

Hydrogen Fuel Cells for Cars

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Introduction

- Captain Crunch: Jack (Atmospheric Science), Corrie (Biology), Lauren (Chem. E)
- Application of Hydrogen Fuel Cells, gained through electrolysis, within the Automotive Industry
 - Electrolysis- the decomposition of chemical bonds by passing an electric current through them. In this case, an electric current is passed through the hydrogen bonds to break them apart.
- It's green energy, it's sustainable and it leads to emission reduction as no CO₂ emissions are released when the vehicle is driven



Description of Topic

- Electrolysis
- Benefits: much more efficient, produce more energy for the amount used, provides cleaner release into the atmosphere.⁽¹⁾
- Challenges: technology is not very common → expensive, the science behind FCV's is relatively young, function best in mild/warm temperatures⁽¹⁾



1. "Hydrogen Fuel Cell - Its Benefits and Challenges." *Conserve Energy Future*. N.p., 08 Oct. 2015. Web. 23 Oct. 2016.

Relevance of Topic

- Everyone wants cleaner vehicles: Toyota released their fuel cell patents for other companies to use to facilitate infrastructure expansion and Nissan and Hyundai have used them to produce their own FCV's. ⁽¹⁾
- It is a renewable energy source: electrolysis can be used anytime to separate water into its components to gain hydrogen fuel cells. Water is an emission from the car as well.⁽¹⁾
- The car industry is heavily impacted by this new technology and product as they will have to alter nearly all traditional car manufacturing if this idea takes off since gasoline will no longer be needed. ⁽²⁾
- Consumers are also impacted as they will have to learn about this new energy form to run their cars.

1. Energy, By Intelligent. "Top 5 Ways That Fuel Cells Will Impact the Way We Live." *The Energy Loft*. N.p., 19 Aug. 2015. Web. 23 Oct. 2016.
2. "11 Big Advantages and Disadvantages of Hydrogen Fuel Cells." *Green Garage Blog*. N.p., 10 June 2015. Web. 23 Oct. 2016.

History of Research/Implementation

- Toyota: Mirai Fuel Cell Vehicle
- The Mirai: achieved a 312 mile driving range on a full tank; it takes roughly 3 minutes to refuel.⁽¹⁾
- As of May 2016, 250 Mirai's were sold in the U.S. at a price of \$57,500 ⁽¹⁾
- It utilizes regenerative braking to slow itself down → aids in efficiency.⁽¹⁾
- There is no CO₂ emission, the only emission is H₂O⁽¹⁾

1. By Additionally Returning Surplus Electricity to the Grid, Power Wastage Can Be Prevented. Establishing a System of This Kind Can Also Reduce

Energy Risk on Islands and in Other Remote Areas. "Toyota Global Site | FCV Fuel Cell Vehicle." *TOYOTA MOTOR CORPORATION GLOBAL*

WEBSITE. N.p., n.d. Web. 19 Oct. 2016.



History of Research/Implementation

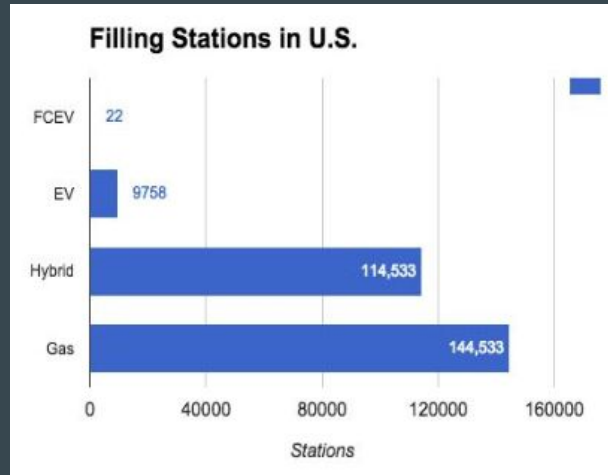
- Hyundai introduced the Tucson fuel cell vehicle in 2013, which didn't gain nearly as much traction as the Toyota Mirai.
- The Tucson only reached half of its projected sales, and the vehicle is only offered over a monthly lease. It is only offered for lease in southern California.
- With a driving range of approx. 265 miles, it takes about 10 minutes to refill an empty tank. ⁽¹⁾
- It features automatic stop/start to reduce energy loss and utilizes near ambient air pressure (instead of pressurized air) to reduce power consumption by 50 percent and reduce noise in the cabin. ⁽¹⁾



1. "Hyundai Ix35 Fuel Cell." *Hyundai Motor Company*. N.p., n.d. Web. 25 Oct. 2016.

