ONTARIO SOCIETY OF PROFESSIONAL ENGINEERS

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OSPE Response: Roadmap to Net-Zero- The Ontario Greens' Climate Plan

The Ontario Society of Professional Engineers (OSPE) would like to thank the Green Party of Ontario (GPO) for requesting input from the public on their Climate Plan. OSPE provides non-partisan public policy input to provincial political parties from a practical engineering perspective. Many energy and environmental concepts proposed by advocates are thought-provoking, even intriguing, but unfortunately suffer from a lack of a firm foundation in basic engineering.

As an advocacy organization for the engineering community and Ontario's 85,000 Professional Engineers that are trained in data-driven evidence and science, OSPE understands and knows that climate change is real, and has been accelerated by human activity. OSPE also knows that more must be done and that the current climate crisis represents a serious – even existential threat - to our way of life.

OSPE commends the Green Party of Ontario for its advocacy efforts and for raising public and political awareness of the catastrophic consequences of continuing to ignore sustainability in our decision processes. It is evident that a considerable amount of thought and effort went into developing the GPO's Climate Plan.

Our comments regarding this plan will focus on issues where engineers believe need further revision and clarity. For some of the reasons noted herein, OSPE believes that achievement of the Net-Zero target will take considerably longer, will cost more and/or will need considerably more effort than has been proposed. Regardless, the environmental issues are not waiting until the "perfect plan" has been created and accepted. Demonstrable progress is necessary.

Given its implementation challenges, sustained and consistent political leadership will be critical to the success of this plan. The costs of such policy implementation are such that it risks undermining public confidence and commitment to the changes necessary to decarbonize our way of life if funds are wasted on either poor choices or poor sequencing of various elements. OSPE agrees the cost and challenge of implementation is great: the cost of doing nothing, even greater.

Previous governments have been dismissive of some past OSPE recommendations resulting in avoidable energy price escalations. OSPE hopes the input provided will help the GPO revise its "Roadmap to Net-Zero." Decarbonization cannot be merely a political/election platform. It must be a credible plan that not only achieves its decarbonization objectives but is justifiable from a technical, cost and implementation perspective.

The current roadmap has several excellent objectives including both mitigative and adaptive goals that would achieve very significant emissions reductions in all our energy systems. However, OSPE believes that this plan could use some enhancements to reflect what is feasible from an engineering perspective.

OSPE has put forward the following comments and recommendations:

1. **Further decarbonization of Ontario's electricity generation capacity is not practical in the medium term, will not achieve a material reduction in overall greenhouse gas (GHG) emissions and risks exhausting public commitment to higher potential decarbonization initiatives.**

Ontario's electricity generation is essentially 96% emissions-free[1]. Given this, the considerable investment needed to further decarbonize this sector will not have a material impact in reducing either Ontario's or Canada's emissions. There are simply better immediate emission-reducing opportunities. The costs to extract the remaining GHG emissions risks exhausting public willingness to support the costs associated with achieving the rest of the roadmap's decarbonization goals.

Per Canada's Official GHG Inventory[2], Ontario's Public Electricity/Heat Generation sector emits only 4,450 kt CO_2-equivalent per year representing only 2.7% of Ontario's GHG emissions[3]. Even if we successfully cut these gas plant emissions by half, the effect would only be a reduction in overall, Ontario emissions by 1.4%.

Also, focusing too early on further reducing the electricity system emissions will divert scarce resources that are needed to address high-emitting sectors or create visible public demonstrations of success. In summary, the benefit versus cost of focusing on additional emissions reductions on the electricity generation sector doesn't exist in the short term.

It is also not generally understood that by providing back-up generation capacity and grid stabilization services, the gas plant generation fleet is actually an enabler of *increased renewable generation capacity* should policy makers so decide. Conversely, decommissioning these critical grid-stabilizing resources without adding more expensive grid level energy storage capacity will not only greatly reduce the Ontario grid's flexibility and capacity to adopt more renewable energy but will perversely increase our reliance on adjacent grids (primarily the predominantly coal-fired US grid). Adjacent grid operators are mandated to prioritize support to their local markets thus resulting in Ontario's grid becoming less self-sufficient and less reliable.

