Advanced Scientific Computing Research

Overview

The ongoing revolutions in artificial intelligence (AI), quantum computing, and high-performance computing are ushering in a new age of scientific research. The Advanced Scientific Computing Research (ASCR) program is accelerating the dawn of this age by advancing applied mathematics and computer science, including AI and quantum information science (QIS); delivering the most sophisticated computational scientific applications in partnership with disciplinary science; creating first-of-a-kind advanced computing and networking capabilities for the Nation; and developing 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 underpin the Genesis mission by increasing the capability, versatility, impact and efficiency of scientific computing through activities described by four thrusts: *Breakthrough Tools and Technologies*, enhancing software and AI for increasingly complex modeling and simulation, including enabling the convergence of AI with QIS; *Deep Understanding of AI and Physical Models*, advancing knowledge in core mathematical methods and algorithms that underlie all AI, modelling, and simulation; *Enabling High-Precision Research and Development*, concurrently advancing applied mathematics and computer science with disciplinary science in critical areas; and *Hardware Innovation*, increasing 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 is core to the Genesis Mission, driving progress through the development of advanced computing, AI, and QIS technologies and tools. ASCR's research, technology development, and user facilities activities are foundational to the Department's goals to build frontier models for science and energy, QIS algorithms and applications for quantum advantage, and a world-leading, secure platform that integrates DOE computing, data, and networks with U.S. partners for the U.S. research community. The ASCR mission strongly aligns with the Genesis Mission core goal to dramatically increase the nation's scientific output and impact. ASCR will not only play a leading role in the design, delivery, and continuous improvement of the Genesis Mission platform, but will also directly leverage the platform, including frontier AI models and data, to further ASCR research frontiers. Also, ASCR is coordinating closely with AIQ in the development, deployment, and management of the Genesis Mission supercomputing partnerships and quantum investments under AIQ's purview, and ASCR's user facilities, the American Science Cloud, and other ASCR investments are being leveraged by AIQ to deploy and manage Genesis Mission computing resources.

ASCR's program activities steward an innovation pipeline addressing the four thrusts. This pipeline starts with basic research, makes connections to scale-up research and development activities through testbeds and centers, and culminates in world-leading computing, networking, and data infrastructure capabilities:

- ASCR Research's Applied Mathematics 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 science applications. The Computational Partnerships activity catalyzes joint inquiry and effort between mathematics and computer science researchers and domain science researchers to solve interwoven challenges.
- ASCR Advanced Computing Technologies (ACT) 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 High Performance Computing and Networking Facilities activities conceive, build, and operate world-class, open access HPC, networking, and data infrastructure for scientific research. ASCR facilities partner with industry to create and deploy next generation computing and networking technology. 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. The effort leverages the American Science Cloud (AmSC) to facilitate and support scientific research, data generation, analysis, and sharing across various disciplines. The effort is also underpinned by the state-of-the-art self-improving AI models developed by the Transformational AI Models Consortium in close collaboration with the leading industry partners. ASCR's request supports leveraging DOE's considerable capabilities to advance scientific AI designed to handle large multi-dimensional data sets and produce the high-precision answers needed for science to meet the Nation's technical challenges. To better couple all elements of the technology innovation chain and combine talents across universities, national labs, and the private sector, 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 2027 Request

The ASCR FY 2027 Request of $1,104.4 million is a decrease of $11.9 million below the FY 2026 Enacted level and is well-aligned with Administration and Department priorities to support the Genesis Mission and advance AI technology and its integration with critical and emerging technologies such as microelectronics and QIS. It also provides support to enhance U.S. competitiveness by developing cutting-edge AI models and applying them to increase the pace of scientific discovery while leveraging AmSC infrastructure, including next-generation HPC, networking, and data processing capabilities.

