

Office of Science Update

HEPAP Meeting May 9, 2024

Harriet Kung

Acting Director

Deputy Director for Science Programs

Office of Science



U.S. DEPARTMENT OF
ENERGY

Office of
Science

[Energy.gov/science](https://www.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, former Associate Director of Science for Basic Energy Sciences (BES), has filled this new position since April 7.
- Dr. Andrew Schwartz, current Division Director for Materials Sciences and Engineering, becomes Acting Director for BES.

◆ Senior Advisor on Equity, Inclusion, and Accessibility

- Given the importance of equity and inclusion in DDSP activities, Dr. Tim Hallman, Associate Director of Science for Nuclear Physics (NP), has been detailed to the DDSP Front Office to fill this position effective April 7.
- Dr. Linda Horton is appointed as Acting Director for NP.

Deputy Director for Science Programs

Realignment:

New Divisions

◆ Fusion Energy Sciences (FES) Enabling Science and Partnerships (ESP) Division

- We are creating a third division within FES to better align the program with the FES strategic vision effective April 21.
- The ESP Division will address the expanded FES mission, established in the Energy Act of 2020, to develop a competitive fusion power industry in the U.S. The new ESP Division will support enabling science programs and growing partnerships with the private sector and international fusion ecosystem.

◆ High Energy Physics (HEP) Accelerator and Technology (AT) Division

- We are creating a third division within HEP, which will consolidate capabilities and expertise in accelerator research and development effective April 21.
- Accelerator Research and Development and Production (ARDAP) will be moving to this new division.
- The new AT Division will improve efficiency and effectiveness of SC investments in this critical area and will also include critical and emerging technologies such as artificial intelligence and quantum information 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

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

3

World-Leading Supercomputers

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 \$40M**
- ◆ 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 Lab Call: Microelectronics Science Research Center Projects For Energy Efficiency And Extreme Environments

- \$160 million lab funding opportunity announcement (5/8/2024) for Microelectronics Science Research Centers (MSRCs), anticipating 4-year awards.
- This funding partially implements Sec. 10731 Microelectronics Research for Energy Innovation (or Micro Act) from the CHIPS and Science Act.
- This DOE-led effort will complement the work of the broader interagency - and especially Commerce, DOD, and NSF - to advance microelectronics innovation.
- These centers will bring together teams led by our national labs to tackle fundamental science research in microelectronics with a focus on **energy efficiency and extreme environments**.
- These centers will be composed of networks of smaller awards, which will total no more than \$25 million per “center.” Each project ceiling is \$3M/year, floor \$750k/year.
- *Each awarded project will be assigned either to an MSRC focused on energy efficiency or an MSRC focused on extreme environments.*
- Pre-proposals due May 30, pre-proposal response June 20, proposal submission due July

