Atlantic Canada Hydrogen Supply Chain Assessment and Development Plan

Final Report

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The information, opinions, and interpretations expressed in this report are those of the authors and do not necessarily reflect the official policy or position of the Government of Canada, the provincial governments, or the project partners.

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List of acronyms and abbreviations

Acronym	Definition
ACOA	Atlantic Canada Opportunities Agency
AHJ	Authority Having Jurisdiction
ASME	American Society of Mechanical Engineers
ASU	Air Separation System
AZEESL	Atlantic Zero-Emission Energy System Laboratory
CAGR	Compound Annual Growth Rate
CBA	Community Benefit Agreement
CCUS	Carbon Capture, Utilization, and Storage
CFR	Clean Fuel Regulations
CNG	Compressed Natural Gas
CO2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalent
CRN	Canadian Registration Number
CSA	Canadian Standards Association
CTRI	Clean Technology Research Institute
cETL	Canadian Electrical Testing Laboratories
cUL	Canadian Underwriters Laboratories
DOE	Department of Energy
EA	Environmental Assessment
EARD	Environmental Assessment Registration Document
EIS	Environmental Impact Statement
EPCM	Engineering, Procurement, and Construction Management
EU	European Union
EVREC	Exploits Valley Renewable Energy Corporation
FCEV	Fuel Cell Electric Vehicle
FEED	Front-End Engineering Design
FID	Final Investment Decision
GHG	Greenhouse Gas
GW	Gigawatt
H2	Hydrogen
H2Hubs	Hydrogen Hubs
HMI	Human-Machine Interfaces
HVAC	Heating, Ventilation, and Air Conditioning
IPCEI	Important Projects of Common European Interest
IRS	Indigenous Relationship Secretariat
ISO	International Organization for Standardization
ITC	Investment Tax Credit

KOH	Potassium Hydroxide
Kg	Kilogram
kPa	Kilopascal
kW	Kilowatt
LOHC	Liquid Organic Hydrogen Carrier
LOI	Letter of Intent
M3	Cubic Metre
MOU	Memorandum of Understanding
MW	Megawatt
MPa	Megapascal
NARL	North Atlantic Refining Limited
NB	New Brunswick
NDA	Non-Disclosure Agreement
NDT	Non-Destructive Testing
NFPA	National Fire Protection Association
NH3	Ammonia
NL	Newfoundland and Labrador
NOC	National Occupational Classification
NS	Nova Scotia
NaOH	Sodium Hydroxide
PED	Pressure Equipment Directive
PEI	Prince Edward Island
PEM	Proton Exchange Membrane
PJ	Petajoule
PLC	Programmable Logic Controllers
PNWH2	Pacific Northwest Hydrogen Hub
PSA	Pressure Swing Adsorption
Psi	Pounds per Square Inch
QA	Quality Assurance
QC	Quality Control
R&D	Research and Development
RERT	Regional Energy and Resource Table
RFNBO	Renewable Fuels of Non-Biological Origin
SAF	Sustainable Aviation Fuel
SCADA	Supervisory Control and Data Acquisition
SMR	Steam Methane Reforming
SOEC	Solid Oxide Electrolyzer Cell
SPI	Strategic Partnerships Initiative
TPRD	Thermal Pressure Relief Devices
TRL	Technology Readiness Level
TWh	Terawatt-hour

Glossary

Term	Definition
Biofuel	A type of low-carbon fuel derived from organic matter, such as plants, crops, or waste materials, which can be used as an alternative to traditional fossil fuels in transportation or energy production.[1]
Biomass	Organic material derived from plants, animals, and microorganisms that serves as a renewable energy source. It includes agricultural residues, forestry waste, dedicated energy crops, animal manure, and organic waste from industries or households. Biomass can be converted into energy through processes such as combustion, gasification, pyrolysis, or biochemical methods like anaerobic digestion to produce electricity, heat, biofuels, or biogas.[2]
Blue hydrogen	Hydrogen is produced primarily from natural gas through a process called steam methane reforming (SMR). This process combines natural gas and high-temperature steam to produce hydrogen and carbon dioxide as a by-product. To qualify as "blue," the carbon dioxide is captured and stored using carbon capture and storage (CCS) technologies, significantly reducing greenhouse gas emissions.[3]
Carbon capture, utilization, and storage (CCUS)	A technology designed to reduce greenhouse gas emissions by capturing carbon dioxide (CO_2) from industrial processes, power generation, or directly from the atmosphere. The captured CO_2 is either transported, typically via pipelines, and stored deep underground in geological formations such as depleted oil and gas reservoirs or saline aquifers, or utilized in another industrial process, such as for the fertilizer industry, or for enhanced oil recovery.[4]
Carbon intensity	A measure of the carbon dioxide (CO_2) emissions produced per unit of energy, product, or activity. It is typically expressed in terms of grams or kilograms of CO_2 equivalent (CO_2e) per kilowatt-hour (kWh) of energy, per ton of product, or per kilometer traveled.[5]
Electrolysis	A chemical process that uses electricity to split water (H_2O) into its components, hydrogen (H_2) and oxygen (O_2). This is achieved by passing an electric current through water using an electrolyzer containing two electrodes (an anode and a cathode) and an electrolyte to facilitate the reaction. When powered by renewable or low-carbon electricity, electrolysis produces green hydrogen.[6]
Electric fuel (power to liquid)	These fuels are derived from hydrogen produced through renewable-powered electrolysis and biogenic or direct air capture carbon dioxide.
Enabling mechanism	Enabling mechanisms are management and other approaches that advance execution in accordance with policy and planning intent.
Feedstock	The raw material or input used in industrial processes to produce energy, fuels, chemicals, or other products. Feedstocks can include fossil-based materials like natural gas, coal, and crude oil; renewable materials such as biomass, agricultural residues, and algae; or non-traditional inputs like captured carbon dioxide or water for processes like electrolysis.[7]
Fuel cell electric vehicle (FCEV)	Vehicles powered by an electric motor that uses electricity generated onboard by a fuel cell. The fuel cell converts hydrogen stored in the vehicle's tank into electricity through an electrochemical reaction, producing only water vapor and heat as by-products.[8]

[1] Biofuel | Definition, Renewable Energy, Types, & Pros and Cons | Britannica (Accessed March 7, 2025)
[2] Biomass explained - U.S. Energy Information Administration (EIA) (Accessed March 7, 2025)
[3] Grey, blue, green – the many colours of hydrogen explained | World Economic Forum (Accessed March 7, 2025)
[4] Carbon capture and storage (CCS) | Definition, Process, & Facts | Britannica (Accessed March 7, 2025)
[5] What is carbon intensity? | National Grid Group (Accessed March 7, 2025)
[6] Electrolysis | Definition, Uses, & Facts | Britannica (Accessed March 7, 2025)
[7] FEEDSTOCK Definition & Meaning - Merriam-Webster (Accessed March 7, 2025)
[8] Alternative Fuels Data Center: How Do Fuel Cell Electric Vehicles Work Using Hydrogen? (Accessed March 7, 2025)

Fuel cells	Electrochemical devices that convert the chemical energy of a fuel, such as hydrogen, directly into electricity, heat, and water through an electrochemical reaction, rather than combustion. Fuel cells consist of an anode, a cathode, and an electrolyte membrane, and they operate silently with high efficiency and low environmental impact.[9]
Green hydrogen	Hydrogen produced through the electrolysis of water using clean electricity generated from renewable energy sources, such as solar or wind power. Electrolyzers split water into hydrogen and oxygen through an electrochemical reaction, resulting in zero carbon dioxide emissions during the production process.[10]
Grey hydrogen	Hydrogen produced from natural gas or methane through a reforming process, such as steam methane reforming (SMR). Unlike blue hydrogen, the carbon dioxide and other greenhouse gases generated during the process are not captured or stored, making grey hydrogen a more carbon-intensive option.[11]
Lighthouse project	A lighthouse project is a short-term, well defined, measurable project that serves as model – or a “lighthouse” – for other similar projects within a broader transformation initiative. Lighthouse projects simply focus on implementation, fast delivery and creating a positive culture for transformation.
Low-carbon fuels	Fuels that produce significantly fewer greenhouse gas emissions compared to traditional fossil fuels over their lifecycle. These include biofuels (e.g., biodiesel, ethanol), renewable fuels, synthetic fuels, and hydrogen.[12]
Low-carbon hydrogen	Hydrogen produced using methods that emit significantly lower levels of greenhouse gases compared to conventional production processes. This can include hydrogen generated through electrolysis powered by renewable energy (e.g., green hydrogen) or through natural gas reforming with carbon capture and storage (e.g., blue hydrogen).[13]
Natural gas pipeline blend	The process of mixing hydrogen with natural gas in existing natural gas pipelines and distribution systems. This blend can be used as a lower-carbon fuel for heating, power generation, or industrial applications. Hydrogen blending reduces the carbon intensity of natural gas by partially substituting it with hydrogen, which produces no carbon dioxide when burned.[14]
Renewable fuels	Fuels produced from naturally replenished resources such as biomass, agricultural waste, algae, or other organic materials. They include sustainable aviation fuel, renewable diesel, and renewable natural gas. In this report, renewable fuels are a classification of low-carbon fuels but are different than synthetic fuels.[15]
Renewable natural gas (RNG)	A sustainable and low-carbon alternative to conventional natural gas, produced from organic waste materials such as agricultural residues, livestock manure, landfill waste, and wastewater treatment plant biogas. RNG is created by capturing and upgrading biogas through the removal of impurities and increasing its methane content to make it pipeline compatible. [16]
Supply chain	The supply chain refers specifically to the network of inputs, materials, components, technologies, and services required to enable the production, storage, distribution, and use of hydrogen. This includes equipment such as electrolyzers, compressors, and storage tanks, as well as the Tier 1, Tier 2, and Tier 3 suppliers, logistics providers, and construction and engineering services that ensure projects can be built and operated. The supply chain emphasizes the availability, cost, and resilience of these enabling elements.
Synthetic fuels	Liquid or gaseous fuels produced artificially through chemical processes, typically by combining hydrogen with carbon dioxide or carbon monoxide as feedstocks. The hydrogen used in synthetic fuel production is often generated through electrolysis powered by renewable energy, while the carbon is typically captured from biogenic sources or directly from the atmosphere. In this report, synthetic fuels are a classification of low-carbon fuels but are different than renewable fuels.[17]

[9] Fuel Cells | Department of Energy (Accessed March 7, 2025)
[10] Grey, blue, green – the many colours of hydrogen explained | World Economic Forum (Accessed March 7, 2025)
[11] Grey, blue, green – the many colours of hydrogen explained | World Economic Forum (Accessed March 7, 2025)
[12] Low-carbon Fuel Procurement Program - Canada.ca (Accessed March 7, 2025)
[13] Low-carbon hydrogen | ontario.ca (Accessed March 7, 2025)
[14] HyBlend: Opportunities for Hydrogen Blending in Natural Gas Pipelines | Department of Energy (Accessed March 7, 2025)
[15] Renewable Fuels | History, Importance, Types, Benefits, & Challenges (Accessed March 7, 2025)
[16] Renewable Natural Gas | US EPA (Accessed March 7, 2025)
[17] Synthetic Fuels - Advanced Biofuels Canada (Accessed March 7, 2025)

Technology Readiness Level (TRL)	A standardized framework for evaluating the maturity of a technology, ranging from initial concept (TRL 1) to full-scale operational deployment (TRL 9). The scale progresses through stages such as concept formulation, laboratory validation, prototype demonstration, and system qualification in real-world environments. TRL is widely used across industries such as aerospace, energy, and manufacturing to assess the readiness of technologies for commercialization and implementation.[18]
Value chain	The value chain refers to the full set of activities that create and deliver value from production to end use. It includes construction, (e.g., electrolysis), storage, transportation, conversion, distribution, and end use across sectors such as industry, transport, and power. The value chain highlights not only the physical flow of hydrogen but also the economic, social, and environmental value generated at each stage.

[18] Technology readiness levels (Accessed March 7, 2025)

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Executive summary

With abundant renewable resources, deep-water ports, established industrial expertise, and proximity to European markets, Atlantic Canada has a strong foundation to build a competitive hydrogen economy. Yet the sector remains at an early stage, with markets, infrastructure, logistics, and regulatory frameworks still developing, presenting both challenges and opportunities. If developed strategically, the region can use this moment to establish and anchor new supply chains that generate economic, environmental, and social benefits across the region.

Recognizing this moment and potential, the **Atlantic Hydrogen Alliance**, **Energy NL**, and **Net Zero Atlantic** partnered with **all four provincial governments** and the federal government, through the **Atlantic Canada Opportunities Agency**, to commission this supply chain assessment and action plan. **Deloitte** was engaged to lead the work, bringing together technical expertise, jurisdictional insights, and industry and community perspectives to evaluate readiness and chart a pathway forward.

Objectives

The objectives of this study are to:

1. Assess the readiness of Atlantic Canada's supply chain to support hydrogen production, distribution and storage, and ultimately end use.
2. Identify opportunities to strengthen the regional supply chain with an emphasis on economic growth and the inclusion of Indigenous Governments & Organizations, and rural communities.
3. Benchmark the region against leading Canadian and international jurisdictions to capture best practices and lessons learned, and
4. Deliver an actionable roadmap to guide the development of a competitive and sustainable hydrogen ecosystem across Atlantic Canada.

The study followed a structured approach combining review of existing research, engagement with industry and community, and in-person regional workshops. This methodology ensured the analysis was evidence-based, rooted in Atlantic Canada's context, and shaped by the voices of key participants.

Atlantic Canada's foundations and opportunities

The foundations of a hydrogen economy in Atlantic Canada are taking shape through a combination of federal leadership, provincial strategies, and emerging projects. All four Atlantic provinces have advanced hydrogen-related strategies or action plans, supported by complementary federal programs and tax incentives.

Together, these policy frameworks provide momentum while signaling to investors that hydrogen development is a regional and national priority.

Hydrogen projects are already moving forward. As of May 2025, multiple production and end-use projects have been announced across the region, with activity clustering near enabling infrastructure. Atlantic Canada's competitive advantage lies in assets such as deep-water ports, extensive transport corridors, and natural gas pipelines that can be adapted for hydrogen blending. Combined with world-class wind and renewable energy resources, these assets uniquely position the region to serve both domestic needs and international markets.

The hydrogen value chain spans project development and construction, production, storage and distribution, and end use, supported by research, innovation, workforce development, and regulatory standards. In Atlantic Canada, most of the announced projects to date focus on green hydrogen production via electrolysis, aligned with renewable resources and European demand for certified green hydrogen. International export of hydrogen (in the form of derivatives such as ammonia, SAF, and LOHCs) can leverage port infrastructure and established trade routes, while blending and road-based transport may serve initial domestic uses. Longer term, opportunities exist in underground storage and industrial decarbonization, provided enabling standards, infrastructure, and market signals are in place.

Unlocking these opportunities require scaling enabling infrastructure, upgrading safety standards, and developing workforce and supplier capabilities. While many specialized systems must currently be imported, Atlantic Canada's industrial base has transferable expertise in fabrication, construction, and engineering that can be adapted to support growth across the hydrogen value chain.

Industry growth & workforce considerations

Hydrogen development in Atlantic Canada is expected to be shaped both by domestic decarbonization priorities and international demand, particularly from Europe. Scenario analysis shows that even under conservative assumptions, the region is projected to become a meaningful producer and exporter of clean hydrogen. In high-ambition net-zero pathways, Atlantic Canada could help supply Europe's demand for hydrogen and hydrogen derivative imports, leveraging its renewable energy base and geographic proximity.

Domestically, hydrogen demand is expected to be driven by heavy transportation, industry, and low-carbon fuels, with additional opportunities in blending with natural gas and power generation. To illustrate the scale of this opportunity, a representative green hydrogen and ammonia (as an example of a derivative) facility was modeled. Analysis shows that meeting mid-century targets would require multiple such facilities—potentially as many as 19 by 2050—each demanding significant equipment, construction inputs, and skilled labour. This underscores the importance of aligning supply chain readiness with growth scenarios.

Based on recent estimates, a single hydrogen facility would require a substantial construction workforce. A smaller 40,000-tonne facility would require about 2,600 construction workers annually over a three-year build, while a large 185,000-tonne facility requires nearly 6,000 workers annually over a four-year period to complete production systems, storage, pipelines, and civil works.

At the upper bound, meeting the Canada Energy Regulator's net-zero scenario could mean up to 19 large facilities in the region by 2050. This could require more than 20,000 construction workers per year through 2035 and nearly 15,000 annually from 2036–2050—exceeding the peak labour demands of Muskrat Falls, Hebron, the Maritime Link, or any other regional project. Combined with offshore wind, transmission upgrades, and other announced infrastructure projects, this demand would place intense pressure on skilled trades, engineers, and technical specialists, creating risks of project delays, wage inflation, and strain on other sectors if not carefully managed.

The upside is substantial. Hydrogen construction could generate one of the largest job creation programs in the region's history, boosting GDP and employment. But success would require strategic planning to phase projects, align with offshore wind and other large infrastructure projects, and avoid overwhelming the local workforce. Host communities could see both opportunities and pressures, as housing, health care, and social services face new demands from labour inflows. Clear workforce strategies, including participation by Indigenous Governments & Organizations and rural communities, will be critical to maximizing benefits and avoiding negative effects.

Once hydrogen production facilities have been built, operations would deliver long-term, stable employment. By 2035, hydrogen plants could support nearly 4,000 operations jobs, doubling to more than 8,000 by 2050. These highly skilled roles—plant operators, electricians, technicians, and safety officers—would anchor the regional economy while generating multiplier effects in logistics, services, and research. Ensuring sufficient workforce training pipelines, mobility, and retention strategies will be essential to turn this opportunity into a sustained advantage for Atlantic Canada.

Supplier landscape

Atlantic Canada's hydrogen supply chain supplier base is in an early stage of development, concentrated in adjacent sectors like oil and gas, mining, renewables, and heavy industry. These companies can provide Tier 2 needs such as valves, piping, safety systems, and fabrication, but critical Tier 1 systems—including electrolyzers, fuel cells, and storage tanks—are not produced locally. Reliance on international suppliers increases cost risks, procurement lead times, and exposure to global supply chain disruptions.

Elsewhere in Canada, Ontario and British Columbia benefit from established Tier 1 companies and robust networks of Tier 2 and Tier 3 suppliers. Globally, Europe, Asia, and the U.S. dominate electrolyzer and fuel cell manufacturing. Lessons from peer jurisdictions such as California, Texas, the UK, Netherlands, and Germany show the importance of pairing production projects with a clear local benefits regime including local supply chain development, workforce planning and training initiatives, and community engagement—an approach Atlantic Canada can tailor to its export-oriented context.

Supplier readiness

80 organizations across Atlantic Canada's emerging hydrogen value chain were surveyed, including upstream producers, midstream infrastructure providers, end users, and a large group of enabling actors such as EPCs, researchers, governments, Indigenous Governments & Organizations and community partners.

Findings show that upstream and enabling organizations are the most active and technically prepared, drawing on strong experience in engineering, fabrication, renewables, utilities, and industrial gases. Midstream readiness remains limited, particularly in storage, logistics, and port infrastructure, and downstream end-use activity is still early-stage, with most firms monitoring developments rather than investing. Overall, only about a quarter of respondents consider themselves fully ready, while most are exploring, piloting, or building capacity.

Across the ecosystem, organizations report that they can adapt existing technologies and skills with targeted investment, but progress is constrained by high production costs, limited infrastructure, uncertain demand, and the need for clearer funding and policy signals. Respondents most frequently identified demand certainty, regulatory clarity, access to grants, partnerships, and demonstration projects as the supports needed to unlock investment and accelerate scaling.

Regional patterns reflect each province's hydrogen maturity: Nova Scotia and Newfoundland and Labrador show stronger involvement tied to active project pipelines; New Brunswick's participation centres on logistics and enabling services; and Prince Edward Island's shows growing interest from industry, academia, municipalities, and community organizations. Overall, the survey points to a region with adaptable expertise but requiring coordinated action on infrastructure, end-use activation, and inclusive participation to build a competitive hydrogen ecosystem.

Supply chain gaps

The gap assessment identified progress to date but also highlights critical areas requiring action:

- **Market demand**. International demand signals are present, but no significant bankable offtake agreements have been secured, and domestic demand is still nascent.
- **Infrastructure**. Port facilities require upgrades, storage and pipeline systems remain underdeveloped, and EPC capacity is limited.
- **Workforce**. Depending on the pace of industry growth in the region, there could be shortages in construction labour, especially among trades and engineers.
- **Tier 1 & 2 suppliers**. While there is considerable experience in upstream and enabling areas, the region lacks Tier 1 OEMs but can scale local Tier 2 capacity while attracting advanced manufacturing investment.

Implications

Atlantic Canada stands at a pivotal point in the development of its hydrogen supply chain. The region's world-class renewable energy resources, deep-water ports, and established energy expertise provide strong foundations, yet reliance on imports, limited hydrogen expertise, and fragmented regulations threaten progress. Without coordinated regional action, Atlantic Canada risks missing the opportunity to turn natural advantages into enduring industrial strength. Maximizing this opportunity would require deliberate efforts to build domestic capacity, upgrade infrastructure, and align policy to secure lasting economic and environmental benefits.

Export-oriented projects currently dominate, but both domestic demand and global market signals have softened compared to expectations two years ago. Weak local uptake limits investment confidence and constrains opportunities for early commercialization, while international demand faces headwinds from cost pressures and delayed policy commitments in key markets. At the same time, critical infrastructure—storage, pipelines, and ports—remains in its infancy, and workforce shortages in construction and technical roles are expected to intensify as clean energy projects accelerate. Coordinated planning among provinces, industry, and educators is needed to ensure supply, demand, and talent grow together in a balanced way.

The supplier base must also mature to reduce exposure to global supply chain disruptions. While regional firms can deliver non-critical components, they lack capacity in key technologies such as electrolyzers, compressors, and cryogenic systems. A unified regional framework—harmonizing infrastructure development, standards, and incentives—will be essential to close these gaps and position Atlantic Canada as a credible, competitive, and resilient hydrogen hub.

Recommendations

The study identifies four priority themes to guide hydrogen development:

1. **Build hydrogen supply and secure demand** – create credible domestic markets and secure export offtake agreements to attract investment.
2. **Grow local suppliers to expand participation** – ensure Indigenous, rural, and local business participation as partners and beneficiaries.
3. **Develop workforce and innovation** – expand training pipelines and R&D to sustain supply chain growth.
4. **Integrate hydrogen into infrastructure planning** – make ports, pipelines, storage, and grids hydrogen-ready.

Conclusion

Atlantic Canada has the assets and ambition to be a leader in the global hydrogen economy. But to realize this potential, governments, industry, and communities must move quickly to close capability gaps, align regional strategies, and build the foundations of a resilient supply chain. The window of opportunity is open now. Timely, coordinated action will determine whether Atlantic Canada becomes a credible supplier to global markets or risks falling behind more advanced jurisdictions.

By the numbers

Current state	**10 large scale projects**	announced in Atlantic Canada producing green hydrogen
2030 CER projections	**9 facilities**	projected to be in operation by 2035
	1,580,000 tonnes	tonnes of hydrogen projected to be produced each year by 2035
	11 GW	electrolyzer capacity required by 2035
2050 CER projections	**19 facilities**	projected to be in operation by 2050
	3,560,000 tonnes	hydrogen projected to be produced each year by 2050
	25 GW	electrolyzer capacity required by 2050
Jobs & workforce	**5,931 construction jobs**	would be created for a large-scale facility, over 4 years
	20,489 construction industry workers	could be required each year to build 9 hydrogen production facilities between 2025 and 2035
	3,536 permanent jobs created by 2035	across facility operations, including plant operators, industrial electricians, instrumentation technicians, control room staff, maintenance teams, safety and compliance officers, and a range of supporting functions in administration, logistics, and supply
	8,398 permanent jobs created by 2050	Permanent operating jobs across the above categories
Supplier readiness survey	**80 organizations**	participated in the regional supplier readiness survey
	33% of respondents	are actively engaged in hydrogen projects
	64%	reported 6-10+ years of hydrogen-related activities or services
	40%	reported being fully or partially ready or developing skills/capacity

Summary of supply chain recommendations

While the size, scope, and precise location of Atlantic Canada's future hydrogen industry and supply chain remain uncertain, one thing is clear: realizing hydrogen's potential would require proactive coordination across the entire ecosystem. To establish a competitive and resilient hydrogen supply chain, Atlantic Canada must first focus on the foundational elements of the value chain itself. The following core supply chain recommendations target the practical enablers of production, storage, distribution, workforce readiness, and industrial deployment. They emphasize actions that directly unlock investment, build local manufacturing capacity, and integrate hydrogen into critical infrastructure—laying the groundwork for a self-sustaining regional supply chain that can scale to meet both domestic and export demand.

Theme	#	Headline	Recommendation
1. Build supply and secure demand to unlock supply chain investment	1.1	**Advance lighthouse hydrogen projects in each province**	Identify and advance lighthouse projects in each Atlantic province that demonstrate key hydrogen technologies and highlight province-specific value chain opportunities, while enabling regional knowledge sharing.
	1.2	**Establish coordinated hydrogen hubs and project nodes**	In coordination with the federal government, identify and designate hydrogen hubs and associated project nodes across Atlantic Canada, aligned with lighthouse projects and infrastructure development, supported by a regional operating structure to coordinate and govern activities.
	1.3	**Leverage public procurement to anchor early demand**	Explore the viability of federal and provincial procurement mandates or local content clauses requiring public sector developments and/or operations to adopt hydrogen, hydrogen-derived fuels, or use hydrogen-based products (e.g., domestically produced cement manufacturing), to help establish a domestic market in Atlantic Canada.
	1.4	**Implement domestic demand-side tools like Contracts for Difference**	Explore domestic demand-side mechanisms, such as Contracts for Difference (CfDs), to connect regional hydrogen supply and demand while accounting for varying willingness to pay across sectors. Federal or provincial funding could support price stabilization tools for early offtakers of green hydrogen and ammonia. This approach could be anchored by local demand from industrial offtakers such as Irving Oil, as well as new end-use sectors like steel, pulp and paper, fertilizer, energy generation (peak and/or baseload), and maritime shipping to convert existing thermal and fuel processes to low-carbon hydrogen or its derivatives.
	1.5	**Conduct targeted feasibility studies for key sectors**	Building on existing studies, support targeted feasibility studies with clear pathways to operationalization for sectoral hydrogen end-use opportunities in Atlantic Canada. Prioritize sectors such as industrial processes and heavy-duty trucking, while also aligning with renewable energy developments for hydrogen-based energy storage and use and collaborating with natural gas utilities to evaluate hydrogen pipeline blending.
2. Grow local suppliers to expand participation	2.1	**Position Atlantic Canada to attract Tier 2 and, over time, Tier 1 hydrogen suppliers**	Develop a forward-looking business development strategy focused on gradually strengthening the regional hydrogen supply chain. Once the first large-scale production project reaches FID, efforts should concentrate on attracting Tier 2 suppliers—those providing enabling equipment, components, and operations and maintenance services—that can integrate with existing industrial capabilities in fabrication, marine, and energy services. By building early momentum and supplier confidence at the Tier 2 level, Atlantic Canada can progressively move up the value chain, creating the conditions to attract Tier 1 hydrogen-specific manufacturers over time. This approach ensures that growth is sequenced with market demand, project deployment, and workforce readiness—laying the foundation for a more mature, self-sustaining hydrogen manufacturing ecosystem.
	2.2	**Develop local hydrogen technology & equipment supply chain**	Develop a regional hydrogen technology and equipment supply chain in Atlantic Canada. This should prioritize knowledge transfer and the gradual development of local expertise across the equipment supplier base.
3. Develop workforce to build and sustain the supply chain	3.1	**Leverage and upskill heavy industry workforce for hydrogen roles**	Map heavy industry workforce to corresponding roles in the hydrogen value chain and develop targeted training programs that build on their existing skills and knowledge to prepare them for hydrogen-related operations.
4. Integrate hydrogen into infrastructure planning to enable efficient deployment	4.1	**Integrate hydrogen readiness into infrastructure upgrades**	Identify and incorporate "hydrogen-ready" components into planned infrastructure development and upgrade projects, including ports, pipelines, and storage assets. This could involve port facilities designed to handle liquid hydrogen, ammonia, or other derivative products such as liquid organic hydrogen carriers (LOHC) and sustainable aviation fuel (SAF), as well as pipelines and associated components (e.g., valves) engineered for hydrogen blending or future conversion to pure hydrogen service.
	4.2	**Enable large-scale hydrogen storage projects**	Support the development of large-scale hydrogen storage infrastructure in Atlantic Canada by facilitating proponent identification and partnerships to enable cost reductions, manage supply variability, and improve price stability. This effort could leverage or build off existing initiatives to build on current momentum and expertise.
	4.3	**Assess feasibility of regional hydrogen distribution network**	Explore the development of a hydrogen and hydrogen-derivative distribution network for Atlantic Canada, modeled on the EU Hydrogen Backbone initiative and informed by provincial supply and demand volumes and timelines along with existing infrastructure. This should begin with feasibility studies to assess the potential to leverage existing ports and pipelines, and to evaluate additional marine, road, and rail connections between provinces to enable cost-effective, low-carbon distribution and unlock regional market opportunities.

Summary of broader hydrogen sector development recommendations

While the previous recommendations focus on the physical and operational enablers of Atlantic Canada's hydrogen supply chain, a complementary set of actions is required to strengthen the broader ecosystem that supports it. These sector development recommendations address the enabling environment—spanning policy alignment, regulatory harmonization, workforce development, Indigenous participation, investment attraction, and research coordination. Together, they establish the governance, market confidence, and social license needed for sustained hydrogen sector growth across the region.

Theme	#	Headline	Recommendation
5. Hydrogen sector development	5.1	**Launch coordinated campaign to attract global investment**	Leverage existing forums and initiatives (e.g., Invest in Canada) and build upon ongoing efforts to market the "Atlantic Hydrogen Advantage" to international investors, through a coordinated regional investment attraction campaign that highlights the region's renewable resources, export potential, political stability, and proximity to European markets.
	5.2	**Develop regional hydrogen awareness and engagement plan**	Leverage existing initiatives, such as the Atlantica Centre for Energy's energy literacy initiative and develop a coordinated Atlantic Canada regional public engagement plan to build awareness, understanding, and social acceptance of hydrogen development and energy literacy across the region.
	5.3	**Create centralized, real-time hydrogen information platform**	Develop a near real-time, centralized online database for Atlantic Canada that consolidates information on policies, funding programs, hydrogen-related projects, standards, research and innovation, financial tools, and educational resources relevant to project proponents and supply chain participants. The platform could incorporate innovative features, such as a chatbot, to provide users with tailored, immediate guidance on funding opportunities and regulatory information based on project specifics.
	5.4	**Advance Indigenous and community hydrogen partnerships**	Building on existing engagement, support, and equity partnerships across Atlantic Canada's energy sector, Atlantic Canada should work with Indigenous leaders and local community representatives to explore opportunities for meaningful participation in hydrogen development. This could include facilitating connections between communities, industry, and project proponents to advance initiatives such as community benefit agreements and Indigenous equity partnerships.
	5.5	**Strengthen regional coordination and collaboration**	Explore a provincial collaboration mechanism—potentially through the Council of Atlantic Premiers—to support information-sharing, policy alignment, and coordinated federal engagement. Light coordination should track progress and include periodic engagement with industry, Indigenous partners, and communities. This strengthens regional cohesion and maintains momentum without a formal regional strategy.
	5.6	**Harmonize hydrogen codes, standards, and regulations**	Review and harmonize codes, standards, permitting, and regulatory processes—including carbon intensity and life cycle assessment methodologies—across Atlantic Canada's provinces, the federal government, and international jurisdictions such as Germany, the Netherlands, and other countries within Europe and the European Union with hydrogen import ambitions to enable efficient collaboration and streamline project approvals and development.
	5.7	**Establish hydrogen workforce and research coordination group**	Leverage existing university research and governance structures in Atlantic Canada to establish or expand an industry–education working group focused on hydrogen. This group would improve coordination between workforce development, project pipelines, and R&D activities by jointly forecasting labour needs, informing the timing and design of training and certification programs, and identifying opportunities for collaborative research to advance hydrogen technologies and regional expertise.
	5.8	**Develop a coordinated H2 research agenda for the Atlantic region**	Leverage existing University R&D governance structures and areas of collaboration across Atlantic Canada to develop a coordinated H2 research agenda that will elevate Atlantic Canada's hydrogen industry. Convene representatives from academia, government, industry and relevant NGOs on an annual basis to identify, optimize, and accelerate opportunities to advance Atlantic Canada's H2 value chain and supply chain through effective R&D.

1. Introduction

The global transition to low-carbon energy is reshaping markets, infrastructure, and supply chains. Within this context, hydrogen and its derivatives have emerged as a critical energy carrier, with the potential to decarbonize heavy industry, transportation, and power generation while enabling new forms of international energy trade.

Atlantic Canada is uniquely positioned to participate in the global transition to clean fuels. The region's abundant renewable and conventional energy resources, deep-water ports, skilled workforce, and proximity to European markets where demand for clean hydrogen is growing rapidly creates a strong foundation to develop a competitive clean hydrogen economy.

Recognizing this potential, the **Atlantic Hydrogen Alliance**, **Energy NL**, and **Net Zero Atlantic** partnered with all **four Atlantic provincial governments** and the federal government through the **Atlantic Canada Opportunities Agency (ACOA)** to assess the region's hydrogen supply chain readiness. Deloitte was engaged to lead the work, with the objective of evaluating the region's current capabilities, identifying critical supply chain gaps, and outlining actions to support coordinated development. In this context, the Atlantic Canada Hydrogen Supply Chain Gap Assessment and Development Plan was undertaken to provide a comprehensive evaluation of Atlantic Canada's readiness, guide investment and workforce planning, and position the region to support both domestic hydrogen production and distribution as well as exports to growing international markets.

1.1 Background

Atlantic Canada is positioning itself to capitalize on the emerging hydrogen economy. Key regional organizations—the Atlantic Hydrogen Alliance, Energy NL, and Net Zero Atlantic—are advancing efforts to define pathways for hydrogen production, distribution, and use, while exploring regional supply-demand dynamics and the potential for international exports.

Provincial governments in the region have signalled their commitment to developing the hydrogen sector through dedicated strategies, reflecting shared recognition that the region's abundant resources, skilled workforce, and established energy expertise—particularly in oil and gas—offer a strong foundation for development. These attributes, combined with Atlantic Canada's proximity to European markets and deep-water ports, position the region advantageously to participate in global clean energy supply chains.

However, realizing hydrogen's potential in Atlantic Canada requires addressing the early-stage nature of hydrogen supply chains. Unlike more mature low-carbon technologies, hydrogen infrastructure and logistics remain underdeveloped, presenting both opportunities and challenges. Atlantic Canada has the potential to build and anchor supply chains locally, but this requires overcoming several constraints, including slow market demand, limited pipeline networks, technical complexities in storage and transportation, and inefficiencies in hydrogen-to-electricity conversion.

Policy and regulatory frameworks are evolving, and further work is required to establish clear standards and market structures that reduce investment risk and enable commercial activity. Social factors also influence the pace of development. Community engagement and participation, public awareness, and workforce readiness are essential to ensuring that hydrogen development proceeds with broad support and inclusivity.

1.2 Objectives

The objective of this study was to assess and identify opportunities to enhance Atlantic Canada's hydrogen supply chain to maximize economic benefits from domestic hydrogen development, as well as international export opportunities. Specifically, the report aimed to:

1. Assess the readiness and capacity of Atlantic Canada's supply chain to support projected hydrogen production, distribution, storage, utilization, and export.
2. Identify opportunities to strengthen the regional hydrogen supply chain, with a focus on economic growth and participation by Indigenous Governments & Organizations and rural communities.
3. Compare Atlantic Canada's supply chain and value chain relative to other leading domestic and international hydrogen jurisdictions to inform regional strategies.
4. Develop an actionable roadmap to guide the development of a competitive, sustainable hydrogen supply chain across Atlantic Canada.

1.3 Approach and methodology

The study followed a structured, phased approach to assess and develop pathways for Atlantic Canada's hydrogen supply chain. The work built on existing studies and incorporated insights from key stakeholders. The approach was organized around three main information pathways:

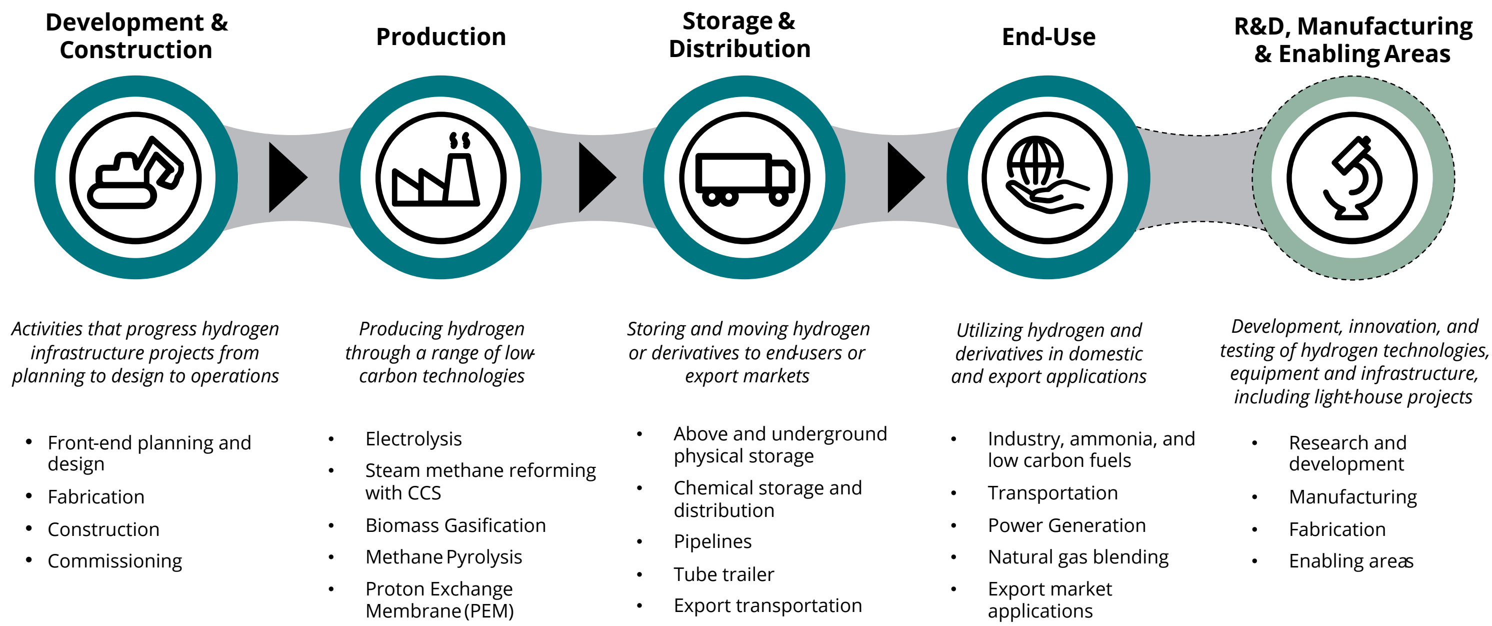
1. **Leveraging existing research and regional initiatives:** Prior work was analyzed to understand the state of hydrogen-related activities and ambitions across Atlantic Canada, including studies on supply and demand, workforce, and supply chain readiness. A jurisdictional scan of leading domestic and international hydrogen regions—including British Columbia, Ontario, California, Texas, the United Kingdom, Germany, and the Netherlands—provided insight into best practices, policy frameworks, and enabling supports.
2. **Engaging directly with participants across the supply chain:** Input was gathered from individuals and organizations involved in the hydrogen supply and value chains through targeted interviews and an online supplier survey, capturing critical perspectives on regional capabilities and readiness.
3. **Facilitating regional dialogue through workshops:** In-person workshops were held in St. John's (NL), Halifax (NS), and Saint John (NB), with participation from Prince Edward Island incorporated into the New Brunswick workshop. These workshops gathered feedback, explored provincial perspectives, and identified opportunities, challenges, and priorities for advancing the regional hydrogen supply chain.

These pathways ensured that the study was informed by existing knowledge, grounded in regional context, and shaped by the perspectives of key participants in Atlantic Canada's hydrogen ecosystem. The resulting report is intended to guide coordinated regional action and position Atlantic Canada to pursue opportunities in domestic hydrogen production and international export markets.

1.4 Understanding the hydrogen value chain

This report uses both the terms **value chain** and **supply chain** in the context of hydrogen. The value chain describes the full set of processes and activities associated with producing and consuming hydrogen with each activity adding value to the industry. In comparison, the supply chain focuses on the how: the inputs, capabilities, and logistics needed to build and operate that value chain.

Figure 1 Overview of the hydrogen value chain



The hydrogen industry's primary value chain represents the processes and activities associated with the life cycle of hydrogen from production to consumption. This can be represented by four primary phases: **development & construction, production, storage & distribution,** and **end use**. **Enabling areas** are also critical to a robust value chain, elevating all other phases. The hydrogen supply chain includes the processes, infrastructure, equipment, workforce, and suppliers used to effectively move, deliver, and use hydrogen feedstocks, products, and intermediaries. The hydrogen supply chain is deeply interconnected with the hydrogen value chain, and both are essential and complementary components of the hydrogen economy. Figure 1 describes the core components of the value chain.

Development & construction: The first stage represents the foundational phase of the hydrogen value chain, during which the physical infrastructure required for production, storage, and distribution is designed and built. This includes the development of renewable energy generation assets (such as wind and solar), hydrogen production plants equipped with electrolyzers and balance-of-plant systems, and supporting civil works such as roads, ports, and utility interconnections.

Large-scale hydrogen construction projects demand a diverse workforce of engineers, project managers, skilled trades, and safety professionals, as well as extensive procurement of industrial materials like steel, concrete, and power transformers. Beyond facility build-out, construction also encompasses enabling infrastructure—pipelines, terminals, and storage units—that would connect the region's hydrogen production to both domestic and export markets. This stage is highly capital- and labour-intensive, and its success directly determines the pace at which hydrogen production can scale to meet regional and international demand.

Production: The second stage of the value chain is focused on hydrogen production. The feedstock and energy used in the process determine the specific production method. The most common production method is steam methane reforming (SMR), which uses natural gas as a feedstock[19] and energy source. A notable process that is rapidly expanding is the production of hydrogen via electrolysis, which uses electricity and water. All proposed projects in Atlantic Canada are contemplating electrolysis as the main method of production. The combination of feedstock, energy, and geographic location determines the color of production and the carbon intensity (CI) of the final hydrogen product.

Storage and distribution: Hydrogen storage and distribution make up the third segment of the value chain and encompasses the transportation of hydrogen products to the end users. Distribution methods can vary depending on the scale of distribution and the geographic location of both the production location and the end user. Hydrogen can be transported in different chemical states, such as compressed gas, liquid, or other chemical compounds. Transportation can occur via road, rail, ship, or pipeline.

End use: The final segment of the hydrogen value chain pertains to the end use of the hydrogen products. Traditional use cases for hydrogen include inputs to oil refining processes and chemical feedstocks for processes such as ammonia production. Newer markets for end uses are emerging to help decarbonize industrial and transportation sectors, including alternative mobility fuels and displacing existing conventional power and heat sources such as industrial or commercial heat.

R&D, manufacturing & enabling areas: All four hydrogen value chain segments are enriched, advanced, and supported by value-add services such as government support, technical and business services, original equipment manufacturer (OEMs) investments, and industry advocacy.

Governments provide funding, policy frameworks, and incentives to accelerate hydrogen adoption, ensuring investment flows into production, infrastructure, and research. Technical and business services, including engineering, consulting, and logistics expertise, optimize operations across production, storage, transport, and use, to enhance efficiency and reduce costs. Industry groups foster collaboration, establish standards, and drive innovation by uniting stakeholders to address common challenges and share best practices.

Together, these services create an ecosystem that not only ensures the value chain functions but also builds the foundation for scaling hydrogen in global markets.

Hydrogen supply chain

While the hydrogen value chain describes the stages through which hydrogen is produced, transported, and ultimately used, the supply chain captures the actors, organizations, and service providers that enable those stages to function in practice. In other words, the value chain defines what needs to happen, while the supply chain focuses on who carries it out.

These participants span the upstream, midstream, and downstream stages of the value chain, as well as cross-cutting support and enabling services that are essential to safe and efficient project delivery. Together, they form the ecosystem that will determine how quickly and effectively the region can build, operate, and scale its hydrogen economy. **Table 1 Supply chain stages and participants** outlines the major categories of supply chain participants considered in this study and engaged through surveys and in-person workshops.

[19] Energy feedstocks are out of scope for this study, so these are not featured above, but would typically be shown to the left of production.

Table 1 Supply chain stages and participants

Supply chain stage	Category	Definition
1. Upstream	**Hydrogen producers & project developers**	Organizations that produce hydrogen and/or its carriers, to provide the region with hydrogen supply, or export to other markets.
	Fabricators	Organizations that assemble parts and components for hydrogen-related equipment such as storage tanks, refueling stations or pipelines.
	System OEMs	Original Equipment Manufacturers that design and assemble pre-packaged hydrogen systems (e.g. modular electrolysis units)
	Parts OEMs	Original Equipment Manufacturers that produce individual hydrogen system components like valves and compressors for integration into larger systems.
2. Midstream	**Infrastructure providers**	Organizations that develop physical or systematic infrastructure, such as pipelines, ports or storage facilities, to support the hydrogen supply chain.
	Distribution and transportation partners	Organizations that are the connectors of hydrogen supply and demand whether it be for local use or export markets from production sites to end-users.
3. Downstream	**End-users**	Downstream users of hydrogen for various applications such as transportation, energy, and industrial processes to reduce their carbon emissions.
4. Support & enabling services	**EPC/EPCMs**	Firms that provide hydrogen project delivery, manage design, procurement and construction to ensure project delivery.
	Professional services & technology providers	Organizations that provide specialized engineering services or technology solutions for hydrogen applications.
	Research & academia	Organizations that drive innovation and technological advancements and who educate the next generation of professionals in the hydrogen economy.
	Industry associations	Groups that support the hydrogen industry, fostering collaboration and advancing safety and efficiency guidelines.
	Indigenous partners & community groups	Indigenous partners and community groups that collaborate on hydrogen projects, focusing on economic development, land use and community benefits.
	Government & regulators	Government and regulatory authorities that provide the legal framework, regulations and public policies.

This report is structured to build from context to detail. **Section 2** begins by examining Atlantic Canada's hydrogen landscape, including the policies, projects, and enabling assets that are shaping early development. In **Section 3**, the focus shifts to a detailed assessment of the region's hydrogen supply chain, mapping the participants, capabilities, and requirements across the value chain. Together, these sections establish the foundation for the jurisdictional review, scenario analysis, gap assessment, and recommendations that follow.

2. Atlantic Canada's hydrogen landscape

Effective strategies drive change by focusing efforts and setting clear goals and actions that shape policy, regulations, programs, and other support mechanisms. The high-level priorities set by governments for the hydrogen sector create a framework for designing targeted grants and incentives. This alignment ensures financial resources are deployed effectively in alignment with long-term objectives, such as reducing greenhouse gas emissions.

This section outlines relevant hydrogen or clean energy strategies, along with supporting regulations, policies, and programs at the federal level and across the four Atlantic Canada provinces.

To achieve hydrogen objectives, governments may develop enabling mechanisms or approaches that support execution in line with policy and planning intent.. The most common enabling mechanisms include:

Strategic finance	Targeted programming	Tax measures	Regulations
Finance mechanisms with broad application across the energy transition ecosystem and hydrogen value chain.	Specific funding mechanisms to advance targeted portions of the hydrogen value chain.	Government tax credits that can be applied across the hydrogen value chain or at targeted locations.	Legally binding rules or standards that operators must follow or face consequences such as fines.

Figure 2 outlines the broad types of initiatives and activity currently underway that are applicable to the Atlantic Canada hydrogen economy.

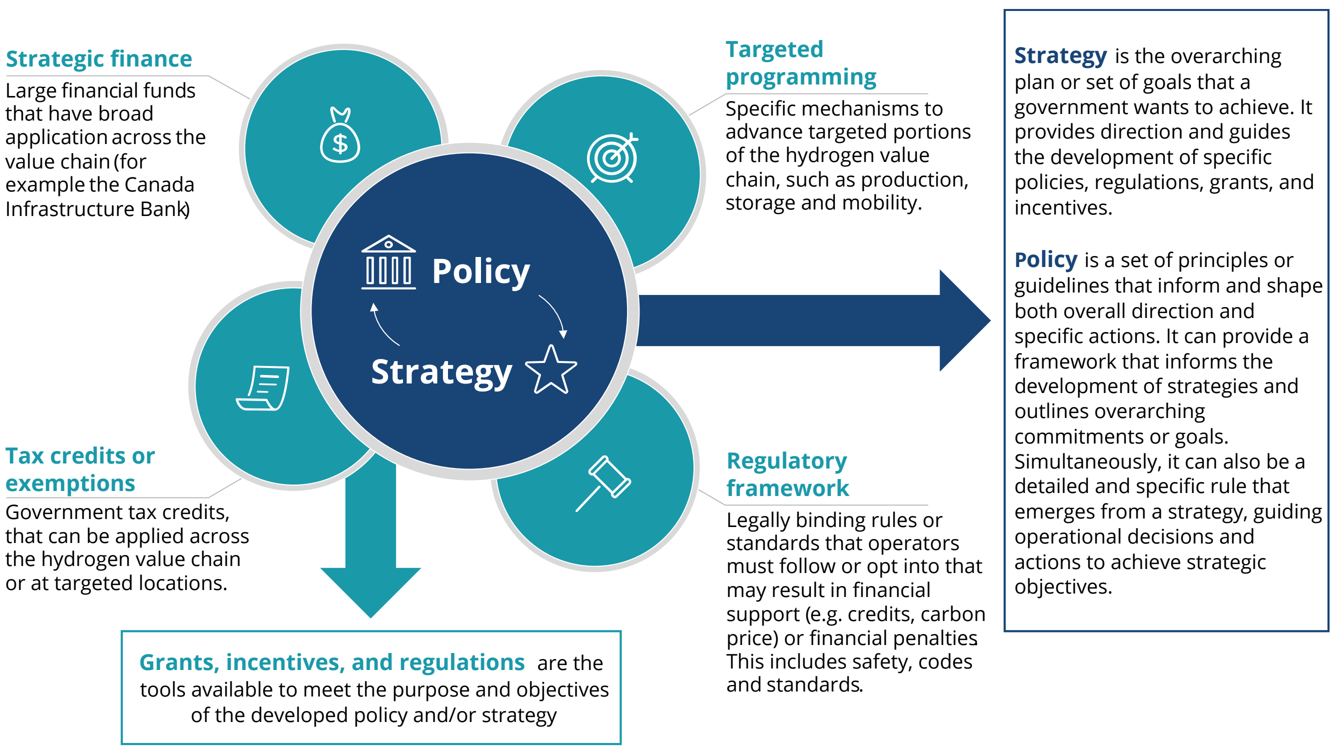


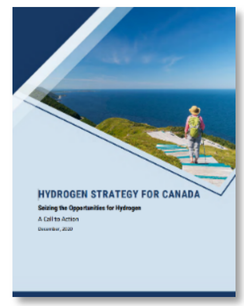
Figure 2 Overview of government support mechanisms

2.1 Federal and provincial hydrogen strategies and policies

Hydrogen development in Atlantic Canada is advancing within a rapidly evolving policy environment shaped by federal and provincial strategies, action plans, and regulatory updates. These frameworks establish priorities, signal investment readiness, and define the mechanisms—such as tax incentives, permitting pathways, and targeted funding programs—that influence project economics and guide industry participation. As the region explores its role in the emerging clean fuels economy, understanding this governance landscape is critical to assessing how and where hydrogen projects can progress. The following subsections outline the key federal and provincial approaches that form the foundation for hydrogen development across Atlantic Canada and provide important context for the proposed projects described in section 2.2.

2.1.1 Federal government

The Government of Canada has identified hydrogen as a key priority under its broader suite of energy transition and clean economic development policies. The Hydrogen Strategy for Canada: Seizing the Opportunities for Hydrogen report, released by Natural Resources Canada in 2020, has identified 32 sequenced recommendations organized by eight pillars, below. The recommendations and roadmap contained within the Hydrogen Strategy for Canada form the basis for all future decisions, including grants, incentives, regulations, and policy decisions. This report greatly influences the advancement of the hydrogen industry in Canada and the Atlantic Canada hydrogen ecosystem.



#	Pillar	Description
1	**Strategic Partnerships**	Strategically use existing and new partnerships to collaborate and map out the future of hydrogen in Canada.
2	**De-Risking of Investments**	Establish funding programs, long-term policies, and business models to encourage industry and governments to invest in growing the hydrogen economy.
3	**Innovation**	Take action to support further R&D, develop research priorities, and foster collaboration between stakeholders to ensure Canada maintains its competitive edge and global leadership in hydrogen and fuel cell technologies.
4	**Codes and Standards**	Modernize existing and develop new codes and standards to keep pace with this rapidly changing industry and remove barriers to deployment, domestically and internationally.
5	**Enabling Policies and Regulation**	Ensure hydrogen is integrated into clean energy roadmaps and strategies at all levels of government and incentivize its application.
6	**Awareness**	Lead at the national level to ensure individuals and communities are aware of hydrogen's safety, uses, and benefits during a time of rapidly developing technologies.
7	**Regional Blueprints**	Implement a multilevel, collaborative government effort to facilitate the development of regional hydrogen blueprints to identify specific opportunities and plans for hydrogen production and end use.
8	**International Markets**	Work with our international partners to ensure the global push for clean fuels includes hydrogen so Canadian industries thrive at home and abroad.

Figure 3 Canada hydrogen strategy's eight strategic pillars

Federal progress report

In April of 2024, the Government of Canada released its first progress report on the Hydrogen Strategy for Canada and the 32 recommendations within. The progress report describes how Canada is on target for 13 of the recommendations, advancing on 16, while action on three recommendations has been limited. For example, progress was made on recommendations related to strategic partnerships, the development of codes and standards, and the creation of an ecosystem of enabling policies and regulations to de-risk investments like the Clean Hydrogen Investment Tax Credit (ITC).

The progress report identifies major policy and regulatory updates. Within this section is an overview of dedicated support available, such as the Clean Hydrogen Investment Tax Credit, as well as other related tax credits that can indirectly support low-carbon hydrogen adoption. These include:

- The Clean Electricity Investment Tax Credit or the Clean Technology Investment Tax Credit;
- The Clean Technology Manufacturing Tax Credit; and,
- The Investment Tax Credit for Carbon Capture, Utilization and Storage.

The strategy update also identified programs focused on the transportation end-use sector, including:

- The Clean Fuels Fund;
- The Zero Emission Transit Fund;
- The Incentives for Medium and Heavy Duty Zero Emission Vehicles;
- The Zero Emission Trucking Program; and,
- The Green Municipal for the Canadian Federation of Municipalities.

Broader strategic finance mechanisms also exist that can be applied more broadly across the value chain to support the development of the ecosystem overall, including associated infrastructure. Programs include:

- The Strategic Innovation Fund – Net Zero Accelerator.
- The Canada Growth Fund; and,
- The Canada Infrastructure Bank.

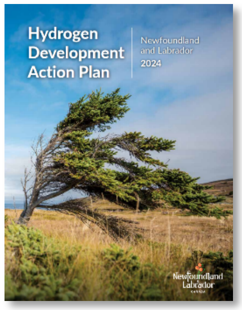
Regulatory updates have been made that are designed to drive demand and lower emissions. Canada's Clean Fuel Regulations (CFR) requires fossil-based transportation fuels to reduce carbon intensity by 15% compared to 2016 levels by 2030. This creates a potential market, which helps to reduce risk for regulated parties (producers and importers) looking to increase supply of low-carbon fuels, including hydrogen, to the market. Additionally, industry specific regulations such as the output-based pricing system, create markets where hydrogen or its derivatives can be a tool to lower emissions.

Designed to fast-track the development of projects aimed at reducing emissions and growing low-carbon regional economies, the Regional Energy and Resource Tables (RERT) were developed by the Government of Canada in 2022. This initiative aims to establish a co-developed dialogue between federal and provincial governments and Indigenous partners on a short list of mutually agreed on energy transition priorities. As of December 2024, ten provinces and territories have launched a Regional Table, including all four Atlantic Canada provinces.[20]

- Newfoundland and Labrador identified four opportunity areas including critical minerals, wind and hydrogen, electrification, and carbon capture, utilization and storage
- Nova Scotia prioritized six opportunity areas including carbon management, clean electricity, critical minerals, forest bioeconomy, hydrogen, and marine renewables.
- Prince Edward Island identified three opportunity areas: clean electricity and energy storage, clean fuels, and clean technology innovation
- New Brunswick continues to work with the federal government to identify specific areas of opportunity.

[20] Regional Energy and Resource Table – Framework for Collaboration on the Path to Net-Zero (Accessed November 28, 2024)

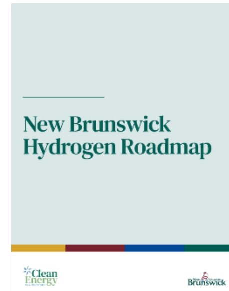
2.1.2 Newfoundland and Labrador



Newfoundland and Labrador has identified the hydrogen industry as a way to support local economic development, create employment opportunities, and advance Newfoundland and Labrador's reputation as a global Clean Energy Centre of Excellence. In 2024, the province released its Hydrogen Development Action Plan, which offers focused policy direction for hydrogen development in the province, guiding participation in both ongoing and upcoming hydrogen initiatives. The action plan identifies 31 targeted action items across four focus areas: market development for both export and domestic use, partnerships and innovation, workforce readiness, and regulatory alignment. It complements the province's Renewable Energy Plan (2021) and Climate Change Action Plan (2025).

The province has introduced several supportive policies and mechanisms that have helped to enable hydrogen development in the province. In 2022, the government lifted the moratorium on commercial wind projects and led a competitive Crown land process for onshore wind development, which resulted in four wind-hydrogen projects being granted rights to pursue development on Crown land. The province has also worked to clarify and improve the economics of hydrogen project development including the release of a Wind-Hydrogen Fiscal Framework[21] that establishes a clear and transparent fiscal system to guide investment decisions and support the development of wind-hydrogen projects. This is supported by existing clean energy financial supports such as the 20% Green Technology Tax Credit,[22] the Green Transition Fund, and the Climate Change Challenge Fund.

2.1.3 New Brunswick



New Brunswick has identified hydrogen as a key component of its clean energy transition and industrial decarbonization efforts. In 2024, the province released its Hydrogen Roadmap, outlining targeted priorities over the next five years to advance hydrogen production, use, and infrastructure development. The roadmap focuses on four areas: regulatory readiness, partnerships with Indigenous Governments & Organizations and industry, the establishment of hydrogen hubs, and accountability through a provincial clean energy coordination team.

As part of this approach, the province is undertaking amendments to several key legislative frameworks, including the Gas Distribution Act, Pipeline Act, Electricity Act, and Underground Storage Act, to enable hydrogen blending, transport, storage, and integration with existing energy systems. These updates are expected to be in place between 2024 and 2026, supported by the adoption of national and international hydrogen safety codes and standards by 2029.

New Brunswick's hydrogen strategy aligns with its broader commitment to achieving net-zero greenhouse gas emissions by 2050, with hydrogen identified as a tool to support emissions reduction across industry, transportation, and energy sectors.

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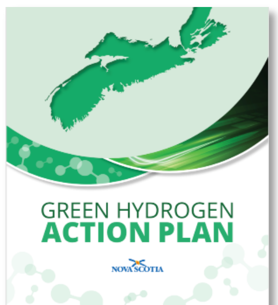
21 Government of Newfoundland and Labrador Releases Wind-Hydrogen Fiscal Framework - News Releases (Accessed 10/1/2025)
22 Green Technology Tax Credit (GTTC) - Finance (Accessed 7/20/25)

2.1.4 Nova Scotia

Nova Scotia has identified green hydrogen as an enabler of its clean energy transition and long-term decarbonization objectives.

Released in December 2023, Nova Scotia's Green Hydrogen Action Plan (GHAP) sets out seven goals, 23 actions, and 28 efforts to date which are focused on local benefits, export competitiveness, climate alignment, community engagement, safety, workforce development, and innovation. The GHAP positions hydrogen as a driver of sustainable economic prosperity, aiming to deliver clean energy solutions, create new clean-economy jobs, strengthen rural communities, and generate economic growth in the province.



To support hydrogen development, Nova Scotia has advanced a suite of regulatory and policy measures. Amendments to the Electricity Act, Subsurface Energy Storage Act, Pipeline Act, and Gas Distribution Act have been made or are underway to formally enable hydrogen production, storage, blending, and transport within the province. These updates will grant the Nova Scotia Energy Board regulatory oversight over hydrogen as part of natural gas distribution systems, providing greater clarity for project developers. These regulatory updates also support Nova Scotia's broader climate commitments, including the legislated target of achieving net-zero greenhouse gas emissions by 2050 under the Sustainable Development Goals Act.

To give the province's industrial and business sectors the support they need to begin making the shift toward cleaner energy and to help keep Nova Scotia at the forefront of exploration of green hydrogen and other clean fuels, funding was made available through targeted clean energy programs, such as the Clean Fuels Fund, a two-year, $6 million, funding program providing funding to clean fuels projects, including several early-stage hydrogen projects within the province.[23] [24] To promote innovation and local expertise, Nova Scotia provides a 15% provincial research and development tax credit, applicable to hydrogen technologies and related clean energy solutions.

2.1.5 Prince Edward Island

Prince Edward Island has committed to achieving net-zero greenhouse gas emissions by 2040, the most accelerated target among Atlantic Canada jurisdictions. While the province does not yet have a dedicated hydrogen strategy, hydrogen is identified as a potential clean energy solution within the Path to Net Zero framework and Energy Strategy. These initiatives recognize hydrogen, alongside renewable electricity, energy storage, and electrification, as critical to achieving the province's climate and energy security objectives.

While hydrogen-specific incentives are not yet in place, several existing programs can indirectly support hydrogen development. These include the Net-Zero Funding Navigator, which provides grants and rebates to advance clean energy adoption, and efficiencyPEI's suite of energy efficiency programs, which create a supportive environment for low-carbon technologies. Additionally, municipalities such as the City of Summerside have expressed interest in exploring hydrogen applications through local clean energy initiatives. Collectively, these efforts provide an early foundation for hydrogen development aligned with the province's aggressive net-zero targets.

[23] Province Helping Industries Move Toward Cleaner Fuels | Government of Nova Scotia News Releases (Accessed 10/2/25)

[24] Province Drives Clean Fuels Innovation | Government of Nova Scotia News Releases (Accessed 7/20/25)

2.2 Proposed hydrogen production projects in Atlantic Canada

This section provides an overview of announced low-carbon hydrogen projects across Atlantic Canada, covering all parts of the hydrogen value chain, as of May 31, 2025 (unless otherwise noted). Mapping these projects offers insight into how the region's hydrogen ecosystem is developing, where activity is concentrated, and how project scale and timing align with policy objectives and market demand. Understanding the current project landscape will help inform future actions to address potential supply chain gaps, infrastructure needs, and opportunities to strengthen domestic capabilities and export readiness.

2.2.1 Newfoundland and Labrador hydrogen production projects

Table 2 Newfoundland and Labrador hydrogen projects

Project name	Project type	Current status[25]	Notes
World Energy GH2 - Project Nujio'qonik	Onshore wind to hydrogen & ammonia (export)	Provincial environmental assessment (EA) approval granted Apr 2024. The Crown lands reserve for the project ended on February 28, 2026.	Export offtake memorandum of understanding (MOU) signed with Germany. Project timelines extended due to delayed market development. Company still plans to produce hydrogen/ammonia but at a later stage.
ABO Energy & CIP - Toqlukuti'k Wind and Hydrogen Project	Onshore wind to hydrogen & ammonia (export and/or domestic use)	Environmental baseline studies and community engagement underway; EA Registration Document submitted July 2025; The Crown lands reserve for the project ended on February 28, 2026.	Braya Renewable Fuels selected ABO for an exclusive letter of support following a request for proposals for the supply of green hydrogen in 2022-2023.
Exploits Valley Renewable Energy Corp (EVREC) Project	Onshore wind and solar to hydrogen & ammonia (export)	EA Registration Document has been submitted; Environmental Impact Statement Guidelines issued. The Crown lands reserve for the project has been extended to February 28, 2027.	Non-disclosure agreements signed with several European off takers and executed an offtake agreement subject to permitting approval.
Everwind - Burin Peninsula Green Fuels Project	Onshore wind and solar to hydrogen & ammonia (export)	EA registration completed; Environmental Impact Statement Guidelines issued; 4 MET towers collecting wind resource data (4 additional locations in permitting); Leveraging first FEED completion in Canada for design of industrial facilities. The Crown lands reserve for the project ended on February 28, 2026.	Project phases combined total 10 GW of wind energy and 2.5 GW of solar energy
Pattern Energy - Port of Argentia Green Hydrogen and Ammonia Project	Green Hydrogen production facility & Ammonia for export	EA Registration Document has been submitted. Pattern withdrew its environmental assessment registration for a green hydrogen production facility in November, 2025 as the green hydrogen and ammonia project has been paused until market conditions improve.	Mabanaft signed a letter of intent to purchase 100% of Phase 1 ammonia output (400 tonnes per day) starting in 2027.
North Atlantic Green Energy Hub	Onshore wind & Green Hydrogen Production	Environmental baseline studies and community engagement underway; EA Registration Document submitted July 2025 ; Environmental Preview Report Guidelines issued in November 2025. The Crown lands reserve for the project has been extended to February 28, 2027.	Project includes converting produced hydrogen to a liquid organic hydrogen carrier (LOHC) for storage and transport. North Atlantic has shared plans to purchase an oil refinery in France to offtake NL hydrogen, and support expansion into the European market.

[25] Unless otherwise noted, the status of the announced projects is limited to publicly available information as of May 31st, 2025

2.2.2 New Brunswick hydrogen production projects

Table 3 New Brunswick hydrogen projects

Project name	Project type	Current status[26]	Notes
Port of Belledune Green Energy Hub	Green hydrogen & ammonia production and export hub	Feasibility studies and environmental assessment in progress	The Belledune Port Authority is working to develop a large-scale hydrogen production facility for both export and domestic markets. The Port Authority recently announced that they have entered into a long-term lease of a tank facility
Nu:ionic Technologies	Pilot-scale hydrogen production	Demonstration	Nu:ionic uses electrified steam methane reforming for on-site, on-demand technology combining electricity with hydrogen carriers such as renewable methanol, biogas or natural gas to produce low carbon hydrogen. MOUs for demonstration and production pilot projects and have been signed with various partners in Canada the United States

2.2.3 Nova Scotia hydrogen production projects

Table 4 Nova Scotia hydrogen projects

Project name	Project type	Current status[27]	Notes
EverWind Point Tupper	Green hydrogen & ammonia production/export hub	Environmental Assessment (EA) approvals have been granted for four EverWind onshore wind projects — Bear Lake Wind Power Project, Kmtnuk Wind Power Project, Windy Ridge Wind Power Project, and Setapuktuk Wind Project. EverWind and Eastward Energy have signed an MOU establishing a strategic partnership to advance domestic transportation and supply of green hydrogen in Nova Scotia. EverWind Fuels was awarded $22.5 Million Investment from the Government of Canada for Clean Port & Green Fuels Hub. Earlier in 2025 EverWind invested $50M for New Tugboat Fleet in Strait of Canso. The Government of Canada announced a $125 million agreement-in-principle with Export Development Canada to support EverWind's green hydrogen and ammonia hub in Nova Scotia. In April 2025, EverWind secured environmental approval for a 2-gigawatt transmission line to cross the Strait of Canso that supports its hydrogen production.	Phase 1 will use ~650 MW of wind energy, ~150 MW of solar generation, and battery energy storage (BESS) to produce approximately 240,000 tonnes/year of green ammonia. Phase 2 will expand onshore wind (~2 GW) and associated transmission infrastructure. Phase 3 will further scale green fuels production from wind resources.
Bear Head Energy Point Tupper	Green hydrogen & ammonia production/export facility	Bear Head Energy is planning to develop, construct and operate a large-scale green hydrogen and ammonia production, storage & loading facility. The	

[26] Unless otherwise noted, the status of the announced projects is limited to publicly available information as of May 31st, 2025
[27] Ibid

		project is permitted up to 2 gigawatts of electrolyzer capacity and is expected to be developed in phases. Phase 1A has 400 MW of electrolysis powered by 500 MW of onshore wind and 150 MW of solar and Phase 1B as an additional 400 MW of electrolysis and 500 MW of onshore wind and **Phase 2** will scale the project to ~1,200 MW of electrolyser capacity, powered by offshore wind resources. Environmental Assessment was approved in 2023. Open Houses held regarding their planned Websters Corner Wind Farm.	
Nova Sustainable Fuels	Renewable Energy Park focused on production of sustainable aviation fuel (SAF), green methanol and low-carbon co-products using biomass and renewable energy	Environmental Assessment for the first phase of its project was approved December 18, 2026.. EA description: proposes a renewable energy park centred near Goldboro for export-oriented SAF, with associated freshwater pipelines and supporting infrastructure.	Project plans to use **biomass and renewable energy** to produce drop-in SAF, green methanol and other low-carbon co-products, with construction **intended to commence in 2028** and minimum 50-year operating life once in service.

2.2.4 Prince Edward Island hydrogen production projects

Table 5 Prince Edward Island hydrogen projects

Project name	Project type	Current status[28]	Notes
Summerside Green Hydrogen	Green hydrogen production & storage (municipal)	Business case in development	Proposed project includes 1 MW electrolyzer powered by renewable electricity, hydrogen storage, 33 MW hydrogen-compatible genset for peak power generation
AKA Energy and RE-FUEL green hydrogen production	Green hydrogen production	Order placed for two 1-Megawatt Electrolyzers	Total system production approximately 450 kg per day of hydrogen

2.2.5 Other hydrogen-related projects across Atlantic Canada's value chain (non-exhaustive)

Table 6 Other hydrogen projects across Atlantic Canada's value chain

Prov	Project	Category	Stage	Notes
NL	Triple Point Resources Fischells Salt Dome	Underground salt dome for hydrogen storage	Development stage / feasibility	Tests have revealed the Fischells Salt Dome could have the potential to store more than 35 million cubic metres of hydrogen, or the equivalent of 180,000 tonnes.
	Vortex Energy Hydrogen Storage	Underground hydrogen storage	Exploration and modelling	Initial modelling of salt structures suggests potential for over 4 million m³ of cavern storage volume.
	Memorial's Thermal Fluids and Energy Research Laboratory	Research and development (R&D)	Operational	Hydrogen production research activities include reaction kinetics for thermodynamic hydrogen production, and chemically reactive multiphase flows for thermochemical hydrogen production.

[28] Unless otherwise noted,he status of the announced projects is limited to publicly available information as of May 31st, 2025

PE	Atlantic Zero-Emission Energy Systems Laboratory (AZEESL) Clean Fuels Lab at the University of PEI	Clean hydrogen and electric fuels research and development (R&D)	Operational	R&D facility focusing on producing hydrogen, syngas, and drop-in fuels from biomass and waste.
NS	Halifax Transit – Dual-Fuel Hydrogen Diesel Bus Pilot	Transportation	In progress	Funding of $367,500 provided through Nova Scotia Clean Fuels Fund (CFF).
	Net Zero Atlantic – Unlocking hydrogen's potential as a zero-emission transport fuel	Modelling / Research	In Progress	CFF funding: $249,250 to assess hydrogen's potential role in NS transportation decarbonization.
	Waterford Energy Services – Containerized H_2 demonstration project	Production / Demonstration	In Progress	CFF: $793,000 to build and test a mobile green hydrogen production unit.
	AlterBiota – Optimizing softwood supply chain + dark green hydrogen	Biomass / Hydrogen Production	In Progress	CFF: $355,368 for biomass-based feedstock assessment and dark green hydrogen concept.
	Municipality of Richmond – Strait of Canso clean fuels domestic-use strategy	Strategy	In Progress	CFF: $221,250 to develop a domestic-use clean fuels strategy for Strait of Canso.
	Balodis Inc. – Hydrogen Dual Fuel Repowering	Transportation	On Hold	CFF: $1,000,000 for pilot electrolyser installation + hydrogen dual-fuel truck deployment.
	King Freight – Hydrogen Dual Fuel Repowering	Transportation	On Hold	CFF: $450,000 to convert freight trucks to hydrogen dual-fuel systems
	Pier Labs / Eastward Energy – Hydrogen blending safety parameters	Research	In Progress	CFF: $189,250 to test and evaluate safety considerations for hydrogen–natural gas blending.
	Net Zero Atlantic – Decarbonizing NS industrial sector with hydrogen	Research	Complete	CFF: $450,000 to assess hydrogen pathways for Nova Scotia's industrial sector.
	Bridgewater – Clean fuel feasibility & opportunity assessment	Feasibility	Complete	CFF: $112,500 to explore clean fuel opportunities for Bridgewater.
	Dalhousie University Green Hydrogen Research Cluster	Green hydrogen research and development	Operational	Focus on hydrogen production, use, combustion, and socio-economic impacts. Research on novel electrolysis catalysts; uses; and renewable electricity simulation.
	Port of Halifax Green Shipping Corridor program	Project components that prepare the port for the fuels and energy sources of the future, including hydrogen	Transport Canada funding confirmed through the Green Shipping Corridor Program	The Halifax Port Authority was awarded funding up to $22.5 million from the Green Shipping Corridor Program.

2.3 Assets, enabling infrastructure, and competitive advantages

While strategies and proposed projects outline the direction of hydrogen development in Atlantic Canada, the region's physical assets and enabling infrastructure ultimately determines where and how this growth can occur. A competitive hydrogen economy depends not only on policy alignment and investor interest but also on the availability of transportation networks, port capacity, natural gas infrastructure, land, water, and high-quality renewable energy resources.

Strong provincial and national highways link industrial hubs and ports

Rail networks connect major ports and industries in Nova Scotia and New Brunswick

Multiple deepwater ports offer global market access and expansion potential for liquid hydrogen derivatives

Established pipelines in NS and NB could enable hydrogen blending or repurposing

Exceptional wind resources support large-scale clean hydrogen production

Abundant water and Crown land enable scalable project development

These foundational elements shape project feasibility, influence supply chain integration, and position the region in relation to domestic and international markets. The following section provides an overview of the infrastructure and natural advantages that underpin Atlantic Canada's hydrogen potential and help explain why activity is emerging in specific locations across the region.

The region already offers a compelling foundation for a robust hydrogen industry, supported by well-established enabling infrastructure and abundant natural resources.

The region's road and rail networks enable efficient movement of goods and industrial equipment, while deep-water ports with existing and potential liquid bulk handling capabilities provide direct access to global markets.

Natural gas pipeline networks in Nova Scotia and New Brunswick offer opportunities for blending or repurposing as hydrogen carriers. Additionally, while outside the scope of this report, Atlantic Canada has vast renewable energy potential—particularly onshore and offshore wind—as well as access to suitable industrial water and crown and industrial lands, positioning the region to produce low-carbon hydrogen at scale for both domestic use and export.

Relative to other jurisdictions, the benefits from abundant undeveloped wind resources—both onshore and offshore—are significant, with some of the highest capacity factors in North America.

Compared to California and Texas, the region's cooler climate improves electrolyser efficiency and lowers freshwater demand, while its deep-water ports provide direct, short shipping routes to European markets.