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 for new applications in science, energy, and national security. The Request also emphasizes applied mathematics, computer science, networking, hardware, and microelectronics research to leverage advanced computing including quantum. Increased or shifted efforts in research, advanced computing technologies, and at the facilities will move forward the implementation of the AmSC and its core ASCR infrastructure component, DOE's Integrated Research Infrastructure (IRI), to seamlessly integrate DOE's unique data, user facilities, computing resources, and applications and to accelerate self-improving AI model development. Strategic partnerships, within DOE, at the interagency level, and with industry expand the impact of the exascale capabilities including software and AI and accelerate scientific discovery through advanced computing (SciDAC) and the Transformational AI Models consortium. For example, partnerships will use AI to accelerate the discovery of new quantum algorithms. 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, robotics, and quantum information testbeds and centers. Continued support enables the NQISRCs and ASCR's regional quantum testbeds, which will be expanded to derisk larger-scale error-corrected quantum systems, 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. The request will also explore incentive-based competitions to support the demonstration of scientifically relevant quantum computing. 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 2027 Request supports full operations and competitive allocation of the Nation's exascale computing systems for open science, 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 and OLCF-6 projects at their CD-2 baseline levels, the ALCF-4 upgrade project, the High Performance Data Facility (HPDF) project, initial planning for the ESnet7, and exploring a quantum computing user facility. The Request builds on the FY 2026 initiation of the AmSC infrastructure platform under the One Big Beautiful Bill's Transformational AI Models provision, advancing the ASCR Facilities as enablers of the AmSC.

Advanced Scientific Computing Research
Funding

(dollars in thousands)

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Advanced Scientific Computing Research				
Applied Mathematics Research	68,182	75,420	58,795	-16,625
Computer Sciences Research	76,718	85,431	50,820	-34,611
Computational Partnerships	56,982	51,151	70,749	+19,598
Advanced Computing Technologies	105,118	120,618	142,236	+21,618
Energy Earthshot Research Centers	3,000	–	–	–
Total, Mathematical, Computational, and Computer Sciences Research	**310,000**	**332,620**	**322,600**	**-10,020**
High Performance Production Computing	154,500	170,328	183,000	+12,672
Leadership Computing Facilities	475,195	513,000	490,000	-23,000
High Performance Network Facilities and Testbeds	93,540	97,261	103,000	+5,739
Integrated Research Infrastructure	3,000	3,119	5,846	+2,727
Total, High Performance Computing and Network Facilities	**726,235**	**783,708**	**781,846**	**-1,862**
Subtotal, Advanced Scientific Computing Research	**1,036,235**	**1,116,328**	**1,104,446**	**-11,882**
Total, Advanced Scientific Computing Research	**1,036,235**	**1,116,328**	**1,104,446**	**-11,882**

Advanced Scientific Computing Research
Explanation of Major Changes

	(dollars in thousands) FY 2027 Request vs FY 2026 Enacted
Mathematical, Computational, and Computer Sciences Research Funding for robust AI research is maintained 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. The ACT activities will increase investments in quantum information sciences research in close coordination with the other SC programs. The decrease represents the transition of some efforts to the Department-wide AI initiative. The consolidation of several core research efforts allow for increased investments in HPC, QIS, and AI.	**-$10,020**
High Performance Computing and Network Facilities The Request provides increased resources for facility operation for ESnet to deliver high performance network access to all DOE national laboratories and dozens of other DOE sites, all of which will support the Genesis mission. Also, the Request supports increase funding for HPDF to advance development of design. Modest reductions to OLCF, ALCF, and NERSC, but will still maintain 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. The Request supports development of IRI across ASCR facilities.	**-$1,862**
Total, Advanced Scientific Computing Research	**-$11,882**

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 AI transformational models. 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 2027, cross-agency interactions and collaborations continue in coordination with the Office of Science and Technology Policy.

Program Accomplishments
Leveraging AI to Fight Cancer: The Argonne Leadership Computing Facility (ALCF) is at the center of new research to tailor medical decisions, practices, and treatments to individual patients, based on each patient's predicted response. Such "precision medicine" can prevent and detect disease at earlier, more treatable stages, and the ALCF's Aurora exascale AI computer will be crucial to identify the exact pathways to make medicines to inhibit tumor growth. Two huge challenges for using AI to fight cancer are limited data and untested deep learning models. Now, Aurora, one of DOE's most advanced AI supercomputers and the National Cancer Institute (NCI) have teamed up to overcome these limitations through their new "IMPROVE" project (Innovative Methodologies and New Data for Predictive Oncology Model Evaluation). IMPROVE will leverage the Argonne supercomputer to optimize AI that can predict from a patient's biopsy the preferred treatment based on their DNA, and genetic profile, while reducing unwanted side effects such as liver damage or birth defects.

Paving the way for scalable quantum chips: Researchers in the Quantum Systems Accelerator NQISRC have achieved a 100x enhancement over state-of-the-art devices in power efficiency of a computer chip that can be used to control quantum systems. The chip, manufactured in the Sandia lab's volume foundry uses their innovative device which is just 2mm long (about as big as a grain of rice) to enable large-scale control of quantum chips. This class of devices enables highly-scalable control of "trapped ion" chips, allowing them to utilize increasingly high numbers of qubits, and therefore achieve quantum computing advantages. The innovative device helps overcome a major obstacle faced by quantum computers of the future: how to match the miniaturization and integration achieved by classical electronics. The team used advanced nanophotonics with a clever design to couple piezoelectric transducers and optical guides aimed at controlling neutral atoms and trapped ions in quantum processing units.

