ONTARIO POWER GENERATION

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Hon. Jeff Yurek
Minister of the Environment, Conservation and Parks
6th Floor, 135 St Clair Ave W Toronto, ON
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RE: Ontario Power Generation Response to the Ontario Low-Carbon Hydrogen Strategy Discussion Paper

Dear Minister Yurek,

Ontario Power Generation (OPG) supports the Ontario Government's efforts to establish a low-carbon hydrogen strategy as outlined in the November 19, 2020 discussion paper. Ontario's low-carbon hydrogen strategy will be a key element of the Made-in-Ontario Environment Plan to reduce greenhouse gas emissions 30% by 2030.

OPG's Hydrogen Strategy and Net-Zero Climate Change Commitments

OPG is a catalyst for efficient, economy-wide decarbonisation and we have a critical role to play in establishing Ontario's economically viable hydrogen economy. Our corporate hydrogen strategy provides a framework for scalable, reliable electrolysis based low-carbon hydrogen production across Ontario by leveraging OPG's distributed electricity assets and low-carbon off-peak electricity. OPG has committed to be a net-zero carbon company by 2040 and to be a catalyst for a net-zero carbon economy by 2050. Low-carbon hydrogen is complimentary to our electrification program and is essential to meeting OPG's climate goals and the Made-in-Ontario climate goals.

Ontario Low-carbon Hydrogen Vision

We are fully aligned with the vision that Ontario's low-carbon hydrogen strategy should leverage our province's existing strengths, create local jobs and attract investment while reducing greenhouse gas emissions. Ontario's low-carbon electricity system is a strength to be leveraged for electrolysis production of low-carbon hydrogen. We recommend that the vision include the ultimate goal of a *self sustaining and economically viable hydrogen economy* that can be realized in the long term, with the right policy and investment today.

Ontario's Low-carbon Hydrogen Strategy: Outcomes and Results

The success of Ontario's low-carbon hydrogen strategy requires government policy, support and alignment on outcomes and results. OPG's detailed responses to 18 Discussion Paper questions on Hydrogen are enclosed and the key outcomes and results of the Ontario low-carbon hydrogen are highlighted below:

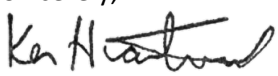
1. **Stimulate Low-carbon Hydrogen Demand** – Low-carbon hydrogen currently has a premium cost and limited market demand in Ontario. Anchor customers are required at "hydrogen hubs" to be off-takers of large quantities of low-carbon hydrogen to stimulate market demand and facilitate economical low-carbon hydrogen production at scale. Several large anchor customers in hubs distributed around the province will expedite the hydrogen economy and allow smaller consumers to adopt low-carbon hydrogen at economical prices. Industries well suited to be hub anchor customers include: natural gas electricity generation plants, industrial processes (e.g., steel, cement, chemical), transit agencies with long distance

service routes, and return-to-base fleets (e.g., airport taxi). These industries can utilize low-carbon hydrogen, where and when it makes sense, while respecting the rate payer and tax payer of Ontario. With Ontario Government support, OPG can be both a low cost producer of hydrogen and anchor customer, stimulating market demand for low-carbon hydrogen and expediting the arrival of the low-carbon hydrogen economy.

