Exploration of Alternative Fuel Sources for Long Distance Trucking

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Motivation

The energy market is over reliant on fossil fuels and demand for alternative fuels is growing. We sought to address Duke Energy's need for current and future alternative energy solutions and examine their feasibility for use in long distance trucking. The goal of our model is to identify the alternative energy solution(s) that are both commercially and environmentally lucrative for Duke Energy long term.

Objectives

There were three primary objectives for this project:

- Compare the direct and indirect environmental impacts of vehicles fueled by hydrogen fuel cells (HFCs), biofuels, CNG, and electric batteries.
- Examine the economic aspects related to the aforementioned clean energy sources.
- Develop an implementation plan for Duke Energy to transition to HFC heavy-duty trucks.

Methodology

To accomplish our objectives, the project was split into 5 stages, with each team member focusing on their respective energy type(s); an emissions analysis and feasibility report, an economic analysis and feasibility report, and the creation of a hydrogen fuel cell implementation model. Stages were completed through independent research and analysis reviewed by team members with feedback from our mentor.

Findings

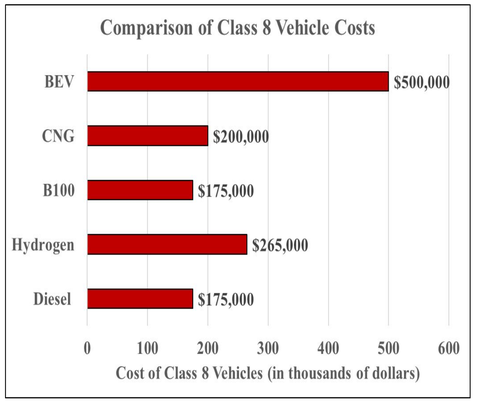


Chart Displaying the Costs of Class 8 Vehicles Powered by Each Fuel Type [1][2]

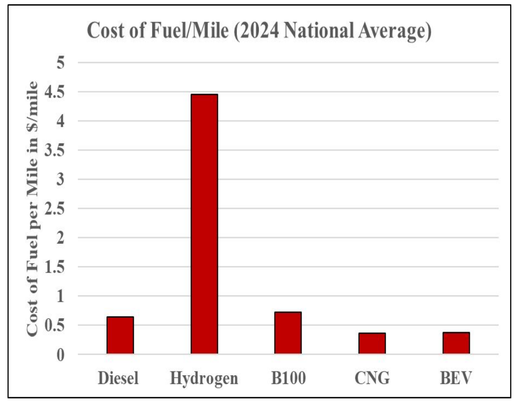


Chart Displaying the Cost per mile for Each Fuel Type. [3][4][5]

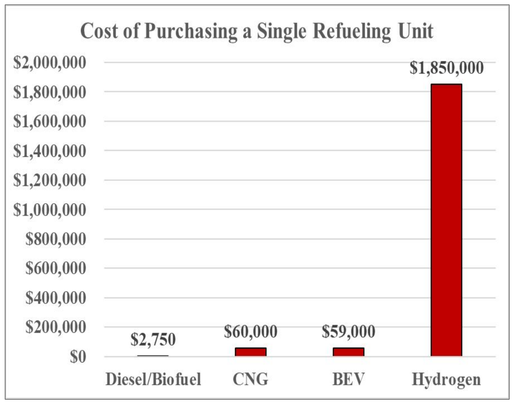
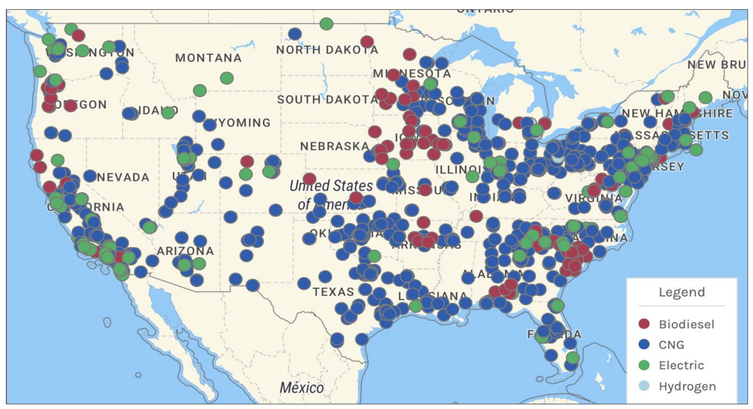


Chart Displaying the Costs of a Single Refueling Unit
Please note that the costs for Diesel/BioFuel is a Replacement Cost
[6][7][8][9][10]

Fuel Type	CO2 [kg/year]	H2O [kg/year]	NOx [kg/year]
Diesel	96,169.44	–	317.50
Hydrogen	–	9300	–
Biofuels (B100)	20,724.52	–	359.88
BEV	~12,400.00	–	3.72
CNG	14,368.50	–	0.897

Comparisons of Some Emissions for Each Fuel Type, on a basis of 62,000 miles Traveled per Year
[11][12][13][14][15][16]



Map of the US, Displaying Locations of Alternative Fuel Stations Capable of Handling Heavy Duty Vehicles [17]

Recommendations

Of the four alternative fuels examined, Hydrogen fuel is perhaps the most attractive candidate. Hydrogen fuel has the most potential for future growth; it is becoming more powerful and easier to make, and unlike other alternatives, it can be a long term option. However, there is a current lack of available infrastructure and a high cost barrier, which makes Hydrogen unattractive in the short term. For a short term solution, biofuels or compressed natural gas vehicles might be considered. It is also important to be cognizant of where the materials of construction are being sourced from, and that care is taken for recycling purposes at the end of a trucks lifespan.

Acknowledgements

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