Advanced Scientific Computing Research

Overview

The Advanced Scientific Computing Research (ASCR) program's mission is to advance applied mathematics and computer science, including artificial intelligence (AI) and quantum information science (QIS); deliver the most sophisticated computational scientific applications in partnership with disciplinary science; create first-of-a-kind advanced computing and networking capabilities for the Nation; and develop future generations of computing hardware and software tools for science and engineering in partnership with the research community, including U.S. industry. ASCR's research and facilities investments increase the capability, versatility, and efficiency of scientific computing through activities described by four thrusts:

- Breakthrough Tools and Technologies: ASCR enhances software, data processes, and AI for increasingly complex or resource intense modeling and simulation, including enabling the convergence of AI with QIS.
- Deep Understanding of AI and Physical Models: ASCR advances and enables knowledge in core mathematical methods and algorithms that underlie all AI, modelling, and simulation.
- Enabling High-precision Research and Development: ASCR focuses on concurrently advancing applied math and computer science knowledge with disciplinary science in critical areas such as fusion energy and material science.
- Hardware Innovation: ASCR increases the robustness of computing, including underlying communication and energy needs, redefines the art of possible in conventional computing, and leads the development of new emerging technologies.

ASCR's program activities steward an innovation pipeline addressing these four thrusts. This pipeline starts with basic research in ASCR Research that comprises of Applied Mathematics Research, Computer Science Research, and Computational Partnerships. It then makes connections to scale-up research and development activities through testbeds and centers in Advanced Computing Technologies (ACT). Finally, it culminates in world-leading, first-of-a-kind computing, networking, and data infrastructure capabilities developed and deployed by High Performance Computing (HPC) and Networking Facilities. Each of these program activities plays a critical role:

- ASCR Research's Applied Math and Computer Science activities focus on long-term research to develop innovative algorithms, software, methods, and workflows underpinning current and future HPC, AI, quantum hardware, and emerging science applications. ASCR Research's Computational Partnerships catalyze joint inquiry and effort between mathematics and computer science researchers and domain science researchers to solve the interwoven challenges.
- ASCR ACT activities anticipates future computing needs and provides testbeds and research centers for the design and development of the newest technologies, including QIS and new microelectronics. ACT focuses on engaging industry and the research community to scale-up research on next-generation technologies for enabling broad research impact, innovation, and initial commercial development.
- ASCR HPC and Networking Facilities activities conceive, build, and operate world-class, open access HPC, networking, and data infrastructure for scientific research. Many thousands of researchers, spanning industry, academia, and government laboratories, rely on the ASCR facilities to advance their research. The expert workforce of the ASCR facilities partners with industry to create and deploy next generation computing and networking technology. ASCR's stewardship of domestic HPC ecosystems, industrial partnerships, and supply chains makes the continued innovation in this strategic technology possible. In addition, ASCR's stewardship of DOE high performance networking connects all DOE national laboratories and major sites to global research networks to advance data-intensive scientific discovery.

The SC crosscutting effort in AI brings together powerful increases in computing power and massive data sets from state-of-the-art facilities to accelerate scientific progress. DOE envisions a future where researchers use foundation models and other AI techniques, combined with physics-based approaches, to analyze complex problems and then use that understanding to make decisions. Especially for high-consequence applications, precision and trustworthiness are critical, and ASCR's request supports leveraging DOE's considerable capabilities to advance scientific AI—that is, AI designed to handle large multi-dimensional data sets and produce the high-precision answers needed for science—to realize its potential in meeting the Nation's technical challenges. At the same time, the cross-cutting nature of QIS increasingly drives scientific frontiers and innovations toward realizing the full potential of quantum-based applications, from computing to sensing, connected through quantum networks. However, there is a need for bold approaches that better couple all elements of the technology innovation chain and combine talents across universities, national labs, and the private sector in concerted efforts to enable the U.S. to lead the world into the quantum future. To meet this need, ASCR continues its full support for the National QIS Research Centers (NQISRCs) and its partnership with DARPA on industry quantum benchmarking.

Highlights of the FY 2026 Request

The ASCR FY 2026 Request of $1,016.0 million is a decrease of $20.2 million below the FY 2025 Enacted level and is well-aligned with Administration and Department priorities to advance AI technology and its integration with critical and emerging technologies such as QIS and microelectronics. It also provides support to enhance U.S. competitiveness through workforce investments, facilitate the adoption of next-generation HPC, and usher in the AI and exascale science era to bolster industrial innovation.

Research

The Request prioritizes delivering on the promise of the exascale and AI enabled science era while leading innovation in next-generation HPC integrated with QIS and AI. This effort includes funding critical basic research in applied mathematics and computer science to merge the power of AI with exascale computing. These investments also include developing tools that facilitate building foundation models useful for basic and applied science, and partnerships that build and use foundation models that support new applications in science, energy, and national security. The Request also emphasizes applied mathematics, computer science, networking, hardware, and microelectronics research to advance and leverage advanced computing including quantum. Increased or shifted efforts in research, advanced computing technologies, and at the facilities will move forward the implementation of DOE's Integrated Research Infrastructure (IRI) to integrate DOE's unique data, user facilities, and computing resources. Strategic partnerships, both within DOE and at the interagency level, expand the impact of the exascale capabilities including software and AI, and accelerate scientific discovery through advanced computing (SciDAC). Underpinning all investments are efforts to grow the necessary competitive workforce through the Computational Sciences Graduate Fellowship (CSGF) and Established Program to Stimulate Competitive Research (EPSCoR).

The Request supports advanced computing technologies innovation through microelectronics and quantum computing, networking, and sensing testbeds and centers. Continued support enables the NQISRCs and ASCR's regional quantum testbeds and user programs to provide U.S. researchers with access to unique and commercial quantum computing and networking resources. It also enables basic research in QIS, in coordination with other relevant Departments and Agencies, to cement national leadership in the field. Through Research and Evaluation Prototypes (REP), partnerships with industry in collaboration with the research community produce computationally efficient advances for scientific AI, HPC, and QIS. The Request also supports Microelectronics Science Research Centers, a network of multiple multidisciplinary teams comprised of researchers from universities, national laboratories, and industry to develop new materials, chemistries, devices, systems, architectures, algorithms, and software in a co-design innovation ecosystem.