In contrast to densely populated European regions like the UK, Netherlands, or Germany—where land, permitting, and grid access constraints elevate project costs—Atlantic Canada offers vast available land, supportive regulatory conditions, and growing alignment between federal and provincial policies. These factors, combined with strong Indigenous partnerships, emerging industrial clusters, and the ability to repurpose existing natural gas infrastructure, position Atlantic Canada as one of the most strategically advantaged jurisdictions in the world for scalable, export-oriented green hydrogen production.

The following section provides an overview of enabling infrastructure across Atlantic Canada that can support hydrogen development. Understanding the current state of these assets helps identify where each province is positioned to support hydrogen production, export, or consumption, and where gaps may remain.

2.3.1 Road networks

The region benefits from a well-developed roadway network that supports trade, economic growth, tourism, and regional connectivity. Anchored by the National Highway System—including sections of the Trans-Canada Highway and a robust ferry network between Nova Scotia and Newfoundland—this infrastructure facilitates the movement of goods, services, and people across provincial and national borders. All four provincial governments also maintain extensive secondary networks, ensuring access to rural and industrial areas. The predominance of paved roads enhances year-round reliability and efficiency, a critical factor for developing hydrogen logistics and enabling infrastructure.

For hydrogen development, road networks would play an important role in the transport of construction materials, oversize components (such as wind turbine blades, electrolyzer skids, and storage vessels), and early-stage hydrogen distribution via tube trailers or other mobile carriers before pipeline or port infrastructure fully matures. Many proposed hydrogen projects are located in rural communities, where additional considerations may include road widening, seasonal load limits, bridge weight capacities, and turning radii for oversize industrial equipment. As hydrogen development scales, targeted upgrades may be required to ensure reliable access for construction, operations, and emergency response.

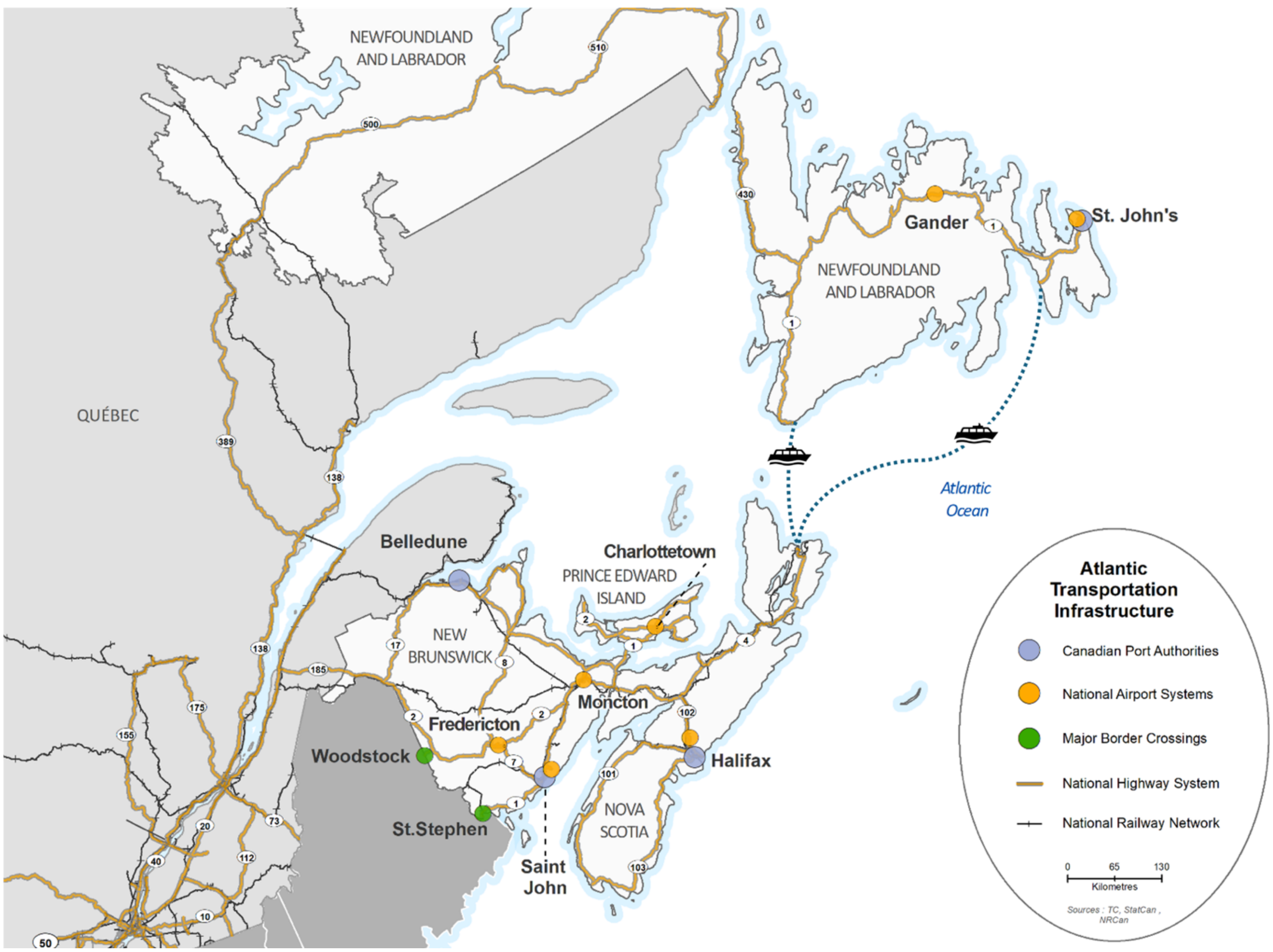


Figure 4 Atlantic Canada Major Highways[29]

[29] Atlantic Transportation Infrastructure and National Highway System - Transport Canada (Accessed 8/28/25)

2.3.2 Rail infrastructure

Atlantic Canada's rail infrastructure provides a strong foundation for freight and passenger movement, supporting economic growth, interprovincial and international trade, and industrial access. **Nova Scotia** and **New Brunswick** maintain active rail networks, with over 2,000 km of track and key railyards serving major ports and industrial hubs, offering potential for hydrogen transport and supply chain integration. **Labrador** is served by the Quebec North Shore and Labrador Railway (QNS&L), a private heavy-haul mining railway that primarily transports iron ore between Labrador City and Sept-Îles, Quebec. However, the QNS&L operates independently of the broader Atlantic rail system, with limited frequency and no direct connection to the rest of the region.

Newfoundland and Prince Edward Island no longer have active rail infrastructure, limiting direct rail connectivity and requiring reliance on road and marine transportation for bulk freight movements.

For hydrogen development, rail could play several enabling roles. In the near term, existing lines can support the movement of hydrogen-related construction materials—such as large steel components, wind turbines, and storage vessels—reducing pressure on rural road networks. Rail can also facilitate the shipment of hydrogen derivatives such as ammonia or methanol in tank cars, leveraging existing liquid-bulk handling capabilities at rail-connected ports. Over time, rail corridors may provide opportunities to develop multimodal logistics hubs where hydrogen produced inland can be aggregated, stored, or converted into derivatives before reaching marine terminals.

Figure 5 maps the rail tracks across New Brunswick and Nova Scotia and Appendix 8.1 lists railyards across each of the two provinces.

Figure 5 Atlantic Canada CN Rail network (Red) and CPKC (Brown)[30]

[30] CN - Network Map (Accessed 7/24/25)

2.3.3 Ports

Atlantic Canada has vast port infrastructure, visualized in Figure 6 and Figure 7, that serve as critical gateways for trade, industrial development, and export market access. Most applicable to the hydrogen export opportunity are deep-water ports, especially ones with existing liquid bulk handling facilities that can provide key logistical advantages for future hydrogen export opportunities, including hydrogen derivatives such as ammonia, LOHC, SAF, and methanol. Newfoundland and Labrador, Nova Scotia, and New Brunswick are home to several deep-water ports with existing liquid bulk handling capabilities, positioning them well to accommodate hydrogen-derived exports with minimal adaptation. Prince Edward Island lacks deep-water ports with significant liquid bulk infrastructure, limiting its immediate role in hydrogen export logistics.

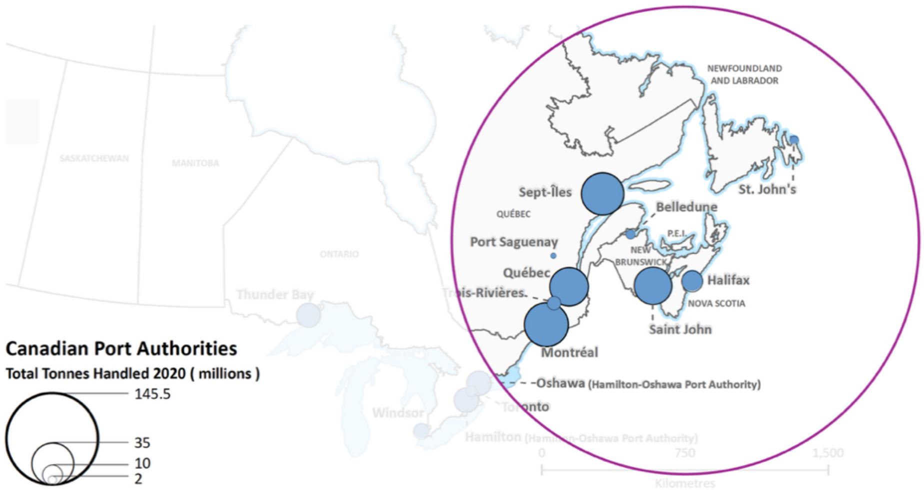


Figure 6 Locations and relative cargo volumes of Canada Port Authorities in Atlantic Canada and parts of Quebec. [31]

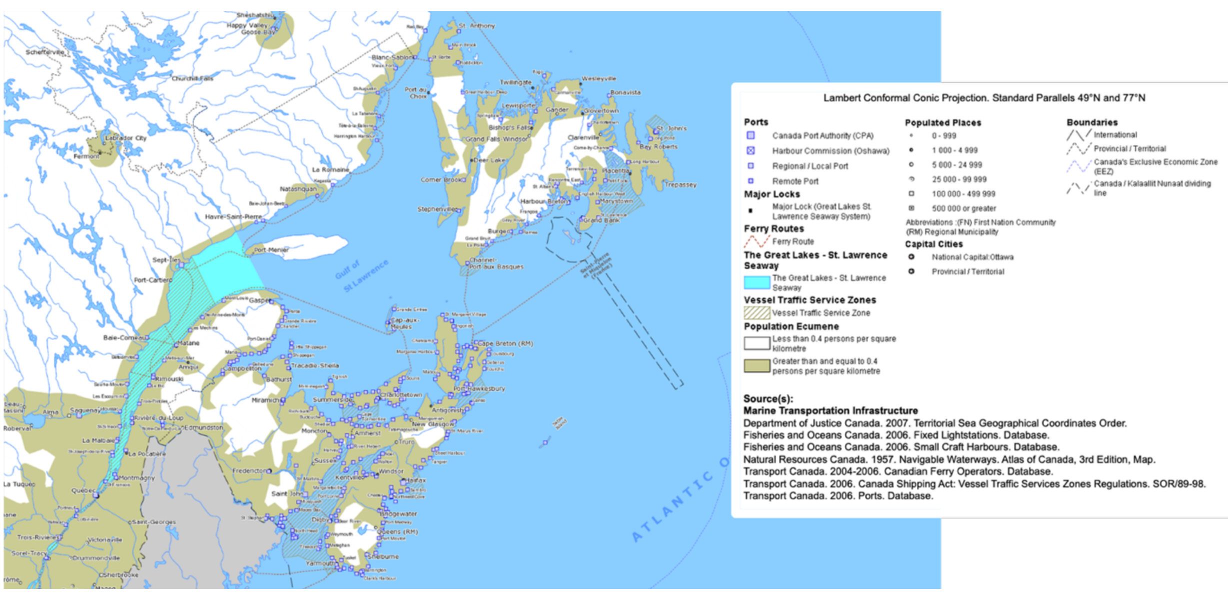


Figure 7 A map of Atlantic Canada highlighting major marine ports and vessel traffic service zones. [32]

[31] Transport Canada, "Canada's Port Authorities" (2020–2021). The map depicts each CPA as a blue circle scaled to total tonnes handled in 2020. Modified to focus on Eastern Canada. (Accessed 12/8/25)

[32] Marine Transportation Infrastructure – Ports (2006) Date of publication: 2010, 6th edition (Accessed 12/8/25)

2.3.4 Natural gas pipelines

Atlantic Canada's natural gas infrastructure is located in Nova Scotia and New Brunswick, with established transmission pipelines and regional distribution networks supporting natural gas delivery to industrial, commercial, and residential consumers. These assets provide potential pathways for future hydrogen blending or repurposing for transportation of pure hydrogen. In contrast, Newfoundland and Labrador and Prince Edward Island lack natural gas transmission and distribution networks, limiting opportunities for pipeline-based hydrogen use-cases.

Figure 8 identifies the large natural gas transmission lines that run across New Brunswick and Nova Scotia, connecting to distribution systems and Appendix 8.1 lists out the general service areas for natural gas distribution.

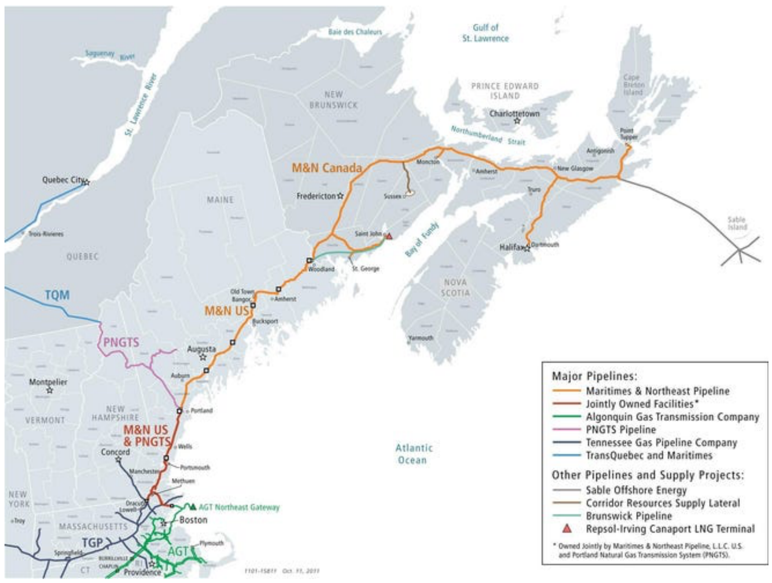


Figure 8 Natural gas transmission lines in Atlantic Canada[33]

2.4 Atlantic Canada hydrogen priority areas to inform hub opportunities

Across the global hydrogen ecosystem, the identification of hubs and corridors has proven to be an effective approach for advancing hydrogen development across the value chain—supporting both domestic applications and export opportunities. While terminology varies, with "hydrogen hubs" and "corridors" commonly used in North America and "hydrogen valleys" in Europe, the underlying objective is the same: to enable a coordinated, place-based strategy that accelerates project development, process knowledge and learning curves, and reduces overall costs through shared infrastructure and targeted investment.

This section adopts that global framing to identify clusters of hydrogen activity emerging in Atlantic Canada that could then be used as a starting point to support the future identification and development of hydrogen hub(s) and corridor(s) in Atlantic Canada.

[33] Natural Gas Grid 101 - Atlantica Centre For Energy (Accessed 7/23/25)

2.4.1 Understanding hydrogen hubs, corridors, and valleys

A hydrogen hub is a regional network of hydrogen producers, end-users, and experts linked by connective infrastructure. Hubs are developed to bring together hydrogen supply, distribution, storage, and end-users in a geographic area to create an integrated hydrogen value chain and advance the common goals of the ecosystem. Hubs may also include academia and research institutions. For example, the Edmonton Regional Hydrogen Hub shown in Figure 9, focuses on supporting low-carbon hydrogen adoption within its municipality and the immediate surrounding communities.

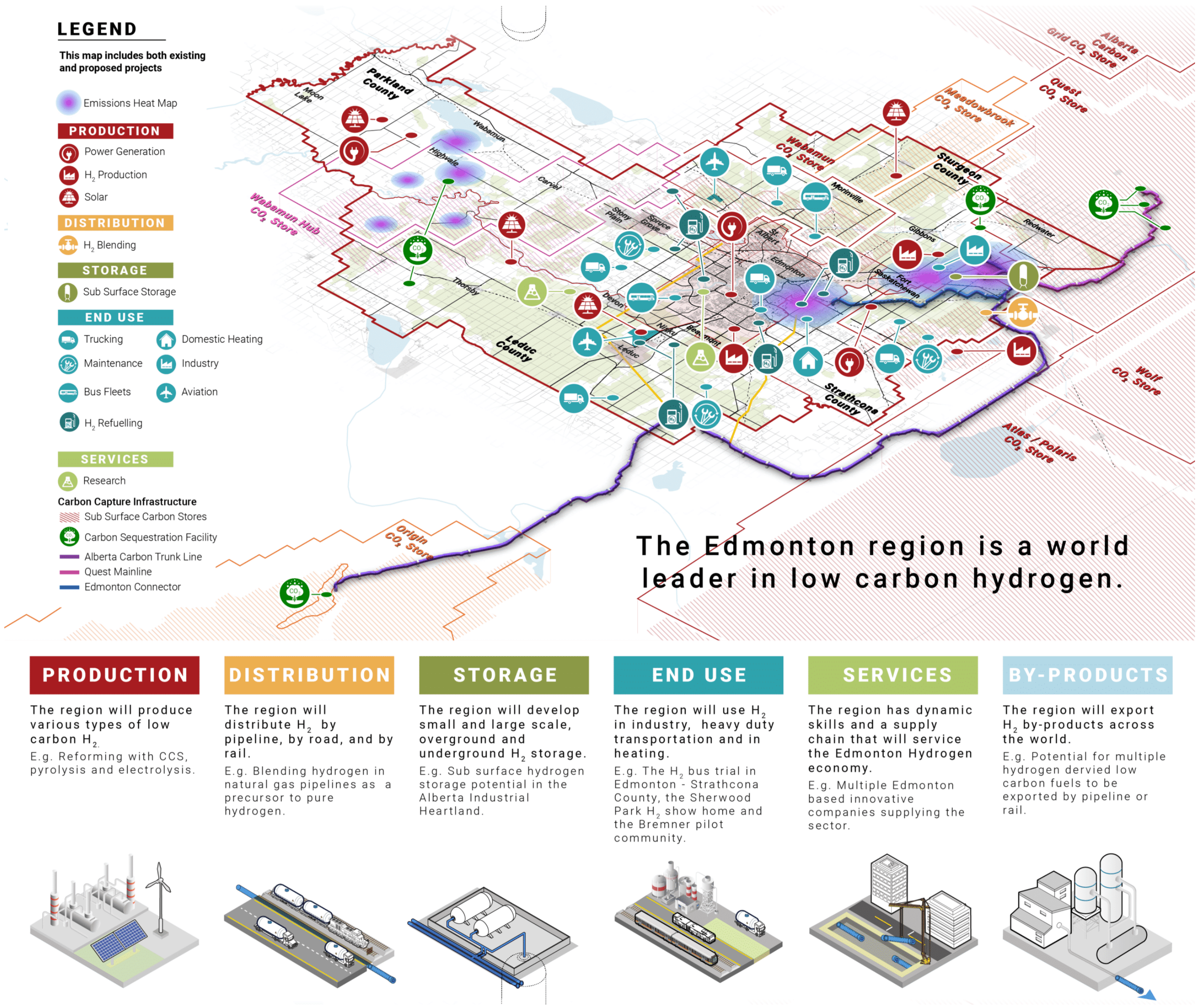


Figure 9 Edmonton region hydrogen activity including existing and proposed projects[34]

In 2023, the United States (US) Department of Energy (DOE) funding allocated $7 billion USD towards developing seven hydrogen hubs.[35] The Regional Clean Hydrogen Hubs (H2Hubs) Program creates a national network of hydrogen producers, consumers,

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[34] Edmonton Global Clean Technology (Accessed 7/10/25)

[35] What to know about DOE's hydrogen hubs - E&E News by POLITICO (Accessed 7/10/25)

and connective infrastructure while supporting the production, storage, delivery, and end-use of hydrogen. The H2Hubs aim to accelerate the commercial-scale deployment of clean hydrogen, helping to generate clean, dispatchable power, create a new form of energy storage, and decarbonize heavy industry and transportation.[36]

Figure 10 shows the geographic distribution of the Regional Clean Hydrogen Hubs and most include more than one state or jurisdiction. Each hub consists of project sites called nodes which produce hydrogen for various purposes such as power generation, transportation, and agriculture. As an example, the Pacific Northwest Hydrogen Hub (PNWH2) includes eight different project nodes across Washington, Oregon, and Montana.

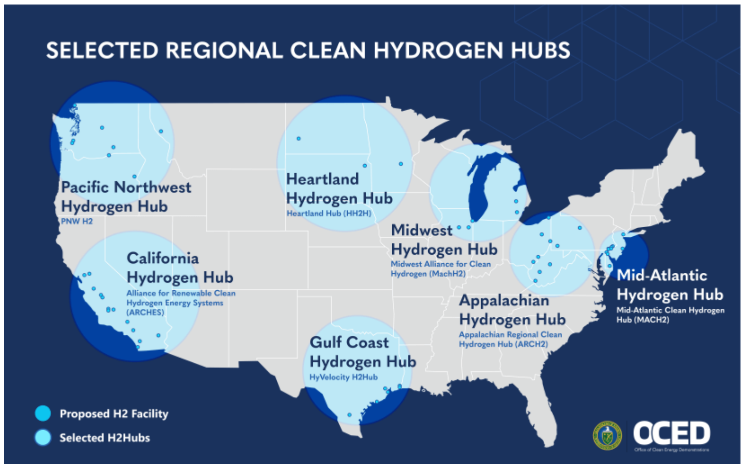

Figure 10 Map of selected hydrogen hubs in the United States[37]

The term "Valley" is used in Europe rather than a hub. However, it is still defined as a large-scale, geographically defined hydrogen ecosystem that integrates hydrogen production, storage, distribution, and end-use applications across multiple sectors.[38] Despite regional differences in structure and terminology, hydrogen hubs consistently serve as critical sub-systems that link key components of the value chain and accelerate the development of the hydrogen economy.

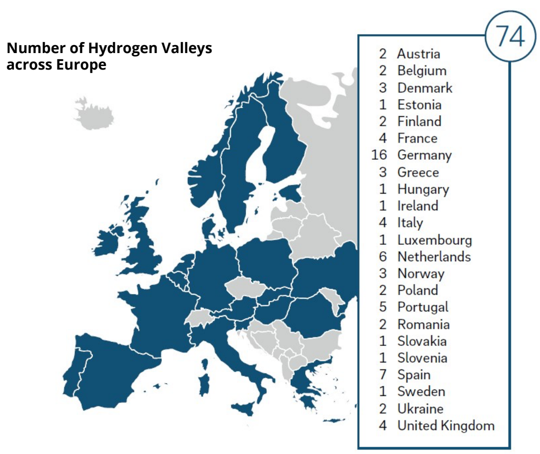

Figure 11 Number of hydrogen valleys, by country, across Europe[39]

[36] Regional Clean Hydrogen Hubs | Department of Energy (Accessed 7/10/25)

[37] A First Look at the Hydrogen Hubs Decisions (Accessed 7/10/25)

[38] Hydrogen Valleys | European Hydrogen Observatory (Accessed 7/10/25)

[39] H2Valleys | Mission Innovation Hydrogen Valley Platform (Accessed 7/10/25)

A hydrogen corridor refers to a transportation and infrastructure pathway that supports the movement and distribution of hydrogen or hydrogen-based products across regions to connect supply and demand. These corridors connect hydrogen hubs to key end users—including industrial facilities, transit systems, export terminals, and research institutions—enabling broader system integration.

Corridors vary in scale and purpose. Some serve urban areas by supplying municipal fleets and small industries, while others span regions, linking major industrial zones and fueling networks. International corridors can also facilitate the export of hydrogen derivatives such as ammonia or methanol via ports and maritime routes. Beyond physical infrastructure like pipelines, refueling stations, and storage, hydrogen corridors may also encompass virtual networks that foster collaboration between research institutions and industry to support innovation and commercialization.

2.4.2 Categorizing hydrogen hubs and corridors in Canada

In Canada, hydrogen hubs and corridors are critical elements of the broader hydrogen ecosystem, serving as enablers of production, distribution, and end use. Each hub operates within a distinct and often complex environment, requiring tailored policy and planning approaches that reflect its specific operational context. Rather than applying a one-size fits all approach, effective hub and corridor development depends on a nuanced understanding of local conditions and the interactions across the value chain.

To help understand the unique development and operating context of hydrogen hubs, four Hub Archetypes were developed reflecting the primary functions each type of hub is designed to serve,[40] informing its development scope, operational complexity, level of ecosystem integration, potential risks, and the requirements for effective implementation and long-term success. These hub archetypes—broadly aligned with the European Union's hydrogen valley framework - are outlined in Figure 12. It is important to note that a hub may align with multiple archetypes and transition between them over time as the ecosystem evolves.

Figure 12 Hydrogen hub archetype definitions[41]

[40] alberta_hydrogen_analysis_-_final_report.pdf (Accessed 7/25/25)

[41] alberta_hydrogen_analysis_-_final_report.pdf (Accessed 7/25/25)

2.4.3 Mapping hydrogen activity and enabling assets

Aggregating the information identified in Section 2.2 and Appendix 8.2, Figure 13 visualizes the locations of announced hydrogen projects across Atlantic Canada, including production, end-use, and export-focused developments, alongside key enabling infrastructure such as ports, roads, rail lines, and natural gas pipelines. This geographic overview shows how hydrogen activity aligns with existing industrial assets and transportation networks.

Mapping projects and infrastructure helps identify regions where hydrogen development is already taking shape, as well as areas with favourable conditions to support future growth. The remainder of this section uses the Hub Archetype framing and highlights area clusters where projects, infrastructure, and natural resources converge—providing a potential foundation for coordinated ecosystem development.

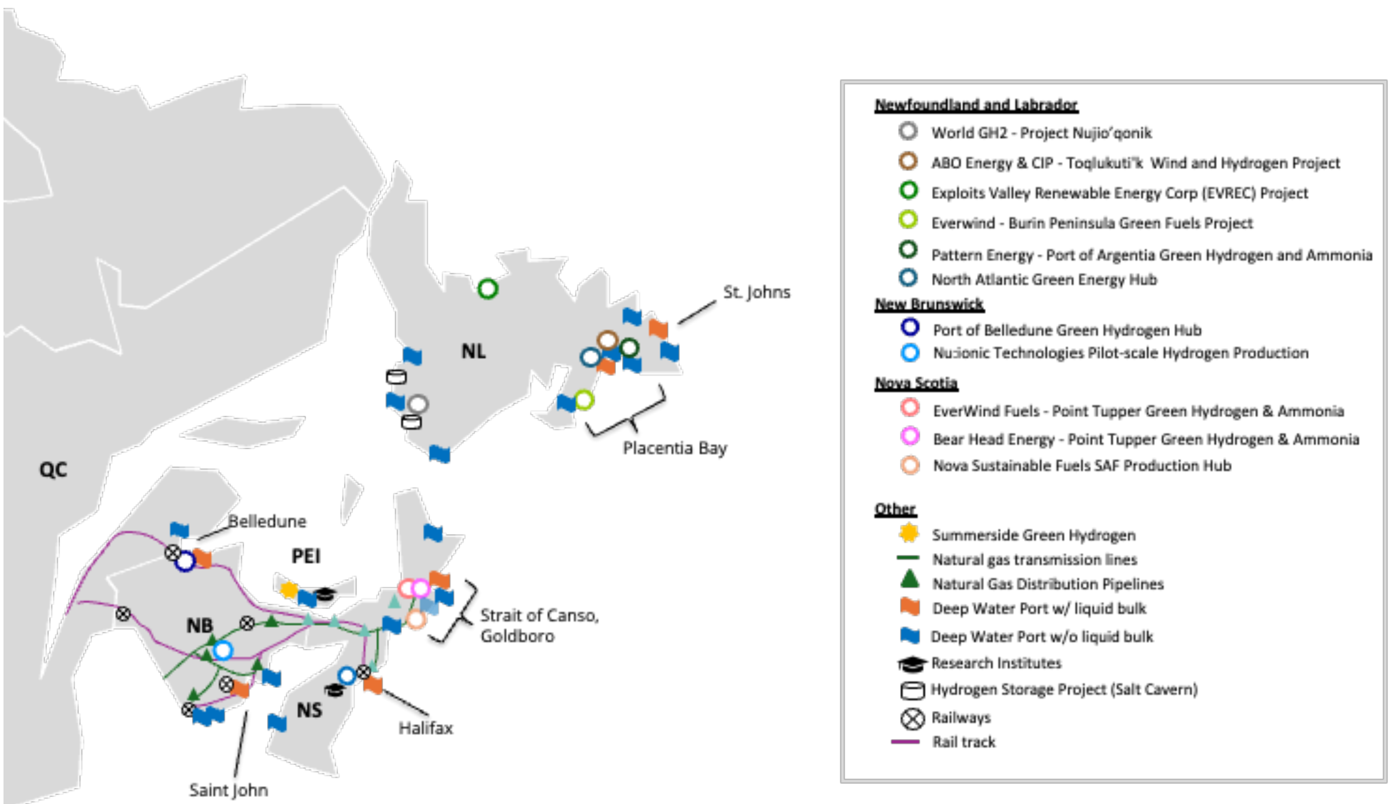

Figure 13 Atlantic Canada hydrogen inventory map

2.4.3.1 Spotlight: Placentia Bay

Placentia Bay has seen considerable hydrogen activity due to its strong onshore wind resources, Crown land, deep-water port access, and decades of experience in refinery and terminal operations. The region offers the infrastructure needed to support large-scale hydrogen production, storage, and export. Several major hydrogen projects support this cluster, including CIP/ABO Wind's Toqlukuti'k Wind and Hydrogen Project, Pattern Energy's Green Hydrogen and Ammonia Project, the North Atlantic Wind-to-Hydrogen Project, and EverWind's Burin Peninsula Green Fuels project. The area is also being positioned as a full-service hub for the hydrogen and wind supply chain—centralizing manufacturing, construction, operations, and maintenance services. Planned outputs include production of green hydrogen and derivatives such as green ammonia and liquid organic hydrogen carriers, targeting both domestic and export markets.

Activity area	Existing or proposed activities	Supporting infrastructure
Production	Multiple large-scale hydrogen production projects proposed by Toqlukuti'k Wind/H_2 Project (CIP/ABO), Pattern Energy's Green Hydrogen and Ammonia project, North Atlantic Wind-to-Hydrogen, and EverWind NL – Burin Peninsula Green Fuels Project.	Renewable energy development (wind and solar).
Storage and Distribution	Hydrogen and ammonia storage facilities proposed as part of the proposed production projects.	Road and port infrastructure, storage tanks from the Come by Chance refinery.
Domestic End-Use	The Toqlukuti'k Wind/H_2 Project has discussed dedicating some of its green hydrogen output to Braya Refinery, displacing existing grey hydrogen.	No activity presently identified.
Export	Four hydrogen and ammonia export projects are proposed in the region. Three plan to export as ammonia, one as a liquid organic hydrogen carrier.	Multiple deep-water ports identified to support export of ammonia and LOHC to global markets.
Research and Development	No activity presently identified; however, the NL Hydrogen Innovation Partnership (HyIP) has been developed. Research also at MUN's Thermal Fluid and Energy Research lab.	No activity presently identified.

Due to the mix of hydrogen production projects for both export and industrial end-use markets, the Placentia Bay hydrogen cluster would be considered Archetype C (export), although there is potential for domestic industrial end-uses to develop.

Beyond Placentia Bay, several proposed hydrogen export projects could significantly benefit the province. These Archetype C projects represent potential export hubs with national and international connections that could drive large-scale hydrogen production. Beyond creating economic opportunities and supporting global decarbonization efforts, these projects would help the province build infrastructure and expertise that could later support domestic hydrogen use and storage initiatives.

2.4.3.2 Spotlight: Strait of Canso

The Strait of Canso region—encompassing an industrial park in Point Tupper and surrounding municipalities—has the potential to develop into a strategic hydrogen industrial centre and export hub due to its deep-water, ice-free port, proximity to renewable energy, and established industrial infrastructure. Two major projects anchor this development. EverWind Fuels is advancing a green hydrogen and ammonia facility at Point Tupper, targeting 240,000 tonnes of ammonia annually in Phase 1, with plans to scale to 1 million tonnes. The project has secured environmental approvals and federal funding for port infrastructure. Adjacent to this site, Bear Head Energy is developing a green hydrogen and ammonia production and export terminal, fully permitted for up to 2 GW of electrolyzer capacity.

Nearby, Nova Sustainable Fuels, an Octopus Energy Generation-backed company, plans to produce SAF and methanol at the Goldboro Renewable Energy Park in Nova Scotia using green hydrogen and sustainable biomass.

All three green hydrogen projects have memorandums of understanding (MOU) with Nova Scotia that outline a path forward to apply to use Crown Lands for onshore wind development to support early stages of their projects. In addition, each has secured private land for onshore wind development.

The Strait of Canso region is also advancing domestic hydrogen development alongside export-oriented projects. The Municipality of the County of Richmond received $221,250 through Nova Scotia's Clean Fuels Fund to develop a regional strategy focused on clean fuel adoption, including hydrogen, for local decarbonization.

Stage	Existing or Proposed Activities	Supporting Infrastructure
Production	Multiple hydrogen and ammonia production projects proposed for export by EverWind Fuels and Bear Head Energy. Nearby Nova Sustainable Fuels is advancing SAF and Methanol production.	Renewable energy development (wind and solar).
Storage and Distribution	Proposed hydrogen and ammonia storage facilities as part of the EverWind and Bear Head projects.	Road, rail, and port infrastructure. M&NP's Point Tupper Lateral gas transmission (Goldboro to Point Tupper).
Domestic End-Use	Port Hawkesbury Paper has studied using hydrogen to decarbonize mill operations with Net Zero Atlantic. They are also participating with several partners on a Domestic Use strategy for the broader Strait region.	-
Export	Hydrogen and ammonia exports proposed by EverWind and Bear Head. EverWind has signed an MOU with Uniper for 500,000 tonnes of ammonia annually. Nova Sustainable Fuels will use hydrogen and biomass to produce SAF.	Multiple deep-water ports with planned expansions to handle liquid bulk (e.g. ammonia) for international export.
Research and Development	Strait of Canso domestic clean fuels strategy is currently in progress, led by Deloitte, aiming to stimulate local demand for hydrogen and derivatives.	An infrastructure assessment is part of this strategy, led by Deloitte and Waterford Energy Services Inc.

Hydrogen project activity in the region is largely focused on the production of green and hydrogen derivatives for export markets, aligning to Archetype C (export). However, as domestic end-use projects evolve in the area, so can its Archetype classification.

2.4.3.3 Spotlight: Halifax

Halifax has been identified as a location for a potential hydrogen cluster due to strategic initiatives in the municipality focused on hydrogen transportation, domestic end uses, and port infrastructure. Halifax Transit is conducting a dual-fuel (hydrogen/diesel co-combustion) bus demonstration project to convert four diesel buses to hydrogen-diesel systems to evaluate hydrogen's role in decarbonizing its public transit fleet. On the export-oriented side, the Port of Halifax has secured up to C$22.5 million from Transport Canada to support the development of green shipping corridor initiatives such as alternate fuel studies, enabling terminal electrification, and conducting a Green Shipping Technology Program aimed at introducing new shipping-related technologies to green the corridor along the Halifax-Hamburg shipping route.[42]

Activity Area	Existing or Proposed Activities	Supporting Infrastructure
Storage and Distribution	Port of Halifax through Government of Canada funding is preparing to host and potentially refuel alternative fuel-powered vessels.	Road, rail, and port infrastructure. Distribution and transmission natural gas pipelines.
Domestic End-Use	Halifax Transit is conducting a dual-fuel (hydrogen/diesel) bus demonstration. Eastward Energy's Halifax Hydrogen Deployment project proposes hydrogen blending into the gas distribution system. Port of Halifax, through Government of Canada funding, is preparing to host and potentially refuel alternative fuel-powered vessels.	Distribution and transmission natural gas pipelines.
Export	MOU in place between the Port of Halifax and EverWind fuels to explore opportunities related to production, bunkering, power generation, and energy storage.	Deep-water port facilities. The Halifax Port Authority has received up to C$22.5 million from Transport Canada to support development of the Halifax-Hamburg green shipping corridor.
Research & Development	Dalhousie Hydrogen Applications Research Lab to assess the performance and safety of using hydrogen-enriched natural gas in gas appliances: $500k program to develop low-cost water-splitting catalysts (ongoing through 2025). Dalhousie Green Hydrogen Research Cluster.	

[42] The Government of Canada invests in port infrastructure for Atlantic Canada - Canada.ca (Accessed 7/25/25)

The hydrogen activity developing in the Halifax region is supporting adoption of hydrogen end-uses, aligning to Archetype A (local scale).

2.4.4 Additional opportunities

As identified in Figure 13, the hydrogen opportunity, whether from announced projects or enabling assets expands throughout the Atlantic Canada region and is not constrained to the above three spotlights. Additional innovative and transformational projects are also proposed across New Brunswick and Newfoundland and Labrador, but at present, may have less activity or progress, or are isolated to a remote area of the region. Understanding the archetypes allows these nuances to be captured, providing insight into the operating context of different hydrogen activity areas.

Saint John and Port of Belledune have been identified as hydrogen hubs in New Brunswick hydrogen roadmap

The New Brunswick Hydrogen Roadmap identifies Saint John and the Port of Belledune as the province's two priority hydrogen hubs, based on their strategic infrastructure, industrial capacity, and port access.[43] These locations are seen as key enablers for hydrogen production, use, and export, and would be central to New Brunswick's contribution to Canada's emerging hydrogen economy.

Under Action 8 of the roadmap, the province commits to supporting the development of both hubs and promoting them nationally as leading hydrogen centres. Each hub would be required to develop a formal development plan with input from local communities, and the province would advocate for federal support to accelerate their establishment.

Belledune is positioned as a future hydrogen production and export centre due to its deep-water port, available industrial land, abundant water resources, and significant onshore wind energy potential. These attributes support the co-location of hydrogen production and downstream green industries.

Saint John can leverage its existing hydrogen production capacity at Canada's largest oil refinery, which is expanding its hydrogen capabilities. The city also hosts Atlantic Canada's only operational LNG terminal, a major container and bulk port, and is well-connected via rail and industrial infrastructure—making it a strong candidate for both domestic hydrogen use and international export.

[43] hydrogen-roadmap-e.pdf (Accessed 7/24/25)

2.4.5 Moving forward on the opportunity for hydrogen clusters in Atlantic Canada

Atlantic Canada's hydrogen ecosystem remains in the early stages of development, with activity emerging across multiple locations and sectors. This study provides an initial snapshot of hydrogen clusters—areas where overlapping projects, infrastructure, and industrial activity are beginning to take shape. These clusters represent early opportunities for hydrogen to serve both domestic and export markets, leveraging existing assets and regional momentum.

As the ecosystem evolves, new opportunities may emerge in currently overlooked areas, while some existing projects may expand, pivot, or not proceed as planned. Sustained success would therefore depend not only on today's activity but on the region's ability to remain flexible, coordinated, and strategically aligned as conditions change.

Governance

Effective governance would be central to advancing hydrogen clusters and strengthening the regional supply chain. Strong, coordinated structures can align public policy, private investment, and community priorities—ensuring that infrastructure planning, project sequencing, and supplier development move forward cohesively. Clear governance frameworks also establish common standards, facilitate transparent decision-making, and build investor and public confidence.

Conversely, weak governance risks creating fragmentation, inefficiency, and uncertainty. Without coordination, projects may compete rather than collaborate, leading to misaligned infrastructure, inconsistent standards, and missed opportunities for shared investment. Suppliers and investors alike depend on predictable market signals; without them, confidence in long-term regional prospects may erode.

Experience from other jurisdictions offers valuable lessons. In Canada, hydrogen hubs tend to be city- or site-specific. By contrast, the **Pacific Northwest Hydrogen Hub (PNWH2)** in the United States spans multiple regions under a single governance framework—linking projects, aligning standards, and enabling participants to respond collectively to market shifts, infrastructure demands, or policy changes.

As Atlantic Canada considers how best to organize and scale its hydrogen ambitions, there is a clear opportunity to establish governance and operating models that enable long-term success. Structures that promote coordination across provinces, adapt to evolving market conditions, and align local priorities with regional and national goals would provide the strongest foundation for a resilient and competitive hydrogen economy.

2.5 Government support mechanisms for Indigenous Governments & Organizations

The development of Atlantic Canada's hydrogen ecosystem presents opportunities for Indigenous Governments & Organizations and rural communities to participate as partners, investors, suppliers, and workforce contributors. A focus area for federal and provincial governments is to ensure these communities are meaningfully included in, and able to benefit from, emerging economic and natural resource opportunities such as hydrogen. To enable this goal, targeted support mechanisms have been established to address existing barriers related to access to capital, workforce readiness, infrastructure, and business development that can be applied or replicated for the hydrogen supply chain. Table 7 provides an overview of select mechanisms, highlighting how they have enabled Indigenous and rural community participation in economic opportunities throughout Atlantic Canada.

Table 7 Government support mechanisms for Indigenous Governments & Organizations (non-exhaustive list)

Jurisdiction	Mechanism	Description	Example outcome
Federal	Indigenous Loan Guarantee Program (2024)[44]	Provides up to $10 billion in loan guarantees to support Indigenous equity ownership in major projects across all sectors, excluding gaming. Initially launched with $5 billion for energy and natural resources, the program was later expanded and doubled in scope and funding.	Similar financial structures supported Indigenous ownership in infrastructure projects like the Maritime Link, enabling long-term revenue and equity participation
	ACOA – Inclusive & Diversified Communities Programs[45]	Provides targeted funding for Indigenous and rural business development, entrepreneurship, and workforce participation.	Ulnooweg Development Group accessed ACOA funding to expand Indigenous entrepreneurship across Atlantic Canada, enhancing business readiness for future opportunities.
	Strategic Partnerships Initiative (SPI)[46]	Coordinates cross-departmental federal funding to support Indigenous participation in priority sectors.	Used nationally to streamline access to funding in energy projects, reducing administrative burden and enabling Indigenous economic involvement.
NL	Call for Bids for Wind Energy Projects	The Province's Call for Bids for Wind Energy Projects explicitly required proponents to demonstrate engagement with Indigenous communities by outlining completed or planned consultations, providing letters of support, and identifying any concerns raised along with proposed mitigation measures.	Importantly, community and Indigenous engagement accounted for 10 percent of the overall project evaluation score, creating a direct incentive for developers to establish meaningful partnerships and ensure Indigenous interests were considered from the outset.
NB	Indigenous-led wind projects in New Brunswick[47][48]	Up to $1 billion in federal support for up to 670 megawatts of Indigenous-led wind projects through the Canada Infrastructure Bank (CIB) Clean Power priority sector and Indigenous Equity Initiative as well as Natural Resources Canada's Smart Renewables and Electrification Pathways program (SREPs)	These Indigenous-led projects provide emissions-free and affordable power for New Brunswick households and businesses and were identified as part of NB Power's request for expression of interest, which was launched in 2023.
NS	Mi'kmaq–NS Consultation Terms of Reference[49]	Establishes a formal process for Indigenous consultation on major projects.	Applied in offshore wind and energy developments, ensuring Indigenous rights are upheld and enabling early project input and influence.
PEI	Indigenous Relations Secretariat[50]	The Indigenous Relations Secretariat (IRS) strengthens government's approach to reconciliation and Indigenous matters within the province. The Secretariat also works to increase public awareness and promote greater inter-departmental collaboration within government on Indigenous matters.	Support for wealth-generating projects that enable First Nations Peoples in their efforts to move toward economic self-sufficiency, such as through renewable energy developments.

[44] Canada Indigenous Loan Guarantee Corporation - Canada.ca (Accessed 7/24/25)
[45] Ulnooweg Development Group helping to build innovative and inclusive Atlantic Canada economy - Canada.ca (Accessed 7/24/25)
[46] Strategic Partnerships Initiative (Accessed 7/24/25)
[47] Federal investment to support Indigenous-led wind projects in New Brunswick (Accessed 12/5/2025)
[48] Powering Canada's Future: Ensuring Access to Affordable, Reliable and Clean Electricity in New Brunswick
[49] Microsoft Word - NS_TOR_Consultation_Trial_June07.doc (Accessed 7/25/25)
[50] About Us - Indigenous Relations Secretariat | Government of Prince Edward Island (Accessed 7/25/25)

3. Atlantic Canada's hydrogen value chain

Section 1.4 distinguishes the region's hydrogen value chain—the sequence of activities involved in hydrogen production and consumption—from the hydrogen supply chain which focuses on the actors and material inputs required to enable the value chain in practice (i.e., who provides the capabilities, equipment, and logistics needed to build and operate hydrogen facilities). This section builds on this with a detailed breakdown of its component parts, mapping the capabilities and readiness across the four value chain stages: development and construction, production, storage and distribution, and end use.

The assessment is grounded in empirical data, integrating publicly available research as well as quantitative and qualitative insights derived from the Atlantic Hydrogen Supplier Readiness Survey of 80 regional organizations. This provides a detailed, point-in-time snapshot of the ecosystem, revealing where technical capacity and industrial experience are strong, and where critical gaps—particularly in midstream infrastructure and downstream market activation—must be addressed. The subsequent subsections detail these findings, providing the necessary context for the gap assessment and roadmap presented later in this report.

Table 8 Announced hydrogen export focused production projects in Atlantic Canada (as of May 31, 2025)

Province	Developer	Project and location	Production method
NS	EverWind Fuels	Point Tupper Green Fuel Hub (Point Tupper, NS)	Electrolysis
	Bear Head Energy	Bear Head Green H_2/NH_3 Facility (Point Tupper, NS)	Electrolysis
	Nova Sustainable Fuels	Renewable Energy Park (Goldboro, NS)	Biomass gasification & methanol synthesis
NL	EverWind Fuels	Burin Peninsula Green Fuels Project (Burin Peninsula, NL)	Electrolysis
	World Energy GH2	Project Nujio'qonik (Stephenville, NL)	Electrolysis
	Exploits Valley Renewable Energy Corp. (EVREC)	Botwood and Area EVREC Green Energy Project (Botwood, NL)	Electrolysis
	ABO Energy / CIP	Toqlukuti'k Wind & Hydrogen (Isthmus of Avalon, NL)	Electrolysis
	Pattern Energy	Argentia Renewables (Port of Argentia, NL)	Electrolysis
	North Atlantic	North Atlantic Wind to Hydrogen Project (Sunnyside/Come by Chance, NL)	Electrolysis
NB	Port of Belledune	Belledune Green Hydrogen & Ammonia Hub (Port of Belledune, NB)	Electrolysis
	Nu:ionic Technologies	Electrified Smart Reformer pilot project, New Brunswick	Electrified reforming

3.1 Atlantic Canada hydrogen value chain overview

The Atlantic Canada hydrogen value chain spans four interconnected stages that together describe how hydrogen moves from concept to commercial use. It begins with developing and constructing the infrastructure required for production, followed by the generation of hydrogen itself—primarily through green electrolysis. Once produced, hydrogen must be safely stored and transported, often as ammonia for export. Finally, hydrogen is delivered to end users, whether in domestic applications or international markets. These stages form a coherent progression that reflects how the regional hydrogen ecosystem will scale from early projects to full market deployment, and the following chapter examines each element in detail.

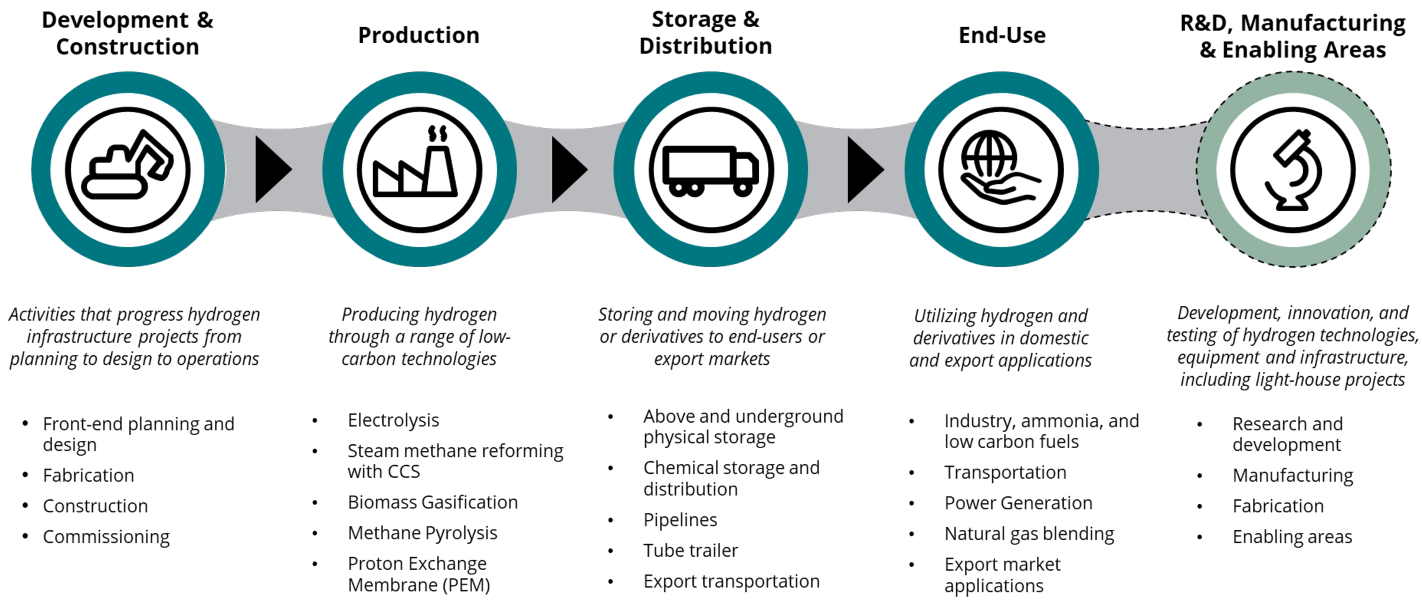

Figure 14 Atlantic Canada's hydrogen value chain

Development and construction: This stage focuses on the development of hydrogen production facilities and related infrastructure across the value chain. It encompasses all stages from planning and design to FEED, construction, commissioning, along with supporting engineering, procurement, and construction management (EPCM) considerations. This foundational step is crucial for establishing the infrastructure needed to support the hydrogen production in the region.

Production: In this stage, the focus is on the technologies currently used for hydrogen production in Atlantic Canada. Given the emphasis on green hydrogen, electrolysis is highlighted as the key technology, aligning with Canada's net-zero goals. This study concentrates on electrolysis as a sustainable method for hydrogen production.

Storage and distribution: This stage addresses the logistics of moving and storing hydrogen after production. With Atlantic Canada's strategic focus on serving export markets, the transportation of hydrogen, particularly in the form of ammonia, via ports, is a critical consideration.

End use: The final stage of the value chain considers the use of hydrogen for both domestic applications and targeted export markets. By aligning with current and future needs, this stage ensures that the hydrogen produced is effectively integrated into various sectors, supporting both local and international energy transition efforts.

R&D, manufacturing & enabling areas: All hydrogen value chain segments rely on enabling services such as government programs, technical and business expertise, OEM activity, and industry advocacy. Governments provide funding, policy frameworks, and incentives that guide investment. Technical and business services—engineering, consulting, logistics—help optimize production, storage, transport, and end use. Industry organizations promote collaboration, standards, and innovation. Together, these enablers strengthen the value chain and support the scaling of hydrogen markets.

3.2 Value chain deep-dive

3.2.1 Development and construction

The development and construction stage includes planning, pre-FEED, FEED, fabrication, construction, and commissioning of hydrogen facilities, turning designs into functional infrastructure for hydrogen production, storage, and distribution. This stage is divided into four main segments: pre-FEED planning, FEED, engineering and procurement finalization, and downstream activities like fabrication, construction, and unit commissioning. Each segment is crucial for ensuring projects are completed on time, within budget, and adhere to high safety and quality standards.

3.2.1.1 Front-end planning and design

Front-end planning and design is the initial activity that establishes project objectives, feasibility, assessment of risk, and the conceptual framework. This process involves feasibility studies to assess economic viability, site selection, and conceptual design. Environmental impact assessments and geological surveys are conducted to ensure compliance with regulations and suitability of the site in addition to engagement with groups such as Indigenous communities, municipalities, and government via socio-economic impact assessments.

3.2.1.2 Front-end engineering design (FEED) and engineering and procurement specifications

The FEED stage refines the conceptual design by developing detailed process flow diagrams, piping and instrumentation diagrams, equipment layouts, and associated civil works design. This stage includes the preparation of preliminary cost estimates, conducting risk assessments, and performing safety studies. Additionally, FEED identifies major equipment requirements, such as electrolyzer stacks and storage tanks, and establishes procurement strategies. A well-executed FEED reduces uncertainties in cost and timeline estimates, minimizing delays during construction. It requires collaboration between engineers, suppliers, and regulators to ensure compliance with standards.

The next step involves finalizing the detailed engineering designs and securing the necessary materials and equipment through procurement. Procurement includes issuing tenders, negotiating contracts, and sourcing components. Global supply chain constraints for hydrogen-specific components, such as electrolyzer stacks, currently have lead times up to 24 months affecting project schedules.[51, 52] Other considerations involve currency fluctuations and tariffs impacting costs and ensuring compliance with Canadian standards and regulations.

3.2.1.3 Fabrication

Fabrication encompasses the manufacturing and assembly of components essential for hydrogen infrastructure, which can be conducted on-site or off-site. This process uses fabrication machinery such as welding equipment, cutting tools, and blending machines to produce items like pressure vessels, pipelines, and electrolyzer frames. The use of modular construction units enables pre-fabrication, thereby enhancing efficiency. Fabrication necessitates skilled labour and specialized equipment, with strict adherence to standards being a priority. Due to limited specialized hydrogen-specific capabilities within Atlantic Canada and elsewhere in Canada, certain specialized components, such as electrolyzers and storage and compression tanks, would require international fabrication.

3.2.1.4 Construction and commissioning

The construction and commissioning process integrates individual components into a fully operational hydrogen facility and verifies its readiness for safe and effective operation. Construction includes civil works, mechanical installation, electrical integration, and piping. Commissioning involves testing equipment to verify integrity, control system tools for subsystems connection, and performance monitoring for efficiency. Weather disruptions can delay construction and labour shortages in remote areas may increase costs. Skilled technicians are needed for commissioning, and acquiring regulatory approvals from appropriate authorities and bodies is mandatory.

3.2.1.5 Systems and components in construction

[51] Water Electrolyzer Installations – Summary Report (Accessed 6/20/25)

[52] The competitive edge of China's electrolyzers | Wood Mackenzie (Accessed 6/20/25)

The following section details the key systems and components within this stage. A detailed list of systems and components can be found in Appendix 8.3.

Fabrication machinery, welding equipment, and non-destructive testing (NDT) tools

Fabrication machinery, particularly welding equipment, is required for producing components suitable for hydrogen systems, such as pressure vessels and pipelines. These machines require specialized welding techniques to prevent hydrogen embrittlement and maintain the integrity and safety of high-pressure hydrogen systems. Non-destructive testing (NDT) tools play a role in quality control by detecting micro-cracks and other potential issues, which aid in maintaining safety standards. While the basic machinery can be used across various industries, hydrogen projects necessitate specific adaptations and adherence to stringent regulatory standards.

Testing equipment in control system integration tools

Testing equipment, such as pressure and leak testers, are used during construction for assembling components and during commissioning to validate the integrity of pipelines, storage systems, and electrolyzer stacks. These instruments ensure that there are no leaks or pressure failures. Equally important are control system integration tools, which facilitate the connection of subsystems and manage dynamic loads from renewable energy sources. While these tools are applicable across various industries, their hydrogen-specific calibration distinguishes them from general construction applications and require having trained personnel to operate these tools effectively, ensuring precise readings and interpretations. Technological advancements, including automated testing processes and remote monitoring capabilities, have enhanced the accuracy, efficiency, and user-friendliness of these tools.

General infrastructure and non-specialized components

In addition to the deployment of specialized machinery and testing equipment, the construction stage of a hydrogen project encompasses a variety of non-specialized components and general infrastructure. This includes site preparation, the development of access roads, establishment of utility connections, and the erection of buildings for administrative offices, control rooms, maintenance workshops, storage warehouses, and staff amenities. Such infrastructure is fundamental in facilitating the safe and efficient operation of hydrogen facilities while accommodating both personnel and equipment requirements. Although these elements are not exclusive to hydrogen projects, their careful integration within the broader design and construction framework is vital for successful project execution. The standards and specifications governing these infrastructure components typically align with industry best practices and local regulatory requirements, thereby ensuring facility accessibility, compliance, and suitability for intended operations.

3.2.2 Production

There are several methods for producing low-carbon hydrogen; Table 9 Low-carbon hydrogen production pathways in 2025 outlines the most common hydrogen production pathways and their technology readiness levels (TRLs) as of 2025.

Table 9 Low-carbon hydrogen production pathways in 2025

Readiness category	Production pathway	Typical process variant	IEA-assessed TRL (2025)
Commercial today (TRL 9)	Electrolytic-based ("green")	Alkaline water electrolysis	9
		Proton exchange- membrane- (PEM) electrolysis	9
	Fossil-fuel based	Steam methane- reforming (SMR) with CCUS – unabated "grey" (partial capture)	9
		Coal gasification with CCUS – unabated "grey" – partial capture	9
Early commercial/ first-of-a-kind (TRL 7-8)	Electrolytic-based ("green")	Solid oxide- electrolysis (SOEC)	8
		Anion exchange- membrane- (AEM) electrolysis	7
	Emerging thermal	Methane pyrolysis ("turquoise")	7
Prototype/pilot (TRL 5-6)	Biogenic / renewable	Biomass gasification to H_2 (with/without CCUS)	5 – 6
	Fossil + CCUS ("blue")	Steam Methane Reforming + CCUS – high capture	5-6
		Autothermal reforming (ATR) + CCUS	5
		Coal gasification + CCUS – high capture	5

Steam methane reforming (SMR) with carbon capture utilization and storage (CCUS), biomass gasification, methane pyrolysis, and electrolysis have been assessed as viable methods for low-carbon hydrogen production in feasibility studies conducted in Atlantic Canada.[53] Although steam methane reforming with CCUS, biomass gasification and methane pyrolysis are potentially viable options, they face challenges in Atlantic Canada, such as high costs of natural gas, limited natural gas infrastructure for steam methane reforming and pyrolysis and limited availability of biomass feedstock for gasification.

Electrolysis is advantageous due to its scalability (modular design) and compatibility with intermittent renewable energy sources (especially proton exchange membrane electrolyzers).[54] The method offers the potential to support export markets like Europe, which has stringent standards for green hydrogen.[55] These factors, along with the region's vast renewable energy resources, make electrolysis a promising option for hydrogen production in Atlantic Canada.

This study focuses on electrolysis as the primary method for producing low-carbon hydrogen in Atlantic Canada because it aligns with the region's abundant renewable energy resources, environmental goals, and economic potential, making it the most

53 Net-Zero Future: A Feasibility Study of Hydrogen Production, Storage, Distribution and Use in The Maritimes - NL Extension | Net Zero Atlantic (Accessed 6/20/25)

54 Evaluation of Renewable Intermittency on Electrolyzers for Hydrogen Production Cost in Australia – HyResearch: Australian Hydrogen R&D Portal (Accessed 6/20/25)

55 Renewable Energy Directive (Accessed 6/20/25)

suitable technology for mapping supply chain systems, components, and suppliers. The following section examines the considerations behind the selection of electrolysis and compares it to alternative production pathways.

Table 10 Comparison of hydrogen production pathways

Consideration	Electrolysis	Steam methane reforming with CCUS	Biomass Gasification	Methane Pyrolysis
Technology readiness level (TRL)	Proton exchange membrane (PEM) and alkaline are at TRL 9 Solid oxide electrolyzer cell (SOEC) is at TRL 8	9	5-6	7
Greenhouse gas (GHG) emissions	Produces nearly zero-emission hydrogen (below 1 kg CO_2e/kg H_2)[56], when powered by renewable electricity sources	Reduced emissions with CCUS, but residual CO_2 emissions and risk of methane leaks remain. Fossil fuel reliance limits sustainability	Carbon-neutral potential if sustainably sourced, though process energy and biomass sourcing can contribute to emissions	Low direct CO_2 emissions, however, energy intensive process and potential methane leaks increase lifecycle emissions
Scalability	Highly scalable with modular electrolyzer design (kW for small scale projects to GW for large export initiatives)	Highly scalable, but requires extensive gas and CO_2 storage infrastructure, limited in Atlantic Canada	Scalable but constrained by feedstock availability, logistics and preprocessing needs	Moderately scalable; pilot plants exist but carbon byproduct handling and high energy needs limit large scale deployment
Operational flexibility	High flexibility; can ramp up/down quickly	Designed for steady-state operations however, CCUS adds complexity, by slowing response to demand changes	Feedstock preprocessing and gasification processes limit rapid response	High temperature processes and carbon handling reduce ability to adjust output quickly
Global and export demand	High demand for green hydrogen in Europe, driven by renewable energy policy and initiatives such as RFNBO, REDIII, and REPowerEU[55]	Strong demand for blue hydrogen and is cost-competitive for export but faces scrutiny due to residual emissions	Niche markets for bio-hydrogen; limited by feedstock logistics and lower purity for export applications	Emerging demand in byproduct markets (e.g. carbon black),[57] limited by TRL and infrastructure for large-scale export
Domestic suitability	Highly suitable; leveraging renewable energy (wind, hydro, solar) and water resources. Also supports local decarbonization needs in transportation, industry, agriculture	Less suitable for Atlantic Canada due to its dependence on natural gas and fossil fuel reliance conflicts with long-term sustainability goals	Moderately suitable as inconsistent feedstock supply, logistics, and land use pose challenges. Lower hydrogen purity makes it less ideal for ammonia production and transportation	Less suitable due to reliance on imported natural gas, low TRL, and limited adoption, though some access and use exist in NB and NS industrial sectors
Alignment to Atlantic Canada's vision	Strong alignment; leverages abundant wind and hydropower, and supports hydrogen export and local decarbonization	Moderate alignment due to limited natural gas infrastructure and green hydrogen focus	Some alignment due to difficulties with seasonal and dispersed feedstock logistics and limited scalability	Low alignment due to emerging technology, though existing pipeline infrastructure in NB and NS could support future adoption

[56] Hydrogen standards should only lend credibility to truly emissions-busting projects | Green Hydrogen Organisation (Accessed 6/20/25)

[57] Sustainable hydrogen production via carbon black: Direct carbon fuel cell application for turquoise hydrogen - ScienceDirect (6/20/25)

3.2.3 Storage and distribution

The storage and distribution stage, which includes transportation, is the midstream stage of the hydrogen value chain, bridging production with end use. This stage ensures that hydrogen is safely stored, efficiently transported, and effectively distributed to satisfy both domestic and export market demands. During this stage, hydrogen is managed in various forms – gaseous, liquid, or as a chemical derivative such as ammonia or liquid organic hydrogen carriers (e.g. methanol) – to facilitate its delivery to diverse sectors, including power generation, mobility applications, and international markets.

Infrastructure readiness is critical in this stage. While existing assets like natural gas pipelines may be repurposed, as well as repurposing/retrofitting unused oil & gas storage tanks, substantial capital investment is required for new infrastructure such as dedicated hydrogen pipelines.[58] Safety and regulatory compliance are critical considerations given hydrogen's high flammability and extremely low boiling point, necessitating rigorous handling protocols. Regional characteristics significantly influence method selection; for example, Atlantic Canada benefits from its proximity to transatlantic shipping corridors, which enhances export opportunities, and its geological potential for underground storage.

3.2.3.1 Above ground physical storage

Above ground physical storage involves the storage of hydrogen in high-pressure vessels made of steel or composite materials or insulated cryogenic tanks. Hydrogen can be stored either as a compressed gas or as a cryogenic liquid at production sites or end-use locations. Compressed gas storage is straightforward and less energy-intensive but requires substantial space.[59] Liquid hydrogen storage is more compact but faces challenges such as boil-off losses and high liquefaction costs.[60] Due to hydrogen's flammability, safety measures, including leak detection and pressure management, are essential.

Above ground storage is ideal for smaller scale projects, such as refueling stations for hydrogen fuel cell vehicles or temporary storage at production sites. However, the region's harsh winters may exacerbate boil-off losses for liquid hydrogen, necessitating advanced insulation. Local manufacturing of pressure vessels could reduce costs, though cryogenic tanks which can be fabricated locally, often depend on Canadian suppliers such as TIW Steel Platework Inc. and Nova Industrial Supplies with lead times of 6-9 months.

The timeline for constructing a greenfield or brownfield above ground hydrogen storage facility can vary between 1-3 years based on several factors, including the size and complexity of the facility, regulatory approvals, site preparation, and the availability of materials and labor.

3.2.3.2 Underground physical storage

Underground physical storage uses geological formations such as salt caverns, depleted gas reservoirs, or aquifers to store large volumes of hydrogen primarily as compressed gas. Salt caverns, created through solution mining, provide high-purity storage with minimal leakage, capable of holding millions of cubic meters of hydrogen at pressures ranging from 50-200 bar. Depleted gas reservoirs and aquifers can also store hydrogen but require careful sealing to prevent gas migration. This method is suitable for long-term, large-scale storage to balance seasonal demand or support export markets.

Underground storage is cost-effective for large volumes with lower operational costs compared to above-ground storage. However, it requires appropriate geological formations, thorough site assessments, and monitoring to prevent leaks. Regulatory frameworks for subsurface storage are still developing, and public acceptance may be challenging in populated areas. The region has geological conditions that are suitable for salt cavern storage, and projects like the Fischells Salt Dome, (that has a projected capacity of over 8,000 tonnes - 2,500 tonnes more than the USA's ACES Delta Hubs, known to be one of the world's largest clean hydrogen storage projects in construction) may be a crucial piece of storage infrastructure for the region, with the potential to act as the cornerstone of a potential energy hub. Initial investments for cavern development and estimated lead times of 12 years from site preparation and permitting to

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58 A techno-economic study of the strategy for hydrogen transport by pipelines in Canada - ScienceDirect (Accessed 6/19/25)

59 Hydrogen Storage | Department of Energy (Accessed 6/18/25)

60 Hydrogen liquefaction and storage: Recent progress and perspectives - ScienceDirect (Accessed 6/18/25)

construction and operational readiness are noted barriers.[61][62] This includes geological exploration, permitting, design, drilling, solution mining, and commissioning.

3.2.3.3 Chemical storage and distribution

Chemical storage and distribution involves converting hydrogen into chemical carriers such as ammonia or liquid organic hydrogen carriers for more manageable storage and transportation. For ammonia, hydrogen is synthesized into ammonia via the Haber-Bosch process, which combines hydrogen with nitrogen under high pressure and temperature. Ammonia is then stored as a liquid at -33 degrees Celsius, facilitating lower-cost transportation compared to gaseous or liquid hydrogen, which liquifies at -253 degrees Celsius. This results in ammonia providing higher volumetric density for storage at higher temperatures and lower pressures.[63] It also uses established global trade networks; however, given that each additional conversion step adds costs and increases energy losses, the necessary synthesis and later cracking of chemical carriers makes this process less efficient than using hydrogen directly in its original gaseous form, . Furthermore, ammonia's toxicity mandates strict handling protocols to ensure safety, presenting possible opportunities for other energy carriers, such as LOHC, should a market opportunity arise.[64] LOHCs offer the advantage of being non-toxic and compatible with existing fuel infrastructure. They remain in liquid form under ambient conditions, enabling safer handling and transport, though they also require energy for hydrogenation and dehydrogenation processes and are still emerging in terms of commercial scale deployment.[65]

At the time of writing this report, ammonia remains the primary focus for export-oriented projects in Atlantic Canada, given the region's proximity to transatlantic shipping routes and European demand for RFNBO compliant ammonia for RED III. An example in Newfoundland and Labrador is at the Port of Argentia, which could serve as a hub for ammonia distribution due to access to shipping routes across the Atlantic Ocean and proximity to Europe as contemplated by Pattern Energy,[66] but conversion facilities require significant investment for construction. In March 2024, Pattern signed an LOI with Germany's Mabanaft to supply about 400 tonnes per day of green ammonia from its planned facility in Argentia, Newfoundland starting in 2027, with Mabanaft also considering co-investment. While most of the proposed export-oriented hydrogen projects have selected ammonia as their chosen chemical carrier, there is appetite for other chemical carriers in the international market. The North Atlantic Wind to Hydrogen project in the Avalon region of Newfoundland is proposing an LOHC-based facility, citing safe and efficient storage as justification.[67]

3.2.3.4 Pipelines

Pipeline infrastructure enables the movement of hydrogen from production sites to storage facilities, end-users, or port facilities for export. Dedicated hydrogen pipelines are engineered specifically for hydrogen export, using materials such as steel or composites resistant to hydrogen embrittlement. Dedicated pipelines allow large volumes of hydrogen to be transported efficiently and without contamination over long distances. While pipelines do require significant upfront capital investment for construction, there is a strong business case for them over the long term. For example, the North Atlantic Wind to Hydrogen project has included plans in their EA Registration document to design a 1.4km pipeline between the hydrogen generation plant and the LOHC hydrogenation plant using a combination of existing infrastructure and new pipes.

An alternative approach involves blending hydrogen with natural gas in existing natural gas pipelines at varying blend ratios. This method can reduce initial investment and leverage existing infrastructure, such as New Brunswick and Nova Scotia's natural gas pipeline distribution system. This requires additional feasibility studies to understand the operational considerations of including hydrogen within the pipeline and compressor system to ensure that they do not suffer from environmental or leakage issues.[68] Furthermore, above certain limits, hydrogen affects conventional appliance performance and pipeline integrity. However, the natural gas pipeline distribution system in Nova Scotia and New Brunswick is mostly constructed with polyethylene plastic pipes, making them more hydrogen-compatible than

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61 Energy Technology Perspectives 2023 – Analysis - IEA (Accessed 6/18/25)
62 H2-Storage-Event-Report-2024-Draft-v0.2.pdf (Accessed 6/18/25)
63 Review of ammonia production and utilization: Enabling clean energy transition and net-zero climate targets - ScienceDirect (Accessed 6/18/25)
64 How safe are hydrogen, ammonia and methanol? - PtX Hub (Accessed 6/18/25)
65 Liquid Organic Hydrogen Carrier (Accessed 7/27/25)
66 Newfoundland's smallest green hydrogen project becomes 1st to ink agreement with a buyer | CBC News (Accessed 6/20/25)
67 North Atlantic Wind to Hydrogen Project | Environmental Assessment Registration (Accessed 10/2/25)
68 Alternative Fuels Data Center: Hydrogen Production and Distribution (Accessed 6/20/25)

traditional steel pipelines. Nonetheless, extracting pure hydrogen from the mixture is energy-intensive and commercially unviable at scale. Additionally, regulatory standards for hydrogen pipeline safety, meter stations, and purity are still being developed,[69] adding another layer of uncertainty to this method.

3.2.3.5 Tube trailers

Tube trailers are used to transport compressed hydrogen gas or liquid hydrogen in high-pressure tanks that are mounted on trailers, typically over short to medium distances. Compressed hydrogen is stored in cylindrical tanks made of steel or composites, whereas liquid hydrogen is transported in insulated cryogenic trailers. Tube trailers deliver hydrogen to refueling stations and industrial sites via road or rail networks.

Tube trailers provide flexibility and require minimal infrastructure, making them ideal for early-stage markets. However, they typically have limited capacity and incur high transport costs.[70] Cryogenic trailers face boil-off losses and must adhere to stringent safety protocols due to the properties of hydrogen. Tube trailers are practical for domestic distribution where demand for hydrogen mobility is emerging, and they can support pilot projects while pipeline infrastructure develops. Though the region has safely delivered compressed natural gas (CNG) by truck, the high cost of tube trailers restricts their scalability for large-scale export.

3.2.3.6 Export transportation

Export transportation involves shipping hydrogen or its derivatives, such as liquid hydrogen, sustainable aviation fuel, or ammonia, to international markets using specialized maritime carriers. Liquid hydrogen is shipped in cryogenic tankers designed to maintain -253°C, while ammonia is transported in refrigerated or pressurized tankers to maintain -33° C. These carriers use deep-water ports for loading and follow transatlantic routes to markets like Europe. Emerging technologies, such as LOHC tankers, are also being explored by North Atlantic for ambient-conditioned transport, while SAF is able to be transported in the same vessels as traditional Jet A fuel.

Ammonia is showing up as the preferred carrier for export due to its higher energy density and established trade networks. It can be cracked back into hydrogen at the destination. However, conversion and cracking processes add to overall costs. Port infrastructure upgrades, including loading and liquid bulk handling facilities, and ensuring compliance with international safety standards are required for scalability.[71] Export transportation is a cornerstone for Atlantic Canada's hydrogen strategy, leveraging deep-water ports to ship green ammonia to Europe. Port upgrades require considerable investment, and the necessary enhancements differ widely based on the existing infrastructure. These may include pipeline integration, liquid bulk handling capabilities, installation of new cranes and handling equipment, and expansion of the port area. Beyond port enhancements, the construction of new ports may also be required to meet demand. This process would involve consultations with stakeholders, including port operators, port authorities, hydrogen facility operators, local governments, and Indigenous communities. Furthermore, establishing partnerships with shipping companies and ensuring a dependable supply chain are crucial for the successful execution of export operations.

3.2.4 End-use

The end-use phase of the hydrogen value chain includes a variety of applications that use hydrogen to aid in decarbonization and enhance energy security. Hydrogen is employed in multiple forms, including pure hydrogen gas, liquid hydrogen, and derivatives such as ammonia, to power industrial processes, generate electricity, fuel transportation, blend with natural gas, or be exported to international markets. The adaptability of hydrogen enables it to act as a clean energy carrier, substituting fossil fuels in hard-to-abate sectors, such as heavy industry and long-haul transport. For Atlantic Canada, this phase offers a chance to use renewable hydrogen production to decarbonize local industries, enhance mobility solutions, and access global markets. Key considerations in this stage of the value chain include:

- Ensuring the availability and readiness of technologies such as fuel cells and turbines compatible with hydrogen

69 Hydrogen Blending into Natural Gas Pipeline Infrastructure: Review of the State of Technology (Accessed 6/25/25)
70 Over the Road Tube Trailers - SHEA (Accessed 6/25/25)
71 A review on ports' readiness to facilitate international hydrogen trade - ScienceDirect (Accessed 6/18/25)

- Establishing infrastructure, such as refueling stations for transportation and pipelines for industrial supply, is crucial for widespread adoption
- Robust safety and regulatory frameworks must address hydrogen's flammability and mitigate risks to secure public acceptance, especially in densely populated regions

3.2.4.1 Industry applications, ammonia, and low-carbon fuels

Hydrogen can function as both a feedstock and an energy source in industrial processes, facilitating decarbonization in sectors characterized by high emissions. Its applications include refining, chemical production (e.g., ammonia synthesis for fertilizers, petrochemicals), and industrial heating. These industrial uses demand high-purity hydrogen, necessitating robust purification systems following production. Ensuring demand stability is essential, as industrial users often need long-term contracts to justify their investments. For instance, New Brunswick's refining sector can use hydrogen to produce low carbon fuels, thereby complying with stringent environmental regulations.

