The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

H2CAR: Another blind alley

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One of my repeated criticisms of the current US administration[1] is that it is dishonestly opposed to real alternatives to petroleum (and fossil fuels in general), and acts to obstruct those alternatives outside the public eye rather than having a fair and public appraisal. Some of this obstruction is more or less direct (cancelling a domestic hybrid-car program set to deliver product in the 2007 timeframe and also suitable for PHEV modification, and replacing it with a program of dubious feasibility and a very long time horizon), but some of it is more subtle, taking the form of misdirection.

This misdirection is evident in the shameless promotion of unready and perhaps impossible fixes, such as:

- Cellulosic ethanol.
- Oil from ANWR (at best, a fraction of what we could save with better CAFE or just plain price-driven demand destruction), and last but not least,
- Hy(pe)drogen.

An ambiguous entry from Purdue

In this climate of disinformation comes a paper from Purdue, titled Sustainable fuel for the transportation sector. The premise is rather simple: US production of biomass contains sufficient carbon to replace all our transportation fuel, but barely enough energy; a lot of that energy and a great deal of the carbon (roughly 2/3) is lost in the conversion to liquid fuels. The Purdue researchers propose to supply additional energy to the conversion process via hydrogen, allowing all of the carbon to be turned into motor fuel; they call this a Hybrid Hydrogen-CARbon process, or H_2CAR. They mention certain advantages for H_2CAR, such as compatibility with the existing fuel-distribution infrastructure. Presumably this will also save the Non-Negotiable American Way Of Life.

At a completely unaffordable price.

The cost of compatible renewability

In the H_2CAR paper, figures such as 239 billion kg/year of hydrogen from 58,000 km^2 of solar PV panels are tossed off rather casually. These numbers bear deeper analysis than they receive. For instance, 58,000 km^2 of panels could be made by assembling an array of about 46 billion BP SX 170B PV panels (at roughly 1.26 m^2 each). At a future cost of \$2/W_{peak}, this array would cost about \$15.7 trillion; today's cost would be closer to \$40 trillion. Clearly we're not going to do this.

Another example of the disconnect between the researchers and reality is their proposed quantity and method of hydrogen production. Their most optimistic (smallest) quantity of hydrogen required is 239 billion kg/year (see Table 1), which they propose to produce from renewable electricity via electrolysis. The quantity of electricity required (at 100% efficiency, no less) is a staggering 9810 billion kWh/year[2]; this is nearly 2.5 times current annual US electric production. (Worse than that, it's roughly 6-10 times what it would take to power all ground transport directly with electricity[3].) Even if produced from nuclear energy by a thermochemical process of 50% efficiency, this rate of hydrogen production would require nuclear plants equivalent to more than 8 times today's capacity[4]. This may be possible in the realm of physics and even engineering, but it's very doubtful that a sane and sober nation would even look at it twice.

Guessing at an unstated agenda

At the very end, the authors toss out a bone: hybrids, and especially plug-in hybrids, can slash the required production of liquid fuels and all the upstream items with it. This is a backhanded and very obscure way of acknowledging that the major problem to be overcome is not the essential energy requirements of ground transport, but the horrendously inefficient internal combustion engines we currently use for the job. (In so doing, they proved that Al Gore's much-ridiculed statement that the nation's #1 enemy is the internal combustion engine... is absolutely correct.) In short, they wrote a whole paper in order to address what they know is the wrong problem in a way which is far too expensive to be put into practice.

Why didn't they say so up front? I suppose it depends who is expected to grasp only the text, versus who is expected to read and understand the subtext.

1. One possibility is that it was written to please the administration. A paper which is properly down on the non-solutions like hydrogen doesn't fit with the priorities of the political minders of the scientific process (e.g. NASA's erstwhile editor and head-of-Minitrue-wannabe, George Deutch). Had the researchers been working for e.g. NASA, this could have helped their chances of getting published without having conclusions re-written. However, as they are from Purdue and the NAS isn't a government organization, this seems unlikely.
2. Could it be intended to mis-direct the old-school proponents of renewables? If so, it doesn't seem to be working. Making hydrocarbons for the same old engines will still dirty the air and contaminate water.
3. The last possibility that occurs to me is that it was written to be gobbled up by the cornucopians and others on the political right. A straightforward paper wouldn't have received anything like the attention this one is getting from them. The surface conclusions are bait; the numerical data within is the poison. The numbers like 239 billion kg/yr say, in language too sophisticated to be seen on the political radar of the clueless, that the present course is untenable. Having flown past their intellectual defenses and into the embrace of their prejudices, these inconvenient truths are utterly devastating to the cornucopian position.

Maybe, just maybe, this will help slay one more of the non-options so we can get on with the things that might actually work.

[1] Some might consider this conspiracy-mongering, but in the light of the documented abuses and obsessive secrecy coming out even in the mainstream news media, the notion must be

considered seriously. Besides, it is relatively safe to assume that a politician is lying if his lips are moving. (back)

[2] $2.39*10^{11}$ kg/yr * 500 mol/kg * 70600 cal/mol * 4.184 J/cal / $3.6*10^{6}$ J/kWh = 9810 billion kWh/year, assuming 100% electrolyzer efficiency. At the authors' figure of 60%, this rises to 16.3 trillion kWh/year. (back)

[3] As of 2003, US energy consumption in road vehicles of all types was approximately 184 GW average, or 1610 billion kWh/year. This is about 1/6 the raw electric requirement to produce hydrogen under the Purdue scenario, or about 1/10 of what's required using 60%-efficient electrolyzers. (back)

[4] 9810 billion kWh/year * 2 / 8760 hr/yr = 2240 gigawatts thermal. Current US nuclear capacity is around 270 gigawatts thermal. (back)