Hydrogen in the Automotive and Mobility Sector:

Understanding Ontario's Strategic Opportunities

Technologies, Infrastructure Requirements, and Deployment Opportunities for the Sector

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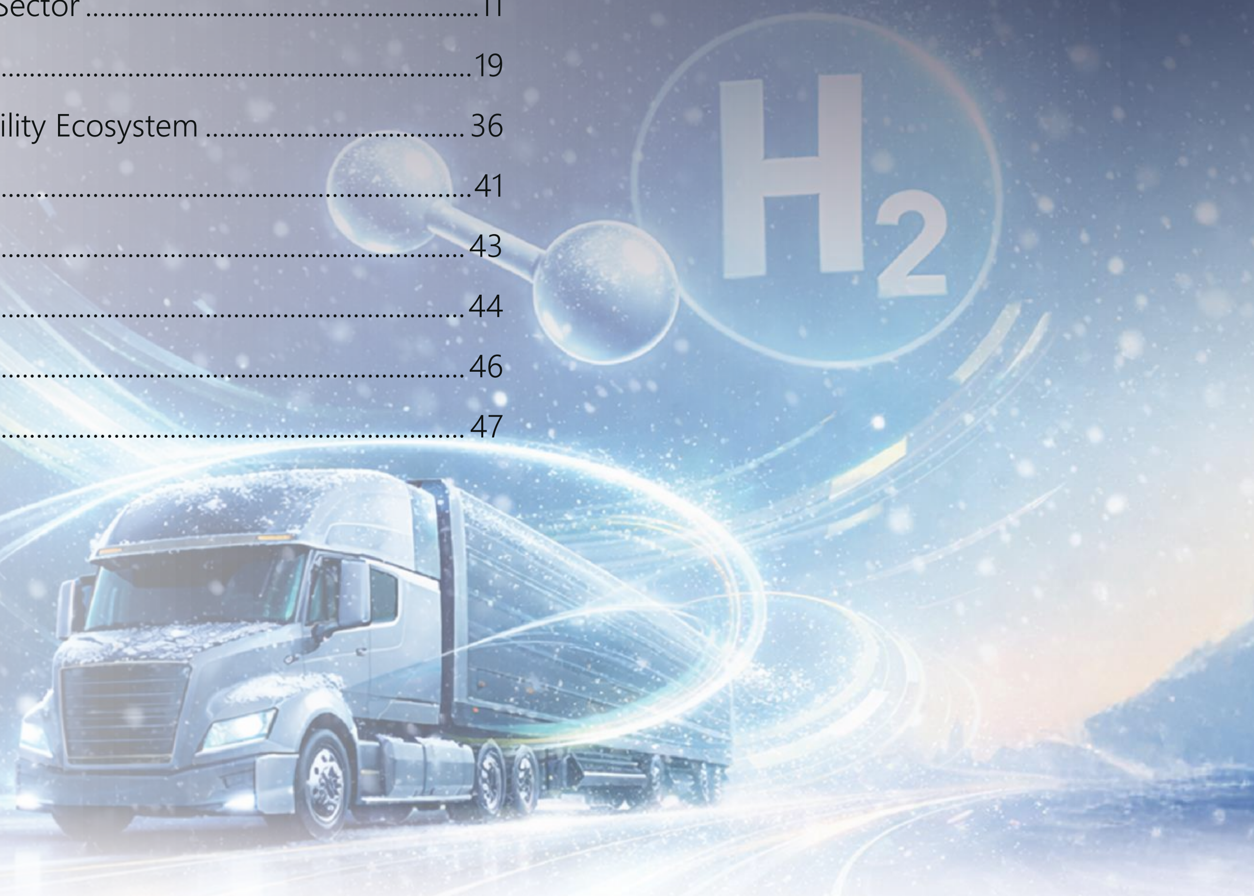
Contents



Executive Summary

Hydrogen is emerging as a strategically important complement to electrification in Ontario's clean mobility advantage, particularly in applications where electrification faces practical or technical limits. As the province advances its decarbonization objectives, hydrogen offers a pathway to address heavy-duty, high-utilization, and energy-intensive transport segments that are difficult to electrify at scale. Ontario's clean electricity system, established industrial base, manufacturing strengths, and large freight corridors create favourable conditions for targeted hydrogen deployment within the mobility ecosystem.

Hydrogen mobility applications show the strongest near-term potential in heavy-duty use cases, including long-haul and regional freight trucking, transit and coach buses, port and airport ground vehicles, material-handling equipment, and mining and off-road fleets in northern and remote regions. These segments benefit from fast refuelling, reliable performance in cold climates, and the ability to maintain high vehicle uptime. Stakeholders consistently emphasized that hydrogen is not a universal solution, however, it is well suited to operational contexts where vehicle uptime, payload requirements, and refueling speed are critical.

Ontario's automotive and advanced manufacturing base provides a strong foundation for the growth of hydrogen mobility. The province has established capabilities in fuel-cell systems, power electronics, vehicle integration, controls, and advanced materials, along with experience supporting emerging vehicle technologies through research, testing, and demonstration. These strengths position Ontario companies to participate in the expanding hydrogen technology supply chain, as vehicle platforms and refuelling networks continue to develop.

Ontario's broader hydrogen ecosystem is progressing, although it remains at an early stage of commercialization. Existing industrial hydrogen production is largely concentrated in the Sarnia–Lambton region, where there is potential to increase access to lower-carbon hydrogen pathways over time. New capacity is also emerging, including the Niagara Hydrogen Centre, which will begin producing green hydrogen in 2026 using clean electricity. On the policy front, regulatory developments, including the Special Projects regulation and the Geologic Carbon Storage Act, have created enabling conditions for pilot and future commercial carbon capture, utilization and storage (CCUS) projects. These measures are critical for reducing emissions from existing hydrogen production. While these developments represent meaningful progress, cost competitiveness, long-term policy certainty, and investment confidence remain key challenges identified by stakeholders.

At the same time, infrastructure readiness represents an opportunity for development. Hydrogen refuelling infrastructure in Ontario is at an early stage with only a small number of stations and pilot sites in operation. Expanding strategically located refuelling stations along the 401 and 402 freight corridors present an opportunity to enable early uptake in the trucking sector. Stakeholders consistently emphasized that modular or packaged refuelling systems located at ports, airports, transit depots, logistics hubs, and industrial sites could accelerate fleet-based adoption while reducing infrastructure risk during the initial stages of market development.

In this context, concentrating early activity in locations where production and demand naturally converge becomes essential. A regional hub approach offers a practical framework for advancing hydrogen deployment in Ontario. Hydrogen hubs in Niagara, the Greater Toronto and Hamilton Area (GTHA), and Sarnia–Lambton can cluster production, demand, infrastructure, and investment. By linking mobility applications with industrial loads and existing energy assets, these hubs support phased development and enable learning through early pilots. Concentrating initial activity where supply and demand can be aligned also helps reduce costs and lowers project risk.

Ontario's opportunity landscape spans both mobility deployment and supply chain development. Near-term mobility opportunities are concentrated in freight transportation, public transit, logistics operations, and off-road and resource-based activities. On the supply-chain side, opportunities include fuel-cell stacks and modules, hydrogen storage tanks, refuelling and compression equipment, vehicle integration services, and related digital and control systems. To enable these opportunities, workforce and skill development, supported by testing and validation infrastructure, will be essential as technologies advance.

Policy and regulatory frameworks remain central enablers of hydrogen mobility. Stakeholders highlighted the importance of electricity price certainty for electrolysis, clear and predictable Carbon Capture Use and Storage (CCUS) rules, streamlined permitting processes, consistent safety and code frameworks, and stable incentive programs to support early adoption. Coordination across provincial, federal, and municipal levels will be essential to reduce uncertainty and support investment decisions.

Within this context, the Ontario Vehicle Innovation Network (OVIN) plays a critical role as a platform for de-risking hydrogen technologies through enabling research, development, testing, and demonstration. By supporting pilot projects, convening industry and public-sector partners, and connecting emerging technologies to Ontario's manufacturing ecosystem, OVIN helps accelerate learning, build evidence on real-world performance and costs, and support pathways to commercialization.

Taken together, hydrogen can support Ontario's economic competitiveness and emission-reduction goals when deployed in targeted, high-value mobility segments. By advancing a hub-based approach, strengthening enabling policies, supporting early pilots, and leveraging Ontario's manufacturing strengths, the province can advance hydrogen mobility in a commercially grounded and responsible manner.

1. Hydrogen Fundamentals

Hydrogen is emerging as a strategic energy vector that can support Ontario's transition toward cleaner, more flexible, and resilient energy systems. As global markets invest in low-emissions hydrogen production, infrastructure, and technology development, jurisdictions are increasingly assessing hydrogen's role across industry, transportation, and electricity.

This section provides an introduction to the fundamentals of hydrogen, including its key properties, production pathways, and end-use applications. It outlines what distinguishes hydrogen from other clean energy carriers, how it can complement electrification, and where it is best positioned to contribute to decarbonization.

1.1. What Is Hydrogen and Why It Matters for Decarbonization

Hydrogen is the lightest chemical element, consisting of a single proton and electron, and while it is extremely abundant in the universe, it is rarely found on Earth in a pure, usable form. Instead, hydrogen is typically bound to other elements, such as oxygen in water or carbon in natural gas, which means energy is required to extract it before it can be used as a fuel. For this reason, hydrogen is better understood as an energy carrier rather than a primary energy source.[1]

Once produced, hydrogen offers several unique energy characteristics. By weight, it contains significantly more energy than conventional fuels. One kilogram of hydrogen holds about 33.6 kilowatt-hours of energy, roughly equivalent to 2.8 kilograms of gasoline or nearly three times the energy content of diesel on a mass basis.[2] This high energy density relative to weight makes hydrogen particularly attractive for applications such as heavy-duty transport and long-distance travel.

According to International Energy Agency (IEA) Global Hydrogen review 2025, hydrogen demand continued its long-term upward trajectory globally, reaching 100 million tonnes (Mt) in 2024, a 2 percent increase from 2023[3] At present hydrogen demand is primarily concentrated in feedstock in industrial processes, such as oil refining, ammonia production for fertilizers, methanol production, and increasingly in iron and steel via direct-reduced iron processes. Beyond feedstock roles, hydrogen can also be used as a substitute for fossil fuels for high-temperature process heat in sectors like glass, cement, and chemical production.

Hydrogen can be stored and transported by compressing or liquefying it, and it can be converted back into usable energy through fuel cells, turbines, or modified engines. When hydrogen is used in a fuel cell, it generates electricity through an electrochemical reaction with oxygen, producing only water and heat at the point of use. When hydrogen is combusted in turbines or modified internal combustion engines, it does not produce carbon dioxide but can generate small amounts of nitrogen oxides (NO_x) due to high-temperature combustion in air. Advanced combustion design and emissions control strategies can mitigate NO_x production.[4] As a result, hydrogen can enable zero-emission operation of vehicles, industrial processes, and power systems when it is produced using low- or zero-carbon energy sources.

In the broader energy system, hydrogen is being explored as an option for decarbonizing parts of the economy where direct electrification is difficult or costly, including:[5]

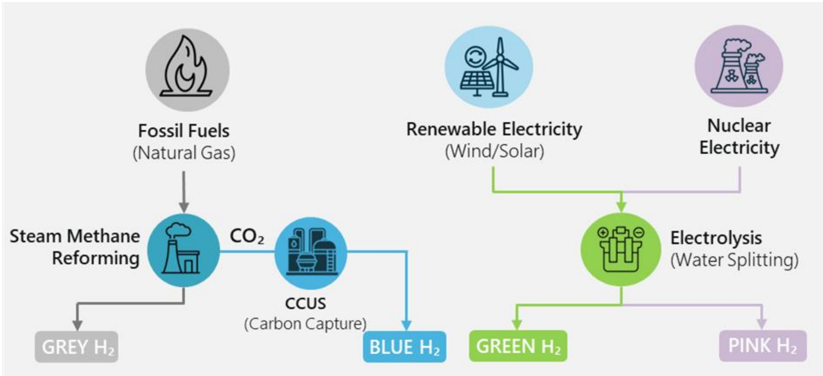
- Heavy industry, where it can replace fossil-based feedstocks and fuels in sectors such as steel, chemicals, refining and fertilizers.
- Heavy transport and long-range mobility, where fuel cells or hydrogen engines can serve long-haul trucks, buses, rail, shipping and potentially aviation when battery size, weight or charging time is a constraint.
- Energy system flexibility and long-duration storage, where surplus low-carbon electricity can be converted into hydrogen and stored for extended periods to meet multi-day or seasonal demand.

Hydrogen is also being explored for use by data centres, primarily as a low-carbon replacement for diesel backup generators using hydrogen fuel cells, and in some cases as a supplementary power source to support large, power-dense facilities where grid capacity or reliability is constrained.[6]

Production Pathways and Colour Typology

Hydrogen is classified by how it is produced. The sector uses an informal "colour" shorthand to distinguish production pathways and their carbon footprints. Figure 1 shows the main hydrogen production pathways based on different energy inputs, production technology and form of hydrogen produced.[7]

Figure 1: Hydrogen Production Pathways and Color Typology



Grey H_2	Grey Hydrogen is produced from fossil fuels, typically natural gas, through steam methane reforming (SMR). The CO_2 generated during this process is released into the atmosphere, resulting in a high carbon footprint.
Blue H_2	Blue Hydrogen is also produced from fossil fuels but is paired with Carbon Capture, Utilization, and Storage (CCUS). This process captures a significant portion of the CO_2 emissions and stores them underground, leading to a reduced carbon footprint compared to grey hydrogen.
Green H_2	Green Hydrogen is produced via the electrolysis of water, powered by renewable energy sources such as wind, solar, or hydro. This process splits water into hydrogen and oxygen, with no direct CO_2 emissions, resulting in a very low or zero carbon footprint.
Pink H_2	Pink / Purple Hydrogen is also produced through the electrolysis of water, but it is powered by nuclear electricity. This method also has a low-carbon footprint, similar to green hydrogen.

