

Basic Energy Sciences Update

Basic Energy Sciences Advisory Committee Meeting
July 27, 2023

- ▲ Linda Horton, Gail McLean, and Andy Schwartz
- ▲ Office of Basic Energy Sciences



U.S. DEPARTMENT OF
ENERGY

Office of
Science

[Energy.gov/science](https://www.energy.gov/science)

Topics for Today's Update

- ◆ Organization and Staffing
- ◆ FY 2023 budget, FOAs, etc.
- ◆ FY 2024 Marks
- ◆ Strategic planning

New Staff
Posted Positions
Vacancies

Office of Basic Energy Sciences
Associate Director
Linda Horton

BES Budget and Planning
 Kara Beles, Financial Management
 Donetta Herbert, Financial Management
 Adam Kinney, Senior Technical Advisor
 (Vacant, Senior Technical Advisor)

BES Operations
 Teresa Crockett, Program Analyst
 Robin Hayes, Program Manager and Acting EFRC Co-Lead
 Kery Hochberger, Program Analyst / BESAC*
 Angie Thevenot, Program Analyst
 (Vacant, Senior Technical Advisor)

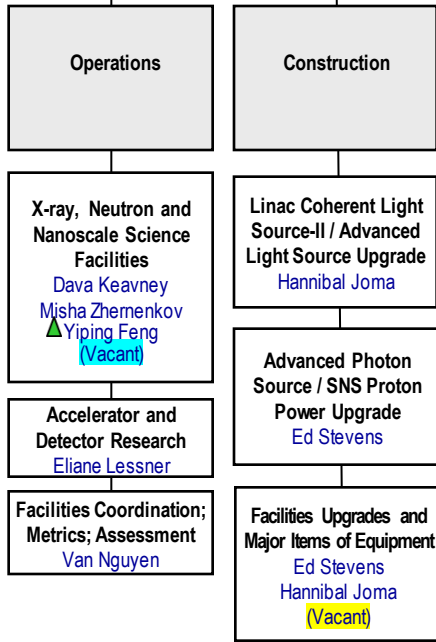
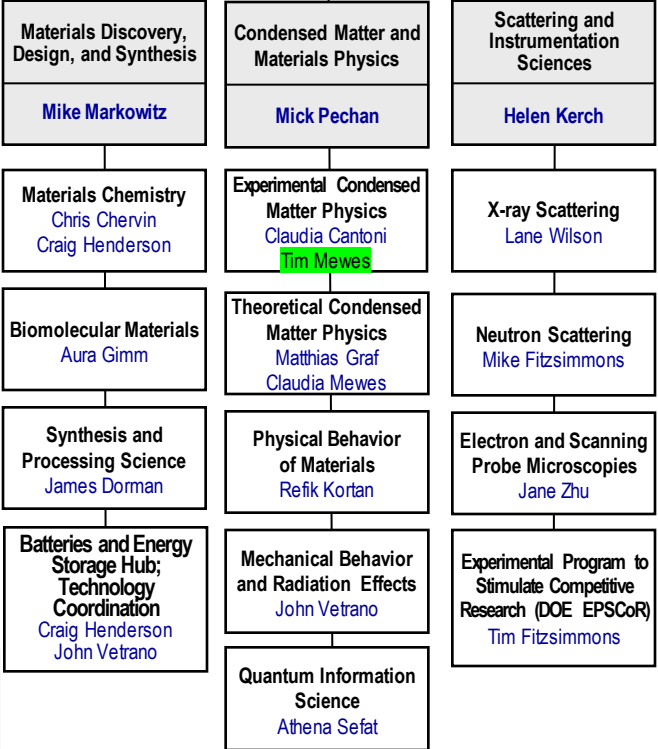
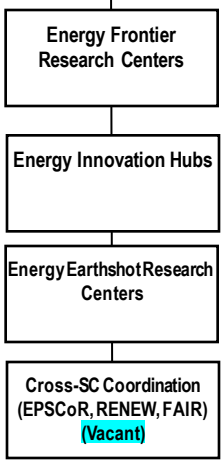
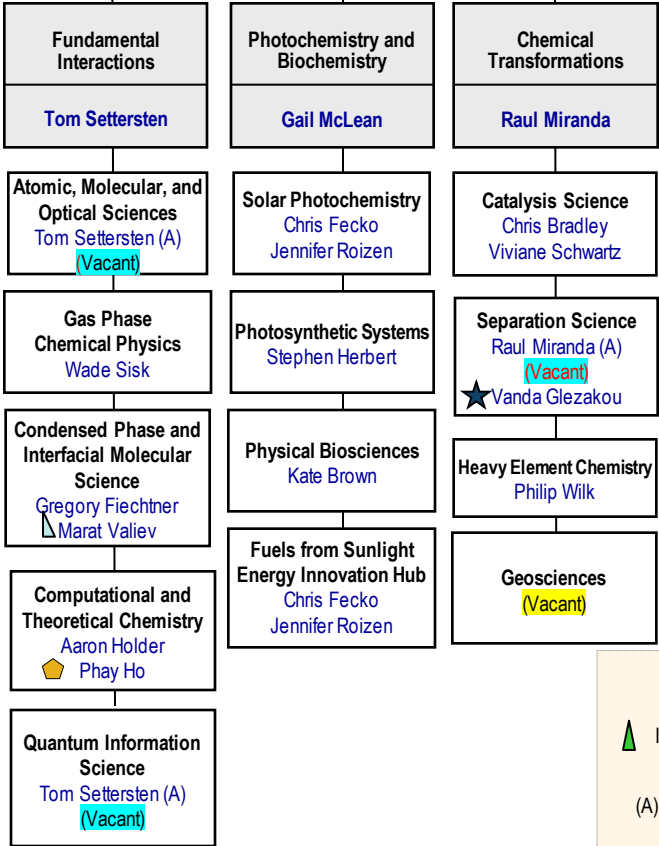
* Basic Energy Sciences Advisory Committee

Chemical Sciences, Geosciences, and Biosciences Division
Gail McLean, Acting Director
 Gregory Fiechtner, EFRC Team Co-Lead (A)
 (Vacant)

Collaborative Research Division
Andy Schwartz, Acting Director

Materials Sciences and Engineering Division
Andy Schwartz, Director
 John Vetrano, EFRC Team Co-Lead (A)
 Shawn Chen

Scientific User Facilities Division
Linda Horton, Acting Director
 Rocío Meneses, Program Support Specialist



LEGEND

- ▲ IPA from SLAC
- ★ Detailee (50%) from ORNL
- (A) Acting
- ◊ Detailee (50%) from ANL
- ◓ Detailee (50%) from PNNL

BES – Our Staff



Welcome to New BES Staff Member -- Angie Thevenot, Management and Program Analyst



- ◆ Angie joins BES following over 13 years with the Office of Advanced Scientific Computing Research (ASCR).
- ◆ Prior to DOE, Angie had administrative support experiences with companies in the Germantown-Washington DC Area.
- ◆ She has a wide range of experience in processing grants, meeting scheduling/organization, travel support, program review, and Committee of Visitor organization, and other administrative support tasks.
- ◆ For BES, Angie is part of the team that oversees, processes, and tracks grants and AFP changes for lab awards; planning and organization for COVs, program reviews, and PI meetings, including the Early Career, EFRCs, EERCs, and Hub programs.

