# Canada's Hydrogen Policy Fiasco

## In-house Audit a Compelling Condemnation

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# CANADA'S HYDROGEN POLICY FIASCO

## EXECUTIVE SUMMARY



Recently, the Commissioner of the Environment and Sustainable Development Canada (CESDC) reported to Parliament on the results of its independent audit of the federal government plans with respect to realizing hydrogen's potential to reduce greenhouse gas (GHG) emissions.

The aspirational view of climate campaigners is that immense amounts of hydrogen can be produced by electrolysis using renewable energy-generated electricity with no emissions. Currently, however, the estimated cost of such generation using wind and solar energy is 17 times the cost of natural gas.

Two departments of the federal government have published different plans and analyses describing the potential of hydrogen, despite its high costs, to meet Canada's emissions reduction targets. In December 2020, Natural Resources Canada (NRCan) published the *Hydrogen Strategy for Canada*[1] and the same month Environment and Climate Change Canada (ECCC) published an ambitious climate mitigation plan, *A Healthy Environment and a Healthy Economy*[2]. The NRCan strategy estimated that hydrogen could reduce Canada's GHG emissions by between 22 and 45 megatonnes of carbon dioxide equivalent (CO2e) by 2030 and as much as 190 megatonnes by 2050. ECCC, in contrast, expected Canada's use of hydrogen to reduce GHG emissions by only 15 megatonnes by 2030.

The CESDC audit was highly critical of the analyses done by both departments, noting that they used unrealistic assumptions to model the potential for hydrogen to reduce emissions. In its pathway modelling, ECCC assumed that all existing buyers of natural gas must switch to a 7.3% hydrogen-natural gas blend by 2030. According to analysis presented to NRCan, a more stringent carbon price of at least $500 per tonne would be needed to encourage businesses to adopt blending at that level. ECCC assumed that new electricity transmission lines would be built and operating by 2028 and 2030 to provide "clean electricity" to provinces that now rely on fossil fuel electricity generation. This, of course, would require the expenditure of billions of dollars and agreement among many different stakeholders (including indigenous groups) to secure a right of way.

The CESDC is the federal government's own in-house auditor. It clearly endorses the federal government's present climate policies and goals. Yet, its audit of the federal government's efforts to assess hydrogen's potential to reduce GHG emissions began as an operational audit of a single program area and ended as a compelling condemnation of two government departments' modelling and policy development practices.

[1] https://www.nrcan.gc.ca/sites/nrcan/files/environment/hydrogen/NRCan_Hydrogen-Strategy-Canada-na-en-v3.pdf
[2] https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/climate-plan/healthy_environment_healthy_economy_plan.pdf

# CANADA'S HYDROGEN POLICY FIASCO



The Office of the Commissioner of the Environment and Sustainable Development Canada (CESDC) is a branch of the Office of the Auditor General of Canada. Its function is to conduct audits and other studies of existing environmental policies and programs to determine whether the management and implementation of those policies and programs meets acceptable standards. It does not challenge the wisdom of the government's policies and programs; rather, it starts from the premise that the government's objectives are well conceived and serve the public interest.

Recently, CESDC reported to Parliament on the results of its independent audit of the federal government plans with respect to realizing hydrogen's potential to reduce greenhouse gas (GHG) emissions. The report[3], which received virtually no media attention, was profoundly critical of the analysis that seeks to support the government's plans. In this article, I will summarize the claims of hydrogen potential that underlie the government's plans and the main criticisms made by the CESDC.

The Dream


The Reality

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## HYDROGEN'S THEORETICAL POTENTIAL

Hydrogen can produce energy in two ways, either by being combusted (in an engine or turbine) or by being fed into a fuel cell to produce electricity. In its pure form (i.e. in water or hydrocarbons), it first has to be produced and stored. Producing hydrogen can take large quantities of energy.

