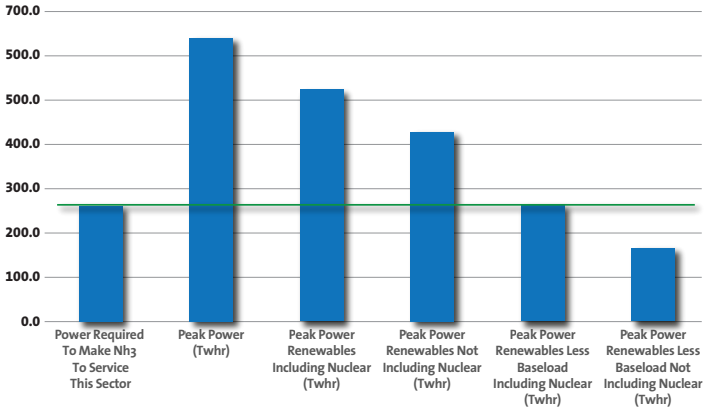
FuelPositive
Fuel For A Mindful World

Analysis: Can Carbon-Free Ammonia (NH_3) Derived from Green Power Sources Cover Transportation Fuel Needs in Canada?

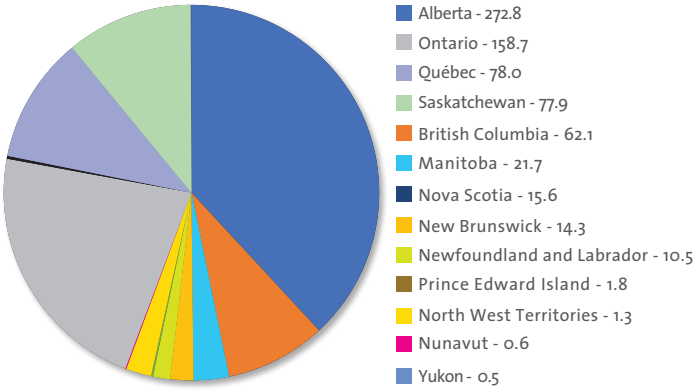
Not quite, but it can cover enough to decarbonize the majority of the sector, offering a transition strategy for Canada as we adopt new practices to address climate change.

Canada produces sufficient green electricity in off-peak demand hours to produce enough carbon-free ammonia (NH_3) to replace the use of fossil fuels for 100% of the passenger and freight aviation and rail, passenger bus, freight trucking, freight rail and freight marine shipping in the country, according to a study commissioned by FuelPositive. The result would be a 15.3% reduction in Canada's total greenhouse gas emissions.

Is national green power sufficient to make enough carbon-free NH_3 for all transportation in Canada at 80% manufacturing efficiency?



Canadian CO_2 emissions totalling 715.8 megatons of CO_2 emissions by province



Canadian-based FuelPositive has developed a patent-pending system to produce carbon-free ammonia from air, water and sustainable or green electricity – anywhere it is needed. Although 80% of the traditional ammonia in the world is used as fertilizer for farming, many people don't know that ammonia can be used as a replacement for fossil fuels to run engines and power vehicles. Converting gasoline- or diesel-running internal combustion engines to work on ammonia is as simple as converting them to work on propane. The advantage of using carbon-free, green ammonia is that the only emission not captured in the engine is water vapor and nitrogen gas. FuelPositive's carbon-free NH_3 is non-polluting.

