

Office of Science Update

NSAC Meeting April 26, 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://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.



U.S. DEPARTMENT OF
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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

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

51

ENERGY FRONTIER RESEARCH CENTERS

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

- ◆ 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) are now closed.
- ◆ 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

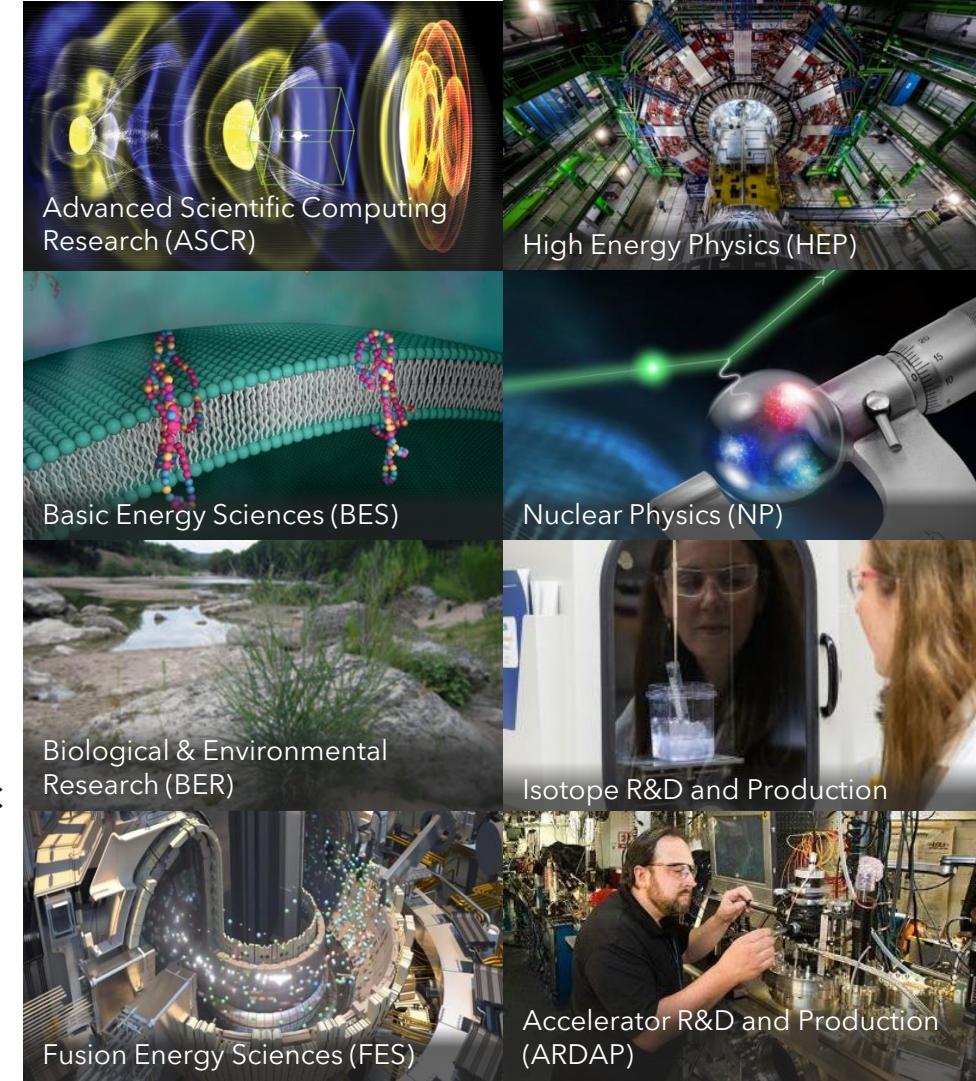
Office of Science - Guiding Principles for FY 2025 Request