New MSE Division Staff Member - Experimental Condensed Matter Physics



Dr. Tim Mewes

Program Manager, Experimental Condensed Matter Physics
Materials Sciences and Engineering Division

Expertise

- ◆ Experimental condensed matter and materials physics
- ◆ Electronic and magnetic materials – dynamics and spintronics
- ◆ Machine Learning and Artificial Intelligence
- ◆ Computational physics
- ◆ Materials synthesis
- ◆ Instrumentation development

Experience

- ◆ Jefferson Science Fellow of the NASEM at the Department of State/Bureau of Diplomatic Security
- ◆ Distinguished Lecturer of the IEEE Magnetics Society
- ◆ Professor of Physics, University of Alabama, Tuscaloosa
- ◆ Post Doc, The Ohio State University, Columbus
- ◆ Ph.D. in Physics, University of Kaiserslautern, Germany

New MSE Division Staff Member - Cross-MSE Program Manager



Dr. Shawn Chen

Program Manager for Materials Sciences
Materials Sciences and Engineering Division

Expertise

- ◆ Mechanics of polymer thin films, charge-containing polymers, membranes for filtration/fuel cells
- ◆ Polymer physics
- ◆ Development and use of novel characterization tools

Experience

- ◆ AAAS Science & Technology Policy Fellow in BES (Sept 2021 – present)
- ◆ NRC Postdoctoral Research Associate, National Institute of Standards and Technology
- ◆ Ph.D. in Materials Science and Engineering, Northwestern University
- ◆ BS in NanoEngineering, University of California San Diego

James Rustad – Congratulations on Retirement



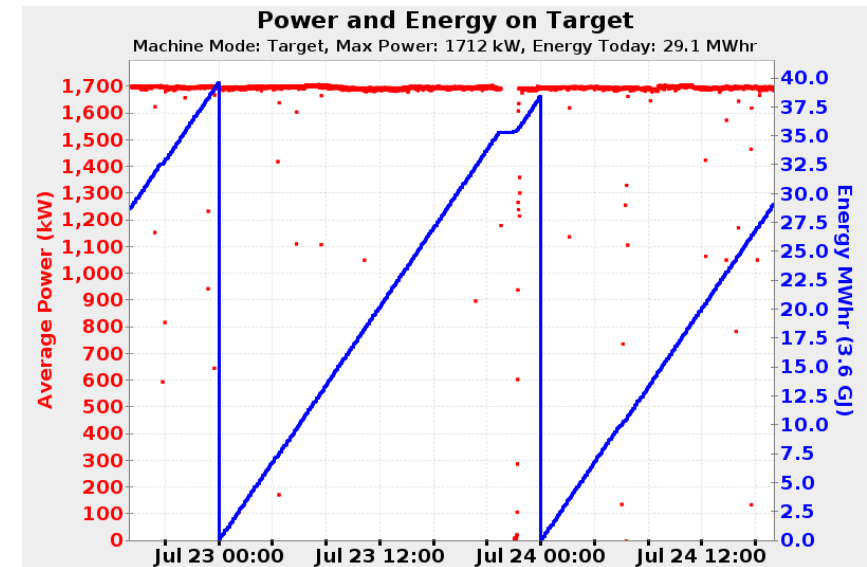
- ◆ Jim Rustad, the Geosciences program manager in the Chemical Sciences, Geosciences, and Biosciences Division, retired June 30, 2023.
- ◆ Prior to joining BES in 2015, Jim worked at Pacific Northwest National Laboratory as a Research/Staff /Chief Scientist (1992-2003); at the University of California, Davis as Associate/Full Professor of Geology (2003-2010); and at Corning Incorporated as a Research Associate (2010-2015).
- ◆ His research career focused on earth materials, interfacial geochemistry, mineral physics, resource scarcity, and earth-abundant energy materials. He is author of more than 100 peer-reviewed publications and served on multiple advisory committees and review panels for industry and government research organizations.

Please join us in wishing Jim the best in his retirement!

Philip Wilk is acting program manager for Geosciences.

Facility Highlights...

- ◆ Advanced Photon Source -- first accelerator components are in the tunnel!
- ◆ First light at the LCLS II is projected for September 2023!
- ◆ SNS successfully operating at 1.7MW! (July 12)
- ◆ Director transitions:
 - Ken Andersen, SNS-HFIR, leaving for ILL
 - John Hill, NSLS-II, promoted to Deputy Lab Director for Science and Technology, BNL
 - Erik Johnson, Interim Director for NSLS-II
 - Welcome to Dimitri Argyriou, ALS Director



Established Program to Stimulate Competitive Research (EPSCoR)

- ◆ The DOE EPSCoR Program seeks to:
 - Promote institutional diversity and enhance the research capabilities in EPSCoR jurisdictions
 - Support competitive early-stage research in DOE science/technology areas
 - Develop science/engineering personnel to meet current/future needs in DOE-related topics
- ◆ Coordination Across DOE – Office of Science and Technology Offices
- ◆ **14 Implementation Awards (\$33M in total funding) announced July 26, 2023**
 - Projects cover a range of topics including grid integration, renewable solar and wind energy, and advanced manufacturing
 - “America’s next big energy breakthrough can come from anywhere in the nation, and that’s why Federal R&D investments should reach and benefit all parts of the country,” said **U.S. Secretary of Energy Jennifer M. Granholm**. “The funding we’re announcing today will spur innovation and create energy jobs around the nation.”

<https://www.energy.gov/articles/doe-announces-33-million-advance-energy-research-across-america>

BES Continues to Support Research on Discovery and Use-Inspired Science

- ◆ **Annual Open Solicitation:** Supports grants for research in the topical areas supported by the Office of Science. **Accepts applications continuously**
- ◆ **Annual Early Career FOA:** Supports the development of individual research programs for outstanding scientists early in their careers in areas supported by the Office of Science; all BES core research areas and facilities operations; **Award Announcement Soon!**
- ◆ **FAIR FOA:** Funding for Accelerated, Inclusive Research on topics that cross the Office of Science, supports research at non-R1 minority serving institutions (MSIs) and emerging research institutions, including partnering with DOE National Laboratories and facilities and R1 MSIs; **Award Announcement Soon!**
- ◆ **RENEW FOA:** Doubling the FY 2022 investment, the SC-wide Reaching a New Energy Science Workforce initiative leverages SC's world-unique National Laboratories and user facilities to provide internships for students at academic institutions currently under-represented in the research portfolio; **Award Announcement Soon!**

BES Continues to Support Research on Discovery and Use-Inspired Science: National Laboratory Announcements

- ◆ **Accelerate:** New in FY 2023, supports research to accelerate the transition of science advances to technologies, enhances the science foundation for the bridge across the “valley of death” between basic and applied research; Review in Progress.
- ◆ **Biopreparedness Research Virtual Environment (BRaVE):** will support development of critical analytical capabilities foundational to responses for future emergencies, focusing on advanced analytics and capabilities for understanding host-pathogen dynamics, molecular interactions at bio-scales, epidemiological models, materials science for bio-protection and sensing, and advanced user facility instrumentation (Supported by ASCR, BES, and BER); **Award Announcement Soon!**
- ◆ **Advanced Scientific Computing Research for DOE User Facilities:** will support development of advanced algorithms and software stacks for new and emerging techniques at DOE light and neutron user facilities to enable on-the-fly data analysis and autonomous experimentation (ASCR and BES); Review in Progress.