Facility Operations

The FY 2026 Request supports full operations and competitive allocation of the Nation's exascale computing systems: Frontier at the Oak Ridge Leadership Computing Facility (OLCF) and Aurora at the Argonne Leadership Computing Facility (ALCF); full operations of the Perlmutter system at the National Energy Research Scientific Computing Center (NERSC); and full operations of the Energy Sciences Network (ESnet). The Request supports user access to advanced computing and AI testbeds, as well as commercial quantum computers at the facilities through competitive, merit reviewed, open access programs. The Request supports the NERSC-10, OLCF-6, and ALCF-4 upgrade projects and the new High Performance Data Facility (HPDF) project (further details below), to strengthen and leverage SC's unparalleled research capabilities. The Request includes support for governance and implementation of DOE's IRI.

Projects

The FY 2026 Request provides no line-item construction funding for the HPDF project. Final design with a phased approach to installation will be completed to determine the next steps for this project, preserving options to meet the urgency of the Department's mission needs in data-intensive research and AI.

Advanced Scientific Computing Research
Funding

	(dollars in thousands)			
	FY 2024 Enacted	FY 2025 Enacted	FY 2026 Request	FY 2026 Request vs FY 2025 Enacted
Advanced Scientific Computing Research				
Applied Mathematics Research	52,182	68,182	60,994	-7,188
Computer Sciences Research	66,718	76,718	62,431	-14,287
Computational Partnerships	75,182	56,982	35,151	-21,831
Advanced Computing Technologies	108,918	105,118	112,618	+7,500
Energy Earthshot Research Centers	5,000	3,000	–	-3,000
Total, Mathematical, Computational, and Computer Sciences Research	**308,000**	**310,000**	**271,194**	**-38,806**
High Performance Production Computing	142,000	154,500	154,328	-172
Leadership Computing Facilities	474,000	475,195	490,098	+14,903
High Performance Network Facilities and Testbeds	91,000	93,540	97,261	+3,721
Integrated Research Infrastructure	–	3,000	3,119	+119
Total, High Performance Computing and Network Facilities	**707,000**	**726,235**	**744,806**	**+18,571**
Subtotal, Advanced Scientific Computing Research	**1,015,000**	**1,036,235**	**1,016,000**	**-20,235**
Construction				
24-SC-20 - High Performance Data Facility	1,000	–	–	–
Subtotal, Construction	**1,000**	**–**	**–**	**–**
Total, Advanced Scientific Computing Research	**1,016,000**	**1,036,235**	**1,016,000**	**-20,235**

SBIR/STTR funding:
- FY 2024 Enacted: SBIR $10,132,000 and STTR $1,341,000
- FY 2025 Enacted: SBIR $10,627,000 and STTR $1,364,000
- FY 2026 Request: SBIR $8,422,000 and STTR $1,184,000

Advanced Scientific Computing Research
Explanation of Major Changes

	(dollars in thousands) FY 2026 Request vs FY 2025 Enacted
Mathematical, Computational, and Computer Sciences Research	-$38,806

Funding for robust AI research are significantly increased by the Request which will develop tools that facilitate building and understanding foundation models useful for basic and applied science, including expanded partnerships with industry, academia, and other agencies, and enable the convergence of AI, HPC, and QIS. DOE will utilize its computing capabilities, AI testbeds, research efforts, and programs like EPSCoR and CSGF to enhance the competitiveness of the U.S. workforce. Computer Science and Applied Mathematics activities will continue foundational and long-term basic research efforts that: explore and prepare for emerging technologies; develop new scalable computationally efficient algorithms and software; address the challenges of data intensive science and emerging computing technologies, such as QIS; and support the development leading AI technologies. Computational Partnerships supports partnerships in critical areas across DOE and with other agencies to expand the impact of exascale capabilities and software. The ACT activities will support the recompetition/renewal of the NQISRCs, quantum computing and networking testbeds, and the Microelectronics Science Research Centers, in close coordination with the other SC programs. Through REP, partnerships with industry will advance technologies for scientific AI, QIS, and HPC.

High Performance Computing and Network Facilities	+$18,571

The Request provides resources for all three ASCR HPC facilities to deliver HPC, storage, visualization, and testbed resources, and for ESnet to deliver high performance network access to all DOE national laboratories and dozens of other DOE sites. OLCF and ALCF will provide full operations and competitive allocation of the nation's first two Exascale computing systems, Frontier and Aurora, and testbed resources focused on novel AI hardware and QIS technologies; NERSC will continue full operations of the NERSC-9 (Perlmutter) system. Funding supports the next generation Leadership Computing Facility upgrade projects (OLCF-6 and ALCF-4) and the NERSC-10 upgrade project at their target profiles. ESnet will continue full operations of the ESnet6 network at or above the designed 99.9% reliability target and deliver site resiliency enhancements. The Request supports development of IRI across ASCR facilities.

Construction	$ —

The FY 2026 Request provides no line-item construction funding for the HPDF project. Final design with a phased approach to installation will be completed to determine the next steps for this project, preserving options to meet the urgency of the Department's mission needs in data-intensive research and AI.

Total, Advanced Scientific Computing Research	-$20,235

Basic and Applied R&D Coordination

Coordination across disciplines and programs is a cornerstone of the ASCR program. Partnerships within SC and the National Nuclear Security Administration (NNSA) continue in advanced computing and applications. ASCR also has partnerships in QIS and AI within SC and is collaborating across DOE and with other agencies to expand the AI-enabled Exascale science era. Through the Networking and Information Technology R&D Subcommittee, the Subcommittee on MLAI, the Subcommittee on QIS, and the Subcommittee on the Economic and Security Implications of QIS of the National Science and Technology Council (NSTC) Committees on Science, Technology, and Homeland and National Security, ASCR coordinates with programs across the Federal Government. Future advanced computing technologies, scientific data, large scale networking, high end computing, AI, and QIS are coordinated with other agencies through the NSTC. In FY 2026, cross-agency interactions and collaborations continue in coordination with the Office of Science and Technology Policy.