Simulating hypersonic flight conditions. Hypersonic flight promises to slash flight times and energy costs with vehicles soaring at thousands of miles per hour, but the extreme speeds generate massive shock waves and scorching temperatures. Now, researchers are tapping into the ALCF's supercomputing power to simulate the behavior of billions of oxygen molecules and temperatures as they flow around a prototype design. Accurately predicting heat loads on a hypersonic vehicle's surface is paramount for devising effective thermal protection strategies, directly impacting mission safety and success. The exciting new work was published in Science Advances and is funded by SC's Innovative and Novel Computational Impact on Theory and Experiment (INCITE) Program. The study's large-scale simulations offer new insights into how shockwaves interact and the molecular-level mechanisms that drive hypersonic flows. The findings could directly contribute to the development of hypersonic rocket cargo vehicles, such as those being developed by SpaceX and the U.S. Air Force.

Leak proof fusion brings abundant low-cost energy closer to reality. A key challenge for fusion reactors is to contain leakage of high-energy particles causing loss of critical plasma conditions needed to sustain nuclear

fusion. Using the advanced mathematical methods developed via support from ASCR, the scientists have made a key breakthrough that will enable engineers to design leak-proof magnetic confinement systems ten times faster than current methods without losing accuracy. For decades, engineers have wrestled with the challenge of magnetic confinement, essential for harnessing fusion energy, often battling troublesome gaps in complex magnetic fields within the stellarator, the leading candidate for commercial fusion. Now, in a leap forward, scientists and their industry partner Type One Energy have deployed a machine learning model, trained on real-world data, that significantly outperforms current standards in this nearly 70-year-old quest. This breakthrough accelerates the production of low-cost nuclear fusion energy.

DOE's new wireless transmission capability connects geothermal scientists to supercomputers. Utilizing wavelengths as short as one millimeter, ESnet is connecting field sites to the high-performance science network DOE supercomputers and is now empowering geothermal energy researchers collecting seismic data. By overcoming the limitations of Wi-Fi and cellular service at remote energy field sites, researchers can now perform vital real-time analysis of massive datasets, enabling them to better locate, monitor, and map geothermal energy sources for efficient exploitation. A novel, highly mobile millimeter wave (mmWave) data transmission prototype, invented and developed by DOE ESnet engineers, successfully passed its field testing in Utah and Nevada, offering easy transport in a pickup truck and flexible battery operation. By combining this wireless transmission with ESnet's blazing fast fiber optics, scientists can achieve real-time interpretation of seismic data, potentially enabling the induction of controlled seismic events for geothermal power production.

Exascale simulations underpin quake-resistant infrastructure designs. Researchers at Berkeley National Laboratory used the Frontier supercomputer at Oak Ridge National Laboratory to develop the most advanced simulations to date for studying earthquake dynamics. The simulations reveal in stunning new detail how geological conditions influence earthquake intensity — and, in turn, how those complex ground motions directly impact buildings and infrastructure. The data is already being shared with the broader earthquake science and engineering communities to deepen understanding of seismic behavior and to guide the designs of earthquake-resistant infrastructure and improved emergency response.

Partnership on muon catalyzed fusion increases industry investment. Muon-catalyzed fusion (MCF), a promising approach for clean, abundant energy uses heavier muon particles to bring nuclei together at lower temperatures than traditional fusion. ASCR partnered with ARPA-E to use leading-edge computational tools to explore an advanced concept for producing muons at 1/10th the normal cost. The project demonstrated strong results to suggest the feasibility of cost-competitive power plants based on MCF. This validated a potential experimental pathway for this promising technology to leapfrog to a higher TRL than today’s leading fusion technologies and led to over $20 million in private investment.

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 and industry 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 mission needs over the long term. ASCR's partnerships with industry, including vendors and users, and discipline sciences are essential to these efforts. The Request supports research and partnerships addressing challenges under the Transformational AI Models Consortium and The American Science Cloud (AmSC), which were launched under the Working Families Tax Cuts Act (Pub. L. 119-21) and the activities supporting the Genesis Mission Executive Order (EO 14363).

