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MICHAEL KANELLOS 12 21 09

Top Ten High Concepts in 2009

Fuel from carbon dioxide anyone? Direct solar fuel, along with fusion and ditch power, was one of the more interesting ideas to gain traction during the year.

2009 was the year reality crept into greentech.

Venture funding declined, companies had to depend on the American Recovery and Reinvestment Act for survival and some futuristic products like the Fisker Karma got kicked into 2010.

But that didn't stop futurists from plugging away at the next big thing. Here's our list of the favorites that surfaced during the year. Some of these ideas have been in the works for a while, but were seen more broadly in 2009.

1. Nuclear Goes Mod(ular): NuScale Power, Sandia National Labs, TerraPower and Babcock & Wilcox discussed plans to **build and/or license small reactors that could produce 45 to 125 megawatts of power.** By connecting 12 or 24 of its reactors in an array, NuScale hopes to build power plants that will produce power for 6 to 9 cents a kilowatt hour. Although that's roughly the same price as regular nuclear plants, NuScale's advantage is that construction time could be considerably less.

"Our principal market is the conventional market for providing power to the grid," said Bruce Landrey, who runs marketing. "We anticipate that the costs will be competitive, perhaps slightly less than the larger [nuclear] plants."

These sort of plants may not be ready for several years, but expect to hear more about nuclear. Energy Secretary Steve Chu, MIT's Ernie Moniz and UC Berkeley's Dan Kammen have also said nuclear in some form will be needed to move away from coal.

2. Fusion: Not in our lifetime, Moniz told me. Others disagree. Livermore National Labs showed off a system in which **192 high powered lasers focused on tiny capsule of hydrogen could generate fusion power.** Scientists hope to show it can work in 2010 or 2011. Another added bonus: By incorporating blankets of waste from nuclear fission plants, more power could be generated and nuclear waste could be eliminated. (The system is called hybrid fusion.)

Among startups, rumors percolated that secretive **Tri-Alpha Energy** might describe its technology next year and **General Fusion** received more VC funds while pushing out the time when it says it can show the technology might be feasible. If fusion works, it could solve a lot of problems.

3. Osmotic Pressure Gradients: In OPGs, fresh water passes through a membrane, drawn through by an inherent attraction to a vat of salty water on the other side. As the volume of water increases in the salty tank, pressure builds, which can be used to crank a turbine. Statkraft in Norway, with some help from Energy Recovery, **built a prototype plant.** IBM and Aquaporin are looking into it as well.

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Maxwell and the Promise of

indirect: sunlight and carbon dioxide create plant matter, but then geological forces are required to turn dead trees and microbes into a fuel. Think of it as microwave petroleum: no more slaving over the Permian basin for millions of years waiting for those hydrocarbons to be done.

An added plus: It creates a market for carbon dioxide and reduces the total amount that will exist in the atmosphere.

7. The Solar Air Conditioner: Fifty percent of the demand for power during peak periods in California and 70 percent of the power in Dubai can be attributed to air conditioners, according to Peter Le Lievre, founder of Chromasun. (He was behind Ausra too.)

Chromasun takes solar thermal collectors and other technologies to gather solar heat to run a double effect chiller, an ornate heat exchanging device that in the end produces cold air. (More here.) It's interesting in a lot of ways: it curbs peak power, broadens the market for solar thermal technology and fits well within the practices of the building trades. Other novel mixes of liquid and solar: the **liquid filled heat sinks** for PV panels that can be used to improve the performance of panels and provide a home hot water.

8. Gravity Power: Think of this as regenerative braking on a massive scale. Vycon Energy's flywheel captures energy released when **large cargo cranes drop those 30 ton storage containers in the holds of ships**. The energy is converted to electric power for the crane for the next hoist. Now, cranes rely on dirty, smelly diesel. Various others are working on technologies to **clean ports**. It's one of the first practical applications for kinetic energy: you get more energy than those crazy harvesters for dance floors.

9. Lithium, Zinc and Air: For renewables and electric cars to move toward broad acceptance, alternatives for energy storage will be required. IBM and others believe the answer could come through lithium air batteries, which could provide ten times the performance of conventional lithium cells. It will just take **a lot of scientific breakthroughs** to get them into production. Meanwhile, zinc battery proponents liked to **point out that their technology already exists**. **Nuclear batteries could boost performance by 100x**, but practical problems may keep them grounded.

10. Biotech Tools Go Green: Wildcat Discovery Technologies has taken the rapid prototyping and high-performance computing techniques devised in drug discovery to help battery and energy storage companies quickly produce new materials. Wildcat can make 250 new substances in a week, eliminating and/or adding molecules and their arrangement. A traditional battery maker might produce just a handful. More materials to test leads to quicker optimization at the factory level. **Intermolecular** exploits rapid prototyping in solar. Wildcat grew out of San Diego's biotech cluster, which will likely become more important as energy and biology converge.

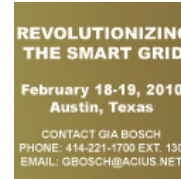
Honorable Mention: Silence as a Business. They didn't come out with products and remained highly vague about their actual plans, but some companies made headlines nonetheless with far-reaching ideas that may or may not work. If there were a Nobel Prize for PR, these companies would win: **EE Stor** (ultracapacitors), **Bloom Energy** (fuel cells), **Calera** (cement out of seawater); **V-Vehicle** (electric cars.)

All of these companies, now that I think about it, received investments from Kleiner, Perkins or Khosla Ventures. Coincidence? But don't dismiss the silence out of hand. Remember, Kleiner also invested in Segway, Pets.com and @Home.

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