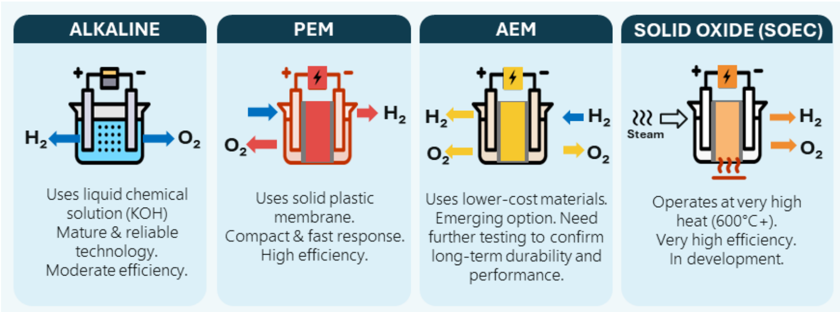
In addition to these commonly referenced colour categories, hydrogen can also be produced from renewable feedstocks through thermochemical processes. Biomass gasification is one such pathway, using organic materials such as forestry residues, agricultural waste, and biomass crops as inputs. These feedstocks absorb CO_2 during growth, and when sustainably sourced, the resulting hydrogen can be near carbon-neutral over its lifecycle. This process involves converting dry biomass into syngas, which is subsequently reformed into hydrogen.[8] While currently at a smaller commercial scale than electrolysis, recent techno-economic modelling indicates that biomass-based pathways, specifically Bioenergy with Carbon Capture and Storage (BESS) and co-production with biochar, are projected to be among the most cost-effective long-term solutions for large-scale hydrogen supply. These routes are particularly valued for their ability to offset residual emission in hard-to-abate sectors, although their deployment remains sensitive to feedstock availability and supply chain complexity.[9]

Overview of Electrolyser Technologies and Characteristics

From a decarbonization perspective, attention is increasingly focused on low-carbon hydrogen production pathways that minimize lifecycle greenhouse gas emissions. Among these pathways, electrolysis-based hydrogen production is central because it enables hydrogen to be produced directly using electricity rather than fossil fuels, with emissions determined largely by the carbon intensity of the power source. When supplied with low- or zero-carbon electricity, electrolysers can produce hydrogen with very low associated emissions, making this pathway particularly relevant for applications seeking decarbonization.

Green and pink hydrogen production are central to low-emission hydrogen systems and are currently dominated by alkaline and proton-exchange membrane (PEM) electrolyser technologies. Anion Exchange Membrane (AEM) electrolysers are emerging as a developing option, while solid oxide electrolysers (SOEC) remain more nascent and are generally suited to specific niche applications.[3] Figure 2 illustrates the four main electrolyser technologies used for hydrogen production and their operating principles, technology maturity, and key performance characteristics.[3]

Figure 2: Illustrative Guide to Hydrogen Electrolysers



Alkaline electrolysers remain the most mature and widely deployed hydrogen production technology, benefiting from decades of industrial development, particularly in markets such as China where the chlor-alkali industry has supported large-scale manufacturing for over 40 years. These systems use a liquid alkaline electrolyte and historically have offered lower headline capital costs compared with other electrolyser technologies, though total installed cost can vary depending on system configuration and project requirements.[10]

Market developments show a clear cost divergence between Chinese-manufactured alkaline systems and those produced in North America and Europe. For instance, Chinese pressurised alkaline electrolysers can reduce project costs by roughly 40–50 percent in some markets, driven by large-scale automated manufacturing and vertically integrated supply chains.[10] Auction results within China further demonstrate significantly lower equipment prices sometimes two to five times below typical North American or European equipment costs although these figures reflect domestic procurement conditions and may not directly translate to international project costs.[11]

While some lower-cost systems offer strong economic advantages, they typically involve performance trade-offs. These include lower operating current densities and higher minimum operating loads, which reduce their ability to respond quickly to fluctuating renewable power.[12] This indicates that these systems struggle with the flexibility needed to integrate variable renewable energy efficiently. The power that cannot be used during these periods of mismatch between supply and the system's operational limits is effectively lost. In contrast, more advanced pressurised alkaline systems developed by suppliers, such as Thyssenkrupp Nucera, address many of these limitations. These newer designs can ramp power up and down at rates comparable to PEM electrolysers, enabling greater operational flexibility and improved suitability for grid-balancing applications.[13]

PEM electrolysers utilize a solid polymer membrane and typically rely on precious-metal catalysts. Compared with alkaline systems, they can operate at higher power densities and respond more quickly to changes in electricity supply. This makes PEM technology well suited to integration with variable renewable energy and to applications where space is limited.[14] However, these performance advantages come at a higher cost. In 2024, typical installed costs for PEM electrolysers outside China were estimated at around 2,400 to 2,500 USD per kilowatt, compared with roughly 2,000 USD per kilowatt for alkaline systems.[15] PEM systems also face potential scalability constraints due to their reliance on iridium and platinum, which are scarce, geographically concentrated, and subject to price volatility.[15] The IEA's Global Hydrogen Review 2025 notes ongoing innovation aimed at reducing PEM stack costs and material intensity so that non-Chinese suppliers can approach levels below 1,000 USD per kilowatt, particularly through modular "plug-and-play" plant designs.[3]

Anion exchange membrane (AEM) electrolysers are an emerging option that sit somewhere between traditional alkaline and PEM systems. They use a solid polymer membrane to separate the gases and conduct ions in a compact cell, similar to PEM electrolysers, however, they operate in an alkaline environment that can use lower-cost non-precious metal catalysts and cheaper metallic components, as in conventional alkaline plants. In this way, AEM technology seeks to combine the cost advantages of alkaline systems with the performance and integration benefits of PEM, offering the potential to reduce overall system costs for green hydrogen production. Despite this potential, AEM electrolysers are still at an early stage of development, with performance and durability that generally lag behind mature alkaline and PEM systems. Compared with mature PEM systems, AEM exhibit lower current densities and shorter operational lifetimes, with membrane degradation under alkaline conditions remaining a key constraint. [16] Early commercial AEM systems and even megawatt-scale products have begun to appear; however, AEM electrolysis is still described as an early-stage technology and that membrane durability and long-term stability under real operating conditions must improve before it can be widely deployed in large-scale industrial applications. [17]

Solid oxide technologies operate at very high temperatures (above 600ºC) using a ceramic electrolyte, allowing them to capture industrial waste heat to reach efficiencies unattainable by other electrolysis technologies. Solid oxide electrolysers (SOEC) can process CO_2 to create synthetic fuels directly, making them a key solution for decarbonizing industries like aviation, shipping, and chemical manufacturing where batteries cannot provide sufficient energy density.[18]

In the automotive context, PEM remains the dominant fuel cell technology because it offers the transient response, compactness and cold-start capability required for road vehicles.[19]

Cost Drivers and Economics

Understanding the cost drivers and economics of different hydrogen production pathways is essential for assessing where hydrogen can realistically compete and how fast it can scale. In practice, investment and policy decisions depend on whether low-emissions hydrogen can reach cost parity with fossil fuels under realistic assumptions for fuel prices, capital costs, and policy support.[20]

"Levelized Cost of Hydrogen (LCOH)" is the standard metric to find the average cost to produce one-kilogram (or unit) of hydrogen over a project's entire lifespan, factoring in all initial capital expense (CAPEX) and ongoing (OPEX) costs like equipment, electricity, labor, and maintenance, divided by the total hydrogen output. It is crucial for comparing different production methods and assessing the economic viability of hydrogen projects to make it competitive with fossil fuels.

For grey or blue hydrogen (fossil-fuel based), the main cost drivers remain natural gas prices and the specific infrastructure required for carbon sequestration. Grey hydrogen is currently produced at 1–3 USD per kg Levelized Cost of Hydrogen (LCOH). [21] At the lower end of this range, hydrogen approaches cost parity with natural gas in high-price or carbon-constrained markets. At the upper end, it remains competitive only in niche or subsidized applications. Grey hydrogen production costs are highly sensitive to natural gas price fluctuations. Regions with access to low-cost natural gas, such as the United States and parts of the Middle East, therefore, have a significant cost advantage, while higher import prices in Europe and Asia, often in the range of 10–15 USD/MMBTU (MMBTU = one million British thermal units, a standard energy unit used to price natural gas)[21], materially reduce competitiveness. Blue hydrogen costs vary by geography from roughly 1.8–4.7 USD per kg LCOH. Unlike green hydrogen, which benefits from increasingly standardized and modular electrolyser designs, blue hydrogen projects require site-specific configurations to align with local carbon capture and storage conditions. As a result, project costs depend heavily on regional geology, infrastructure availability, and regulatory frameworks for carbon sequestration.

For green hydrogen, production costs are mainly driven by electricity prices, electrolyser capital cost and other supporting equipment and financing costs. Globally, green hydrogen production costs currently range from 4.5–12 USD/kg LCOH, which means it often requires policy support or incentives to compete with fossil fuels.

Costs are expected to decline more rapidly in regions with access to very low-cost renewable energy. For example, in the Gulf Cooperation Council (GCC) region (e.g., Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates) where solar resources are among the best in the world and power auctions have reached prices below 13 USD/MWh (Mega-Watt hour), green hydrogen costs could decline to roughly 2-4 USD/kg LCOH within the next three years. Large-scale, off-grid projects using lower-cost alkaline electrolysers and solar panels could potentially achieve costs near 2 USD/kg LCOH. At that level, green hydrogen becomes competitive with natural gas priced at approximately 15 USD/MMBTU.[21]

Figure 3: Different Hydrogen Cost Comparison by Region

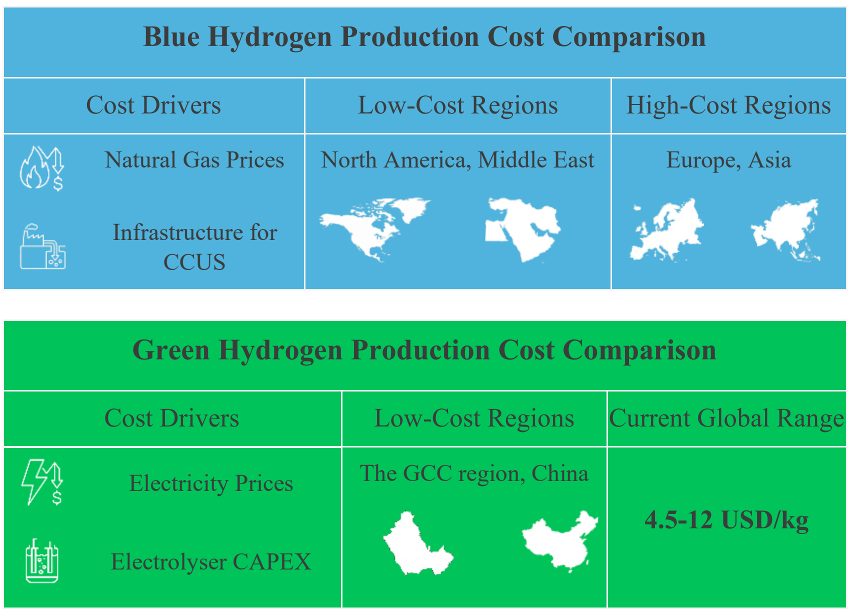


Table 1 compares hydrogen production costs. Grey hydrogen is the most cost-competitive, followed by blue hydrogen; however, their competitiveness is increasingly conditional on carbon pricing and emissions policy, while green hydrogen remains more expensive but strategically essential for long-term decarbonization. In the United States, with natural gas priced at approximately 3.50-4.20 USD/MMBTU in late 2025, hydrogen currently remains significantly more expensive than natural gas. In Europe, higher natural gas prices (estimated at 10 USD/MMBTU in 2025) and carbon pricing make parity more attainable.

Table 1: Hydrogen Production Cost Comparison, 2023

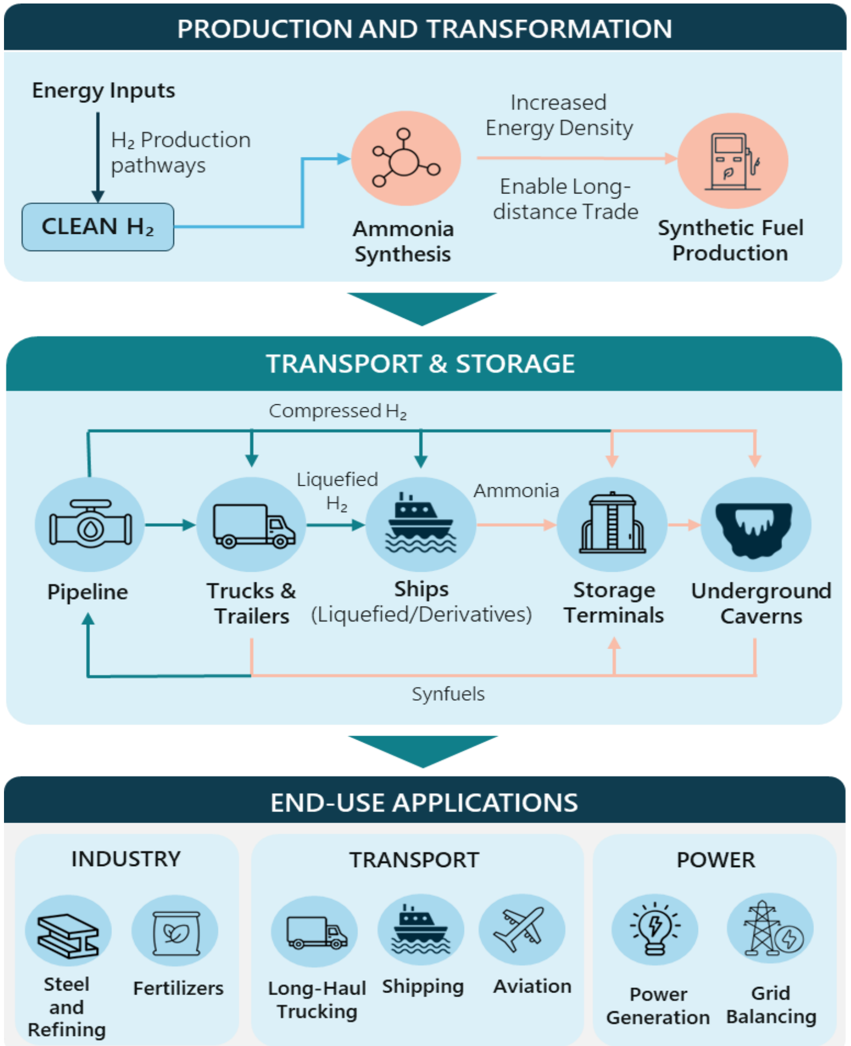
Hydrogen Type	Production Method	Estimated LCOH (USD/kg)	Estimated Cost (USD/MMBTU, HHV)*
Grey Hydrogen	Steam Methane Reforming (SMR) from natural gas	1.0 - 3.0	7.5 - 22.4
Blue Hydrogen	SMR with CCUS	1.8 - 4.7	13.4 - 35.0
Green Hydrogen	Electrolysis using renewable electricity (solar, wind)	4.5 - 12.0	33.6 - 89.5

* 1 kg of H_2 ≈ 0.134 MMBTU, HHV (Higher Heating Value).
Source: A 2025 Penspen Centre of Technical Excellence study

At the system level, differences in electrolyser capital cost contribute to wide variation in the LCOH across regions and project designs. LCOH outcomes are influenced not only by equipment pricing, but also by electricity costs, capacity factors, financing assumptions, grid connection requirements, and soft costs such as engineering, permitting, and interconnection. As a result, similar electrolyser technologies can produce materially different hydrogen costs depending on location and application, even when nominal equipment prices appear comparable.