Applied Mathematics Research

The FY 2027 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 results enable greater capabilities for scientific discovery, design, and decision-support in complex systems and 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 2027 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 2027 Request for the Computational Partnerships activity supports the Scientific Discovery through Advanced Computing, or SciDAC, program, for the effective use 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 accomplishes 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 2027 Request supports building SciDAC partnerships focused on AI for science with other SC and DOE programs.

Advanced Computing Technologies

The FY 2027 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 and DOE 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 for AI applications, and novel AI training methods for robotics. The activity will support testbeds for emerging neuromorphic and robotics hardware that enable edge and embodied AI applications for science.

In close coordination with IRI and American Science Cloud activities, the Request will support the development of critical components of a high-level programming interface that supports and facilitates integrated AI-enabled scientific workflows for all major DOE science instruments and user facilities with ASCR HPC and external compute resources, including cloud computing. 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 and quantum technologies, including quantum hardware performance verification and validation, quantum error corrected architectures, algorithms, and software research and development, as well as testbeds to derisk the scaling of fault tolerant quantum computing and supporting quantum networking technologies. 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 and HPC will be leveraged to optimize and explore new system designs, and combined with quantum computing systems, to enable algorithmic and architectural innovations.

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. 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 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.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Mathematical, Computational, and Computer Sciences Research **$332,620**	**$322,600**	**-$10,020**
Applied Mathematics Research $75,420	$58,795	-$16,625
Funding focuses 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. Funding continues 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 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 Request will support the consolidation of several efforts to focus on the most promising future directions for increasingly hybrid architectures that integrate HPC, QIS, and AI and the transition of some efforts to the Department-wide AI initiative.
Computer Science Research $85,431	$50,820	-$34,611
Funding focuses 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	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	The Request will support the consolidation of several efforts to focus on the most promising future directions for increasingly hybrid architectures that integrate HPC, QIS, and AI and the transition of some efforts to the Department-wide AI initiative.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
increases focused on critical tools to facilitate building and understanding foundation models and making massive data sets AI-ready. Funding for this activity continues long-term basic research efforts that explore and prepare for emerging technologies and the integration of HPC, QIS, and AI. Small investments in cybersecurity continues. In addition, funding supports partnerships between mathematicians and computer scientists to develop computationally efficient scalable algorithms and methods.	increases focused on critical tools to facilitate building and understanding foundation models and making massive data 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 $51,151	$70,749	+$19,598
Funding continues 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 continues.	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 scientific automation and realize the promise of exascale computing.	The Request will focus on increased investments in AI and QIS research and technology in support of the Genesis Mission. Lower priority research is decreased as the program focuses on the transition of some research reaching testbed readiness, including that focused on AI memory technologies, to Advanced Computing Technologies, other minor adjustments, and the transition of some efforts to the Department-wide AI initiative.
Advanced Computing Technologies $120,618	$142,236	+$21,618
Funding supports quantum computing testbed efforts, and regional quantum networking testbeds. Funding allows REP to increase strategic investments in hardware, and research that	The Request will continue to support quantum , AI, neuromorphic, and robotics technology testbed efforts. The Request allows REP to increase strategic investments in	The Request will prioritize AI, HPC, and QIS-focused applications and hardware investments. New partnerships with industry in collaboration with the research community will

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
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. Funding continues support for the CSGF fellowship, in partnership with NNSA. Also, funding supports the NQISRCs, as authorized in the National Quantum Initiative Act. Additionally, funding continues support for research awards that contribute to the Microelectronics Science Research Centers.	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 and the Microelectronics Science Research Centers. The request will explore incentive-based competitions to support the demonstration of scientifically relevant quantum computing.	be leveraged to develop computationally efficient, leap-ahead technologies for scientific AI, HPC, and QIS.

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 ASCR Facilities will continue to play a central role in developing and deploying infrastructure powering the Genesis Mission. 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 Request advances the HPDF to CD-2/3, preserving options for phased installation to meet the urgency of the Department's mission needs in data-intensive research and AI. 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 upgrade projects, software innovation, 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 2027 Request builds on the FY 2026 initiation of the American Science Cloud (AmSC) infrastructure platform under the Working Families Tax Cut Act (Pub. L. 119-21) and supports the Genesis Mission's creation of an integrated AI platform. The ASCR Facilities and HPDF will be core enablers of the AmSC and, in turn, the Integrated Research Infrastructure (IRI) activity supports the core governance and services spanning across all ASCR Facilities to meet the Department's AI research requirements and uplift the AmSC for the Genesis Mission. IRI activities focus on unlocking the ASCR Facilities computing, data, and networking services for users to run seamless automated computational and experiments workflows across DOE's world class user facilities and research infrastructure. ASCR is coordinating closely with AIQ in the development, deployment, and management of the Genesis Mission supercomputing partnerships and quantum investments under AIQ's purview, and ASCR's user facilities, the American Science Cloud, and other ASCR investments are being leveraged by AIQ to deploy and manage Genesis Mission computing resources. The FY 2027 request will also support the exploration of a quantum computing user facility.

