clean tomorrow | Re-Energizing America

Why Energy Innovation Matters Now

From Moonshots to Megawatts: Reclaiming America's Energy Edge

For more than a century, American innovation has powered global progress. We invented mass production, split the atom and put men on the Moon. We created computers, connected them through the Internet and pioneered the digital world.

The American energy system underpinned all these achievements. But today, the system is facing unprecedented challenges. If we fail to rapidly deliver clean technology at scale, the United States' national security and economy, as well as the global environment, will suffer.

Half a century ago, a global oil crisis sent shockwaves through the U.S. economy. In response, we did what we do best: we innovated. We founded the Department of Energy (DOE) and made massive investments in new energy technologies.

The decision paid off. DOE-led research unlocked private innovation, helping entrepreneurs and industries thrive, bolstering domestic production and opening export opportunities. The returns on public investment have been massive. One study found that investments by DOE's Office of Energy Efficiency and Renewable Energy have delivered a 630% return for taxpayers, with conservative assumptions.[1]

We must act boldly again today. If we do, we can lower costs for Americans families, strengthen U.S. national security and help lead the world in meeting global challenges.

The rest of the world isn't waiting. China, especially, isn't waiting: it's flooding world markets with subsidized goods and controlling vital supply chains.

The next 50 years will be defined by how we respond to today's challenges. Their scale and urgency require forward-looking investment and a renewed sense of national purpose.

Now is the time to choose. Let's show the world that the United States can meet this moment—decisively, boldly and with an unwavering focus on the defining challenges of the 21st century.

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Executive Summary

The United States has led the world in energy technology development for over 150 years, from developing the first modern oil wells and catalyzing the petroleum industry that powered the 20th century to generating the technologies that led us to the civil atomic age to inventing the solar cells that are helping power the world today. Entering the 2020s, though, the United States was a laggard on clean energy innovation, with China dominating technology development and manufacturing in key sectors where America once led. In response to this troubling situation, the Information Technology & Innovation Foundation (ITIF) and Columbia University Center for Global Energy Policy published *Energizing America* (2020),[2] an energy innovation roadmap that sought to re-establish American leadership and accelerate global progress in reducing carbon emissions by dramatically expanding federal investment in energy research, development, and demonstration (RD&D) through 2026.

...it is time for a new roadmap, one that takes **stock of progress made since 2020** and **charts a path forward** through the end of this decade.

Amid transformation of our domestic energy policies and ongoing alterations to the international economic order, it is time for a new roadmap—one that takes stock of progress made since 2020 and charts a path forward through the end of this decade. Significant legislative achievements have taken place since *Energizing America* was published, but implementation challenges and changing economic, political, and geopolitical circumstances have left America's energy innovation enterprise vulnerable. With substantial federal funding set to expire in 2026, our nation faces a coming "innovation cliff." To ensure continued momentum and to set the course for the future, four policy imperatives now drive the need for renewed federal investment: energy security, affordability, economic opportunity, and decarbonization.

The Road Traveled

Funding for energy RD&D reached its peak following the 1970s energy crisis, when Congress created DOE in 1977 and appropriated what would now be close to $32 billion for the new department, exceeding 0.1% of the national GDP.[3] For nearly all of the following 40 years, as the size of the U.S. economy more than doubled, funding levels for energy RD&D dropped or remained essentially stagnant relative to GDP.

The 2020s marked a turning point in the nation's commitment to clean energy innovation. In this decade so far, Congress has passed landmark bipartisan legislation signed and championed by presidents of both parties to increase funding for energy innovation, including the Energy Act of 2020, the Infrastructure Investment and Jobs Act (IIJA), the CHIPS and Science Act, and the Inflation Reduction Act (IRA). These measures meaningfully increased RD&D funding across multiple technology areas.

FIGURE ES-1. The four policy imperatives to re-energize America.

FIGURE ES-2. DOE RD&D funding from 1978–2025.