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

Artificial Intelligence and Machine Learning

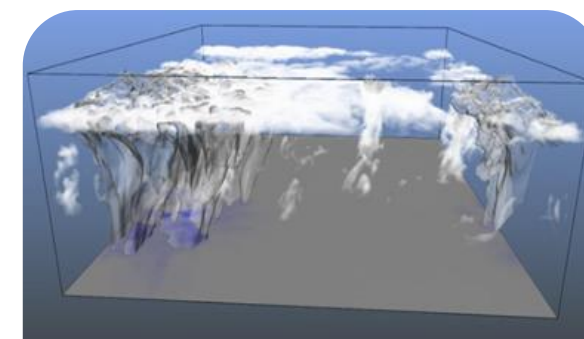
FY 2025 \$259.0M, $\Delta=+\$93.1M$

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


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

<p>Affordable Home Energy Shot</p>  <p>50%+ Technology Cost Reduction</p>  <p>20% Lower Cost</p>  <p>Within the Decade</p>
<p>Floating Offshore Wind Shot</p>  <p>>70% Reduction</p>  <p>2035</p>
<p>Industrial Heat Shot</p>  <p>85% Reduction</p>  <p>2035</p>
<p>Enhanced Geothermal Shot</p>  <p>90% Reduction</p>  <p>2035</p>
<p>Clean Fuels and Products</p>  <p>85% Reduction</p>  <p>2035</p>


Hydrogen Shot



1 Dollar




1 Kilogram



1 Decade

Long Duration Storage Shot




Reduce storage costs by 90%*...
*from a 2020 Li-Ion baseline


...in storage systems That deliver 10+ hours of duration

...in 1 decade


Carbon Negative Shot



<100 Dollars



1 Ton



1 Decade

NSAC Priorities: Congratulations on The New NP Long Range Plan: A New Era of Discovery

Capitalize on the extraordinary opportunities for scientific discovery made possible by the substantial and sustained investments of the United States. We must draw on the talents of all in the nation to achieve this goal.

We reaffirm the exceptionally high priority of the following two investments in new capabilities for nuclear physics. The Electron–Ion Collider (EIC), ...will elucidate the origin of visible matter in the universe and significantly advance accelerator technology... Neutrinoless double beta decay experiments have the potential to dramatically change our understanding of the physical laws governing the universe.

As the highest priority for new experiment construction..., lead an international consortium that will undertake a neutrinoless double beta decay campaign.

We recommend the expeditious completion of the EIC as the highest priority for facility construction.

Capitalize on the unique ways nuclear physics can advance discovery science and applications for society.



