Office of Science Update

BESAC Meeting
April 10, 2024

Harriet Kung
Acting Director
Deputy Director for Science Programs
Office of Science

U.S. DEPARTMENT OF ENERGY | Office of Science

Energy.gov/science

With Thanks to Dr. Berhe

- First earth scientist to lead the Office of Science (SC)
- Key Accomplishments:
  - Urban Integrated Field Labs
  - Fusion
  - Exascale Computing
  - SC Energy Earthshots
  - ITER Head of Delegation
  - International agreements
  - Broadening participation
    - Reaching a New Energy Sciences Workforce (RENEW)
    - Funding for Accelerated, Inclusive Research (FAIR)
    - Promoting Inclusive and Equitable Research (PIER) Plans
    - Community Outreach
- SC does business differently due to Dr. Berhe's visionary leadership.

Deputy Director for Science Programs Realignment: Leadership Changes

- **Associate Deputy Director for Science Programs**
  - Established in last year's Office of Science realignment.
  - Dr. Linda Horton, current Associate Director of Science for Basic Energy Sciences (BES), will fill this new position effective April 7.
  - Dr. Andrew Schwartz, current Division Director for Materials Sciences and Engineering, will become Acting Director for BES.

- **Senior Advisor on Equity, Inclusion, and Accessibility**
  - Given the importance of equity and inclusion in DDSP activities, Dr. Tim Hallman, current Associate Director of Science for Nuclear Physics (NP), will be detailed to the DDSP Front Office to fill this position effective April 7.
  - Dr. Linda Horton will become Acting Director for NP.

U.S. DEPARTMENT OF ENERGY | Office of Science

Driving Discovery Science for the Nation

Discovery science supported by the Office of Science builds the foundation for ensuring America's future prosperity and competitiveness by addressing its energy, environment, and national security challenges.

Fostering Great Minds and Great Ideas

The Office of Science addresses the world's most challenging scientific problems, supporting innovation from America's brightest minds, across multiple disciplines, and at universities, DOE's national laboratories, and other research institutions.

Providing Unique, World-Class Facilities

The Office of Science stewards a suite of scientific user facilities that provide the broad scientific community with world-leading capabilities for research - from physics, materials science, and chemistry to genomics, advanced computing, and medicine.

OFFICE OF SCIENCE BY THE NUMBERS

Delivering scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States

FY23

6 CORE SCIENCE PROGRAMS

- Advanced Scientific Computing Research
- Basic Energy Sciences
- Biological and Environmental Research
- Fusion Energy Sciences
- High Energy Physics
- Nuclear Physics

3 ENGINEERING AND TECHNOLOGY OFFICES

- Accelerator Research and Development and Production
- Isotope Research and Development and Production
- Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR)

5 NATIONAL QUANTUM INFORMATION SCIENCE RESEARCH CENTERS

ACROSS ITS 10 NATIONAL LABS, OFFICE OF SCIENCE MAINTAINS APPROXIMATELY

24 MILLION
SQUARE FEET OF SPACE

1,600
BUILDINGS

38,000
ACRES OF LAND OWNED

SUPPORTS RESEARCH SPANNING

16
DOE NATIONAL LABS

50
STATES, GUAM, PUERTO RICO, AND WASHINGTON, D.C.

>310
UNIVERSITIES AND HIGHER-LEARNING INSTITUTIONS

4
BIOENERGY RESEARCH CENTERS

2
ENERGY INNOVATION HUB PROGRAMS

51
ENERGY FRONTIER RESEARCH CENTERS

STEWARDS 10 DOE NATIONAL LABORATORIES

3
World-Leading Supercomputers

ESTIMATED RESEARCHERS SUPPORTED

- **11,100** Permanent PhDs
- **3,400** Postdoctoral Associates
- **5,200** Graduate Students
- **9,700** Other Scientific Personnel

OVER 39,500 USERS AT 28 OFFICE OF SCIENCE FACILITIES

10
SITE OFFICES

1
CONSOLIDATED SERVICE CENTER

OVER 100 NOBEL PRIZES

$8.1 BILLION
OVERALL OFFICE OF SCIENCE BUDGET

$918 MILLION
USER FACILITY CONSTRUCTION

$281 MILLION
SCIENCE LABORATORIES INFRASTRUCTURE

Highlights from the FY 2024 Enacted Budget

- FY 2024 Enacted: $8.24B, an increase of $140M over FY 2023 Enacted
- Initiate Microelectronics Science Research Centers at $30M
- Initiate Fusion Innovation Research Engine (FIRE) Collaboratives at $45M
- SC Energy Earthshots reduced to $20M
- User facilities at 89% optimal operations
- "The Department is directed to provide not later than 90 days, and quarterly thereafter, a briefing on its actions to progressively move to fully funding research awards of $2,500,000 or less."