2. **Provide Electricity Cost Certainty** – Electricity cost makes up the majority of ongoing operations and maintenance costs of an electolyzer operating budget. As a result, economic electricity prices with cost certainty is required for economic low-carbon hydrogen with price certainty. Electrolyzers are well suited to hydrogen production during lower demand electricity hours, when the carbon intensity of the grid is lower. In addition, operating during lower demand does not increase the generation capacity requirements of the grid. The Ontario Government has a policy role to play in ensuring electricity cost certainty for the success of electrolyzer projects. Electricity cost certainty can be achieved by implementing policies such as an interruptible industrial electricity rate or through providing long term certainty on electricity rates. Surplus Baseload Generation (SBG) of electricity has been historically high from 2013-2020, however, it is expected to be significantly reduced going forward. OPG is well-positioned to leverage available SBG at hydro electric facilities for hydrogen production.
3. **Enable Scalable and Distributed Production** – Transporting large quantities of low-carbon hydrogen can be expensive and logistically challenging. Scalable and distributed low-carbon hydrogen production across Ontario can support wide adoption of low-carbon hydrogen (particularly for heavy duty trucking). OPG has real estate, electricity infrastructure and potential consumption needs for low-carbon hydrogen across the province of Ontario. The distributed production of low-carbon hydrogen should take a phased approach, starting in Southern Ontario and graduating to Northern Ontario as markets are established. OPG has sufficient coverage of highway 401 to enable regular hydrogen fueling stops along from Windsor to Cornwall. In addition, we have assets at the ends of highway 407 for which reduced tolls could be an incentive for clean heavy trucking (both hydrogen of battery electric).
4. **Expedite Regulations** – Storage and transportation of hydrogen is complex and costly. Regulations regarding blending of low-carbon hydrogen in the natural gas pipeline will help facilitate and expedite industrial customer adoption and reduce capital costs incurred for large quantity storage and transport. Government policy supporting financial transactions where hydrogen is produced, injected into the natural gas pipeline and credit given to industrial consumers willing to pay a premium, will facilitate broader industrial adoption and greater GHG reduction, while minimizing near term costs.

We look forward to supporting the Ontario Government in the development and implementation of Ontario's low-carbon hydrogen strategy.

Sincerely,



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OPG Reponses to 18 Discussion Paper Questions

A vision for Ontario's hydrogen strategy	
1. Do you support Ontario's efforts to create a hydrogen strategy?	OPG supports the Ontario Government's efforts to establish a low carbon hydrogen strategy and will actively participate in the formulation and execution of the strategy.
2. How would you refine the vision statement?	OPG is fully aligned with the vision statement. In addition, we believe the long term goal should be a hydrogen economy that is *economically viable and self sustaining*. In the near term, there may be policy and economic stimulus required to develop the hydrogen economy, but this should not persist for an extended period of time. OPG would recommend the following change: Leverage our existing strengths to develop Ontario's *economically viable and self sustaining* hydrogen economy, creating local jobs and attracting investment while reducing greenhouse gas emissions.
3. What should be the key outcomes of Ontario's hydrogen strategy?	Key outcomes of Ontario's Hydrogen Strategy should include policy actions that will: a) Stimulate demand for low-carbon hydrogen; b) Provide operating cost certainty through electricity rate certainty for electrolysis projects; c) Enable scalable and distributed production to facilitate transportation transition to H2; and, d) Expedite regulations for natural gas blending. Outcomes are expanded upon in the cover letter and responses to other questions in this response.
4. How should the hydrogen strategy define and measure success?	Success of key outcomes should be measured against established metrics and target values that progress towards the realization of an economically viable and self-sustaining hydrogen economy. Metrics such as quantity of low-carbon hydrogen produced, number of low-carbon market participants (i.e., number of end users), and number of hydrogen hubs realized in Ontario are examples of these metrics. Ontario jobs will be created and economic impact / value can be measured to demonstrate near term value to Ontarians and will be a positive by-product of a successful hydrogen strategy. OPG endorses hydrogen hubs which have multi-users co-located in a geographic area. Southern Ontario has several locations that would be advantageous for hosting these hubs. Ultimately, success should be measured as projects and policy that enable the self-sustaining economically viable hydrogen economy.