Program Accomplishments

Exascale Computing Project: Pushing Resilient Computing Forward for Simulation and Artificial Intelligence
One of the fundamental challenges in scaling up accelerated computing to exascale is reliability. When the NVIDIA PathForward project started, the estimated GPU compute nodes required to reach exascale was many tens of thousands. At that time, NVIDIA foresaw that silent data corruption and failures in time would be high enough that the resulting mean-time-to-failure would be inadequate to meet exascale system requirements. The PathForward program funded the development and implementation of a number of enhancements to NVIDIA's engineering methodology and hardware that reduce the failure rate and improve availability by a large factor, while only incurring a small silicon area overhead. This enabled NVIDIA GPUs to meet exascale system requirements and also improved performance for AI—leading to higher speed, larger models, and better training efficiency. Results of the PathForward funding of NVIDIA resilience efforts contributed to several improvements for GPUs that are used in Perlmutter, and many other large GPU systems. NVIDIA continues to see PathForward investments influence its roadmap with new resilience features funded by PathForward in the Blackwell generation.

Industry Partners Leverage ECP to Digitally Customize Materials
Titanium alloys are critical materials for the aerospace industry—stronger and lighter than steel, resistant to rust and corrosion and resilient to high temperatures. Companies such as RTX, formerly Raytheon Technologies, rely on these sturdy alloys to build critical components like jet-engine turbine blades, landing gear, and exhaust ducts. However, manufacturing usable components from titanium alloy typically wastes as much as half the raw metal. Simulations performed on the Summit supercomputer at the Oak Ridge Leadership Computing Facility are saving time and money by helping researchers digitally customize the materials. RTX worked with Oak Ridge National Laboratory (ORNL) researchers to use phase-field modeling, a computationally demanding and time-consuming mathematical technique that rigorously captured the physics of the process. The approach sought to simulate the complicated dynamics of melting and solidifying of various alloys of titanium, copper, and niobium. The computational power of Summit allowed the team to simulate microstructures down to the nanometer—about a millionth of a millimeter—under a wide range of extreme conditions, including various stages of heating and cooling and the evolution of millions of microscopic metal grains. Summit's predictive simulations shrank a decade of physical testing into 2 or 3 years by RTX estimates, which also found that the new alloy could cut in half their annual $273 million production costs of machining titanium components and save as much as 2.5 quadrillion British thermal units of energy by 2050. The results of this work hold promise for improvements across aerospace and energy applications.

Quantum Computing Testbeds: A Critical Hardware Capability for the Nation
Access to the state-of-the-art hardware is critical for enabling rapid scientific progress in the nascent field of quantum computing. Researchers from the quantum computing testbed project QSCOUT at the Sandia National Laboratories have delivered an industry-leading ion trap called Roadrunner. Its main feature is a junction of three electrode zones that makes qubit reordering possible and enables a key quantum operation – called mid-circuit measurement – for future error-corrected quantum computers. In addition to the novel ion trap, the QSCOUT team also built a full stack quantum computer infrastructure around it. It is accessible to researchers nation-wide for remote experimentation. The ion traps built by the QSCOUT team are in high demand by the scientific

community and, to date, about 40 ion trap devices have been delivered to many research teams across industry, academia, and the Federal government, including teams affiliated with Duke University, Georgia Tech Research Institute, IonQ, Air Force Research Laboratory, University of Maryland, and the DOE NQISRC Quantum Systems Accelerator (QSA). These traps are being used in applications beyond quantum computing, enabling basic science research in quantum networking and quantum sensing.

Opening a Vast Map of the Universe to Investigate the Mystery of Dark Energy
With support from NERSC, the High Energy Physics program's Dark Energy Spectroscopic Instrument (DESI) is mapping millions of celestial objects to better understand dark energy, the mysterious driver of our universe's accelerating expansion. Objects in DESI's catalog range from nearby stars in our own Milky Way to galaxies billions of light-years away; because of the time it takes light to travel to Earth, looking out in space is akin to looking back in time. The DESI collaboration recently released a vast new collection of data (DESI's Data Release 1), hosted by NERSC, for anyone in the world to investigate. Every night, thousands of celestial images captured by DESI are automatically transferred via ESnet to the Perlmutter supercomputer at NERSC, which conducts automated precision analysis and sends processed data back over ESnet to the DESI researchers – a workflow 40 times faster than previous methods. This integrated approach represents a new, more efficient way of doing research where experimental facilities, HPC, and high performance networking combine to drastically accelerate the pace of science.

Quantum Networking Uses Hyperentanglement
Entanglement is a key resource that enables distributed quantum computing and helps the technology scale. Entanglement generation and distillation between distributed quantum systems is the main challenge in quantum networking. A promising approach is to use the so-called hyperentanglement – the entanglement between different fundamental properties of a single particle – to boost entanglement distillation rates, information capacity, and enhance noise resilience of a quantum network. The team of researchers led by ORNL experimentally demonstrated a two-qubit controlled-NOT gate designed for manipulating polarization-frequency hyperentangled photons, achieving near-perfect operational fidelity. This work represents the first demonstration of a controlled-NOT operation between polarization and frequency within a single photon, enabling advanced quantum communication and networking protocols. This mechanism promises to serve as one of the building blocks for wide-area quantum networks.

Using Supercomputers to Understand the Repair of DNA
Understanding how the body heals and protects itself from DNA damage is vital for treating genetic disorders and life-threatening diseases such as cancer. Despite numerous studies and medical advances, much about the molecular mechanisms of DNA repair remains a mystery. By leveraging the immense capabilities of the Summit supercomputer at ORNL, researchers constructed a molecular-level model of the DNA repair process called nucleotide excision repair, solving a critical puzzle that explains how damaged strands of DNA can be repaired by multiple proteins working together. AlphaFold, an AI machine learning model developed by Google DeepMind, paired with the Nanoscale Molecular Dynamics, or NAMD, high-precision molecular-dynamics simulation application, played a crucial role in predicting the unknown 3D structures and intricate interfaces between proteins involved in DNA repair. This work provides key insights into developing novel treatments and preventing conditions that lead to premature aging and certain types of cancer.