[3] https://www.oag-bvg.gc.ca/internet/English/parl_cesd_202204_03_e_44023.html

Advocates of “Net Zero” decarbonization (i.e., reducing and ultimately ending people’s use of oil, natural gas and coal as energy sources) are attracted to hydrogen because it can reduce emissions where electrification is not technically or economically feasible, such as in energy-intensive industries or long-distance transportation by trucks, marine vessels or aircraft. At present, 99% of the hydrogen used commercially in Canada is produced from natural gas through steam methane reforming[4]. This production method has 2.2 times the GHG emissions of natural gas, and costs about 4.4 times the cost of natural gas. Typically, the hydrogen presently produced is vital for making agricultural fertilizer.

The aspirational view is that immense amounts of hydrogen could be produced by electrolysis using renewable energy-generated electricity with no emissions. This means that wind/solar farms or hydro (or a combination) would power an electrolysis unit which would split water into molecules of hydrogen (H2) and oxygen (O2). The separated hydrogen would be captured and stored in pressurized containers for later use as ‘fuel.’ Thus, the theory is that this would be an entirely emissions-free cycle. Currently, the estimated cost of such generation using hydroelectricity is $22 per gigajoule (almost 6 times the cost of natural gas), while the cost of generation using solar is $62.60 per gigajoule (almost 17 times the cost of natural gas), and the cost of generation using wind is $63.80 per gigajoule (17 times the cost of natural gas).

