

From: Starr, Chauncey [CSTARR@epri.com]

Sent: Wednesday, May 11, 2005 11:20 AM

To: pmpgrant@pacbell.net; ausubel@rockvax.rockefeller.edu; Gehl, Steve; Eckroad, Steve

Subject: RE: White Paper Comments (Finally)

Paul: All interesting points, but they end up with a non-directional mix, and are mostly based on the self-interest reflex of already committed sectors of today's energy participants. I stick to my objective, which is simply to open new options made available by developing applied science. On that basis, I can argue against most of the implied criticisms, and I am obviously not impressed by them. They miss the key fundamental, namely that the overall social utility of a future system will determine if it gets used, not the subsystems competitive costs or uniqueness.

I welcome new titles and PR names for the White Paper. SuperGrid was chosen for PR attention. Send me a substitute that doesn't sound like science jargon. With regard to coal, it is almost ridiculous to assume that coal based power won't get used in the coming century. Whether CO2 get stored or emitted is secondary. Capital investment flow dynamics assures coal use. So the availability of a pure oxygen stream to remove the nitrogen burden should be explored. What do any of you suggest? Chauncey

From: Paul M. Grant [mailto:pmpgrant@pacbell.net]

Sent: Tuesday, May 10, 2005 6:52 PM

To: Starr, Chauncey; ausubel@rockvax.rockefeller.edu; Gehl, Steve; Eckroad, Steve

Subject: White Paper Comments (Finally)

I've finally found a few hours to reflect on Chauncey's white paper. It's been a busy month. I've made a lot of hardware changes to my server to improve its reliability, like adding a 1 kW battery UPS. These things never go easily. Computers are one of the greatest time sinks humans have ever created. And then there's been National Geographic and their climate change article which I've put a lot of time into on the hydrogen side...all pro bono, something I'm not going to do again. I hope they give me a free subscription. Also, IBM lent me many of their archival video transcripts of the discovery period of HTSC in 87 and 88 which I've digitized and will be posting on the "history channel" of my website as time permits. It took a week to review and organize these tapes...it's amazing how so many otherwise really bright people made fools of themselves on national television predicting all the applications HTSC would engender before the mid-1990s. There's a lesson there.

On top of all that, I had to mid-wife a litter of six kittens.

Anyway, let me couch my remarks in the context of Jesse's e-mail of April 24 which I thought was very cogent...for the most part!

We should stick with nuclear and leave coal out. Jesse's comments are right on the mark. About three years ago, 2002 to be exact, John Stringer gave an invited talk at an APS meeting on the status of sequestration technologies, all of which remain unproven, and all of which would involve massive amounts of eco-invasion and uncertainty over the centuries that the CO2 would stay where you put it. This fact violates one of the precepts of SuperGrid...that the supporting technologies are pretty much proven and do exist. The "nuclear

waste” problem pales in comparison. I have a copy of John’s talk which I don’t think he’d mind sharing if any of you would like one, but you have to imagine Dr. Stringer delivering it in his inimitable British understatement style. For example, pointing out that “supercritical CO₂ would occupy twice the volume of the coal from whence it came.” At several points in his talk when the prospect of a given sequestration technology appeared rather staggering, he turned to the audience remarking, “that’s why we have to reconsider nuclear, folks.” His concluding slide pointed out, somewhat tongue in cheek, that perhaps the best place to sequester CO₂ was the atmosphere, taking into account some 60 million years ago, the geologic record suggests the CO₂ concentration was some 7000 ppm, about 17 - 18 times the current value of 380.

My own guess is that, in the absence of compelling evidence that CO₂ forcing of global climate change is not just a plausibility, but is actually proceeding, or we return to a no-regrets policy reminiscent of the Carter administration, an industrialized world will continue to oxidize every atom of carbon in the earth’s crust it can dig out or pump up.

On the other hand, SuperGrid is a “code symbol” for an alternative should one be needed, a clear concrete vision of an environmentally friendly, non-eco-invasive symbiosis of existing nuclear, hydrogen and superconducting technologies for energy generation and delivery. Back to this meaning of the word “SuperGrid” momentarily.

I also agree pretty much with Jesse’s observations regarding thermochemical versus electrolytic production of hydrogen. It’s too early to tell, but both processes are well understood and it’s “simply” a matter of economics. The study EPRI conducted for Entergy concluded that at this point thermal cracking of water was to be preferred, primarily, if I remember right, because of uncertainties in the capital cost of very large electrolyzers.

Still, by virtue of the reciprocity of the electrolysis-fuel cell cycle, hydrogen and electricity are mutually fungible and interconvertible forms of high-grade energy, a fact that should be exploited. I think of hydrogen as “electrical potential energy,” and electricity as “hydrogen-released kinetic energy.” In this context, the description “hydricity” is very appropriate.

