Clean Hydrogen Investment Tax Credit Discussion Paper Feedback

Submitted by Energy Storage Canada

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About Energy Storage Canada

Energy Storage Canada (ESC) is the trade organization that represents the broad range of companies engaged in the energy storage industry across Canada. We represent over 70 member organizations that range in size from large multinationals to smaller, innovative technology companies. Our goal is to build a sustainable market and demonstrate the value that energy storage contributes to our energy systems, our environment, and our economy. Canada has the opportunity to become a global leader in the energy storage industry, including the hydrogen sector, by reinforcing innovation, creating expertise and jobs, and ensuring the establishment of a strong supply chain.

Introduction

Energy Storage Canada (ESC) is pleased to provide comments on the federal government's Clean Hydrogen Investment Tax Credit Discussion Paper. There is no pathway to net zero for the electricity sector that does not include energy storage, including in the form a Hydrogen as an energy carrier.

Storage has the unique ability to extract more value from existing zero-carbon assets, such as nuclear, solar, wind, tidal, geothermal, and hydro. It is also unique in its capacity to provide multiservice benefits, including flexible capacity, peak capacity, ancillary services, deferral of additional investments in generation, transmission and distribution, improved reliability of the grid, system stability and empowerment of customers.

Energy Storage investments address climate change by:

1. Increasing deployment of new and existing renewable energy by improving renewable energy output;
2. Reducing reliance on peak thermal resources; and
3. Enabling multi-service capability (e.g., capacity, energy, reliability, regulation service, operability, stability) whereby energy needs can be met using stored energy from zero carbon resources rather than fossil fuels.

Long, very long and seasonal durations of energy storage are an emerging and critical piece of the decarbonization of the electricity sector. Hydrogen is a key contender for very long and seasonal durations of energy storage and the scaling up of clean hydrogen production in Canada thus represents a key aspect of decarbonizing Canada's electricity supply. Additionally, hydrogen allows a key pathway for energy produced from renewable electricity to help decarbonize high emission industries, such as petrochemical or fertilizer production.

Clean hydrogen is a versatile clean fuel and energy carrier. At Energy Storage Canada we are especially focused on hydrogen's connections to the electricity system but are fully supportive of scaling up the hydrogen economy in all aspects. We envision increasing links between electricity system and a hydrogen system constituting energy storage, both at the discrete project level and at the system-to-system level. We also recognize that enabling means of large scale storage of hydrogen itself is a key aspect of hydrogen's successful application as energy storage.

Please direct any questions or follow-ups to robert.tremblay@energystoragecanada.org or 1-403-903-6234.

Sincerely,

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Answers to provided questions:

1. What clean hydrogen production pathways can be expected going forward? What are expectations for future hydrogen demand (e.g., by 2030)? What are potential hydrogen opportunities in Canada?

Expected demands are in the displacement of existing high carbon hydrogen demand and in the need for clean fuels in both transportation and stationary applications.

Today, high carbon hydrogen, mostly produced via steam methane reforming, representing "grey" hydrogen, serves the existing hydrogen demand. This demand is primarily in industrial processes, such as those in petrochemical, ammonia, and fertilizer production. Canada produces 3 Mt of grey hydrogen per year.[1] With carbon intensity of roughly 10kg of CO2 per kg of H2[2], this represents 30 Mt of CO2 emissions. This represents 4% of Canada's 738 Mt CO2 equivalent pre-pandemic greenhouse gas footprint[3]. Displacing existing grey hydrogen with low carbon hydrogen represents both a significant decarbonization opportunity, especially needed in the context of Canada's 2030 emissions reduction targets, and a significant opportunity to scale up low carbon hydrogen production. Scaling up low carbon hydrogen, especially electrolytic and thermolytic hydrogen, will lead to bigger economies of scale and lower long terms costs for hydrogen use outside of existing demand.