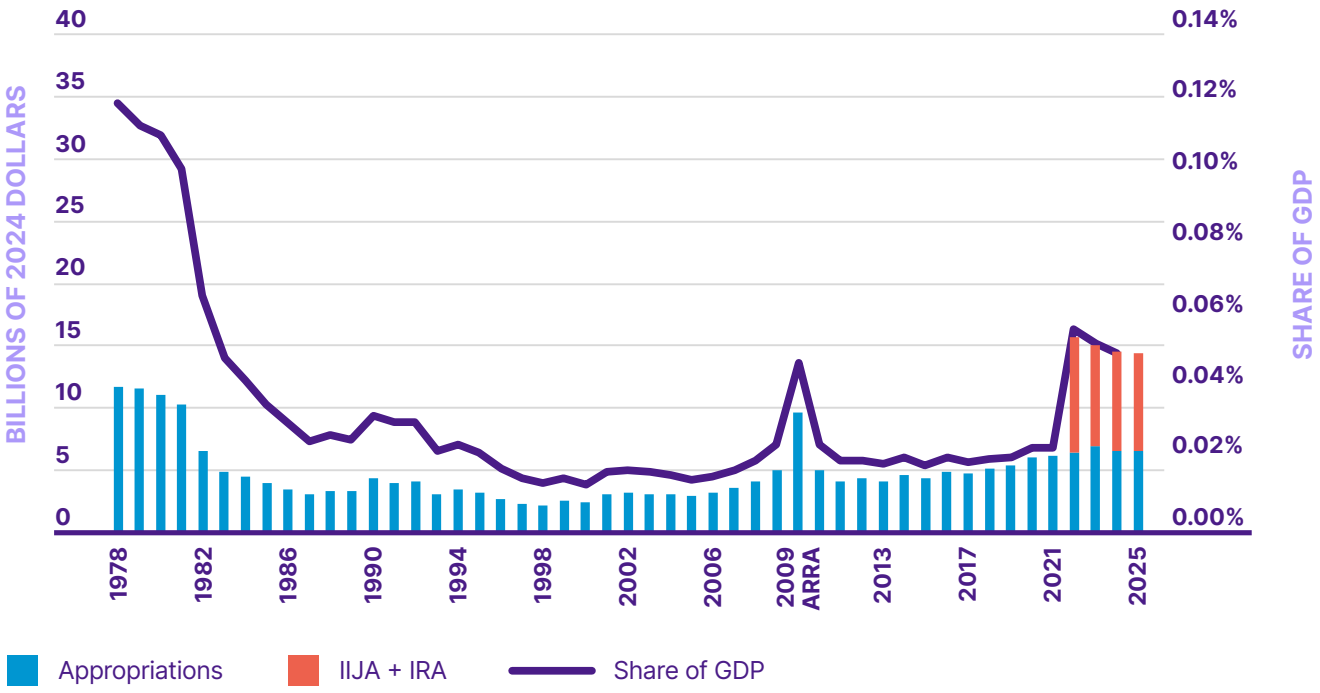
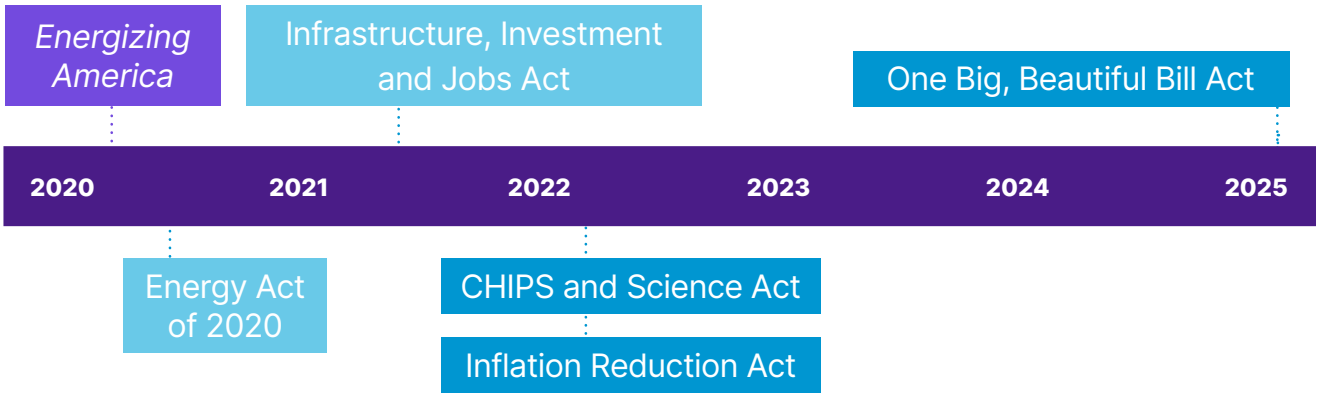


