

Hydrogen Development Action Plan

Newfoundland
and Labrador
2024



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Executive Summary

Climate change is one of the greatest challenges facing the world today and jurisdictions around the world, including Newfoundland and Labrador, are responding, setting renewable energy and net zero greenhouse gas (GHG) emission targets. Reaching these goals will require a multifaceted approach, incorporating elements such as direct electrification, energy efficiency, demand management, and energy storage. Many countries are pursuing the use of green hydrogen for decarbonization, especially for hard-to-abate sectors including long-haul transportation and heavy industry.

Green hydrogen is produced using electrolysis (splitting water into hydrogen and oxygen) powered by renewable energy. Since green hydrogen does not emit GHGs during production or use, countries around the world are seeking opportunities to incorporate it and its derivatives, such as green ammonia, into their decarbonization strategies.

Newfoundland and Labrador has an abundance of natural resources, such as wind, water, and land, which can be harnessed for the production of renewable energy, positioning the province to advance its status as a Clean Energy Centre of Excellence, and global clean energy supplier. Newfoundland and Labrador has the natural resources critical to Canada achieving its net-zero target by 2050, and supporting the global effort to decarbonize. Further developing the province's clean energy industry will increase jobs, develop supply chains, support innovation, and increase revenues, creating an unprecedented opportunity for economic growth in the province.



The Department of Industry, Energy and Technology (IET) recognizes this potential, and committed to a number of hydrogen-related action items in its December 2021 Renewable Energy Plan, “Maximizing Our Renewable Future”. These actions included: enhancing the province’s ability to identify and pursue hydrogen opportunities that provide the highest long-term benefit for residents of the province; and drafting a Hydrogen Development Action Plan. Since the release of the Renewable Energy Plan, the Province has made great progress in enabling the use of its world-class resources to power the large-scale production of green hydrogen and ammonia.

The release of the province’s Hydrogen Development Action Plan is the next step in enabling the development of a green hydrogen and ammonia production industry in Newfoundland and Labrador. With 31 action items over a three-year period in areas such as markets, regulation, industry, and training and jobs, this plan will advance the province’s status as a global supplier of clean energy. Given the evolving nature of this industry, this plan will be nimble to maximize Newfoundland and Labrador’s global competitiveness and ability to produce green hydrogen and ammonia for export markets.

1. The Opportunity

1.1 What is Hydrogen?

Newfoundland and Labrador's Renewable Energy Plan, "Maximizing Our Renewable Future", provides a sustainable long-term vision for the province's energy future. Under the Renewable Energy Plan, Government has committed to enhancing our ability to determine hydrogen opportunities that provide the highest long-term benefit for residents of the province, releasing a Hydrogen Development Action Plan, and building our understanding of export opportunities for hydrogen.

Hydrogen is the most abundant element in the universe and is widely available across the world in molecules like water. Most hydrogen produced globally today is used for industrial purposes, including in oil refining, fertilizer production, and steel manufacturing. Hydrogen has the potential to replace fossil fuels in a range of applications that are considered difficult to decarbonize, such as powering marine vessels and heavy-duty vehicles and blending into natural gas networks.

Different ways of producing, distributing, and using hydrogen impact its carbon intensity (CI) and contribution to climate change. A variety of hydrogen production methods are at various stages of technological readiness and commercialization. Production methods are labelled with colours, such as:

Grey hydrogen is produced from fossil fuels. Through an industrial process known as steam methane reforming, hydrogen is separated from the other components of the fossil fuel, but the GHGs produced in the process are released into the atmosphere and contribute to climate change.

Blue hydrogen is produced using the same method as grey hydrogen, but the leftover GHGs are captured and stored, rather than released into the atmosphere.

Green hydrogen is produced by using renewable electricity (like wind, solar, or hydroelectricity) to split water into hydrogen and oxygen using an electrolyzer.

Other colours of hydrogen include pink, orange, white, and turquoise. Nearly all hydrogen produced today uses fossil fuels, primarily natural gas and coal, while less than one per cent is green hydrogen.

1.2 Why now?

Since green hydrogen does not emit GHGs during use, it can be used in the place of fossil fuels to decrease GHG emissions, contributing to reaching net zero GHG emissions at a global level by mid-century. Once produced, hydrogen can be stored and transported as compressed gas or liquefied hydrogen, or combined with nitrogen from the air to make ammonia and transported as a compressed liquid.

Many jurisdictions are seeking to diversify their energy sources to mitigate the impacts of climate change and increase energy security. The war in Ukraine and other ongoing global conflicts have added an urgency to the need for diversification, increasing global support for renewable electricity and green hydrogen. Demand for hydrogen is growing in mature applications, such as ammonia production for

fertilizer, as well as emerging uses. Hydrogen is expected to be the preferred method to decarbonize sectors where direct electrification is challenging (e.g., high-temperature industrial processes and heavy-duty transport). Newfoundland and Labrador will be a strategic partner to meet global demand for hydrogen in new and emerging applications as nations pivot to secure sources of clean energy.

According to the International Energy Agency (IEA), global hydrogen demand was 95 million metric tonnes (Mt) in 2022 and the IEA anticipates that hydrogen demand will grow six per cent annually to 150 Mt by 2030 under a Net Zero Emissions by 2050 Scenario. Not all countries have the resources needed to satisfy their own demand, leading many countries to focus strategies on importing green hydrogen. Demand from European Union (EU) countries is expected to also grow during this period, with the EU having set a goal to import 10 Mt of renewable hydrogen annually by 2030 to meet its energy security and net zero goals. Forecasts indicate that there will be a potential clean hydrogen demand of 30 Mt in Europe by 2030. In addition, with Germany's updated hydrogen strategy released in 2023, it is anticipated that Europe's largest economy will need to import up to 70 per cent of its hydrogen to be climate neutral by 2045. European ports are preparing their infrastructure to receive hydrogen and its derivatives, such as ammonia, to meet this projected demand.

Other countries are positioning to become significant producers of green hydrogen. The United States' **2022 Inflation Reduction Act** contains tax credits that will reduce the levelized cost of hydrogen across the production chain, making American hydrogen cheaper, quicker. These measures open the door for potential cross-continental

collaboration; however, Newfoundland and Labrador must remain competitive, while ensuring financial prudence and meeting the challenge of our competitors. Given Canada's wealth of resources and supporting attributes, the Government of Canada has recognized the country's economic development potential in supplying a portion of global hydrogen demand, estimating the value to be in the billions.

A number of federal and provincial financial incentives and funding programs are already in place to support the development of green hydrogen and ammonia in Newfoundland and Labrador. For example, the Federal Government has introduced a Clean Hydrogen Investment Tax Credit of up to 40 per cent for eligible project costs for clean hydrogen and ammonia projects and continues to prioritize financing through the Canada Infrastructure Bank for hydrogen and other green infrastructure and clean power projects.

The Provincial Government has introduced a Green Technology Tax Credit of 20 per cent for the capital costs of green activities, including green hydrogen, and has released a Wind-Hydrogen Fiscal Framework to provide a predictable and transparent fiscal system to inform investment decisions and resource development for wind-hydrogen projects.

