cost. The EIA publishes these for various regions in the U.S. The ECCC should provide equivalent assumptions for Canada; and,
3) Exchange rates should not be universally applied when converting U.S. costs to Canadian costs as not all elements of the cost of generation should be scaled uniformly by the exchange rate, particularly when there are some domestic sources of the supply. In general, generation options like nuclear with significant domestic content will have lower net exchange rate implications than for imported technologies e.g., renewables.

The previously described system modelling is required to establish the capacity factors relevant to each Canadian jurisdiction. The total system cost associated with a supply mix option is most informative. For example, Figure 4 compares a renewables-based solution to a CCGT with the CCS option and a nuclear-based option. These are the comparators that would be most informative to decision-makers.

The ECCC should undertake to provide this guidance and create a comprehensive Canada wide, jurisdictionally representative guide on the cost implications of the various, available technologies for a low-carbon supply mix. This guide should convey the total system cost impacts including for backup, storage and wasted energy.

Relationships to other Federal Initiatives

The PWU recommends that the CES framework be adjusted to more assertively adopt a clear position in support of the role of low-carbon nuclear to meet Canada's future energy needs. Nuclear generation is an essential element of Canada's response to the climate change challenge and for achieving NZ by 2050. Strong, sustained advocacy and policy incentives by the federal government are imperative to ensure long-term, low-carbon energy security for Canada and achieve its economic and environmental targets. By providing a more balanced view of the available options and the cost and economic implications of each, the federal government, in concert with its carbon pricing policies, should not need additional programs.

Recommendation #11 – Federal tax credits should be available to all low-carbon, baseload and intermediate resource options to support the CES's technology agnostic objective.

The PWU supports the notion of a CCUS investment tax credit to help Canada's transition to a net-zero economy. However, the scope of such a program should be broadly structured to help reduce emission costs and to provide equitable tax support for the emission reduction strategies of all the provinces and territories. This means expanding tax credits to other non-emitting technologies that help displace emissions from natural gas consumed by the electricity system.[32]

The PWU has identified three examples of technologies that warrant tax credit support, particularly in regions where long-term carbon storage may be cost prohibitive or non-viable:

i. *Biomass-fired generation*

Biomass-fired generation is a source of flexible, dispatchable, low-carbon energy that can displace the contributions of natural gas-fired generation.

For example, Ontario Power Generation's biomass-fueled Atikokan Generating Station's strategic geographic location with transportation and grid connections, existing biomass infrastructure, and available heat outputs support its development as a low-carbon energy centre.[33]

Analyses show that Ontario has vast, renewable biomass resources available from forestry and agriculture wastes and purpose grown crops. Equipping the station with carbon capture and some level of storage/utilization capacity (e.g., increasing yields in nearby greenhouses) would make it a net carbon sink. Utilizing the wasted heat for pellet production would expand the existing supply chain providing additional economic, environmental and social benefits, including enhanced regional energy security.

ii. *Nuclear Production of Zero-carbon Hydrogen*

Nuclear generation—existing and future and any associated infrastructure for hydrogen production should be eligible for tax credits. Nuclear's 24/7 baseload output provides cost-effective low-carbon electricity for hydrogen electrolysers. In addition, the production from these electrolysers can complement nuclear's baseload role while providing system services that displace the need for natural gas-fired generation.[34]

iii. *Role of Hydrogen Electrolyser in the Electricity System*

During times of peak electricity demand, flexible, rapid response resources are required to ensure reliability — the role traditionally played by natural gas-fired generation. Reducing demand during peak times would help mitigate the need for gas-fired generation. Hydrogen electrolysers supplied

[32] PWU submission on the CCUS tax credit.
[33] PWU, Submission to MNRF on ERO 019-3514, Ontario's Draft Forest Biomass Action Plan, 2021.
[34] Strategic Policy Economics, "Electrification Pathways for Ontario to Reduce Emissions", 2021.

by baseload nuclear power can respond quickly to the needs of the electricity system by adjusting their production levels.[35] Ultimately, sufficient hydrogen production can be used to flatten the seasonal and daily load profile to better utilize all assets within the electricity system, enable the use of low-cost non-emitting baseload resources and displace natural gas fired generation.[36] The tax credits should be extended to the infrastructure required to enable hydrogen production to benefit the system and displace the emissions from gas-fired generation.

Recommendation #12 – The federal Green Bond Framework (GBF) should be technology agnostic and include nuclear.

Nuclear energy was specifically excluded from the list of eligible GBF investments. This exclusion was arbitrary, without consultation and was not based on evidence, logic, or science.

Nuclear energy is clean, safe and affordable. Last year the UN's Economic Commission for Europe (UNECE) determined that nuclear energy has one of the lowest carbon life-cycle footprints of any generation technology. Nuclear energy was central to the most successful carbon-emission reduction initiative in North America: the closure of Ontario's coal plants and the refurbishment of the province's low-carbon nuclear fleet.

The Government of Canada is aware that nuclear energy is proposed for inclusion in the European Union's sustainable taxonomy for electricity production technologies. This reflects years of consultation and collaboration, including the work of the EU's Joint Research Centre (JRC), which found no evidence that nuclear energy does more harm to human health or to the environment compared to other electricity production technologies that are already included in the taxonomy. In Canada, Bruce Power, issued its Green Financing Framework in mid-2021 followed by the issuance of its first $500 million Green Bond in November the same year.

Based on a 70-year legacy of nuclear excellence, Canada is a top-tier nuclear nation with demonstrated expertise in uranium mining, research and development, design, construction, operation and refurbishment, fuel recycling and waste management. Canada's nuclear industry contributes $17 billion in GDP and provides 33,000 direct and 43,000 indirect jobs. The current GBF discourages investment in nuclear energy and exposes the success and sustainability of the existing industry to unnecessary risk.

Closing

The PWU believes these comments and recommendations are supportive of Canada's CES NZ 2035 objectives. We will continue to work with the ECCC and other stakeholders to help achieve Canada's climate goals. The PWU is committed to the following principles: create opportunities for sustainable, high-pay, high-skill jobs; ensure reliable, affordable, and environmentally responsible electricity; build economic growth for Canadian communities; and, promote intelligent reform of Canada's energy policy.

The PWU would appreciate the opportunity to brief the Ministry directly as offered during the CES webinar on March 22, 2022.

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[35] PWU submission to Canada's Hydrogen Strategy, 2020.
[36] Strategic Policy Economics, "Electrification Pathways for Ontario to Reduce Emissions", 2021.