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**Ontario Sustainable Energy Association
Ontario Low-Carbon Hydrogen Strategy
Discussion Paper Response
January 19, 2021**

Ontario Sustainable Energy Association (OSEA)

The Ontario Sustainable Energy Association (OSEA) represents Ontario’s large and diverse clean and sustainable energy sector. This sector includes technology developers, manufacturers, distributors, contractors, consulting engineers, architects, energy consultants, utilities, financial institutions, insurance companies and legal firms, all of which are essential to create and maintain Ontario’s sustainable energy sector.

OSEA is “technology agnostic” as our members are involved in a wide range of sustainable energy renewable energy, energy conservation, energy storage and distribution technologies. We support and advocate for technologies as diverse as solar photovoltaics, solar thermal, wind turbines, hydro power, geo-exchange, biomass, renewable natural gas, district energy, micro-grids, battery storage, many types of energy conservation technologies, and of course hydrogen.

Support for Ontario Low-Carbon Hydrogen Strategy

OSEA is pleased to offer its support the proposed government of “Ontario Low-Carbon Hydrogen Strategy”. We are also honoured to have the opportunity to participate in the dialogue about this important technology. We are aware that this initiative is a key element of the government’s “Made-in-Ontario Environmental Plan” and represents a concrete advancement in our province’s progress to a more ecologically and economically sustainable energy future.

We strongly believe that the provincial government’s investing in Ontario’s hydrogen future can make a significant contribution to making Ontario more ecologically and economically sustainable. Ontario’s widespread adoption of hydrogen technologies will contribute to a major reduction in GHG by reducing the combustion fossil fuels.

In addition, the widespread adoption of hydrogen technology can help Ontario achieve both its environmental GHG reduction goals and will contribute in a major way to reinvigorate Ontario’s economy as it emerges from the devastating effects of the global COVID-19 pandemic.

Ontario's Energy Leadership Heritage

It should be recognized that Ontario has a long and distinguished history of energy innovation and leadership. This strength has been a critical success factor in Ontario's development and economic prosperity. Ontario has long been a leader in green renewable hydro electric power. Following the construction of smaller hydro power facilities beginning in 1892 at the Canadian Niagara Falls, Ontario developed the first phase of the massive Sir Adam Beck Hydroelectric Generation Station in Niagara Falls in 1922, using innovative underground diversion techniques to preserve our world-famous Horseshoe Falls.

Another often forgotten fact is that Niagara Falls generating stations employed a leading application of the "radical" new alternating current (AC) developed by Nicolas Tesla and Westinghouse instead of the then conventional direct current (DC) technology pioneered by Thomas Edison. High voltage AC current could travel far greater distances than DC current, and as a result, this power was able to be transmitted to City of Hamilton, Ontario's heavy industry centre, which was subsequently dubbed Power City to recognize this achievement. Soon after AC current was able to be transmitted all the way to distant Toronto.

A later major boost to Ontario's energy supply was the development of Pickering, Darlington and Bruce zero GHG emission nuclear power stations based on Ontario's unique CANDU nuclear fuel management system.

More specifically to hydrogen, Ontario has a long and distinguished history with this technology. Alexander T. Stuart pioneered the development of electrolyser beginning in 1913. Over many decades, the Stuart family and the businesses they founded generated many innovations and patents based on their early fuel cell technology to produce pure oxygen and hydrogen from water and electrical power through the application of electrolysis.

The continuous flow of innovation from this fount of technology laid the foundation for a diverse and dynamic hydrogen economy till today. Ontario's Hydrogenics, the province's largest hydrogen technology manufacturer, which was purchased by USA based Cummins Inc. in September 2019, and Ontario's Next Hydrogen are products of over a century of engineering and commercialization in our province.

Vancouver based Ballard Technologies developed as a second locus of Canadian hydrogen technology development, and for years Canada's two centres of hydrogen expertise dominated the development of this vital technology. Both Ballard and Hydrogenics took Canadian hydrogen technology global with most of their sales to markets such as Germany and China, where Canadian fuel cell technology was adapted to commuter trains, transit buses and other applications.

Because of this long history, Ontario has a wealth of engineering and scientific expertise in various applications of hydrogen technologies. Many universities and colleges have active research in a diversity of hydrogen fuel cell, electrolysis and related academic pursuits. Likewise, Ontario has considerable practical and proven expertise in technology development, marketing and sales, production and maintenance of a wide variety of hydrogen related technologies. It is of critical to recognize that for many years, Canada, including its two hydrogen nodes in Ontario and British Columbia, have been globally recognized as "the Silicon Valley" of hydrogen technology.