In June 2023, the Provincial Government also launched the Green Transition Fund, a \$100-million program providing financial support to businesses, organizations, post-secondary institutions, and industry associations to assist with the province's transition to a green economy. The Fund targets the greening of commercial operations in traditional sectors and the development of new opportunities related to the growth of a green economy.

1.3 Why Newfoundland and Labrador?

The development of green hydrogen presents a transformative opportunity for Newfoundland and Labrador, yielding significant benefits both economically and environmentally.

The establishment of green hydrogen production in our province has the ability to spark a burgeoning new industry, increase provincial revenues, ignite job creation across sectors ranging from research and development to manufacturing and construction, and create new trade and investment opportunities with international jurisdictions. The majority of this economic activity will take place in rural areas of our province and will invigorate local economies for its residents.

Through targeted initiatives with our post-secondary institutions in recruitment, specialized training and up-skilling programs tailored to the clean energy sector, Newfoundland and Labrador can navigate a seamless transition to a low-carbon economy while providing new skill sets and work opportunities to the people of our province. The advancement of green hydrogen will take commitment and time but holds the potential to propel Newfoundland and Labrador as a leader in green energy, drive sustainable development, spur economic growth, and contribute to a cleaner, greener future for our region, the rest of Canada and around the globe.

Benefits of Green Hydrogen

- Diversifies our economy
- Creates new jobs
- Increases Provincial revenue
- Creates rural opportunities
- Leads to a cleaner future

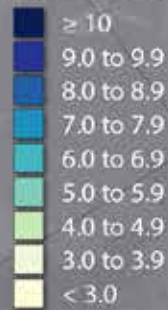


Annual Average Wind Speed at 100 m above surface level of North America

from the
Wind Toolkit

Wind Speed

(meters/second)



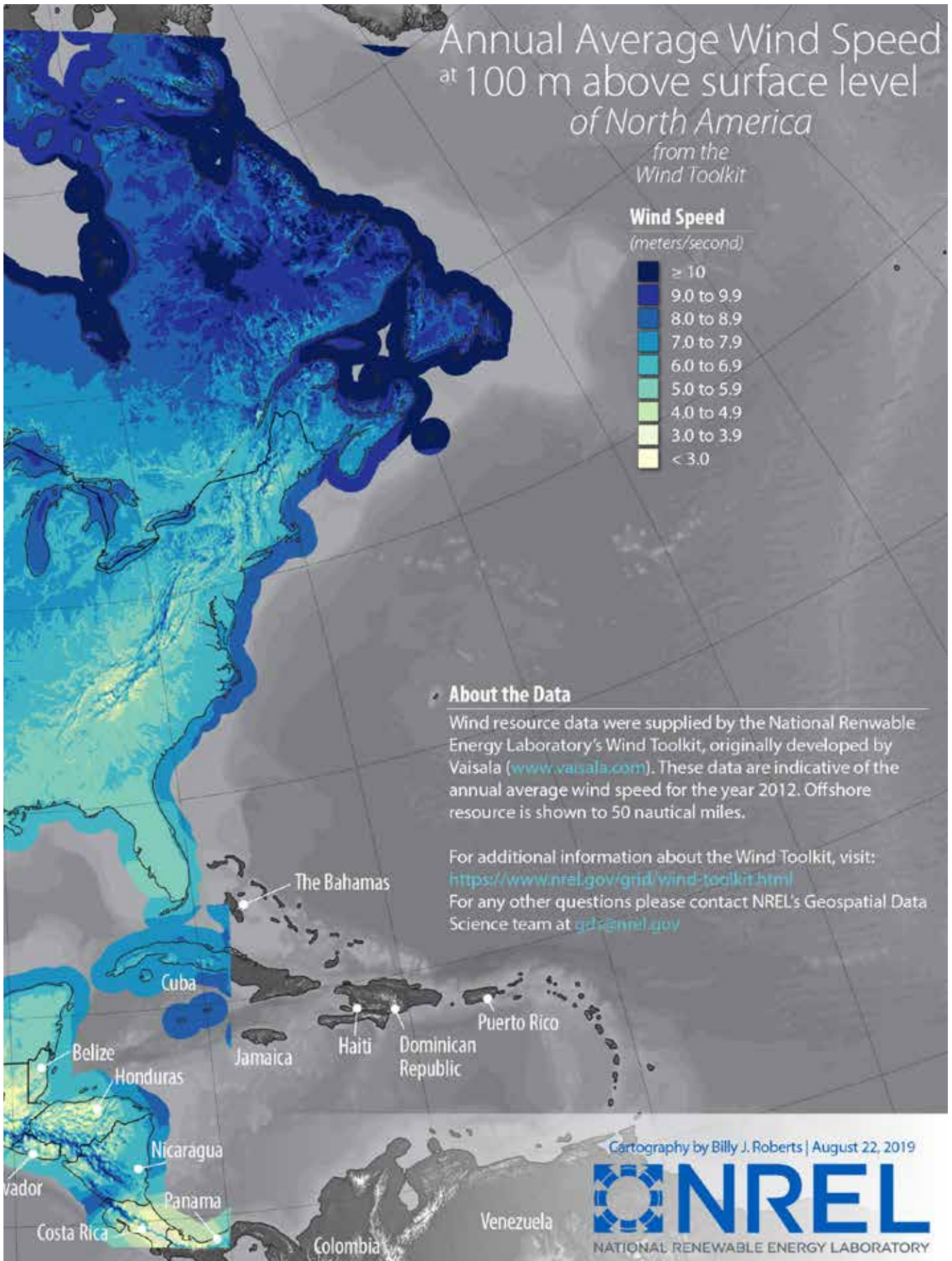
About the Data

Wind resource data were supplied by the National Renewable Energy Laboratory's Wind Toolkit, originally developed by Vaisala (www.vaisala.com). These data are indicative of the annual average wind speed for the year 2012. Offshore resource is shown to 50 nautical miles.

For additional information about the Wind Toolkit, visit:

<https://www.nrel.gov/grid/wind-toolkit.html>

For any other questions please contact NREL's Geospatial Data Science team at gds@nrel.gov



Cartography by Billy J. Roberts | August 22, 2019



Newfoundland and Labrador has abundant resources and other competitive advantages that support the large-scale production of green hydrogen in the province. These include:

Strategic location

- Most easterly jurisdiction in North America
- Positioned along international shipping lanes
- Marine access: Numerous developed deep-sea ice-free ports, and 29,000 kilometres of marine coastline

Wealth of resources

- Wind: World-class onshore and offshore resources, with average wind speeds surpassing 9 metres per second
- Water: Among the highest fresh water runoff in Canada, reducing green hydrogen project costs as use of seawater and desalination not required
- Land: An estimated 350,000 square kilometres of Crown lands exist in the province, mostly unpopulated with low population density (1.4 people/km²), and a significant amount of those Crown lands may be available for renewable energy projects
- Storage: Potential underground hydrogen storage via discovered salt caverns on west coast of island

Highly renewable electricity grid

- Over 90 per cent renewable electricity grid through hydroelectricity
- Annual surplus energy exports of approximately 3.2 terawatt hours; another 30 terawatt hours from the

Upper Churchill Falls hydro station under a long-term contract that will expire in 2041.

