Advanced Research Projects Agency – Energy
Proposed Appropration Languange

For Department of Energy expenses necessary in carrying out the activities authorized by section 5012 of the America COMPETES Act (Public Law 110–69), [$470,000,000] *$650,200,000*, to remain available until expended: Provided, that of such amount, [$37,000,000] *$55,200,000* shall be available until September 30, [2024] *2025*, for program direction. (Energy and Water Development and Related Agencies Appropriations Act, 2023.)

Public Law Authorizations

P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 109-58, "Energy Policy Act of 2005"
P.L. 110-69, "America COMPETES Act of 2007"
P.L. 111-358, "America COMPETES Reauthorization Act of 2010"
P.L. 116-260, Section 10001, "Consolidated Appropriations Act, 2021" ARPA-E Amendments

Advanced Research Projects Agency – Energy
(dollars in thousands)

FY 2022 Enacted	FY 2023 Enacted	FY 2024 Request
450,000	470,000	650,200

Overview

The U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E) was established by the America COMPETES Act of 2007 (Public Law 110–69), as amended. The mission of ARPA-E is to enhance the economic and energy security of the U.S. through the development of energy technologies that reduce imports of energy from foreign sources; reduce energy-related emissions, including greenhouse gases; improve the energy efficiency of all economic sectors; provide transformative solutions to improve the management, clean-up, and disposal of radioactive waste and spent nuclear fuel; and improve the resilience, reliability, and security of infrastructure to produce, deliver, and store energy. ARPA-E will ensure that the U.S. maintains a technological lead in developing and deploying energy technologies. ARPA-E will identify and promote revolutionary advances in energy, translating scientific discoveries and cutting-edge inventions into technological innovations. It will also accelerate transformational technological advances in areas where industry by itself is not likely to invest due to technical and financial uncertainty. ARPA-E focuses on novel early-stage energy research and development with technology applications that can be meaningfully advanced with a small investment over a defined period of time. ARPA-E coordinates its work with DOE's basic research and applied programs and other Federal research agencies to ensure work is not duplicated.

ARPA-E has established a nimble, effective management structure and developed a portfolio of technical programs that is delivering innovative, investable opportunities to the commercial sector. ARPA-E will continue to deliver value to the U.S. economy with continued emphasis on maintaining a healthy portfolio of projects. These projects cover a broad range of topics, with a growing focus on additional scale-up of the most promising projects that have demonstrated success in technical development, project management, and definition of commercial pathways.

Since its inception in 2009 through September 2022, ARPA-E has provided approximately $3.27 billion in funding to over 1,415 projects through focused programs and open funding solicitations. A total of 200 ARPA-E projects have attracted more than $11 billion in private-sector follow-on funding, 281 project teams have partnered with other agencies for further development, and 131 companies have been formed from ARPA-E projects. In addition, ARPA-E project teams have generated 6,257 peer-reviewed journal articles and received 934 patents from the U.S. Patent and Trademark Office.

Projects that receive ARPA-E support are considered ”high risk” and too early for private sector support. They are subject to strict technical and commercialization milestones intended to ensure accountability and transparency that enable rapid reprioritization of Agency funds towards only the most promising technologies. This has resulted in significant commercial interest, investment, and follow-on funding for successful technologies, amplifying the impact of the Agency’s funding decisions and accelerating progress towards achieving the Agency’s mission.

In FY 2024, ARPA-E’s will support research and development (R&D) on climate adaptation and resiliency energy innovations as well as support the Administration’s Net Zero Gamechangers Initiative. This will support the target to achieve net zero emissions by 2050, including coordination across agencies, to meet the Administration’s goals to adapt and strengthen resilience from the most devastating impacts of climate change. Funding is requested to support the Administration’s energy technology agenda that will drive innovation to tackle the climate crisis while creating good paying jobs, assure the United States remains the world’s leader in energy technologies, and increase societal resilience to climate change impacts. ARPA-E will work with the other Agencies to develop transformative solutions for the climate crisis, including adaptation and resilience, and lay the foundation for future improvements in R&D across the Federal Government.

ARPA-E also supports the Administration’s Justice40 and Equity initiatives. In FY 2024, ARPA-E will in engage in stakeholder consultation and outreach, including Historically Black Colleges and Universities and minority serving institutions , and the

broader R&D community, to advance equitable outcomes and explore benefits and investments that may benefit disadvantaged communities.

