

## WHY THE PRODUCTION OF GREEN HYDROGEN IS A WASTE OF OUR LIMITED RENEWABLE ELECTRICITY

Green hydrogen has been promoted as the coming thing in the rush to “decarbonize” industry and transportation. Various governments in Europe and the United States have promised lucrative subsidies to help reduce the cost of producing green hydrogen as an electricity generating feedstock and as a natural gas displacement feedstock.<sup>1</sup> The Biden administration, for example, has pledged \$7 billion to subsidize seven regional hydrogen “hubs” to develop this technology in the US. Even Premier Eby appears to embrace the notion of a hydrogen hub for BC.

But there is a growing awareness that this method of production, and the use of this gas itself, has severe economic, technical, and environmental drawbacks. Recently, a citizens committee in Edmonton has recommended that that the city reject hydrogen as a clean energy option for all but the most difficult sectors to decarbonize. Amongst the failings were the high cost of producing green hydrogen, and it is inefficiently compared to using natural gas per unit of energy delivered.<sup>2</sup>

### Types of Hydrogen Production

The production of green hydrogen is achieved by a process that breaks down water into hydrogen and oxygen gases through electrolysis. Currently, the most common production method splits hydrogen molecules from water using high-pressure steam produced using natural gas.

Green hydrogen is produced by using renewable electricity, while grey hydrogen is produced by using natural gas. Variations include blue hydrogen which uses natural gas and capture and storage of the carbon byproduct; turquoise hydrogen from natural gas using methane pyrolysis where solid carbon is the byproduct<sup>3</sup>; and black hydrogen uses coal as the energy source.<sup>4</sup>

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<sup>1</sup> [https://www.canarymedia.com/articles/hydrogen/a-dispatch-from-the-dawn-of-the-green-hydrogen-era?utm\\_id=106015&sfmc\\_id=4455302](https://www.canarymedia.com/articles/hydrogen/a-dispatch-from-the-dawn-of-the-green-hydrogen-era?utm_id=106015&sfmc_id=4455302)

<sup>2</sup> <https://energi.media/news/ditch-hydrogen-as-poor-decarbonization-tool-citizens-committee-urges-edmonton/>

<sup>3</sup> Yet to be proven at scale; see <https://www.biv.com/news/economy-law-politics/why-methane-pyrolysis-may-be-best-way-to-make-hydrogen-in-bc-8616855>

<sup>4</sup> <https://www.nationalgrid.com/stories/energy-explained/hydrogen-colour-spectrum#:~:text=Green%20hydrogen%2C%20blue%20hydrogen%2C%20brown,between%20the%20types%20of%20hydrogen.>

Except for the green variety, all these forms of hydrogen production produce carbon emissions. For this reason, some environmental groups and energy companies are promoting the development of green hydrogen.

### **Poor Economics**

The production of green hydrogen requires large amounts of clean electricity and water. It has been calculated that to produce one tonne of hydrogen through the electrolysis of water requires 52.5 MWh of electricity (including compression) and, the burning of one tonne of hydrogen will generate 15 MWh. Therefore, the energy invested is 3.5 times greater than energy returned.<sup>5</sup> Another study suggests that the energy invested need be only 1.5 times the energy returned.<sup>6</sup>

The production of hydrogen by electrolysis also requires 9,000 liters (or 2,377 gallons) of water per tonne.<sup>7</sup>

In addition to the cost of production hydrogen is difficult to store and transport. Due to their chemical structure metals become brittle when exposed to hydrogen. Current pipelines, compressor stations, and storage facilities cannot be used to handle hydrogen gas.<sup>8</sup> It is highly explosive, and it is prone to leaking from pipes and storage facilities.<sup>9</sup>

Hydrogen is energy intensive. It produces 2.5 times the energy compared to an equivalent weight of natural gas. However, because hydrogen is much less dense than natural gas one requires three times the volume of hydrogen to achieve the energy of natural gas. This adds to the cost of transport and storage.