Ammonia and other low-carbon fuels derived from hydrogen play crucial roles as energy carriers and feedstocks, particularly in export and industrial sectors. Ammonia, synthesized from hydrogen and nitrogen using the Haber-Bosch process, serves multiple purposes: it is a fertilizer feedstock, a potential maritime shipping fuel, and a hydrogen carrier for export. Despite their advantages, low-carbon fuels face competition from biofuels and require carbon dioxide capture infrastructure for scalable production.[72] Economic viability is driven by market demand, notably from Europe, which shapes the prospects for export-oriented applications. Atlantic Canada's abundant onshore and offshore wind resources strategically position the region to become a hub for green hydrogen, ammonia, and SAF production, aiming to meet the European market demand.

3.2.4.2 Transportation

Hydrogen powers transportation either through fuel cells or within an internal combustion engine. Fuel cell electric vehicles (FCEVs) use hydrogen to generate electricity via a fuel cell, thus powering electric motors with water as the only byproduct. Applications include heavy-duty trucks, buses, trains, and maritime vessels. In addition to FCEVs, dual fuel engines and hydrogen combustion engines are emerging technologies that use hydrogen to enhance efficiency and reduce emissions in traditional internal combustion engines.[73] Hydrogen refueling stations compress or liquefy hydrogen for delivery to vehicles. The high energy density of hydrogen makes it ideal for long-haul transportation; however, the infrastructure for refueling is limited, with stations each costing approximately $2-$4 million USD to construct.[74]

3.2.4.3 Power generation

Hydrogen can play a pivotal role in power generation by enhancing grid stability, providing backup power, and offering baseload energy, thereby facilitating the integration of renewable energy sources. It can be combusted in gas turbines to produce grid-scale electricity and blended with natural gas in existing turbines to lower emissions. Fuel cells for power generation deliver high efficiency, whereas turbines offer scalability to meet larger-scale power demands. Given the region's fluctuating wind resources, hydrogen could serve as an option for energy storage and grid balancing, using fuel cells for backup power at remote locations and turbines for baseload generation.

3.2.4.4 Natural gas blending

Blending hydrogen with natural gas can decrease the carbon intensity of building heating, power generation, and industrial processes. This strategy uses existing natural gas infrastructure and requires fewer modifications to end-use equipment at lower blend levels. However, higher blends (above 20%) may cause pipeline embrittlement and require modifications or replacement of natural gas appliances. The development of regulatory standards for blending limits and safety is ongoing, influencing the rate of adoption. In Atlantic Canada, hydrogen blending would occur within the distribution grids operated by Liberty Utilities and Eastward Energy, serving various cities in New Brunswick and Nova Scotia. The newer plastic piping of these natural gas networks allows for this blending.

3.2.4.5 Export market applications

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72 E-fuels: A Challenging Journey To A Low-Carbon Future (Accessed 6/18/25)

73 The role of hydrogen for future internal combustion engines - A Onorati, R Payri, BM Vaglieco, AK Agarwal, C Bae, G Bruneaux, M Canakci, M Gavaises, M Günthner, C Hasse, S Kokjohn, S-C Kong, Y Moriyoshi, R Novella, A Pesyridis, R Reitz, T Ryan, R Wagner, H Zhao, 2022 (Accessed 6/19/25)

74 Review of transportation hydrogen infrastructure performance and reliability (Journal Article) | OSTI.GOV (Accessed 6/18/25)

Exporting hydrogen or its derivatives, such as liquid hydrogen, LOHC, ammonia or sustainable aviation fuel, to international markets leverages the global demand for clean energy. Hydrogen is transformed into these carriers and transported via maritime vessels to regions like Europe, where it is used for industrial decarbonization, power generation, or as fuel. At the destination, ammonia is either converted back into hydrogen or employed directly in applications such as fertilizer production or maritime fuel. Establishing offtake agreements with European purchasers and adhering to stringent international safety and trade regulations is essential.

3.2.4.6 Systems and components of export applications

The end-use phase involves various systems tailored to specific applications, each requiring specialized components to ensure efficient and safe operation. A detailed list of systems and components can be found in Appendix 8.3.

Industry applications, ammonia, and low-carbon fuels

Key components in these systems include hydrogen burners, hydrocracking reactors, gas purification units, ammonia synthesizer reactors, and ammonia storage tanks. The specialized burners for hydrogen combustion are engineered to manage high flame speeds, while high-pressure reactors are employed to remove sulfur from fuels. Given the complexity of their design, global demand, and material specifications, these components experience significant lead times—ranging from 6-9 months for burners. Ammonia synthesizer reactors, such as the Haber-Bosch reactor vessel, also face international dependencies with lead times of 12-18 months due to intricate designs and global demand. Furthermore, the requirement for high-purity hydrogen imposes additional constraints, necessitating supplementary purification infrastructure.

Transportation

The delivery of hydrogen through refueling stations requires compression and dispensing infrastructure. Critical components, including fuel cells and high-pressure dispensers, are subject to international dependencies, with lead times ranging from 6-9 months. This is due to high demand, stringent material durability requirements, safety certification processes, and global supply chain constraints.[75] In Atlantic Canada, the scarcity of refueling stations coupled with the high construction costs creates an economic bottleneck, hindering widespread adoption.

Power generation

The use of hydrogen in power generation facilitates cleaner electricity production. Essential components include hydrogen-compatible gas turbines and advanced fuel cells, both of which require significant lead times due to high demand and the necessity for custom modifications. Gas turbines are specifically adapted to accommodate hydrogen's unique combustion characteristics, whereas fuel cells convert hydrogen directly into electricity with high efficiency. Hydrogen storage solutions, such as high-pressure tanks, ensure a reliable fuel supply and must comply with stringent safety standards.

Natural gas blending

Natural gas blending involves integrating hydrogen into existing natural gas pipelines, offering a promising application for hydrogen. This approach employs current infrastructure to gradually reduce carbon emissions while ensuring a stable energy supply. Important components and systems in this process include pipeline materials compatible with hydrogen, advanced monitoring systems for leak detection, and specialized compressors designed to manage hydrogen's unique properties. Additionally, metering and regulation equipment must be adapted to accurately measure and control the hydrogen-natural gas blend, along with the end-use appliances, such as stoves, and not only how it could impact performance, but warranties as well.

To accommodate these modifications, regulatory frameworks and technical standards need to evolve to permit higher hydrogen concentrations in the blend. However, the current infrastructure's limited capacity to manage significant hydrogen volumes, along with the requirement for technological upgrades, presents challenges to widespread adoption in Atlantic Canada, similar to other jurisdictions globally.[76]

Export

Ammonia can be used directly or decomposed back into hydrogen at its destination. Before reaching this stage,

[75] H2-MOBILITY_Overview-Hydrogen-Refuelling-For-Heavy-Duty-Vehicles_2021-08-10.pdf (Accessed 6/19/25)

[76] A review of challenges with using the natural gas system for hydrogen - Martin - 2024 - Energy Science & Engineering - Wiley Online Library (Accessed 7/25/25)

cryogenic tankers for liquid hydrogen and ammonia storage tanks are essential components for export applications. However, the capacity for exporting ammonia is constrained by port infrastructure delays and the limited availability of tankers, which can significantly restrict export capabilities.

3.2.5 Domestic and export value chain distinctions

The domestic hydrogen value chain in Atlantic Canada is designed to support the region's ambitious decarbonization targets and stimulate local economic development. The export hydrogen value chain aims to position Atlantic Canada as a leading global supplier of hydrogen, leveraging its strategic geographic location and abundant onshore and offshore wind resources. Table 11 below outlines the domestic and export distinctions across the value chain stages.

Table 11 Distinctions in domestic and export value chain of Atlantic Canada

	Domestic value chain	Export value chain
Construction	The establishment and development of infrastructure, including hydrogen production facilities, storage tanks, pipelines, and distribution networks, specifically designed to meet regional demand, such as hydrogen refueling stations for heavy-duty transport.	Construction for export-oriented projects involves large-scale, capital-intensive facilities, such as green hydrogen production plants using electrolysis. These projects also require large-scale hydrogen derivative storage terminals, significant port infrastructure upgrades (especially to deep-water ports) for export, ensuring compliance with international standards.
Production	Production is smaller scale, tailored to local or regional demand to decarbonize local industries, supporting energy security, and reducing greenhouse gas emissions in alignment with the regions' developmental goals. It serves regional sectors such as refining, power generation, and heavy transportation.	Export production emphasizes large-scale green hydrogen facilities to supply high-demand international markets such as Europe to position Atlantic Canada as a global supplier of green hydrogen and its derivatives, particularly ammonia. Production also needs to meet stringent internal emissions standards, increasing operational complexity and costs.
Storage and Distribution	Domestic storage solutions and distribution channels focus on gaseous hydrogen stored in pressure vessels or salt caverns with distribution via repurposed natural gas pipelines or localized trucking.	Export storage solutions and distribution include liquid hydrogen or hydrogen carriers such as LOHC, SAF, or ammonia for long-distance marine transport. These require specific liquefaction plants, port-based storage facilities, and specialized shipping vessels for international transport. Infrastructure must also adhere to international safety and certification standards, adding complexity. Salt caverns can also be utilised for export opportunities, should their location align with port and production infrastructure.
End-Use	Domestic end-uses focus on decarbonizing hard-to-abate sectors including heavy-duty transportation, industrial processes, power generation and natural gas blending for industrial and building heating.	The export end-use targets international markets, such as Europe, for ammonia production and other industrial applications. Hydrogen is frequently converted into ammonia or other carriers to facilitate efficient transport.

3.2.6 Regional value chain distinctions

Each province contributes to the hydrogen ecosystem, based on resource availability, industry, policy, and market focus. The tables below outline strategic efforts across construction, production, storage/distribution, and end-use, highlighting regional variations and priorities in the value chain.

3.2.6.1 Development and construction

	Areas of focus
Nova Scotia	• The development of large-scale onshore and offshore wind farms to fuel green hydrogen production (domestic and export markets). • The construction of green hydrogen and derivative production, and marine distribution infrastructure (e.g. ports).
Newfoundland and Labrador	• The development of large-scale onshore wind farms to fuel green hydrogen and derivative production for export markets. Offshore wind development is a medium to longer-term priority. • The construction of green hydrogen and derivative production and marine distribution infrastructure (e.g. ports).
New Brunswick	• The development of large-scale onshore wind farms and small modular reactors to fuel green or low carbon hydrogen production (domestic and potentially export markets). • Future investments in decarbonizing existing grey hydrogen production and use in Saint John (Irving Oil refinery). • The construction of green hydrogen production and marine distribution infrastructure (e.g. ports).
Prince Edward Island	• The development of small-scale or microgrid green hydrogen applications for domestic markets.

3.2.6.2 Production

	Focus for province
Nova Scotia	• Focus on green hydrogen and derivative production via electrolysis powered by renewable energy, primarily onshore wind and offshore wind for medium-term.
Newfoundland and Labrador	• Focus on green hydrogen and derivative production via electrolysis using renewable energy from onshore (near term) and offshore (medium-long-term scaling up) wind.
New Brunswick	• Focus on green hydrogen production via electrolysis powered by renewable energy, primarily wind, with potential contributions from nuclear. • Decarbonization of grey hydrogen production and use in Saint John (Irving Oil refinery).
Prince Edward Island	• Focus on green hydrogen production via electrolysis using PEI's wind energy to produce hydrogen for local applications.

3.2.6.3 Storage/distribution/transportation

	Focus for province
Nova Scotia	• Exploration of underground salt caverns for large-scale hydrogen storage • Support the decarbonization of Eastward Energy's natural gas distribution system through the blending of domestically produced green hydrogen.
Newfoundland and Labrador	• Development of underground salt caverns for large-scale hydrogen storage • Development and repurposing of above-ground storage for hydrogen and derivatives as part of export-oriented projects • Marine shipments of hydrogen and derivatives for international export
New Brunswick	• Support the decarbonization of Liberty Utility's natural gas distribution system through the blending of domestically produced green or low carbon hydrogen
Prince Edward Island	• No dedicated pipeline infrastructure—transport of hydrogen would be via tube trailers

3.2.6.4 End-use

	Focus for province
Nova Scotia	• Primary focus is on export markets, particularly Europe, for green hydrogen and derivatives

	Focus for province
	• Domestic use for green hydrogen would be for hard-to-abate sectors such as industrial processes, heavy industry, heavy transportation, and marine vessels to support decarbonization goals. The Clean Fuels Fund provided funding to domestic production and end-use projects as identified in Table 4, including the Strait of Canso region which developing a Hydrogen and Clean Fuels Domestic Use Strategy. • Blending of hydrogen with natural gas in the distribution system
Newfoundland and Labrador	• Primary focus is on export markets, particularly Europe, for green hydrogen and derivatives • In the future, domestic use for green hydrogen could be utilised for hard-to-abate sectors such as industrial processes, heavy industry and transportation, to support decarbonization goals.
New Brunswick	• Focus on export markets, particularly Europe, for green hydrogen/ammonia to support industrial decarbonization as well as domestic use in hard-to-decarbonize sectors such as replacing natural gas in industrial processes (e.g. Irving Oil Refinery) to reduce emissions • Potential for hydrogen in heavy transportation • Exploration of hydrogen for power generation and heating in industrial clusters • Blending of hydrogen with natural gas in the distribution system
Prince Edward Island	• Primary focus is domestic applications – using hydrogen in transportation, agriculture, fisheries and local power generation

3.3 Supplier landscape and capability review

A review of supplier availability was conducted to assess their geographic distribution and availability of suppliers for Atlantic Canada's hydrogen value chain to identify suppliers to support the forecasted demand within Atlantic Canada, across Canada, and globally, highlighting strengths, gaps, and dependencies to guide regional supply chain development.

3.3.1 Methodology

Primary data collected from the supplier self-identification survey (survey insights are detailed in Appendix 8.4) helped validate regional supplier base offerings and capabilities. Secondary research included insights from industry reports produced by industry organizations, as well as web-based research covering government announcements, company websites, and trade publications, to understand supplier locations and their capabilities. The review focuses on suppliers of components and systems related to hydrogen production, storage and distribution, and end use, excluding upstream electricity generation. Emphasis was placed on systems and equipment within the value chain which are more critical to hydrogen, such as electrolyzer stacks. The suppliers are grouped into two tiers: Tier 1 suppliers, which provide major systems like electrolyzers or fuel cells directly to end-users, and Tier 2 suppliers, which supply subcomponents like valves or sensors to Tier 1 suppliers or integrators.

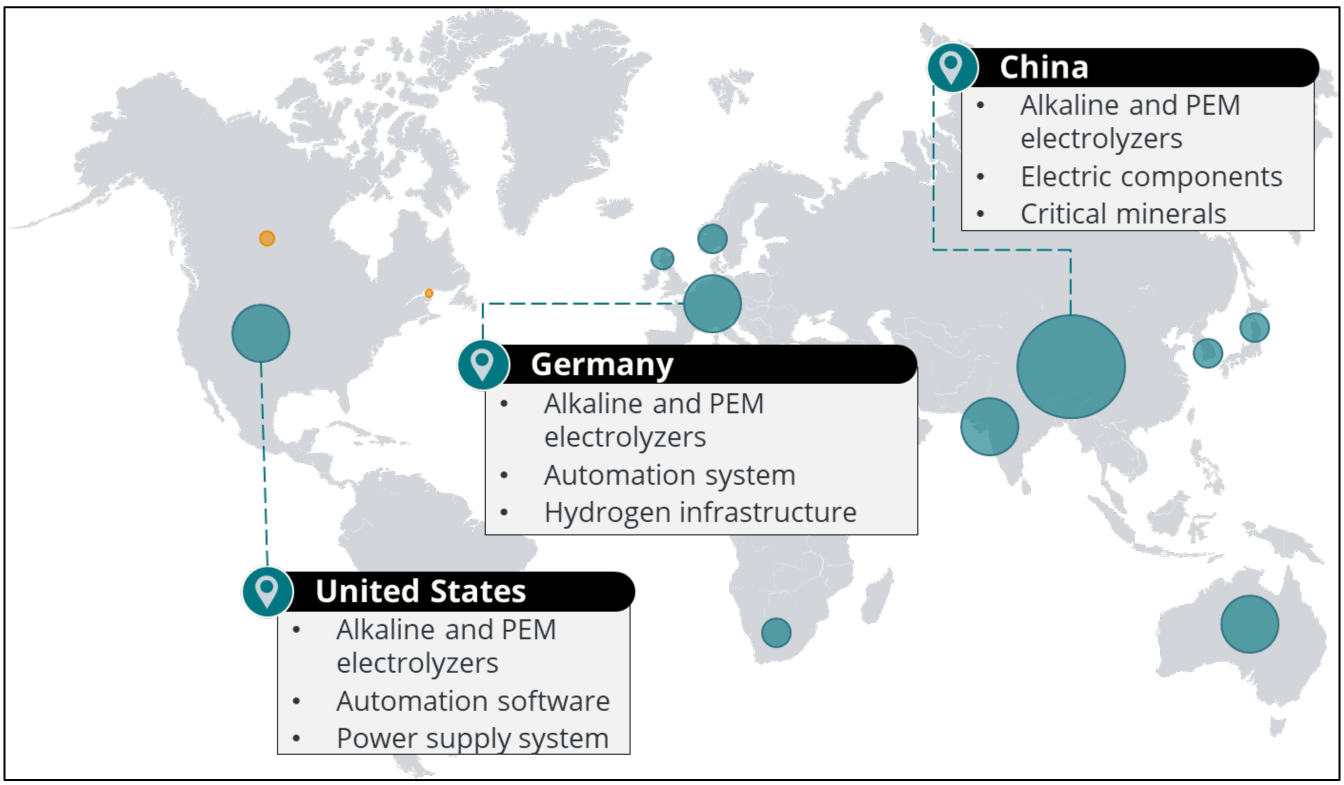


Figure 15 Current supplier presence for critical components

3.3.2 Supplier landscape in Atlantic Canada

Atlantic Canada's hydrogen supplier ecosystem is still emerging, with limited local availability of hydrogen-specific components. The region's industrial supplier base currently focuses on related sectors such as oil and gas, wind energy, and heavy industry. While companies experienced in high-pressure systems, fluid handling, and industrial fabrication could support hydrogen projects—especially for piping, valve systems, and instrumentation—the availability of locally-produced hydrogen components remains limited. However, these existing capabilities provide a foundation for supporting hydrogen activities in facility design, engineering, system integration, and logistics.

There are notable gaps in the local availability of critical Tier 1 components essential for hydrogen production and use, including electrolyzers, fuel cells, advanced compressors, and hydrogen storage vessels. These key systems are not manufactured in the region and must be sourced from other parts of Canada or from international suppliers, resulting in longer lead times if sourced overseas, and increased exposure to supply chain risks such as market fluctuations, procurement delays, and currency volatility.

In contrast, there is greater availability of less complex but essential Tier 2 components, such as valves, control systems, sensors, and mechanical sub-assemblies. Many of these suppliers are small or medium-sized enterprises with transferable skills that, with targeted support, can be adapted for hydrogen-specific requirements. Engineering and consulting firms in the region further contribute by providing services in project design, feasibility assessment, and infrastructure planning, helping to strengthen the overall value chain.

To improve the availability of hydrogen components, Atlantic Canada's key priority should be to expand and enhance the capacity and availability of local Tier 2 suppliers. This includes adapting production processes, achieving relevant certifications, and upgrading quality systems to meet hydrogen industry standards. By increasing local production and supply of components, the region can reduce reliance on global suppliers, shorten lead times, and improve its resilience and competitiveness in the growing hydrogen sector.

Lastly, Atlantic Canada can begin developing a regionally anchored supply chain, supported by both domestic and international players. This includes attracting key OEMs, but importantly, creating meaningful opportunities for Indigenous, rural, and local community suppliers and service providers to participate. The opportunity extends beyond hydrogen-specific components to include general facility equipment, structural materials, and construction and installation services—areas that align well with the existing capabilities of many suppliers and service providers already operating across the region.

3.3.3 Supplier readiness survey

To better understand Atlantic Canada's emerging hydrogen ecosystem, an Atlantic Hydrogen Supplier Readiness Survey was developed and conducted to qualitatively assess organizational capabilities, readiness, and perspectives across the hydrogen value chain. The survey targeted a diverse set of organizations active in or adjacent to hydrogen, ranging from equipment suppliers and fabricators to EPCs, government agencies, and Indigenous partners. A total of 80 organizations participated in the survey, representing all four Atlantic provinces and spanning the full hydrogen value chain. Their distribution across supply chain stages is shown below:

#	Value chain segment	Supply chain segment	Types of organizations	Respondents
1	**Production**	Upstream	Hydrogen producers & project developers; Fabricators; System OEMs; Parts OEMs	25
2	**Storage & Distribution**	Midstream	Infrastructure providers; Distribution and transportation partners	12
3	**End use**	Downstream	End-users (e.g., industrial, mobility, fuel switching)	4
4	**R&D, Manufacturing & Enabling Areas**	Support & Enabling Services	EPC/EPCMs; Professional services & technology providers; Research and academia; Industry associations; Indigenous and community partners; Government & regulators	39

There was strong survey strong participation from organizations in support and enabling roles, indicating high institutional interest and preparedness for hydrogen-related work (e.g. advisory, R&D, engineering, regulatory support). Upstream actors (e.g. producers, fabricators, OEMs) comprise a notable share, reflecting early-stage project development and supply chain formation. Midstream participation was more limited. Fewer end-users took part, suggesting that downstream market activation remains largely overseas at this stage and in its infancy locally.

While the survey captures a broad cross-section of regional stakeholders, it reflects self-reported perspectives and varying levels of hydrogen maturity, meaning results should be interpreted as indicative rather than exhaustive. Nonetheless, the insights clearly define where targeted interventions—in supply chain and market development, infrastructure, funding, skills, and inclusion—can accelerate ecosystem growth and position Atlantic Canada as a competitive player in the global hydrogen economy.

Current involvement and readiness across the hydrogen value chain

Across the Atlantic hydrogen ecosystem, organizational involvement and readiness vary widely by supply chain segment, reflecting differences in maturity, investment readiness, and transferable experience from adjacent industries. Survey responses show that roughly one-third of all organizations are actively engaged in hydrogen projects, another quarter are supporting others through advisory, engineering, or research roles, and nearly one-fifth are not yet involved but interested. The results underscore that while technical capability exists, much of the sector remains in an early stage of activation.

Production
(producers, fabricators, OEMs)

Upstream participants reported the highest level of hydrogen activity and readiness. More than half are currently developing or directly supporting hydrogen projects, including feasibility studies, pilot production systems, and component manufacturing. Their experience base is comparatively deep: over half have more than five years of hydrogen-related activity, and 28% report a decade or more.

Nearly all upstream organizations also bring experience from adjacent heavy industries—oil and gas, petrochemicals, renewables, and biofuels—providing a strong base of transferable skills in engineering, fabrication, process design, and industrial safety. Open-ended responses highlight this sector's practical readiness: many note they are already adapting pressure vessels, valves, and electrical systems for hydrogen applications, or supporting project development through EPC and fabrication roles.

Storage & Distribution
(infrastructure, storage, and logistics providers)

Midstream organizations are less mature but beginning to mobilize. Around one-third are actively exploring hydrogen opportunities, often focused on storage, port logistics, or distribution feasibility studies. Most have fewer than five years of direct hydrogen experience, though several draw on deep operational expertise in analogous sectors such as LNG, natural gas, and marine transport. Respondents cited transferable skills in terminal operations, supply-chain management, and energy storage, while emphasizing that project advancement depends on policy certainty and demonstrable demand to justify infrastructure investments.

Open responses from this group frequently referenced adaptation potential—such as repurposing LNG handling systems or port infrastructure for hydrogen derivatives—but also pointed to uncertainty around codes, safety standards, and capital recovery as barriers to readiness.

End-use
(industrial and transportation end-users)

End-use readiness remains limited but growing. Only a small number of downstream respondents reported active hydrogen projects or are participating in early feasibility or pilot stages (e.g., industrial boiler retrofits, heavy transport trials, or backup power systems). All organizations in this group have less than ten years of hydrogen experience, and most are in early exploration phases.

However, most downstream firms possess relevant expertise in adjacent areas—such as fleet management, industrial process optimization, and renewable energy integration—positioning them to adopt hydrogen as infrastructure and fuel availability improve. Qualitative comments underscored a pragmatic stance: end-users are monitoring hydrogen developments closely but remain cautious until fuel cost, infrastructure, and safety standards stabilize.

R&D, Manufacturing & Enabling Areas (EPCs, academia, advisory, and government)

Support and enabling service organizations form the backbone of the region's current hydrogen ecosystem. Nearly 40% are already supporting others' projects, and a further 23% are directly engaged in hydrogen-related work. This group also exhibits the deepest institutional experience: more than four-fifths report over five years in the field, and many exceed a decade.

Transferable expertise spans renewable energy, utilities, and industrial gases, along with policy, permitting, and R&D. Open responses highlighted active involvement in hydrogen policy design, safety research, and technical feasibility studies. Several academic and applied research institutions also reported leadership in pilot design, workforce development, and industry collaboration. Collectively, this segment provides much of the advisory, technical, and analytical capacity underpinning early hydrogen development in the region.

Taken together, the survey points to an ecosystem anchored by strong upstream and enabling capabilities, complemented by growing but still tentative midstream and downstream activity. Many respondents view hydrogen as a logical extension of their existing operations rather than a wholly new sector, suggesting that the region's transition would be shaped by the ability to adapt existing industrial and research strengths to hydrogen-specific applications.

Table 12 Current hydrogen sector activities by supply chain segment

Value chain segment	Working on H2 projects	Exploring / evaluating	Not involved but interest	Piloting H2 technologies	Supporting other orgs	No interest / relevance
Production	56%	8%	16%	12%	8%	0%
Storage & Distribution	17%	17%	33%	17%	17%	0%
End-use	25%	25%	25%	0%	25%	0%
R&D, Manufacturing & Enabling Areas	23%	15%	13%	8%	38%	3%
Grand Total	33%	14%	18%	10%	25%	1%

Table 13 Years of experience in Hydrogen-related activities/services

Value chain segment	0–2 years	3–5 years	6–10 years	10+ years
Production	1	9	5	7
Storage & Distribution	0	7	4	1
End-use	0	2	2	0
Enabling Areas	2	3	15	17
Total	**3**	**21**	**26**	**25**

Table 14 Relevant experience in similar industries (sorted by overall %)

Related industry / domain	Production	Storage & Distribution	End-use	Enabling areas	Overall (%)
Engineering / construction / EPC	84%	67%	50%	72%	**73%**
Power generation / renewables	52%	50%	50%	64%	**57%**
Environmental services	32%	25%	25%	69%	**50%**
Utilities / grid operations	32%	58%	25%	49%	**45%**
Oil & gas / petrochemicals	68%	42%	25%	21%	**39%**
Manufacturing / fabrication	60%	33%	25%	31%	**39%**
Transportation / logistics	28%	83%	50%	18%	**38%**
Research / academia	8%	17%	0%	54%	**32%**
Marine / port operations	16%	67%	0%	8%	**22%**
Government / regulatory	4%	8%	0%	38%	**20%**

3.3.3.1 Readiness to support hydrogen projects in Atlantic Canada

Table 15 Percentage of respondents by readiness level and value chain segment

Readiness level	Production	Storage & Distribution	End-use	Enabling areas	Overall
Fully ready or operational	40%	8%	0%	21%	24%
Partially ready or developing skills/capacity	20%	8%	75%	13%	16%
Researching/piloting or in early exploration/evaluation	28%	33%	25%	41%	36%
Not ready or not applicable	4%	33%	0%	8%	12%
Unsure	8%	8%	0%	8%	6%

The readiness assessment reveals notable differences across the hydrogen value chain in Atlantic Canada. **Upstream organizations**—including project developers, OEMs, and fabricators—are currently the most prepared, with 40% reporting they are fully ready to support or develop hydrogen projects. A further 28% are engaged in early exploration, research, or piloting, signaling strong momentum and technical capability at the supply-side entry point of the value chain.

In contrast, **midstream readiness**—comprising infrastructure, logistics, and storage providers—is significantly lower. Just 8% of respondents in this segment are fully ready, while 25% remain in early exploration and another 25% consider hydrogen development not applicable to their current business. This points to a need for strategic investment and capacity building in hydrogen-compatible transport, storage, and distribution systems to support future scaling.

The **downstream sector** is currently the least ready, with no respondents indicating full readiness and 75% reporting they are only partially prepared. This suggests limited hydrogen demand from end users today, likely due to cost, infrastructure limitations, and uncertainty around commercial-scale fuel switching or technology adoption.

Meanwhile, **support and enabling service providers**—such as EPCs, research institutions, advisory firms, and government bodies—show a mixed state of readiness. While 18% of respondents are fully ready, the majority (over 50%) are developing skills, researching, piloting, or exploring their role in the ecosystem. This segment is essential for bridging policy, workforce, and project development gaps and is critical to helping the broader ecosystem scale effectively.

Overall, while 23% of organizations across the value chain report full readiness, more than half are still evaluating, piloting, or developing capacity—highlighting the need for targeted support, especially in midstream and end-use activation, to unlock a coordinated and investable hydrogen economy in Atlantic Canada.

3.3.3.2 Barriers to sector development

Table 16 Top barriers to hydrogen sector development

	High cost of production	Lack of critical infrastructure	Uncertainty of H2 demand	Lack of funding/ incentives	Underdeveloped supply chain
Production	64%	32%	32%	28%	28%
Storage & Distribution	75%	58%	42%	17%	33%
End-use	75%	50%	25%	0%	25%
Enabling Areas	56%	28%	33%	38%	28%

(% of respondents in each segment rating the barrier as "Very Significant")

As shown in Table 16, across the value chain, the high cost of hydrogen production is perceived as the single most significant barrier, with 64–75% of upstream, midstream, and downstream participants rating it as "very significant." This underscores the urgency of cost competitiveness—both in production and conversion—to make hydrogen viable regionally and internationally.

The lack of critical infrastructure is of particular concern for the midstream (58%) and downstream (50%) segments. These results suggest that logistics, storage, and port-adapted facilities are currently ill-equipped to support scaled hydrogen transport and end-use, creating bottlenecks for project developers and potential offtakers.

Uncertainty surrounding hydrogen demand is a medium-level concern across all segments, but is strongest in the midstream (42%), where investment requires clear offtake signals. The lack of funding or incentives is more acutely felt by support and enabling actors (38%), indicating that while advisory and technical providers are ready, they see financial enablement as key to unlocking full project deployment.

Finally, the underdeveloped regional supply chain is viewed similarly by all segments (25–33%)—reflecting that while capability exists, scaling would require coordinated industrial development and local manufacturing expansion.

These findings highlight the need for targeted government support in cost reduction, infrastructure deployment, and incentives, especially to accelerate midstream and downstream capacity and market activation. These findings reveal a clear alignment between perceived barriers and the forms of support most requested by respondents.

3.3.3.3 Support required

Across all segments, the most consistently cited need was for clear and stable market signals — particularly long-term offtake visibility and demand certainty to justify investment in facilities, infrastructure, and workforce development. This reflects the region's early stage of hydrogen commercialization and the need for anchor projects or demand-pull mechanisms to validate business cases.

Table 17 Top forms of support across the hydrogen ecosystem

Rank	Type of support	% of respondents (n=80)
1	Clear market signals / demand certainty	**64%**
2	Access to funding / grants	**59%**
3	Policy and regulatory clarity	**44%**
4	Partnerships or matchmaking opportunities	**34%**
5	Access to pilot or demonstration projects	**21%**
6	Operational and supply chain support	**20%**
7	R&D collaboration and best practices	**20%**
8	Risk mitigation / insurance mechanisms	**20%**

Support needs vary notably across the hydrogen value chain. Upstream organizations most strongly emphasized the need for demand certainty and funding support, reflecting their capital-intensive projects and reliance on offtake agreements to justify investment. They also prioritized regulatory clarity to streamline permitting and safety compliance. Midstream respondents—focused on transport, storage, and port infrastructure—highlighted policy certainty and financing mechanisms as essential to unlock large-scale infrastructure upgrades, alongside stronger partnership coordination across the supply chain.

Downstream actors, including end-users and industrial customers, expressed interest in pilot and demonstration projects that would reduce adoption risk and validate hydrogen use cases. Meanwhile, support and enabling service providers (EPCs, researchers, government bodies, and consultants) underscored the importance of collaboration frameworks, R&D investment, and coherent policy direction to create the ecosystem conditions needed for all other segments to scale.

Value chain segment	Top support needs (by frequency)
Production	Demand certainty (19), Funding (13), Policy clarity (9), Partnerships (9), Pilots (8)
Storage & Distribution	Policy clarity (6), Funding (5), Partnerships (4), Demand certainty (3), Technical guidance (2)
End-use	Demand certainty (2), Funding (2), Pilots (2), Partnerships (1)
Enabling Areas	Demand certainty (27), Funding (24), Policy clarity (20), Partnerships (13), R&D collaboration (7)

3.3.3.4 Regional differences in responses

Nova Scotia and Newfoundland and Labrador contributed the largest share of respondents, dominated by upstream and support-service organizations. This aligns with active project pipelines and policy momentum in both provinces—Nova Scotia's green hydrogen export projects around the Strait of Canso and NL's Crown-land wind-to-hydrogen allocations have spurred activity among project developers, fabricators, and EPCs. In both jurisdictions, the survey revealed relatively higher self-reported readiness and experience, suggesting that early policy clarity and anchor project visibility are driving supplier engagement and capability building.

New Brunswick's participation leaned more toward midstream and enabling service providers, including logistics, port operations, and research organizations. This reflects the province's evolving role as a potential hydrogen distribution and domestic-use hub, tied to its refining, transportation, and port infrastructure. Respondents here emphasized infrastructure readiness, policy coordination, and funding availability as critical enablers—consistent with a focus on repurposing existing energy assets and workforce capabilities rather than developing new greenfield production.

In contrast, **Prince Edward Island** exhibited limited direct hydrogen activity but notable interest from academic, municipal, and community organizations within the support and enabling segment. These actors highlighted the importance of demonstration projects, education, and local engagement to ensure that smaller jurisdictions can participate in the emerging regional value chain. Respondents from PEI and rural Nova Scotia also underscored the potential for hydrogen to serve localized decarbonization goals, such as renewable integration and transportation applications, but cited limited technical capacity and investment readiness as key barriers.

Overall, the geographic pattern mirrors the maturity of each province's hydrogen strategy: production-focused readiness in NL and NS, infrastructure and logistics planning in NB, and ecosystem development interest in PEI. The data suggest that while hydrogen is emerging as a regional priority, each province occupies a distinct niche within the Atlantic hydrogen landscape—reinforcing the value of coordinated regional planning to align capabilities, policy, and investment across the four jurisdictions.

3.3.3.5 Future outlook

From the survey responses, clear signals emerged around future hydrogen opportunities and adaptable capabilities across Atlantic Canada's supply chain. Most respondents indicated that, while their current operations are not yet hydrogen-focused, they can adapt existing technologies, services, or expertise to hydrogen applications with modest investment or retraining. This was particularly strong among engineering, construction, and equipment manufacturing firms, who cited transferable experience in oil and gas, renewables, and industrial gas systems. Typical examples include adapting pressure vessels, valves, and control systems for hydrogen use, retooling fabrication and maintenance services for hydrogen plants, and applying process and electrical engineering expertise.

Across all segments, organizations framed hydrogen as a logical extension of existing energy and industrial capabilities rather than an entirely new domain. Upstream and midstream respondents highlighted opportunities to expand to hydrogen production, storage, and transport; downstream organizations pointed to future uses in mobility, backup power, and industrial heating once infrastructure matures. Support and enabling service providers—including EPCs, professional services, and research institutions—emphasized their readiness to scale R&D, policy, and technical advisory functions as demand grows.

Overall, the results suggest that the region's ecosystem is rich in adaptable expertise but still constrained by limited market visibility and investment certainty. Many firms are "hydrogen-ready" in capability terms yet await clearer commercial signals before committing significant capital or workforce to the sector.

3.3.3.6 Collaboration with Indigenous communities

Collaboration with Indigenous communities

Insights related to Indigenous participation and rural community engagement were modest but notable across the survey. Only a small subset of respondents—primarily within the support and enabling services segment—reported existing partnerships or proximity to Indigenous or rural communities. These relationships were typically framed around consultation, local engagement, workforce participation, or site hosting opportunities, rather than direct project ownership or investment. A few municipalities and community organizations expressed early interest in hosting hydrogen production or demonstration facilities as a means of driving local economic development, but most indicated they were still in exploratory stages.

Across segments, many organizations acknowledged the importance of ensuring inclusive participation yet noted that formal mechanisms and funding streams to support Indigenous business involvement or community-led hydrogen initiatives remain underdeveloped. Several respondents suggested that targeted capacity-building, training, and partnership programs—particularly those that align with clean energy, transportation, or infrastructure priorities in rural Atlantic Canada—would help strengthen readiness and equity in the emerging hydrogen economy.

3.3.3.7 Implications of the survey for this study

The survey results provide a detailed point-in-time snapshot of Atlantic Canada's emerging hydrogen ecosystem, highlighting both areas of strength and the gaps that must be addressed to achieve full value chain readiness. Collectively, the findings point to an industry still in early formation, anchored by capable upstream and support actors but constrained by midstream infrastructure, downstream demand, and policy clarity.

The following implications distill the most actionable insights from the survey, outlining where strategic focus and targeted interventions would have the greatest impact on advancing Atlantic Canada's hydrogen ecosystem.

- **Hydrogen demand remains the defining uncertainty** – The survey underscores the absence of clear and sustained offtake signals across the region, with many upstream producers and fabricators indicating that project advancement depends on visibility into long-term demand and contracting mechanisms.
- **Upstream and enabling capabilities are regional strengths** – The survey shows a strong foundation in engineering, fabrication, research, and advisory services, positioning Atlantic Canada to play a leading role in early project development, technical standardization, and knowledge transfer.
- **Midstream capacity represents the key system constraint** – Respondents identified limited readiness in storage, transport, and port infrastructure, suggesting that these physical enablers of a regional hydrogen economy remain underdeveloped and would influence the pace of scaling.
- **End-use markets are still nascent** – Downstream participation remains low, with most end-users still in exploratory phases. This highlights the need for confidence-building through pilot and demonstration projects to validate hydrogen's role in industrial and transport applications.
- **The regional supply chain is emerging but fragmented** – While specialized suppliers and service providers exist, integration across tiers is limited, suggesting that improved visibility and coordination among firms is necessary to develop a competitive local ecosystem.
- **Skills development and workforce adaptation remain priority enablers** – Respondents cited the need for hydrogen-specific training and certification to build deployable capacity, noting that existing programs are limited and lag current industry ambition.
- **Equitable participation is underdeveloped but increasingly recognized** – Engagement with Indigenous and rural communities remains limited, though many organizations acknowledged the importance of inclusive participation and the need for capacity-building and partnership mechanisms to ensure broad-based regional benefits.

3.3.4 Supplier landscape for rest of Canada

Outside Atlantic Canada, provinces like Ontario and British Columbia have a more developed hydrogen supplier ecosystem. These areas benefit from existing industrial infrastructure, provincial strategies, and federal support.

A notable advantage in these provinces is the presence of some Tier 1 suppliers who can readily provide key systems for hydrogen production and use, supported by a robust network of Tier 2 suppliers offering crucial subsystems and services. Ontario, for example, is home to Cummins' Accelera division will begin to manufacture PEM electrolyzers for green hydrogen generation Atura Power.[77] Ballard Power Systems in British Columbia specializes in PEM fuel cell stacks for mobility and stationary power, showcasing the province's capability to deliver commercial-scale Tier 1 systems through integrated operations and exports.[78] The provinces also are supported by a network of Tier 2 and Tier 3 firms specializing in subcomponents, auxiliary equipment, and supporting services, further strengthening the overall availability of hydrogen components.

Gaps exist in the domestic availability of other specialized hydrogen components. High-pressure compressors required for storage and distribution are predominantly sourced from international suppliers because of limited local supply. Likewise, advanced hydrogen-specific sensors, which are vital for leak detection, system monitoring, and safety compliance, are typically imported from Europe or the United States. This reliance on foreign suppliers can create challenges for project developers seeking to implement integrated, just-in-time procurement strategies.

Looking ahead, the availability of hydrogen components in these provinces is expected to improve through ongoing provincial initiatives and interprovincial collaboration under the Canada Hydrogen Strategy. This approach encourages supply chain integration and knowledge sharing, allowing regions like Atlantic Canada to access Tier 1 systems from other provinces while enhancing infrastructure and logistics. Joint ventures and technology partnerships between Atlantic developers and Western manufacturers also present opportunities to broaden the national hydrogen supply base and improve the timely availability of critical components.

3.3.5 Supplier landscape outside of Canada

The global hydrogen supplier ecosystem has a broad availability suppliers and OEMs of critical hydrogen components primarily concentrated in Europe, Asia, and the United States. These regions serve as central hubs for sourcing advanced and critical hydrogen technologies, components and equipment. At present, the availability of all essential Tier 1 systems including electrolyzers, fuel cells, and large-scale storage infrastructure, relies on multinational corporations based outside of Canada.

In Europe, Siemens (Germany) and Nel Hydrogen (Norway) lead electrolyzer production with their alkaline and PEM technologies for industrial hydrogen generation. Their systems are widely used in Europe and exported to North America. Asia, especially China, is crucial for cost-effective manufacturing, with companies like LONGi scaling up production through integrated supply chains and government subsidies. In the United States, Plug Power dominates the PEM fuel cell market for transportation, material handling, and backup power. Toyota (Japan) leads in automotive fuel cells and hydrogen technology, backed by extensive R&D. For storage and distribution, Linde (Germany/US) and Chart Industries (US) provide essential high-pressure tanks, cryogenic equipment, compressors, and liquefaction units, crucial for hydrogen logistics at export terminals, refuelling stations, and industrial hubs. However, even in these mature regions, supply gaps exist in specialized areas. Hydrogen-specific safety sensors and monitoring devices are currently limited to a small number of advanced manufacturers, which poses potential supply constraints.

Supporting this ecosystem is a vast and specialized supplier base. Tier 1 firms control the core systems and proprietary technologies, while a network of Tier 2 supplier, including firms focused on valves, sensors, control systems, and power electronics, contribute key subsystems. Innovation is further accelerated by prominent research institutions, such as Germany's Fraunhofer Institute, which is spearheading the development of next-generation hydrogen carriers, materials, and safety protocols. Overall, supplier density in Europe and Asia exceeds 100 active firms specializing in hydrogen technology, creating a dynamic and competitive market that continues to push technological boundaries and reduce production costs.

Currently, all key systems for hydrogen production, conversion, and transportation must be imported from Tier 1 suppliers abroad. This dependency leads to long lead times, potentially elevated costs, and currency/geopolitical risks. Although Tier 1 system production will stay abroad for now, investing in local Tier 2 and Tier 3 capabilities can diversify the economy, reduce project risks, and build resilience against supply chain fluctuations.

[77] Atura Power selects Cummins - Atura Power (Accessed 6/25/25)

[78] FCgen® - Fuel Cell Stacks (Accessed 6/25/25)

3.4 Workforce requirements

The successful development of a hydrogen economy in Atlantic Canada would require alignment of workforce capabilities across the entire hydrogen value chain. This includes construction, production, storage, distribution, end-use applications, and supporting functions - each requiring specific occupations, specialized skills, and equipment suited to hydrogen applications.

This section details relevant occupations using the National Occupational Classification (NOC) framework. The workforce spans engineers and skilled trades necessary for infrastructure construction, process specialists and safety professionals essential for hydrogen production, logistics experts crucial for effective storage and distribution, as well as technicians and engineers vital for end-use systems. Furthermore, support roles in research, policy development, and education are foundational to the entire value chain.

Table 18 provides a summary of these occupational groups, their corresponding NOC codes and descriptions, required workforce skills, and essential equipment, thereby offering valuable guidance for workforce planning and strategic investment.

Table 18 Workforce roles, NOC codes and skills requirements[79]

	Stage	Workforce roles	NOC codes	Workforce skills requirements
1	**Development & Construction**	Public and environmental health and safety professionals, Geoscientists and Oceanographers, Land surveyors, Urban and Land Use Planners, Lawyers, Civil Engineers, Structural Engineers, Electrical Engineers, Mechanical Engineers, Construction Managers, Project Managers, Site Supervisors, Skilled Trades (Welders, Electricians, Pipefitters, Plumbers, HVAC Technicians), Safety Officers, QA/QC Inspectors, Heavy Equipment Operators, Boilermakers, Ironworkers	21120, 21102, 21203, 21202, 41101 21300, 21310, 21301, 21321, 70010, 72014, 72011, 72106, 72200, 72300, 72010, 72021, 72102, 72103, 72104, 72201, 72301, 72400, 75110, 72101.	Project planning and management; Structural analysis and design; Electrical and mechanical systems design; Installation of hydrogen-specific equipment; Welding and pipefitting; Safety and building code compliance; Quality assurance/control; Multidisciplinary coordination; Equipment operation; Construction site safety
2	**Production**	Process Engineers, Plant Operators, Industrial Electricians, Instrumentation & Control Technicians, Safety Professionals, Chemical Engineers, Control Room Operators, Maintenance	21310, 21320, 21321, 22101, 92101, 72201, 22312, 22232, 92100, 92010, 93101,	Hydrogen production methods (Electrolysis, steam methane reforming with CCS); Operation of high-pressure systems; Instrumentation control; Equipment maintenance; Safety protocols; Troubleshooting; Process optimization; Data analysis
3	**Storage & Distribution**	Logistics Coordinators, Transport Operators, Pipeline Engineers & Technicians, Cryogenics Experts, Regulatory Compliance Officers, Material Handlers	13201, 73300, 22101, 21300, 21301, 21332, 21331, 22101, 41402, 73400, 92100.	Cryogenic systems knowledge: Dangerous goods transport; Pipeline construction and maintenance; Regulatory & documentation compliance; Hydrogen refueling operations; Material handling
4	**End-Use Applications**	Fuel Cell Technicians & Engineers, HVAC Professionals, Industrial Process	22311, 22302, 72402, 21321,	Fuel cell integration and service; HVAC retrofitting for H_2 blending; Mechanical

[79] Disclaimer: This is not meant to be a completely exhaustive list but rather to provide examples of the workforce roles required across the hydrogen value chain.

	Stage	Workforce roles	NOC codes	Workforce skills requirements
		Engineers, Maintenance Personnel, Mechanical Engineers, Technicians	72400, 72402, 73300.	troubleshooting; Equipment reliability assessment; Energy efficiency tuning; End-user support
5	**R&D, Manufacturing and Testing**	R&D Professionals, Policy Analysts & Regulatory Experts, Educators & Trainers, Project Managers, Chemists, Business Development Officers	21110, 21101, 41400, 41200 41210, 41402, 41403, 70010.	Hydrogen R&D; Policy and regulation expertise; Training program development; Project coordination; Stakeholder engagement; Lifecycle analysis; Communication of technical concepts

A cross-stage analysis of the hydrogen value chain reveals that certain occupations and skills are foundational to the sector's long-term development. Among all roles examined, engineers—particularly electrical, mechanical, and industrial engineers (NOC 21310, 21301, 21321)—emerge as the most consistently required across all stages, from infrastructure construction to production system design, equipment integration, and end-use deployment. Their technical versatility and ability to design, implement, and oversee hydrogen technologies make them indispensable to both early-stage and operational activities.

In terms of competencies, project planning and multidisciplinary coordination are the most emphasized skills, cutting across the construction, production, and support functions. These skills are critical for navigating the complex interdependencies between engineering design, safety compliance, logistics, and system commissioning. Furthermore, equipment-specific operational knowledge—such as working with electrolyzers, compressors, fuel cells, and cryogenic systems—recurs throughout the value chain, emphasizing the need for hands-on technical training alongside strategic planning capabilities.

This consistency in occupational demand and skill requirements presents a clear opportunity for workforce development in Atlantic Canada: investing in engineering education, applied technical training, and cross-functional project management capabilities is central to building a sustainable, scalable hydrogen economy in the region.

3.5 Codes and standards

The safe and effective deployment of hydrogen infrastructure in Atlantic Canada depends on adherence to established codes, standards, and certifications. These apply across all stages of the hydrogen value chain and serve as the regulatory and technical foundation to ensure systems are designed, constructed, and operated safely and in compliance with jurisdictional requirements.

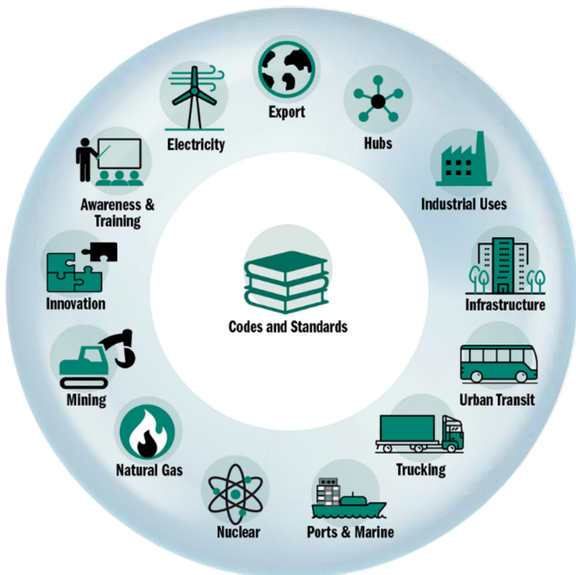


Figure 16 Areas of interest identified for the Canadian Hydrogen Codes and Standards Roadmap[80]

This section aims to help ecosystem participants understand applicable codes, standards, certifications, and regulatory requirements, identifying the resources that are available in navigating a first-of-a-kind project within their respective communities. This, in turn, can reduce the risk of project delays or redesigns and support safe, efficient project development and operations.[81]

The relationship of codes and standards with Authorities Having Jurisdiction (AHJs), regulations, and accredited engineers

The applicable code or standard is informed by the Authority Having Jurisdiction (AHJ) in accordance with relevant regulations. Multiple codes may exist globally for similar applications (e.g., NFPA 2 in the US vs. the Canadian Hydrogen Installation Code), and in some cases, a Canadian standard may not yet exist, requiring reliance on an international equivalent. Final determination often rests with the engineer and/or AHJ, depending on the specific application, the maturity of available standards, and whether regulations have been updated to reflect recent developments.

AHJs vary based on project type, location, and jurisdiction, and are present across the ecosystem, including in all three levels of government. For example, a non-exhaustive list of AHJs for different levels of Government applicable to Atlantic Canada could be:

- **Municipal**: Local building and fire officials enforce codes and by-laws for construction and fire protection.
- **Provincial**: Technical safety authorities regulate equipment installations, such as boilers and pressure

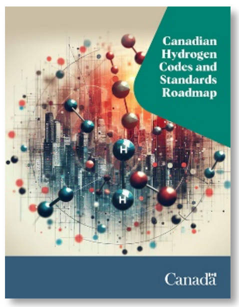
[80] Canadian Hydrogen Codes and Standards Roadmap - Natural Resources Canada (Accessed 6/18/25)

[81] **Disclaimer**: The information provided in this section is for general informational purposes only. It is not intended to serve as technical guidance or regulatory advice for project development, engineering design, or operational decision-making. Project teams must consult the relevant authorities having jurisdiction (AHJs), certified professionals, and applicable codes and standards directly to determine the specific requirements for their projects. The inclusion of referenced standards or certification bodies does not constitute endorsement or guarantee of compliance.

vessels (e.g., Technical Safety Nova Scotia, New Brunswick Technical Inspection Services).

- **Federal**: Transport Canada oversees hydrogen handling in federally regulated transport modes, while Environment and Climate Change Canada applies environmental regulations where applicable.

Recognizing that rapidly evolving hydrogen technologies and gaps in codes and standards pose a barrier to widespread adoption, the Government of Canada released the Canadian Hydrogen Codes and Standards Roadmap. The roadmap outlines the current state of hydrogen codes and standards across the value chain, identifies key gaps, and proposes short- and medium-term actions to address them.[82] This includes a comprehensive inventory of current codes, standards, and guidance documents applicable to hydrogen across the entire value chain and supporting ecosystem.[83]



In addition to identifying the codes and standards currently available, the roadmap also highlights full or partial gaps across the hydrogen value chain. A key consideration for Atlantic Canada, distinct from some other provinces, is the need for codes and standards that support hydrogen exports to international markets. Present gaps include standards related to ammonia conversion, electrolysis production, and carbon intensity tracking.

Equipment compliance and certification

All hydrogen systems, equipment, and components must meet the codes and standards of the jurisdiction in which they will operate. Specific requirements may vary depending on the intended application; however, two common examples of required certifications for equipment used in Canada include:

- **Electrical equipment**: Electrical products, such as electrolyzers, power electronics, or control panels must meet Canadian national safety standards and be certified by an accredited certification body such as CSA, cUL, or cETL. These certifications verify the products are assessed and conform to the required Canadian national safety standard.[84]
- **Pressurized components**: Must carry a Canadian Registration Number (CRN), which is issued provincially under the Pressure Equipment Safety Regulations.[85] A CRN is required for any pressure-retaining component or assembly that operates above 15 psi (103 kPa or 0.103 MPa) gauge pressure.[86] For hydrogen this could be hydrogen pressure vessels, pipe fittings, valves, or piping systems, as well as balance of plant systems (e.g. heat exchanger) that support hydrogen operations.

The following table provides an example of the certification process. When sourcing equipment from international suppliers (including the United States), early engagement with the supplier or original equipment manufacturer (OEM) is essential to confirm that the equipment holds all required certifications for use in Canada and any other relevant jurisdiction. If certifications are not in place, they may be obtained; however, this can lead to significant delays and added costs. Project developers should avoid committing to equipment purchases until certification status is confirmed or a clear path to certification is established.

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[82] Canadian Hydrogen Codes and Standards Roadmap - Natural Resources Canada (Accessed 6/18/25)
[83] Validated List of Codes, Standards, and Guidance Documents - Natural Resources Canada (Accessed 6/18/25)
[84] Electrical product safety - Canada.ca (Accessed 6/18/25)
[85] About the Canadian Registration Number (CRN) (Accessed 6/18/25)
[86] What is a Canadian Registration Number (CRN)? (Accessed 6/17/25)

Table 19 Illustrative certification process for hydrogen equipment

Category	Mechanical, piping, and pressurized components[87]	Electrical components and systems[88]
High-level certification steps	1. Submit design documentation with proof of design, quality control, and applicable code compliance 2. Independent review by jurisdiction 3. CRN issued upon approval	1. Apply to CSA 2. Five-step process: construction review, testing, report preparation, project review, certification report
Relevant codes and standards	CSA B51 ASME Section VIII-1 for pressure vessels ASME B31.3 for process piping	CSA Certification Canadian Electrical Code Provincial ESA approvals
Additional considerations	Manufacturer must hold a valid QC certificate (e.g. ASME or ISO)	ISO 22734 may apply for hydrogen generators using electrolysis

In addition to meeting Canadian equipment certification requirements, hydrogen systems with operations spanning multiple jurisdictions (such as the export of hydrogen or ammonia) must comply with both domestic and international regulations and standards, including those applicable at the port of origin and the port of delivery.

Table 20 provides an example of how the construction of hydrogen or ammonia storage vessels used for transport may need to consider additional design, construction, and testing.

Table 20 Examples of design, fabrication, and testing considerations for hydrogen storage vessels

Category	Canada	European Union
Design and fabrication	In Canada, pressure vessels and piping systems must be designed and fabricated in accordance with the requirements of CSA B51: Boiler, Pressure Vessel, and Pressure Piping Code, which references applicable sections of the ASME Boiler and Pressure Vessel Code for design, fabrication, and inspection standards.[89]	In the European Union, the design and fabrication of pressure vessels and piping systems are governed by the Pressure equipment Directive (PED) 2014/68/EU.[90]
Inspection and testing	Non-destructive testing (NDT) is required to verify the quality and safety of welds and structural components. In Canada, the Canadian General Standards Board (CGSB) manages the CGSB-48.9712 for non-destructive testing certification.[91]	Applicable to the EU, the International Standards Organization (ISO) manages ISO 9712 standard through Technical Committee 135 Sub-Committee 7 for NDT certification.[91]

87 CRN 101 - Pressure Vessel Engineering (Accessed 6/17/25)

88 What is the difference between UL, CSA, and CE? (Electrical Certification) (Accessed 12/8/25)

89 CER – Guidance Notes for the Design, Construction, Operation and Abandonment of Pressure Vessels and Pressure Piping (Accessed 6/17/25)

90 Pressure Equipment directive. (n.d.). Internal Market, Industry, Entrepreneurship and SMEs. Pressure Equipment Directive - European Commission (Accessed 6/16/25)

91 Standards Framework for the NDT Certification Program - Natural Resources Canada (Accessed 6/16/25)

Summary of codes, standards, and certifications for Atlantic Canada

Codes, standards, and certifications are a complex but required element of Atlantic Canada's hydrogen ecosystem to ensure the safe and effective deployment of hydrogen infrastructure in communities throughout the region. Their application depends on the system being developed, the jurisdiction in which it will operate, and the interpretation of the relevant Authority Having Jurisdiction (AHJ) as well as the responsible engineer. Key considerations include:

- **Jurisdictional compliance**: Projects must apply the correct codes and standards based on design and location. Identifying the applicable requirements can be complex and may vary depending on regulatory updates, AHJ interpretation, and engineering perspectives.
- **Cross-border applicability**: Equipment used across jurisdictions must meet the certification requirements of all regions in which it will operate.
- **Early integration**: Engaging engineers, manufacturers, and regulators early in project design helps identify and build equipment to applicable standards, reducing risk of delays, and supporting efficient development.

4. Jurisdictional review

The global hydrogen economy is rapidly evolving, with jurisdictions around the world advancing strategies to decarbonize key sectors, develop new value chains, and position themselves as leaders in clean energy innovation. In this context, Atlantic Canada is seeking to establish itself as a competitive player in the emerging hydrogen market—particularly in green hydrogen production, export potential, and supply chain development. To support this effort, this jurisdictional scan has been undertaken to inform the Atlantic Canada Hydrogen Supply Chain Study by identifying relevant international and domestic approaches to hydrogen ecosystem development.

The primary objective of this scan was to identify strategies, mechanisms, and initiatives that have worked, or are working, as well as the challenges faced by peer jurisdictions that are actively developing hydrogen supply chains and infrastructure. By examining policy frameworks, infrastructure planning, supply chain development, workforce readiness, and community engagement, the review provided insight into the real-world conditions that enable hydrogen ecosystems to mature, the pitfalls that slow progress, and the levers governments and industry have used to accelerate development.

To ensure consistency and comparability, a standardized assessment framework with six key areas as described in Figure 17 was applied across all jurisdictions. The findings informed opportunities and risks for hydrogen supply chain development and the formulation of targeted recommendations to close gaps and advance the regional ecosystem.

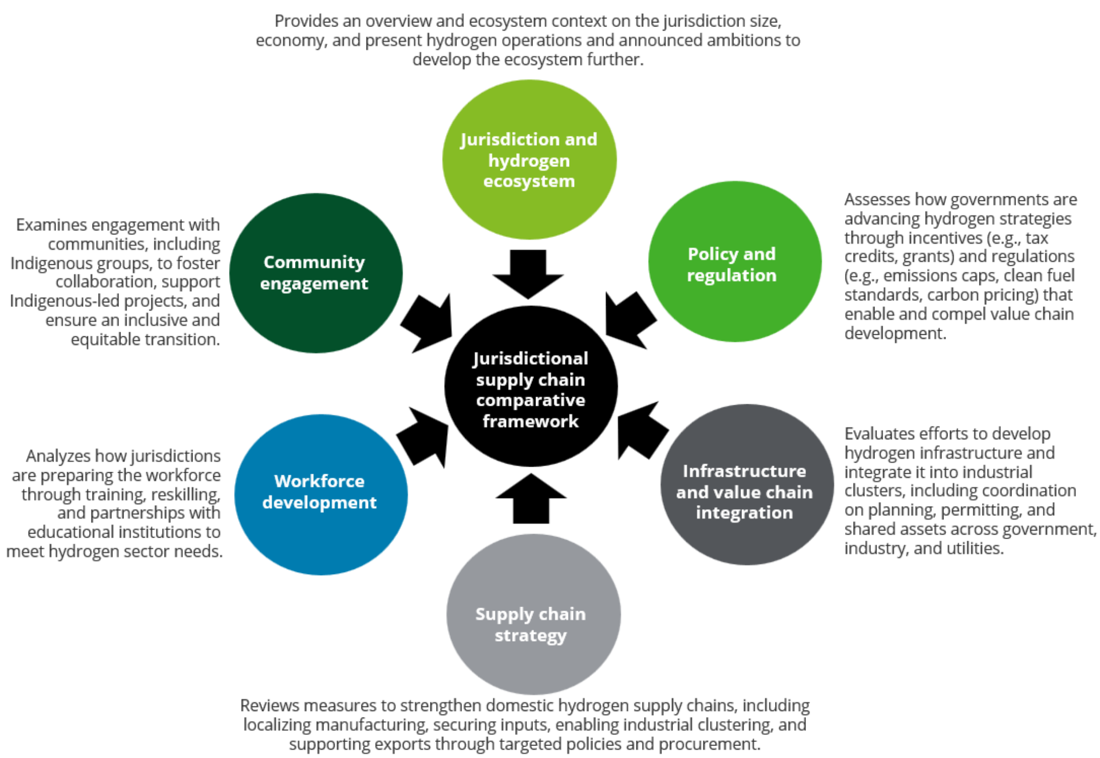

Figure 17 Jurisdictional supply chain comparative framework

To identify the highest value jurisdictions for the scan, a list of 28 jurisdictions was compiled. Each jurisdiction was then assessed to understand:

1. Alignment to Atlantic Canada based on population size, built environment, and low-carbon hydrogen goals.
2. Hydrogen ecosystem maturity by assessing the development stage of their hydrogen market.

In addition to the above two criteria, the selection methodology evaluated jurisdictions both within and outside North America to gather diverse market perspectives and experiences. The results are the following seven jurisdictions: British Columbia, Ontario, California, Texas, United Kingdom, Netherlands, and Germany.

British Columbia

British Columbia is a national leader in hydrogen development, guided by its 2021 BC Hydrogen Strategy and supported by non-emitting hydroelectric power. The province has launched projects such as the H2 Gateway initiative, a refueling and production network throughout the province, and is home to multiple fuel cell manufacturing companies like Ballard Power Systems. With investments in heavy-duty vehicle pilots (e.g., Innovate BC) and export-oriented projects proposed in Prince Rupert, BC is focused on scaling clean hydrogen production for both domestic use and Asia-Pacific markets.

Ontario

Ontario's hydrogen strategy, released in 2022, focuses on clean hydrogen production from nuclear and renewable electricity. The province supports pilot-scale projects through the Hydrogen Innovation Fund and has active initiatives like Enbridge's blending pilot in Markham. Ontario is also home to Canada's largest hydrogen electrolyzer manufacturer (Hydrogenics by Cummins) and the Ontario Government has increased support for hydrogen to be integrated into its economy to support energy security and economic growth.

California

California has one of the most advanced hydrogen ecosystems globally, supported by the California Hydrogen Roadmap and zero-emission mandates under the Advanced Clean Trucks Rule. Over 60 retail hydrogen stations support a growing fleet of fuel cell electric vehicles, while projects like the SoCalGas Angeles Link aim to deliver renewable hydrogen for power and industry. The state has also secured federal funding through the ARCHES Hydrogen Hub to build out hydrogen infrastructure across sectors.

Texas

Texas is rapidly emerging as a low-carbon U.S. hydrogen hub by capitalizing on its natural gas resources, carbon storage potential, and industrial demand. The state is home to large-scale projects like Air Products' $4.5B blue hydrogen complex in Port Arthur and ExxonMobil's Baytown hydrogen expansion. With federal support through the HyVelocity Hub, Texas is building out infrastructure for hydrogen production, pipeline transport, and Gulf Coast exports while engaging major energy and chemical companies in hydrogen supply chains with ambitions to export to international markets.

United Kingdom

The UK's Hydrogen Strategy (2021) supports a dual approach to hydrogen production—green and blue—with a target of 10 GW of low-carbon hydrogen capacity by 2030. The country is investing in industrial clusters like HyNet North West and the East Coast Cluster, which combine carbon capture and storage (CCS) and hydrogen infrastructure. Pilot programs in hydrogen home heating (e.g., the H100 Fife project) and hydrogen blending in the gas grid are underway, while UK ports such as Teesside and Humber are being developed for hydrogen export and maritime use. The UK is also one of the few jurisdictions globally who have completed a hydrogen supply chain assessment to identify gaps and go-forward strategies supporting future growth.

The Netherlands

The Netherlands is advancing an integrated hydrogen ecosystem through its National Hydrogen Programme and port-centric strategies. Projects like the NortH2 consortium aim to generate green hydrogen from offshore wind, while Rotterdam and Eemshaven ports are being developed as key hydrogen import and distribution hubs. The Dutch government is co-funding a national hydrogen backbone and electrolyzer capacity targets of up to 4 GW by 2030 to support industrial decarbonization and cross-border energy trade.

Germany

Germany's National Hydrogen Strategy, launched in 2020, commits over €9 billion to build a green hydrogen economy. Flagship initiatives include the H2Global auction platform for international imports and the Hydrogen IPCEI projects that fund electrolyzer and infrastructure development. Germany is scaling hydrogen in steel (e.g., Salzgitter's SALCOS program), transport (hydrogen trains in Lower Saxony), and heating sectors, positioning itself as a hydrogen technology exporter but hydrogen molecule importer.

Spotlight: European Hydrogen Observatory

Applicable to European jurisdictions, including the United Kingdom, Netherlands, and Germany is the European Hydrogen Observatory, an open access platform supported by the European Commission designed to serve policymakers, industry, researchers, and the public by providing updated insights into Europe's hydrogen economy. It offers extensive databases of hydrogen production, trade, infrastructure, storage, end-use, and technology manufacturing, complete with interactive dashboards downloadable datasets (e.g. demand forecasts), policy and regulatory updates, project repositories, and funding opportunities. The latest site redesign, re-launched in September 2023, emphasizes enhanced visualizations and analytic tools—such as geomaps, cost calculators, demand scenarios, and case studies—to facilitate evidence-based decision-making and knowledge exchange across the full hydrogen value chain.

The value of a platform like this is the ability to maintain and update as new information develops, especially relevant for hydrogen which is an ever-changing ecosystem.

European Hydrogen Observatory

Clean Hydrogen Partnership

Understanding jurisdiction characteristics

Table 21 compares the seven jurisdictions selected to the four Atlantic Canada provinces. While the economies of each Atlantic Canadian province is smaller than those of the comparator jurisdictions, this context highlights the differing scales and capacities within which each region is developing its hydrogen ecosystem, without diminishing the relevance or impact of the initiatives pursued elsewhere.

Table 21 Jurisdiction characteristics

Jurisdiction	Level	Climate targets
British Columbia	Sub-national	80% greenhouse gas (GHG) reduction by 2050 (vs. 2007); 30% low carbon fuel standard (LCFS) reduction in fuel carbon intensity (CI) by 2030; zero emission vehicle (ZEV) mandate incl. H_2 vehicles
Ontario	Sub-national	30% GHG reduction by 2030 (vs. 2005)
California	Sub-national	Net-zero by 2045; 40% GHG reduction by 2030 (vs. 1990); 100% clean electricity by 2045; ZEV mandate by 2035
Texas	Sub-national	Voluntary GHG reduction plans; 174 MMT GHG cut (2025–2030) under CPRG Priority Action Plan
United Kingdom	National	Net-zero by 2050 (legally binding); 68% cut by 2030 compared to 1990 levels; 10 GW low-carbon hydrogen by 2030
Netherlands	National	95% GHG cut by 2050 (vs. 1990); climate neutrality by 2050; coal phase-out by 2030
Germany	National	Net-zero by 2050 (legally binding); 65% GHG cut by 2030 compared to 1990 levels; 80% renewables in electricity by 2030
Nova Scotia	Sub-national	53% GHG reduction by 2030 (vs. 2005); net-zero by 2050 (legally binding under Environmental Goals and Climate Change Reduction Act); 80% renewables by 2030
Newfoundland and Labrador	Sub-national	30% GHG reduction by 2030 (below 2005); Net-zero by 2050; Clean Electricity Standard (98% from renewable/hydro); Climate Change Action Plan focuses on green industry and clean fuels
New Brunswick	Sub-national	46% GHG reduction by 2030 (vs. 2005); net-zero by 2050; Climate Change Action Plan includes hydrogen and clean fuels R&D focus
Prince Edward Island	Sub-national	Net-zero by 2040; climate action includes H_2 pilot projects and electrification plans

4.1.1 Jurisdictional assessment and insights

The six themes within the jurisdiction assessment framework offer key insights into the development of Atlantic Canada's hydrogen supply chain and infrastructure ecosystem. Together, they highlight current challenges and emerging opportunities across policy, infrastructure, supply chains, workforce, and community engagement. For each theme, the scan identifies barriers encountered across the hydrogen ecosystem and summarizes mechanisms used by peer jurisdictions to overcome them and advance their hydrogen ambitions. Drawing on both Canadian and international experience, the framework supports the design of a cohesive, regionally grounded strategy and provides thematic considerations to guide actionable recommendations and potential pathways for a resilient, inclusive, and competitive hydrogen economy in Atlantic Canada.

4.1.2 Jurisdiction and hydrogen ecosystem

To support comparison with Atlantic Canada's hydrogen activity, Table 22 summarizes current hydrogen operations and announced projects across selected jurisdictions as of May 31, 2025. While not exhaustive, this overview highlights the scale, focus areas, and level of development in each region's hydrogen ecosystem. A full assessment for each jurisdiction is provided in section 8.7 of the Appendix.

Table 22 Jurisdiction hydrogen ecosystem summary

Jurisdiction	Strategy	Milestones	Existing H2 operations	Announced H2 projects
British Columbia	*B.C. Hydrogen Strategy* (July 2021)	Net-zero by 2050; decarbonize transport & industry; build hubs; 7.2 Mt CO_2e reduction potential by 2050	Grey H_2 for refining and low-carbon fuel production (Parkland, Tidewater); low-carbon H_2 for early fueling stations (HTEC); pilot trucks (Hydra)	HTEC H2 Gateway (19 stations); FortisBC and Enbridge blending; Salish Elements (25 MW); Hy2Gen export facility; Tse'khene Hub; Hydra refueling station
Ontario	*Low-Carbon Hydrogen Strategy* (April 2022)	Eight actions expected to lead to an eight-fold increase in the province's capacity of low-carbon hydrogen	Grey H_2 in Sarnia; Enbridge blending pilot (Markham); electrolyzer manufacturing (Hydrogenics); early fueling projects at Toronto Pearson Airport	Atura Niagara (20 MW); Mississauga Transit hydrogen bus FCEV bus trial; Hydrogen ready DRI Dofasco steel plant; Sarnia-Lambton hydrogen, chemical and refinery industrial corridor; salt cavern storage studies
California	Hydrogen in *2022 Scoping Plan*	1,000 H_2 refueling stations by 2030; long-duration storage, industrial decarbonization	50 active H_2 stations; >100 in development; leading FCEV adoption; hydrogen blending pilots	ARCHES hub ($1.2B); Angeles Link pipeline; Lancaster power-to-gas; Long Beach port corridor; Elk Hills blue H_2; ACES Delta hub
Texas	*Texas Hydrogen Production Policy Council Report* (Dec 2024)	Regulatory clarity; leverage Gulf Coast; jobs & storage; leveraging existing natural resources for blue and green hydrogen	Longstanding grey H_2; emerging blue & green H_2; refining, petrochemicals, ammonia; salt cavern storage	HyVelocity Hub ($1.2B); Hydrogen City (280K t/yr); Exxon Baytown H_2/NH_3 project; Chevron Bayou Bend project; 5 refueling stations funded
United Kingdom	*UK Hydrogen Strategy* (Aug 2021); updated 2022	10 GW by 2030 (50% green); 5 clusters; 20–35% final energy use by 2050	~27 TWh/yr (mainly grey); pipelines in Teesside & Grangemouth; 16 H_2 stations; pilot electrolyzers	Hynet & Net Zero Teesside; Gigastack (100 MW); H2H Saltend; Project Union pipeline; hydrogen village (2025); £9B+ in project value
Netherlands	*National Hydrogen Strategy* (2020); *NWP* (2022)	4 GW by 2030; 42% renewable H_2 in industry; build 1,200 km pipeline; lead H_2 import/export	~180 PJ/yr grey H_2; imports from Belgium; fertilizer & refining dominant; 6–10 public stations	Shell Hydrogen I (200 MW); HyNetherlands (1 GW); H-Vision blue H_2; Zeeland ammonia hub; HyTrucks (1,000 trucks); Delta Rhine pipeline
Germany	*National Hydrogen Strategy* (2020); updated 2023	10 GW of electrolyzer capacity by 2030; import to support demand; global H_2 tech leader	55–60 TWh/yr; 400 km pipelines; 100+ stations; FCEV trains; Power to Gas (PtG) pilots; municipal buses	600 MW production projects announced; 130 km hydrogen pipeline; Giga-factory for electrolyzer manufacturing

The following section summarized insights from the jurisdictional review across policy and regulation; infrastructure and value chain integration; supply chain strategy; workforce development; and community engagement. A detailed jurisdictional review can be found in section 8.7 of the Appendix.

4.2 Policy and regulation

Learning from best practices in government incentives, risk-sharing, and regulatory design can help attract investment, de-risk early-stage projects, and support export competitiveness. This section highlights gaps and opportunities to tailor local policy tools to regional strengths such as abundant renewable energy and proximity to international markets.

4.2.1 Hydrogen ecosystem barriers

Market dependency on government policy and fiscal support

The success of the hydrogen ecosystem depends on government policy and the strategic use of support mechanisms—such as grants, subsidies, and tax incentives—which often require public funding and must be carefully designed to ensure impact and value for taxpayers. For example, Texas has high potential to be a large producer of green hydrogen, but the lack of policy supporting hydrogen production from renewable resources has left the state operating largely from fossil fuels.

In addition, policy uncertainty is impacting project development in several jurisdictions. For example, in the United States, proposed changes to the 45V tax credit under H.R. 1, the “One Big Beautiful Bill Act”, could impact future low-carbon hydrogen development, eliminating the credit for hydrogen facilities that have not begun construction by the end of 2027.

Regulatory complexity and uncertainty in project development

The majority are first of their kind projects, making the development complicated and uncertain from permitting, regulations, codes, standards, and the level of community engagement. Regulatory complexity and evolving standards can create uncertainty and delay projects. Blending of hydrogen in natural gas pipeline is one application of hydrogen that has been held back by ongoing safety and efficacy studies in jurisdictions such as California.

Jurisdictional coordination challenges in an interdependent market

The coordination of jurisdictional policy, whether that is between countries or between domestic governments (i.e. federal and provincial) is needed to create market scale and streamline cross border construction and market access. Germany, for instance, faces challenges with overlapping federal and EU regulations, which can cause confusion and bottlenecks in the supply chain.

4.2.2 Mechanisms to support advancement

Advancing the market through legislative and fiscal support

Jurisdictions are accelerating hydrogen deployment through legislative and fiscal measures designed to attract investment and de-risk projects. These include targeted incentives, such as California’s stacking of state programs with the federal 45V clean hydrogen production tax credit, and the United Kingdom’s use of contracts for difference and capital allowances. Legislative reforms are also being used to define hydrogen’s role in national energy systems—such as the Netherlands’ amendment to its Gas Act and Germany’s carbon pricing framework. In the United States, Texas has established a Hydrogen Production Policy Council to guide strategic development of its hydrogen economy.

