A Renewable Hydrogen Strategy for Canada

BRIEFING NOTE

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environmental defence

Recommendations on a Hydrogen Strategy for Canada

- In order to align with Canada's commitment under the Paris Agreement, a credible and robust hydrogen strategy for Canada must focus on supporting and growing the nascent renewable hydrogen sector through investment in research and development and the creation of a supportive regulatory and policy framework. The strategy must be explicit about a preference and focus on renewable hydrogen, rather than using the term "clean" to mislead Canadians and allow for fossil-fuel derived ("blue") hydrogen to play a key role.
- In order to align with Canada's G20 and G7 commitments to eliminate inefficient fossil fuel subsidies, Canada should not be providing any form of financial support for the development of fossil hydrogen. Support for research and development of natural gas for the production of hydrogen, as well as for infrastructure, falls under the international definitions for fossil fuel subsidies.
- The application of hydrogen should be prioritised for the hardest to decarbonize sectors, which cannot be electrified and for which no viable alternatives exist. Hydrogen blending – the injection of hydrogen into the gas grid - is not a suitable option for decarbonizing space and water heating.
- The development of a hydrogen sector should not be coupled to the development of small modular reactors (SMR), given significant concerns with the feasibility, costs, safety and timeliness of the technology.

Introduction

As the government rolls out its national hydrogen strategy, critical decisions about Canada's future role in the emerging hydrogen economy must be made. The most important steps for decarbonizing our economy remain increased electrification, wide-scale use of renewable energy and intensifying energy efficiency. In addition, Canada needs a just transition to plan a phase-out of all fossil fuels and their associated infrastructure in line with climate science.

However, we recognize the potential of renewable hydrogen to play a critical role in decarbonizing the hardest-to-abate sectors. Strategic deployment of renewable hydrogen technology will help Canada meet its climate commitments under the Paris Agreement, setting us on a pathway to net-zero emissions as soon as possible before 2050. There is a real opportunity for Canada to become a world leader in this new green energy industry.

This risks being undermined by a focus on fossil fuel derived hydrogen. The oil and gas sector is pushing for governments to invest in fossil fuel derived hydrogen as a way to create new markets for their products as the world transitions away from oil. There is little scientific or economic evidence that investing in fossil hydrogen production can make a meaningful and cost-effective contribution to achieving a zero emissions economy. Investing

in fossil-derived hydrogen would lock Canada into a future of fossil fuel use and methane emission leakages. While hydrogen is being presented as a climate panacea, that isn't the case as long as its production continues to be powered from fossil fuels rather than renewable energy.

The Government of Canada must stand firm and not allow the oil and gas industry to exploit this opportunity as a last chance to create a market for its product. The development of a hydrogen strategy must be truly green, building on Canada's renewable energy advantages.

Aligning with net-zero by 2050

Only renewable hydrogen is truly emissions-free, and as such, renewable hydrogen aligns with the deep decarbonization required to tackle climate change. A focus on enabling renewable hydrogen is the only path to 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

Renewable hydrogen both complements and supports the development of the renewable energy sector. The creation of electrolysis-derived hydrogen provides a ready mechanism to allow for more rapid deployment of renewable energy. This is because hydrogen can act as an energy carrier to enable increased penetration of renewables by providing time shifting and energy storage capabilities.

Fossil hydrogen is not aligned with a pathway to zero emissions economy

Fossil-derived hydrogen's abatement potential relies on carbon capture and storage (CCS) technology, an unproven technology which falls short of a zero emissions objective and is still prohibitively expensive. There is little reason to expect that CCS applied to natural gas won't end up like coal power with CCS: a technology hailed a decade ago as a promising way of reducing emissions but now seen as a costly distraction and dead end that provided cover for a last burst of dirty coal investment.

In addition, CCS does not address upstream methane emissions from leakages in the gas production and distribution system. There emissions are consistently underreported.[1] Upstream emissions significantly alter the climate impact of fossil-derived hydrogen.[2] Nor does CCS 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. Furthermore, the only current commercial application for using captured carbon dioxide is improving the efficiency of oil wells, which in turn creates more carbon pollution.