Exascale Advances NASA's Manned Mission to Mars.
NASA has set a goal to send humans to Mars in the 2030s, but major technical challenges need to be resolved to achieve that milestone. Safely landing a vehicle with humans onboard will most likely require retropropulsion, in which rockets are fired downward to slow the vehicle's descent. However, it is impossible to replicate the unique conditions of Mars here on Earth. NASA uses computational fluid dynamics (CFD) simulations to model the aerodynamic forces, heat transfer, and other factors that spacecraft encounter, which informs designs that will make space missions safer and more efficient. The computational demands of these calculations have been out of reach until the NASA team, including experts from Georgia Institute of Technology's Aerospace Systems Design Laboratory, partnered with OLCF. After five years of software efforts and annual campaigns running increasingly sophisticated simulations, in FY 2024 researchers successfully completed a groundbreaking 35-

second autonomous closed-loop test flight simulating the vehicle’s final descent from 8 kilometers to about 1 kilometer as the vehicle approached its landing phase. These capabilities are critical for assessing the controllability of future vehicles, bringing humanity one step closer to walking on Mars.

Advanced Scientific Computing Research
Mathematical, Computational, and Computer Sciences Research

Description

The Mathematical, Computational, and Computer Sciences Research subprogram supports research activities to effectively meet the SC AI, QIS, HPC, and computational science mission needs, including both data and computationally intensive science. These sciences coupled with AI are central to progress at the frontiers of science and our most challenging engineering problems, including for next-generation microelectronics and systems exploring the convergence of HPC, AI, and QIS. The Computer Science and Applied Mathematics activities in ASCR provide the foundation for increasing the capability of the national HPC ecosystem and scientific data infrastructure. This goal is accomplished through long-term research focused on developing intelligent software, algorithms, and methods that anticipate future hardware challenges and opportunities, and address evolving science needs. ASCR's partnerships with disciplinary science deliver some of the most advanced scientific computing applications in areas of strategic importance to the Nation and help realize the promise of the exascale and AI-enabled science era. Research efforts anticipate changes in hardware and rapidly developing capabilities such as AI and QIS, as well as science needs over the long term. ASCR's partnerships with industry, including vendors and users, and discipline sciences are essential to these efforts.

Applied Mathematics Research

The FY 2026 Request for the Applied Mathematics activity supports basic research leading to fundamental mathematical advances and computational breakthroughs across DOE and SC missions. Basic research in scalable algorithms and libraries, multiscale and multi-physics modeling, methods that facilitate building and understanding foundational models for leading AI capabilities, and efficient data analysis underpin all of DOE's computational and data-intensive science efforts. More broadly, the Request supports foundational research in problem formulation, multiscale modeling and coupling, mesh discretization, time integration, advanced solvers for large-scale linear and nonlinear systems of equations, methods that use asynchrony or randomness, uncertainty quantification, and optimization. Historically, advances in these methods have contributed as much, if not more, to gains in computational science than hardware improvements alone. The forward-looking efforts of these activities' anticipate DOE mission needs from the closer coupling and integration of advanced computing with scientific modeling, AI, and QIS. The result will enable greater capabilities for scientific discovery, design, and decision-support in complex systems; enable the development of new algorithms to support data analysis at the edge of experiments and instruments; and protect the privacy of sensitive datasets. Industry often uses software developed with Applied Mathematics investments and integrates it with their own software.

Computer Science Research

The FY 2026 Request for the Computer Science activity supports long-term, basic research on the software infrastructure that is essential for the effective use of the most powerful HPC and networking systems in the Nation; the tools and data infrastructure to enable the incorporation of AI techniques and real-time exploration and the understanding of extreme scale; and complex data from both simulations and experiments. Additionally, Computer Science efforts play a key role in understanding gaps and future opportunities for the design of future computing systems, ensuring that the U.S. maintains leadership in high-performance and data-intensive computing, and integrating them with AI and QIS technologies. To advance these goals, this activity includes support for foundational research in data analysis and visualization, data management and storage, distributed systems and resource management, programming models and tools enabling high performance and portability, program verification and testing, operating and runtime systems, advanced networking, hardware/software co-design, computer-science fundamentals, and HPC cybersecurity. Hardware and software vendors often use software developed with ASCR Computer Science investments and integrate it with their own software. In addition, partnerships between mathematicians and computer scientists, jointly supported by this activity and Applied Mathematics, develop computationally efficient algorithms and methods that scale from intelligent sensors to HPC and advance the Department's energy goals.

Computational Partnerships
The FY 2026 Request for the Computational Partnerships activity supports the Scientific Discovery through Advanced Computing, or SciDAC, program, for the employment of HPC for scientific discovery. Established in 2001, SciDAC involves ASCR partnerships with the other SC programs, other DOE program offices, and other federal agencies in strategic areas with a goal to dramatically accelerate progress in scientific computing, including AI, through deep collaborations between discipline scientists, applied mathematicians, and computer scientists. SciDAC does this by providing the intellectual resources in applied mathematics and computer science, expertise in algorithms and methods, and scientific software tools to advance scientific discovery through modeling, simulation, large-scale data analysis, and scientific AI in areas of strategic importance to SC, DOE, and the Nation. These efforts include partnerships with industry, academia, and other agencies to utilize DOE's advanced computing capabilities and AI testbeds to build foundation models that support new applications in science and energy. The FY 2026 Request supports building SciDAC partnerships focused on AI for science with other SC and DOE programs.

Advanced Computing Technologies
The FY 2026 Request for the Advanced Computing Technologies (ACT) activity supports research focused on the development of emerging computing technologies through REP and center investments, in partnership with the other SC program offices. These technologies include QIS, neuromorphic computing, robotics, automated systems for scientific discovery, and other advanced microelectronics technologies. ACT also strengthens the competitiveness of the U.S. scientific computing workforce through CSGF.

REP has a long history of partnering with U.S. vendors to develop the next generation of computing technologies that advance the state-of-the-art enabling DOE researchers to better understand the challenges and capabilities of emerging technologies. REP partnerships with industry and in collaboration with the research community focused on computationally efficient, leap-ahead technologies for scientific AI, HPC, and robotics will accelerate the development of scalable qubit architectures, first-of-a-kind neuromorphic devices AI applications, and novel AI training methods for robotics.

In close coordination with IRI activities, the Request will support the exploration of critical components of a high-level programming interface that will enable integrated workflows for all major DOE science instruments and user facilities with HPC. The efforts foster a DOE national laboratory ecosystem of automated labs, edge sensors, data resources, and access to commercial cloud capabilities to radically accelerate the pace of innovation and discovery.