FY 2024 RENEW and FAIR FOAs are open

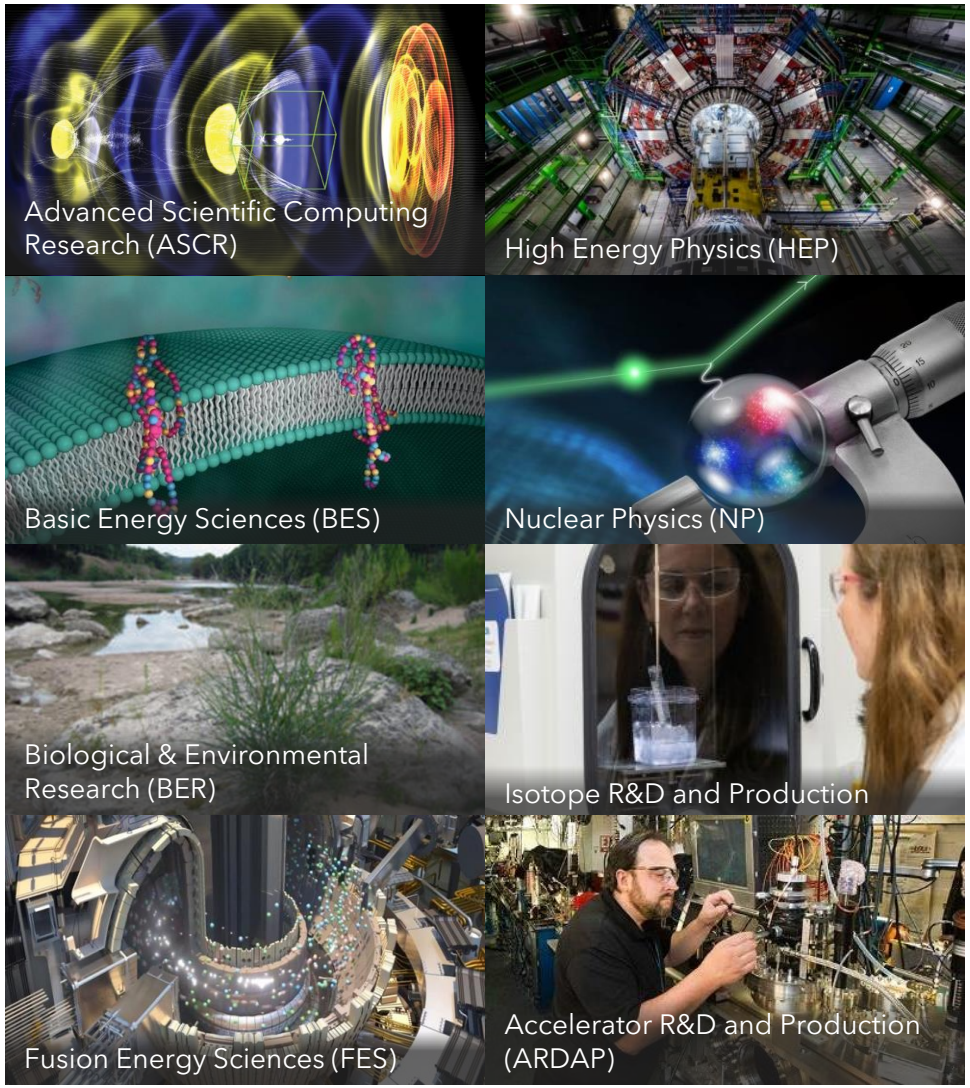
- FY 2024 FAIR FOA - https://science.osti.gov/Initiatives/FAIR
  - Build research capacity, infrastructure, and expertise at institutions historically underrepresented in the SC portfolio
  - Up to $35 million in current fiscal year funds available
  - All applications must be submitted on behalf of a lead institution that is a non-R1 emerging research institution or non-R1 minority serving institution.
  - Pre-applications due April 23
- FY 2024 RENEW FOA - https://science.osti.gov/Initiatives/RENEW
  - Build foundations through traineeships at institutions historically underrepresented in the SC portfolio
  - Single, combined solicitation; up to $50 million in current fiscal year funds available
  - All applications must be submitted on behalf of a lead institution that is a non-R1 emerging research institution or non-R1 minority serving institution.
  - Pre-applications due April 30

