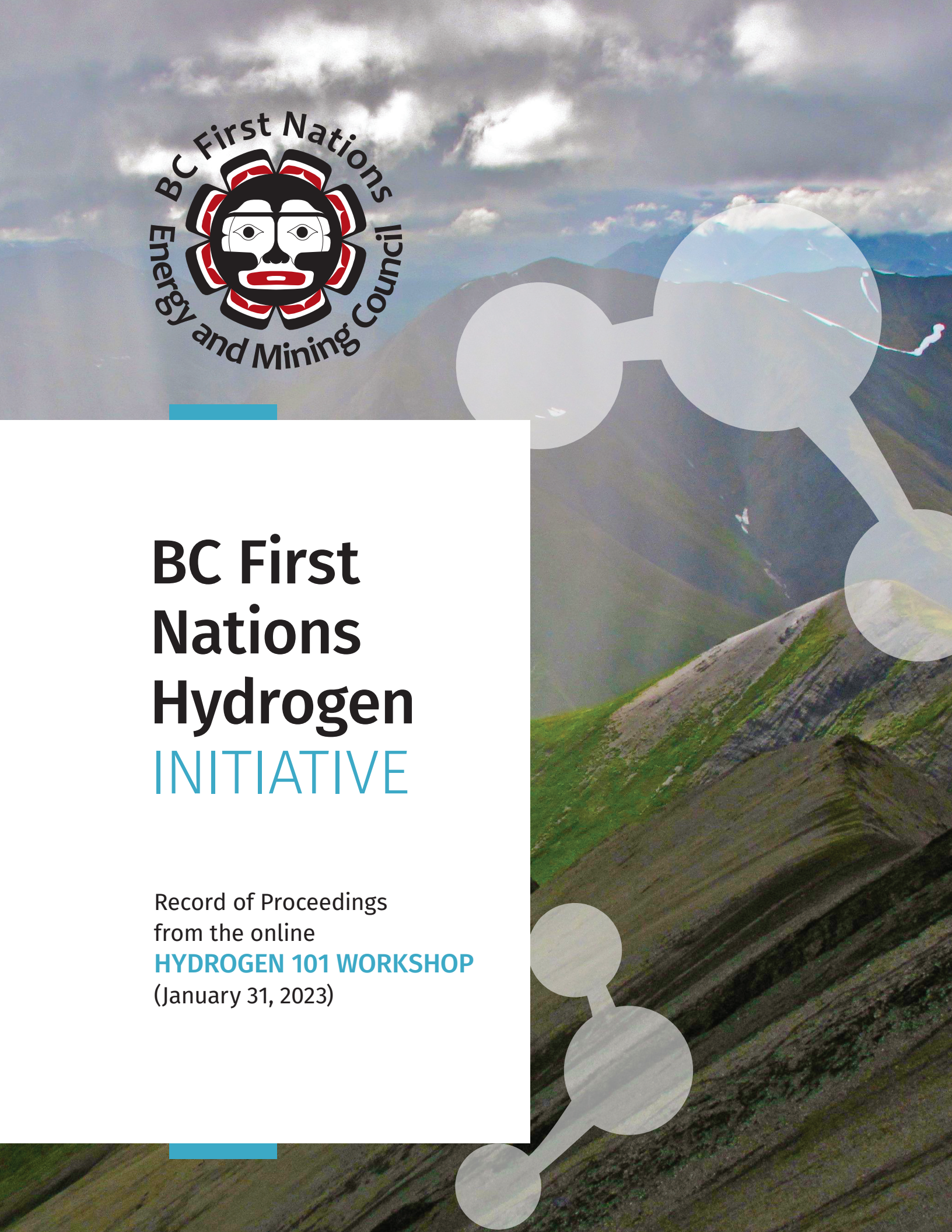


BC First Nations Energy and Mining Council

BC First Nations Hydrogen INITIATIVE

Record of Proceedings
from the online
HYDROGEN 101 WORKSHOP
(January 31, 2023)

Acknowledgements

The Hydrogen 101 Webinar was offered in partnership by the BC First Nations Energy and Mining Council and the BC Hydrogen Office within the Ministry of Energy, Mines and Low Carbon Innovation. Content development was supported by Foresight Canada.

The Webinar was presented on January 31, 2023 and was facilitated by Kwatuuma Cole Sayers (FNEMC) and Tricia Thomas (Tumuxw Communications).

We gratefully acknowledge the financial support of the Province of BC through the Ministry of Energy, Mines and Low Carbon Innovation.

The Project Team would like to thank the many individuals and organizations that provided input to this process through participation in webinar workshops, surveys, and individual interviews.

CREDITS:

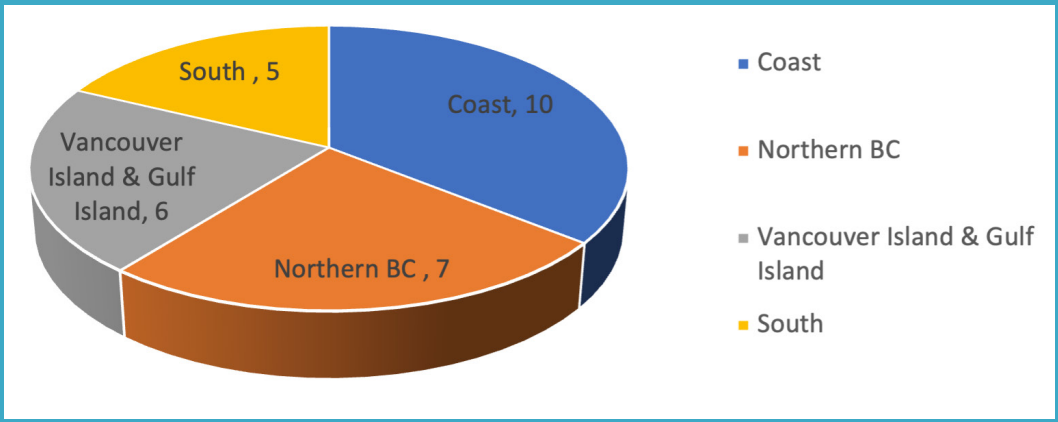
Photos: David Sanguinetti and Alyssa Kelly, Foresight Canada

Report development and design: Salish Eye Productions

EXECUTIVE SUMMARY

This report is a summary of proceedings from the Hydrogen 101 webinar on January 31, 2023. It outlines the topics that were presented and includes the questions and comments from participants. Emerging themes from the discussions will support the next phase of the initiative and inform the development of the "BC First Nations Hydrogen Strategy" that will be completed later in 2023.

