Elon Musk is wrong: Hydrogen can compete with Fossil Fuels and Batteries

An Israeli startup may change the rules of the game

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On February 2015, ThinkProgress published an article by Joe Romm - **“Elon Musk Is Right: Hydrogen Is ‘An Incredibly Dumb’ Car Fuel”**- which argued against the use of Hydrogen as an energy source for electric vehicles.

Musk assumes that Hydrogen Technology, which is meant to be used as car fuel, would be no different than high pressure currently used Hydrogen Technology.

According to this assumption, Musk is right. Compressed Hydrogen is indeed "dumb". Hydrogen contains the highest rate of energy per kg, but its high volume makes it inefficient for use without compression. Compressing it up to 350 or 700 atmospheres is very expensive, both in terms of infrastructure as well as in terms of handling (not to mention safety issues and psychological fears). And storing it in fueling stations is very expensive as well.

Hydrogen production cost is another complex issue.

There are two options:
I. Local high cost production by means of water electrolysis or steam reforming from natural gas (around $7/ kg)
or
II. Centralized, high volume, low cost production from natural gas. This process lowers the cost to $2/ kg. However, transporting centrally produced Hydrogen to fueling stations in compressed Hydrogen tanker trucks, and then compressing it to about 900 atmospheres in the stations, raises the cost to the same level as of the one implied in local electrolysis method.

Since current passenger cars use 5 kg of Hydrogen for a 300 mile drive, Hydrogen produced by either method cannot compete with gasoline, pricewise.

So, what is, indeed, wrong with Elon Musk’s argument?

In Oct 8, 2015, Dr. Mark Allendorfof Sandia National Laboratories stated: "Hydrogen, as a transportation fuel, has great potential to provide highly efficient power with nearly zero emissions. Storage materials are the limiting factor right now.”

If we assume:

That Hydrogen could be chemically stored as a non-toxic, non-flammable inert liquid, and, thus, be easily released on demand for immediate use in fuel cells.

That Chemical process of charging and discharging Hydrogen is done with a negligible amount of energy at near ambient conditions.

That this liquid can be stored in plastic tanks, with no pressure, and could therefore be transported in tankers similar to those used for water transportation.

***Therefore,* this sort of Hydrogen fuel could change the name of the game.**

A number of programs have tried to attain these goals while failing to achieve all mentioned features simultaneously.

NrgStorEdge, an Israeli start-up, has found a breakthrough solution based on proven technology developed over the last 9 years.

Now, with the above mentioned centralized $2/ kg Hydrogen production, NrgStorEdge liquid can be delivered, handled and stored with water-like cost. The result is a Hydrogen fuel that costs drivers about $20 per 300 miles.

A game changer!

But even without this breakthrough, a detailed comparison of the current Hydrogen powered Toyota Mirai with Tesla S reveals some interesting facts.

Tesla's battery weight is 540kg, while the Mirai tank weighs only 87.5 kg.

Tesla's full charging time from public charging station is about 27 hours. With a Tesla supercharger station, charging takes 75 minutes. Tesla's website recommends that during those 75 minutes, one can "Grab a cup of coffee or a bite to eat." Mirai is fully charged within 3 – 5 minutes.
Tesla abandoned the option of replacing the whole battery pack within 90 seconds, due to its very high cost.

If you leave your Tesla car unused for a month, battery loss implies 20% of its charge.

Tesla guaranties 8 years of operation. But after those 8 years, battery replacement cost is about 22% of new car price.

The driving range of Mirai with a full tank is 300 miles; Tesla S's is 265 miles. After 30,000 miles driving (about 2 years) Tesla's battery capacity (and therefore driving range) decreases by 5%.

Used battery recycling is problematic due to battery flammability.

Currently, Tesla has one strong advantage: cost per km. Based on electricity costs of 13 cents per kWh, it can compete with gasoline. But this price of electricity is atypical in many geographic locations and during daytime hours tariffs are usually higher. Mirai cannot compete with gasoline when Hydrogen production prices are $5 -$7 per kg.

Last but not least are full cycle-related environmental concerns: more battery operated cars means lot of used batteries. Cost of extracting Lithium, Cobalt and Nickel from used batteries is higher than producing such new material. The result is extremely high land contamination.

New evolving Hydrogen storage technologies, such as NrgStorEdge technology, will dramatically reduce Hydrogen's price, and will enable Hydrogen to compete with gasoline and batteries, using fully safe materials, easy transportation, and low cost fueling stations.

Note: all data used in this article is taken from free public information such as Tesla's and Toyota's publications, and DOE documents