**Hydrogen Fuel for New Zealand's Transport Sector**

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**Abstract**

The transport sector in New Zealand (NZ) is heavily dependent on fossil fuels and accounts for more than one-fifth of the country’s annual gross greenhouse gas (GHG) emissions. It is also the fastest-growing source of emissions. Under the Paris agreement, NZ has set environmental targets to reduce 30% of its 2005 GHG emissions by 2030 and achieve net-zero emissions by 2050. Alongside other major economies such as the United States (US) and Australia, NZ is developing a roadmap to unlock the potential of hydrogen fuels and enable a just transition from carbon-intensive growth, especially within the transport sector. Therefore, replacing the internal combustion vehicle (ICE) fleet with fuel cell electric vehicles (FCEVs) powered by hydrogen will positively impact the decarbonisation pathway in NZ.

This study, therefore, aims to provide a comprehensive review of the literature regarding the transition to hydrogen fuel in the transport sector as well as deliver quantitative results based on scenario analysis for the heavy fleet to inform the potential deployment of green hydrogen fuel in NZ[[1]](#footnote-1). Specifically, this paper qualitatively reviews a vast number of academic articles, government documents and reports from numerous international organisations, then leverages their methodologies, findings, and policy recommendations to establish a guideline for the deployment of hydrogen as an alternative fuel for transportation in NZ. The literature review section discusses state-of-art technologies and the associated economic policies on a global scale. We find evidence that reflects upward-sloping demand curves for hydrogen fuel and FCEVs due to decarbonisation and broader economic benefits, including increased employment opportunities. Additionally, the size of demand varies depending on factors such as preferences for battery electric vehicles (BEVs), diesel price and technological advances. Moreover, hydrogen fuel and FCEVs are currently not cost-competitive; in order to promote the use of hydrogen fuel in the transportation sector, significant initial investments in building and expanding current infrastructure are required. Furthermore, economies of scale and technological learning rates have been incorporated when examining the investment returns to hydrogen fuel. Lastly, four scenarios (i.e., 1) NZ will have high supply and high demand of green hydrogen fuel domestically; 2) NZ will have high supply and low demand of green hydrogen fuel domestically; 3) NZ will have low supply and low demand of green hydrogen fuel domestically; 4) NZ will have low supply and high demand of green hydrogen fuel domestically) are conducted for NZ’s heavy fleet using the MBIE-Castalia Model[[2]](#footnote-2). All scenarios are further compared to two cases if NZ is more/less competitive against other international exporters. In particular, if an ‘international exporter’ can produce green hydrogen at a lower cost, then NZ is likely to be an importer or producing green hydrogen for domestic use only; and vice versa. Our findings show that in both scenarios 1 and 2 where supply is high, NZ is likely to export green hydrogen as domestic conditions are more competitive against other international exporters. The changes in demand do not majorly affect this observation. In contrast, for scenarios 3 and 4 where supply is low, NZ is likely to import green hydrogen as domestic conditions are less competitive against other international exporters. These outcomes are also reflected in the dashboard results of the levelised cost of green hydrogen. For example, NZ is likely to export green hydrogen in scenario 1 where the levelised cost in NZ is lower than all other exporters. Once NZ’s domestic conditions are no longer competitive internationally, NZ is still likely to produce green hydrogen for domestic use only if its levelised cost does not have a margin that is large enough to trigger exportation. In addition, scenario 1 achieves the highest consumption of green hydrogen fuel, reaching nearly 450 tonnes for the combined consumption of hydrogen fuel by heavy vehicles and natural gas blending. Conversely, in scenario 2, the reduction in demand sees an immediate and significant fall to almost null in consumption of hydrogen fuel for heavy vehicles. While in scenario 3 where both supply and demand are observed at a low level in NZ, green hydrogen fuel is majorly consumed by heavy vehicles only. Lastly, near no consumption of green hydrogen is found in scenario 4 of low supply and high demand. This particular outcome calls the need for investment and government policies to bridge the necessity for substantial initial capital financing during the transitional phase to a hydrogen economy. In summary, our empirical results indicate that the international competitiveness of NZ produced hydrogen depends on a significant positive margin between domestic and international production costs, while the consumption of hydrogen fuel and FCEVs are found more sensitive to the impacts of the supply-side parameters than influences from the demand-side.

**Keywords**:Hydrogen fuel; transport sector; net-zero emissions

**JEL Codes**: N7; R4; Q5

1. All Costs are expressed in New Zealand Dollars (NZD). [↑](#footnote-ref-1)
2. [A roadmap for hydrogen in New Zealand | Ministry of Business, Innovation & Employment (mbie.govt.nz)](https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-strategies-for-new-zealand/a-vision-for-hydrogen-in-new-zealand/roadmap-for-hydrogen-in-new-zealand/) [↑](#footnote-ref-2)