High Performance Production Computing

The FY 2027 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 2027 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 2027 Request supports NERSC operations and the NERSC-10 upgrade project to build and commission the Dell/NVIDIA Doudna system, a 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 2027 OMB Request provides funding to advance the HPDF to CD-2/3 as the data services foundational infrastructure for the AmSC with options for phased installation in the future, preserving options to meet the urgency of the Department's mission needs in data-intensive research and AI.

Leadership Computing Facilities

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 larger 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 software innovators.

The FY 2027 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 for the AmSC, advanced testbeds, and supporting resources.

The FY 2027 Request for this activity 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, and the 44 PF HPE/AMD/NVIDIA testbed (Polaris), the AI testbed, IRI efforts for the AmSC, and supporting resources.

The ALCF and OLCF systems are architecturally distinct, consistent with DOE's strategy to manage enterprise risk, provide the Nation's HPC user community with the most effective resources, explore diverse advanced computing, AI, and QIS technologies, and expand U.S. competitiveness. The demand for 2025 INCITE allocations at the LCFs outpaced the available resources by a factor of three, the 2025–2026 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 2027 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, expand access to cutting edge AI and quantum hardware, and develop new services essential to the Genesis Mission.

High Performance Network Facilities and Testbeds

The FY 2027 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, regularly achieving lossless high-volume low-latency data transmission 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 the American Science Cloud for the Genesis Mission, and DOE's data-intensive science goals. The FY 2027 Request for 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, and will also support initial planning for the ESnet7 upgrade project.

Integrated Research Infrastructure (IRI)

