HYDROGEN ECONOMY? UNCERTAIN FUTURE

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ABSTRACT

Article describes hydrogen as carrier of energy. Hydrogen is similar such as global warming. Today, hydrogen is regarded as a kind of chimera. The purpose of this article is specifying reality of hydrogen power.

1. INTRODUCTION

Hydrogen is light chemical element. It occurs at three isotopes, as lightest isotope, heavy isotope and triton. In first phase isotope hydrogen is mostly. His features summarize table one.

Element	^{1}H	^{2}D	^{3}T
Atomic mass [u]	1.007825	2.0140	3.01605
Natural abundance [%]	99.985	0.015	e-18
Half life time [yr]	--	--	12,26
Ionisation energy [eV]	13.5989	13.6025	13.6038
Thermal neutron capture cross section [10−24 cm^2]	0.322	0.51e-03	<6e-6
Nuclear spin [h/2π]	1/2	1	1/2
Nuclear magnetic moment, nuclear magnetons [μN]	+2.79285	+0.85744	2.97896

Table 1: Hydrogen characteristic [3].

It takes about 1 kg of hydrogen to replace 200 MJ (55 kWh) dc energy from 9 kg water by electrolysis. Steam reforming of methane requires only 4.5 kg of water for each kilogram of hydrogen, but 5.5 kg CO_2 emerge from the process. One kilogram of hydrogen can also be obtained from 3 kg of coal and 9 kg of water, but 11 kg of CO_2 are realised and nees to be sequestered.

2. THE PROBLEM

In program NATIONAL HYDROGEN ENERGY ROADMAP of USA is precondition several scenarios [1]:

a) On the basis of projection is cheaper overall price of production hydrogen (!).
b) Efforts should focus on existing commercial processes such as steam methane reforming, multi-fuel gasifiers, and electrolysers, and on the development of advanced techniques such as biomass pyrolysisand nuclear thermochemical water splitting, photoelectrochemical electrolysis, and biological methods

If will be electrolysis of water primary hydrogen method, question is: Where do we take clean water?
It follows from available information [1] that only USA will be in need of great quantity of hydrogen. Annually 100 millions tons hydrogen!

Each of the following scenarios could produce 40 million tons per year of hydrogen:

a) Distributed Generation Production Methods
   - Electrolysis: 1,000,000 small neighbourhood based systems could fuel some of the cars and provide some power needs.
   - Small reformers: 67,000 hydrogen vehicle refuelling stations, which is about one third of the current gasoline stations.

b) Centralized Production Methods
   - Coal/biomass gasification plants: 140 plants each about like today's large coal fired plants.
   - Nuclear water splitting: 100 nuclear plants making only hydrogen
   - Oil and natural gas refinery: 20 plants, each the size of a small oil refinery, using oil and natural gas in multi-fuel gasifiers and reformers. [1]

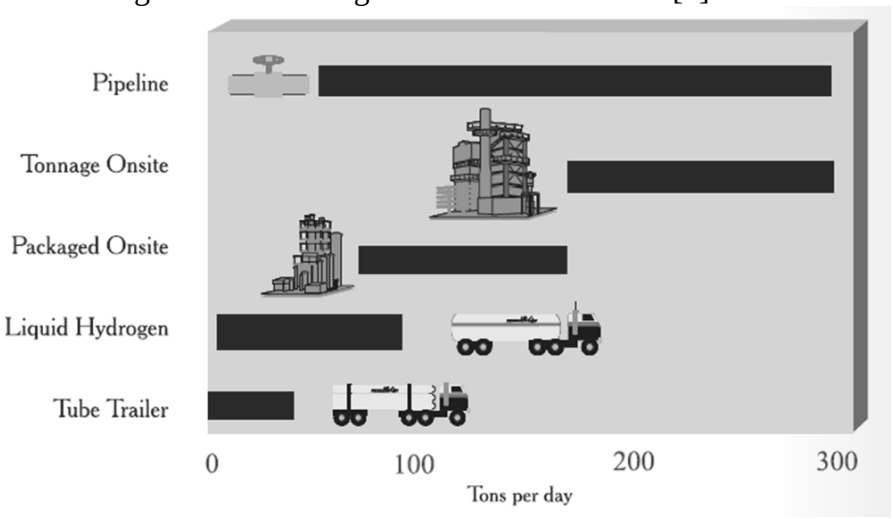


Fig 1: Hydrogen Delivery Methods [1]

If we will see hydrogen as fuel in transport, we have argument on the figure 2 about non-sense of plan. It compares the two basic principles energy storage and transport of energy. It is used model with batteries and hydrogen. It doesn't matter for end user. From point of view of primary produce electric energy is enormous difference.

Figure shows this effect.