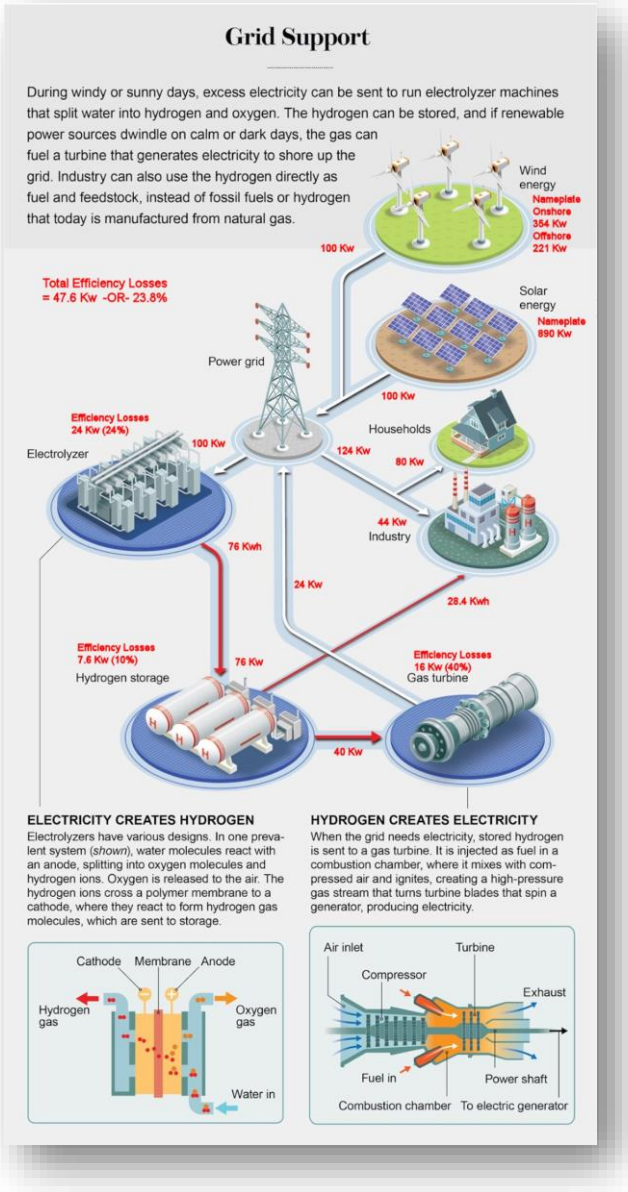


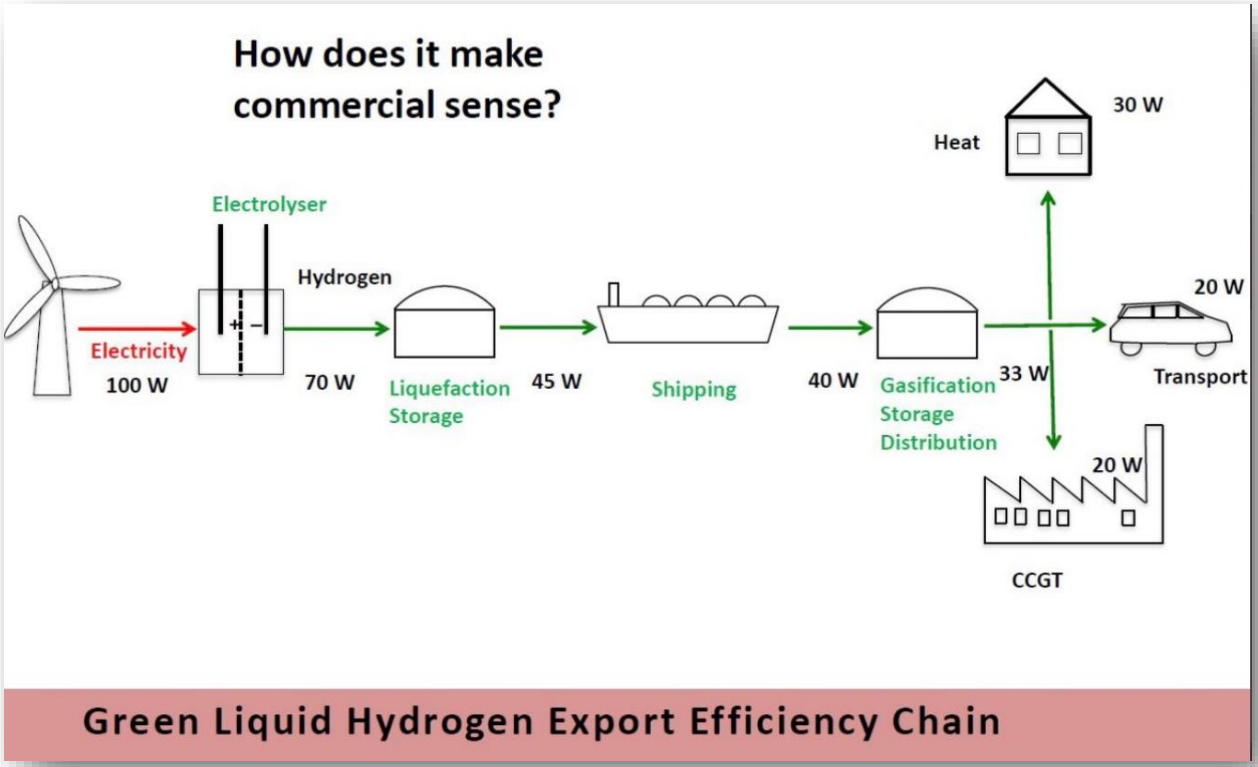

Image: 5W Infographics https://www.scientificamerican.com/article/solar-and-wind-power-could-ignite-a-hydrogen-energy-comeback/

[4] https://www.energy.gov/eere/fuelcells/hydrogen-production-natural-gas-reforming

## FEDERAL GOVERNMENT MODELLING



Two departments of the federal government have published different plans and analyses describing the potential of hydrogen, despite its high costs, to meet Canada's emissions reduction targets. In December 2020, Natural Resources Canada (NRCan) published the *Hydrogen Strategy for Canada*[5] and the same month Environment and Climate Change Canada (ECCC) published an ambitious climate mitigation plan, *A Healthy Environment and a Healthy Economy*[6].




*Not addressed in the analyses, there are significant energy losses throughout the processing of hydrogen.*
*https://www.linkedin.com/posts/tom-baxter-a141a1b_shipping-liquid-hydrogen-around-the-world-activity-6976133146882797568-zqFO/?trk=public_profile_like_view&originalSubdomain=ca*

The NRCan strategy estimated that hydrogen could reduce Canada's GHG emissions by between 22 and 45 megatonnes of carbon dioxide equivalent ($CO_2e$) by 2030 and as much as 190 megatonnes by 2050.

