Power Workers' Union (PWU) Feedback on IESO's Pathways to Decarbonization Study
Submission to the Ministry of Energy, ERO 019-6647, May 2023

The Ministry of Energy (MoE) is working strategically with its energy agencies and partners to ensure the building blocks are in place for an integrated energy plan that meets Ontario's energy needs and while maintaining reliability and our clean energy advantage, at the lowest cost to families and businesses. Critical initiatives, such as the IESO 's Pathways to Decarbonization Study (P2D Report) and the Minister's Electrification and Energy Transition Panel (the Panel), will help to inform the government's next steps towards its longer-term vision for an integrated energy system.

This future integrated energy plan will incorporate input from Ontario families and businesses, stakeholder groups and Indigenous communities. To this end the Ministry of Energy is seeking feedback on the P2D report and, in particular, the IESO's "no-regret" recommendations.

The Power Workers' Union (PWU) is pleased to support the Ministry of Energy's efforts to develop an approach to energy planning that helps decarbonize Ontario's energy system. During the last several years, the PWU has supported independent analysis of Ontario's options for meeting its energy challenges. This submission draws upon previous PWU advice to the government, the Ontario Energy Board (OEB) and the Independent Electricity System Operator (IESO):[1]

- MENDM's reform of the long-term energy planning framework (2021);
- MoE's need for robust analytical capability from its consultants for the 2022 Pathways Study for the Panel;
- IESO's P2D Study assumptions (2022);
- IESO's DER Potential Study (2022);
- Detailed requirements for benefit costs analysis for the OEB's Framework for Energy Innovation (2023);
- Advice to the Panel regarding the IESO P2D Study (2023);
- IESO's 2023 Annual Acquisition Report Approach (2023);
- NRCan Grid Modernization (2023); and,
- Finance Canada's Proposed Clean Tech Investment Tax Credit (2023).

The body of work that has underpinned the above noted PWU submissions points to future electricity system options with much lower cost and far superior economic benefits to the province. The MoE should apprise themselves of these analyses.

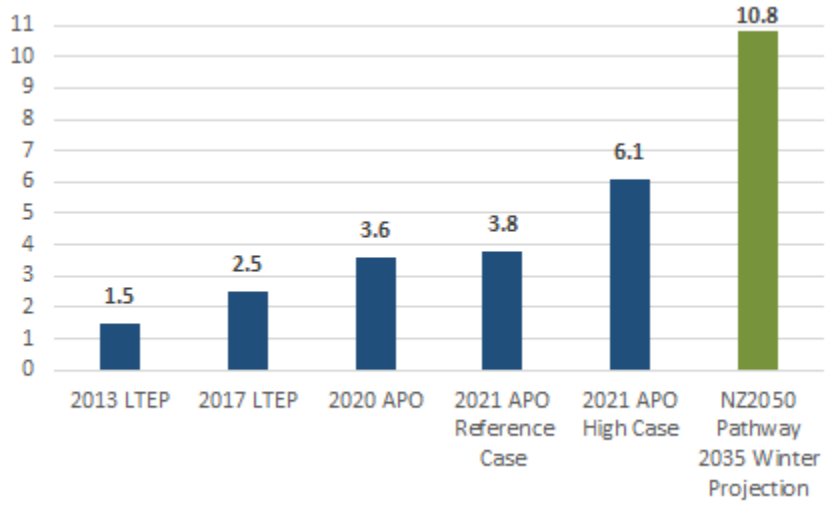
Context

The IESO's P2D Report illustrated a possible non-emitting supply mix scenario for 2050. An unresolved challenge, as noted by the IESO is the definition of the transition pathway options. Ontario is facing an electricity system crisis that is forecasted to result in brownouts before 2030.[2] The nearer-term needs are the focus of the IESO's proposed "no regret" actions and the MoE's questions to stakeholders.

[1] Copies of all PWU submissions are available at at https://www.pwu.ca/pwu-connects/submissions/
[2] https://torontosun.com/opinion/editorials/editorial-ontario-at-risk-of-blackouts; Toronto Star; "Ontario must double down on energy storage to combat looming supply issues", Oct 7, 2022, argues that the IESO's plan for

This crisis results primarily from the IESO's adoption of conservative demand forecasting assumptions and their over dependence upon procurement of natural gas fired generation through their administered electricity markets. Following an intervention in March 2022, the IESO changed its procurement approach but struggled for the last 18 months to accept the more appropriate procurement criteria. However, despite the recent P2D study, the IESO has not included any plans in their APO or AAR processes for the needed new non-emitting generation. Figure 1 shows how since 2013 the IESO continued to underestimate Ontario's long-term electricity needs through to the 2021 APO.[3] This trend was acknowledged by the IESO's Stakeholder Advisory Committee (SAC) Working Group which stated that each IESO forecast since 2016 has resulted in larger supply shortfalls.[4] The P2D Report now shows an additional 12 GW of peak demand above the 2022 APO forecast.

Figure 1: Trend in IESO 2030 Capacity Gap Forecast Assuming All Existing Resources are Renewed
(GW by Source of Forecast)



This risk is further compounded by demand rising faster than the IESO's forecasts, driven by the accelerating adoption of new technologies by consumers as they switch from fossil fuels.[5] Furthermore, Government policies in Canada and Ontario continue to increase public interest in decarbonizing as fast

---

Ontario must "increase the use of natural gas to produce power and to go big into energy storage to avert a looming power crunch that could lead to rotating blackouts" and claiming Minister Smith said a "limited" increase in gas generation is necessary to avoid "emergency actions" such as blackouts and conservation appeals; https://www.cbc.ca/news/canada/toronto/ontario-gas-plant-electricity-doug-ford-government-1.6820256 quotes Ford's energy minister, Todd Smith, says Ontario needs gas plants now to help meet an expected surge in demand for electricity and to provide power while some units of the province's nuclear stations are down for refurbishment. "It's really important to have natural gas as an insurance policy to be there to keep the lights on and provide the reliability that we need."; PWU submission to the MENDM, 2021; Strategic Policy Economics, Electrification Pathways for Ontario, 2021.

[3] Figure originally provided to the IESO in the PWU's submission on the 2021 APO in Jan 2022. The NZ2050 pathway is from Strategic Policy Economics' demand forecast in Electrification Pathways for Ontario, 2021.

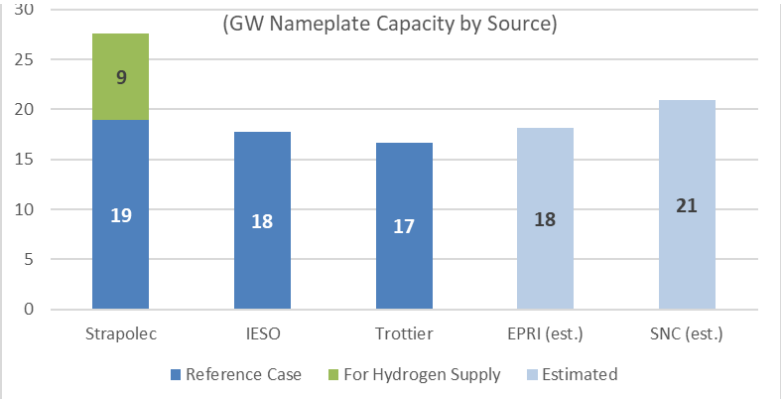
[4] SAC Challenge Statement on Currency and timing of new resources, March 2022.