- Significant undeveloped hydroelectric capacity available (e.g., 2,250 megawatt [MW] Gull Island)

Skilled workforce

- Highly qualified persons with experience in large-scale construction, fabrication, and operation of energy, industrial and technology projects in challenging environments, including the offshore
- Recognized post-secondary education, researchers, and research capabilities
 - Memorial University (including various campuses across the province and one in the United Kingdom) and Marine Institute
 - College of the North Atlantic with 17 campuses across Newfoundland and Labrador

Environment, Social, and Governance (ESG) advantages

- Provincial net zero by 2050 commitment
- 2019 Climate Change Action Plan
- Published Environmental Assessment guidance for onshore wind-hydrogen projects
- Mandatory disclosure requirements for large GHG emitters
- Stable social and political environment

2. Our Recent Accomplishments

Since the release of the Province's Renewable Energy Plan, Government has been strategically focused on various activities to enable a green hydrogen and ammonia production industry.

2.1 Supporting International Collaboration on Green Hydrogen Export

Numerous jurisdictions located near Newfoundland and Labrador are targeting the import of green hydrogen to meet their renewable energy and security goals, including Belgium, Germany, and the Netherlands. Renewable energy companies from Canada and abroad have recognized the competitive advantages Newfoundland and Labrador has in meeting this need. As such, international companies have expressed interest in securing access to the province's renewable energy resources to produce green hydrogen and ammonia for export to Europe. To support international collaboration on the export of green hydrogen from Newfoundland and Labrador, IET has signed various agreements

and participated in related events over the past two years.

On August 23, 2022, the Canada-Germany Hydrogen Alliance Declaration of Intent was signed in Stephenville, committing Canada and Germany to promote opportunities for a bilateral trade relationship pertaining to hydrogen and its derivatives, as well as hydrogen-related technologies, and to accelerate the expansion of the hydrogen industry and the improvement of infrastructure and supply chains. The Premier of Newfoundland and Labrador signed a letter of support for this agreement, under the Council of Atlantic Premiers who noted that allies are looking to Atlantic Canada to help them achieve their critical sustainability and energy security goals. Furthermore, the Premier hosted a roundtable with industry attendees at the Stephenville event, an objective of which was to identify ways industry and governments can work together to facilitate the establishment of a green hydrogen industry.



Port of Rotterdam, Netherlands

December 2021

Released **Maximizing Our Renewable Future: A Plan for Development of the Renewable Energy Industry in Newfoundland and Labrador.**

July 2022

Call for Nominations of Areas of Interest for wind energy projects in the province issued.

September 2022

Declaration of Intent with the Free and Hanseatic City of Hamburg, Germany, signed.

May 2023

Memorandum of Understanding with the Port of Rotterdam, the Netherlands, signed.

Amendments to the **Canada-Newfoundland and Labrador Atlantic Accord Implementation Act** tabled in Parliament to govern regulation of offshore renewable energy.

October 2023

Hosted delegation of hydrogen business and government representatives from Hamburg, Germany.

April 2022

Lifted the Moratorium on Wind Development.

August 2022

Canada-Germany Hydrogen Alliance founded in Stephenville.

December 2022

Crown Lands Call for Bids for Wind Energy Projects launched.

March 2023

Regional Assessment of Offshore Wind Development launched with the Government of Canada.

August 2023

Four companies received Wind Application Recommendation Letters through Crown Lands Call for Bids for Wind Energy Projects.

December 2023

Memorandum of Understanding signed with Canada to enable Newfoundland and Labrador to solely regulate offshore wind projects within 16 provincial bays.

On September 27, 2022, the Government of Newfoundland and Labrador signed a Declaration of Intent with the City of Hamburg, Germany, to encourage the establishment of hydrogen supply chains that could be involved in the export of green hydrogen from the province to Germany. The declaration further develops joint efforts in areas such as technology and infrastructure development, regulatory regimes, and commercial investment and partnerships. In October 2023, Government hosted a delegation of over 30 hydrogen business and government representatives from the City of Hamburg, Germany. The delegation met with local wind-hydrogen developers, engaged with our industry associations Energy NL and econext, and engaged with local business, stakeholders, and Indigenous Governments and Organizations.

At the World Hydrogen Summit 2023, the Province signed a Memorandum of Understanding with the Port of Rotterdam to cooperate and explore opportunities in the area of green hydrogen and hydrogen technologies.

The Government of Canada and its international partners recognize the strategic importance of Newfoundland and Labrador in meeting global clean energy needs. Acknowledging this fact, on November 23-24, 2023, the 19th Canada-EU summit was held in St. John's, attended by the Prime Minister and EU President. At the summit, Canada and the EU agreed to launch a joint green hydrogen roadmap to develop the hydrogen market on both sides of the Atlantic.

In March of this year, Canada signed an agreement with Germany to accelerate work towards the commercial-scale trade of clean hydrogen fuel. The Memorandum of Understanding commits to backing transactions between Canadian hydrogen producers and Germany's industrial manufacturing and energy

distribution sectors. This is a strong affirmation of the role hydrogen will play in the German and EU economy with Canada as a major supplier.

In 2023, IET also participated in numerous national and international conferences and events on renewable energy and hydrogen to promote Newfoundland and Labrador as a destination of choice for investment in renewable energy. Participating in these events allows IET to showcase our province's unique assets, paving the way for future partnerships and major investments to secure Newfoundland and Labrador's future in the green economy.

2.2 Enabling Onshore Wind Development

Recognizing the interest in our renewable energy resources and seeking to maximize the benefits to Newfoundlanders and Labradorians, the Province has embarked on an ambitious agenda to develop our wind-hydrogen resources to meet global demand. In 2022, Government lifted the moratorium on commercial wind energy projects and launched a Crown lands nomination and Call for Bids process for wind energy projects. On August 30, 2023, Government announced that four bids from four companies would receive Wind Application Recommendation Letters and were granted the exclusive right to pursue the development of their project through the Government of Newfoundland and Labrador Crown lands application and approval process.

Toqlukuti'k Wind and Hydrogen (ABO)

ABO is proposing a three-phase wind energy project in the Isthmus region to produce green hydrogen for local use at the Come-By-Chance Refinery, in partnership with Braya Renewable Fuels, and for export as hydrogen/ammonia on the global market. ABO has an approved bid area of approximately 108 thousand hectares of

land for the wind farm, storage and production facility.

EverWind NL Company

EverWind is proposing a multi-phase wind energy project to produce and export hydrogen/ammonia from facilities on the Burin Peninsula. EverWind has an approved bid area of approximately 270 thousand hectares of land for the wind farm, storage and production facilities.

