Re: Question for William Mook

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- *From*: Willie.Mookie@xxxxxxxxx
- *Date*: Sat, 22 Dec 2007 16:36:58 −0800 (PST)

On Dec 23, 2:34 am, Monkey Clumps <spacebrai...@xxxxxxxxx> wrote:

> On Dec 22, 12:11 am, Williamknowsbest <William.M...@xxxxxxxxx> wrote:
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> > On Dec 22, 12:38 am, Monkey Clumps <spacebrai...@xxxxxxxxx> wrote:
> >
> > > On Dec 19, 8:38 am, Monkey Clumps
> > > <spacebrai...@xxxxxxxxx> wrote:
> > >
> > > > I know that you intend to use CPV system to
> > > > generate hydrogen rather
> > > > than sell electrical energy to the grid.
> > > > However, I am curious if the
> > > > hydrogen end of things didn't pan out, what
> > > > sort of cost would you
> > > > have for kWh? Are there technical issues
> > > > such as energy storage and
> > > > power demand vs. insolation that make
> > > > selling to the grid impractical
> > > > for you? I would think wind energy would
> > > > have the same issues since
> > > > you can't control when the wind blows.
> > > > Maybe the issue is converting
> > > > the DC from you solar system to high
> > > > voltage AC? You have been
> > > > talking about plant costs of $.07 per peak
> > > > watt, which seems to be way
> > > > below any other type of power plant,
> > > > including coal or gas. Even if
> > > > your cost doubled to convert to grid AC it

seem you would still be way
ahead of the competition.

I think your plans for hydrogen are exciting,
but would a more
straight forward approach for you be to buy
some cheap desert land
somewhere between LA and Las Vegas,
build a giant CPV farm and just
sell the electricity to the grid? California
could certainly use the
power on hot sunny days.

So after writing pages and pages about your CPV invention,
now you
clam up? If my suggestion is stupid let me know. It seems
like an
obvious question since the keystone of your plan was low
cost
production of electricity from solar. As Dan Lancaster says
electricity has far higher "exergy" than hydrogen. So why
not just
sell the electricity? What up dog?− Hide quoted text −

− Show quoted text −

I didn't clam up − I was busy replying to the tons and tons and tons pointless argumentation you and the other stooges have been dumping on me here as you persistently oppose any attempt of mine to teach you a little about aircraft design principles! lol. I also have other stuff I'm doing − even before Christmas.

Your question is a common one and has been answered before − though its been a while since anyone has asked it. I might have someone put up a web page on it since it is such a common question.

The answer revolves around balance of system costs and their impact on solar power costs.

Recall, that my goal is to produce low−cost energy that's competitive and to do that with sunlight you have to reduce capital costs to a minimum, since on Earth, they're in the dark most of the time.

So, here's my setup to produce hydrogen;

solar panel −−> DC power −−> variable load electrolyzer −−−> hydrogen

Now, solar panels produce electricity in response to sunlight. That means the power they make changes with lighting conditions. Now, any electrical generator must feed its energy into a matched load. If not you have problems. Brownouts, short circuits etc.

This means that the amount of energy you make with a solar panel, aka the power level of the generator, varies with lighting conditions − and you've gotta have the load to match it EXACTLY to have efficient production. That's why there's a VARIABLE LOAD electrolyzer in the process above. When lighting conditions change, the production of hydrogen changes to match it.

This is where you lose me.

A variable load electrolyzer makes sense
if your DC electrical power is available to meet the load.

This sounds confused to me. The variable load electrolyzer IS the load for the PV cells. The demand for electricity by the grid isn't part of this.

The PV cells generate DC electricity in response to sunlight. As lighting conditions change, the AMOUNT of power produced by the solar panel varies. The load must absorb PRECISELY that amount to EFFICIENTLY use the solar panel generators. The variable load electrolyzer achieves this. In the end what you are doing is producing hydrogen at rates that vary with lightnng conditions. PERIOD.

> During the
> daylight hours that may be the case.

The system only works when the sun is out. That's a central feature of a solar powered system.

> However, your basic problem is
> that there is demand for electricity at night and on rainy days,

Yes.

> when
> CPV will not be generating.

Yes.

> The other scenario, when you have more
> power available than you have demand is also a problem.

Look. You have two choices when you design a solar power system;

(1) You can have a backup power source to switch on when the sun isn't shining
(2) You can make a fuel when the sun shines and sell it when you get your price

> I don't
> really see how your variable load electrolyzer addresses this unless
> it is able to store energy.

??? A ton of hydrogen contains 143 gigajoule of energy. WHY do you think I'm making it? lol. Using $0.07 per peak watt solar panels, operating in a location that gets more than 1,700 hours of sunlight per year, I can make a ton of hydrogen from 9 tons of water for less than $200.