Reducing greenhouse gas emissions	
5. What are Ontario's key technology, regulatory and business opportunities in developing low-carbon hydrogen?	Ontario's key technology and business opportunity for low-carbon hydrogen production lies in leveraging the strength of our low-carbon electricity grid for the purposes of electrolysis produced low-carbon hydrogen production. Ontario has the opportunity to leverage our Made in Ontario electrolyser technology with low-carbon electricity from the grid to produce of low-carbon hydrogen. Several geographical hydrogen hubs that have electricity infrastructure for production, industrial end-user, high traffic (heavy duty trucking) and tie-in to natural gas grid are key to establishing production across Ontario. OPG can stimulate low-carbon hydrogen market demand by being an early "anchor" customer and utilize hydrogen in our electricity generation fleet to further decarbonize Ontario's electricity generation. We are actively engaged in discussions with heavy duty transport OEMs, gas production / distribution companies, and hydrogen technology companies to contribute to the Ontario low-carbon hydrogen strategy and attract investment from other industry participants. Lastly, electricity policy should provide cost certainty for input price of electricity for electrolysis producers, while keeping respecting the electricity rate payer.
6. What is the potential for hydrogen to contribute to Ontario's 2030 greenhouse gas emission reduction target?	Transportation accounts for approximately one third of Ontario's GHG emissions. Heavy duty trucking and freight transport is an excellent opportunity reduce GHGs for Ontario's 2030 reduction target. Heavy duty hydrogen fuel cell trucks should become commercially available around 2025. In discussion with auto-makers, we understand the North East is considered the second best opportunity for deployment after California. Ontario needs to establish distributed low-carbon hydrogen production along highway 401, to enable this market opportunity to be realized. From 2025-2030, there is potential for the highway 401 corridor to have significant number of fuel cell heavy duty vehicles, which would support reduction in transportation emissions. Natural gas combined cycle gas turbines (CCGTs) can utilize low-carbon hydrogen to further decarbonize the (already very clean) electricity grid. The opportunity to blend low-carbon hydrogen produced with off-peak electricity with natural gas to reduce emissions from CCGT during peak demand periods can yield emission reductions. This is a great opportunity to establish the low-carbon hydrogen market in Ontario by having anchor customers that utilize large quantities of low-carbon hydrogen. Heavy industry such as steel and cement account for a substantial percentage of Ontario's GHG emissions and have opportunity to adopt low-carbon hydrogen technologies in 2030. The industrial applications can be achieved through both direct use of low-carbon hydrogen and potential financial transactions of low-

	carbon hydrogen blended in the natural gas grid (that accomplish the same GHG reduction, with potentially less infrastructure costs).
7. What additional environmental benefits should be considered in the development of the strategy (for example during hydrogen production)?	Leveraging our low-carbon electricity assets for low-carbon hydrogen production and seeking innovative approaches to maximize these assets contribution to low-carbon hydrogen production.
8. What role can hydrogen play in various regions and sectors?	See response to question 6.
9. What actions can Ontario take to help Ontario companies get ready to meet expected international demand (for example research and development, innovation, procurement)?	Firstly, have a robust domestic market for low-carbon hydrogen and be a technology and market leader. We need provincial demand to keep talent and companies like Cummins (previously Hydrogenics) in Ontario.
10. What are the training needs for the workforce to support the economy across Ontario?	Training should be extended to small and medium size businesses to better understand the opportunities in hydrogen for these businesses.

Promoting energy resilience	
11. How can hydrogen support a reliable and affordable energy system, including energy storage?	Electrolyzers are well suited to hydrogen production during lower demand electricity hours by using low-carbon intensity electricity and not increasing the generation capacity requirements of the grid. Leveraging the capacity of Ontario's electricity generation during off-peak periods and providing policy that gives electrolyser produced hydrogen cost certainty on electricity prices. Surplus Baseload Generation (SBG) of electricity has been historically high from 2013-2020, however, it is expected to be significantly reduced going forward. OPG will seek to leverage available SBG for hydrogen production where possible. Energy storage and emission reductions can be achieved by leveraging the capacity of Ontario's electricity generation during off-peak periods and utilizing low-carbon hydrogen in natural gas generation facilities during periods of electricity demand.
12. What are the barriers and opportunities for hydrogen in the energy system?	Electricity cost makes up the majority of ongoing operations and maintenance costs of an electolyzer operating budget. As a result, economic electricity prices with cost certainty is required for economic low-carbon hydrogen with price certainty. The Ontario Government has a policy role to play in ensuring cost certainty for the success of electrolyzer projects. Electricity cost certainty can be achieved by implementing policies such as an interruptible industrial electricity rate or long term certainty on electricity rates.