The H2Global mechanism, which uses a two-sided auction to contract both supply and offtake, is also emerging as a key policy tool to provide long-term revenue certainty. This mechanism will be used in the upcoming auction involving Canadian hydrogen producers and German offtakers, illustrating its relevance to transatlantic hydrogen trade.

Supporting hydrogen through regulatory processes

Jurisdictions are supporting hydrogen development through regulatory reforms that accelerate permitting and enable early project deployment. California’s SB 1075 clean hydrogen standard streamlines approvals and unlocks funding to shorten timelines. In the Netherlands, interim blending guidance allows regional projects to proceed while national regulations are finalized. Germany’s 2024 Hydrogen Acceleration Act fast-tracks infrastructure approvals, while the UK has conducted national trials demonstrating the safety of blending up to 20% hydrogen into natural gas networks.

In addition, BC and California both have implemented a low-carbon fuel standard that creates a regulatory structure that supports low-carbon fuel producers (including hydrogen) supply cost competitive products to their transportation markets.

Facilitating market expansion through cross-jurisdiction policy coordination

Jurisdictions are enabling market expansion by aligning national policies with cross-border frameworks. The Netherlands' Hydrogen Law and Guarantees of Origin support integration with EU markets, while access to Important Projects of Common European Interest (IPCEI) funding—paired with national hydrogen and renewable energy initiatives—has accelerated project development in both the Netherlands and Germany.

4.2.3 Considerations for Atlantic Canada

Which regulatory frameworks, codes, and standards would benefit most from regional alignment, creating opportunities to simplify permitting processes and create a more attractive environment for hydrogen investment?

Could Atlantic Canada implement a regional low-carbon fuel standard, like California and BC, to drive domestic adoption of low-carbon transportation fuels?

Is there an opportunity to designate hydrogen as infrastructure of public interest to accelerate permitting — such as export terminals or ports?

How might Atlantic Canada align its hydrogen carbon intensity certification with European and global trade partners to enable export market compatibility?

4.3 Infrastructure and value chain integration

Atlantic Canada has a unique opportunity to become a sizeable hydrogen export hub, especially to Europe. Learning how other regions coordinate large-scale hydrogen infrastructure can inform how Atlantic provinces should align regional planning, build-out priorities, and public-private coordination. It can also support decisions on site selection for hubs, grid upgrades, port investments, and integration with offshore wind and ammonia production.

4.3.1 Hydrogen ecosystem barriers

Permitting delays, infrastructure lag, and misalignment between supply and demand readiness

Many jurisdictions face challenges coordinating large-scale hydrogen infrastructure rollouts with varying or uncertain demand signals. Germany and the Netherlands have ambitious hydrogen backbone plans — large-scale dedicated hydrogen transmission networks designed to transport hydrogen across regions and between industrial clusters — but rollout has been delayed due to spatial planning constraints, demand uncertainty, and phased timelines. In British Columbia and California, infrastructure gaps remain between urban fueling networks and rural or industrial corridors, limiting scale-up in freight and industry. Even where pipeline repurposing is planned (e.g., Netherlands, Germany, United Kingdom), regulatory and technical readiness often lags project timelines. Across regions, the challenge is ensuring that infrastructure buildout, hydrogen production, and end-user conversion happen in a synchronized and investment-ready way.

Development within a complex, multi-faceted ecosystem

The advancement of hydrogen infrastructure across the value chain relies heavily on coordinated efforts among various stakeholders, including government bodies, industry players, and local communities. This is a complex ecosystem that, if not executed properly, can erode public trust, slow progress, and affect financial viability. In addition, lack of coordination and delays undermine industry and offtaker confidence to commit to long-term investments in hydrogen infrastructure. As seen with the Netherlands' HyWay 27 project, complex permitting processes and multi-stakeholder coordination challenges can result in significant project delays.

4.3.2 Mechanisms to support advancement

Coordinated, phased infrastructure planning with strong public-private governance

Jurisdictions are advancing hydrogen infrastructure through centralized, phased planning and strong public-private collaboration. Germany's 9,000 km Hydrogen Core Network is a national blueprint linking industrial clusters through coordinated development. The Netherlands, led by Gasunie, is repurposing up to 80% of its existing natural gas network to reduce costs and accelerate deployment while connecting key ports, industrial zones, and import terminals. In California, the ARCHES initiative unites public agencies, utilities, transit authorities, and manufacturers to co-develop integrated hydrogen corridors. The UK's Cluster Sequencing approach prioritizes infrastructure investment in regions with aligned hydrogen, CCS, and storage potential. Similar models are emerging in North America, such as California's ARCHES and Texas's HyVelocity hubs, with others, like the UK's HyNet, also integrating manufacturing. Cross-jurisdictional networks—such as B.C.'s HTEC planned hydrogen refueling infrastructure extending into Alberta and Washington State—highlight the value of integrated, regional systems.

Innovative business models enable scalable development

Jurisdictions are deploying innovative business models to manage the complexity of hydrogen infrastructure. The UK has adopted strategies such as bundled procurement, joint ventures, and enterprise zones to align stakeholders and de-risk investment. Anchor-user models, also used in the UK, leverage early industrial adopters to justify shared infrastructure that can later serve smaller users. Both HTEC and Hydra in British Columbia are offering a leasing and pay as you go type service for hydrogen FCEV class 8 trucks, removing the capital burden on customers.

Streamlining permitting reduces delays and unlocks growth

Reducing regulatory barriers is critical to timely project delivery. Granting priority status to strategic initiatives—such as the Netherlands' SEVI program or Germany's Network Development Plan—has helped fast-track permitting and approvals. In regions like Texas, streamlined regulatory environments enable faster project execution, supporting early-stage hydrogen ecosystem growth.

4.3.3 Considerations for Atlantic Canada

- How can the provincial governments in Atlantic Canada work together to sequence infrastructure investments with industrial, export, and transport use cases to help with labour availability, supply chain readiness, and avoid stranded assets?
- Could a regional hydrogen backbone connecting export ports, industrial clusters, pipeline and transport corridors strengthen logistics integration and supplier participation?
- Can hydrogen hubs with co-located production, storage, and end-use facilities be designated to help concentrate early supply chain activity and build regional capacity?
- How might interprovincial coordination with Quebec enable shared infrastructure, streamlined permitting, and expanded supplier opportunities across regions?

4.4 Supply chain strategy

With greater visibility into how other jurisdictions are developing hydrogen supply chains, Atlantic Canada can apply these strategic insights to build its own. This includes determining which parts of the hydrogen supply chain can be most effectively developed in the region, targeting supply chain gaps through investment and partnerships, and aligning workforce, R&D, and trade policies to support a competitive, resilient hydrogen ecosystem.

4.4.1 Hydrogen ecosystem barriers

Global competition for raw materials and constraints on domestic manufacturing limit hydrogen scalability

Most jurisdictions face challenges to build domestic manufacturing capacity for hydrogen system components like electrolyzer stacks, fuel cells, storage tanks, and hydrogen-ready equipment. Germany's strength in electrolyzer design is offset by limited EU capacity for membranes and catalysts, increasing dependency on imports. A lack of long-term demand certainty and export strategies makes it harder for domestic OEMs to justify investment. This is compounded by global competition for critical minerals and components, increasing supply chain vulnerability.

Difficulties with storage and transportation challenge hydrogen's cost effectiveness

The need for new infrastructure for safe and efficient storage and transportation of hydrogen fuel presents challenges in the hydrogen distribution supply chain.

4.4.2 Mechanisms to support advancement

Industrial clustering, co-location, and public procurement to stimulate domestic supply chains

Germany's hub-and-spoke manufacturing ecosystems (e.g., Baden-Württemberg's fuel cell valley and Berlin's Siemens electrolyzer gigafactory) demonstrate how industrial clustering can anchor supplier ecosystems and leverage academic partnerships. The UK's approach mirrors offshore wind strategy — combining gigafactories (e.g., ITM Power in Sheffield), Freeport incentives, and a 50–60% UK content aspiration to stimulate local capacity. The Netherlands supports electrolyzer scale-up through its HyScaling program, integrating research innovation with testbeds and regional manufacturing zones. Public procurement — like the UK's H2Bus program or California's ZEV mandates — helps anchor early market demand and incentivize domestic content. In Ontario and BC, anchor companies (e.g., Ballard, Hydrogenics) are enabling localization of components and workforce development.

Diversified production pathways enhance market flexibility and resilience

Jurisdictions are pursuing a mix of hydrogen production technologies to expand supply and reduce risk. Projects like the UK's Aberdeen Hydrogen Hub use wind and solar, alongside blue hydrogen development leveraging natural gas and carbon sequestration. Broader investments in R&D—such as the Netherlands' H2ermes and H2-Fifty, and blue hydrogen project development and innovation in Texas aim to improve technological readiness, enhance energy security, and ensure flexibility through varied feedstocks and cost effective, yet low-carbon production methods.

4.4.3 Considerations for Atlantic Canada

- Can Atlantic Canada leverage offshore wind and ammonia export potential to co-locate manufacturing and equipment servicing near production zones?
- How can federal and provincial incentives prioritize projects with local supply chain participation?
- Is there an opportunity to develop a regional hydrogen innovation hub tied to local universities, colleges and OEM partnerships to accelerate component production and system integration?
- Could Atlantic Canada join interprovincial or cross-border supply chain consortia to improve access to parts and innovation?

4.5 Workforce development

While Atlantic Canada has a skilled workforce, supporting the development of the hydrogen industry would require targeted upskilling and new educational pathways. Studying how other regions are addressing workforce gaps can help local governments and training institutions anticipate labour demands and develop curricula that align with hydrogen project timelines. This approach will strengthen local hiring, enhance community benefits, and ensure safe operations.

4.5.1 Hydrogen ecosystem barriers

Shortages of skilled workers hinders hydrogen growth potential

There are identified shortages of skilled workers across each identified jurisdiction, and the pace of curriculum development can lag behind industry needs. For example, California's rapid infrastructure expansion has outpaced the availability of certified technicians, leading to project delays.

Lack of training for similarly skilled workers prevents lateral career shifts into hydrogen

An aging workforce in traditional industrial and transport sectors and limited awareness of hydrogen career opportunities further constrain growth. Leveraging skills from adjacent sectors (e.g., oil & gas, utilities) present opportunities but are underdeveloped or fragmented in many regions.

Hydrogen-specific certification pathways are still emerging, especially for safety-sensitive roles. To this point, industrial and transport workers who are aware of hydrogen employment opportunities can face difficulty finding the correct training or certification to acquire the necessary qualifications for hydrogen projects. In the UK, shortages of skilled workers in hydrogen safety and plant operations are a concern, while Germany's aging workforce in traditional energy sectors risks a loss of expertise unless reskilling programs are accelerated.

4.5.2 Mechanisms to support advancement

Building hydrogen into education curriculum and career development pathways offers promising solutions to hydrogen labour demands

Jurisdictions are addressing future labour needs by embedding hydrogen into education and training systems. California's Hydrogen Training and Workforce Development Initiative partners with colleges to prepare technicians for roles in infrastructure and vehicle maintenance. In British Columbia, BCIT includes hydrogen systems within their Renewable Energy Electrical Systems Installation & Maintenance certificate program.

Re-skilling or certifying industrial workers in hydrogen eases the development of a clean energy economy

Upskilling programs can ease the shift for workers looking to move from traditional energy sectors to hydrogen, ensuring workforce continuity and supporting clean energy goals. Texas is supporting oil and gas workers to move into hydrogen roles as more blue hydrogen facilities are developed, while the UK's Hydrogen Skills Alliance and Germany's Hydrogen Competence Centers offer structured upskilling programs that align with industrial demand and safety requirements.

4.5.3 Considerations for Atlantic Canada

- What upskilling pathways could help Atlantic Canada heavy industry workers, tradespeople, and energy technicians support hydrogen projects?
- Should the region pursue its own standards or leverage existing certification standards for hydrogen safety, installation, and inspection? How can it avoid 4 sets of standards across four provinces?
- How can employers and educators jointly forecast labour needs based on project pipelines, and fund pilot programs to address them?
- How can Atlantic Canada tailor their outreach and awareness campaigns to engage youth and promote early development of these emerging workforce needs?

4.6 Community engagement

Community and Indigenous engagement will be fundamental to building a sustainable and inclusive hydrogen economy in Atlantic Canada. As the region develops large-scale energy projects, learning how other jurisdictions foster meaningful community relationships provides valuable context. This goes beyond project advancement to build long-term trust, legitimacy, and shared prosperity across the region.

4.6.1 Hydrogen ecosystem barriers

Public opposition and community concerns

Public apprehension and community concerns regarding hydrogen safety, environmental impacts, and infrastructure developments can lead to project delays or cancellations. These concerns often stem from limited familiarity with hydrogen technologies, perceived health and safety risks, and environmental uncertainties, and can be exacerbated by misinformation. In the Netherlands, for example, some local communities have voiced concerns about hydrogen pipeline and storage safety, requiring ongoing reassurance. Across the UK, there has been skepticism about hydrogen for residential heating—concerns over cost-effectiveness and safety compared to electrification have been raised. These are market adoption barriers requiring targeted outreach, demonstration projects, and incentives to normalize hydrogen use.

In addition, jurisdictions are experiencing opposition not just to hydrogen production itself, but to the renewable energy infrastructure needed to power green hydrogen facilities. For instance, Nova Scotia saw local resistance to a plan for over 400 onshore wind turbines intended to power a green hydrogen facility.

Considerations of existing economic disparities influence hydrogen policy and project development in local communities

Hydrogen policy and project development in local and remote communities as well as Indigenous communities requires balancing rapid technological deployment with the need to protect existing jobs and ensure equitable economic benefits. Addressing these challenges can require proactive engagement and equitable partnerships with affected parties to prevent social and economic disparities as the hydrogen sector expands. In British Columbia for example, engagement with Indigenous populations is widely recognized as critical to the success of any major capital project. Meanwhile, in California, equity concerns have arisen regarding the distribution of hydrogen infrastructure, with calls to ensure that disadvantaged communities benefit from new investments.

4.6.2 Mechanisms to support advancement

Early engagement with Indigenous communities

Early and meaningful engagement with Indigenous communities ensures inclusivity, fosters collaborative relationships, and respects traditional lands and rights. This approach, pursued by Fortescue in British Columbia and HTEC with Tsawwassen First Nations as part of the H2Gateway project, highlights the importance and benefits of involving Indigenous communities in project planning and execution.

For example, in BC, Fortescue and the Lheidl T'enneh First Nation developed a constructive engagement approach based on building strong relationships. While the project did not proceed, they were in a process of negotiating an Impact and Benefits Agreement to maximize the Nation's economic opportunities on the project.

Additionally, Salish Elements, a majority Indigenous-owned green hydrogen company led by Tsleil-Waututh and other Coast Salish nations, is developing a "Hydrogen Highway" network in British Columbia. Its partnership with Xaxli'p First Nation includes a 51 % equity stake in a 25-MW production facility. Supported by a $4.48 million NRCan grant, this initiative exemplifies Indigenous-led project ownership and advanced collaboration in hydrogen infrastructure.

Community Benefit Agreements (CBAs)

Ensuring Indigenous and rural communities benefit from hydrogen projects may require formal Community Benefit Agreements (CBAs) that provide equity ownership, job training, and economic opportunities. Models such as local cooperatives, co-ownership, and community benefit funds ensure localities reap economic gains of hydrogen project development (e.g. Foundation Scottland Community Benefit Fund and Germany's Citizen energy cooperatives).

Addressing equity and accessibility in hydrogen development

Beyond Indigenous engagement, hydrogen investments should consider benefits for economically disadvantaged communities. Frameworks such as the one utilised by BC in their 2024 Call for Power mandate a minimum of 25% First Nation equity in an energy project. The EU's Just Transition Mechanism also provides a model for prioritizing equitable clean energy deployment.

Land use and hydrogen infrastructure siting issues

The development of hydrogen production and storage facilities is subject to complex land-use regulations that can slow permitting. Development of proactive zoning policies can alleviate public resistance to locating hydrogen hubs in urban and environmentally sensitive areas. Best practices from Germany show that integrating hydrogen infrastructure into existing industrial zones minimizes conflict and accelerates approvals.

Proactive community engagement

The Netherlands' Hydrogen Experience House and California's Hydrogen Public Education Program are examples where transparent communication on environmental impacts, safety measures, and economic benefits built public trust and stakeholder collaboration.

4.6.3 Considerations for Atlantic Canada

- How can governments support effective engagement and equity partnerships with Indigenous and rural communities from project inception?
- How can the region use demonstration projects and educational events to build public understanding, acceptance, and support?
- As hydrogen infrastructure expands, how can land use planning or pre-zoning incorporate early community consultation to avoid conflict and delays?
- Should community benefits—such as training programs, co-ownership, or cost guarantees—be included in publicly funded hydrogen projects?

5. Future state scenarios

Analyzing the future supply chain requirements and economic opportunities associated with Atlantic Canada's hydrogen value chain begins with understanding the current state of the region's hydrogen sector and the projected growth of its hydrogen economy. This context provides a basis for evaluating the infrastructure, workforce, and manufacturing considerations that support future development.

5.1 Methodology

This section describes the approach used to assess hydrogen supply and demand forecasts, current hydrogen activity, and associated development timelines to inform the assessment of supply chain requirements and economic opportunities for Atlantic Canada's hydrogen sector.

Step 1: Forecast scenario review and comparison

To develop an understanding of Atlantic Canada's hydrogen supply and demand outlook, all publicly available provincial, regional, and national forecast scenarios were collected and reviewed.[92] These scenarios provide a range of possible pathways for hydrogen production, end-use, and export potential, based on varying policy, technology, and market conditions. The following sources were included and are summarized in Table 23.

➢ ***Source 1: 2023 Canada's Energy Future: Canada's Energy Supply and Demand Projections to 2050***

This national outlook from the Canada Energy Regulator includes hydrogen production and end-use forecasts under three distinct scenarios, each reflecting different levels of global and domestic climate ambition:

- **Global Net-Zero Scenario**: Assumes Canada achieves net-zero greenhouse gas emissions by 2050, alongside significant global action to limit warming to 1.5°C. This scenario reflects a high level of coordinated international effort to decarbonize energy systems.
- **Canada Net-Zero Scenario**: Assumes Canada reaches net-zero emissions by 2050, but global progress occurs more gradually, leading to more moderate international emissions reductions.
- **Current Measures Scenario**: Assumes limited new action beyond existing policies in Canada to reduce emissions. In this scenario, Canada does not achieve net-zero by 2050, and global climate action remains limited.

The Canada Energy Future outlook includes hydrogen production estimates across pathways such as electrolysis, steam methane reforming with carbon capture (SMR + CCS), and biomass, along with end-use projections for transportation, residential, commercial, and industrial sectors. The production scenarios also include production for both domestic and export markets.

➢ ***Source 2: Navius Research – Canada Energy Policy Simulator: Energy Supply, Demand, and Emissions Forecasting Tool***

The Navius Energy Dashboard provides national and provincial level energy modelling that explores how different policy pathways and market conditions may shape Canada's energy transition, including hydrogen production and demand. Three primary policy scenarios were considered:

- **Legislated Scenario**: Reflects all policies in place as of January 2025, representing Canada's current policy trajectory.
- **Announced Scenario**: Builds on the Legislated Scenario by including policies that federal and provincial governments have formally committed to pursuing, even if not yet legislated.

[92] Available as of May 31st, 2025

- **Net-Zero Scenario**: Models a future where Canada implements policies necessary to achieve net-zero greenhouse gas emissions by 2050.

In addition to policy pathways, the Navius model allows for variations in commodity and technology costs (such as carbon capture, solar, wind, batteries, hydrogen production, and oil) and the availability of emissions offsets. For this assessment, these factors were held constant at reference levels to provide a consistent basis for comparing hydrogen development potential across scenarios. The Navius model includes domestic hydrogen production and demand projections but does not incorporate export market estimates.

➢ ***Source 3 and 4:*** ***2021 Feasibility Study for Hydrogen Production, Transportation, and Distribution in Nova Scotia, New Brunswick, and Prince Edward Island*** ***and the*** ***2021 Feasibility Study for Hydrogen Production, Transportation, and Distribution in Newfoundland and Labrador***

These regional studies provide hydrogen demand projections for Atlantic Canada across sectors such as transportation, marine, industry, and remote communities. Two distinct scenarios are presented to reflect different levels of hydrogen market development:

- **Incremental Scenario**: Reflects a lower-cost, lower-risk pathway focused on opportunities that align with existing policies and regulatory frameworks. This scenario emphasizes smaller-scale, early-stage hydrogen deployment using available infrastructure.
- **Transformative Scenario**: Represents a more ambitious pathway aimed at achieving deeper emissions reductions through hydrogen. It assumes increased investment in production and distribution infrastructure, the introduction of new policies, and accelerated technology development and adoption.

The regional studies focus on hydrogen demand projections but do not include detailed production forecasts or estimates for hydrogen export markets.

Table 23 Production and end-use coverage across forecasts

Forecast source	Production categories	End-use categories	Export market included
1. 2023 CEF	Electrolysis, SMR w/ CCS, Biomass	Residential, Commercial, Industrial, Transportation	Yes
2. Navius	Electrolysis, SMR w/ CCS	Agriculture, Commercial Buildings, Industry, Transport (LD/MD/HD), Oil & Gas, Residential, Utilities	No
3. NS/NB/PEI Study	Not included	Transportation, Marine, Remote Communities, Industry	No
4. NL Study	Not included	Transportation, Marine, Remote Communities, Industry	No

Step 2: Structuring of supply and demand scenarios for comparison

Each of the supply and demand sources organizes hydrogen production and end-use categories differently, reflecting varying assumptions, modelling approaches, and levels of detail. To support a consistent, side-by-side comparison across sources—and to better understand the range of possible outcomes and differing perspectives—supply and demand values were organized in a common structure, as follows:

- Domestic and export hydrogen market projections were separated to clearly distinguish between production intended for regional use and volumes that may support international markets.
- For domestic market projections, hydrogen end-use categories were aligned to one of four segments relevant to Atlantic Canada's hydrogen value chain, as introduced in Section 3:
    - Industry, ammonia, and low-carbon fuels
    - Transportation
    - Natural gas blending

- Power generation and storage

From these sources, only regional-level data was retained to maintain an aggregated Atlantic Canada perspective. Provincial-level disaggregation was not included, as the focus of this assessment is to provide a high-level, region-wide understanding of hydrogen market potential, supply chain implications, and future development opportunities.

Step 3: Forecast selection to inform opportunity assessment

To support the assessment of economic, workforce, and supply chain opportunities for Atlantic Canada's hydrogen sector, one publicly available forecast was selected to provide a consistent basis for analysis. The selected forecast needed to provide a balanced perspective of potential hydrogen production volumes, including both domestic use and export potential, out to 2050.

The following criteria were used to compare the available forecast sources:

Criteria	1. 2023 CEF	2. Navius	3. NS/NB/PEI Study	4. NL Study
Forecast extends to 2050	✓	✓	✓	✓
Includes both supply and demand projections	✓	✓	X	X
Includes export market projections	✓	X	X	X

Based on this assessment, the 2023 Canada Energy Future forecast was selected as the most aligned scenario for Atlantic Canada to provide a perspective of the supply and workforce requirements out to 2050.

Step 4: Validation of export assumptions

To help understand Atlantic Canada's potential role in global hydrogen markets, the surplus production identified in the Canada Energy Future forecast was compared to European hydrogen demand projections and import targets. This provides a general estimate of the share of future European hydrogen and ammonia demand that could be met by Atlantic Canadian hydrogen. These estimates are for context only, as actual export outcomes will depend on factors such as project development, infrastructure, market access, and trade agreements.

Step 5: Representative hydrogen production facility to identify supply chain and workforce requirements

To translate hydrogen growth scenarios into supply chain and workforce requirements for Atlantic Canada, a representative hydrogen production facility was defined. This facility reflects a scale that aligns with projects proposed in Atlantic Canada's emerging hydrogen ecosystem. The characteristics of this representative facility were then identified to estimate, on a per-facility basis, the supply chain components, workforce needs, and hydrogen production output required for development.

Step 6: Scale the representative facility to meet production projections

Using hydrogen production scenarios from the selected Canada Energy Future forecast, the number of representative facilities needed over time to meet production targets can be estimated. By multiplying the per-facility supply chain and workforce requirements by the number of facilities, the overall capacity and capability needed to support hydrogen development across Atlantic Canada can be assessed.

5.2 Hydrogen growth scenarios

The potential future growth of Atlantic Canada's hydrogen ecosystem can be assessed by examining publicly available reports and studies that provide scenarios for hydrogen supply and demand in the region, as described in Section 5.1. This section explores three items:

- First, it examines hydrogen production for international markets (exports).
- Second, it looks at hydrogen production to meet domestic needs within Atlantic Canada.
- Third, it explores how hydrogen could be used across key sectors in the region, supporting decarbonization and economic growth.

5.2.1 Hydrogen production for international markets

Export-oriented hydrogen production represents a defining feature of Atlantic Canada's emerging hydrogen ecosystem. Of the public sources examined, only the Canada Energy Future (CEF) 2023 scenarios provide a quantitative outlook on hydrogen production for international markets, with all scenarios assuming this production is delivered via electrolysis powered by renewable electricity.

Figure 18 illustrates projected hydrogen production volumes for export under three different CEF policy scenarios across multiple time horizons.

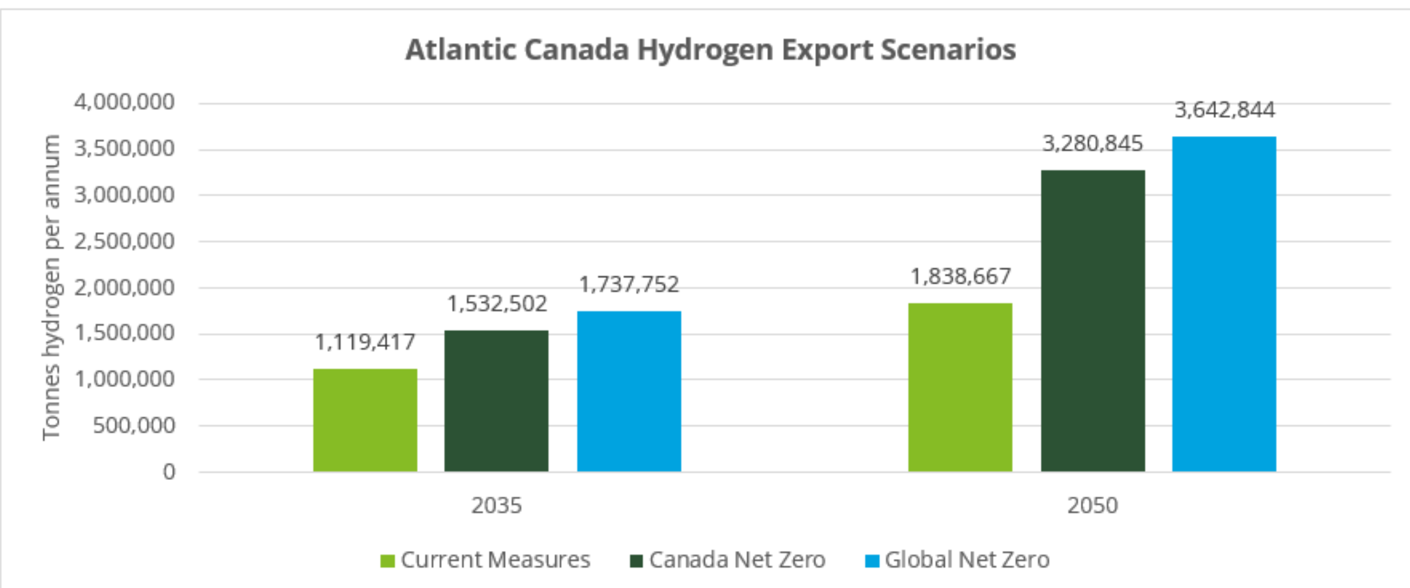

Figure 18 Atlantic Canada hydrogen export scenarios

The Global Net Zero scenario results in the highest hydrogen production for export, driven by aggressive decarbonization policies and strong international demand. Even under the Current Measures scenario, which assumes no new climate policies beyond those already implemented, significant export-oriented hydrogen production is still projected.

This highlights Atlantic Canada's unique position: the region's hydrogen development is influenced by both global and domestic policies. With abundant renewable resources, established deep-water ports, and proximity to European hydrogen markets, Atlantic Canada can serve both domestic and export markets.

It is important to note that Figure 18 focuses on hydrogen production volumes and does not account for the specific energy carriers or derivatives—such as ammonia, liquid organic hydrogen carriers, or other low-carbon fuels like sustainable aviation fuel—that will likely be used for export. The choice of carrier or derivative will depend on market requirements, infrastructure readiness, as well as policy and trade agreements.

To assess the realism of the CEF scenarios against current European low-carbon hydrogen markets, the following outlines key European Union initiatives, targets, and legally binding mandates that also affect international organizations operating within EU jurisdictions.

- **REPowerEU:** The European Commission's REPowerEU plan targets 10 million tonnes per year of domestic renewable hydrogen production and 10 million tonnes of imports by 2030 to reduce reliance on fossil fuels and accelerate decarbonization of hard-to-abate sectors.
- **RED III & Renewable Fuels of Non-Biological Origin (RFNBO) Targets:** The updated Renewable Energy Directive (RED III) sets binding targets for renewable hydrogen consumption, including RFNBO quotas for industry and transport sectors, driving demand for imported hydrogen and its derivatives.
- **SAF Blend Mandates:** The EU's Fit for 55 package includes tightening mandates to increase SAF blends in aviation, starting in January 2025, with hydrogen-derived synthetic fuels playing a key role in meeting these targets.
- **IMO Clean Shipping Fuel Mandates:** The International Maritime Organization (IMO) has adopted emissions reduction targets and fuel transition requirements for the global shipping sector, creating additional demand for clean hydrogen-based marine fuels such as ammonia and methanol.[93]

While not an exhaustive list, these initiatives demonstrate market demand for low-carbon hydrogen and its derivatives, reinforcing Atlantic Canada's opportunity to supply European markets. Success will depend on project readiness, competitive production costs, and supportive trade and pricing frameworks.

5.2.2 Hydrogen production for the domestic market

Beyond export opportunities, Atlantic Canada's hydrogen development will be shaped by domestic demand which supports energy system decarbonization, industrial competitiveness, and regional economic growth. Both the CEF 2023 and the Navius Canada Energy Dashboard provide forecasts for hydrogen production to meet domestic needs, each offering multiple scenarios reflecting different policy, technological, and market conditions and assumptions.

Figure 19 presents a snapshot of projected low-carbon hydrogen production in Atlantic Canada by 2035 across both sources, while Figure 20 provides a similar comparison for 2050, illustrating longer-term growth trajectories.

[93] IMO approves net-zero regulations for global shipping – April 2025

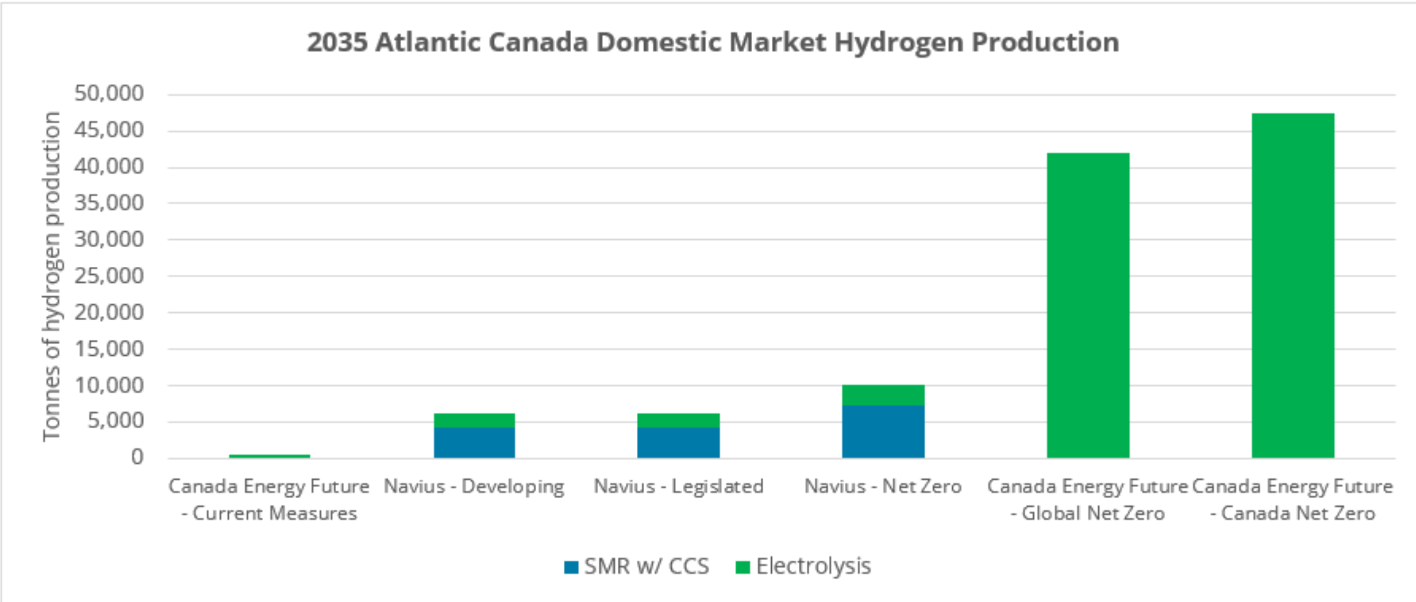

Figure 19 2035 Atlantic Canada domestic market hydrogen production

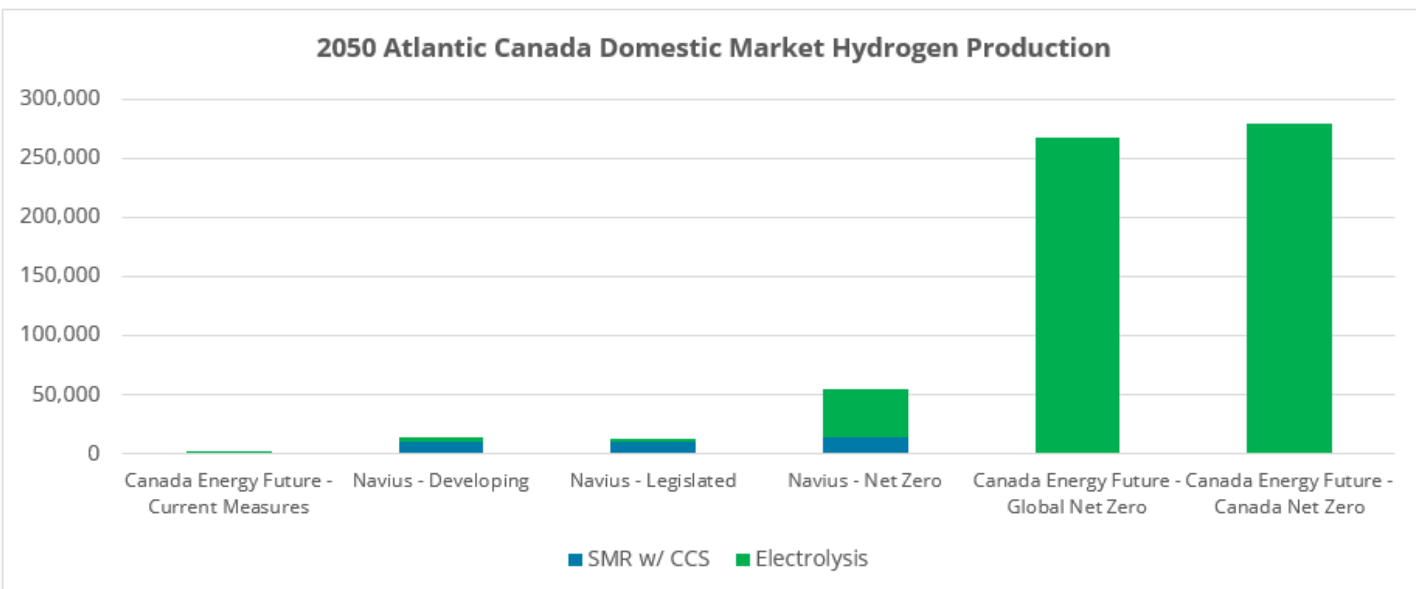

Figure 20 2050 Atlantic Canada domestic market hydrogen production

A comparison of the two sources across 2035- and 2050-time horizons reveals several insights:

- The Navius Canada Energy Dashboard projects domestic hydrogen production through a combination of electrolysis and steam methane reforming with carbon capture and storage (SMR+CCS), confined in areas with access to natural gas infrastructure and CO_2 storage potential. In contrast, the CEF 2023 scenarios focus solely on electrolytic hydrogen as the primary low-carbon production pathway in the region.
- The range of projected production varies significantly. The CEF scenarios show wide variability, with 2050 domestic hydrogen production in Atlantic Canada ranging from over 1,000 tonnes per year under conservative assumptions to under 300,000 tonnes per year under high-growth conditions driven from net zero policies.

- The range for the Navius scenarios is narrower, with production estimates approximately between 13,000 tonnes per year and 55,000 tonnes per year by 2050.

5.2.3 Hydrogen Demand within Atlantic Canada's Domestic Market

Four sources provide estimates for hydrogen consumption volumes and applications within Atlantic Canada's regional economy. For consistency, projected hydrogen demand from each source has been organized according to the end-use categories defined in this report's value chain section and summarized in Figure 21. The sources include Canada's Energy Future (CEF), Navius Research, and the 2021 feasibility studies for hydrogen production, transportation, and distribution in Nova Scotia, New Brunswick, Price Edward Island, and Newfoundland & Labrador. Each source presents multiple scenarios reflecting different assumptions and policy environments.

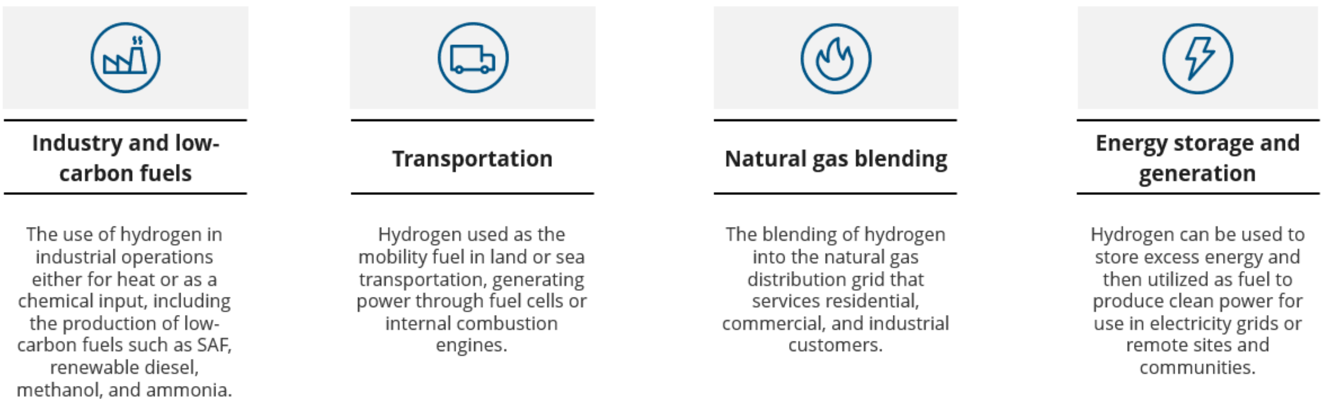

Figure 21 Hydrogen domestic end-use categories

Figure 22 presents a 2035 outlook for hydrogen demand across these sources and scenarios, broken down by end-use category.

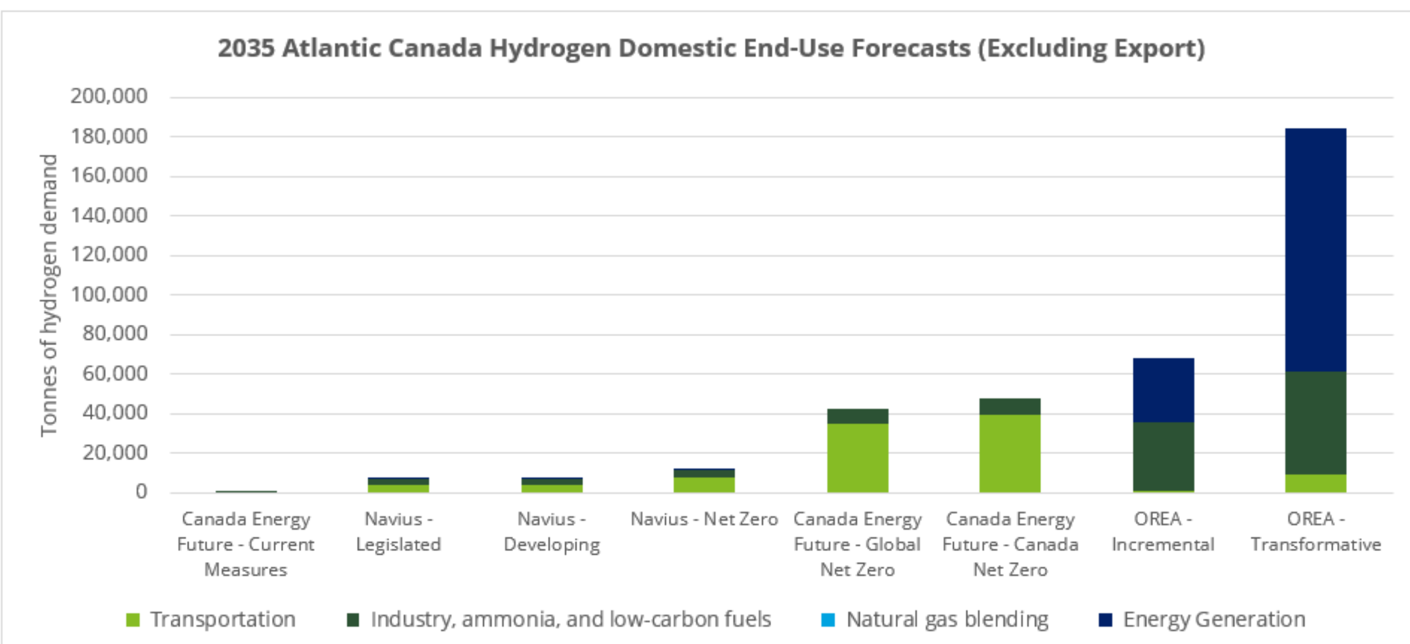

Figure 22 2035 Atlantic Canada Hydrogen Domestic End-Use Forecasts (Excluding Export)

A similar comparison is provided in Figure 23, showing the projected hydrogen demand for 2050 across all sources and scenarios.

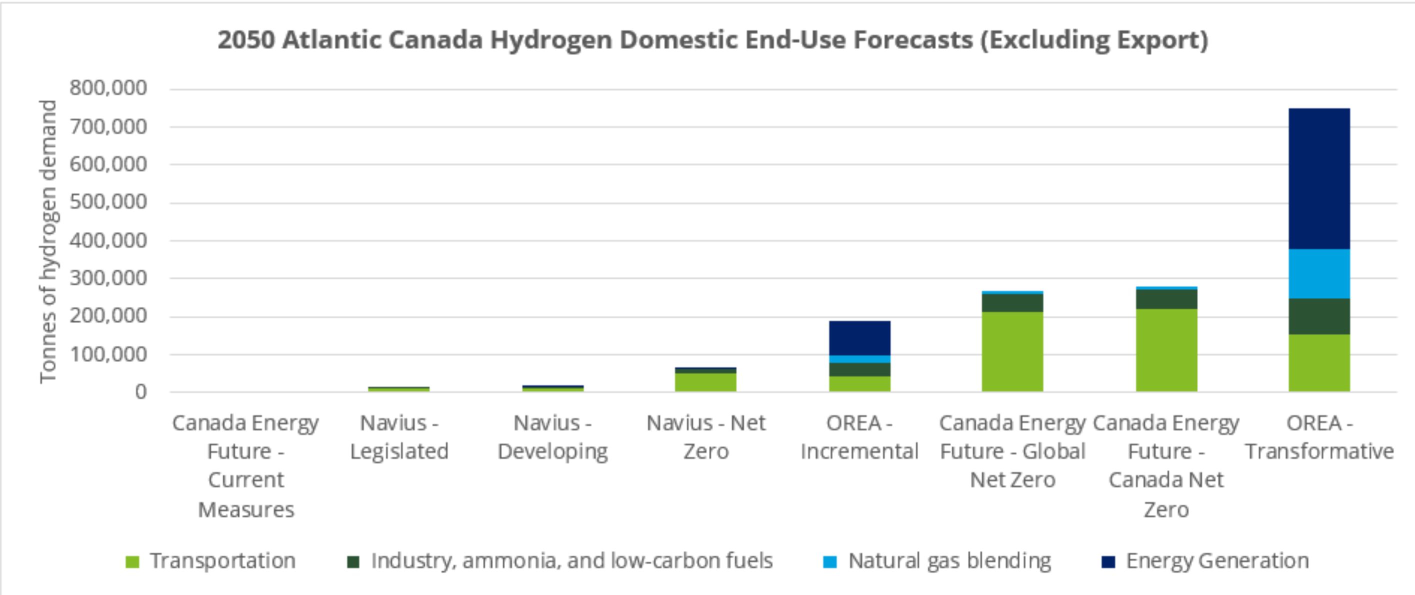

Figure 23 2050 Atlantic Canada Hydrogen Domestic End-Use Forecasts (Excluding Export)

Several insights were noted from these figures:

- When comparing Navius and CEF scenarios, similar trends emerged regarding hydrogen use in Atlantic Canada. Both sources identify the largest opportunities for hydrogen in transportation and industry, ammonia production, and low-carbon fuels. Additionally, both conclude that Atlantic Canada has sufficient renewable energy resources and infrastructure capacity to meet its projected domestic hydrogen demand over the long term.
- The primary difference between the CEF and Navius scenarios lies in the total projected demand. Canada's Energy Future presents a wider range of potential outcomes, reflecting the significant influence of government policy and external market factors on domestic hydrogen uptake. In contrast, Navius offers a more targeted and consistent range, though with lower overall demand volumes compared to Canada's Energy Future.
- In contrast, the OREA and Zen Energy Solutions study presents the most aggressive hydrogen demand outlook for Atlantic Canada. Even the most conservative scenario from OREA and Zen exceeds the highest hydrogen demand projection in Canada's Energy Future. Their analysis also presents a different perspective on how hydrogen could integrate into the region's economy, with energy storage and power generation identified as the largest potential use, followed by industry, ammonia production, and low-carbon fuels.

Looking ahead, while both Navius and Canada's Energy Future scenarios indicate that Atlantic Canada has the potential to produce enough hydrogen to meet domestic demand, temporary supply-demand imbalances may emerge as the low-carbon hydrogen ecosystem develops. In the early stages of market growth, domestic end-users may rely on transitional supply sources such as grey hydrogen from existing industrial processes or low-carbon hydrogen imports from other regions, such as Quebec.

5.3 Representative facility

To assess potential supply chain requirements and economic opportunities under different hydrogen growth scenarios, this assessment defined a representative hydrogen electrolysis production facility based on proposed projects in Atlantic Canada. The representative facility illustrates the scale and nature of equipment, workforce, and development requirements needed to support the production scenarios identified in Section 5.

The representative facility is a large-scale green hydrogen and ammonia production plant designed for both domestic end uses and for export. Consistent with current project proposals in the region, the facility would be developed in two phases, as outlined in Table 24.

Table 24 Representative facility characteristics

Characteristic	Phase 1	*Phase 1 to 2 addition*	Phase 2
Hydrogen production [tonnes]	40,000	*145,000*	185,000
Electrolyzer capacity [MW]	280	*1,015*	1,295
Ammonia production [tonnes]	240,000	*800,000*	1,040,000

This representative facility provides a useful reference point for understanding the scale of infrastructure, equipment, and workforce needed to develop Atlantic Canada's hydrogen ecosystem. While hydrogen-specific equipment like electrolyzers are important, a broad range of additional equipment and materials will also be required—many of which are common to other industries. These include transformers, compressors, valves, electrical equipment, construction materials like concrete and steel, and the skilled workers and trades needed for installation and commissioning.

Appendix 8.3 provides a detailed list of equipment, components, and materials required not only for production facilities but across the full hydrogen value chain. While not specific to this representative facility, the list demonstrates opportunities for Atlantic Canada's existing suppliers and service providers by highlighting areas where they may already participate or could adapt to support growth of the hydrogen ecosystem. This serves as a roadmap for local industries and workers to position themselves for economic opportunities as the regional hydrogen value chain expands.

Connecting the representative facility with the hydrogen growth scenario from the 2023 Canada's Energy Future report.

The representative hydrogen production facility provides a basis for understanding the hydrogen production scenarios presented in Section 5. **Based on production projections from the 2023 Canada's Energy Future report—which includes hydrogen for both domestic use and export—achieving the Canada Net Zero scenario would require nine similar facilities by 2035 and eleven additional facilities by 2050, for a total of nineteen representative facilities**. These projections enable development of high-level estimates of future construction, equipment procurement, and workforce requirements.

5.4 Workforce needs

This section outlines the construction and operating workforce requirements for the representative hydrogen project across Atlantic Canada. The assessment is based on a representative facility with two implementation phases: Phase 1 (three years) and Phase 2 (four years). This approach assesses the scale of labour needs while identifying potential pressures on occupations such as skilled trades, engineers—particularly in provinces central to project development and operations.

It is important to note that this analysis does not account for unexpected or competing labour demands in the region. For example, if a large infrastructure project is brought forward during the same period, it could significantly disrupt the available construction or utility workforce and alter the projected workforce capacity and require labour to be redirected from other areas of spending.

5.4.1 Construction phase employment and workforce

In a Phase 1 facility, approximately 2,613 construction workers would be employed annually. This demand increases in Phase 2, with an estimated 5,931 workers required. This includes the construction of production facilities, storage units, pipelines, and supporting civil infrastructure. The scale and complexity of the project place significant demands on occupations such as civil engineers, structural engineers, construction managers, electricians, and skilled tradespeople, reflecting the intensive construction activity concentrated in the province.

Construction phase workforce requirements of a single production facility (annual)[94]

(This analysis assumes that Phase 1 would take **three** years to complete, while Phase 2 would require **four** years)

	Phase 1 facility 40,000 tonnes of H2 annually		**Phase 2 facility (large-scale)** 185,000 tonnes of H2 annually	
	Share of workforce	No. of workers	Share of workforce	No. of workers
Representative facility	2.2%	2,613	5.1%	5,931

Scaling this up to 9 facilities in Atlantic Canada by 2035 to meet a production projection of 1,580,000 tonnes would be an enormous task. Between 2025 and 2035, this would require an average 20,489 construction workers each year focused entirely on building hydrogen production facilities to bring these 9 large-scale facilities online, representing 17.6% of the total construction labour force.

Meeting Atlantic Canada's 2050 production projections would require approximately 19 large-scale facilities, producing 3,560,000 tonnes of hydrogen each year. Between 2036 and 2050, this equates to an average of 14,760 construction workers focused on building hydrogen production facilities.

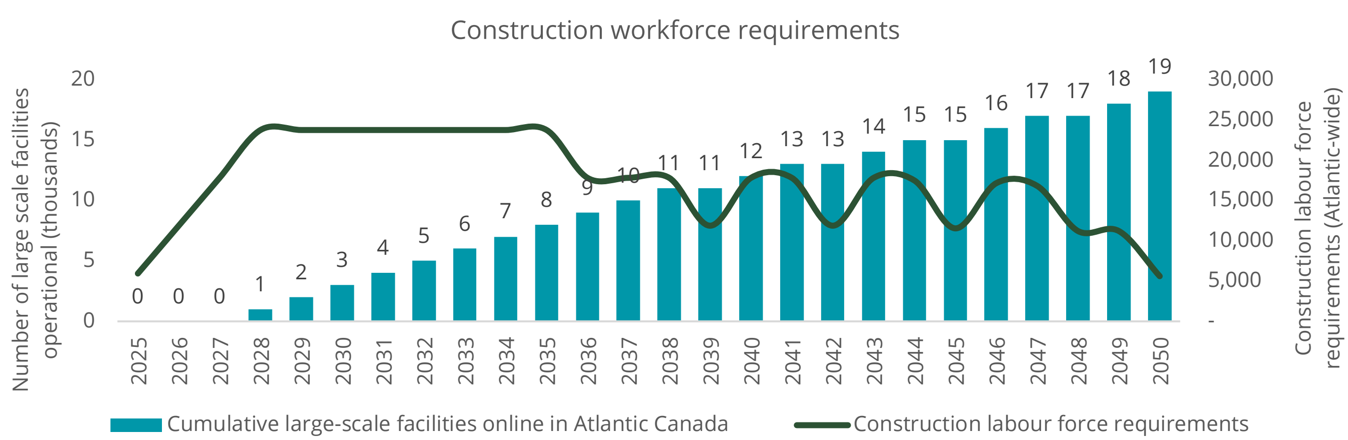

Figure 24 Projected number of facilities and construction workforce requirements through 2050

[94] Workforce estimates are derived from an Economic Impact Assessment (EIA) conducted using input-output modelling techniques. The projections are informed by a 2024 study involving facilities of similar scale and complexity, providing a benchmark for estimating workforce requirements across project phases.

This scenario assumes a linear deployment of construction, beginning immediately, with the first facility coming online in 2028. To complete 19 facilities between now and 2050 would require starting new construction every year until 2038, and then 2 new facilities in every 3 years through 2050.

Uncertainty around scenarios and projections

While the workforce projections illustrate the scale of potential workforce requirements under defined buildout scenarios, it is important to recognize that there are infinite possible development pathways between these bookends of one facility and nineteen facilities. At the lower end of the spectrum, Atlantic Canada may see only a single large-scale hydrogen facility in the short term if market conditions remain constrained. At the high end, if the Canada Energy Regulator's (CER) net-zero scenario materializes, the region could require up to nineteen facilities by 2050 to meet projected global hydrogen demand. In practice, any number of intermediate outcomes are possible, depending on variables such as export agreements, domestic uptake, technology costs, and global policy shifts.

This inherent uncertainty underscores the need for flexible workforce planning and training strategies that can scale up or down as the hydrogen market evolves. Rather than planning for a single fixed outcome, regional stakeholders should anticipate a dynamic range of labour needs—adjusting capacity and skills development in line with real-time market signals and project sequencing.

Implications if region achieves CER projections

In this higher-growth scenario, the scale of labour required would be unprecedented in the region's history. Based on the representative facility model, the sector could require more than 20,000 construction workers annually between 2025 and 2035, representing nearly one in five of all construction workers across the region. Even in the subsequent period from 2036 to 2050, when the pace of development slows somewhat, demand would remain exceptionally high at approximately 14,760 workers per year, or 12.7 percent of the construction labour force. These figures demonstrate that hydrogen development would not be a single project but rather a multi-decade mega-program that would dominate the region's construction landscape for a generation.

When compared with past large-scale projects, the magnitude of these workforce requirements becomes clear. The Muskrat Falls hydroelectric project in Labrador, often cited as one of the largest infrastructure builds in Atlantic Canada, engaged roughly 5,000 workers at its peak. The Hebron offshore oil platform required between 3,500 and 4,000 workers during its construction. Even the Maritime Link transmission project, which connected Nova Scotia and Newfoundland and Labrador, employed only 1,200 to 1,500 people at peak activity. By contrast, hydrogen projects could require four to five times the workforce of Muskrat Falls, sustained not for months or a few years, but across two decades. Preliminary estimates for offshore wind development in Nova Scotia suggest a peak workforce requirement of 5,000+ workers[95]. Taken together, hydrogen and offshore wind construction could create simultaneous demand well in excess of anything Atlantic Canada's labour market has experienced before.

Potential impacts

The implications of workforce demand on this scale could be far-reaching. First, pressures on the labour market would intensify significantly. Skilled trades such as welders, pipefitters, electricians, and heavy equipment operators would be in particularly high demand, alongside civil, structural, and electrical engineers. This competition is likely to draw workers away from other construction sectors, potentially delaying critical projects in other sectors such as housing, transportation, and public infrastructure. When combined with concurrent demand from offshore wind, transmission system upgrades, and other clean energy initiatives, labour availability could become the defining constraint for project delivery.

Second, the economic impact would be substantial. Sustained employment for tens of thousands of workers annually would make hydrogen one of the largest sources of job creation in the region, driving increases in regional GDP and household incomes. Yet these benefits could be tempered by wage inflation and supply shortages in other sectors, creating ripple effects across the broader economy.

Third, host communities would experience the social impacts of large-scale industrial activity. A rapid influx of workers has the potential to strain local housing, healthcare, and social services, creating dynamics like those seen in resource "boomtowns." For Indigenous and rural communities, the

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[95] Wind West Strategic Plan. 2025.

scale of development could create significant opportunities for economic participation, but only if clear pathways are established to ensure equitable access and long-term benefits.

Finally, a program of this magnitude could catalyze new industrial development and supply chain diversification. Sustained demand for materials and services may justify investments in regional manufacturing capacity for hydrogen-related components, fabrication yards, or assembly plants, enabling Atlantic Canada to capture greater long-term value from the hydrogen economy. However, these opportunities will only materialize if workforce bottlenecks are addressed. If not, the region risks cost overruns, project delays, and diminished competitiveness in the global hydrogen market.

5.4.2 Operations phase employment and workforce

In a Phase 1-sized facility, approximately 226 workers would be required annually. This demand increases to 442 workers in Phase 2. These systems require continuous technical oversight and utility support. Key occupations involved include plant operators, control room technicians, utility maintenance personnel, and industrial electricians.

Table 25 Annual operating phase workforce requirements for a representative facility

	Phase 1 facility 40,000 tonnes of H2 annually	**Phase 2 facility (large-scale)** 185,000 tonnes of H2 annually
	No. of workers	No. of workers
Representative facility	226	442

This analysis assumes that Phase 1 will take three years to complete, while Phase 2 would require four years.

If requirements scale from one to nine facilities by 2035, and 19 facilities by 2050, there would be a slow but steady increase in operating employment across the region. While construction activity represents the most visible surge in workforce demand, the operating phase of hydrogen facilities would create a sustained and growing source of employment across Atlantic Canada. Unlike construction, which is cyclical and peaks during build-out, operational roles endure for decades and form the backbone of the regional hydrogen economy once facilities are commissioned.

Figure 25 Projected cumulative operating phase workforce requirements through 2050

Based on these CER scenario projections, by 2035, operating hydrogen production facilities in Atlantic Canada are projected to support approximately 3,536 direct jobs. These roles span plant operators, industrial electricians, instrumentation technicians, control room staff, maintenance teams, safety and compliance officers, and a range of supporting functions in administration, logistics, and supply.

By 2050, operational employment is expected to more than double, reaching approximately 8,398 jobs as the hydrogen industry scales to meet both domestic and export demand. This growth reflects the addition of new facilities across the region, the expansion of associated distribution infrastructure, and the diversification into derivative fuels such as ammonia, methanol, and sustainable aviation fuel. Importantly, many of these jobs would be highly skilled and long-term, offering stable career pathways in technical and engineering disciplines that have historically been limited in Atlantic Canada.

The economic significance of this sustained employment cannot be overstated. While construction jobs would taper once projects are completed, operational employment ensures ongoing benefits to communities, supporting local economies through steady wages and regional spending. For Indigenous and rural communities, operations-phase employment provides a generational opportunity to build enduring participation in the energy sector, supported by training and capacity-building initiatives.

Equally important are the multiplier effects. For every operations job within a hydrogen facility, additional roles would be created in supporting industries such as transportation, equipment servicing, regulatory oversight, and R&D. By 2050, the hydrogen industry would not only be a key export engine but also one of the region's most stable employers, anchoring Atlantic Canada's position in the global clean energy transition.

5.4.3 Workforce needs in hydrogen supply chain for 2035 and 2050 growth scenarios

The workforce assessment highlights several critical considerations for workforce demand and supply in the region. The analysis began by determining the workforce requirements for a single representative facility. Importantly, workforce needs scale linearly with plant power output—as power capacity increases, the required number of workers, particularly during construction, increases proportionally. Similarly, larger facilities require greater operational workforces to ensure smooth and effective performance.

However, a significant constraint identified through this analysis is the limited availability of skilled workers in the region.

The current skilled labour supply in Atlantic Canada will struggle to support simultaneous construction of multiple large hydrogen production facilities, particularly given concurrent infrastructure projects requiring the same skilled workers. Therefore, meeting the 2035 forecasts would require strategic planning of construction activities. Rather than initiating multiple projects simultaneously, a phased approach would enable workers from facilities that have been completed or nearing completion to transition to other projects. This sequential method can effectively address regional labour constraints by leveraging the workforce efficiently without straining local labour markets.

To estimate workforce requirements across multiple facilities, it is advisable to use the workforce data from the representative facility as a baseline and scale it proportionately to targeted energy capacities. Project timing is another critical factor in workforce planning. Accelerated construction timelines create increased pressure on workforce demands, potentially worsening existing labour shortages. Conversely, extending construction timelines can significantly mitigate this pressure and enable more effective use of the available workforce and ensuring project feasibility and continuity.

Looking ahead to 2035 and 2050 growth scenarios, workforce demand in the hydrogen supply chain is projected to increase substantially as previously discussed. By 2035, the region could see significantly more hydrogen facilities, necessitating proportionate increases in both construction and operational workforces. As the scale and number of projects grow, the linear relationship established from the representative facility could serve as a predictive tool for workforce planning.

By 2050, workforce requirements could be significantly higher due to anticipated larger-scale facilities and advanced hydrogen technologies requiring highly skilled specialists, technicians, and engineers. The increase in workforce requirements highlights the importance of proactive measures to significantly expand training, education, and workforce retention strategies to ensure labour supply keeps up with demand.

Additional measures that could enhance workforce capacity and flexibility include targeted training and education programs, partnerships with local educational institutions to create a skilled workforce pipeline, incentives to attract and retain workers in the region, and initiatives aimed at upskilling or reskilling current workers to align with the specific demands of hydrogen facility construction and operations. Furthermore, cross-regional collaboration and resource-sharing agreements could alleviate local shortages by temporarily mobilizing skilled workers from other regions. In summary, successfully growing the hydrogen sector in Atlantic Canada depends on accurately scaling workforce needs to match plant energy capacity while strategically timing, workforce development and project phases to manage regional labour supply constraints.

6. Supply chain gap assessment

A gap assessment was conducted to evaluate the readiness and maturity of supply chain capabilities necessary to support projected future domestic and export hydrogen demand in Atlantic Canada. As the region seeks to become a leader in the global hydrogen economy, this assessment offers a structured approach to identifying gaps across key supply chain enablers, including infrastructure, workforce, regulatory policies, supply, and technology.

The primary objective of the gap assessment was to align current and future supply chain requirements with projected hydrogen demand and export goals. By examining the current state (2025), mid-term projections (2035), and long-term needs (2050), the assessment provides a roadmap for sustainable and scalable hydrogen supply chain development.

Table 26 outlines the key assessment areas used to evaluate requirements and identify gaps across the hydrogen ecosystem. These assessment areas cover the critical factors shaping hydrogen supply chain development in Atlantic Canada in consideration of market dynamics, policy and regulatory frameworks, infrastructure needs, workforce capabilities, and the local supplier ecosystem. The assessment collected baseline data on current capabilities across the assessment areas, then analyzed planned projects and anticipated developments through 2035 and 2050. Input sources include the supplier survey, industry workshops, and industry reports and announcements.

Table 26 Assessment areas of the gap assessment

#	Assessment Area	Description
1	**Market demand**	Evaluating hydrogen export demand signals from Atlantic Canada and comparing existing efforts to what is required to achieve emissions reduction targets and new export opportunities.
2	**Storage, transportation and infrastructure**	Evaluating Atlantic Canada's hydrogen storage, pipelines, port capabilities, and EPC firm availability, and comparing existing and planned infrastructure with projected requirements for hydrogen production, export, and safe distribution.
3	**Workforce, research and skills**	Assessing the availability of certified facility operators, technical training programs, and R&D expertise to determine talent gaps that could slow deployment.
4	**Local supplier ecosystem**	Assessing the availability of major regional suppliers, including OEMs, in relation to forecasted requirements for critical components, and readiness to support the anticipated growth of the hydrogen sector.
5	**Domestic policy, regulations and support mechanisms**	Assessing the effectiveness of hydrogen codes, regulatory frameworks, permitting processes, government support, and policy coordination in facilitating safe, scalable hydrogen development and investment across the value chain in Atlantic Canada.

To determine future supply chain requirements, this assessment uses hydrogen supply and demand projections from the 2023 Canada's Energy Future report, focusing on the Canada Net Zero scenario. With net zero targets set by all Atlantic Canada provinces and the federal government for 2050 or earlier, this scenario—which includes international export opportunities—provides a reasonable, though ambitious, basis for assessing future supply chain development. This section also references the "representative facility" introduced in Section 5.3 to translate production scenario values into potential facility and equipment requirements.

Timeframe	Projected demand	No. of representative production facilities	Electrolyzer capacity
2025	N/A	N/A	N/A
2035	1,580,000 tonnes H2 per year	~9	~11 GW
2050	3,560,000 tonnes H2 per year	~19	~25 GW

This section below analyzes each of the five assessment areas, highlighting the current state in Atlantic Canada, existing initiatives, their impact on regional supply chain development, and future requirements and identified gaps.

6.1 Market demand

Understanding current and emerging market demand is key to shaping hydrogen supply chain development in Atlantic Canada. Demand signals—both domestic and international—drive investment decisions, infrastructure development, and support project timelines. For Atlantic Canada, the opportunity is influenced by international and domestic policies alongside commercial interest in both markets as well as how well the production project pipeline aligns with these demand signals. Building on the analysis conducted in Sections 1 and 2 of this report, this section of the supply chain gap assessment connects market demand with Atlantic Canada's hydrogen supply chain across four dimensions:

- **International policy drivers**: How global decarbonization policies and import targets influence demand for Canadian hydrogen and derivatives.
- **Market interest and commitments**: Evidence of demand through offtake agreements, memorandums of understanding, partnerships, or other expressions of interest.
- **Domestic end-use activity**: The scale and type of hydrogen demand within Atlantic Canada, such as for transportation, power, or industrial use.
- **Production pipeline**: The status and scale of announced hydrogen production projects and how they align with potential demand.

The table below identifies the current state of the above four dimensions and their impact on Atlantic Canada's hydrogen supply chain that allows for an understanding on the present influence market demand has on advancing the regional supply chain.

Table 27 Market demand current state and impact on Atlantic Canada's hydrogen supply chain

Dimension	Current state	Supply chain impact
International policy drivers	European policies and initiatives (e.g., REPowerEU, RED III, REFuelEU Aviation, RFNBO) and mechanisms like H2Global and Canada-Germany double auction are creating demand signals with financial support programs supporting their implementation, as explored in detail in Section 2. For example, the REPowerEU initiative provides a target of 10 million tonnes of hydrogen imports from non-EU nations by 2030, and the Canada-Germany double auction includes up to $600 million in subsidies to compensate the difference in price between the supply and purchase bids. However, stakeholders have noted that Atlantic Canada faces a production cost gap versus European buyers' willingness to pay.	Positions Atlantic Canada as a potential exporter requiring the development of large-scale production and distribution facilities but exposes projects to domestic and international policy shifts as well as external competition from other jurisdictions looking to supply a more cost-competitive product to the European market, both affecting the business case for development in Atlantic Canada.
Market interest and commitments	Early-stage MOUs, LOIs, and NDAs with European buyers have been announced across four Atlantic Canada projects: Everwind, NARL, Pattern Energy, and	Initial commercial interest is promising but is insufficient to secure project financing for export facilities proposed across Atlantic Canada. In response to this, stakeholders

Dimension	Current state	Supply chain impact
	EVREC (details on each project and their commercial interest details provided in Section 1) but no formal, bankable agreements have been secured and announced publicly.	engaged highlighted the importance of diversifying markets while working to secure long-term offtake commitments to de-risk projects from the international market.
Domestic end-use activity	Eight early-stage projects (details on each are provided in Section 1 for each Province) for domestic hydrogen end-use adoption across Atlantic Canada are identified but none yet operational with their demand volumes not yet in the public domain.	Domestic demand is not yet sufficient to anchor production projects at scale. However, pilot projects underway indicate early progress to building out new offtake opportunities, further contributing to the local supply chain development and domestic decarbonization, but with the need for targeted support to advance these domestic pilots, as highlighted by stakeholders in each Atlantic Canada province.
Production project pipeline	Sixteen low-carbon hydrogen production projects have been announced or are in development across Atlantic Canada, linked to both domestic and export markets. Details on these projects are provided in Section 1 of this report. Eight projects target domestic use, and ten focus on exports, two are positioned to serve both, depending on how demand evolves. Summing the production volumes announced across all hydrogen production projects across Atlantic Canada roughly equates to 1.5 million tonnes of hydrogen production presently announced.[96]	There is strong interest in hydrogen production across Atlantic Canada, but projects will only proceed if matching demand is secured. The key challenge is ensuring supply and demand develop in lock step—across both domestic and export markets—to support project viability.

What we heard from industry

As part of the study's industry and community engagement, in-person workshops were held in Newfoundland and Labrador, Nova Scotia, and New Brunswick, bringing together participants from across the value chain. Several common themes were mentioned by workshop participants, including:

- **Market demand** was a key topic of interest in all three provinces.
- **Export focus and uncertainty**. Participants noted that more than 90% of projected hydrogen production is for export to Europe. While this represents a clear opportunity, participants questioned the long-term sustainability of this strategy.
- **Domestic offtake is underdeveloped**. Beyond pilot initiatives in transportation, industrial decarbonization, and blending, domestic markets are nascent. Many workshop participants emphasized the importance of credible, small-scale domestic projects to build demand and develop supply chains.
- **Price concerns**. Uncertainty around the price that customers will be willing to pay for low carbon hydrogen emerged as a key issue.
- **Diversification needed**. Stakeholders cautioned against overreliance on ammonia exports to Europe. Broader opportunities exist across multiple derivatives—such as methanol, sustainable aviation fuel (SAF), and e-methanol—that could reduce exposure to market concentration risks.
- **Communication gaps**. Participants highlighted that both the public and many industries lack a clear understanding of hydrogen's role and benefits. This knowledge gap was seen as a barrier to building demand, securing political and public support, and attracting investment.

[96] This estimate is based on publicly available information as of May 31, 2025, related to green hydrogen production projects, including those targeting ammonia, sustainable aviation fuel (SAF), and liquid organic hydrogen carrier (LOHC) production. Assumptions include an electrolyzer energy consumption of 55 kWh per kilogram of hydrogen and stoichiometric conversion ratios for hydrogen-to-ammonia synthesis.

Future requirements and gaps

Atlantic Canada's hydrogen supply chain requires stronger, coordinated demand signals from domestic and international end-users to attract investment and spur project execution. European policies such as REPowerEU, RED III, REFuelEU Aviation, and the RFNBO framework must remain in place and continue to drive demand for renewable hydrogen (and derivative) imports to sustain market opportunities for Atlantic Canada. For example, RED III and REFuelEU Aviation provide renewable fuel blending requirements for 2035 and 2050, which can support projects such as the proposed Nova Sustainable Fuels Renewable Energy Park facility.

While European policies are outside Canada's direct control, Atlantic Canada can prepare by ensuring hydrogen production meets EU sustainability, additionality, and traceability requirements, and by aligning export infrastructure, certification, and partnerships with European import conditions. A key gap remains the potential cost difference between Atlantic Canada's green hydrogen and what European buyers are willing to pay—closing this cost gap will support securing formal, bankable offtake agreements, which are an important factor in financing and advancing project development.

Based on the Canada Net Zero scenario from the 2023 Canada's Energy Futures report, Atlantic Canada's domestic hydrogen demand could reach 50,000 tonnes by 2035 and 280,000 tonnes by 2050. The transportation sector is expected to drive the highest demand, followed by industrial applications and natural gas blending. A growing domestic market could provide demand diversity and resilience, reducing reliance on a single export market and creating additional economic, supply chain, and decarbonization opportunities for Atlantic Canada communities.

Early adoption in priority sectors and pilot projects is be key to building market foundations and enabling scale-up. The current gap in operational end-use projects for low-carbon hydrogen is limiting demand growth and market confidence, underscoring the need for targeted support, alignment with production planning, and clear pathways for adoption.

Atlantic Canada's announced hydrogen production pipeline of approximately 1.5 million tonnes per year aligns with the 2035 production target identified in the Canada Net Zero scenario. However, by 2050, approximately 3.5 million tonnes would be needed to supply both domestic and international markets. Meeting this demand would require 11 additional large-scale facilities beyond current proposals, creating a significant supply gap for longer-term scenarios.

A balanced production strategy that serves both domestic use and export markets will be essential, along with coordinated planning across production, demand, and infrastructure will be key to sustain long-term growth. *Table* 28 summarizes the key gaps identified.

Table 28 Market demand key gaps

Dimension	Key gaps identified
International policy drivers	Gap between the cost of green hydrogen produced in Atlantic Canada and the price that European buyers are willing to pay
Market interest and commitments	Formal, bankable offtake agreements for green hydrogen are limited, which creates a risk of over-reliance on European demand with insufficient market diversification.
Domestic end-use activity	Domestic hydrogen demand remains unquantified with no operational projects and weak or delayed market signals, limiting the ability to anchor production and support supply chain development.
Production project pipeline	Hydrogen production pipelines align with 2035 targets, but future domestic supply are needs not fully addressed; need for supply-demand coordination to support long-term growth.

6.2 Storage and transportation infrastructure

Infrastructure availability to support forecasted demand represents one of the most capital-intensive and long-term components required to meet future needs. Four key infrastructure elements were evaluated: **storage capacity, pipeline networks, port facilities, and the availability of EPC firms capable to support modular execution**. Each of these components plays a distinct role in enabling the storage and distribution required for the production and export of hydrogen and its derivatives.

As of 2025, infrastructure development for hydrogen in Atlantic Canada remains in its initial phases. Table 29 outlines current initiatives in progress; however, substantial investment and strategic planning are necessary to achieve a comprehensive hydrogen value chain infrastructure.

Table 29 Current state (2025) outlook for storage and transportation infrastructure

Infrastructure	Status as of 2025	Current initiatives
Storage infrastructure	Limited; no large-scale hydrogen storage facilities operational	• Nova Scotia and Newfoundland and Labrador are both examining storage options connected to production projects, but physical infrastructure is still in early stages of development. • Most initiatives are in the planning or early development stages, such as the Robinsons River and Fischells Salt Dome projects in Newfoundland and Labrador
Hydrogen pipeline network	Early development with research underway; no operational hydrogen pipelines	• Newfoundland and Labrador and Prince Edward Island lack existing natural gas pipeline networks. The NARL project plans to retrofit an existing pipeline on the project site, but there have been no announced plans for development of a wider hydrogen pipeline. • Nova Scotia has amended the Gas Distribution Act and the Pipeline Act to enable the integration of hydrogen into the provincial energy systems, while New Brunswick has updated their Gas Distribution Act to include renewable gas and hydrogen.
Export port infrastructure	Some ports are positioned for export but require upgrades	• There are many high-quality deep-water ports across the region. In addition, many project developers are proposing their own port infrastructure as part of the project. • The Port of Halifax offers deep-water, ice-free facilities, modern terminals, and federal support for hydrogen initiatives. • The Strait of Canso, Port of Sydney and Goldboro areas are examples of prime locations with vacant land but would require upgrades. • Newfoundland and Labrador's ports in St. John's and Argentia are accessible hubs preparing for hydrogen exports and renewable energy projects. • New Brunswick's Port Saint John, the region's largest by volume, handles diverse cargo, including liquified natural gas (LNG), and is a strong candidate for hydrogen export. • The Port of Belledune is a major deep-water port for bulk and cargo handling with considerable energy ambitions. • Prince Edward Island's ports are tailored toward regional trade and fishing, lacking infrastructure or plans for hydrogen development.
Availability of modular EPC firms	Sufficient availability with strong expertise from related sectors to adapt existing capabilities to meet hydrogen-specific needs	• Strong foundation of regional expertise in large-scale energy projects from the offshore oil, gas, and wind sectors. • Many EPC firms in the region possess relevant skills and experience that closely align with the requirements of hydrogen projects. • A growing number of these firms are actively engaging with hydrogen initiatives, while dedicated hydrogen expertise is still developing as projects advance beyond the early stages

What we heard from industry

Infrastructure was consistently identified as both a strength and a gap during the in-person workshops held in Newfoundland & Labrador, Nova Scotia and New Brunswick.