As I said above a ton of hydrogen contains 143 gigajoules of energy − this is equivalent to;

6.2 tons of coal
24.8 bbls of crude oil
2.55 tons of natural gas.

Since hydrogen burns under all the conditions the fuels above burn, hydrogen may replace any of them directly in burners and engines that use these other fuels − with only minor modifications.

At $200 per ton for hydrogen made by my solar panels, I can deliver heat to any of these engines for the cost equivalent of;

Coal at $35 per ton
Oil at $9 per barrel
Natural gas at $80 per ton

And by producing 3.34 billion tons of hydrogen per year from 552,000 sq km of solar panels − I can displace every bit of coal, natural gas and oil now used on the planet, with very little change in most of the systems that now use these fuels. BMW has shown how to build a hydrogen car. Others are talking about hydrogen airplanes. Coal fired, gas fire, residual oil fired power plants are easily switched to hydrogen− easily − and supplied hydrogen with gaseous pipelines.

> At first I didn't even understand why you would need to match hydrogen production to a load.

You are definitely confused. Lets take it a step at a time.

There is a load the panels must see to produce efficiently. What that load is depends on how your system is designed.

The solar panel load is the electrolyzer in my system.
The solar panel load is the intertie in the system you are telling me is superior because of Exergy considerations.

My system produces hydrogen − which can be sold and burned in place of any of the fuels we use. As long as I deliver heat at less cost than any of these fuels, I'm competitive in the marketplace for fuels.

The alternative − direct connetion to the grid − produces electrons when the sun shines, and parts of the entire system sit idle no matter what.

> Its a fuel.

Yes, that stores the enegy captured by the solar panels.

> Just store some extra to get you
> through the down and up cycles and you should be good to go.

Since hydrogen can be burned in any power plant that burns coal, oil or natural gas, that's what I'm doing. I make hydrogen on old stripped out coal mines using vast arrays of solar panels tied into variable load electrolyzers, and ship the hydrogen by pipeline to generators. End of story.

> Then I
> remembered that you don't plan on liquifying your hydrogen,

Well, there are OTHER uses for hydrogen beyond burning it to run EXISTING power plants.

> so storing
> it becomes a problem.

??? You appear to be confused on other matters.

> You want to set up a pipeline to the powerplant
> and feed them hydrogen as they need it. Makes sense since it
> eliminates the losses of liquifying,

There's also energy used to compress the stuff. These losses as you call them are comparable. About 20% of the energy stored by hydrogen is used to handle it − no matter how you do it. This doesn't come out of the hydrogen you burn. Its an accounting entry to the cost.

The same thing happens when you make gasoline. It takes about 20% of the energy in a gallon of gas to pump it out of the ground, pipe it somewhere, load it on a ship, powre that ship somewhere, load it into a pipe, pipe it to a refinery, run the refinery, pipe it to a tank, load it on a truck, haul it across the countryside, put it into another tank, pump it into your car. ALL these things take enregy. ALL of them ADD UP to about 20% of the energy in every gallon of gas you consume. Does that make it inefficient? No, it just increases the cost by 25%

($1.00/0.8 = $1.25)

same with hydrogen. It takes energy to run a hydrogen infrastructure just as it takes energy to run a fossil fuel infrastructure. Its the same with coal. You gotta dig it out of the ground. Haul it somewhere. Grind it. Haul it somewhere else. Grind it. Haul it. Burn it. Haul the ash away. Bury it. and so forht.

ALL FUELS HAVE THIS SORT OF COST.

Hydrogen has gotten a bad rap over the years as folks who work for the major oil companies have taken thes costs and blown them out of propotion − to scare away investors in real alternative energy systems that have the capacity to really compete where they live. They've regulated dangerous chemical transport out of existence, while carefully excluding fuels they make. People talk about embrittlement for example like it was a huge issue. Sure, in 1911 when Haber started up his first hydrogen production unit to make ammonia, he noted that hydrogen caused embrittlement in steel pipe. HE RANKED IT BELOW CORROSION AS A FACTOR IN REPLACEMENT SCHEDULES FOR THE PIPE. Yet, embrittlement issues are spoken of as if they're a HUGE problem. Forget the fact that in 1958 NASA developed a practical and safe and reliable hydrogen fueling infrastructure for its rockets. haha.. And progress has been made since that time. The AMSE in 2006 just released design standards for the hydrogen energy infrastructure. From these an competent engineer can determine the size scope costs and reliability of delivering hydrogen wherever you need it. And guess what? PRACTICAL SYSTEMS CAN BE MADE.

So, I don't understand why you are saying there's a cost of liquefying it in the manner you do. OF COURSE there's a cost of liquefying it. OF COURSE there's acost of pressurizing it. Just as there are costs in boiling crude oil to get gasoline, or costs involved in hauling gasoline by truck, or costs involved in pumping crude oitl though a pipe, or lifting it out of the ground... NONE of these costs subtract from the enregy in your tank − ALL of these costs ADD to the cost of a gallon in your tank however.