BES SBIR/STTR Update

- ◆ **Annual SBIR/STTR FOA:** Topics support research that is ready for commercialization, including topics related to accelerators, detectors, and nanoscale instrumentation
- ◆ **FY 2023 Awards Issued:** Due to SC facilities becoming exempt from SBIR/STTR taxes in FY 2023, available BES funding for awards was reduced by ~50% from previous years
 - Phase I: 29 SBIR/7 STTR
 - Phase II: 25 SBIR/3 STTR
- ◆ **FY 2024 FOA:** Will be released August 7, 2023
 - 9 BES-funded topics
 - Coordination with NE, EERE, and FECM continues

SC Energy Earthshots FY 2023 Funding Announcements (BES, BER, ASCR)

- ◆ Address key research challenges at the interface between basic research and applied R&D to realize DOE Energy Earthshots stretch goals.
- ◆ FY 2023 lab announcement for Energy Earthshot Research Centers (EERCs).
 - Modeled on EFRCs, EERCs will support large multi-investigator, multi-disciplinary, and multi-institution (academic, national lab, industrial) teams to advance foundational knowledge and enabling capabilities to address Earthshot goals.
 - Closely coordinated with the Energy Technology Offices.
- ◆ EERCs are complemented with FOA for foundational science, small group awards.
 - Focus on use-inspired fundamental research to address knowledge gaps that limit achievement of the Energy Earthshot goals.
- ◆ **Reviews Underway**

Enhanced Geothermal Shot



90% Reduction



2035

Floating Offshore Wind Shot



>70% Reduction



2035

Industrial Heat Shot



85% Reduction



2035

<https://www.energy.gov/policy/energy-earthshots-initiative>

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

FY 2023 Batteries and Energy Storage Hub FOA

- ◆ On January 26, 2023, BES issued a FOA to openly re-compete the Batteries and Energy Storage Hub program
 - Hub-scale projects provide scientific foundations for next-generation energy storage
 - Supports both grid and mobile electrochemical energy storage
 - Collaboration among National Laboratory, academic, and/or industrial team partners
- ◆ Key elements of the FOA
 - Pre-applications were due by April 3; encouraged full applications due by May 18
 - Subject to appropriations, a total of \$125M in current and future fiscal year funds
 - DOE anticipates that award sizes will range from an average of \$8M - \$15M/year; up to three 5-year awards expected
- ◆ Program Coordination
 - Coordination across DOE through the Joint Strategy Team for Batteries, including the Energy Storage Grand Challenge and the Long Duration Storage Shot
- ◆ **Award Announcement Soon!**

https://science.osti.gov/bes/-/media/grants/pdf/foas/2023/SC_FOA_0002923.pdf

JCESR'S 350+ EARLY CAREER ALUMNI, UNIQUELY TRAINED IN A DIVERSE AND COMPREHENSIVE RESEARCH TEAM



Evonik

Boğaziçi Univ.

General Motors

ORNL

Univ. of Minnesota

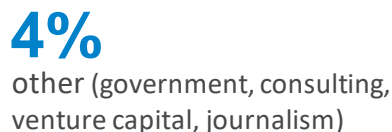
CO School of Mines

Argonne

Univ. of Liverpool

- JCESR graduate students and postdocs have been immersed in heavily multidisciplinary teams – imparting the **breadth of expertise** required to bring new ideas and technologies to fruition, **collaboration skills**, and extensive professional **networks**.
- JCESR supported 135 Ph.D. degrees and 221 postdocs.

Where Are They Now?



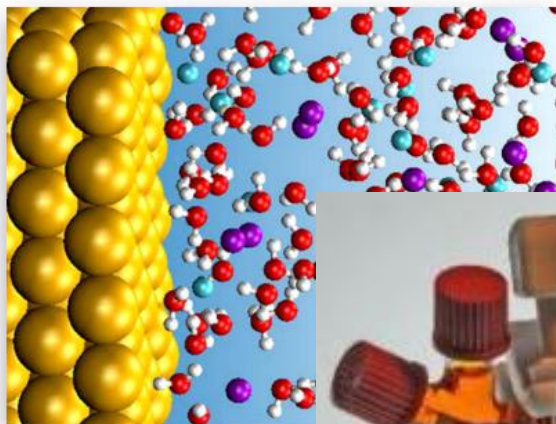
How meaningful is/was your JCESR experience?

Responses from the JCESR Alumni...

- “JCESR provided me with broad exposure to battery science and a wide spectrum of collaborators and their perspectives. It made me a better scientist.”
- “My training in JCESR was incredibly formative and allowed me to see more of the research process than I otherwise could have seen from my research group.”
- “In addition to developing applicable skills, my JCESR experience has broadened my perspective around energy technologies, providing access to knowledge and exposure to fields I may not have otherwise experienced.”
- “The network I gained has proven to be valuable over and over again. I have a strong network of folks in universities, national labs, and industry. This network has provided sources for recruiting new candidates to my team, consultant contracting work, proposal collaborators, and professional mentors.”

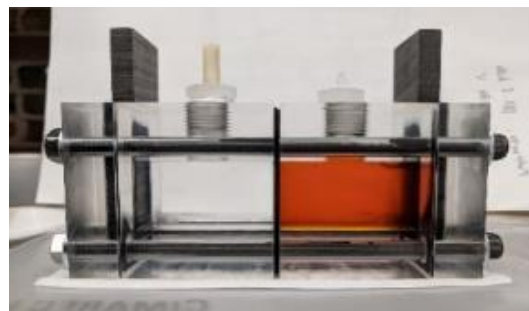
JCESR Science to Technology: Development of Long-term Energy Storage for the Electrical Grid

JCESR investigations identify concepts for ultra-low-cost flow batteries made from earth-abundant water, oxygen, sulfur



Domestic supply chain, low materials cost

JCESR spins out Form Energy



Demonstration scale long-duration battery



Applied research supported by DOE: EERE-AMO and VTO, ARPA-E; DOD

Form Energy providing a 1.5-megawatt iron-air battery pilot project for Great River Energy
Xcel Energy plans a 10-megawatt battery system



56-megawatt iron-air battery system
May 2023: Announced plans to build its first full-scale manufacturing facility in Weirton, WV

<https://formenergy.com/>

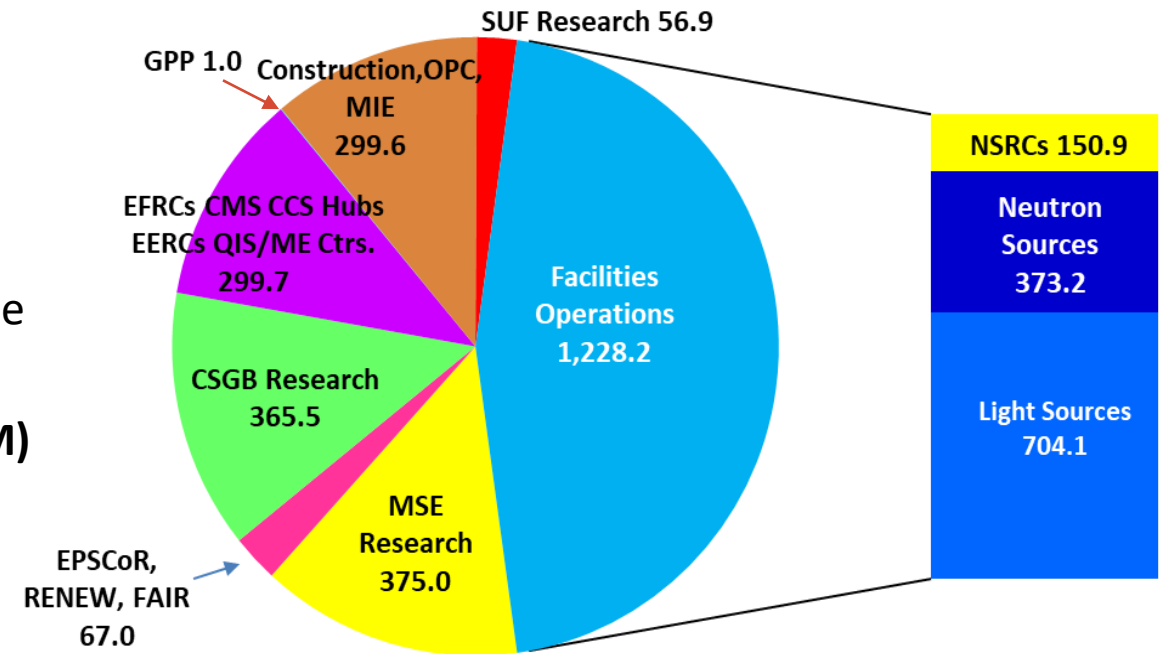
FY 2024 Request: \$2,693M (+\$159M or 6.3% above FY 2023 Enacted)