Figure 4 illustrates the clean hydrogen value chain for net-zero applications, from low-carbon production through to final energy use.

Figure 4: Clean Hydrogen Value Chain: From Production to End Use



Source: Hydrogen Council 2022

At the top, clean hydrogen supply is produced and can be used directly or transformed into derivatives such as ammonia and synthetic fuels to increase energy density and enable long-distance trade.[22] It is then transported and stored as compressed or liquefied hydrogen, or in derivative form via pipelines, trucks, ships and storage terminals or underground caverns, before being consumed in end-use sectors such as steel, refining, fertilizers, long-haul transport, shipping and flexible power generation.

Hydrogen Storage

> **"Bar"** is a metric unit of pressure. Hydrogen gas at normal pressure (1 bar) takes up a lot of space—1 kilogram would fill about 11 cubic meters. Therefore, hydrogen for vehicles is stored at much higher pressures, typically 350–700 bar, allowing a large amount of hydrogen to fit into a small tank for practical use.

Hydrogen can be stored in several forms, each with different trade-offs in energy density, cost and complexity. The most common form is compressed gas, where hydrogen is stored in high-pressure cylinders (typically 350–700 bar) for vehicles and tube trailers. [24] Where space is constrained or for moving large volumes liquefied hydrogen may be used. Producing liquid hydrogen involves cooling hydrogen to around −253°C which increases volumetric energy density, but liquefaction is energy-intensive and requires specialized cryogenic tanks.[24]

Beyond these physical options, chemical and material-based storage methods are also being developed. In metal hydrides systems, hydrogen is absorbed into a solid material, giving high volumetric density and allowing storage at much lower pressures, but adding weight and requiring careful heat management. Liquid-Organic Hydrogen Carriers (LOHCs) use a different approach; instead of storing hydrogen as a gas or liquid, the hydrogen is chemically bonded to a reusable liquid carrier molecule, typically a stable organic oil such as dibenzyl toluene. This carrier remains in a liquid state at ambient temperatures and pressures, allowing it to be transported and handled using existing fuel infrastructure such as tanks, pipelines, tankers. However, LOHC systems require additional hydrogenation and dehydrogenation steps at each end of the supply chain, which adds complexity and reduces overall efficiency.[24]

Hydrogen also has distinctive storage and safety characteristics. It is odourless, colourless and has a wide flammability range, making robust safety design such as leak detection, ventilation, appropriate materials, and standards for tanks, valves and piping essential. At the same time, hydrogen is much lighter than air and disperses quickly if released, which can be a safety advantage in open or well-ventilated environments when systems are designed correctly.[23]

In practice, compressed gas dominates current mobility applications, while liquid hydrogen, hydrides and LOHCs are being tested for higher-volume or specialized use cases.[24]

Transport and Distribution Options

Hydrogen can be moved as a compressed gas by truck, using tube trailers, or cylinder trucks, or as liquefied hydrogen in cryogenic tankers for higher-volume deliveries. It can also be transported via dedicated hydrogen pipelines, which are cost-effective at high throughput and over short to medium distances, and by blending hydrogen into existing natural gas networks, typically at low percentages. This reduces the carbon intensity of gaseous fuel while leveraging existing infrastructure.

From a system design perspective, hydrogen supply chains can be built around centralized production plus distribution, such as large plants feeding multiple users by pipeline or truck, or on-site/behind-the-fence production, where electrolysers or reformers are co-located with industrial sites, refuelling stations or mobility hubs. In centralized models, hydrogen is delivered to public or depot-based refuelling stations and industrial users, where it is stored, compressed, and dispensed for mobility or process applications. [25] Alternatively, behind-the-fence systems integrate production, storage, and dispensing directly at industrial sites, warehouses, or fleet depots, serving captive demand without reliance on the public network. [26]

Centralized production can benefit from economies of scale, while on-site production reduces transport costs and losses, and can provide flexible loads to the power system when electrolysers are tied to the electricity grid.[27]

2. Hydrogen in the Automotive and Mobility Sector

Hydrogen is gaining momentum as a complementary pathway to electrification across the global mobility and automotive sectors. While battery-electric vehicles continue to dominate light-duty applications, hydrogen offers strategic advantages for segments that require long range, fast refuelling, high payload capacity, or continuous operation, such as heavy-duty transport, transit, materials-handling equipment, and select off-road and industrial vehicles.

This section explores the current state of hydrogen mobility, examining technology readiness across fuel cell systems, storage, and refuelling infrastructure. It also outlines emerging applications where hydrogen can deliver operational, environmental, and economic value. In addition, it highlights how global market signals, OEM activity, and policy momentum are shaping the trajectory of hydrogen-powered vehicles.

2.1. Comparative Suitability of Hydrogen and Battery Technologies

Zero-emission technologies for road transport must contend with constraints such as range, payload, duty cycle, refuelling/charging time, and infrastructure requirements, which vary significantly by use case. For light-duty vehicles (LDVs), battery electric vehicles already meet most daily range needs, with hydrogen fuel cell options mainly emerging where fast refuelling and long range are critical.[28] Currently, hydrogen deployment is focused on buses, heavy-duty trucks, and depot-based logistics fleets, with additional trials underway in rail, maritime, and synthetic fuels for aviation. Many national and regional plans now assume that early hydrogen truck deployment will cluster along major freight corridors, with refuelling stations spaced to support long-haul and regional logistics operations. This reflects a growing view that logistics and long-distance freight are among the first practical markets for hydrogen in road transport. Similarly, leading commercial fleet operators and manufacturers, including Toyota/Kenworth, Hyundai, Hyzon, UPS, and J.B. Hunt, are already integrating hydrogen trucks into decarbonization strategies, supported by OEM-led demonstrations and corridor-based pilot programs.[29] [30]

Beyond road transport, hydrogen trials are also advancing in harder-to-electrify modes. In 2025, the United States launched its first hydrogen-powered passenger train, the Stadler FLIRT H2, into commercial service on Metrolink's Arrow corridor in San Bernardino County, supported by purpose-built refuelling and maintenance infrastructure.[31] Across continental Europe, the FCH2Rail consortium has successfully completed major on-network trials of a hydrogen fuel cell/battery hybrid train, demonstrating a credible zero-emission alternative for non-electrified passenger corridors.[32]

Hydrogen maritime pilots are also progressing, particularly for inland and regional routes. The H2 Barge 1 and H2 Barge 2 retrofits in the Netherlands now operate as zero-emission inland container vessels, providing early evidence of hydrogen's suitability for predictable, short-sea shipping patterns where bunkering can be centralized.[33]

Despite this breadth of activity, as of 2025, hydrogen demand in road transport remains a small share of total use (about 0.1 percent of the global hydrogen consumption), with most activity still at pilot or early commercial scale.[5] Urban delivery trucks typically operate on predictable routes and return-to-base duty cycles, making them technically suited to battery-electric vehicles or depot-based hydrogen refuelling. However, payload penalties associated with heavier batteries and the cost of on-site charging or hydrogen infrastructure can present challenges, particularly for smaller operators with limited capital flexibility.[34] [35] Long-haul freight faces the most significant decarbonization trade-offs. Battery-electric options increase vehicle weight and reduce payload capacity, while high-power fast charging is difficult to deploy at scale along freight corridors. An alternative solution that is being evaluated as a high-efficiency alternative for the Quebec City–Windsor corridor is catenary electric road systems (ERS). These offer a potential 76 percent well-to-wheel efficiency and significant GHG reductions, though the technology currently remains in the techno-economic assessment phase within Canada.[36] Hydrogen fuel cell trucks offer potential advantages in range and refuelling time but require coordinated investment in large-scale hydrogen production and corridor-based refuelling networks to become commercially viable.

Transit buses and other closed-loop applications, including mining operations, ports and drayage, and airport fleets, represent some of the earliest practical use cases for zero-emission technologies. These environments combine high vehicle utilization with controlled operating patterns, enabling more efficient deployment of charging or hydrogen refuelling infrastructure. While upfront capital costs and depot retrofits remain key barriers, these applications align closely with early hydrogen adoption due to their concentrated demand and operational predictability.[37]

Defence and security fleets are also beginning to trial hydrogen for specialized mobility needs. The North Atlantic Treaty Organization (NATO) countries including militaries in North America are testing fuel cell–equipped tactical vehicles and light off-road platforms where low acoustic and thermal signatures, the ability to operate in silent-watch, and exportable electric power provide operational advantages. Collaborations between companies such as SFC Energy and Polaris Government and Defense, have integrated fuel cell power units onto Polaris MRZR light tactical vehicles, a compact off-road military platform used by NATO and allied forces, to supply quiet, reliable onboard power without running the main engine.[38] In parallel, defence research programs in Canada and Europe are exploring solid-state hydrogen storage and hydrogen-powered logistics vehicles as part of broader decarbonization and energy-resilience strategies, although most applications remain at the prototype and pilot stage.[39]

Fuel Cell Electric Vehicles (FCEV)

Fuel Cell Electric Vehicles (FCEVs) utilize a dedicated hydrogen storage system, fuel cell stack, and high-voltage battery in an architecture that prioritizes payload and uptime. While the fuel cell converts hydrogen to electricity on board, the battery remains critical for regenerative braking and peak power smoothing. Based on analysis published by the International Council on Clean Transportation (ICCT) in 2022, the heavy-duty FCEVs demonstrate energy-use efficiencies that are roughly 10 to 12 percent higher than comparable diesel trucks under typical long-haul and regional duty cycles, with peak performance approaching 60 percent efficiency in optimal conditions. However, battery-electric trucks remain the most energy-efficient option overall, using approximately 50 percent less energy than fuel cell trucks and more than 55 percent less energy than diesel trucks.[40]

For long-haul freight applications, FCEV offer a structural advantage over battery-electric trucks through better preserving vehicle range, refuelling time, and payload capacity. These attributes are critical for high-utilization freight operations that must maintain tight delivery schedules and maximize cargo efficiency. As of 2025, some manufacturers claim long-haul fuel cell trucks ranges of up to 500 miles with refueling times in the order of 20 minutes.[41] This is broadly comparable to diesel duty cycles and offers longer range and faster refuelling than current battery-electric truck offerings. Modeling of long-haul use cases shows that at 1,000 km range, battery-electric trucks require very large (about 1.9 MWh) battery packs that can impose payload penalties of approximately 40 percent, whereas fuel cell trucks with high-density hydrogen storage systems can deliver comparable ranges with a payload loss of only 10 percent, effectively preserving most of the freight capacity of a conventional diesel tractor.[40]

The global landscape for FCEVs continues to evolve, with several major automakers actively developing and deploying hydrogen-powered models, while others have scaled back or exited the market. Toyota, Hyundai, Honda, BMW, and General Motors remain committed to FCEV technology, focusing on commercial vehicles, Sport Utility Vehicles (SUV), and pilot fleets. Toyota's Mirai and Hyundai's Nexo are among the available passenger FCEVs, and Honda has launched the CR-V e:FCEV in select markets. BMW is advancing the iX5 Hydrogen, and GM is collaborating with Honda on next-generation fuel cell systems.[42]

At the same time, some manufacturers have discontinued their hydrogen vehicle programs. Stellantis and Renault, for example, have abandoned their hydrogen van initiatives, citing slow market uptake and persistent infrastructure challenges.[42] These developments reflect the broader industry trend. While FCEVs offer compelling advantages for long-range and heavy-duty applications, widespread adoption in the passenger segment remains constrained by refuelling infrastructure and cost barriers. As a result, OEM activity is increasingly concentrated in commercial, fleet, and pilot deployments where hydrogen's strengths are most pronounced.

Hydrogen Internal Combustion Engine (H_2-ICEs)

Hydrogen Internal Combustion Engine (H_2-ICEs) vehicles adapt conventional diesel engine architectures to operate on hydrogen, using similar engine blocks, components, production lines, supply chains, and maintenance practices. This makes them one of the least capital-intensive and fastest-to-deploy zero-emission options in heavy-duty use. Compared with FCEVs, H_2-ICE trucks are less energy-efficient, with commercial H_2-ICE vehicles consuming approximately 9–10 kg of hydrogen per 100 km compared to less than 8 kg per 100 km for comparable fuel cell trucks. However, H_2-ICE vehicles offer operational familiarity, robust performance in harsh environments, and the ability to scale more easily using existing vehicle platforms.[43]

Hydrogen combustion eliminates tailpipe CO_2 but still produces nitrogen oxides and particulate emissions. As a result, advanced combustion strategies and aftertreatment are needed to meet strict air-quality standards. Overall, life-cycle assessment has shown that converting existing diesel engines or machinery to hydrogen can reduce greenhouse-gas emissions by more than 90 percent when supplied with green hydrogen, enabling repowering and upcycling of current assets instead of full vehicle replacement.[44]

Hydrogen-Derived Fuels

Hydrogen-derived fuels are emerging as a complementary family of energy carriers that convert hydrogen into forms that are easier to store, ship, or use in existing engines. Ammonia, produced from hydrogen and nitrogen, is being actively explored as both a hydrogen carrier and a zero-carbon marine fuel because it can be stored as a liquid under moderate conditions and leverages existing fertilizer and chemical infrastructure. However, it faces challenges around toxicity, nitrogen-oxide emissions, and the additional energy required for synthesis and converting back to hydrogen.[45]

Electrofuels ("e-fuels") such as e-kerosene, e-diesel, and e-methanol are synthetic hydrocarbons made from green hydrogen and captured carbon dioxide. They can be used as "drop-in" fuels in current aviation and shipping systems, yet today they remain at pilot scale, are very energy- and capital-intensive to produce, and are generally viewed as an option reserved for long-distance, hard-to-electrify transport.[46]

In parallel, hydrogen-derived methanol and hydrogen-enriched methanol blends use methanol synthesized from hydrogen and carbon sources as a liquid carrier. Research shows that enriching methanol combustion with hydrogen can improve ignition properties, efficiency, and emissions, while still taking advantage of existing liquid-fuel storage and handling systems.[47]