- **Grid and electricity constraints**. In Nova Scotia, participants emphasized that the cost of electricity—more than the cost of hydrogen equipment—will determine competitiveness. Challenges around new power generation, transmission, and behind-the-fence solutions were seen as critical bottlenecks.
- **Port and shipping opportunities**. Newfoundland and Labrador and New Brunswick participants highlighted the advantage of short shipping distances to Europe and existing port capacity. At the same time, concerns were raised about whether ports will be upgraded in time with the necessary ammonia and hydrogen handling capabilities.
- **Shared and regional infrastructure**. Several groups stressed the importance of shared infrastructure across provinces—such as hubs, corridors, and joint port or pipeline facilities—to spread costs and ensure coordinated development.
- **Storage solutions**. Discussions pointed to the need for diverse storage options, from tanks and domes to underground caverns. Participants cautioned that storage for hydrogen derivatives would require specific planning and investment beyond ammonia alone.
- **Permitting and sequencing**. Infrastructure build-out was seen as highly dependent on streamlined permitting, careful sequencing of large projects, and alignment across jurisdictions to avoid duplication or stranded assets.

Future requirements and gaps

Atlantic Canada is working to become a leading hydrogen production hub by 2035 with ongoing efforts to strengthen its infrastructure to meet forecasted domestic and export demand.

The region has several deep-water port facilities capable of handling liquid bulk cargo, but these would need upgrades to accommodate hydrogen and ammonia exports. Necessary investments include cryogenic handling systems, enhanced safety protocols, and dedicated loading infrastructure to support an export opportunity in the millions of tonnes by 2050. Ports must also balance additional hydrogen loads with their current liquid bulk volumes while securing legislative alignment and capital investment for these developments. Moreover, while ports such as Port Saint John and Port of Halifax are positioned to meet short- and mid-term requirements, consideration should be given to existing ports outside residential areas to support long-term expansion and address potential community concerns. By 2050, at least one or two secondary ports should be equipped for hydrogen exports to manage future volumes.

The region must ensure that EPC firms are available to build up to 4 hydrogen facilities by 2035, considering some of the facility and other infrastructure projects could be executed in parallel. These firms should possess proven expertise in delivering complex hydrogen infrastructure initiatives and demonstrate experience in modular construction. Given the number of announced projects and associated supporting infrastructure, EPC firms would need to enhance their capabilities with a focus on hydrogen while managing concurrent demand from other high-growth sectors such as wind within the region. By 2050, as the number of full-scale hydrogen facilities could increase to 19, continued investment in workforce development would be essential to ensure sufficient capacity, given competing demand from other sectors.

Dedicated hydrogen pipeline infrastructure would be required for efficient transportation of hydrogen and derivatives from production facilities to storage facilities to key export ports as well as for domestic distribution. Nova Scotia and New Brunswick are exploring the repurposing of existing plastic natural gas pipelines to reduce costs, but technical and safety challenges must be addressed. Newfoundland and Labrador, due to its geography, would require new pipelines to connect production sites to export ports.

By 2035, an integrated pipeline system could be required to link production, storage, and export facilities, with further expansion potentially required by 2050 to span provincial boundaries and support both domestic distribution and large-scale exports.

By 2035, a mix of hydrogen storage solutions—such as compressed gas, liquid hydrogen, or other hydrogen-derived carriers—will be needed to support the distribution of approximately 1.5 million tonnes of hydrogen per year between supply and demand centres across both centralized and decentralized applications. Large-volume storage options, including the potential use of underground salt caverns, could play a role in helping to balance supply and demand, like how natural gas underground storage is used to manage price stability throughout the year.

While feasibility studies are underway, particularly for salt cavern storage in Newfoundland and Labrador, no firm construction commitments exist. There are also no region-wide standardized designs for hydrogen storage facilities, nor comprehensive regulatory frameworks to ensure safe and efficient deployment. This uncertainty delays project approvals and increases risks for investors. For example, the underground storage projects in Newfoundland and Labrador, e.g. Robinsons River and Fischells Salt Dome, have the potential combined storage capacities of over 800,000 tonnes of hydrogen, depending on geological conditions. However, these projects are still in exploration, drilling, or feasibility phases, with estimated development timelines of 5–7 years post-approval.

As Atlantic Canada continues to explore its potential as a future hydrogen hub, it would require a balanced and collaborative approach to infrastructure development. Ongoing dialogue among governments, industry partners, and local communities can help to identify priorities, streamline regulatory processes, and promote knowledge sharing. Continued assessment of infrastructure needs, along with flexible, phased investment strategies, can help address current gaps and adapt to evolving market demands.

6.3 Workforce and skills

Although the current workforce should be sufficient to support near-term hydrogen development, significant pressure is anticipated by 2035 as construction activity peaks and operations expand. Atlantic Canada's hydrogen workforce is in the early stages of development, with foundational efforts underway in construction, operations, and training. While overall labour availability remains adequate, intensifying infrastructure activity across all four Atlantic provinces, as well as the rest of Canada, would create labour market pressures, particularly for technical, engineering, and utility roles.

Construction needs remain manageable in most provinces, although growing demand in high-activity areas suggests this balance may be short-lived. On the operations side, workforce demand remains modest as most hydrogen facilities are still in development. However, regions that are already advancing multiple clean energy projects, including offshore wind, hydrogen infrastructure, and grid upgrades, could soon experience strain in technical workforce capacities.

If the region meets its hydrogen production projections, as discussed above, pressures on the construction labour force would be extreme, with potentially between 12 and 17 percent of construction workers in the region focused entirely on hydrogen facility construction.

Post-secondary institutions in Atlantic Canda are actively exploring new courses and training to support hydrogen industry needs. Newfoundland and Labrador currently leads with a specialized hydrogen technician diploma program, while Nova Scotia Community College (NSCC) offers micro-credentials to support technical hydrogen applications for process occupations. Hydrogen-specific educational initiatives in New Brunswick and Prince Edward Island are emerging but remain preliminary and require further development to adequately meet future workforce requirements. During the industry workshops academic institutions said they were cautious about training graduates before jobs in the hydrogen sector materialize.

There is a need for increased provincial collaboration to build a comprehensive and sustainable hydrogen workforce, particularly to address challenges in rural areas and Indigenous communities. To bolster rural workforce capacity, targeted initiatives could include expanding local training infrastructure, deploying mobile training units to deliver specialized hydrogen skills directly to rural communities, and establishing incentivized apprenticeship programs. Collaboration should also focus on engaging Indigenous by co-developing culturally relevant training programs, establishing clear career pathways into the hydrogen industry, and ensuring equitable access to employment opportunities. Strengthened regional cooperation and shared best practices among provinces can accelerate capacity-building, prevent skills duplication, and foster a cohesive and inclusive approach to workforce development across Atlantic Canada.

What we heard from industry

Labour availability and skills development were flagged as central to hydrogen's future in Atlantic Canada.

- **Existing labour shortages**. In Newfoundland and Labrador, participants pointed to 10,000–15,000 unfilled jobs in marine transport alone, warning that hydrogen could exacerbate these gaps without targeted workforce planning.
- **Education and training needs**. Nova Scotia participants stressed the importance of building pathways from P-12 through post-secondary, including micro-credentials, diplomas, and advisory committees to align training with industry needs. New Brunswick discussions linked hydrogen to retaining university and college students in the region.
- **Specialized expertise**. Across provinces, stakeholders noted the need for skills in electrolyzers, cryogenic storage, compressors, and other hydrogen-specific technologies, which are not yet common in the local workforce.
- **Indigenous and rural participation**. Several groups emphasized the opportunity to strengthen Indigenous partnerships and create training and career pathways in rural communities, ensuring broad participation in the hydrogen economy.
- **Research and innovation**. Universities and colleges were recognized as key players in advancing hydrogen R&D, standardization, and safety protocols. However, stakeholders asked for more practical quantification of inputs (turbines, tanks, steel) to inspire supplier investment and research alignment.

Future requirements and gaps

Looking ahead to 2035 and beyond, the region's hydrogen sector would face significant and evolving workforce challenges as activity shifts from preparation to full-scale project development and operations. By 2035, the demand for skilled construction and operational workers is expected to intensify. This surge in activity is projected to coincide with a tightening labour market, driven by both peak project buildout and a wave of retirements that would shrink the overall construction workforce. The result would be a growing deficit between labour supply and hydrogen project needs.

Compounding these pressures, hydrogen will not be the only sector seeking skilled workers. Offshore wind, transmission system upgrades, and other clean energy infrastructure projects will be ramping up simultaneously, all drawing from the same limited pool of trades and technical talent. This competition would make it increasingly difficult for hydrogen projects to secure the necessary workforce, even if the size of the overall workforce grows.

Operational roles would face similar constraints. As hydrogen production and integration into energy systems expands, demand would increase for workers with experience in utility, plant operations, and energy systems - roles already in short supply due to broader electrification trends. Without dedicated pipelines into these careers, labour shortages could slow facility ramp-up, impact facility operations, and delay system interconnections.

By 2035, regional training systems are expected to be more developed, with new programs emerging and expanded credential offerings in Newfoundland and Labrador and Nova Scotia. While these efforts would help address some of the gaps, training alone may not be sufficient unless coupled with strong labour mobility, retention strategies, and targeted supports for hydrogen career pathways.

Looking further ahead to 2050, workforce development systems are anticipated to be significantly more robust. Educational institutions should have fully integrated hydrogen content into trade and technical programs, and new generations of workers would have been trained through these updated pipelines. Automation may alleviate some operational staffing needs, and the region's training and credential infrastructure would likely be more responsive and coordinated.

Even with these advancements, structural workforce risks are expected to persist. Demographic pressures such as aging populations and outmigration could continue to constrain regional labour supply. Sectoral competition will remain a challenge, as hydrogen's growth is expected to coincide with ongoing development in offshore renewable energy projects, electrified transportation, and advanced clean tech manufacturing. These industries will continue to draw from overlapping talent pools, potentially leading to labour shortages when multiple sectors scale up at once.

By 2050, the primary challenge may shift from access to relevant training programs to the system's ability to consistently attract, retain, and deploy workers into hydrogen-related roles. Without strong cross-provincial coordination, comprehensive housing and relocation support, and sustained career development incentives, the region may struggle to fully realize its hydrogen potential—even if the right institutions and programs are in place.

Addressing these future workforce challenges would require a coordinated and proactive approach. Ensuring the region is well-positioned to support the growth of hydrogen and related clean energy sectors means going beyond expanding training programs alone. Targeted measures to strengthen labour mobility, enhance retention, and build robust pathways into hydrogen careers will be required to ensure workforce supply keeps pace with industry demand through 2035 and beyond.

6.4 Local supplier ecosystem

Three key factors will shape Atlantic Canada's hydrogen supplier ecosystem: the number of available suppliers, the presence of major original equipment manufacturers (OEMs), and access to critical components, considering regional economic activity and supply chain stability. Each factor contributes to the development of hydrogen infrastructure, equipment manufacturing, and operational processes. Supplier availability affects production capacity, major OEMs influence technology and investment, while access to critical components determines project timelines and supply chain stability.

As of 2025, Atlantic Canada's local hydrogen supplier ecosystem is in the early stages of developing the capacity required to fully support a large-scale, end-to-end hydrogen value chain. Currently, much of the supplier base serves a broad range of industries and lack dedicated hydrogen specialization. Critical components required for green hydrogen production such as electrolyzers, power transformers, hydrogen-compatible storage systems, and desalination units are primarily sourced from OEMs headquartered outside the region. Regional manufacturing and fabrication capacity for these items is modest, though it is important to note that Nu:ionic Technologies, based in New Brunswick, is an OEM for its Nu-X system and operates in the teal hydrogen space (Electric SMR). However, there are currently no OEMs based in the region specializing in green hydrogen components. Furthermore, the ecosystem lacks vertically integrated suppliers capable of manufacturing key sub-components locally, such as power electronics, high-pressure vessels, or advanced membranes.

Local suppliers are well-positioned and have a strong foundation to support the supply of non-critical components across the hydrogen value, particularly in areas of mechanical systems, HVAC, civil works, safety and water treatment. While critical hydrogen-specific components may still require import or OEM-investment, many general industrial components are already available through established industrial supply chains. This indicates that the regional supplier ecosystem is in an emerging stage with clear potential to scale and mature as demand grows.

Table 30 Supplier presence in supplying non-critical components

Component category	Examples of non-critical components	Supplier presence in Atlantic
Sealing and gasketry	Seals and gaskets	Established
Heating, ventilation, and air conditioning (HVAC)	Thermostats, chillers, heat exchangers, piping, ducting	Established
Electrical and power distribution	Busbars, control relays, low-voltage panels, cabling, pressure sensors	Established
Control and monitoring systems	PLCs, HMIs, data loggers, communication modules, SCADA	Emerging
Ventilation and exhaust systems	Fans, scrubbers, exhaust systems, flow meters	Established
Water treatment systems	Activated carbon filters, purified water tanks, reverse osmosis units	Established
Safety systems	Pressure relief valves, fire suppression systems, alarms	Established
Piping and valving	Low/high-pressure piping, fittings, valves	Established
Instrumentation	Flow meters, gas sensors, temperature/pressure gauges	Emerging
Compression and storage hardware	Pressure regulators, skids, mounting framers	Emerging
Civils and site infrastructure	Concrete pads, trenching, electrical grounding, drainage	Established
Structural and fabrication	Racks, enclosures, steel framing, modular platforms	Established
Transport components	Chassis, brackets, hose assemblies, vehicle mounts	Emerging

Looking ahead to 2035 and 2050, establishing a supply chain that is both locally built and internationally supported is essential. Strengthening local capabilities while leveraging global expertise and resources will help ensure the region can meet increasing demand, enhance resilience, and position itself as a competitive player in the global hydrogen economy.

What we heard from industry

Discussions revealed optimism about supplier opportunities but also realism about current limitations.

- **Construction and industrial support**. Participants agreed that Atlantic firms are well positioned to provide construction, civil works, piping, valves, and safety systems—essential Tier 2 and Tier 3 capabilities.
- **Limits of local manufacturing**. Critical Tier 1 components such as electrolyzers, storage tanks, and turbines would continue to be imported in the near term. Several stakeholders noted that it may never make sense to manufacture some items locally, given global cost advantages.
- **Supplier inspiration**. Participants from Newfoundland and Labrador stressed that assessments should quantify inputs in tangible terms (steel, turbines, tanks) to show suppliers the scale of opportunity. This framing was seen as more motivating than abstract statistics on jobs or costs.
- **SME opportunities**. In New Brunswick, small and medium-sized enterprises were identified as potential suppliers to fabrication, barge terminals, and niche services, especially if paired with international partnerships.
- **Global competition**. Some groups raised concern about China's ability to compress costs by controlling its entire supply chain, warning that Atlantic firms must be strategic about where they can compete.

Future requirements and gaps

To achieve its hydrogen deployment goals for 2035, Atlantic Canada must ensure reliable access to a broad range of equipment suppliers capable of supporting increased production, conversion, and distribution needs. Key components such as electrolyzers, high-voltage power transformers, hydrogen-compatible storage systems, desalination units, and modular refueling infrastructure, need to be readily available to facilitate both project execution and ongoing operations. However, current challenges include limited local supplier capacity, restricted procurement options, extended delivery timelines, and exposure to international supply chain uncertainties. While some local suppliers are beginning to participate in hydrogen projects, their capabilities are not yet sufficient to meet the anticipated scale and technical requirements for 2035.

Table 31 Critical components required to meet projected demand

Critical component	2035 projected requirement	2050 projected requirement
Electrolyzer capacity	~11 GW based on Canada Net Zero Scenario (2023 Canada's Energy Future Report)	~25 GW based on Canada Net Zero Scenario (2023 Canada's Energy Future Report)
Power transformer	~11,000 MVA of total transformer capacity[97] which would equate to ~22 units required[98] to meet capacity	11,000 MVA of total transformer capacity[97] which would equate to ~50 units required[98] to meet capacity
Storage tanks *(compressed gas, liquid/cryogenic)*	Up to 75 ammonia storage tanks may be required[99] for the production volumes for international markets	Up to 160 ammonia storage tanks may be required[99] for the production volumes for international markets

To address these challenges and support large-scale infrastructure deployment, the region should consider attracting one or two major OEMs to establish operations by 2035. This strategy would enhance domestic supply capacity, reduce delivery and supply risks, and support regional economic growth through technology localization, skilled job creation, and long-term service capabilities.

Looking ahead to 2050, Atlantic Canada's ambition to become a globally competitive hydrogen production and export hub will rely significantly on the establishment of an almost entirely localized supply ecosystem capable of supporting manufacturing systems and components at far greater scale and complexity. The scale of forecasted demand of components such as the need

[97] Assuming a power factor of 1 and only considering the electrolyzer, not any other processes or balance of plant.

[98] Assuming the use of 500 MVA transformers

[99] Based on an estimate of approximately eight tanks per facility producing 1 million tonnes of ammonia per year. This is calculated assuming each tank has a 20,000 m³ capacity and provides one month of on-site ammonia storage to support continuous export operations.

for over 50 power transformers and 160 ammonia storage tanks,[100] would require advanced manufacturing and logistics infrastructure, as well as consistent access to OEMs and component suppliers for critical systems across the hydrogen value chain. The anticipated scale of demand underscores that continued dependence on external or imported components may increasingly result in challenges concerning cost efficiency, operational coordination, and supply reliability.

Moving forward, the region would require potentially attracting OEMs specializing in hydrogen technologies to set up manufacturing operations within Atlantic Canada. This approach would fortify regional supply chains, mitigate procurement risks, and position the region not only as a producer but also as an integral contributor to the global hydrogen technology value chain. A robust local supplier base would further enhance the region's capacity to meet export schedules, address surges in demand, and retain the economic benefits derived from equipment manufacturing and servicing activities.

[100] Deloitte order-of-magnitude estimate illustrating the scale of equipment required to align with the Canada Net Zero 2050 hydrogen production scenario from the 2023 Canada’s Energy Future report. The estimate assumes 50 transformers rated at 500 MVA each, operating at a power factor of 1, and excludes balance-of-plant loads. Electrolyzer efficiency is assumed at 55 kWh per kilogram of hydrogen produced.

6.5 Domestic policy, regulation, and support mechanisms

Understanding domestic policies, regulations, and support mechanisms will help clarify federal and provincial priorities and actions that will influence hydrogen development in Atlantic Canada. These factors shape how the hydrogen supply chain aligns with regional objectives, affects the efficiency of project development, and influences the supports available to enable progress. Evolving codes, standards, permitting frameworks, strategies, and programs all play a role in shaping project timelines, investment confidence, and market growth in the region. These four dimension are reviewed in this category:

- **Codes and standards**: The availability, alignment, and readiness of hydrogen-related technical codes and standards.
- **Permitting and regulations**: The consistency and efficiency of permitting processes and regulatory requirements that affect project development and operations.
- **Government strategy and policy**: Federal and provincial strategies and policy frameworks that guide hydrogen ecosystem development and priorities.
- **Government support mechanisms**: Programs, incentives, and funding designed to support hydrogen projects, supply chain growth, and market adoption.

Table 32 Domestic policy, regulation, and support mechanisms & impact identifies the current states of the above four dimensions and their connection to the Atlantic Canada hydrogen supply chain to inform the connection between the successful development of a regional hydrogen supply chain and provincial and federal governments.

Table 32 Domestic policy, regulation, and support mechanisms & impact

Dimension	Current state	Supply chain impact
Codes and standards	The 2024 Canadian Hydrogen Codes and Standards Roadmap identifies 20 priority areas and 72 additional elements across the hydrogen value chain that require development, organizing these areas over short-, medium-, and long-term priority timelines.	Progress in codes and standards development will directly affect project readiness, permitting efficiency, and the ability of Atlantic Canada's supply chain to meet domestic and international requirements, particularly for export opportunities.
Permitting & regulations	Highlighted by stakeholders was the variation of permitting processes across Atlantic Canada, with differing timelines, overlapping reviews with other levels of government, and multiple requirements that create complexity for multi-jurisdictional projects or developer operations.	Inconsistent permitting practices increases uncertainty and complexity for developers and may delay project timelines, affecting supply chain activation and Atlantic Canada's competitiveness as a location for hydrogen investment.
Government support mechanisms	Supporting the operationalization of federal and provincial strategies are support programs, such as the federal Clean Hydrogen Investment Tax Credit, Strategic Innovation Fund, and Clean Fuels Fund. However, stakeholders note challenges with limited availability and alignment with project timelines. Further details are in Section 1 of this report.	The federal and provincial governments play a key enabling role in supporting export readiness by improving international market access, certification, and trade relationships. However, aligning federal and provincial support program requirements and application timelines with project and market development timelines will be important to avoid delays, reduce uncertainty for proponents, and enable timely supply chain growth in Atlantic Canada.

What we heard from industry

Policy clarity and coordination were recurring themes across all workshops.

- **Regulation as both enabler and barrier**. Stakeholders agreed that clear, consistent permitting and safety standards are essential to unlock investment—but today, frameworks are fragmented and often slow.
- **Provincial and regional coordination**. Participants in Nova Scotia and Newfoundland and Labrador highlighted the need for a unified Atlantic voice and alignment of provincial approaches. A "one project, one review" model was frequently cited as a way to streamline permitting—meaning that a project that receives provincial approvals should not then require additional federal approvals, repeating much of the same process (or vice-versa).
- **Federal clarity and incentives**. Across provinces, participants called for greater certainty from Ottawa on tax credits, procurement policies, and incentives to bridge the gap between the cost of hydrogen production and the price markets are willing to pay.
- **Support for domestic demand**. Many participants felt that current programs focus too heavily on hydrogen production and exports, without creating strong demand-side signals for domestic users in the transportation, industrial, or power sectors.
- **Community and Indigenous engagement**. In all sessions, stakeholders emphasized that Indigenous partnerships, community engagement, and public awareness are essential to securing the social licence needed for projects to proceed.

Future requirements and gaps

Clear and consistent codes, standards, permitting, regulations, strategies, and support mechanisms will be essential to enabling Atlantic Canada's hydrogen supply chain. These frameworks must work together to give project developers confidence, ensure projects can proceed efficiently, and remain responsive to evolving technologies, markets, and community expectations.

For codes and standards, all identified gaps should be addressed in order of priority, with particular attention to areas critical for Atlantic Canada's hydrogen value chain—such as standards for ammonia use, water electrolysis, and carbon intensity tracking, which are key to enabling export opportunities. Closing these gaps will help avoid delays during permitting, construction, and operations.

On strategy and policy, Atlantic Canada would benefit from a clear, regionally integrated hydrogen strategy that aligns provincial efforts with federal priorities. This shared vision would help coordinate actions, attract investment, and ensure that policies and programs advance infrastructure and project development in a way that supports both domestic use and export markets.

Support mechanisms, both the type as well as implementation, will need to evolve as the ecosystem advances. Provincial programs can address local needs, such as domestic end-use opportunities and pilot projects, while complementing federal supports that must remain competitive globally for export focused initiatives. Current programs lack strong demand-side mechanisms, as highlighted by stakeholders, which are needed to create reliable offtake signals in domestic markets and build investment confidence.

Table 33 summarizes key gaps summarized across codes and standards, permitting & regulations, government strategy and policy.

Table 33 Domestic policy, regulation, and support mechanism key gap summary

Dimension	Key gaps identified
Codes and standards	The Canadian Hydrogen Codes and Standards Roadmap highlights short-term priority gaps in key areas needed to enable Atlantic Canada's export potential—specifically in water electrolysis, carbon intensity tracking, ammonia-based hydrogen delivery, and hydrogen storage. Additional short term priority gaps exist for hydrogen end-use in mobility, steel production, and natural gas blending, including appliance compatibility.

Permitting & regulations	Inconsistent permitting processes across provinces and additional permitting processes with federal departments creates complexity for multi-jurisdictional projects.
Government strategy and policy	No unified regional strategy for Atlantic Canada. The region often engages in the sector with four difference voices.

6.6 Implications for Atlantic Canada's hydrogen supply chain

This section outlines the implications of current trends and gaps for Atlantic Canada's hydrogen supply chain across five key areas: market demand, infrastructure, workforce, suppliers, and policy. It highlights where action is needed to unlock investment, build capacity, and support both domestic and export hydrogen markets, with potential actions suggested to guide strategic interventions.

Table 34 Implications for Atlantic Canada's hydrogen supply chain

Lens	Implications	Potential mitigating actions
Market demand	• Focus on export demand exposes projects to international policy shifts and cost competitiveness pressures. • Domestic demand is underdeveloped, with pilot projects underway but insufficient to anchor large-scale production.	• Support early domestic pilot projects to demonstrate hydrogen applications in transportation, industry, and energy, creating credible demand signals. • Encourage multi-market offtake agreements to diversify export markets beyond Europe and reduce reliance on a single buyer. • Coordinate production planning with projected demand to ensure supply and demand evolve in parallel, reducing risk of stranded assets. • Leverage policy incentives to bridge the cost gap between local production and international buyers' willingness to pay. • Conduct sector-specific feasibility studies to quantify domestic hydrogen demand and guide future infrastructure and investment decisions.
Storage and transportation infrastructure	• Hydrogen storage, pipelines, and port infrastructure are in early stages, creating potential bottlenecks once production gets underway. • Existing deep-water ports and EPC expertise provide a strong foundation, but upgrades to infrastructure are needed. • Integrated cross-provincial infrastructure could be critical for cost-effective distribution and avoiding stranded assets.	• Develop and upgrade storage infrastructure (e.g., tanks, underground caverns) to support flexible distribution between production and demand centers. • Advance port readiness projects with hydrogen-compatible handling, cryogenic systems, and safety protocols for export volumes. • Plan integrated pipeline networks to connect production sites, storage hubs, and ports, considering cross-provincial coordination. • Enhance EPC firm capabilities in hydrogen-specific projects to ensure timely and modular facility execution.
Workforce and skills	• Current workforce can support near-term development, but shortages will intensify by 2035–2050 in construction, technical, and operational roles depending on how the market materializes.	• Develop targeted programs for Indigenou xs and rural communities to increase participation and build local career pathways. • Coordinate cross-provincial workforce planning to manage labour mobility and retention amid overlapping clean energy projects. • Integrate hydrogen content into post-secondary curricula and micro-credentials to create pipelines for skilled graduates. • Forecast workforce demand aligned with project timelines to proactively mitigate labour shortages in construction and operations.

	• Education and training programs are emerging but waiting on clearer market signals; Indigenous and rural participation is currently limited. • Competition from other clean energy sectors will exacerbate labour pressures.	
Local supplier ecosystem	• Strong regional capability for non-critical components exists, but critical hydrogen technologies (electrolyzers, storage systems, power electronics) are largely imported. • Supply chain gaps create risk for project timelines and operational reliability. • Scaling to meet 2050 targets would require a more mature, locally integrated supplier base.	• Position the region to attract strategic Tier 2 OEMs for critical hydrogen components to establish local manufacturing capacity. • Leverage existing suppliers for non-critical components while developing their capabilities to support hydrogen-specific requirements. • Encourage collaboration between local SMEs and international technology providers to build knowledge transfer and regional capacity. • Quantify local supplier opportunities in tangible terms (e.g., volume of steel, tanks, transformers) to motivate participation. • Plan for long-term localization of component supply to enhance reliability, reduce delivery risk, and support scaling to 2050 demand.
Domestic policy, regulation, and support mechanisms	• Provincial permitting, codes, and standards not yet harmonized, increasing potential for complexity. • Lack of a unified Atlantic Canada hydrogen strategy could limit inter-provincial coordination. • Existing support mechanisms focus on production and export, lacking domestic demand-side incentives.	• Coordination regionally to advance efforts and align on a clear regional vision. • Harmonize codes, standards, and permitting processes to streamline multi-jurisdictional project approvals. • Strengthen demand-side incentives to stimulate domestic hydrogen adoption in transportation, industry, and energy sectors. • Align federal and provincial support mechanisms with project timelines to reduce uncertainty for developers. • Enhance community and Indigenous engagement frameworks to secure social license and facilitate project execution. • Streamline infrastructure permitting and sequencing to reduce project delays and optimize regional coordination.

6.7 Summary of strengths, weaknesses, opportunities and threats (SWOT)

This following page summarizes the strengths, weaknesses, opportunities and threats relating to Atlantic Canada's hydrogen sector, informed by desktop research, industry engagement, the supplier survey, and gap assessment results. Table 35 consolidates these SWOT findings, providing a strategic basis for formulating actionable recommendations aimed at enhancing the growth and resilience of Atlantic Canada's hydrogen supply chain.

Table 35 Summary of strengths, weaknesses, opportunities and threats (SWOT)

Strengths

- Atlantic Canada's proximity to export markets such as Europe enables the region to capitalize on growing demand.
- Strong history and expertise in energy production such as oil and gas and renewable energy.
- Supportive domestic provincial strategies and policy frameworks for clean energy transitions, including hydrogen.
- World-class onshore and offshore wind resources and regimes.
- Deep-water ports with liquid bulk handling capabilities across the region offer a strong foundation for hydrogen export infrastructure.
- Modern and hydrogen-compatible gas pipeline infrastructure that can be repurposed or upgraded for hydrogen use.
- Emerging research and innovation ecosystem consisting of universities and industry associations to advance the hydrogen sector.
- Local EPC firms that have related experience in sectors like oil and gas, heavy industry, and wind and are well positioned to transition to hydrogen-related projects.
- Presence of suppliers for non-critical components and equipment required throughout the hydrogen value chain

Weaknesses

- Heavy reliance on international supply chains for importing critical materials and components, which constraints scalability and increases costs.
- No established manufacturing facilities by major OEMs for green hydrogen technology.
- Speculative and uncertain market demand for low-carbon hydrogen
- Hydrogen-specific technology expertise is limited, and upskilling programs are in early stages of development
- Specific regulations and standards for hydrogen production, storage, transportation, and use are still evolving
- Dependency on external (international) expertise on technologies requiring partnerships to bridge gaps

Opportunities

- Targeted training and upskilling initiatives can enhance local workforce capabilities, building expertise in hydrogen-specific activities throughout the value chain
- Collaboration with government and industry can accelerate the development of local industrial clusters, focusing on manufacturing components locally and reducing import reliance
- Establishment of safety and permitting regulations across the hydrogen value chain
- Engagement with Indigenous and rural communities to enhance social license to operate and leverage local knowledge
- Building on existing trade relationships to secure hydrogen off take agreements and long-term market stability.

Threats

- Growing global demand for hydrogen can pose a threat for critical component availability, potentially outpacing Atlantic Canada if local capabilities lag
- Inconsistent or delayed regulatory frameworks for component manufacturing, hydrogen production, storage, and transportation could deter investment and project growth
- High initial capital costs of projects combined with uncertain demand pose risks for investors
- Competition from other regions in Canada and internationally that are further advanced in hydrogen development
- Changes in federal and provincial policies such as reduced funding or shifting priorities could undermine the industry's growth
- Environmental and social opposition to local hydrogen development from environmental groups or local communities
- Global supply chain disruptions due to geopolitical tensions and trade restrictions can strain supply of critical components leading to project delays and increased costs
- Misconceptions about hydrogen safety or environmental impacts could lead to public resistance
- Specialized-talent retention challenges in areas such as engineering, project management and research

7. Recommendations and action plan

Advancing Atlantic Canada's hydrogen ecosystem requires a coordinated and pragmatic path forward that builds on this report's analyses, findings, and community and engagement insights. This section presents priority recommendations to support the development of Atlantic Canada's hydrogen supply chain, regional market growth, and long-term operations.

Four recommendation themes have been identified, each with overarching objectives to unlock regional potential, support economic development, and position Atlantic Canada as a key contributor to Canada's low-carbon energy future. Each of these themes focus on opportunities that require action or coordination across all four Atlantic Canada provinces—and, in some cases, with federal and international partners—to drive growth. The following section describes each recommendation theme, the context for its selection, and its overarching ecosystem objective.

Theme	Background	Ecosystem objective
Build supply and secure demand to unlock supply chain investment	Hydrogen markets for new end-uses are relatively undeveloped compared to other clean energy sectors, with hydrogen competing alongside options like electrification and biofuels. For Atlantic Canada, establishing a credible and visible hydrogen supply and demand foundation will help attract private and public investment into the regional hydrogen value chain and supply chains. Demonstrating that Atlantic Canada can produce competitively priced hydrogen, build local demand, and access international markets will provide a strong foundation for mobilizing investment and advancing long-term supply chain activity.	A strong market foundation that attracts investment across the hydrogen value chain to enable sustained supply chain activity.
Grow local suppliers to expand participation	Advancing Atlantic Canada's hydrogen ecosystem depends on technology and markets, and on strong relationships with Indigenous Nations and local communities. Meaningful engagement is essential to build awareness and support for hydrogen's decarbonization potential and economic opportunities, while identifying ways for Indigenous, rural, and local businesses to participate as suppliers, service providers, and partners across the hydrogen value chain. This approach ensures that the benefits of hydrogen development are shared widely across Atlantic Canada and builds the social acceptance necessary to support ongoing projects and operations.	Broad-based participation from local, rural, and Indigenous communities alongside new entrants in the supply chain.
Develop workforce and innovation to build and sustain the supply chain	A skilled workforce and robust innovation pipeline are essential for operating, maintaining, and expanding the hydrogen supply chain. Atlantic Canada has foundational strengths including an experienced industrial and energy workforce and respected educational institutions. To fully leverage these assets, coordinated efforts are needed to align training programs and research with project and supply chain requirements. This alignment can support workforce readiness, reduce reliance on external expertise, and promote sustained regional participation in hydrogen markets.	A skilled regional workforce and active research ecosystem that support the construction, operation, and evolution of the supply chain.
Integrate hydrogen into infrastructure planning to enable efficient deployment	Hydrogen development presents opportunities to leverage existing or planned infrastructure—such as ports, pipelines, and storage facilities—reducing project costs and timelines while supporting new economic and decarbonization opportunities. However, retrofitting infrastructure or planning hydrogen-ready infrastructure is complex, capital-intensive, requiring strategic foresight. Incorporating hydrogen considerations into infrastructure planning in Atlantic Canada can help maximize efficiency, ensure compatibility with future market needs, and position the region to capture both domestic and export opportunities.	Infrastructure systems are designed or upgraded to enable efficient hydrogen production, distribution, end-use, and export.

Alignment with current federal and provincial priorities for hydrogen development will be important to enable implementation of the recommendations. Building on the focus areas, goals, and strategic documents summarized in Section 1, Table 36 illustrates how each of the recommendation themes supports the strategic pillars of Canada's Hydrogen Strategy and the key focus areas of each Atlantic Canada province. This alignment demonstrates that the recommended actions for advancing Atlantic Canada's hydrogen supply chain are consistent with, and contribute to, both provincial and national objectives.

Recommendations

To contextualize for each recommendation within Atlantic Canada's hydrogen supply chain ecosystem, the following descriptors are included:

Observation and importance to Atlantic Canada's supply chain: Describes the ecosystem context and its significance to the development of Atlantic Canada's hydrogen supply chain, providing the basis for each recommended action.

Desired outcome: The desired outcome of the successful implementation of each recommendation to identify the overall intent and goal(s). This is integrated into the Action Plan and Roadmap to provide clarity on the target state while providing flexibility to the region on how to achieve these ends.

Following the full list of recommendations, the report presents an action plan and roadmap, which outlines how the ecosystem can move forward by defining the respective roles of government, industry, and other parties. It also proposes high-level success metrics and describes how local communities—including Indigenous Nations and rural regions—can meaningfully participate in, and benefit from, the opportunities created by Atlantic Canada's growing hydrogen economy.

Summary of supply chain recommendations

To establish a competitive and resilient hydrogen economy, Atlantic Canada must first focus on the foundational elements of the value chain itself. The following core supply chain recommendations target the practical enablers of production, storage, distribution, workforce readiness, and industrial deployment. They emphasize actions that directly unlock investment, build local manufacturing capacity, and integrate hydrogen into critical infrastructure—laying the groundwork for a self-sustaining regional supply chain that can scale to meet both domestic and export demand.

Theme	#	Headline	Observation and importance to regional supply chain	Recommendation
1. Build supply and secure demand to unlock supply chain investment	1.1	**Advance lighthouse hydrogen projects in each province**	Provincial workshop discussions identified hesitancy to adopt hydrogen technologies, driven by uncertainty and perceived risks, as a barrier to early end-use adoption and a factor slowing production deployment. Reducing this hesitancy builds market confidence, unlocks upstream investment, and supports early activation of the hydrogen supply chain.	Identify and advance lighthouse projects in each Atlantic province that demonstrate key hydrogen technologies and highlight province-specific value chain opportunities, while enabling regional knowledge sharing.
	1.2	**Establish coordinated hydrogen hubs and project nodes**	Provincial and federal governments have already identified hydrogen hubs as a key element of their hydrogen ambitions, with workshop discussions emphasizing the need for a coordinated approach to supply and demand aggregation. Establishing hubs enables focal points for infrastructure development, investment attraction, and regional coordination, allowing Atlantic Canada to engage more effectively in national and international hydrogen markets.	In coordination with the federal government, identify and designate hydrogen hubs and associated project nodes across Atlantic Canada, aligned with lighthouse projects and infrastructure development, supported by a regional operating structure to coordinate and govern activities.
	1.3	**Leverage public procurement to anchor early demand**	Identifying early adopters willing to purchase hydrogen has been recognized as a challenge due to uncertainty about operational impacts and costs, with workshops highlighting the opportunity for government entities to serve as initial offtakers. Early demand anchors create market certainty, catalyze investment, and reduce risk for producers and supply chain participants.	Explore the viability of federal and provincial procurement mandates or local content clauses requiring public sector developments and/or operations to adopt hydrogen, hydrogen-derived fuels, or use hydrogen-based products (e.g., domestically produced cement manufacturing), to help establish a domestic market in Atlantic Canada.
	1.4	**Implement domestic demand-side tools like Contracts for Difference**	The current cost differential between incumbent fuels and low-carbon hydrogen is significant, with willingness to pay varying by sector. Mechanisms like Contracts for Difference, adopted internationally, can bridge this gap while markets scale, helping to stimulate demand, reduce financial barriers for early adopters, and encourage production scale-up.	Explore domestic demand-side mechanisms, such as Contracts for Difference (CfDs), to connect regional hydrogen supply and demand while accounting for varying willingness to pay across sectors. Federal or provincial funding could support price stabilization tools for early offtakers of green hydrogen and ammonia. This approach could be anchored by local demand from industrial offtakers such as Irving Oil, as well as new end-use sectors like steel, pulp and paper, fertilizer, energy generation (peak and/or baseload), and maritime shipping to convert existing thermal and fuel processes to low-carbon hydrogen or its derivatives.
	1.5	**Conduct targeted feasibility studies for key sectors**	Industrial sectors in Atlantic Canada classified as hard to abate present potential opportunities for low-carbon hydrogen, but their technical and commercial feasibility may not yet be fully understood. Clarifying these opportunities helps identify where hydrogen can have the greatest impact, supports prioritization of projects, and directs supply chain development and investment toward sectors with realistic adoption potential.	Building on existing studies, support targeted feasibility studies with clear pathways to operationalization for sectoral hydrogen end-use opportunities in Atlantic Canada. Prioritize sectors such as industrial processes and heavy-duty trucking, while also aligning with renewable energy developments for hydrogen-based energy storage and use and collaborating with natural gas utilities to evaluate hydrogen pipeline blending.

2. Grow local suppliers to expand participation	2.1	**Attract Tier 1 and Tier 2 hydrogen suppliers**	The low-carbon hydrogen value chain in Atlantic Canada is still emerging, creating uncertainty for potential participants and making it more difficult to establish a strong business case to attract new supplier entrants.	Develop a targeted business development plan to attract at least one Tier 1 (hydrogen-specific equipment) manufacturer and two to three Tier 2 (hydrogen-enabling equipment and operations and maintenance services) suppliers to Atlantic Canada. This plan should align with regional industrial strengths and integrate with demand-side and project deployment initiatives to clearly articulate which companies to target, why they are a strategic fit, and how to support their establishment in the region.
	2.2	**Develop local hydrogen technology & equipment supply chain**	The supply chain gap assessment found that hydrogen equipment OEMs, suppliers, and service providers specific to hydrogen equipment are minimally present in Atlantic Canada, highlighting the need to strengthen regional capacity. Addressing this gap is important because limited local supplier presence reduces regional resilience, delays project execution, and limits opportunities for regional businesses to contribute to and benefit from hydrogen supply chain development.	Develop a regional hydrogen technology and equipment supply chain in Atlantic Canada. This should prioritize knowledge transfer and the gradual development of local expertise across the equipment supplier base.
3. Develop workforce to build and sustain the supply chain	3.1	**Leverage and upskill heavy industry workforce for hydrogen roles**	Atlantic Canada has a strong heavy industry workforce that uses skills similar to those required across the hydrogen value chain. Leveraging this existing workforce helps accelerate workforce readiness, retains regional expertise, and provides additional opportunities for those working in heavy industry as hydrogen projects scale up.	Map heavy industry workforce to corresponding roles in the hydrogen value chain and develop targeted training programs that build on their existing skills and knowledge to prepare them for hydrogen-related operations.
4. Integrate hydrogen into infrastructure planning to enable efficient deployment	4.1	**Integrate hydrogen readiness into infrastructure upgrades**	The assessment of Atlantic Canada's hydrogen value chain identified that existing and planned infrastructure may be leveraged for hydrogen integration, and jurisdictional scan insights highlighted the value of aligning future infrastructure development with regional assets. Aligning infrastructure planning could help reduce costs, improve asset utilization, and ensure new developments are compatible with future hydrogen supply chain requirements.	Identify and incorporate "hydrogen-ready" components into planned infrastructure development and upgrade projects, including ports, pipelines, and storage assets. This could involve port facilities designed to handle liquid hydrogen, ammonia, or other derivative products such as liquid organic hydrogen carriers (LOHC) and sustainable aviation fuel (SAF), as well as pipelines and associated components (e.g., valves) engineered for hydrogen blending or future conversion to pure hydrogen service.
	4.2	**Enable large-scale hydrogen storage projects**	Hydrogen has the potential to be stored underground in large volumes, similar to natural gas, providing cost-effective flexibility for distribution and market balancing. Developing storage capacity could help manage supply variability, enable reliable supply to domestic and export markets, and support regional energy security.	Support the development of large-scale hydrogen storage infrastructure in Atlantic Canada by facilitating proponent identification and partnerships to enable cost reductions, manage supply variability, and improve price stability. This effort could leverage or build off existing initiatives to build on current momentum and expertise.
	4.3	**Assess feasibility of regional hydrogen distribution network**	The distribution of hydrogen presents technical and economic challenges due to its low volumetric energy density but may be enabled by leveraging modified natural gas infrastructure, as exemplified by the EU Hydrogen Backbone initiative. Advancing distribution infrastructure could help reduce transport costs, improve connectivity between provinces, and support a reliable, integrated hydrogen market across Atlantic Canada.	Explore the development of a hydrogen and hydrogen-derivative distribution network for Atlantic Canada, modeled on the EU Hydrogen Backbone initiative and informed by provincial supply and demand volumes and timelines along with existing infrastructure. This should begin with feasibility studies to assess the potential to leverage existing ports and pipelines, and to evaluate additional marine, road, and rail connections between provinces to enable cost-effective, low-carbon distribution and unlock regional market opportunities.

Atlantic hydrogen sector development recommendations

While the previous recommendations focus on the physical and operational enablers of Atlantic Canada's hydrogen supply chain, a complementary set of actions is required to strengthen the broader ecosystem that supports it. These sector development recommendations address the enabling environment—spanning policy alignment, regulatory harmonization, workforce development, Indigenous participation, investment attraction, and research coordination. Together, they establish the governance, market confidence, and social license needed for sustained hydrogen sector growth across the region.

Theme	#	Headline	Observation and importance to regional supply chain	Recommendation
5. Hydrogen sector development	5.1	**Launch coordinated campaign to attract global investment**	Recent initiatives, such as Canada's presence at the 2025 World Hydrogen Summit, reflect growing momentum to position Atlantic Canada as an attractive destination for international hydrogen investment. Sustaining this momentum is important for attracting the capital and expertise that will accelerate infrastructure development, strengthen the regional hydrogen supply chain's competitiveness, and advance Atlantic Canada's development as a key low-carbon energy trading partner enabling future export opportunities.	Leverage existing forums and initiatives (e.g., Invest in Canada) and build upon ongoing efforts to market the "Atlantic Hydrogen Advantage" to international investors, through a coordinated regional investment attraction campaign that highlights the region's renewable resources, export potential, political stability, and proximity to European markets.
	5.2	**Develop regional hydrogen awareness and engagement plan**	Workshop discussions and jurisdictional scans revealed low public awareness and understanding of hydrogen, potentially limiting community support and participation, similar to early challenges in industries like wind energy and oil and gas where community trust has been key to long-term success. For Atlantic Canada's hydrogen supply chain, public trust and understanding underpin successful project delivery and investment attraction, helping to create an environment where hydrogen developments can proceed efficiently and inclusively.	Leverage existing initiatives, such as the Atlantica Centre for Energy's energy literacy initiative and develop a coordinated Atlantic Canada regional public engagement plan to build awareness, understanding, and social acceptance of hydrogen development and energy literacy across the region.
	5.3	**Create centralized, real-time hydrogen information platform**	There are limited resources offering a single, up-to-date reference point for information on Atlantic Canada's hydrogen ecosystem, with existing reports often being snapshots in time that quickly become outdated. Improving information access is important to reduce friction for market entrants, ensure project proponents have current and reliable data, and support a responsive, well-functioning hydrogen supply chain as the market evolves.	Develop a near real-time, centralized online database for Atlantic Canada that consolidates information on policies, funding programs, hydrogen-related projects, standards, research and innovation, financial tools, and educational resources relevant to project proponents and supply chain participants. The platform could incorporate innovative features, such as a chatbot, to provide users with tailored, immediate guidance on funding opportunities and regulatory information based on project specifics.
	5.4	**Advance Indigenous and community hydrogen partnerships**	Support from Indigenous Nations and local communities is fundamental to the success of large-scale hydrogen development, with an increasing expectation that projects contribute to local economic independence, reconciliation, and decarbonization. Strengthening these relationships is important for Atlantic Canada's hydrogen supply chain to maintain long-term social acceptance, ensure equitable participation, and embed regional ownership in the growth of this emerging sector. Examples of collaboration are already present across Atlantic Canada with federal government Indigenous funding and equity partnerships with wind projects in Atlantic Canada.	Building on existing engagement, support, and equity partnerships across Atlantic Canada's energy sector, Atlantic Canada should work with Indigenous leaders and local community representatives to explore opportunities for meaningful participation in hydrogen development. This could include facilitating connections between communities, industry, and project proponents to advance initiatives such as community benefit agreements and Indigenous equity partnerships.
	5.5	**Strengthen regional coordination and collaboration on hydrogen development**	While each Atlantic province has developed its own hydrogen-related strategy or action plan, industry and community partners consistently expressed a desire for greater regional coordination to support supply chain development and investment attraction. Numerous reports, initiatives, and priorities are emerging simultaneously across governments, creating a risk that momentum could stall without sustained alignment and resourcing. A more deliberate regional approach would help avoid duplication, better align policy and infrastructure planning, and position Atlantic	Explore and establish mechanisms for ongoing provincial collaboration on hydrogen—potentially through existing structures such as the Council of Atlantic Premiers or a similar intergovernmental forum—to support consistent information-sharing, policy alignment, and coordinated engagement with the federal government. This collaboration should include at least an annual cadence of discussions focused on progress, market developments, supply chain needs, and opportunities for joint action; a light-touch coordination function to monitor advancement of key actions from this report; and periodic engagement with industry, Indigenous partners, and community

		Canada as a cohesive and competitive region in both domestic and international hydrogen markets.	representatives to ensure alignment between policy direction, project requirements, and regional benefits. This approach enhances regional coordination without requiring a formal regional strategy, while helping maintain sustained momentum on priority actions that advance Atlantic Canada's hydrogen ecosystem.
5.6	**Harmonize hydrogen codes, standards, and regulations**	Hydrogen projects face complex permitting and regulatory requirements, with codes and standards varying across provinces and international markets. Provincial workshops identified that these differences could create administrative inefficiencies and increase project risk. Harmonization is important as it helps reduce friction across jurisdictions, creates clearer expectations for proponents, and supports Atlantic Canada's ability to attract projects that span multiple provinces and global value chains.	Review and harmonize codes, standards, permitting, and regulatory processes—including carbon intensity and life cycle assessment methodologies—across Atlantic Canada's provinces, the federal government, and international jurisdictions such as Germany, the Netherlands, and other countries within Europe and the European Union with hydrogen import ambitions to enable efficient collaboration and streamline project approvals and development.
5.7	**Establish hydrogen workforce and research coordination group**	Education and research are needed to support hydrogen supply chain development and operations, but there is a need in aligning these efforts with project timelines, risking readiness that is either too early or too late. Coordination ensures that training and R&D activities are timed to meet real project needs, reducing workforce gaps and supporting ongoing innovation in the regional hydrogen ecosystem.	Leverage existing university research and governance structures in Atlantic Canada to establish or expand an industry–education working group focused on hydrogen. This group would improve coordination between workforce development, project pipelines, and R&D activities by jointly forecasting labour needs, informing the timing and design of training and certification programs, and identifying opportunities for collaborative research to advance hydrogen technologies and regional expertise.
5.8	**Develop a coordinated H2 research agenda for the Atlantic region**	Provincial workshop discussions and international examples identified in the jurisdictional scan suggest that Atlantic Canada may benefit from a more coordinated approach to sharing knowledge, research, and technical insights as the hydrogen sector evolves. Enhancing this coordination could help build regional expertise, support continuous improvement, and enable the region to apply international best practices in low-carbon hydrogen and derivative product development.	Leverage existing University R&D governance structures and areas of collaboration across Atlantic Canada to develop a coordinated H2 research agenda that will elevate Atlantic Canada's hydrogen industry. Convene representatives from academia, government, industry and relevant NGOs on an annual basis to identify, optimize, and accelerate opportunities to advance Atlantic Canada's H2 value chain and supply chain through effective R&D.

The section that follows sets out a high-level action plan and roadmap for core supply chain recommendations.

7.1 Action Plan and Roadmap

Atlantic Canada stands at a pivotal moment in the global energy transition. The region's abundant renewable resources, deep-water ports, skilled industrial workforce, and growing clean energy expertise position it to become a significant player in North America's emerging hydrogen economy. However, realizing this potential requires a coordinated effort to move from early momentum to a fully operational and competitive hydrogen ecosystem—one that integrates production, distribution, and demand while creating sustainable economic and community benefits.

This Action Plan and Roadmap provides a structured framework to guide that progression. It translates strategic recommendations into clear, actionable steps for governments, industry, Indigenous Nations, academia, and community partners. Each action identifies its importance to the regional supply chain, the desired outcome of successful implementation, the parties responsible, and the timing for delivery across three development phases: Foundational (2026–2027), Scaling (2028–2030), and Sustaining (post-2030).

Together, these actions define how Atlantic Canada can strengthen its hydrogen value chain, build domestic supply capabilities, and ensure long-term competitiveness in both domestic and export markets. The roadmap emphasizes practical implementation—advancing lighthouse projects, establishing coordinated hydrogen hubs, mobilizing public procurement and demand-side tools, developing local supplier capacity, and ensuring infrastructure readiness. It also recognizes the importance of workforce transition, Indigenous participation, and regional collaboration to ensure the hydrogen economy grows inclusively and benefits all communities.

Ultimately, this Action Plan charts a pragmatic and phased pathway for Atlantic Canada to move from ambition to execution—positioning the region as a trusted, resilient, and export-ready hydrogen hub that contributes meaningfully to Canada's net-zero goals and to global clean energy security.

To operationalize the core supply chain recommendations, the following Action Plan defines specific actions, desired outcomes, responsible parties, and implementation timing. These actions target the tangible enablers of production, storage, distribution, and workforce readiness that will drive hydrogen supply chain activation across Atlantic Canada.

Each recommendation is categorized by one of three implementation timeframes:

- Foundational (initiated within 12 months): Near-term priorities establishing conditions for growth.
- Scaling (initiated by 2026–2030): Mid-term initiatives to expand capability and accelerate deployment.
- Sustaining (initiated by 2030+): Longer-term efforts to optimize, govern, and sustain competitiveness.

7.1.1 Theme 1 — Build Supply and Secure Demand to Unlock Supply Chain Investment

Ecosystem Objective: A strong market foundation that attracts investment across the hydrogen value chain, enabling sustained supply chain activity.

#	Recommendation	Desired outcome	Actioned party	Timeline
1.1	Advance lighthouse hydrogen projects in each province	A portfolio of provincial demonstration projects that de-risk investment, generate learning, and stimulate early supply chain activity.	Government; Industry (producers, distributors, or end-users/offtakers)	Foundational (within 12 months)
1.2	Establish coordinated hydrogen hubs and project nodes	A network of hydrogen hubs and project nodes that cluster supply, demand, and infrastructure investment.	Federal & Provincial Governments; Industry Associations	Foundational (within 12 months)
1.3	Leverage public procurement to build early demand	Predictable early demand through government procurement of hydrogen or hydrogen-based products.	Federal & Provincial Governments	Foundational (within 12 months)

#	Recommendation	Desired outcome	Actioned party	Timeline
1.4	Implement demand-side tools like Contracts for Difference	Reduced market risk and improved price certainty for early adopters, enabling scalable production and sustained demand.	Federal Government; Provincial Governments	Foundational (within 12 months)
1.5	Conduct targeted feasibility studies for key sectors	Clear, actionable pathways for hydrogen adoption in priority sectors that inform infrastructure and supply chain investment.	Provincial Governments; Industry; Utilities	Foundational (within 12 months)

7.1.2 Theme 2 — Grow Local Suppliers to Expand Participation

Ecosystem Objective: Broad-based participation alongside new entrants in the supply chain.

#	Recommendation	Desired outcome	Actioned party	Timeline
2.1	Position Atlantic Canada to attract Tier 2 and, over time, Tier 1 hydrogen suppliers	Attraction of key Tier 1 and Tier 2 suppliers, anchoring local supply chain growth and supporting domestic project execution.	Provincial Governments; Industry Associations; Economic Development Agencies	Foundational (within 12 months)
2.2	Develop local hydrogen technology & equipment supply chain	A network of capable regional suppliers integrated into the hydrogen value chain, improving project execution and resilience.	Provincial Governments; Industry Associations	Scaling (initiated by 2026–2030)

7.1.3 Theme 3 — Develop Workforce to Build and Sustain the Supply Chain

Ecosystem Objective: A skilled workforce and applied R&D base that can build, operate, and sustain hydrogen assets.

#	Recommendation	Desired outcome	Actioned party	Timeline
3.1	Leverage and upskill heavy industry workforce for hydrogen roles	A trained, hydrogen-ready workforce that supports construction, operations, and maintenance across the regional value chain.	Industry; Colleges & Universities; Governments	Scaling (initiated by 2026–2030)

7.1.4 Theme 4 — Integrate Hydrogen into Infrastructure Planning to Enable Efficient Deployment

Ecosystem Objective: Integrated infrastructure systems that enable cost-effective hydrogen production, storage, transport, and export.

#	Recommendation	Desired outcome	Actioned party	Timeline
4.1	Integrate hydrogen readiness into infrastructure upgrades	Future-proofed infrastructure capable of supporting hydrogen production, transport, and export.	Governments; Port Authorities; Infrastructure Owners	Scaling (initiated by 2026–2030)
4.2	Enable large-scale hydrogen storage projects	Operational large-scale hydrogen storage projects providing flexibility and price stability.	Industry; Governments	Sustaining (initiated by 2030)
4.3	Assess feasibility of regional hydrogen distribution network	Feasibility plan for a regional hydrogen backbone leveraging multimodal infrastructure (pipeline, port, rail).	Governments; Industry; Utilities	Scaling (initiated by 2026–2030)

Summary of roadmap phasing

Successful advancement of Atlantic Canada's hydrogen supply chain requires **coordinated, multi-actor implementation** spanning governments, industry, Indigenous Nations, academia, and infrastructure partners. Each party has a distinct and complementary role to play across the **Foundational, Scaling, and Sustaining** phases.

Element	Foundational Phase	Scaling Phase	Sustaining Phase
Timeline	2026–2027	2028–2030	Post-2030
Narrative	In the **Foundational phase (2026–2027)**, the emphasis will be on **activation and alignment**. Governments should prioritize lighthouse projects and hydrogen hub designation to establish regional focal points for investment and learning. Public procurement and demand-side mechanisms, such as Contracts for Difference, will be instrumental in anchoring early offtake and building investor confidence. Industry associations and economic development agencies can play a coordinating role in supplier attraction, ensuring that Tier 1 and Tier 2 manufacturers view Atlantic Canada as a strategic location for hydrogen-related production and servicing. Early workforce planning and training programs should begin in tandem, leveraging the region's skilled industrial base.	During the **Scaling phase (2028–2030)**, the focus shifts toward **industrial build-out and supply chain integration**. Governments and industry should jointly expand hydrogen storage capacity, advance the development of regional distribution networks, and implement targeted training to support project execution at scale. Supplier development programs will be critical to embedding local and Indigenous businesses within the emerging hydrogen value chain. This period also provides the opportunity to strengthen export readiness by aligning infrastructure upgrades—particularly ports and pipeline networks—with hydrogen and derivative product handling requirements.	Finally, the **Sustaining phase (post-2030)** will emphasize **optimization, innovation, and long-term competitiveness**. A mature hydrogen governance framework will be needed to maintain coordination across provinces, monitor performance metrics, and guide reinvestment in innovation, infrastructure, and workforce evolution. By this stage, a fully integrated regional hydrogen ecosystem—spanning production, storage, distribution, and end-use sectors—should be capable of sustaining itself through continuous improvement, export growth, and deep collaboration with international markets.
Focus	Establish lighthouse projects, designate hydrogen hubs, begin implementation of early demand and financing mechanisms (e.g., CfDs), and initiate workforce readiness and supplier attraction programs.	Expand domestic manufacturing, supplier participation, and large-scale storage and distribution infrastructure; deepen workforce training and industrial deployment.	Optimize infrastructure and regulatory alignment, sustain competitiveness through innovation and reinvestment, and expand export integration.
Key players	Governments, early adopters, industry associations, workforce development organizations.	Industry, utilities, suppliers, training institutions, Indigenous and community partners.	All ecosystem partners under a regional hydrogen governance entity.

Collectively, this phased pathway ensures that Atlantic Canada not only activates its hydrogen potential but also builds a **durable, inclusive, and globally competitive hydrogen supply chain** that supports regional prosperity, industrial decarbonization, and leadership in the clean energy transition.

8. Appendix

8.1 Alignment of recommendations themes and provincial strategies

Table 36 Recommendation theme alignment to strategic federal and provincial hydrogen or energy initiatives

Recommendation Theme	Canada Hydrogen Strategy pillars	New Brunswick Hydrogen Roadmap focus areas	Newfoundland And Labrador Hydrogen Development Action Plan focus areas	Nova Scotia Green Hydrogen Action Plan goals	Prince Edward Island Energy Strategy[101]
1. Build supply and secure demand to unlock supply chain investment	Supports strategic partnerships, de-risking early investment, regional blueprint development, and access to international markets.	Advances the foundation for success and drives action and accountability through early projects and supply-demand activation.	Reinforces focus on export and domestic market growth and encourages industry partnerships and innovation.	Enables local and export-facing opportunities, helping establish competitive, sustainable conditions for the hydrogen sector.	Supports emissions reductions and cost-effective investment while creating clean energy jobs and export-oriented opportunities.
2. Grow local suppliers to expand participation	Advances awareness-building and inclusive partnerships across the hydrogen value chain.	Reflects commitment to broad community engagement and collaborative partnerships.	Supports innovation and industry engagement	Delivers on goals for community engagement, transparent communication, and local benefit generation.	Advances inclusive economic development and supports local business participation in clean energy growth.
3. Develop workforce to build and sustain the supply chain	Advances workforce development and technological innovation across the hydrogen value chain.	Supports building the necessary workforce and skills foundation to support the sector.	Aligns with training and job creation goals to enable long-term local participation in hydrogen activities.	Advances skills training and supports research and innovation to strengthen hydrogen sector capability.	Builds local skills, supports workforce transition, and fosters R&D linked to clean energy priorities.
4. Integrate hydrogen and infrastructure to enable efficient deployment	Supports infrastructure planning through regional blueprints and de-risking investments to accelerate deployment.	Reinforces foundational infrastructure planning and coordinated development across jurisdictions.	Aligns with goals to enable export and domestic market infrastructure backed by regulatory clarity.	Advances infrastructure readiness to support competitive export market access and hydrogen system integration.	Encourages integrated planning for clean energy infrastructure that supports self-sufficiency and decarbonization.

[101] At the time of writing, Prince Edward Island does not have a dedicated hydrogen strategy or roadmap and is in the process of refreshing its provincial energy strategy. However, PEI's 2016 energy strategy is guided by three principles: lowering greenhouse gas emissions, ensuring actions and decisions are cost-effective, and creating local economic opportunities. These principles are reflected across each of the five recommendation themes, ensuring alignment with PEI's overall energy policy direction.

8.2 Atlantic Canada enabling infrastructure and assets

Table 37 Atlantic Canada rail yards

Province	City	Facility name	Status	Owner/operator
Nova Scotia	Halifax	Pace Yard (formerly Rockingham Yard)	Operational	Canadian National Railway (CN)
Nova Scotia	Dartmouth	Dartmouth Yard	Operational	CN
Nova Scotia	Truro	Truro Yard	Operational	CN / Cape Breton & Central Nova Scotia Railway
Nova Scotia	Stellarton	Stellarton Yard	Operational	Cape Breton & Central Nova Scotia Railway
Nova Scotia	Point Tupper	Point Tupper Yard	Operational	Cape Breton & Central Nova Scotia Railway
Nova Scotia	Sydney	Sydney Yard	Out of Service	Cape Breton & Central Nova Scotia Railway
New Brunswick	Moncton	Gordon Yard	Operational	CN
New Brunswick	Saint John	Island Yard	Operational	CN / New Brunswick Southern Railway (NBSR)
New Brunswick	Saint John	Dever Road Yard	Operational	NBSR
New Brunswick	McAdam	McAdam Yard	Operational	NBSR

Table 38 Atlantic Canada natural gas distribution service areas (general)

Province	General service area	Owner/operator
Nova Scotia	Halifax Regional Municipality	Eastward Energy
Nova Scotia	Goffs	Eastward Energy
Nova Scotia	New Glasgow, Stellarton, Pictou	Eastward Energy
Nova Scotia	Oxford	Eastward Energy
Nova Scotia	Amherst	Eastward Energy
Nova Scotia	Strait of Canso	M&NP Pipeline
New Brunswick	Moncton	Liberty
New Brunswick	Saint John	Liberty
New Brunswick	St Stephen	Liberty
New Brunswick	Fredericton	Liberty
New Brunswick	Oromocto	Liberty

8.3 Atlantic Canada hydrogen value chain systems and component details

This section details the major systems and components for each stage of the hydrogen value chain.

Table 39 Non-critical components across the value chain

	Value chain stage		
	Construction	**Production**	**Storage and distribution**
Non-critical components	• Structural steel frames • Concrete foundations • Construction cranes • Temporary fencing • Safety netting • Drainage systems • Portable equipment • Piping insulation • Electrical cabling • Lighting systems • HVAC systems • Scaffolding and temporary structures • General fasteners • Non-specialized valves • Facility signage	• Cooling water pumps non in direct contact with hydrogen • Non-hydrogen piping (water, air, etc.) • General-purpose motors • Electrical control panels • Air compressors for general plant operations • Sensors (e.g. ambient temperatures) • Water treatment filters • Lubricants and seals • Maintenance and tools • Personal safety equipment	• Facility flooring • Ventilation fans • Shelving and racks • Non-hydrogen storage tanks for auxiliary fluids (water, coolant, etc.) • Lighting fixtures • Access ladders/platforms • Monitoring displays • Fire extinguishers • Signage • Pipeline supports • Trailer axels

Note: This is not an exhaustive list of components. Non-critical components are those that do not directly handle hydrogen, ensure its containment, or mitigate its specific risks (e.g. flammability, high pressure). They are typically standard, widely available, or replaceable without impacting core hydrogen processes or safety.

Table 40 Processes and related systems and components in construction

Processes	**Equipment fabrication**	**Site construction**	**Safety installation**	**System testing**	**Performance verification**
Systems & components	• Electrolyzer stacks • High-pressure storage tanks • Cryogenic tanks • Compressors • Piping systems • Valves and fittings	• Foundation structures • Structural frameworks • Piping installation • Electrical cabling and busbars • HVAC systems • Construction cranes and rigging	• Hydrogen leak detectors • Fire detection and suppression systems • Ventilation systems • Emergency shutdown systems	• Pressure testing equipment • Leak testing tools • Flow calibration • Electrical continuity testers • Control system validators	• Performance monitoring software • Gas analyzers • Data loggers

Table 41 Systems and components in electrolysis production

Systems	Components
Electrolyzer System	Stack assembly (modular unit); Electrodes (nickel, platinum/iridium); Membrane/Diaphragm (polymer membrane, asbestos-free diaphragm, ceramic); Bipolar plates (titanium, stainless steel); Electrolyte (potassium hydroxide, solid polymer, ceramic)
Power supply system	Rectifiers; Transformers; Power conditioning units; Busbars; Control relays
Water purification system	Reverse osmosis units; Deionization units; Filters; Water pumps; Storage tanks for purified water
Gas separation and purification system	Gas separators (gravity, membrane-based); Dryers (desiccant, refrigerated dryers); Purifiers (catalytic purifiers, pressure swing adsorption units); Gas analyzers (hydrogen purity sensors); Valves (check valves, solenoid valves)
Cooling system	Heat exchangers (plate, shell-and-tube); Cooling towers/chillers; Coolant pumps; Thermostats/sensors; Piping
Control and monitoring system	Programmable Logic Controllers (PLCs); Human-Machine Interfaces (HMIs); Sensors (pressure, temperature, flow rate); Data loggers; Communication modules
Safety system	Gas detectors (electrochemical, infrared); Pressure relief valves; Emergency shutdown systems; Fire suppression systems; Alarms
Hydrogen compression and storage system	Compressors; Storage tanks (high pressure); Pressure regulators; Piping and fittings; Safety valves
Ventilation and gas management system	Ventilation fans; Scrubbers; Exhaust systems; Ducting; Flow meters

Table 42 Systems and components in compressed gas hydrogen storage

Systems	Components
Compression system	Reciprocating/diaphragm compressors; Intercoolers/aftercoolers; Inlet filters; Check valves; Pressure control valves
Storage vessel	Pressure tanks (Type I, II, III, IV); Polymer/metal liners; Thermal pressure relief devices (TPRDs); Tank shut-off valves
Safety and monitoring system	Pressure sensors; Gas detectors; Temperature sensors; Emergency shutdown systems; Programmable Logic Controllers (PLCs)
Dispensing system	Dispensing nozzles; Flow meters; High-pressure hoses and fittings

Table 43 Systems and components of liquid hydrogen storage

Systems	Components
Liquefaction system	Cryogenic compressors; Helium/nitrogen refrigeration units; Counterflow heat exchangers; Expansion valves/turbines (Joule-Thomson, turboexpanders)
Cryogenic storage system	Cryogenic tanks; Vacuum insulation; Pressure relief valves; Liquid level sensors
Boil-off management system	Vaporizers; Reliquification units; Vent stacks; Pressure control valves
Transfer and dispensing system	Cryogenic centrifugal pumps; Vacuum-jacketed transfer lines; Cryogenic globe valves; Quick connect couplings; Flow meters
Safety and monitoring system	Thermocouples; Hydrogen gas detector; Hydrogen flame detector; Oxygen depletion sensors; Emergency venting systems; Programmable Logic Controllers (PLCs)

Table 44 Systems and components of ammonia as a hydrogen storage and distribution of ammonia

Systems	Components
Ammonia synthesis system	Haber-Bosch reactor vessel; Iron-based catalysts; Gas compressor; Shell-and-tube heat exchanger; Gas purification unit
Ammonia storage system	Carbon steel pressure vessels; Polyurethane insulation; Pressure relief valves; Liquid level sensors; Vapour return lines
Transfer and dispensing system	Centrifugal pumps; Stainless steel piping; Globe/check valves; Hoses; Flow meters
Safety and monitoring system	Ammonia gas detectors; Pressure transducers; Thermocouples; Water scrubbers; Programmable Logic Controllers (PLCs)
Auxiliary system	Air separation system (ASU); Cooling water system; Power supply unit; Inert gas system

Table 45 Systems and components for distributing hydrogen through pipelines

Systems	Components
Pipeline infrastructure system	Pipes; Coatings and linings; Welds and joints; Pipeline fittings; Flanges and connectors; Pipeline supports and anchors
Compression system	Centrifugal and reciprocating compressors; Compressor motors and drives; Cooling system (air or water based); Compressor station housing; Inlet filters; Vibration dampers and noise suppression systems; Compression control
Pressure regulation and flow control system	Pressure regulators; Control valves; Shut-off valves; Flow meters; Pressure relief valves; Orifice plates
Safety and monitoring system	Leak detection systems; Supervisory control and data acquisition (SCADA) system; Pressure sensors and transducers; Temperature sensors; Emergency shutdown systems; Hydrogen sensors; Fire and gas detection systems; Alarm and communication systems; Gas composition analyzers
Inlet and delivery systems	Custody transfer metering systems; Inlet filters and separators; Delivery station regulators; Isolation valves; Data acquisition systems; Utility systems

Table 46 Systems of storage and distribution using tube trailer and cylinders (trucks, trains, and ships)

Systems	Components
Compression system	High pressure compressors; Compressor motors and drives; Intercoolers and aftercoolers; Inlet filters; Compressor control systems; Vibration dampeners and noise suppression systems
Storage and transport vessel system	High pressure cylinders (Type I–IV); Tube trailer modules; High pressure cylinder valves; Pressure relief devices; Cylinder/tube supports and frames; Protective coatings; Manifold system
Transport vehicle system	Truck/trailer chassis (heavy-duty road transport); Railcar platform (hydrogen-specific for trains); Ship cargo holds (for marine transport, with hydrogen containment); Suspension systems; Tie downs and securing mechanisms; Vehicle cooling systems
Safety and monitoring system	Hydrogen leak detectors; Pressure sensors and gauges; Temperature sensors; Gas composition analyzers; Emergency shut off valves; Onboard telemetry systems; Ventilation systems
Loading and unloading system	High pressure transfer hoses; Quick connect fittings; Transfer pumps; Loading and unloading manifolds; Pressure regulators; Flow meters; Grounding systems; Safety interlocks
Thermal management system	Insulation layers; Cooling units; Temperature control valves; Thermal shield; Monitoring thermometers

Table 47 Systems and components in end-use applications for industry, ammonia and low carbon fuels

Systems	Components
Hydrogen delivery and storage system	High pressure storage tanks; Cryogenic storage tanks; Delivery pipelines; Pressure regulators; Flow meters; Safety valves
Process integration system	Hydrogen burners; Catalytic reactors; Gas injectors; Heat exchangers; Gas purifiers
Monitoring and control system	Hydrogen sensors; Process control units; Gas analyzers; Temperature and pressure sensors
Ammonia synthesis system	Haber-Bosch reactors; Hydrogen compressor; Nitrogen generator; Catalysts; Heat recovery systems
Fuel processing system	Methanol synthesis reactors; Gasifiers; CO_2 capture units; Purification units
Storage and handling	Ammonia storage tanks; Fuel storage vessels; Transfer pumps; Safety valves and vents

Table 48 Systems and components in end-use applications for transportation

Systems	Components
Fuel cell system	Proton exchange membrane (PEM) fuel cells; Fuel cell stacks; Hydrogen storage tanks; Air compressors; Humidifiers; Cooling systems
Refuelling system	Hydrogen dispensers; Refilling hoses; Flow meters; Pressure regulators
Vehicle integration system	Electric motors (powered by fuel cells); Power electronics; Onboard hydrogen sensors (for leak detection)

Table 49 Systems and components in end-use applications for power generation

Systems	Components
Fuel cell power system	Stationary proton exchange membrane (PEM) cells; Fuel cell stacks; Hydrogen storage tanks; Air supply systems; Inverters; Heat recovery units
Gas turbine system	Hydrogen-compatible gas turbines; Fuel injectors; Combustion chambers; Turbine blades; Exhaust systems
Power management system	Grid integration transformers; Energy management systems; Backup batteries; Control units

Table 50 Systems and components in end-use applications for natural gas blending

Systems	Components
Blending system	Hydrogen injection units; Mixing chambers; Flow controllers; Gas analyzers; Compressors
Pipeline integration system	Modified pipelines; Pressure regulators; Shut-off valves; Leak detection systems
End-use appliance adaptation system	Modified burners (for blended hydrogen gas); Gas meters; Safety sensors; Flame arrestors

Table 51 Systems and components in end-use applications for export

Systems	Components
Liquefaction system	Cryogenic liquefiers; Heat exchangers; Compressors; Expansion valves; Insulation systems
Transport vessel system	Project anchors; Cryogenic tankers; High pressure tube trailers; Ship cargo holds; Transfer pumps; Safety valves and vents
Terminal and handling system	Loading and unloading arms; Storage tanks; Metering systems; Hydrogen purifiers; Grounding systems

8.4 Industry and community engagement

Engagement with industry and community members was conducted through three methods:

1. A supplier readiness survey sent to organizations throughout Atlantic Canada that could be involved in the hydrogen supply chain, even if they are not operating within it today.
2. Three workshops across Atlantic Canada in St. John's, NL, Halifax, NS, and Saint John, NB.
3. Individual interviews with organizations across the hydrogen value chain.

I am writing to invite you to participate in the upcoming **Supplier Self-Assessment Survey for the Atlantic Canada Hydrogen Supply Chain**. This survey will provide important information to inform the Hydrogen Supply Chain Gap Assessment and Development Plan for Atlantic Canada. This important initiative to assess the regional clean hydrogen supply chain is a collaboration between The Atlantic Hydrogen Alliance (AHA), Energy NL, and Net Zero Atlantic, the four Atlantic provinces and ACOA, in partnership with Deloitte.

Your insights are crucial as we assess our region's readiness to develop a clean hydrogen economy that will support Atlantic Canada's transition to a low-carbon future. The survey will gather valuable perspectives from suppliers, Indigenous communities, government departments, and industry partners across Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland and Labrador.

Key Survey Information:

- Distribution date: May 20, 2025
- Completion deadline: June 4, 2025
- Estimated time: 15-20 minutes
- Topics covered: Organizational capacity, industry outlook, hydrogen experience, workforce, supply chain integration, and engagement with Indigenous and rural communities

Your responses will remain confidential and will be used exclusively to identify collaboration opportunities, assess gaps, and drive sustainable economic development in our region's emerging hydrogen sector.

