Office of Science Update

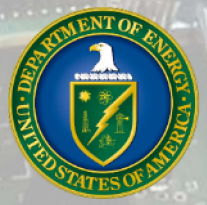
Board on Physics and Astronomy 2023 Fall Meeting

Harriet Kung
Deputy Director for Science Programs

November 8, 2023

U.S. DEPARTMENT OF ENERGY | Office of Science

Energy.gov/



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 World-Clas

The Office of Sc
a suite of scientif
that provide the
community with
capabilities for
physics, materia
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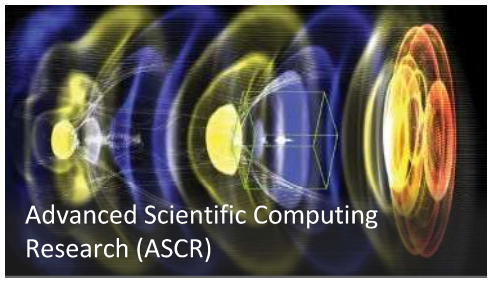
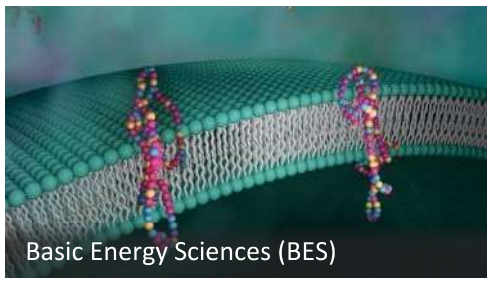
Office of Science Guiding Principles for Budget Formulati

FY 2023 Enacted: $8.1B
FY 2024 President's Request: $8.8B

- Sustain the **critical enabling infrastructure** for U.S. global leadership in innovation that is unique to SC
- Advance **critical and emerging technologies** crucial to U.S. leadership in innovation and the growth of our inclusive 21st-century economy
- Recruit and retain the **next generation innovation workforce** that looks like all of America and deliver on Justice40
- Bring all of SC's capabilities to bear on **addressing the climate crisis**
- Meet the **challenges of our present moment** by addressing the impact of inflation, supply-chain challenges, and rapidly changing threat landscape





Office of Science FY 2024 Request Highlights

Increases investments in Administration priorities to include:

- **Facility operations supported at ~90% optimal funding levels** (+$189M)
- **U.S. Fusion Program Acceleration** supporting public/private partnerships (+$27
- **Microelectronic Science Research Centers** (+$60M)
- **Reaching a New Energy Sciences Workforce (RENEW)** for targeted efforts to in participation and retention of underrepresented groups in SC research activities t non-R1 MSIs (+$47M)
- **Funding for Accelerated, Inclusive Research (FAIR)** (+$13.5M)
- **Energy Earthshots** to include Geothermal, Offshore Wind, Building Sector, Proce and Transportation Sector (+$75M)
- DOE **Isotope Initiative** (+$14.5M)
- **Climate Resilience Centers** and **Urban Integrated Field Laboratories** (+$6M)

FY 2024 House Mark Highlights

FY 2024 President's Request: $8.8B

FY 2024 House Mark: $8.1B

- $20M for Energy Earthshots ($175M Request).
- No funding for RENEW or FAIR.
- No funding for SC Office of Scientific Workforce Diversity, Equity an Inclusion.
- Reductions in research across all programs.
- Most construction projects supported at the level of the request.
- General provision prohibits the Office of Science from entering into funding agreements with a value of less than $5,000,000.
  - All agreements less than $5M must be forward funded. Current level is $1M.