The FY 2027 Request for IRI Operations will support the core governance and services spanning across all ASCR Facilities and the HPDF project to meet the Department's AI research requirements and uplift the AmSC. IRI activities will translate Genesis Mission architecture and security requirements, such as interface standards, user vetting, and workflow authentication and authorization, into coherent practice across the ASCR Facilities to continually improve frictionless interoperability for the broader AmSC effort integrating SC's experimental and observational scientific user facilities, data assets, and AI tools. IRI supports DOE's Genesis Mission vision for researchers to effortlessly combine these tools in novel ways to radically increase scientific productivity for competitive advantage.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
High Performance Computing and Network Facilities **$783,708**	**$781,846**	**-$1,862**
High Performance Production Computing $170,328	$183,000	+$12,672
Funding supports 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. Funding sustains support for implementation of IRI and 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 ECP software and technologies critical to HPC operations and users and NERSC's integration with the AmSC.	The funding will support the Genesis Mission NERSC operations and the NERSC-10 upgrade project at the CD-2 baseline level as the project enters the Doudna system delivery phase.
National Energy Research Scientific Computing Center (NERSC) *$154,328*	*$151,000*	*-$3,328*
Funding continues support for operations at the NERSC user facility, including user support, power, space, system leases, and staff. Funding also supports 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 supports implementation of IRI and ECP software and technologies critical to HPC operations and users. Funding continues support for 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 ECP software and technologies critical to HPC operations and users and NERSC's integration with the AmSC. The Request continues support for exploratory efforts in AI and quantum computing to benefit the NERSC user community and advance DOE priorities.	The funding will support NERSC operations, and the NERSC-10 upgrade project at the CD-2 baseline level as the project enters the Doudna system delivery phase.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
High Performance Data Facility, OPC *$16,000*	*$32,000*	*+$16,000*
Funding provides support to complete the design of HPDF with options for phased installation in the future.	The Request provides funding to pursue CD-2/3 approval for HPDF.	The Request provides funding to pursue CD-2/3 approval for HPDF, preserving options to meet the urgency of the Department's mission needs in data-intensive research and AI.
Leadership Computing Facilities $513,000	$490,000	-$23,000
Funding continues support for operations at LCF facilities at ANL and ORNL, including user support, power, space, system leases, early access systems and testbeds, and staff. Funding also supports operations and allocation of exascale systems at OLCF and ALCF. Funding supports implementation of major upgrade projects; AI testbeds; user access to commercial quantum systems; vendor partnerships; and IRI. The LCFs continues support for 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; novel AI computing platforms for the AmSC; AI testbeds; user access to commercial quantum systems; and vendor partnerships. The LCFs will continue support for ECP software and technologies critical to HPC operations and users.	The funding will support the Genesis Mission, LCF operations, the OLCF-6 project at the target baseline as the project enters the Discovery system delivery phase, and implementation of the ALCF-4 project.
Leadership Computing Facility at ANL *$238,000*	*$225,000*	*-$13,000*
Funding supports operations and competitive allocation of the Aurora exascale system and the AI Testbed. Funding supports implementation of the ALCF-4 upgrade project. Funding continues to support implementation of IRI. ALCF continues to deploy and maintain ECP software and technologies critical to HPC operations and users.	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 and novel AI computing platforms for the AmSC. ALCF will continue to deploy and maintain ECP software and technologies critical to HPC operations and users.	The funding will support ALCF operations and implementation of the ALCF-4 upgrade project and novel AI computing platforms for the AmSC.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Leadership Computing Facility at ORNL *$275,000*	*$265,000*	*-$10,000*
Funding supports operations at the OLCF facility, including user support, power, space, maintenance, and staff. Funding supports the OLCF-6 upgrade project at the target baseline. Funding supports 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 continues to deploy and maintain ECP software and technologies critical to HPC operations and users.	The Request will support operations at the OLCF facility, including user support, power, space, maintenance, and staff. The Request will support the OLCF-6 upgrade project at the target baseline. The Request will also support operation and competitive allocation of the Frontier exascale system, access to novel quantum hardware, and the user access program for commercial quantum computing platforms. OLCF will continue to deploy and maintain ECP software and technologies critical to HPC operations and users.	The funding will support OLCF operations and the OLCF-6 upgrade project at the target baseline as the project enters the Discovery system delivery phase.
High Performance Network Facilities and Testbeds $97,261	$103,000	+$5,739
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 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 the networking requirements for AI efforts and the AmSC. Planning efforts begin for the ESnet7 upgrade project.	The funding will support the Genesis Mission, ESnet operations, implementation of site resiliency improvements, networking requirements for AI efforts and the AmSC. Planning efforts begin for the ESnet7 upgrade project.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Integrated Research Infrastructure $3,119	$5,846	+$2,727
Funding supports continuation of IRI community governance activities and software engineering for core IRI operations services.	The Request will support continuation of IRI community governance activities and software engineering for core IRI operations services that are instrumental to the AmSC.	The funding will support limited expansion of software engineering efforts that are instrumental to the AmSC and the Genesis Mission.

Advanced Scientific Computing Research
Capital Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 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 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Equipment						
Major Items of Equipment						
Total, MIEs	N/A	N/A	–	–	–	–
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.*

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 2025 Enacted	FY 2025 Current	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Scientific User Facilities - Type A					
National Energy Research Scientific Computing Center	**146,500**	**146,800**	**154,328**	**151,000**	**-3,328**
Number of Users	10,750	11,719	11,000	11,000	–
Planned Operating Hours	8,585	8,585	8,585	8,585	–
Argonne Leadership Computing Facility	**215,195**	**215,195**	**238,000**	**225,000**	**-13,000**
Number of Users	1,700	2,103	1,800	1,800	–
Planned Operating Hours	7,008	7,008	7,008	7,008	–
Oak Ridge Leadership Computing Facility	**260,000**	**260,000**	**275,000**	**265,000**	**-10,000**
Number of Users	1,800	1,738	1,900	1,900	–
Planned Operating Hours	7,008	7,008	7,008	7,008	–
Energy Sciences Network	**93,540**	**93,540**	**97,261**	**103,000**	**+5,739**
Number of Users	–	169	–	–	–
Planned Operating Hours	8,760	8,760	8,760	8,760	–
Total, Facilities	**715,235**	**715,535**	**764,589**	**744,000**	**-20,589**
Number of Users	14,250	15,729	14,700	14,700	–
Planned Operating Hours	31,361	31,361	31,361	31,361	–

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 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Number of Permanent Ph.Ds (FTEs)	811	850	850	–
Number of Postdoctoral Associates (FTEs)	341	386	386	–
Number of Graduate Students (FTEs)	510	542	542	–
Number of Other Scientific Employment (FTEs)	219	217	217	–
Total Scientific Employment (FTEs)	**1,881**	**1,995**	**1,995**	**–**

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