Office of Science - Guiding Principles for FY 2025 Request

FY 2023 Enacted : $8.1B
FY 2024 Enacted : $8.24B
FY 2025 Request : $8.583B

- The FY 2025 Request supports a balanced research portfolio, focused on cutting edge, early-stage R&D for discovery and use-inspired sciences. SC programs invest in basic research for the advancement of clean energy, to transform our understanding of nature, and to strengthen the foundation for S&T innovation.

- The Request includes:
  - Research investments
  - Moving towards optimal operations and upgrades to scientific user facilities
  - Upgrades/improvements to national laboratories infrastructure/utilities and reduce deferred maintenance



FY 2025 Request – Research Highlights

- Artificial Intelligence research (+$93.127M; $259M)
- Microelectronics (+$22M, $94.7M), including $45M for Microelectronics Science Research Centers
- U.S. Fusion Acceleration (+$18.8M), including the Fusion Innovation Research Engine (FIRE) collaboratives
- Climate Initiative ($20M)
- SC Energy Earthshots (+$95M; $115M)
- Broadening Participation & Workforce Development
  - Reaching a New Energy Sciences Workforce (RENEW) to increase participation to include non-R1 MSIs (+$68.6M; $120M)
  - Funding for Accelerated, Inclusive Research (FAIR) (+$31.6M; $64M)

FY 2025 Request – Lab & User Facility Operation and Construction Highlights

- Scientific user facility operations, supporting 88% of operations (+$189.05M)
- Upgrade core laboratory infrastructure, i.e. utilities and laboratory workspace through ongoing SLI infrastructure projects and General Plant Projects (+$31.7M; $50M)
- Support line-item construction and MIE projects
- Reduce backlog of deferred maintenance and improve obsolete infrastructure at SC National Laboratories
- Continue the Laboratory Operations Apprentice Program (+$2M; $5M)
- SC fully funds Oak Ridge Nuclear Operations

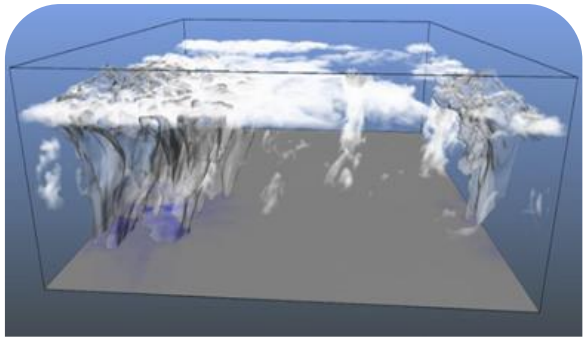
Artificial Intelligence and Machine Learning

FY 2025 $259.0M, Δ=+$93.1M

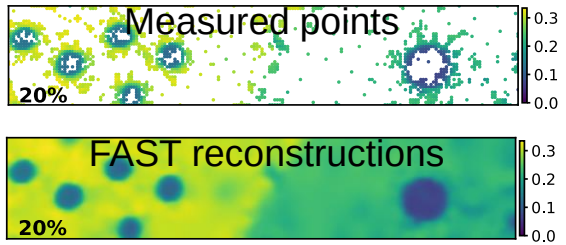
DOE FASST (Frontiers in Artificial intelligence for Science, Security, and Technology) initiative – investing in transformative AI for science.