This activity also supports ASCR's investments in the NQISRCs, as well as quantum computing and networking testbeds. These investments focus on building game-changing quantum-computing systems that will provide the U.S. scientific community with transformative capabilities to simulate physical systems at scales and levels of fidelity out of reach of classical techniques. To accelerate scientific discovery, AI will be leveraged to optimize and explore new system designs, and combined with quantum computing systems, to enable novel algorithmic innovations. The networking initiatives will build the capability to connect and integrate different quantum technologies by distributing quantum resources, such as entanglement.

Success in fostering and stewarding a highly skilled and competitive workforce is fundamental to SC's mission and key to also sustaining U.S. leadership in HPC and computational science. The high demand across DOE missions and the unique challenges of high-performance computational science and engineering led to the establishment of the CSGF in 1991. This program has delivered leaders across the computational science community. With increasing demand for these highly skilled scientists and engineers, ASCR continues to partner with the NNSA to support the CSGF to increase the availability and breadth of a trained workforce for exascale computing, AI, and QIS.

Additionally, the Request supports ASCR's contribution to the SC Microelectronics Science Research Centers are formed as networks of individual projects, aggregated into three centers, that each address a common challenge. These Centers include researchers from universities, national laboratories, and industry that develop materials, chemistries, devices, systems, architectures, algorithms, and software.

Advanced Scientific Computing Research
Mathematical, Computational, and Computer Sciences Research

Activities and Explanation of Changes

(dollars in thousands)

FY 2025 Enacted		FY 2026 Request	Explanation of Changes FY 2026 Request vs FY 2025 Enacted
Mathematical, Computational, and Computer Sciences Research	**$310,000**	**$271,194**	**-$38,806**
Applied Mathematics Research	$68,182	$60,994	-$7,188
Investments continue to support innovative research efforts in algorithms, libraries, and methods that underpin high-end scientific simulations, scientific AI techniques, including methods that facilitate building foundation models useful for basic and applied science, and methods that help scientists extract insights from massive scientific datasets with an emphasis on foundational capabilities. Partnerships between mathematicians and computer scientists focus on developing computationally efficient algorithms and methods, and in physics-informed, multiscale algorithms.		The Request will focus on core foundational research efforts in algorithms, libraries, and methods that underpin high-end scientific simulations, scientific AI techniques, building and understanding foundation models, and methods that help scientists extract insights from massive scientific datasets with an emphasis on capabilities for making data AI-ready. The Request will continue partnerships between mathematicians and computer scientists to develop computationally efficient algorithms and methods for hybrid architectures including HPC, quantum, and AI, and in physics-informed, multiscale algorithms.	The decrease represents the consolidation of several efforts to focus on the most promising future directions for increasingly hybrid architectures that integrate HPC, QIS, and AI.
Computer Science Research	$76,718	$62,431	-$14,287
Funding supports innovative investments in software that improves the utility of HPC and advanced networks for science. This includes AI techniques, workflows, tools, data management, analytics and visualizations with strategic increases focused on critical tools to facilitate building and understanding foundation models useful for basic and applied science and to enable an integrated		The Request will focus on foundational research efforts in software that improves the utility of HPC and advanced networks for science. This includes AI techniques, workflows, tools, data management, analytics and visualizations with strategic increases focused on critical tools to facilitate building and understanding foundation models and making massive data	The decrease represents the consolidation of several efforts to focus on the most promising future directions for increasingly hybrid architectures that integrate HPC, QIS, and AI.

(dollars in thousands)

FY 2025 Enacted	FY 2026 Request	Explanation of Changes FY 2026 Request vs FY 2025 Enacted
research infrastructure. Funding for this activity continues long-term basic research efforts that explore and prepare for emerging technologies, such as quantum computing and networking, and other specialized and heterogeneous hardware and accelerators. Small investments in cybersecurity continue. In addition, funding supports partnerships between mathematicians and computer scientists to develop computationally efficient scalable algorithms and methods.	sets AI-ready. Funding for this activity will also continue long-term basic research efforts that explore and prepare for emerging technologies and the integration of HPC, QIS, and AI. Small investments in cybersecurity will continue. In addition, funding will support partnerships between mathematicians and computer scientists to develop computationally efficient scalable algorithms and methods.	
Computational Partnerships $56,982	$35,151	-$21,831
Funding supports the SciDAC partnerships with SC and DOE programs. Efforts are focused on enabling widespread use of DOE HPC resources by Federal agencies in support of networks of scientists to work together on multidisciplinary research priorities such as the on-going partnership with the National Cancer Institute.	The Request will continue support for the SciDAC partnerships with other SC and DOE programs to enable AI-driven, high precision science R&D and realize the promise of exascale computing. Support for Advanced Computing will continue.	The decrease will be focused on lower priority research as the program focuses on the transition of some research reaching testbed readiness, including that focused on AI memory technologies, to Advanced Computing Technologies, and other minor adjustments.
Advanced Computing Technologies $105,118	$112,618	+$7,500
Funding supports quantum computing testbed efforts, and regional quantum networking testbeds. The funding allows REP to increase strategic investments in emerging technologies including AI-focused hardware, and continued support for hardening of critical software developed under ECP to enable science in the exascale era. The funding supports the CSGF fellowship, in partnership with NNSA. The NQISRCs will be recompeted, as authorized in the National Quantum Initiative Act. The funding also supports research awards that contribute to the	The Request will continue to support quantum computing testbed efforts, and regional quantum networking testbeds. The Request allows REP to increase strategic investments in hardware, and research that supports the integration of HPC, QIS, and AI, as well as continued support for hardening of critical software developed under ECP to enable science in the exascale era. The Request will continue support for the CSGF fellowship, in partnership with NNSA. The Request will continue support for the NQISRCs, as authorized in the National Quantum Initiative	The Request will support increases for AI-focused hardware investments, and Microelectronics Science Research Centers. New investments include partnerships with industry in collaboration with the research community in computationally efficient, leap-ahead technologies for scientific AI, HPC, and QIS. Also, some research reaching testbed readiness, including that focused on AI memory technologies, will be transferred from Computational Partnerships.

(dollars in thousands)

FY 2025 Enacted	FY 2026 Request	Explanation of Changes FY 2026 Request vs FY 2025 Enacted
Microelectronics Science Research Centers.	Act. Additionally, the Request will continue support for research awards that contribute to the Microelectronics Science Research Centers.	
Energy Earthshot Research Centers $3,000	$ —	-$3,000
Funding provides limited support for the EERCs established jointly between SC programs (BES, ASCR, and BER) with coordination with the DOE Applied Technology Offices to closeout this activity.	No funding is requested for the EERCs.	The decrease will provide no funding for the EERC initiative.