Though Canada is home to some of the most successful CCS projects and companies in the world, these are expensive demonstration projects. CCS isn't commercially viable and would require massive scaling up. The United States government spent US$5 billion from 2010 to 2018 on the technology[3], but it would take additional significant investments, more research

[1] https://www.bloombergquint.com/markets/methane-emissions-are-higher-than-thought-in-canadian-oil-patch
[2] https://www.pembina.org/reports/hydrogen-climate-primer-2020.pdf
[3] https://ideas.repec.org/a/spr/bioerq/v5y2020i3d10.1007_s41247-020-00080-5.html

and some technological breakthroughs for the technology to lower the cost of capturing carbon to $94-232 per tonne.[4]

Huge CCS capacity would be required for a wide implementation of fossil-derived hydrogen and that simply does not exist - and it is hard to see how it can. Given that carbon storage will be a scarce resource as we move towards a net-zero emissions future, its use should be prioritised towards the sectors where CCS is most needed, e.g. where there are no other decarbonization options.[5]

Canada's commitments to eliminate fossil fuel subsidies

Nearly all of the hydrogen created in Canada today is grey hydrogen. Given the issues with CCS technology, investments made into blue hydrogen would actually support grey hydrogen.

All new government investments must be focused on rapid transition to carbon-free energy systems. To the extent that any public resources are available for hydrogen development, they should be reserved for renewable hydrogen for the hardest-to-decarbonize sectors that do not have viable decarbonization alternatives. Canada should not be providing any form of financial support for the development of fossil-fuel derived hydrogen. Support for research and development of natural gas for the production of hydrogen, as well as for infrastructure, falls under the international definitions for fossil fuel subsidies. **Any funding for fossil hydrogen is a fossil fuel subsidy and goes against Canada's G7 and G20 commitments to eliminate inefficient subsidies.**

Renewable hydrogen quickly becoming cost-competitive option

The European Commission estimates that blue hydrogen would cost €2 a kilograms at today's prices, and renewable hydrogen €2.50-€5.50/kg, compared to €1.50/kg for existing grey hydrogen.[6] However, there is widespread optimism about renewable hydrogen's ability to compete. New analysis by Morgan Stanley says plummeting renewable energy prices, as well as ongoing reductions in the costs of electrolyser technology, could push renewable hydrogen to be more cost competitive by 2023 than even unabated fossil hydrogen by 2023.[7]

The prices of renewable energy sources that power green hydrogen are falling precipitously and are now the lowest cost sources of new power in many parts of the world.[8] Renewables have managed to undercut conventional power generation over the past decade. Since 2009, the cost of unsubsidized solar power in the U.S. has fallen 90% and wind is down 70%.[9]

[4] https://www.cell.com/joule/fulltext/S2542-4351(18)30225-3
[5] https://www.e3g.org/wp-content/uploads/E3G_Renewable_and_decarbonised_gas_Options_for_a_zero-emissions_society.pdf
[6] https://www.thefifthestate.com.au/energy-lead/energy/hydrogen-for-homes-is-a-terrible-idea-we-should-fight-it/
[7] https://ieefa.org/morgan-stanley-green-hydrogen-could-be-economically-competitive-by-2023/
[8] https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/May/IRENA_Renewable-Power-Generations-Costs-in-2018.pdf
[9] https://www.lazard.com/media/451419/lazards-levelized-cost-of-energy-version-140.pdf

Another key factor is the rollout of electrolysers used to produce the renewable hydrogen, which have already fallen in price by 60% over the past decade. According to the European Commission, prices are expected to halve in 2030 compared to today with economies of scale. In China production costs are already 80% lower than in Europe and North America.[10]