- AI for Science, including Scientific AI Foundation Models
  - AI to accelerate innovation for forefront science and for models trained on unique, highly-curated scientific datasets, including models that can *only* be trained on supercomputers
- AI Hardware Innovation
  - New AI algorithms and hardware co-design to improve energy efficiency by >100x, including dedicated AI hardware that leverages exascale software
- AI for User Facilities and Advanced Instrumentation/Technology
  - Optimized, self-driving, autonomous instruments/experiments and real-time data analysis, coupling experimental instruments to computing and AI resources
  - AI-enabled real time control of accelerators and detectors for optimal operational efficiency
- AI Tools for Design and Evaluation of Trustworthy AI Systems
  - New storage and archival tools for FAIR (Findable, Accessible, Interoperable, and Reusable) data and privacy-preserving algorithms to enable science using proprietary and sensitive data
- A diverse AI workforce
  - Leverage the broad and deep expertise of DOE's technical workforce, including skilled AI practitioners, to integrate AI across the science research community

Using AI-powered tools to hunt neutrinos



Fine structure of simulated clouds and drizzle with AI

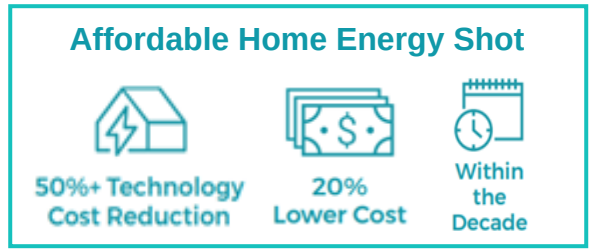


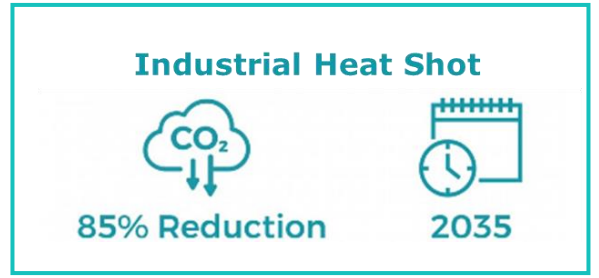
AI-driven workflow for high-resolution imaging – less data yields a full fidelity image

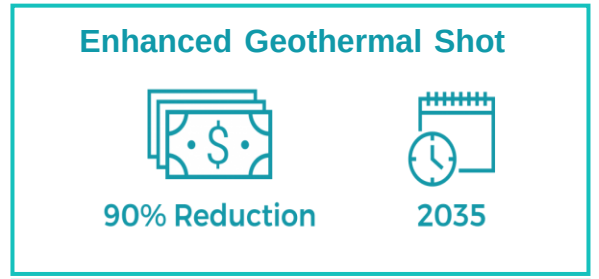
SC Energy Earthshots

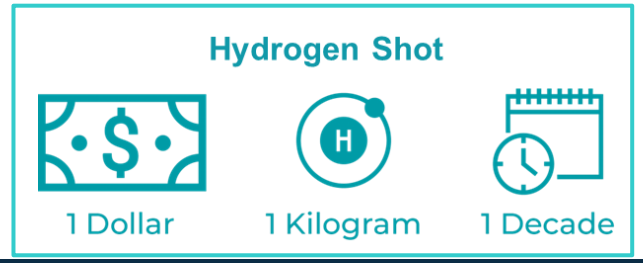
FY 2025 $115.0M, Δ=+$95M

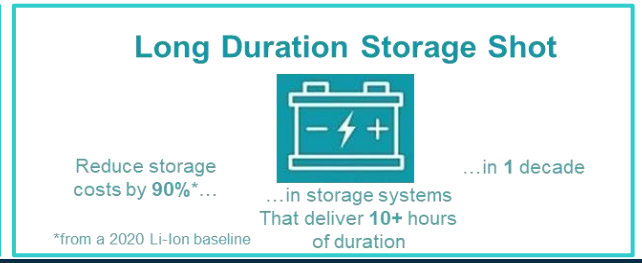
- Increases investments in fundamental research to accelerate breakthroughs required to address challenges for the stretch goals of the DOE Energy Earthshots
  - Eight Energy Earthshots have been announced; Six Shots were funded and two new efforts announced in FY 2023 (Affordable Home Energy and Clean Fuels & Products Shots)
- Continues the Energy Earthshot Research Centers (EERCs) established in FY 2023
  - Advances foundational knowledge and state-of-the-art capabilities in experimental, theoretical, and computational sciences needed to realize new approaches and solutions
  - Large, multi-investigator, multi-disciplinary national laboratory-led teams
  - Close coordination with the Energy Technology Offices and existing research consortia/demonstration projects to enhance cross-office research cooperation
- EERCs are complemented by small group awards focused on use-inspired fundamental research to address knowledge gaps that limit achievement of the Energy Earthshot goals