FY 2024 Senate Mark Highlights

FY 2024 President's Request: $8.8B

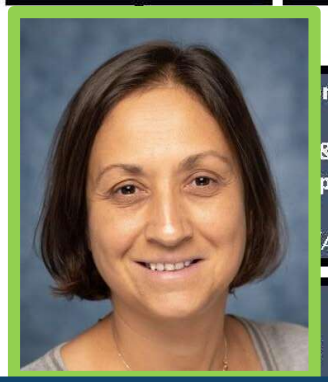
FY 2024 Senate Mark: $8.43B

- $67M for Energy Earthshots ($175M Request).
- Support for RENEW and FAIR
- Encourages microelectronics research and microelectronics science centers.
- Largest reductions in ASCR research (-$110M) and FES research (-$2 relative to request.
- Most ongoing construction projects supported at the level of the re Some new starts zeroed (HFIR PVR, NEXT-III, CARP).
- Strong support for Program Direction (+$10.5M over Request).

*Realignr

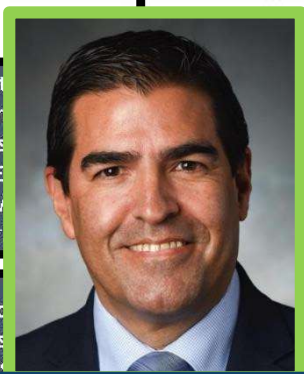
Deputy Director for Science Programs
DDSP*
Harriet Kung

- Office of Advanced Scientific Computing Research (ASCR) — *Ceren Susut*
- Office of Basic Energy Sciences (BES) — *Linda Horton*
- Office of Biological & Environmental Research (BER) — *Dorothy Koch*
- Office of Fusion Energy Sciences (FES) — *Jean Paul Allain*
- Office of High Energy Physics (HEP) — *Regina Rameika*
- Office of Nuclear Physics (NP) — *Timothy Hallman*
- Office of Accelerator R&D and Production (ARDAP) — *Eric Colby*



Dr. Ceren Susut
ASCR

Dr. Dorothy Koch
BER



Dr. Jean Paul Allain
FES

Dr. Gina Rameika
HEP

- Advanced Computing Technology (ACT) — *Ceren Susut (A)*
- Materials Sciences & Engineering (MSE) — *Andrew Schwartz*
- Scientific User Facilities (SUF)
- Physics Research (RD) — *Timothy Hallman (A)*
- Facilities & Project Management (FD) — *Paul Mantica*
- Office of Science & Technical Information (OSTI) — *Brian H*
- Office of Sponsored Activities (OSA) — *Michael*
- Office of SBIR/STTR Programs (SBIR/S

Strategic Outlook for Advanced Scientific Computin Research (ASCR)

- **Leadership in AI and integrated science:** DOE operates the most capab computing systems and the world's largest collection of advanced experin facilities and is the largest producer of classified and unclassified scientific world. ASCR will invest in projects that foster the Department's user facilit nationwide AI-capable integrated research infrastructure (IRI).
- **Targeted innovation for advanced computing:** Each ASCR high perform computing, networking, and data project is a public-private partnership in ASCR drives U.S. vendors to advance technology in new directions. Advan competitiveness in energy-efficient computing, AI computational accelera quantum-HPC systems, and high-data-bandwidth computing architectures strategic priorities in the 2025-35 era.
- **An ecosystem that is both leading edge and reliable:** Moving to an inte ecosystem of unique computing and data management infrastructure, via demanding use cases can "surge" to HPC and data resources of the appro scale.

Linking distributed resources is becoming paramount to modern collaborative science, to integrated science.

The challenges of our time call upon DOE and its national laboratories to be an open innovation ecosystem.

- Accelerating discovery & innovation
- Democratizing access
- Drawing new talent
- Advancing open science

DOE's IRI Vision: *To empower researchers to meld DOE's world-class r infrastructure, and user facilities seamlessly and securely in novel way accelerate discovery and innovation*

Advanced Networking

Edge Sensors

Advanced Computing

Researchers

Local Campus Computing

Computing Testbeds

Cloud Computing

Data Management

High Performance Data Facility

Data Repositories PuRE Data Assets

Software

Software and Applications

AI Tools Digital Twins

New modes of integrated science

Rapid data analysis and steering of experiments

Novel workflows using multiple user facilities

AI-enabled insight fr integrating vast data sc

Integrated Research Infrastructure (IRI) Program Developm

FY 2021 President's Budget Request includes **Integrated** Computation and Data Infrastructure Initiative