[5] https://www.nrcan.gc.ca/sites/nrcan/files/environment/hydrogen/NRCan_Hydrogen-Strategy-Canada-na-en-v3.pdf
[6] https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/climate-plan/healthy_environment_healthy_economy_plan.pdf

This would represent up to 15% of all emissions reductions by 2030 and up to 26% of the reductions by 2050. More than half (25 megatonnes) of the emissions reduction from hydrogen by 2030 would come from oil and gas production, but by 2050 the largest share (61.5 megatonnes) would come from the transportation sector. ECCC, in contrast, expected Canada's use of hydrogen to reduce GHG emissions by only 15 megatonnes by 2030.



The CESDC audit was highly critical of the analyses done by both departments, but especially that done by NRCan.

- Both departments used unrealistic assumptions for modelling the potential for hydrogen to reduce GHG emissions.
- **NRCan used a "transformative" approach that assumed the adoption of aggressive and sometimes nonexistent policies.**
- **It assumed the most favourable future regulations, technological developments, and adoption growth rates.**
- **It did not systematically assess the cost effectiveness of different alternatives or evaluate whether technologies would be ready or deployable.**
- It assumed that all provinces would adopt supportive regulations and programs.
- It did not factor in how the supply of hydrogen and associated costs would be deployed to meet the projected demand.
- **It did not factor in how the existing electrical grid and infrastructure could accommodate the electrification ambitions, as well as hydrogen production from renewable generation (including the time to build supporting infrastructure).**

Environment and Climate Change Canada, for its part, used an inadequate approximation, called a proxy, in modelling the potential demand for hydrogen and used this estimate to comment on the Hydrogen Strategy for Canada. **In its pathway modelling, the department assumed that all existing buyers of natural gas must switch to a 7.3% hydrogen-natural gas blend by 2030.** To blend hydrogen with natural gas, natural gas providers face many technical barriers, such as the weakening of pipes, the lack of measurement standards, and the lack of end-use equipment. **The proxy (a government-imposed hydrogen-natural gas blending obligation) was not based on any existing policy at the provincial or federal level. In addition, it was uneconomical based on the current trend of carbon pricing. This weakness called into question whether the emission reduction pathway was realistic and achievable.**

The Canada Energy Regulator (CER), another federal government agency, has conducted various analyses on the projected energy supply and demand in Canada. In its report *Canada's Energy Future*

*2021*[7], **the regulator assumed hydrogen blending in natural gas at 1% by 2030.** This was because of the physical limits on how much hydrogen can be blended into existing natural gas pipelines and how much can be used in existing end-use devices. This rate is far below that assumed by Environment and Climate Change Canada. The CER did not foresee a 7% blending of hydrogen into natural gas until 2050.



This is more than a technical issue. The CESDC audit noted that a 7.3% blending of hydrogen with natural gas might be technically feasible in some networks, but it was not justified economically. **According to analysis presented to NRCan, a more stringent carbon price of at least $500 per tonne would be needed to encourage businesses to adopt blending at that level.** As the carbon dioxide tax is scheduled to rise to "only" $170 per tonne in 2030, it is contradictory to assume that utility providers would adopt blending that would be uneconomical for them. One might add that, at a carbon dioxide tax of $500 per tonne, there would be very few firms left operating in Canada to purchase natural gas. When questioned about this by CESDC, ECCC officials responded that "it is not in the purview of Environment and Climate Change Canada's modelling group to develop cost-effective decarbonization pathways".

