Submission to Finance Canada

Consultation on the Clean Hydrogen Investment Tax Credit

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Submission on behalf of:

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Environmental Defence Canada recognizes that the strategic deployment of renewable hydrogen technology has the potential to help Canada meet its climate commitments by decarbonizing the sectors of the economy that do not have existing electrification solutions.

Finance Canada's proposed investment tax credit will be an important tool in supporting the growth of renewable hydrogen technologies.

However, there is a risk that if poorly designed, the proposed tax credit will be used to support fossil-hydrogen technology - which is incompatible with Canada's climate commitments - or inadvertently impact the availability of more cost-effective and reliable climate solutions. This would risk locking Canada into a fossil-based economy and divert funds from effective, cost-effective decarbonization measures that align with a 1.5 pathway.

To the extent that any public resources are made available for hydrogen development, they should be reserved for renewable hydrogen for the hardest-to-decarbonize sectors that do not have viable decarbonization alternatives.

Recommendations:

1. The tax credit should not be made available to any form of fossil-derived hydrogen.
2. The tax credit should only support forms of hydrogen with virtually no greenhouse gas emissions. If carbon intensity bands are used, emissions intensity levels should be no greater than 0.45 - 1.0 kg CO_2e per kg H_2 for the entire lifecycle of hydrogen, taken as an average over a 12-month period.
3. Emissions intensity levels must include the full 'well-to-wheel' life cycle of hydrogen.
4. The tax credit should target strategic applications and certain applications should be ineligible where their use would delay better decarbonization solutions, such as blended hydrogen for home heating or for power generation.
5. Require that electrolysis hydrogen be produced from additional renewable electricity that would not be generated without hydrogen production.
6. Companies receiving tax credits must be held accountable to mitigate harmful impacts on Indigenous and frontline communities, and provide compensation where mitigation is not possible. These communities must be involved in the design and implementation of the tax credit.
7. Ensure the tax credit is not stackable with the CCUS investment tax credit or with credits generated under the Clean Fuel Standard or carbon pricing systems, such as Alberta's Technology Innovation and Emissions Reduction (TIER) system.

Aligning the Tax Credit with Canada's Climate Commitments

Recommendation 1: The tax credit should not be made available to any form of fossil-derived hydrogen.

Recommendation 2: The tax credit should only support forms of hydrogen with virtually no greenhouse gas emissions. If carbon intensity bands are used, emissions intensity levels should be no greater than 0.45 - 1.0 kg CO2e per kg H2 for the entire lifecycle of hydrogen, taken as an average over a 12-month period.

Recommendation 3: Emissions intensity levels must include the full 'well-to-wheel' life cycle of hydrogen.

The only scalable and truly low-emissions hydrogen is produced from solar or wind-generated electricity.[1] A focus on enabling renewable hydrogen is the only way to have an emission-free hydrogen strategy that aligns with the profound transformation required to move Canada's energy system from one largely based on fossil fuels to renewable energy systems.

Blue hydrogen is not a climate solution

Hydrogen produced from fossil fuels - including pathways that use carbon capture, storage and utilization (CCUS) to reduce GHG emissions - should not be eligible for support.

The emissions abatement potential of blue hydrogen relies on CCUS. Despite decades of research, CCUS is neither economically sound nor proven at scale, with a terrible track record and limited potential to deliver significant, cost-effective emissions reductions.[2] A 2021 study found that more than 80 per cent of the CCS projects attempted in the U.S. have ended in failure.[3] A 2022 report analyzed 13 flagship projects - comprising over half of the total nominal capture capacity operating worldwide - and found that 10 of these projects are either underperforming or have failed completely.[4]

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[1] Zhou, Y. et al. (2021) Life-Cycle Greenhouse Gas Emissions of Biomethane and Hydrogen Pathways in the European Union. The International Council on Clean Transportation. Available: https://theicct.org/publication/life-cycle-greenhouse-gas-emissions-of-biomethane-and-hydrogen-pathways-in-the-european-union/