[5] Clean energy is moving faster than you think- IEA, Financial Times, Apr 14, 2023.

as possible.[6] But Ontario does not have the low-carbon energy resources in place, nor is it possible to build them soon enough. The IESO's P2D Report acknowledges that demand may outpace supply requirement projections. The PWU suggests further that there are many drivers of demand from economic growth that are not yet considered in the forecast such as the critical minerals strategy, the investment in needed infrastructure like electricity, and the emerging immigration policies that will see accelerated population growth. The IESO's Stakeholder Advisory Committee (SAC) advised the IESO that it should consider developing a greater understanding of demand side trends to ensure it can identify needs in a timely manner.[7]

The options for developing the requisite new generation capacity are limited, even cost not-withstanding. The IESO's suggested options are limited to nuclear, hydro, possible imports from yet to be developed new hydroelectric capacity in Quebec, and a fleet of hydrogen fueled flexible generation that is supplied from outside the province and paired with intermittent renewables. The IESO has rightly pointed out that the timelines are on the order of decades for developing the bulk solutions required: nuclear, hydroelectric, electrical transmission, and hydrogen infrastructure. The IESO has been clear that renewables cannot solve Ontario's energy problems without being paired with flexible thermal generation and enabled by extensive transmission. Furthermore, the IESO's P2D Report scenario has largely discounted the possibility of new hydroelectric generation based on cost and ruled out carbon capture in the long run as not suitable for natural gas "peaker" plants. It is worth noting that the 4000 MW of new imports from Quebec are unlikely to materialize given the challenge of electrification demand in that province.[8] It is also worth noting that conventional nuclear is the only non-emitting new generation that can provide Ontario with the amount of non-emitting supply needed in the short term to get the transition started. Recent studies examining future supply mix options for Ontario all identify a need for 18 to 21 GW of new nuclear in Ontario as shown in Figure 2.[9]

Figure 2 –Forecasts of New Nuclear for Ontario



[6] Federal subsidies for EVs and heat pumps, the federal clean technology standard and ITCs, Ontario rate programs to encourage EVs and electrolytic hydrogen, OPG electrify campaign, Ontario government media campaign about the need for a Green Ontario.
[7] IESO SAC Meeting materials, March 2022.
[8] Hydro Quebec, 2022-2026 Strategic Plan, 2022.
[9] CNA, Environmental Scan Presentation at CNA Policy Workshop, Feb 2023.

The IESO has prudently identified several challenges to be addressed:

- Large infrastructure, e.g., hydroelectric, nuclear & transmission, can take 10 to 15 years to operationalize;
- Communities and First Nations across the province want a voice in how and where new infrastructure is located, requiring meaningful and transparent discussions about siting and land use;
- Many technologies, including low-carbon fuels and small modular reactors, are still in development;
- Energy plans need to be approved and new infrastructure needs to be planned, permitted and sited; and,
- Costs must be carefully managed to ensure the actual impact on total energy costs is affordable and Ontario energy prices remain competitive.

There is evident urgency to resolving Ontario's energy planning framework and initiating the siting and procurement processes, particularly for nuclear, the generally accepted most economic option for supplying Ontario's future baseload electricity needs. The PWU believes that there are alternative electricity system scenarios that can provide lower cost and higher economic and environmental benefits to Ontario than identified by the P2D scenario. To unlock these opportunities requires urgent reform of Ontario's long term planning framework and revised roles for the MoE, IESO, and OEB. The PWU's recommendations are organized into three categories:

1) Specific supply mix considerations addressing the first three of the above IESO-identified issues

A) Accelerating siting and procurement design for nuclear and hydro

1. The procurement approach for long-economic life span nuclear and hydro assets be developed as soon as possible.
2. The government should establish an energy infrastructure development plan and a communication program that clarifies what the public and societal needs for new energy infrastructure are, and the considerations that must be weighed to achieve Net Zero.
3. The government should ensure that appropriate business models reflect Indigenous and Community interests.
4. The government should pursue validation of hydroelectric generation options, and include within any procurement criteria the economic benefits to taxpayers and ratepayers over the life of the projects and reflect them in the pathway planning.

B) Objectively evaluating the benefits of hydrogen, CCUS and available strategies for the off-gas transition

5. The MoE should ensure that proper modelling of how renewables are integrated in the electricity system is performed with adequate fidelity to bring out the full system cost implications.
6. The MoE should continue to evaluate the feasibility of carbon capture in Ontario, including Northern Ontario e.g., the potential at the Atikokan (biomass-fuelled) Generating Station to provide a carbon sink offset for peaking natural gas facilities.
7. The MoE should continue to support the development and implementation of electrolytic hydrogen within Ontario's hydrogen strategy in concert with the work of NRCan.

8. The MoE should promote the examination of the potential synergies of electrolytic hydrogen with the electricity system to optimize cost.
9. The MoE should ensure that electrification pathways consider the full cost of renewables operations over their economic life under various scenarios and optimize the cost effectiveness of any emission reduction benefits they provide during the energy transition.

C) Examining the implications on Transmission costs of integrating intermittent renewables

10. To accelerate the connection of the needed new supplies and minimize transmission costs, Ontario should consider siting new nuclear facilities at locations with existing transmission connection assets.
11. As the cost risks for wind resources are significantly higher in Northern Ontario, other known cost-effective resources should be prioritized in the near-term. The cost effectiveness of developing significant wind assets in Northern Ontario should be clearly and transparently established by a long-term energy plan prior to any commitments being made.

D) Validating the benefits, costs, and associated limitations of DER and CDM

12. Energy Efficiency programming should be targeted at dual heat pumps, bidirectional charging of EVs and BTM DSM tools, such as TOU rates.
13. The MoE should review and consider the PWU's BCA and integrated planning recommendations made to the OEB.

2) Planning, Procurement, and Regulatory Framework considerations

14. The MoE should ensure that effective mechanisms are in place to financially support (combination of rate and or tax base) to help mitigate the risks to public and private investors undertaking site identification work and EAs.

15. The MoE should re-visit the PWU's recommendations made in its 2021 submission to the MENDM.[10]

3) The need for explicit and transparent cost responsibility and greater accountability thereto, addressing the last of the above IESO-identified issues.

16. The MoE should ensure that future alternative scenarios are adequately considered and evaluated. Additionally, a robust, transparent mechanism for independently validating principal assumptions and approaches is required to better inform decision makers.
17. Ontario needs a transparent, accountable, and effective long-term energy planning framework to ensure the development of reliable and affordable energy infrastructure.
18. The OEB could better represent civil society's interests with inputs to IESO's planning activities, where these interests pertain to the implications of IESO's plan on electricity and natural gas rates.
19. The MoE should ensure that the resource acquisition planning framework and procurement approach prioritizes a "low system cost" approach, considers the cost implications and

[10] PWU Submission to the MENDM on Reforming the Long-Term Energy Planning Framework, 2021.

benefits of integrated bulk, regional, and local solutions and optimizes the economic benefits of infrastructure investments.