Ontario's investing in accelerating the growth of the hydrogen energy sector would contribute to build this latest stage in this tradition of energy engineering excellence.

Ontario's Hydrogen Ecosphere

For over a century, Ontario has built a strong foundation of hydrogen technology and expertise. This leadership has been demonstrated in both academic circles as well as in the global marketplace. This is not a new industry for Ontario – we are already leaders in this sector, but we need to build strategically on our existing foundation.

OSEA strongly believes hydrogen is an essential element in our province's ambition to achieve Ontario's goal of a low carbon economy and society. Ontario has an existing and well-developed hydrogen economy which includes all the following elements.

Ontario has research activities at Centennial College, Ontario Tech, University of Toronto, University of Waterloo, University of Windsor and York University among other institutions. The Ontario Centre of Innovation provides valuable support for collaboration between businesses and academics including in the hydrogen sector.

Enbridge produces hydrogen at its Sarnia refining operation, and in addition Enbridge built and operates a large power-from-gas plant in Markham.

Canada's longstanding leadership in the nuclear technology through CANDU, Ontario Power Generation, Bruce Power and Canadian Nuclear Laboratories provide valuable engineering and technological expertise that contribute to Ontario's hydrogen leadership.

Vehicle and parts manufacturing is one of Ontario's largest industrial sectors, which provides massive opportunities for the province's hydrogen ambitions.

There are many hydrogen sector start-ups which are pioneering new technologies and ventures including in the energy from waste sector.

Building a Comprehensive Hydrogen Sector

It should be also understood that widespread adoption of hydrogen technology cannot be effectively done piecemeal if it is to be successful since we are discussing the changing an entire energy paradigm for our province. It should be recognized that in order to successfully create a hydrogen economy for Ontario the following elements are needed: methodologies to produce hydrogen, to distribute hydrogen, to store hydrogen and to utilize hydrogen. We will briefly explore each of these in turn.

Hydrogen Production and Distribution

The Ontario Low-Carbon Hydrogen Strategy focuses on several methodologies to producing hydrogen. Green hydrogen is produced by electrolysis and the gasification of biomass, Steam reformation of natural gas is considered a less environmentally friendly blue hydrogen. This process can be supplemented with carbon capture technology to be reclassified as green hydrogen.

The reality is that hydrogen can be extracted from any hydrogen-containing feedstock including various waste materials including used plastic, mixed municipal waste and municipal water sludge. These latter zero-cost feedstocks should be added to the roster of technologies for producing green hydrogen.

It should be also recognized that various scales of hydrogen production are required for our province. There is a need for large scale hydrogen production which can be achieved by utilizing surplus power from Ontario's nuclear generation fleet. An impediment to this has been the pricing of this surplus power, an issue addressed specifically in a research paper from the Ontario Society of Professional Engineers which was submitted and received by the Ontario government.

Ontario can potentially generate large volumes of hydrogen from the gasification of both biomass but also from a wide variety of hydrogen rich waste products including plastics, municipal solid waste as sewer sludge. This hydrogen source should all be classified as green.

Medium scale production of hydrogen can be achieved at large solar and wind renewable facilities which generate power intermittently and often at the wrong times so that hydrogen can serve as an energy storage medium to make these renewable energy producers more economically viable.

Small scale hydrogen production would be useful for isolated northern First Nations and mines to make them more energy self sufficient. These isolated and often off grid communities could produce hydrogen locally from solar PV, wind and run-of-river hydro power in order to displace diesel generators which are phenomenally expensive and difficult to operate and generate large amounts of GHG emitting pollutants.

Hydrogen Distribution

The distribution of hydrogen from centres of its production to end users needs to be a key focus for Ontario's strategy. Modes of hydrogen fuel transportation including trucking of fuel, pipelines, institutional distribution and retail distribution.

Ontario needs to develop a significant amount of hydrogen transportation and storage infrastructure in order to connect hydrogen production and consumption. Enbridge has developed considerable expertise in the area of hydrogen injection into its massive pipeline network. There has been recent discussion about the benefits of installing hydrogen fueling stops at rest stations along Ontario's critically important 400 series highways, to serve Class 8 trucks, a key hydrogen market, and to begin to resolve the chicken-and-egg dilemma that has challenged the creation of a hydrogen economy in Ontario. Considerable technology development and deployment will be required to achieve large scale deployment.

It should be recognized that jurisdictions like California's "Hydrogen Highway" have invested heavily in developing a network of hydrogen fueling station across the state. The governments of BC and Quebec are currently investing in a small number of hydrogen fueling stations to help kick start their provincial hydrogen initiatives. The good news is that Ontario's consulting engineers and contractors have considerable expertise and experience with all types of massive infrastructure development. In Renew Magazine, Canada's national infrastructure publication, reported that 5 of Canada's 6 largest infrastructure development projects are in Ontario.

