Due Diligence: A reader's response to Khosla

Posted by Super G on August 13, 2006 - 11:22am
Topic: Alternative energy

[editor's note, by Super G] The following is a guest post from Engineer Poet. It is a response to the recent post by Vinod Khosla.

Please pardon the length and rambling nature of the following, but I lack the time to make it shorter. Disclaimer: I do not stand to benefit financially in any way from any position I'm taking or company I'm citing below.

> If you think all rich people are bad or everyone has evil or self-interest as their only goal, stop reading.

No, I don't think that. But I know that people don't get rich without going after their self-interest very efficiently, and that might even be an unconscious habit. So, if you:

1. are telling people to vote for something which looks to benefit you long before it comes to full fruition, and
2. refuse to tell the public just how we can get what you say we will,

I'm going to be just a little bit suspicious.

I'm from Missouri. Show me.

> Finally I believe that the problem of stationary power (electricity) and mobile power (mostly transportation) are different and can be addressed separately.

IMO, that is your biggest mistake. Coupling the transport-energy system to the electric system has huge benefits for both. Even partial fungibility of electricity and motor fuel would remove much of the brittleness from the transport energy system and the grid.

> Ethanol has the best TRAJECTORY!

If that's true, I'd like to see the evidence which proves it; it looks more like a fractional arc into a cliff, ala Wile E. Coyote.

Here's my take on it: the USA's highest-yielding crop right now is corn. The average acre of corn can produce about 150 bushels of grain and another 2.5 tons of excess stover; at 2.8 gal/bu of grain and Iogen's 87 gallons/ton of dry plant matter, that acre can make a mere 640 gallons of ethanol. That's a long, long way from the 2000+ gallons even you claim is necessary.

Either you have something to triple the ethanol production over corn, or you don't. If you mean well, you should have no reason not to tell us. Even *Miscanthus* at 14-odd tons per acre isn't going to break the 2000-gallon mark.

> First, what am I invested in? One corn ethanol venture, one corn plus cellulosic ethanol venture, three cellulosic (only) ethanol ventures (all very different approaches), three non-ethanol liquid fuel ventures (next generation fuels to replace ethanol we hope), two gasification ventures (one for coal to natural gas and one for biomass), one solar, one high efficiency lighting (LED - very high risk project), one new high efficiency engine venture, one sugarcane venture, one low impact very low cost housing venture ($5000 homes), a few microfinance institutions and a few others. **Battery technologies are among my highest priorities.**

Then why don't they rate a specific mention in the above? You talk specifics about your ethanol investments, but nothing about batteries.

Are we wrong to infer that there's a whole lot less there than with ethanol?

> I would also like to see much broader energy efficiency legislation but I suspect that is harder....

Harder still, if the pols can point to a loophole-ridden half-measure and say "We did that already".

The USA has had a bunch of half-measures and abortive efforts toward petroleum independence. CAFE regulations are one of them (they did nothing to discourage ever-more driving). California's ZEV mandate, badly-designed and finally rescinded, is another. Now we're at multiple points of crisis (oil supply AND climate), and we don't have time to mess up again.

These several problems must all be tackled head-on, immediately. Ethanol barely helps either one.

> The difference between what is and what can be has to be reached in an evolutionary not a revolutionary fashion.

Then why do you propose a major shift of direction in mid-effort? Because that's what you did.

> A more likely path is ethanol in today's internal combustion engines, followed by better hybrid technology to make hybrids more broadly acceptable, to increasing the amount of battery storage on cars to make them more "plug-in" capable and over time to reduce the size of the ethanol driven internal combustion engine, thereby reducing the amount of liquid fuel we need for our automobiles.

Okay, let's go over this one point at a time:

1. Ethanol in today's engines means going E-10, "gasohol". That takes us up to about 14 billion gallons/year of EtOH, replacing perhaps 10 billion gallons/year of gasoline.

2. Then you promote better hybrid technology. This is orthogonal to fuel supply, but even the gas-only HEV's reduce fuel consumption and CO_2 emissions far more than current flex-fuel vehicles do (and they start from a lower base).

3. Last, you suggest going plug-in as the evolutionary path to pure electric vehicles. This would also obsolete the entire 200-billion-gallon-per-year ethanol infrastructure you talk about, the beginnings of which you happen to be invested in.

Then there's the matter of carbon emissions. There is no practical way to capture carbon from a vehicle, so anything which comes out of a pump is almost certain to wind up in the atmosphere. Hybrids slash carbon emissions by about a third right off the bat, and by far greater amounts if they become plug-ins charged by wind, nuclear or sequestered anything. On top of this, there are some short-term considerations and some long-term considerations:

1. The field-to-wheels efficiency of ethanol in FFV's is currently about 7.5%. Biomass-fired stationary plants should be able to get at least 50% field-to-grid, with PHEV field-to-wheels efficiency of at least 30%, perhaps 40%.

2. This both stretches biomass several times as far as any ethanol scheme, and it provides biomass backup for the grid.

3. A stationary bio-fuel plant could sequester its carbon and become carbon-negative.

I believe rapid action along those lines is the only way to prevent a climate catastrophe (if it isn't already too late). Your preferred trajectory rules that out.

> And the energy ratio of electricity is far worse than that of corn ethanol.

That statement is, to put it bluntly, false. The field-to-wheels energy ratio of cellulosic ethanol is under 10%. Burning biomass in a conventional powerplant at 33%, with a transmission and use efficiency of 60%, yields 20% - at least twice as good. Burn the biomass in a gasifying combined-cycle system at 50% efficiency, and the throughput goes to 30% - more than three times as good as ethanol.

You have access to the best experts on the planet. You also have access to the best spin-meisters. When you say things like the above, guess which ones we think are writing your scripts?

> any liquid fuel that has a shot at replacing our gasoline needs has to scale up to 2,000-3,000 gallons per acre.

Which not even cellulosic ethanol from *Miscanthus* can do; 14 tons put through Iogen's process at 87 gallons/ton gives you only 1220 gallons/acre. But that's inside-the-box thinking.

If you re-phrase the demand in vehicle-miles per acre, you are talking 40,000 to 60,000 vehicle-miles/acre/year (assuming 20 miles/gallon of EtOH). Using PHEV's consuming even 300 watt-hours per mile (the Prius+ uses ~250 at the plug) you need 12 to 18 MWH/acre/year. Burning 14 dry tons of *Miscanthus* at 16 GJ/ton yields 224 GJ of heat, or about 62 MWH; efficiency as low as 20% will get you there, and we can probably get 40%.

On top of that, the plug-in car will run on nuclear or wind and allow the crop to be saved for later, or even sequestered. The flex-fuel vehicle's supply chain is dumping carbon into the atmosphere before anything gets to a pump.

You may really have your heart in the right place, Mr. Khosla... but if that's the case, I believe it's proof that you have not really thought this thing all the way through.