FIGURE ES-3. Major legislative actions since *Energizing America.*



By fiscal year 2025, total funding allocated for clean energy RD&D at DOE reached approximately $15 billion—roughly 2.5 times the FY 2020 level and nearing levels appropriate to ensure continued American leadership.

These federal investments prompted strong responses from the innovation ecosystem. Funding announcements were often oversubscribed by factors of two to four times available funding.[4] Private investment followed federal investments.

...implementation challenges delayed disbursement of essential funding and left private sector innovators, startups, and investors vulnerable to program and project cancellations under a new Administration.

Unfortunately, the full impact of Congress's renewed commitment to energy innovation remains unrealized. Implementation challenges delayed disbursement of essential funding and left private sector innovators, startups, and investors vulnerable to program and project cancellations under a new administration. Less than half of IIJA funding was obligated by early 2025, with just 5% disbursed to recipients—nearly four years after IIJA was passed into law.[5] With many of these federal funds not disbursed, and many projects not yet having even broken ground, the current administration has proposed rescinding much of the available unobligated clean energy-related funding. This administration has considered canceling an additional $23 billion in funding already allocated to projects, representing significant portions of the innovation investments made by DOE in recent years.

THE ROAD AHEAD:

Federal Budgets and Priorities

To restore American energy innovation leadership, we recommend increasing energy RD&D funding by 80% from the FY 2025 baseline, reaching $25 billion in FY 2030.

This target—equivalent to less than 0.4% of the federal budget and only 1.4% of discretionary spending—would restore the United States to top-tier global standing in energy innovation as a share of GDP.

Table 2. Multipliers for priority technology pillars.

PRIORITY ONE	PRIORITY TWO	PRIORITY THREE
Secure, efficient, digitally enabled power systems: Advanced transmission, storage, cybersecurity, and digital technologies to support AI, manufacturing, and electrification while ensuring reliability and security of the electric grid	**Foundational science at platform technologies:** Platform technologies, including advanced materials, quantum computing, and AI, enabling breakthroughs across energy systems	**Variable electricity generation:** Next-generation solar, floating wind, and marine energy, building on renewable momentum and staying ahead of rapidly advancing technologies
Clean firm electricity generation: Around-the-clock, low-emission power from advanced nuclear, fusion, and enhanced geothermal to compete with China and power critical sectors	**Sustainable fuels:** Advanced biofuels, hydrogen, and synthetic hydrocarbons for transportation, industry, and agriculture security	**Advanced transportation systems:** Electrification and autonomous systems across all modes, from passenger vehicles to heavy-duty trucking and aviation
Secure supply chains: Domestic capacity for critical minerals, battery chemistry, and materials processing to reduce dependence on China	**Efficient buildings:** Heat pumps, smart controls, and advanced envelopes to reduce the 40% of U.S. energy consumed by buildings	**Carbon management:** Capture, storage, and removal technologies for hard-to-abate industrial and power sector emissions
Clean and competitive manufacturing: Process innovations and electrification for chemicals, steel, cement, and energy component production to meet global sustainability standards		