As of 2025, Several hydrogen-derived fuels have moved into real-world use, though mostly at pilot or early commercial scale. In Japan, the ammonia-fuelled tugboat Sakigake, developed under the New Energy and Industrial Technology Development Organization (NEDO)'s Green Innovation Fund, completed a three-month pilot while performing normal tug operations in Tokyo Bay. It has since entered commercial service, with measured greenhouse gas emission reductions of more than

90 percent compared with conventional fuel.[48] In the United States, Infinium's Project Pathfinder plant in Texas began operating in March 2024. The company describes the facility as the world's first operational, commercial-scale e-fuel facility, producing synthetic aviation fuel and other e-fuels from renewable power and captured carbon dioxide for airline and other off-takers.[49] In China, Geely's Yuanchun 001, a 64-TEU multi-purpose river vessel launched in September 2025 near Hangzhou, uses a methanol–hydrogen hybrid electric drive system powered by methanol generators, electric motors, and batteries. This is an early application of hydrogen-derived methanol fuel in commercial inland waterway transport.[50]

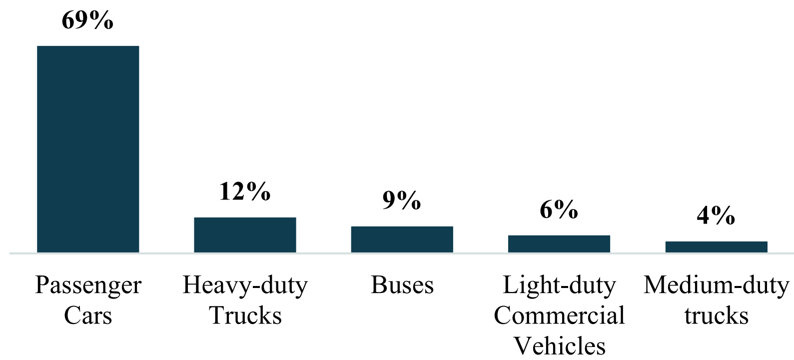
Global Deployment Snapshot

According to the IEA Advanced Fuel Cells Technology Collaboration Programme's 2024 Annual Report, 97,356 FCEVs were in operation worldwide at the end of 2024. As shown in Figure 5, passenger cars account for roughly 69 percent of the fleet, followed by heavy-duty trucks at about 12 percent, buses at about 9 percent, light-duty commercial vehicles at about 6 percent, and medium-duty trucks at around 4 percent.[51]

The same survey counted 1,302 hydrogen refuelling stations (HRS) across 28 countries, with China, South Korea, and Japan hosting roughly 71 percent of the global HRS network.[51]

In terms of new demand, SNE Research reports that from January to September 2025 8,970 fuel cell electric vehicles were newly registered globally, a 9.8 percent year-on-year decline, suggesting a slowdown in the growth of the FCEV market despite the expanding installed base.[52]

Figure 5: Distribution of Global Fuel Cell Electric Vehicle Fleet by Vehicle Category, 2024



Source: IEA Advanced Fuel Cells Technology 2024 Annual Report

Some of the notable deployments that help illustrate how fuel cell buses, trucks, and port equipment are being used in practice include:

- In public transport, the Joint Initiative for hydrogen Vehicle across Europe (JIVE) has deployed approximately 300 fuel cell buses across 16 locations. By coordinating large-scale procurement and high-capacity refuelling infrastructure, these initiatives validated commercial performance and operational availability, although ownership costs and infrastructure reliability remain key considerations for the next phase of commercialization.[53]

- In freight and logistics, Hyundai's XCIENT Fuel Cell program has become a key commercial benchmark for hydrogen trucking. Between the start of operations in 2020 and mid-2024, a fleet of 48 XCIENT Fuel Cell trucks in Switzerland accumulated more than 10 million kilometres of real-world driving, providing linehaul and regional delivery services for major national retailers including Coop and Migros.[54]

- In port and terminal operations, the H2Ports project at the Port of Valencia successfully demonstrated the world's first hydrogen-powered container stacker developed by Hyster-Yale and a 4x4 Terminal Tractor developed by Atena in real-world cargo handling operations. Rather than a simple vehicle pilot, H2Ports validated a complete on-site hydrogen ecosystem, including a dedicated mobile refueling station capable of dispensing hydrogen at 350 bar during active shifts. This showed that hydrogen equipment can match the duty cycles of diesel machinery without disrupting terminal logistics.[55]

Typical Business Models

Based on the successful deployment and pilot FCEV projects, a few dominant business models have emerged to de-risk hydrogen adoption.

- Pay-Per-Use / Truck-as-a-Service: To overcome the high upfront capital cost of FCEVs, OEMs and energy providers are bundling the vehicle, fuel, maintenance, and insurance into a single "pay-per-use" rate (e.g., per kilometer or per month). This model shifts the technology risk from the fleet operator to the provider and converts capital costs into a predictable operating expense. Hyundai's XCIENT trucks deployment is one such example in which Hyundai Hydrogen Mobility AG offers an all-inclusive per kilometre flat rate while taking into account the vehicle's usage profile and annual milage.[56]

- The industrial hub (cluster) Model: This model co-locates large-scale production with multiple large-scale users in a confined geographic area, typically ports or industrial zones, to share infrastructure costs and guarantee baseload demand. By aggregating diverse off-takers into a single "Hub", projects can secure the long-term volumes needed to finance gigawatt-scale electrolysers without relying on a single customer. The Port of Valencia H2Ports project utilizes this model.

- Government-Backed Intermediary Models: To bridge the price gap between green hydrogen and fossil fuels, governments are stepping in as intermediaries. One such use case is H_2Global's double auction mechanism, where the government of Germany (Hydrogen Intermediary Network Company) purchases hydrogen from global market at the lowest possible production price and then sells it to industrial users in Germany or the European Union at the highest possible market price, with the government subsidizing the difference.[57]

- Hydrogen-as-a-Service (HaaS): Hydrogen-as-a-Service models bundle vehicle conversion, fuel supply, and fuelling infrastructure into a single service contract, allowing fleets to adopt hydrogen with little or no upfront capital outlay. In this model, the provider converts existing diesel trucks to hydrogen-enabled drivetrains, secures hydrogen supply and refuelling at key depots or along major corridors, and charges the fleet a per-kilometre or per-kilogram fee designed to be comparable to, or slightly below, diesel on a Total Cost of Ownership (TCO) basis. This approach shifts technology and infrastructure risk to the service provider while giving operators a way to trial or scale hydrogen in day-to-day operations without large balance-sheet impacts.[58]

Barriers

Hydrogen deployment faces a number of barriers related to economics and infrastructure. Low-emissions hydrogen (from electrolysis or with CCUS) remains more expensive than unabated fossil-based hydrogen. The IEA's Global Hydrogen Review 2025 explicitly identifies this persistent cost gap as a central barrier to investment and project final investments decisions (FIDs).[3] On the demand side, FCEVs and equipment have higher upfront capital costs than diesel or battery alternatives, and the hydrogen prices at refuelling stations keep fuel costs high. This means that TCO analyses for heavy-duty trucks show fuel cell trucks are only competitive in specific scenarios with low hydrogen prices and favourable duty cycles. These economics are compounded by sparse infrastructure. Global reviews of hydrogen mobility and fuel cell transport repeatedly highlight the limited number and uneven geographic distribution of hydrogen refuelling stations as a major barrier, especially outside a few early markets in East Asia, Europe, and California.[59] The viability of these networks is heavily dependent on the complexity of upstream transmission and distribution. The high cost of establishing dedicated hydrogen pipelines or large-scale centralized electrolysis creates a significant 'chicken-and-egg' investment hurdle, as these upstream assets often require a guaranteed, high-volume demand to justify their initial capital expenditure.[9]

Technical maturity and non-economic factors create additional barriers. Durability and longevity of fuel cell power systems remain critical challenges particularly for heavy-duty applications that require long lifetimes and high utilization.[59] These factors usually affect a vehicle's residual value and warranty terms, which are part of the assumptions in a TCO model.[60] [61] In addition, regulations, codes and standards (RCS) are often labeled as key non-technical barriers. Harmonised rules for high-pressure storage and refueling are also essential building blocks for the new energy system.[60] [62]

Finally, broader public-acceptance research indicates that safety perception remains a significant soft barrier, with consumers frequently citing concerns regarding high-pressure leaks and the potential for explosions due to historical associations with hydrogen flammability.[63] These perceptions persist despite modern FCEVs being engineered to meet rigorous international safety standards.[64] [65]

Enablers

Hydrogen uptake is being enabled by a combination of policy, public procurement, OEM strategies, falling costs, and hub-based deployment. On the policy side, carbon pricing and clean-fuel standards directly improve the economics of low-carbon hydrogen. California's Low-Carbon Fuel Standard (LCFS) and British Columbia's LCFS-style regulation both award credits for fuels with lower lifecycle carbon intensity. These explicitly include hydrogen used in transport, which creates an additional revenue stream on top of fuel sales that helps offset higher costs. Governments are also using public procurement to create early demand. One such example is the 300 fuel cell buses deployed by the JIVE and JIVE 2 projects co-funded by the European Union's Clean Hydrogen Partnership.[53]

On the industry side, OEM strategies and falling costs are key enablers. Major truck and bus manufacturers have set hydrogen roadmaps and formed joint ventures to share development costs and scale production. For example, Daimler Truck and Volvo created the Cellcentric Joint Venture to industrialize fuel cell systems for heavy-duty vehicles in 2021.[66] Hyundai has committed to scaling its XCIENT Fuel Cell truck platform based on real-world deployment experience.[54] Global assessments from the IEA show that alkaline and PEM electrolyser costs have fallen significantly and are expected to further decline as manufacturing scales.[67]

Many national strategies now centre on hydrogen hubs or industrial clusters. For example, in the United States, the Regional Clean Hydrogen Hubs (H2Hubs) program accelerates commercial-scale deployment by funding a national network of co-located producers, consumers, and infrastructure. By aggregating supply and demand, these hubs aim to decarbonize heavy industry and transportation, provide dispatchable power and storage, and drive economic growth through local investment and job creation.[68] While the H2Hubs program may remain a pillar of long-term decarbonization strategy in the United States, its immediate implementation is subject to fiscal and regulatory uncertainty.

The Hydrogen Valley model represents the European framing of hub-based hydrogen deployment. Originally conceptualized through the European Union's Clean Hydrogen Partnership and later promoted globally through the Mission Innovation initiative, Hydrogen Valleys are integrated regional ecosystems that cluster hydrogen production, distribution, and multiple end-use applications to create self-sustaining, local hydrogen economies.[69] This model has become a dominant global strategy. As of December 2025, the European Union has 78 Hydrogen Valleys across 20 countries with a total investment of €121.3 billion. An additional 23 global valleys across 18 countries represent another €80.3 billion in investment, forming a worldwide network of large-scale clusters designed to de-risk commercial adoption.[70]

Hydrogen in Existing EV Charging Grid Infrastructure

As electric vehicle adoption accelerates, constraints within the electricity grid are emerging as a practical barrier to expanding fast and fleet-based charging. In many locations, total generation capacity is sufficient, but the ability to deliver power to specific sites is limited by local distribution infrastructure, long upgrade timelines, and high capital costs. [71] These constraints are particularly acute at fleet depots, logistics hubs, and high-power fast-charging sites where simultaneous charging can overwhelm transformers and substations.

Hydrogen fuel cells are increasingly being explored as a complementary solution to address these grid limitations.[72] Rather than replacing the electricity system, hydrogen can function as a distributed energy resource that supplies clean, on-site power for EV charging when grid capacity is constrained or unavailable. In practice, hydrogen integration can take several forms. Fuel cell systems can supplement grid power during peak demand periods, reducing strain on local infrastructure and deferring costly upgrades. In more constrained or remote locations, they can provide standalone power for EV charging where grid connection is not feasible in the near term. When supplied with low-carbon hydrogen, these systems allow EV charging to remain aligned with emissions-reduction goals.[71]

Early real-world deployments demonstrate how this model is being applied. Pilot projects in the United Kingdom have tested hydrogen fuel cell chargers that deliver fast EV charging without relying on the electricity grid, highlighting applications for temporary, mobile, or remote charging sites.[73] In the United States, hybrid charging systems combine hydrogen fuel cells with grid connections and battery storage to support high-power charging at sites where peak loads exceed local grid capacity. Other projects integrate hydrogen production, storage, fuel cell generation, and EV charging at a single location, improving resilience and enabling continued operation during grid interruptions.

While deployment remains at pilot and early commercial scale, hydrogen fuel cells offer a flexible option for addressing grid bottlenecks, improving charging reliability, and enabling fleet electrification in locations where conventional grid upgrades are costly, slow, or uncertain.

3. Ontario's Strategic Context for Hydrogen

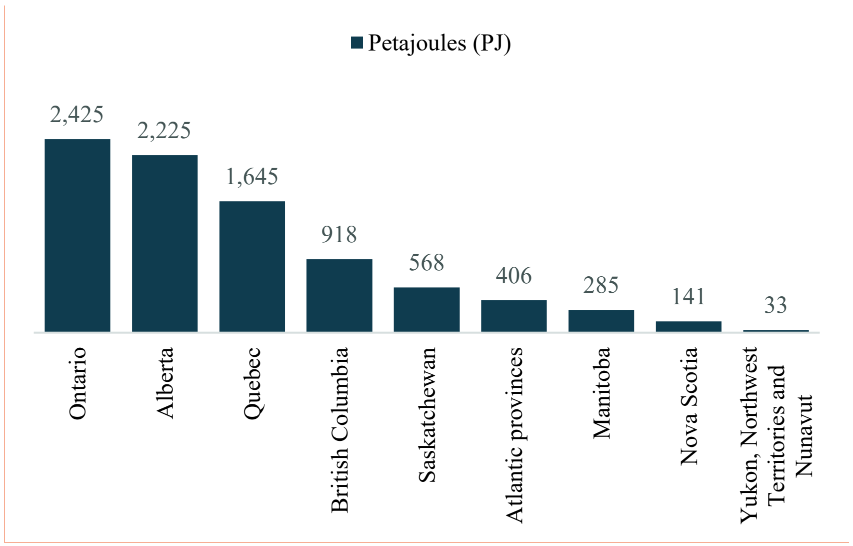
Ontario is entering a pivotal stage in shaping its hydrogen economy, with policy direction, infrastructure planning, and industry activity converging to position the province as a leader in clean energy innovation. Ontario's strategic advantages, including its established automotive ecosystem, clean electricity grid, and emerging hydrogen clusters provide a strong foundation for growth as global markets scale up low-carbon hydrogen production and demand grows across transportation, industry, and power systems.

This section outlines the province's current policy landscape, economic drivers, and foundational initiatives that are accelerating hydrogen development. It examines how provincial strategies, federal programs, and regional partnerships are shaping market readiness, while highlighting Ontario's unique assets—such as its manufacturing capabilities, R&D strengths, and cross-sector collaborations.

