

Why Canada is a leader in ammonia, a fuel of the future

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The world is undergoing an unprecedented energy transition and Canada is uniquely positioned to supply clean energy for the globe. Ammonia—a stable, easy to transport carbon-free fuel, with applications as a medium to carry hydrogen—is emerging as a fuel of the future.

Canada is already a major ammonia producer thanks to its well-established hydrogen production capabilities and available infrastructure in the country. With the added benefits of carbon capture technologies and the country's abundant renewable energy resources, Canada is the ideal location for investment in ammonia fuel projects.

Why is ammonia a fuel of the future?

Ammonia (NH₃) is a building-block chemical used in the production of fertilizer and many other everyday products. About [90% of the ammonia](#) produced today is used for fertilizer, which helps sustain food production for billions of people around the world.

However, ammonia's emissions-reducing uses are gaining greater [attention and investment](#). Five emission-reducing uses for ammonia fuel are:

- As an [energy storage medium](#);
- As a [zero-carbon fuel](#) in fuel cells or by combustion;
- To [generate electricity](#) for city power grids or in remote locations;
- As a fuel used in [district heating systems](#); and
- As an effective [energy carrier](#) in sustainable international energy supply chains

Ammonia's uses as both a zero-carbon fuel and as an effective energy carrier for hydrogen fuel are its most important advantages. Canada is perfectly positioned to produce ammonia fuel for both those applications.

Ammonia and the hydrogen economy

Due to ammonia's chemical composition and the relative ease in transforming, it is a stable medium for the [transportation and storage of hydrogen](#). Therefore, ammonia is key to the widespread adoption of hydrogen. Rather than requiring to be cryogenically frozen to -253°C like hydrogen, ammonia only needs to be cooled to [-33°C](#) to remain in a liquid state. Liquefied ammonia contains [50% more hydrogen by volume](#) than liquid hydrogen fuel, it is easily stored in large quantities as a liquid, and can be "cracked" using inexpensive catalysts to provide hydrogen when needed.

As such, ammonia as an energy carrier can overcome one of the greatest barriers to the adoption of hydrogen—the [cost of storage and transportation](#). Ammonia's properties and existing international infrastructure will provide a safe, easy to manage and cost-effective hydrogen supply chain.

[Hydrogen Canada Corps](#) is a company drawing on this precise strategy with their project in Edmonton, Alberta, which aims to supply 300 metric tonnes of CO₂-free hydrogen per day to both the Asian and North American markets. Leveraging the infrastructure already in place in Canada for ammonia, the company will transport all hydrogen produced at their Edmonton facility as ammonia. It will then be extracted using the dehydrogenation process at its final destination.

Ammonia and hydrogen in global industries and markets

In the maritime industry, the cost of ammonia is [32%](#) cheaper than hydrogen and 15% cheaper than methanol. The fuel can enter the global market relatively quickly to meet [2050 net-zero emission goals](#). Projections indicate that ammonia will be the [most used zero-emission fuel](#) in the maritime industry by 2050. Ammonia also has the potential to be used to [decarbonise](#) rail, heavy road transport and aviation.

Japan has bet on ammonia as the fuel of the future, and is [looking to foreign markets](#) for supply as demand is projected to rise to [3 million mt/year](#) by 2030 and 30 million mt/year by 2050. Canada's free trade regime with Japan through [CPTPP](#) makes the country an ideal partner and supplier for their global ammonia supply chain.

Outside of the ammonia infrastructure already in place, Canada is also investing in large-scale liquefied natural gas (LNG) infrastructure. These capacities, such as seaports and liquefaction facilities, can be

[adapted towards the transportation of ammonia](#) for use in the hydrogen economy. With [13 LNG export terminal projects](#) on the west coast (British Columbia) and five on the east coast (2 in Quebec and 3 in Nova Scotia), Canada will have large-scale ammonia-ready infrastructure to fuel the global economy.

Canada's advantages for clean ammonia fuel production

Canada ranks in the top ten countries in the world for ammonia, with [3.9 million metric tonnes produced in 2020](#). Alberta is the leading region in this regard, producing about [3.5 million metric tons of ammonia per year](#).