In my view, perhaps the most important aspect of SuperGrid demanding study is the future societal balance between these two forms of energy. I think it’s pretty clear that on-board hydrogen will dominate most, if not all (except rail), transportation applications as a one-to-one replacement for hydrocarbons (the scenario addressed in my Nature article), and this “pre-destined” hydrogen could be produced entirely thermochemically in principle. The right balance in other areas such as storage and end use is not so transparent, and you have “hydrogen radicals” (pun intended) on the distributed energy side who foresee the demise of centrally generated and distributed electricity. At some point you have to make electricity (I know of no digital technology yet that directly exploits the H₂ singlet/triplet states as ones and zeroes!). The question is where, when and how much and that’s very intriguing and by and large societal driven and dependent on existing energy corridors. This would be an ideal topic for an EPRI project and I have not been backward in pointing that out. Anyone interested?

With respect to the term “SuperGrid,” I come from a different perspective than Jesse. I agree the word has some currency and “cachet” in general technical and scientific circles because we’ve been using it for a while, but not in the utilities and the DOE OETD. I became brutally aware of this during the National Transmission Grid Roadmap Workshop Jimmy Glotfelty ran in July, 2003. Earlier that year, Paul Chu and I had helped Jimmy with a presentation he was to give to OMB. I still have a copy. It included a slide describing the SuperGrid...in fact, there were slides for RegionGrid and UrbanGrid as well. By the time of

the Roadmap meeting, Energetics (the big consulting firm DOE uses) had gotten their hands on it and the term SuperGrid was removed, replaced by “national backbone,” which Jimmy used in his opening remarks. A well-known utility figure from one of the founding companies of EPRI remarked that a “national backbone” already existed and what was needed was not to replace the grid but to make the present one work better...and, by the way, dc superconducting cables were not needed. One should note that a proposal, far less ambitious than the SuperGrid, to create a nationwide HVDC backbone has been around for over four years and has not received any serious attention in DOE or by the utilities that I can see (this is the B&V, Siemens TransAmerica Grid).

The issue with the designation “SuperGrid” is the suffix “grid” which is taken very literally by DOE and utility folks who actually know what a grid is. It’s a very overworked four-letters...appearing in the likes of GridWise, GridWorks, IntelliGrid, MicroGrid, and on and on. “Grid” is congested, overloaded, at capacity and its use should perhaps now be “constrained.” Outside of Jimmy Glotfelty, no one else in OETD signed up. I had to call in some favors to get even Phil Overholt to attend SG2. Now if you start talking about components of the “SuperGrid,” like low voltage superconducting dc cables and their associated power electronics support, they pay more attention. Lately, I’ve been urging them (at the January HTSC wire development workshop) to think about the LNG SuperCable hybrid concept as an adjunct to future natural gas pipelines such as Mackenzie and ANWAR...especially the latter since it’s still far enough off to begin planning and pushing now.

Last December I gave a talk at China Light and Power to a sort of Rotary Club group of utility execs and local HK city planners. My title was, “SuperCities and SuperGrids: Teratechnologies for an Exajoule World.” I thought this would be a good 19-orders-of-magnitude take-off on “nanotechnologies,” a phrase which has gotten huge publicity mileage, let alone substantial grant money from NSF and DOE BES. The term “teratechnology” encompasses all aspects of the SuperGrid vision without the confusion of a given embodiment. The subtitle went down well. Anticipating Jesse, I even slipped in an extra “green r” via Powerpoint animation to emphasize the environmental “terra”-scale.

The pseudo-phonic (I don’t know if that’s a real word) resemblance to “terror” has also been pointed out to me. After most of my “public” talks, I take a lot of flak over my strong nuclear stance, especially regarding reprocessing and its possible use for weapons development (btw, if we really do get to a hydrogen economy, we may have to face clandestine efforts to extract deuterium via filtering after electrolysis or thermal cracking of water). My answer is that renewing the nuclear option gives civilized society a chance to kill two birds with one stone...plentiful energy and weapons control through rigorous regulation such as IMRSS combined with military force through an alliance analogous to NATO. I was disappointed to read a few days ago that the UCS is opposing the opening of Japan’s reprocessing facility at Rokkasho (which I’ve visited and is a marvel). The antidote to “terror” technology is teratechnology.

A final word on the EPRI – DOE relationship as it applies to furtherance of the SuperGrid vision. While I was at EPRI, I became quite close both to the policy and project management staff of the DOE EERE and OETD offices in my specialty and gained their trust (otherwise they would not have offered me the chance for an IPA), and learned what they really thought about EPRI who was often viewed as a competitor to their ambitions and programs (especially in the national labs). EPRI was (is) most appreciated in DOE when it acts as a matchmaker (a shadkhan...I think that’s the right Yiddish spelling) bringing its members on board to DOE programs like we did with superconducting cables and FCLs. If I remember the traditions of my Hudson Valley Jewish pals correctly, a successful shadkhan was able to often extract a fee from both parties. EPRI’s challenge is to do just that with SuperGrid.

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