

Hydrogen in Canada

Status Quo, Debates and Potential

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Executive Summary

Canada has the potential to become a major hydrogen exporter and lays out the aspirations to realise this potential in the federal Hydrogen Strategy of December 2020. The study by adelphi analyses recent economic and political developments regarding hydrogen in Canada. The chapters go into 1) the Canadian hydrogen sector and current demonstration projects, 2) the federal Hydrogen Strategy, 3) the heterogeneous interests and political contexts of the provinces, 4) the potential for the production and export of hydrogen, with special emphasis on renewable energy resources, as well as 5) the potential for cooperation with Germany.

The Canadian hydrogen sector produces around 3 million tonnes of grey hydrogen per year, making Canada one of the ten largest producers globally. Small quantities are already being exported to the US today. In Canada, hydrogen is mostly used in chemical production and refineries. Since the 1980s, Canadian companies have been developing hydrogen technologies, the best-known companies being Hydrogenics/Cummins and Ballard Power Systems. There exist a large number of demonstration projects and research programmes on hydrogen in Canada. A number of smaller green hydrogen projects with a total electrolysis capacity of 23.4 MW are operational. With Shell's Quest Project, one of the world's first blue hydrogen projects has been in operation since 2015. A large number of projects with larger capacities are being planned, including in Québec, where German companies are also involved.

In December 2020, Canada released its long-awaited Hydrogen Strategy, which had been in the works for more than three years. Canada views hydrogen as an opportunity to combine economic growth, security of supply, climate action and clean air as well as to create a business perspective for its oil and gas sector. By 2050, Canada wants to become one of the three largest hydrogen producers worldwide, consuming up to 20.5 million tonnes of domestically produced hydrogen as well as exporting large quantities. The Hydrogen Strategy did not include an explicit budget, rather 1.5 billion CAD (1 billion EUR) worth of funding will be available through the previously announced Low-carbon and Zero-emissions Fuels Fund. Although the strategy aims to look at emissions intensity instead of leaning towards certain technologies or production routes, it does focus on hydrogen production from fossil fuels (especially natural gas, but also oil and coal) and the economic prospects that it offers for Canada's struggling oil and gas sector. Electrolysis is described as a promising production technology, but as less promising cost-wise than fossil production due to Canada's cheap and vast gas reserves. With respect to the expansion of renewable energy for electrolysis, the strategy does not go into detail.

How the focus on blue hydrogen will be aligned with Canada's goal of reaching climate neutrality by 2050 is not spelled out in detail. As a result, the strategy seems to be more of a vision for the future of those provinces with large fossil fuel resources. Consequently, the strategy received some criticism from the climate and environmental movement within Canada, which had already, before its publication, appealed in a joint statement to the Minister of Natural Resources to focus on green hydrogen. The provinces are now tasked with implementation and the development of regional blueprints. The fossil-fuel-dominated province of Alberta was very satisfied with the federal strategy. Québec on the other hand, which has large renewable sources, claimed that it had not been consulted on the federal strategy and is currently developing its own strategy, which will focus on green hydrogen. This shows clearly that provinces will follow their own hydrogen pathways based on their economic and political interests.

This is possible, since provinces and territories in Canada have relatively large authority on energy issues in comparison to the federal level. Despite their different interests and starting

points, the provinces generally align on the goal of building a hydrogen economy. Alberta, the largest oil and gas producer in Canada and already a big hydrogen producer, is particularly interested in hydrogen as a way of expanding its natural gas sales, potentially to markets in the US, Asia and Europe. British Columbia is also interested in building a hydrogen economy and has also announced its own strategy. The province possesses large gas reserves, good conditions for hydro and wind power, as well as a strong hydrogen technology sector. Ontario, a province without fossil fuel resources but using a low-carbon electricity mix due to large shares of nuclear energy and renewables, has published a hydrogen discussion paper in November 2020, which will be followed by a strategy. Québec has been interested in hydrogen for many years. With an electricity mix based almost entirely on renewables, it sees itself as a green hydrogen producer. Various demonstration projects are in operation or have been announced and Québec's Hydrogen Strategy is expected by the end of the year.

Although not emphasised or quantified in the Canadian Hydrogen Strategy, Canada has a large potential for the production of green hydrogen. As several studies show, Canada's renewable energy potential is so great that the country could cover its entire energy needs with considerable surplus available for green hydrogen exports. Depending on what level of energy demand and renewable potential is assumed, the potential for hydrogen exports lies between 25 and 35 million tonnes per year. That corresponds to more than a third of the German final energy consumption. The production potentials are particularly pronounced in Eastern Canada, where there are large (excess) hydro capacities and cheap wind power resources in sparsely populated areas. In the medium term, the production costs for small quantities of green hydrogen from Eastern Canada are likely to be particularly low in global comparison. The great potential for cheap blue hydrogen, on the other hand, is particularly pronounced in Western Canada (Alberta, British Columbia, Saskatchewan), where exports would likely focus on Asia and the US. For said blue hydrogen to reach Europe, pipelines of a length of over 4,000 km would have to be built from West to East. There are also gas reserves in Eastern Canada, but the overall potential for blue hydrogen production in Eastern Canada appears limited.

Eastern Canada has optimal conditions for a rapid market uptake of green hydrogen, possibly among the best in the world. This has to do with favourable electricity prices, existing excess power capacities, the favourable conditions for the expansion of wind power, and good business conditions in general. With growing volumes, Canada is unlikely to be able to compete with the world's best locations for solar production in terms of generation costs. However, if hydrogen shipping to Europe becomes a viable option for exports, Canadian green hydrogen could still maintain a competitive position in the merit order of potential suppliers due to other advantages such as low capital costs and high investor confidence. Additionally, Canadian ports are relatively close to Europe and trade via the North Atlantic is geopolitically less vulnerable than other shipping routes. Canada is also an important and stable political and economic partner for Germany and Europe. A future hydrogen trade could deepen this relationship, as well as move forward international climate policy.

On several topics, there is great potential for cooperation between Canada and Germany. In the existing energy policy dialogue and within a future energy partnership, the topic of (green) hydrogen could play a central role. German interest for Canadian green hydrogen could be expressed politically and a future supply route could be tested through concrete demonstration projects. Particularly, the establishment of local hydrogen hubs, as suggested in the Canadian Hydrogen Strategy, could be used for bilateral cooperation projects. Cooperation in the area of certification is also important given the focus of the Canadian strategy on blue hydrogen. However, if emission standards for hydrogen are not stringent enough, there is the risk of considerable additional GHG emissions. Beyond these issues, there is further potential for cooperation along the entire value chain of hydrogen.