Specific Supply Mix Considerations

The majority of the questions posed by the MoE pertain to specific supply mix implementation considerations which have been grouped in four areas:

A) Accelerating siting and procurement design for nuclear and hydro;
B) Objectively evaluating the benefits of hydrogen, CCUS and available strategies for the off-gas transition;
C) Examining the implications on transmission costs of integrating intermittent renewables; and,
D) Validating the benefits, costs, and associated limitations of DER and CDM.

A common theme among the above is the need for an effective long term energy planning framework which is discussed in the next major section.

A) Accelerating siting and procurement design for nuclear and hydro

As the MoE has acknowledged, the IESO's P2D Report recommends beginning work on planning and siting for new resources like new long-lived energy storage (e.g., pump storage), nuclear generation and waterpower facilities.

Given the recognized timelines for developing such projects and the urgent need to build out a non-emitting energy system to meet the rising demand from electrifying Ontario's economy, the PWU agrees that the initial analysis and identification of location/site options should begin as soon as practicable. The PWU also agrees that the government should ensure the protection of existing corridors of land and rights of way that will likely be needed for future transmission lines, e.g., to connect new nuclear facilities at sites with existing transmission infrastructure.

The PWU further recommends that:

Recommendation #1 – The *procurement approach* for long-economic life span nuclear and hydro assets be developed as soon as possible.

> The IESO's procurement processes over the last year have proven cumbersome, taken significant time to advance, are putting the required in-service dates of new capacity at risk, and, as several analyses have shown, remain ill-suited for the competitive procurement of the non-emitting generation resources now required in Ontario.[11] The PWU has frequently commented on the shortcomings and risks in the IESO's current procurement approach in

[11] Strategic Policy Economics, "Electricity Markets in Ontario", 2020; Strategic Policy Economics, "Electrification Pathways for Ontario", 2021; Green Ribbon Panel, 2020.

previous submissions e.g., the IESO's Resource Adequacy and Annual Acquisition Report consultations.[12]

The PWU's 2021 Submission to the MENDM also noted that clear government actions, such as expedited requests for expressions of interest in new non-emitting supply, would send a positive message to private sector investors, and help accelerate resource development.

The MoE has asked for feedback on two additional areas:

1) Early engagement of the public and indigenous communities; and,
2) The potential for development of new hydroelectric generation in light of the costs.

Engagement

Each step of the development process – planning, siting, approvals – requires robust consultations with affected stakeholders e.g., the general public, affected governments, including municipalities and Indigenous peoples.

Recommendation #2 - The government should establish an energy infrastructure development plan and a communication program that clarifies what the public and societal needs for new energy infrastructure are, and the considerations that must be weighed to achieve Net Zero.

The Government needs a strong communication plan that clearly establishes the "collective" need to achieve Net Zero, the challenges ahead, the viable generation options and urgency to act immediately.

A transparent, detailed benefit/cost-based comparison of the options for achieving Net Zero will be a prerequisite in the communication plan. This provides the foundation for the pathway Ontario chooses going forward.

Recommendation #3 – The government should ensure that appropriate business models reflect Indigenous peoples Community interests in participation.

Indigenous participation in major infrastructure projects, including energy, is evident across Canada. Drivers include treaty rights, self-determination, and cultural values such as sustainability. Canada's First Nations want new developments to include their participation or "there will be no development".[13] Ontario's electricity sector has many examples of successful projects that have included Indigenous peoples' participation.[14]

Opportunities for New Hydroelectric Development

The IESO has identified 650 MW of new hydroelectric generation in its P2D scenario and OPG has indicated that there may be up to 5000 MW of new potential capacity in Ontario. The MoE has asked for

[12] PWU Submissions to the AAR and APO from 2021 to 2022; PWU Submission on the IESO's 2022 Annual Acquisition Report, April 27, 2022.

[13] First Nations leaders in Treaty 9 say their message is clear — no development without us as partners, CBC News, Apr 26, 2023.

[14] Hydro One launches industry-leading 50-50 equity model with First Nations on new large-scale transmission line projects, Hydro One, Sept 2022.

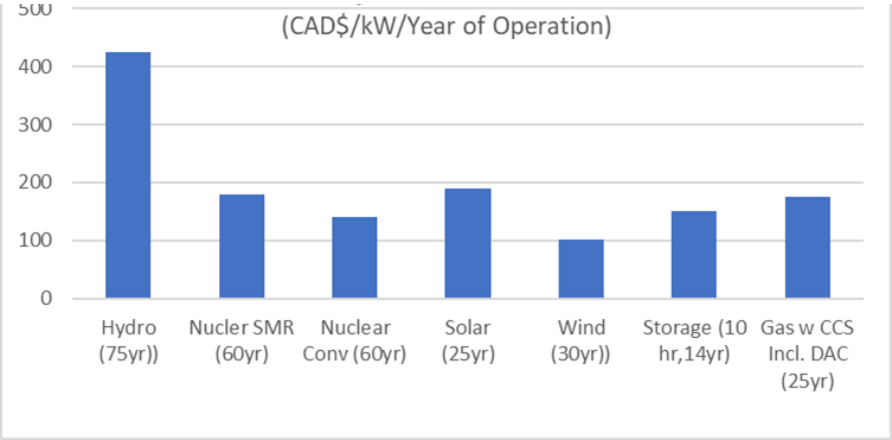
perspectives on whether the capital costs for hydroelectric generation, which may be higher than nuclear, wind, solar, and natural gas, can justify investments in large scale hydroelectric assets that may operate for over a hundred years.

Given Ontario's significant need for non-emitting generation to avoid brownouts as its economy transitions to Net Zero, it is prudent to evaluate as many cost-effective new generation options as practicable. The evaluation of Ontario's viable, available hydro options should continue as recommended by the afore noted parties. Several additional investment considerations are relevant: Capital cost recovery of asset life; ultimate unit cost of energy produced; future benefits from long lived assets; and available public policy tools to balance costs to current vs future generations.

While capital costs are important, the more relevant factor is how they are financed over the economic life of the project and combined with the annual operating costs to yield the annual cost of producing the energy. For decision-makers and policy makers, the most appropriate metric is the ultimate unit cost of energy e.g., $/MWh.

