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# Tech Talk - The ARPA-E 2012 Awards

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The Department of Energy has just announced the projects selected for funding in the next round of the ARPA-E program. This is the Advanced Research Projects Agency-Energy, first funded in 2009, to, *inter alia*, "focus on creative "out-of-the-box" transformational energy research that industry by itself cannot or will not support due to its high risk but where success would provide dramatic benefits for the nation". There are some 66 projects on the list, which is broken down into eleven different focus areas. These are the technologies that the ARPA-E program is betting some $130 million on as sources of future energy supply or savings. It is worth taking a quick glance through the topics to see what is considered important and likely of success.

The two largest areas of funding are Advanced Fuels and Grid Modernization, both of which get around $24 million or 18% of the pie. This is split among 13 fuel projects, and 9 grid-related projects. With the growing supply of natural gas that is coming from the developing shale gas reserves in the country, it is perhaps no surprise to see that methane conversion to liquid fuel captures the largest part of the fuel funding this year, being the theme of nine of the awards.

The largest of the fuel awards goes to Allylix, a company that specializes in terpenes, and who is tasked with turning these into a viable aviation fuel. Specific genes needed for terpene production are extracted from a biosource, and then optimized for use in a yeast host. The optimization is an engineered change that can increase product yield several hundred fold (according to their website). From that point there is a fermentation process, and then a recovery and purification of the liquid fuel, which is stated to be already commercially viable.

There is only one algae award this year, to Cornell for $910k, and they will look at using light fibers in a small reactor as a means of improving economics. After having looked into this process I am prone to disagree that smaller is better (if you are going to generate hundreds of thousands of barrels a day you need large systems, and anything on a smaller scale is hardly worthwhile). Further there are issues with engineered light paths, but they will no doubt find those out as they carry on with their work.

The "different" program in this effort is for $1.8 million that is being given to Plant Sensory Systems to develop a high-output, low-input beet plant for sugar production.

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There are just two awards for Advanced Vehicles, one to Electron Energy Corp to produce better permanent magnets that don't rely on rare-earths, and one to United Technologies to improve efficiency by using laser deposition of alternate layers of copper and insulation in a new electric motor design. This will also reduce rare-earth dependence. They roughly split $5.6 million.

The $5.3 million for improving building efficiency goes to California, and is split with two awards to Lawrence Berkeley and one to Stanford. Each has a project on using coatings to alter the thermal transfer to the buildings and cars, while Lawrence Berkeley also gets almost $2 million for modeling studies of building heat losses.

The $10 million for carbon capture is split four ways, with two awards (to Arizona State and

Dioxide Materials) for electrochemical systems that will generate new fuels from the carbon dioxide output of power plants, while the University of Massachusetts at Lowell is developing (for $3 million) a catalyst that will also combine sunlight, CO2 and water into a fuel precursor.

The fourth award is to the University of Pittsburg (at $2.4 million) for a way to thicken liquid CO2 either as a way of improving EOR, or as a substitute for water in hydrofracking. I can't quite see the advantage of a thicker fluid for use in EOR, since the hope, surely, is to have a very low viscosity fluid that can more easily penetrate into the formation and mix with the oil, but the application in fracking is intriguing.

The emphasis with the investments in Grid Modernization (the co-largest topic) is on improving switchgear (five awards). In addition. there are two awards for modeling, one on improved instrumentation and one to Grid Logic ($3.8 million) for developing a new super-conducting wire for power transmission.

There are two awards, both for $2 million, in the "Other" category. One is to MIT for a water purification system, wile the other is to Harvard. This latter is for a "self-repairing" coating that can be applied to water and oil pipes to reduce friction and thus lower pumping costs. The old fall-back on this was Teflon, which could be very effective, but any particulate matter in the fluid will erode this over time, so the "self-healing" aspect could be worthwhile, since it might allow a much thinner liner.

The $18.76 million for Renewable Energy projects is distributed to wind, sun, and water energies, with two projects in waves where Brown University will be building a new underwater wing to capture flowing water energy, and Sea Engineering, who will be developing a better buoy for acquiring data for tidal energy potential assessment. Wind is down to a two projects, one, which seems a bit regressive, is to GE who will develop fabric blades for wind turbines for $3.7 million. A similar amount is going to Georgia Tech to develop a vertical axis turbine. The remaining six projects deal with solar power of which the most interesting, perhaps, is that at Cal Tech which is going to look into splitting light into its different color bands (think prism) before using them to improve device efficiency. We have seen that converting white light electronically to the narrow optimal color band can have dramatic effects on improving algae growth rates, for example, but it requires a bit more refinement to achieve the narrow division than, I suspect, will be possible optically.

The section that will invest $12 million in Stationary Energy Storage is funding eight projects looking at different battery technologies. The largest investment ($4 million) is going to Alveo Energy, which has an intriguing entry in Find the Company. It was apparently only founded this year. The technology that it is chasing involves using Prussian Blue dye as the active ingredient in the battery.

The other "out of the ordinary" award is to Tai Yang which is affiliated with Florida State University. Superconductivity Center. The $2.15 million award is to develop a method for storing energy in a high-power superconducting cable.

Pratt and Whitney get two of the three Stationary Generation awards - the first for $650k is to develop a continuous detonation gas turbine, while the second, for $600k is for work on an ultra-high temperature gas turbine. The University of North Dakota gets the third award to look at developing air cooling for power plants.

The $9.5 million for Thermal Energy Storage is split five ways, with three awards for the development of power from the waste heat in existing systems, one to the NREL for a solar thermal electric generator, and one to Georgia Tech for a solar fuels reactor using liquid metals.

When it comes to finding answers to Transportation Energy Storage the Agency is committing

$15.3 million to seven projects. Six of these deal with battery development. (A123 Systems who previously received a $249 million federal grant to develop electric car batteries recently went bankrupt.) Two of the awards, to Georgia Tech and to UC Santa Barbara will seek to combine super-capacitor design with battery capabilities, while the Palo Alto Research Center will use a printing process to construct batteries.

Ceramatec is being funded, at $2.1 million, to develop a solid-state fuel cell using low-cost materials.

There is a clear change in emphasis from earlier years reflecting, no doubt, the results from ongoing research, as well as the obvious change that the current natural gas availability is allowing in developing technical advances for the future. It should, however, be born in mind that while some of these will likely prove to be quite successful, it will still take perhaps a decade before any of them can be anticipated to have any significant impact on the market.