The costs of blue hydrogen are harder to gauge as they depend on the cost of adding CCS to conventional production. Though the cost of CCS is also highly uncertain, current estimates place it at about a 30% cost increase.[11] Furthermore, fossil hydrogen is dependent on the price of natural gas. According to analysts at Wood Mackenzie, the cost of renewable hydrogen will drop by up to 64% until 2040, while the cost of blue hydrogen will see a rise of 59% over the same period, mostly due to natural gas prices.[12]

Fossil-fuel based technologies are expected to have limited cost reduction potential relative to the expected cost reductions for electrolysis.[13] While most of the technologies used for fossil hydrogen are already mature technologies, there is still a lot of potential for innovation and cost reduction in the renewable hydrogen process, as large-scale electrolysis is a novel field of application.[14] Focusing on current metrics to dismiss green hydrogen's prospects is highly risky. Both cost trends and capacity deployment lessons from other sectors point to a future competitive environment very different from today.[15]

Prioritising applications for renewable hydrogen

While electrification plays the leading role in pathways identified by the Intergovernmental Panel on Climate Change (IPCC)[16], it cannot currently unlock some sectors. Hydrogen has the potential to reduce emissions in hard to decarbonize sectors with few alternatives and where electrification isn't an option, such as the production of steel and cement as well as heavy-duty transport and maritime shipping.

However, hydrogen is and will continue to be a scarce resource during the growth of this emerging clean energy sector. Even a niche application of hydrogen would require a dramatic scaling up of its production and use, which will take time. There is also the risk that renewable power generation is diverted from the grid for the production of hydrogen. Furthermore, hydrogen faces technical and economic challenges compared with other zero-carbon competitors. Its use should be prioritised for the sectors most difficult to electrify or decarbonize.

[10] https://www.carbonbrief.org/in-depth-qa-does-the-world-need-hydrogen-to-solve-climate-change
[11] https://www.e3g.org/wp-content/uploads/E3G_Renewable_and_decarbonised_gas_Options_for_a_zero-emissions_society.pdf
[12] Wood Mackenzie. (2020, August 25). Green hydrogen costs to fall by up to 64% by 2040 [Press release]. https://www.woodmac.com/press-releases/ green-hydrogen-costs-to-fall-by-up-to-64-by-2040/
[13] imperial.ac.uk/sustainable-gas-institute/research-themes/white-paper-series/white-paper-3-a-greener-gas-grid-what-are-the-options/
[14] https://www.e3g.org/news/a-global-green-hydrogen-market-made-in-germany/
[15] https://www.petroleum-economist.com/articles/low-carbon-energy/renewables/2020/green-hydrogen-can-be-cost-competitive
[16] https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf

Hydrogen blending is not a suitable alternative fuel for space and water heating.

The draft strategy supports the injection of hydrogen into the gas grid for space and water heating, but in effect, this is merely an argument for extended use and reliance on fossil gas. Hydrogen blending is highly ineffective, expensive, and speculative in comparison to alternatives measures to decarbonize space and water heating. We have cost-effective solutions now to decarbonize space and water hearing, including energy efficiency and electric heat pumps. The energy conversion losses associated with hydrogen means that at least 2-3 times more green electricity is required to decarbonize space and water heating via hydrogen versus electric heat pumps. Hydrogen blending is extremely expensive in comparison to alternatives. Whereas hydrogen blending will cost in the range of $4,000 to $5,000 per tonne, energy efficiency saves money, often over $100 per tonne. Hydrogen blending cannot play a substantial role in decarbonizing buildings. Existing infrastructure is not equipped to handle more than a very low percentage (up to 6%) of hydrogen blended into fossil gas, due to the corrosive nature of pure hydrogen to steel. Blending a negligible volume of hydrogen into carbon emitting fossil gas is a dangerous distraction from realistic measures to decarbonize space and water heating. Lastly, this application would divert hydrogen from other uses where it is actually needed.

There is no time for a later transition to renewable energy

During the stakeholder engagement session, officials from Natural Resources Canada laid out the plan to begin investing in blue hydrogen and later transition to zero-emission green hydrogen. There are significant concerns with this approach.