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

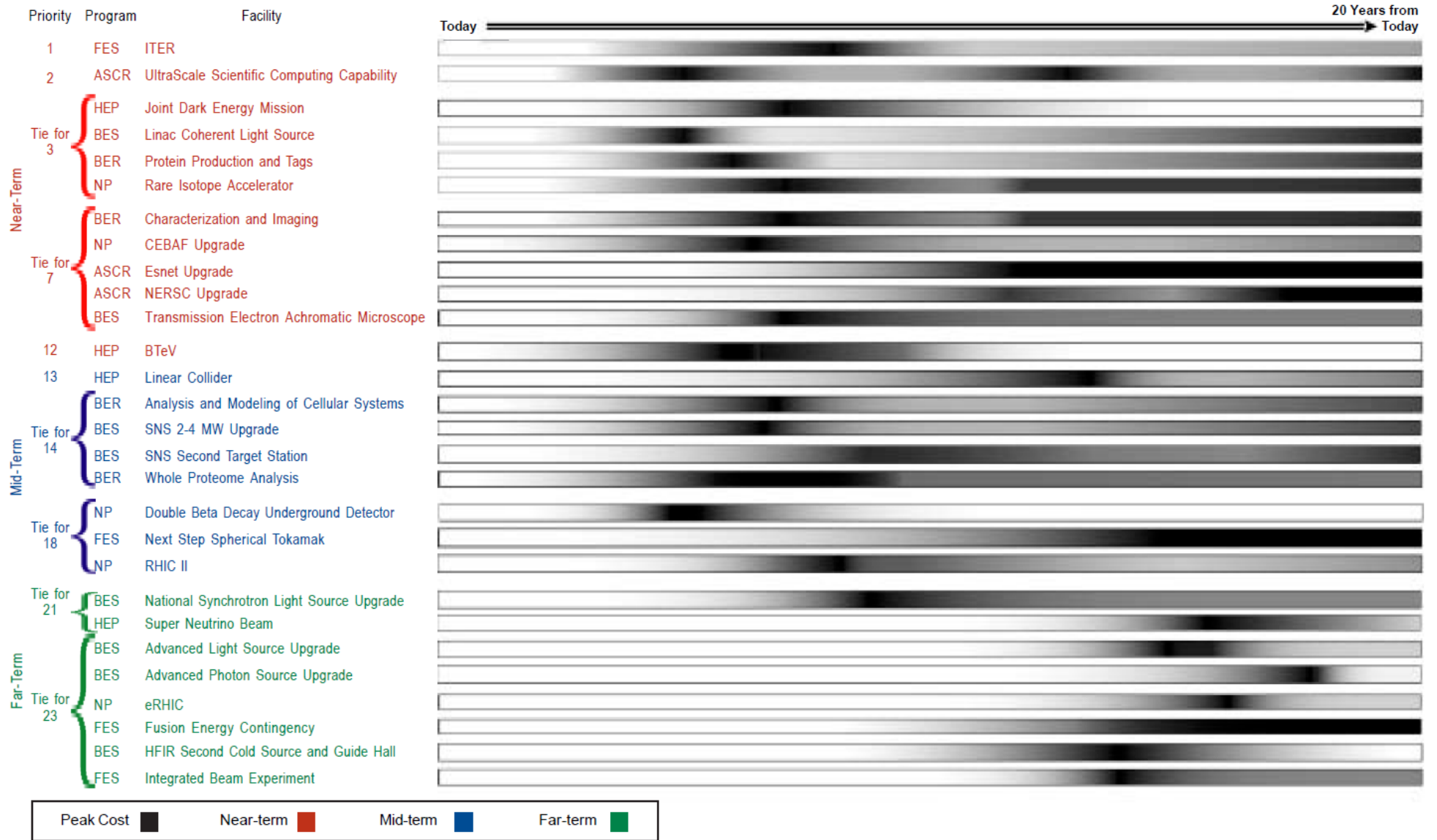
- ◆ Published in 2003, report provided a prioritized list of major scientific facilities for the next 20 years
 - Interim report highlighting progress released in 2007

"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."

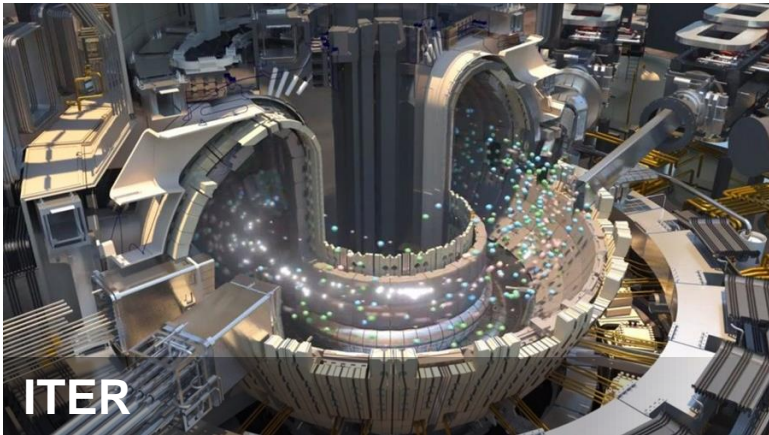
–Dr. Charles M. Vest, Chair of SEAB Task Force on the Future of Science Programs