Hydrogen 101 was a virtual workshop, hosted by the BC First Nations Energy and Mining Council (FNEMC) and experts from Foresight Canada. Facilitators were Cole Sayers (FNEMC) and Tricia Thomas (Tumuxw Communications). Participants included representatives from First Nations (FN) communities across the province, as well as experts in the field. The following chart shows distribution of the registration.



The webinar objectives were to share information about hydrogen (H_2) as a source of clean energy in BC communities and to invite input from participants in order to gain a preliminary understanding of existing questions pertaining to the hydrogen industry. The goal was to build a solid understanding of H_2 so First Nations can respond in an informed and appropriate way to potential proposals and begin to engage with the subject as a potential component to First Nations energy and economic plans .

Topics presented were: the Clean Energy Transition in BC; what is hydrogen and how it is made; how H_2 is used and transported; and environmental and safety risks. Polls engaged participants and Question and Answer sessions allowed time to address concerns from the group. This sharing informed next steps in the process towards creating a strategy that benefits all First Nations in BC.

Emerging themes from discussion were:

a. the practicalities and steps needed to transition from diesel and other fossil fuels to hydrogen
b. costs and funding opportunities for introducing hydrogen
c. understanding different types of H_2 (blue/turquoise) and implications of using methane or ammonia
d. effects on nature of H_2 and other alternative fuels
e. water requirements and implications for production of green H_2
f. safety regulations
g. shipping and transportation via pipelines

Contents

Hydrogen 101 WEBINAR

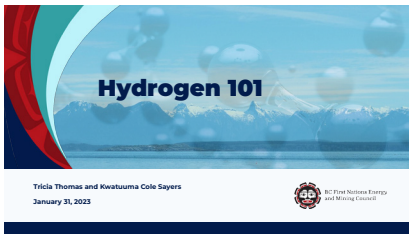
I'm coming from Musqueam territory, and welcome you today as we did back in the 1700s…

This workshop is quite important because resource extraction has been the mainstay of BC since the first Europeans arrived here and began extracting resources and sending them around the world… However, understanding and seeing the effects throughout British Columbia, it's challenging to arrive at a balance that makes everything a win-win and a sustainable environment without contributing to the effects of global warming…

[We] live in a completely extracted environment that is not sustainable for our traditional lifestyle today… it's been devastating in some instances, so I'd like to see a more balanced way of maintaining economic development.

– sʔəyəɬəq, Musqueam Elder (Webinar Opening Remarks)

The Watchman
carving by Myles Edgars (Haida)



Indigenous Clean Energy Opportunities (ICEO)

Identifying Clean Energy opportunities for Indigenous Peoples (ICEO) is part of the **BC Declaration Act Action Plan for 2022-2027.** The goal is to co-develop recommendations on strategic policies and initiatives for clean and sustainable energy. This includes identifying and supporting First Nations-led clean energy opportunities related to CleanBC, the Comprehensive Review of BC Hydro, and the BC Utilities Commission Inquiry on the Regulation of Indigenous Utilities.

The purpose is to ensure collaborative dialogue between the Ministry and First Nations leadership, rights holders and organizations in order to position First Nations to fully participate in current and future opportunities in BC's clean energy sector; and to engage on related legislation and policies and align BC clean energy laws with UNDRIP.

Relevant to the H_2 discussion, the province holds two different classes of obligations to First Nations in BC:

1. Obligations under Section 35 of the Constitution Act to consult and accommodate, which are aimed at respecting pre-existing First Nation rights and title ("Section 35 Rights").
2. Obligations under Bill 41, the UN Declaration and the TRC Calls to Action, which go beyond the legal obligations under Section 35, to consult and accommodate.[2] They are equally important for furthering reconciliation but are distinct from meeting Section 35 obligations.

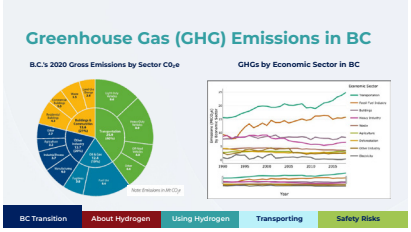
How familiar are you with hydrogen?

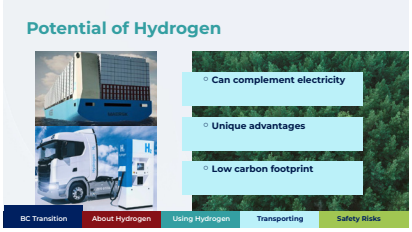
Poll # 1 How Familiar are you with Hydrogen?

1. How Familiar Are you with Hydrogen? (Multiple Choice) *

No knowledge, I am here to learn from scratch	19%
Basic knowledge, I've heard some things	42%
Some knowledge, I'm reasonably familiar	31%
Expert, I know a lot about the topic	11%
Not sure/ prefer not to say	0%

BC Clean Energy Transition





Summary

Greenhouse gas (GHG) emissions across Canada and in BC must be reduced. The Government of Canada has committed to net zero by 2050 and the Province of BC to 80% fewer emissions by 2050. (Climate Change Accountability Act)

BC created a Hydrogen Strategy in 2021 to focus on phasing out propane and building capacity to replace fossil fuels where relevant in Indigenous communities.