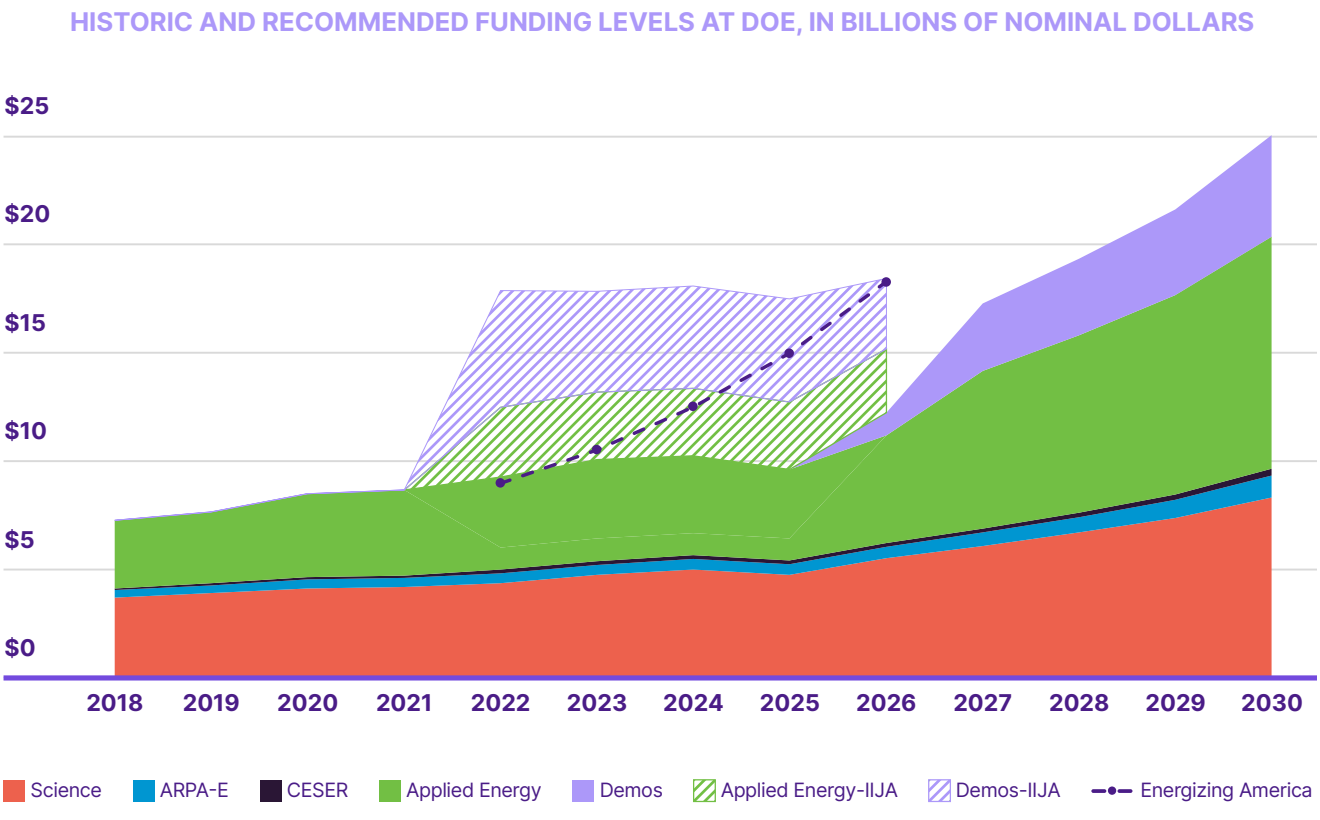
We structured this funding around 10 technology pillars: thematic groupings that advance specific energy outcomes or services. Each pillar encompasses technologies at varying stages of market readiness, with funding levels tailored to sector needs and commercialization stage.

We prioritized pillars based on the key imperatives of affordability, national security, economic competitiveness, historic underinvestment, decarbonization potential, and geopolitical dynamics. Affordability was based on the technologies' potential to reduce energy costs. Security considerations encompassed defense applications, critical material supply chains, and grid stability—related but distinct dimensions we weighted toward pillars with defense nexus and infrastructure resilience potential. Economic opportunity and competitiveness drew on market analyses, including DOE Liftoff Reports and technology deep dives from several sources.[6,7,8,9] Historic underinvestment was assessed against *Energizing America* targets described above. Decarbonization prioritized sectors with the highest emissions.[10]

We then estimate the degree to which each DOE office advances each pillar and recommend budgets for each. This bottom-up prioritization of technology pillars, combined with current DOE office funding levels and alignment with priority pillars, yielded the proposed funding targets in Figure ES-4.