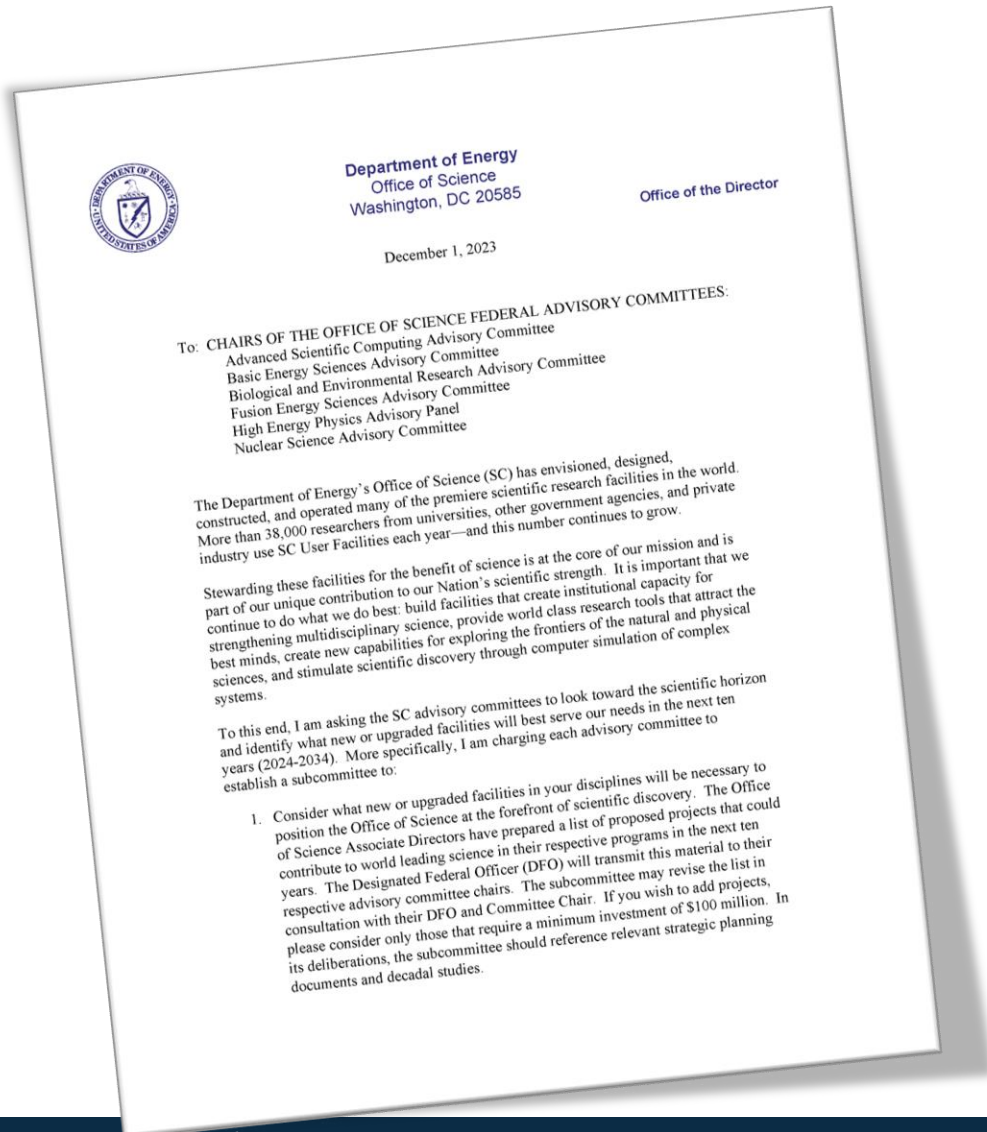
Did the hard job of prioritizing across scientific disciplines by focusing on world leadership, timeliness



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



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

NSAC Facilities Charge: NP Projects

List of projects provided by NP for consideration by the subcommittee:

- ◆ Electron-Ion Collider (EIC)
- ◆ High Rigidity Spectrometer (HRS)
- ◆ Ton Scale Neutrinoless Double Beta Decay (TS-NLDBD)
 - Large Enriched Germanium Experiment for NLDBD (LEGEND-1000)
 - Next Enriched Xenon Observatory (nEXO)
 - Cryogenic Underground Observatory for Rare Events with Particle Identification (CUPID)
- ◆ Project 8
- ◆ FRIB Energy Upgrade (FRIB400)
- ◆ Solenoid Large Intensity Device (SoLID)
- ◆ EIC Detector II

