



EMERGING

# Government Innovation? Yes, You're Reading Right

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By Atlantic Re:think

## Story Highlights

- The U.S. Department of Energy launched the Advanced Research Projects Agency-Energy (ARPA-E), aimed at improving U.S. prosperity and national security and protecting the environment.
- To date, ARPA-E has invested approximately \$1.1 billion across more than 400 futuristic projects.

In October 1957, the Soviet Union launched Sputnik, the world's first man-made satellite, which hurried the U.S. into the space race. Within six months, the U.S. Department of Defense launched an experimental research agency that has become legendary, enabling the country's top scientists and engineers to invent the impossible and vault the American military ahead of its enemies.

The Defense Advanced Research Projects Agency (DARPA) gave rise to the Internet, GPS, 3D mapping, unmanned vehicles and more. The dream factory has been so successful that it spawned a sequel six years ago when the U.S. Department of Energy launched the Advanced Research Projects Agency-Energy (ARPA-E). Modeled after DARPA, ARPA-E's futuristic projects are aimed at improving U.S. prosperity and national security, and protecting the environment.

To date, ARPA-E has invested approximately \$1.1 billion across more than 400 projects, some of which seem straight out of science fiction: oscillating underwater wings that capture energy from rivers and tidal basins, roving robots to improve crop yield and machines powered by dust devils. The agency has been designed to encourage out-of-the-box innovation that can inspire private-sector investment.

In its founding documents, ARPA-E was envisioned as a "lean, effective and agile—but largely independent—organization that can start and stop targeted programs based on performance and ultimate relevance." It would have a small staff, perform no R&D itself and turn over that staff every three to four years to promote innovation.

ARPA-E's initial request for proposals generated more than 3,000 concept papers, which were narrowed down to 37 awards. "This one percent success rate is suggestive of not only an innovative program design, but also an enormous capacity at American universities and other research organizations the innovation pipeline," Ernest J. Moniz wrote in *Daedalus*, the Journal of the [American Academy of Arts and Sciences](http://www.amacad.org/) [1], in 2012. An engineering professor at MIT, Moniz is now secretary of the U.S. Department of Energy.

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Joshua Yuan, an associate professor of bioenergy at Texas A&M, appreciates ARPA-E's active project managers who require frequent presentations and updates that keep research productive and on track.

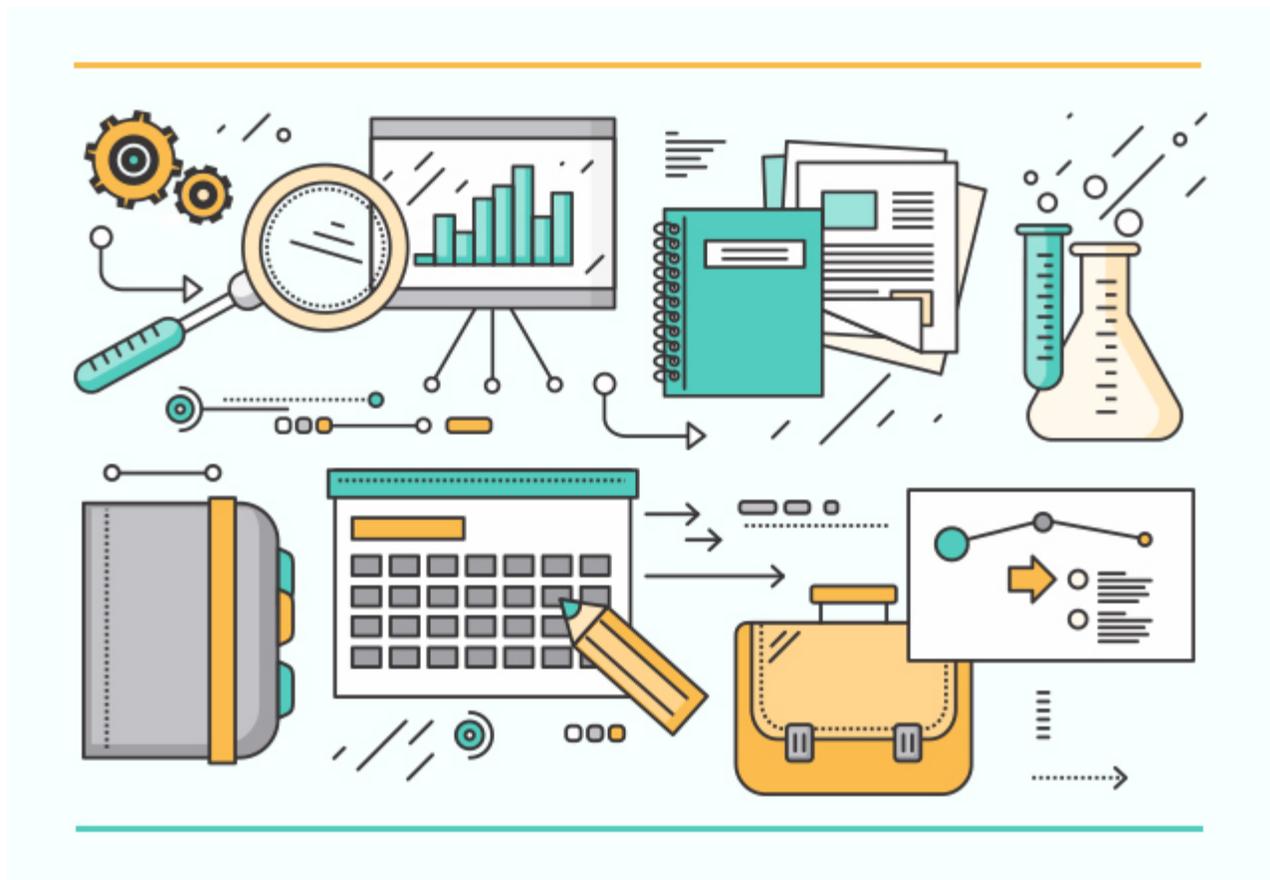
“For scientists, our human weakness is our curiosity. We say, ‘This looks interesting, let’s make a story out of that.’ But ARPA-E asks, ‘Where is my milestone?’ You need to meet that milestone, the next milestone, the next milestone and then we reach the final project goal, commercialization.”

