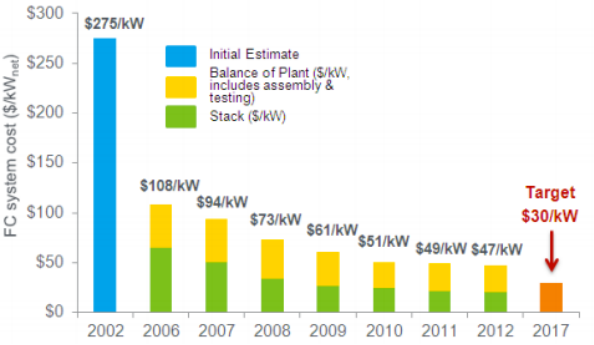
Hydrogen Fuel Cell Vehicles (HFCVs)

By Drew Beyer

Past and Projected Engine Manufacturing Cost ($/kW)



How does the decrease occur?

- Increased efficiency through R&D into greater pressure capacity fuel vessels.
- More advanced system technologies.

Fuel Costs

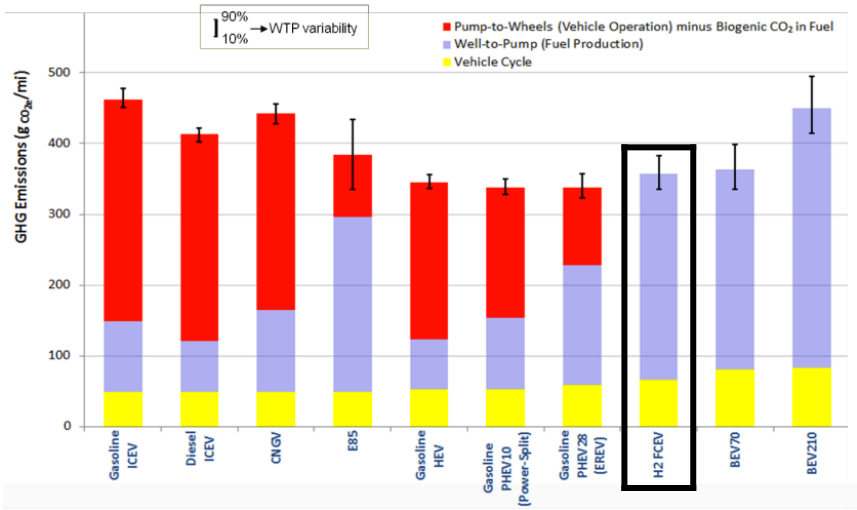
-Liquid H2 is produced via steam reformation or oxidization from fossil fuels.
-Currently, prices vary from $5.50-$11.00 per kg Hydrogen.
-Projected cost of 1kg Hydrogen assuming high volume production, widespread deployment ~$2.00/kg (1 gal Gas equivalent) – a cost competitive with gas.
-There is also the possibility of producing liquid H2 through electricity-necessary hydrolysis with renewables.

Averaging current and projected prices, H2 fuel costs ~$400 less per year than gas.

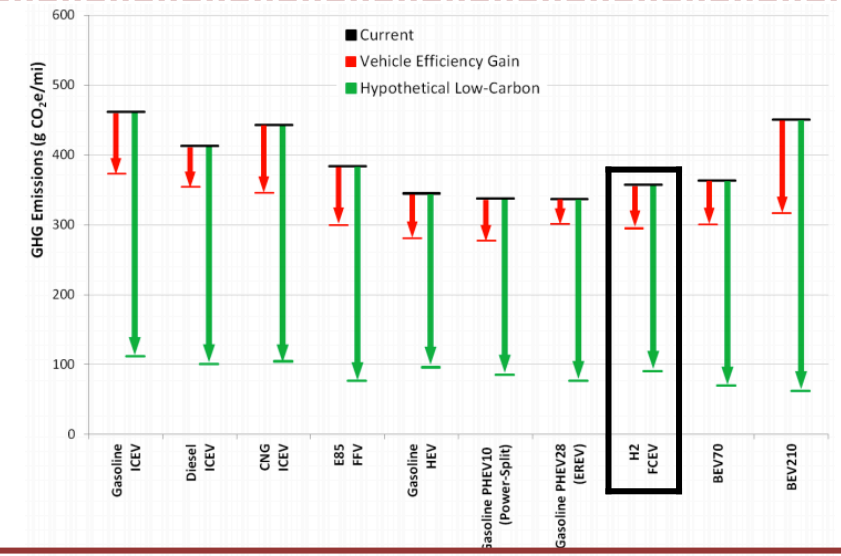
Life Cycle Analysis Comparison

Vehicle Cycle
- Raw Material Extraction
- Materials Processing
- Component Manufacture
- Vehicle Assembly
- Vehicle Operation (None)
- Vehicle End of Life

Fuel Cycle
- Raw Material Extraction
- Transportation
- Refining
- Delivery
- Vehicle Operation (None)