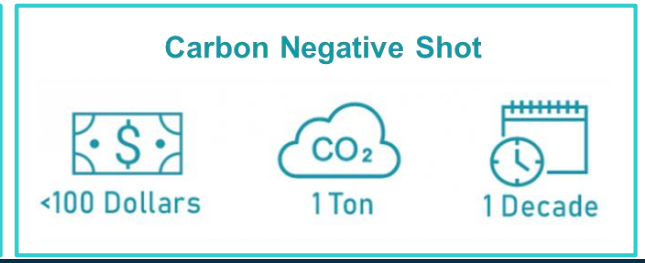






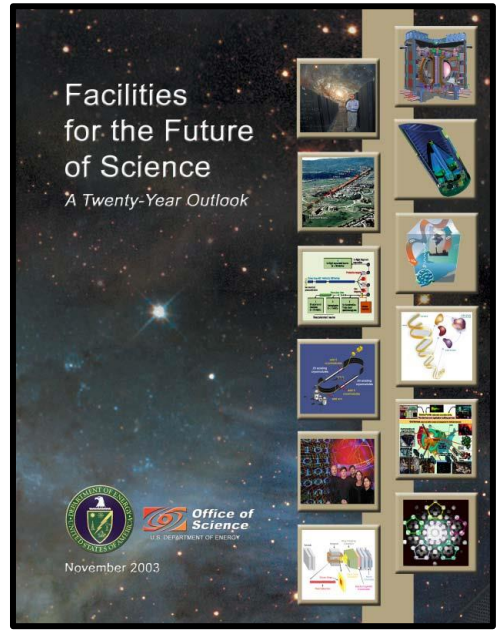


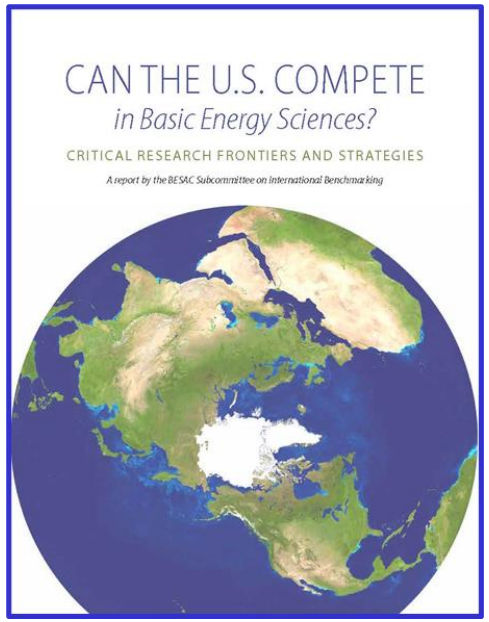




Current BESAC Priorities

- Building on the impact and success of previous BESAC assessments, the current charges focus on important priorities for the future of BES:
  - Assessment of BES facilities of the future
  - Assessment of the impact and future directions for the Nanoscale Science Research Centers
  - Input on strategies for research prioritization