FY 2024 Request advances IRI a
High Performance Data Facility (

ASCR IRI Task Force launch

ASCR IRI Task Force report

SC IRI Blueprint Activity launch

IRI Blueprint Activity results

IRI Program Developme

Jan **2020**

Jan **2021**

Jan **2022**

Jan **2023**

Vision **Strategy** **Implem**

The IRI Blueprint Activity created a framework for IRI imple

IRI Science Patterns (3)

Time-sensitive pattern has *urgency*, requiring real-time or end-to-end performance with high reliability, e.g., for timely decision-making, experiment steering, and virtual proximity.

Data integration-intensive pattern requires combining and analyzing data from multiple sources, e.g., sites, experiments, and/or computational runs.

Long-term campaign pattern requires sustained access to resources over a long period to accomplish a well-defined objective.

Convened over **150 DOE national laboratory experts** from **all 28 SC user facilities** across **13 national laboratories** to consider the **technological, policy, and sociological challenges** to implementing IRI.

IRI Practice Areas (6)

User experience practice will ensure relentles perspectives and needs through requirements centric (co)-design, continuous feedback, and c

Resource co-operations practice is focused o of cooperation, collaboration, co-scheduling, a across facilities and DOE programs.

Cybersecurity and federated access practice creating novel solutions that enable seamless s within a secure and trusted IRI ecosystem.

Workflows, interfaces, and automation prac creating novel solutions that facilitate the dynar components across facilities into end-to-end IR

Scientific data life cycle practice is focused or can manage their data and metadata across fac to curation, archiving, dissemination, and publi

Portable/scalable solutions practice is focuse transitions can be made across heterogeneous and from smaller to larger resources (scalability

High Performance Data Facility (HPDF)

- The HPDF mission is to enable and accelerate scientific discovery by delivering state-of-the-art data management infrastructure, capabili tools.
- HPDF will provide leadership in:
  - the stewardship of the scientific data lifecycle.
  - advanced computing models for processing streaming data, including manag high performance distributed computing and data resources, as well as interc distributed high performance data infrastructure with high-performance com resources.
- HPDF also has the potential to uplift high performance data manage research endeavor and as a community of practice.
- HPDF can provide national and regional outreach and engagement access to DOE data resources.

High Performance Data Facility (HPDF)

- Selection announced October 16
- Thomas Jefferson National Accelerator Facility (JLab) will be the HPI Director and the lead infrastructure will be located at JLab
- The project to build the Hub will be a partnership between JLab and Berkeley National Laboratory (LBNL), and the two labs will form a jo team led by JLab charged to create an integrated HPDF Hub design
- The HPDF will have a "hub-and-spoke" model in which JLab and LB mirrored centralized resources and also enable high priority DOE m applications at "spoke" sites by deploying and orchestrating distribu infrastructure at the spokes or other locations.