In FY 2026, we propose increasing DOE's energy innovation budget by 11%, with the largest increases going to offices supporting grid modernization (Office of Electricity), nuclear energy (Office of Nuclear Energy), and breakthrough science (Office of Science and ARPA-E). From there, we recommend a steady ramp-up across all civilian DOE offices to the target, building capacity and achieving consistent, sustained funding levels going forward.

FIGURE ES-4. Historical and recommended funding levels for DOE.



THE ROAD AHEAD:

How to Deliver on Energy Innovation

The ambitious energy innovation agenda outlined in this report will only be successful if DOE's capacity to execute matches its strategic vision. While Congress has provided unprecedented funding over the past five years, implementation challenges have limited its impact. The core problem is fragmentation across the innovation pipeline: promising technologies stall in two "valleys of death"—first between early research and pilot-scale demonstration, and then between demonstration and commercialization. Technologies languish not from technical flaws, but from lack of institutional coordination, with no single entity managing handoffs between DOE offices. Simultaneously, "supply-push" RD&D support must be matched with market and commercialization levers to advance technology adoption and to compete with our global competitors.

Transforming DOE will require both structural reforms and cultural changes that prioritize collaboration, speed, and long-term thinking. High-level recommendations include:

Building a Unified Innovation Framework: Establish structural reforms and realigned incentives to create a seamless pipeline from research to deployment, redefining success around shared outcomes across programs and establishing specific milestones for priority technologies as they move through the commercialization process.

Enabling Cross-Program Planning and Funding: Create financial mechanisms allowing sustained collaboration across organizational boundaries. Congress should expand multi-year appropriations for demonstration projects—as it did in IIJA—enabling DOE to make reliable funding commitments and reducing pressure to obligate funds hastily at fiscal year-end.

Enhancing Program Agility and Responsiveness: Supplement traditional procurement with alternative funding tools, including other transaction authorities, milestone-based payments, prizes, and demand-side support. Experiment with rolling and annual competitions aligned with applicant timing, and design solicitations with sufficient flexibility to accommodate innovative technologies.

Strengthening Industry Partnerships for Market-Driven Innovation: Systematically expand programs that make national laboratory resources available to private companies facing specific technical challenges, including technology prototype test facilities, voucher programs for lab access, and entrepreneurial programs designed to incubate new technologies.

Building for Institutional Continuity: Design programs for durability through multi-year budget authority; strong partnerships with states, universities, and industry that create external constituencies; and demonstrated value through measurable outcomes. While no design can fully insulate programs from political change—as recent cuts show—these features can enhance resilience.

These principles represent a pragmatic starting point rather than a comprehensive blueprint. The complexity of DOE's institutional challenges—and the lessons from recent implementation efforts—warrant deeper analysis of specific reform mechanisms and their application across different technology pillars. Success demands not just increased funding, but also fundamental changes in how federal agencies approach energy innovation—creating an institution built for continuity that serves as a reliable partner to American innovators and a trusted engine for the nation's energy security and economic future.

Reclaiming American Leadership

Today, the United States ranks 13th in energy innovation investments globally, adjusted for GDP. DOE was established in 1977 to "use energy efficiently," to "encourage additional production of available expendable energy supplies in our own country," and to "shift towards more abundant supplies of energy."[11] In the years since, the United States has met much of its energy demand through increased efficiency,[12] has become the world leader in oil and gas production,[13] and has contributed to the development of the technologies—from horizontal drilling to unlock shale reserves to solar cells that harvest the energy of the sun to the battery technologies that are helping balance grid demand—that power the world today. These innovations and others were spurred by American investment, and if we are to see the United States once again develop and build the energy technologies of the future, then we must see sustained investment and federal support for this critical work.

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