In addition to existing hydrogen use, hydrogen use as a clean fuel and energy carrier may also be significant. By producing hydrogen electrolytically and either using a hydrogen-capable turbine or a fuel cell to produce electricity from the produced hydrogen, functional energy storage is achieved. Due to a lower round-trip efficiency, hydrogen energy storage will likely serve very long duration and seasonal storage opportunities. In a closed system, this can represent a discrete energy storage system comparable to most other energy storage technologies, with relatively fixed capacity and storage capabilities. However, if a hydrogen transmission and distribution system emerges that is connected to electrolyzers and hydrogen-based electric generators, such as large fuel cells or hydrogen gas turbines, then the scale and capability of hydrogen storing and returning electrical energy may be distinctly large, with capacity and storage capabilities changing.

In Ontario's Independent Electric System Operator's recent Pathways to Decarbonization Report, hydrogen makes up 17% of Ontarian grid capacity in 2050, notably assumed to be 100% imported.[4] This conjures a vision of a hydrogen system that has significant interdependence with the electrical system, with the electrical system being utilized to produce a portion of the hydrogen that is used to back up the electrical system itself.

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[1] Hydrogen Strategy for Canada: Seizing the Opportunities for Canada, page 19
[2] Towards Net-Zero Energy Systems In Canada: A Key Role For Hydrogen, Figure 3.1, Page 32
[3] National Inventory Report 1990–2020: Greenhouse Gas Sources and Sinks In Canada, page 32, 2019 total emissions
[4] Pathways to Decarbonization ,Pages 12, 29

2. What would constitute appropriate carbon intensity tiers in the Canadian context? What makes such tiers appropriate?
3. Under what carbon intensity tiers are the different clean hydrogen production pathways in Canada expected to be found?
4. What levels of support would be appropriate for each carbon intensity tier, including the proposed top rate of at least 40 percent?

In the United States, Hydrogen technologies also have access to a production tax credit (PTC). In Canada, there is no such credit and additional applicability under the ITC will be needed to remain competitive. We believe that a more lenient tier structure will work towards providing competitive support without the introduction of a PTC.

ESC recommends that the upper bound of the hydrogen ITC be equivalent to 36 gCO_2e/MJ (roughly 5 kg CO_2 per kg H_2) to be in alignment with NRCan's Clean Fuels Fund and the European CertiHy standard. We then recommend simplifying the tiers as below.

Life Cycle GHG Emissions Intensity (kg CO_2 / kg H_2)	Investment Tax Credit Rates
< 5	30%
< 0.5	40%

5. What equipment is required at clean hydrogen production facilities? Is there equipment that is external to the facility that may be needed to support clean hydrogen production and how should the government consider eligibility for that equipment under the clean hydrogen investment tax credit or other investment tax credits?

It is critical that facilities needed to store hydrogen in a project, such as salt cavern storage facilities, liquefiers and cryogenic storage, ammonia conversion and storage, and HP compressors and receivers, be applicable under the Clean Hydrogen ITC.

6. What are the most common methods used to prepare clean hydrogen for transportation, including the various forms that hydrogen could take (e.g., compressed gas, liquid, or intermediate "hydrogen carrying" products like ammonia or methanol)? What stationary infrastructure is required to prepare hydrogen for transportation, either domestically or internationally?
7. Life cycle carbon intensity calculation:
   a. Are there any concerns with using the Government of Canada's Fuel Life Cycle Assessment Model for calculating the life cycle carbon intensity of clean hydrogen production?

We have concerns surrounding the incorporation of electricity carbon intensity in the calculation of electrolytic hydrogen carbon intensity. This is elaborated below.

   b. What additional guidance or support could be provided to help with the calculation of life cycle carbon intensity of clean hydrogen production with this model?

As stated below, grid carbon intensity should not be considered as part of the project lifecycle carbon intensity.

However, if the carbon intensity of electricity must be considered, there should be simple and explicit guidance from the Federal Government on how it may be considered.

The carbon intensity of the grid is going to decrease over time and varies greatly moment to moment. Canada is targeting a net-zero-by-2035 electric grid. The trajectory of the current details for the Clean Electricity Regulations allows for emitting electricity after 2035 in certain exceptional circumstances, with financial compensation or offsetting applied.[5]

Explicit guidance on these questions will be needed:

- Will the average annual grid intensity be used?
- Will the hourly grid intensity be used?