The IESO's P2D assumptions, confirmed in OPG's report, suggest that the capital investment in a hydro facility could be over 10 times that of wind. However, when capacity factors and economic life of the assets are considered, capital investment costs are more comparable across generation options as illustrated in Figure 3.[15,16]

Figure 3 – Life Adjusted Energy Equivalent Annualized Capital Cost Allocations



When considering the low annual operating costs of hydro, the P2D Report shows the annual revenue requirement is similar to nuclear, although hydroelectric's lower capacity factor suggests a per unit of energy cost exceeding $220/MWh, more than double that of nuclear. However, for renewables to provide the same functional capabilities to the system, they must be paired with storage and/or flexible generation, such as natural gas in the near term or in the long-term hydrogen fueled flexible generators,

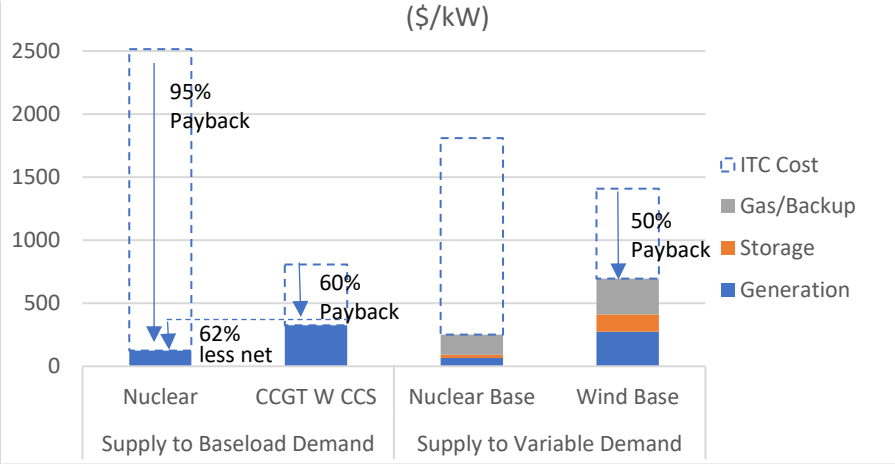
[15] Illustration is based on the assumptions in the IESO's P2D Report. Chart originally produced by the PWU in its submission on Finance Canada's Proposed Clean Tech Investment Tax Credit (2023).
[16] Life adjusted annualized energy equivalent Capital allocation is calculated by dividing the capital cost per kW by the asset's operating capacity factor and then by the number of years of economic life (shown in brackets). All values from IESO except Gas with CCS which is from CER and Strategic Policy Economics.

as the IESO has simulated. Analyses have shown that the equivalent costs for these solutions are in excess of $260/MWh.[17]

The economic life of the options being compared is also important. Twenty to thirty years from now, renewable generation or clean fuel-fired generation plants will require replacement at higher cost driven by inflationary factors. Thirty years of inflation, at a conservative 2% per annum increase, results in an 80% increase in cost. There is a long-term economic benefit to long lived assets such as hydroelectric, nuclear and transmission, whose initial higher capital costs will not be subject to inflationary pressure. It is for this reason that Ontario's existing hydro and nuclear assets are Ontario's lowest cost supply today.

Finally, the notion of incurring higher costs now in anticipation of longer-term lower costs raises the question of creating savings for future generations at the expense of current generations. Fortunately, investments in hydro development directly benefits Ontario's economy with at least 75% of capital expenditures and 90% of lifetime operational expenditures spent in Ontario.[18] Such domestic spend levels translate into significant benefits to taxpayers. In the assessment of the recent federal Investment Tax Credits (ITCs), nuclear was shown to recover almost the full cost of federal credits in the first 20 years of operation. This recovery is twice that which could be expected from renewables-based solutions as shown in Figure 4. The economic benefits of long-lived assets provide government with mechanisms to defray the costs to current generations and still provide benefits for future generations.

Figure 4 – Federal Tax Recovery from Energy Projects



Recommendation #4 – The government should pursue validation of hydroelectric generation options and include within any procurement criteria the economic benefits to taxpayers and ratepayers over the life of the projects and reflect them in its pathway planning.

B) Objectively evaluating the benefits of hydrogen, CCUS and available strategies for the off-gas transition;

[17] PWU submission on Finance Canada's Proposed Clean Tech Investment Tax Credit (2023)
[18] OPG, Made-in-Ontario Northern Hydroelectric Opportunities, 2022, page

The P2D report shows the reliability role provided by natural gas-fired generation will continue to be required in the short to medium term and indeed to an even greater extent in the future.[19] In the long term, the IESO has postulated the use of hydrogen fueled thermal generators in place of natural gas to meet this need. The MoE has asked for comments or concerns regarding two factors:

1) The development and adoption of hydrogen or other low-carbon fuels for use in electricity generation in the long term and potential cost increases for electricity consumers; and,
2) Whether additional investment in clean energy resources should be made in the short term to reduce the energy production of natural gas plants.

Long Term Strategies

The fundamental long-term Scenario of the P2D Report for supplying flexible generation in 2050 relies on a fleet of hydrogen-fueled generation capacity using imported hydrogen from Alberta. The PWU does not believe this to be a likely outcome for Ontario as the costs of the IESO's P2D Scenario are likely much higher than the P2D report suggests, many near-term factors may impact the availability of options prior to hydrogen infrastructure being available and the fact that more cost-effective alternatives exist.

a) Cost implications of the IESO P2D Scenario

An examination of the projected generation output from the IESO's P2D Scenario indicates that renewables have not been properly modelled in their forecasting. The IESO's analysis shows that only half of the nuclear production is utilized while 100% of the renewables output is assumed. This is a material misrepresentation of system behaviour in the IESO's scenario and is due to inadequate fidelity in the IESO's models. It is well understood that renewable production is a function of weather and does not align with electricity demand. Detailed assessments of renewables output in Ontario suggest that approximately a third of its output will be wasted or curtailed, even if equipped with storage. This shortfall will need to be made up by flexible generation. Furthermore, the IESO modelled storage, at 2000 MW, is insufficient to effectively backstop the inherent intermittency of wind and solar.

The cost implications of improperly modelling the system impacts of renewables intermittency will be significant, as previous PWU submissions have communicated to the MoE and the IESO.[20] These costs arise from the need for greater storage, generation from backup supplies and greater backup capacity to meet system requirements.

- *Storage:* Analyses suggest that the amount of storage warranted is 50% more than the P2D Report estimates could be required,[21] which could add additional cost of $0.5B per year.
- *Backup generation:* Analyses suggest that it is reasonable to expect that at least 15% of the wind output will be curtailed, requiring the hydrogen-fired backup generation to provide an

[19] The P2D Report states that the need for ramping capacity will double from the high range of 5000 MW today to up to 10,000 MW in 2050.
[20] PWU Feedback to the IESO on Pathways to Decarbonization Assumptions Assessment, March, 2022; PWU Response to the Ministry of Energy's Request for Information (RFI) on Scoping a Cost-Effective Energy Pathways Study for Ontario, June, 2022.
[21] Strategic Policy Economics "Electrification Pathways for Ontario", 2021.

additional 10 TWh, for a total output more than double what has been modelled. The IESO estimated $67/MWh[22] as the variable cost of hydrogen. A corrected figure for the IESO's assumption would increase the system's costs by another $0.8B, before contingency costs are added.

- *Greater backup capacity:* The IESO also overestimated the capacity contribution of Ontario's wind resources at times of peak demand. The contribution from solar has been correctly defined as negligible. The IESO has assumed that aggregate wind resources can provide a capacity contribution of 50% of their nameplate rating. The IESO also assumes a 20% capacity factor for wind resources. Other analyses show that this figure could be closer to zero for the 2.4 hrs/year required to meet NERC reliability requirements.[23] This reality will require an additional 8000 MW of hydrogen fired generation capacity at a cost of another $1.4B per year.

Combined, these three factors alone add up to approximately $2.7B/year, almost double the IESO's assumed cost of wind resources in their P2D report, effectively increasing the overall annualized non-hydro/nuclear generation costs by almost 20%. Additionally, there are the costs of the transmission infrastructure required to support Ontario's wind generation.