Note:

- Funding for the subprogram above includes 3.65 percent of research and development (R&D) funding for the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs, excluding facility operations.

Description

The High Performance Computing (HPC) and Network Facilities subprogram supports the construction and operations of forefront research computing, networking, and data user facilities to meet critical mission needs and advance American dominance of HPC, Artificial Intelligence (AI), and Quantum Information Science (QIS). The HPC activity supports the National Energy Research Scientific Computing Center (NERSC) at Lawrence Berkeley National Laboratory (LBNL), which provides HPC resources and large-scale storage to a broad range of SC researchers, and the High Performance Data Facility (HPDF) that will provide a managed computational and data resource to attack fundamental problems in science and engineering. The Leadership Computing activity supports the two Leadership Computing Facilities (LCFs) at Oak Ridge National Laboratory (ORNL) and Argonne National Laboratory (ANL), which provide leading-edge HPC capabilities to the U.S. research and industrial communities. The High Performance Network Facilities and Testbeds activity supports the high-performance network user facility, ESnet, which connects all DOE national laboratories and many other sites to global research networks and delivers highly reliable data transport capabilities optimized for the requirements of large-scale science. Within the subprogram, facility operations include investments in upgrading projects, software stewardship, and testbeds. The core strength of the facilities is the dedicated staff who work to maximize user productivity and science impact and efficiently operate and maintain world-leading research computing, networking, and data infrastructure, while simultaneously executing major upgrade projects and exploring advanced applications of AI and commercial quantum computing technologies.

The HPC and Network Facilities subprogram investments are informed through formal collection of strategic user requirements for research computing and data management from stakeholders across SC and DOE, including the other SC research programs, SC scientific user facilities, DOE national laboratories, U.S. industry, and other stakeholders. ASCR continues to observe an accelerating pace of innovation in computing technology through and beyond the exascale era. Allocation of HPC resources to users follows the merit review public-access model used by all SC scientific user facilities. The Innovative and Novel Computational Impact on Theory and Experiment (INCITE) allocation program provides access to the LCFs; the ASCR Leadership Computing Challenge (ALCC) allocation program provides a path for critical DOE mission applications to access the LCFs and NERSC, and a mechanism to address urgent national emergencies and priorities.

The FY 2026 Request will continue to support the implementation of DOE's Integrated Research Infrastructure (IRI) so that researchers can seamlessly and securely access DOE's unique data, user facilities, and computing resources to accelerate discovery and innovation. At the dawn of the exascale science era, many researchers and collaborations strive to meld data, simulation, and AI tools in novel ways, some with strict operational demands. Agency and program leaders feel the urgency to bring the best-integrated science and AI approaches to bear on our greatest challenges and highest priorities. All ASCR Facilities and HPDF are collaborating to create an IRI ecosystem that meets these requirements.

High Performance Production Computing

The FY 2026 Request for this activity will continue to support the NERSC user facility at LBNL to deliver high-end production computing resources and data services for the SC research community. NERSC users come from nearly every state in the U.S., with about half based in universities, approximately one-third in DOE laboratories, and other users from government laboratories, non-profits, small businesses, and industry. NERSC aids users entering the HPC arena for the first time, as well as those preparing leading-edge codes that harness the full potential of ASCR's exascale resources.

The FY 2026 Request will continue to support NERSC operation of the 125 pf HPE/AMD/NVIDIA NERSC-9 system (Perlmutter), an AI-enabled GPU-CPU system, which came online in FY 2021. NERSC is consistently oversubscribed, with user requests exceeding capacity by a factor of 3–10 each year. In addition, the variety of data- and compute-intensive research workflows is expanding rapidly. The FY 2026 Request supports NERSC operations and the NERSC-10 upgrade project, which is intended to provide SC with an innovative, flexible HPC platform to serve an even wider range of NERSC users, workflows, and applications. The Request also supports NERSC's exploratory efforts in AI and access to commercial quantum computing technologies to benefit the NERSC user community.

The FY 2026 Request provides funding to complete the design of the High Performance Data Facility (HPDF) with options for phased installation in the future.

<u>Leadership Computing Facilities</u>
The LCFs are national resources featuring first-of-a-kind supercomputing systems that drive innovation in HPC to enable open scientific computational applications, including industry applications, that harness the full potential of extreme-scale leadership computing to accelerate discovery. The success of this effort is built on the gains made in the ECP, REP and ASCR research efforts. The LCFs foster partnerships between domain scientists and computational science experts that extend the power of exascale computing to the Nation's most pressing research challenges. Industrial users of LCFs often prompt their companies to invest in their own HPC resources, which benefit from ASCR's investments that reduce risk for vendors and enable pioneering product lines for the broad consumer markets. The LCFs' experienced staff deploy cutting edge technologies and conduct scaling tests, while providing direct support to users, early science application teams, and HPC tool and library developers.

The FY 2026 Request for this activity supports operation and competitive allocation of the OLCF at ORNL, including the Nation's first exascale computing system, an HPE-Cray/AMD exascale system (Frontier), deployed in 2021. The Request also supports the Quantum Computing User Program, IRI efforts, advanced computing testbeds, and supporting resources.

The FY 2026 Request for this activity also supports operation and competitive allocation of the ALCF at ANL, including the Nation's second exascale and DOE's most AI capable system, an Intel/HPE-Cray system (Aurora) deployed in 2023. The Request also supports the 44 PF HPE/AMD/NVIDIA testbed (Polaris), the AI testbed, IRI efforts, and supporting resources.

The ALCF and OLCF systems are architecturally distinct, consistent with DOE's strategy to manage enterprise risk, foster diverse capabilities that provide the Nation's HPC user community with the most effective resources, and expand U.S. competitiveness. The demand for 2025 INCITE allocations at the LCFs outpaced the available resources by a factor of three, 2024–2025 ALCC demand outpaced resources by a factor of five, and demand continues to increase as industry and interagency partners adopt exascale technologies and as users leverage the LCFs for a wide range of AI applications. The FY 2026 Request for the LCFs will continue implementation of the OLCF-6 and ALCF-4 upgrade projects, cultivate vendor partnerships to spur innovation of strategic value and to drive U.S. competitiveness, continue cutting edge AI testbeds and user access programs for commercial quantum computing platforms, and develop seamless IRI solutions.