The Hydrogen Strategy for Canada established in 2022 emphasized "Early and meaningful engagement" by Indigenous peoples on all aspects of hydrogen economic development.

NOTE:

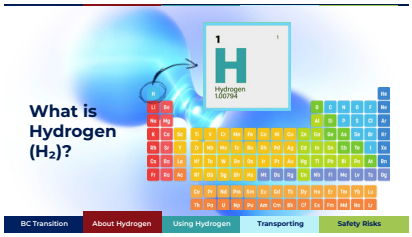
In this report, we have included 'what we heard' from participants through comments in the chat or spoken questions. Responses to the questions and comments came from the team of FNEMC and Foresight presenters.

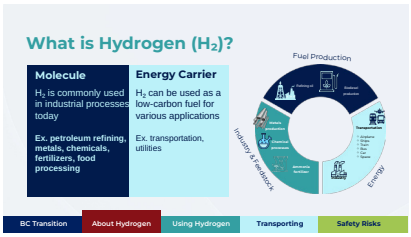
Questions and comments from Participants are in blue throughout the report.

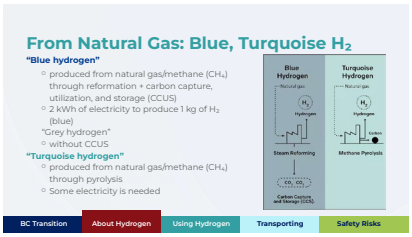
Atomic habits - will be many efforts by many people. Change has to be altruistic. Renewable Diesel and Hydrogen/Green Ammonia are stepping stones with less GHG's. Our Nation is working hard to decarbonize and firing on all cylinders with various projects to reduce our carbon footprint. 82% desire Green hydrogen… let's set the bar high for BC and Canada and make this pathway for Green hydrogen.

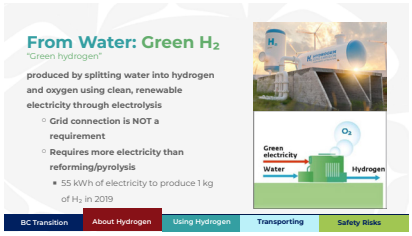
Eco and Climate Justice is indigenous-led projects with land based decisions made by land based peoples in those territories. Be great to have capacity building, funding opportunities for FN gathering on Hydrogen.

About Hydrogen





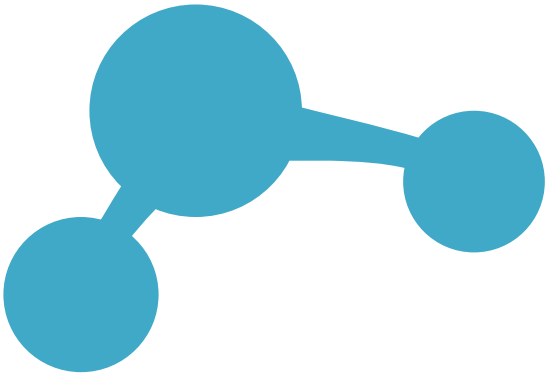


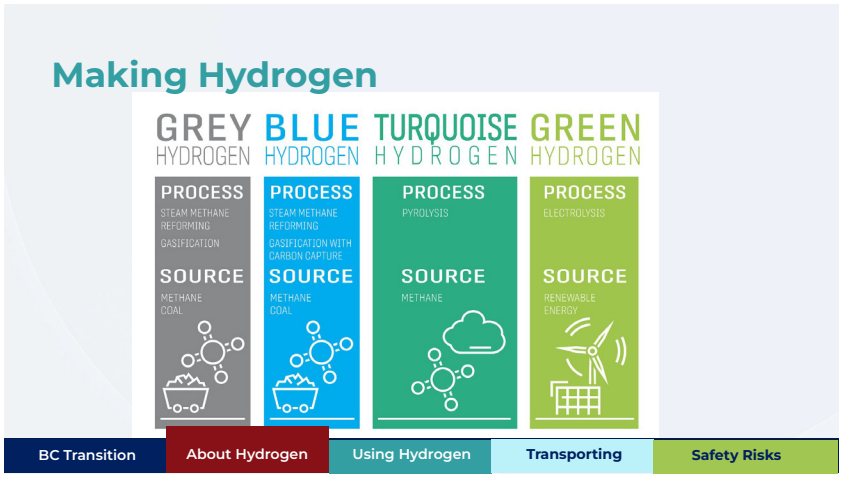


Summary

In cases where electricity is not possible or cost-effective, hydrogen can be a low-carbon source of energy.

What is H2?





Hydrogen is the first element on the periodic table. It is stable as a pair – two hydrogen atoms bonded together – which is why it is often referred to as H_2. Hydrogen is not found naturally as H_2, meaning any H_2 we use is produced by the addition of energy. Hydrogen is therefore an energy carrier.

Hydrogen is currently used in various industrial processes such as metal refining, chemical production, and food processing. As it is an energy carrier, low-carbon hydrogen is also being considered as a source of energy for various use cases such as transportation or utilities

Types of H2

Hydrogen production pathways are commonly referred to as colours. Though we are seeing a shift away from this, these 'colour' pathways are still commonly referred to in the media.