[2] Levin, J. (2022) Buyer Beware: Fossil Fuels Subsidies and Carbon Capture Fairy Tales in Canada. Environmental Defence Canada. Available: https://environmentaldefence.ca/wp-content/uploads/2022/03/Buyer-Beware-FFS-in-2021-March-2022.pdf

[3] Abdulla A. *et al* (2021) Explaining successful and failed investments in U.S. carbon capture and storage using empirical and expert assessments. Environ. Res. Lett. Available: https://iopscience.iop.org/article/10.1088/1748-9326/abd19e/pdf

[4] Robertson, B. & Mousavian, M. (2022) The carbon capture crux: Lessons learned. Institute for Energy Economics and Financial Analysis. Available: https://ieefa.org/resources/carbon-capture-crux-lessons-learned

Two of Canada's leading blue hydrogen projects, Quest and Nutrien have carbon capture rates of 43% and 29%, respectively.[5] Even if carbon capture was able to capture 99% of emissions generated during hydrogen production, CCUS does not address the significant methane leakage from the production and distribution of gas. Methane is 80 times more powerful a greenhouse gas than carbon dioxide.

Recent studies confirm that fossil-based hydrogen, even with carbon capture, offers no climate benefits over using fossil fuels directly.[6] In fact, a recent study from Cornell and Stanford found that the greenhouse footprint of 'blue' fossil hydrogen can be up to 20% higher than burning coal or fossil gas directly, and concludes there is no role for fossil hydrogen in a carbon-free future.[7] The former head of UK's leading hydrogen industry association stepped down from the role, stating that he would be betraying future generations if he remained silent on the fact that blue hydrogen is at best an expensive distraction, and at worst a lock in for continued fossil fuel use that would guarantee a failure to meet decarbonisation goals.[8]

Furthermore, blue hydrogen production does not address the other impacts associated with exploring and developing fossil gas deposits, including Indigenous rights violations, biodiversity, water, air quality, and the industry's failures to remediate wells. An increasing share of Canadian fossil gas production is made up by fracking.[9] In areas surrounding fracking operations, groundwater and surface water have been found to be polluted by the chemicals, which in some instances have been linked to cancer.[10]

Not only is blue fossil hydrogen not a climate–aligned technology, it's also a competitive laggard. By the time planned blue hydrogen projects become operational, most of the expected market for energy demand will have been taken over by renewable energy, electrification and

[5] Gorski, J., Jutt, T. Tam Wu, K. (2021). *Carbon intensity of blue hydrogen production.* Pembina Institute. Available at: https://www.pembina.org/reports/carbon-intensity-of-blue-hydrogen-revised.pdf
[6] Zhou, Y. et al. (2021) Life-Cycle Greenhouse Gas Emissions of Biomethane and Hydrogen Pathways in the European Union. The International Council on Clean Transportation. Available: https://theicct.org/publication/life-cycle-greenhouse-gas-emissions-of-biomethane-and-hydrogen-pathways-in-the-european-union/
[7] Howarth, R. & Jacobson, M. (2021) How green is blue hydrogen? Energy Science and Engineering. Available: https://www.actu-environnement.com/media/pdf/news-38015-etude-energy-science-engineering-hydrogene-bleu.pdf
[8] Ambrose, J. (2021) Oil firms made 'false claims' on blue hydrogen costs, says ex-lobby boss. The Guardian. Available: https://www.theguardian.com/environment/2021/aug/20/oil-firms-made-false-claims-on-blue-hydrogen-costs-says-ex-lobby-boss
[9] National Energy Board (2022). *Historical Canadian Provincial Marketable Natural Gas Production.* Available at: https://open.canada.ca/data/en/dataset/3bb59253-94d9-47e7-893d-5a794496e931
[10] Vogel, L. (2017). Fracking tied to cancer-causing chemicals. *Canadian Medical Association Journal. 189 (2) E94-E95*. Available at: https://doi.org/10.1503/cmaj.109-5358

renewable hydrogen.[11] This means that spending on blue fossil hydrogen comes with a significant risk of creating stranded assets.[12]

Fossil hydrogen production cannot be considered as a temporary or interim measure. Hydrogen plants typically have an operational life of 30 years - meaning any new hydrogen production facilities will likely be operating into the 2060s.[13]

Blue hydrogen locks us into prolonged fossil fuel dependence at a time when preventing catastrophic climate change requires *winding down* fossil fuel use. Investing in fossil hydrogen would lock Canada into a future of fossil fuel use and methane emissions leakages.