3.1. Ontario's Energy Profile

Ontario's interest in hydrogen is shaped by the province's existing industrial activity, energy resources, and evolving needs across transportation and manufacturing. Ontario has large manufacturing centres, significant heavy-duty freight movement, and a diverse set of energy-intensive sectors that rely on continuous and reliable energy supplies. Together, these factors shape both the opportunities and the early priorities for hydrogen adoption in the province. Figure 6 shows end-use energy consumption by province in 2024.

Figure 6: End-Use Energy Consumption by Province, 2024



Source: Statistics Canada. Table 25-10-0029-01 Supply and demand of primary and secondary energy in terajoules, annual

Ontario's total end-use energy demand exceeds 2,400 PJ annually, representing roughly one quarter of Canada's provincial energy consumption. This reflects the scale of Ontario's population, industrial base, and transportation activity. In this context, the province's energy system represents one of the largest opportunities for clean energy transition in Canada. The magnitude of overall energy demand highlights the importance of scalable decarbonization solutions, particularly for sectors where electricity alone may not fully meet operational requirements. [74]

Table 2 shows Ontario's end-use energy consumption by source. Refined petroleum products and natural gas together make up more than 70 percent of total energy demand, while electricity accounts for 21 percent.[75]

Table **2**: Ontario energy use by fuel type, 2024

Energy type	PJ	%
Refined petroleum products	904	37
Natural gas	885	36
Electricity	504	21
Other	138	6
Total	2,432	100

Source: Ontario Energy Snapshot.

This fuel mix highlights both the scale of Ontario's decarbonization challenge and the limits of direct electrification. Heavy industry, high-temperature heat, and long-distance freight, cannot easily transition to electricity alone due to performance, cost, and operational constraints. For these applications, hydrogen could support the decarbonization objectives only if it is produced with low lifecycle emissions. As a result, Ontario's ability to supply low-carbon hydrogen becomes a key consideration.[76]

3.2. Hydrogen Research & Development, and Policy landscape in Ontario

Research, Development and Innovation

Ontario is home to a dynamic and expanding hydrogen research, development, and innovation ecosystem that spans public research institutions, universities, government agencies, and private-sector collaborators. This ecosystem plays a foundational role in advancing hydrogen technologies, supporting commercialization, and positioning the province as a leader in Canada's clean energy advantage.

Federal research institutions located in Ontario provide technical capability for hydrogen development. The National Research Council conducts applied research in hydrogen production, fuel cell systems, and advanced materials through its facilities in Ontario, working in collaboration with industry partners. This work supports performance improvements, cost reduction, and manufacturability across hydrogen and fuel cell technologies.[8] Canadian Nuclear Laboratories (CNL) at Chalk River contributes specialized research focused on hydrogen safety, storage, and nuclear-enabled hydrogen production pathways. Ongoing research includes the study of hydrogen behaviour under accidental release conditions, with the objective of informing safety standards, siting requirements, and mitigation strategies for hydrogen infrastructure. CNL is also exploring hydrogen production methods linked to nuclear energy, including thermochemical processes that could leverage reactor heat.[77] These activities address technical and safety considerations that are critical for large-scale hydrogen deployment.

Provincial public-sector organizations are also actively engaged in applied hydrogen research and demonstration. Ontario Power Generation, through its subsidiary Atura Power, is advancing hydrogen production projects that integrate electrolysis with existing electricity assets, such as the development of large-scale electrolytic hydrogen production and the evaluation of hydrogen production linked to nuclear generation. Additionally, Enbridge Gas has operated a power-to-gas facility in Markham since 2018, producing hydrogen via electrolysis and blending it into the natural gas distribution system. This facility has functioned as a long-running demonstration of hydrogen production, storage, and blending within regulated gas infrastructure, generating operational data and informing technical standards.

Ontario's hydrogen research & development activity is increasingly organized around regional clusters that combine industrial infrastructure, applied research, and demonstration projects. The Sarnia–Lambton region is supported by existing petrochemical operations, hydrogen feedstock production, and potential geological storage. Research parks and post-secondary institutions in the region are also engaged in pilot-scale hydrogen production, storage, and utilization projects that link laboratory research with industrial-scale applications. This allows hydrogen technologies to be developed, tested, and scaled within the same region, making Sarnia–Lambton a focal point for applied hydrogen research and demonstration. Other regions in Ontario also contribute to applied hydrogen research. Niagara Falls, for example, is emerging as a centre for hydrogen production research linked to hydroelectric generation, while Bruce County is being assessed for hydrogen production opportunities associated with nuclear power. These regional initiatives provide testbeds for evaluating hydrogen technologies under real-world operating conditions and for understanding how hydrogen can be integrated into existing energy and industrial systems.

Table 3 shows some key post secondary institutions (PSIs) supporting hydrogen research in Ontario. These academic institutions represent a core component of the hydrogen research ecosystem, contributing both fundamental research and applied engineering expertise.

Table 3: PSIs Supporting Hydrogen Research in Ontario

PSIs	Hydrogen Research Area
Ontario Tech University (Oshawa)	Clean Energy Research Laboratory (CERL): Ontario Tech has emerged as a national leader in hydrogen research. Its Clean Energy Research Lab, established in 2010, was the site of the world's first lab-scale demonstration of a novel thermochemical cycle for water-splitting[78]
The University of Toronto	Hydrogen & Fuel Cell Innovation: The University of Toronto (UofT) hosts multiple research groups advancing hydrogen science. In its Department of Mechanical & Industrial Engineering, researchers have developed new hydrogen production processes. For example, Prof. Murray Thomson's lab invented a methane pyrolysis technology using microwave radiation: this method converts natural gas into hydrogen gas and solid carbon with no CO_2 emissions.[79]
The University of Waterloo	Fuel Cell & Green Energy Lab: The University of Waterloo hosts the Fuel Cell and Green Energy Laboratory, led by Prof. Xianguo Li, which is internationally recognized for fuel cell research. This lab focuses on the fundamental and applied aspects of hydrogen fuel cells – from modeling heat and mass transport in fuel cell membranes to developing new fuel cell components.[80]
McMaster University	Advanced Catalysis & Materials: McMaster researchers are advancing hydrogen-related technology through work on electrocatalysts, hydrogen storage materials, and powertrain electrification. In the Department of Chemical Engineering, groups like the Higgins Lab design novel nanomaterial catalysts for water electrolysis (to improve hydrogen production) and for fuel cells (to make them more efficient and durable).[81]

Academic institutions across Ontario conduct work spanning hydrogen production pathways, fuel cells, storage materials, catalysis, and energy system integration. This academic ecosystem was further strengthened in 2026, when Ontario's Ministry of Colleges, Universities, Research Excellence and Security announced over $47 million in funding for 195 research projects across the province, including more than a dozen projects with a focus on hydrogen and related clean-energy technologies, supporting applied and fundamental research at universities, colleges, and hospitals.[82] Together, the combination of fundamental research (e.g., new materials, processes) and applied engineering (e.g., prototypes, field trials) happening at these schools is a cornerstone of Ontario's hydrogen innovation ecosystem. Beyond research and development, these institutions play a critical role in building the hydrogen workforce by training highly skilled graduates and supporting the creation of spin-off companies that feed into Ontario's growing hydrogen sector. [83]

Ontario's hydrogen research ecosystem is supported by a network of innovation platforms that connect research to commercialization. OVIN provides infrastructure, testing facilities, and business support for hydrogen and alternative powertrain technologies through its regional technology development sites. These sites enable prototyping, validation, and demonstration of hydrogen-related technologies, particularly in transportation applications. Industry coordination and collaboration are supported through Hydrogen Ontario, which brings together industry, academic, and public-sector stakeholders to share knowledge and align research and innovation priorities. Additional incubators and accelerators across the province support hydrogen-related startups in areas such as electrolyser components, fuel cell systems, hydrogen storage, and industrial applications, helping early-stage technologies progress toward deployment.

Policy and Funding Landscape

- Canada's Hydrogen Strategy (2020)

Federal initiatives reinforce Ontario's strategy through national frameworks and financial incentives. Canada's Hydrogen Strategy (2020) positions hydrogen as a critical tool for decarbonizing transportation, heavy industry, and long-duration energy storage.[8] To advance deployment, the federal government launched the C$1.5 billion Clean Fuels Fund, which co-finances clean-fuel production and infrastructure. Ontario has benefited from this program, receiving C$1 million to support Ontario's first public hydrogen refuelling station at Toronto Pearson International Airport and C$5 million toward Enbridge's hydrogen-blending studies for the provincial gas grid. In 2024, Natural Resources Canada released a Hydrogen Strategy Progress Report, which reaffirmed hydrogen's supporting role alongside electrification, and documented significant growth in announced low-carbon hydrogen projects across Canada. The report outlined priorities to advance domestic deployment, infrastructure development, and market formation.[84]

- Clean Hydrogen Investment Tax Credit (2023)

On the production side, the federal Clean Hydrogen Investment Tax Credit introduced in 2023 provides a refundable credit of up to 40 percent of capital costs for low-carbon hydrogen projects, with the full rate available to green hydrogen produced through electrolysis. Additional incentives include a 30 percent tax credit for clean energy equipment, including electrolysers, and a separate CCUS investment tax credit that improves the economics of projects incorporating carbon capture technologies.[85] These measures significantly enhance the financial viability of new hydrogen projects in Ontario. Federal programs also support end-use applications, such as hydrogen-powered transit deployments and heavy-duty vehicle corridors, through Infrastructure Canada programs and loans from the Canada Infrastructure Bank.

- Ontario's Low-Carbon Hydrogen Strategy

As briefly discussed in the earlier sections, Ontario's Low-Carbon Hydrogen Strategy outlines the province's roadmap for advancing hydrogen production and use across the economy. Key actions include piloting early production facilities, identifying regional hydrogen hubs including the Sarnia–Lambton petrochemical cluster, and developing an interruptible electricity rate to support hydrogen producers with access to lower-cost off-peak power. The strategy also prioritizes hydrogen use in hard-to-electrify sectors, including industrial processes and transit applications. The Province's 2025 Integrated Energy Plan also provides an update on Ontario's Low-Carbon Hydrogen Strategy and signals a renewed focus on market development.[86] In particular, the Plan identifies three new initiatives to support a provincial low-carbon hydrogen economy: an expanded Hydrogen Innovation Fund, including streams for electricity grid integration and broader end-use applications such as transportation and heavy industry; development of a Hydrogen Interruptible Rate Pilot, with the IESO directed to provide recommendations on a program that would allow hydrogen producers to lower electricity costs in exchange for reducing consumption during peak periods; and exploration of potential regulatory oversight for dedicated hydrogen pipelines through a possible expansion of the Ontario Energy Board's mandate.

- Hydrogen Innovation Fund (HIF)

To support implementation, Ontario launched the Hydrogen Innovation Fund (HIF) in 2023. HIF is administered through the Independent Electricity System Operator (IESO) and commits C$15 million to projects focused on integrating hydrogen into the energy system.[87] The initial round funded 15 projects, ranging from grid-balancing demonstrations and storage pilots to early refuelling infrastructure for heavy-duty transportation. In 2025, the province expanded the program to C$30 million with two funding streams. One stream is focused on projects delivering direct electricity-system benefits, and another supports hydrogen use in transportation, industry, and regional hubs. Current HIF-supported demonstrations include hydrogen blending at the Halton Hills gas-fired power station and a 1 MW electrolyser integrated into a Brampton waste-to-energy facility, supplying hydrogen for heavy trucks while providing peak-shaving services to the grid. These initiatives are intended to reduce technology risk, develop local expertise, and support the province's goal of integrating hydrogen into its clean-energy advantage.

- OVIN Research & Development Partnership Fund.

OVIN Research & Development Partnership Fund (R&D PF) provides co-investment of up to $1 million to support the development, demonstration, and commercialization of automotive and mobility technologies in Ontario. Delivered by the Ontario Centre of Innovation, the program focuses on applied, industry-led projects that advance technologies toward market readiness rather than early-stage feasibility or basic research. The R&D PF supports projects across four focus areas: Connected and Autonomous Vehicles, Smart Mobility and AI; Electric Vehicles; Advanced Charging and Vehicle-to-Grid; and Semiconductor and Hardware. The program operates through two funding streams: Stream 1, which provides up to $100,000 for projects of up to 12 months, and Stream 2, which provides up to $1 million for larger-scale projects of up to 24 months, with all OVIN funding matched by a minimum 2:1 contribution from applicants and/or private-sector partners.[88] While the R&D PF is technology-agnostic and not hydrogen-specific, its emphasis on demonstration, system integration, and commercialization has enabled hydrogen-related and hydrogen-adjacent projects, including fuel-cell integration, alternative powertrains, heavy-duty vehicle platforms, and enabling hardware, reinforcing OVIN's role in de-risking advanced zero-emission mobility technologies and accelerating their path to market.

- Geologic Carbon Storage Act, 2025

At the beginning of 2026, Ontario has taken significant steps to enable CCUS as a tool for cutting greenhouse gas emissions from heavy industries. After lagging behind provinces like Alberta and Saskatchewan, which have had CCUS projects since 2015, Ontario is now implementing a comprehensive regulatory framework for geologic CO_2 storage, rolling out supportive strategies, and engaging industry in pilot projects. Below is an overview of Ontario's current CCUS policy, including the regulatory framework, government initiatives, funding and incentives, key stakeholders, and emerging CCUS projects in the province.[89] [90]

Jan–Mar 2022: CCUS Discussion Paper

Ontario launches consultation on enabling carbon storage (Environmental Registry of Ontario No. 019-4770), signaling intent to develop a provincial CCUS framework as part of its climate plan.

Mar 2023: Ban on CO_2 Storage Removed

The province repeals a 2010 prohibition on geologic carbon storage by amending the Oil, Gas and Salt Resources Act. This legal change clarifies that Ontario is open to carbon storage projects, addressing a key barrier identified by industry.

Jan 1, 2024: Pilot-Project Regulations in Effect

Ontario implements O. Reg. 425/23 ("Special Projects" regulation) under the Oil, Gas and Salt Resources Act. This regulation allows companies to apply for carbon storage demonstration projects on private lands, subject to strict safety and monitoring standards (e.g. CSA Z741). It establishes a permit process for pilot CO_2 injection wells to test storage in deep saline aquifers of southwestern Ontario.