<u>High Performance Network Facilities and Testbeds</u>
The FY 2026 Request for this activity supports ESnet, SC's high performance network user facility, providing world-leading wide-area network access for all of DOE. ESnet is widely recognized as a global leader in the research and education network community, with a multi-decade track record of developing innovative network architectures and services, and reliable operations designed for 99.9 percent uptime for connected sites. The ESnet backbone network spans the continental U.S. and the Atlantic Ocean, connecting all 17 DOE National Laboratories and dozens of DOE sites to 200+ research and commercial networks around the world, enabling many tens of thousands of scientists across the country to access data and research resources. ESnet supports the data transport needs of all SC user facilities. The expert staff at ESnet operate the current generation network, ESnet6, leveraging its unique data transport orchestration, automation, and programmability features to advance DOE's data-intensive science and AI goals. In FY 2026, ESnet will continue to invest in site resiliency improvements across the DOE complex and will leverage ESnet6 to develop advanced services to support DOE priority R&D thrusts, IRI, AI, and cybersecurity.

Integrated Research Infrastructure (IRI)

The FY 2026 Request for IRI Operations will support the activities of the IRI Management Council and investments to build core IRI operations services. IRI is a program activity to integrate SC's experimental and observational scientific user facilities, data assets, and advanced computing resources so that researchers can combine these tools in novel ways that make complex data-intensive workflows much faster and more resource-efficient for research teams, enabling new research paradigms. IRI investments are thus foundational to DOE's broader AI research goals and bringing the power of HPC solutions to high-priority research challenges.

Activities and Explanation of Changes

(dollars in thousands)

FY 2025 Enacted		FY 2026 Request	Explanation of Changes FY 2026 Request vs FY 2025 Enacted
High Performance Computing and Network Facilities	**$726,235**	**$744,806**	**+$18,571**
High Performance Production Computing	$154,500	$154,328	-$172
Funding supports operations at the NERSC user facility, including user support, power, space, system leases, and staff. Funding also supports the NERSC-10 upgrade project and the High Performance Data Facility project. In addition, funding supports early implementation of IRI. NERSC supports sustaining ECP software and technologies critical to HPC operations and users.		The Request will support operations at the NERSC user facility, including user support, power, space, system leases, staff, and the NERSC-10 upgrade project at the CD-2 baseline level. The Request will sustain support for implementation of IRI and ECP software and technologies critical to HPC operations and users.	The increase will support NERSC operations and the NERSC-10 upgrade project at the CD-2 baseline level.
National Energy Research Scientific Computing Center (NERSC)	*$146,500*	*$150,328*	*+$3,828*
Funding supports operations at the NERSC user facility, including user support, power, space, system leases, and staff. Funding supports full implementation of site upgrades and procurements for the NERSC-10 upgrade project, and full operations and allocation of the NERSC-9 Perlmutter system. NERSC will support sustaining ECP software and technologies critical to HPC operations and users. In addition, funding supports the early implementation of IRI and exploratory efforts in AI and quantum computing to benefit the NERSC user community.		The Request will support operations at the NERSC user facility, including user support, power, space, system leases, and staff. The Request will also support the NERSC-10 upgrade project at the CD-2 baseline level, and full operations and allocation of the NERSC-9 Perlmutter system. In addition, funding will support implementation of IRI and ECP software and technologies critical to HPC operations and users. The Request continues support for exploratory efforts in AI and quantum computing to benefit the NERSC user community.	The increase will support NERSC operations, and the NERSC-10 upgrade project at the CD-2 baseline level.
High Performance Data Facility, OPC	*$8,000*	*$4,000*	*-$4,000*
Funding supports conceptual design for the HPDF project in preparation for CD-1.		The Request provides funding to complete the design of HPDF with	Final design with a phased approach to installation will be completed to determine next steps

(dollars in thousands)

FY 2025 Enacted	FY 2026 Request	Explanation of Changes FY 2026 Request vs FY 2025 Enacted
	options for phased installation in the future.	for this project, preserving options to meet the urgency of the Department's mission needs in data-intensive research and AI.
Leadership Computing Facilities $475,195	$490,098	+$14,903
The funding supports operations at the LCF facilities at ANL and ORNL, including user support, power, space, system leases, early access systems and testbeds, and staff. Funding supports operations and allocation of exascale systems at OLCF and ALCF as well as planning and implementation for the major upgrade projects; AI efforts; user access to commercial quantum computing resources; vendor partnerships; and IRI. The LCFs will maintain ECP software and technologies critical to HPC operations and users.	The Request will support operations at LCF facilities at ANL and ORNL, including user support, power, space, system leases, early access systems and testbeds, and staff. The Request will support operations and allocation of exascale systems at OLCF and ALCF. The Request will grow support implementation of major upgrade projects; AI testbeds; user access to commercial quantum systems; vendor partnerships; and IRI. The LCFs will continue support for ECP software and technologies critical to HPC operations and users.	The increase will support LCF operations, the OLCF-6 project at the target baseline, and implementation of the ALCF-4 project.
Leadership Computing Facility at ANL $215,195	*$222,755*	*+$7,560*
Funding supports the start of operations and competitive allocation of the ALCF-3 exascale system, Aurora, which will deploy and maintain ECP software and technologies as well as serve the user community as DOE's most capable AI system. The funding supports continuing operation and competitive allocation of the ALCF systems as well as AI testbeds, planning for the ALCF-4 upgrade project, vendor partnerships, and early implementation of IRI.	The Request will support operations and competitive allocation of the Aurora exascale system and the AI Testbed. The Request will support implementation of the ALCF-4 upgrade project. The Request will continue to support implementation of IRI. ALCF will continue to deploy and maintain ECP software and technologies critical to HPC operations and users.	The increase will support ALCF operations and implementation of the ALCF-4 upgrade project.
Leadership Computing Facility at ORNL $260,000	*$267,343*	*+$7,343*
Funding supports operations at the OLCF facility, including user support, power, space, maintenance, and staff. Funding also supports operation and competitive allocation	The Request will support operations at the OLCF facility, including user support, power, space, maintenance, and staff. The Request will support the OLCF-6	The increase will support OLCF operations and the OLCF-6 upgrade project at the target baseline.