The proposed tax credit must not become a new fossil fuel subsidy

As well as undermining government efforts to reach net-zero by 2050, allowing this tax credit to apply to blue hydrogen projects would contradict the promise made by the Government of Canada to eliminate fossil fuel subsidies by 2023 as well as Canada's international commitments under the Paris Agreement.

The Government of Canada ignored the advice from over 400 of Canada's leading climate scientists and experts when it implemented the CCUS tax credit.[14] It should not repeat the error by creating another tax credit for fossil gas.

Setting an emissions intensity ceiling of 0.45 - 1 kg CO2e/kg H2

There is currently no consensus on how to measure and rank the GHG intensity of hydrogen. Given the complexity of evaluating lifecycle emissions, the preferable approach to ensure the tax credit aligns with a climates-safe future is by making fossil produced hydrogen ineligible.

Given that the Government of Canada seems to favour an approach that relies on ties of emissions intensity, Environmental Defence recommends using a threshold that ensures that fossil hydrogen will be ineligible. The production of renewable electricity can involve some greenhouse gas emissions. In certain circumstances, there may be some greenhouse gas emissions associated with electrolysis and associated processes (such as water treatment / desalination). The 'Green Hydrogen Standard' proposed by the Green Hydrogen Organization

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[11] Sanzillo, T. et al. (2022) Federal blue hydrogen incentives: No reliable past, present or future. IEEFA. Available: https://ieefa.org/ieefa-u-s-federal-blue-hydrogen-incentives-no-reliable-past-present-or-future/
[12] Longden, T. et al. (2022) 'Clean' hydrogen? – Comparing the emissions and costs of fossil fuel versus renewable electricity based hydrogen. Applied Energy, 306 (B). Available: https://www.sciencedirect.com/science/article/abs/pii/S0306261921014215?dgcid=author
[13] https://h2sciencecoalition.com/wp-content/uploads/2022/12/Clean-Hydrogen-Definition_final.pdf
[14] Letter from scientists, academics, and energy system modellers: Prevent proposed CCUS investment tax credit from becoming a fossil fuel subsidy (2022) Available: https://www.researchgate.net/publication/363485567_Letter_from_scientists_academics_and_energy_system_modellers_Prevent_proposed_CCUS_investment_tax_credit_from_becoming_a_fossil_fuel_subsidy

requires that projects operate at <1 kg CO2e per kg H2 (taken as an average over a 12-month period). This includes GHG emissions from the entire supply chain.[15]

Environmental Defence supports the recommendations made by the Hydrogen Science Coalition (HSC), including the below carbon intensity tiers and credit rates proposed by HSC.

Carbon Intensity Tiers (CO2e per kg of H2 produced taken as an average over a 12-month period)	Investment Tax Credit Rates
<0.45 kg	40%
0.45 kg to <0.65 kg	30%
0.65 to <1 kg	20%

When it comes to blue hydrogen, the emissions intensity depends significantly on assumptions about carbon capture rates and methane leakage. With a 90% CO2 capture rate, the carbon intensity of blue hydrogen could be reduced to approximately 3.2 kg CO2e/kg H2.[16] Though the United States is considering a definition of “clean hydrogen” that is set at 2 kg CO2e/kg H2, this level could still allow proponents of fossil hydrogen to use crafty accounting to claim to meet that threshold.