Replacement of nuclear generation with renewables as is proposed in the plan creates other environmental liabilities that are similarly not widely known. In addition to known issues with disposal and lack of recyclability of solar panels and wind turbine blades, the lifecycle GHG emissions of solar panels and wind turbines are not insignificant and should be considered in the plan. According to a U.S. National Renewable Energy Laboratory Study (NREL)[4] that considered hundreds of research studies, wind turbines had an approx. 50% higher lifecycle GHG emission than did light water nuclear. While solar lifecycle emissions were cited as approximately 50% of nuclear (or one third of that of wind), it must be noted that solar generation calculations were adjusted to reflect average radiation in the United States. Available irradiation in Ontario is considerably lower so lifecycle GHG emissions in Ontario will be higher

[1] Canada Energy Regulator. Provincial and Territorial Energy Profiles: Ontario. https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-ontario.html
[2] Greenhouse gas emissions inventory - Canada.ca
[3] Canada. 2021 National Inventory Report (NIR) | UNFCCC
[4] Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics (Fact Sheet), NREL (National Renewable Energy Laboratory)

than the NREL analysis. Ontario should be mindful of lessons learned from Germany who has embarked on a nuclear plant reduction path and is now experiencing some of the highest electricity prices in the G7. Germany will likely also experience large increases in GHG emissions as it commences construction and commissioning of several new gas generators to provide the grid reliability services lost with the retirement of the nuclear plants. That gas is mostly coming in from outside the country, increasing Germany's reliance on the stability of foreign governments and relations.

Furthermore for reasons that are unique to Ontario's current grid, we need our gas generators now more than ever. Ontario has embarked on a lengthy refurbishment and upgrade cycle for our nuclear power plants. For decades, these emission-free nuclear power plants have been the backbone of Ontario's electrical energy system generating up to 60% of Ontario's electrical energy needs. They have served Ontario well and have been amongst the safest and highest performing plants in the world[5].

2. **Electrification of the transportation sector provides significant opportunity but will require significant investment in electrical generation, transmission, and distribution system capacity.**

The transportation sector, particularly light pick-up trucks, not only represents the largest emitting sector of Ontario's GHG emissions, but also the fastest growing one. With the right focus, it can also be one of the easiest areas to reduce GHG emissions. The popularity of pick-up trucks and SUVs are such that these vehicles now outsell regular passenger cars. There are areas of the province (i.e. north and rural) and certain industries (i.e. construction, mining, forestry, agriculture) that pick-up trucks are essential, therefore a "fit for purpose" study would be required to determine viable and reliable alternatives.

On an energy basis, the total amount of energy consumed by the transportation sector is approximately 1.9 times the amount of electricity demand from the entire Ontario electricity sector,[6] so the challenges of a complete switchover from fossil fuels in the transportation sector should not be underestimated. Even adjusting for potential efficiency improvements offered by electric vehicles, the resulting added electrical demand is equivalent to an additional 50% of Ontario's existing total electricity demand.

The resulting expansion of the electric grid to service this additional demand would not only be in addition to new demand from electric heat pumps, but it would need to happen concurrently with planned historic investments to refurbish, replace, upgrade and improve climate resiliency of existing generation, transmission and distribution infrastructure. The latter is due to normal equipment/material lifespans and the amount of past deferred maintenance. The majority of Ontario's transmission and distribution infrastructure will need to be replaced over the next 30 years.

It is OSPE's view that a policy that targets GHG emission reduction by electrifying urban personal light duty cars, trucks and SUVs first, improving the fuel efficiency of heavy trucks/delivery vehicles and encouraging the use of electrified public transportation, cycling, ride-sharing offers the highest profile way to engage the public on critical lifestyle changes,

[5] World Nuclear Performance Report 2021, World Nuclear Association, COP26 Edition. performance-report-2021-cop26.pdf.aspx (world-nuclear.org)

[6] Government of Canada. Energy Efficiency Trends in Canada 1990 to 2013. https://www.ieso.ca/en/Power-Data/Demand-Overview/Historical-Demand

while concurrently having the potential to involve them in making a material impact on emissions.

