Federal Hydrogen Strategy to energize Canada's industries

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Part three of BLG's hydrogen economy series

The federal Hydrogen Strategy for Canada (the National Strategy) has finally been released, reflecting many of the priorities of the numerous provincial hydrogen initiatives already announced.

The federal plan is unique in both its recognition of the need for regional adoption strategies and the sheer magnitude of the undertaking – the National Strategy seeks to vault Canada into a top 3 hydrogen producer globally and has included a number of industry and sector-specific goals to achieve this lofty goal.

Advantage Canada?

The National Strategy points to six distinct advantages that Canada can seek to utilize in the global hydrogen market:

1. Feedstock abundance: low carbon energy, along with fossil fuels, CO2 storage capacity, biomass supply and freshwater resources;
2. Innovative industry: both hydrogen fuel cell and carbon capture, utilization and storage;
3. Energy sector: ability to "pivot to include at-scale hydrogen as an energy currency;"
4. International collaborations: through government, industry and academia;
5. Exports: Proximity to export markets, with capacity for shipping or pipeline delivery to United States, Asia and Europe; and
6. "Unique starting point": Canada is identified as a top 10 producer of hydrogen - with aspirations to come within the top 3 global producers.

The federal government overtly seeks to capitalize both the country's existing progress on hydrogen and its plentiful natural resources. Further, COVID-19 recovery is viewed an opportune time to promote financial recovery with a repositioning on national priorities towards green growth.

The eight pillars of the Hydrogen Strategy

The National Strategy contains no fewer than 32 recommendations across eight “pillars” in promoting investment and collaboration within and across sectors:

1. Grow strategy-related partnerships
2. Establish funding and long-term policies to de-risk investment
3. Research and development
4. Modernize codes and standards within Canada and internationally
5. Include hydrogen in clean energy strategies at all levels of government
6. Public promotion and education
7. Develop regional “blueprints” for hydrogen production and usage
8. Ensure international clean fuel mandates include hydrogen

In short, all of the elements of a successful hydrogen program are assembled locally, domestically and internationally.

In addition to the eight pillars, the National Strategy goes into detail on the production, distribution, storage and end uses of hydrogen. For each stage of the hydrogen lifecycle, the National Strategy looks at the near term objectives (2020 – 2025), medium term objectives (2025 – 2030) and long-term objectives (2030 – 2050).

Production

In its virtual announcement releasing the National Strategy, the government (specifically Ministers O’Regan (Natural Resources) and Wilkinson (environment)) underscored the two principal objectives of the National Strategy: reduce emissions, and jobs. The carbon intensity of hydrogen is therefore of the utmost importance to the federal government.

Carbon intensity measures the emissions that go into the production of hydrogen. At a high level, the federal government sees Blue hydrogen (hydrogen produced using natural gas and carbon capture utilization and storage (CCUS)) as being one of the main sources of hydrogen in the near term, until renewables and other forms of zero-emissions production of hydrogen are developed at competitive prices. Grey hydrogen (produced using natural gas and no CCUS) and smaller amounts of Blue hydrogen are already being produced in various provinces, primarily in Alberta. The goal of the federal government is to increase CCUS for hydrogen production to capture 50 per cent of Green House Gas (GHG) emissions as soon as possible and 90 per cent of GHG emissions using CCUS by 2030.

Other methods of producing hydrogen (referred to as ‘pathways’ in the National Strategy) include electrolytic hydrogen (using clean electricity to separate the H2 molecules from H20), hydrogen from biomass (using dry gasification) and hydrogen produced as an industrial by-product. In outlining the various hydrogen production pathways, the government underscores the importance of regional diversification. The National Strategy also notes that as the drive towards electrification continues, it will increase the demand for electricity. This will happen over the same timeframe that

hydrogen demand grows. Consequently, the market will decide as to which emissions reduction strategy to adopt as each area competes for clean or zero-emissions electricity. To help scale green hydrogen, the federal government will introduce a renewables threshold in the projects it funds.

Distribution and storage

The National Strategy outlines the challenges and barriers with distributing and storing hydrogen. These challenges are significant and include the requirement to build out new gas distribution infrastructure to support the local distribution of pure hydrogen, as well as the technical challenges related to its non-pipeline transportation. In particular, large capital investments are required to build out hydrogen distribution infrastructure at a time when demand is growing and uncertain. The document highlights Canada's unique geological reserves that could be used to store hydrogen, including salt caverns and depleted natural gas wells. Although liquefaction of hydrogen gas presents safety challenges and is energy intensive, requiring up to 30 per cent of the energy stored by hydrogen, it is required for large-scale distribution.

Given the foregoing challenges, the National Strategy places an emphasis on producing hydrogen close to where it will be used, and refers to these as regional Hubs.