Research programs $\Delta = +\$56.0M$

- ◆ Continued investments in research for clean energy, manufacturing, microelectronics, critical materials and minerals, BRaVE, and RENEW (+\$12M)
- ◆ Computational Materials and Chemical Sciences, Energy Innovation Hubs, and National QIS Research Centers continue (\$119.7M)
- ◆ **Establish Microelectronics Science Research Centers (+\$25M)**
- ◆ Energy Frontier Research Centers continue (\$130M)
- ◆ **Expanded investments in SC Energy Earthshots initiative (+\$35M)**

Scientific user facilities $\Delta = +\$165.9M$

- ◆ Operations of 12 facilities supported at ~90% of funding required for re-baselined, normal operations (\$1,228.2M)
- ◆ Facilities research (\$56.9M, +\$7M): Accelerator & Detectors; AI/ML; BRaVE



Construction/MIE $\Delta = -\$63.1M$ (includes OPC)

- ◆ LCLS-II-HE (\$120M); ALS-U (\$57.3M); PPU (\$15.8M); STS (\$52M); CRMF (\$10M)
- ◆ **New starts: HFIR Pressure Vessel Replacement (\$13M); NEXT-III (\$6.6M)**
- ◆ MIEs: NSRC Recap (\$5M); NEXT-II (\$20M)

FY 2024 House and Senate Marks

- ◆ **House Mark** (June 14): \$2,587M (-\$105.8M or 3.9% below FY 2024 Request and \$53.1M or 2.1% above FY 2023 Appropriation).
- ◆ **Senate Mark** (July 20): \$2,679M (-\$13.5M or 0.5% below FY 2024 Request and +\$145.4M or 5.7% above FY 2023 Appropriation).

	FY 2023 Enacted	FY 2024 President's Request	FY 2024 House Mark	FY 2024 Senate Mark	FY 2024 House Mark vs Request	FY 2024 Senate Mark vs Request	FY 2023 House Mark vs Enacted	FY 2023 Senate Mark vs Enacted
Research (SC Energy Earthshots; microelectronics)	1,172,153	1,204,056	1,197,385	1,198,300	(6,671)	(5,756)	25,232	26,147
Facility Operations								
Light Sources	599,498	704,134	605,000	704,000	(99,134)	(134)	5,502	104,502
Neutron Sources	315,740	373,163	373,163	373,000	-	(163)	57,423	57,260
Nanoscale Science Research Centers (NSRCs)	153,409	150,880	150,880	150,000	-	(880)	(2,529)	(3,409)
	1,068,647	1,228,177	1,129,043	1,227,000	(99,134)	(1,177)	60,396	158,353
Projects								
<i>Advanced Photon Source Upgrade (APS-U), ANL</i>	9,200	-	-	-	-	-	(9,200)	(9,200)
<i>Spallation Neutron Source Proton Power Upgrade (PPU), ORNL</i>	17,000	15,769	15,769	15,769	-	-	(1,231)	(1,231)
<i>Advanced Light Source Upgrade (ALS-U), LBNL</i>	135,000	57,300	57,300	57,300	-	-	(77,700)	(77,700)
<i>Linac Coherent Light Source-II-High Energy (LCLS-II-HE), SLAC</i>	90,000	120,000	120,000	120,000	-	-	30,000	30,000
<i>Second Target Station (STS), ORNL</i>	32,000	52,000	52,000	52,000	-	-	20,000	20,000
<i>Cryomodule Repair and Maintenance Facility</i>	10,000	9,000	9,000	9,000	-	-	(1,000)	(1,000)
<i>HFIR Pressure Vessel Replacement (PVR), ORNL</i>	-	4,000	4,000	-	-	(4,000)	4,000	-
<i>NSLS-II Experimental Tools—III (NEXT-III)</i>	-	2,556	2,556	-	-	(2,556)	2,556	-
	293,200	260,625	260,625	254,069	-	(6,556)	(32,575)	(39,131)
Total, Basic Energy Sciences	2,534,000	2,692,858	2,587,053	2,679,369	(105,805)	(13,489)	53,053	145,369

DOE/BES User Facility Science Webinar: Forefront Microelectronics Fabrication and Characterization - Monday, July 31, 2023, 12:00 - 1:30 pm EST

Department of Energy Office of Science User Facilities advance national scientific priorities in microelectronics fabrication, materials, and characterization. Hear from facility scientists on how the facilities advance processing technology, lithography, new flexible electronics, and 3D imaging. Register here: https://science-doe.zoomgov.com/webinar/register/WN_oUIbNG9OTxOo7PYIkU_u_A



Dr. Jie Xu
Center for
Nanoscale Materials,
Argonne National
Lab



Dr. Patrick Naulleau
Center for X-ray Optics,
Lawrence Berkeley
National Lab



Dr. Stefan Vogt
Advanced Photon
Source, Argonne
National Lab



Dr. John Baniecki
Stanford Synchrotron
Radiation Lightsource,
SLAC National
Accelerator Lab



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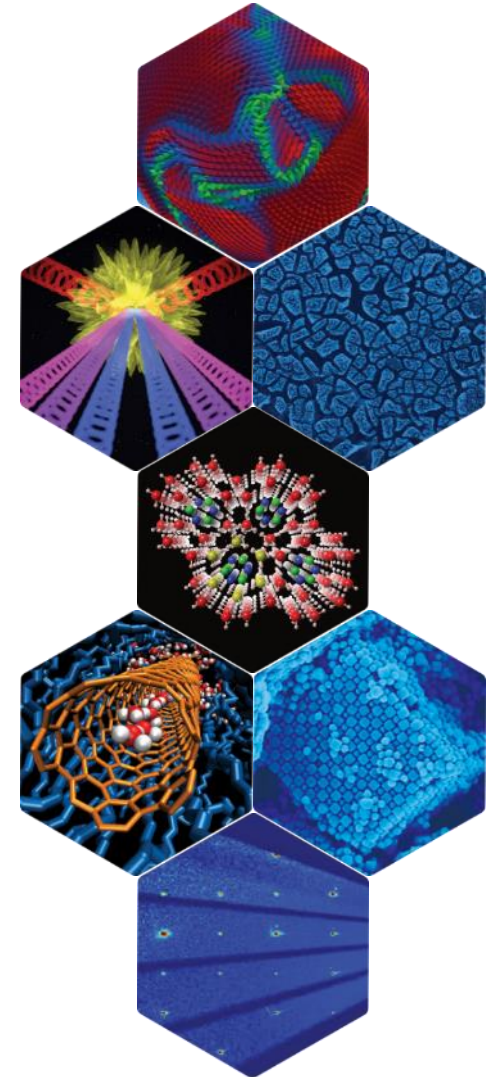
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Future Topics for User Facility Webinars