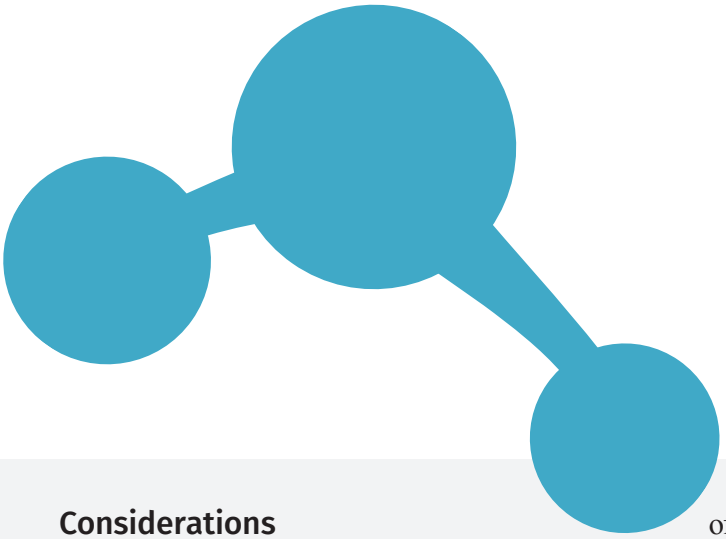
There are four common hydrogen production pathways:

1. Grey hydrogen is produced through methane reformation processes. It is not a low-carbon method of production.

Blue and turquoise hydrogen can be produced from natural gas:

2. Blue hydrogen is produced through methane reformation processes, paired with carbon capture, utilization, and storage (CCUS)
3. Turquoise hydrogen is produced through methane pyrolysis

4. Green hydrogen is produced from renewable electricity through the process of electrolysis, which separates water into hydrogen and oxygen. This provides the cleanest form of hydrogen.



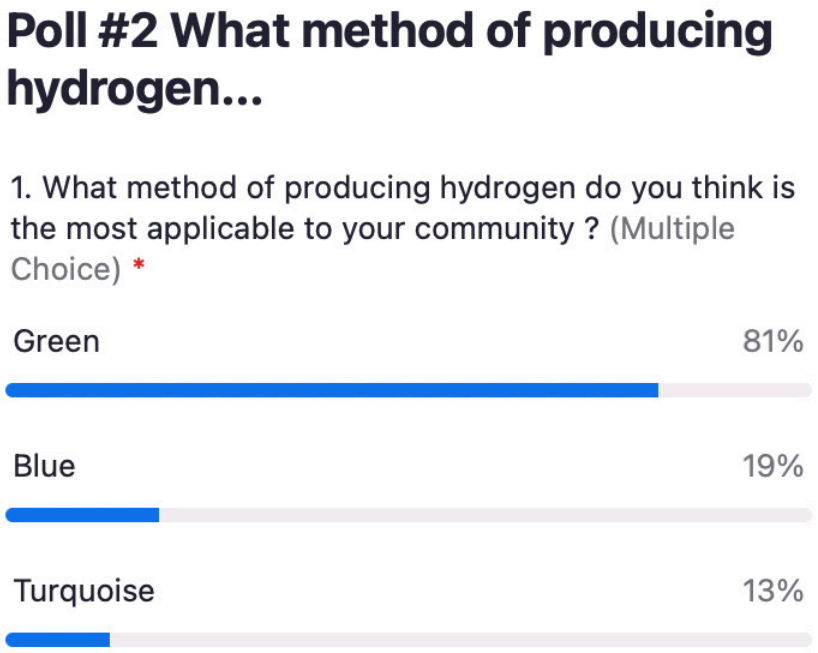
Considerations

When evaluating methods of hydrogen production, two key considerations are the relative cost and carbon intensity of each

Relative cost: The production cost of hydrogen for all pathways is impacted by a variety of factors. When evaluating options, feedstock costs (e.g. natural gas, electricity), capital costs, ongoing operating costs, and transportation costs are important considerations that are unique to each situation.

Carbon intensity: While the use of H_2 doesn't produce any GHG emissions, the production of it can. In order to compare the emissions of the different methods of production, the concept of carbon intensity is used. Carbon intensity is the measure of the total carbon emissions of something per unit of production or economic activity. For hydrogen, carbon intensity is measured as the amount of CO_2 equivalents emitted per kilogram of hydrogen produced (kg CO_2e/kg H_2). The key point is that when we're looking at the carbon intensity of any hydrogen production pathway, that the entire 'life cycle' of emissions is considered – this includes emissions from the feedstocks' production and transportation, as well as the hydrogen production process.

What method of producing hydrogen do you think is the most applicable to your community?



Q&A / Comments from Participants

[NOTE: Responses from presenters are in black]

Wondering about the practicality regarding realising net zero goals…Trillions of dollars are invested in infrastructure across Canada based on diesel/carbon fuels, how reasonable and feasible is it to be able to retrofit refineries, resource extraction, equipment to transition over to hydrogen and/or electricity… Site C Dam impacts environment, traditional territories and cultural practices in order to produce electricity…

The mining sector is working to transition; refineries switching to renewable diesel; vehicles switching to other fuels; these conversations are necessary.

We need plastics, steel, other everyday energy needs – how to do this with work force issues, COVID and other factors…renewable transition is a huge challenge that requires big change of habits for everybody…

I'm optimistic, if everybody acknowledges changes have to happen… We are not going to eliminate these materials for everyday use but it's possible to make them with fewer emissions, and people are working in that direction… and I believe that's the solution we need to come to.

For the different types of hydrogen production, which, if any, are being subsidized via tax incentives by either the federal or BC government?

Re. subsidies, I believe the clean fuel standards (BC and Canada) can help.
See a list of Hydrogen Funding Sources at the end of this report. More to come in our second workshop...

We recommend starting with the *Community Climate Funding Guide* – https://communityclimatefunding.gov.bc.ca/

The search engine captures all funding sources, not just Provincial Government. If you search 'hydrogen', the following funding programs pop up:

- **Zero Emission Vehicle Awareness Initiative (federal government)**
- **CleanBC Go Electric – Commercial Vehicle Programs (provincial government)**
- **Funding for Indigenous-led clean production capacity projects (federal government)**

In addition, funding is also available through the CleanBC Industry Fund, and credits can be generated for fuels under the BC LCFS / Part 3 Agreements

I am wondering if you can provide any leads for funding that may be allocated to FN for feasibility studies and the adoption of existing hydrogen technology…

Is the NRCAN funding limited to installed capacity of 1 MW electrolyzer or greater?

