



Hydrogen 101



Hydrogen Basics

- Hydrogen (H_2) is the most common chemical element in the universe. It is rarely found in nature on its own – rather, it is bonded to something else (e.g., water H_2O).
- H_2 is both a fuel and an energy carrier, easy to store in large amounts, and can be produced from many different processes.
- If spilled, H_2 evaporates. It is non-toxic and emits no carbon emissions.
- It has the highest energy content of common fuels.

Fuel Type	Energy Density (MJ/kg)
Gasoline	46
Diesel	45
Hydrogen	120



Ways to Produce Hydrogen

H₂ can be produced via several processes. Two of the most common are:

- Electrolysis: an electrical current is passed through water (H₂O) to separate the hydrogen from the oxygen atoms.
 - The electricity used can be from grid electricity or from intermittent renewables
- Steam Methane Reforming (SMR): high-temperature steam separates hydrogen from the carbon atoms in methane (CH₄).
- Both production methods present made-in-B.C. solutions while reducing GHGs in the province

Waste hydrogen from chemical plants (such as chlor-alkali) can be captured and used in other applications, such as transportation.



CleanBC Targets

- GHG reduction targets
 - 40% by 2030, 60% by 2040, and 80% by 2050
- 15% renewable gas by 2030 target (~30-50 PJs)
 - Significant potential for H₂
- ZEV Mandate (light-duty vehicles)
 - ZEV Act passed in May 2019
 - 10% by 2025, 30% by 2030, 100% by 2040
- Low Carbon Fuels
 - Increase the LCFS to 20% by 2030





Alignment with CleanBC

“Hydrogen can play a major role in B.C.’s low-carbon energy systems.”

As part of CleanBC, the Province is accelerating development of BC’s hydrogen economy with:

- Injection of sustainable hydrogen into the natural gas grid to lower the overall carbon intensity;
- Support for centralized hydrogen production; and
- Financial supports for the deployment of fuel cell electric vehicles and infrastructure.

The Province will be developing a **Hydrogen Roadmap** to be released in 2020.



A Hydrogen Society

- While transportation is the most “talked about” application for hydrogen, it can be used across the economy:
 - **Natural gas:** injection of hydrogen can lower the carbon intensity of the end-product resulting in fewer emissions
 - This would have downstream effects on emissions originating from industry and buildings that use natural gas for space and water heating
 - **Renewable energy generation:** the optimization of intermittent renewables, enabling them to be more reliable
 - **Low carbon fuels:** using renewable hydrogen in the refining process will lower the overall carbon intensity of conventional fuels, like gasoline, diesel and jet fuel
 - **Regional development opportunities:** remote and off-grid communities could be pioneers in using stationary power systems with fuel cells to decarbonize their isolated power grids



Hydrogen Around the World

Japan: Committed to transition to a “Hydrogen Society” and introduced their Basic Hydrogen Strategy in 2018; and,

China: In December 2016, China’s 13th “Five-Year Plan” included a Fuel Cell Technology Roadmap and committed to building over 1,000 hydrogen refueling stations by 2030;

South Korea: In January 2019, laid out a plan to develop the technology and infrastructure needed for a hydrogen-based economy;

New Zealand: June 2019, released discussion paper on developing a hydrogen economy;

United States: The State of California is taking a leading role and has allocated USD\$92 million in funding to support an additional 40+ hydrogen refueling stations;

Australia: In 2018, released their National Hydrogen Roadmap to provide a blueprint for the development of a hydrogen industry for export;

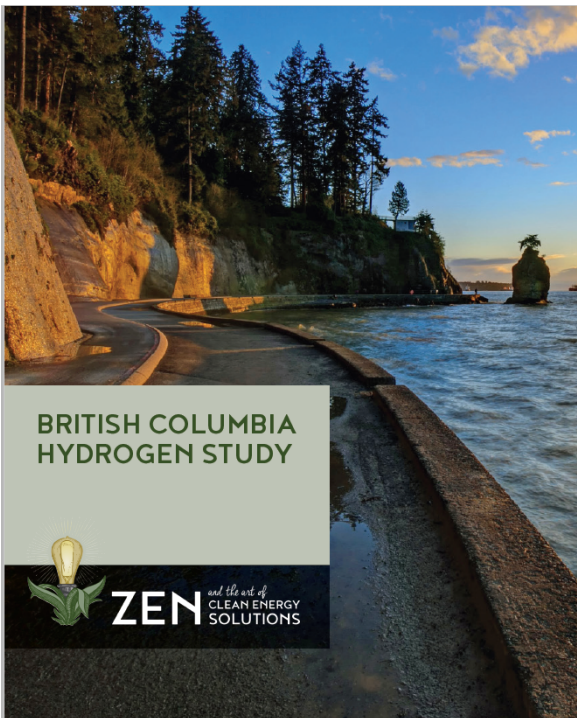
France: June 2018, announced a Hydrogen Deployment Plan for Energy Transition;

United Kingdom: Studying hydrogen as a means of displacing natural gas to decarbonize heat.



B.C. Hydrogen Roadmap

- Hydrogen in B.C. Study was completed in June 2019
(can be found on the Ministry webpage)
- Hydrogen can play a large role in decarbonizing provincial energy systems
- **B.C. Hydrogen Roadmap – expected 2020**





Thank you!

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