Highlights and Major Changes in the FY 2024 Budget Request

In FY 2024, ARPA-E plans to release OPEN 2024 and Seeding Critical Advances for Leading Energy Technologies with Untapped Potential (SCALEUP) funding solicitations and up to 12 new funding opportunity announcements (FOAs). The FOAs will address new areas not represented in the present portfolio and develop new opportunities opened by the outcomes of previous programs.

Advanced Research Projects Agency - Energy
Funding by Congressional Control ($K)

	FY 2022 Enacted	FY 2023 Enacted	FY 2024 Request	FY 2024 Request vs FY 2023 Enacted	
				$	%
ARPA-E Projects	414,000	433,000	595,000	+162,000	+37%
Program Direction	36,000	37,000	55,200	+18,200	+49%
Total, Advanced Research Projects Agency - Energy	**450,000**	**470,000**	**650,200**	**+180,200**	**+38%**
Federal FTEs	**64**	**66**	**100**	**+34**	**+52%**

ARPA-E Projects

Overview

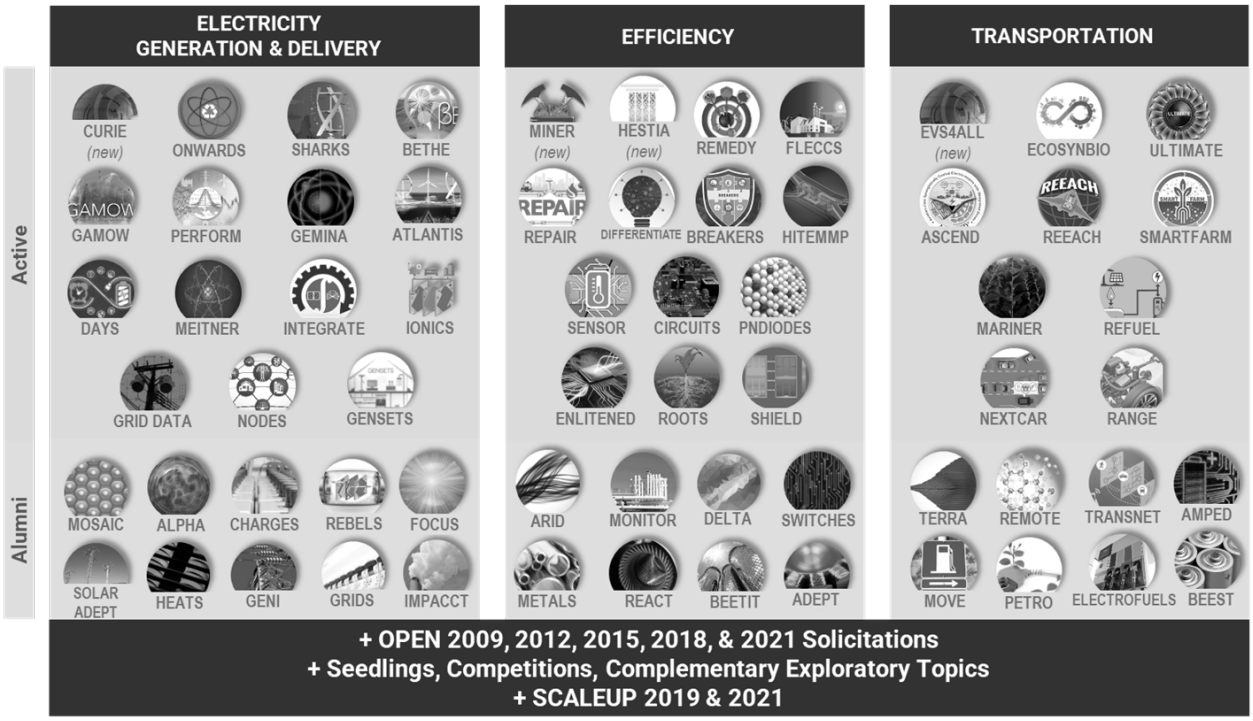
ARPA-E identifies and supports revolutionary inventions and transformational energy advances, which requires constant evolution of its programmatic focus. This is accomplished by establishing dynamic technical programs (each lasting about three years) designed to accelerate innovation in high-potential areas. The breadth of the program portfolio that has developed over ARPA-E's lifetime addresses different parts of the energy technology space from year to year.