SO, the bottom line is WHAT DOES A BTU or kJ OF THERMAL ENERGY COST?

Like I said, I can get hydrogen at the panel head so to speak for $200 per ton. I can deliver it anywhere in the world for $270 per ton. Liquid gas, you name it. At $800 per ton selling price it competes against oil and natural gas products. With carbon credits thrown in, $800 per ton even competes with coal

And that's just one use. Another use is to upgrade low rank oils into higher grade refined products, or upgrade coal to higher grade refined products, by direct hydrogenation. Here storage isn't much of an issue.

> but then you need to supply the
> hydrogen when the grid needs it.

Yes.

> What is going to happen at night?

A long pipeline can store one or two days supply. Shorter pipelines not so much.

I have been experimenting in Cleveland Ohio with 10 depleted natural gas wells. There I have injected hydrogen into these wells. It turns out that one can store significant amounts of hydrogen in such wells − and restart production since hydrogen mobilizes the stationary reserves that remain. So, there's a double benefit to geological storage.

Think of it this way. Folks are talking about carbon sequestration using spent oil and gas wells. These same wells can be used to store hydrogen efficiently. Not only that, because hydrogen is 1/22nd the mass of carbon dioxide, it is a better agent to promote oil and gas recovery from stationary reserves.

So, the picture is this;

(1) build low cost solar panels on old stripped out surface mines in sunny regions
(2) use the DC electricity to make hydrogen from water found or piped to the site
(3) pipe the hydrogen to an old gas well field.
(4) store the hydrogen underground (100 days is what we like to keep)
(5) recover the hydrogen when you need it (along with natural gas)
(6) sell the hydrogen and natural gas to power plants
(7) pipe the hydrogen and natural gas to the power plants

> Fire up the diesel generator? Maybe the solution is liquify *some* of your hydrogen, so that you can match the load curve.

You seem to be begging to start an argument with a third party over liquefaction. I guess this is an attempt to put another nail in the coffin as they see it, of using liquid hydrogen aboard aircraft.

It costs 20% of the energy contained in a kg of hydrogen to liquefy it. THIS DOES NOT COME FROM THE HYDROGEN THAT'S LIQUEFIED. Its also no more than the 20% of the energy contained in a gallon of jet fuel being used to get that jet fuel into the tank of the jet liner! lol. These costs are really accounting entries for the fuel producer, and are covered in the cost of the fuel that's recieved. Every gallon of gas you buy, covers ALL the costs of extraction, transport, refining, deliver, you name it. It is the same with hydrogen.

So I want to be clear. There are large energy costs associated with processing hydrogen. It takes energy to liquefy the gas. It takes energy to gasify the liquid. It takes energy to pressurize the gas. You even waste energy when you expand it again. A careful accounting of all these additional 'costs' in a well designed system − like those adopted by the ASME last year − add up to 20% of the energy content of a kg of hydrogen. This only means the price is 25% higher at the pump than at the panel. See?

Lets put it a different way.

Imagine that hydrogen were so difficult to manage that it takes 200% of the energy in a kg of hydrogen to take it from the panel to the pump. That means there isn't enough energy to do it right? No, wrong. All it means is that for every kg of hydrogen you buy at the pump, you've gotta pay for producing 3 kg of hydrogen at the panel. The cost rises from $200 to $600 per ton − which is still under my selling price of $800 per ton. See?

Now, I'm not saying the costs of handling hydrogen are that high. I am saying the cost of hydrogen are easily supported at my production costs. A careful reader will note that $270 delivered cost is more than a 25% increase − what's up with that. Well, that's additional costs NOT associated with th eengineering or physics of the process.

> This system is simple and the hydrogen
> is produced at a cost that less than that of any of the fuels I compete against on a heat value basis−, coal, oil natural gas − and can burn in anything that burns them − and I can use hydrogen to make coal into petrol. The market for protons used this way, is largely unregulated and market prices for highly energetic liquids, like gasoline, are at an all time high.

> What you propose is that I replace the setup above with a setup that produces electrons and sell those to people who want them. The markets for electrons are regulated, and their prices are not driven by the market as much as the prices for say crude oil.

> Now logistically it seems like this would be simpler setup though;

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    solar panel -->  DC power
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And it would be if this is all I needed. But, DC power generated at a rate that depends on lighting conditions isn't as high quality as AC power generated in response to loads.