Most ammonia in the world and in Canada is produced through the [Haber-Bosch process](#), which takes hydrogen from natural gas and combines it under pressure with nitrogen in the air to produce grey ammonia. However, [advancements in carbon capture technology](#) in Canada have enabled the production of blue ammonia, and water electrolysis powered by renewable energy allows for green ammonia to be produced. These two processes can be leveraged to ensure future production is low carbon intensity and becomes carbon neutral.

Abundant renewable energy sources

The widespread availability of clean energy across Canada makes the country one of the most ideal locations in the world for *green ammonia* production.

Canada is the [6th largest electricity generator](#) in the world and [60%](#) of the country's energy is generated through hydroelectricity, with [Manitoba](#), [Yukon](#), [Quebec](#), [British Columbia](#) and [Newfoundland and Labrador](#) all generating at least [91%](#) of their electricity through hydro. Likewise, [99%](#) of electricity generated in Prince Edward Island is generated from wind and [96%](#) of Ontario's energy mix is generated through non-emitting sources, allowing the province to produce [pink hydrogen](#) as feedstock for clean ammonia production.

Electricity in these regions is extremely affordable. Quebec has some of the lowest utility costs in North America with industrial users paying only [3.3 cents per kilowatt hour \(c/kWh\)](#). Manitoba closely follows at [3.74 c/kWh](#) and then British Columbia at [5.6 c/kWh](#). Green ammonia production is therefore both possible and an attractive endeavour from coast-to-coast.

The country's potential for *blue ammonia* production is also excellent. Alberta, British Columbia and Saskatchewan collectively produce [16.6 billion cubic feet of natural gas per day](#), with 71% of that production coming from Alberta. These production levels make Canada the [4th largest natural gas producer](#) in the world.

These three provinces have the largest [carbon capture storage resources in Canada](#) and contain the most carbon capture projects currently in development. Alberta alone has committed [\\$1.24 billion](#) through 2025 to two commercial-scale carbon capture and storage projects. These will reduce GHG emissions in the oil sands and the ammonia industry by 2.76 million tonnes each year, the equivalent to the yearly emissions of 600,000 vehicles.

Framework for ammonia industry growth

With the release of the national hydrogen strategy—as well as provincial hydrogen strategies in [British Columbia](#), [Alberta](#), [Quebec](#) and [Ontario](#)—Canada has the framework in place to scale-up hydrogen production across the country. The domestic market is estimated to generate revenue of up to [\\$50 billion per year by 2050](#). Canada's massive hydrogen economy will allow ammonia producers to source large supplies of clean hydrogen from whichever centre best fits their needs.

Thanks to the infrastructure and expertise within the [Edmonton Region Hydrogen Hub](#), the [Alberta Industrial Heartland](#) is already poised to become the first major hydrogen center in the country, which makes it an ideal location for any new ammonia fuel projects to be developed.

Incentives for ammonia project development

Canada offers several attractive incentives for proponents of zero-emission and carbon-neutral ammonia projects.

Blue ammonia projects of a minimum CAPEX of \$50 million are eligible for the [Alberta Petrochemicals Incentive Program](#), which provides grants upwards to 12% of the total project cost once operational. Alberta's [Technology Innovation and Emissions Reduction \(TIER\) Regulation](#) also sets emission reduction targets on high emitters and rewards more efficient production facilities. Ontario has dedicated \$74 million towards cleantech innovations as part of their [Green Investment Fund](#). British Columbia has a similar program called the [CleanBC Industry Fund](#), and an additional \$104 million [Innovative Clean Energy \(ICE\) Fund](#).

There is a [federal tax incentive for clean energy equipment](#) for businesses to fully expense clean energy generation and energy efficiency equipment, and a recently created [\\$1.5 billion Clean Fuels Fund](#). The federal government also offers foreign companies funding through the SIF Net-Zero Accelerator. This \$8 billion dollar fund, announced in the 2021 federal budget, will expedite decarbonization projects by large emitters, scale-up clean technology, and accelerate Canada's industrial transformation in the energy sector.

By leveraging the [Scientific Research and Experimental Development \(SR&ED\) Tax Credit](#), foreign companies also gain a combined federal and provincial/territorial tax credit of 23.83% when conducting ammonia-related R&D in Canada.

Canada holds several distinct advantages for companies looking to produce ammonia as a fuel or develop hydrogen projects with ammonia as the medium to carry it. As the world continues to transition away from fossil fuels, companies can count on Canada as a hub for clean energy production well into the future.

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