Upbraiding the Utilities

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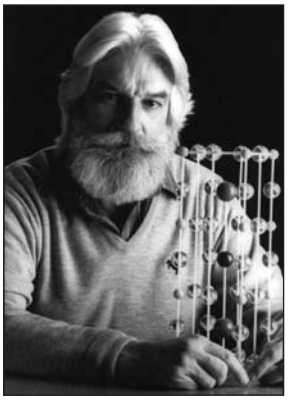

Yes, you've read it right. Upbraiding, not upgrading.

Twenty-five years ago, in early 1986, Georg Bednorz and Alex Mueller discovered high-temperature superconductivity in the family of copper oxide perovskites. The field exploded later that year and in early 1987 when Paul Chu and his collaborators at the Universities of Houston and Alabama sighted tell-tale signs of superconductivity onsets above the boiling point of liquid nitrogen, 77K. These developments unleashed a flurry of studies, especially in the United States and Japan, of markets eventually exceeding several hundreds of billions of dollars, mostly centered around electric power applications. The summit of this euphoria occurred in July 1987, when President Ronald Reagan convened the White House Conference of Superconductivity in the ballroom of the Hilton Hotel in central Washington, DC. I was there representing IBM, and, as the saying goes, a "good time was had by all."

The President announced a series of initiatives[1] which became embodied in the Superconductivity Act of 1988. This legislation created the Department of Energy Initiative for Power Applications of Superconductivity, a 30 million dollar (average) annual program designed to "upgrade" American electric utilities and power equipment manufacturers to face the looming energy demand challenges of the coming 21st century. After retiring from IBM in 1993 to join the Electric Power Research Institute (EPRI), I became actively involved in the DOE efforts as a co-funder, peer reviewer, and, yes, an occasional congressional lobbyist.

So, here we are today, some 22 years and 700-800 million dollars later, and perhaps half that amount additionally invested by the private sector. Numerous successful demonstrations, employing both low and high temperature superconductors, in almost every type of power equipment—cables, transformers, rotating machinery, fault current limiters, storage and power conditioning devices—have been undertaken in America and elsewhere. The US National Laboratories, particularly Los Alamos, Oak Ridge, Argonne and Brookhaven, in conjunction with private companies such as American Superconductor and SuperPower, have developed high performance, "second generation," long-length (hundreds of meters), and reliable $YBa_2Cu_3O_{7-y}$ (YBCO, "1-2-3") superconducting tape suitable for deployment in all the above applications. Several US utilities have very generously donated talent and facilities, and redirected a portion of their EPRI dues for financial assistance, in support of such efforts. The fruits of their labors now "sit on the shelf" awaiting insertion into the American electric power infrastructure. Beginning in 2010, funding for the Power Applications of Superconductivity program has been removed as a "line item" in DOE's congressional appropriation, and I believe justifiably so. If Ronald Reagan were still with us, he might say, albeit perhaps tongue-in-cheek, "mission accomplished."

So why has not a single US investor-owned utility[2] yet, on its own nickel, picked the fruits of our national effort? One often hears, "…the high cost of the wire." However, in many conversations during my EPRI career with utility executives, planners, engineers and "linemen in the substations and out in the field," I often heard what I term the "hassle factor." The "hassle factor" involves such locutions as, "…electricity is cheap and our in-plant and in-field efficiencies are pretty good right now, so there's no compelling reason to implement incremental increases of only a few percent," "…any new technology that involves a new skill set can lead to tedious negotiations with our labor unions," "…anyway, our grid infrastructure works pretty well right now and when there are outages it's responding just as it was designed to do." Of all these catch-phrases, "no compelling need" emerges as most frequent.[3]

But what about the wire cost? It's this issue on which I now want to focus in the rest of the present polemic.

At IBM, when we would review the commercial potential of a particular new technology, part of the process would involve asking, "What if the product were free? Would our customers still buy it?"