Yuan received a four-year, \$4.8 million ARPA-E grant to reengineer tobacco plants to produce terpenes—energy-dense molecules that can be converted into petroleum products such as jet or diesel fuel. So far, Yuan has reached terpene levels of seven percent in tobacco grown in greenhouses and is now performing field trials. He hopes to extend the grant another year and achieve terpene levels of 20 percent.

A paper published by the Journal of Technology Transfer lauded the agency's streamlined approval process, which is free of peer review, bureaucratic hierarchy and other sources of resistance. This style of “fleet-footed decision-making” relies on project managers with deep experience in academic research and industry, who are empowered to evaluate and encourage research directions.

Byron Reeves, a media psychologist at Stanford University, applauds the agency's “useful administrative oversight,” adding, “They have an entrepreneurial focus.”

Reeves knows this from experience, having led a team of researchers across 10 university departments in whom ARPA-E invested \$8.1 million to change energy-use behavior. Experiments included financial incentives, a calculator to understand the potential savings of efficient appliances, and a video game in which players chase a family around the house turning off lights and appliances and learning how much electricity is used. “It’s a hundred lessons wrapped up in five minutes of game play,” Reeves says.



Researchers are now recruiting energy customers with smart meters—devices that record consumption of electric energy in intervals of an hour or less and communicate that information to the utility company on a daily basis. For further testing of the game, which is available online (to PG&E customers only), visit <https://www.freeenergygame.com> (<https://www.freeenergygame.com>) [3].

Playing the game changes energy usage by two to four percent, Reeves says, and that is consistent with similar interventions to change financial or health behavior. “It’s a small effect statistically,” says Reeves, “but in terms of social significance, it’s a rather large effect if you could cut down one percent of energy usage with a program as cheap as this.”

“The next big thing can’t progress within the system,” says Usha Haley, professor of management at West Virginia University, who works on technology development through government investments in the energy sector. “Some initiatives may never come to fruition, but we need someone in the game willing to take a moonshot. Otherwise, finance people dominate in companies, and their time horizons are very short.”

According to the *Journal of Technology Transfer*, the agency’s imprimatur has a halo effect, attracting the interest of venture capitalists and commercial firms. “The private sector views the ARPA-E...selection process as rigorous and sound enough that it is prepared to fund projects emerging from that process. ARPA-E’s selection helps in identifying and, in effect, validating a candidate pool,” writes William B. Bonvillian, director of MIT’s Washington Office, and Richard Van Atta, a senior research analyst at the Institute for Defense Analyses.

The agency also hosts an annual innovation summit, which convenes leaders in academia, business and government to showcase several hundred transformational technologies, many of which are being revealed in public for the first time.

## “SOME INITIATIVES MAY

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Even if scientists don't achieve all their project goals—and most won't given the risky, early-stage nature of the research—their discoveries can lead them to new breakthroughs. In 2010, Berkeley's Lawrence National Laboratory received a \$3.4 million grant to genetically modify bacteria that can convert hydrogen and carbon dioxide to produce biofuels. The hydrogen was generated by electrocatalysts tethered to engineered proteins located on the surface of the bacteria.

“There were a few different moving parts, each of which was difficult to achieve. We published on each of the parts separately but were not able to integrate everything in the time span of the grant,” says Harry Beller, the project's co-principal investigator and a senior scientist at the Berkeley lab.