Deloitte representatives may contact you in the coming days to confirm your participation. We deeply appreciate your expertise and commitment to advancing the hydrogen industry in Atlantic Canada.

Thank you for your support in building a sustainable future for our region.

Sincerely,

Derek Estabrook
Executive Director
Atlantic Hydrogen Alliance

8.5 What we heard: regional workshops

8.5.1 Newfoundland and Labrador industry workshop

Deloitte organized in-person workshop in St. John's, NL. Below is a summary of the insights and discussions from the workshop.

The Canadian H2 landscape

Following a presentation by the Deloitte project team on the Canadian hydrogen landscape, participants reflected on what surprised them and where they saw the greatest potential impacts. Their feedback highlighted both opportunities and concerns shaping the future of hydrogen development in Atlantic Canada and beyond.

Participants emphasized the interdependence between hydrogen and other energy sectors, noting that hydrogen growth will rely on synergies with wind development as well as capabilities and infrastructure from the oil and gas industry to scale up in the near term. At the same time, there was recognition that grey hydrogen continues to dominate Canada's production profile, with Alberta ranking among the top five global producers. While this positions Canada with early-mover experience, parties stressed the importance of moving beyond grey hydrogen to maintain credibility in export markets. Some referenced Germany's pragmatic approach—prioritizing supply chain development first, with a view to tightening emissions standards later—as a potential lesson for Canada.

Concerns were also raised about competition for resources and talent. Participants noted that Canada may face more intense supply chain competition than previously assumed, with other jurisdictions also advancing hydrogen strategies anchored in renewable power. In parallel, labour constraints are already acute: the marine transport sector alone is facing 10,000–15,000 unfilled positions. Adding hydrogen development to the mix could exacerbate these shortages unless proactive workforce strategies are adopted.

Finally, participants reflected on the uncertainty surrounding hydrogen's role relative to electrification. While some end-uses (e.g., heavy industry, marine fuels) appear well suited for hydrogen, others (such as aviation) may remain contested between electrification and hydrogen pathways. This underlines the importance of monitoring global market signals and policy choices, particularly in Europe, where demand will be influenced as much by considerations of stability, reliability, and democratic alignment of suppliers as by price alone.

Supplier survey findings & discussion

During the plenary debrief, participants reflected on the high-level survey results and offered perspectives on what was most and least surprising.

Participants noted that regulation and policy remain central concerns for suppliers, with many viewing regulatory frameworks not as barriers but as critical enablers of industry growth. The lack of emphasis on regulatory issues in survey responses was surprising to some, given their importance in shaping investment and operational readiness.

Survey findings also revealed a low percentage of suppliers identifying as "ready" or "nearly ready" for hydrogen-related opportunities. Participants questioned how readiness was defined, who responded, and how targeted the survey outreach had been. While many suppliers possess experience with large capital projects, such as oil and gas construction, they acknowledged that knowledge and components for hydrogen and offshore wind—particularly turbines and blades—may need to be imported initially. That said, participants highlighted the potential for local manufacturing of certain high-volume components, such as turbine blades, where scale and demand could justify regional production.

Discussion also touched on the global competitiveness of supply chains, with China cited as an example of how low-cost production, vertical integration, and reliance on fossil-fuel energy sources allow some jurisdictions to compress costs in ways that Atlantic Canadian suppliers cannot replicate. As a result, participants recognized that not every component of the hydrogen value chain will make sense to produce locally. Instead, the region should focus on areas of comparative advantage and where suppliers see tangible opportunities.

Importantly, participants stressed the need to quantify supply chain requirements in meaningful terms for industry. Rather than presenting only high-level statistics on jobs or GDP impacts, suppliers want to understand the specific materials, components, and services—such as metals, tanks, or turbines—that will be required to build projects. Framing the assessment in this way could help suppliers evaluate where to invest in new capacity, adapt existing operations, or seek partnerships. Several participants noted that the ultimate purpose of the assessment should be to inspire suppliers to invest in their capacity and output, and that asking industry directly what signals or conditions would drive their investment would add value.

Workshop Insights: Opportunities for Atlantic Canadian companies and organizations

Participants identified a broad range of opportunities for Atlantic firms and institutions within a growing hydrogen economy. Many emphasized construction and industrial support services as near-term areas where existing capabilities could be leveraged to support large-scale project build-out. Others highlighted opportunities in research, development, and innovation, positioning Atlantic Canadian companies to play a role in advancing hydrogen technologies and integration.

Strategic partnerships with experienced global companies were seen as an important pathway, particularly in wind and hydrogen, offering knowledge transfer and opportunities for local suppliers. Participants also underscored the importance of training and upskilling programs to prepare the workforce, accompanied by cultural shifts that normalize hydrogen-related work and career pathways.

On the supply chain side, opportunities exist in collaborative procurement, specification rationalization, and the standardization of operations and requirements, which could create efficiencies and strengthen competitiveness. Ensuring that projects embed requirements for local benefits was also seen as critical to enabling wide participation and building durable economic gains.

Workshop Insights: What would need to be true for this to be a reality in Atlantic Canada

Participants agreed that realizing these opportunities would require a set of enabling conditions. Foremost among them is political will and policy alignment, both domestically and with key trading partners such as the European Union. Participants stressed the importance of patient capital, supportive incentives, and efficient permitting processes to make projects economically attractive and reduce delays.

At the same time, public support is essential. Building confidence in hydrogen requires clear communication, correction of misinformation, and demonstration of tangible community benefits. Strong and transparent Indigenous partnerships were emphasized as a prerequisite for success, alongside efforts to ensure labour availability through workforce readiness and attraction strategies.

Participants also highlighted structural needs, including a robust supply chain, credible offtakers, and realistic project goals that align with market demand. Finally, participants underscored the importance of fostering a culture of ambition and collaboration across projects, where companies are motivated not only by commercial opportunity but also by the potential to deliver lasting public and economic benefits.

Workshop Insights: Now, Soon, Later

As part of the workshops, participants identified actions required across different time horizons to advance Atlantic Canada's hydrogen economy. Grouped into "Now," "Soon," and "Later", these priorities reflect both immediate enablers and longer-term system requirements.

Now

Participants emphasized the need for early clarity and direction from government. This includes a clear federal position on hydrogen, a regionally coordinated hydrogen strategy, and alignment through legislation such as renewable energy acts. Critical enabling measures identified include "one project, one review" regulatory processes, targeted government incentives to reduce capital costs, and benefits agreements and local content requirements to ensure inclusive participation. Building strategic partnerships with global players, launching demonstration projects, and raising public awareness and understanding of hydrogen were also seen as immediate priorities. Education efforts—particularly around partnering with foreign companies—were highlighted as necessary to strengthen early capacity.

Soon

Looking to the medium term, participants focused on creating and securing demand as a central requirement. Clarity on government policy, improved ease of doing business in Canada, and alignment of codes and standards were seen as key to unlocking investment and scaling projects. Other priorities included ensuring quality inputs and equipment, addressing construction labour requirements, and supporting knowledge transfer and technology integration. Maintaining public communication and iterating policy frameworks as the ecosystem evolves were considered important to build confidence and sustain momentum.

Later

In the longer term, participants identified the importance of building a skilled operational workforce through specialized training and ensuring the availability of operational labour. Opportunities for domestic applications—particularly in Newfoundland and Labrador—were highlighted as future demand anchors. Beyond core hydrogen development, participants noted the potential for spinoff industries, value-added activities, and global expertise exports, positioning Atlantic Canada as not just a producer but an innovator. Cultural linkages, such as exchange programs with Germany, were seen to strengthen international collaboration and embed Atlantic Canada within global hydrogen networks.

8.5.2 Nova Scotia workshop

Following the session in Newfoundland & Labrador, Deloitte organized an in-person workshop in **Halifax, Nova Scotia**. Below is a summary of the insights and discussions from the workshop.

The Canadian H2 landscape - Key questions and concerns

Participants emphasized the challenge of maintaining momentum and ensuring the hydrogen opportunity resonates with decision-makers. With 90% of projected demand tied to export markets, the success of a handful of large projects will determine whether supply chain development scales as planned. Participants called for clarity on priority end-use applications—starting with areas that can realistically anchor supply chains—and stressed the importance of considering hydrogen derivatives such as methanol, not only ammonia.

Economic and financial concerns were also prominent. Participants noted uncertainty around the willingness to pay a premium for low-carbon fuels compared with diesel. The high cost of electricity in Nova Scotia relative to other jurisdictions was identified as a critical challenge, since electricity is the dominant cost driver for electrolysis. In addition, issues around grid interconnection constraints, the need for behind-the-fence generation, and the high capital requirements for new power generation versus hydrogen production were all identified as structural hurdles.

Surprises and opportunities for impact

Participants were encouraged by how well-situated Nova Scotia is in terms of existing infrastructure capabilities, particularly when paired with hydrogen's potential synergies with broader electrification trends. The group acknowledged that the global supply landscape is shifting rapidly, creating both competitive pressures and export opportunities. Areas such as low-carbon methanol production, dome storage for hydrogen, and the potential role of regulatory frameworks in achieving price parity were seen as emerging opportunities.

Finally, participants emphasized that while Nova Scotia has real advantages, the scale of work ahead is significant. There is a need for broad education and awareness, both within industry and among the public, to build understanding of hydrogen's role, its economics, and its long-term potential. The discussion reinforced that developing a competitive hydrogen economy in Nova Scotia will be a long-term undertaking, requiring patient capital, supportive policy, and clear communication of benefits.

Opportunities for Atlantic companies and organizations

Participants identified a wide range of opportunities that could emerge as Atlantic Canada develops its hydrogen economy. Many emphasized that success will depend on strong political will and a clear, region-wide vision, supported by research institutions and academic expertise.

On the business side, opportunities span both new and existing industries. Companies may retool current assets—such as trucks or industrial equipment—for hydrogen applications, while entirely new firms could emerge around product development, lifecycle carbon accounting, recycling and decommissioning, and hydrogen-specific end-use expertise. Complementary industries such as tourism were also noted, with ideas like hosting a global hydrogen summit to profile the region internationally.

Hydrogen growth was seen as a chance to create high-quality jobs and retain local talent, particularly through upskilling and leveraging the capacity of existing SMEs. Participants stressed that expertise built locally could later be exported to other regions. At the same time, communities stand to benefit from infrastructure investments in ports and energy systems, which could both attract vessels seeking hydrogen or derivatives and deliver broader economic improvements, including local tax revenues and GDP growth.

Finally, participants highlighted broader societal benefits: opportunities for municipalities and rural areas to capture sustained employment and service improvements, increased average incomes, and a renewed sense of regional pride in delivering ambitious projects. Collaboration across provinces and sectors was seen as essential to realizing these gains and embedding hydrogen as a driver of inclusive growth in Atlantic Canada.

Workshop Insights: What would need to be true for this to be a reality in Atlantic Canada

Participants underscored that realizing the opportunities of a hydrogen economy in Atlantic Canada requires a clear, stable, and coordinated policy environment. This includes greater clarity from the federal government on its long-term hydrogen position, complemented by supportive provincial policies and a single Atlantic voice to engage with national and international partners. Incentives—both to reduce project costs and to encourage industry to decarbonize—were seen as essential, alongside consistent regulatory frameworks, streamlined permitting, and a “one-window” approach across jurisdictions. Alignment with European policy requirements and securing long-term offtake agreements were emphasized as critical to de-risk investment and mobilize capital.

On the demand side, participants stressed the importance of building both domestic and export markets. This entails ensuring guaranteed supply at scale, developing credible domestic offtakers, and strengthening community engagement, including meaningful partnerships with First Nations and local content requirements. Public support, social license, and equity participation were viewed as central to sustaining momentum.

Enabling conditions also extend to infrastructure, workforce, and innovation systems. Atlantic Canada will need hydrogen-ready infrastructure, including storage and transport, paired with a skilled workforce supported by training pipelines, micro-credentials, and clear career pathways. Education, research, and recognition of prior learning were identified as important tools to build capacity. Participants also noted the role of federal procurement policy, industrial benefits requirements, and emerging services (e.g., insurance, emergency response) in creating a stable ecosystem. Finally, effective project management, pacing of major capital projects, and collaborative contracting models will help align industry, government, and communities to ensure that capacity is not overstretched.

Potential barriers to participation

Participants identified a range of barriers that could limit the ability of Atlantic organizations to participate fully in the hydrogen economy.

- **Policy and regulatory alignment**. A recurring theme was the need for consistent standards and regulations across jurisdictions. Differences in permitting requirements, codes (CSA, ASTM), and certification processes create uncertainty and increase costs. Limited regulatory capacity and experience—particularly around new hydrogen technologies—could further slow approvals. Participants also noted the importance of credible carbon intensity validation and clear land-title processes to build investor and community confidence.
- **Infrastructure and resource constraints**. Adequate roads, ports, laydown areas, and grid capacity will be critical enablers, yet current limitations were flagged as barriers. Rural development challenges, limited shovel-ready Crown land, and competing land uses may constrain project siting. Access to feedstocks such as water was also highlighted, alongside the need for robust emergency response services to manage new safety risks.
- **Technology and supply chain risks**. Dependence on a small number of technology providers, uncertainty around technology performance, and a lack of mature domestic supply chains pose risks to cost, timelines, and reliability. Participants stressed that building an end-to-end hydrogen supply chain in Atlantic Canada will be a significant undertaking, requiring early policy support, subsidies, and risk-sharing to attract private investment.
- **Labour and skills availability**. Labour shortages, competition with other sectors, and the need to upskill workers were seen as critical constraints. Organizations highlighted challenges in both attracting and retaining skilled trades, engineers, and technical specialists, as well as in providing adequate education and training pathways for new entrants.
- **Community and social license**. Securing public and Indigenous support was recognized as fundamental. Barriers include legacies of industrialization, community concerns about safety and land use, and the need for meaningful consultation and benefit sharing. Without proactive engagement, misconceptions about hydrogen safety or uneven distribution of benefits could erode trust and delay projects.
- **Financial and market challenges**. The high upfront capital costs of hydrogen projects, coupled with uncertain long-term demand and the need for subsidies in the near term, were seen as major risks. Access to financing and insurance for new technologies remains limited, while organizations expressed concern about achieving unsubsidized profitability.

Workshop insights: Now, Soon, Later

As part of the workshops, participants identified actions required across different time horizons to advance Atlantic Canada's hydrogen economy. Grouped into "Now," "Soon," and "Later", these priorities reflect both immediate enablers and longer-term system requirements.

Yesterday

Participants emphasized that hydrogen development has already been the subject of considerable discussion. They highlighted two pressing imperatives carried forward into today: building public understanding and shifting from dialogue to action.

Now

Immediate priorities focus on creating visible momentum through demonstration projects, establishing regional hydrogen hubs and corridors, and confirming long-term demand signals through offtake contracts and policy clarity (e.g., the Clean Hydrogen Investment Tax Credit). A coordinated Atlantic hydrogen strategy, supported by transparent policies, unified regional voices, and streamlined permitting processes, was seen as essential. Critical enablers include developing a workforce plan, mapping research priorities, and forming alliances among educational institutions to build training pathways. Participants also emphasized the importance of municipal planning for housing, zoning, and water infrastructure to support project deployment.

Soon

In the near term, participants saw the need to scale up demonstration projects into commercial hubs, supported by clear safety standards, workforce certification pathways, and publicized regulations. Securing wins in Nova Scotia and across the region would help build momentum and credibility. Infrastructure upgrades—including ports and grids—must be planned and aligned with interprovincial and federal initiatives such as the Independent Energy System Operator (IESO). Broader collaboration with other jurisdictions, coupled with integration of hydrogen into government procurement and industrial CO_2 reduction pathways, were identified as opportunities to strengthen demand and supply chain resilience.

Later

Over the longer term, participants envisioned Atlantic Canada as a hub for green fuels, industrial decarbonization, and hydrogen-enabled economic growth. Priorities included achieving cost parity between grey and green hydrogen, building a Green Fuel Centre of Excellence, and scaling specialized workforce training programs. Grid transformation—achieving a 100% renewable, low-cost system—was highlighted as critical, alongside underground storage and industrial applications such as green steel, fertilizers, and methanol for shipping. Desired outcomes for the region include stronger social licence, community ownership, enhanced GDP performance relative to other North American jurisdictions, and broad-based industrial retention and growth.

8.5.3 New Brunswick workshop

Capping off the in-person engagement sessions, Deloitte organized an in-person workshop in **Saint John, New Brunswick** including some participating from Prince Edward Island. Below is a summary of the insights and discussions from the workshop.

What surprised participants

Participants were struck by the scale of potential hydrogen demand compared to current levels. While projections of 1–2 million tonnes within five years were referenced, today there is effectively no domestic market, creating uncertainty about how to bridge this gap. Several noted the imbalance between the advanced state of industry planning and the limited public awareness and understanding of hydrogen, raising concerns about whether the broader community will support major investments. The fact that more than 90% of production is currently targeted for export was seen as harder to champion locally, especially given uncertainty around cost recovery.

Where participants saw the biggest impact

Discussion emphasized that the greatest opportunities would come from creating domestic demand alongside exports, starting with smaller, site-based projects to build momentum. Participants highlighted the importance of pairing hydrogen with other industries and secondary products to bring down costs and broaden value. Shared infrastructure across provinces—such as projects that straddle borders—was seen as a practical pathway to scale and align with the national hydrogen agenda. Examples from abroad, such as Swedish steelmaking where hydrogen supply and demand are co-located, were cited as useful models.

Finally, participants underscored that certainty of demand is critical: without clear offtake pathways and political clarity, the scale of required investment appears risky. Public education—particularly on what hydrogen is, how it compares to other energy sources, and its cost implications—was viewed as essential to building durable support and enabling the province to participate meaningfully in Canada's hydrogen future.

Workshop Insights: Opportunities for Atlantic companies and organizations

<u>General opportunities</u>

Participants emphasized that hydrogen represents a transformational growth opportunity for New Brunswick and the wider Atlantic region. Building a hydrogen sector could drive workforce development, create and retain employment, and expand research capacity. Universities and community colleges were identified as important pipelines for talent, with the sector offering new reasons for students to remain in the province. Hydrogen development was also seen as a chance to strengthen Indigenous partnerships and give Atlantic Canada a stronger reputation as an energy leader, both nationally and globally. Importantly, participants noted that hydrogen could finally create a "true Atlantic play" where provinces act together rather than in isolation.

<u>Logistics and infrastructure</u>

New Brunswick's port capacity and short shipping times to Europe were identified as strategic advantages. Hydrogen exports could open new markets and reduce dependence on the U.S., while also transforming the domestic electricity sector and grid resilience. Participants stressed that hydrogen can de-risk the regional energy sector by diversifying supply and creating additional export pathways.

<u>Small and medium enterprise (SME) opportunities</u>

Hydrogen projects will create new contract opportunities for SMEs in areas like fabrication, barge terminals, and supply of components. Participants highlighted the potential for SMEs to form partnerships with international firms and to leverage existing industrial capacity, including forestry by-products for biofuels, brownfield redevelopment, and facilities tied to industrial operators such as Irving Oil. Beyond urban centres, hydrogen was also seen as a catalyst for rural development, though this would require strategies for workforce attraction and retention to ensure local businesses can participate fully.

What would need to be true for this to be a reality in Atlantic Canada

Policy, planning, and regulatory clarity

Participants emphasized that government vision and long-term commitment are essential to anchor hydrogen development. Clear, integrated energy plans—at both federal and provincial levels—will be required to define where hydrogen fits within the broader decarbonization landscape, particularly in relation to electrification. A regional planning approach across Atlantic Canada was highlighted as a priority, ensuring provinces align infrastructure, permitting, and investment strategies. Regulatory certainty for both development and operations, combined with targeted incentives to close the well-to-production cost gap, were identified as critical enablers.

Markets and customers

For hydrogen to be viable, participants stressed the need for long-term, low-risk offtakers and diversified markets. Local industrial buy-in will be particularly important to create credible use cases within New Brunswick. Securing domestic demand was seen as a necessary complement to export opportunities, reducing reliance on external buyers. Participants also pointed to the importance of issuing clear signals, such as a provincial or regional request for proposals (RFP), to mobilize investment and supply chain activity.

Public and community engagement

Workshop participants underscored the importance of public understanding, acceptance, and social license. Clear communication of hydrogen's benefits to New Brunswickers—including economic growth, jobs, and energy security—will be essential to secure public support. Strong and respectful relationships with Indigenous Nations were also identified as a foundation for long-term success.

Workforce and safety

Ensuring a ready and available workforce will be key to implementation. Training and recruitment programs must align with hydrogen's specific skill requirements. Participants also raised safety concerns, noting that the supply chain must build robust practices around storage, handling, and explosion risk mitigation to build confidence among communities and customers.

Potential barriers to participation

- **Policy, coordination, and market alignment**: Participants highlighted the risk of fragmentation across Atlantic provinces and the absence of a clear, unified vision for hydrogen development. Political uncertainty, shifting priorities, and limited coordination between federal, provincial, and municipal governments were seen as barriers to long-term investor confidence. Market risks—including unstable demand, lack of compelling use cases, and questions about whether energy should be exported or retained locally—were also noted as constraints.
- **Public perception and social license**: A consistent theme was the challenge of public education and communication. Limited understanding of hydrogen applications, misinformation about safety, and "technology fatigue" among communities could slow adoption. Concerns about NIMBYism and negative PR were raised, alongside broader issues such as energy poverty and skepticism toward subsidizing emerging technologies. Participants stressed that without trust and transparency, public acceptance could become a major barrier.
- **Industrial base and infrastructure limitations**: New Brunswick's relatively modest industrial base was identified as a structural constraint, limiting immediate domestic offtake and supply chain depth. Infrastructure challenges include aging assets, gaps in rural connectivity, lack of hydrogen storage options, and limited capacity within utilities to integrate new projects. Participants also noted that intermittent renewable energy supply poses risks to efficient hydrogen production and grid stability.
- **Workforce and technical readiness**: Labour availability and specialized skills were cited as critical challenges. Participants expressed concern that the region may lack sufficient technical expertise, engineering capacity, and permitting knowledge within authorities having jurisdiction. Building a capable hydrogen workforce would require significant investment in training and education. Technical risks—such as efficiency losses from intermittent production, integration with existing industries, and uncertainty around the hydrogen "colour wheel"—add further complexity.

Workshop Insights: Now, Soon, Later

As part of the workshops, participants identified actions required across different time horizons to advance Atlantic Canada's hydrogen economy. Grouped into "Now," "Soon," and "Later", these priorities reflect both immediate enablers and longer-term system requirements.

Now

Participants emphasized the need for policy clarity and alignment at both the federal and provincial levels, along with a shared Atlantic Canada hydrogen strategy. Establishing a priority initiative and first-mover project was seen as essential to anchor the ecosystem and demonstrate feasibility. Early actions should include mapping organizations across the value chain, identifying near-term offtake opportunities (particularly in ammonia and natural gas blending), and benchmarking against leading jurisdictions. Public communication, supported by entities such as the Atlantic Centre for Energy, was highlighted as key to improving awareness, alongside engagement with First Nations to ensure equitable participation. Participants also called for mechanisms to reduce costs, provide price certainty, and launch early pre-development work (e.g., zoning, permitting) to accelerate timelines.

Soon

In the next phase, participants stressed the importance of moving from planning to visible progress, with "shovels in the ground" for at least one major project. Instruments such as contracts-for-differences (C4Ds) and carbon regulations were seen as necessary to provide investor certainty and support offtake agreements. Building a hydrogen hub and ecosystem—supported by joint procurement, regional infrastructure planning, and secure supply chain access—was highlighted as a priority. Dialogue with utilities, clarity on regulatory gaps, and joint statements by provincial premiers were also identified as confidence-building measures. Workforce training and engagement of supporting services (e.g., permitting bodies, regulators, logistics providers) will be essential to build capacity and credibility.

Later

Participants envisioned a fully developed hydrogen economy in which Atlantic Canada hosts robust hubs, integrated with a regional H_2/CO_2 pipeline corridor and domestic storage capacity. By this stage, hydrogen would be widely available across industrial and public applications, supported by certified technologies such as appliances, aviation fuels, and vehicles. The workforce would be skilled and adaptable, and hydrogen would achieve cost competitiveness with other energy sources. Co-location of production and use would be the norm, driving industrial retention, while foundational projects would create momentum for subsequent developments. Participants also suggested that Atlantic Canada could eventually position itself as a North American pricing benchmark for green hydrogen, signaling maturity, stability, and global competitiveness.

8.6 Case studies from jurisdictional review

Three case studies have been identified that highlight important advancements in the hydrogen ecosystem across North America and International markets that provide insight into how broader hydrogen initiatives support the development of the supply chain and future growth.

8.6.1 California Hydrogen Highway Network

Context and problem faced

California encountered persistent barriers to the adoption of hydrogen-powered vehicles, including the high costs associated with developing refueling infrastructure and the “chicken-and-egg” dilemma: consumers were reluctant to purchase hydrogen vehicles due to a lack of refueling stations, while investors were hesitant to build stations due to low vehicle numbers. The absence of clear market signals further constrained private-sector investment, limiting the growth of the hydrogen economy.

Applicability to Atlantic Canada

California, now a global leader in hydrogen, faced early growing pains similar to those Atlantic Canada may encounter as it develops and scales its domestic hydrogen market. California’s experience highlights the value of proactive government leadership in addressing infrastructure gaps and sending clear market signals to enable private-sector investment and stimulate demand, particularly in transportation and heavy-duty vehicle applications where market readiness remains limited.

Initiative launched

California launched the California Hydrogen Highway Network (CHHN) to establish a coordinated, statewide network of hydrogen refueling stations. The initiative aimed to build sufficient infrastructure to enable consumer and fleet adoption of hydrogen-powered vehicles and was closely integrated with the state’s broader Zero-Emission Vehicle Program to transition to clean transportation.

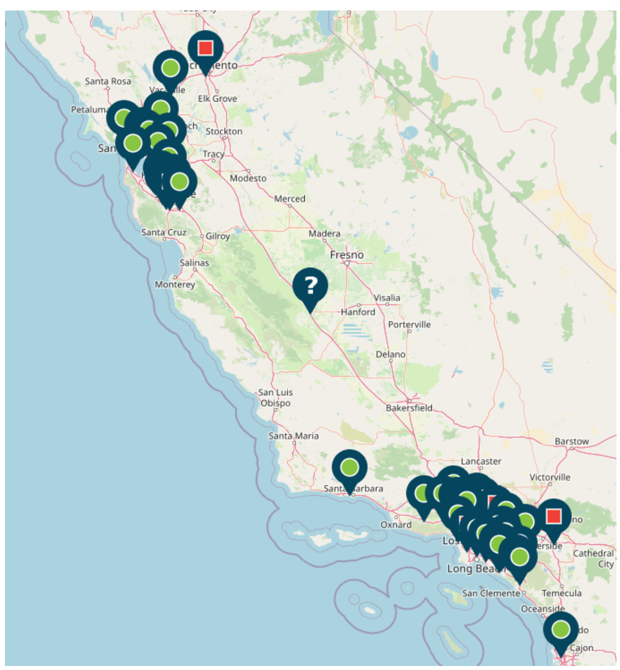

Figure 26 Hydrogen refueling station map[102]

[102] Station Map | H2FCP (Accessed (7/25/25)

Enabling organizations

The CHHN was supported by key California state agencies including the California Air Resources Board, the California Energy Commission, and the Governor's Office of Business and Economic Development. Private-sector involvement was critical, with major automakers (such as Toyota, Honda, and Hyundai) and hydrogen infrastructure companies (including FuelCell Energy and Air Products) contributing to implementation and delivery.

Outcomes

The initiative resulted in the deployment of over 40 publicly accessible hydrogen refueling stations across California, with an expansion target of over 100 stations by 2025. This infrastructure has supported the growth of hydrogen-powered vehicles, including fleets of transit buses and heavy-duty trucks, and has delivered measurable reductions in transportation-sector emissions. The program has also established California as a leading jurisdiction for demonstrating the operational viability of hydrogen in real-world transport applications.

Implication for the hydrogen supply chain

California's experience shows that investing early in infrastructure unlocks demand and stimulates growth across the hydrogen supply chain—from production and distribution to end-use. The program demonstrates the effectiveness of public-private partnerships in overcoming early market barriers and provides a roadmap for regional integration of hydrogen into transportation systems, helping catalyze a domestic hydrogen economy while reducing fossil fuel dependency.

8.6.2 European Hydrogen Backbone Initiative

Context and problem faced

Several European countries, including the Netherlands, Germany, and Belgium, faced a fragmented hydrogen market characterized by high production costs, inadequate infrastructure for hydrogen transport, and limited cross-border integration. The lack of interconnected infrastructure constrained the ability to aggregate demand at scale, impeding the development of a viable hydrogen economy and making it difficult to justify large-scale investments in hydrogen production and transport.

Applicability to Atlantic Canada

Atlantic Canada can draw lessons from Europe's approach to regional collaboration and cross-jurisdictional infrastructure planning. As Atlantic Canada develops its hydrogen economy, particularly with ambitions to export, overcoming regional fragmentation and ensuring sufficient scale to support infrastructure investments will be essential. Europe's experience demonstrates the importance of building infrastructure that connects production hubs to major demand centers, including potential export markets, enabling economies of scale and a more resilient supply chain.

Initiative launched

The Hydrogen Backbone initiative, launched in 2020, aims to develop a transnational hydrogen pipeline network connecting hydrogen production hubs in the Netherlands, Germany, and Belgium with other European Union countries. The initiative focuses on building the infrastructure required for cross-border transport and trade of hydrogen, enabling a robust and integrated European hydrogen market.

European Hydrogen Backbone in 2030

European Hydrogen Backbone in 2040

Figure 27 The European Hydrogen Backbone initiative

Enabling organizations

The initiative is driven by a consortium of transmission system operators including Gasunie (Netherlands), Open Grid Europe and Gasunie Deutschland (Germany), alongside key industrial and logistics players such as the Port of Rotterdam and multinational energy companies like Shell, BP, and Uniper. It is also supported by the European Commission and coordinated through the European Hydrogen Backbone Initiative.

Outcomes

The initiative is enabling the development of approximately 5,000 km of dedicated hydrogen pipeline infrastructure by 2030, linking major industrial hubs and ports across Europe. It has fostered international collaboration on hydrogen infrastructure, enhanced green hydrogen production capacity, and supported the establishment of hydrogen hubs in key regions such as Rotterdam, North Rhine-Westphalia, and Lower Saxony. These developments contribute directly to the European Union's carbon neutrality objectives and regional decarbonization goals.

Implication for the hydrogen supply chain

The Hydrogen Backbone initiative demonstrates how cross-border infrastructure can integrate fragmented markets, aggregate demand, and unlock economies of scale critical to reducing hydrogen production and transport costs. It reinforces the importance of infrastructure planning that connects producers, industrial users, and export pathways, laying the groundwork for regional hydrogen economies while improving resilience to energy supply volatility.

8.6.3 H2Global Initiative

Context and problem faced

Germany faced several challenges in developing its hydrogen economy, including the high production costs of green hydrogen at the scale required to meet decarbonization targets, a fragmented market with limited demand, and difficulty aggregating sufficient industrial demand to justify early infrastructure and production investments. These factors created uncertainty for producers and hindered the development of a mature hydrogen market.

Applicability to Atlantic Canada

Atlantic Canada may encounter similar early-market challenges as it seeks to establish hydrogen production and stimulate both domestic and export demand. The H2Global model demonstrates how government-backed mechanisms can help bridge the gap between production costs and market prices while aggregating industrial demand to create predictable market conditions. This approach could inform strategies in Atlantic Canada for stimulating domestic uptake, de-risking production investments, and positioning the region to supply both local industries and international markets. Importantly, Atlantic Canada's hydrogen production projects targeting export markets could directly participate in mechanisms like H2Global, providing potential offtake opportunities that support long-term market access and revenue certainty for producers in the region.

Initiative launched

H2Global was initially established by the German Federal Ministry for Economic Affairs and Climate Action to connect German industries with international suppliers of green hydrogen and its derivatives through a market-based procurement mechanism. The initiative facilitates long-term purchasing agreements that stabilize hydrogen prices, aggregates demand from hard-to-abate sectors such as steel, cement, and chemicals, and supports early market formation by providing producers with clear, bankable demand signals.

While designed to address Germany's domestic decarbonization needs, H2Global has since expanded to include participation from other European Union member states and is now integrated into the European Hydrogen Bank's international procurement pillar. The mechanism is intended to accelerate the creation of functioning markets for clean hydrogen and other low-emission fuels, mobilize public and private capital toward scaling production, and contribute to the broader European and global energy transition.

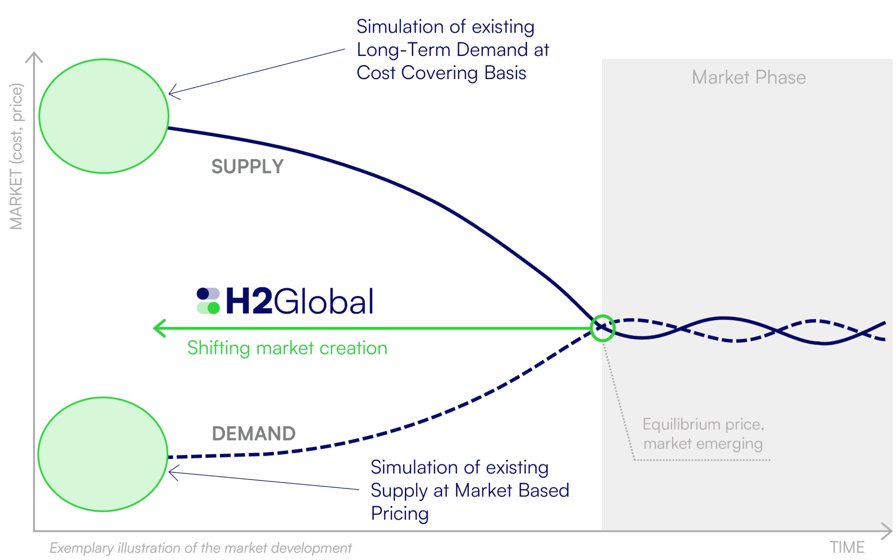

Figure 28 H2Global supply and demand prince balancing visual

Enabling organizations

The initiative is led by the German Federal Ministry for Economic Affairs and Energy, working through the H2Global Foundation. It engages international hydrogen suppliers (such as Air Products, Linde, and RWE) and major German industrial consumers across sectors. The European Commission has also supported the initiative as part of the EU's broader hydrogen strategy.

Outcomes

H2Global has enabled the creation of long-term hydrogen purchasing contracts, providing price stability during the early stages of market development. Its demand aggregation model offers predictability for producers, while government-backed financial instruments cover the difference between high production costs and market prices. This has stimulated industrial sector uptake and contributed to building a viable domestic hydrogen market.

Implication for the hydrogen supply chain

H2Global demonstrates how aggregating industrial demand and stabilizing prices can help scale hydrogen production and accelerate cost reductions over time. The initiative underscores the value of government support in overcoming early-market risks and fostering collaboration between public and private sectors. It provides a useful example of how demand-side policy instruments can drive supply chain development by ensuring predictable and sustainable market conditions for hydrogen producers and consumers alike.

8.7 Jurisdictional scan results

8.7.1 British Columbia

Jurisdiction General overview	
National or sub-national jurisdiction	Sub-national
Population	~5.7 million (2025 estimate)[103]
Gross domestic product	Approximately $304 billion USD[104]
Climate targets	• Legislated greenhouse gas (GHG) reduction targets of 16% below 2007 levels by 2025, 40% by 2030, 60% by 2040, and 80% by 2050. These targets guide the province's climate actions under the CleanBC plan, aiming for significant emissions cuts across all sectors on the path toward net-zero by 2050.[105] • CleanBC requires all new large industrial facilities to align with B.C.'s legislated climate targets and submit 2050 net-zero emissions plans.[106] • B.C.'s Low Carbon Fuel Standard requires a 30% reduction in transportation fuel carbon intensity by 2030, compared to 2010 levels, pushing cleaner fuels into the supply chain.[107] • The Zero-Emission Vehicle mandate which includes both electric and hydrogen powered vehicles to transform the transportation supply chain toward electric and hydrogen fuel cell vehicles.[108]
Hydrogen ecosystem	
Hydrogen strategy or roadmap	In July 2021, the Government of British Columbia released the B.C. Hydrogen Strategy, one of Canada's first comprehensive provincial hydrogen plans. As part of the broader CleanBC initiative, the strategy outlines a vision to integrate renewable and low-carbon hydrogen into B.C.'s energy system to help achieve the province's net-zero emissions target by 2050. Hydrogen is identified as a critical solution for decarbonizing sectors that are difficult to electrify, including heavy-duty transportation and industrial heat, and has the potential to reduce B.C.'s annual emissions by 7.2 megatonnes by 2050 (11% of 2018 emissions). The strategy highlights B.C.'s advantages, such as its vast hydroelectric resources for green hydrogen production and natural gas reserves with carbon capture potential for blue hydrogen. It presents a phased roadmap to 2050, with short-, medium-, and long-term actions focused on scaling hydrogen production, creating regional hydrogen hubs, and supporting vehicle and infrastructure deployment. Hydrogen's versatility across energy, transportation, industrial, and residential sectors is emphasized, including its use in stationary power systems and blending into the natural gas grid. B.C.'s strong base of hydrogen and fuel cell innovation, with more than half of Canada's sector companies based in the province positions it to capture a share of the growing global hydrogen market, projected to surpass $300 billion by 2050.[109]
Goals and objectives	• Position B.C. as a major producer of renewable and low-carbon hydrogen. • Establish B.C. as a hub for hydrogen technology and innovation.

103 Population estimates, July 1, by census metropolitan area and census agglomeration, 2021 boundaries (Accessed 6/11/25)
104 B.C. Economic Accounts & Gross Domestic Product - Province of British Columbia (Accessed 6/11/25)
105 B.C. sets new 2025 emission target, details climate action in CleanBC report (Accessed 6/11/25)
106 CleanBC Roadmap to 2030 - Trade and Invest BC (Accessed 6/11/25)
107 Renewable and Low Carbon Fuels - Province of British Columbia (Accessed 6/11/25)
108 Zero-Emission Vehicles Act - Province of British Columbia (Accessed 6/11/25)
109 bc_hydrogen_strategy_final.pdf (Accessed 6/11/25)

	• Decarbonize heavy transportation and industrial processes by replacing diesel, gasoline, and natural gas with hydrogen. • Scale up local hydrogen production to reduce reliance on imported fossil fuels. • Expand hydrogen fueling infrastructure across key freight, transit, and industrial corridors. • Foster clean economy job creation and workforce development in hydrogen supply chain roles. • Enable long-term export opportunities to international hydrogen markets.
Key milestones and timelines[110]	• Short-term (2020–2025): Establish enabling policies and regulations, fund pilot projects and feasibility studies, and begin building initial. • Mid-term (2025–2030): Scale up deployment – larger hydrogen production projects come online, regional hydrogen hubs, integration of hydrogen into natural gas pipelines up to the targeted blend, and expansion of fuel cell vehicle fleets in public transit and freight. • Long-term (2030 and beyond): Transition to mass-market adoption – hydrogen becomes a mainstream energy carrier. Actions include developing export supply chains achieving self-sufficiency in clean hydrogen for domestic needs, and continuing to decarbonize sectors like industrial heating, marine shipping, and aviation with hydrogen-based fuels.
Existing hydrogen operations	• Industrial grey hydrogen use remains dominant. Hydrogen has long been used in B.C. for refining petroleum products, particularly by Parkland and Tidewater at their refinery sites. These operations rely on conventional (grey) hydrogen for hydrocracking and desulphurization processes. This remains the largest current use of hydrogen in the province. • Low-carbon hydrogen use is emerging but limited. The HTEC network includes a small number of operational public hydrogen refueling stations, supporting a modest fleet of fuel cell electric vehicles such as transit buses and passenger vehicles. Hydra Energy has initiated a demonstration in Prince George, supplying waste hydrogen to a dual-fuel truck fleet.
Hydrogen projects announced or in development	• Ekona Power is piloting a methane pyrolysis technology to produce low-emission hydrogen and solid carbon as an alternative to SMR + CCS.[111] • VulcanX Energy and FortisBC are trialing methane pyrolysis in B.C. to produce hydrogen from natural gas without CO_2 emissions, supported by CICE funding.[112] • FortisBC – Blending Expansion Program: Expansion of low-carbon gas blending to include hydrogen in addition to renewable natural gas.[113] • Hy2Gen – Prince Rupert Hydrogen Export Project: Secured a lease option on 79 acres of Watson Island in Prince Rupert to study the feasibility of a large-scale renewable hydrogen and hydrogen-based fuels export facility. Status: Pre-FID (feasibility study phase).[114] • Xaxli'p "Salish Elements" - Lillooet Region Hydrogen Plant (Pre-FID, 2024–25): A proposed 25 MW green hydrogen plant led by the Xaxli'p First Nation and private partners. Aims to supply mining transport and regional demand; nearing financial close and land agreements. Status: Pre-FID, targeting financial close in 2024–25.[115]

[110] bc_hydrogen_strategy_final.pdf (Accessed 6/11/25)
[111] Ekona Power Inc. Pilots Methane Pyrolysis Solution for Low-cost Clean Hydrogen | Ekona Power (Accessed 6/11/25)
[112] VulcanX and FortisBC sign deal to support new hydrogen technology (Accessed 6/11/25)
[113] FortisBC first energy utility in North America to automatically designate Renewable Natural Gas for customers (Accessed 6/11/25)
[114] Lease Option Signed Between Prince Rupert Legacy and Hydrogen Based Project on Watson Island | City of Prince Rupert | Civikit (Accessed 6/11/25)
[115] Salish Elements - Xaxli'p - 25MW Green Hydrogen Production (Accessed 6/11/25)

	• McLeod Lake Indian Band - Tse'khene energy transition hub: The Tse'khene Hub, located north of Prince George, BC, is valued at approximately $7 billion and will include a hydrogen production facility and a straddle plant. Once fully developed, it will be one of the largest Indigenous energy projects in Canada. Status: Pre-FID (planning and development stage).[116] • HTEC – H2 Gateway Program: 19 new hydrogen refueling stations across B.C. and Alberta, three electrolyzer production facilities, and a 15 tonnes/day hydrogen by-product capture and liquefaction system to supply local fueling stations and industrial users. Status: Post-FID (in construction/pre-operations).[117] • Hydra Energy – Hydrogen Refuelling Station for Heavy-Duty Trucks. Deployment of dual-fuel hydrogen-diesel trucks using low-carbon hydrogen produced via on-site electrolysis (target: 82 trucks by 2026; planned electrolyzer capacity: 3.25 tonnes/day). Status: Post-FID (construction underway).[118]
Challenges being faced in meeting ecosystem goals	• Limited refueling station network and electrolyzer capacity restrict near-term scalability of hydrogen mobility and industrial use. • Many projects remain at pre-FID stage, facing delays in land agreements, financial close, and regulatory approvals. • Demand signals are still emerging, especially outside of transit and pilot freight applications, making it difficult to reach economies of scale. • Interconnection between hydrogen producers, utilities, end-users, and Indigenous communities requires robust governance frameworks and capacity-building. • Early-stage development of biohydrogen and CCS infrastructure introduces uncertainty in scaling diverse production pathways.
Policy and regulation	
Financial subsidies / funding models established to support the hydrogen value chain and supply chain	• Low Carbon Fuel Standard (LCFS) – The LCFS creates market incentives for low-carbon alternatives, including hydrogen, by awarding credits based on lifecycle emissions reductions. Hydrogen produced from renewable electricity or with carbon capture can generate significant LCFS credits, making it more financially viable for applications such as fuel cell vehicles, transit, and heavy-duty transport. Funding example: $133M in LCFS credits allocated to hydrogen infrastructure under Part 3 Agreements.[119] • CleanBC Industry Fund: The CleanBC Industry Fund offers four funding streams that support industry to reduce emissions, trial new innovations, and develop future plans to improve industrial operations supported by the revenues collected by the BC Output-Based Pricing. Applicable to hydrogen, the fund has backed hydrogen blending pilots and electrolyzer studies.[120] Funding value: Not publicly disclosed by project, but total fund reallocations exceed tens of millions annually. • Innovative Clean Energy (ICE) Fund: Provides capital and demonstration funding for pre-commercial clean energy projects, including hydrogen technologies. Supports research and development as well as feasibility studies.

[116] TETH (Accessed 6/11/25)

[117] H2 Gateway - HTEC (Accessed 6/11/25)

[118] Hydra Energy Breaks Ground on World's Largest Hydrogen Refuelling Station for Heavy-Duty Trucks — Hydra Energy (Accessed 6/11/25)

[119] BC Gov News (Accessed 6/11/25)

[120] CleanBC Industry Fund - Province of British Columbia (Accessed 6/11/25)

	Funding value: Disburses approximately $10–15 million/year across multiple clean energy technologies.[121] • B.C. Centre for Innovation and Clean Energy (CICE): A jointly funded innovation agency (established 2021) focused on accelerating commercialization of clean energy solutions, including hydrogen production, conversion, and use technologies.[122] • FortisBC Clean Growth Innovation Fund: A utility-led program supporting low-carbon gas innovation, including hydrogen blending trials, safety studies, and equipment development.[123] • Federal Incentives – Tax Credits and Infrastructure Bank: B.C.-based hydrogen projects are eligible to stack the federal 40% Clean Hydrogen Investment Tax Credit (ITC) and financing from the Canada Infrastructure Bank (CIB). Example value: $337M CIB loan allocated to hydrogen infrastructure in B.C. (e.g. fueling networks and electrolyzers).
Regulatory frameworks encouraging hydrogen development	• B.C. amended the Greenhouse Gas Reduction Regulation to allow gas utilities to own and operate hydrogen infrastructure (production, blending, distribution).[124] • The B.C.'s hydrogen strategy describes a carbon intensity based approach to low-carbon hydrogen production, following guidance from the Government of Canada and their carbon intensity threshold of 36.4 gCO_2e / MJ of H2 produced.[125] • B.C.'s Zero-Emission Vehicles Act mandates that zero-emission vehicles- including both electric vehicles (EVs) and hydrogen fuel cell vehicles (FCEVs) make up 26% of new car sales by 2026, 90% by 2030, and 100% by 2035. In 2023, these vehicles already made up nearly 23% of new car sales, up from 18% in 2022.[126] • Hydrogen is recognized within several CleanBC regulatory frameworks- including the Low Carbon Fuel Standard (LCFS), utility regulations, and building codes-as an eligible low-carbon energy option. Its inclusion in these structures supports the potential for hydrogen development but does not mandate its use.
Initiatives supporting permitting and regulatory approval processes	• Clean Energy and Major Projects Office: Acts as the provincial coordination body for clean energy projects, including hydrogen. Supports proponents with permitting, Indigenous engagement, and inter-agency navigation. • BC Energy Regulator – New regulation streamlines requirements for hydrogen manufacturing in B.C.: Effective April 1, 2025, the British Columbia Energy Regulator (BCER) is responsible for the oversight of hydrogen manufacturing in British Columbia. With this expanded mandate, the BCER has been working with the hydrogen sector as well as First Nations and communities to build a shared understanding of how the BCER can support the objectives of the BC Hydrogen Strategy • CICE – Hydrogen Regulatory Mapping Study (2023): Analyzed six hypothetical hydrogen projects to identify regulatory gaps with a recommendation to explore a tiered permitting model based on project size and complexity.

[121] Innovative Clean Energy (ICE) Fund - Province of British Columbia (Accessed 6/11/25)

[122] BC Clean Energy Centre Rebrands as NorthX Climate Tech to Reflect National Ambitions | CleanEnergy.ca (Accessed 6/11/25)

[123] Clean Growth Innovation Fund (Accessed 6/11/25)

[124] Greenhouse Gas Reduction Regulation - Province of British Columbia (Accessed 6/11/25)

[125] bc_hydrogen_strategy_final.pdf (Accessed 6/11/25)

[126] Zero-Emission Vehicles Act - Province of British Columbia (Accessed 6/11/25)

Infrastructure and value chain integration	
Designation of hydrogen hubs, corridors, or other co-location initiatives	• Regional hydrogen hubs are identified in Metro Vancouver, Prince George, and the North Coast, designed to co-locate hydrogen production, fueling infrastructure, and high-demand end users (e.g. freight, transit, industrial heat applications).[127] • Prince George is the focal point of the proposed Northern B.C. Hydrogen Hub, which has received federal support for pre-feasibility planning and hub development coordination.[128] • The H2 Gateway project, led by HTEC, will deploy 19 hydrogen fueling stations across B.C., forming targeted provincial hydrogen corridors to support light- and heavy-duty vehicle deployment. While the original plan references expansion into Alberta, current confirmed stations are within B.C.[129]
Regional infrastructure planning initiatives or mechanisms	• The 2023 Accelerated electrification load scenario is approximately 2,000 GWh lower in fiscal 2030 primarily due to adjustments to the timing of forecast electrification in the natural gas industry, and approximately 3,400 GWh higher in fiscal 2040 primarily due to forecast load from the additional production of hydrogen through electrolysis.[130] • FortisBC and UBC are testing pipeline material compatibility for hydrogen blending.[131] • Provincial planning includes identifying geological formations suitable for underground hydrogen and CO_2 storage, supporting the development of blue hydrogen by enabling long-term carbon sequestration and facilitating bulk hydrogen storage to provide low-cost, high-capacity energy reserves that enhance system reliability and flexibility.[132]
Innovative business models enabling development	• HTEC's hydrogen network is being built with a $337 million loan from the Canada Infrastructure Bank, alongside private and public investment. HTEC's innovative business model includes purchasing hydrogen fuel cell electric trucks and leasing them to fleet operators through its Vehicle Leasing Corporation (VLC), offering a pay-as-you-go service that bundles vehicle use, maintenance, and fueling access. HTEC also generates Low Carbon Fuel Standard (LCFS) credits by supplying low-carbon hydrogen to its refueling stations; these credits can then be sold on British Columbia's LCFS credit trading market, creating an additional revenue stream that supports network expansion.[133] • Hydra Energy's hydrogen-as-a-service model provides heavy-duty fleet operators with zero-cost retrofits for hydrogen-diesel co-combustion and long-term hydrogen fuel contracts. The company is constructing its own $62-million electrolysis facility in Prince George, BC, which will use renewable electricity from BC Hydro to produce up to 3,250 kilograms of low-carbon hydrogen per day. This hydrogen will supply Hydra's dedicated refueling station, supporting more than 80 trucks from eight commercial fleets under long-term agreements. Hydra's business is enabled by government incentives, including

[127] Metro Vancouver's Future Low-Carbon Hydrogen Ecosystem - Foresight (Accessed 6/11/25)

[128] Northern BC Hydrogen Hub - Canadian Hydrogen Association (Accessed 6/11/25)

[129] H2 Gateway - HTEC (Accessed 6/11/25)

[130] BC Hydro. (2023). 2021 Integrated Resource Plan (2023 Update). (Accessed 6/11/25)

[131] UBC Okanagan and FortisBC collaborating on made-in-B.C. hydrogen research (Accessed 6/11/25)

[132] Hydrogen | BC Energy Regulator (BCER) (Accessed 6/11/25)

[133] HTEC. (2024, May 24). CIB invests $337 million towards hydrogen production and refuelling network in Western Canada. (Accessed 6/11/25)

	funding from the federal Low Carbon Economy Challenge and support from the BC Ministry of Energy, Mines and Low Carbon Innovation.[134]
Infrastructure re-tooling to support hydrogen	• FortisBC is testing hydrogen compatibility of existing pipelines for 5–15% blending, identifying materials and components that require retrofitting.[135] • BC Hydro is planning substation and grid upgrades in areas where electrolyzer projects are sited.[136] • Hydrogen equipment maintenance (compressors, tanks) is being incorporated into existing provincial energy inspection regimes.[137]
Supply chain strategy	
Supply chain targets	No targets identified
Manufacturing strategies or supply chain assessments	The B.C. Hydrogen Strategy supports onshoring of electrolyzer manufacturing and hydrogen refueling system production by offering targeted incentives like the Clean Industry and Innovation Rate, which lowers electricity costs for local producers. The province also fosters industry partnerships and streamlines permitting processes to attract and accelerate hydrogen technology development and manufacturing within B.C. These combined efforts aim to build a robust local hydrogen supply chain and expertise.
Critical hydrogen supply chain components	Critical minerals (e.g. nickel, aluminum) and logistics (e.g. shipping terminals) are under provincial review to align with hydrogen equipment demand.
Supply chain risk mitigation strategies deployed	• B.C. promotes a portfolio of hydrogen pathways (green, blue, by-product, bio-hydrogen) to mitigate feedstock, cost, and infrastructure risks.[138] • BC's Low Carbon Fuel Standard (LCFS) now mandates that, effective April 1, 2025, the minimum 8% renewable fuel requirement for diesel must be met with fuels produced in Canada, and effective January 1, 2026, the minimum 5% renewable fuel requirement for gasoline must also be met with Canadian-produced fuels. These changes are designed to strengthen local biofuel production, support domestic industry, and reduce reliance on imported fuels.[139]
Hub and spoke manufacturing ecosystems	BC hosts Canada's largest hydrogen fuel cell manufacturing and technology cluster, including Greenlight, Loop Energy, Cellcentric, Unilla, with one of the largest and most established being Ballard Power Systems. • Serves as B.C.'s anchor hydrogen manufacturing firm, specializing in proton exchange membrane (PEM) fuel cells for heavy-duty transportation applications (buses, trucks, trains, marine). • Ballard operates one of the world's leading fuel cell R&D and manufacturing facilities in Metro Vancouver. • Supplies both domestic and global markets, exporting fuel cell modules to over 15 countries. • Acts as a regional anchor, attracting local suppliers for components (membranes, plates, electronics) and supporting workforce development through partnerships with BCIT, UBC, and SFU.

[134] Canada's Hydra Energy First Company to Deliver a Hydrogen-converted, Heavy-duty Vehicle to a Paying Fleet Customer — Hydra Energy (Accessed 6/11/25)

[135] GHD. (n.d.). Enhancing hydrogen blending in natural gas distribution systems. (Accessed 6/11/25)

[136] Government of British Columbia. (2024, April 3). BC Hydro issues call for new clean electricity to power B.C.'s future. (Accessed 6/11/25)

[137] Stantec Consulting Ltd. (2023). B.C. Hydrogen Regulatory Mapping Study. Ministry of Energy, Mines and Low Carbon Innovation; B.C. Centre for Innovation and Clean Energy. (Accessed 6/11/25)

[138] bc_hydrogen_strategy_final.pdf (Accessed 6/11/25)

[139] Low Carbon Fuel Standard requirements - Province of British Columbia (Accessed 6/11/25)

Workforce development	
Hydrogen skills or workforce market assessments	The 2024 Hydrogen Symposium at BCIT identified emerging workforce needs includir hydrogen safety specialists, gas fitters with hydrogen certification, fuel cell vehicle techs, and electrolyzer engineers.[140] Findings from the symposium are being used to inform curriculum development and guide collaboration between post-secondary institutions, industry, and the province on hydrogen-specific training pathways. Key workforce gaps identified were: • Hydrogen system installers and maintenance technicians, industrial control system operators for hydrogen blending, and field safety officers for hydrogen refueling. • FCEV (fuel cell electric vehicle) technician roles are underdeveloped, with certification frameworks still in progress.
Initiatives to support workforce development	• BCIT is actively developing hydrogen workforce capacity, hosting annual Hydrogen Symposiums that bring together industry, academia, and government to identify workforce gaps and promote hydrogen-related training and collaboration. [141] • British Columbia's post-secondary system already delivers foundational degrees, diplomas, and trades certifications relevant to hydrogen, and there is a growing emphasis on short-term micro-credential programs to help workers transition from related industries into the hydrogen sector.[142]
Educational partnerships and certification development	• Ballard and NSERC co-fund a hydrogen research chair at UBC.[143] • BCIT is creating micro-credentials focused on hydrogen safety, blending, and systems maintenance.[144] • Indigenous training pathways are supported through CleanBC Skills Training for Clean Energy Programs.[145]
Community engagement	
Education and outreach programs	CleanBC and Hydrogen BC coordinate public education via online hubs, fact sheets, and events.[146]
Community benefit or local hiring initiatives	• The BC Procurement Plan 2024 emphasizes leveraging government purchasing to support local economies, including Indigenous and small businesses. Program examples include but are not limited to Indigenous Procurement Initiative and the BC Bid platform.[147] • Community Benefits Agreements on major public infrastructure projects in B.C. prioritize apprenticeships, training, and employment opportunities for Indigenous peoples, women, and local workers, supporting workforce development for sectors including hydrogen and clean energy. [148]

[140] Fraser Basin Council. (2024, December). B.C. Hydrogen Labour Market and Skills Analysis. British Columbia Ministry of Energy and Climate Solutions. (Accessed 6/11/25)

[141] Fuel of the future: BCIT hosts the first annual Hydrogen Symposium - Post-Secondary BC (Accessed 6/11/25)

[142] Jan-2025-BC-H2-Labour-Market-and-Skills-Analysis.pdf (Accessed 6/11/25)

[143] Fifty-two projects led by UBC researchers awarded funding through the NSERC Alliance Grants program | UBC Research + Innovation (Accessed 6/11/25)

[144] Fuel of the future: BCIT hosts the first annual Hydrogen Symposium - Post-Secondary BC (Accessed 6/11/25)

[145] BC Gov News (Accessed 6/11/25)

[146] BC Hydrogen Office - Province of British Columbia (Accessed 6/11/25)

[147] BC Procurement Plan 2024 - Province of British Columbia (Accessed 6/11/25)

[148] BC Gov News (Accessed 6/11/25)

Indigenous engagement practices and participation structures	• Indigenous contractors and suppliers are participating in hydrogen pilot projects, such as projects like Salish Elements (Xaxli'p) that include First Nations in ownership and future operations.[149] • The First Nations Clean Energy Business Fund provides seed funding and training to support Indigenous ownership or participation in clean energy projects, including hydrogen.[150] • The CleanBC Remote Community Energy Strategy (RCES) partners with remote and Indigenous communities to reduce diesel reliance by deploying renewable energy and supporting local capacity. While renewables and batteries are the main focus, hydrogen is being explored as a complementary solution-offering reliable backup power, supporting full diesel displacement, and creating future opportunities in operations and maintenance as hydrogen technologies develop.[151] • McLeod Lake Indian Band and Mitsubishi Power are partnering on the proposed Tse'khene Energy Transition Hub, a hydrogen and ammonia production facility north of Prince George. The project includes direct economic participation and community benefit planning.[152] • Lheidli T'enneh First Nation and Fortescue Future Industries signed an MOU for the Coyote Project, a proposed green hydrogen and ammonia facility in Prince George. Although the project has been cancelled, the initiative reflected efforts to position Indigenous communities as equity participants in export-oriented hydrogen supply chains. [153]

[149] Indigenous partnership announced in B.C. to create 25MW green hydrogen (Accessed 6/11/25)
[150] First Nations Clean Energy Business Fund - Province of British Columbia (Accessed 6/11/25)
[151] CleanBC Remote Community Energy Strategy (RCES) - Province of British Columbia (Accessed 6/11/25)
[152] Williams, A. (2023, May 26). McLeod Lake Indian Band, Mitsubishi Power working on $5B hydrogen project. Prince George Citizen (Accessed 6/11/25)
[153] Hydrogen Central. (2024, October 18). Hydrogen plant cancelled as Fortescue unplugs from Prince George plan (Accessed 6/11/25)

8.7.2 Ontario

Jurisdiction General overview	
National or sub-national jurisdiction	Sub-national
Population	16,200,000 (2025) (StatCan, 2025[154])
Gross domestic product	CAD $1.12 trillion (2023) (StatCan, 2024 estimate; USD equivalent ≈ $0.9 trillion)
Climate targets	2030 target: Reduce emissions 30% below 2005 levels (Ontario Climate Change Accountability Act)[155]

Hydrogen ecosystem	
Hydrogen strategy or roadmap	Ontario released its first Low-Carbon Hydrogen Strategy in April 2022. The strategy outlines how hydrogen will be used to reduce emissions in hard-to-decarbonize sectors, stimulate clean economic growth, and support energy resilience. It emphasizes leveraging Ontario's clean electricity grid (primarily nuclear and hydro) for green hydrogen production, while also exploring blue hydrogen through natural gas with CCS. The strategy identifies eight immediate actions, including launching regional hydrogen hubs (e.g. Niagara), enabling hydrogen blending in gas networks, and studying hydrogen production from off-peak nuclear and hydro generation. It integrates with Ontario's energy, climate, and industrial competitiveness goals.[156]
Goals and objectives[157]	• Generate economic development and jobs: Capitalize on Ontario's competitive and regional advantages, including our talent, infrastructure and resources, to accelerate growth in Ontario's low-carbon hydrogen economy. • Reduce greenhouse gas emissions: Support our Made-in-Ontario Environment Plan targets to reduce greenhouse gas emissions by encouraging the use of low-carbon hydrogen. • Promote energy diversity: Consider how low-carbon hydrogen can cost-effectively support Ontario's evolving energy system and build redundancies through electricity storage and clean fuel supply. • Promote innovation and investment: Enable opportunities for low-carbon hydrogen use and position Ontario as a leading destination for investment. • Strengthen collaboration: Work with the private sector, the federal government, municipalities, Indigenous communities, academic institutions and other stakeholders to grow and sustain a low-carbon hydrogen economy in Ontario.

Key milestones and timelines	• While no specific milestones with timelines are included in the Ontario Low-Carbon hydrogen strategy, there are eight immediate actions identified:[158]
	  ○ Launching the Niagara Falls Hydrogen Production Pilot
	  ○ Identifying Ontario's Hydrogen Hub Communities
	  ○ Assessing the Feasibility of Hydrogen Opportunities at Bruce Power
	  ○ Developing an Interruptible Electricity Rate

[154] Population and demography statistics (Accessed 6/11/25)

[155] Ontario's responsible and balanced approach to meeting the federal benchmark for the Emissions Performance Standards industrial emissions program for 2023-2030. | Environmental Registry of Ontario (Accessed 6/11/25)

[156] Ontario's Low-Carbon Hydrogen Strategy | ontario.ca (Accessed 6/11/25)

[157] Canadas hydrogen policy landscape | Gowling WLG (Accessed 6/11/25)

[158] Canadas hydrogen policy landscape | Gowling WLG (Accessed 6/11/25)

	○ Supporting Hydrogen Storage and Grid Integration Pilot Projects ○ Transitioning Industry Through the Use of Low-Carbon Hydrogen ○ Consulting on an Ontario Carbon Sequestration and Storage Regulatory Framework ○ Supporting On-going Hydrogen Research
Existing hydrogen operations	• Over 150,000 tonnes of grey hydrogen is currently produced each year for refining, chemicals, and fertilizer production in the Sarnia-Lambton region[159] • Enbridge Gas blending pilot in Markham: 2% hydrogen injected into local grid, serving ~3,600 homes[160] • HF Sinclair currently produces hydrogen through steam methane reforming (SMR), using the entire output for their operations. Additionally, HF Sinclair captures and sells CO_2 by-products • Established in 2024 Ontario's first public hydrogen refueling station for vehicles, supported by a $1 million federal investment. Aiming to reduce transportation emissions and exploring hydrogen production and usage, including transitioning the bus fleet to hydrogen. • Hydrogenics (Cummins Mississauga) manufactures electrolyzers and fuel cell systems for domestic and international markets.[161]
Hydrogen projects announced or in development	• Niagara Falls pilot (Atura Power): 20 MW electrolyzer under construction, operational by 2025[162] • Developing a 500 kW hydrogen facility in Mississauga using Anion Exchange Membrane (AEM) electrolyzers. This will supply Ontario's first public fueling station and support the hydrogen economy in the area, with collaborations including Pearson Airport[163] • Signed a MOW with YUL, YYZ and YVR to study the feasibility of hydrogen infrastructure in Canada.[164]
Challenges being faced in meeting ecosystem goals	• Policy uncertainty: No long-term provincial climate legislation beyond 2030 target; reliance on federal policy creates inconsistency[165] • Infrastructure readiness: Pipeline conversion and permitting for new H_2 networks is in early stages • Offtaker risk: Industrial buyers require clearer price signals and long-term offtake agreements to commit • Hydrogen cost gap: Green hydrogen still significantly more expensive than natural gas or grey H_2 • Technology readiness: Large-scale hydrogen storage and import infrastructure still in planning phase • Permitting and CCS regulation delays: Carbon storage framework for blue hydrogen still in development
Policy and regulation	

159 Ontario's Hydrogen Hub in Sarnia-Lambton Strategic Plan (Accessed 6/11/25)

160 Clean hydrogen enters the Markham energy mix - Enbridge Inc. (Accessed 6/11/25)

161 Cummins closes $290 million acquisition of fuel cell maker Hydrogenics [Update] - FreightWaves (Accessed 6/11/25)

162 Atura Power Selects Accelera to Design, Manufacture 20MW Electrolyzer System for Niagara Hydrogen Centre | Accelera (Accessed 6/11/25)

163 $30M Investment Announced for Hydrogen Innovation Fund (Accessed 6/11/25)

164 Montréal–Trudeau International Airport, Toronto Pearson International Airport and Vancouver International Airport sign with Airbus and ZeroAvia for hydrogen hubs at Canadian airports | Airbus (Accessed 6/11/25)

165 Overcoming hurdles in the Canadian green hydrogen industry: More than hot air – Part 2 | Miller Thomson (Accessed 6/11/25)

Financial subsidies / funding models established to support the hydrogen value chain and supply chain	Hydrogen Innovation Fund (2022): Initial $15 million (doubled to $30M in 2023–2025) to support pilot and demonstration projects, including electrolyzer installations, blending pilots, and refueling infrastructure.[166]
Regulatory frameworks encouraging hydrogen development	No applicable regulatory frameworks identified
Initiatives supporting permitting and regulatory approval processes	• The Ontario Energy Board is actively reviewing rules and approving pilot hydrogen blending in distribution pipelines, including safety, rate treatment, and leave-to-construct applications.[167] • Bill 46 ("Less Red Tape, Stronger Ontario Act, 2023") amended the OGSRA effective March 22, 2023, by removing the prohibition on carbon storage and enabling "special project" permits—paving the way for blue hydrogen with CCS.[168] • Proposed amendments to the Ontario Energy Board Act (2024) include expanded leave-to-construct exemptions to streamline approvals for pipeline relocation, reconstruction, and future hydrogen infrastructure[169]. • The Technical Standards and Safety Authority (TSSA) is strengthening its hydrogen safety framework to support Ontario's low-carbon hydrogen economy[170]
Infrastructure and value chain integration	

Designation of hydrogen hubs, corridors, or other co-location initiatives	• These hubs aim to connect supply, infrastructure, and users to form early-stage self-sustaining hydrogen economies.
	  ○ Niagara Region: Site of Atura Power's 20 MW electrolyzer pilot; serves as a showcase for green hydrogen using surplus hydroelectricity.
	  ○ Sarnia-Lambton: Proposed as a major hub for blue and green hydrogen, leveraging existing refineries, pipelines, and petrochemical facilities.
	  ○ Bruce Nuclear Region: Undergoing feasibility study for a large electrolyzer co-located with Bruce Power, leveraging surplus nuclear power and grid access.
	  ○ Greater Toronto–Hamilton Corridor: Identified as a future demand center for transportation hydrogen (freight corridor along Highway 401), refueling stations, and industrial use.

Regional infrastructure planning initiatives or mechanisms	• Ontario is leveraging hydrogen to meet the province's growing electricity needs and strengthen Ontario's long-term energy security to reduce reliance on energy providers from outside the province. Two initiatives have been developed to support the development of required infrastructure in coordination with other utilities:[171] ○ Creating a New Hydrogen Interruptible Rate Pilot (H2 IRP): The government will direct the Independent Electricity System Operator

[166] Ontario Investing in Hydrogen to Fuel Province's Growing Economy | Ontario Newsroom (Accessed 6/11/25)

[167] Ontario Energy Board Approves Hydrogen Blending Pilot Project (Accessed 6/11/25)

[168] Proposed amendments to the Oil, Gas and Salt Resources Act, to remove the prohibition on carbon sequestration | Environmental Registry of Ontario (Accessed 6/11/25)

[169] Proposed amendment to regulations under the Ontario Energy Board Act, 1998 to further streamline approvals for pipeline relocations or reconstructions to build infrastructure projects faster. | Environmental Registry of Ontario (Accessed 6/11/25)

[170] TSSA Strengthens Hydrogen Safety Framework to Support Ontario's Low-Carbon Hydrogen Economy (Accessed 6/11/25)

[171] Ontario Leveraging Hydrogen to Power Jobs, Growth and Energy Security - Laurie Scott, MPP (Accessed 6/11/25)

	(IESO) to provide recommendations for a pilot program that would offer hydrogen producers discounted electricity rates in exchange for reducing consumption during peak demand periods. o Exploring Options to Regulate Hydrogen Pipelines: The province is evaluating the expansion of the Ontario Energy Board's (OEB) mandate to regulate dedicated hydrogen pipelines to protect consumers, while facilitating more development of this new hydrogen infrastructure.
Innovative business models enabling development	• Public-private partnerships (PPP): Atura Power (OPG subsidiary) collaborates with private developers and municipalities to fund hydrogen pilots. • Utility-led innovation: Enbridge Gas is spearheading hydrogen blending in gas networks, using a regulated utility model to pass innovation costs through rate bases. • Municipal co-investment: Cities like Mississauga are piloting hydrogen transit with potential provincial and federal funding matches. Mississauga transit hydrogen bus pilot (MiWay): A municipal-level early adopter use case for hydrogen in public transport, co-funded by provincial and federal programs. • Stacked incentives and grants: Provincial grants and incentives typically have the ability to be stacked with federal programs, increasing the overall support available.
Infrastructure re-tooling to support hydrogen	• Gas pipeline repurposing: Ontario is assessing existing natural gas pipelines (Enbridge network) for conversion to 100% hydrogen or blend service. • Salt cavern storage retrofits: Near Sarnia, former natural gas or NGL storage caverns are being assessed for hydrogen storage viability by Linde and Plains Midstream.
Supply chain strategy	
Supply chain targets	• Ontario does not publish explicit numeric hydrogen supply chain targets, but its strategy includes clear supply chain development goals, including: o Becoming a leading supplier of hydrogen technologies and systems (e.g., electrolyzers, fuel cells, components). o Achieving 4 GW of electrolyzer deployment by 2030, with a growing share manufactured or assembled in-province. o Localizing production of hydrogen-ready equipment to support the steel, transit, and power sectors. o Encouraging Ontario-based firms to integrate into global hydrogen value chains, especially in clean transportation, mining, and equipment manufacturing.
Manufacturing strategies or supply chain assessments	• Ontario leverages its existing clean tech and automotive supply chains to support hydrogen component manufacturing. • The province is promoting battery and EV ecosystem linkages to fuel cells and hydrogen storage components. • Hydrogenics (Cummins, Mississauga): A key manufacturer of PEM electrolyzers and fuel cells for both domestic and export markets. • Ontario's hydrogen strategy includes a 2025–2030 action item to assess domestic manufacturing capacity and identify gaps in the supply chain.

Critical hydrogen supply chain components	• Electrolyzer stacks and balance of plant (Cummins/Hydrogenics is a current producer). • Fuel cell systems and storage tanks for buses, trucks, and stationary use. • Pipelines, valves, and regulators adapted for hydrogen blending or transmission. • Smart metering and sensing technologies to monitor hydrogen quality and safety in gas networks. • Hydrogen storage solutions, especially underground salt caverns and high-pressure systems.
Supply chain risk mitigation strategies deployed	• Supporting domestic manufacturing of electrolyzers and hydrogen components to reduce dependency on foreign suppliers. • Linking hydrogen development to Ontario's clean electricity surplus ensures feedstock cost stability and grid utilization.
Hub and spoke manufacturing ecosystems	Mississauga (Hydrogenics/Cummins): Core manufacturing hub for PEM electrolyzers and fuel cells; exports globally and supplies domestic pilots.
Workforce development	
Hydrogen skills or workforce market assessments	Ontario has not published a hydrogen focused skills or workforce assessment. However, a national view has been developed by the Transition Accelerator with a "Hydrogen Workforce Assessment Tool".[172]
Initiatives to support workforce development	• Ontario's Low-Carbon Hydrogen Strategy (2022) indicates support via Skills Development Fund and pre-apprenticeship programs targeting advanced manufacturing—including steel and clean-tech sectors. • Municipal pilot projects (e.g. MiWay's hydrogen bus rollout) include staff training programs for hydrogen refueling, fuel cell diagnostics, and driver protocols. • Lambton College received recognition for delivering hydrogen micro-credential training; Ontario Tech hosts hydrogen workshops involving students.
Educational partnerships and certification development	A dedicated hub at Ontario Tech's ACE Core facility supporting R&D, prototype testing, and production of hydrogen technologies (fuel cells, mobility systems) in collaboration with industry.
Community engagement	
Education and outreach programs	• Markham hydrogen blending pilot (Enbridge): Includes community education campaigns, fact sheets, public tours, and local media engagement to explain hydrogen safety and benefits in residential heating. • Hydrogen Strategy public engagement (2020–2022): The development of Ontario's Low-Carbon Hydrogen Strategy included a discussion paper and consultation process with municipalities, Indigenous communities, utilities, and the public. • Niagara Hydrogen Centre: Designed to serve as both a demonstration project and a public education platform for green hydrogen and electricity storage. • Transit demonstrations (e.g. MiWay hydrogen buses): Include public signage, community info sessions, and driver/rider education on hydrogen's environmental benefits.

172 Assessing the Workforce Required to Advance Canada's Hydrogen Economy - The Transition Accelerator (Accessed 6/11/25)

	• College and university partnerships (e.g. Lambton, Centennial) have held public webinars and industry-day events showcasing hydrogen career paths and safety technologies.
Community benefit or local hiring initiatives	Hydrogen Innovation Fund includes optional criteria for projects to demonstrate regional economic benefits and local employment impacts.
Indigenous engagement practices and participation structures	Ontario’s strategy commits to working with Indigenous communities as partners in hydrogen development, particularly in Northern Ontario, where hydrogen could support remote energy resilience and mining decarbonization.

8.7.3 California

Jurisdiction General overview	
National or sub-national jurisdiction	Sub-national
Population	39,500,000 (2025)[173]
Gross domestic product	USD 4.1 trillion (2024)[174]
Climate targets	• Legally binding 40% GHG reduction below 1990 levels by 2030 (SB 32) • Net-zero by 2045, with 85% emissions reduction and 15% carbon removal (per 2022 Scoping Plan)[175] • 100% clean electricity by 2045, 94% reduction in oil use, and smog-forming air pollution cut by ~70% • 100% zero-emission new passenger vehicle sales by 2035[176] • California currently mandates that drivers use at least a particular type of gasoline known as California Reformulated Gasoline (CaRFG), which is designed to lower vehicle emissions. To comply with state environmental standards, refineries in California manufacture fuels with reduced pollutants. Due to strong demand for these cleaner fuels and the absence of interstate pipelines capable of transporting them into California, the state's refineries frequently run at or close to full capacity.