NRCAN is still accepting applications for Indigenous-led clean production capacity projects: https://www.nrcan.gc.ca/funding-for-indigenous-led-clean-production-capacity-projects/24040

Minimum Production Capacity Thresholds

NRCAN funding targets commercial-scale projects in advanced states of technological readiness. As such, the Program has set a minimum production capacity threshold for liquid fuel facilities, renewable natural gas and hydrogen facilities eligible for both production and feasibility projects:

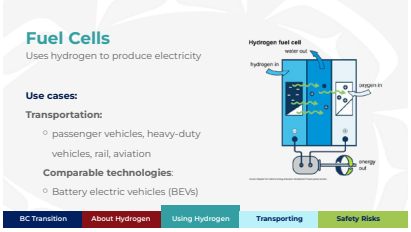
- **15 million liters (ML) per year for liquid clean fuels (including methanol);**
- **30,000 gigajoules (GJ) per year for renewable natural gas;**
- **30,000 gigajoules (GJ) per year for hydrogen from biomass gasification;**
- **500,000 gigajoules (GJ) per year for hydrogen from natural gas, or petroleum, with carbon abatement; and,**
- **1MW of installed capacity for hydrogen produced using electrolysers**

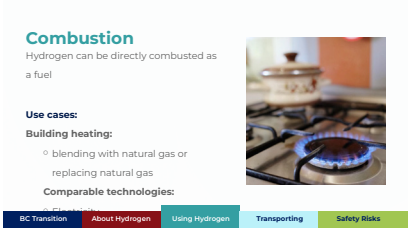
For projects producing more than one fuel type, the total combined production capacity must be equal to or greater than the larger minimum production capacity threshold of the fuel types produced at the facility.

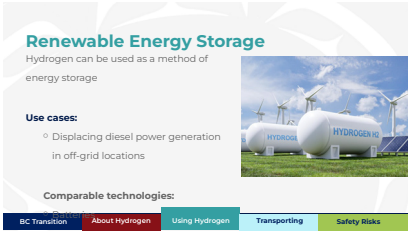
- **Ammonia is required to meet the minimum production capacity of 500,000 GJ per year**

A list of *Hydrogen Funding Programs for BC First Nations* is found at the end of this document.

Using Hydrogen







Summary

Some of the ways that Hydrogen can be used are:

- Fuel cell: transportation
- Combustion: building heating
- Industrial processes: petroleum, metals, chemicals, etc.
- Renewable energy storage: remote power generation
- Synthetic fuels: methanol, ammonia, SAF (Sustainable Aviation Fuel)

Where do you see opportunities for hydrogen in your community?

Poll #3 Where do you see opp for hydrogen.....

1. Where do you see opportunities for hydrogen in your community (Multiple Choice) *

Renewable energy storage	65%
Non-road mobile machinery	58%
Methanol or Ammonia	15%
Personal vehicles (FCEVs)	46%
Long-distance trucking	42%

Q&A / Comments from Participants

Haber-Bosch is very energy intensive, and is only competitively economical at large scale. Would be interested in any concepts around small scale green ammonia production.

Are we talking traditional ammonia or green ammonia, there is a difference right?

Green ammonia is just ammonia with green hydrogen. Most ammonia is made from grey hydrogen, globally… Responsible for 2-4% of global GHG emissions.

One of the biggest uses of hydrogen in the world today is in the production of ammonia, but that is using grey hydrogen not low-carbon hydrogen.

Tied to the blue economy - the world needs to look to kelp as a natural growth supplement as opposed to chemical fertilizers.

That's a good point... Looking at how we transition our entire economy, we need to transition agriculture to more regenerative methods using natural fertilizers.

When we use hydrogen, what happens to the gas?

When we burn hydrogen, it reacts with oxygen. In combustion, it's a chemical reaction where it produces water vapour. In a fuel cell, the same reaction happens across a membrane inside the fuel cell. The gas that is produced is gaseous water or steam. Burning one molecule of methane produces four molecules of water and one CO_2.

How many kw of useable energy per kg of H_2?

The energy density of hydrogen is approximately 33 kWh per kg

Could you provide some approx. numbers about the water needed to produce green hydrogen? Can ocean water be used?

It has to be purified and desalinated. All water must be purified. How you purify it depends on what the water starts out like – ocean, lake, river, well water. There is energy required for desalination membrane or reverse osmosis but relatively speaking, the total energy required is very low compared to the energy required for the production of hydrogen. If you have a source of water, then you're in good shape.

When you start out with water, you end up producing both hydrogen and oxygen. If you're in a region with a pulp mill that uses oxygen for bleaching, then you have someone who will pay for it. It offers a more cost effective resource for your nation.

There's a formula for figuring out how many litres of water is required to produce a kg of hydrogen… If you're in an area that is water-constrained (southern interior), pay close attention to it, but in rainy areas like the coast, you should be able to get the water without much difficulty.

From climate change perspective, there are some issues in future for certain areas of BC with droughts and summer season. Has BC made a hydrological balance tally to know which areas would be affected by climate change and environmental impact to give us more information about where Green Hydrogen would be of use.… Impacts of desalination process on the oceans…I hear that plants that are doing that process have been studied in South Korea and Europe… increased salinity affects the marine environment…

You need 9 kg of water for every kg of hydrogen. Increase salinity is a result of the desalination process so I suggest you study what the implications are for your particular area…. High currents with a lot of water flow will have less impact than an inlet with less flow. Bring in experts to evaluate the ecosystems in your area. Studies on water resources available in the province…Geoscience BC and other studies… lots of info is available but may not be suited to this particular path but a starting point.

The BC Hydrogen Office will look into this area of water scarcity with Ministry of Land and Water and provide more info regarding studies at the next workshop.