### **The Fortescue Proposal**

In this province a number of green energy proponents have suggested hydrogen production facilities, with the massive Fortescue Minerals Group project being the most obvious example. The Fortescue proposal is for a green large green hydrogen production facility in the Prince George area, with the promise of turning that city into a provincial

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<sup>5</sup> <https://wattsupwiththat.com/2024/05/12/hydrogen-town-plan-cancelled-after-protests-over-forced-switch-from-natural-gas/> The article noted that using intermittent wind and solar to power the process would require an installed capacity of 4.2 GW to deliver 1 GW of clean electricity.

<sup>6</sup> <https://wattsupwiththat.com/2024/05/12/the-h-stands-for-hype/>

<sup>7</sup> [https://energypedia.info/wiki/Green\\_Hydrogen](https://energypedia.info/wiki/Green_Hydrogen)

<sup>8</sup> <https://www.twi-global.com/technical-knowledge/faqs/what-is-hydrogen-embrittlement>

<sup>9</sup> See [https://docs.bcuc.com/documents/arguments/2023/doc\\_69691\\_2023-01-20-tc-energy-worskhop-submission.pdf](https://docs.bcuc.com/documents/arguments/2023/doc_69691_2023-01-20-tc-energy-worskhop-submission.pdf)

hydrogen hub.<sup>10</sup> The same company is bidding on government subsidies in the American Pacific northwest energy hub with a 40,000 annual tonnes proposal.<sup>11</sup>

The proposal, announced in September of 2023, would see a very large green hydrogen and ammonia facility constructed in Prince George that would produce 140,000 tonnes of hydrogen and 700,000 tonnes of ammonia per year. The company estimates that 100 permanent jobs would be created, but 1,000 megawatts of clean electricity would be required to create the hydrogen and ammonia.<sup>12</sup>

Assuming that one tonne of green hydrogen requires 53 MWh of clean electricity to produce, the Fortescue proposal would require 7,300 GWh of electricity per year. It would also require some 330,000 gallons of water, assuming 2,377 gallons per tonne. Clearly, this is well beyond the capacity of BC Hydro to deliver. Nor does it make economic sense to consume 7,300 GWh of clean electricity to produce the equivalent of 4,700 GWh of power through clean hydrogen.<sup>13</sup>

Such a huge commitment of clean electricity is not in BC Hydro's latest 20-year power demand forecast. Under its accelerated scenario, BC Hydro forecasts a need for 27,000 additional GWh by 2040. This does not include any allowance for a green hydrogen hub anywhere in the province.

Yet, despite the lack of clean electricity, and the potential for losses in the sale of the power (if it existed) due to the lower Industrial rate, there appears to be strong political support from Premier Eby and the NDP government for the Fortescue project. The premier vigorously defended the proposal in the Legislature, perhaps believing that the interest in producing green hydrogen would show that the government's ambitious GHG reduction targets were not barriers to economic development.

I've met with the CEO. He flew to Prince George. He met with the mayor. He met with the First Nations. I love the project.... There is a huge challenge. They need 1,000 megawatts of power to do what they want to do, and it has to be clean energy. We have to do this work with Fortescue.... We have to do this work with hydrogen.<sup>14</sup>

A few days later the premier doubled down on his support:

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<sup>10</sup> The proposal was unveiled in conjunction with the local Indigenous band, which has approximately 400 members on the reserve; [https://en.wikipedia.org/wiki/Lheidli\\_T%27enneh\\_Band#:~:text=There%20are%20approximately%20400%20members,also%20live%20off%20the%20reserve](https://en.wikipedia.org/wiki/Lheidli_T%27enneh_Band#:~:text=There%20are%20approximately%20400%20members,also%20live%20off%20the%20reserve).

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<sup>12</sup> <https://vancouversun.com/news/local-news/australian-energy-company-submits-proposal-for-green-hydrogen-plant-in-prince-george/wcm/2db4b824-b647-4a8a-88a0-3f2da17ae94f>

<sup>13</sup> Assuming that one tonne of hydrogen requires 53 MWh of clean electricity to produce and results in 33.3 MWh of power: [https://energypedia.info/wiki/Green\\_Hydrogen](https://energypedia.info/wiki/Green_Hydrogen)

<sup>14</sup> BC Hansard, Question Period, November 23, 2023; <https://www.leg.bc.ca/documents-data/debate-transcripts/42nd-parliament/4th-session/20231123am-Hansard-n367>

Our government has created an investment environment where we have a long line of proponents that want to invest right here in B.C. It's also true that because we have prioritized clean energy projects, we have multiple hydrogen producers that want to locate in B.C., across the province. Just three of these projects require 1,500 megawatts of power. This is massive....