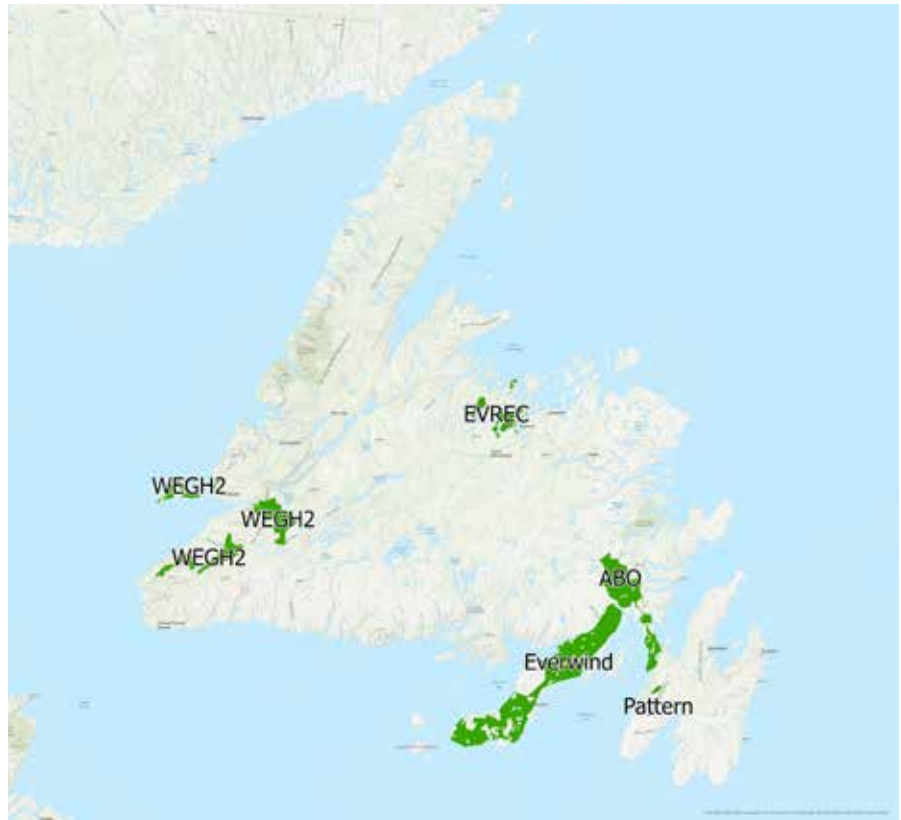
Exploits Valley Renewable Energy Corporation (EVREC)

EVREC is proposing a multi-phase wind energy project in central Newfoundland and a hydrogen/ammonia production facility in Botwood, Newfoundland to produce and export green hydrogen/ammonia. EVREC has an approved bid area of approximately 30 thousand hectares for the wind farm, storage and production facilities.

World Energy GH2 Inc.

World Energy GH2 is proposing a three-phase project including wind turbines and a hydrogen/ammonia production facility. World Energy GH2 has an approved bid area of approximately 107 thousand hectares for the wind farm, storage and production facilities.

Over the lifetime of all projects – 35 to 40 years each – the estimated economic impact of these four projects is \$206.2 billion in GDP and an overall treasury impact of \$11.7 billion. Based on plans for the four projects, peak employment is estimated at 11,694 full time equivalent jobs during the construction period and 2,254 full time equivalent jobs during the operation phase, with a total capital spend of \$66.3 billion.



Wind energy projects in Newfoundland and Labrador (May 2024)

Argentia Renewables Wind LP (Pattern)

In addition to these projects on Crown lands, Pattern Energy has publicly announced that it is pursuing a project with the Port of Argentia outside of the Call for Bids process on private land. On April 1, 2024, IET announced that a Wind-Energy Contingency Land Reserve of approximately 2,453 hectares has been established for Argentia Renewables Wind LP (Pattern). Pattern may apply for Crown land within this limited reserve should it be required for its 300-MW project.

Any Environmental Assessment (EA) considerations for energy projects are under the purview of the Department of Environment and Climate Change. To guide the industry through the EA process, in 2022, the Department of Environment and Climate Change issued Environmental Assessment Guidance for Registration of Onshore Wind Energy Generation and Green Hydrogen Production Projects. The purpose of the guidance is intended to guide the proponent in:



- Describing the potential benefits and adverse environmental effects of a project;
- Proposing measures to minimize or eliminate adverse environmental effects;
- Determining the significance of residual environmental effects;
- Engaging with Indigenous Governments and Organizations and the public and addressing concerns; and,
- Planning and designing a project that optimizes environmental protection and sustainability.

Further, wind energy and hydrogen/ammonia manufacturing projects are subject to registration for Environmental Assessment (EA) under the **Environmental Protection Act** and related regulations. Final project details such as wind turbine locations will be informed through the Crown lands and EA processes.

To ensure that any wind-hydrogen projects maximize the benefits to the people of Newfoundland and Labrador, on February 23, 2023, Government released a new Wind-Hydrogen Fiscal Framework for the province. The fiscal framework will be applicable to wind-hydrogen projects in the province. The framework provides a predictable and transparent fiscal system to inform investment decisions and resource development for wind-hydrogen projects. The framework provides for a sharing of financial returns between investors and Government to achieve a balance between benefits to the province for use of its resources (land, wind and water) while recognizing project investment and risk. The framework is comprised of several elements including Crown lands fees, water use fees, a wind electricity tax, and a water royalty.

2.3 Enabling Offshore Wind Development

To enable development of the province's world-class, offshore wind energy resources, the governments of Newfoundland and Labrador and Canada are cooperating to expand the mandate of the Canada–Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) to include the regulation of offshore renewable energy in the Newfoundland and Labrador offshore area. Legislation has been tabled in the Parliament of Canada to amend the Atlantic Accord legislation to implement these changes. Bill C-49 will:

- Ensure the necessary measures are in place to support offshore renewable energy opportunities;
- Allow for a fiscal regime that provides the maximum economic returns to Newfoundland and Labrador;
- Rename the C-NLOPB as the Canada–Newfoundland and Labrador Offshore Energy Board and expand its mandate to become the lead regulatory body for offshore energy in the offshore area. This furthers joint-management of the offshore area and builds upon extensive expertise the C-NLOPB has in managing offshore projects; and,
- Define the offshore area for offshore renewable energy that excludes areas within provincial jurisdiction, to ensure that the Provincial Government can move forward to regulate developments within provincial jurisdictional waters.

On December 6, 2023, Canada and Newfoundland and Labrador signed a Memorandum of Understanding to enable Newfoundland and Labrador to take the regulatory lead on offshore wind projects

within its inland bays. The agreement enables the development of offshore wind projects in Newfoundland and Labrador that will power the province's economy forward and establishes a clear process for the Province to administer land tenure and life-cycle regulation, including revenues for offshore renewable energy projects within provincial bays. Recognizing that the Government of Newfoundland and Labrador has ambitious growth plans and wants to move ahead quickly, this agreement will allow the province to dictate the speed and pace of development in the bays. It is a direct signal to investors, workers and communities that Newfoundland and Labrador and Canada are collaborating to unlock offshore renewable energy development within provincial bays while affirming our shared commitment to joint management under the Atlantic Accord Acts as part of a thriving and sustainable offshore energy sector in the province.