*Abstract: Despite the fact that nowadays Hydrogen is mostly considered a carbon-free energy vector, this tiniest molecule is in its artificially separated status and one of the most difficult and dangerous substances to handle on earth. The engineering community acknowledges this fact and treats hydrogen carefully, using it in the chemical industry with a respectable safety record. However, to distribute hydrogen to millions of untrained customers such as vehicle owners seems a parlous idea. Serious risks can arise due to the mass production, the cost sensitivity of which might has a negative impact on material and production quality. Further risks are posed by imprudent user behaviour, unqualified maintenance and repair, in which the unreliable quality of aftersales parts can increase the possibility of faults and equipment time-wear, may lead to additional risks. Any failure within a H2-system may incur not only the cost of an unworkable vehicle, but the cost of human lives.*

https://www.science-climat-energie.be/wp-content/uploads/2021/02/e1_Rising-safety-hazard-related-to-hydrogen_compressed.pdf

The unrealistic assumptions did not end there. Between 1990 and 2017 overall energy efficiency for the Canadian residential sector improved by an annual average of 1.6% and for the commercial and institutional sectors by an annual average of 0.7%. Yet, ECCC assumed in its modelling that the energy efficiency of all buildings after 2022 would meet a target of 2% annual average reduction for residential

[7] https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2021/#:~:text=Welcome%20to%20Canada's%20Energy%20Future,modelling%20for%20the%20first%20time.
Plain language discussion of hydrogen risks. https://www.science-climat-energie.be/2021/02/26/pushing-hydrogen-out-of-the-safety-controlled-laboratory-environment-for-mass-on-road-application-will-cause-critical-safety-hazards/

and 2.5% for commercial buildings. ECCC assumed that sales of zero-emission heavy duty vehicles (essentially nil now in Canada) would increase in line with California's policy and regulations, even though no such policy has been announced or implemented in Canada. Perhaps most significant, **ECCC assumed that new electricity transmission lines would be built and operating by 2028 and 2030 to provide "clean electricity" to provinces that now rely on fossil fuel electricity generation. This, of course, would require the expenditure of billions of dollars and agreement among many different stakeholders (including indigenous groups) to secure a right of way.** These and other faulty assumptions call into question the credibility of all the ECCC climate modelling.



CESDC noted that ECCC further lacked transparency in the reporting of its modelling. Its published reference case, the basis for its assessment of the effects of past and present emissions reduction actions and of those that may be proposed in future, provided no clear and comprehensive public list of assumptions for each case. It presented only high-level and vague assumptions, which prevents an informed public debate about policy choices. The models also could not attribute the impact of a specific policy initiative when modelled as a package.

**When one considers that the federal government rarely, if ever, assesses the costs and benefits of emission reduction programs or their cost-effectiveness, the ECCC policy approach can perhaps be summarized as policy making based on adherence to purely political goals rather than objective analysis.**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## CONCLUSION



The CESDC is the federal government's own in-house auditor. As noted previously, it clearly endorses the federal government's present climate policies and goals. Yet, its audit of the federal government's efforts to assess hydrogen's potential to reduce GHG emissions began as an operational audit of a single program area and ended as a compelling condemnation of two government departments' modelling and policy development practices.

**Whatever hydrogen's long-term potential to reduce GHG emissions, the CESDC report makes clear that the government's assessment of hydrogen's role to 2030 is poorly founded and therefore exaggerated. The 45 megatonnes in emissions reduction from use of hydrogen that NRCan projects by 2030 are very unlikely to occur. This offers one more reason why the public should doubt the government's claims concerning the feasibility and desirability of the 2030 target.**

## ABOUT THE AUTHOR

ROBERT LYMAN is an economist with 27 years' experience as an analyst, policy advisor and manager in the Canadian federal government, primarily in the areas of energy, transportation, and environmental policy. He was also a diplomat for 10 years. Subsequently he has worked as a private consultant conducting policy research and analysis on energy and transportation issues as a principal for Entrans Policy Research Group. He is a frequent contributor of articles and reports for Friends of Science, a Calgary-based independent organization concerned about climate change-related issues. He resides in Ottawa, Canada. Full bio.

## ABOUT FRIENDS OF SCIENCE SOCIETY

Friends of Science Society is an independent group of earth, atmospheric and solar scientists, engineers, and citizens that is celebrating its 20th year of offering climate science insights. After a thorough review of a broad spectrum of literature on climate change, Friends of Science Society has concluded that the sun is the main driver of climate change, not carbon dioxide (CO2).

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