Dec 2025: Geologic Carbon Storage Act Passed

Ontario enacts the Geologic Carbon Storage Act, 2025, creating a dedicated legal framework for commercial-scale CO_2 storage. The Act vests underground "pore space" rights, enables permits for storage sites, sets long-term liability rules, including a Carbon Storage Stewardship Fund, and provides for Crown oversight via the Ministry of Natural Resources and Forestry (MNRF) and Ontario Energy Board. With Royal Assent in Dec 2025, Ontario has the authority to regulate and approve large CCUS projects on both Crown and private lands.

Winter 2026: Full Regulations & Open Applications

Regulations under the new Act are expected to take effect by early 2026, allowing businesses to officially submit proposals for commercial CCUS projects in Ontario. Ontario's MNRF has a team in place to review applications and ensure safe, responsible management of CO_2 storage.

Ontario's emerging CCUS framework is a foundational enabler for the province's hydrogen strategy, particularly for the production of low-carbon "blue" hydrogen. Without a viable pathway to capture and permanently store the CO_2 produced as a byproduct of its production, blue hydrogen cannot meet low-carbon thresholds. By removing legal prohibitions on geologic carbon storage and passing the Geologic Carbon Storage Act (2025), Ontario has created the legal and regulatory conditions necessary for blue hydrogen projects to proceed. This alignment is explicitly recognized in Ontario's Low-Carbon Hydrogen Strategy, which identifies CCUS as a critical tool for decarbonizing hydrogen production and supporting industrial emissions reductions. Historically, uncertainty around permitting authority and long-term liability for geologic carbon storage constrained CCUS investment. With full-scale CCUS regulations come into force in 2026, Ontario is establishing clearer regulatory and permitting pathways that support investment in integrated hydrogen-CCUS infrastructure, particularly in regions like Sarnia-Lambton and Niagara with existing natural gas and petrochemical assets.

3.3. Hydrogen Production and Resource Potential in Ontario

Current and Planned Hydrogen Production Projects

Ontario's hydrogen production landscape has an established industrial base with significant hydrogen production capacity. Most notably, the Sarnia-Lambton region already produces and uses more than 150,000 tonnes of grey hydrogen each year as feedstock for refining, petrochemicals, and fertilizer production, which represents the largest concentration of hydrogen production in the province.[91] This existing activity creates a practical foundation for low-carbon hydrogen production since these facilities can incorporate CCUS technologies to transition from grey to blue hydrogen as regulatory conditions evolve. At the same time, Ontario is beginning to advance low-carbon hydrogen production through a series of pilot, demonstration, and early commercial projects.

Table 4 shows several key projects currently advancing low-carbon hydrogen supply across the province. The Niagara Hydrogen Centre, led by Atura Power (OPG), is nearing completion and will begin commercial operations in the second half of 2026. It will produce green hydrogen via a 20 Mega-watt PEM electrolyser to serve industrial and mobility sectors, including heavy-duty trucking.[92] Enbridge's Markham Energy Storage Facility, operational since 2018, is piloting blending hydrogen into the natural gas grid using a 2.5 Mega-watt PEM system to help meet building heating demand. Emerald Energy's active pilot in Brampton uses a 1 Mega-watt PEM electrolyser powered by waste energy to

Table 4: Current Hydrogen Production Plants in Ontario

Project Name	Niagara Hydrogen Centre	Markham Energy Storage Facility (Hydrogen Blending Pilot)
Location	Niagara Falls, ON	Markham, ON
Developer / operator	Atura Power (OPG)	Enbridge Gas & Hydrogenics/Cummins
Technology (electrolysis, SMR, biomass, etc.)	Electrolysis (PEM)	Electrolysis (PEM)
Scale (MW, t/day)	20 MW	2.5 MW
Status: operational, construction, announced, concept	Construction was completed in 2025. Commercial operation in second half of 2026	Operational (commissioned 2018)
Primary off-takers (industry, mobility, export)	Industry & mobility (heavy-duty trucking, transit)	Buildings (natural gas customers via 2 percent H_2 blending)

produce hydrogen for heavy vehicles and construction equipment, while also providing grid services and storing up to 400 kg of hydrogen.[93]

In addition to the pilot projects already underway, Ontario has several hydrogen production initiatives in development. At Halton Hills (GTA), Atura Power has completed a hydrogen blending pilot at the Halton Hills Generating Station, demonstrating the ability to blend up to 15 percent low-carbon hydrogen with natural gas to reduce the carbon intensity of gas-fired electricity generation. The project focused on testing turbine performance, operational impacts, and emissions outcomes and was supported by Ontario's Hydrogen Innovation Fund. Atura is using the results to inform future hydrogen blending and decarbonization opportunities at the site.[94]

Beyond Atura's portfolio, Bruce Power is advancing hydrogen production as part of its Project 2030 initiative, which explores leveraging surplus nuclear electricity and steam from the Bruce Nuclear Generating Station to produce low-carbon ("pink") hydrogen at scale.[95] The vision is to establish a hydrogen hub around the Bruce site, using its constant clean power to generate hydrogen that can serve multiple sectors (potentially for industrial feedstock, energy storage, or heavy transport fuel) as technical, regulatory, and market conditions are further developed.

These planned projects, while still in development or concept stages, illustrate the next wave of Ontario's low-carbon hydrogen build-out, targeting strategic locations, larger capacities, and integration with existing energy infrastructure to supply industry and transportation as deployment advances.

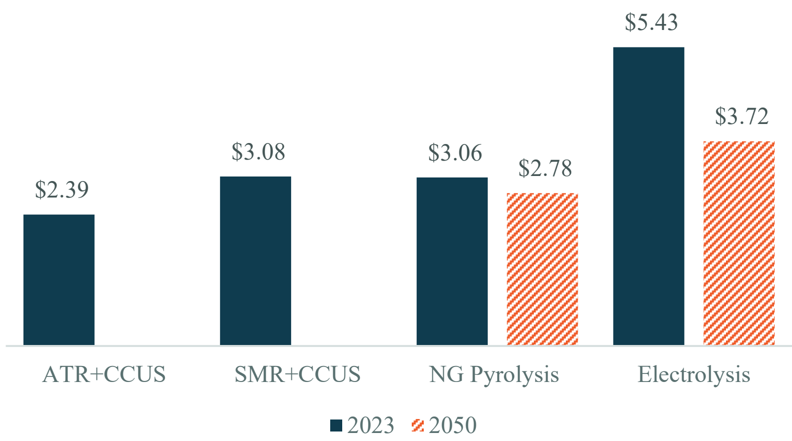
Cost Drivers and Competitiveness of Low-Carbon Hydrogen

Hydrogen's cost competitiveness in Ontario is primarily driven by production pathway, energy input prices, facility scale, and the ability to capture additional value streams such as carbon co-products. The Transition Accelerator study (2023), funded through the Hydrogen Innovation Fund, assesses the role of hydrogen in supporting a net-zero electricity system in Ontario by examining hydrogen demand scenarios, production pathways, and system-level impacts, with a particular focus on cost, feasibility, and electricity system integration. The study found that while Ontario has the technical capability to produce low-emissions hydrogen, market conditions indicate that hydrogen remains more expensive than conventional fuels across most applications.[96]

Figure 7 summarizes the LCOH across four production pathways used in the study: autothermal reforming with carbon capture (ATR+CCUS), steam methane reforming with carbon capture (SMR+CCUS), natural gas pyrolysis (NG Pyrolysis), and electrolysis. NG Pyrolysis refers to converting methane into hydrogen and solid carbon through high-temperature thermal decomposition, without directly producing carbon dioxide. This pathway is less prominent in Ontario discussions because pyrolysis is still emerging, while current focus is on electrolysis and CCUS-enabled reforming.

The Transition Accelerator (2023) analysis assumes a common production scale of 250 tonnes per day, electricity prices of $70 per megawatt-hour (reflecting a long-term illustrative assumption rather than a near-term customer tariff), and natural gas prices of $5.50 per gigajoule.[96] Under these assumptions, reforming pathways with carbon capture represent the lowest-cost hydrogen production option in the near term. ATR+CCUS yields an LCOH of approximately $2.39 per kilogram, while SMR+CCUS produces hydrogen at approximately $3.08 per kilogram. These pathways benefit from relatively low feedstock costs and high conversion efficiencies, provided carbon capture and storage infrastructure is available.

Figure 7: LCOH for Different Hydrogen Production in Ontario



Source: The Transition Accelerator study

NG Pyrolysis occupies an intermediate cost position, producing hydrogen at an LCOH of approximately $3.06 per kilogram, comparable to SMR+CCUS. The economics of NG Pyrolysis are highly sensitive to scale and co-product revenue. Where solid carbon can be sold into downstream markets, hydrogen costs decline materially, improving competitiveness relative to other pathways. This highlights the importance of carbon markets and demand for solid carbon products in determining the viability of pyrolysis-based hydrogen in Ontario.

Electrolysis remains the highest-cost pathway under current assumptions. At a production scale of 250 tonnes per day, electrolytic hydrogen has an LCOH of approximately $5.43 per kilogram. This reflects the dominance of electricity input costs and lower conversion efficiency relative to reforming pathways. While capital costs are expected to decline over time, electricity prices remain the primary constraint on near-term competitiveness.

Looking ahead to 2050, the analysis projects cost reductions for both Electrolysis and NG Pyrolysis as technologies mature and deployment scales increase. Electrolysis costs decline to approximately $3.72 per kilogram, while NG Pyrolysis costs fall to approximately $2.78 per kilogram under baseline assumptions, with further reductions possible where carbon co-product revenues are realized.

Despite these improvements, reforming pathways with carbon capture remains cost-competitive at scale, particularly in jurisdictions with access to carbon storage infrastructure. The analysis also benchmarks hydrogen costs against forecast retail-equivalent prices for diesel, electricity, and natural gas, inclusive of carbon pricing. On a fuel-to-fuel basis, hydrogen is shown to be broadly competitive with diesel under current assumptions and increasingly competitive with electricity by 2050. Reducing reliance on natural gas becomes plausible only at large production scales and under favourable cost conditions.

These pathway-level cost findings are reinforced by the Ontario Ministry of Energy and Electrification's Cost-Effective Energy Pathways Study for Ontario, which evaluates hydrogen deployment within least-cost, system-wide net-zero scenarios.[9] The study finds that hydrogen plays a targeted role in Ontario's cost-effective energy transition, with supply scaling primarily after 2035 and concentrated in hard-to-electrify industrial applications and select electricity system uses. Across modeled pathways, hydrogen production initially relies on natural gas-based pathways with carbon capture, while production from natural gas without CCS is phased out over time. In later years, biomass-based hydrogen with carbon capture contributes to supply, alongside limited imports, reflecting both cost and resource constraints.

Consistent with the LCOH results above, the Pathways Study finds that electrolytic hydrogen is largely absent in most least-cost pathways, except under scenarios requiring deeper decarbonization or synthetic fuel production.[9] This outcome reflects the significant electricity system build-out required for large-scale electrolysis and the lower end-to-end efficiency of producing hydrogen from electricity compared to direct electrification. Under more favourable electrification conditions, the study finds that overall hydrogen demand declines further, reinforcing hydrogen's role as a complementary, rather than dominant, decarbonization solution.

Cost Effective Energy Pathways Study for Ontario

ESMIA Consultants, in collaboration with Dunsky Energy + Climate Advisors, was commissioned by the Ontario Ministry of Energy and Electrification to deliver an independent Cost-Effective Energy Pathways Study. The study identifies least-cost pathways to decarbonize Ontario's energy system through to 2050, informing long-term energy and climate policy decisions. Click *here* to read the full report.

Beyond production-level costs, the H2GO Canada study (2023) examines the broader capital and operating cost implications of scaling a hydrogen economy in Ontario through to 2050 under different scenarios.[97] The H2GO analysis finds that building a hydrogen economy in Ontario requires significant upfront investment. Under the status quo scenario, total capital investment is estimated at approximately C$85 billion by 2050, covering hydrogen production facilities, delivery infrastructure, and refuelling stations. Capital spending is also front-loaded over time. Most investments occur between 2025 and 2040, during the initial build-out of production and delivery infrastructure, before tapering as the system matures and assets are fully utilized.

This investment includes:

- Large-scale hydrogen production assets, including electrolysis facilities, reforming plants with carbon capture, and emerging technologies such as pyrolysis.
- Distribution infrastructure, including pipelines, truck and rail delivery systems, and refuelling stations.
- Supporting infrastructure such as grid connections, water treatment, compression, and storage.

Capital requirements are highly sensitive to location and siting decisions. The study shows that locating hydrogen production close to major demand centres, such as industrial clusters and freight corridors, can materially reduce the need for costly delivery infrastructure. As a result, Ontario's hub-based development approach plays a key role in managing capital intensity.[97]

While capital investment is substantial, operating costs ultimately determine hydrogen's competitiveness in Ontario. By 2050, the study estimates cumulative operating costs of approximately C$77.6 billion, alongside C$22.8 billion in maintenance costs associated with hydrogen facilities, pipelines, and refuelling infrastructure.[97]

Consistent with the pathway-level LCOH findings from the Transition Accelerator study, the H2GO analysis shows that operating costs in Ontario vary primarily by production pathway:

- Electrolysis is primarily driven by electricity prices. Ontario's low-carbon grid provides an emissions advantage, but electricity remains the single largest operating cost component.
- SMR and ATR with carbon capture are driven mainly by natural gas prices, with additional costs for carbon capture, transport, and storage.

- Natural gas pyrolysis depends on gas prices but can benefit materially from revenue generated through the sale of solid carbon co-products, which can offset operating expenses.

Labour costs are also significant and include both direct employment in operations and maintenance, as well as indirect jobs across supporting industries.

Hydrogen delivery costs reinforce the importance of domestic production and strategic siting. The H2GO study estimates that delivering hydrogen within Ontario would cost approximately C$1.3 billion under a well-planned domestic supply scenario.

Taken together, cumulative domestic hydrogen supply costs by 2050 including capital investment, operating costs, maintenance, and in-province delivery are estimated at approximately C$187 billion under the status quo scenario. By contrast, relying heavily on hydrogen imports would be substantially more expensive. If Ontario were required to meet demand through external supply, total hydrogen import costs could reach approximately C$406 billion.

The H2GO Canada analysis demonstrates that investment in a coordinated, domestically focused hydrogen strategy could contribute to substantial net socio-economic and environmental benefits. In particular, the modelling estimates:

- Cumulative greenhouse gas emissions reductions of up to 874 Mt CO_2e by 2050, driven by hydrogen replacing higher-carbon fuels across transportation, industrial, and buildings sectors.
- Peak job creation of approximately 160,000 to 230,000 jobs, depending on the scenario, reflecting both construction-phase employment and ongoing operations and maintenance.
- Delivered hydrogen costs falling to approximately C$5 per kilogram under scenarios that prioritize domestic production and technology learning, with some pathways achieving negative abatement costs (approximately–C$35/t$CO_2$) once avoided emissions and co-product revenues are considered.