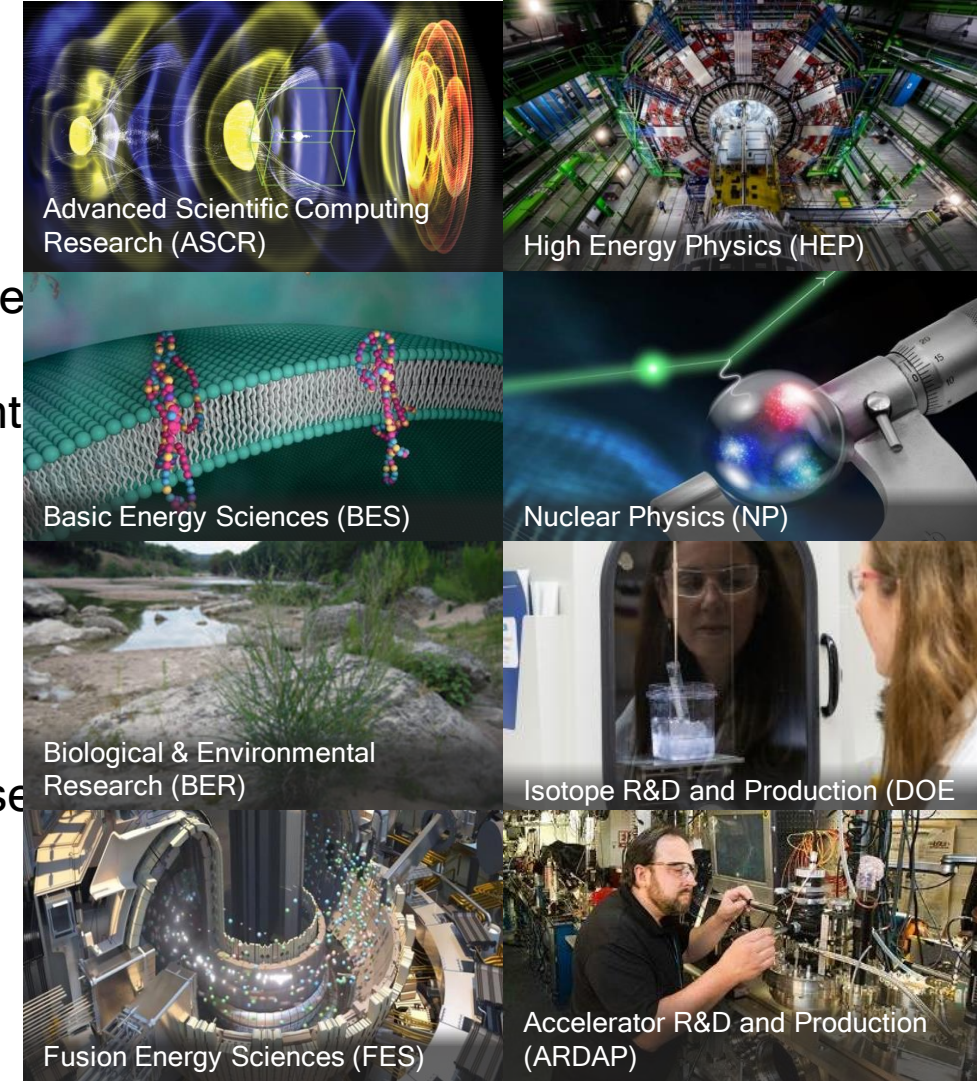
Office of Science - Guiding Principles for FY 2025 Request

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 Apprenticeship Program (+\$2M; \$5M)
 - SC fully funds Oak Ridge Nuclear Operations

Artificial Intelligence and Machine Learning

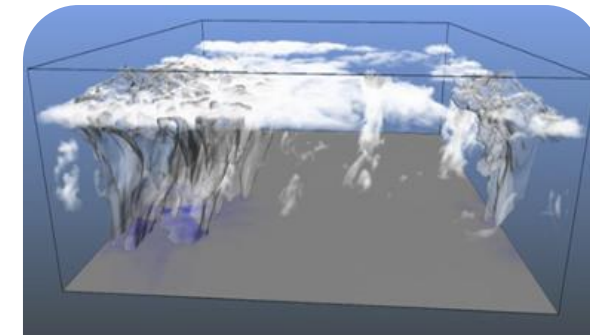
FY 2025 \$259.0M, $\Delta=+\$93.1M$

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

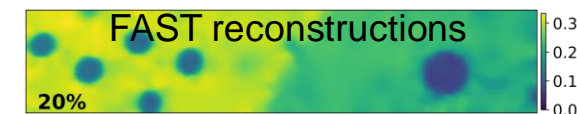
- ◆ AI for Science, including Scientific AI Foundation Models
 - AI to accelerate innovation for forefront science and for models trained on unique, highly-curated scientific datasets, including models that can *only* be trained on supercomputers
- ◆ AI Hardware Innovation
 - New AI algorithms and hardware 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



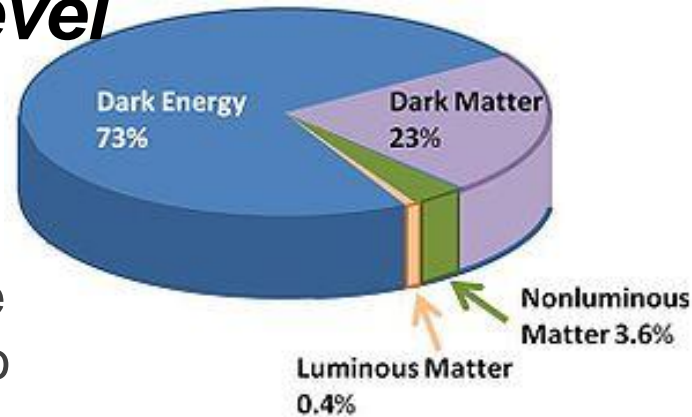
AI-driven workflow for high-resolution imaging – less data yields a full fidelity image