IET and the Department of Environment and Climate Change are also supporting the federal Regional Assessment of Offshore Wind Development for areas offshore Newfoundland and Labrador, including informing the definition of the goals, objectives, geographic boundaries, activities, and governance structure of the assessment. The Regional Assessment will help inform future project-specific federal impact assessments and decisions for offshore wind projects in these areas. Federal and Provincial Ministers signed the Regional Assessment agreement on March 22, 2023. The Committee conducting the Regional Assessment released its Interim Report on March 22, 2024. The Interim Report's findings are preliminary and further engagement and research will be undertaken until the final Regional Assessment Report is submitted in January 2025.

2.4 Federal Provincial Cooperation

Federal and provincial cooperation spans the entire hydrogen value chain. Under Canada's Hydrogen Strategy, the Province has joined provincial and territorial counterparts, industry and academia, on a Hydrogen Codes and Standards Working Group. The Working Group is co-chaired by Natural Resources Canada and the Standards Council of Canada and is assessing barriers and solutions related to hydrogen codes, standards and regulations in support of the commercialization of hydrogen technologies in Canada in three areas: production, delivery and storage, and end-use.

Federal Budget 2022 announced the launch of Regional Energy and Resource Tables (RERT). In June 2022, the Newfoundland and Labrador RERT was launched. The RERT is a collaborative initiative with the provinces and territories to identify, prioritize and pursue opportunities for sustainable job creation and economic growth for a low-carbon future. Newfoundland and Labrador's RERT has four focus streams: Wind-Hydrogen; Carbon Capture, Utilization and Storage (CCUS); Critical Minerals; and Electrification. Over 2023, through RERT, the Provincial and Federal Governments engaged with Indigenous Governments and Organizations; labour organizations; academia; and industry and industry organizations, including in the traditional energy and the renewable energy sectors. These consultations have informed the ongoing work of RERT in its focus streams and the development of the Province's Hydrogen Development Action Plan. In March 2024, a RERT Collaborative Framework was released for Newfoundland and Labrador to guide federal and provincial cooperation to make Newfoundland and Labrador a global energy, mining and technology supplier of choice in a net-zero world while creating good jobs and lasting prosperity across the province.



2.5 Renewable Energy Resource Data Hub

IET launched its web-based [Renewable Energy Resource Data Hub](#) to provide the public and industry information on Newfoundland and Labrador's renewable energy resources and supporting attributes. This tool incorporates public education, investment attraction, and open-access data. For example, the Hub includes an interactive map with data on the province's world-class onshore and offshore wind resources at varying heights above ground, the location and size of utility-scale energy projects, and supporting attributes such as the province's numerous deep-sea, ice-free ports.

2.6 Critical Minerals Plan

Our province has an abundance of natural resources that will be used to support clean energy, including the local and global hydrogen sector. On November 1, 2023, Government released the Critical Minerals Plan. In 2023, the mineral development industry employed almost 9,000 persons and resulted in over \$4 billion in mineral shipments from the province. The Critical Minerals Plan recognizes the importance of our province's mineral



resources in supporting the global energy transition to renewable energy sources, such as solar, wind and hydroelectricity, and the importance of energy storage technology in that transition. Net zero goals will require critical minerals, and the Plan has identified 34 minerals in Newfoundland and Labrador. Hydrogen is important in adding value in not only the use of our critical minerals, but also in greening mineral production and adding value to our mineral products. As an example, with high-grade, low-impurity iron ore and using hydrogen in electric arc furnaces instead of

coal in traditional steelmaking, emissions can be reduced up to 95 per cent, producing green steel to meet global demands in a sustainable and more environmentally conscious manner.

Work achieved to date positions Newfoundland and Labrador as a global supplier of clean energy. The Hydrogen Development Action Plan lays the foundation for a strong and vibrant green hydrogen production industry, and positions the province as an early mover, while ensuring maximized benefits for Newfoundlanders and Labradorians.



3. The Action Plan

3.1 Foundations

The Government of Newfoundland and Labrador recognizes the economic development opportunities associated with enabling a green hydrogen and ammonia production industry in the province. This includes increased jobs, gross domestic product, and tax revenue for programs and services. To take advantage of this opportunity, the Premier's April 15, 2021 mandate letter to the Minister of Industry, Energy and Technology (IET) included direction to consider new export energy sector development including hydrogen and wind. IET's subsequent December 2021 Renewable Energy Plan, "Maximizing Our Renewable Future," included a number of hydrogen-related action items, including: enhancing the province's ability to identify and pursue hydrogen opportunities that provide the highest, long-term benefit for residents of the province, and drafting a Hydrogen Development Action Plan.

In addition to supplying other jurisdictions with green hydrogen, hydrogen use in the province is another pathway to contribute to Government's net-zero target. Opportunities may exist in sectors such as mining, heavy industry, and marine and long-haul transport to use green hydrogen to increase value-added processing activities or reduce the province's GHG emissions. The **Management of Greenhouse Gas Act** covers over 95 per cent of GHG emissions from mining and heavy industrial sources and about 40 per cent of the total provincial GHG emissions. Annual scheduled increases in GHG reduction targets and the regulated carbon price are increasing the business case for the deployment of new clean technologies that can facilitate GHG reductions by industry at least cost.

The Hydrogen Development Action Plan covers the three-year period from 2024 to 2027. The

complexity of the industry and its early stages of development will require many adjustments over the next few years.

To deliver a long-term plan, an active dialogue is needed between communities, businesses, Indigenous Governments and Organizations, educational institutions, and international partners over the next three years. This is to ensure that all stakeholders understand the dimension of the unique opportunities before the province and that a comprehensive plan is in place to guide long-term action.

3.2 Public, Industry and Stakeholder Input

The direction and content of this Plan was informed by input received from the public, industry and stakeholders. This includes input from:

- The Premier’s Economic Recovery Team’s (PERT) report, “The Big Reset”, which included a recommendation to release a Hydrogen Development Action Plan;
- IET’s “Renewable Energy Plan: What We Heard” document, which summarized the feedback received from residents, Indigenous Governments and Organizations, the Premier’s Youth

Council, industry, and stakeholders, during IET’s fall 2021 consultation process;

- Numerous companies that contacted IET since 2021 interested in using the province’s world-class wind resources to power the production of green hydrogen and ammonia, primarily for export to markets in northern Europe;
- Engagement sessions through RERT;
- Feedback from companies and government representatives from countries in northern Europe and around the world; and
- Ongoing engagement with industry associations and other stakeholders.

3.3 The Vision

Develop a world-class green hydrogen industry that maximizes benefits for all Newfoundlanders and Labradorians, ensures environmental sustainability, enables economic development and job creation, and supports our province, Canada, and the world to reduce fossil fuel use and achieve net zero greenhouse gas emissions by 2050.





3.4 Principles / Objectives

Over the next three years, Newfoundland and Labrador will continue to lay the groundwork for a green hydrogen economy, building on our work to date to support the sustainable development of the province's renewable energy resources to maximize benefits to the people of the province.