Call for Nominations: 2025 E.O. Lawrence Awards

- ◆ **Award recognizes** mid-career U.S. scientists and engineers for exceptional technical contributions and achievements in research and engineering supporting the broad missions of DOE and its programs to advance national, economic, and energy security of the U.S.
- ◆ **Awards considered in nine categories:**
 - Atomic, Molecular, and Chemical Sciences
 - Biological and Environmental Sciences
 - Computer, Information, and Knowledge Sciences
 - Condensed Matter and Materials Sciences
 - Energy Science and Innovation
 - Fusion and Plasma Sciences
 - High Energy Physics
 - National Security and Nonproliferation
 - Nuclear Physics
- ◆ **Eligibility requires nominees be:**
 - Mid-career, defined as within 20 years of earning highest degree (2004 or later);
 - United States citizen;
 - Recognized for achievement(s) in research principally funded by DOE; and
 - Recognized primarily on the scientific impact and technical significance of their work relative to its discipline and/or related DOE mission.
- ◆ **Deadline to submit nominations: Thursday, May 9, 2024, 5:00 p.m. ET**
 - Submit nominations via Lawrence Award Online System: <https://apps.ornl.gov/Award/Lawrence>
- ◆ **For additional information:** <https://science.osti.gov/lawrence>

Backup

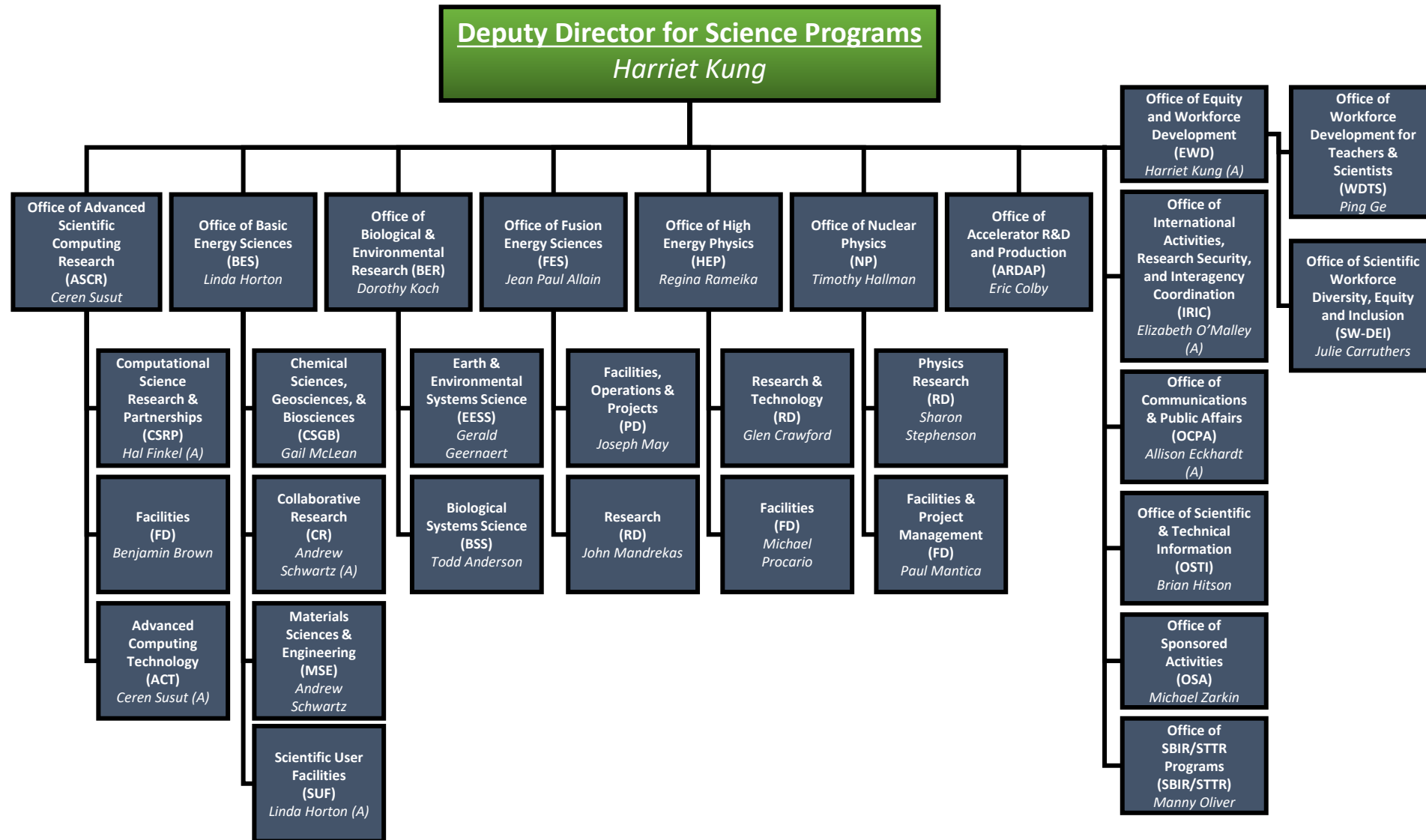


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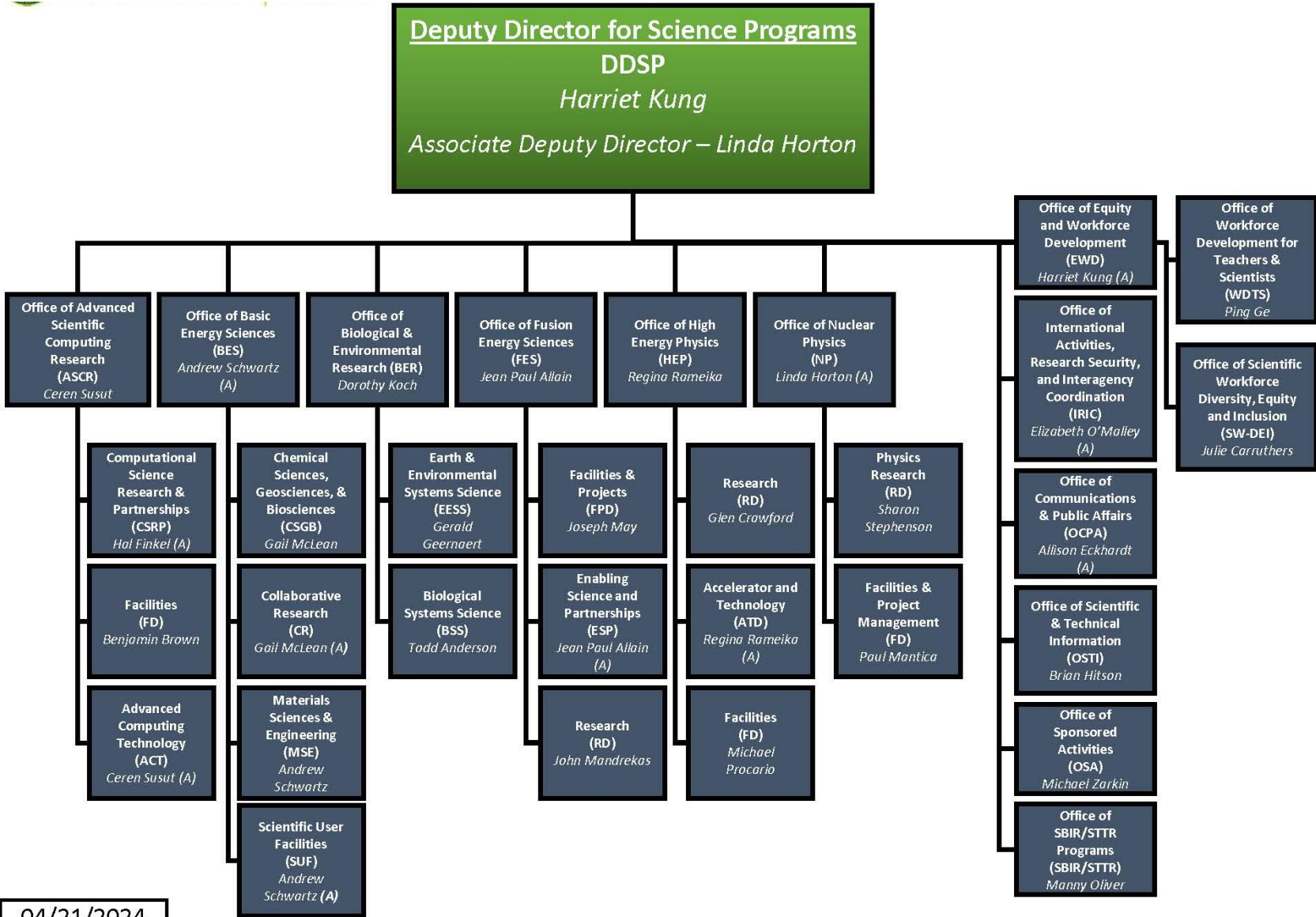
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Existing Deputy Director for Science Programs Organization