ARPA-E has demonstrated the efficacy of its model for accelerating high-potential, novel technical approaches to existing and emerging U.S. energy challenges. Program Directors, recruited for their technical expertise, leadership, and experience in energy issues, are given significant autonomy in identifying potential high-impact areas for R&D investment. ARPA-E's Program Directors work to develop their proposals in the context of both private sector and federally funded work in the technical space, and ultimately propose a program designed to accelerate research and commercial development in the topic area.

As a complement to its focused technology programs, ARPA-E also supports OPEN solicitations. OPEN solicitations seek the most innovative new ideas in energy technology across the full spectrum of energy applications, allowing the Agency to support the development of important technologies that fall outside the scope of its focused programs. OPEN solicitations are released every three years and were run in 2009, 2012, 2015, 2018, and 2021. Consistent with the triennial release schedule, ARPA-E plans on releasing another OPEN solicitation in 2024.

Selection of project awards within each program occurs by a rigorous process of proposal review. Selection criteria include the transformative character of the technology, the potential impact of the technology on ARPA-E's energy missions as defined in its authorizing statute, and the potential for the project to yield commercial applications that benefit U.S. economic and energy security. Within these criteria the most highly rated proposals are selected for award negotiations. The majority of the funded projects involve more than one institution, and the lead institutions are distributed among universities, businesses, federally funded R&D centers, and non-profit organizations.

The resulting portfolio of alumni and active R&D projects (shown below) broadly covers the U.S. energy technology landscape, from transportation fuels and energy storage, through residential, commercial, and manufacturing efficiency to the storage, distribution, and generation of electrical power. The programs are designed to deliver value given a targeted investment over a defined period of time. The projects are structured in a portfolio funding approach to 'de-risk' areas of technological opportunity by supporting multiple high-potential approaches to the program goals to the point where their relative value for further applications can be determined. This allows the most effective approaches to emerge based on their technical performance and potential. Under ARPA-E's rigorous project management process, project teams work to quarterly milestones for both technical and commercialization goals.



FOA Acronym	Definition
Electricity Generation and Delivery – Active	
ATLANTIS	Aerodynamic Turbines Lighter and Afloat with Nautical Technologies and Integrated Servo-control
BETHE	Breakthroughs Enabling THermonuclear-fusion Energy
CHARGES	Cycling Hardware to Analyze and Ready Grid-Scale Electricity Storage
CURIE	Converting used nuclear fuel Radioisotopes into Energy
DAYS	Duration Addition to electricitY Storage
GAMOW	Galvanizing Advances in Market-aligned fusion for an Overabundance of Watts
GEMINA	Generating Electricity Managed by Intelligent Nuclear Assets
GENSETS	GENerators for Small Electrical and Thermal Systems
GRID DATA	Generating Realistic Information for the Development of Distribution and Transmission Algorithms
INTEGRATE	Innovative Natural-gas Technologies for Efficiency Gain in Reliable and Affordable Thermochemical Electricity-generation
IONICS	Integration and Optimization of Novel Ion-Conducting Solids
MEITNER	Modeling-Enhanced Innovations Trailblazing Nuclear Energy Reinvigoration
NODES	Network Optimized Distributed Energy Systems
ONWARDS	Optimizing Nuclear Waste and Advanced Reactor Disposal Systems
PERFORM	Performance-based Energy Resource Feedback, Optimization, and Risk Management
SHARKS	Submarine Hydrokinetic And Riverine Kilo-megawatt Systems
Electricity Generation and Delivery – Alumni	
ALPHA	Accelerating Low-cost Plasma Heating and Assembly
CHARGES	Cycling Hardware to Analyze and Ready Grid-scale Electricity Storage
FOCUS	Full-spectrum Optimized Conversion and Utilization of Sunlight
GENI	Green Electricity Network Integration
GRIDS	Grid-scale Rampable Intermittent Dispatchable Storage
HEATS	High Energy Advanced Thermal Storage
IMPACCT	Innovative Materials and Processes for Advanced Carbon Capture Technologies
MOSAIC	Micro-scale Optimized Solar-cell Arrays with Integrated Concentration