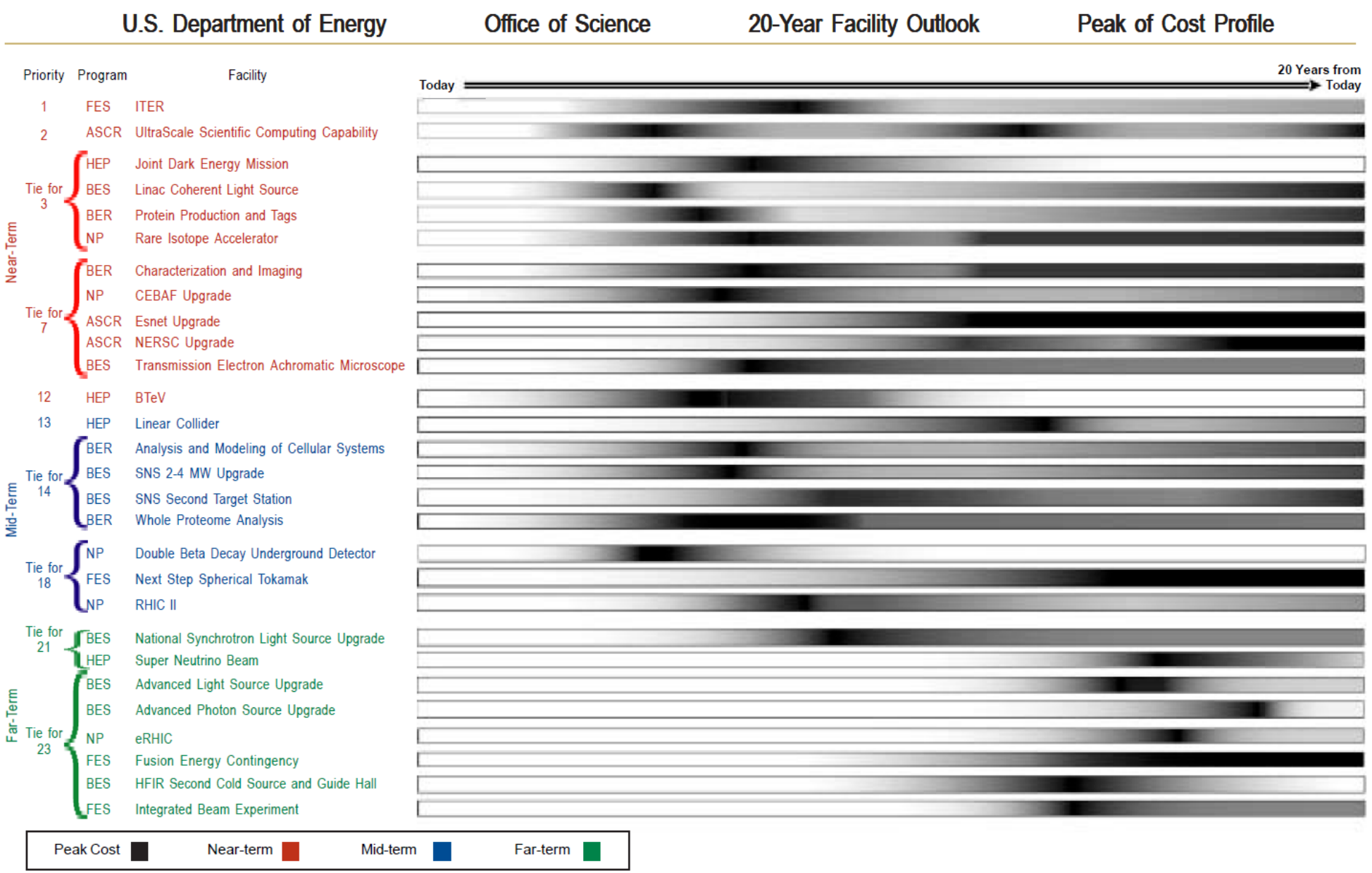
Facilities for the Future of Science established best practice of long-term planning and prioritization

- Published in 2003, report provided a prioritized list of major scientific facilities for the next 20 years
  - Interim report highlighting progress released in 2007

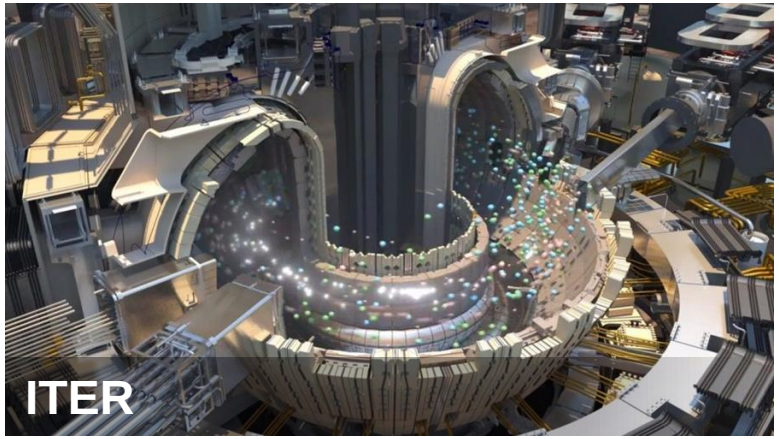
"We believe that the 20-year vision of future scientific facilities currently being developed in the Office of Science is outstanding and could have a far-reaching, positive effect on the Nation's leadership in science."