The H2GO analysis reinforces that hydrogen competitiveness in Ontario is not driven by a single technology choice, but by system-level decisions around scale, siting, energy prices, and infrastructure coordination. While the investment required is significant, it also supports meaningful emissions reductions, job creation, and long-term energy system resilience.

3.4 Hydrogen Infrastructure and Mobility Ecosystem

Automotive Manufacturing Base

Ontario remains one of North America's most significant vehicle manufacturing regions, providing a strong industrial foundation for the province's emerging hydrogen economy. The province is home to five major automotive assemblers along with a dense supplier and research ecosystem. In 2024, Ontario's automotive producers manufactured approximately 1.3 million vehicles and employed nearly 90,000 workers directly. This industrial strength is reinforced by a robust talent and innovation pipeline, including 36 automotive-focused programs at Ontario universities and colleges and more than 400 companies active in connected and autonomous vehicle development and smart mobility.[98]

Several Ontario-based manufacturers are already integrating hydrogen into industrial operations, demonstrating how hydrogen can be embedded within existing manufacturing ecosystems. In the Sarnia–Lambton region, industrial parks such as Bluewater Energy Park and Bio-Industrial Park Sarnia offer serviced sites with access to rail, marine terminals, and existing hydrogen and industrial gas infrastructure. These assets reduce capital barriers for hydrogen-related manufacturing and support future scale-up. For example, Cabot Canada operates three facilities in Sarnia producing carbon black used in tires, rubber products, and plastics. The production process generates hydrogen as a secondary output, which is currently used on site as a fuel source, illustrating early industrial integration and circular economy potential within Ontario's manufacturing base.

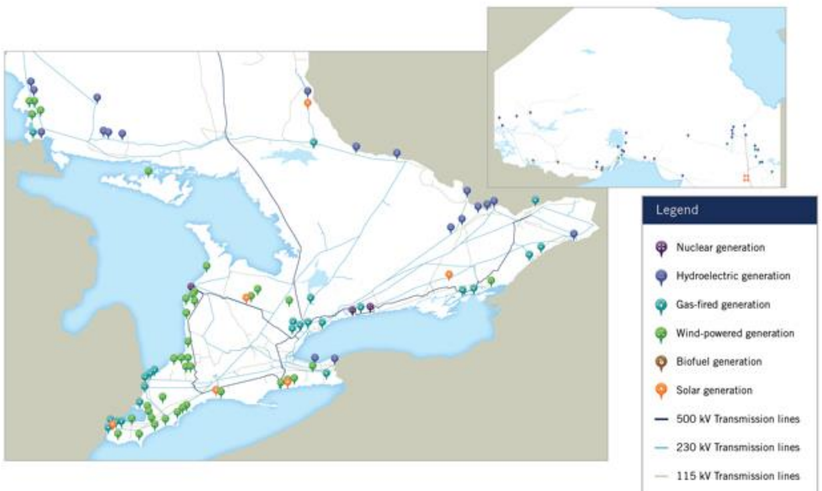
Figure 8 shows the primary automotive and transportation corridor along Highway 401, which extends from Windsor through the Greater Toronto Area to eastern Ontario. The concentration of vehicle assembly, component manufacturing, logistics activity, and continuous industrial operations along this corridor corresponds with some of the province's highest energy demand and most difficult decarbonization challenges. Heavy-duty transportation, high-temperature industrial processes, and round-the-clock manufacturing operations often face technical or economic limitations under full electrification alone. This creates a practical role for low-carbon hydrogen as a complementary energy solution alongside electricity, particularly in freight transport, industrial heat, and select manufacturing applications.

Figure 8: Ontario's Automotive Corridor: Windsor-to-Ottawa

Source: InvestOntario Automotive

Figure 9 illustrates the geographic distribution of Ontario's major electricity generation assets and the high-voltage transmission network that connects them.[99] This infrastructure supports the delivery of large volumes of clean electricity to population centres and industrial regions across the province, including potential hydrogen production sites where transmission capacity is available. Notably, several of these generation nodes and transmission corridors overlap with the primary automotive and transportation corridor along Highway 401, shown in Figure 7. This alignment means that many of the regions with strong potential for electrolytic hydrogen production are the same regions where demand is expected to emerge first, such as vehicle-assembly hubs, logistics clusters, and heavy-duty freight routes.

Figure 9: Map of Electricity generation sources in Ontario



Source: IESO Ontario's Electricity System

Building on this profile, Ontario's emerging hydrogen production hubs are increasingly aligned with major industrial regions. Projects such as the Niagara Hydrogen Centre and Bruce Power's Project 2030 are advancing large-scale green and pink hydrogen production intended to serve industrial users, logistics operators, and fleet-based transportation applications. In parallel, smaller on-site electrolyser deployments across the GTA and Southwestern Ontario are supporting material handling equipment, fleet operations, and pilot vehicle programs, reducing reliance on long-distance hydrogen transport during early adoption phases.

Existing and Planned Hydrogen Refuelling Infrastructure

Ontario's hydrogen refuelling network remains at an early stage of development. Carlsun Energy is developing a public hydrogen refuelling station at Toronto Pearson International Airport, supported by C$1 million in funding from Natural Resources Canada. Once operational, this station is expected to serve both light-duty and heavy-duty vehicles at 350 and 700 bar. It will be strategically located along the Toronto–Windsor–Montréal freight corridor. [100] The Toronto Pearson International Airport project illustrates how hydrogen refuelling can be integrated into major transportation hubs and is expected to expand public access to hydrogen fueling in Ontario.

Transit agencies are also beginning to build capacity. MiWay, Mississauga's transit provider, is advancing a multi-phase hydrogen fuel cell electric bus pilot project. Phase 1, which focused on feasibility analysis covering hydrogen supply, infrastructure requirements, regulatory considerations, lifecycle emissions, and cost performance, has been completed. This phase provided the analytical foundation for subsequent deployment. The project has now progressed to Phase 2, which involves the piloting of ten hydrogen fuel cell buses supported by C$10.9 million in federal funding from the Zero Emission Transit Fund. The buses are scheduled to enter service in 2026, (vehicle delivery is expected in March 2026), and will be supported by dedicated hydrogen refuelling infrastructure at MiWay's Malton and Central Parkway depots.[101] Although not public facing, these depot installations form a critical component of the province's emerging heavy-duty hydrogen ecosystem, enabling transit operators to gain operational experience and supporting future municipal deployments. [102] Overall, Ontario's hydrogen infrastructure remains limited but is transitioning from individual demonstration sites toward a corridor-based network that supports freight, transit, and early commercial fleet applications.

In terms of the hydrogen transportation network, Ontario currently has no dedicated hydrogen pipelines in operation. All hydrogen is transported via road to end users. In practice, this means compressed hydrogen is trucked in high-pressure tube trailers from production sites to fueling stations or industrial sites. Given the early stage of Ontario's hydrogen market (low volumes and dispersed demand), trucked distribution is the default approach, offering flexibility without the need for costly new pipelines. In contemplation of potential future pipelines, the government is evaluating the expansion of the Ontario Energy Board's mandate to regulate dedicated hydrogen pipelines to protect consumers while facilitating further development of new hydrogen infrastructure. Ontario's hydrogen strategy emphasizes a "hub model", co-locating hydrogen production near major users (industrial clusters, freight corridors) to minimize transport distances and costs. This is why initial fueling stations are sited in the Greater Toronto Area (GTA) and along Highway 401 close to both hydrogen supply points and heavy-duty demand.

3.5. Hydrogen Technology Deployment and Programs in Ontario

Mobility-Related Hydrogen Pilots and Deployment

Hydrogen mobility activity in Ontario remains in the early stages and is progressing through targeted pilots and feasibility studies. Initial deployment is influenced by several conditions that must be in place for pilots to operate effectively. These include access to hydrogen supply, consistent refuelling capability, available vehicle platforms, and operating environments where production, distribution, and fleet use can be located together. These factors align with patterns seen in other early hydrogen jurisdictions such as California and Germany, where adoption began with controlled fleets rather than broad public use.

Ontario's limited public hydrogen refuelling infrastructure represents a development opportunity to enable broader adoption of hydrogen mobility. The absence of publicly accessible refuelling stations has constrained the availability of light duty fuel cell vehicles in the province, with automakers such as the Toyota Mirai or Hyundai Nexo prioritizing markets with more established hydrogen networks, including British Columbia, Quebec, and several regions in the United States. Expanding strategically located refuelling infrastructure would create the conditions needed to support early vehicle deployment and attract OEM participation. This suggests that in the near term, Ontario's hydrogen mobility activity is well positioned to focus on fleet-based applications operated by government agencies, airports, transit providers, and commercial partners with access to dedicated or depot-based refuelling. The planned public station at Toronto Pearson International Airport is expected to support this type of early deployment.

Cold weather performance is an additional factor for Ontario. Experience from Québec found that FCEVs consume approximately 40 percent more hydrogen at −6 °C, raising operating costs to roughly C$27 per 100 kilometres at a hydrogen price of C$17.30 per kilogram.[103] These findings align with broader evidence from cold-climate jurisdictions, where battery-electric vehicles and hybrid vehicles also experience performance degradation in winter, albeit to a lesser extent. Battery-electric vehicles typically see a 20–40 percent reduction in range due to battery inefficiencies and cabin heating loads, though their operating costs remain significantly lower, often under C$4 per 100 kilometres when charged at residential rates.[104] In contrast, conventional gasoline vehicles and hybrids exhibit more modest efficiency losses of 10–30 percent, with fuel costs rising incrementally in cold weather at about C$10-15 per 100 km on fuel.[105] [106]

In this context, Ontario's early hydrogen mobility projects are concentrated in applications that operate from centralized depots, have predictable routes, or can incorporate on site production. These applications reduce infrastructure requirements and allow operators to monitor performance under real world operating conditions.

Hydrogen in Rail and Other Modes

Hydrogen is also being evaluated for rail applications. Metrolinx previously conducted a feasibility study on hydrogen fuel cell trains as part of the GO Expansion program, assessing whether hydrogen could serve as an alternative to overhead electrification on non-electrified corridors.[107] While no procurement decision has been made as of December 2025, the option remains under consideration. Alstom's Coradia iLint hydrogen train was piloted in Québec in 2023 to evaluate the technology's viability under Canadian operating conditions.[108] The pilot concluded in late 2023 and the results from the pilot indicated that hydrogen-powered trains can operate safely and reliably, provided that a robust hydrogen ecosystem is in place to supply fuel.

Freight rail developments may also have implications for Ontario. Canadian Pacific Kansas City (CPKC) has progressed a hydrogen locomotive pilot in Alberta, retrofitting locomotives with fuel cell

Case Study: HYGN Energy Inc

Hydrogen Hybrid Vehicle Kits

Many vehicle applications face technical or economic barriers to full electrification, particularly where duty cycles, capital costs, or infrastructure constraints limit the feasibility of battery-electric solutions. HYGN Energy's hydrogen hybrid retrofit kits address this gap by integrating hydrogen into existing gasoline and diesel engines to improve combustion efficiency and reduce emissions without requiring full vehicle replacement.

With support from OVIN, HYGN deployed its hydrogen hybrid technology at the Sarnia Blue Water Bridge, converting operational vehicles into hydrogen-assisted hybrids. The project demonstrated measurable performance benefits, including fuel consumption reductions of up to 20 percent and emissions reductions of up to 75 percent, achieved by enhancing combustion efficiency and reducing unburned fuel in exhaust streams.

This demonstration highlights the potential role of hydrogen as a transitional decarbonization solution for existing vehicle fleets. By enabling near-term emissions reductions using current infrastructure and assets, hydrogen hybrid systems offer a cost-effective pathway to lower transportation emissions where full electrification is not yet practical.

systems beginning in 2022.[109] If these pilots continue to scale, hydrogen locomotives could eventually be deployed on specific Ontario freight routes, particularly yard-switching or short-haul operations where centralized refuelling is feasible.

Additional modes are in exploratory stages. At Toronto Pearson International Airport, interest exists in hydrogen for ground-side operations, such as fuel cell baggage tractors or shuttle vehicles, building on the airport's existing refuelling infrastructure. Marine applications on the Great Lakes have not yet advanced beyond conceptual studies, but the province has identified potential opportunities for hydrogen or ammonia-based fuels in ferries and port operations.[110] In off-road sectors such as mining, hydrogen remains at the assessment stage, although global pilots of large fuel cell haul trucks have attracted attention within Northern Ontario's mining industry.

Overall, hydrogen deployment in Ontario's mobility sector remains early but is progressing through targeted pilots and feasibility studies. Near-term activity is concentrated in heavy-duty use cases, with passenger vehicles and broader modal adoption expected to follow as infrastructure, supply, and operational experience mature.

Case Study: Elemental Trucks Inc

Heavy Hydrogen Electric Truck for Long Haul Trucking

Long-haul trucking faces growing environmental and economic pressures, with rising emissions, tightening regulations, fuel price volatility, and operational challenges affecting fleet viability. While zero-emission vehicle technologies are advancing, there remains a gap in solutions for heavy-duty trucking, particularly for vehicles operating at a 63.5 tonnes gross combined weight. These configurations, commonly used on Canadian highways in A-train and B-train operations, are not currently served by major truck manufacturers.

To address this gap, Elemental Trucks designed and built a hydrogen fuel cell electric prototype chassis specifically engineered for a 63.5 tonnes gross combined weight rating. Supported through the OVIN's EV Stream 2 program, the project focused on demonstrating a zero-emission alternative capable of meeting the range, payload, and refuelling requirements of long-haul freight operations.

The project successfully advanced the technology to Technology Readiness Level 7, enabling vehicle demonstration and establishing a platform for future testing, certification, and potential manufacturing. The prototype illustrates the potential role of hydrogen fuel cell technology in heavy-duty trucking applications where battery-electric solutions face practical limitations.

4. Opportunities for Ontario's Hydrogen Mobility Ecosystem

Ontario is well-positioned to play a leading role in the emerging hydrogen mobility ecosystem. As global markets invest in hydrogen-powered transportation and supporting infrastructure, the province's established automotive supply chain, clean electricity system, research capacity, and diverse industrial clusters create a strong foundation for innovation and commercialization.

This section outlines the opportunity landscape across vehicle technologies, component manufacturing, refuelling infrastructure, and integrated energy-mobility solutions. It examines where Ontario can lead in developing fuel cell systems, hydrogen storage technologies, heavy-duty vehicle platforms, and hybrid mobility solutions that combine battery-electric and hydrogen applications. Additionally, it highlights opportunities for collaboration between industry, academia, utilities, and government to advance pilots, scale demonstrations, and strengthen local value chains.