Reducing barriers and enabling action	
13. How can the provincial government best support partnerships with the private sector, academia and other government / levels of government?	Hydrogen hubs should be established in Ontario that bring together private sector and academia with support from provincial and federal government. As noted in the cover letter, low-carbon hydrogen currently has a premium cost and limited market demand in Ontario. Anchor customers are required in the "hydrogen hubs" to be off-takers of large quantities of low-carbon hydrogen to stimulate market demand and facilitate economical low-carbon hydrogen production at scale. Several large anchor customers in hubs distributed around the province will expedite the hydrogen economy and allow smaller consumers to adopt low-carbon hydrogen at economical prices. Industries well suited to be anchor customers include: natural gas electricity generation plants, industrial processes (e.g., steel, cement, chemical), transit agencies with long distance service routes, and return-to-base fleets (e.g., airport taxi). These industries can utilize low-carbon hydrogen, where and when it makes sense, while respecting rate payer and tax payer of Ontario. With Ontario Government policy, regulation and financial support, OPG can be both a producer and anchor customer, stimulating market demand for low-carbon hydrogen and expediting the arrival of the low-carbon hydrogen economy.
14. Are you aware of regulatory barriers that need to be addressed or regulatory enabling mechanisms that need to be put in place? Please explain.	As noted in our cover letter, storage and transportation of hydrogen is complex and costly. Regulations regarding blending of low-carbon hydrogen in the natural gas pipeline will help facilitate and expedite industrial customer adoption and reduce capital costs incurred for large quantity storage and transport. Government policy supporting financial transactions where hydrogen is produced, injected into the natural gas pipeline and credit given to industrial consumers willing to pay a premium, will facilitate broader industrial adoption, economies of scale and greater GHG reduction, while minimizing costs.
15. What are the best opportunities to cost-effectively support hydrogen across Ontario while respecting tax payers?	A hydrogen hub approach that has geographic co-location of: hydrogen production, large anchor customer / blending with natural gas grid, facilitates smaller user adoption. There would be limited further value in proof of concept pilots, as we believe the technology is proven and now needs to be deployed at scale and demonstrate economic viability for a variety of end users.

Using hydrogen where and when it makes sense	
16. What potential feedstocks and stages of the hydrogen supply chain (production, storage and distribution, and end-use) do you think Ontario is best-positioned to develop and lead in and which uses have the greatest potential for cost reduction?	**Production:** Consistent with the response to question 11, electrolysis produced low-carbon hydrogen should leverage our low-carbon electricity grid. Electrolyzers are well suited to hydrogen production during lower demand electricity hours using low-carbon intensity electricity and not increasing the generation capacity requirements of the grid. Surplus Baseload Generation (SBG) of electricity has been historically high from 2013-2020, however, it is expected to be significantly reduced going forward. Leverage the capacity of Ontario's electricity generation during off-peak periods and provide policy that gives electrolyser produced hydrogen cost certainty on electricity prices. OPG will leverage SBG were possible to produce low-carbon hydrogen. Storage and Distribution: In the near term, blending of low-carbon hydrogen with natural gas and distribution leveraging existing natural gas pipeline can avoid near term compression, storage, and transportation infrastructure costs. End Use: Heavy duty trucking utilization of fuel cell vehicles poses an opportunity for cost competitiveness with diesel and significant GHG reduction.
17. What are the main risks of hydrogen use in Ontario and are there opportunities for the government to decrease these risks?	Electricity cost certainty is an area of economic risk for electrolyser producing companies that could be addressed by electricity policy such as interruptible industrial electricity rates for committed quantities of electricity consumption. Reliable supply of hydrogen for industries like transportation can achieved by having long term off-take of large anchor customers as 'baseload' users of low-carbon hydrogen that can taper use to support smaller user uptake.
18. Considering that low-carbon hydrogen is expected to be more competitive over time, what should be the timeframe for Ontario's hydrogen strategy?	OPG recommends alignment with the Federal hydrogen strategy and is implementing similar timeframes for the OPG hydrogen strategy.