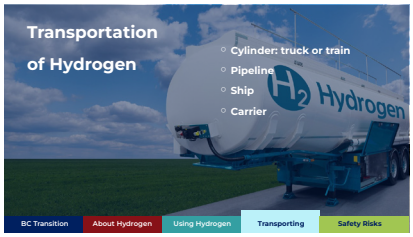
I think most look at Hydrogen as another tool for the toolbox, not the end-all and be-all. The holistic Heiltsuk approach to green energy is a good model to follow, imho.

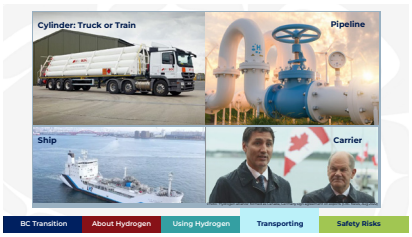
Yes, I agree. Not the answer to everything, but to some things. Consider Hydrogen an option as you go down the path.

Transportation of Hydrogen

Summary

- Hydrogen can be transported in several ways from the place of production to the areas where it will be used:
- Cylinder: transported over land in pressurized gas cylinders or as a liquid in insulated, cryogenic tankers.
- Pipeline: transported as a gas through pipelines, similar to how natural gas is transported today.





- Shipping: can be liquefied and transported via specialized tanker ships.
- Carrier: Hydrogen can be used to synthesize ammonia or other compounds called liquid organic hydrogen carriers (LOHCs) and transported as these *carrier* substances. They are then broken down at the destination and hydrogen is isolated as H2 again.

What means of transportation are available in your community?

Poll #4 What means of transportation are.....

1. What means of transportation are available in your community? (Select all that apply) (Multiple Choice) *

Road	68%
Rail	41%
Ship (i.e., ocean)	36%
Pipeline (i.e., natural gas)	45%
none of the above	5%

Environmental & Safety Risks

Summary

Hydrogen is a non-toxic substance. Burning hydrogen as a fuel will not produce any polluting substances. Hydrogen has been used in industry for decades so safety standards are well established.

There are still important risks:

- Hydrogen as a GHG: Hydrogen itself is being studied for its potential as an indirect greenhouse gas, and is potentially more potent than carbon dioxide. Safety precautions are required to prevent leakage in storage, transportation and use.
- Hydrogen Combustion: Hydrogen is a flammable substance that is easily ignited, hard to detect, and requires appropriate precautions and equipment at all stages.

What would you like to learn more about when it comes to hydrogen?

Poll #5 Planning for Workshop 2:

1. Planning for Workshop 2: What would you like to learn more about when it comes to hydrogen? (Multiple Choice) *

What BC is doing in hydrogen	63%
Environmental and safety risks	50%
Opportunities for my community in hydrogen production	67%
Opportunities for using hydrogen in my community	67%
Transporting hydrogen	54%

Q&A / Comments from Participants

Does Hydrogen produce blevy ('bleve') concerns similar to propane?

[Note: BLEVE = Boiling Liquid Expanding Vapour Explosions]
The key thing is that extreme care has to be taken to prevent leaks.
There is a risk of a BLEVE with liquid hydrogen, but it is believed to be of a lower risk than with propane.

Safety standards have improved over time so problems with past industry are not the same today… Hydrogen is new and it's understandable that people are hesitant… For our people, bringing Hydrogen in as a climate solution requires us to provide education and openness to learn how to use it safely… A few hundred years ago it seemed preposterous to say that we would power vehicles by controlled explosions, but that's what combustion is so we've learned how to do it safely… As an industry, we have responsibility for earning the trust and deserving the trust. I am one of the first NGO representatives to meet with the four levels of government so I'm happy to refer to friends… hoping to be a resource to help others. (Coquitlam Nation)

Re shipping issues with methanol and ammonia… when you liquify Hydrogen, it takes a phenomenal amount of energy so takes about 30% of energy from hydrogen to re-gasify and ship, so not very efficient… Instead industry are shipping it combined with Methanol… it releases CO_2 when burned, but if renewable methanol is used, the numbers are lower. Methanol is relatively benign molecule and only toxic if you drink it, but in a leak, it's biodegradable. It's the most shipped liquid after oil.

Ammonia does not release CO_2 on burning. But the negative is it is highly toxic so a leak can be fatal, and that's understandably scary to everyone… Both are shipped regularly around the world today so people have a lot of experience with it. We need to find out the risks of an ammonia tanker or methanol tanker running aground in the Salish Sea. We must look at the safety concerns and design systems to prevent that… Those risks need to be identified by any First Nation who are planning to go into production and export of methanol or ammonia… and make sure any safety concerns are addressed.

Ammonia is produced at a very large industrial scale – it would be a tanker process, not for local consumption.

Why do most info sessions not talk about Hydrogen as the great escape artist? Because of the size on the molecule, it slowly creates pin holes in piping over time. It's the reason why Fortis only allows 5% hydrogen in their pipelines.

Fair point. Hydrogen is a very small molecule and escapes easily so part of the GHG risk… Greater risk in domestic pipe systems for use in the home, but industrially, there are pipelines around the world and in Alberta… they can control for leaks there. Studies must be done on using existing natural gas pipelines. There's a greater risk… before any pipe is used for transporting hydrogen, it must be tested to make sure that it's safe. Not every pipe is usable for hydrogen.

NEXT STEPS

This Hydrogen 101 webinar is the first component to the overall initiative that will eventually result in the development of a **First Nations Hydrogen Strategy for BC**. Your voice is important and we appreciate your time and input.

This report presents the outcomes of the first webinar and informs the design of the second workshop with communities where economic development opportunities and strategies will be explored. A First Nations Hydrogen Strategy will be developed based on input from BC communities and experts, and released later in 2023 as a public resource.