Emissions intensity must be based on robust life cycle assessments (LCA)

It is very important for Finance Canada to utilize the most robust life-cycle methodology possible in making pathway GHG determinations in order to ensure that Canadian policy only incentivizes pathways consistent with a vision of deep decarbonization

Life-cycle GHG accounting is complex. GHG intensity estimates depend on a large number of data inputs and assumptions, and also on methodological choices used in the life-cycle calculation.

LCA should include emissions from:

- feedstock extraction and delivery, include methane leakage from natural gas extraction and recovery, transmission and storage, using a 20 year Global Warming Potential in order to better account for the near-term climate impacts from methane
- hydrogen production, including fuel combustion and process fuels (emissions from natural gas used to power hydrogen production and carbon capture process, including fugitive emissions)

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[15] Green Hydrogen Organisations (2022) The GH2 Green Hydrogen Standard. Available: https://gh2.org/our-initiatives/gh2-green-hydrogen-standard
[16] Yan, F., Simon, N. & McCurdy, M. (2022) Why should we care about hydrogen carbon intensity? ICF. Available: https://www.icf.com/insights/energy/care-about-hydrogen-carbon-intensity

- emissions from electricity consumed, including upstream emissions from feedstocks
- if the captured carbon is used for enhanced oil recovery, then emissions from the increased oil production and consumption

To understand the actual GHG emissions throughout the life-cycle of hydrogen, it is important to measure methane leakage and losses at each step. Given the fact that methane is a potent greenhouse gas with a short lifetime, we recommend considering 20-year GWP when estimating GHG intensity. To facilitate this process, we recommend that policymakers provide detailed and consistent guidelines on the methodology for measuring methane leakage and provide related guidance to verification schemes regarding how to verify these measurements. (For example, see Zhou, Y. et al. (2021)[17]).

Though more difficult to do, the life cycle analysis should also incorporate the global warming potential of leaked hydrogen. Hydrogen is an indirect greenhouse gas whose warming impact is both widely overlooked and underestimated.[18] Over a 20 year period, hydrogen has 33x the global warming potential of carbon dioxide.[19] Given how prone to leakage hydrogen is - it is still largely unknown how much H2 will leak in future value chains[20] - we must be cautious in the type of hydrogen infrastructure we build. In fact, if leaks are moderately high, even green hydrogen may initially yield more warming than would the use of the fossil fuel system it replaces.[21]

Target Hardest-to-Decarbonize Sectors

> **Recommendation 4: The tax credit should target strategic applications and certain applications should be ineligible where their use would delay better decarbonization solutions, such as blended hydrogen for home heating or for power generation.**

According to the 2022 IPCC report, decarbonized hydrogen will remain a relatively small portion of the global energy balance – at best 2% in 2050.[22] However, hydrogen may have the potential to reduce emissions in hard to decarbonize sectors with few alternatives and where electrification isn't yet an available option, such as the production of steel and cement as well as heavy-duty transport and maritime shipping. A strategic priority is also replacing current applications of grey hydrogen, for example the production of ammonia for fertilizer.

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[17] Zhou, Y. et al. (2021) Life-Cycle Greenhouse Gas Emissions of Biomethane and Hydrogen Pathways in the European Union. The International Council on Clean Transportation. Available: https://theicct.org/publication/life-cycle-greenhouse-gas-emissions-of-biomethane-and-hydrogen-pathways-in-the-european-union/
[18]Ocko, I. B. & Hamburg, S. P. (2022). Climate consequences of hydrogen emissions. *Atmospheric Chemistry and Physics*, *22*(14), 9349-9368. Available at: https://doi.org/10.5194/acp-2022-91
[19] https://www.gov.uk/government/publications/atmospheric-implications-of-increased-hydrogen-use
[20] https://www.nature.com/articles/s41467-022-35419-7
[21] Ocko, I. B. & Hamburg, S. P. (2022). Climate consequences of hydrogen emissions. *Atmospheric Chemistry and Physics*, *22*(14), 9349-9368. Available at: https://doi.org/10.5194/acp-2022-91
[22] IPCC, 2022. Climate Change 2022 – Mitigation of Climate Change, AR6 WG III, Chapter 12, p.123, https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_FullReport.pdf

However, the widespread and untargeted use of hydrogen may actually complicate the task of decarbonizing by delaying the deployment of electrification and energy efficiency. If poorly designed, the tax credit could risk stalling climate progress and increase the costs of the transition to a clean economy.