(dollars in thousands)

FY 2025 Enacted		FY 2026 Request	Explanation of Changes FY 2026 Request vs FY 2025 Enacted
of the Frontier exascale system and planning and implementation of the OLCF-6 upgrade project, contingent on achievement of CD-2/3. The funding supports user access programs for commercial quantum computing platforms, vendor partnerships, and advanced computing testbeds. OLCF will deploy and maintain ECP software and technologies critical to HPC operations and users. Funding also supports the early implementation of IRI.		upgrade project at the target baseline. The Request will also support operation and competitive allocation of the Frontier exascale system and the user access program for commercial quantum computing platforms. The Request also will support implementation of IRI. OLCF will continue to deploy and maintain ECP software and technologies critical to HPC operations and users.	
High Performance Network Facilities and Testbeds	$93,540	$97,261	+$3,721
Funding supports operations of ESnet at 99.9 percent reliability, including user support, operations and maintenance of equipment, fiber leases, R&D testbed, and staff. Funding also supports site resiliency investments and early implementation of IRI.		The Request will support operations of ESnet at 99.9 percent reliability, including user support, operations and maintenance of equipment, fiber leases, R&D testbed, and staff. Funding also supports site resiliency investments and implementation of IRI.	The increase will support ESnet operations, and implementation of site resiliency improvements.
Integrated Research Infrastructure	$3,000	$3,119	+$119
Funding supports commencement of IRI community governance activities and initial investments to build core IRI operations services.		The Request will support continuation of IRI community governance activities and software engineering for core IRI operations services.	The increase will support limited expansion of software engineering efforts.

Note:

- *Funding for the subprogram above includes 3.65 percent of research and development (R&D) funding for the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs, excluding facility operations.*

Advanced Scientific Computing Research
Capital Summary

(dollars in thousands)

	Total	Prior Years	FY 2024 Enacted	FY 2025 Enacted	FY 2026 Request	FY 2026 Request vs FY 2025 Enacted
Capital Operating Expenses						
Capital Equipment	N/A	N/A	5,000	5,000	5,000	–
Total, Capital Operating Expenses	**N/A**	**N/A**	**5,000**	**5,000**	**5,000**	**–**

Capital Equipment

(dollars in thousands)

	Total	Prior Years	FY 2024 Enacted	FY 2025 Enacted	FY 2026 Request	FY 2026 Request vs FY 2025 Enacted
Capital Equipment						
Total, Non-MIE Capital Equipment	N/A	N/A	5,000	5,000	5,000	–
Total, Capital Equipment	**N/A**	**N/A**	**5,000**	**5,000**	**5,000**	**–**

Note:
- *The Capital Equipment table includes MIEs with a Total Estimated Cost (TEC) > $10M.*

(dollars in thousands)

	Total	Prior Years	FY 2024 Enacted	FY 2025 Enacted	FY 2026 Request	FY 2026 Request vs FY 2025 Enacted
24-SC-20, High Performance Data Facility						
Total Estimated Cost (TEC)	112,000	-	1,000	-	-	-
Other Project Cost (OPC)	10,933	3,860	7,000	-	-	-
Total Project Cost (TPC)	122,933	3,860	8,000	-	-	-
Total, Construction						
Total Estimated Cost (TEC)	N/A	N/A	1,000	-	-	-
Other Project Cost (OPC)	N/A	N/A	7,000	-	-	-
Total Project Cost (TPC)	N/A	N/A	8,000	-	-	-

Advanced Scientific Computing Research
Scientific User Facility Operations

The treatment of user facilities is distinguished between two types: TYPE A facilities that offer users resources dependent on a single, large-scale machine; TYPE B facilities that offer users a suite of resources that is not dependent on a single, large-scale machine.

(dollars in thousands)

	FY 2024 Enacted	FY 2024 Current	FY 2025 Enacted	FY 2026 Request	FY 2026 Request vs FY 2025 Enacted
Scientific User Facilities - Type A					
National Energy Research Scientific Computing Center	135,000	135,155	146,500	150,328	+3,828
Number of Users	10,500	–	10,750	11,000	+250
Achieved Operating Hours	–	8,485	–	–	–
Planned Operating Hours	8,585	8,585	8,585	8,585	–
Unscheduled Down Time Hours	–	100	–	–	–
Argonne Leadership Computing Facility	219,000	219,000	215,195	222,755	+7,560
Number of Users	1,650	–	1,700	1,750	+50
Achieved Operating Hours	–	8,742	–	–	–
Planned Operating Hours	7,008	7,008	7,008	7,008	–
Oak Ridge Leadership Computing Facility	255,000	255,045	260,000	267,343	+7,343
Number of Users	1,750	–	1,800	1,800	–
Achieved Operating Hours	–	8,603	–	–	–
Planned Operating Hours	7,008	7,008	7,008	7,008	–
Energy Sciences Network	91,000	90,923	93,540	97,261	+3,721
Achieved Operating Hours	–	8,760	–	–	–
Planned Operating Hours	8,760	8,760	8,760	8,760	–
Total, Facilities	700,000	700,123	715,235	737,687	+22,452
Number of Users	13,900	–	14,250	14,550	+300
Achieved Operating Hours	–	34,590	–	–	–
Planned Operating Hours	31,361	31,361	31,361	31,361	–
Unscheduled Down Time Hours	–	100	–	–	–

Note:
- *Achieved Operating Hours and Unscheduled Downtime Hours will only be reflected in the Congressional budget cycle which provides actuals.*
- *Percent optimal operations defines what is achieved at this funding level. This includes staffing, up-to-date equipment and software, operations and maintenance, and appropriate investments to maintain world leadership.*

Advanced Scientific Computing Research
Scientific Employment

	FY 2024 Enacted	FY 2025 Enacted	FY 2026 Request	FY 2026 Request vs FY 2025 Enacted
Number of Permanent Ph.Ds (FTEs)	795	811	802	-9
Number of Postdoctoral Associates (FTEs)	335	341	338	-3
Number of Graduate Students (FTEs)	500	510	505	-5
Number of Other Scientific Employment (FTEs)	215	219	217	-2
Total Scientific Employment (FTEs)	**1,845**	**1,881**	**1,862**	**-19**

Note:
- *Other Scientific Employment (FTEs) includes technicians, engineers, computer professionals and other support staff.*