Future Research

- The technology for use of hydrogen fuel cells in everyday cars is already there- the only thing that is holding the technology back is the modification of our existing infrastructure.
- The main focal points of research should be how to produce mass amounts of hydrogen while limiting CO2 emissions and how to power the fueling stations using clean energy.



Will it work? Is it practical?

Pros:

- No CO₂ emissions from the car, or at all if the hydrogen is produced with renewable energy
- Less moving parts involved which means less required maintenance¹
- Easily accessible hydrogen would result in more stable fuel prices

Cons:

- 1000kg of hydrogen/day would be needed at a fueling station, requiring 10,200kWp of solar energy for the electrolysis used to produce the hydrogen²
- It takes 10m² of solar cells with 10% efficiency to produce 1kWp
- Certain ways of producing the hydrogen actually make more CO₂ than gas or diesel cars per MJ³

1. "How do Hydrogen Fuel Cell Vehicles Work?", Union of Concerned Scientists, March 15 2016

2. Florida Solar Energy Center, University of Central Florida, Hydrogen Basics - Solar Production.<http://www.fsec.ucf.edu/En/consumer/hydrogen/basics/production-solar.htm>

3. Wuppertal Institute for Climate Environment Energy, Research Group "Future Energy and Mobility Structures", PO Box 10 04 80, 42004 Wuppertal, Germany⁴

Conclusion

- It is a great idea and is possible, but chances are, it will not take off for several more years. It is unrealistic to completely replace the gasoline industry as it is so heavily relied on in our everyday lives so suddenly.
- It may be possible to implement for use in mass transportation (i.e. trains and buses). This will not involve a complete turnover of infrastructure in the country.⁽⁹⁾

Questions?

Works Cited

1. By Additionally Returning Surplus Electricity to the Grid, Power Wastage Can Be Prevented. Establishing a System of This Kind Can Also Reduce Energy Risk on Islands and in Other Remote Areas. "Toyota Global Site | FCV Fuel Cell Vehicle." *TOYOTA MOTOR CORPORATION GLOBAL WEBSITE*. N.p., n.d. Web. 19 Oct. 2016.
2. Energy, By Intelligent. "Top 5 Ways That Fuel Cells Will Impact the Way We Live." *The Energy Loft*. N.p., 19 Aug. 2015. Web. 23 Oct. 2016.
3. Florida Solar Energy Center, University of Central Florida, Hydrogen Basics - Solar Production, <http://www.fsec.ucf.edu/En/consumer/hydrogen/basics/production-solar.htm>
4. "How do Hydrogen Fuel Cell Vehicles Work?", Union of Concerned Scientists, March 15 2016
5. "Hydrogen Fuel Cell - Its Benefits and Challenges." *Conserve Energy Future*. N.p., 08 Oct. 2015. Web. 23 Oct. 2016.
6. "Hyundai Ix35 Fuel Cell." *Hyundai Motor Company*. N.p., n.d. Web. 25 Oct. 2016.
7. Wuppertal Institute for Climate Environment Energy, Research Group "Future Energy and Mobility Structures", PO Box 10 04 80, 42004 Wuppertal, Germany
8. "11 Big Advantages and Disadvantages of Hydrogen Fuel Cells." *Green Garage Blog*. N.p., 10 June 2015. Web. 23 Oct. 2016.
9. Fingas, John. "Hydrogen fuel cell train offers pollution-free rail trips." *Engadget.com*. Engadget, 22 September 2016. Web. 29 September 2016.