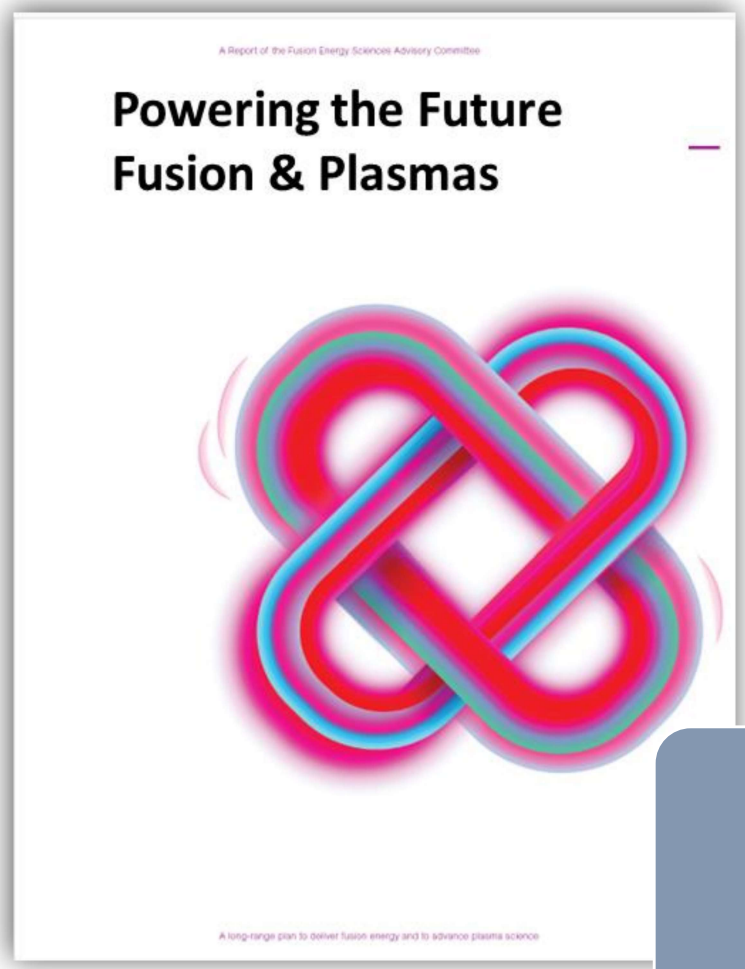
https://www.energy.gov/science/articles/us-department-energy-selects-high-performance-data-fa

Vision for Fusion Energy Sciences: Key Elem

- ***Workforce Development:*** ensuring we establish sustainable and resilient pathways for diverse and exceptional talent
- ***Building Bridges:*** Creating innovation engines with national laboratories, universities, and industry to support domestic supply chains for fusion energy
- ***Transformational Science:*** Nurturing plasma science and technology discovery translating to innovation impact

Foundational Science **will always** play a role in a vibrant ***private fusion industry***