Even with an aggressive use of incentives, penalties, sales mandates and regulations (i.e. buy-back incentives, licencing penalties, carbon taxes, emissions inspections, etc.) replacement of light vehicles will take decades for the needed system capacity adjustment. Replacement of heavy duty and off-road vehicles will require more advances in technology and therefore adjustment time for the electricity sector must be provided.

3. **The roadmap should clearly emphasize opportunities in Ontario's industrial sector**.

In addition to the emissions in 2019 from Ontario's petroleum refining industry, Ontario's commercial, institutional and manufacturing sectors are responsible for emitting approximately 29,500 kt CO_2e and represent almost 20% of Ontario's emissions (i.e. approximately 8 times Ontario's electricity generation sector).

A targeted efficiency improvement and conservation program geared to these sectors would not only lead to material GHG emissions but would also make Ontario's businesses and economy more competitive. Development and adoption of such technologies would create good paying jobs and incentivize technology development in Ontario.

4. **Incentivizing heat pump adoption is a good idea but cannot replace natural gas heating in the roadmap's timeframe.**

Although high efficiency cold-weather heat pumps in the residential sector can generate significant energy savings while reducing GHG emissions, the Ontario electric grid will be stressed to support the resulting energy load while concurrently refurbishing our nuclear fleet (especially if our natural gas plants are decommissioned) and our transportation sector electrified.

Ontario's residential sector consumes approximately 1 billion cubic feet/day of natural gas, primarily for space and water heating. This energy represents approximately 9 times the amount of electrical energy that can be generated by Ontario's existing nuclear fleet.[7]

Furthermore, Ontario's existing peak electricity demand occurs during hot, muggy summer days when air conditioning is providing cooling. Peak electrical demand does not occur during winter nights only because most residential energy demand (i.e. space and water heating) is met by the natural gas system. Although modern cold weather air-source heat pumps perform at 160% to 200% efficiency, during cold winter nights, shifting the energy demand back from the natural gas system to the electrical system (at the same time of shifting transportation energy from gasoline to electricity) will overwhelm our current electrical generation, transmission and distribution capacity.

[7] Canada Energy Regulator. Provincial and Territorial Energy Profiles: Ontario. https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-ontario.html

5. **The significance of the present deficit in skilled engineers, technologists, technicians, and trades has not been fully recognized in the plan**.

A 30-year roadmap horizon must recognize that, with exception of new engineering graduates and apprentices, most of the current workforce will have retired or turned over before the roadmap's objectives have been achieved. Furthermore, demand for engineers and skilled trades is expected to grow to support government affordable housing plans, mass transit initiatives, installation of thousands of EV charging stations, upgrade of municipal infrastructure, and other urgent needs. Engineering firms and contractors are already struggling to support current initiatives. Engineering enrollment in Ontario's universities and subsequent employment in the profession is being undermined by surging tuition costs while at the same time, education tax incentives to Ontario families have been either curtailed or eliminated.

It takes a minimum of 4 years of university education and between 5 to 10 years of practical experience for Professional Engineers to become highly skilled in their role. This is especially true for the design of highly complex systems such as our power grid. Training of a large portion of Ontario's junior power engineers historically was done in Ontario's publicly owned utilities but with increased cost pressures, privatization and outsourcing, many of these training roles no longer exist. The roadmap does not recognize this delay from entering school to become a skilled professional engineer, journeyman, linesman or fully licensed electrician.

We cannot rely on obtaining licensed engineers, experienced technical professionals and skilled trades from other jurisdictions. Other jurisdictions also have aggressive decarbonization plans and will not have surplus human resources to offer Ontario. Secondly, current construction union labour contracts have restrictions on the use of foreign skilled trade workers on domestic construction projects, potential conflicts with trade agreements and complex personal tax implications for the workers involved. Thirdly, engineering in our power sector not only requires specific expertise, but performance at a level not available in almost any other field.

We commend the GPO for its plan to train tens of thousands of skilled trades and subsidize associated college tuition. However, without meaningful provincial and/or federal government financial support for the families of student engineers, it may become impossible for highly qualified students in Ontario to access engineering education.