Recommendation #5 – The MoE should ensure that proper modelling of how renewables are integrated in the electricity system is performed with adequate fidelity to bring out the full system cost implications.

b) Near-term energy transition initiatives available to Ontario

The PWU previously indicated to the Panel two key elements of the energy transition that must be considered:[24]

- The role of Carbon Capture in supporting the electricity system should be examined:
    - More investment is flowing into carbon capture solutions than any other technology and Ontario is exploring the potential for carbon capture & sequestration.
    - Ontario imports most of its natural gas via pipelines from the U.S. In future, the economics suggest that hydrogen production from natural gas in Pennsylvania will be imported into Ontario as opposed to hydrogen from Alberta.
- Ontario's Hydrogen Strategy includes electrolytic hydrogen, the associated increase in electricity demand for which has not been included in the IESO's P2D forecast.

Carbon Capture

[22] The IESO P2D assumptions show the USD variable cost of hydrogen fired electricity generation to be $7/MWh plus a fuel cost of $41/MWh for a total of $48/MWh. The IESO P2D report has assumed a 39% conversion factor to Canadian dollars. Applying this factor to the $48/MWh yields $66.75/MWh in CAD. On the additional needed 21 TWh of energy this comes to an annual cost of approximately $1.4B.
[23] Strategic Policy Economics, "Extending Atikokan Biomass Generating Station (AGS) Operations", 2022..
[24] PWU letter to the MoE with advice to the Panel regarding the IESO P2D Study, Jan 2023.

The IESO has excluded a role for carbon capture in Ontario's electricity system assuming that it might not be economic for supporting peaking gas-fired generation. While this may be relevant to gas-fired generation in 2050, CCUS may offer benefits in the medium term.

1) The need for flexible supply may lead to higher capacity factors for some forms of generation, for example the previously described underestimation of the need for output from the flexible hydrogen fueled generation by the IESO. This could change the analysis performed by the IESO on the economics of CCUS.
2) The gas-fired fleet will be required to operate for a significant period of time between now and when sufficient non-emitting supply options come into service. Some of this will be baseload production when the Pickering Nuclear Generation Station ceases operation. Given Ontario's need to minimize emissions during the energy transition over the next twenty to thirty years, investments in carbon capture could provide an economic pathway. There may be specific gas-fired generation sites in Ontario that are more cost effective than others.
3) Ontario also requires carbon capture to help reduce emissions from the existing production of hydrogen for refineries, fertilizer production and possibly for new steel manufacturing processes in Hamilton.
4) The MoE is investigating carbon capture opportunities.[25] Analyses show that equipping the Atikokan Generating Station with carbon capture can make it a carbon sink, providing electricity system offsets to the potential emissions from rarely used peaking gas-fired generation and offering nearer term compliance options for the Clean Electricity Regulation (CER).[26]
5) Analyses have suggested a significant amount of potential carbon capture exists in Pennsylvania in shale formations.[27] If carbon capture is viable, there may be blue hydrogen options available from there, potentially before the infrastructure is available from Alberta. These options, while potentially lower cost, will introduce significant energy security and trade deficit implications for Ontario's economy. Such implications are additional reasons why the energy procurement approach mentioned earlier should consider socio-economic factors such as GDP, jobs and energy security.

Recommendation #6 – The MoE should continue to evaluate the feasibility of carbon capture in Ontario, including Northern Ontario e.g., potential at the Atikokan (biomass-fuelled) Generating Station to provide a carbon sink offset for peaking natural gas facilities.

Electrolytic Hydrogen Production

Ontario's Hydrogen strategy showcases the production of hydrogen through electrolysis, beginning with many hubs. Investments have already begun, such as the 20 MW facility near Niagara Falls. The IESO has been clear that Ontario's hydrogen strategy has not been included in the P2D Report and would increase demand further. Analyses have shown that this demand could require as much as 8 GW more baseload.[28]

The economics of electrolytic hydrogen production are improving. The federal government is providing significant tax credits for electrolytic hydrogen technology development. Combined with

[25] https://www.ontario.ca/page/geologic-carbon-storage
[26] Strategic Policy Economics, 'Extending Atikokan Biomass Generating Station (AGS) Operations", 2022.
[27] https://carbonherald.com/new-report-says-carbon-storage-could-generate-783b-for-great-lakes-region/
[28] Strategic Policy Economics "Electrification Pathways for Ontario", 2021.

Ontario's electric rate infrastructure, preliminary analyses performed for NRCan's Hydrogen Strategy Electricity working group indicate that industrial electrolytic production may be economically competitive. And the hydrogen infrastructure challenges in Ontario are less significant with electrolytic production. These developments may inhibit the development of hydrogen delivery infrastructure to Ontario from Alberta.

Recommendation #7 – The MoE should continue to support the development and implementation of electrolytic hydrogen within Ontario's hydrogen strategy in concert with the work of NRCan.

c) More affordable alternative solutions have been identified.

Analyses have shown that, in the presence of a material electrolytic hydrogen production capability in Ontario, electrolysers can provide very low-cost demand response options. Forecasts show that, in conjunction with low emissions baseload supply such as nuclear and appropriate behind the meter demand side management (discussed later), the use of available hydrogen electrolysers for demand response might remove the need for most peaking generation capacity by 2050.[29]

Recommendation #8: The MoE should promote the examination of the potential synergies of electrolytic hydrogen with the electricity system to optimize cost.

Short term strategies

The MoE suggests that "*the IESO P2D Report shows that most of the projected Ontario demand in 2035 can be met with the build out of non-emitting sources, but some natural gas will still be required to address local needs and provide the services necessary to operate the system reliably*." The PWU suggests that this statement is relevant only to the Gas Moratorium portion of the P2D Report which is based on the 2021 APO forecast. The 2021 APO forecast is materially lower than the IESO's more recent 2022 APO forecast. More importantly, the P2D Study does not include any plan with respect to meeting Ontario's projected 2035 demand of almost 12 GW of new peak generation over and above the gap forecasted in the IESO's recent 2022 APO. As a result of these more significant gaps, the findings of the moratorium portion of the P2D Report are not relevant to the real challenges facing Ontario's electricity system.

The implications of the P2D scenario are that Ontario will be depending upon its growing fleet of natural gas generation until long-lead time, new low-carbon nuclear and hydro resources are commissioned. It is important for Ontario's new energy plan to transition off natural gas to be strategic, benefit/cost based and include other government policy goals.

The role of renewables is a critical element given its dependence upon natural gas fired back up and the impact their variable output has upon Ontario's emission profile. The optimal utilization of wind power occurs when its output can be used to offset that of natural gas-fired generation, particularly for baseload supply. Solar generation may complement the use of natural gas for daytime or intermediate demand, particularly in the spring when solar output is at its peak. Inefficiencies arise when renewables output exceeds demand and require curtailment and/or supporting storage. Oversizing renewables capacity compared to natural gas places additional costs on the system. Given the significant potential

[29] Strategic Policy Economics, "Electrification Pathways for Ontario", 2021.

costs to the electricity system it is important that Ontario's energy transition plan include a full and transparent assessment of the viable role of renewables. Analysis shows that renewables solutions could cost twice as much as equipping Ontario's gas fleet in southwestern Ontario with carbon capture or other nuclear/storage hybrid solutions.