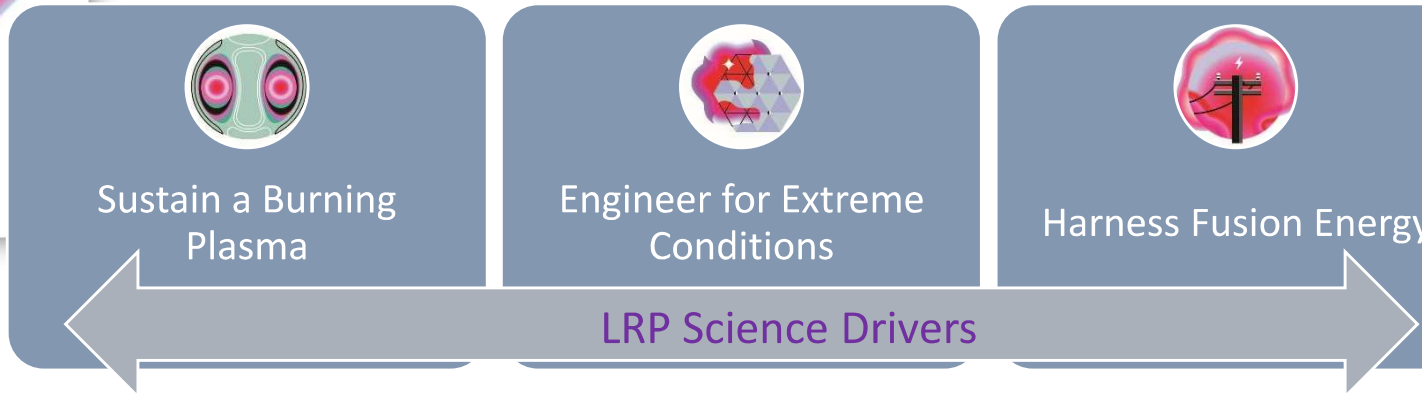
Vision for a balanced and bold FES prog



2020 FESAC
Long-Range Plan (LRP)

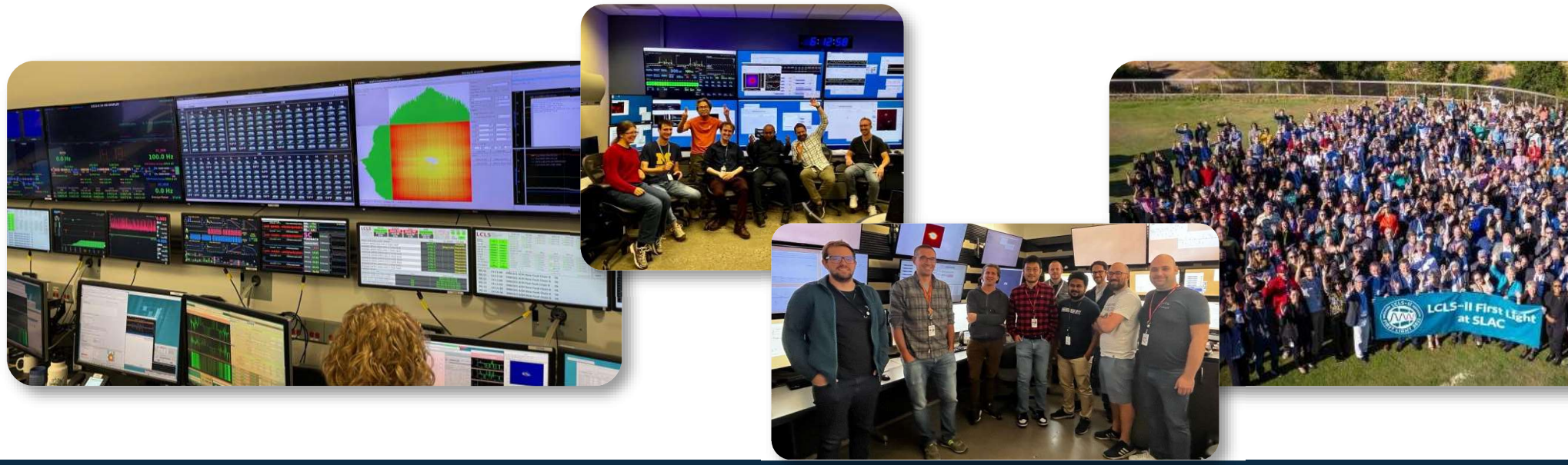
"Fulfilling the [fusion] energy mission demands a shift in the ba research toward FM&T (Fusion Materials and Technology), whic three science drivers: Sustain a Burning Plasma, Engineer for Ex Conditions, and Harness Fusion Energy." p. 6 FESAC-LRP

- U.S. Fusion Science and Technology (S&T) Roadmap
- **Focus:** critical science and technology gap
- Support public-private partnerships (PPPs)
- Leverage international collaborations



A Celebration of First Light for the LCLS-II Project

- The LCLS-II project – a 10-year, $1B effort at SLAC National Accelerator La achieved first light in August, offering beam to users in early October.
- With the upgrade, LCLS will provide X-ray pulses 10,000 times brighter tha previous system at up to one million pulses per second.
- The LCLS-II project adds capacity AND capability to LCLS, transforming th scientists to explore atomic-scale, ultrafast phenomena that are key to a br of applications, from quantum materials to clean energy technologies and



2023 Nobel Prize Recipients Supported by Basic Energy Sc

Nobel Prize in Chemistry 2023

"For the Discovery and Synthesis of Quantum Dots"

Moungi G. Bawendi (MIT)

Louis E. Brus (Columbia U.)

Aleksey Yekimov (Nanocrystal Tech., Inc.)

BES supported the research of Prof. Brus (photochemistry of carbon nanotubes, graphene, and nanoparticles) and Prof. Bawendi (quantum dot heterostructures, quantum optical materials) for twenty-five years, including through the Energy Frontier Research Center for Excitonics (Bawendi).

Nobel Prize in Physic

"for experimental methods that ge pulses of light for the study of ele matter"

Pierre Agostini (OSU)

Ferenc Krausz (Max Planck Institute)

A

BES supported Prof. Agostini (correlated electron dynamics using attosecond pulses), including research at the Linac Coherent Light Source (right), where current capabilities were enabled by the Nobel-honored work.


THANK YOU!