- ◆ **Clean Energy** – Multiple webinars! Facility research for energy storage, photovoltaics, biofuels, carbon capture, etc.
- ◆ **Bio-preparedness** – structural characterization for vaccines and therapeutics, materials for bio-protection, instrumentation and sensing
- ◆ **Advanced Manufacturing** – *in situ* and *operando* understanding of 3D printing and alternative low-carbon processes

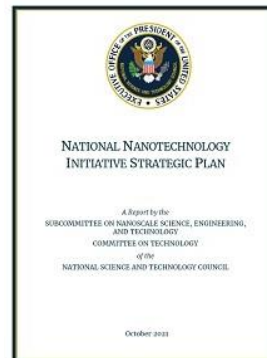
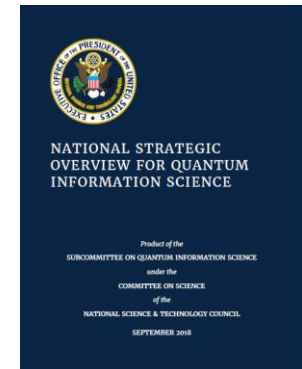
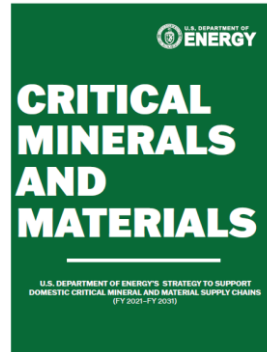
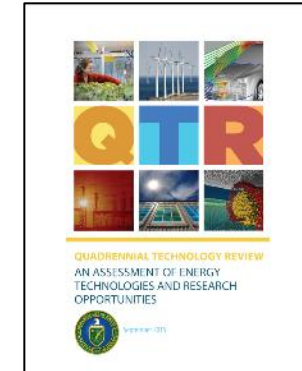
Strategic planning is driven by BES and Division mission

- ◆ **BES Mission: Understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels to provide the foundations for new energy technologies and national priorities**
 - CSGB: Fundamental understanding of chemical transformations and energy flow in systems.
 - MSE: Knowledge base for the discovery and design of new materials with novel structures, functions, and properties.
 - SUF: Provide world-leading user facilities critical to maintaining U.S. scientific leadership.
- ◆ **Complementary discovery and use-inspired fundamental research**
- ◆ **Innovative management of science portfolios to address key and evolving scientific challenges**



Research Directions Come from Many Sources with Strategies Expected from the BESAC Charge

- ◆ DOE strategic planning
- ◆ BES strategic planning
 - BESAC and BES reports, including Basic Research Needs, Grand Challenges
 - Annual budget planning at the division level, including program manager assessment of scientific fields (conferences, PI/potential-PI interactions, cross-agency engagement, scientific literature) and of topical areas for expansion/reduction
- ◆ National Academy Assessments and Reports
 - Decadal assessments, topical reports (e.g., negative emissions technologies, photonics, memristive materials)
- ◆ Interagency planning
 - 2021 Materials Genome Initiative Strategic Plan
 - 2021 National Nanotechnology Initiative Strategic Plan
 - 2018 National Strategic Overview for Quantum Information Science



Questions?



FY 2024 Construction Funding – Including IRA

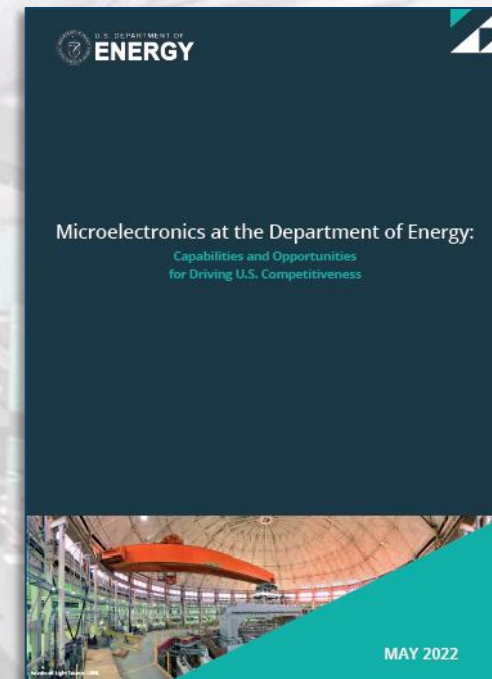
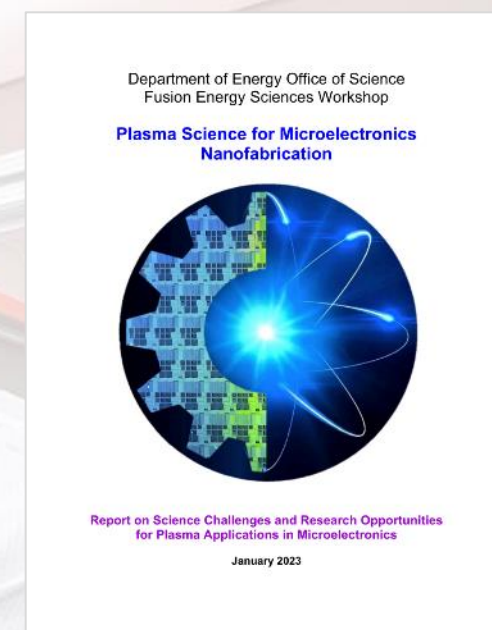
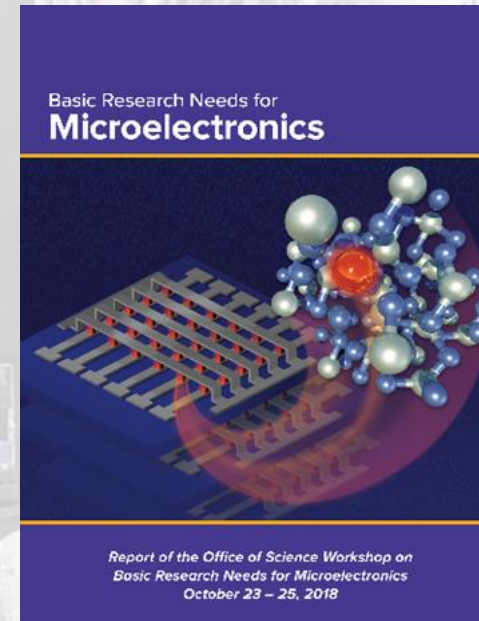
	FY 2022	FY 2022	FY 2023	FY 2024
	Enacted	IRA Funds	Enacted	Request
OPC Funds				
19-SC-14, Spallation Neutron Source Second Target Station (STS), ORNL	...	...	5,000	...
13-SC-10, Linac Coherent Light Source II (LCLS-II), SLAC	4,300	...	...	...
18-SC-13, Linac Coherent Light Source-II-High Energy (LCLS-II-HE), SLAC	3,000	6,000	4,000	...
18-SC-11, Spallation Neutron Source Proton Power Upgrade (PPU), ORNL	...	...	...	...
18-SC-10, Advanced Photon Source Upgrade (APS-U), ANL	5,000	...	5,000	...
21-SC-10, Cryomodule Repair & Maintenance Facility (CRMF), SLAC	2,000	700	1,000	1,000
24-SC-10, HFIR Pressure Vessel Replacement (PVR)	...	...	3,000	9,000
24-SC-12, NSLS-II Experimental Tools-III (NEXT-III)	...	...	1,500	4,000
Total, OPC	14,300	6,700	19,500	14,000
TEC Funds				
24-SC-10 HFIR Pressure Vessel Replacement (PVR), ORNL	...	...	...	4,000
24-SC-12 NSLS-II Experimental Tools - III (NEXT-III), BNL	...	...	...	2,556
21-SC-10 Cryomodule Repair & Maintenance Facility (CRMF), SLAC	1,000	20,000	10,000	9,000
19-SC-14 Second Target Station (STS), ORNL	32,000	42,700	32,000	52,000
18-SC-10 Advanced Photon Source Upgrade (APS-U), ANL	101,000	...	9,200	...
18-SC-11 Spallation Neutron Source Proton Power Upgrade (PPU), ORNL	17,000	...	17,000	15,769
18-SC-12 Advanced Light Source Upgrade (ALS-U), LBNL	75,100	96,600	135,000	57,300
18-SC-13 Linac Coherent Light Source-II-High Energy (LCLS-II-HE), SLAC	50,000	90,000	90,000	120,000
13-SC-10 Linac Coherent Light Source-II (LCLS-II), SLAC	28,100	...	...	...
Total, TEC	304,200	249,300	293,200	260,625
Total, BES Construction	318,500	256,000	312,700	274,625