Through implementation of this plan, the Government of Newfoundland and Labrador will be guided by the following overarching principles.

1. We will ensure that our resources are used in a sustainable and environmentally responsible manner while maximizing the benefits to the province.
2. We will engage with Indigenous Governments and Organizations, industry, and stakeholders to support Indigenous participation in the green hydrogen economy.
3. We will have a well-trained, diverse, and inclusive workforce able to support a growing hydrogen economy.
4. We will build public awareness of green hydrogen.
5. We will pursue harmonization of regulations with other jurisdictions, where possible,

to ensure safety and a hydrogen sector that maximizes export opportunities, as appropriate.

6. We will consult and collaborate with Indigenous Governments and Organizations wherever land or resource management or development decisions have the potential to affect settled or asserted Aboriginal or treaty rights.
7. We will ensure that competing interests are balanced while encouraging hydrogen development.
8. We will pursue opportunities across all stages of the hydrogen value chain.

3.5 Focus Areas

Aligned with the Renewable Energy Plan and the Climate Change Action Plan, over the next three years, the Hydrogen Development Action Plan will focus on four areas:

- Export and Domestic Markets
- Partnership, Innovation and Industry Support
- Training and Jobs
- Regulatory Framework

4. Actions

Actions are identified as short term (completion within one year), medium term (completion within two years) or long term (completion within three years).

4.1 Export and Domestic Markets

The development of a wind-hydrogen industry offers unprecedented economic growth opportunities for Newfoundland and Labrador. The majority of the activity associated with the construction and operation of wind-hydrogen projects will take place in rural areas of the province, providing a new economic base that can align with other opportunities such as mineral development. The development of Newfoundland and Labrador's mineral potential will require access to clean energy and inputs that reduce emissions and produce what is needed globally for the transition to a green economy such as critical minerals and green iron.

Beyond our shores, other jurisdictions are seeking to import green hydrogen and ammonia to decarbonize, including Belgium, Germany, the Netherlands, and other countries. Given Newfoundland and Labrador's close proximity to Europe, and our competitive advantages in producing green hydrogen and ammonia (see section 1.3), industry and stakeholders from these countries have expressed interest in the province supplying a portion of their demand. As outlined in section 2, Newfoundland and Labrador has taken significant action to enable supply to these markets. As part of this Plan, we will further enable, pursue and support these economic development opportunities.

We will focus on developing relationships with international export markets and exploring cost-competitive hydrogen uses within the province.

Green hydrogen is also recognized as a potential pathway that can assist Newfoundland and Labrador in achieving net zero by 2050 target. Current GHG emissions modelling suggests that achieving its net zero emissions will require the use of new sources of renewable energy to displace fossil fuel use in hard-to-abate sectors, as well as increased electrification, efficiency investments and deployment of energy-intensive carbon removal technologies. As such, action will also be taken to further identify decarbonizing opportunities that may be viable over the long term within the province, thus advancing our status as a global player in clean energy.

Actions

In the short term (within one year):

1. Guide approved wind-hydrogen companies through Government's policy and regulatory processes.
2. Target promotion of the province in key export markets and continue to pursue green hydrogen memoranda of understanding and agreements with relevant jurisdictions.
3. Build our understanding of the domestic market for green hydrogen.

In the medium term (within two years):

4. Consider business development opportunities for further wind-hydrogen projects onshore and potential new opportunities in provincial bays and offshore.
5. Continue to guide approved companies through Government's policy and regulatory processes.
6. Continue to target promotion of the province in key export markets and demonstrate progress in implementing hydrogen agreements with relevant jurisdictions.

In the long term (within three years):

7. Pursue opportunities for the local green hydrogen supply chain to support the industrial, mining, electricity generation and marine and heavy-duty vehicles sectors, to support economic development and reduce greenhouse gas emissions in the province.



4.2 Partnership, Innovation and Industry Support

Awareness

Hydrogen has been used globally by various industrial sectors, including but not limited to refining and chemical production, and more recently for steel-making and transportation. As interest in green hydrogen production and use increases globally, and as technology develops for other applications and sectors, there is a need to enhance awareness in the public and industry. This includes an enhanced understanding of the ability of green hydrogen and ammonia to decarbonize hard-to-abate sectors nationally and globally, assisting in the fight against climate change, as well as measures to maximize public safety during production and use.

Support for hydrogen development depends on people having adequate knowledge and information through a variety of trusted sources. Further, the more exposure and experience that people have with hydrogen and its uses, whether through demonstrations

We will collaborate with industry partners and stakeholders, encourage innovation, and leverage funding opportunities.

or other methods, the more knowledge they have to inform their view and comfortability. In promoting awareness of hydrogen, we must ensure that people and communities are engaged fully as the hydrogen economy develops and grows. Through awareness, Newfoundland and Labrador will position itself for hydrogen production, export, and, in the future, use within the province.

Actions

In the short term (within one year):

8. Raise public and industry awareness of how hydrogen is produced, its benefits, and safety measures regarding green hydrogen and ammonia.

In the medium term (within two years):

9. Increase industry awareness of local hydrogen supply chain and business opportunities associated with hydrogen development projects in the province, and potential alignment with emission reduction and mineral opportunities.

Cooperation

From a net zero perspective, renewable energy technology advancement and deployment, the use of new energies, and the deployment of energy-intensive carbon removal technologies are key to achieving net zero GHG emissions at the federal and provincial levels by 2050. This includes the introduction of a federal **Clean Fuels Regulation** in the transportation sector in 2023, and federal sectoral commitments such as a **Clean Electricity Regulation** that would take effect in 2035 and net zero emissions reduction targets in the oil and gas sector by 2050 with targets starting as early as 2030.

Continued cooperation with the federal and provincial/territorial (F-PT) governments on the development and regulation of green hydrogen and ammonia will enhance opportunities for Newfoundland and Labrador. This builds on existing work, including the Government of Newfoundland and Labrador's participation in Natural Resource Canada's Regional Energy and Resource Table initiative, on various F-PT hydrogen working groups under the federal "Hydrogen Strategy for Canada", and support from the Council of Atlantic Premiers to work together on hydrogen opportunities. Further, the governments of Canada, Newfoundland and Labrador, and Nova Scotia are working with their offshore energy regulators to position the region for increased investment and development of offshore renewable energy, with amendments to the Atlantic Accord Act tabled in Parliament to expand the mandate of the C-NLOPB to include renewables and an Memorandum of Understanding signed between Canada and the Province to allow Newfoundland and Labrador to regulate renewable energy projects within provincial bays.

Leveraging federal funding sources, including the clean energy tax credits and infrastructure



funding supports, will provide support for the emerging clean hydrogen industry. We will also work with Indigenous Governments and Organizations, as well as local, regional, national, and international stakeholders, with the goal of enabling hydrogen development. National and regional strategies, and cooperation over management of resources, will instill investor confidence to grow our sector together.