- We will only get one chance to kick start innovation and investment in the right direction. The economic crisis created by COVID-19 means that the ability of governments to invest "later" in renewable hydrogen is likely to be severely compromised.
- It will likely take a decade to develop a blue hydrogen sector. By the time blue hydrogen projects can be completed – if ever, given the limitations of CCS - the cost of producing renewable hydrogen is likely to have dropped significantly, but we will be locked into a fossil hydrogen industry. In the meantime, the majority of hydrogen production in Canada continues to be grey – with enormous climate implications.
- The urgency of the climate crisis leaves no time for a "later" transition. Climate change impacts are mounting at such a rate that all new government investments must be focused on rapid transition to carbon-free energy systems.

The development of a hydrogen strategy should not be coupled with SMRs

There are significant concerns with linking hydrogen to the development of small modular reactors (SMRs), given significant issues with the feasibility, costs, safety and timeliness of the technology.

SMRs are an expensive distraction from more viable, cost-competitive decarbonization solutions. Developing new nuclear energy is too slow to address the climate crisis – as well

as more expensive – compared to renewable energy and energy efficiency.[17] Cost benefit analysis of SMRs has largely failed to address operations and maintenance costs as well as decommissioning costs satisfactorily.[18] A Canadian study found that energy from small nuclear reactors would be up to ten times the cost of renewable energy.[19] SMRs are still conceptual, with designs only 5 – 20% complete.[20] The models being proposed will take a decade or more to develop. Nuclear-powered hydrogen is not renewable hydrogen.

Opportunity for Canada to be a global leader in renewable hydrogen

There is an opportunity for Canada to become a global leader in the renewable hydrogen industry. Canada is among a small group of countries with the highest potential for exporting clean hydrogen, thanks to plenty of access to water (required for electrolysis) and a clean power system. However, we are at risk of squandering this opportunity with a focus on fossil hydrogen.

Both the European Commission and German government are clear in setting out renewable hydrogen as the only sustainable hydrogen source. The EU envisions installing at least six gigawatts of green hydrogen by 2024 and at least 40 gigawatts by 2030. This would be followed by the large-scale deployment of new hydrogen technology out to 2050.[21] France announced €2 billion over two years for green hydrogen as part of a stimulus package, with a further €5.2 billion to be invested by 2030.[22] Lacking sufficient cheap renewables, European nations will turn to imports. Germany has earmarked funds to create partnerships with countries where green hydrogen can be efficiently produced.[23]

If Canada is to compete and succeed in the global hydrogen economy, we must harness our competitive advantages and focus on the long-term with a plan to produce, use, and export the world's cleanest hydrogen and its related technologies.

[17] https://www.lazard.com/media/451419/lazards-levelized-cost-of-energy-version-140.pdf
[18] Mignacca, B., & Locatelli, G. (2020). Economics and finance of Small Modular Reactors: A systematic review and research agenda. Renewable and Sustainable Energy Reviews, 118, 109519. https://linkinghub.elsevier.com/retrieve/pii/S1364032119307270
[19] https://policyoptions.irpp.org/magazines/august-2020/small-modular-reactors-arent-the-energy-answer-for-remote-communities-and-mines/
[20] Canadian Nuclear Safety Commission, Presentation for Management Committee: Small Modular Reactor (SMR) Update– Readiness for Regulation, January 14, 2016. Acquired through Access to Information, A-2016-00010
[21] European Commission. (2020, July 8). A hydrogen strategy for a climateneutral Europe. https://ec.europa.eu/energy/sites/ener/files/hydrogen_ strategy.pdf; Renewable Energy News. (2020, July 8). EU unveils 40GW green hydrogen vision. https://www.renews.biz/61529/eu-unveils-40gw-greenhydrogen-vision/
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[23] https://www.carbonbrief.org/in-depth-qa-does-the-world-need-hydrogen-to-solve-climate-change