In order to respond to loads instead of sunlight, I've got to add a SECOND power source that's independent of sunlight to my solar panel, and then shed load to that power source when the solar panel loses output and get it back when the solar power increases output. So, the actual system looks like this;

```
   solar panel -->  DC power --->  Peak power match <--  Second
Source
                                          |
                                          V
                                       DC Load
                                          |
                                          V
                                       Inverter
                                          |
                                          V
                                       AC Load
```

Now, for all intents and purposes, this second source has to be as big as the solar panel or larger to be of any use. to this sytem. When the sun isn't shining the solar panel is standing idle. When the sun is shining the second source is standing idle. So, you're adding hardware and costs and not making good use of it

And we're not done adding hardware either. Of course we don't use DC power in our power grid. We use AC power. So, we need more equipment on top of all of this to invert the DC to AC. This by itself adds $0.20 per watt or more. Recall, my system above costs less than $0.07 per peak watt.

What matters is what the other guys cost.

What other guys? My price point is contingent on production volume.

Plain and simple. I need a factory that produces 1 sq km per day.
So, I need demand for 365 sq km per year − to meet my price points.
I have two sites of 500 sq km each in Indonesia. I have one site 160 sq km in Australia. This gets my factory built. Once built and the price point is achieved − success with these facilities (two coal to liquid and one hydrogen direct) will spawn others. I expect to be building 14 sq km of panels per day within 10 years.

> From what I have seen, even
> a new coal fired generator cost a over $1.00 per watt of capacity, probably significantly more. And of course they have have to pay for their fuel, while you don't.

The big bugaboo with solar is utilization − and balance of system.

While my panel is $0.05 and utilization is 20% − balance of system for direct intertie is around $0.25 − and that doesn't include any storage. So, you're up to $0.30 for direct intertie and with 20% utilization, you're at $1.50 per peak watt − and you're off line 80% of the year.

Any system of storage is going to decrease efficiency, raise costs dramatically.

That's why we make hydrogen when the sun shines, store it in old gas wells until we need it for our own process, or until someone wants to pay us for the hydrogen natural gas mix that comes out.

(we get more than 20% boost in energy content by the natural gas we retrieve btw)

> > Now, we ALREADY have a second power source, that's already powering the AC Grid, so all we have to do is invert and tie into that right; something like this;
> >
> > Solar panels −−> DC Power −−> Peak Power Match −−> Invert −−> Grid
> >
> > This is every bit as complex as my first diagram, and the parts cost more. The peak power match and inverter (aka intertie) cost nearly $0.50 per Wp. Not too much if you're paying $5.00 per Wp for the panel, but a deal breaker when your Wp drops below $0.07.
>
> Once again, as long as your costs remain significantly below your

competition, the concept may be economically feasible.

When I add balance of system costs I find MOST of my money is going to lower the cost of components (inverters and intertie) that make my competitors more competitive and lowers by return for my money spent.

The $.07
number doesn't really matter, because for $.07 you can't produce grid ready electrical power,

No solar panel can that's the point.

and this is what the consumer want to buy.

Yes. Its better to deal with an unregulated market and a sophisticated buyer. Its simpler, easier and more efficient and less costly to make hydrogen and deliver it to power stations who want to reduce or eliminate their carbon emissions while saving money on fuel.

Another thing, we still NEED the secondary power source. WE ARE NOT RIDDING OURSELVES OF THE RELIANCE ON FOSSIL FUELS, WE ARE CREATING A
REQUIREMENT FOR FOSSIL FUELS.FOR OUR SYSTEM TO WORK.
Which makes
those who sell fossil fuels happy, but doesn't really help us move forward into a post fossil fuel age.

Unless you have a way to store your hydrogen energy, which I haven't heard you describe, this problem exists with your plan as well.

As I said, one to two days supply is stored in a pipeline. I've already looked at storing hydrogen underground in test wells. I have geological engineers and geologists who not only can estimate the storage capacity of old wells based on historical production patterns, but can also estimate the amount of natural gas and oil we'll recover from the stationary reserves still there.

I've said throughout that I have sufficient spent wells in Indonesia and Australia to maintain a 100 day supply of hydrogen gas, boosted by additional natural gas from the 'empty' wells stationary reserve.

Also, the way people USE power, means that this will never be more than 15% of our total energy supply when hooked up this way. Check it out;

Power levels flowing through the power grid are at about 50% peak throughout the day 24/7. About two hours before sunrise, you start to see power levels increase as folks wake up and turn shit on, and then continue to rise s they get to work and turn more shit on. There's a slight dip at lunch, and then a rise again, that peaks after sunset, when they get home and turn more shit on. It starts to fall again after 9 pm, to the 'baseload' level.

Now, the solar panels don't produce ANY power at night. They start at zero near sunrise, and rise along a cosine curve until local noon is reached (assuming there's no clouds) and then, the cosine curve drops after noon, until it drops to zero again near sunset.

Take the area of the solar curve and the area of the use

I guess we end here...
.