–Dr. Charles M. Vest, Chair of SEAB Task Force on the Future of Science Programs

Did the hard job of prioritizing across scientific disciplines by focusing on world leadership, timeliness



Facilities for the Future of Science has driven 20 years of investment in U.S. scientific excellence

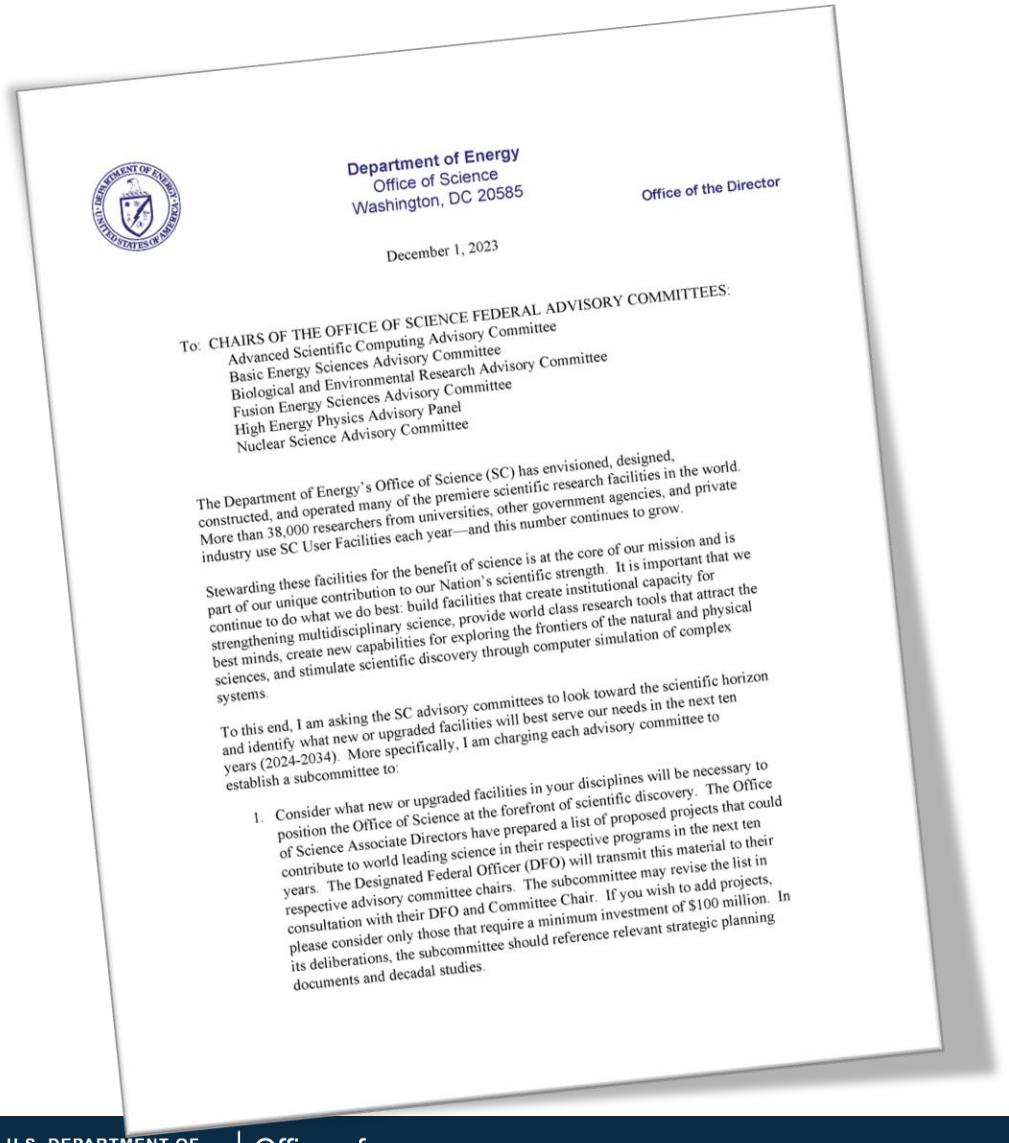


BESAC Report on BES Facility Upgrades (Report June 2016)