6. **Recent developments in nuclear energy technology and its potential contribution to providing sustainable emission-free energy have been dismissed**

OSPE believes that new research and developments in nuclear reactor research such as fast neutron reactors that consume depleted and reprocessed uranium will mean that current "spent" fuel bundles will become a valuable and cheap source of new emission-free energy. This resource will enable less raw material extraction and be able to supply our increasing energy demand for hundreds of years, certainly at least until we solve the limitations with other alternative forms of clean energy generation.

Consequently, in absence of a fundamental change in the average Ontarian's way of life, OSPE believes that there is currently no better technology to achieve a deep and permanent reduction in emissions than nuclear energy. Nuclear energy's modest use of land and other natural resources and its high operating capacity factor, modest operating costs, and large lifecycle energy output per unit of installed capacity are major advantages compared to other technologies for base-load energy production. While nuclear energy works exceptionally well as

a form of baseload generation, it can be designed to flexibly ramp to support increased penetration of renewables such as wind, solar and hydro.

There are other energy benefits from nuclear generating facilities. Ontario showcased one of the world's largest zero-emission district heating systems at the Bruce Power site between 1976 and 1996 using thermal energy from the four Bruce A reactors. Nuclear plants can produce twice more energy as low temperature heat, while simultaneously producing electricity. This heat represents a significant source of emission free energy to support existing and emerging businesses and technologies, as well as a number of manufacturing businesses located on site specifically for this reason.

However, to use that low temperature heat for space and water heating, new passively safe, small modular reactors (SMRs) need to be developed so that the reactors can be located closer to the large urban heat loads. Deploying SMRs that generate significant low temperature heat could have significant environmental benefits for remote communities that generate most community energy from diesel generators. The roadmap does not mention Canada's SMR Action Plan to develop those SMRs for commercial deployment by 2030 and seems to be dismissive of their potential value in all potential environments. Alternate low-emission thermal energy technologies are at least twice more expensive than nuclear district heating.

Various technologies are also under development that use high temperature SMR heat to improve the hydrogen producing efficiency of electrolyzers as a means to use both surplus heat and electricity when normal consumer electrical demand is low.

In the interim until the SMRs are deployed, we can use the surplus clean electricity during low demand periods to displace some fossil fuel use and reduce our emissions. OPSE has previously noted that Ontario had over 19 TWh[8] of surplus clean electricity in 2020 that could have been used to displace fossil fuels for space and water heating, to produce green hydrogen or to charge electric vehicles at night. All that is required is to modify Ontario's retail electricity rate plans to enable these uses. The surplus clean electricity is currently being exported at low prices or being curtailed (i.e. wasted) while we burn fossil fuels for that energy, because the grid does not have affordable energy storage capacity.

7. GHG reduction plans must recognize the pressures facing Ontario's economy and its capacity to adjust.

Setting goals must recognize that Ontario's economy is integrated in a very competitive North American and global economy. Large and unpredictable increases in energy costs risks discouraging investment in Ontario and incentivises businesses to simply shift operations to neighbouring jurisdictions.

The roadmap correctly notes that border carbon tax adjustments will be critical to implementing the planned emission taxes. While these mechanisms are critical, their creation requires more multilateral treaty negotiations, likely a complex compliance regime. Ontario's automotive sector is a prime example of how regulatory policies in Ontario must recognize the economic and political realities within a business environment. While we may have a world-class raw material mining sector, we are having severe challenges attracting new investment in automotive battery manufacturing and are at risk of becoming an exporter of raw materials for battery

[8] Ontario Continues Wasting Clean Electricity for 7th Consecutive Year: Engineers https://ospe.on.ca/advocacy/ontario-continues-wasting-clean-electricity/

manufacturers elsewhere. While Canada's business competitive index remains reasonably strong, we are slipping[9] and "Ease of Doing Business" has been identified and noted as a key factor holding us back[10]

Thank you for the opportunity of providing feedback to your Roadmap to Net-Zero-The Ontario Greens' Climate Plan. If you have any additional questions please contact Stuart Atkinson, OSPE Public Affairs Manager at satkinson@ospe.on.ca or 416-223-9961 ext. 225.

Sincerely,

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[9] Trading Economics. Competitiveness Rank - Countries - List (tradingeconomics.com)
[10] Trading Economics. Ease of Doing Business - Countries - List (tradingeconomics.com)