Hydrogen Fueled Home Generators

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SITUATION

Burning fossil fuel, such as coal, oil and natural gases contribute to pollution and global warming due to the emission of carbon dioxide. 33% of green house emissions are due to electricity generation, which is the highest percentage amongst other factors [1]. Also, fossil fuels are finite resources that will eventually deplete. The suggested hydrogen fuel cell does not burn oxygen rather it simply combines itself with oxygen from air to form water [2]. Hydrogen fuel was already integrated to cars such as the BMW 740i Sedan but this concept has not yet been integrated to home generators [3].

PROBLEMS

What is Hydrogen fuel?

Hydrogen fuel is a substitute fuel to gasoline. It is much cleaner and has water as the main emission rather than CO2.

Limitations:

- Hydrogen in its pure gaseous form is expensive to obtain. [4]
- Hydrogen fueled machines tend to have a high fuel consumption . [5]
- Large scale hydrogen generators do not exist currently. [5]
- Hydrogen in its gaseous form is hard to store as it has a low volumetric energy density. [4]

SOLUTION

- Solar power is integrated in our design to create a self-filling cycle to eliminate the need of constantly refilling the motor
- The solar power system diffuses water into its basic component and that way hydrogen is created.
- The system is a perfect replacement to the traditional gasoline cycle as it has double the efficiency.
- Hydrogen fuel cells are used to convert the chemical energy into electric energy.
- One fuel cell generates 236.17 kJ/mol, which is not sufficient energy to power a home, therefore a stacking fuel cells is the solution. [6]
- The amount of electricity generated by the fuel stack is proportional to the number of cells [1].

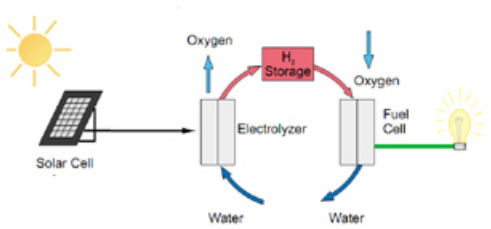

Figure 1: Modeled cost of an 80-kWnet PEM fuel cell system based on projection

EVALUATION

Cost:

- "Comparing the delivered cost of hydrogen transportation fuel on an energy cost basis (dollars per gigajoule), we find that hydrogen is 50%–100% more costly than gasoline." [7]

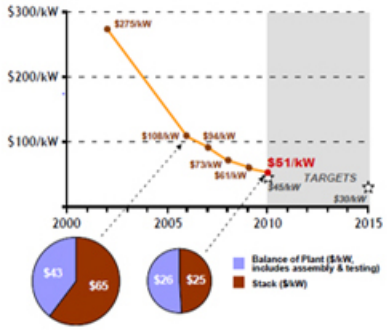

Figure 2: Modeled cost of an 80-kWnet PEM fuel cell system based on projection [8]

Although the initial costs are high, in the long run the costs decrease. (see figure 2)

Efficiency:

The efficiency of these motors reaches 60-70 percent which is better than the efficiency of motors that work with gasoline which have 30% efficiency. [7]

Major Benefits:

	Hyundai Tucson (gasoline)	Hyundai Tucson FCEV (hydrogen from natural gas)	Hyundai Tucson FCEV (33% renewable California hydrogen)**	Hyundai Tucson FCEV (46% renewable California hydrogen)***
Gasoline vehicle emissions equivalent (MPG_{GGE})	25	38*	54	63
Global warming emissions per mile (g CO_2eq/mile)	436	286	202	173
Emissions reduction relative to gasoline		34%	54%	60%

*The EPA rating for the Hyundai Tucson FCEV is 49 miles/kilogram hydrogen.

**California law (California State Senate 2006) requires a minimum of 33 percent renewable hydrogen content.

***The Air Resources Board projects renewable hydrogen content in California for 2015 will be 46% (CARB 2014).

Figure 3: reduction of emissions [9]

Emissions are decreased by %60 (see figure 3)

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