

WHITE PAPER

ARPA-E: Energy Technology Bets That Matter

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"First. Fast. Ambitious. America must lead in energy innovation. Or other nations will."

This is the [tagline](#) for the Advanced Research Projects Agency - Energy (ARPA-E).

Created in 2009, when the United States was facing energy security headwinds and feared losing its technological edge to global competitors, ARPA-E now advances high-risk, high-reward research by bridging gaps in public and private funding for energy technology development.

ARPA-E's unique structure and operational design was modeled on the Pentagon's Defense Advanced Research Projects Agency (DARPA), known for launching breakthroughs such as the Internet, GPS, and stealth technology. In its much shorter history than DARPA, ARPA-E has repeatedly demonstrated success in identifying disruptive technological opportunities, seeding impactful research teams, and validating early-stage technology too risky for private sector investment.

What Makes ARPA-E Unique?

At the heart of ARPA-E's mission are several unique characteristics: tech-neutrality, operational independence, and empowered technical experts who lead and design programs.

The Agency recruits subject matter experts as program directors (PDs) for limited 3-year terms, giving them broad authority to design and manage focused research portfolios. From program conception through award selection, PDs weigh the two priorities of novelty and impact. That tension is captured by a heuristic that staff constantly use: “If it works, will it matter?” This standard ensures their work is not just scientifically rigorous but also directed toward potentially transformational technologies.

ARPA-E’s research portfolio spans agriculture, bioenergy, buildings, grids, industrial efficiency, power generation, natural resources, and transportation. Awards are actively managed against technical objectives: ARPA-E can revise milestones or terminate projects that fail to progress. This combination of technical rigor, active management, and clear off-ramps allows ARPA-E to pursue breakthroughs while protecting taxpayer dollars.

ARPA-E’s Impact and Potential

Since 2009, the Agency has provided \$4.3 billion in R&D funding to more than 1,750 projects in nearly every state. As of 2026, 293 of those projects have attracted nearly \$20 billion of follow-on funding from private sources, more than [4x ARPA-E’s original investment](#). That support helped create 181 new companies and 38 exits, with market valuations worth over \$23 billion from mergers, acquisitions, and IPOs.

The National Academies’ recent [analysis](#), commissioned by Congress, identifies another important dimension of ARPA-E’s impact: spillover effects beyond direct award recipients into the broader R&D ecosystem. Specifically, they measured field crowding: the extent to which subsequent patents cluster around technology areas researched by ARPA-E awardees. The findings were mixed but promising. While just over half of awards showed no significant change, around 40 percent of awards showed significant field crowding after their ARPA-E award. These findings reinforce ARPA-E’s role in identifying technological whitespace and catalyzing subsequent sector-wide growth.

Given the long and circuitous path to commercializing energy technology, it can be difficult to separate ARPA-E’s impact from broader market and technology trends. For that reason, portfolio-level success metrics are best read alongside stories of individual awardees and their trajectories. The following case studies highlight examples of where ARPA-E identified technology whitespace, how program awardees answered ARPA-E’s call with solutions, and the impact of those projects today.

CASE STUDY 1

Fervo Energy: Next-Generation Technology Harnessing the Heat Below Our Feet

The next-generation geothermal company Fervo Energy was [founded](#) in 2017 by two Stanford colleagues who set out to adapt horizontal drilling and hydraulic fracturing from the shale revolution to modernize geothermal power generation. Their business case was built on the theory that if oil and gas companies can use these techniques to maximize production and dramatically increase the number of viable sites, a geothermal company could use the same toolkit to optimize heat extraction from the earth.

A critical barrier to their approach was collecting data on how water flowed through the fractures below ground. ARPA-E recognized the importance of this missing capability, and in 2019 [awarded](#) \$1.2 million to Fervo, as the company proposed combining deep underground fiber-optic infrastructure with vibration equipment that sent tiny seismic waves into the subsurface. That early award helped Fervo develop and refine the advanced sensing technologies to assess system performance across its projects.

Crucially, Fervo developed much of its core drilling and reservoir management IP with private capital. ARPA-E was never the prominent backer of its large commercial pilots. Instead, ARPA-E identified a high-risk, high-leverage gap and provided the capital necessary to de-risk fundamental capabilities that now [underpin](#) a multi-billion dollar, several-hundred-megawatt geothermal orderbook.

CASE STUDY 2

Antora Energy: Thermal Energy Storage for Affordable Industrial Heat and Power

Thermal batteries store cheap electricity as heat and then provide that heat for industrial applications or convert it into power on demand. Antora Energy was founded in 2018 to commercialize thermal storage using inexpensive carbon blocks heated to extreme temperatures that could later be transformed into useful energy.

One challenge that Antora Energy faced was the low efficiency of repeatedly converting the heat stored in the thermal blocks into electricity using thermophotovoltaic panels (TPV). In 2019, ARPA-E [awarded](#) nearly \$8 million to Antora to develop a TPV panel that doubled heat-to-power efficiency, improving the viability of their energy storage solution. ARPA-E's early backing

helped the company innovate on new materials and system design to improve their TPV technology.

In 2023, through the agency's [SCALEUP](#) cohort, Antora was [awarded](#) \$14.5 million to help cross a commercial valley of death between its proof-of-concept and first-of-its-kind manufacturing lines. This follow-on award provided an intentional bridge for Antora to create factory-made modules and integrated systems at the speed and scale its customers demanded.

Since receiving its initial ARPA-E backing, Antora has [raised](#) over \$700 million in private capital and has deployed its first [commercial scale project](#) in South Dakota, providing low-cost, low-emissions industrial heat to a biorefinery. Antora continues to build out its manufacturing capacity and commercial orderbook for supplying industrial heat and power across the United States.

CASE STUDY 3

HexaTech, Inc.: Advanced Semiconductor Innovation for High-Performing Power Systems

The power grid is a complex system of generators, substations, transmission, and distribution that must instantaneously transmit electricity across large distances and for a wide variety of end uses. An essential component of this system is the switch, which helps control electricity by switching on and off. This is particularly important for converting between direct current (DC) and alternating current (AC). A class of materials known as wide-bandgap semiconductors allows for power switching at higher temperatures and voltages than more commonly used silicon-based materials.

Founded in 2001 by researchers in North Carolina, HexaTech Inc. focuses on scaling and manufacturing single-crystal substrates of aluminum nitride (AlN), one of these wide-bandgap semiconductors. Materials like AlN can enable more efficient power conversion for a smarter, more reliable, and more affordable electric grid. In 2012, through its OPEN solicitation for projects outside of topic-specific programs, ARPA-E [awarded](#) \$2.8 million to HexaTech to develop their AlN semiconductor technology. In March 2020, the company was fully [acquired](#) by Stanley Electric, a Japanese electronics company.

Since receiving ARPA-E funding and being acquired, HexaTech has continued to develop and manufacture high-performing AlN substrates, receiving [funding](#) from DARPA in 2024 to fabricate even [larger](#) substrates that can be used in a wider range of power applications. ARPA-E's early investment in HexaTech's technology helped derisk their proprietary fabrication technique,

supporting a small American manufacturer in its development of cutting-edge, advanced semiconductor materials.

In Short

ARPA-E was created to fund the bets others won't: early-stage, high-risk research with the potential for outsized impact on energy security, affordability, and the environment. By backing technology-neutral, disruptive energy solutions across the value chain, the Agency has repeatedly helped move ambitious ideas from the lab toward new companies, patents, and follow-on investment.

The stories highlighted here show how modest, well-targeted public investments can expand the possibilities for an innovative energy system to meet America's power needs.