FOA Acronym	Definition
REBELS	Reliable Electricity Based on ELectrochemical Systems
Solar ADEPT	Solar Agile Delivery of Electrical Power Technology
Efficiency – Active	
BREAKERS	Building Reliable Electronics to Achieve Kilovolt Effective Ratings Safely
CIRCUITS	Creating Innovative and Reliable Circuits Using Inventive Topologies and Semiconductors
DIFFERENTIATE	Design Intelligence Fostering Formidable Energy Reduction and Enabling Novel Totally Impactful Advanced Technology Enhancements
ENLITENED	ENergy-efficient Light-wave Integrated Technology Enabling Networks that Enhance Dataprocessing
FLECCS	FLExible Carbon Capture and Storage (FLECCS)
HESTIA	Harnessing Emissions into Structures Taking Inputs from the Atmosphere
HITEMMP	High Intensity Thermal Exchange through Materials, and Manufacturing Processes
MINER	Mining Innovations for Negative Emissions Resource recovery
PNDIODES	Power Nitride Doping Innovation Offers Devices Enabling SWITCHES
REMEDY	Reducing Emissions of Methane Every Day of the Year
REPAIR	Rapid Encapsulation of Pipelines Avoiding Intensive Replacement
ROOTS	Rhizosphere Observations Optimizing Terrestrial Sequestration
SENSOR	Saving Energy Nationwide in Structures with Occupancy Recognition
SHIELD	Single-pane Highly Insulating Efficient Lucid Designs
Efficiency – Alumni	
ADEPT	Agile Delivery of Electrical Power Technology
ARID	Advanced Research In Dry cooling
BEETIT	Building Energy Efficiency Through Innovative Thermodevices
DELTA	Delivering Efficient Local Thermal Amenities
METALS	Modern Electro/Thermochemical Advances in Light metals Systems
MONITOR	Methane Observation Networks with Innovative Technology to Obtain Reductions
REACT	Rare Earth Alternatives in Critical Technologies
SWITCHES	Strategies for Wide bandgap, Inexpensive Transistors for Controlling High-Efficiency Systems
Transportation – Active	
ASCEND	Aviation-class Synergistically Cooled Electric-motors with iNtegrated Drives
ECOSynBio	Energy and Carbon Optimized Synthesis for the Bioeconomy
EVs4ALL	Electric Vehicles for American Low-carbon Living
MARINER	Macroalgae Research Inspiring Novel Energy Resources
NEXTCAR	Next-Generation Energy Technologies for Connected and Automated On-Road Vehicles
RANGE	Robust Affordable Next Generation Energy storage systems
REEACH	Range Extenders for Electric Aviation with low-Carbon and High-efficiency
REFUEL	Renewable Energy to Fuels through Utilization of Energy-dense Liquids
SMARTFARM	Systems for Monitoring and Analytics for Renewable Transportation Fuels from Agricultural Resources and Management
ULTIMATE	Ultrahigh Temperature Impervious Materials Advancing Turbine Efficiency
Transportation – Alumni	
AMPED	Advanced Management and Protection of Energy storage Devices
BEEST	Batteries for Electrical Energy Storage in Transportation
ElectroFuels	Microorganisms for Liquid Transportation Fuel
MOVE	Methane Opportunities for Vehicular Energy
PETRO	Plants Engineered To Replace Oil
REMOTE	Reducing Emissions using Methanotrophic Organisms for Transportation Energy
TERRA	Transportation Energy Resources from Renewable Agriculture
TRANSNET	Traveler Response Architecture using Novel Signaling for Network Efficiency in Transportation

One significant component of ARPA-E's mission is accelerating the economic impact of U.S. investments in energy R&D, and advancing the commercialization readiness of successful projects (depth of investment) is essential to achieving this goal. Developing the pathway to commercial applications is an intrinsic component of all projects, and project teams are required to conduct activities such as development of a detailed techno-economic analysis, market research, intellectual property protection, and engagement with potential customers and investors. As project teams demonstrate success, ARPA-E's Technology-to-Market Advisors and Program Directors work closely with the teams to help identify pathways toward commercial deployment. Many of ARPA-E's alumni projects have been able to obtain follow-on funding from private investors, state agencies and/or federal programs, and ARPA-E's maturing portfolio is offering increasing opportunities for commercialization of ARPA-E funded technologies.

