

**The Hydrogen Hallucination**

The “Freedom Fuel” Leaves Us in Chains

*by Mark Sardella, June 17, 2003*

It's being called the “freedom fuel”, capable of releasing us at last from the grip of the oil barons. The “hydrogen economy” is even the buzz of the bestseller list. But don't break out the party balloons yet, because hydrogen hasn't got a chance of solving our energy problems. A bold assertion, perhaps, but it is based on the simplest of facts: Hydrogen is not a source of energy.

It is true that hydrogen is the most abundant element in the universe, but here on Earth all of the hydrogen is combined with other elements. The best example has two hydrogen atoms bonded to an oxygen atom, forming the familiar H<sub>2</sub>O water molecule. Four hydrogen atoms bonded to a carbon atom makes methane, which we know as “natural gas”. But if what you need is pure hydrogen – the stuff fuel cells run on – you have to manufacture it. Doing so requires tearing hydrogen loose from whatever it's bonded to, which requires an input of energy. The energy you invest in breaking the bonds is essentially “stored” in the hydrogen, and you can get it back by allowing the hydrogen to bond to something again, as a fuel-cell does. So hydrogen is simply a storage medium – you have to put energy in before you get any back. It could thus be considered a carrier of energy, by it is by no means a source of energy.

This notion of hydrogen as a storage device is vastly different from petroleum, which is clearly a source of energy. As with hydrogen, petroleum requires an energy investment before it is a usable fuel. You have to drill for it, then pump, transport, refine, and transport it again before it can be used as an automobile fuel. But in the case of petroleum, the fuel you end up with contains about five times the energy needed to produce it. That's why it's called a

source of energy – the energy returned is greater than the energy invested.

The distinction between energy sources and carriers is significant because the decline of our major sources of energy has reached a critical point. The production of petroleum, our most important energy source and the provider of about 40 percent of the world's energy, is now falling in more than 50 countries. The falling production in these regions must be offset by increased production somewhere else, but as more and more regions head into decline, fewer and fewer places remain to pick up the slack. Significant increases in oil production require large oil reserves, but at this point, the Middle East is the only place that still possesses a reserve large enough to allow production increases on the scale needed to offset the collective decline of all other countries. Rates of decline, meanwhile, are accelerating, and within the decade even the Middle East will be unable to bridge the gap. At that point oil production will peak, and from there it can only begin an irrevocable decline. Efforts by the petroleum geology community to nail down the exact date of peak are interesting academically, but the real trouble begins with the loss of oil stability, which is already happening. Price stability requires that excess production capacity be available, but excess capacity is down to around two percent of the market volume – far less than is needed. And with every developed nation's economic future reliant on Middle Eastern oil, geopolitical stability hangs in a delicate and unsustainable balance.

If world oil depletion isn't distressing enough, the heating fuel crisis in the US poses an imminent economic threat. Natural-gas

production from existing US wells now falls at an alarming 29 percent per year – a rate too steep to overcome even with 892 drill rigs working full-time to bring new gas wells on line. The inability to increase production apace with demand is already destabilizing gas markets, as evidenced by the current price hikes and storage deficits. At winter's end, the US had just nine days of gas remaining in storage overall, and the northeast region dipped to just three days of reserve. Propane and heating-oil also finished the winter at near-record lows, and even the U.S. Department of Energy's Energy Information Administration – a group well known for emotionless reporting of dire news – termed the situation “precarious.” In its characteristic matter-of-fact style, the EIA writes in its April 16, 2003 weekly report, “The prospect of rebuilding propane inventories to prior year levels appears to be in jeopardy.” The EIA goes on to discuss the possibility of supply disruptions as if they were normal occurrences as opposed to early warnings of a structural failure of the industry.

If three different heating fuels all run short next winter, what market dynamics are likely to ensue? When oil and gas prices skyrocket, what's the alternative? Hydrogen? I think not. You might as well suggest we heat our homes and power our cars with batteries and flywheels. We'll need energy sources, not carriers.

Some enthusiasts acknowledge that hydrogen is not a source, but that coupled with renewable sources, it's the perfect fuel. Unfortunately, that's just not the case. Hydrogen's low energy density makes it exceedingly inefficient to transport. To illustrate this, consider that a 40-ton tanker truck loaded with gasoline contains nearly 20 times the energy of a 40-ton truck loaded with compressed hydrogen. If both trucks deliver fuel to a filling station 800 miles away, the gasoline truck consumes about three percent of the energy in its payload to make the

roundtrip. But the hydrogen truck traveling the same route would consume all of the energy in its payload. Put another way, if you tried to run the hydrogen delivery truck on hydrogen, it would consume its entire payload making the trip, and have no fuel to deliver.<sup>1</sup>

If it's not a source and it's a lousy carrier, why does hydrogen get so much attention? Are the 985 U.S. organizations that are listed as fuel cell developers, researchers, distributors, consultants, suppliers, associations, government agencies, and laboratories really on to something, or are they simply riding a tidal wave of government hype and subsidies? Are the coal and nuclear industries pushing hydrogen in hopes that they will get to provide the necessary energy to produce it? Once again the answers may be academic. It doesn't matter why we are fixated on an energy carrier while charging headlong into a source crisis. We must simply acknowledge the oversight and move on.

Imagining that the simplest element in the universe held the key to solving our energy problems was exciting, but now it's time to awaken from our hydrogen hallucination and devote attention to the real solutions of improved efficiencies and sustainable sources.

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<sup>1</sup> Final Report: “The Future of the Hydrogen Economy: Bright or Bleak?” Ulf Bossel, Baldur Elaisson, and Gordon Taylor, April 15, 2003.  
<http://www.efcf.com/reports/>