Microelectronics Science Research Centers

FY 2024 Request: \$60M across SC (\$25M in BES)

CHIPS and Science Act authorizes up to **four new DOE Office of Science Microelectronics Science Research Centers** to perform mission-driven research to address foundational challenges in the design, development, characterization, prototyping, demonstration, and fabrication of microelectronics

SC-wide Centers would focus on **fundamental science and early-stage research**, complementing the investments already made through the CHIPS Act with the Departments of Commerce and Defense



Microelectronics Science Research Centers

FY 2024 Request: \$60M across SC (\$25M in BES)

- ◆ CHIPS and Science Act (Section 10731, Micro Act) authorizes DOE to establish a crosscutting program of RD&D in microelectronics relevant to DOE missions, including establishing up to four new SC Microelectronics Science Research Centers to perform mission-driven research to address foundational challenges in the design, development, characterization, prototyping, demonstration, and fabrication of microelectronics.
 - Complements existing SC microelectronics awards
- ◆ SC-wide Centers would focus on fundamental science and early-stage research, complementing the investments already made through the CHIPS Act, most relevantly:
 - Department of Commerce National Semiconductor Technology Center: Focused on later-stage prototyping and applied RD&D; requires external basic research for success
 - Department of Defense (DOD) Microelectronics Commons: Focused on capabilities required for DOD; unlikely to address most DOE mission areas
- ◆ Centers would leverage the broad infrastructure and expertise at the DOE National Labs as well as in academia and industry.



Microelectronics Science Research Centers

FY 2024 Request: \$60M across SC (\$25M in BES)

◆ Potential areas of emphasis include:

- Accelerated discovery and development of new microelectronics science and technology
- Advanced experimental and computational capabilities, including materials science, chemistry, plasma science, artificial intelligence, and multiscale co-design
- Innovative methods for circuits, architectures, systems, modeling, and synthesis
- Sustainable and energy-efficient microelectronics devices, including logic, memory, and sensors/detectors
- Testbeds for prototyping platforms for validation/verification of new concepts; Prototyping of novel devices to facilitate lab-to-fab transition
- Development of advanced cybersecurity capabilities for computing architectures



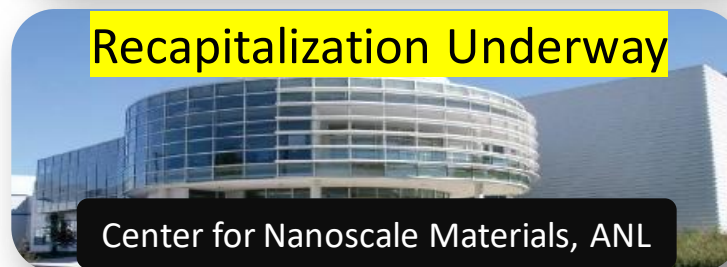
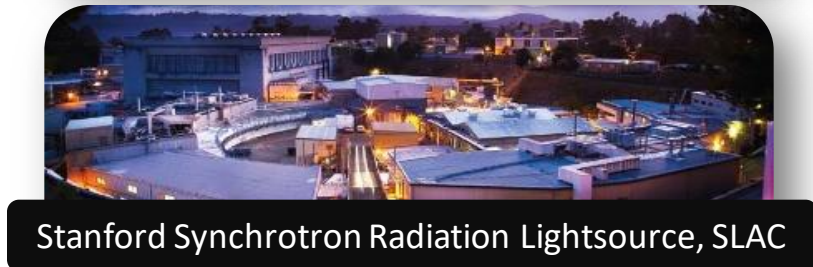
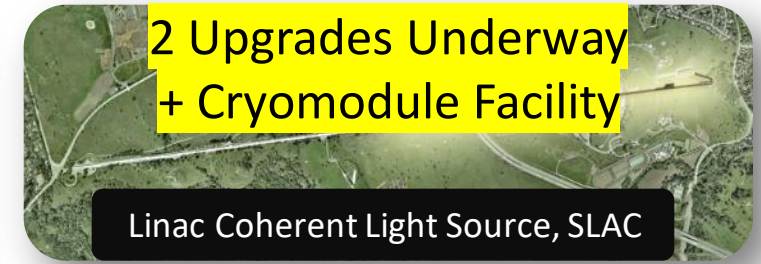
BES FY 2022 RENEW – Five Awards announced in December

Total Funding: \$11.25M for three years; Five new institutions for BES support

- ◆ **Controlling Additive Manufacturing Properties of Surfaces (CAMPS)**
 - Navajo Technical University (MSI Type: TCU; ANNH); Lab-Partner: LBNL
 - Goal: Control the effect of reactive gasses on formation of additively manufactured materials for clean energy applications, and training & mentorship tailored for Native American students.
- ◆ **Hydrogen Innovation: Preparing and Obtaining a Workforce in Energy Research (HI POWER)**
 - Florida A&M University; (MSI Type: HBCU); Lab-Partner: Ames
 - Goal: Study the impact of prolonged hydrogen exposure on structural materials performance, design hydrogen-tolerant alloys for the nation's hydrogen storage needs, and training & mentorship tailored for African American students.
- ◆ **Controlling Reaction Pathways under the Non-ideal Conditions of Seawater Electrolysis**
 - University of Guam (MSI Type: ANNH, AANAPISI); Lab-Partner: PNNL
 - Goal: Control the influence of organic matter on the electrochemistry of water splitting by controlling the complex electrode/liquid interface, and training & mentorship tailored for Micronesian and Filipino students.
- ◆ **Nanopore Characterization for Geologic Storage of H₂ and CO₂**
 - California State University Bakersfield (MSI Type: HSI); Lab-Partner: LBNL
 - Goal: Study of caprock nanopores for long term hydrogen and carbon dioxide capture and clean energy storage, and training & mentorship tailored for Hispanic students.
- ◆ **Partnership to Increase Representation in Energy Research in Puerto Rico (PIRES-PR)**
 - Universidad Ana G Mendez - Gurabo Campus in Puerto Rico (MSI Type: HSI); Lab-Partner: NREL
 - Goal: Study earth-abundant electrocatalysts for oxygen reduction for carbon-neutral hydrogen technologies, and training & mentorship tailored for Puerto Rican students.