[5] https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/publications/proposed-frame-clean-electricity-regulations.html

- Are clean electricity credits or virtual power purchase agreements allowed to provide functional clean electricity for a project?
- How should a project determine the future carbon intensity of grid electricity over a project's lifetime?
- Are carbon offsets allowed to decrease grid carbon intensity?
- Should electricity after 2035 be assumed to be non-emitting?
- Is there a minimum scale needed to qualify for the tax credit?

How will the forecasted grid carbon intensity over the project

Additionally,

c. What should be included in the scope of the life cycle carbon intensity calculation? How could this extend to clean hydrogen that is produced alongside co-products, or as a by-product of an industrial process?

Electrolytic hydrogen projects, especially when functioning as energy storage for the electric grid, should not include the carbon intensity of input electricity as part of the life cycle carbon intensity of produced hydrogen. Energy storage resources applicable under the Clean Technology ITC, such as batteries, are not penalized for operating in high carbon grids. This is intentional, as these storage assets will proliferate low-cost variable renewable electricity. The same is true of electrolytic hydrogen.

If the carbon intensity of grid is included in the carbon intensity calculations of applicable electrolytic hydrogen projects, this will preclude investment in current high-carbon, but to be decarbonized, grids, such as Alberta and Saskatchewan. In high carbon grids storage is especially needed to support the integration of net-zero electricity generation. Hydrogen will be an important part of decarbonizing the electric grid and it is critical the Clean Hydrogen ITC enable electrolytic hydrogen investment in grids which are not yet decarbonized.

While some electrolytic hydrogen investments may not be part of an explicit storage project, they may eventually take part in a more abstract energy storage relationship between the electricity system and an emerging hydrogen system. For example, Capital Power in Alberta is installing 2 hydrogen capable turbines at their Genesee station[6] which may run completely on hydrogen in the future. If this hydrogen is coming in from an electrolytic hydrogen source located somewhere else and owned by someone else, then this would still represent storage of electricity in the hydrogen system, similar to if Capital Power installed an electrolyzer and hydrogen storage on site and operated the entire system itself.

Additionally, exactly how to incorporate the impact of grid carbon intensity into the calculation of a project's lifecycle carbon intensity is not straightforward and a likely source

[6] https://www.capitalpower.com/sustainability/innovation/repowering/

of uncertainty. Eliminating grid carbon intensity from the calculation will simplify this calculation.

Finally, even clean provincial grids have been found to produce hydrogen with carbon intensity higher than the lowest tier of the presented carbon intensity tiers. Electrolytic hydrogen utilizing British Columbian clean grid electricity has been found to have a carbon intensity as high as 3.88 kg CO2 per kg H2, just making it under the 4 kg CO2 per kg H2 limit to be even considered for the Clean Hydrogen ITC.[7] This hints that electrolytic hydrogen may be poorly supported by an ITC based on the tiers presented. In the United States, Hydrogen technologies also have access to a production tax credit. In Canada, there is no such credit and additional applicability under the ITC will be needed to remain competitive. We believe that exempting grid carbon intensity from electrolytic hydrogen carbon intensity will work towards providing this additional support.

8. Once hydrogen is being produced, by how much would the carbon intensity differ from the carbon intensity that was expected based on the design of the plant? Does this differ by production pathway? Is it possible to ensure that the carbon intensity of the clean hydrogen produced will be within a certain band and would this change over time? For the different clean hydrogen production pathways, what ongoing monitoring and calculations are done to measure carbon intensity once a clean hydrogen facility begins production?

Electrolytically produced hydrogen would generally change in carbon intensity as the carbon intensity of the electrical grid changes. Exceptions would exist where systems are designed such that only zero carbon electricity is used, such as an on-site electrolyzer connected to a renewable energy or nuclear facility.

9. How could life cycle carbon intensity calculations at the stage of plant design, and once a plant has actually started operations, be verified?

[7] BCBN BC Hydrogen Study, Figure 26, converted from 27.4 kgCO2/MJ

10. What is the typical service life of a clean hydrogen production facility and what are the risks that a project may not operate through to the end of its useful life?