High Energy Physics (HEP)

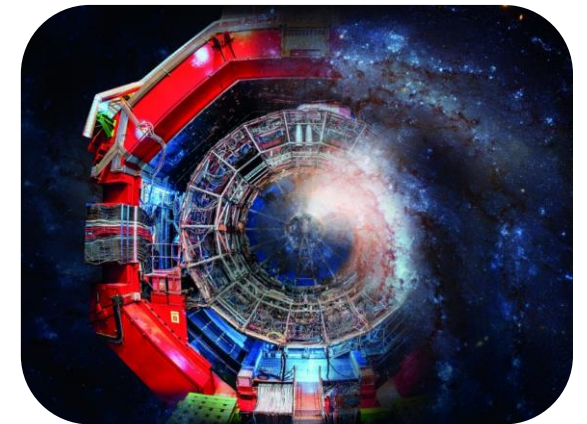
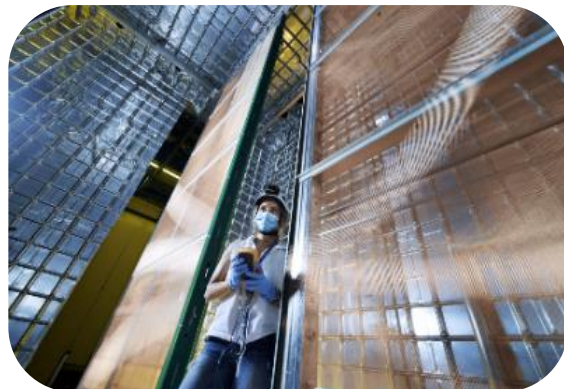
Understanding the how the universe works at its most fundamental level

Office of Science supports HEP to carry out this mission through experiments on the Energy, Intensity and Cosmic Frontier by:

- building **projects** that enable discovery science
- operating **facilities** that provide the capability to perform discovery science
- supporting a balanced **research** program that produces discovery science



2023 P5 Report



Current NSAC Charge: *2003 Facilities for the Future of Science* established best practice of long-term planning and prioritization

