

## Just Say No to GGE (and other silly hydrogen metrics)!

### Danger, Will Robinson!

There are a number of analyses and metrics that frequently appear in debates over the economics of renewable energy systems and, especially, hydrogen. While they pose (for some people) interesting intellectual exercises, their results should prompt the response "OK, but who cares?" Unfortunately, governmental policy and business decisions are being made using these misleading metrics to determine what constitutes an "economic" energy system. Further – and most importantly - R&D investment decisions are sometimes driven by these metrics. If any of the handful of terms (among many others) that appear below show up as the basis for decision or policy making, they should not only raise red flags but shoot off red flares:

- Overall efficiency calculations
- Well to wheels efficiency
- Net energy balance
- Gallon of gas equivalent (GGE)

### What's Wrong With This Picture?

Here's what's wrong: these terms describe analyses and metrics that are only applicable to conventional energy systems or are based in petroleum economics, or both. And they lead to really bad decisions.

So let's start with the threshold question: Why would you want to have renewable and/or hydrogen energy? Three simple reasons:

- Energy security
- Emissions
- Climate change

None of these goals are valued when in any of the four metrics described above. Were that they were benign: they are not.

First Overall Efficiency. Some really easy examples are solar to electrolyzer to hydrogen evaluations. Conventional efficiency calculations make this look like a really bad idea, but relative to what? What if, for example, PV generated hydrogen can be made at about \$30/kg, and what if the end user is paying over \$40/kg? Efficient in the eyes of a physicist, no, but Who Cares? It's economic. Try PV to hydrogen to power production. Efficient relative to the grid? No. Efficient relative to reforming natural gas? No. But what's the value when there is no grid? Or compared with the added expense and complexity of reformers, not to mention the fact that you are consuming a fossil fuel that is already at 15% import levels and rising; that emits CO<sub>2</sub>; and that has enormous price volatility? Is this efficient in this context? Who Cares?

"Well to Wheels " Studies. I saw a presentation earlier this year from a Japanese group that presented the results of such an analysis. A hybrid gas-electric vehicle was compared with a fuel cell vehicle. The hybrid was marginally more efficient. The presenter said, "Obviously we would select the hybrid." Albeit, hybrids use less petroleum than other IC engines. And today there is an economic calculus that cannot be ignored. The presenter, however, was making a statement about what areas of R&D were important for the long term. We can all agree that saving petroleum now is important, but over the long term don't we want to eliminate, as much as possible, petroleum use?

Net energy balance analyses are really pretty meaningless. Frankly, very few conventional energy sources used today, including gasoline, diesel and nuclear power, show a net positive energy balance in an honest analysis. These are

analyses that excite engineers and scientists but they have little usefulness (other than employment) in real world economics.

Now – GGE. Let's enter fantasy land for a moment (to keep things simple), and assume that we have oil reserves that are considerably larger than most people think and which can be delivered to the US with no supply security concerns, whether with the country of origin or because of issues with transportation or natural disasters. Why, on earth, would we use petroleum economics to make judgments about the efficacy of investments in new energy technologies? What does a GGE really represent: does it reflect all in costs to deliver; or a full accounting of its impacts on the environment, or climate change or energy security? Of course not. It is an artificially set number controlled by a cartel. The Department of Defense doesn't buy the notion of GGE. They can tell you with precision that a gallon of diesel in Basra is about \$450/gallon. Or that an independent combat team making a landing is using \$750/gallon fuel. How much in hidden taxes goes to the Defense budget for oil security; for health costs due to respiratory ailments from vehicle emissions. We still don't have a good number for the climate change issue, but it does have a significant value.

#### Clear and Present Danger to R&D

Setting R&D goals and prioritizing investments on the basis of any of these metrics, especially ones based in achieving petroleum based economics makes no sense whatsoever. Someone once said "Using today's yardstick to plan for the future guarantees recreating the past." Yet it is happening and happens everyday. The clear and present danger here is the possibility that investments will not be made in appropriate and important technologies because they can't meet the GGE test (unless you can show that you can achieve \$1.50 GGE, you do not merit funding) or other silly metrics.

#### What Can You Do?

Every time analyses and/or policy issues are discussed with these "who cares" metrics and not challenged, they gain further credence. Every time you, as a member of the renewable energy and hydrogen energy community remain silent on this topic, you perpetuate the continuation of faulty decision and policy making.

Join the revolution. Help end this wrong headed thinking.

- Write papers for conferences
- At every opportunity, challenge those who use these metrics in any forum or media
- Speak out at every opportunity

Don't let the real societal values of security, climate change or emissions be dismissed as fuzzy, unquantifiable "externalities." They are real and have a true and significant value.

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