Hydrogen ecosystem	
Hydrogen strategy or roadmap	California does not have a standalone hydrogen strategy document but integrates hydrogen into its broader climate, energy, and transportation planning. The 2022 Carbon Neutrality Scoping Plan identifies hydrogen as a pillar of decarbonization.[175] The ARCHES (Alliance for Renewable Clean Hydrogen Energy Systems) initiative, a public-private partnership, is coordinating hydrogen activities and received $1.2 billion in federal funding as a designated hydrogen hub. A dedicated Hydrogen Market Development Strategy is currently in preparation.[177]
Goals and objectives	Key objectives include decarbonizing heavy-duty transport, enabling long-duration energy storage, displacing grey hydrogen in refining and industry, and positioning California as a global leader in hydrogen technology and innovation. Specific goals include 1,000 hydrogen refueling stations by 2030, 5 million metric tons of CO_2e reduction via hydrogen by 2030, and significant contributions toward the 2045 carbon neutrality target.
Key milestones and timelines	• California has joined H_2USA, a public-private partnership led by the U.S. Department of Energy, dedicated to accelerating the commercialization of clean transportation solutions, primarily fuel cell electric vehicles (FCEVs) and a fueling infrastructure that will make these vehicles more accessible and affordable.[176] • Short term (2020–2025): Pilot projects for hydrogen trucks and buses, 200+ fueling stations planned by 2025, multiple electrolyzer projects underway, ARCHES hydrogen hub launched.[178]

173 Counties (accessed 5/14/25)
174 California overtakes Japan as fourth largest global economy (accessed 5/14/25)
175 2022 Scoping Plan Documents | California Air Resources Board (accessed 5/14/25)
176 California moves to accelerate to 100% new zero-emission vehicle sales by 2035 | California Air Resources Board (accessed 5/14/25)
177 California wins up to $1.2 billion from feds for hydrogen - Arches H2 (accessed 5/14/25)
178 California's 2017 Climate Change Scoping Plan (accessed 5/14/25)

	• Mid-term (2025–2035): Commercial deployment of hydrogen trucks, fuel cell rail and port applications, 1,000 MW of electrolysis, significant hydrogen penetration into industry and power sectors. • Long-term (2035–2050): Fully scaled hydrogen economy supporting zero-emission transport, green industrial use, and seasonal power storage. Up to 6 million metric tons of hydrogen used annually by 2045.
Existing hydrogen operations	• California currently has 50 available retail hydrogen fueling stations and 100+ in development • California leads U.S. deployment of fuel cell vehicles, buses, and trucks with examples such as San Mateo County making the largest purchase of hydrogen powered buses valued at 168.25M[179] • Demonstration-scale production is operational, with several 10 MW-class electrolyzer projects in development. Hydrogen blending into gas grids (up to 5%) is underway.[180] • Verdagy, a leading green hydrogen electrolysis company developed in partnership from the Department of Energy, a 100,000 sq-ft manufacturing facility in Newark that leverages advanced manufacturing automation, low-cost, high-reliability stack design, and domestic nickel alloy integration to achieve gigawatt-scale capacity at one-fifth the cost of competitors, enabling rapid, cost-effective scaling and agile roadmap adjustments. • Fuel cell ferry pilot (Sea Change): One of the world's first hydrogen-powered ferries launched in the Bay Area, demonstrating hydrogen in maritime use.[181] • Hydrogen blending pilots: Real-world testing of hydrogen mixed into residential gas lines (e.g. 44 pilot partnerships to address knowledge gaps) underway.[182]
Hydrogen projects announced or in development	• ARCHES hydrogen hub – Awarded $1.2B in U.S. federal funding (out of the 7 billion bipartisan fund for clean hydrogen hubs); will support multiple production, distribution, and end-use projects across California[177] • SoCalGas Angeles Link – Proposed large-scale green hydrogen pipeline to serve the Los Angeles Basin[183] • Lancaster green hydrogen plant – 10 MW power-to-gas facility under construction (operational ~2024)[184] • Port of Long Beach hydrogen corridor – Conceptual cluster linking production, fueling stations, and port operations to become the first zero-emission port in the world[185] • ACES Delta hub, a large-scale renewable energy hub developed by Mitsubishi Power and Magnum Development designed to generate, store, and distribute green hydrogen throughout the Western United States.[186]

[179] California public transport company places North America's largest ever hydrogen bus order | Hydrogen Insight (accessed 5/15/2025)

[180] SoCalGas, SDG&E outline plan for hydrogen blending demonstration projects in California | Utility Dive (accessed 5/15/2025)

[181] Sea Change Hydrogen Ferry Demonstration Project - San Francisco Bay Ferry (accessed 5/16/2025)

[182] Utilities are trying hydrogen-blended fuels. There are a lot of 'unknowns.' (accessed 5/16/2025)

[183] Angeles Link | SoCalGas (accessed 5/15/25)

[184] World's Largest Green Hydrogen Project to Launch in California — SGH2 Energy (accessed 5/15/25)

[185] Renewable Energy Project Powers Port with Hydrogen - Port of Long Beach (accessed 5/15/2025)

[186] Mitsubishi Power delivers Hydrogen-Ready Gas Turbines to "IPP Renewed" Project | Mitsubishi Power Americas, Inc. (accessed 5/15/25)

	• Elk Hills Blue Hydrogen plant in Kern County funded by California Resources Corp., expecting to double their carbon sequestration to store 200 million metric tons of CO_2 underground at a cost of $2.5B[187] • Numerous smaller electrolyzer deployments, fueling station expansions, and heavy-duty vehicle pilots funded by the California Energy Commission (CEC)
Challenges being faced in meeting ecosystem goals	• Cost competitiveness – Green hydrogen production costs remain high relative to fossil fuels; incentives like the LCFS and federal 45V credit are essential but may not fully close the gap[188] • Infrastructure gaps – Hydrogen fueling infrastructure is still concentrated in urban areas; rural, freight, and industrial zones remain underdeveloped[189] • Permitting and regulatory uncertainty – Long timelines for siting, environmental review, and interconnection slow project deployment • Public acceptance and safety concerns – Local opposition has delayed some fueling stations and blending pilots; safety education and engagement are ongoing priorities[190] • Workforce readiness – Rapid scaling requires retraining of fossil fuel workers and expansion of hydrogen technician programs to avoid labor shortages
Policy and regulation	
Financial subsidies / funding models established to support the hydrogen value chain and supply chain	• Clean Transportation Program: Over $200 million allocated by the California Energy Commission to support hydrogen fueling station deployment.[191] • Federal 45V alignment: California plans to stack state-level incentives with the new U.S. Clean Hydrogen Production Tax Credit to enhance project economics.[192] • Vehicle and fleet programs: Transit, freight, and port fleets receive funding for zero-emission hydrogen vehicle deployment.[193] • Production and infrastructure grants: Additional CEC and state-level grants support electrolyzer deployment and local manufacturing facilities.[194]
Regulatory frameworks encouraging hydrogen development	• Low Carbon Fuel Standard (LCFS): Provides tradable credits to hydrogen producers and station operators based on carbon intensity, creating a performance-based revenue stream.[195] • ZEV mandates: Fuel cell electric vehicles qualify under California's zero-emission vehicle regulations, incentivizing automakers.[196] • Transit regulations: Public transit agencies are required to transition to 100% zero-emission fleets, including fuel cell buses.[197]

[187] CRC Is Getting Into Hydrogen - Los Angeles Business Journal (accessed 5/15/2025)
[188] DOE Sets Eyes on Cutting Clean Hydrogen Cost, $1/Kilo by 2031 (accessed 5/15/2025)
[189] Logistical woes and high pump prices stall California H2 market development | S&P Global (accessed 5/15/2025)
[190] CPUC Issues Independent Study on Injecting Hydrogen Into Natural Gas Systems (accessed 5/15/2025)
[191] CEC Clean Transportation Program (accessed 5/15/2025)
[192] Final Section 45V Regulations (accessed 5/15/2025)
[193] AFDC Alternative Fuel and Vehicle Incentives (accessed 5/15/2025)
[194] CEC Clean Hydrogen Program(accessed 5/15/2025)
[195] CARB LCFS Program (accessed 5/15/2025)
[196] Zero-Emission Vehicle Program | California Air Resources Board (accessed 5/15/2025)
[197] Alternative Fuels Data Center: Zero-Emission Transit Bus Requirement (accessed 5/15/2025)

	• Code and standards updates: Hydrogen refueling infrastructure and appliances are supported through updates to building and plumbing codes.[198] • Hydrogen blending regulations: CPUC pilot programs allow hydrogen blending (5–15%) into natural gas pipelines with ongoing safety evaluations.[190] • Future Renewable Hydrogen Standard: California is developing a standard for qualifying green hydrogen, similar to the Renewable Portfolio Standard for electricity.[192]
Initiatives supporting permitting and regulatory approval processes	• NFPA 2 adoption: Federal hydrogen safety code integrated to guide local authorities and project developers.[198] • First responder training: State fire marshal and technical agencies support H_2-specific training for permitting of facilities and safety systems.[198] • ARCHES coordination: The hydrogen hub initiative includes a regulatory workstream to align permitting agencies and reduce delays.[199] • Ongoing challenges: Despite improvements, permitting remains decentralized and time-consuming, especially for multi-jurisdictional infrastructure projects.[200] • Micro-CHP pilots: Building code updates now allow residential-scale hydrogen fuel cell heat and power units.[201]
Infrastructure and value chain integration	
Designation of hydrogen hubs, corridors, or other co-location initiatives	• ARCHES hydrogen hub: Designated by the U.S. DOE with $1.2B in federal funding; coordinates production, fueling, and end-use projects statewide.[199] • Hydrogen Highway initiative: Legacy program laying the foundation for a connected refueling network from San Diego to the Bay Area.[202] • Port of Long Beach hydrogen corridor (concept stage): Plans for integrated hydrogen fueling, production, and usage in port operations.[185] • Freight corridor planning: Hydrogen fueling stations are being located along major trucking routes like I-5 to enable regional and long-haul hydrogen transport.[202]
Regional infrastructure planning initiatives or mechanisms	• CEC funding programs: Prioritize station development in underserved regions (e.g., Central Valley, Inland Empire) to improve geographic coverage.[191] • Hydrogen blending pilots: SoCalGas and others are exploring 5–20% hydrogen blending in regional natural gas networks.[180] • Transmission Pipeline feasibility studies: Planning underway for backbone hydrogen pipelines linking inland production to urban demand centers (e.g., Kern County to LA Basin).[203] • Power-to-gas integration: Pilot projects are co-locating electrolysis with solar and wind assets to absorb excess renewable generation.[204] • Vehicle-to-grid fuel cells: Pilot in Los Angeles demonstrated fuel cell buses, trucks, or other EVs feeding electricity back to the grid during outages.[205]

198 Microsoft PowerPoint - SoCal FPO Presentation. (accessed 5/15/2025)
199 About - Arches H2 (accessed 5/15/2025)
200 Hydrogen Fuel Stations in California:: A Practical Guide To Permitting and CEQA Review (accessed 5/15/2025)
201 The Role of Hydrogen in the U.S. Zero-Emission (accessed 12/8/2025)
202 The Role of Hydrogen in the U.S. Zero-Emission (accessed 12/8/2025)
203 PG&E launch feasibility study on hydrogen within gas pipelines | Technology | H2 View (accessed 5/16/2025)
204 Renewable, clean hydrogen power is coming to California. Here's what you need to know. | University of California (accessed 5/16/2025)
205 CES2G | Los Angeles Department of Water and Power (accessed 5/16/2025)

	• ARCHES consortium model: Brings together utilities, transit agencies, manufacturers, universities, and community groups to co-develop projects.[206] • Regional clusters: Port, freight, and renewable energy regions are evolving into integrated innovation zones for hydrogen pilots and demonstrations.
Innovative business models enabling development	• Performance-based station incentives: Funding tied to hydrogen throughput encourages station operators to grow customer bases.[191] • Hydrogen fuel purchasing cooperatives: Transit agencies collaborate to secure bulk H_2 pricing and reduce procurement risk.[207] • Station commissioning innovation: HyStEP (Hydrogen Station Equipment Performance device) streamlines testing and speeds up approvals.[208] • Public-private partnership governance: ARCHES includes community organizations, utilities, and manufacturers in project planning to balance interests and reduce friction.[199] • Transit agency cooperatives: Hydrogen fuel purchasing consortia allow smaller agencies to benefit from economies of scale.[209]
Infrastructure re-tooling to support hydrogen	• Gas grid transition: Feasibility studies underway to convert sections of California's gas infrastructure to distribute hydrogen.[203] • Electrolyzer co-location: Renewable-rich zones (e.g., Mojave, Inland Empire) being targeted for new electrolyzer and production facility development.[204] • Port and freight retrofits: Hydrogen yard equipment and fueling stations being added to existing port and logistics infrastructure.[185] • Workforce integration: Infrastructure projects include training partnerships to re-skill utility and industrial workers for hydrogen system operations.[210]
Supply chain strategy	
Supply chain targets	• Hydrogen station deployment: 200 stations by 2025, 1,000 by 2030 (California Fuel Cell Partnership target).[211] • Electrolyzer and fuel cell capacity: in 2024, the Hydrogen Fuel Cell Technology office selected 52 projects across 24 states, California receiving 3 of these projects to advance electrolysis and fuel cell technologies to enable 10 GW/year and 14 CW/year of electrolyzer and fuel cell capacity respectively.[212]
Manufacturing strategies or supply chain assessments	In-state manufacturing preference: State and federal procurement rules encourage California-sourced components for buses, trucks, and stations.[213]
Critical hydrogen supply chain components	• Electrolyzers and compressors: Identified as bottlenecks; programs in place to localize production and reduce lead times.[214]

[206] Arches H2 (accessed 5/16/2025)

[207] CTE to Lead 1,000-Bus Initiative as DOE Signs $12.6 Billion Agreement for California's Regional Clean Hydrogen Hub Project (accessed 12/8/2025)

[208] HYSTEP DEVICE - HYDROGEN STATION EQUIPMENT PERFORMANCE (accessed 12/8/2025)

[209] LCTI: Zero-Emission Hydrogen Ferry Demonstration Project | California Air Resources Board (accessed 5/16/2025)

[210] Kern Energy's Hydrogen Initiative with Claire Tech & HyAxiom (accessed 5/16/2025)

[211] Hydrogen Readiness - California Governor's Office of Business and Economic Development (accessed 5/16/2025)

[212] Progress in Hydrogen and Fuel Cells (Accessed 5/15/25)

[213] State of California -- Procurement Division (accessed 5/16/2025)

[214] Research Project Helps Make Hydrogen and Electrolyzer Production More Affordable | SoCalGas (accessed 5/16/2025)

	• Fuel cell vehicle components: California supports in-state production of FCEV drivetrains, tanks, and control systems.[215] • Biogenic feedstocks: Agricultural waste and landfill gas are being developed as renewable hydrogen feedstock sources.[216]
Supply chain risk mitigation strategies deployed	• Buy Clean California Act: Limits embodied carbon in materials for state-funded projects, indirectly supporting local low-carbon supply chains.[217] • Diverse production pathways: Encouraging multiple hydrogen sources (electrolysis, biomass, blending) to reduce dependency on a single input.[218]
Hub and spoke manufacturing ecosystems	No hydrogen and hub and spoke model identified for California
Workforce development	
Hydrogen skills or workforce market assessments	• California Workforce Development Board has identified clean hydrogen as a growth sector and included it in its broader clean energy job planning.[219] • Hydrogen technician roles are emerging in fueling infrastructure, electrolyzer operations, and vehicle maintenance.[220] • Oil & gas skill transferability: Over 90% of skills from fossil fuel sectors are considered transferable to hydrogen-related work.[221] • High-demand roles: Include pipeline technicians, pressure system specialists, fuel cell mechanics, and control system engineers.[222] • Labor shortages: Early-stage projects have faced difficulties hiring technicians with hydrogen-specific experience. • Credentialing needs: A gap exists in standardized certification pathways for hydrogen safety and operations.[223]
Initiatives to support workforce development	• "High Road Training Partnerships" provide union-supported pathways into hydrogen-related trades.[224] • Hydrogen workforce panel in ARCHES coordinates training efforts across community colleges, industry, and labor groups.[225] • H2EDGE initiative: Cal State LA and SoCal Gas joined forces to create training and development opportunities for upcoming graduates and working professionals interested in the hydrogen industry in California.[226] • Refinery retraining programs: Initiatives in Torrance and Bakersfield are helping fossil fuel workers transition to hydrogen system work.[210]

215 Resources | Hydrogen Fuel Cell Partnership (accessed 5/16/2025)

216 RNG in California Update August 2023 LCFS Thru End of 2022 (accessed 5/16/2025)

217 Buy Clean California Act (accessed 5/16/2025)

218 Green Hydrogen Proposals Across California (accessed 5/16/2025)

219 CPUC and State Workforce Development Board Sign Agreement to Advance Shared Prosperity As California Transitions to Zero-Emissions Energy and Transportation Systems (accessed 5/16/2025)

220 Automotive Training Hydrogen Fuel Cell Cars 101 (accessed 12/8/2025)

221 In a Clean Energy Future, What Happens to California's Thousands of Oil Refinery Workers? | World Resources Institute (accessed 5/16/2025)

222 TA_H2-Workforce-Requirements-Assessment-Tool_FINAL-1.pdf (accessed 5/16/2025)

223 naseo_emerging-clean-hydrogen-workforce_final.pdf (accessed 5/16/2025)

224 High Road Training Partnerships | CWDB (accessed 5/16/2025)

225 Workforce Development - Arches H2 (accessed 5/16/2025)

226 Cal State LA and SoCalGas to help develop the emerging hydrogen industry workforce | Cal State LA Newsroom (accessed 5/16/2025)

	• Hydrogen technician training programs: First-in-nation community college programs (e.g., Rio Hondo College) support technical workforce for hydrogen systems.[227]
Educational partnerships and certification development	• Community colleges: Institutions like Los Angeles Trade Tech and Rio Hondo College now offer hydrogen technician and vehicle maintenance programs.[228] • University programs: UC Irvine's National Fuel Cell Research Center and UC Davis's Hydrogen Center provide training and R&D integration.[229] • Apprenticeship integration: emerging apprenticeship programs from California Community Colleges can support state funded hydrogen projects[230] • Equity focus: State grants prioritize programs that include underrepresented and disadvantaged community members in the clean hydrogen workforce.[231]
Community engagement	
Education and outreach programs	• Public education campaigns: Local authorities and fire departments hold community sessions to explain hydrogen safety, benefits, and deployment.[232] • Corporate Community Engagement: SunLine Transit educate the youth on clean energy innovation through their annual Student Art Contest and youth sustainability committee.[233] • Multilingual outreach: Information about hydrogen projects is shared in multiple languages to reach diverse communities.[234]
Community benefit or local hiring initiatives	• Community Benefits Agreements (CBAs): Projects such as those in Stockton include job training, local hiring, and emissions monitoring commitments.[235] • Local workforce plans: Grant-funded hydrogen stations must demonstrate strategies for employing local residents and apprentices.[236] • Clean mobility access: Hydrogen bus routes are designed to serve disadvantaged and transit-dependent neighborhoods.[237] • Equity-based project scoring: ARCHES funding criteria include workforce diversity and community benefits as a condition for hydrogen project selection.[238]
Indigenous engagement practices and participation structures	• Equity-focused funding criteria: ARCHES hydrogen hub scoring includes Indigenous and community representation as part of proposal evaluations.[231] • Tribal consultation practices: While limited in hydrogen to date, California's energy planning framework requires consultation with Indigenous groups for major energy projects, including hydrogen.[239] • Environmental justice integration: Projects sited in disadvantaged communities must meet strict emissions and safety requirements.[218]

[227] Electric Vehicle And Fuel Cell Technology Technician COA - Guided Pathways (accessed 5/16/2025)
[228] Alternative Fuels and Electric Fuel Cell Vehicles - Río Hondo College (accessed 5/16/2025)
[229] National Fuel Cell Research Center (NFCRC), UC Irvine (accessed 5/16/2025)
[230] Turnkey Apprenticeships (accessed 5/16/2025)
[231] ARCHES_CB_PROPOSAL_for-release.pdf (accessed 5/16/2025)
[232] J Scan Links.xlsx (accessed 5/16/2025)
[233] Student Art Contest | SunLine Transit Agency (accessed 5/16/2025)
[234] Multicultural Engagement Program | Mountain View, CA (accessed 5/16/2025)
[235] BayoTech Hydrogen Hub (accessed 12/8/2025)
[236] Workforce Training and Development (accessed 5/16/2025)
[237] ATN Zero Emission Bus Pilot Project_FInal.pdf (accessed 5/16/2025)
[238] ARCHES-PMO-RFP.pdf (accessed 5/16/2025)
[239] Tribal Program | California Energy Commission (accessed 5/16/2025)

	• Community-based organization partnerships: ARCHES includes environmental justice and community groups as formal stakeholders.[231] • Safety and awareness initiatives: Operators of blending and fueling pilots conduct community open houses before deployment.[180] • Public transparency: Tools and dashboards from agencies like CARB and the CEC ensure public access to hydrogen project data and progress.[240]

[240] Data Exploration Tools (accessed 5/16/2025)

8.7.4 Texas

Jurisdiction General overview	
National or sub-national jurisdiction	Sub-national
Population	31.3 million (2024 est.)[241]
Gross domestic product	$2.7 trillion USD (≈$3.7 trillion CAD per May 29, 2025 exchange rate).[242][243] Texas is the 2nd-largest US economy.
Climate targets	• Texas Emissions Reduction Plan (TERP): Administered by the Texas Commission on Environmental Quality (TCEQ), TERP provides grants to reduce nitrogen oxide (NO_x) emissions from vehicles and equipment, indirectly contributing to GHG reductions.[244] • Climate Pollution Reduction Grants Priority Action Plan: Texas developed this plan to outline voluntary measures for reducing GHG emissions across sectors like industry, transportation, and electric power. The plan estimates potential reductions of 174 million metric tons (MMT) of greenhouse gas emissions from 2025 through 2030 and 592 MMT from 2025 through 2050.[245]

Hydrogen ecosystem	
Hydrogen strategy or roadmap	Texas does not have a formal hydrogen strategy or roadmap document. However, the following initiatives have taken place to support ecosystem development: • Texas has initiated a comprehensive approach to developing its hydrogen economy through the establishment of the **Texas Hydrogen Production Policy Council**. This council was created by the Texas Legislature in 2023 under House Bill 2847 and is tasked with providing strategic recommendations to bolster the state's leadership in hydrogen production, transportation, and storage. The council's inaugural report, released in December 2024, outlines the state's vision, goals, and proposed actions for advancing hydrogen energy development. The report is introduced with ten findings and recommendations for the industry and policymakers.[246] • The **Texas Hydrogen Production Policy Council** aims to position Texas as a global leader in the hydrogen industry by leveraging its existing energy infrastructure, natural resources, and skilled workforce. The council's report emphasizes the importance of regulatory clarity, safety, environmental protection, and economic opportunity in the development of the hydrogen sector. The council is authorized to operate until January 1, 2030, allowing for ongoing assessment and adaptation of strategies as the industry evolves.[247]
Goals and objectives	• **Regulatory Oversight**: Ensure that existing statutes and rules provide effective safety measures for personnel and communities, protect the environment, and offer clear, consistent, and predictable regulatory requirements for industry participants.[248]

241 U.S. Census Bureau QuickFacts: Texas (accessed 5/29/25)
242 GDP by State | U.S. Bureau of Economic Analysis (BEA) (accessed 5/29/25)
243 USD to CAD Exchange Rate (accessed 5/29/25)
244 Texas Emissions Reduction Plan - Texas Commission on Environmental Quality (accessed 5/29/25)
245 Climate Pollution Reduction Grants Priority Action Plan for the State of Texas (accessed 5/29/25)
246 Texas Hydrogen Production Policy Council Report, Dec. 2024 (accessed 5/29/25)
247 Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)
248 Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)

	• **Economic Opportunity**: Maximize the economic benefits of hydrogen industry development, including job creation, infrastructure investment, and GDP growth.[249] • **Infrastructure Development**: Support the expansion of hydrogen production, transportation, storage infrastructure, and co-developed industries to meet growing demand and facilitate market growth. [250] • **Environmental Stewardship**: Promote clarity around low-carbon hydrogen to reduce greenhouse gas emissions and support environmental sustainability.[251] • **Workforce Development**: Address critical skill gaps and support workforce development initiatives to prepare Texans for employment opportunities in the hydrogen sector. [252]
Key milestones and timelines	No milestones or timelines identified
Existing hydrogen operations	• **Texas hydrogen alliance (industry group):** A Texas-based trade association (501(c)(6)) founded in 2021 to promote hydrogen opportunities across transportation, power, distribution and storage. THA mobilizes industry stakeholders to advocate policy and education[253] • The Gulf Coast hosts ~1,600 miles of pure hydrogen pipelines (the largest H_2 network in the US)[254] supporting major assets including the Houston Ship Channel petrochemical/refinery complex (32 petroleum refineries, 42% of US output).[255] In addition, large underground salt-cavern storage (e.g. Air Liquide's Spindletop facility) provides 120 GWh of hydrogen.[256]
Hydrogen projects announced or in development	• **New supply sources are emerging:** blue hydrogen from SMR+CCS (e.g. Exxon, Chevron projects) and green hydrogen via electrolysis (e.g. Hydrogen City). Future demand includes traditional users (refining, ammonia, methanol, metals) and growing sectors: heavy transportation (fuel-cell trucks and buses), power generation, cement/steel, and export fuels (green ammonia/methanol). For example, federal grants ($70M) will fund up to 5 new H_2 fueling stations across Texas (Dallas-Fort Worth, Houston, San Antonio, Austin) to enable heavy-duty truck deployments.[257] The Texas Hydrogen Production Policy Council forecasts that with scale-up, Texas H_2 demand could reach new markets and jobs (90K–over 180K jobs by 2050).[258] • **ExxonMobil Baytown H_2 / Ammonia Project:** ExxonMobil (with partners including Marubeni and Air Liquide) is developing a world-scale low-carbon H_2 and ammonia complex at Baytown, TX.[259] Final investment decision pending

249 Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)
250 Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)
251 Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)
252 Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)
253 Texas Hydrogen Alliance - Leading the Sustainable Energy Revolution (see above) (accessed 5/29/25)
254 Texas Hydrogen Alliance - Leading the Sustainable Energy Revolution (accessed 5/29/25)
255 Snapshot - Energy is Good for Texas (accessed 5/29/25)
256 Geologic storage critical for hydrogen, but more research needed.pdf (accessed 5/29/25)
257 Federal grant will bring hydrogen truck fueling to Texas | Texas Standard (accessed 5/29/25)
258 Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)
259 Marubeni and ExxonMobil's low-carbon ammonia deal marks major step in unleashing new energy supply (accessed 5/29/25)

	policy support.[260] The facility will produce ~1.0 billion cubic feet/day H_2 (via SMR+CCS) and ~250,000 t/yr NH_3, capturing >98% of process CO_2.[261,262] • **Chevron Gulf Coast H_2 / Bayou Bend CCS:** Chevron New Energies is exploring a phased hydrogen facility in Southeast Texas. The first phase (2029) is a natural gas-reforming plant for trucks, industry and ammonia, paired with the Bayou Bend CCS project (storage for H_2 plant CO_2). Jefferson County granted ten-year tax incentives.[263] • "**Hydrogen City" (Energy Abundance Development Corporation):** Energy Abundance Development Corporation (formerly Green Hydrogen International) intends to build the world's lowest-cost green H_2 hub in south Texas, with a 120km pipeline connecting to the Corpus Christi energy port. Plans call for producing ~280,000 tons/yr of H_2. Salt caverns under the site can provide up to 24,000 tons of storage. Outputs are intended for domestic use and export (e.g., green NH_3).[264,265]
Challenges being faced in meeting ecosystem goals	• Uncertainty in federal US hydrogen policy is affecting final investment decisions, such as the potential repeal of the 45V hydrogen production tax credit and the hydrogen hub funding from the department of energy[266] • Green hydrogen electrolyzers require fresh water. In water-stressed Texas—especially with rising drought and groundwater stress—securing sufficient water adds complexity, cost, and regional contention[267]
Policy and regulation	
Financial subsidies / funding models established to support the hydrogen value chain and supply chain	• **Texas Clean Fleet Grants (TERP**): Through the Texas Emissions Reduction Plan (TERP), TCEQ provides THIVE grants for hydrogen vehicles and refueling equipment. Grants cover repowering or replacing heavy-duty units with FCEVs and installing H_2 fueling infrastructure.[268] Similarly, Light-Duty PEV/H_2 rebates (TERP LDPLIP) offer up to $2,500 for new hydrogen fuel-cell cars.[269] These programs encourage adoption of H_2 fleets and, in the case of THIVE, grantees are selected by their cost-effectiveness in reducing NO_x emissions.[270] • **Gulf Coast Hydrogen Hub (HyVelocity):** ~$1.2B US federal funds towards a regional clean hydrogen hub, using electrolysis and SMR/CCS production methods. [271]
Regulatory frameworks encouraging hydrogen development	• **TxDOT Hydrogen Program (Transp. Code 201.618)**: A 2017 Texas statute enables the Texas Department of Transportation to fund and operate hydrogen vehicles and publicly accessible H_2 fueling stations for demonstration purposes. TxDOT must collect and compare emissions data

260 'Final investment decision on world's largest blue hydrogen project hinges on subsidies from two different governments': Air Liquide \| Hydrogen Insight (accessed 5/29/25)
261 ExxonMobil to utilize Topsoe technology for world's largest low carbon hydrogen facility (accessed 5/29/25)
262 Marubeni & ExxonMobil Low-Carbon Ammonia Deal | ExxonMobil (accessed 5/29/25)
263 Chevron granted county tax break for gas-powered hydrogen plant (accessed 5/29/25)
264 Energy Abundance Unveils Data City, Texas — World's Largest 24/7 Green-Powered Data Center Hub with Future Hydrogen Integration (accessed 12/8/25)
265 Hydrogen City project in Texas appoints ABB | New Civil Engineer (accessed 5/29/25)
266 Republican-led House committee votes to confirm termination of 45V clean hydrogen tax credits | Hydrogen Insight (accessed 6/12/25)
267 Texas water fight shows pushback on 'clean' hydrogen - E&E News by POLITICO (accessed 6/12/25)
268 Grants for Hydrogen Infrastructure, Vehicles, and Equipment - Texas Commission on Environmental Quality - www.tceq.texas.gov (accessed 5/29/25)
269 Grants for Alternative Fuel Vehicles and Conversion Systems - Texas Commission on Environmental Quality - www.tceq.texas.gov (accessed 5/29/25)
270 FY24 THIVE RFGA (accessed 5/29/25)
271 Gulf Coast Hydrogen Hub | Department of Energy (see above) (accessed 5/29/25)

	from H_2 vehicles vs. conventional fuels.[272] Supported the federal funding of 5 hydrogen fueling stations in 2024. • **Regulatory framework (RRC/TCEQ):** Hydrogen falls under existing state safety and environmental laws. The RRC (Railroad Commission) regulates intrastate H_2 pipelines (public utilities commission rules do not apply) and well injections, while TCEQ handles air/water permits. [273] Texas's current framework is deemed "effective" and consistent across industries. [274] H_2 projects largely use existing gas/fuel regulations, such as OSHA's federal-level policies that apply across industries.[275] • **Meeting international hydrogen demand**: Texas policymakers have recognized the large demand for hydrogen in Europe and Asia and are eager to maintain Texas's lead as a low-cost hydrogen supplier. European and Asian countries can be off-takers and equity partners for Texas hydrogen production. Regulation may be developed to promote both green and blue hydrogen, the latter being more demanded in Asia.[276]
Initiatives supporting permitting and regulatory approval processes	• Established under HB 2847 in Dec 2023 by the Texas Legislature to study regulatory gaps and recommend streamlined oversight structures for hydrogen production, transportation, and storage.[277] • EPA approved Texas to administer its own Underground Injection Control (UIC) Class VI permits for geological storage wells (critical for CO_2 sequestration and hydrogen storage. This transfer grants Texas greater flexibility and expedited permitting capacity, essential for scaling carbon-capture-enabled "blue" hydrogen projects.[278] • Houston enjoys a reputation as an easy place to do business, and this was called out by many companies in their willingness to establish significant manufacturing presence.[279]
Infrastructure and value chain integration	
Designation of hydrogen hubs, corridors, or other co-location initiatives	DOE is helping fund a Gulf Coast (HyVelocity) Hub (see above) that will connect production with regional users and export destinations via pipelines. [280] In 2024 DOE also funded a Texas Triangle H_2 corridor: ~$70M to North Central TX Council of Governments for up to 5 new H_2 stations (DFW, Houston, San Antonio, Austin) for freight trucks. This establishes an interstate H_2 corridor linking to California.[281]
Regional infrastructure planning initiatives or mechanisms	Large electrolyzer clusters plan to co-locate at sites with transmission and water access. The >1,000 mi existing H_2 pipelines and ~5 B cubic feet salt storage in TX provide a strong base for expansion. [282]

[272] TRANSPORTATION CODE CHAPTER 201. GENERAL PROVISIONS AND ADMINISTRATION (accessed 5/29/25)
[273] Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)
[274] Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)
[275] Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)
[276] Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)
[277] Texas Hydrogen Production Policy Council Report, Dec. 2024 (accessed 6/12/25)
[278] Long-Awaited Proposal to Give Texas Primacy for Class VI Injection Wells Signed by EPA Administrator (accessed 6/12/25)
[279] CHF-PiP-H2E-Report-Softlaunch-Final.pdf (accessed 6/12/25)
[280] Gulf Coast Hydrogen Hub | Department of Energy (see above) (accessed 5/29/25)
[281] Texas receives $70M grant for hydrogen fuel stations | Trucking Dive (accessed 5/30/25)
[282] Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)

Innovative business models enabling development	Partnerships are common in the hydrogen and CCUS sectors. The Chevron/Total/Equinor Bayou Bend CCS venture could potentially be integrated with the HyVelocity blue hydrogen production hub.[283] Some proposed projects use vertical integration (e.g. ExxonMobil selling NH_3 to Marubeni). [284]
Infrastructure re-tooling to support hydrogen	Existing pipeline and storage assets, which abound in the state, may be considered for H_2.[285] Texas salt domes (e.g. Spindletop) are being engineered to store pure H_2.[286] There is interest in studies to explore blending in natural-gas pipelines (permits allow limited H_2 blending). [287]
Supply chain strategy	
Supply chain targets	Texas aims to capture the H_2 value chain locally, recognizing the economic growth potential. This includes manufacturing electrolyzers and fuel cells, producing catalysts, and fabricating storage/compression equipment. [288]
Manufacturing strategies or supply chain assessments	To assess the City's potential as a hub for hydrogen and hydrogen equipment manufacturing, analysis was conducted through interviews and consultation with 100+ market players as well as study of global, national, and local conditions – including technological and economic factors. Market players surveyed included:[289] ○ Existing businesses with relevance to the supply chain ('suppliers'). ○ Companies that integrate the components for large-scale electrolyzer systems ('integrators'). ○ Public authorities, institutions and other groups who will create supportive conditions ('enablers') US generation of green hydrogen is predicted to exceed 100 Mt/y by 2050, approximately 20% of the global market. The growth of electrolyzer technologies will vary based on advances and demand for future technologies, but the overall market potential for all technologies is massive and manufacturing capacity for both electrolyzers, Balance of Plant (BoP) equipment, and electrolyzer components is currently quite limited.
Critical hydrogen supply chain components	Key components include electrolyzers, hydrogen pipelines, compressors, storage tanks/caverns, and fuel cells. Texas hosts suppliers across the hydrogen supply change, enabling a local supply of advanced H_2 equipment. [290]
Supply chain risk mitigation strategies deployed	
Hub and spoke manufacturing ecosystems	Houston serves as the industrial anchor, focusing on electrolyzer and BoP equipment production, recycling, and assembly. Distributed manufacturing zones—potentially clustered around industrial parks—linked to the core for R&D,

[283] Chevron VP Linking Gulf Coast hydrogen efforts with Bayou Bend CCS 'makes a lot of sense'.pdf (accessed 5/30/25)

[284] Marubeni and ExxonMobil's low-carbon ammonia deal marks major step in unleashing new energy supply (accessed 5/29/25)

[285] The Gulf Coast Hydrogen Ecosystem (accessed 5/30/25)

[286] Geologic storage critical for hydrogen, but more research needed.pdf (accessed 5/29/25)

[287] Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)

[288] Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)

[289] CHF-PiP-H2E-Report-Softlaunch-Final.pdf (accessed 6/12/25)

[290] Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)

	supply chain, and logistics olyzer and BoP equipment production, recycling, and assembly.
Workforce development	
Hydrogen skills or workforce market assessments	The Texas Hydrogen Production Policy Council projects 90,000–180,000 new Texas jobs by 2050 in H_2 production, distribution and related industries.[291] There are opportunities across levels of experience for workforce development, especially for a workforce increasingly interested in climate change solutions.[292]
Initiatives to support workforce development	Texas has a large workforce in the energy industry with transferrable skills to hydrogen production. Continued workforce development efforts between communities, universities, and companies would be pivotal for Texas's continued leadership.[293]
Educational partnerships and certification development	• Texas colleges (e.g., UT Austin, University of Houston) have established programs or are beginning curricula in hydrogen and "hydrogen economy" topics.[294,295] Partnerships with the DOE create certificate programs: e.g., the Gulf Coast Clean Energy workforce program (UH).[296] Many companies offer apprenticeships for H_2-specific instrumentation and operations.[297] • The Texas RRC and PHMSA endorse existing oil/gas training for H_2 pipeline workers with additional module on H_2 hazards.
Community engagement	
Education and outreach programs	Industry groups (Texas Hydrogen Alliance, Greater Houston Partnership) publish reports and host workshops explaining H_2 benefits.[298,299] In 2024, Air Liquide invited state legislators to tour a hydrogen facility (La Porte) to inform policymaking.[300]
Community benefit or local hiring initiatives	Some H_2 projects in Texas pledge local hiring (e.g. workforce provisions in county incentives for Chevron project).[301]
Indigenous engagement practices and participation structures	• There is no discernible effort to engage with the three federally-recognized tribes in Texas (i.e., the Alabama-Coushatta Tribe, the Kickapoo Traditional Tribe, and the Ysleta Del Sur Pueblo) regarding hydrogen project development. • Texas has large minority communities that have important roles in the growing hydrogen economy. Research has also discussed how disadvantaged communities can access high-potential opportunities in the sector.[302]

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[291] Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)

[292] The Gulf Coast Hydrogen Ecosystem (accessed 5/30/25)

[293] Texas Hydrogen Production Policy Council Report, Dec. 2024 (see above) (accessed 5/29/25)

[294] H2@UT – Enabling a hydrogen energy economy. (accessed 5/30/25)

[295] The Hydrogen Economy Micro-Credential Program | University of Houston (accessed 5/30/25)

[296] University of Houston Leads Collaborative Effort to Improve Gulf Coast Area Workforce Development and Community Benefits in the Unfolding Energy Transition - University of Houston (accessed 5/30/25)

[297] Mapping Paths to Prosperity Skills-Driven Workforce Development for Houston's Hydrogen Sector (see above) (accessed 5/30/25)

[298] Texas Hydrogen Alliance - Advocacy (accessed 5/30/25)

[299] Houston Investing in its Future Hydrogen Workforce with New Development Strategy (accessed 5/30/25)

[300] Air Liquide welcomes Department of Energy to La Porte SMR | Air Liquide USA (accessed 5/30/25)

[301] Chevron granted county tax break for gas-powered hydrogen plant (accessed 5/30/25)

[302] Houston Investing in its Future Hydrogen Workforce with New Development Strategy (see above) (accessed 5/30/25)

8.7.5 United Kingdom

Jurisdiction General overview	
National or sub-national jurisdiction	National
Population	68.3 million (2023)[303]
Gross domestic product	£2.85 trillion (2024 estimate)[304] (~C$5.0 trillion equivalent)
Climate targets	• Net-zero GHG emissions by 2050 (legally binding under UK Climate Change Act)[305] • Interim targets o 68% reduction by 2030 (vs. 1990 levels)[306] o 81% reduction by 2035[307] o Current planning aligned with 6th Carbon Budget (2033–2037)[308] • Sector specific targets o Power sector: Fully decarbonize electricity by 2035[309] o Transport: 100% zero-emission car sales by 2030[310] o Hydrogen: 10 GW of low-carbon hydrogen production by 2030 (50% green, 50% blue)[305]

Hydrogen ecosystem	
Hydrogen strategy or roadmap	The UK Hydrogen Strategy, released in August 2021, outlines a comprehensive roadmap for low-carbon hydrogen deployment. The UK follows a "twin-track" approach, supporting both green hydrogen (produced via electrolysis using renewables) and blue hydrogen (from natural gas with carbon capture and storage). The strategy initially targeted 5 GW of low-carbon hydrogen production by 2030, but this was doubled to 10 GW in the 2022 Energy Security Strategy, with at least 50% from electrolytic (green) hydrogen.[311] Implementation mechanisms include a Hydrogen Business Model (a Contracts-for-Difference-style subsidy), the Net Zero Hydrogen Fund (£240 million) for CAPEX support, and cluster-based development via the Industrial Decarbonisation Strategy. Separate strategies exist in devolved nations—Scotland's Hydrogen Policy Statement (2020) targets 5 GW by 2030 and 25 GW by 2045, with a strong export orientation.
Goals and objectives	By 2030, the UK aims to: • Deploy 10 GW of low-carbon hydrogen capacity (split evenly between green and blue hydrogen)[311] • Produce up to 42 TWh/year of hydrogen[312] • Establish five major hydrogen-enabled industrial clusters[313]

303 Population estimates for the UK, England, Wales, Scotland and Northern Ireland - Office for National Statistics (accessed 5/27/25)
304 Gross domestic product (GDP): Economic indicators - House of Commons Library (accessed 5/27/25)
305 Climate change: Is the UK on track to meet its net zero targets? (accessed 5/27/25)
306 UK's 2035 Nationally Determined Contribution (NDC) emissions reduction target under the Paris Agreement - GOV.UK (accessed 5/27/25)
307 UK shows international leadership in tackling climate crisis - GOV.UK (accessed 5/27/25)
308 Carbon Budgets - Hansard - UK Parliament (accessed 5/27/25)
309 Plans unveiled to decarbonise UK power system by 2035 - GOV.UK (accessed 5/27/25)
310 Decarbonisation pathways for UK transport - Anable - 2024 - IPPR Progressive Review - Wiley Online Library (accessed 5/27/25)
311 UK hydrogen strategy - GOV.UK (accessed 5/27/25)
312 Nuclear-Sector-Hydrogen-Roadmap-February-2021.pdf (accessed 5/27/25)
313 UPDATED: UK cluster sequencing could support 10GW of hydrogen capacity | ICIS (accessed 5/27/25)

	• Enable blending of up to 20% hydrogen into the gas grid, subject to safety approval[314] • Scale use of hydrogen in heavy transport, power generation, and industrial fuel switching • By 2050, hydrogen is expected to supply 20–35% of final energy demand, contributing to decarbonization of steel, shipping, aviation (via e-fuels), and heating with major exports going to continental Europe.[312]
Key milestones and timelines	• 2021: UK Hydrogen Strategy published; Net Zero Hydrogen Fund and CfD business model introduced[311] • 2022: Hydrogen target doubled (10 GW); Hydrogen Champion appointed; first industrial clusters (Hynet, East Coast) designated for Track-1 funding[311] • 2023: Contracts for first 350 MW of low-carbon H_2 awarded; Net Zero Hydrogen Fund Phase 2 opened; Scotland launched its £100 million Hydrogen Action Plan[312] • 2024: Pilot-scale projects operational (~5–10 MW green H_2); large projects preparing for FID[312] • 2025: First hydrogen village trial (~2,000 homes) in North East England; major projects expected to reach final investment decisions[315] • 2030: 10 GW of low-carbon hydrogen capacity operational (4,800,000 kg/day); blending into the gas grid to begin if approved[312] • Status: Policy frameworks and pilot projects are in place; full-scale implementation depends on contract awards and investment decisions during 2024–2025.[312]

Existing hydrogen operations	• Hydrogen consumption
	  ○ Hydrogen consumption: ~27 TWh/year, primarily grey hydrogen used in oil refineries (e.g., Pembroke, Grangemouth) and fertilizer production[316]
	• Existing production
	  ○ 5.8 – 11.7 million tonnes/year of green hydrogen, making up only a small fraction of total hydrogen production[317]
	  ○ Small-scale electrolyzers (e.g. 1.5 MW project in Orkney, Scotland)[318]
	• Infrastructure
	  ○ Teesside: 31 km dedicated hydrogen pipeline (BP production site to refineries)[319]
	  ○ Grangemouth: 30km hydrogen pipeline from INEOS refinery to Granton[320]
	• Fueling stations and vehicles

[314] Hydrogen blending in GB distribution networks: strategic decision - GOV.UK (accessed 5/27/25)

[315] Confirmed, an Area of up to 2,000 Properties in Ellesmere Port has Made The Shortlist (of Two) to be The UK First Hydrogen Village - Hydrogen Central (accessed 5/27/25)

[316] Hydrogen-Who-Pays-Onward.pdf (accessed 5/27/25)

[317] Production of Green Hydrogen in the UK - Haush (accessed 5/27/25)

[318] 1.5 MW Electrolyzer Deployment in Scotland | ITM (accessed 5/27/25)

[319] Costain awarded multimillion FEED contract by BP for Teesside hydrogen pipeline | Global Hydrogen Review (accessed 5/27/25)

[320] Hydrogen pipeline trial (accessed 5/27/25)

	○ 16 public hydrogen stations as of December 2023[321], ~300 fuel cell cars and buses as of January 2022[322]
Hydrogen projects announced or in development	• Blue hydrogen: ○ Hynet (Stanlow, NW England): 350 MW plant by ~2026 (1.5 TWh H_2/year)[323] ○ Net Zero Teesside (BP): 1.2 GW blue hydrogen plant (~2027)[324] • Green hydrogen: ○ Whitelee Wind Farm (Scotland): 20 MW electrolyzer (ITM, operational 2023)[325] ○ Gigastack (Humber): 100 MW by 2025 (Ørsted, Phillips 66)[326] ○ Scottish Cluster: Up to 500 MW green energy capacity by 2030[327] • Industrial pilots: ○ British Steel: H_2 trials in blast furnaces[328] ○ Glass Futures (St Helens): H_2 in glass manufacturing[329] • Transport: ○ Wrightbus (N. Ireland): Scaling hydrogen bus production[330] ○ HVPR (Teesside): Building H_2 refueling stations[331] • Storage and pipelines: ○ H2H Saltend (Equinor): Blending H_2 into gas grid by 2027[332] ○ Project Union (National Gas): Repurposing parts of the 5,000 mile National Transmission System and creating new pipes to make a 1,500 mile network of pipelines for H_2 by 2032[333] • International: ○ UK-Netherlands North Sea interconnector study for hydrogen pipeline in 2030s[334] ○ Estimated total announced investment: ~£9 billion, with many projects awaiting FID and CfD contracts[335]
Challenges being faced in meeting ecosystem goals	• Policy/funding gaps: Delays in awarding CfDs and uncertainties over long-term subsidies could hinder investor confidence • Infrastructure coordination: Success of blue hydrogen relies on timely CCS infrastructure; misalignment of timelines risks stalling clusters • Manufacturing capacity: Domestic electrolyzer and fuel cell manufacturing capacity is growing but not yet scaled to meet 2030 targets

321 Uncertain Future: Hydrogen Fuel Stations UK - What's Next? (accessed 5/27/25)
322 Hydrogen Vehicles to 'Evolve in The Future' as Investment Continues Into UK Transport - Express - Hydrogen Central (accessed 5/27/25)
323 HyNet Low Carbon Hydrogen Plant: BEIS Hydrogen Supply Competition (accessed 5/27/25)
324 bp enters final stage of negotiations with UK Government | News | Home (accessed 5/27/25)
325 20MW Electrolyzer with ScottishPower, UK's largest | ITM (accessed 5/27/25)
326 HICP - Gigastack Project one step closer to renewable hydrogen at industrial scale as Phase 2 concludes | HICP (accessed 5/27/25)
327 500MW Scottish hydrogen site gets nod - reNews - Renewable Energy News (accessed 5/27/25)
328 British Steel: Green hydrogen in steel manufacture (accessed 5/27/25)
329 Glass Futures secures daily hydrogen deal (accessed 5/27/25)
330 Wrightbus unveils latest-generation hydrogen bus, powered by Ballard (accessed 5/27/25)
331 UK: Teesside International Airport to Construct Hydrogen Refuelling Station | Airport Industry-News (accessed 5/27/25)
332 H2H Saltend (accessed 5/27/25)
333 Project Union | National Gas (accessed 5/27/25)
334 Offshore power and hydrogen networks for Europe's North Sea - ScienceDirect (accessed 5/27/25)
335 Hydrogen Champion Report: Recommendations to government and industry to accelerate the development of the UK hydrogen economy (accessed 5/27/25)

	• Public acceptance and safety: Hydrogen use in homes (heating) remains controversial; H_2 safety and retrofitting pipelines face scrutiny • Grid competition: Electrification may outcompete hydrogen in sectors like heating if cost and policy
Policy and regulation	
Financial subsidies / funding models established to support the hydrogen value chain and supply chain	• Net Zero Hydrogen Fund (NZHF): £240 million in capital grants for low-carbon hydrogen production projects, with awards beginning in 2023[336] • Hydrogen Business Model (HBM): A Contracts-for-Difference-style (CfD) scheme that provides hydrogen producers a price, topping up market revenue. The first CfD contracts were awarded in 2023 (~350 MW capacity), with further rounds ongoing.[337,338] • Industrial Decarbonisation Challenge / Cluster Sequencing: Capital grants and strategic coordination for H_2 projects in industrial areas, such as Hynet and East Coast Cluster.[339,340] • UK Infrastructure Bank: Offers lending for hydrogen infrastructure, including storage, pipelines, and transport corridors. Invested \$30 million in hydrogen power units and green hydrogen production[341] • Transport Funding: Grants for zero-emission bus programs (e.g., Bus Back Better) provide funding, including for hydrogen buses specifically[342] • Scotland's Green Hydrogen Fund: £90 million fund supporting green hydrogen projects and export development in Scotland[343] • Tax incentives: Accelerated depreciation (capital allowances) available for qualifying hydrogen production and infrastructure equipment[344]
Regulatory frameworks encouraging hydrogen development	• Energy Act 2023: Includes provisions to implement the Hydrogen Business Model and enable net-zero licensing frameworks[345] • Ofgem & Hydrogen Blending: National trials (HyDeploy) showed blending up to 20% H_2 into natural gas networks is safe. The UK government is broadly supportive, and legislation may approve blending or designate hydrogen-only networks[346] • Low Carbon Hydrogen Standard: Defines lifecycle carbon intensity thresholds for hydrogen to be eligible for certain forms of government support. Current benchmark: ≤ 20 gCO_2/MJ[347] • Hydrogen licensing and market rules (under development): OFGEM has been engaging stakeholders to inform future funding and asset valuation for hydrogen generation, transmission, and storage infrastructure[348]

336 Net Zero Hydrogen Fund strands 1 and 2: Round 2 (closed to applications) - GOV.UK (accessed 5/27/25)

337 Hydrogen Business Model and Net Zero Hydrogen Fund: Electrolytic Allocation Round: guidance for applicants (accessed 5/27/25)

338 Vertex Hydrogen's CCUS Project Gains UK Government's Support (accessed 5/27/25)

339 About HyNet - HyNet (accessed 5/27/25)

340 East Coast Cluster - The CCUS Hub (accessed 5/27/25)

341 UK Infrastructure Bank backs UK's green hydrogen expansion with £30 million GeoPura investment | National Wealth Fund (accessed 5/27/25)

342 Bus Back Better (accessed 5/27/25) and UK on track to reach 4,000 zero emission bus pledge with £200 million boost - GOV.UK (accessed 5/27/25)

343 Realising Hydrogen's potential - gov.scot (accessed 5/27/25)

344 Claim capital allowances: 100% first-year allowances - GOV.UK (accessed 5/27/25)

345 Summary of Energy Act 2023 provisions relating to hydrogen (Norton Rose Fulbright) (accessed 5/27/25)

346 UK Government Broadly Supports Blending Hydrogen in Gas Supply – Minister (accessed 12/8/25)

347 UK Low Carbon Hydrogen Standard Greenhouse Gas Emissions Methodology and Conditions of Standard Compliance (accessed 5/27/25)

348 RIIO-3 Sector Specific Methodology Decision – Overview Document (accessed 5/27/25) and Natural Gas asset repurposing valuation methodology (accessed 5/27/25)

	• Planning reform: Large H_2 and CCS projects (e.g., Hynet) designated as Nationally Significant Infrastructure Projects (NSIPs), enabling fast-track planning through development consent orders[349] • Transport regulation: Refueling infrastructure is subject to Health & Safety Executive (HSE) standards[350] • Devolved administration coordination: Scotland aligns its hydrogen development with UK standards through its Hydrogen Policy Statement and associated planning powers[351] • Overall, the UK's regulatory regime is still evolving, with major implementation milestones due by 2025 to support blending, market operation, and hydrogen network regulation[352]
Initiatives supporting permitting and regulatory approval processes	• Cluster Sequencing process: Used for Track-1 clusters (Hynet, East Coast) to prioritize and coordinate permitting, financing, and regulatory support across government departments[353,354] • HSE hydrogen safety guidance: Reviews underway to update the Gas Safety (Management) Regulations and develop new safety protocols for pre-existing gas network appliances and infrastructure[355] • Hydrogen for heating trials: Scottish and UK government supporting H100 Fife, a "first of a kind" demonstration of a 100% hydrogen network[356,357] • Future planning reforms: The British Energy Security Strategy (2022), along with similar policy directives, are accelerating net-zero infrastructure development; formal proposals for hydrogen permitting streamlining are under discussion as part of a wider national planning reform initiative[358]
Infrastructure and value chain integration	
Designation of hydrogen hubs, corridors, or other co-location initiatives	• Hynet (North West England): Anchor cluster for blue hydrogen production (Essar refinery at Stanlow), chemical and manufacturing demand, and CO_2 storage in Liverpool Bay.[359,360,361] • East Coast Cluster (Teesside and Humberside): Major hub integrating low-carbon hydrogen projects, linked to North Sea CO_2 storage and hydrogen pipeline networks[362] • Tees Valley Hydrogen Transport Hub: With over £15 million in government funding, pilot region for cross-modal hydrogen use (buses, trains, airport vehicles) and refueling infrastructure[363]

349 HyNet Carbon Dioxide Pipeline - Project information (accessed 5/27/25)

350 Refuelling infrastructure requirements for renewable hydrogen road fuel through the energy transition (accessed 5/27/25)

351 Chapter 5. Scotland's Natural Resources, Infrastructure and Place - Scottish Government Hydrogen Policy Statement - gov.scot (accessed 5/27/25)

352 Hydrogen Strategy Update to the Market: December 2024 (accessed 5/27/25)

353 The Ten Point Plan for a Green Industrial Revolution (accessed 5/28/25)

354 Cluster sequencing Phase-2: Track-1 project negotiation list, March 2023 - GOV.UK (accessed 5/28/25)

355 Hydrogen Blending into GB Gas Distribution Networks: A Strategic Policy Decision (accessed 5/28/25)

356 H100 Fife Monthly Report July 2021 (accessed 5/28/25)

357 About H100 Fife - SGN (accessed 5/28/25)

358 British energy security strategy - GOV.UK (accessed 5/28/25) and Planning revolution to fuel growth and make Britain energy secure - GOV.UK (accessed 5/28/25)

359 HyNet North West (accessed 5/28/25)

360 HyNet partners Essar UK to build £360 million carbon capture facility - HyNet (accessed 5/28/25)

361 Liverpool Bay Offshore (accessed 5/28/25)

362 East Coast Cluster (accessed 5/28/25)

363 Tees Valley hydrogen transport hub: successful bidders - GOV.UK (accessed 5/28/25)

	• Aberdeen Hydrogen Hub (Scotland): Integrates solar and wind-powered electrolyzers with hydrogen transport (buses, fleet vehicles, potentially other future use cases)[364] • South Wales and Southampton (emerging hubs): Being explored for industrial hydrogen applications and co-location with refining and port infrastructure[365,366] • These hubs follow a "hydrogen economy hotspot" model—concentrating demand and supply to lower costs and build regional expertise.
Regional infrastructure planning initiatives or mechanisms	• Cluster development roadmaps: Carbon capture, usage, and storage clusters (e.g., Hynet, East Coast) have a phased roadmap, reflecting their priority in enabling the UK to make the greatest progress towards its climate goals, and are supported by DBT and DESNZ (formerly BEIS)[367,368] • Project Union (National Gas): Engineering studies underway to convert 2,500 km of existing gas pipelines into a national hydrogen backbone connecting Scotland, NE England, NW England, South Wales, and the Midlands[369]
Innovative business models enabling development	• Contracts for Difference (CfD): The hydrogen business model gives producers a fixed price, reducing revenue risk and enabling long-term bilateral supply contracts[370] • Anchor-user model: Industrial clusters use large early adopters (e.g., Essar refinery, British Steel, bp CHP plants) to catalyse investment.[371] Smaller users benefit from infrastructure that is in place • Offshore wind farms generating green hydrogen: Proposed projects like floating offshore wind farms in the Celtic Sea may produce hydrogen onboard and offload it onshore—an integrated model to absorb surplus wind power[372] • Bundled procurement (H2Bus, H2Freight): Government-facilitated joint purchasing of buses and associated infrastructure by local transport authorities creates more stable demand for vehicle manufacturers and hydrogen suppliers[373] • Joint ventures and alliances: Many JVs (e.g. Vertex Hydrogen and Emerald Green Hydrogen) have formed between OEMs, utilities, and end-users through the support of organizations such as UK Hydrogen to align standards, coordinate permitting, and explore risk pooling[374] • Government leverage of Freeports and enterprise zones: These are used to incentivize hydrogen infrastructure and equipment manufacturing in designated economic areas (e.g., Teesside Freeport, Freeport East)[375,376]

364 Homepage - Aberdeen (accessed 5/28/25)
365 South Wales Industrial Cluster (accessed 5/28/25)
366 Southampton Water project investigates south coast hydrogen superhub | SGN (accessed 5/28/25)
367 Cluster sequencing Phase-2: project shortlist (power CCUS, hydrogen and ICC) - GOV.UK (accessed 5/28/25)
368 Carbon capture, usage and storage (CCUS) supply chains: a roadmap to maximise the UK's potential - GOV.UK (accessed 5/28/25)
369 Project Union | National Gas (accessed 5/28/25)
370 Hydrogen Business Model and Net Zero Hydrogen Fund: Electrolytic Allocation Round: guidance for applicants (see above) (accessed 5/27/25)
371 HyNet Core Infrastructure Gets Green Light from the UK Government; Essar Energy Transition (EET) to Play Anchor Role - Essar (accessed 5/28/25)
372 Celtic Sea Power Wins £887K Grant for Innovative Offshore Hydrogen Venture in Wales (accessed 5/28/25)
373 Apply for zero emission bus funding (ZEBRA 2) - GOV.UK (accessed 5/28/25)
374 Our Members - Hydrogen UK (accessed 5/30/25)
375 Teesside Freeport great.gov.uk international (accessed 5/28/25)
376 Green Hydrogen Hub - Freeport East (accessed 5/28/25)

Infrastructure re-tooling to support hydrogen	• Pipeline conversion: ○ Project Union will repurpose high-pressure natural gas pipelines for hydrogen transport, starting with regional loops (e.g., NW England to Teesside) by 2030377 ○ Distribution networks are undergoing hydrogen compatibility assessments (e.g., National Grid's FutureGrid micro-transmission network)378 • Salt cavern storage retrofits: ○ Sites like Aldbrough (Yorkshire) are being converted for seasonal hydrogen storage (~320 GWh planned)379 • Gas terminal and power plant retrofits ○ St Fergus Terminal, Saltend CHP plant, and others being adapted to hydrogen input380 • Appliance and housing retrofits ○ Pilot neighborhoods (e.g., Winlaton, H100 Fife) are experimenting with hydrogen blending and also undergoing full conversion of domestic boilers and cookers to hydrogen systems, with extensive safety validation[381,382] • Industrial integration ○ Existing SMRs at refineries are being upgraded for CO_2 capture; some blue hydrogen sites (e.g., Hynet) will re-use natural gas reforming infrastructure with CCS [383] • Refueling and transport: ○ Fueling sites and bus depots are being adapted for hydrogen (e.g., Aberdeen depot retrofit), including vehicle maintenance upgrades[384]
Supply chain strategy	
Supply chain targets	• Electrolyzer manufacturing target: At least 10 GW of UK-made electrolyzer capacity by 2030, supported in part by the Net Zero Innovation Portfolio[385] • UK content aspiration: Target of 50% content taking place locally across the hydrogen value chain, consistent with the low carbon energy project goal stated in the North Sea Transition Deal[386] • Energy security alignment: Hydrogen development is aligned with the UK's goal to dramatically reduce reliance on oil and gas imports, supporting domestic energy resilience[387] • Export leadership: The UK aims to become a global exporter of hydrogen-related technology, such as electrolyzers (ITM Power), fuel cells (Ceres Power), and engineering services (Petrofac)[388]

377 Project Union | National Gas (see above) (accessed 5/28/25)

378 FutureGrid | National Gas (accessed 5/28/25)

379 Equinor and SSE Thermal Aldbrough contract awards demonstrate Humber hydrogen ambition — Aldbrough Hydrogen Storage (accessed 5/28/25)

380 Project Union St. Fergus to Teesside Net Zero Pre-construction Work and Small Net Zero Projects Reopener Submission (accessed 5/28/25) and H2H Saltend Kick-starting a Zero Carbon Humber (accessed 5/28/25)

381 UK: Pioneering Hydrogen Blending Pilot to Tackle Climate Changes Ends in Success (accessed 12/8/25)

382 About H100 Fife - SGN (see above) (accessed 5/28/25)

383 About HyNet - HyNet (see above) (accessed 5/27/25)

384 Homepage - Aberdeen (see above) (accessed 5/28/25)

385 Hydrogen Net Zero Investment Roadmap (accessed 5/28/25)

386 FINAL-HUK-Supply-Chain.pdf (accessed 5/30/25)

387 British energy security strategy - GOV.UK (accessed 5/28/25)

388 UK Hydrogen Export Capability Guide (accessed 5/28/25)

	• Defence sector adoption: Armed Forces target operational hydrogen systems (generators, EV fleets), driving niche manufacturing and standards development[389]
Manufacturing strategies or supply chain assessments	• Strengths ○ PEM electrolyzer leadership, with companies such as ITM Power and Oort Energy[390,391] ○ Fuel cell development (e.g., Johnson Matthey, Intelligent Energy)[392,393] ○ Catalyst manufacturing (Johnson Matthey is a global platinum group metals specialist)[394] ○ Good industrial and academic R&D capability ○ Strong domestic policies in support of the hydrogen economy ○ Established supply chains in adjacent energy industries (e.g., gas) with cross-sector applicability to hydrogen ○ Hydrogen project developer network ○ Stable investment location for FDI in renewables[395] • Weaknesses[396] ○ Lower level of capital funding ○ Smaller project sizes ○ Lack of visibility regarding UK capabilities ○ Pre-commercialisation funding gap ○ Over-incentivization of lowest-cost supply chain options • Actions ○ Government supported UK-based gigafactories (e.g., ITM Power's 1 GW/yr Gigafactory in Sheffield)[397] ○ Leveraged Freeport zones (e.g., Teesside Freeport) and additional enterprise incentives to anchor hydrogen tech companies[398] ○ Funded and aggregated research and manufacturing through Catapult Centres (e.g., ORE Catapult's electrolyzer testing arm)[399]
Critical hydrogen supply chain components	• Higher priority items: a strategic assessment of the UK hydrogen supply chain identifies 13 higher priority items across six value chain areas. These are: H_2 compressors, High voltage transformers, Construction, engineering & installation activities, Electrolyzer stack, Power electronics, Reformer package, Air separation unit, CO2 capture package, Hydrogen network pipes, Hydrogen Storage Compressed storage tanks (tube trailer & stationary), Industrial equipment (boilers, kilns etc.), Burners, and Hydrogen gas turbine.[400]

389 Hydrogen and sustainable energy in defence | Public Sector News (accessed 5/30/25)

390 ITM (accessed 5/28/25)

391 Oort Energy (accessed 5/28/25)

392 Fuel cells | Johnson Matthey (accessed 5/28/25)

393 Hydrogen Fuel Cell Manufacturer | Intelligent Energy Limited (accessed 5/28/25)

394 Platinum: a crucial enabler of hydrogen in the energy transition | Johnson Matthey (accessed 5/28/25)

395 UK Hydrogen Supply Chain Strategic Assessment (assessed 5/28/25)

396 UK Hydrogen Supply Chain Strategic Assessment (see above) (assessed 5/28/25)

397 ITM Power moves in 1-GW-per-year electrolyzer plant in Sheffield | Renewable Energy News | Renewables Now (assessed 5/28/25)

398 Teesside Freeport great.gov.uk international (accessed 5/28/25)

399 Offshore Renewable Energy | Innovation Centre | ORE Catapult (accessed 5/28/25)

400 UK Hydrogen Supply Chain Strategic Assessment (see above) (assessed 5/28/25)

Supply chain risk mitigation strategies deployed	• Dual production approach: Supports both blue and green hydrogen to avoid dependence on one technology pathway[401] • Localization of manufacturing: Encouraging domestic production of key components (e.g., PEM stacks, catalysts) to reduce exposure to import disruptions[402] • Critical materials procurement: Includes platinum group metals (PGMs), with sourcing relationships and recycling capabilities: Johnson Matthey is world's largest recycler of PGMs[403] • Gradual scale-up: Starting in clusters to contain risk geographically before national build-out (e.g., "East Coast Cluster") [404] • Ammonia and H_2 storage buffers: Strategic use of ammonia cracking and salt caverns to provide stability to hydrogen supply[405,406]
Hub and spoke manufacturing ecosystems	• Teesside Cluster (North East): Anchored by bp's H_2 plant and associated CO_2 transport projects[407] • Midlands Cluster (Coventry–Birmingham–Derby): Anchored by JCB (H_2 engines), Rolls-Royce (fuel cells), and numerous Tier 2 automotive suppliers pivoting to H_2 components (e.g., compressors, thermal systems)[408,409,410] • Energy Transition Zone (Aberdeen): Combining a strategic harbour location to integrate with offshore renewable energy production, including large-scale green hydrogen production, to be combined with manufacturing and supply chain activities[411] • Liverpool–Manchester Region: Hynet as anchor; [412] firms like Pilkington piloting hydrogen fuel switching;[413] nuclear-derived hydrogen facility being developed in West Cheshire and North Wales[414] • Catapult Centres and testbeds: Offshore Renewable Energy Catapult is serving as central hub for testing, certification, and OEM–SME matchmaking across hydrogen value chain[415] • Freeport zones: Encourage manufacturers to locate in proximity to supply chain partners (e.g., Harwich Freeport's bid to host electrolyzer factory + component makers)[416]
Workforce development	

401 UK hydrogen strategy - GOV.UK (see above) (accessed 5/27/25)
402 UK hydrogen strategy - GOV.UK (see above) (accessed 5/27/25)
403 Resilience for the Future: The United Kingdom's Critical Minerals Strategy (accessed 5/29/25)
404 East Coast Cluster - The CCUS Hub (see above) (accessed 5/27/25)
405 AFC Energy announces First Ever "International– UK" Ammonia Cracking Demonstration - AFC Energy (accessed 5/29/25)
406 Hydrogen Transport and Storage Analytical Annex Analytical Annex to the consultation on hydrogen transport and storage infrastructure (accessed 5/29/25)
407 East Coast Cluster (see above) (accessed 5/27/25)
408 World's First Hydrogen-Powered Digger Set to Drive on UK Roads (accessed 5/29/25)
409 Rolls-Royce Collaborates With Technology Partners on Highly Efficient Hydrogen Engine for Stationary Power Generation (accessed 12/8/25)
410 Midlands Engine Hydrogen Technologies (accessed 12/8/25)
411 Energy Transition Zone (ETZ) Aberdeen: a new hub for the renewable energy sector (accessed 5/29/25)
412 About HyNet - HyNet (accessed 5/27/25)
413 Pilkington UK plans to scale low carbon glass production under pioneering hydrogen plans (accessed 5/29/25)
414 Circular Refining Announces Development of First Ruby Hydrogen Facility in West Cheshire and North Wales (accessed 5/29/25)
415 Offshore Renewable Energy | Innovation Centre | ORE Catapult (see above) (accessed 5/28/25)
416 Freeport East welcomes million-pound funding for international green hydrogen project - Freeport East (accessed 5/29/25)

Hydrogen skills or workforce market assessments	• The UK Hydrogen Strategy (2021) identified hydrogen and CCS as job growth sectors, estimating over 100,000 jobs could be created by 2050 across production, infrastructure, and end-use applications[417]
	• The 2023 ECITB Hydrogen Champion Report projected the sector would support 12,000 jobs by 2030, many transitioning from oil and gas roles[418]
	• The North Sea Transition Deal (2021) included specific provisions for workforce reskilling and new job creation to support hydrogen and CCS deployment in offshore energy regions[419]
	• Skills shortages identified include:[420]
	  o Pipeline welders and mechanical technicians
	  o Chemical and process engineers
	  o High-pressure systems technicians
	  o Hydrogen safety and commissioning professionals
	• Hydrogen was added to the UK's Green Jobs Delivery Group agenda, linking industrial needs with workforce planning[421]

Initiatives to support workforce development	• Hydrogen Skills Academy: Coordinated, cross-sector effort to update vocational curricula to reflect hydrogen sector needs[422] • National Hydrogen Research, Innovation and Skills Centre (Sheffield): The partnership will examine opportunities for job creation across all levels within the hydrogen industry, support ongoing workforce training, and advance the development and adoption of hydrogen both nationally and globally[423] • Hydrogen Technician apprenticeships: Standards developed through the Hydrogen Skills Alliance, rolling out via consulting university and corporations[424] • OPITO conversion programs: Offshore oil workers retrained for hydrogen and CCS roles under the North Sea Transition Deal[425] • Hy4Heat program training modules: Delivered pilot training to gas engineers on hydrogen boilers and appliances[426] • Bus technician training schemes: Delivered in Aberdeen and Liverpool to support H_2 fleet operation and maintenance[427] • University led MSc programs: advanced degrees in hydrogen and low carbon technologies offered at universities such as Brunel University, University of Birmingham, University of Sheffield, Cranfield University, and University of Manchester[428]

417 UK Hydrogen Strategy (see above) (accessed 5/28/25)
418 Hydrogen Champion Report: Recommendations to government and industry to accelerate the development of the UK hydrogen economy (accessed 5/28/25)
419 North Sea Transition Deal (accessible webpage) - GOV.UK (accessed 5/28/25)
420 Hydrogen+Competency+Framework+Report_V7.pdf (accessed 5/28/25)
421 Hydrogen net zero investment roadmap: leading the way to net zero - GOV.UK (see above) (accessed 5/28/25)
422 FE News | Strategic plan Launched to Futureproof UK Hydrogen Workforce and Drive net zero Ambitions (accessed 5/28/25)
423 Intention to Purchase Site in Sheffield for the Second UK Giga Factory Collaboration with University of Sheffield | ITM (accessed 5/28/25)
424 Hydrogen-Workforce-Assessment-Executive-Summaryfinal.pdf (accessed 5/28/25)
425 North Sea Transition Deal: one year on (accessible webpage) - GOV.UK (accessed 5/28/25)
426 Comparative Safety Assessment Report (inc. QRA) (accessed 5/28/25)
427 Zero Emission Bus Regional Areas (ZEBRA) 2 application (accessed 5/28/25)
428 Advanced Chemical Engineering (Hydrogen and Low Carbon Technologies) MSc | Brunel University of London (accessed 5/28/25)

	• Professional accreditations: New hydrogen continuous professional development pathways from IChemE and IGEM for engineers seeking H_2 specialization[429]
Educational partnerships and certification development	• East Midlands Hydrogen: Includes partnerships with Loughborough University, University of Nottingham, Toyota UK, and regional colleges, develop hydrogen school events and zero-carbon innovation centers[430] • EnerHy Centre for Doctoral Training: Institution of Gas Engineers & Managers (IGEM) Collaborates with universities to train doctoral researchers on hydrogen technologies and complex net zero engineering of hydrogen[431] • Hydrogen Training Center for Gas Engineers: Scottish Gas Network (SGN) and Fife College partner to open the UKs first hydrogen training center to train over 100 Gas Safe registered engineers on converting homes from natural gas to hydrogen[432] • Public awareness & youth engagement: Royal Academy of Engineering's "This Is Engineering: Net Zero" campaign features hydrogen engineers to promote the sector to students[433]
Community engagement	
Education and outreach programs	• Hynet Early Education: Hynet reaches over 1,000 young people as well as teachers with their education efforts to teach the importance of sustainability and renewable energy in the North West and North Wales[434] • H100 Fife public engagement: Educate primary school children on hydrogen and participate in community projects and local charities[435] • Hydrogen Public Perception Survey (UK-wide): Conducted to gauge baseline awareness and inform education campaigns (initial results showed moderate and increasing understanding with high interest)[436] • STEM Ambassadors – Hydrogen initiative: Engineers from ITM Power, Baxi, and others visit schools to demonstrate hydrogen applications and promote hydrogen careers[437] • Science Museum London – "Energy Revolution" gallery: Includes hands-on hydrogen demonstrations (e.g., working electrolyzer) to educate school groups and the public[438] • Midlands hydrogen bus public demos: Free rides and open days with Wrightbus hydrogen buses helped demystify the technology and gather rider feedback[439]

[429] AIChE and IChemE Announce Alliance on Hydrogen | AIChE (accessed 5/28/25)
[430] News | East Midlands Hydrogen (accessed 12/8/25)
[431] IGEM announces support for EnerHy Centre for Doctoral Training to advance green hydrogen technologies | The Institution of Gas Engineers and Managers (IGEM) (accessed 5/28/25)
[432] UK's first hydrogen training centre opens for next generation of green gas engineers - SGN (accessed 5/28/25)
[433] This is Engineering (accessed 5/28/25)
[434] HyNet educates over 1,000 young people across the North West and North Wales - HyNet (accessed 5/28/25)
[435] Community - SGN (accessed 5/28/25)
[436] DESNZ Public Attitudes Tracker: Spring 2024 - GOV.UK (accessed 5/28/25)
[437] Become a STEM Ambassador (accessed 5/28/25)
[438] Energy Revolution: The Adani Green Energy Gallery | Science Museum (accessed 5/28/25)
[439] Wrightbus hydrogen coach driveline demonstrator – a closer look - Bus & Coach Buyer (accessed 5/28/25)

Community benefit or local hiring initiatives	• HyNet community jobs pledge: Aims to deliver over 6,000 local jobs in North West England, with commitments to local hiring and apprenticeships[440] • Acorn Hydrogen (Scotland): Committed to establishing development priorities in cooperation with local government and just transition initiatives such as the North Sea Transition Deal which safeguards North Sea jobs[441] • Aberdeen Hydrogen Bus Program: Tied funding to local economic benefit, including vehicle maintenance at local depots and establishment of a hydrogen skills centre[442] • Aberdeen City Council co-ownership: Owns part of the hydrogen refueling network and bus fleet, creating a community asset with long-term value[443] • Community energy models: Co-ownership models and community benefit funds are encouraged by local and national government to support financially sustainable renewable energy growth and economic development[444] • Housing trial benefits: Households participating in hydrogen heating pilots (e.g., H100 Fife) receive free hydrogen-ready appliances and ongoing technical support[445] • Apprenticeship guarantees: Projects like Tees Green Hydrogen include explicit targets for youth apprenticeship intake from local schools and training colleges[446] • Foundation Scottland Community Benefit Funds: brought together with the support of renewable energy businesses, development trusts, and community councils and companies to support renewable energy projects in Scottland[447] • Local Net Zero Programme (UK Government): Provides small grants to parish councils and community energy groups to trial hydrogen innovation concepts, such as hydrogen-powered tractors or heating systems in remote villages[448]
Indigenous engagement practices and participation structures	• The UK does not have constitutionally recognized Indigenous peoples; however, its approach reflects comparable practices in equity and consultation: • Scottish Highlands & Islands hydrogen projects involve early-stage dialogue with crofting communities and landowner groups to protect land access rights and support fair compensation[449] • Crown Estate and marine use consultation: Offshore hydrogen and wind projects engage local communities (e.g., fishing groups, Scottish island councils) on access, benefit sharing, and marine stewardship[450] • Cost equity considerations: Government discussions on hydrogen heating adoption include mechanisms to prevent cost burdens on low-income households—framing hydrogen adoption as part of a just transition[451]