End uses

The National Strategy focuses on three categories of end-uses for hydrogen:

- Fuel for transport and power production;
- Heat for industry and buildings; and
- Feedstock for products and chemicals.

Fuel for transport

The National Strategy identifies three separate hydrogen applications for transportation fuels:

> Fuel cell electric vehicles: The National Strategy promotes hydrogen fuel cell electric vehicles, and includes light-duty passenger vehicles, buses and on a level that it admits is aspirational, long-haul heavy-duty trucks, trains, marine and aviation industry applications. In these applications, hydrogen is viewed as a better performing energy carrier than electronic vehicle batteries in colder climates.
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> Compressed natural gas: Hydrogen's usage in natural gas networks is also prioritized under the National Strategy, augmenting if not eventually supplanting other renewable fuel additives.
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> Co-combustion with diesel: Finally, there is an opportunity to combine hydrogen with diesel in internal combustion engine trucks using retrofit diesel engines. This application is noted as likely transitional so incentives for this initiative would be short-term.

Fuel for power production

Hydrogen can be used as a fuel for power production through combustion or used in stationary fuel cell power plants. When it comes to combustion, similar to distribution pipelines, current infrastructure and generation facilities can only handle up to 10 – 15 per cent hydrogen. Therefore, hydrogen could not be used in current gas-fired generating stations. Turbines capable of combusting pure hydrogen are still in development, but expected to be viable in the near future. Hydrogen can be used however to provide load management capabilities, daily and seasonal utility scale energy storage capabilities, and is an enabler for renewable generation.

Regarding renewables, storage will be key. Surplus renewable electricity can be used during off-peak hours to create hydrogen via electrolysis. It can be stored on site and used to produce electricity during peak demand (via combustion or stationary fuel cell) or it can be injected into the natural gas grid to lower the carbon intensity of natural gas (referred to as Power-to-gas). The National Strategy points to Ontario in particular has having an opportunity to utilize the renewables that will be exiting their power purchase agreements within the decade. More renewables in Canada's energy mix will expand the potential of low carbon hydrogen. Large-scale energy storage using hydrogen will also improve the economics of renewables. As noted in Part 2 of the BLG Hydrogen Series, Europe is relying mostly on renewables to support its hydrogen growth.

Heat for industry and buildings

Hydrogen could potentially be used by industry to replace natural gas that is combusted to create process heat in the form of steam. Canada's oil and gas sector is a significant contributor to GHG emissions, responsible for 26 per cent of total emissions in 2018. Low carbon hydrogen can offer emissions reduction benefits in both upstream extraction and downstream refining. The cement and steel industries are two others areas that could benefit significantly from low-carbon hydrogen.

Hydrogen can reduce emissions resulting from the heating of buildings by helping to decarbonize the natural gas grid. Blending hydrogen to be used in natural gas distribution and combustion infrastructure has technical challenges as noted above. The National Strategy proposes increasing R& D in this area and developing pilots for hydrogen mini-grids.

Feedstock for industry

Hydrogen is primarily used by heavy industry as a feedstock. The top four sectors utilizing hydrogen are oil refining, ammonia production, methanol production and steel production. Currently, the hydrogen used in heavy industry is Grey hydrogen (produced using natural gas). Lower carbon hydrogen therefore represents a major opportunity to lower emissions. The National Strategy notes that the most significant opportunity to reduce emissions related to Grey hydrogen used by heavy industry, particularly the oil and gas sector, involves retrofitting existing conversion technology to include CCUS.

Emissions reductions

The federal government estimates that, if the National Strategy is executed as planned, it could achieve a reduction of up to 45 Mt-CO2e/year by 2030 in an aggressive emissions reduction scenario. In order to meet its commitment under the Paris Accord, Canada must reduce its annual CO2e emissions by approximately 720 Mt-CO2e/year by 2050. The federal government intends to achieve the bulk of this by steadily increasing the carbon tax, while rebating the money collected to Canadians, as outlined in its recently released Climate Change Plan. However, the National Strategy highlights the importance of hydrogen in achieving these emissions reductions goals. By 2050, hydrogen could help Canada reduce its GHG emissions by as much as 145 Mt-CO2e/year, accounting for approximately 20 per cent of Canada's overall emissions reduction target.

What's first?

The National Strategy combines short-term, mid-range and long-term objectives across a number of industries. As immediate priorities, the federal government will:

- Encourage hydrogen deployment "Hubs" for mature applications and support demonstration technologies;
- Finalize the Clean Fuel Standard and other regulation to facilitate near-term investment; and
- Create new policy/regulatory measures to reach the federal government goals of "net-zero" emissions by 2050.

There is much needed for Canada to become a hydrogen global leader, but the breadth of the National Strategy contains the necessary ambition to achieve these ends.

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