https://science.osti.gov/-/media/Initiatives/pdf/renew/RENEW_Public_Abstracts-FY22.pdf

BES User Facilities: Operating and Maintaining 12 World-leading Capabilities



Launch of the BES User Facility Science Webinar Series To Celebrate and Communicate User Facility Impact

Public webinar series to enhance communication on BES User Facility science, highlighting contributions to national scientific priorities of Clean Energy, Microelectronics, Advanced Manufacturing, and Biopreparedness

Kickoff Event: Friday, January 27, 2023



Dr. Asmeret Asefaw Berhe
Director, Office of Science
Welcome Remarks



Prof. Sossina Haile
Northwestern University
Materials for batteries and
hydrogen



**Prof. Leora
Dresselhaus-Marais**
Stanford University
Low-emissions steel,
additive manufacturing



Dr. Yong Chu
Brookhaven National Lab
Nanoscale imaging in
Microelectronics



Dr. Andrey Kovalevsky
Oak Ridge National Lab
Antiviral compounds for
COVID-19

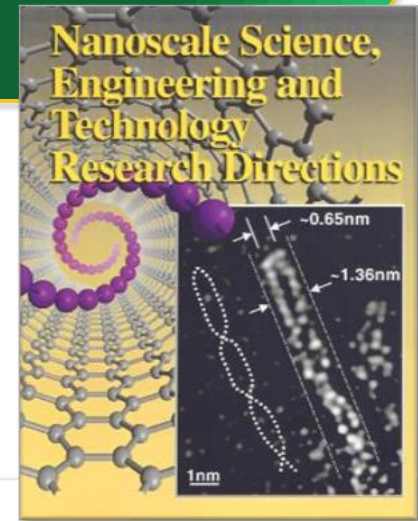
Nanoscale Science Research Center Vision

▶ 1999 Report: "Nanoscale Science, Engineering and Technology Research Directions"

- ❖ "In order to increase the impact of major DOE facilities on the national nanoscience and technology initiative, it is proposed to establish several new Nanomaterials Research Centers."

▶ 2001: NSRC Vision (Dehmer, BESAC)

- ❖ NSRCs will Advance science; Serve the scientific community; Enhance laboratory core competencies; Provide local and national coordination.
- ❖ NSRCs will provide state-of-the-art nanofabrication and characterization facilities to in-house and visiting researchers and support research for fundamental understanding and control of materials at the nanoscale.



Nanoscale Science Research Centers will:

- Advance science**
 - Advance fundamental understanding and control of materials at the nanoscale
 - Support investigators and groups working together on problems of a scope, complexity, and disciplinary breadth not possible working separately, with the whole being greater than the sum of the parts
- Serve the scientific community**
 - Provide state-of-the-art nanofabrication and characterization facilities to in-house and visiting researchers at no cost
 - Provide a mechanism for short- and long-term collaborations and partnerships among DOE laboratory, academic, and industrial researchers
 - Provide training for students in interdisciplinary nanoscale research in cooperation with regional or national academic institutions
- Enhance laboratory core competencies**
 - Advance the strategic vision and build on the core competencies of the host laboratory, particularly the BES user facilities and research programs already in place
 - Optimize the use of the BES national user facilities for materials characterization
 - Provide the foundation for the development of nanotechnologies important to DOE
- Provide local & national coordination**
 - Partner with state government and local institutions
 - Complement one another and other-agency centers (e.g., existing components of the NSF National Nanofabrication Users Network)



Because the five BES NSRCs all will come of age within the next few years, it is important that we now set down a few common principles for these facilities.



The light sources and neutron sources have taught us that we need both consistency and individualism among our facilities. One of the purposes of this meeting is to talk about some areas where consistency will be important.

BESAC, Dehmer
02/2004



Nanoscale Science Research Centers Then and Now: Over 15 Years Serving the Nation