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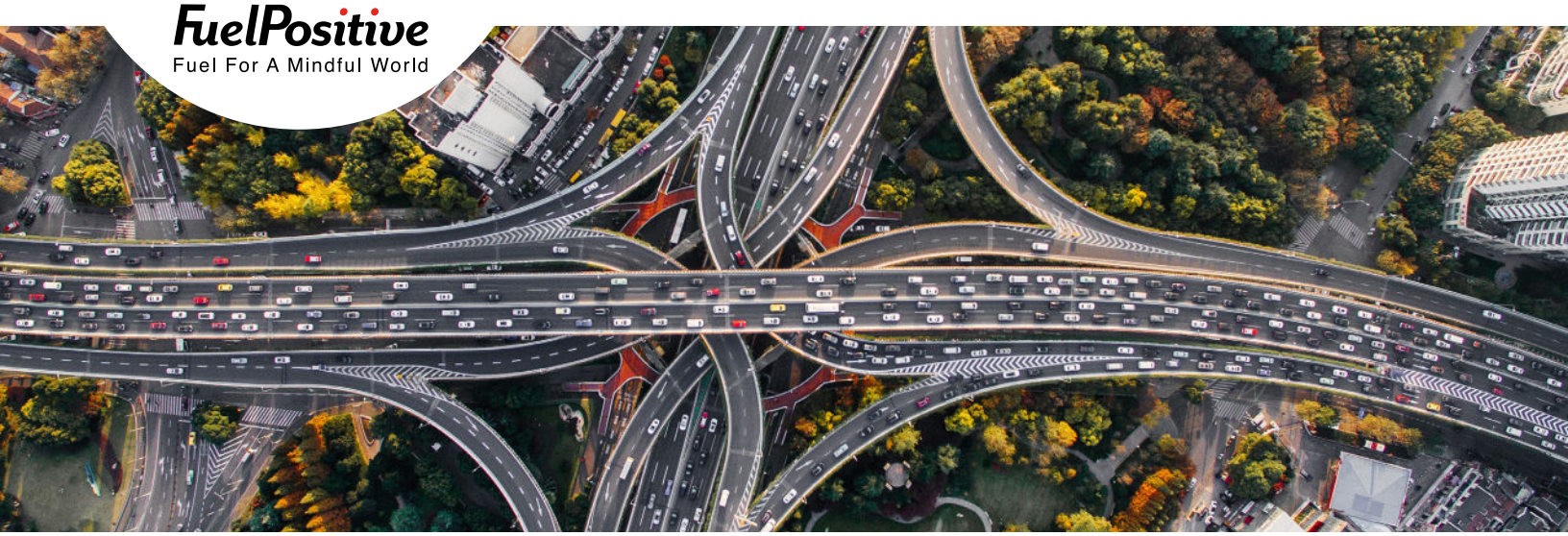
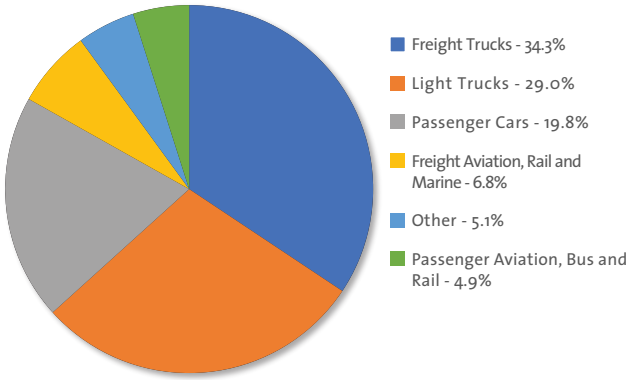


Canadian transportation sector emissions as a percentage of the 174.4 megatons of CO_2 emissions of total Canadian emissions that can be serviced by carbon-free NH_3



The Analysis

In early 2021, FuelPositive commissioned emissions reduction specialist André Mech to conduct an analysis of Canada's green off-peak electricity capacity and to determine the fuel needs and the carbon emissions of the Canadian transportation sector. The intention was to discover whether it would be possible to replace fossil fuels used for transportation with carbon-free, green ammonia – and to measure the impact on our country's carbon emissions.

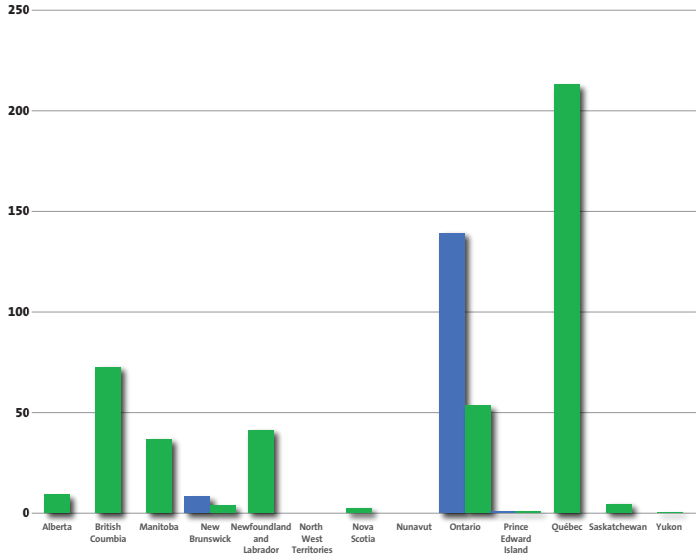
Mech has been advising organizations and governments focused on sustainability, energy efficiency and carbon reduction worldwide since 2001 – most recently in North America and Europe. As one of the most knowledgeable emissions reduction and carbon credit specialists in the sector, he has assessed the emission profiles of hundreds of technologies.

Mech formally joined FuelPositive as a Strategic Advisor in July 2021.