Workshop #2 is coming soon! You asked and we listened – An 'in-person' workshop is being planned, with live streaming for those who cannot travel.

Developing a BC First Nations Hydrogen Strategy will be presented in June 2023.

Sign up here:
https://www.eventbrite.com/e/hydrogen-as-an-economic-opportunity-online-event-tickets-528883503797

Thank you!

FORESIGHT CANADA

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BC First Nations Energy and Mining Council

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Pre-register for Hydrogen Workshop 2
For Government, Industry, and First Nations in BC
Mark.Blom@FNEMC.ca

FNEMC.ca

Q&A / Comments from Participants

What would you like to learn more about in the second workshop to inform these discussions?

I would be interested in any housing projects that are using hydrogen for heat. Though it's more expensive, is BC working towards using it for housing?

Perhaps for our Workshop in May, we request different industries to present on how they plan to transition to hydrogen, how and by how much of their operations? What is their current plan... to support or direct that 'early engagement' that government has committed to.

Funding possibilities…?

We will touch on some of those in the second workshop.

Hydrogen is an opportunity for Indigenous participation from the beginning of its development, and I have a lot of questions, and to be honest, this form of communication is not great for a fulsome discussion on the various contents listed. In my opinion, this discussion should be done at break-out tables to get the many Q's answered.

Would you prefer a Regional approach or subject matter break out for workshop 2?

Prefer subject matter (eg. Safety regulations; green H_2 from water…)

I support Ross Wilson's recommendation for an In-Person workshop.

At this point, we have planned only virtual workshops but we see the value of in-person, so we will explore possibilities in future, especially around complex conversations.

Are FN's going to be given chance to review draft strategy and provide input/feedback before finalized?

Yes, it will be shared.

In addition, will there be room for more FN participation on any of the 3 tables?

We established an Advisory Group that includes First Nations. It's important to hear that you are asking how can we incorporate greater level of participation at the level of table. It lets our colleagues know that more involvement is desired. We will have that conversation and find ways to have greater participation… such as in working groups, advisory, etc. …

Thank you all for all your questions and comments, and engaging to help inform the process and be part of the information sharing. We are respecting UNDRIP through all your contributions to ensure free prior informed consent by having reliable credible and accurate information to make decisions.

Information sharing keeps EMLI informed as well.

HYDROGEN FUNDING PROGRAMS – BC First Nations

The following list of funding programs are applicable for hydrogen or renewable energy related initiatives for First Nations communities in BC. It is recommended to also review the BC Community Climate Funding Guide for opportunities that may be of interest.

Program	Funder	Description
Energy Peers in Indigenous Communities (EPIC) Network https://www.fraserbasin.bc.ca/epicnetwork.html#administration-funding	Fraser Basin Council	Capacity-building program to support Indigenous representatives in developing community readiness to implement renewable energy projects
Clean Industry and Innovation Rate	BC Hydro	BC Hydro offers discounted electricity rates to producers of renewable or low-carbon fuels, including electrolytic hydrogen. The rate provides a 20% discount on the standard industrial rate for five years, followed by a 13% and 7% discount for the next two years.
Innovative Clean Energy (ICE) Fund	BC Government	A funding program designed to promote development of BC's clean energy sector and GHG reduction priorities.
Funding for Indigenous-led clean production capacity projects	Natural Resources Canada.	Federal funding, through the Clean Fuels Fund for new, or to retrofit existing, clean fuel production facilities in Canada, as well as support for feasibility studies, basic engineering studies and detailed front-end engineering studies for Indigenous businesses and communities.
Zero Emission Vehicle Awareness Initiative (ZEVAI)	Natural Resources Canada	Federal funding for projects to increase awareness, knowledge and public confidence in zero-emission vehicles and public charging and refueling infrastructure (i.e., outreach, education, and capacity-building activities).
CleanBC Go Electric - Commercial Vehicle Programs	BC Ministry of Energy, Mines and Low Carbon Innovation	Funding to aid in the deployment of zero-emission commercial vehicles (including hydrogen fuel cell electric vehicles).
First Nations Clean Energy Business Fund	BC Ministry of Indigenous Relations and Reconciliation	Funding for BC First Nations communities related to clean energy projects on traditional territories and treaty areas. Includes capacity, equity, and revenue sharing funding streams.
Clean Energy in Indigenous, Rural and Remote Communities Program	Natural Resources Canada	$300 million of federal funding from 2021-2027 to support a transition to clean energy use in Indigenous, rural and remote areas that use fossil fuels for heat or power. Includes funding support for all project stages and a variety of technology types including hydrogen.
First Nation Regeneration Fund – Loan Program	Tale'awtxw Aboriginal Capital Corporation (TACC), Tribal Resources Investment Corporation (Tricorp)	Provides financing for First Nations communities to have equity stakes in renewable energy projects.
CleanBC Industry Fund	BC Government	Future funding calls for emission reduction projects expected to be announced in early 2023.
BC Low Carbon Fuel Standard (LCFS) - Part 3/Credits	BC Government	Credits can be generated for the production of low carbon fuels (including hydrogen) through the B.C. LCFS and traded with other fuel suppliers

HYDROGEN RESOURCES

Clean Hydrogen Ladder

- https://www.linkedin.com/pulse/clean-hydrogen-ladder-v40-michael-liebreich

Clean Energy Transition in Remote Indigenous Communities: Hydrogen Energy

- https://era.library.ualberta.ca/items/de39be81-9a95-42ee-b332-cc6e83d8f221/view/b96f4a8b-bda8-4d5b-9af0-418d8da9399f/2021229035.pdf

BC Hydrogen Strategy

- https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/electricity/bc-hydro-review/bc_hydrogen_strategy_final.pdf

BC Renewable and Low-Carbon Gas Supply Potential Study

- https://www.cdn.fortisbc.com/libraries/docs/default-source/news-events/bc-renewable-and-low-carbon-gas-supply-potential-study-2022-03-11.pdf