So, what if the wire were free, would American utilities then "buy it"? And how could we bring that about? "Zero cost" would be obtained in the form of a Federal State "tax credit (not a subsidy!)" to the equipment manufacturer or utility for the wire cost alone associated with a given application. For example, were such application to be a power cable, the tax credit would apply only to the wire or tape and not to "packaging" such as insulation and cryogenics, or actual installation. Such is the core of my "modest proposal," one I've been presenting at my plenary and invited talks this year to the American Physical Society, Materials Research Society and Cryogenic Engineering Conference.[4]

Hence, my challenge directed to the American utility industry is, "Would such a cost accommodation induce you to deploy what is now a national treasure?" Please get back to us on this.

One often hears the "day of superconductivity in power" will dawn with the large-scale build-out of renewable electricity generation, which I take to comprise principally wind, solar and biomass. The argument goes that new connection cabling to grid and storage substations will be necessary, so why not use superconductivity? Also, the advantageous power-to-weight ratio of a superconducting generator makes its deployment on high towers quite attractive. However, from my point of view, such an occurrence in the US is extremely problematic given present basic and, likely future as well, American political and social views about their "living space." Anyone who has ever visited a wind farm certainly doesn't want one in their backyard, and not even on the horizon.[5] All three mentioned "renewables" are massively eco-invasive.[6] The North American continent is awash in fossil fuel reserves, arguably the largest in the world. Under such circumstances, it is likely its inhabitants will continue to oxidize as many carbon atoms as possible.

So when would power applications of superconductivity become truly massive?

(Continued on page 6)

Upbraiding the Utilities

(Continued from page 4)

Some readers of ***Cold Facts*** may be familiar with this writer's speculations[7] on the future possibility of wheeling large amounts of power from remote locations, be those sources, fossil, nuclear or possibly solar, and maybe way out there, fusion…maybe. I call these the energy enterprise's equivalent to the physicist's large hadron colliders.

Will such become the "upgraded utilities of the future" that finally say "yes" to superconductivity?

References

1. Ronald Reagan, "White House Conference on Superconductivity, 18 July 1987." http://www.w2agz.com/Library/HTSC%20History/Reagan%20Speech%20072887a.pdf

Reagan 18 July 1987 Video (Warning: This is a large wmv file). http://www.w2agz.com/Video%20Content/Superconductivity/Reagan%201987%20Speech.wmv.

2. There is a superconducting cable currently undergoing demonstration by the Long Island Power Authority. LIPA is not an investor owned utility, rather it is a publicly funded non-profit utility whose governance is appointed by the governor and legislature of the State of New York and subsidized by its taxpayers.

3. The Grid: A Journey Through the Heart of Our Electrified World," by Phillip F. Schewe, Joseph Henry Press (2007). Reviewed by P. M. Grant, "Plugged into the matrix," Nature 447, 147 (2007) http://www.w2agz.com/Publications/Book%20Reviews/06%20(2007)%20Plugged%20Into%20the%20Matrix.pdf

4. Copies of these talks can be obtained by contacting the author.

5. Some of the first US wind farms were built in California in the north at Altamont pass and in the southeast at Tehachapi pass under large state subsidies. Many are in disrepair. It is problematic whether significant wind power development will continue in California.

6. P. M. Grant, "Hydrogen lifts off – with a heavy load," Nature 424, 129 (2003) http://www.w2agz.com/Publications/Opinion%20&%20Commentary/EPRI/Nature/(2003)%20Hydrogen%20Lifts%20Off%20-%20With%20a%20Heavy%20Load%20%20424129a_fs.pdf.

This commentary exposes the extreme eco-invasiveness of wind, solar and biomass electricity generation. An exception is solar roofs inasmuch as no additional land area is required.

7. P. M. Grant, C. Starr and T. J. Overbye, "A Power Grid for the Hydrogen Economy," Scientific American 295, 76 (2006) http://www.w2agz.com/Publications/Popular%20Science/'A%20Power%20Grid%20for%20the%20Hydrogen%20Economy,'%20P.%20M.%20Grant,%20C.%20Starr%20and%20T.%20J.%20Overbye,%20Scientific%20American%20295,%20No%201,%20July%202006,%20pp.%2076-83.pdf.

P. M. Grant, "Extreme Energy Makeover," Physics World, October 2009 http://www.w2agz.com/Publications/Opinion%20&%20Commentary/W2AGZ/Physics%20World/(2009)%20Extreme%20Energy%20Makeover,%20Physics%20World,%20October%202009,%20pp.%2037-39.pdf