Hydrogen End-Uses

Finally, and perhaps most critically for a hydrogen economy to prosper, there needs to be a ready domestic and local market for the hydrogen fuel that is produced and transported. Currently, almost all of Canada's hydrogen fuel cell technology is exported. In Ontario, Canadian Tire and Walmart have acquired hydrogen fuel cell powered forklifts for several of their distribution centres, but this is just a small start for what needs to take place in order to create a viable market for hydrogen fuel.

Ontario recently made a massive investment, with support from Unifor, to produce new lines of battery electric vehicles at GM's Oshawa and Ford's Oakville car manufacturing plants. Almost all the car parts required for a battery EV are the same as those for a hydrogen EV, except for the hydrogen fuel cell itself. There may be an opportunity for our tier one automakers to build hydrogen powered cars right here in Ontario. Many European and Asian car manufacturers are launching hydrogen power cars for the expected boom in the sale of these vehicles.

In addition to cars, Ontario builds commuter trains, LRT (light rail transit), buses, trucks and mining equipment. In many global markets, other national governments are investing in Canadian designed and built fuel cell technology for their own transit vehicles, both rail and bus, to help jumpstart their own hydrogen transitions. Ontario can and should do likewise by strategically investing in hydrogen conversion of regional GO trains using designed in Ontario hydrail technology.

The government of Ontario can is well positioned to lead the hydrogen market transformation by converting GO trains and regional buses as well as support the conversion of municipal transit bus fleets to hydrogen fuel. CUTRIC (the Canadian Urban Transit Innovation Consortium) has proposed such projects in both Mississauga and York Region, so the background work for these specific projects is largely already available.

Many studies have suggested that Class 8 tractor trailer trucks that ply our highways may be a high priority segment to convert to hydrogen from high GHG diesel fuel, if a network of hydrogen fueling stations could be created along Ontario's major highway routes.

In addition to the transportation sector, hydrogen powered emergency generators could be implemented quickly at hospitals, data centres, universities who all need a significant supply of uninterrupted power.

In many leading industrial nations, strategic government procurement of promising locally developed and manufactured technology products is a fundamental foundation for accelerating industrial development. Ontario can use its immense purchasing capacity as a key element to foster rapid technology and economic development for the hydrogen sector.

Hydrogen as An Economic Driver for Ontario

Hydrogen can become a key and pivotal economic and environmental driver for Ontario. Initially the benefits of investing in and supporting a hydrogen economy include local business and job creation. Looking more widely, Ontario already has a first market advantage in exporting hydrogen fuel cell technology which can be widened to incorporate engineering construction, maintenance and financing opportunities. In addition, since Ontario produces almost none of the hydrocarbon fuels that hydrogen can supplant, Ontario's cash outflow for diesel, propane, natural gas, but especially natural gas, can be

dramatically reduced by substituting their use with clean made-in-Ontario hydrogen. In addition, as we saw with the decommissioning of Ontario's three coal fired power generation stations, reducing GHG and its various pollutants, can improve the cardiovascular health of the residents of Ontario, reducing provincial healthcare service costs significantly.

Hydrogen Policy Landscape

One non-fiscal area that the government of Ontario can assist with the rapid deployment of its Low-Carbon Hydrogen Strategy is using various related regulatory measures that can create a better environment for the rapid growth of our hydrogen economy including the following measures:

- **Electricity Rates:** The April 2019 Ontario Society of Professional Engineers (OSPE) Retail Electricity Price Reform policy recommendation to the Ontario government suggested using surplus power to produce hydrogen instead of selling to New York Power or spinning it off. This would result in both the generation of usable hydrogen, and some income to Ontario power producers.
- **Certification of Hydrogen Technicians:** There is a need for training in all aspects of and applications of innovative hydrogen technologies, and not just for technicians. Funds should be made available for more forms of hydrogen, and for the creation of certification programs.
- **Transit Procurement:** Ontario should be more pro-active in guiding our rapidly expanding transit sector to hydrogen by specifying hydrogen specifically as a fueling option for these projects rather than simply giving bidders the opportunity to propose alternative electrification options.
- **Green Vehicle Licence Plate Program:** Create a unique plate for hydrogen powered vehicles to raise the profile of this technology. This effort should complement a province-wide marketing and promotional program for Ontario's critically important hydrogen economy.
- **Hydrogen Readiness:** Ontario should take the lead in reviewing all provincial regulations and related standards (CSA, TSSA) to ensure that there is a firm regulatory environment to support the roll out of a provincial hydrogen strategy.
- **Food and Organic Waste Policy Statement:** Ontario's efforts in these forms of solid waste should be matched by a similar policy for diverting waste plastic and other hydrogen rich solid materials from our landfills. During the COVID-19 crisis the volume of many of these waste products has exploded, which threatens to overflow our waste handling facilities.
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Key Principles