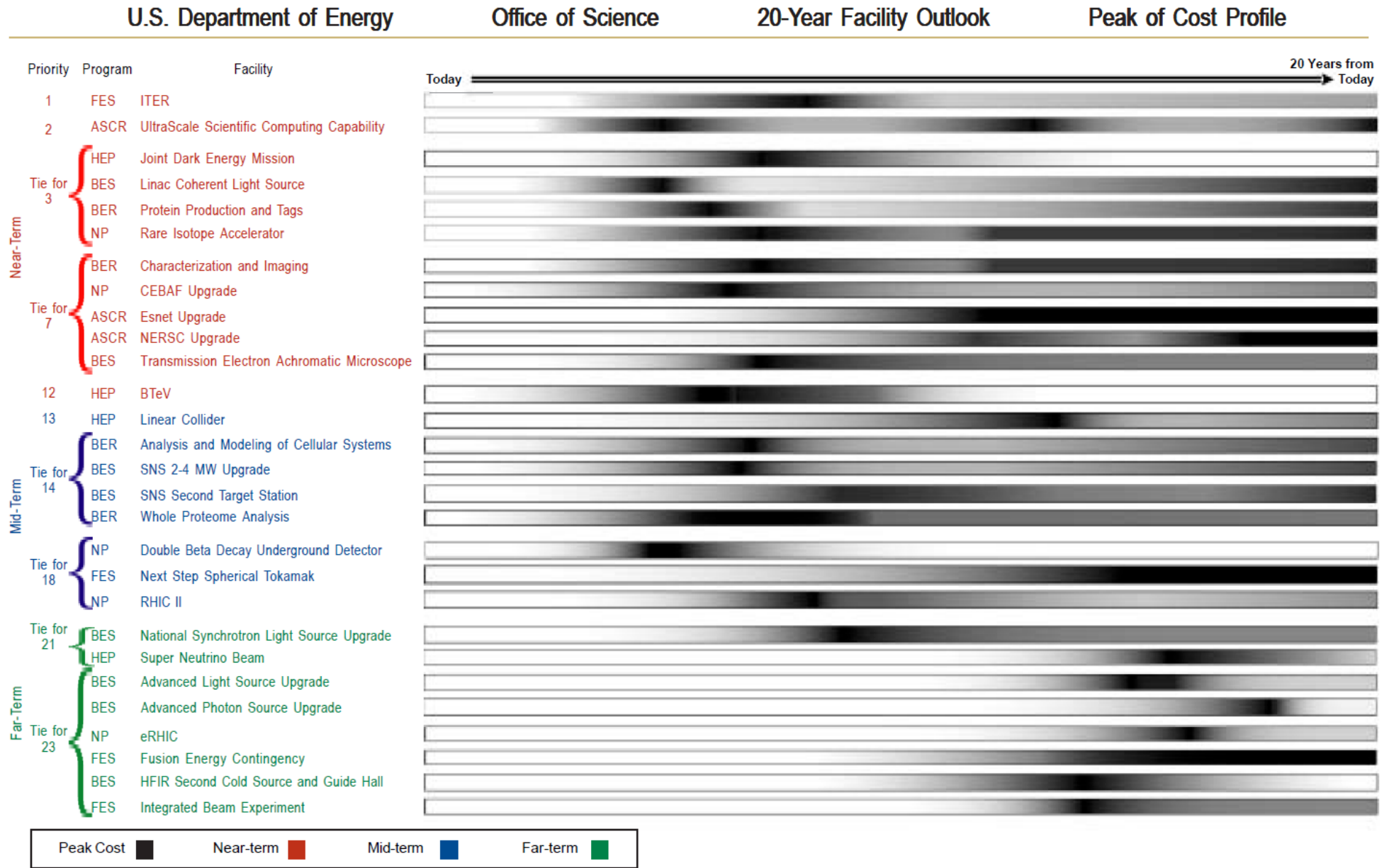
- ◆ Published in 2003, report provided a prioritized list of major scientific facilities for the next 20 years
 - Interim report highlighting progress released in 2007

“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.”

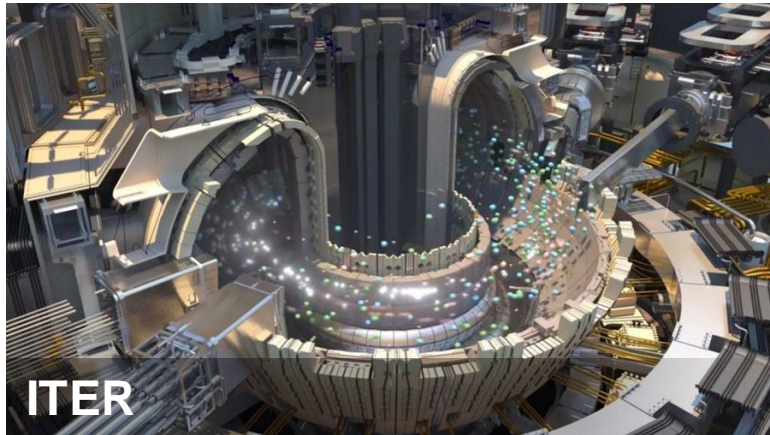
–Dr. Charles M. Vest, Chair of SEAB Task Force on the Future of Science Programs