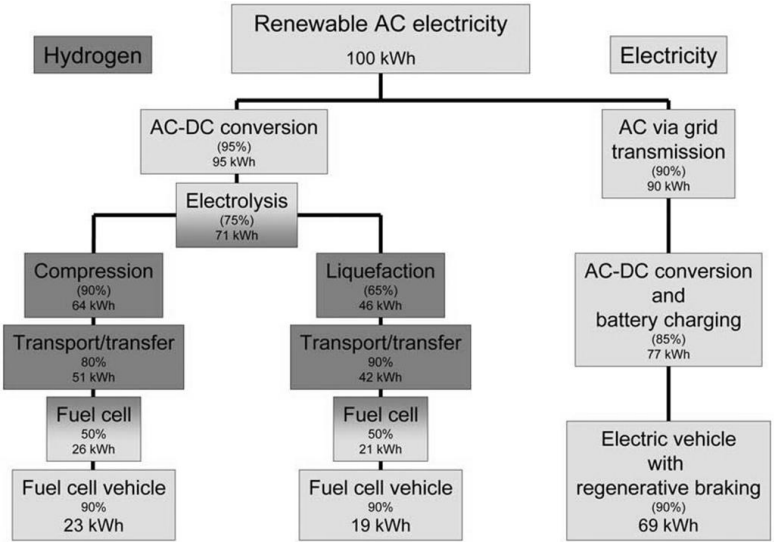
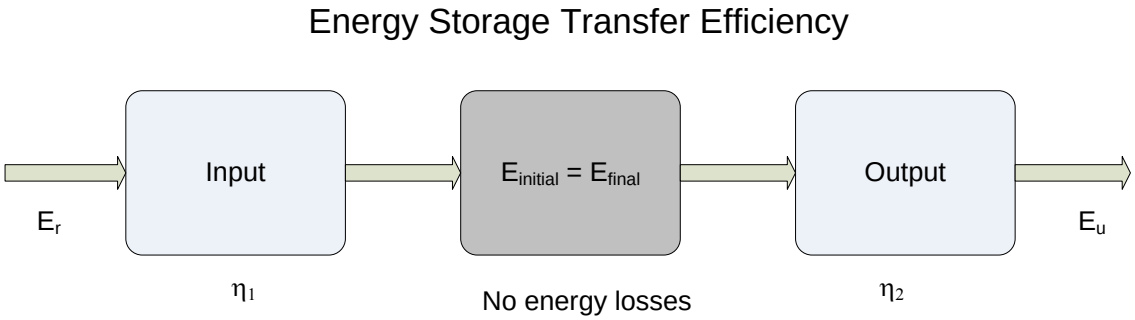


Fig 2: Super capacitor and batteries much better than hydrogen [2]

On the next figure are efficiency of systems, we can see link between technologies. Hydrogen is the worst of all. The gaseous phase is better than liquid phase. The very much energy needs for liquefy to phase of hydrogen. It is a little bit waste energy.



Efficiency	Input	Output	Total
	V ≈	V≈	
Super capacitors	0.95	0.95	0.90
Lithium-ion batteries	0.93	0.93	0.86
Flywheel Storage	0.90	0.90	0.81
Lead acid batteries	0.85	0.90	0.77
Pumped water storage	0.85	0.85	0.72
Compressed Air Storage	0.75	0.85	0.64
Gaseous H_2 Storage	0.70	0.45	0.32
Liquid H_2 Storage	0.50	0.45	0.25
Hot Water Storage	0.95	0.95	0.90

Fig 3: Super capacitor and batteries much better than hydrogen [5]

3. CONCLUSION

Although hydrogen is regarded as a fuel of future, it is not right. Hydrogen is only carrier of energy. It is not possible to mine it, nor pump from earth. Production of hydrogen in a big volume is not real. At least don't today. Just a big volume is necessary condition for complete hydrogen economy.

I think that reality is substituted maximum 20% of fuel now. Production of hydrogen from water by the help of electrolysis or thermal dissociation of water requires reactors HTR (High thermal reactor) and so on. We have not experience with HTR reactors.

Thermonuclear synthesis is possible past fifties years. May be cold fusion the solution of our problem? But it is not subject this article.

Low cost energy is necessary for electric energy producing. Renewable sources of energy would be suitable, but they are instable and cheap. The question is why to transform electric energy into hydrogen and a few kilometres away transform hydrogen back into electric energy. Batteries a move forward. Production of hydrogen from biomass is not effective, because we can transform biomass straight into the heat.

I am afraid that money is in research of hydrogen economy for automobile industry is not on a right place.

The future will be in batteries.

ACKNOWLEDGEMENT

This paper contains the results of research works funded from project of specific research program of Brno University of Technology No. FEKT-S-11-2.

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