Project	ANL APS-U	LBNL ALS-U	ORNL SNS PPU	ORNL SNS STS	SLAC LCLS-II	SLAC LCLS-II-HE
Proposed Project	Hard X-ray ~Diffraction Limited 6 GeV MBA Ring	Soft X-ray ~Diffraction Limited 2 GeV MBA Ring	Proton Power Upgrade to 2.8 MW (2MW Target) 1.3 GeV SC Linac	High Resolution Neutron Science; Second Target Station	High Rep-Rate, Soft X-ray FEL, 4 GeV SC Linac	High Rep-Rate, Medium Energy X-ray FEL, 8 GeV SC Linac
Current Status of Facility	APS operational since 1996; ring has been replaced	ALS operational since 1993; ring will be replaced	SNS Linac operational since 2006, now at 1 GeV, 1.7MW	SNS operational since 2006	LCLS operational since 2010; LCLS-II completed	LCLS operational since 2010; LCLS-II completed
Worldwide Competition	EU ESRF Germany PETRA3,4 Japan SPring-8(-II) China HEPS	Sweden MAX-IV Brazil SIRIUS UK Diamond-II Switzerland SLS-II	EU ESS Japan JPARC China CSNS UK ISIS, ISIS-II	EU ESS Japan JPARC China CSNS UK ISIS, ISIS-II	EU XFEL Japan SACLA Korea PAL XFEL Switzerland Swiss FEL	EU XFEL China SHINE
Status 1Q/FY 2024	CD-3	CD-3	CD-2/3	CD-1	CD-4 requirements met, operation 1Q FY2024	CD-1/3A, 3B (pending CD 2/3)
Project launched	**Last funds in FY 2023** **MIE needed for Beamlines**	**Last funds in FY 2024** **MIE needed for Beamlines**	**Last funds in FY 2024**	**Included in current charge; CD-1**	**Last funds in FY 2022** **MIE needed for Beamlines**	**Included in current charge; CD-1 (CD-2/3 in FY 2024)**

Updated April 2024

Now is the time for an updated plan to advance U.S. science & innovation leadership for the next decade+



Department of Energy
Office of Science
Washington, DC 20585

Office of the Director

December 1, 2023

To: CHAIRS OF THE OFFICE OF SCIENCE FEDERAL ADVISORY COMMITTEES:
Advanced Scientific Computing Advisory Committee
Basic Energy Sciences Advisory Committee
Biological and Environmental Research Advisory Committee
Fusion Energy Sciences Advisory Committee
High Energy Physics Advisory Panel
Nuclear Science Advisory Committee

The Department of Energy's Office of Science (SC) has envisioned, designed, constructed, and operated many of the premiere scientific research facilities in the world. More than 38,000 researchers from universities, other government agencies, and private industry use SC User Facilities each year—and this number continues to grow.

Stewarding these facilities for the benefit of science is at the core of our mission and is part of our unique contribution to our Nation's scientific strength. It is important that we continue to do what we do best: build facilities that create institutional capacity for strengthening multidisciplinary science, provide world class research tools that attract the best minds, create new capabilities for exploring the frontiers of the natural and physical sciences, and stimulate scientific discovery through computer simulation of complex systems.

To this end, I am asking the SC advisory committees to look toward the scientific horizon and identify what new or upgraded facilities will best serve our needs in the next ten years (2024-2034). More specifically, I am charging each advisory committee to establish a subcommittee to:

1. Consider what new or upgraded facilities in your disciplines will be necessary to position the Office of Science at the forefront of scientific discovery. The Office of Science Associate Directors have prepared a list of proposed projects that could contribute to world leading science in their respective programs in the next ten years. The Designated Federal Officer (DFO) will transmit this material to their respective advisory committee chairs. The subcommittee may revise the list in consultation with their DFO and Committee Chair. If you wish to add projects, please consider only those that require a minimum investment of $100 million. In its deliberations, the subcommittee should reference relevant strategic planning documents and decadal studies.

- SC Director Berhe charged each advisory committee to form subcommittee to assess list of future facilities from Associate Directors
- Assessment on:
  - The potential to contribute to world-leading science in the next decade.
  - The readiness for construction.
- Assessments due to Advisory Committees by May 2024
- SC leadership will gather input and develop prioritized strategy for facility investments for next decade