4.1 Leverage Ontario's Clean Electricity Advantage to Accelerate Low-Carbon Hydrogen Leadership

Ontario's clean electricity grid provides the province with one of the strongest foundations in North America for cost-competitive low-carbon hydrogen production. Expert interviews consistently underscored that the high cost of hydrogen remains the dominant barrier to widespread adoption, particularly in mobility applications. Both research and interview insights highlight Ontario's off-peak nuclear and hydro capacity as one of the most viable pathways to lowering low-carbon hydrogen costs.

Pairing this with advances in electrolyser design, has the potential to significantly reduce the cost of low-carbon hydrogen, especially at transit depots, logistics hubs, and industrial clusters. The province can use this advantage to support local decarbonization while also positioning itself as a credible supplier for emerging hydrogen markets across the Great Lakes basin. Through continued investment in innovation, rate design, and power-to-gas integration, converting surplus renewable electricity into hydrogen, Ontario can cement its status as a leader in clean hydrogen, fueling transport, stabilizing the grid, and reinforcing long-term energy security.

4.2 Advance Priority Mobility Segments and Freight Corridors

The clear consensus that emerged from the literature review and conversations with operators, technology developers, and sector experts, was that hydrogen offers the greatest value for use cases requiring long range, high payload capacity, fast refuelling, and continuous uptime, conditions under which battery-electric solutions face notable operational constraints.

This suggests that there is an opportunity for Ontario to focus early deployment on heavy-duty trucking, transit buses, airport ground-service vehicles, material-handling equipment, and mining fleets. Strategic deployment along high-traffic freight corridors such as Highways 401 and 402, supported by stations at major logistics and border locations, can enable early fleet conversion and generate valuable data on performance, operations, and cost. Over time, these corridors can link Ontario's emerging hubs and help build a more coordinated hydrogen mobility network.

4.3 Leverage Public Procurement to Anchor Early Hydrogen Demand

Global analyses including those from IEA emphasize that public procurement and government fleet leadership are among the most effective tools for catalyzing early hydrogen adoption, particularly in heavy-duty transport. Ontario's low-carbon hydrogen strategy highlights the importance of innovative procurement approaches that enable public agencies to adopt low-carbon vehicles and equipment. Yet hydrogen vehicles face early-market barriers such as high upfront costs, limited refuelling infrastructure, and technology unfamiliarity. Fleet companies are unlikely to overcome these barriers without public-sector leadership.

Strategic procurement by transit agencies, municipalities, provincial ministries, airports, and other public fleets can provide the stable, multi-year demand signals needed to justify investment in refuelling infrastructure, vehicle supply chains, and local manufacturing capacity. Expert interviews emphasized that without early anchor customers, the economics of hydrogen projects remain challenging. Public procurement can help de-risk adoption, accelerate technology learning, and make Ontario an attractive market for OEMs and integrators.

4.4 Build Out Hydrogen Refuelling Infrastructure at High-Throughput Logistics Nodes

Hydrogen mobility adoption in Ontario will depend on early investment in strategically located refuelling infrastructure. Interviews consistently identified fuelling availability, public or depot-based, as the primary barrier to scaling hydrogen fleets, particularly for transit agencies, heavy-duty trucking operators, and municipal fleets. Establishing hydrogen stations at high-throughput logistics nodes such as airports, ports, border crossings, distribution hubs, and major freight corridors can create anchor points that support predictable, high-volume demand. These sites already concentrate yard tractors, buses, heavy trucks, and material-handling equipment, making them natural early candidates for hydrogen fuelling.

By supporting targeted refuelling infrastructure development, potentially co-located with production assets such as the Niagara Hydrogen Centre, Ontario can create the enabling conditions for commercial fleet deployments and reduce project risk for both vehicle operators and supply-chain investors.

4.5 Strengthen Policy and Regulatory Foundations to Enable Market Confidence

Ontario has an opportunity to advance hydrogen adoption by strengthening the policy and regulatory environment that underpins both production and mobility applications. Interview findings emphasized the importance of clear permitting pathways, more fully developed RCS, updated safety classifications, and predictable approval timelines to reduce uncertainty for project proponents. Participants also highlighted the importance of technology-neutral incentives that focus on low-carbon performance outcomes, rather than specific hydrogen "colour" pathways, to support a broad range of viable options as the market evolves in Ontario.

Clearer CCUS pathways, stable electricity pricing for electrolysis, streamlined permitting, and well-defined codes and standards can help reduce uncertainty for investors and early adopters. Targeted provincial programs, together with incentives that reduce early-stage risk, would support refuelling infrastructure development, encourage fleet transitions, and accelerate commercialization. A coordinated, investment-ready policy framework, with predictable regulations, efficient approvals, and long-term signals for private capital, would create the conditions needed for hydrogen technologies to scale while contributing to Ontario's economic and emissions-reduction goals.

4.6 Activate Ontario's Industrial Strength to Enable Low-Carbon, Blue Hydrogen at Scale

Ontario's most mature hydrogen activity is in Sarnia-Lambton, where long-standing petrochemical and refining operations already produce and use hydrogen. This existing industrial base gives the province a practical platform for early low-carbon hydrogen deployment. Across consultations with industry experts, there was broad consensus that blue hydrogen represents the most commercially viable near-term pathway, particularly given the cost premium associated with green hydrogen and the ongoing maturation of electricity-based production technologies.

Changes to Ontario's CCUS framework strengthen this opportunity. A clearer regulatory pathway enables existing hydrogen producers to decarbonize output and move toward lower-carbon supply. This shift can help anchor the first wave of hydrogen demand and create the production volumes necessary to support additional applications.

Sarnia-Lambton's integrated industrial cluster also creates a natural bridge to early mobility use cases. Refinery logistics fleets, chemical-plant yard equipment, and regional freight operating along Highway 402, Sarnia–Lambton's primary freight corridor, can leverage existing hydrogen production, storage, and distribution assets already in place for industrial uses to support early adoption of low-carbon hydrogen. These localized applications can increase utilization of new production assets, help reduce unit costs, and provide Ontario with real-world demonstrations of hydrogen in both industrial and transportation settings. Together, they offer a practical opportunity to build on existing infrastructure, workforce expertise, and supply chain capabilities to advance industrial decarbonization and enable early mobility deployment.

4.7 Develop Regional Hydrogen Hubs Focused on Practical, Localized Use Cases

Hydrogen adoption is most viable when production and demand are co-located. This pattern is reflected in international experience with hydrogen valleys and regional clean hydrogen hubs. Industry consultations underscored the advantages of developing concentrated hydrogen clusters. These clusters can reduce delivered fuel costs, streamline distribution, and support more reliable early-stage operations. Together, these factors make the clustered approach both practical and commercially well-founded. Ontario can build on this principle by advancing regional hydrogen hubs that reflect local conditions.

- In Niagara, proximity to hydroelectric generation and existing pilot projects enables early green hydrogen production for municipal transit, heavy-duty vehicles, and industrial operations.
- In the Greater Toronto and Hamilton Area (GTHA), high-throughput freight, airport and port operations, and large return-to-base fleets create opportunities for targeted mobility demonstrations and energy-storage applications.
- In Sarnia-Lambton, industrial hydrogen demand and existing energy infrastructure offer a foundation for future low-carbon hydrogen expansion.

Together, these hubs enable Ontario to test real-world applications, refine cost structures, and develop supply chains in a controlled, evidence-based environment. They also allow industrial hydrogen projects to serve as anchors for early mobility deployment, rather than treating these two domains in isolation.

4.8 Grow a Domestic Supply Chain for Hydrogen Components and Systems

Ontario's established automotive and advanced manufacturing ecosystem positions the province to develop key components for hydrogen systems, including fuel cell stacks and modules, high-pressure storage tanks, refueling equipment, and power electronics. As outlined in previous sections, this potential is supported by the province's dense cluster of automotive Tier 1 suppliers, many of whom are transitioning from internal combustion powertrains towards clean propulsion technologies.

The capabilities required to produce these systems align closely with Ontario's existing supply chain strength. For example, the region's expertise in precision machining and fluid dynamics, originally established for fuel injection and engine block manufacturing, is directly transferable to the production of balance-of-plant components for hydrogen systems.[111] Similarly, Ontario's established leadership in vehicle cooling technologies provides a strong foundation for designing the thermal management systems that are critical to fuel cell performance.[112]

As hydrogen mobility demonstrations expand, demand for these components will grow both within Ontario and across North America. By supporting the retooling of existing metal fabrication and assembly lines, the province can position its legacy automotive assets as a competitive strength in the emerging hydrogen economy.

4.9 Strengthen Ontario’s Skills, Safety, and Technical Standards for Hydrogen

As hydrogen technologies scale across production, storage, distribution, and mobility use cases, Ontario’s ability to deploy them safely and reliably will depend on building the right workforce skills and updating the codes, regulations, and technical standards that support safe hydrogen deployment. Conversations with training institutions and technology experts highlighted that workforce capacity can be a growing constraint: technicians, maintenance staff, and fleet operators will need new competencies in hydrogen systems, high-pressure storage, and refueling equipment.

The province’s colleges, research institutions, and training organizations are well placed to develop specialized programs that build on existing automotive, electrical, and mechanical skill sets. Establishing clear guidelines, safety protocols, and permitting pathways will further support safe and efficient deployment across municipalities. This technical foundation will not only enable early adoption but also help reduce project timelines and foster industry confidence.

4.10 Expand Collaboration with International Partners

Interview findings indicated that Ontario’s ability to scale hydrogen deployment will depend in part on how effectively it aligns with activities beyond its borders. Stakeholders emphasized that cross-border coordination with the U.S. is especially important for long-haul trucking routes that connect Ontario to major U.S. logistics hubs. Ontario’s proximity to U.S. states that are advancing hydrogen initiatives, including Michigan, Ohio, Illinois, and New York, creates opportunities for coordinated demonstration projects, harmonized standards, collaborative research, and joint mobility pilots.

Additionally, collaboration with European and Asia-Pacific partners that are working on fuel-cell technologies, hydrogen mobility, and safety codes can accelerate Ontario’s learning curve and support technology transfer. Strengthening these partnerships can help Ontario-based firms participate in broader supply chains and ensure that the province’s hydrogen solutions are aligned with international best practices and evolving market requirements.

4.11 Support a Gradual Transition Toward Hydrogen-Enabled Industrial and Mobility Ecosystems

Across interviews, participants consistently described hydrogen adoption in Ontario as a phased and incremental process rather than a rapid, system-wide transition. Early progress is expected in applications where hydrogen already provides clear operational advantages, particularly in high-utilization and heavy-duty fleets.

As supply, infrastructure, and workforce skills continue to develop, Ontario can expand hydrogen use into additional sectors, including goods movement, municipal fleets, off-grid industrial operations, and eventually rail and marine applications. Over the longer term, the combination of clean electricity, improved carbon-capture options, and advancing technology can support the integration of hydrogen into a broader clean-energy system. This will enhance system flexibility, reduce emissions, and create new opportunities for sector development.

5. Glossary

AEM	Anion Exchange Membrane
ATR	Autothermal Reforming
CAPEX	Capital Expenditure
CCUS	Carbon Capture, Utilization, and Storage
CO_2	Carbon Dioxide
EV	Electric Vehicle
EU	European Union
FCEV	Fuel Cell Electric Vehicle
GTHA	Greater Toronto and Hamilton Area
GTA	Greater Toronto Area
H_2-ICE	Hydrogen Internal Combustion Engine
HaaS	Hydrogen-as-a-Service
HIF	Hydrogen Innovation Fund
HRS	Hydrogen Refuelling Station
IEA	International Energy Agency
IESO	Independent Electricity System Operator
ITC	Investment Tax Credit
JIVE	Joint Initiative for hydrogen Vehicles across Europe
LCFS	Low-Carbon Fuel Standard
LDV	Light-Duty Vehicle
LCOH	Levelized Cost of Hydrogen
LOHC	Liquid Organic Hydrogen Carrier
MW	Megawatt
MMBTU	Million British Thermal Units

MNRF	Ministry of Natural Resources and Forestry
NATO	North Atlantic Treaty Organization
NREL	National Renewable Energy Laboratory
NRCan	Natural Resources Canada
OEM	Original Equipment Manufacturer
OPEX	Operating Expenditure
OPG	Ontario Power Generation
OVIN	Ontario Vehicle Innovation Network
PEM	Proton Exchange Membrane
PJ	Petajoule
PSI	Post-Secondary Institution
R&D	Research and Development
RCS	Regulations, Codes, and Standards
SMR	Steam Methane Reforming
SOEC	Solid Oxide Electrolyser Cell
SUV	Sport Utility Vehicle
TCO	Total cost of ownership

6. OVIN Team

Information on OVIN team members and relevant contacts for outreach is available on OVIN's website at: https://www.ovinhub.ca/connect/team/

7. Disclaimers

This report was commissioned by the Ontario Centre of Innovation (OCI) through a Request for Proposals titled "Ontario Vehicle Innovation Network (OVIN) – Annual Comprehensive Sector Report & Quarterly Specialized Reports," dated September 26, 2025, and has been prepared by MNP LLP. It is one of five reports covering an analysis of Ontario's automotive technology, electric vehicle and smart mobility landscape while incorporating implications for the sector's skills and talent landscape.

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8. Expert Interviews

The project team conducted targeted consultations with industry, transit operators, technology developers, regulators, and regional economic organizations between December 2025 and January 2026. Consistent with the engagement protocol, interviews were non-attributable and findings are presented in aggregated form. The table below summarizes the organizations and areas of expertise represented in these consultations.

Organization	Interviewees
Canadian Hydrogen Association	Maike Althaus, Vice President, Government Relations and Public Affairs
Sarnia-Lamton Economic Partnership	Matthew Slotwinski, CEO
H2GO Canada	Bob Oliver, President
Elemental Trucks	Jamie Ally, CEO
NewFlyer	Patrick Jones, Business Segment Director
Sarnia-Lamton Economic Partnership	Matthew Slotwinski, CEO
Ontario Energy Board	Rachel Anderson, Manager, Energy Transition John Lau, Senior Advisor, Energy Transition
H2GO Canada	Bob Oliver, President
University of Waterloo	Dr. Xianguo Li, Professor
Niagara College	Wayne Toth, Former Professor & Coordinator Duane Bender, Faculty Instructor
University of Waterloo	Xianguo Li, Professor
Canadian Hydrogen Association	Maike Althaus, Vice President, Government Relations and Public Affairs

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