To deliver on the Hydrogen Development Action Plan, the Province will also establish a Green Hydrogen Network as a way to assist in the coordination of communities, businesses, government departments, Indigenous Governments and Organizations, and other stakeholders. Leveraging existing ties established by organizations such as Energy NL, techNL, and econext, the Department of Industry, Energy and Technology will serve as the lead for the Network.

Actions

In the short term (within one year):

10. Continue to work with the Federal Government to implement the Regional Energy and Resource Table Collaborative Framework and Canada's Hydrogen Strategy to support the green hydrogen sector.
11. Establish a Green Hydrogen Network that assists in providing a coordinated approach to hydrogen development in Newfoundland and Labrador.

In the medium term (within two years):

12. Work with the Federal Government to establish regulatory mechanisms for offshore renewable resource development and management.
13. Engage with and seek opportunities to support the priorities of Indigenous Governments and Organizations in the development of the hydrogen economy.

In the long term (within three years):

14. Work with the other Atlantic Canadian provinces to facilitate the establishment of a green hydrogen industry in the region.
15. Explore opportunities to develop a hydrogen hub.



Research and Development and Business Innovation

Enhancing research and development (R&D) and business innovation will support the development and use of green hydrogen in the province and elsewhere, enhancing our capabilities as a global supplier of clean energy. This may include opportunities to examine means to increase efficiency of hydrogen and ammonia production, investigate long-term environmental impacts of green hydrogen development, support regulatory development, storage and transport of hydrogen and ammonia. Canada is a world leader in hydrogen fuel cell technology, with proven transportation uses for hydrogen in the passenger vehicle sector. Opportunities exist to further determine applications in marine, industrial and other sectors in Newfoundland and Labrador. R&D opportunities exist on scalability of production, converting existing industrial/transport/electricity infrastructure within the province, measuring/monitoring/verification of hydrogen processes, underground storage and water efficiency. The province has a rapidly growing technology sector that is receiving increasing international recognition and that can potentially help to develop or advance technologies that will play important roles in the hydrogen economies. The Province will continue to support the R&D efforts of local technology companies in high-growth areas such as this to help capitalize on the opportunities presented by the hydrogen economy.

The province has world-class public post-secondary institutions, and the Government of Newfoundland and Labrador continues to invest in building their R&D capacity. Further, we have some of the most well qualified energy experts in the world, traditionally focusing on the offshore oil industry, harsh environments, and technology, but with knowledge and skills

transferable to the hydrogen economy. Our education and research institutions have a history of collaboration with industry, working to meet their skilled labour and applied research needs. Recent investments include support for College of the North Atlantic (CNA) to develop a Centre for Energy and Thermal Systems at the Corner Brook campus and funding to Memorial University (MUN) for a new Core Science Facility at St. John's campus.

We will focus on planning and partnerships to ensure our labour requirements are met.

Also, under development at the MUN St. John's campus is the Harsh Environment Research Facility that will assist with applied research related to infrastructure, such as electrical, in harsh environments. The Marine Institute has a long-standing history of collaboration and support for our oceans technology sector with growing capacity at The Launch (formerly the Holyrood Marine Base). They are already taking steps to support hydrogen R&D, including work at MUN's Thermal Fluids and Energy Research Lab, where research on hydrogen production and wind energy is occurring. IET has significant funding programs that have provided support for faculty and students conducting applied research at our post-secondary institutions that will be tapped to build the foundations of a hydrogen economy. This presents opportunities to target this funding to support R&D and business innovation in the hydrogen sector.

Actions

In the short term (within one year):

16. Collaborate with industry, MUN, and CNA to identify R&D needs and funding to support the sector in Newfoundland and Labrador.

In the long term (within three years):

17. Pursue opportunities to support hydrogen pilot, demonstration, R&D and start-up projects identified through partnerships between education and research institutions and industry.

Inventory of Resources

Newfoundland and Labrador's strategic geographic location in the Atlantic provides opportunities to supply green hydrogen and ammonia to markets in North America and Europe. Further, as outlined in section 1.3, Newfoundland and Labrador has an abundance

of wind, water, land, harbours and coastline, as well as natural geological features that could be used to store hydrogen. As part of this Plan we will inventory our infrastructure, study its potential uses in the hydrogen economy, and assess what may be needed to fully utilize those resources where economically feasible.

Actions

In the short term (within one year):

18. Update, enhance and promote our Renewable Energy Resource Data Hub.
19. Conduct a needs analysis of infrastructure required to support hydrogen (e.g., ports and harbours).

In the medium term (within two years):

20. Assess natural geological features that may be used for hydrogen/ammonia storage.
21. Continue to monitor the sustainable use of available water resources.

4.3 Training and Jobs

Newfoundland and Labrador has an established history of producing highly skilled workers for large scale construction and energy projects in challenging environments, both onshore and offshore. This skill set enables our province to further opportunities for its residents in the transition to a low-carbon economy. A significant proportion of the employment related to wind powered hydrogen projects occurs during planning and construction. Targeted interventions are key to attract and retain a provincial hydrogen workforce. This includes student recruitment, internships, and alignment between K-12 and post-secondary education, as well as leveraging the expertise of the province's highly skilled oil and gas workers and other skilled trades workers and supporting the participation of interested workers in the transition to a low-carbon economy.

During the construction phase of any projects, workers will be needed to assemble and install equipment (e.g., windmills, electrolyzers, mechanical, electrical). During the operations phase of hydrogen production, workers will be required to manage production, storage, and transport facilities. Work is already beginning in these areas with the recent launch of CNA's one-year Wind Turbine Technician Certificate and two-year Hydrogen Technician Diploma in September 2023. These programs support the up-skilling and re-skilling of the next generation of energy workers and technicians to work in Newfoundland and Labrador's emerging hydrogen economy. Across all stages of project



development, skilled workers will be required to ensure that the production, storage, and distribution of hydrogen, as well the operation of wind farms, adheres to the relevant codes, standards, and regulations.

In 2022, the Department of Immigration, Population Growth and Skills initiated a two-year partnership with econext, supported by over \$2,500,000 through Labour Market Development Agreement (LMDA) funding, to work with training institutions and industry partners to accelerate the participation of Newfoundland and Labrador's workforce in emerging clean energy industries, including the wind-hydrogen sector. The project will help to identify workforce capacity gaps; meet short-term workforce needs through micro-learning, attraction, and retention; develop hydrogen-focused post-secondary curriculum and courses; create greater awareness of job opportunities and requirements with clean growth; and increase clean energy innovation in Newfoundland and Labrador.

Actions

In the short term (within one year):

22. Explore funding opportunities to support hydrogen-related training.

In the medium term (within two years):

23. Work with industry and other stakeholders to support hydrogen workforce development, including identifying gaps, and developing a workforce attraction and retention strategy for the sector that promotes equality, diversity, and inclusion.
24. Engage with and seek opportunities to support the hydrogen and related training priorities of Indigenous Governments and Organizations.
25. Launch a K-12 awareness campaign to promote jobs relevant to the hydrogen sector as a career choice.

In the long term (within three years):

26. Work with provincial post-secondary institutions to provide comprehensive and responsive program offerings for the hydrogen sector.