Carbon intensity of blue hydrogen production

- https://www.pembina.org/reports/carbon-intensity-of-blue-hydrogen-revised.pdf

BC Hydrogen Study

- https://www2.gov.bc.ca/assets/gov/government/ministries-organizations/zen-bcbn-hydrogen-study-final-v6.pdf

Federal Clean Fuel Regulations

- https://www.canada.ca/en/environment-climate-change/services/managing-pollution/energy-production/fuel-regulations/clean-fuel-regulations.html

Glossary - Key Terms

Term	Definition
Battery electric vehicle (BEV)	A zero-emissions vehicle that is powered by electricity from a battery. (link)
BLEVE	Boiling-Liquid-Expanding-Vapour Explosion (BLEVE). An explosion that occurs when a liquid contained in a pressurized container (meaning it is contained above its boiling point) is rapidly depressurized. This causes an immediate transition from liquid to vapour with a release of energy, sometimes accompanied by a fireball. (link)
Blue hydrogen	Common term used to refer to hydrogen produced from methane through reformation processes, paired with carbon capture, utilization, and storage (see definition of CCUS). The fraction of CO_2 that is captured varies depending on the process.
Carbon capture, utilization, and storage (CCUS)	Refers to a suite of technologies that capture carbon dioxide (CO_2) from point sources or directly from the atmosphere, store it in geological formations, or use it in a variety of applications. (link)
Carbon intensity	A measure of total carbon emissions of something per units of production or economic activity. Ex: for hydrogen, carbon intensity is measured as the amount of CO_2 equivalents emitted per kilogram of hydrogen produced (kg CO_2e/kg H2). (link)
Clean energy transition	The global shift away from fossil fuel-based energy systems to renewable energy systems. (link)
Combustion	A chemical reaction that produces heat and light in the form of a flame (e.g., burning). (link)
Cryogenic tanker	A ship designed to store and transport liquefied gases, such as hydrogen, at very low temperatures. (link)
Decarbonization	The process of reducing the levels of carbon emissions associated with a system or process. (link)
Electrolysis	A process by which electric current is passed through a substance to create a chemical change. When referring to production of hydrogen, electric current is passed through water to produce hydrogen and oxygen. (link)

Emission(s)	A substance that is produced and sent out into the air that is harmful to the environment. (link)
Energy carrier	An energy carrier is a transmitter of energy. Includes electricity and heat as well as solid, liquid and gaseous fuels such as hydrogen. (link)
Fuel cell	A power generation device that uses hydrogen as fuel to produce electricity, with water and heat as the only by-products. (link)
Fuel cell electric vehicle (FCEV)	A zero-emissions vehicle that runs on a fuel cell powered by hydrogen. (link)
Global Warming Potential (GWP)	A metric used to measure a greenhouse gas's ability to trap heat in the atmosphere in comparison to carbon dioxide (CO_2). Ex. carbon dioxide has a GWP of 1, methane has a GWP of 28. (link)
Green hydrogen	Common term used to refer to hydrogen produced by electrolysis (see definition of electrolysis) using electricity generated from renewable energy sources.
Greenhouse gas (GHG)	Any gas in the Earth's atmosphere that absorbs infrared radiation (heat) emitted from the Earth's surface and reradiates it back, creating the greenhouse effect. Include gases such as carbon dioxide (CO_2), methane, and water vapour. (link)
Grey hydrogen	Common term used to refer to hydrogen produced from methane through reforming processes. Grey hydrogen is NOT low-carbon hydrogen. (see definition of methane reformation)
Hydrogen	The chemical element of atomic number 1. A colourless, odourless, highly flammable gas that can be used as a molecule or energy carrier. (link)
Hydrogen carrier	A carrier is a molecule containing hydrogen (such as ammonia) that can be easily transported and then broken down to isolate hydrogen for use at its destination. (link)
Low-carbon hydrogen	Common term used to refer to hydrogen produced from methods that produce fewer to no carbon emissions. Includes hydrogen produced by electrolysis, methane reforming with CCUS, and methane pyrolysis (green, blue, and turquoise hydrogen). (link)
Methane pyrolysis	A process to produce hydrogen from natural gas/methane that

	produces solid carbon as a byproduct instead of CO_2. (link)
Methane reforming	Industrial processes used to produce hydrogen from natural gas. Includes methods such as steam methane reforming (SMR) or auto-thermal reforming (ATR). SMR and ATR produce carbon dioxide as well as hydrogen. (link)
Molecule	Two or more atoms bonded together. (link)
Natural gas	A gaseous, naturally occurring hydrocarbon consisting primarily of methane. (link)
Net zero	A stage where economies emit no greenhouse gas emissions or offsets any emissions. (link)
Pressurized gas cylinder	A vessel designed for the storage and transport of pressurized gases, including hydrogen. (link)
Renewable energy	Energy created from natural processes that are replenished at a rate that is equal to or faster than the rate at which they are consumed. Includes energy generated from solar, wind, geothermal, hydropower, and ocean resources, solid biomass, biogas and liquid biofuels, but biomass is considered renewable only if its rate of use does not exceed its rate of regeneration. (link)
Renewable natural gas (RNG)	Refers to natural gas captured and purified from decomposing organic waste. RNG has a lower carbon intensity than conventional natural gas and can be used in similar ways. (link)
Sustainable Aviation Fuel (SAF)	Sustainable aviation fuel (SAF) is a term that refers to fuels derived from non-fossil sources that have the same approximate composition and energy content but significantly lower life-cycle carbon emissions of conventional jet fuel. (link)
Synthetic fuel	A term used to describe any manufactured fuel that has the approximate composition and similar energy content of a fuel derived from crude oil sources. (link)
Turquoise hydrogen	Common term used to refer to hydrogen produced from methane through pyrolysis (see definition of methane pyrolysis).