The extent to which Ontario needs to renew, replace, or augment the province's renewables capacity will be impacted by the development and availability of carbon capture and hydrogen technologies and applications. One risk that should be addressed is the extent to which new energy resources may become prematurely "stranded" before the end of their economic life.

Another consideration is the economic impact that carbon pricing in Ontario has on natural gas generation and its interplay with renewables. Currently, most of Ontario's gas-fired generation is largely exempt from the province's Emissions Performance Standard (EPS). Without a carbon price, renewables are more costly, two to three times the cost of any natural gas fired generation they may displace. The P2D Report has assumed high carbon pricing will be applied, but such a policy is not established. Analyses suggest that carbon capture technologies may be less costly to rate payers than carbon pricing.

An effective transition plan should lay out the timelines, identify the resources required, and assess how their integrated operations will be cost effective. The IESO's P2D study did not illustrate the costs of different options nor the transition pathway to get to 2050.

Recommendation #9 – The MoE should ensure that electrification pathways consider the full cost of renewables operations over their economic life under various scenarios and optimize the cost effectiveness of any emission reduction benefits they provide during the energy transition.

C) Examining the implications on Transmission costs of integrating intermittent renewables

The MoE noted that the P2D Report suggests significant transmission capacity will be needed to: ensure cost effective supply; help balance intermittent sources of electricity (e.g., wind and solar) with dispatchable supply (such as natural gas and energy storage); and, meet demand in regions with retiring assets. Specifically, the MoE has asked for feedback on the need to preserve transmission corridors and enable new lines to be built quickly and cost effectively as possible.

New transmission will be required to connect the approximately 70 GW of new supply identified in the P2D Report scenario. Developing cost-effective infrastructure is impacted differently by two broad considerations:

1) Connecting new nuclear and hydro facilities for baseload supply; and
2) Integrating renewables into the supply mix.

Connecting Nuclear and Hydro Generation

As discussed earlier, it is critical that Ontario begin the identification of possible sites for new nuclear and hydro facilities as soon as possible. These choices will impact on the long lead development challenges of new transmission to connect them. The economic life spans of both of these forms of

generation and the connecting transmission lines are well matched at about 60-80 years presenting an economic benefit while minimizing the risk of stranding assets in the future.

Siting new nuclear generation on existing sites already equipped with bulk transmission connections can help expedite projects. Examples include Ontario Power Generation sites such as Pickering, Darlington and Bruce, as well as former coal stations such as Nanticoke, Thunder Bay, Lennox and Wesleyville. Identifying which sites can benefit from existing transmission will help accelerate the in-service operation of the new supplies. Transmission support for new nuclear will come at much lower cost than other supplies given the 93% operating factor of the nuclear units. Most candidate sites are located near Ontario's major population centres in the south/central part of the province and will involve shorter distances for new transmission. Siting decisions on initial nuclear projects are "no regret" decisions given the forecast need for new supply and, as such, can be advanced immediately, even ahead of the development of the long-term energy planning framework addressed later.

Recommendation #10 – To accelerate the connection of the needed new supplies and minimize transmission costs, Ontario should consider siting new nuclear facilities at locations with existing transmission connection assets.

Most of the new hydroelectric capacity identified by OPG in the far north will require significant stakeholder engagement, especially with Indigenous peoples to move any hydro projects forward, along with the extensive transmission lines. New connecting transmission costs can be expected to be high given the long distances involved and the forecast 37% to 45% capacity factor of the new hydroelectric assets being connected. These considerations should be transparently addressed in Ontario's going forward plan to establish the reasonableness of the approach.

Connecting Renewables

The IESO's P2D report notes that connecting renewables, particularly wind resources is more costly than other resources and adds additional transmission costs to these wind assets. There are several factors:

- Low capacity utilization
- Shorter life of the generating assets (only 30 years) creating risk of stranded transmission assets
- Long transmission lines to the P2D identified wind sites
- Significant uncertainties associated with stakeholder support for new transmission assets in the North.

The P2D Report modelled 8200 MW of new wind generation in south/central Ontario, the area where most of the province's existing wind assets are located. These are allocated under $500M of incremental new transmission capacity. However, the P2D report also identifies 9400 MW of new wind assets in the north with a total required Tx development cost estimated at $5.4B. This represents over 20% of the projected $19B minimum cost of new transmission assets identified in the P2D forecast. On an annualized basis, these transmissions costs would add between $250M and $500 M to the cost of these renewables -- over an above the $2.7B of additional costs identified earlier. These factors should be transparently assessed in Ontario's plan given their low utilization factor and an increased risk of asset stranding before commitments are made for any new wind resources.

Recommendation #11 – As the cost risks for wind resources are significantly higher in Northern Ontario, other known cost-effective resources should be prioritized in the near-term. The cost effectiveness of developing significant wind assets in Northern Ontario should be clearly and transparently established by a long-term energy plan prior to any commitments being made.

Furthermore, analyse have shown that optimizing the integration of baseload generation, locally sited storage and hydrogen electrolysers to improve the utilization factor of the wires assets can reduce by 40% the contribution of transmission and distribution systems to the per unit of delivered energy cost.[30] This cannot be achieved with an over reliance on renewables and their centralized flexible generation backup. This places in further context the ramifications of undertaking higher cost onshore and offshore wind resources in Northern Ontario.

D) Validating the benefits, costs, and associated limitations of DER and CDM

The MoE, in light of the P2D Report's recommendation for more investment in energy efficiency programs, has asked how the programming at the end of the current 2021-2024 energy efficiency framework should be targeted to better address changing system needs as Ontario's demand forecast and electrification levels grow.

Energy efficiency, as a term, is a subset of the broader discussion of conservation and demand management (CDM). The current CDM framework targets peak demand mitigation as the priority areas for energy efficiency programs. As the electrification of Ontario's economy advances, the nature of these peaks can be expected to shift. The P2D Report shows that Ontario is shifting towards winter peaking within the next ten years and the peaks are shifting to different times of the day.

In previous PWU submissions, recommendations called for clarification of the system needs and how investments in CDM would cost-effectively address them.[31] It is commonly understood that the primary cause of these changes in peak behaviour are the accelerating consumer adoption of heat pumps and EVs, and their associated charging. The most commonly discussed mitigation mechanism is with behind-the-meter (BTM) demands side management (DSM). The IESO's commissioned DER Potential study of last year, identified that most of the potential for distributed energy resources (DER) is in the area of DSM involving EV charging and HVAC (e.g. heat pumps and air conditioning).[32]

The PWU has consistently advanced the benefits of electrification incentives for dual fuel heat pumps and bidirectional EV chargers.[33] Analyses demonstrate that these two innovations have the potential to reduce system peaks by up to 6 GW and further contributes to total system cost effectiveness and delivery system cost reduction discussed earlier.[34]

1) *Dual source heat pumps.* Studies have shown that this technology can help mitigate demand on the electricity system and reduce winter peaks by over 10% while still achieving a 90% emission reduction.[35] Blending renewable natural gas and hydrogen increases the benefits. While heat pumps are expensive, their adoption could be accelerated with incentives. NRCan currently

[30] Strategic Policy Economics, Electrification Pathways for Ontario, 2021.
[31] PWU submission on the IESO's Conservation and Demand Management (CDM) Mid-Term Review (MTR), 2022.
[32] Readers are cautioned, when reviewing the DER Potential Study, to carefully consider the numerous contentious modeling assumptions that it contains ref PWU Submission to the IESO on the DER Potential Study, 2022.
[33] PWU submission to NRCan on Grid Modernization, 2023; PWU Submission to the IESO on the DER Potential Study, 2022.
[34] Strategic Policy Economics, Electrification Pathways for Ontario, 2021.
[35] Strategic Policy Economics, Electrification Pathways for Ontario, 2021; Guidehouse Report to Enbridge, Pathways to Net Zero Emissions for Ontario; 2022.

provides heat pump subsidies. Ontario could prioritize dual fuel heat pumps that use natural gas on very cold days. Accelerating the adoption of dual fuel heat pumps versus other heat pump technologies could help manage the transition while a non-emitting electricity system is being developed.