Goals and Structure of the Analysis

a. A survey of Canada's green (hydroelectric, solar and wind) off-peak electricity
b. A determination of off-peak green electricity availability for manufacture of carbon-free NH_3
c. A determination of all transportation fuel needs in Canada by individual transportation sector, cars, light trucks, freight trucking, etc.
d. A determination of provincial transportation needs

Green power in terawatt hours by province including nuclear (blue) and without nuclear (green)



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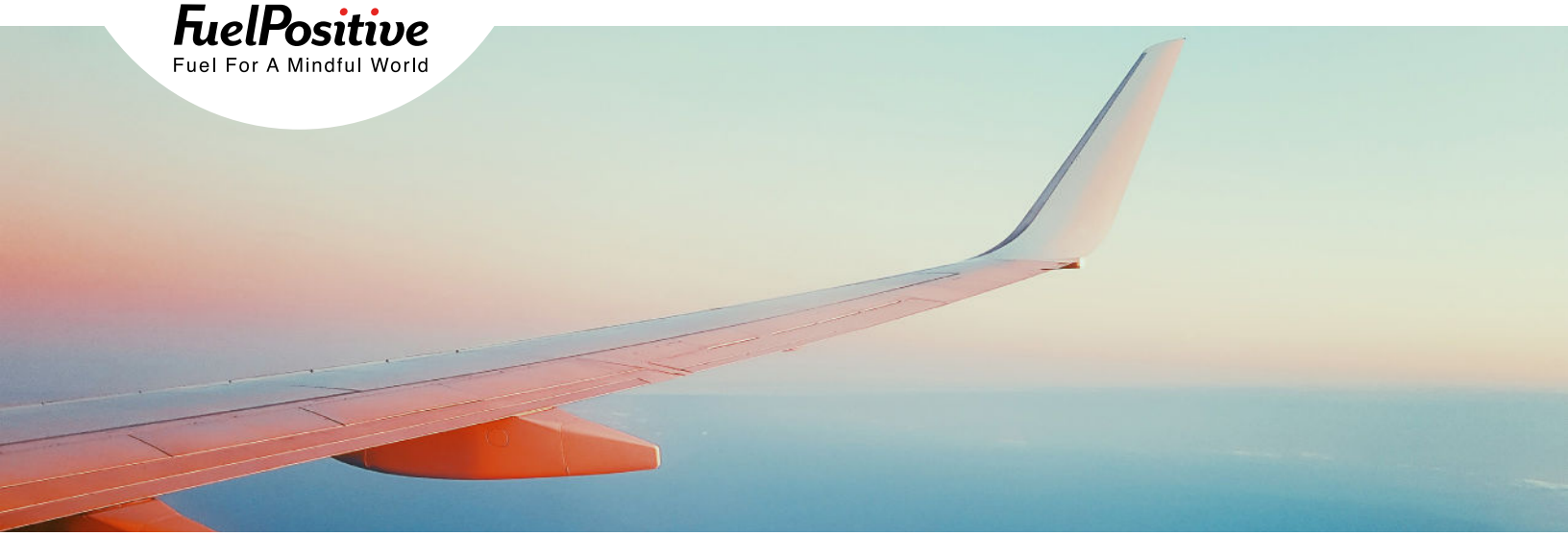

e. A determination of CO2e emissions attributed to transportation fuel in Canada and by province and territory

f. A calculation to determine if all available off-peak electricity in Canada would be sufficient to manufacture the carbon-free NH3 required to replace all transportation fuels required for Canada.

g. A calculation to determine transportation sectors, on a national basis and on a provincial/territorial basis, that can be serviced by carbon-free NH3.

Conclusions

The findings of Mech's analysis were startling. Based on 2019 data, Canada produces enough off-peak green electricity to provide non-polluting, carbon-free NH3 fuel to power 63% of all the passenger cars, light trucks, passenger aviation, buses, light rail, motorcycles, freight trucking, freight aviation, rail, marine and other sector vehicles in the country. But even more exciting, Canada has enough off-peak green electricity to provide carbon-free NH3 to power 100% of the needs of passenger and freight aviation and rail, passenger bus, freight trucking, freight rail and freight marine shipping in Canada – all regulated industries that are notoriously high emitters with significant government mandates to decarbonize.

The analysis outlines opportunities and needs at the provincial and territorial levels.

It shows that three provinces (Manitoba, Quebec and Newfoundland & Labrador) can cover their transportation requirements with FuelPositive's carbon-free NH3 fuel produced using their own off-peak, green-generated power. They would be green ammonia suppliers for the Canadian market and the remaining provinces and territories would be green ammonia consumers.

This clearly identifies which provinces offer the best option to adopt this technology early, and which provinces would need emission reduction credits to offset their emissions while they transition to green fuel.

Interestingly, the analysis also points out that the three provinces can also store their excess renewable electricity for later use, by running FuelPositive's commercial modular and scalable carbon-free NH3 production systems on site. The problem with renewables in the past was that there was no viable and scalable excess energy storage mechanism. FuelPositive's production system changes that. During periods of peak demand, even when there is no wind for windmills or sun for solar panels, the extra carbon-free NH3 stored on site can be combusted in NH3-burning turbines to generate and distribute electricity to meet demand.