Despite the level of technology 'de-risking' projects from the focused and OPEN solicitations achieved, ARPA-E determined that in some areas, further de-risking was necessary to validate technologies at a scale pertinent to investment. To this end, ARPA-E released SCALEUP solicitations in 2019 and 2021. SCALEUP is designed to fund successful technologies that were previously funded by ARPA-E for which the proof-of-concept R&D challenges have been addressed, and which can progress toward real-world impact through scaling. An enduring challenge to ARPA-E's mission is that even technologies that achieve substantial technical advancement under ARPA-E support are at risk of being stranded in their development path once ARPA-E funding ends. Experience across ARPA-E's diverse energy portfolios, and with a wide range of investors, indicates that pre-commercial "scaling" projects are critical to establishing that performance and cost parameters can be met in practice for these very early stage technologies. Success in these scaling projects would enable industry, investors, and partners to justify substantial commitments of financial resources, personnel, production facilities, and materials to develop promising ARPA-E technologies into early commercial products. ARPA-E plans to release another SCALEUP FOA in FY 2024 to continue the push toward commercialization for previous extremely early-stage ARPA-E programs and to continue the focus on ensuring manufacturing in the U.S.

In FY 2024, ARPA-E plans to release OPEN and SCALEUP funding solicitations and up to 12 new focused FOAs including research and development in support of the Net Zero Gamechangers Initiative five priority areas. The focused FOAs will address new areas not represented in the present portfolio and develop new opportunities opened by the outcomes of previous programs. The assessment process for the new programs is now underway.

Potential technology areas for focused programs in FY 2024:

ARPA-E is developing programs for transformational research across a wide range of energy technologies, and applications including:

- Net-Zero Gamechangers Initiative five priority areas: net-zero low greenhouse gas (GHG) building heating and cooling; net-zero aviation; net-zero power grid and electrification; industrial products and fuels for a net-zero, circular economy; and fusion energy at scale.
- Other topic areas may include: climate sensors and monitoring for dramatically improved GHG detection for potential capture and sequestration; carbon neutral/negative agricultural production; innovative carbon capture technologies, including those utilizing land and water bodies; prevention of GHG emissions from land sources; carbon neutral waste and recycling; research of resilient energy infrastructure to facilitate protection against climate-related severe events, resiliency via wireless power transfer using novel configurations, and new technologies for difficult to address methane abatement.

ARPA-E will also continue its stand-alone SBIR/STTR program to provide additional support to small businesses beyond the significant number of awards to small businesses via ARPA-E's standard non-SBIR/STTR solicitations.

ARPA-E Projects
Funding ($K)

	FY 2022 Enacted	FY 2023 Enacted	FY 2024 Request	FY 2024 Request vs FY 2023 Enacted
ARPA-E Projects:				
ARPA-E Projects:	414,000	433,000	595,000	+162,000
Total, ARPA-E Projects	**414,000**	**433,000**	**595,000**	**+162,000**

SBIR/STTR
- FY 2022 Enacted: $15,111 total (SBIR $13,248 / STTR $1,863)
- FY 2023 Enacted: $15,805 total (SBIR $13,856 / STTR $1,949)
- FY 2024 Request: $21,718 total (SBIR $19,040 / STTR $2,678)

ARPA-E Projects
Explanation of Major Changes ($K)

	FY 2024 Request vs FY 2023 Enacted
ARPA-E Projects: The FY 2024 Request Level is $162 million greater than the FY 2023 Enacted. At the increased appropriation, ARPA-E will increase the number of focused FOAs, funding allocated towards the SCALEUP FOA, and/or funding allocated towards ARPA-E's triennial OPEN FOA. The increase in ARPA-E's FY 2024 appropriation will also include funding towards the Net Zero Gamechangers Initiative, which aims to allocate funding towards five priority areas: (i) net-zero low GHG building heating and cooling; (ii) net-zero aviation; (iii) net-zero power grid and electrification; (iv) industrial products and fuels for a net-zero, circular economy; and (v) fusion energy at scale.	**+162,000**
Total, ARPA-E Projects	**+162,000**

Program Direction – Appropriations Request
Funding ($K)

	FY 2022 Enacted	FY 2023 Enacted	FY 2024 Request	FY 2024 Request vs FY 2023 Enacted
Washington Headquarters				
Salaries and Benefits	11,810	12,666	20,189	+7,523
Travel	400	1,000	2,000	+1,000
Support Services	17,432	17,048	24,450	+7,402
Other Related Expenses	6,358	6,286	8,561	+2,275
Total, Program Direction	**36,000**	**37,000**	**55,200**	**+18,200**
Federal FTEs	**64**	**66**	**100**	**+34**
Support Services				
Technical Support	6,101	5,967	8,558	+2,591
Management Support	11,331	11,081	15,892	+4,811
Total, Support Services	**17,432**	**17,048**	**24,450**	**+7,402**
Other Related Expenses				
Working Capital Fund	4,123	4,123	5,061	+938
Energy Information Technology Services (EITS)	1,588	1,588	2,500	+912
Other Services	647	575	1,000	+425
Total, Other Related Expenses	**6,358**	**6,286**	**8,561**	**+2,275**