Now we face a similar challenge in Prince George with the Fortescue proposal. They need 1,000 megawatts of electricity. This is a transformative economic investment for Prince George. We've got to find a way forward. We're not going to do what the old government did and force that investment somewhere else. We're going to find a way to move forward... We've got to ensure economic opportunities for the entire province.<sup>15</sup>

Not to be outdone, in October 2023 the provincial government and the McCleod Lake Band signed an MOU respecting a proposed \$7.0 billion facility to produce clean and low-carbon hydrogen. Subject to sufficient federal and provincial funding contributions, the plant would be built, owned operated by Mitsubishi Power and create 500 permanent jobs. Premier Eby expressed his support; "When fully developed (the energy hub) will be one of the largest Indigenous energy projects in the country.... It has the potential to generate significant green hydrogen to decarbonize industry in British Columbia."<sup>16</sup> No estimate of the clean electricity requirement was released with the glowing press announcement.

Just this week Premier Eby was again promoting green hydrogen. The latest announcement was a plan by Vancouver-based HTEC to invest \$900 million (dependent on a \$337 million loan from the Canada Infrastructure Bank) in hydrogen plants targeted to fuel long-haul trucks in BC and Alberta. The three facilities noted in the announcement would appear to require only some 60 GWh of clean electricity from BC Hydro to produce the limited amount of clean hydrogen.<sup>17</sup>

### **Finding a Way Forward?**

The production of green hydrogen is not economic when the energy value of the green hydrogen is only some 63% of the green electricity used to produce it (33.3 MWh vs 53 MWh). It has other serious drawbacks, including issues with transportation and storage. Yet the BC government appears to believe that green hydrogen will advance its CleanBC

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<sup>15</sup> Ibid., November 27, 2024; <https://www.leg.bc.ca/documents-data/debate-transcripts/42nd-parliament/4th-session/20231127pm-Hansard-n370>

<sup>16</sup> <https://www.biv.com/news/economy-law-politics/province-mcleod-lake-indian-band-formalize-agreement-proposed-hydrogen-plant-8273961> see also <https://news.gov.bc.ca/releases/2023EMLI0061-001646>

<sup>17</sup> <https://www.biv.com/news/900m-bc-based-hydrogen-fuel-network-will-create-jobs-while-cutting-emissions-ebly-8816359> and <https://www.htec.ca/media-assets-2/>

agenda and reduce GHG emissions in a number of economic sectors. And the green hydrogen industry is expecting governments to provide financial incentives to encourage innovation and investment.

Premier Eby seems to desire three objectives; economic development using clean electricity, and all at affordable rates. He appears unreceptive to arguments that BC Hydro does not have sufficient clean electricity to power the large-scale green hydrogen projects currently being proposed. The attraction of green jobs, linked however tenuously to Indigenous participation, is strong.

Given BC Hydro's 20-year demand forecast, the only mid-term way to acquire sufficient electricity for the Fortescue project would be by importing the required power. Given the opaque public reporting of Powerex, we would not know if the imported power was generated from renewable sources or from fossil fuels. The resultant financial loss incurred through the production of the green hydrogen could be buried in one of BC Hydro's many deferral accounts for future generations of customers to pay.

With an election in the offing, it is likely that the government will continue to encourage the green hydrogen industry. Will it have the courage to adhere to the fundamental economic logic if reelected?

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The writer is a retired senior BC government public servant whose paper describing the BC government's manipulation of the finances of BC Hydro from 2008 to 2014 was published by BC Studies in November 2016. BC Studies published his paper on the 40-year financial history of ICBC in 2013. He is an intervener in the BC Utilities Commission's reviews of ICBC's and BC Hydro's rate requests