2) *Bidirectional EV charging.* Studies have shown that on its own, bidirectional EV charging can provide much of the needed DSM required to help smooth end user demand. If even 30% of Ontario's EV owners were equipped with bidirectional chargers, Ontario's need for additional storage beyond that being procured today could be obviated.[36] Bidirectional EV chargers that provide vehicle-to-building (V2B) power supply should be supported, not vehicle to grid (V2G). Analyses show that connecting to the grid is complex and of negligible, if not negative, value. However, using a homeowner's EV to supplement electricity needs within the home and reduce demand from the grid provides the benefits required. [37] While NRCan currently supports the installation of EV chargers, Ontario should encourage it to support bidirectional chargers and consider provincial CDM programming.

While these challenges have received significant attention, other solutions can be effectively implemented without the need for developing sophisticated grid management capabilities. Time of Use (TOU) rate programs that incent consumers to shift their power consumption from times of daily peaks to times of lower demand have been shown to provide up to 70% of the benefits.[38] These solutions are more effective than hourly electricity market pricing as they are: deterministic, predictable, of known value and are simple to implement. Studies show that using market-based mechanisms with grid management technologies to control non-emitting technology resources is not viable in the absence of a true variable cost signal.[39]

With TOU regimes, it is easy to program EV charging and heat pump operations to avoid using electricity at peak times. Furthermore, bidirectional EV chargers can supply power to the home at peak times. The result could achieve a 15% reduction in peak demand, or, more importantly, defer the need to construct 15% more new capacity.[40] Ontario has recently implemented an Ultra-Low TOU program, specifically aimed at encouraging EV owners to charge their vehicles at night. That same program offers significant value to EV owners that use their vehicles to offset their power consumption during peak hours. The mechanism to achieve that is bi-directional EV chargers.

Recommendation #12 – Energy Efficiency programming should be targeted at dual heat pumps, bidirectional charging of EVs and BTM DSM tools, such as TOU rates.

Critical to best leverage of DER and other CDM initiatives is the development of a Benefit Cost Analysis (BCA) approach as was investigated by the OEB's Framework for Energy Innovation Working Group.[41] To implement such a framework requires a more integrated local, regional, and provincial bulks system energy planning framework. The PWU provide the OEB with specific implementation guidance on how

[36] Strategic Policy Economics, Electrification Pathways for Ontario, 2021.
[37] Strategic Policy Economics, EV Batteries Value Proposition for Ontario's Electricity Grid and EV owners, 2020.
[38] MIT, Electricity Retail Rate Design in a Decarbonizing Economy: An Analysis of Time-of-Use and Critical Peak Pricing 2022.
[39] Strategic Policy Economics, Electricity Markets in Ontario, 2020.
[40] Strategic Policy Economics, Electrification Pathways for Ontario, 2021.
[41] OEB, Framework for Energy Innovation: Setting a Path Forward for DER Integration, Jan 2023.

to successfully progress a transparent and effective integrated planning process and the associated BCA approach. integrated energy planning.[42] The recommendations included to integrate collaborative regional planning among the LDCs, transmitters and the IESO to establish requirements for cost-effectively meeting distributor needs with DERs.

Recommendation #13 – The MoE should review and consider the PWU's BCA and integrated planning recommendations made to the OEB.

[42] Considerations for Developing a DER BCA Framework – A Submission by the PWU to the OEB, Jan 2023.

Planning, Procurement, and Regulatory Framework Considerations

The MoE acknowledged the P2D Report's recommendation to streamline regulatory, approval and permitting processes in recognition of the long-lead times required for new generation and transmission infrastructure. The MOE has asked for feedback on appropriate and streamlined regulatory requirements for any additional feedback on the IESO's "no-regret" recommendations. The PWU anticipates that the MoE is both well informed and will receive advice from other stakeholders on such key elements as Environmental Assessments (EAs) and the Clean Energy Regulation (CER).

Recommendation #14 - The MoE should ensure that effective mechanisms are in place to financially support (combination of rate and or tax base) to help mitigate the risks to public and private investors undertaking site identification work and EAs.

The PWU focuses here on planning, procurement, and a regulatory framework. The IESO P2D Report recommendations include several statements:

- The scale of the energy transition is far reaching and will require new regulatory approaches to govern how Ontario makes decisions and develops and pays for its energy infrastructure;
- The Minister should work with all levels of government and with regulators to ensure that approaches to regulating the development of new large infrastructure projects and expanding the use of CDM, DERs, and other innovative technologies are appropriate given the scale and pace of the challenge ahead; and,
- The Minister establish a new and enduring process to track progress and plan for Ontario's energy transition. The planning should be incorporated into regular planning products such as the IESO's APO.

As has been indicated throughout this submission, the development of a credible energy plan provides the foundation for the sequence and framework for on-going decision-making on Ontario's energy infrastructure. The PWU has recommended that advancing the siting and procurement approach for new nuclear is a no-risk necessary step to begin the transition.

The PWU previously submitted several recommendations to the Ministry of Energy, Northern Development and Mines in response to their 2021 consultation on reforming the long-term energy planning framework.[43] The primary recommendations included:

- Ontario needs a transparent, accountable and effective long-term energy planning framework to develop reliable and affordable energy infrastructure.
- Government should provide clear, transparent, non-prescriptive Policy Priorities to establish goals and objectives for such areas as: total cost to ratepayers; emission reductions; job creation; GDP; energy security; and other government policy objectives such as roles for indigenous peoples.
- Using an IESO "Living Plan" approach, supported by the OEB's participation and annual reporting against the Government's Policy Priorities could require minimal change to existing roles, create

[43] PWU Submission to the MENDM on Reforming the Long-Term Energy Planning Framework, 2021.

negligible burden to planning timelines, and provide the accountability required to bolster the process.

These recommendations align with those in the IESO P2D report and were backed by a total of 20 specific recommendations on addressing Ontario's long term planning challenges. The importance and considerations relevant to the development of policy priorities and the planning roles of the government, OEB and the IESO were also communicated by the Green Ribbon Panel.[44]

In the two years following the MENDM's consultation, the need to address these critical issues has become more urgent. Addressing these complex issues during the transition of Ontario's energy system warrants an integrated energy plan — electricity, natural gas and the emerging hydrogen economy. The PWU recently communicated these recommendations to the OEB.[45]

Recommendation #15 – The MoE should re-visit the PWU's recommendations made in its 2021 submission to the MENDM.