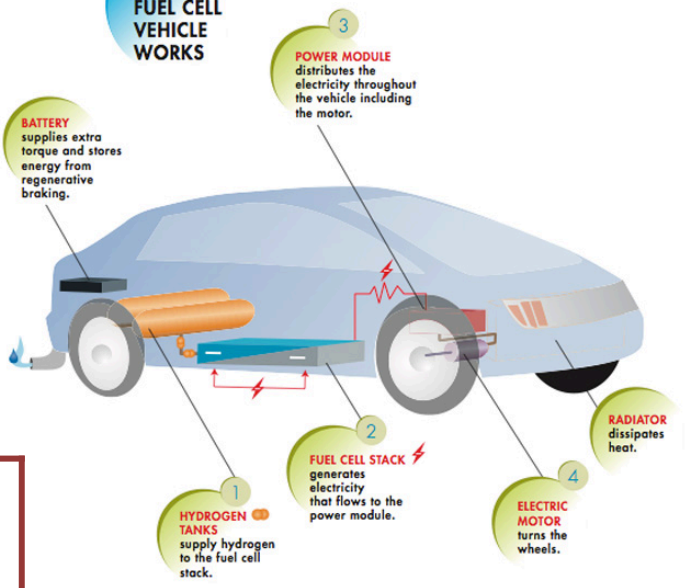


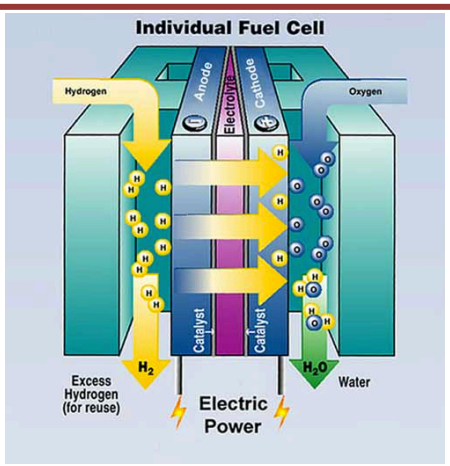
Current Life Cycle GHG Emissions



Projected GHG Reductions via Vehicle Efficiency Gains and Low-Carbon Resource Extraction Techniques

How a Fuel Cell Vehicle Works



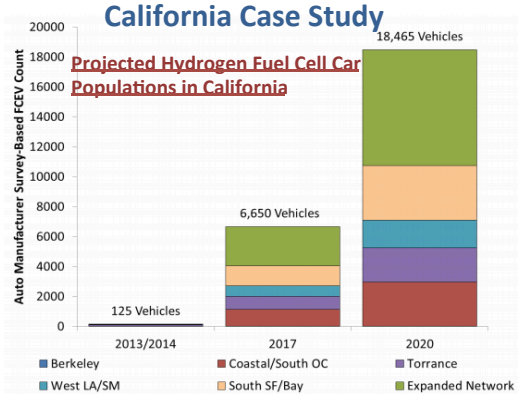


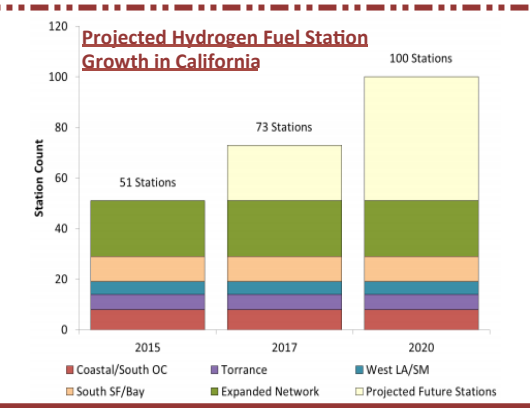
Hydrogen is fed into the anode and the cathode is exposed to air (oxygen source).

Hydrogen ions (missing an electron) are directed to the cathode via an alternate route where they regain electrons from/combine with oxygen to become water molecules.

The anode causes the release of electrons from the hydrogen which travel towards the positive cathode to create an electric current.

California Case Study





The DOE has lead many initiatives which have rolled into commercial purchasing or increased fuel cell production without any further DOE funding. Maybe all we need is an initial incentive to get the ball rolling with hydrogen.

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Past and Projected Engine Manufacturing Cost

Fuel Cell System Cost-2012. **Department of Energy. 21 Aug. 2012. Web. 20 Apr. 2015.**

Hydrogen Car Graphic:

"How a Hydrogen Fuel Cell Vehicle Works." ***Hygen.com*****. Hygen Industries, n.d. Web. 20 Apr. 2015.**

Fuel information

Accomplishments and Progress**. Department of Energy. 14, Nov. 2014. Web. 20 Apr. 2015.**

For Projected fuel cost comparison, I first found an example of a Hydrogen car: 2014 Honda FCX Clarity which has 59 miles per kg H2 (gallon of gas equivalent and a 2015 Hyundai Tucson Fuel Cell which has 49 miles per kg H2. Averaging these, I got 54 mi/kg H2 as an average Hydrogen car fuel economy. Using the average gasoline car fuel efficiency from class ~20 mpg, I compared the fuel costs per year currently and projected for hydrogen cars versus gasoline cars over one year using the average number of miles traveled per car in the US from class: 13,500 miles. I did this by averaging the current hydrogen fuel costs ($5.50-$11) given by the DOE to get $8.25 per kg H2. Using the projected cost of hydrogen fuel given by the DOE under the assumption of high volume hydrogen production and deployment of $2.00/kg. Then I looked up the average cost of gasoline and got $2.46. Carrying out each yearly cost completely:

Current H2 avg: (13,500miles/54mpkg) *$8.25=$2,062.50/yr

Projected H2: (13,500miles/54mpkg)*$2.00=$500/yr

- AVG Current and projected future H2 fuel cost = **$1281.25/yr**
- Gasoline: (13,500 miles/20mpg)*$2.46=**$1660.50/yr**

Difference ~$400 less for H2 in near future.

Individual Fuel Cell Graphic

"How a Hydrogen Fuel Cell Vehicle Works." ***Hygen.com*****. Hygen Industries, n.d. Web. 20 Apr. 2015.**

California Fuel Cell Data

Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development**. Rep. California Environmental Protection Agency, 20 June 2014. Web. 20 Apr. 2015.**

Life-Cycle Analysis Graphs

Cradle to Grave Lifecycle Analysis of Vehicle and Fuel Pathways**. Department of Energy. 21 Mar. 2014. Web. 20 Apr. 2015.**

Accomplishments and Progress. Department of Energy. 14, Nov. 2014. Web. 20 Apr. 2015.