Current Deputy Director for Science Programs Organization



04/21/2024

Climate Science

FY 2025 \$20.0M $\Delta = +\$20.0M$

GOAL: Enhance and accelerate climate research with a new climate science initiative focused on robust climate-energy predictability for America's rural and semi-urban regions.

- ◆ Extend the DOE climate prediction framework with model-data fusion, involving high resolution multi-component and interdependent climate, energy, and adaptation and mitigation pathways
- ◆ Framework is assisted by advanced machine learning methodologies to constrain uncertainty and incorporation of digital twins.
- ◆ Research is informed by community and stakeholder engagement from America's rural and semi-urban regions, to complement the Urban Integrated Field Laboratories.
- ◆ FY 2025 Activities:
 - Design the end-products with community and stakeholder engagement
 - Design and launch a predictive framework that combines climate, electric grid, clean energy, and other infrastructure modeling and data into a unified system
 - Initiative will be led by a consortium of emerging research institutions and underserved HBCU and MSI communities, and national labs



Office Hours

- ◆ As part of efforts to improve outreach and accessibility, SC is holding monthly virtual office hours to share information and provide opportunities to ask questions.
- ◆ All are welcome to attend; no existing relationship with DOE or the DOE national laboratories is required. Research administrators are also encouraged to attend.
- ◆ Program managers will be available to answer questions.
- ◆ Schedule and details on the program office hour pages at science.osti.gov:
 - ASCR – second Tuesday of the month
 - BES – third Thursday of the month
 - BER – fourth Tuesday of the month
 - FES – first Wednesday of the month
 - HEP – third Tuesday of the month
 - NP – first Monday of the month
 - ARDAP – second Wednesday of the month
 - IP – second Monday of the month

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U.S. Fusion Program Acceleration

FY 2025 \$116.8M , $\Delta=+\$18.8M$

- ◆ **Fusion Development Milestone Program:** Resolve S&T challenges for commercializing fusion energy through partnerships with the private sector; a key goal of this program is the achievement of preconceptual designs and technology roadmaps for a Fusion Pilot Plant
- ◆ **Fusion Innovation Research Engine (FIRE) Collaboratives:** Address critical scientific and technology gaps in enabling technologies, advanced simulations, blanket/fuel cycle and materials; bring together discovery science, innovation, and translational research in partnership with multiple public and private partners
- ◆ **Future Facilities Studies:** Support design studies/R&D for future facilities
- ◆ **INFUSE:** Provide private-sector fusion companies with access to world-class expertise and capabilities available at DOE's national laboratories and U.S. universities
- ◆ **Inertial Fusion Energy (IFE):** Implement priority research opportunities identified in the IFE Basic Research Needs Workshop