[44] Green Ribbon Panel, Submission for the Ministry of Energy, Northern Development and Mines review of Ontario's long-term energy planning framework, 2021.
[45] PWU submission to the OEB on a Regulatory Framework, 2023. EB-2022-0302.

The need for explicit and transparent cost responsibility and greater accountability thereto

The MoE noted the estimated capital cost of the IESO P2D Report scenario and has asked stakeholders if they are concerned with the cost implications of the investments needed and for ideas on how to reduce costs of a new clean electricity infrastructure.

As previously noted in the discussion of hydroelectric investments, the magnitude of the capital costs is not the primary driver for rate payer costs but the resulting ultimate unit cost of energy e.g., $/MWh. The real concern to ratepayers is the $200-$215/MWh unit cost of energy not the upfront $425B capital cost.

The IESO P2D Report's findings raise three key considerations:

1) There are alternatives available to Ontario to meet the projected P2D demand at much lower cost and with greater economic benefit.
2) There is no transparent and accountable mechanism for evaluating and advising government on the cost and other implications of the IESO's recommendations and/or other alternatives.
3) There is no analysis of the impacts of the P2D scenario on Ontario ratepayer classes, most importantly the competitiveness of industrial electricity rates.

Available Better Alternatives

Analyses have shown that future electricity unit costs could be reduced by 25% from today to around $125/MWh in alternative system solution scenarios.[46] This provides a direct comparison for to the IESO's projected 30% growth in cost to $215/MWh. These lower costs in the alternative solution scenarios result from integrating BTM DSM, hydrogen electrolysis, optimization of the use of baseload and its integration with storage as referenced earlier in this submission.

This dramatic difference in potential future costs warrants a robust review. It is worth noting that the impact of the recent federal ITCs should have a greater impact on improving the economic benefits of the alternative scenarios than those of the P2D scenario due to their high domestic content and lower reliance on energy imports.

Recommendation #16 – The MoE should ensure that future alternative scenarios are adequately considered and evaluated. Additionally, a robust, transparent mechanism for independently validating principal assumptions and approaches is required to better inform decision makers.

Transparent Process Mechanisms for Accountability

Analyses have identified significant gaps in accountability for cost decisions of Ontario's existing electricity sector governance structure.[47] The lack of transparent validation of the cost implications of the P2D Report and any alternatives is an example of the risks to both tax and rate payers. The PWU raised these matters in its submission to the MENDM.

Recommendation #17 - Ontario needs a transparent, accountable, and effective long-term energy planning framework to ensure the development of reliable and affordable energy infrastructure.

[46] Strategic Policy Economics, Electrification Pathways for Ontario, 2021; Green Ribbon Panel, 2020.
[47] PWU submission to the MENDM on Long Term Energy Planning Framework, 2021.

Currently, Ontario's energy planning process has no mechanism that links cost decision accountability to the interests of ratepayers and the financial viability of the sector. The IESO has no mandate to address the cost-benefit trade-offs for total system cost and the nature and acquisition of the resources required to meet electricity demand. The omission of these cost implications is obvious in the IESO's current APO process where no cost information is included in the APO. The OEB provides an accountability measure, only "after" implementation plans are proposed by regulated entities. No such check occurs on the inputs to those plans or the planning decisions driving these investments. This creates economic/business uncertainty for utilities/generators that need stability and certainty in the regulatory environment to support their own planning and investments. This omission also impacts the OEB's mandate with respect to balancing ratepayer interests against the need to ensure the financial viability of the sector.

Rate payer implications

Under the P2D scenario, the Industrial Conservation Initiative (ICI) approach to industrial rates would see industry electricity costs grow from approximately $20/MWh in 2018 to approximately $66/MWh in 2050, a greater than 300% increase, and a factor of 10 greater than the IESO-suggested overall average impact of 30% may be.[48]

Analyses have identified gaps in Ontario's regulatory framework for protecting rate payer interests. Both the OEB and government play a role in rate-setting. Rates set by government, such as the ICI and Net Metering programs, currently have no accountability links to the OEB for assessing ratepayer interests. The ICI and net metering programs have both had unintended rate impacts on Class B rate payers. The Electricity Act does not require the IESO to consider consumer impacts, including the possible transfer of risks between categories of ratepayers or between ratepayers and taxpayers.[49] Indeed, the IESO does not report on the implications to ratepayers in its APO. The PWU previously recommended the following:

Recommendation #18 - The OEB could better represent civil society's interests with inputs to IESO's planning activities, where these interests pertain to the implications of IESO's plan on electricity and natural gas rates.

Several analyses have identified many viable alternatives to the IESO's current procurement approach that will mitigate risks, accelerate investor interest and reduce the costs of the transition. These procurement strategies all involve moving away from they IESO's markets-based mechanism to more sophisticated procurement processes and associated business models.[50] The PWU's 2021 MENDM submission noted that better specification of Ontario's demand needs—distinguishing between baseload and intermediate demand—would allow the province to act early and prudently to meet its

[48] The $66/MWh is the estimate for the variable cost of hydrogen fuel in the P2D scenario as discussed earlier in this submission.
[49] Electricity Act, 1998, Part II.2, Subsection 25.29 (3).
[50] Strategic Policy Economics, Electricity Markets in Ontario, 202; Strategic Policy Economics, Electrification Pathways for Ontario; Green Ribbon Panel, 2021.

future low carbon energy requirements. Three complementary procurement approaches could improve Ontario's needed procurement of non-emitting supplies:[51]

1. Procure by demand type required;
2. Seek integrated hybrid energy resources; and,
3. Enable the integration of existing assets to achieve Ontario's transition to a NZ electricity system.

Recommendation #19 – The MoE should ensure that the resource acquisition planning framework and procurement approach prioritizes a "low system cost" approach, considers the cost implications and benefits of integrated bulk, regional, and local solutions and optimizes the economic benefits of infrastructure investments.

Closing

There is evident urgency to creating an effective energy planning framework for Ontario and initiating the siting and procurement processes. This is particularly urgent for new nuclear generation, the generally accepted most economic option for supplying Ontario's future baseload electricity needs. There are alternative electricity system scenarios that can provide lower cost and higher economic and environmental benefits to Ontario than identified in the IESO P2D scenario. Unlocking these opportunities requires an urgent reform of Ontario's long term planning framework and revised roles and accountabilities for the MoE, the IESO and the OEB.

The PWU has a successful track record of working with others in collaborative partnerships. We look forward to continuing to work with the MENDM and other energy stakeholders to strengthen and modernize Ontario's electricity system. The PWU is committed to the following principles: Create opportunities for sustainable, high-pay, high-skill jobs; ensure reliable, affordable, environmentally responsible electricity; build economic growth for Ontario's communities; and, promote intelligent reform of Ontario's energy policy.

We believe these recommendations are consistent with, and supportive of Ontario's objectives to supply low-cost and reliable electricity for all Ontarians. The PWU looks forward to discussing these comments in greater detail with the MoE and participating in the ongoing stakeholder engagements.

[51] Strategic Policy Economics, Electrification Pathways for Ontario, 2021.