Program Direction

Activities and Explanation of Changes

FY 2023 Enacted	FY 2024 Request	Explanation of Changes FY 2024 Request vs FY 2023 Enacted
Program Direction $37,000,000	**$55,200,000**	**+ $18,200,000**
Salaries and Benefits		
At the FY 2023 Enacted level, ARPA-E anticipates needing up to 66 Federal FTEs.	At the FY 2024 Request Level, ARPA-E anticipates needing up to 100 Federal FTEs. Federal salaries and benefits (S&B) cost is assumed to escalate by 5.2 percent in FY 2024. Additional Program Directors, Tech to Market, and Operations staff will be added in FY 2024 to support ARPA-E's growing portfolio. Federal staff will be increased from 66 to 100 in a prudent manner that is consistent with applicable laws, hiring practices, and the Executive Order on Diversity, Equity, Inclusion, and Accessibility in the Federal Workforce (E.O. 14035). Some of ARPA-E's FTE expansion will be from paid fellows and/or paid summer scholars via Oak Ridge Institute for Science and Education, consistent with E.O. 14035 section 6 (Promoting Paid Internships).	+ $7,523,000: The increase from the FY 2023 Enacted level is due to an increased federal staff to support ARPA-E's growing portfolio. Additionally, federal S&B cost is assumed to escalate by 5.2 percent.
Travel		
At the FY 2023 Enacted level, ARPA-E Program Directors and Technology-to-Market advisers will visit performers regularly as part of ARPA-E's hands-on engagement. The number of site visits will be commensurate with the number of ongoing projects. FY 2023 Travel is expected to return to pre-COVID levels.	At the FY 2024 Request level, ARPA-E Program Directors and Technology-to-Market advisers will increase visits to performers as part of ARPA-E's hands-on engagement. The number of site visits will increase with the number of ongoing projects.	+ $1,000,000: Increase in travel budget commensurate with the increase in the mission portfolio and number of ongoing projects.
Support Services		
At the FY 2023 Enacted level, ARPA-E anticipates continuing the use of support service contractors to support ARPA-E federal staff in the management and oversight of projects and other required functions.	At the FY 2024 Request level, ARPA-E anticipates the use of support service contractors to increase with the number of ongoing and anticipated projects.	+ $7,402,000: Increase in support services budget commensurate with the increase in the mission portfolio and number of ongoing projects.

FY 2023 Enacted	FY 2024 Request	Explanation of Changes FY 2024 Request vs FY 2023 Enacted
The level of support is commensurate with the number of ongoing and anticipated projects.		
Other Related Expenses		
The FY 2023 Enacted level for other related expenses primarily consists of Working Capital Fund and Energy Information Technology Services (EITS) support costs, which are commensurate with the level of FTEs and support services requested.	At the FY 2024 Request level, ARPA-E anticipates Other Related Expenses to increase although some WCF and IT fixed costs will not increase proportionally with appropriations. FY 2024 WCF costs are projected to increase by 23 percent.	+ $2,275,000: Increase in other related expenses budget commensurate with the increase in the mission and program direction portfolios and the increased necessity for WCF, EITS and other program direction support.

Advanced Research Projects Agency - Energy
Research and Development ($K)

	FY 2022 Enacted	FY 2023 Enacted	FY 2024 Request	FY 2024 Request vs FY 2023 Enacted
Basic	0	0	0	0
Applied	225,000	235,000	325,100	+90,100
Development	225,000	235,000	325,100	+90,100
Subtotal, R&D	450,000	470,000	650,200	+180,200
Equipment	0	0	0	0
Construction	0	0	0	0
Total, R&D	**450,000**	**470,000**	**650,200**	**+180,200**

Advanced Research Projects Agency - Energy
Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) ($K)

	FY 2022 Enacted	FY 2023 Enacted	FY 2024 Request
ARPA-E Projects			
SBIR	13,248	13,856	19,040
STTR	1,863	1,949	2,678
Total, SBIR/STTR	**15,111**	**15,805**	**21,718**