SCIENCE; Mining the Imagination for New Energy; Scientists call for a research blitz targeting extreme possibilities.; [HOME EDITION]

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Full Text (1229 words)

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To allay concerns over dwindling oil and mounting carbon residues, President Bush has proposed relying on "clean" coal, a revived nuclear industry and hydrogen cars, which he says could be widely available by 2040. Critics denounce these ideas as either impractical or environmentally outrageous, calling instead for intensified renewable energy development.

Both visions are naive. The dilemma isn't just getting enough clean energy, but getting enough energy, period. As world population quadrupled last century, power consumption increased sixteenfold. With China and India joining the industrialized feeding frenzy, by 2050 our current usage will triple. And neither Bush nor environmentalists know how to meet such demand.

To run the world on biomass fuel (a favorite idea of John Kerry's) would require dedicating an area comparable in size to all land now used for human agriculture. Because sun and wind energy aren't constant, tapping them on a massive scale not only means huge arrays of solar panels and turbines but redesigned grids with vast new storage mechanisms. Atmospheric scientist Ken Caldeira of Lawrence Livermore National Laboratory calculates that if we somehow built 900-megawatt, zero-emissions plants each day for the next 50 years, we'd barely double our current output. Even if we embraced universal nuclear power, there's far too little uranium -- unless we again accept breeder reactors, which proliferate weapons-grade fuel.

Writing in the journal Science, Caldeira and 17 other eminent American and Canadian scientists conclude that the only hope for solving the world's looming energy shortage is to consider things we've barely imagined. They propose a research blitz of previously unimagined proportions, far beyond what any politician is currently suggesting, in search of entirely new carbon-free technologies.

One of them, New York University physicist Martin Hoffert, has resurrected a notion broached during the first Arab oil crisis: orbiting solar collectors in space, where the sun appears eight times brighter, and beaming it to Earth via microwaves ("probably no stronger than your cell phone's"). In 1978, the concept involved a mirror the size of Manhattan; today the idea is smaller reflectors - - possibly balloons made of shiny Mylar -- strung around the Earth. David Criswell and John Lewis, of the universities of Houston and Arizona, respectively, set their sights higher: on the moon, where reflectors could be made from silicates and metals mined on site, rather than hauled expensively into orbit. The moon might also hold the key to practical, clean nuclear fusion, still elusive on Earth but reportedly more promising if He-3, a helium isotope found on the lunar surface and in the atmospheres of Jupiter and Saturn, is used.

Or, they write, if we can't wean ourselves from coal, then seed our own atmosphere with sulfate particles, which would form an artificial cloud cover to counteract greenhouse warming. Or hang a 2,000-kilometer-wide screen in space, which, like a permanent sunspot, might block enough solar flux to compensate for a doubling of carbon dioxide in the atmosphere. Or try to somehow harness the explosive, fleeting potential energy of antimatter. The idea, Hoffert says, is to imagine everything, however outlandish, in hopes that something proves possible. At Chicago's 1893 World's Columbian Exposition, he notes, technology exhibits for the coming century failed to predict airplanes or television.

But to go from imagination to reality requires commitment and investment. Hoffert proposes spending several hundred billion dollars a year over the next 15 years on an Apollo-scale project to force technology for clean, abundant energy. Although both Bush and Kerry declare that market incentives like emissions trading will produce solutions, Hoffert argues that major technologies of the last 50 years, from space travel to atomic power to the Internet, sprang from government mandates, not markets. "Markets only react to short-term opportunities. They're not equipped to address long-term problems like this one," he said.

Last July, Hoffert and his coauthors gathered in Aspen, Colo., with other scientists to brainstorm.

Discussions included a proposal by high-altitude-wind specialist David Shepard for suspending turbines on giant kites at 30,000 feet, where jet-stream power is enormous. UC Irvine physicist and science fiction novelist Gregory Benford had a low-tech, low-cost plan: Instead of using crop wastes for biomass energy, we'd save even more carbon buildup in the atmosphere by simply burying them at sea. Much talk involved revolutionizing the electrical grid, possibly with superconductors, or by connecting the entire world so the off-peak side could power the half in shadow, as Buckminster Fuller once proposed.

The keynote speaker was Rice University's Richard Smalley, a Nobel laureate and discoverer of the fullerene, the geodesic carbon molecule named for Fuller. When these "buckyballs" align to form carbon nanotubes, they are the strongest substance known -- possibly strong enough to send a tether into space. An elevator moving along such a nanotube cable to a satellite in a fixed geosynchronous position 22,500 miles above Earth could ferry materials for space- based solar collectors far more cheaply than space shuttle launches.

On Earth, the highly conductive nanotubes might form lighter, more flexible grids, vast enough that we could move all our energy through wires rather than with tank trucks. To these grids, Smalley would connect all kinds of storage, ranging from wind compressed into airtight caves to appliance-sized home units that might be batteries, flywheels, hydrogen tanks -- whatever would let us both tap and feed the total power supply as needed.

Of course, all this is speculative -- the longest carbon nanotube produced so far measures barely half an inch. But Smalley concurs that another Apollo-like project is crucial. Not since then, he notes, have our universities been filled with engineering students inspired by a great challenge. A line graph he projected at Aspen showed the sobering result of subsequent generations diverted to Wall Street or Silicon Valley: As numbers of science and engineering PhDs plummet in the United States, in China and India they've soared.

"Suppose" he said, "from 2004 through 2009 we collect 5 cents from every gallon of oil. We invest the resulting $10 billion per year in frontier energy research. Maybe for the decade after, we collect 10 cents a gallon: $20 billion a year. At worst, we'll create a cornucopia of new technologies and new industries. At best, we'll solve the energy problem before 2020 and lay the basis for peace and prosperity worldwide."

An expensive long shot, but, as Hoffert noted, the U.S. went from the Wright brothers to the first atomic pile in less time than from now to 2050 -- when either we'll have carbon-free energy or face temperatures the Earth hasn't seen for 100,000 years.

"To continue more than another century, we'll have to do all this stuff," he said. "Otherwise, we'll use up all the coal, then maybe methane hydrates on the ocean floor. When we've completely exhausted fossil fuels, civilization will collapse. We'll go back to being hunter-gatherers. It will be much harder for the next intelligent species that evolves because they won't have cheap fossil fuel like we did. They'll have to go directly to fusion and photovoltaic cells. That may not be so easy."

No easier, probably, than imagining Bush's or Kerry's political handlers daring to float so bold a vision. The only thing harder to contemplate is what will happen if some leader doesn't, and soon.

Credit: Alan Weisman teaches journalism at the University of Arizona and is the author of the memoir "An Echo in My Blood."

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