Hydrogen as an Alternate Fuel for Class 8 Heavy-Duty Trucks: A Case study

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ABSTRACT

Considering the enormous environmental effects of the harmful carbon dioxide emissions due to human activities on global warming, it is necessary to find more sustainable sources of energy. Transportation sector is a substantial source of CO₂ emissions, consuming about one third of the overall energy production. Thus, it is vital to find alternate fuels which could significantly mitigate the detrimental greenhouse gas emissions from transportation sector. Hydrogen, as a potential clean fuel, can significantly lower hazardous greenhouse gas emissions released by vehicles, specifically in heavy-duty applications. In order to assess the possibility of the transitioning from internal combustion vehicles to fully hydrogen-based trucks, it is crucial to conduct a thorough investigation of CO₂ emission levels as well as the hydrogen cost delivered to refueling stations. Current study examines the practicality of replacing a certain number of heavy-duty trucks by their hydrogen counterparts across important Highway 401 using an analytical approach in which various hydrogen truck adaptation rates including conservative, probable and ambitious scenarios have been taken into consideration. Moreover, this research provides an estimation of the required network of hydrogen refueling stations utilizing a techno-economic analysis. The amount of CO₂ emissions prevented from entering the atmosphere by replacing hydrogen trucks have been calculated for each case scenario. Findings indicate that the most ambitious case study prevents almost 44,000 tons of carbon dioxide from entering the atmosphere by year 2030. This has an equal impact as removing 9,362 typical gasoline passenger vehicles from the road. Moreover, the most ambitious scenario leads to a carbon abatement cost of about 1,825,000 CAD by 2030. Also, the results delineate that about 62,000 tons compressed hydrogen will be required to be distributed along the Highway 401 to meet the demands of the hydrogen trucks fleet. Estimations of the hydrogen price for different hydrogen generation methods have been taken into consideration. This analysis was initiated by and coordinated with the Economics Working Group of the Hydrogen Business Council (HBC) of Canada. MITACS co-funded this work with HBC.