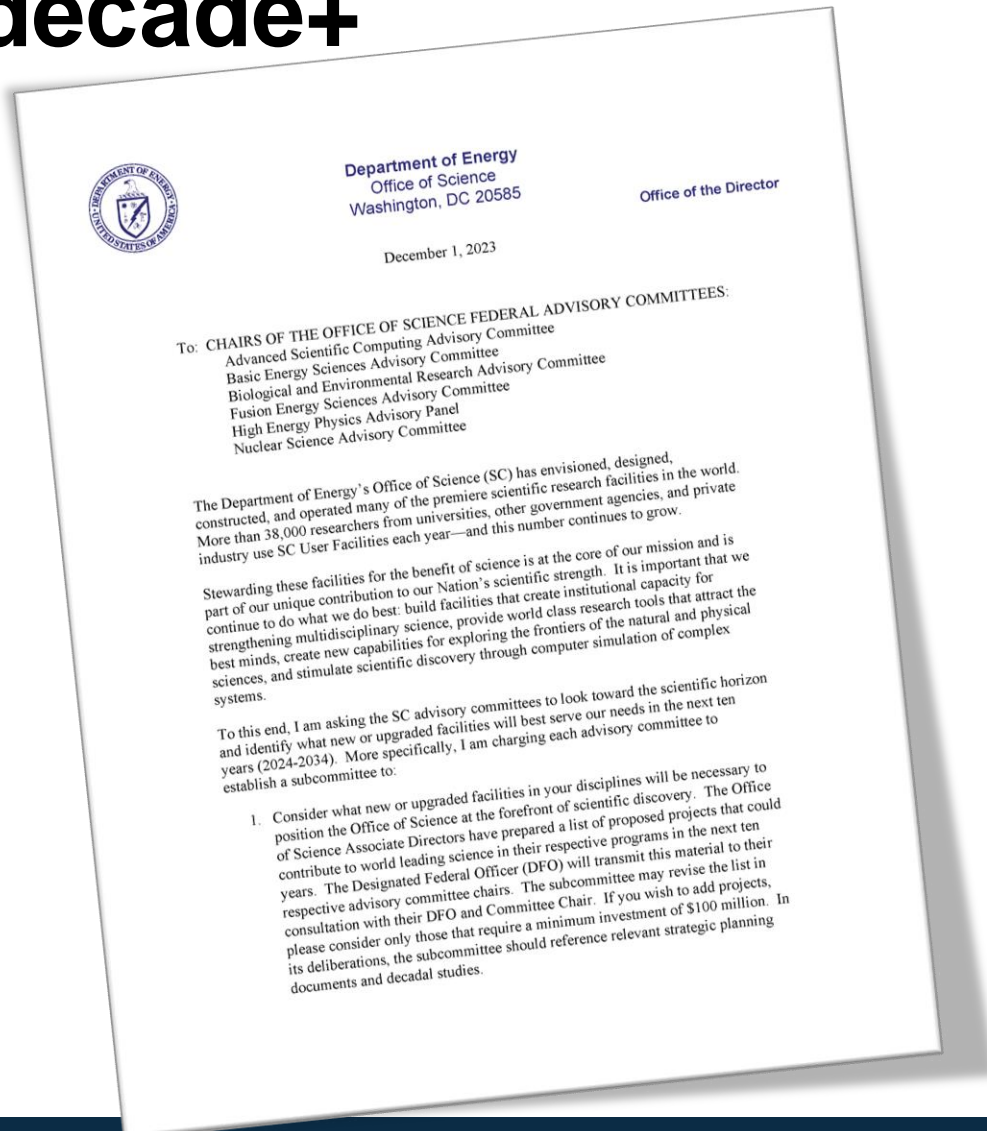
hard job of prioritizing across scientific disciplines by focusing on world leadership, timelines



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



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



- ◆ 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

List of projects provided by HEP considered by sub-panel

- ◆ LBNF/DUNE Phase I
- ◆ Off-Shore Higgs Factory
- ◆ CMB-S4 : Cosmic Microwave Background Survey
- ◆ LBNF/DUNE Phase II :
 - ACE-MIRT (2.1MW to LBNF)
 - FD3 (3rd far at SURF for DUNE),
 - MCND (more capable Near Detector at FNAL for DUNE)
 - FD4 (4th detector at SURF)
- ◆ ACE-BR (Fermilab Booster Replacement)
- ◆ Accelerator Test Facilities
- ◆ G3 Dark Matter (Generation 3)
- ◆ Spec-S5
- ◆ 10 TeV pCM Collider