440 062021-First-chance-for-communities-to-have-their-say-on-ground-breaking-net-zero-decarbonisation-project.pdf (accessed 5/28/25)
441 Acorn in the Community - The Acorn Project (accessed 5/28/25)
442 Community - Aberdeen (accessed 5/28/25)
443 Projects H2 Aberdeen | Aberdeen City Council (accessed 5/28/25)
444 Community benefits and shared ownership for low carbon energy infrastructure: working paper (accessible webpage) - GOV.UK (accessed 5/28/25)
445 First Minister opens Scotland's first hydrogen homes - SGN (accessed 5/28/25)
446 Working with communities - EDF Renewables (accessed 5/28/25)
447 Community Benefit Funds | Foundation Scotland (accessed 5/28/25)
448 Local net zero: central support for local authorities and communities - GOV.UK (accessed 5/28/25)
449 Climate Change and Energy - National Islands Plan: annual report 2024 - gov.scot (accessed 5/28/25)
450 Offshore Wind and CCUS Co-Location Forum | The Crown Estate (accessed 5/28/25)
451 Position-Piece-NEA.pdf (accessed 5/28/25)

8.7.6 Netherlands

Jurisdiction General overview	
National or sub-national jurisdiction	National
Population	18,050,000[452]
Gross domestic product	$1.15 trillion USD (2023) [~€1.06 trillion] World Bank, 2023; conversion using average 2023 USD to Euro rate)[453]
Climate targets	• Climate neutrality by 2050 (aligned with EU target)[454] • 49% reduction in GHG emissions by 2030 and 95% by 2050 (relative to 1990 levels; legally binding) under the national Climate Act • 100% emissions-free electricity by 2035 (PBL, 2023) • Phasing out coal by 2030; scaling green hydrogen to decarbonize industrial clusters
Hydrogen ecosystem	
Hydrogen strategy or roadmap	The Netherlands released its national Hydrogen Strategy in 2020, positioning clean hydrogen as a key solution to decarbonize hard-to-abate sectors and maintain the country's role as a European energy hub. The strategy prioritizes green hydrogen produced from offshore wind power, supported by blue hydrogen (with CCS) as a transitional measure. A coordinated implementation framework, the National Hydrogen Programme (NWP), was launched in 2022 to align infrastructure, funding, innovation, and workforce development. The strategy is embedded in the broader Climate Agreement (2019) and aligns with EU targets under the REPowerEU and Fit for 55 packages.[455]
Goals and objectives	It aims to decarbonize hydrogen use in refining, chemicals, and steel production, targeting a 42% renewable share in industrial hydrogen use by 2030. Other objectives include building out a national hydrogen transport backbone by 2030, becoming a leading hydrogen import hub via the Port of Rotterdam, enabling export to Germany and Belgium, and creating the conditions for a hydrogen trading market with Guarantees of Origin and price transparency.[456]
Key milestones and timelines[456]	• 2019: Hydrogen included in the Dutch Climate Agreement; 3–4 GW electrolysis ambition announced • 2020: National Hydrogen Strategy published; SDE++ subsidy made available for hydrogen production • 2021–2022: National Hydrogen Programme launched; Rotterdam port import terminal plans announced; multiple EU IPCEI projects selected • 2023: Construction began on first 30 km of national hydrogen pipeline (Rotterdam); Shell's 200 MW electrolyzer project under construction[457] • By 2025: Several 100 MW-scale electrolyzer s expected online; first imports of hydrogen/ammonia anticipated at Rotterdam[458]

[452] Lower population growth in 2024 | CBS (accessed 5/19/2025)
[453] GDP (current US$) - Netherlands | Data (accessed 5/19/2025)
[454] The Netherlands' climate action strategy (accessed 12/8/2025)
[455] The Netherlands' climate action strategy (accessed 12/8/2025)
[456] Hydrogen Roadmap (accessed 5/20/2025)
[457] Netherlands begins construction of national hydrogen pipeline network | S&P Global (accessed 5/20/2025)
[458] Shell to build 100-megawatt renewable hydrogen electrolyser in Germany (accessed 12/8/2025)

	• By 2030: Target of 4 GW electrolysis; full hydrogen backbone; 42% renewable hydrogen use in industry • Status (2024): Netherlands is ahead in infrastructure planning and project announcements but behind in electrolyzer capacity deployment (PBL projects only 1.2–1.5 GW by 2030 without stronger measures)
Existing hydrogen operations	• The Netherlands produces ~180 PJ/year of hydrogen, almost entirely grey hydrogen produced from natural gas and oil. The primary uses of pure hydrogen (excluding waste, gas mixtures) in the Netherlands include the production of nitrogen fertilizers (around 60 PJ) and processes such as hydrogenation and desulphurization in oil refineries (approximately 65 PJ). With the country's total gross energy consumption at roughly 3000 PJ, current hydrogen production already plays a significant role in the national energy landscape and contributes notably to associated CO_2 emissions.[459] • The Netherlands imported 19.6K tonnes of hydrogen from EU countries in 2023, of which 19.3K tonnes were imported from Belgium.[460] • Key sites include Shell Pernis, BP Rotterdam, and Yara Sluiskil. Some by-product hydrogen is captured from chemical processes (e.g. Dow Terneuzen). A small number of public hydrogen refueling stations (6–10) support buses and pilot vehicles. Demonstration projects include HyStock (1 MW solar-to-H_2 pilot in Veendam), PosHYdon (offshore electrolyzer pilot), and a hydrogen co-firing trial at the Magnum gas plant.[461]
Hydrogen projects announced or in development[461]	• Shell Holland Hydrogen I: 200 MW green H_2 electrolyzer (Rotterdam); under construction, operational by ~2025 • HyNetherlands (Groningen): 1 GW green & blue H_2 project; 100 MW phase by 2025 • H-Vision (Rotterdam): Blue H_2 for industrial decarbonization; uses CCS via Porthos storage (2.5 Mt CO_2/yr) • Green Hydrogen Hub Zeeland: Ørsted/Yara 100 MW electrolyzer for ammonia production by 2026 • Delta Rhine Corridor: Cross-border pipeline project (Rotterdam → Limburg → Germany) • HyTrucks initiative: Deploy 1,000 hydrogen trucks between Rotterdam, Antwerp, Duisburg by 2025 • Hydrogen Backbone: 1,200 km national pipeline network phased through 2030; first 30 km in construction
Challenges being faced in meeting ecosystem goals[462, 463]	• Permitting and spatial constraints: Limited space and long environmental permitting timelines (especially for onshore wind and infrastructure near Natura 2000 sites) • Electrolyzer scale-up delays: Only ~1.2–1.5 GW capacity likely by 2030 unless stronger incentives or mandates are introduced • High cost gap: Green hydrogen production remains 2–3x more expensive than grey; uncertain CO_2 pricing and lack of long-term offtake contracts deter investment

[459] The Dutch hydrogen balance, and the current and future representation of hydrogen in the energy statistics (accessed 5/20/2025)

[460] Hydrogen Trade | European Hydrogen Observatory (accessed 5/27/2025)

[461] Hydrogen Projects in the Netherlands | Top Sector Energie (accessed 5/20/2025)

[462] Netherlands hydrogen pipeline network delayed by three years to 2033 | S&P Global (accessed 5/20/2025)

[463] Hydrogen in the Netherlands (accessed 5/20/2025)

	• Infrastructure rollout slippage: Hydrogen backbone delayed to 2033 in some phases; pipeline and storage buildout may lag production • Demand risk: Industry adoption depends on regulatory certainty and clear economic incentives; risk of overbuilding supply without matching demand • Global competition: Other ports (Antwerp, Hamburg) also aiming to lead in hydrogen, creating pressure to move fast and secure anchor projects • Personnel capacity is scarce across the hydrogen supply chain
Policy and regulation	
Financial subsidies / funding models established to support the hydrogen value chain and supply chain	• SDE++ (Stimulation of Sustainable Energy Production): Offers operating subsidies to cover the cost gap between green hydrogen and grey hydrogen, based on CO_2 avoided.[464] • National Growth Fund (Nationaal Groeifonds): Includes hydrogen-specific programs such as GroenvermogenNL, which has received over €338 million to fund hydrogen innovation, skills development, and early deployment.[465] • IPCEI (Important Projects of Common European Interest): Dutch companies are participating in over €1.5 billion worth of IPCEI-funded hydrogen projects, including large electrolyzer s, system components, and hydrogen transport infrastructure.[466] • Climate Fund (Klimaatfonds): Allocated €1 billion for hydrogen in 2024, with multi-year commitments through 2030 to accelerate scaling and support the national backbone.[467] • Additional funding supports hydrogen fueling stations, R&D programs, and potential contracts for difference (CfDs) under development to stabilize green hydrogen prices for producers.[468]
Regulatory frameworks encouraging hydrogen development	• The Netherlands is implementing the EU Gas Decarbonisation Package, including reforms to the Gas Act to recognize hydrogen as a regulated energy carrier.[469] • Gasunie has been designated as the national hydrogen transmission system operator (TSO), operating the future hydrogen backbone under regulated access and tariffs. • A draft Energy Act (Energiewet) is under review, which defines hydrogen transport, quality standards, and unbundling requirements in line with EU rules.[470] • The Netherlands Emissions Authority (NEa) is establishing a system of Guarantees of Origin (GOs) for hydrogen delivery in alignment with the EU CertifHy system.[471] • The government supports a national carbon price floor[472], and SDE++ indirectly imposes a carbon value by rewarding CO_2 reductions from hydrogen.[468]

464 Sustainable energy production subsidy scheme (SDE++) | Business.gov.nl (accessed 5/19/2025)

465 Netherlands | Green Hydrogen Organisation (accessed 5/19/2025)

466 Seven EU States Provide $1.5B Funding for Hydrogen R&D | Rigzone (accessed 5/19/2025)

467 Netherlands to hold €1bn auction for green hydrogen subsidies in 2024, targets 8GW by 2032 | Hydrogen Insight (accessed 5/19/2025)

468 Dutch climate subsidy scheme will allocate at least €750m to green hydrogen and other renewable fuels | Hydrogen Insight (accessed 5/19/2025)

469 Hydrogen and decarbonised gas market (accessed 5/19/2025)

470 Dutch hydrogen developments (accessed 5/19/2025)

471 Registering delivery of gaseous biofuels (accessed 12/8/2025)

472 CARBON PRICE FLOOR FOR ELECTRICITY GENERATION AND INDUSTRY (accessed 5/19/2025)

Initiatives supporting permitting and regulatory approval processes	• Projects of national interest (e.g., the hydrogen backbone and offshore hydrogen pilots) receive fast-track planning status under the Crisis and Recovery Act.[473] • The National Hydrogen Programme (NWP) provides coordinated support and serves as a one-stop-shop for developers navigating spatial planning and permitting challenges.[474] • Temporary Hydrogen Pilot Framework: Allows regional hydrogen blending or distribution projects to proceed under interim regulatory approvals while national laws are finalized.[475] • For offshore hydrogen, the government has committed to including electrolysis permits in offshore wind tenders by 2026, reducing lead time and complexity.[476] • Safety standards for hydrogen handling, transport, and storage are being rapidly developed by NEN (the Dutch standards institute) and TNO (Netherlands Organisation for Applied Scientific Research), ensuring regulators and municipalities have clear criteria for project approval.[477]
Infrastructure and value chain integration	
Designation of hydrogen hubs, corridors, or other co-location initiatives	The Netherlands is explicitly pursuing a "hub-and-spoke" hydrogen development model centered around five key industrial clusters: • Rotterdam/Maasvlakte: Anchor hub for hydrogen imports, refining, blue/green H_2 production, and bunkering.[478] • Northern Netherlands (Groningen/Delfzijl): Designated EU Hydrogen Valley (HEAVENN project), with integrated production, storage, and local use.[479] • Zeeland (Terneuzen/Vlissingen): Fertilizer and chemical hub with plans for green ammonia via hydrogen.[480] • IJmond/Amsterdam: Hydrogen to decarbonize steel and logistics at Tata Steel and surrounding industries.[481] • Limburg/Chemelot: Focus on hydrogen feedstock and cross-border corridors to Germany.[482] • The HyTrucks corridor between Rotterdam–Antwerp–Duisburg and the Delta Rhine Corridor for cross-border hydrogen transport to Germany are also key initiatives supporting value chain integration.[483, 484]

473 THE DUTCH CRISIS AND RECOVERY ACT: ECONOMIC RECOVERY AND LEGAL CRISIS (accessed 5/19/2025)
474 Hydrogen Roadmap (accessed 5/19/2025)
475 ACM draws up framework to make pilot projects with hydrogen possible | ACM.nl (accessed 5/19/2025)
476 Dutch Gov't Shelves Two Offshore Wind Tenders, Plans Single Site Auction | Offshore Wind (accessed 5/19/2025)
477 Safety Standardisation of Green Hydrogen Electrolyzer Systems (accessed 5/19/2025)
478 The hydrogen system is taking shape | Port of Rotterdam (accessed 5/19/2025)
479 Heavenn - About (accessed 5/19/2025)
480 Hydrogen in the Zeeland port district and over the border › Gasunie (accessed 5/19/2025)
481 Tata Steel and ECOLOG are collaborating on a liquid hydrogen and CO2 corridor between Norway and Amsterdam. (accessed 5/19/2025)
482 Dutch provincial government set to permit waste-to-hydrogen project against advice of environmental study | Hydrogen Insight (accessed 5/19/2025)
483 1000 trucks - 25 filling stations by 2025 (Hytrucks) (accessed 5/19/2025)
484 Delta Rhine Corridor | DRC (accessed 5/19/2025)

Regional infrastructure planning initiatives or mechanisms	• The National Hydrogen Network Plan (2022) defines a phased rollout of the 1,200 km hydrogen backbone, integrating production and demand across regions by 2030. • Coordination is led by Gasunie, working with provinces, industrial stakeholders, and the Ministry of Economic Affairs and Climate Policy.[485] • Hydrogen infrastructure is embedded into the Structuurvisie Energie Infrastructuur (SEVI), which grants it "national interest" status in spatial planning.[486] • The Netherlands participates in the European Hydrogen Backbone initiative, coordinating pipeline routes with Belgium and Germany to facilitate cross-border trade and redundancy.[487] • Offshore infrastructure planning includes hydrogen-ready offshore platforms, with test cases like PosHYdon feeding into future multi-GW hydrogen islands.[488]
Innovative business models enabling development	• Public-private consortia: Projects like H-Vision and HEAVENN integrate stakeholders across the value chain—TSOs, ports, chemical firms, and utilities—sharing risk and infrastructure.[489] • Port authority investment: Port of Rotterdam co-invests in import terminals, electrolyzers, and bunkering infrastructure, then leases to users or collects throughput fees.[478] • Common carrier model: Gasunie's hydrogen backbone is designed as open-access infrastructure, enabling multiple producers and consumers to share pipeline capacity. • Green hydrogen as a service: Large chemical players like Nouryon and Shell are entering supply agreements where they produce H_2 and sell via long-term contracts, shifting CAPEX burden from smaller buyers.[490] • Aggregated demand initiatives: HyTrucks consortium aggregates demand from logistics firms to secure vehicle deployments and incentivize hydrogen refueling stations.[491]
Infrastructure re-tooling to support hydrogen	• Gas pipelines: Up to 80% of the national hydrogen backbone is being built by repurposing natural gas pipelines, which is faster and cheaper than new construction.[492] • Salt caverns: Existing natural gas storage caverns (e.g. Zuidwending) are being converted into hydrogen storage facilities.[493] • Power plants: Plants like Magnum are being modified to enable hydrogen combustion in gas turbines.[494]

485 National hydrogen network roll-out plan updated › Gasunie (accessed 5/19/2025)
486 A4 brochure (accessed 5/19/2025)
487 Country Narratives | EHB European Hydrogen Backbone (accessed 5/19/2025)
488 Poshydon | Green Hydrogen Energy (accessed 5/19/2025)
489 H-vision Rotterdam (accessed 5/19/2025)
490 BioMCN to produce renewable methanol with green hydrogen › Gasunie (accessed 5/19/2025)
491 About the cluster (accessed 5/19/2025)
492 The Netherlands' National Hydrogen Network for a Connected Cleaner Future – Boˆreal (accessed 5/19/2025)
493 Storing hydrogen in salt caverns is safe, efficient and affordable (accessed 5/19/2025)
494 Vattenfall investigates sale of Magnum power plant in the Netherlands | IFRF (accessed 5/19/2025)

	• Port terminals: Ammonia and LOHC import terminals are being developed by adapting existing fossil fuel infrastructure (e.g., converting oil jetties and LPG tanks).[478] • Distribution networks: Pilots in cities like Hoogeveen are retrofitting gas distribution networks to enable 100% hydrogen heating in select neighborhoods.[479]
Supply chain strategy	
Supply chain targets	The Netherlands aims to become a hydrogen logistics and trading hub for northwest Europe. Key targets include: • 4 GW of domestic electrolysis capacity by 2030[495], with up to 8 GW by 2032[496] • Import infrastructure for 4 million tonnes of hydrogen equivalents per year by 2030 (via ammonia, LOHC, or liquid hydrogen)[497] • Hydrogen backbone connecting all major industrial clusters by 2030 • A functioning hydrogen marketplace by 2026 (HyXchange platform at Port of Rotterdam)[497] • Domestic electrolyzer manufacturing capacity (non-binding target via HyScaling: up to 5 GW/year production)[498]
Manufacturing strategies or supply chain assessments	• The HyScaling initiative, supported by GroenvermogenNL, maps the domestic manufacturing potential for electrolyzer stacks and system components.[498] • Dutch government and TNO studies have identified strengths in catalysis, offshore engineering, and control systems.[499] • Eindhoven/Brainport region is pivoting high-tech manufacturing to include hydrogen sensors and power electronics to optimize hydrogen production technology.[500] • Government strategy supports leveraging chemical parks (e.g. Chemelot) to host system integrators and test centers (e.g. Hydrohub GW Lab).[501] • InvestNL promotes foreign investment in assembly plants, targeting collaboration with innovation labs like Faraday lab and manufacturing companies like VDL.[502]
Critical hydrogen supply chain components	• Electrolyzer stacks and membranes (PEM and alkaline)[498] • Compression and storage systems for hydrogen gas and ammonia[503] • Cryogenic and chemical conversion equipment (e.g. ammonia crackers)[504] • Control and sensing systems for hydrogen detection and flow control[500] • Shipping and bunkering infrastructure (vessels, terminals)[497]

[495] Netherlands | Green Hydrogen Organisation (accessed 5/19/2025)

[496] Government's target is 8 GW of electrolysis capacity by 2032 | National Hydrogen Program (accessed 5/19/2025)

[497] Port of Rotterdam (accessed 5/19/2025)

[498] HyScaling: making better electrolyzers in a better way (accessed 5/20/2025)

[499] Hydrogen production in the HyScaling project | TNO (accessed 5/20/2025)

[500] Hydrogen transition for Clean Energy | Brainport Eindhoven (accessed 5/20/2025)

[501] Integration of Hydrohub GigaWatt Electrolysis Facilities in the Netherlands (accessed 5/20/2025)

[502] The Hydrogen Current in the Netherlands is Intensifying, Making Waves to Surf Towards the Zero-emission Economy - NFIA (accessed 5/20/2025)

[503] towards-reducing-hydrogen-supply-chain-costs.pdf (accessed 5/20/2025)

[504] Preparing the Netherlands for large-scale ammonia imports - Ammonia Energy Association (accessed 5/20/2025)

	• Availability of renewable electricity (primarily offshore wind) is considered a critical upstream input for green hydrogen supply chains[505]
Supply chain risk mitigation strategies deployed	• Diversified hydrogen import strategy with bilateral MOUs across multiple countries (Canada, Chile, UAE, Portugal, Oman, etc.)[506] • Buffer storage in repurposed salt caverns for supply stability[507] • Interoperability planning with Germany and Belgium (hydrogen solidarity mechanisms and European Hydrogen Backbone integration)[487] • Participation in EU IPCEI and Horizon Europe programs to reduce technology dependency and increase innovation resilience[508] • Investment in domestic offshore wind (21 GW by 2030) to reduce overreliance on imported hydrogen[505]
Hub and spoke manufacturing ecosystems	• Chemelot (Limburg): Cluster around OCI and SABIC includes smaller suppliers and research labs focused on green ammonia and hydrogen burners.[509] • Amsterdam/IJmond: Tata Steel and Port of Amsterdam serve as anchors; nearby logistics and maritime firms are developing bunkering and transport subsystems.[510] • Hydrogen Campus Zeeland: R&D and testing hub integrating DOW Chemical, TU Delft, and SMEs working on component manufacturing.[511] • Brainport Eindhoven: High-tech manufacturers and research institutes pivoting to develop hydrogen sensors, membranes, and control electronics.[512] • Rotterdam: Central anchor (Shell, BP, Port Authority) surrounded by shipbuilders, engineering firms, and import terminal operators—forming a dense hydrogen industrial ecosystem.[497]
Workforce development	
Hydrogen skills or workforce market assessments	• Scaling green hydrogen through country initiatives will create employment opportunities for 6,000–17,300 full-time hydrogen-related workers in 2030.[513] • The analysis emphasized urgent needs in technical roles, such as electrolyzer operators, pipeline technicians, safety inspectors, and hydrogen vehicle mechanics. • It also identified aging workforces in adjacent sectors (e.g. natural gas), highlighting a critical need for knowledge transfer and retraining. Mid-career reskilling in logistics, maritime, and gas utilities is a growing priority • Talent needs also include Hydrogen-certified welders and pipefitters (due to hydrogen embrittlement risks, electrolyzer operation and maintenance specialists (particularly at MW–GW scale), Hydrogen safety engineers, fire risk professionals, HAZOP specialists, Process engineers and chemical operators (familiar with ammonia cracking and hydrogen purification), control systems

505 Excelling-in-hydrogen-Dutch-solutions-for-a-hydrogen-economy-V-April-2023.pdf (accessed 5/20/2025)
506 Waterstof in Nederland (accessed 5/21/2025)
507 Clean_Hydrogen_Monitor_10-2022_DIGITAL.pdf (accessed 5/21/2025)
508 Northwest European Hydrogen Monitor (accessed 5/21/2025)
509 Chemelot wants to become Europe's first climate-neutral and circular chemical cluster - NedZero (accessed 5/21/2025)
510 Sustainable fuels bunkering at port | Port of Amsterdam (accessed 5/21/2025)
511 Hydrogen Delta | Smart Delta Resources (accessed 5/21/2025)
512 Hydrogen transition for Clean Energy | Brainport Eindhoven (accessed 5/21/2025)
513 Jobs from investment in green hydrogen. Update and extension - CE Delft - EN (accessed 5/21/2025)

	engineers, and IT experts for smart hydrogen grids and digital trading platforms • National planning platforms (e.g. Topsector Energie and GroenvermogenNL) support regular forecasting of skills needs based on project pipelines.
Initiatives to support workforce development	• GroenvermogenNL's "Make Hydrogen Work" initiative develops training modules across vocational, applied, and professional education streams.[514] • Hydrogen Experience House (Hoogeveen): A training center demonstrating hydrogen appliances and safety protocols for technicians and the public.[515] • National retraining programs for gas sector workers (especially offshore) to move into wind and hydrogen roles. • Technical colleges (ROCs) in Groningen, Emmen, Rotterdam and others now offer hydrogen technician tracks (in gas fitting, maintenance, and energy systems). • Companies like Shell and Gasunie sponsor hydrogen-specific apprenticeships and on-the-job training tied to major projects. • Port of Rotterdam training programs are evolving to include ammonia handling, H_2 bunkering, and safety practices.
Educational partnerships and certification development	• Hanze University of Applied Sciences (Groningen): Runs hydrogen technology programs and training courses embedded in Hydrogen Valley pilot projects.[516] • TU Delft and Eindhoven University of Technology (TU/e): Offer master's-level programs and research fellowships in hydrogen electrochemistry, energy systems, and offshore integration.[517] • EnTranCe (Energy Transition Centre): A living lab at Hanze University where students co-develop and test hydrogen technologies with SMEs and industry.[518] • RH2INE Academy: Maritime-focused training program for barge and vessel operators switching to hydrogen fuels.[519] • Hydrogen Campus Zeeland: Platforms where students and startups test hydrogen components (e.g. burners, fuel cells) with guidance from large industry partners.[520] • Certification development is underway with NEN and DEKRA, including installer safety certifications, hydrogen responder training, and future alignment with EU-wide standards under CertifHy.[521]
Community engagement	
Education and outreach programs	• Hydrogen Experience House (Hoogeveen): A model home operating on hydrogen, open to the public for site visits and used as a local awareness-raising tool during the residential heating pilot.[515] • New Energy Coalition outreach days: Events hosted in Groningen and Drenthe that bring citizens into Hydrogen Valley labs to see and discuss H_2 projects.[522]

514 Make Hydrogen Work - GroenvermogenNL (accessed 5/21/2025)

515 Hoogeveen Is Ready to Connect the First Homes to Hydrogen (accessed 12/8/2025)

516 Wind Energy meets Hydrogen | Hanze UAS (accessed 5/21/2025)

517 H2 Platform (accessed 5/21/2025)

518 ENTRANCE – Centre of Expertise Energy | Hanze UAS (accessed 5/21/2025)

519 Explore Our Resources: Dive Deeper into Condor H2: rh2ine (accessed 5/21/2025)

520 Energy Campus Zeeland | HZ University of Applied Sciences (accessed 5/21/2025)

521 Hydrogen Infrastructure | DEKRA (accessed 5/21/2025)

522 HyNetherlands | Hydrogen tour organized by New Energy Coalition (accessed 5/21/2025)

	• Hydrogen public awareness campaigns by municipalities, such as Arnhem and Rotterdam, include hydrogen transit showcases, public bus demonstrations, and open houses for new fueling stations.[523]
Community benefit or local hiring initiatives	• In Hoogeveen, residents participating in the hydrogen heating pilot received fully subsidized boilers and price guarantees pegged to natural gas levels to eliminate risk.[524] • Community input into hydrogen infrastructure siting is a formal requirement in projects receiving public funding. In Hoogeveen, residents influenced project design through over 6 years, helping build trust and legitimacy.[524] • The Port of Rotterdam's hydrogen expansion includes funding for technical training programs aimed at workers in surrounding neighborhoods.[497] • Provincial green deal agreements (e.g. Groningen, Zeeland) often stipulate that a share of project construction and maintenance contracts be reserved for local SMEs and tradespeople.[525] • In agricultural pilots (e.g. Groningen and Friesland), local cooperatives are being included as users and co-developers, ensuring that decentralized hydrogen systems support local resilience and just transition outcomes.[526] • Some port- and wind-linked hydrogen projects are piloting community co-ownership or community funds for project opportunities, similar to wind co-op models.[527]
Indigenous engagement practices and participation structures	The Netherlands does not have an Indigenous population in the same context as settler countries. However, equity and inclusion principles are integrated into project planning through social justice lenses. For example, experimental clean hydrogen bus routes have prioritized deployment in historically disadvantaged neighborhoods first (e.g. in Rotterdam), targeting air quality and mobility equity.[528]

[523] City of Arnhem - Energy Cities (accessed 5/21/2025)

[524] Heavenn - First homes in Hoogeveen are switching to hydrogen (accessed 5/21/2025)

[525] ICLEI Europe •• Local Green Deals (accessed 5/21/2025)

[526] Dutch farmers in Groningen will start producing their own green hydrogen - IO (accessed 5/21/2025)

[527] Shared ownership or shared value? What's best for local communities? (accessed 5/21/2025)

[528] Transition governance for just, sustainable urban mobility: An experimental approach from Rotterdam, the Netherlands - ScienceDirect (accessed 5/21/2025)

8.7.7 Germany

Jurisdiction General overview	
National or sub-national jurisdiction	National
Population	83.5 million (2023)[529]
Gross domestic product	€4.18 trillion (at the 2023 $ to €) (2023)[530] (~C$6.1 trillion equivalent at the 2023 FX average)
Climate targets	• Net-zero GHG by 2045 (legally binding under Federal Climate Action Law)[531] • Interim targets: ○ 65% reduction by 2030 (vs. 1990 levels) ○ 88% reduction by 2040 • Sectoral targets: [532] ○ 80% renewable electricity by 2030 ○ Coal phase-out by 2030 (target), 2038 (legally permitted)
Hydrogen ecosystem	
Hydrogen strategy or roadmap	Germany adopted its National Hydrogen Strategy (Nationale Wasserstoffstrategie, NWS) in June 2020 and released an updated version in July 2023 to reflect increased urgency and demand. The strategy identifies hydrogen as indispensable for achieving climate neutrality by 2045 and outlines a roadmap to integrate green and low-carbon hydrogen into Germany's industrial, transportation, and energy sectors. Germany positions itself as a global leader in hydrogen technologies while acknowledging the need to import more than 50% of its future hydrogen supply [533]
Goals and objectives	Germany aims to install at least 10 GW of domestic electrolyzer capacity by 2030, double its original 2020 target of 5 GW for use particularly in hard-to-electrify sectors like steel, chemicals, and heavy transport. Strategic objectives include establishing Germany as a hydrogen technology export leader, decarbonizing industrial and transport sectors, and building both domestic production and international import partnerships. The strategy emphasizes green hydrogen as the long-term goal, while allowing blue hydrogen as a transitional option.[534]
Key milestones and timelines[533]	• 2020: National Hydrogen Strategy launched with €9 billion investment • 2021–2022: 62 IPCEI (Important Projects of Common European Interest) hydrogen projects approved; initial R&D and industrial pilot projects launched • 2023: Strategy updated, 10 GW target confirmed, H2Global import mechanism launched, hydrogen core network planning approved • 2024–2025: First large electrolyzers (e.g., 100 MW projects) under construction; early hydrogen imports (e.g., ammonia from UAE, Canada) begin • 2030: Target year for 10 GW operational capacity, 1,800 km of hydrogen pipelines, and import of 50–70% of demand

529 Current population of Germany - German Federal Statistical Office (accessed 5/21/2025)

530 Germany GDP and Economic Data (accessed 5/21/2025)

531 Climate Change Act: climate neutrality by 2045. (accessed 5/21/2025)

532 Germany's aim for 80 percent renewables in electricity by 2030 well within reach – minister | Clean Energy Wire (accessed 5/21/2025)

533 Germany's National Hydrogen Strategy | Clean Energy Wire (accessed 5/21/2025)

534 Germany doubles its green hydrogen production target for 2030 in new update of national strategy | Hydrogen Insight (accessed 5/21/2025)

Existing hydrogen operations	Germany already uses ~55–60 TWh of hydrogen annually, primarily for oil refining and ammonia production. This is produced via on-site SMRs (Steam Methane Reformers). Germany also has:[535] • Legacy hydrogen pipelines (~400 km total), including a 240 km Ruhr network operated by Air Liquide[536] • Hydrogen refueling infrastructure: ~100 public H_2 refueling stations, primarily in urban and logistics corridors (h2.live)[537] • Hydrogen trains: Alstom's Coradia iLint operating since 2018 (Lower Saxony), with additional projects in Frankfurt (Taunusnetz) and Berlin-Brandenburg (Heidekrautbahn)[538, 539] • PtG systems: leading nation in the development of the new power to gas concept, particularly through CO_2 catalytic methanation through the application of renewable hydrogen[540] with companies such as Audi[541] • Municipal H_2 bus deployments: 100+ hydrogen fuel-cell powered buses commissioned for public transportation across Hamburg, Aschaffenburg, Düsseldorf, Oldenburg, Vestische, and Deutsche Bahn[542]
Hydrogen projects announced or in development	Germany has over 9 GW of electrolyzer capacity in the project pipeline for 2025–2030. Notable projects include: • GET H2 Nukleus: 300 MW electrolyzer and 130 km pipeline from Lingen to Ruhr (by 2027 with the first 100 MW operational in 2025) for industrial customers[543] • SALCOS (Salzgitter): 100 MW electrolyzer and green steel DRI plant (by 2026)[544] • tkH2Steel (Thyssenkrupp, Duisburg): 2.5-million mt/year DRI facility to replace the four blast furnaces (2026–2027)[545] • Wilhelmshaven Green Terminal (Uniper): 300,000 tonnes H_2/year (10-20% of Germany's 2030 expected demand) via ammonia thermos-chemical cracking (in 2030)[546] • Refhyne II (Shell Rhineland): 100 MW electrolyzer (operational by 2027)[547] • Air Liquide & Siemens: Gigafactory for electrolyzer production in Berlin (3 GW by 2025) leveraging automation and robotics for manufacturing[548] • GOLIAT (Ground Operations of Liquid hydrogen Aircraft) project: receiving €10.8 million from the EU's Horizon Europe Framework Programme to demonstrate LH2 handling and refueling technologies for aviation – includes

535 Germany Hydrogen Demand (accessed 12/8/2025)
536 Air Liquide will set up Europe's largest electrolyser in Germany (accessed 12/8/2025)
537 Braunschweig – Where hydrogen mobility is already a reality - H2.LIVE (accessed 05/22/2025)
538 Coradia iLint: The world's first hydrogen passenger trains | CNN (accessed 05/22/2025)
539 Siemens battery and hydrogen trains launched in Brandenburg and Bavaria - Urban Transport Magazine (accessed 05/22/2025)
540 Power to Gas projects review: Lab, pilot and demo plants for storing renewable energy and CO2 - ScienceDirect (accessed 05/22/2025)
541 Audi e-gas - Audi Technology Portal (accessed 05/22/2025)
542 Power-to-X - municipalities step on the gas (1): H2 buses for public transport in Germany (accessed 05/22/2025)
543 Hydrogen project GET H2 Nukleus (accessed 05/22/2025)
544 Salzgitter orders one of Europe's largest green hydrogen plants from ANDRITZ | Salzgitter AG (accessed 05/22/2025)
545 Thyssenkrupp Steel to connect to GET H2 German hydrogen pipeline in 2028 - EUROMETAL (accessed 05/22/2025)
546 Green Wilhelmshaven | Uniper (accessed 05/22/2025)
547 Shell to build 100-megawatt renewable hydrogen electrolyzer in Germany | Shell Global (accessed 05/22/2025)
548 The inauguration of Air Liquide and Siemens Energy Gigawatt electrolyzer factory paves the way to renewable hydrogen development at scale | Air Liquide (accessed 05/22/2025)

	Airbus and 9 other partners with locations across Europe, including Germany[549]
Challenges being faced in meeting ecosystem goals[550]	• High production cost: Green hydrogen remains ~2–3× more expensive than fossil hydrogen[551] • Permitting delays: Infrastructure and electrolyzer projects face 1–2 year approval times • Infrastructure lag: Pipeline buildout not fully aligned with production/demand timelines • Import dependency: High reliance on geopolitically secure hydrogen sources • Skilled labour shortages: Need for rapid workforce upskilling to operate and maintain H_2 infrastructure • Regulatory complexity: Uncertainty in certification, grid access, and safety codes until EU hydrogen regulations are fully implemented
Policy and regulation	
Financial subsidies / funding models established to support the hydrogen value chain and supply chain	Germany has deployed a wide range of public funding tools to de-risk investment and scale the hydrogen sector: • €9 billion committed under the 2020 National Hydrogen Strategy, including €2 billion for international hydrogen partnerships[552] • IPCEI Hydrogen: Approved 24 German projects with total aid of ~€4.6 billion. Covers the production of green hydrogen to transport and storage infrastructure and the use of hydrogen in industry and transport[553] • H2Global mechanism: ~€900 million initial funding (additional €3–4 billion planned). Operates a double auction model. A special-purpose entity buys long-term green hydrogen import contracts, reselling short-term domestically[554] • Carbon Contracts for Difference (CCfDs): First round, with funding volume of €4 billion, awarded in 2024 for industrial decarbonization (steel, chemicals). Government helps companies protect themselves against price risks and further funds the use of green hydrogen[555] • R&D funding and innovation programs: ~€1.4 billion through the National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP) for R&D, demonstration, and market activation[556] • KfW Bank support: Offers low-interest loans and guarantees for hydrogen infrastructure (e.g., terminals, production)[557]
Regulatory frameworks encouraging hydrogen development	Germany's legal framework is actively evolving to support hydrogen uptake, with several key mechanisms in place:

549 Innovative aviation hydrogen handling and refuelling project, led by Airbus and supported by partners launched to demonstrate small-scale liquid hydrogen aircraft ground operations at three European airports - Hydrogen Central (accessed 05/22/2025)

550 communique-boosting-european-framework-renewable-energy.pdf (accessed 05/22/2025)

551 Germany's Green Hydrogen Market: A Strategic Perspective - Haush (accessed 05/22/2025)

552 Germany's Hydrogen Industrial Strategy (accessed 5/22/2025)

553 BMWE - European Commission gives the go-ahead for the funding of 24 German IPCEI hydrogen projects (accessed 5/22/2025)

554 State aid: Commission approves €900 million German scheme (accessed 5/22/2025)

555 Carbon Contracts for Difference - Klimaschutzverträge (accessed 5/22/2025)

556 National Hydrogen and Fuel Cell Technology Innovation Programme (accessed 5/22/2025)

557 How KfW works to promote green hydrogen all over the world | KfW (accessed 5/22/2025)

	• Energy Industry Act (EnWG) amendments: A nationwide grid tariff will apply in two phases until 2055, allowing end users to make economically reasonable use of the network in the first phase[558] • Guarantees of Origin (GO): Germany is implementing hydrogen certification aligned with EU RED III and CertifHy to validate renewable H_2 for subsidy eligibility and trade[559] • Carbon pricing: Under both the EU Emissions Trading System (EU ETS) and the German National Emissions Trading System (nETS). These create a price signal favoring green hydrogen over fossil alternatives[560] • Building codes and sectoral targets: Germany's climate law proposes sector-specific CO_2 budgets, pushing high-emission sectors (e.g., steel, transport) toward hydrogen where electrification is not feasible[561] • Hydrogen blending: No federal mandate, but blending into gas grids is permitted under safety guidelines (up to 10% under certain conditions)[562]
Initiatives supporting permitting and regulatory approval processes	• Hydrogen Acceleration Act (H2-Beschleunigungsgesetz): Adopted in 2024 to fast-track approvals for hydrogen infrastructure, including production plants, pipelines, import terminals, and associated electricity lines. Projects receive "overriding public interest" status, simplifying environmental and construction regulation[563] • Expediated permitting: Under the Hydrogen Acceleration Act, permitting will be simplified and digitised and legal cases challenging hydrogen projects and environmental impact assessments will be shortened[564] • Accelerated repurposing of gas pipelines: The German Federal Network Agency (BNetzA) issued guidance that pipeline conversion projects may undergo faster assessment if limited to existing corridors[565]
Infrastructure and value chain integration	
Designation of hydrogen hubs, corridors, or other co-location initiatives	• North German Hydrogen Alliance: Includes Hamburg, Bremen, Lower Saxony, and Schleswig-Holstein. Focuses on wind-to-hydrogen projects, port import terminals, and supply to local industry[566] • Hydrogen Hub Ruhr: Leveraging legacy hydrogen pipelines and dense industrial demand in Duisburg, Cologne, and surrounding areas. Includes hydrogen-ready steel production and chemical clusters[567] • Chemicals Triangle (Saxony-Anhalt): Hosts early H_2 storage pilots (e.g., Bad Lauchstädt) and chemical refineries utilizing green hydrogen[568] • Delta Rhine Corridor: At the beginning of 2024 BASF, Gasunie, OGE and Shell have signed a Cooperation Agreement which details their intention to jointly

558 Germany's revision of the Energy Industry Act: a highway for hydrogen? (accessed 5/22/2025)

559 Hydrogen Certification - FfE (accessed 5/22/2025) and CertifHy Applauds German Environment Agency's Recognition of RFNBO Certification Schemes - CERTIFHY (accessed 5/22/2025)

560 Emissions trading generates 18.5 billion euros in revenue in Germany in 2024 – UBA | Clean Energy Wire (accessed 5/22/2025)

561 Germany's Climate Action Law | Clean Energy Wire (accessed 5/22/2025)

562 Recent progresses in H2NG blends use downstream Power-to-Gas policies application: An overview over the last decade - ScienceDirect (accessed 5/22/2025)

563 Statement on the German Hydrogen Acceleration Act: Further improving the important course for the hydrogen ramp-up (accessed 5/22/2025)

564 German cabinet approves bill to accelerate hydrogen power expansion | Reuters (accessed 5/22/2025)

565 Bundesnetzagentur - Hydrogen core network (accessed 5/22/2025)

566 HY-5 | Projects | HMG (accessed 5/22/2025)

567 The Ruhr region – A new Hydrogen Valley (accessed 5/22/2025)

568 Hydrogen in Saxony-Anhalt (accessed 05/22/2025)

	enable, de-risk and coordinate the development of a cross-border pipeline system in a cost effective, scalable and flexible manner[569] • These hubs co-locate electrolyzers, refueling stations, import infrastructure, and industrial offtake—supporting economies of scale and lowering distribution costs.
Regional infrastructure planning initiatives or mechanisms	• Hydrogen Core Network (Wasserstoff-Kernnetz): A 9,000 km national pipeline network plan submitted by German gas transmission system operators. The 2022-2032 plan prioritizes retrofitting gas pipelines and supports national connectivity[570] • Network Development Plan (Netzentwicklungsplan, NEP): Hydrogen is formally included in the national gas grid planning process overseen by BNetzA, updated every two years[571] • HyLand Program: Competition funded by the Federal Ministry of Digital and Transport supporting HyStarters, HyExperts, and HyPerformers in dozens of German municipalities to develop regional hydrogen roadmaps and feasibility studies[572] • EU Hydrogen Backbone: Germany is a core member of this initiative connecting hydrogen corridors across 28 countries, aligning its planning with cross-border pipeline and import hubs[573] • Spatial planning at state level: Network deployment planning must include all effective measures for the needs-based and efficient optimisation, reinforcement and expansion of the networks required for safe and reliable network operation in the respective reference periods. Converting existing pipeline infrastructure to hydrogen takes priority over building new pipelines.[574]
Innovative business models enabling development	• H2Global (double auction): Government buys green hydrogen from international producers under long-term contracts and resells it to German buyers—enabling imports to materialize even in an immature market[575] • Industrial offtake alliances: Steel, chemical, and utility companies form vertically integrated consortia (e.g., RWE, Thyssenkrupp, TotalEnergies in GET H2) to co-invest in hydrogen production, transport, and end use[576] • Hydrogen buses partnerships: Hydrogen buses manufacturing occurs through partnerships (e.g., CaetanoBus, in partnership with Toyota), and fueling stations are established in collaboration with public transport operators[577] • Hydrogen Power Purchase Agreements (H2-PPAs): Projects like Energiepark Bad Lauchstädt test the entire value chain of green hydrogen on an industrial scale[578] • Public anchor customer models: DB (Deutsche Bahn) and public bus fleets are procuring hydrogen vehicles and fuel. DB is working with Siemens Mobility on

569 Delta Rhine Corridor \| DRC (accessed 05/22/2025)

570 Hydrogen Network 2030: towards a climate-neutral Germany - FNB Gas (accessed 05/22/2025)

571 Bundesnetzagentur - Network development plan gas/hydrogen (accessed 05/22/2025)

572 HyLand - Hyland (accessed 05/22/2025)

573 Country Narratives \| EHB European Hydrogen Backbone (accessed 05/22/2025)

574 Bundesnetzagentur - Network development plan gas/hydrogen (accessed 05/22/2025)

575 State aid: Commission approves €900 million German scheme (see above) (accessed 5/22/2025)

576 RWE and TotalEnergies agree groundbreaking long-term offtake agreement for green hydrogen (accessed 5/22/2025)

577 Toyota's second gen Fuel Cell Stack powers hydrogen buses (accessed 05/22/2025)

578 About the project / Energiepark Bad-Lauchstaedt (accessed 05/22/2025)

	an innovative complete hydrogen system consisting of supply infrastructure, as well as train and maintenance infrastructure.[579]
Infrastructure re-tooling to support hydrogen	• Pipeline repurposing: ~56% of the Hydrogen Core Network will consist of repurposed natural gas pipelines, cutting construction timelines and costs.[580] • Salt cavern storage conversion: Facilities in Etzel, Bad Lauchstädt, and Krummhörn are undergoing testing for hydrogen storage viability—key for seasonal balancing [581,582] • Hydrogen-ready LNG terminals: New LNG terminals at Brunsbüttel and Wilhelmshaven are being designed with hydrogen/ammonia import and conversion capacity[583] • Power plant retrofits: Germany invests in new gas turbines to be hydrogen-ready, and is planning to retrofit dispatchable power plants for 100% H_2 between 2035 and 2040[584] • Industrial asset upgrades: Leveraging government investment, refineries and steel plants are adapting furnaces and process heat systems to use hydrogen (e.g., ArcelorMittal Hamburg H_2 DRI trial furnace, Thyssenkrupp Duisburg DRI plant)[585,586]
Supply chain strategy	
Supply chain targets	• 10 GW of electrolyzer capacity deployed domestically by 2030[587] • 50-70% of it's renewable H2 demand in 2030 to be supplied through imports[588] • Hydrogen Start Network of 1,800 km of hydrogen pipeline (both natural gas converted and newly built) connected to the broader European Hydrogen Backbone by 2030[589]

Manufacturing strategies or supply chain assessments	Germany's Hydrogen Council and federal ministries conducted a Hydrogen Technology Competitiveness Study in 2020 and 2023. Findings and actions include:
	• Germany is a global leader in PEM electrolyzers, but depends on foreign suppliers for membranes and catalysts
	• Launch of large-scale manufacturing projects, including:
	    ○ Siemens Energy gigafactory (Berlin) for PEM electrolyzers (opening 2024)[590]
	    ○ Thyssenkrupp Nucera expansion of alkaline electrolyzer production in Dortmund[591]

579 Deutsche Bahn 2023 Integrated Report (accessed 05/22/2025)

580 Hydrogen Network 2030: towards a climate-neutral Germany - FNB Gas (see above) (accessed 05/22/2025)

581 Hydrogen in Saxony-Anhalt (see above) (accessed 05/22/2025)

582 The Green Hydrogen Economy (accessed 05/22/2025)

583 Yara drives hydrogen economy with new ammonia import terminal | Yara International (accessed 05/22/2025) and Green Wilhelmshaven | Uniper (accessed 05/22/2025)

584 BMWE - Agreement on power plant strategy (accessed 05/23/2025)

585 Creating facts for the transformation: Air Liquide completes hydrogen pipeline to thyssenkrupp Steel in Duisburg (accessed 05/23/2025)

586 Hydrogen-based steelmaking to begin in Hamburg (accessed 12/8/2025)

587 Green hydrogen made in Germany will be cheaper than shipped imports in 2030: study | Hydrogen Insight (see above) (accessed 05/23/2025)

588 Green hydrogen made in Germany will be cheaper than shipped imports in 2030: study | Hydrogen Insight (see above) (accessed 05/23/2025)

589 Factsheet Germany's National Hydrogen Strategy Update 2023_0.pdf (accessed 05/23/2025)

590 Major new electrolyzer factory in Berlin is harbinger of budding hydrogen industry - Scholz | Clean Energy Wire (see above) (accessed 05/23/2025)

591 Expansion to 5 gigawatts of annual production capacity: thyssenkrupp represented in all three BMBF hydrogen lead projects - thyssenkrupp nucera (accessed 05/23/2025)

	◦ Sunfire scaling high-temperature SOEC electrolyzers (Saxony-based)[592] • Support via IPCEI, Clean Hydrogen Partnership, and KfW green finance[593] • Strategy includes incentivizing automotive suppliers to transition into fuel cell and hydrogen components[594]
Critical hydrogen supply chain components	• Electrolyzer stacks and catalysts (PEM and alkaline) – strategic focus of Siemens, Sunfire, Thyssenkrupp[595] • Fuel cell systems – produced by Bosch, Cellcentric (Daimler–Volvo JV)[596] • Compressors and cryogenic pumps – supplied by Neuman & Esser, Burckhardt, Linde[597] • Hydrogen storage tanks – Type IV composite cylinders (e.g., Hexagon Purus, Iljin H2 Europe)[598] • Membranes and ionomers – currently limited EU capacity, with domestic initiatives for scaling[599] • Power electronics, control systems, hydrogen sensors – supplied by Siemens, WIKA, and others[600] • PGMs (platinum group metals) – platinum and iridium flagged as critical raw materials; Germany supports recycling initiatives[601]
Supply chain risk mitigation strategies deployed	• Diversifying import partners (e.g., Canada, Australia, UAE, Norway, Chile) to avoid overdependence[602] • Investing in PGM recycling (e.g., Umicore, BASF projects) and substitution R&D (e.g., single-atom catalysts)[603] • Supporting alternative technologies (e.g., SOEC and AEM electrolyzers) to reduce iridium/platinum use[604] • Domestic manufacturing incentives tied to IPCEI and CCfD support for resilience in supply chains[605] • Certification and quality control systems to avoid low-grade or unsafe imported components[606]
Hub and spoke manufacturing ecosystems	These ecosystems follow a "hub and spoke" approach, where OEMs anchor innovation, and regional SMEs supply components, engineering, and testing services

592 RWE – Three-Digit Megawatt Electrolysis | Sunfire (accessed 05/23/2025)
593 Homepage - Clean Hydrogen Partnership (accessed 05/23/2025)
594 Automotive industry calls on German government to expand hydrogen infrastructure | Clean Energy Wire (accessed 05/23/2025)
595 Expansion to 5 gigawatts of annual production capacity: thyssenkrupp represented in all three BMBF hydrogen lead projects - thyssenkrupp nucera (accessed 05/23/2025)
596 Bosch to supply fuel-cell components to cellcentric (accessed 12/8/2025)
597 Compressors & compressor systems: Neuman & Esser (accessed 05/23/2025)
598 Hexagon Purus | Hydrogen high-pressure Type 4 cylinders (accessed 05/23/2025)
599 Critical and strategic raw materials for electrolyzers, fuel cells, metal hydrides and hydrogen separation technologies - ScienceDirect (accessed 05/23/2025)
600 Hydrogen product overview - WIKA (accessed 05/23/2025)
601 BASF Opens New Hydrogen Component Lab in Hannover, Germany (accessed 05/23/2025)
602 Toward a hydrogen import strategy for Germany and the EU: Priorities, countries, and multilateral frameworks (accessed 05/23/2025)
603 Heraeus Precious Metals to expand its recycling capacity - Recycling Today (accessed 05/23/2025)
604 Hydrogen Technologies - Fraunhofer IKTS (accessed 05/23/2025)
605 EU approves German subsidy scheme for slashing industry emissions | Clean Energy Wire (accessed 05/23/2025)
606 Hydrogen Certification - FfE (see above) (accessed 05/23/2025)

	• Baden-Württemberg (Fuel Cell Valley): Anchored by Daimler Truck, Bosch, Mahle – focused on heavy-duty mobility fuel cells, with network of SME suppliers[607] • North Rhine-Westphalia and Lower Saxony: Electrolyzer production and chemical industry integration (Thyssenkrupp Nucera, Siemens, Linde)[608] • Saxony (Sunfire cluster): High-temperature electrolysis and SOEC component manufacturing[609] • Bavaria (Hydrogen Aviation Cluster): MTU Aero Engines and Airbus working on aviation-grade hydrogen systems • Fraunhofer and university ecosystems (e.g., Fraunhofer ISE, KIT, TU Munich) link R&D with local industry development. Comprising of 38 Fraunhofer institutes, the network unites expertise across the entire hydrogen value chain, from hydrogen production to storage, distribution, infrastructure, and application in industry, mobility, energy, and heat. Its goal is to develop market-ready hydrogen technologies and actively contribute to the energy transition. Approximately 750 full-time equivalents at Fraunhofer are dedicated to these innovative solutions.
Workforce development	
Hydrogen skills or workforce market assessments[610, 611]	• The National Hydrogen Council (Wasserstoffrat) was appointed by the German National Hydrogen Council, consisting of 26 esteemed experts in economics, science, and civil society to support the development of the hydrogen market • Regional assessments (e.g., North Rhine-Westphalia, Saxony) forecast workforce transition needs in coal and chemical regions to staff new hydrogen production, logistics, and infrastructure operations[612] • Talent needs supply the increasing hydrogen market include, electrolyzer and fuel cell technicians, industrial mechanics and pipefitters (with hydrogen-specific safety and pressure system training), gas grid technicians and control room operators, fuel cell electric vehicle (FCEV) mechanics, health, safety, and environment (HSE) professionals, and permitting and regulatory compliance officers [613] • The Eu's skills strategy emphasizes reskilling from adjacent fields (natural gas, automotive, mechanical trades) but recognizes a lag in certified hydrogen-specific training pathways
Initiatives to support workforce development	• DVGW "H2-Ready" Training Certification: German gas utility workers and installers can certify for hydrogen infrastructure safety and blending standards[614] • Hydrogen Competence Centers: Established in Chemnitz and Duisburg to provide technical training for skilled trades (welding, pipe systems, system control)[615]

[607] How will hydrogen come to Baden-Württemberg? - Fraunhofer ISE (see above) (accessed 05/23/2025)

[608] Expansion to 5 gigawatts of annual production capacity: thyssenkrupp represented in all three BMBF hydrogen lead projects - thyssenkrupp nucera (see above) (accessed 05/23/2025)

[609] Hydrogen in Saxony-Anhalt (see above) (accessed 05/23/2025)

[610] White Paper: What needs to be done to increase the number of more skilled workers in the hydrogen sector from 4th November 2022 (accessed 05/22/2025) (accessed 05/23/2025)

[611] Green-Skills-for-Hydrogen-European-Hydrogen-Skills-Strategy-last-update-24102023.pdf (accessed 05/22/2025)

[612] North Rhine-Westphalia - Industry Transition Platform Strategy.pdf (accessed 05/22/2025)

[613] Federal Institute for Vocational Education and Training (BIBB) - Germany (accessed 05/22/2025)

[614] DVGW Services (accessed 12/8/2025)

[615] H2 funding: Germany approves millions in grants for ITZ Chemnitz and ITZ Nord - electrive.com (accessed 05/22/2025)

	• Hydrogen Skills Campus (Energieagentur NRW): Offers modular short courses for fossil fuel workers transitioning to hydrogen (e.g., refinery technicians to electrolyzer operators)[616] • Dual education adaptations: Apprenticeship programs for roles such as Industrial Mechanics and Plant Technicians now include hydrogen system training modules[617] • Public retraining subsidies: Administered by the Federal Employment Agency to support reskilling in coal regions (e.g., Lausitz), especially for displaced lignite workers[618] • Linde and Siemens internal academies: Run company-specific virtual reality trainings for hydrogen safety, commissioning, and plant operations for both employees and contractors[619, 620]
Educational partnerships and certification development	• RWTH Aachen Hydrogen Lab: Co-funded by government and private sector to train engineers and technicians in hydrogen plant operation, diagnostics, and control[621] • TU Munich & KIT: Offer graduate-level specializations in hydrogen technologies, covering fuel cell systems, electrochemical engineering, and hydrogen economy modelling[622] • Ballard, Bosch, and Fraunhofer partnerships: Collaborate with local universities (e.g., Hochschule Esslingen, University of Duisburg-Essen) to deliver hydrogen research projects with embedded student placements[623] • NSF-funded PhD and Master's fellowships all topics related to green hydrogen, tied to public labs (e.g., Helmholtz Institute)[624] • Go MINT Hydrogen Initiative: Federal program encouraging young people in STEM to pursue hydrogen careers, including scholarship and mentorship support[625] • TÜV Rheinland and VDI certification programs: Offer formal certifications such as "Certification of Green Hydrogen" and "Specialist for Safe Handling of Hydrogen" for mid-career professionals[626]
Community engagement	
Education and outreach programs	• Hydrogen Roadshow ("Daimler Truck"): A mobile exhibit truck tours cities across Germany with interactive demonstrations (e.g., fuel cell cars, electrolyzer displays) targeting schools, local officials, and the general public[627] • Public broadcasting and documentaries: ARD and ZDF aired prime-time specials like "Wundermittel Wunderstoff" to educate the public about hydrogen's benefits and limitations[628]

616 Hydrogen training courses of the DVGW - wasserstoff-niedersachsen.de (accessed 05/22/2025)

617 Green-Skills-for-Hydrogen-European-Hydrogen-Skills-Strategy-last-update-24102023.pdf (see above) (accessed 05/22/2025)

618 German Just Transition Case Study_0.pdf (accessed 05/22/2025)

619 Consulting & Training | A Linde Company (accessed 05/22/2025)

620 Virtual reality and field operator training - Siemens Global (accessed 05/22/2025)

621 Hydrogen Technologies - RWTH AACHEN UNIVERSITY Institute of Automatic Control - English (accessed 05/22/2025)

622 Hydrogen technologies for a sustainable energy system - Chair of Energy Systems (accessed 05/22/2025)

623 Internships (accessed 05/22/2025)

624 ERA Fellowships - Green Hydrogen - DAAD (accessed 05/22/2025)

625 MINT / STEM - BMBF (accessed 05/22/2025)

626 Hydrogen Pipelines | TÜV SÜD (accessed 05/22/2025)

627 Pressrelease | Daimler Truck (accessed 05/22/2025)

628 Wundermittel Wasserstoff (accessed 05/22/2025)

	• Hydrogen Events and Trade Fairs: Held by states such as Schleswig-Holstein and Saxony-Anhalt, where residents and professionals alike can visit hydrogen facilities and talk to experts on active projects and the future of hydrogen[629] • Curriculum integration: The H_2 Network Germany distributes hydrogen science teaching kits and lesson plans to secondary schools, helping integrate clean energy concepts and innovative technology into science education[630]
Community benefit or local hiring initiatives	• Local job commitments: Projects like SALCOS (Salzgitter) include retraining for regional workers, especially those affected by coal or industrial transitions[631] • Community co-ownership models: Wind-hydrogen cooperatives in Mecklenburg-Vorpommern and Lower Saxony allow local residents and farmers to invest in and share profits from hydrogen production projects[632] • Municipal investments: Cities like Rostock have taken equity stakes in hydrogen port terminals to retain local value and participate in long-term profits[633] • Works councils and labor agreements: Hydrogen projects integrated into Germany's co-determination model for the coal, iron, and steel industries allow employee-elected works councils to represent local voices in workforce and community matters[634] • In regions like Lusatia and the Rhineland, formerly dependent on coal, Germany's Just Transition Framework ensures displaced workers are prioritized for new hydrogen jobs and training[635] • Citizen energy cooperatives: Enable local ownership of hydrogen infrastructure, modeled on Germany's successful wind energy cooperatives[636] • Community advisory panels: Established for major hydrogen infrastructure (e.g., pipeline routing, terminal siting) to gather local input and prevent opposition[637] • Public procurement prioritizing local SMEs: Hydrogen procurement contracts by municipalities often include small business participation requirements to ensure local economic benefit[638]
Indigenous engagement practices and participation structures	No initiatives or structures identified

[629] Invitation to the discussion event "Saxony-Anhalt as model region for green hydrogen" (accessed 5/23/25)

[630] Horizon Educational - ABOUT US (accessed 5/23/25)

[631] German steelworkers win a green steel transition | TUC (accessed 5/23/25)

[632] Success factors of citizen energy cooperatives in north western Germany | Energy, Sustainability and Society (accessed 5/23/25)

[633] Rostock Port: ANDRITZ to engineer another 100 MW green hydrogen plant for Germany (accessed 5/23/25)

[634] German steelworkers win a green steel transition (accessed 12/8/25)

[635] German Just Transition Case Study_0.pdf (accessed 5/23/25)

[636] Citizens' participation in the Energiewende | Clean Energy Wire (accessed 5/23/25)

[637] National Hydrogen Council (accessed 5/23/25)

[638] German Just Transition Case Study_0.pdf (see above) (accessed 5/23/25)

8.8 Value chain components

8.8.1 Production

8.8.1.1 Electrolysis

Electrolysis powered by renewable electricity is considered a green hydrogen production pathway and is increasingly being adopted, as demonstrated by the region's announced projects.

Electrolysis produces hydrogen by using electricity to separate water into hydrogen and oxygen within an electrolyzer.[639] When powered by renewable electricity sources such as solar or wind, this method results in minimal greenhouse gas emissions. The electrolysis process incorporates an anode and cathode separated by an electrolyte, with electricity facilitating the electrochemical reaction. The high-purity hydrogen produced is suitable for applications such as fuel cells that require 99.999% purity.[640]

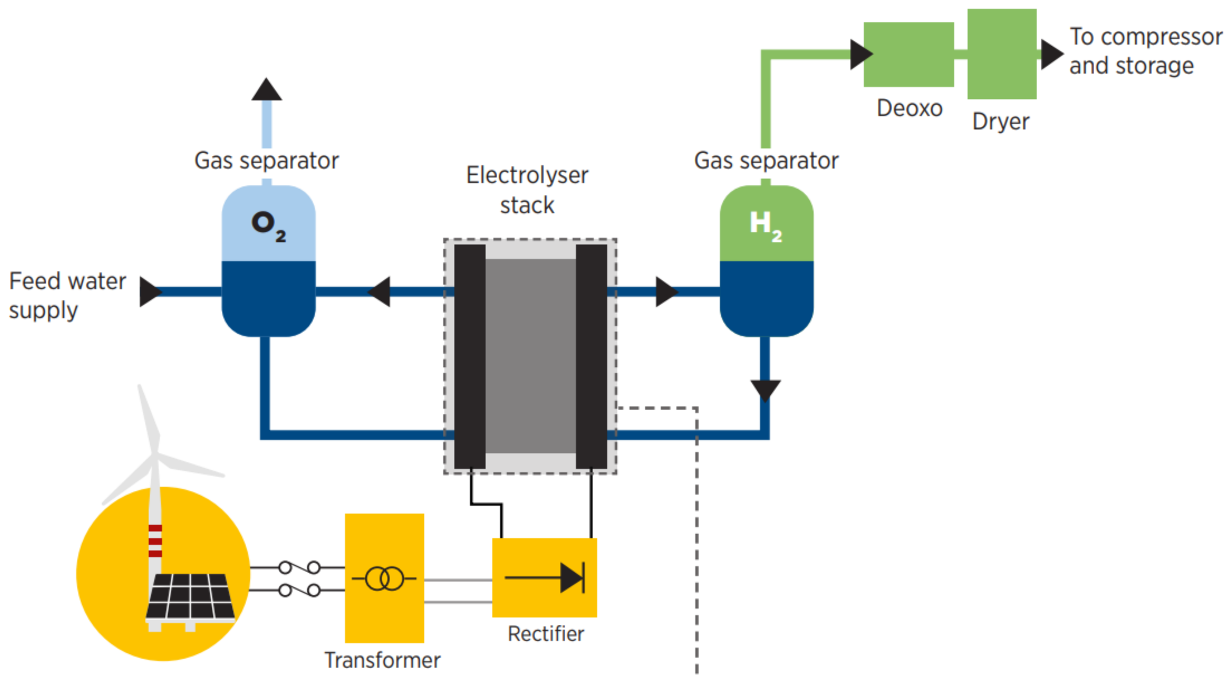

Figure 29 Basic components of water electrolysis at a system level[641]

There are three primary electrolysis technologies, each possessing unique technical characteristics, operational requirements, TRLs and application potentials. Following is a summary of each technology and its compatibility with the region's renewable energy infrastructure.

Proton exchange membrane (PEM) electrolysis

[639] International Renewable Energy Agency (2020) Green Hydrogen Cost Reduction. Online: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Dec/IRENA_Green_hydrogen_cost_2020.pdf

[640] Stargate Hydrogen (2025) How Pure Is Pure Enough? The Most Important Questions About Hydrogen Purity. Online: https://stargatehydrogen.com/blog/hydrogen-purity/

[641] International Renewable Energy Agency (2020) Green Hydrogen Cost Reduction. Online: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Dec/IRENA_Green_hydrogen_cost_2020.pdf

PEM electrolysis uses a solid polymer electrolyte membrane to conduct protons and separate generated oxygen and hydrogen gases. This solid electrolyte enables compact designs and fast system responses. Advantages include easy installation in tight spaces, compatibility with variable renewable energy inputs, high current densities, and high-purity hydrogen production.[642] However, the need for precious metal catalysts like platinum and iridium raises costs of the electrolyzer and poses supply risks.[643] High-grade deionized water is required to prevent membrane fouling. PEM electrolysis is ideal for areas with abundant wind energy due to its rapid ramping capabilities and modular design, suiting decentralized and offshore hydrogen production. Although high costs and material dependencies currently challenge large-scale deployment, PEM technology remains effective and is increasingly being scaled for small-to-medium projects in ports and transportation sectors, with ongoing advancements aimed at improving its competitiveness for larger export projects.

Alkaline electrolysis

Alkaline electrolysis, a mature technology for hydrogen production, uses a liquid alkaline electrolyte (KOH or NaOH) to conduct electricity between two electrodes separated by a diaphragm. Its advantages include long operational history of over 100 years, lower production costs (when compared to other types of electrolysis), the use of inexpensive catalysts like nickel, and proven durability for large-scale hydrogen generation. The established manufacturing base also supports component sourcing and deployment. However, alkaline electrolysis has limitations such as slower dynamic response, making it less suitable for integration with intermittent renewables like wind and solar. It requires larger system footprints due to lower current density, and gas crossover can affect hydrogen purity under partial load operations. This method is ideal in regions with stable renewable electricity sources, however, its slower power response may be restrictive in areas that rely heavily on variable wind energy.

Solid oxide electrolyzer cell (SOEC)

SOEC is a high-temperature (600°C to 850°C) electrolysis technology that uses a solid oxide or ceramic electrolyte to conduct oxygen ions, enhancing electrical efficiency through electricity and thermal energy. SOEC efficiently produces hydrogen by using available electricity and waste heat, integrating well with industrial and nuclear heat sources. This results in large-scale production with minimal additional energy. It also reduces reliance on critical minerals thanks to abundant ceramic materials. SOEC can co-electrolyze CO_2 and water to produce syngas, which can be converted into synthetic fuels like sustainable aviation fuel and e-methanol.[644] Despite its potential, SOEC is still in the demonstration phase with limited commercial availability. High operating temperatures pose challenges in thermal management, material degradation, and sealing integrity, making small-scale applications less feasible.[645] Future deployment in Atlantic Canada may depend on regional industrial decarbonization or synthetic fuel export market developments.

8.8.1.2 Systems and components of electrolysis

Electrolysis systems are intricate assemblies of components working together to produce hydrogen. This section details the key systems and components of the electrolysis technologies, along with insights dependencies, approximate lead times and other considerations. A detailed list of systems and components can be found in Appendix 8.3.

Electrolyzer stack

The electrolyzer stack is the heart of the hydrogen facility and is currently experiencing high global demand. Its modular design allows it to be adapted based on capacity requirements, offering flexibility and the potential for expansion in planned units. The electrolyzer stack is a key component of the electrolysis system, consisting of multiple cells with electrodes and an electrolyte, where water is divided into hydrogen and oxygen through an electrochemical reaction.

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642 PEM Electrolyzers vs. Alkaline Electrolyzers. (Accessed 6/20/25)

643 ANALYSIS | Will rising platinum and iridium prices restrict the growth of PEM hydrogen electrolyzers and fuel cells? | Hydrogen Insight (Accessed 6/20/25)

644 Synthetic Fuels – H2Electro (Accessed 6/20/25)

645 High Efficiency, High Costs: Is There Space for Solid Oxide Electrolyzers in the Hydrogen Industry? | Cleantech Group (Accessed 6/20/25)

At present, Atlantic Canada does not have local manufacturing infrastructure and capabilities for electrolyzer stacks, necessitating their import from Europe and Asia with a lead time currently up to 24 months due to heightened demand and competition.[51,52] This lack of local production hampers rapid deployment, particularly for large-scale projects that have been announced. Furthermore, individual components within the electrolyzer stack (e.g., electrodes and electrolytes) are currently being sourced from global markets. Suppliers for electrolyzer and related components include Nel Hydrogen, Plug Power, and ITM Power.

Electrodes that require expensive and critical minerals (i.e., nickel (alkaline/SOEC), platinum (PEM), and iridium (PEM)) must be sourced from regions including Europe, Asia, or South Africa, which are often central to global trade discussions. This international dependence on essential materials, coupled with an import-dependent system, and inadequate infrastructure, contributes to price volatility and supply constraints resulting from high global demand and limited production capacity.

Power supply system

The power supply system ensures that the electrolyzer stack receives the required electrical input to drive the reaction. It converts alternating current from renewable sources or the grid into direct current, supplying specific voltages. PEM systems require advanced power electronics capable of handling variable inputs from renewables such as wind, often sourced internationally (e.g., Germany). Transformers for large-scale systems are typically imported from the US or Europe, with increasing lead times ranging from 2 to 4 years,[646] reflecting the raising global demand for renewable energy projects though some local procurement is possible. While standard power supply components are available through North American distributers, the advanced electronics required for PEM systems are not locally produced, increasing reliance on international supply chains. Primary industry players and suppliers of the power supply systems include Schneider Electric, General Electric, Siemens Canada, and ABB.

Water purification system

The water purification system ensures that the electrolyzer stack receives deionized water, which is crucial to prevent degradation of the components resulting from pollutants originating from the feedwater and the electrolyzer. Producing ultra-pure water for PEM and alkaline systems necessitates the use of ion exchange units. Maintaining the purity of water after it enters the electrolyzer stack is important for safe, stable, and long-term use. Alkaline and PEM electrolyzers face unique challenges due to their different operational processes, requiring specific solutions for each.[647]

These systems are relatively less complex compared to other purification methods and are widely used across various industries for their efficiency and reliability. The broad supplier base ensures the availability of such systems, which are frequently procured from international suppliers such as DuPont in the USA and LANXESS in Germany.

Gas separation and purification system

This system separates and purifies hydrogen and oxygen gases produced during electrolysis, effectively removing water vapour and impurities. It does so using a series of membrane filters and adsorption materials, which are specially designed to capture and eliminate unwanted substances. This ensures that the gases achieve the necessary purity levels, reaching up to 99.999%, to meet specific end-use requirements such as medical applications, industrial processes, and fuel cells.[648]

To achieve such high purity levels, high-purity pressure swing adsorption (PSA) units are employed. These units work by alternating pressures to separate hydrogen from other gases, ensuring the highest level of purity. The PSA units are procured from European suppliers such as Hygear and American suppliers like Air Products.

Cooling system

[646] Addressing the Critical Shortage of Power Transformers to Ensure Reliability of the U.S. Grid (Accessed 6/20/25)

[647] WhitePaper-RefinementLoop-UPW-Hydrogen-EUROWATER.pdf (Accessed 6/20/25)

[648] Hydrogen Purification Technologies Overview 2021 ARPA-E Methane Pyrolysis Annual Program Review Virtual Meeting (Accessed 6/20/25)

The cooling system regulates the temperature of the electrolysis system to optimize performance and protect components from thermal stress. Current hydrogen electrolysis technologies convert 20-40% of their capacity into excess heat, which must be continuously cooled.[649] High-efficiency cooling loop components (e.g., heat exchangers, and pumps), are typically sourced from international suppliers in Europe (e.g. Alfa Laval and Kelvion) and the US. However, local capabilities also exist within Atlantic Canada and elsewhere in Canada to procure other generic components, as most other components in this system are widely used across various industries.

Safety, control, and monitoring systems

Safety and monitoring systems designed to detect hydrogen leaks, manage pressure, and prevent gas crossover facilitate rapid shutdown in emergencies. Hydrogen sensors for high-pressure and high-temperature environments are sourced from suppliers in the USA such as Temp-Pro and from Canadian suppliers such as SUCO ESI. High-pressure valves are also imported from the USA. Control and monitoring systems use complex control circuits, primarily sourced from the USA and Taiwan, with limited local production capacity, contributing to supply chain challenges. Standard safety components are available through local suppliers; however, the requirement for advanced monitoring can increase costs and complexity, necessitating investments in training.

8.8.1.3 Additional hydrogen production methods

Steam methane reforming (SMR) with carbon capture, utilization, and storage (CCUS)

A widely used industrial process that extracts hydrogen from natural gas. This process involves reacting methane (the main component of natural gas) with steam under high temperatures to produce hydrogen and carbon dioxide. To mitigate the environmental impact, CCUS technology is employed to capture the carbon dioxide produced and store it underground, preventing it from entering the atmosphere.

While SMR and CCUS are both established and efficient processes, their combined deployment in Atlantic Canada is currently limited. This is primarily due to the region's existing natural gas infrastructure, which influences the availability and distribution of methane required for the process. However, as infrastructure evolves and with potential future investments, opportunities for SMR with CCUS may expand.[650] At present, there are no large-scale SMR with CCUS facilities operating in Atlantic Canada, but the technology is mature, with a technology readiness level of 9, and is commercially deployed in other parts of the world, including other regions in Canada.[651]

Biomass gasification

A method of producing hydrogen by converting organic materials, such as agricultural residues, wood chips, and other biomass feedstocks, into gas through a high-temperature process. This gas, primarily composed of hydrogen, carbon monoxide, and carbon dioxide, is further processed to extract hydrogen. Biomass gasification is particularly appealing for regions with abundant organic material.

In Atlantic Canada, the region's strong forestry and agricultural sectors present a promising foundation for biomass gasification. While the availability and consistency of biomass feedstock are important considerations, the logistics of collecting, transporting, and processing these materials can present operational challenges that require coordinated efforts among multiple parties. Nevertheless, ongoing advancements in supply chain management could support future development. Currently, there are no commercial-scale biomass gasification plants in operation in Atlantic Canada, but the region's resource base offers potential for future projects.

The TRL for biomass gasification varies, but it is considered to be between

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649 Optimize hydrogen electrolyzer cooling efficiency | Alfa Laval (Accessed 6/20/25)

650 Net-Zero Future: A Feasibility Study of Hydrogen Production, Storage, Distribution and Use in The Maritimes | Net Zero Atlantic (Accessed 6/19/25)

651 ETP Clean Energy Technology Guide – Data Tools - IEA (Accessed 6/19/25)

TRL 5-6, indicating that while the technology is technically proven and has been demonstrated at pilot scale, it is not yet widely commercialized.

Methane pyrolysis

Methane pyrolysis is an industrial process that extracts hydrogen from methane without producing carbon dioxide as a byproduct. Unlike steam methane reforming, methane pyrolysis involves the thermal decomposition of methane at high temperatures in the absence of air or oxygen, resulting in the production of hydrogen and solid carbon. This method reduces the emission of carbon dioxide, thus decreasing the need for CCUS technologies.

The implementation of methane pyrolysis in Atlantic Canada is currently hindered by several factors, including the region's limited natural gas infrastructure and elevated natural gas prices in provinces such as Nova Scotia and New Brunswick, which constrain methane availability and distribution for this process. Additionally, the technology itself remains in development, with most large-scale projects still at the pilot or demonstration stage.

The TRL for methane pyrolysis is considered to be TRL 7, indicating that while the technology has been demonstrated in relevant environments, it is not yet fully commercialized. Additional advancements and investments are needed to overcome infrastructural and economic barriers before widespread adoption can occur in regions like Atlantic Canada.

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