The following are additional measures that the government of Ontario can take into consideration while undertaking the implementation of the Ontario Low-Carbon Hydrogen Strategy:

- **Reduce Greenhouses Gas Emissions:** Including reducing use of GHG emitting fuels of all types especially gasoline, diesel and propane.
- **Generating Economic Development and Jobs:** Focus on supporting technologies and companies that have wide deployment across Ontario and possibly major export opportunities too. Aside from manufacturing technologies, OSEA views that development of associated developers, contractors, investors, insurers, engineers and other professionals needed to support a hydrogen ecosystem.

- Promoting Energy Resilience: Hydrogen can become a key form of energy storage and distribution which can optimize Ontario's entire energy system.
- Reducing Barriers and Enabling Action: Use government resources to promote new opportunities for hydrogen companies and professionals.
- Using Hydrogen Where and When it Makes Sense: Focus Ontario's resources on hydrogen application which have the greatest prospect of success technologically and economically including for vulnerable northern communities.

Conclusions

Ontario's widespread adoption of hydrogen technologies will contribute to a major reduction in GHG by reducing the combustion fossil fuels. Ontario is well positioned to leverage more than a century of research and development in the production and utilization of hydrogen and expect that governmental support for this strategic sector can result in enormous employment and business opportunities which will benefit the province for years to come. We therefore wholeheartedly endorse Ontario's initiative to develop to cultivate and expand Ontario's hydrogen economy.

With Respect,



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APPENDIX 1

Ontario Sustainable Energy Association

Ontario Low-Carbon Hydrogen Strategy Discussion Paper:

Discussion Questions

The following are points to address the specific points listed in the Discussion Paper:

Vision

1. OSEA supports Ontario's efforts to create a hydrogen strategy.
2. Vision needs to be broadened and strengthened to focus on vehicle production, solid waste as a plastic as a fuel, and developing/building out assured distribution channels.
3. Ontario should aim to adopt hydrogen widely, but also support hydrogen products and expertise for export.
4. There is a need to begin to track key metrics including companies, employees, sales, exports for both hydrogen products as well as services.

Reducing Greenhouse Gas Emissions

5. Ontario should focus on hydrogen for all transit vehicles and support the entire hydrogen ecosphere
6. Major hydrogen GHG reduction opportunities include transit vehicles, class 8 heavy trucks diesel dependant northern communities.
7. Additional benefits that should be quantified and tracked include health indicators such as what we did when we decommissioned our three major coal fueled power plans.
8. There are hydrogen opportunities in all parts of Ontario as well detailed in this presentation.
9. Funds should be made available through Ontario of Economic Development Job Creation and Trade (MEDJCT) to promote the adoption of hydrogen through key domestic and export markets especially for the transportation sector
10. There is an urgent need for in class and in the workplace for all aspects of the emerging hydrogen sector including general hydrogen energy training.
11. Hydrogen can help Ontario to stabilize its power system which includes nuclear power plants which cannot be turned off, so they generate surplus power which can be used to produce hydrogen. Similarly, intermittent renewable power (without some form of storage) generated from the sun and wind can be stored as hydrogen to balance supply and consumption.
12. The general public, industry groups and professional including engineers, bankers and others need to be introduced to the opportunities for hydrogen.
13. Ontario needs create grants, opportunities and events to specifically focus on hydrogen as well as to help individual companies and research projects.
14. There are likely Ontario regulations as well as policies which may be handicaps to hydrogen, so there is a need to strike a committee to explore, document and address these potentially hidden barriers. Similarly, CSA, TSSA and other practice guides need to be reviewed for completeness and adequacy to support this sector.

15. Ontario should fund high profile demonstrations projects to highlight Ontario developed hydrogen technologies.
16. Ontario should lead in the production of all kinds of hydrogen vehicles as well as all the ancillaries required for this sector from hydrogen generation to distribution and retailing.
17. The main risk for Ontario hydrogen technologies is to traverse the “Chasm of Death” the gap between the design of technologies and early commercial sales. Ontario can do this by becoming first purchasers and testers of new technologies.
18. There is no time to lose, other provinces as well as many countries are now investing in the emerging hydrogen economy, so Ontario needs to commit immediately to seize and lead this opportunity.