Low Carbon Intensity Hydrogen (2023)

Issue

Hydrogen is a gas that is recognized as a solution for the world's low carbon heat, transportation, and industrial needs. Alberta has an excellent opportunity to produce inexpensive, clean hydrogen. While there are various production technologies to consider, the bottom line is that all forms of clean, low carbon intensity hydrogen should be considered as part of Alberta's future hydrogen plan as we continue in our role as a global energy leader.

Background

Hydrogen is a burgeoning clean fuel that governments around the world have been rallying around that has no carbon release into the atmosphere when utilized as an energy source. While there are several methods of hydrogen production, each one may be advantageous in specific geographical locations as we move to a low-carbon future. The hydrogen technologies that are currently available, plus those that are being developed, must consider total carbon intensity from the production method to the form of transportation utilized to the end user.

"Colours" have been adopted to make hydrogen production technologies easier to communicate. These refer to the means by which hydrogen is produced, but not necessarily their carbon intensity. Grey hydrogen is made from natural gas, with CO_2 released into the atmosphere. Green hydrogen is made through electrolysis (water-splitting), which releases no CO_2 during production, but does use significant freshwater feedstock and requires a renewable electricity source powering the process to avoid upstream emissions. Blue hydrogen, like grey, is also produced from natural gas, however the CO_2 is captured and stored underground, so that it emits nearly zero emissions during production. Turquoise hydrogen uses methane pyrolysis to produce a marketable product called "carbon black" which safely embeds the CO_2 in products such as tires, asphalt and more, with hydrogen being a by-product. Finally, pink hydrogen is produced via electrolysis powered by nuclear energy.

There are four factors for a desirable fuel source: reliability, cost, safety, and carbon intensity, with the two most crucial factors being carbon intensity and safety. While there are many different methods and "colours" of hydrogen production, this alone does not necessarily describe the carbon intensity of the hydrogen produced. Therefore, we must remain colour/technology agnostic and focus on carbon intensity as the key conversation. It is vital that carbon intensity be measured from the start of the production process all the way to the end user, so that a true picture can be analyzed when comparing the specific methods of production. For example, green hydrogen via electrolysis is among the cleanest ways to produce hydrogen, however, the electrolyzer used must be powered by clean electricity, or else it may have a higher carbon intensity than other forms of production. There are also other environmental impacts to consider, such as use of freshwater and upstream carbon intensity of the components. Blue hydrogen uses natural gas as feedstock but up to 95% of emissions may be captured during production, which can bring it very close to zero emissions. According to a recent Edmonton Region Hydrogen HUB presentation the respective ranges for blue and turquoise CO_2 emissions per kg of H_2 (including both production and upstream) is 3-5kg, whereas the range for green hydrogen can be as low as 1kg and as high as 18kg depending on what source powers the electrolyzer. Therefore, multiple productions methods have low carbon intensity potential; each of these, and as well as any other colour that can prove the same or better, should be considered to achieve our net zero goal.

Safety is also a concern, and while hydrogen comes with its own unique challenges, hydrogen can be a safe, widely used clean source of energy.

The Canadian Government has already signaled strong support for hydrogen with its own Hydrogen Strategy[137], supported within Budget 2022[138], and with recent agreements to collaborate on Hydrogen with the Netherlands[139] and Germany.[140] There is also significant support for hydrogen in Alberta, with the

Alberta government's Hydrogen roadmap,[141] Alberta Innovates' Hydrogen Centre of Excellence,[142] and the new "Edmonton Region Hydrogen HUB[143]", as well as over $60M in funding support provided to hydrogen projects across the value chain by Emissions Reduction Alberta, allocated by the Government of Alberta under the Technology Innovation Emissions Reduction (TIER) fund. In Alberta's Industrial Heartland, the Transition Accelerator has been playing an important 'thought leadership' role in Alberta's hydrogen[144] production industry. The Alberta Chambers of Commerce has already adopted a position supporting blue hydrogen ("Alberta's Opportunity in the Hydrogen Economy), as well as a position supporting Nuclear SMRs (Small Modular Reactor) ("Including Nuclear in Alberta's Energy Mix"), a technology which may become useful in the creation of "pink" hydrogen in the future.

Hydrogen is a valuable fuel for heat, transportation, and to power industry; it will be vital to determine hydrogen markets in order to build a business case for building a hydrogen supply. The time is now for the Governments of Alberta and Canada to work with industry partners to determine demand markets so that the needed hydrogen supply and infrastructure can be built to support a low carbon future. For example, if hydrogen vehicles are used increased fueling station access and methods to efficiently distribute hydrogen, such as pipelines, will be essential.

It is important to note that hydrogen is not a "silver bullet," but one important piece in solving the net- zero puzzle that will also include electrification, nuclear, wind, solar, fossil fuels with carbon-capture, and more.

The Alberta Chambers of Commerce recommends the Government of Alberta work with the Government of Canada and industry partners:

1. To support colour agnostic research and development of all forms of clean hydrogen that are

[137] https://www.nrcan.gc.ca/sites/nrcan/files/environment/hydrogen/NRCan_Hydrogen-Strategy-Canada-na-en-v3.pdf

[138] https://budget.gc.ca/2022/report-rapport/chap3-en.html

[139] https://www.nrcan.gc.ca/climate-change/canadas-green-future/the-hydrogen-strategy/memorandum-understanding-between-the- government-canada-and-the-government-the-netherl/23907

[140] https://www.nrcan.gc.ca/climate-change-adapting-impacts-and-reducing-emissions/canadas-green-future/the-hydrogen-strategy/joint-declaration-intent-between-the-government-canada-and-the-government-the-federal/24607

[141] https://www.alberta.ca/hydrogen-roadmap.aspx

[142] https://albertainnovates.ca/programs/hydrogen-centre-of-excellence/

[143] https://erh2.ca/

[144] https://transitionaccelerator.ca/

low carbon intensity measured from “start to finish;”

2. To determine demand markets, and to ensure that Canada can meet domestic and international supply needs through low-carbon hydrogen production;
3. To ensure that infrastructure to transport hydrogen domestically is in place to meet demand now and into the future;
4. To recognize that government’s immediate support is of the essence to compete as other jurisdictions are moving quickly with both financial and policy support;
5. To effectively communicate with the public about the importance and safety of hydrogen as an energy source and to promote the importance of producing low-carbon intensity hydrogen rather than specific colours.