4.4 Regulatory Framework

Establishing appropriate hydrogen regulatory frameworks, standards, and certification systems will build consumer and investor confidence. However, a balance must be found between attracting investment, mitigating risk to public safety, protecting the environment, and promoting responsible stewardship of our natural resources. As with any large-scale development, it is important to ensure that Crown lands are used as intended and projects progress in a timely manner. Legislation and policy will also ensure that Crown lands are restored to their original condition, to the greatest extent possible, without using public funds.

Regulatory frameworks are needed to ensure that during hydrogen production, storage, transportation, and use, appropriate safety measures are taken, and environmental impacts

are minimized. Furthermore, regulations need to be compatible with the requirements of the rest of Canada and international jurisdictions. Standardized and predictable regulations will ensure a stable investment environment, and safety for workers and customers.

Newfoundland and Labrador will work to ensure the legislative framework is updated to regulate the new wind-hydrogen industry. The Provincial Government will also work with the Government of Canada, the Atlantic Provinces, and export markets of interest, to cooperate on the development of hydrogen codes and standards. Compatibility of codes, standards, and regulations between jurisdictions will ensure predictability and safety for stakeholders across the hydrogen value chain. Newfoundland and Labrador will work with the Federal Government and other partners to ensure safety in hydrogen production and use.

Actions

In the short term (within one year):

27. Partner with the Federal Government and other jurisdictions on hydrogen safety regulation standardizations.
28. Begin to update and implement provincial legislation and policy to provide a clear regulatory framework for wind-hydrogen projects.
29. Review national and international hydrogen safety regulations for applicability to Newfoundland and Labrador.

In the medium term (within two years):

30. Continue to update and implement provincial legislation and policy intended to regulate wind-hydrogen projects.

In the long term (within three years):

31. Begin to implement new hydrogen codes and standards developed in cooperation with the Federal Government and other jurisdictions in Newfoundland and Labrador to close any gaps identified for new hydrogen processes and uses.

5. Into the Future

Hydrogen has significant potential to meet the world's energy needs as we collectively tackle climate change. With existing and emerging uses in industry, transportation, heating and electricity generation, global interest in hydrogen as a fuel source is growing.

Newfoundland and Labrador has numerous competitive advantages, with an abundance of renewable resources and proximity to major export markets that well places the province to be a global supplier of clean energy, in particular green hydrogen and its derivatives, such as ammonia. Harnessing this opportunity will also involve finding opportunities to use green hydrogen domestically to support the Province's net-zero by 2050 target.

The public and industry stakeholders have highlighted hydrogen development as an avenue for economic development and as a pathway to achieve net zero objectives. The release of the Province's Hydrogen Development Action Plan is the next step in enabling these opportunities. This three-year plan includes 31 action items in the focus areas of markets, regulation, industry, and training. IET will issue progress reports on action items after the plan's first year, second year, and third year (in 2025, 2026, and 2027). Through this Plan we will enable Newfoundland and Labrador to be an early mover in the green hydrogen economy.



6. Appendix: Summary of Action Items

Export and Domestic Markets

In the short term (within one year):

1. Guide approved wind-hydrogen companies through Government's policy and regulatory processes.
2. Target promotion of the province in key export markets and continue to pursue green hydrogen memoranda of understanding and agreements with relevant jurisdictions.
3. Build our understanding of the domestic market for green hydrogen.

In the medium term (within two years):

4. Consider business development opportunities for further wind-hydrogen projects onshore and potential new opportunities in provincial bays and offshore.
5. Continue to guide approved companies through Government's policy and regulatory processes.
6. Continue to target promotion of the province in key export markets and demonstrate progress in implementing hydrogen agreements with relevant jurisdictions.

In the long term (within three years):

7. Pursue opportunities for the local green hydrogen supply chain to support the industrial, mining, electricity generation and marine and heavy-duty vehicles sectors, to support economic development and reduce greenhouse gas emissions in the province.

Partnership, Innovation and Industry Support

Awareness

In the short-term (within one year):

8. Raise public and industry awareness of the how hydrogen is produced, its benefits, and safety measures regarding, green hydrogen and ammonia.

In the medium term (within two years):

9. Increase industry awareness of local hydrogen supply chain and business opportunities associated with hydrogen development projects in the province, and potential alignment with emission reduction and mineral opportunities.

Cooperation

In the short term (within one year):

10. Continue to work with the Federal Government to implement the Regional Energy and Resource Table Collaborative Framework and Canada's Hydrogen Strategy to support the green hydrogen sector.
11. Establish a Green Hydrogen Network that assists in providing a coordinated approach to hydrogen development in Newfoundland and Labrador.

In the medium term (within two years):

12. Work with the Federal Government to establish regulatory mechanisms for offshore renewable resource development and management.
13. Engage with and seek opportunities to support the priorities of Indigenous Governments and Organizations in the development of the hydrogen economy.

In the long term (within three years):

14. Work with the other Atlantic Canadian provinces to facilitate the establishment of a green hydrogen industry in the region.
15. Explore opportunities to develop a hydrogen hub.

Research and Development and Business Innovation

In the short term (within one year):

16. Collaborate with industry, MUN, and CNA to identify R&D needs and funding to support the sector in Newfoundland and Labrador.

In the long term (within three years):

17. Pursue opportunities to support hydrogen pilot, demonstration, R&D and start-up projects identified through partnerships between education and research institutions and industry.

Inventory of Resources

In the short term (within one year):

18. Update, enhance and promote our Renewable Energy Resource Data Hub.
19. Conduct a needs analysis of infrastructure required to support hydrogen (e.g., ports and harbours).

In the medium term (within two years):

20. Assess natural geological features that may be used for hydrogen/ammonia storage.
21. Continue to monitor the sustainable use of available water resources.

Training and Jobs

In the short term (within one year):

22. Explore funding opportunities to support hydrogen-related training.

In the medium term (within two years):

23. Work with industry and other stakeholders to support hydrogen workforce development, including identifying gaps, and developing a workforce attraction and retention strategy for the sector that promotes equality, diversity, and inclusion.
24. Engage with and seek opportunities to support the hydrogen and related training priorities of Indigenous Governments and Organizations.
25. Launch a K-12 awareness campaign to promote jobs relevant to the hydrogen sector as a career choice.

In the long term (within three years):

26. Work with provincial post-secondary institutions to provide comprehensive and responsive program offerings for the hydrogen sector.

Regulatory Framework

In the short term (within one year):

27. Partner with the Federal Government and other jurisdictions on hydrogen safety regulation standardizations.
28. Begin to update and implement provincial legislation and policy to provide a clear regulatory framework for wind-hydrogen projects.
29. Review national and international hydrogen safety regulations for applicability to Newfoundland and Labrador.

In the medium term (within two years):

30. Continue to update and implement provincial legislation and policy intended to regulate wind-hydrogen projects.

In the long term (within three years):

31. Begin to implement new hydrogen codes and standards developed in cooperation with the Federal Government and other jurisdictions in Newfoundland and Labrador to close any gaps identified for new hydrogen processes and uses.



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