“There is a tendency in all funding agencies to want every project to win and to win quickly,” he adds. “When you're a researcher in that environment and you know you have to have a lot of success in the first year, it constrains the possibilities of the kind of research that you could propose. ARPA-E gives a lot of opportunity to take big risks, some of which fail and some of which result in a huge win.”

Industry watchers say the agency has done a good job of sourcing nationally for a wide variety of projects and preparing awardees for the rigors of commercialization. “The key with ARPA-E is they're not just technologists and scientists, but business folks giving the ground truth, saying, ‘If you have any shot of getting to market, this is how it's going to work,’” says Troy Ault, director of Cleantech Group's i3 Connect, a San Francisco market research and networking platform.

In 2012, Smart Wires received a \$3.9 million ARPA-E award to develop a device that clamps onto transmission lines and routes power within the electric grid more efficiently and economically. The funding supported a pilot demonstration on the Tennessee Valley Authority's transmission system. Jim Davis, Smart Wires' chief executive, credits the award with helping the company commercialize its first product.

“Government plays an important role funding research in our national interest that otherwise wouldn't get funded in the private sector,” says Steve Westly, managing partner and founder of a clean technology venture capital firm in Menlo Park, CA.

He lauds ARPA-E projects that focus on combining renewable energy and energy storage. “Getting that right will unlock large-scale deployment of solar. ARPA-E's work is vital...and is exactly the kind of cutting-edge work the government should do more of. Some of these ideas won't bear fruit, but others may revolutionize our way of life and keep America at the forefront of innovation.”

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"The \$4 million award that Smart Wires received from ARPA-E effectively enabled our company to commercialize our first product, the PowerLine Guardian, and to establish ourselves as the leader in distributed power flow control solutions for the electric transmission grid," said Jim Davis, chief executive of Smart Wires. The award helped fund a 2013 pilot demonstration of the startup's technology on the Tennessee Valley Authority's power transmission system. Installed on a 161-kilovolt transmission line near Knoxville, the Smart Wire system provided congestion relief by redistributing power flow onto underused lines, thereby optimizing transmission system operations. The technology consists of an array of distributed series "reactance" units that attach to a transmission line. The units, which weigh about 150 pounds each and resemble a rectangular box, limit the electrical current flow on the line and can be operated autonomously or with full operator control to provide line sensing and monitoring. Smart Wires monitored the 99 units for a year to verify performance. "Today we're working with utilities all over the world to develop strategies that enable them to respond to changing dynamics in the industry and to reposition their businesses through technology innovation," Davis said. "The ARPA-E award was critical in getting us started down this path."

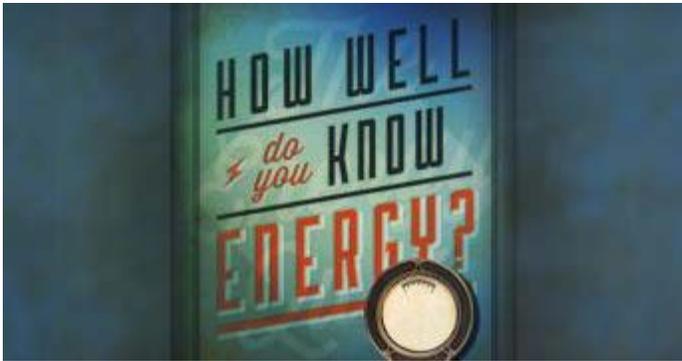
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The Lithium-ion Battery That Could: How We'll Reinvent the Grid

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[1] <http://www.amacad.org/>

[2] [https://twitter.com/intent/tweet?url=http://hpmatter.com/issue-no-6-fall-2015/government-innovation-yes-youre-reading-right&text=ARPA-E's work is vital...and is exactly the kind of cutting-edge work the government should do more](https://twitter.com/intent/tweet?url=http://hpmatter.com/issue-no-6-fall-2015/government-innovation-yes-youre-reading-right&text=ARPA-E's%20work%20is%20vital...and%20is%20exactly%20the%20kind%20of%20cutting-edge%20work%20the%20government%20should%20do%20more)

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[3] <https://www.freeenergygame.com>

[4] [https://twitter.com/intent/tweet?url=http://hpmatter.com/issue-no-6-fall-2015/government-innovation-yes-youre-reading-right&text=Some initiatives may never come to fruition, but we need someone in the game willing to take a](https://twitter.com/intent/tweet?url=http://hpmatter.com/issue-no-6-fall-2015/government-innovation-yes-youre-reading-right&text=Some+initiatives+may+never+come+to+fruition,+but+we+need+someone+in+the+game+willing+to+take+a+moonshot.&via=HPMatter)

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[5] <http://hp.nu/BfBac>