Building out renewable hydrogen systems requires a huge amount of energy, as its production and use incur a chain of energy conversions and losses. It is always more efficient to use renewable energy directly than convert it to hydrogen. Electrification and energy efficiency will always beat out hydrogen as the most efficient and cost-effective way to meet most energy needs. Depending on the end-use of green hydrogen, electricity generation requirements can be 2 to 14 times higher than direct electrification solutions for the same effect.[23]

Many provincial and national hydrogen strategies are proposing blended hydrogen into natural gas grids or power generation. However hydrogen blending would result in negligible emissions reductions, at a high cost for ratepayers, and poses additional risks to public health and safety. Blended hydrogen also risks the lock in of fossil fuel infrastructure. Investing in inefficient hydrogen solutions for heating and power generation diverts resources from better, more efficient and affordable solutions. For example, heat pumps are five to six times more efficient than using blended hydrogen.[24] A recent review of 32 studies concluded that hydrogen for heating and cooking is a distraction: it is inefficient, costly and resource intensive.[25] Not one of the studies suggested a major role for hydrogen for heating.

Widespread deployment of hydrogen in applications that can be more efficiently decarbonized with alternatives risks putting significant pressure on the energy system, unnecessarily increasing the costs of the transition to a clean economy, and complicating climate progress. Therefore the tax credit should only be made available for sectors for which there are no decarbonization options and not for applications such as blended hydrogen, where there are more cost-effective and reliable options to use electricity directly.

[23] Ueckerdt, F., et al., 2021. "Potential and risks of hydrogen-based e-fuels in climate change mitigation", Nature Climate Change, Vol 11, pages 384–393, https://dx.doi.org/10.1038/s41558-021-01032-7
[24] Energy Transitions Commission (2021). Making the Hydrogen Economy Possible: Accelerating Clean Hydrogen in an Electrified Economy. Available at: https://www.energy-transitions.org/wp-content/uploads/2021/04/ETC-Global-Hydrogen-Report.pdf
[25] Rosenow, J. (2022). Is heating homes with hydrogen all but a pipe dream? An evidence review**.** *Joule 6*(10) 2225-2228. Available at https://doi.org/10.1016/j.joule.2022.08.015

Require Additionality for Hydrogen from the Grid

> **Recommendation 5: Require that electrolysis hydrogen be produced from additional renewable electricity that would not be generated without hydrogen production.**

Additionality is a key requirement to avoid emissions increases on the grid as a result of the new load from grid-connected electrolyzers.[26] If electrolyzer loads are not paired with new renewable generation, the grid could respond by ramping fossil generators to serve the new load. To offset emissions linked to new grid power consumption, electrolyzers must contract new clean generation to match this load.

This requirement could be met through power purchase agreements with new renewable energy projects that come online within a set timeframe.

Additionality is critical to ensuring that the renewable electricity for hydrogen is not diverted from existing uses.

Prohibit Stacking with Other Credit Systems

> **Recommendation 7: Ensure the tax credit is not stackable with the CCUS investment tax credit or with credits generated under the Clean Fuel Standard or carbon pricing systems, such as Alberta's Technology Innovation and Emissions Reduction (TIER) system.**

The prohibition of credit stacking for hydrogen projects prevents market distortions and double dipping. Similarly, the hydrogen production tax credit (PTC) in the *Inflation Reduction Act* expressly prohibits hydrogen projects from receiving both the 45Q tax credits for carbon capture and the hydrogen PTC; it's either/or.

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[26] Natural Resources Defense Council (2022) Comments by the Natural Resources Defense Council to Notice 2022-58- Request for Comments on Credits for Clean Hydrogen and Clean Fuel Production. Available: https://www.regulations.gov/comment/IRS-2022-0029-0079