CINT at SNL/LANL

Start yr. 2006

Users (FY22): 632 on-site; 274 remote



CNMS at ORNL

Start yr. 2006

Users (FY22): 509 on-site; 307 remote



TMF at LBNL

Start yr. 2006

Users (FY22): 645 on-site; 323 remote



CNM at ANL

Start yr. 2007

Users (FY22): 401 on-site; 355 remote



CFN at BNL

Start yr. 2008

Users (FY22): 421 on-site; 219 remote

Nanoscale Science Research Centers: Then and Now



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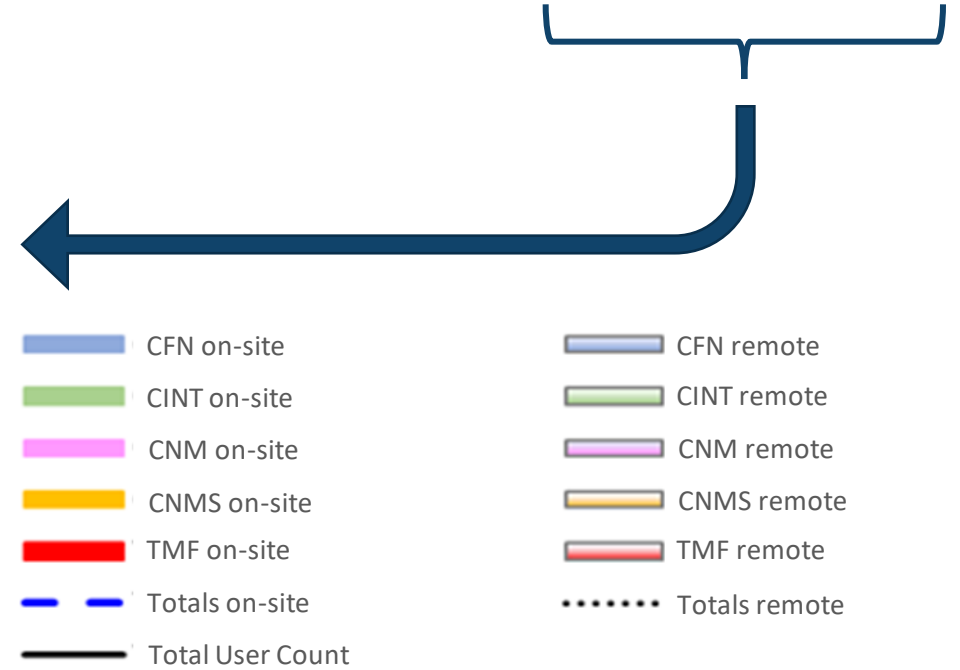
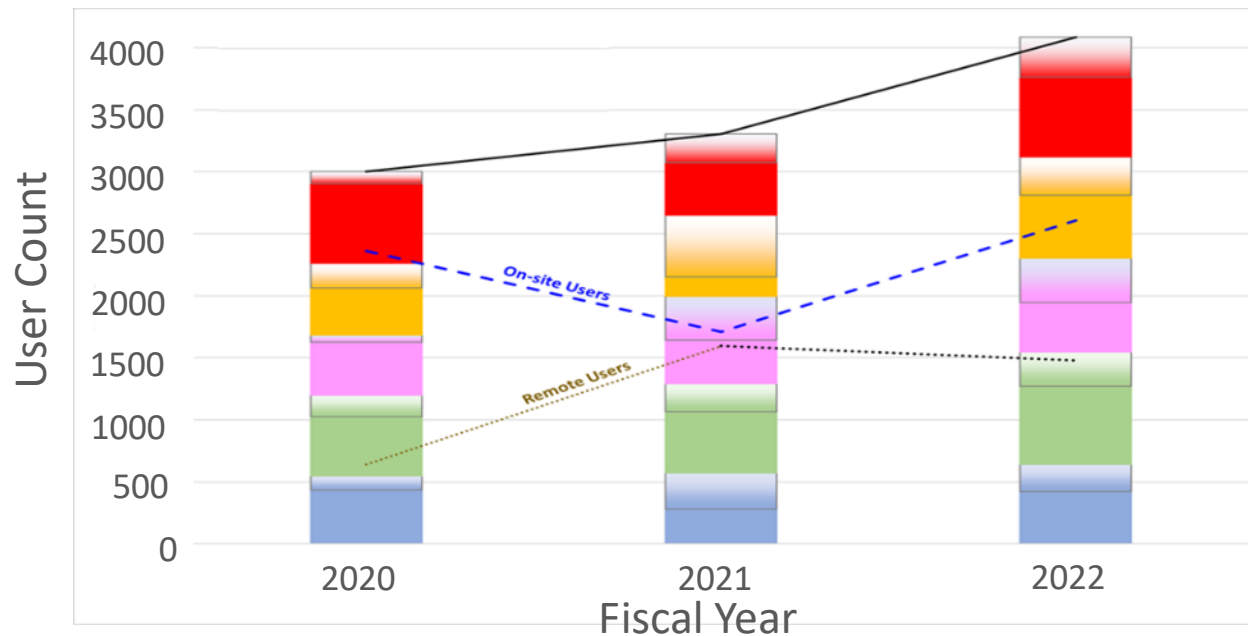
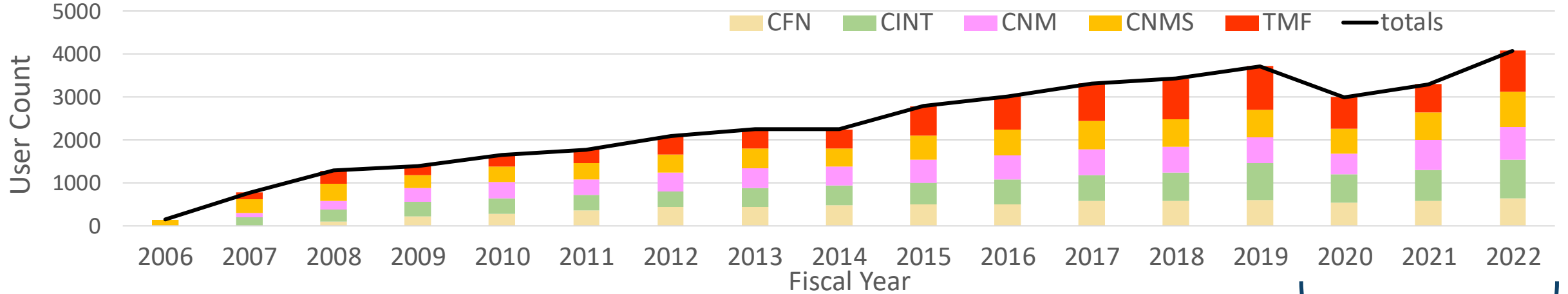


CFN at BNL
Start yr. 2008

Users (FY22): 421 on-site; 219 remote

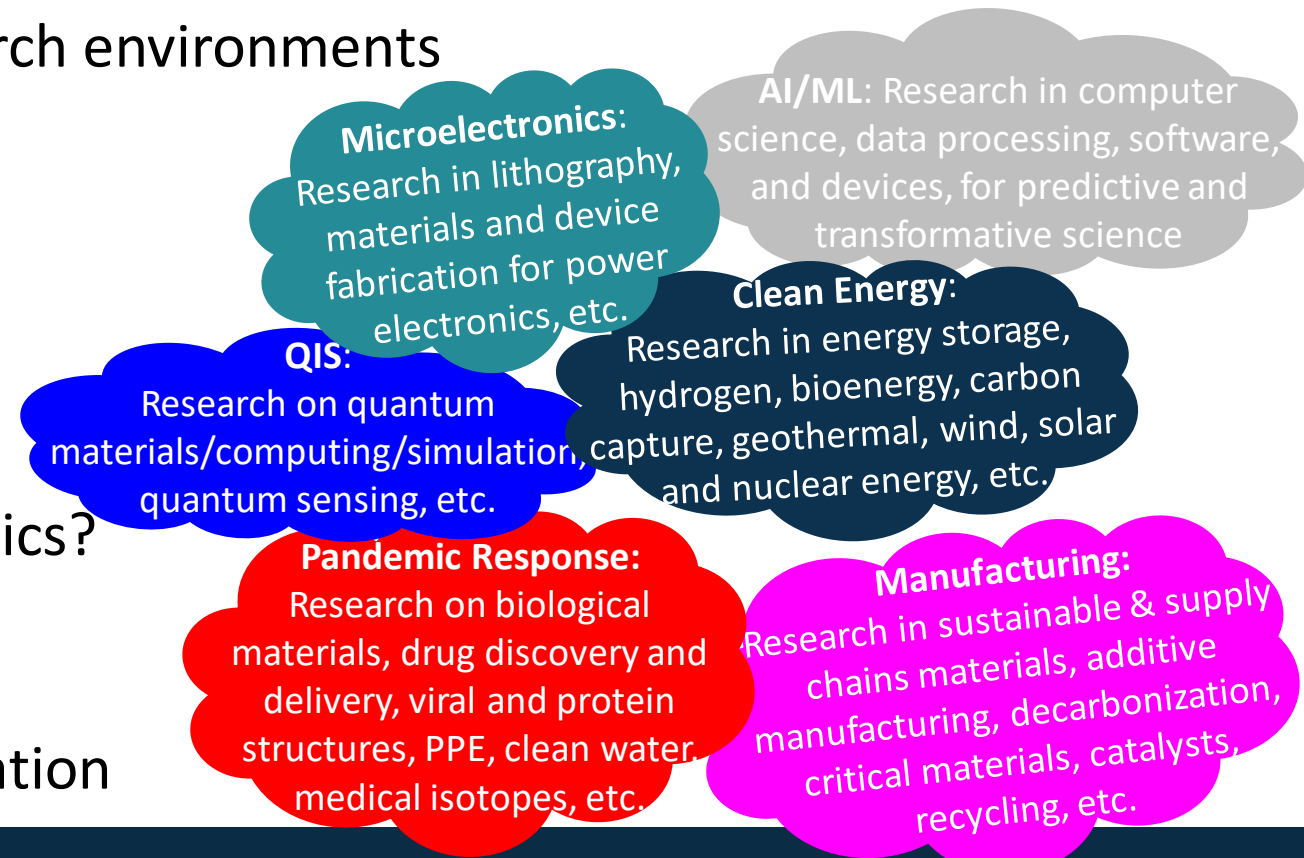


Impressive Growth of User Community – Including Remote Users!



Multi-disciplinary NSRCs – Today’s Science

- ◆ Unique in comparison to BES scattering user facilities, for their strong basis in materials research: synthesis/fabrication & microscopy
- ◆ Aligned to respond to important national priorities with multi-purpose user capabilities and highly-collaborative research environments
- ◆ 15 years ago, would you have imagined nanoscience’s role in pandemic solutions?
 - ...in QIS? ...manufacturing?
 - ...in AI/ML (and huge data rates)?
 - ...in the national priority for microelectronics?
 - ...or the extraordinary, and growing, role in clean energy?
- ◆ Panel discussion will provide more information



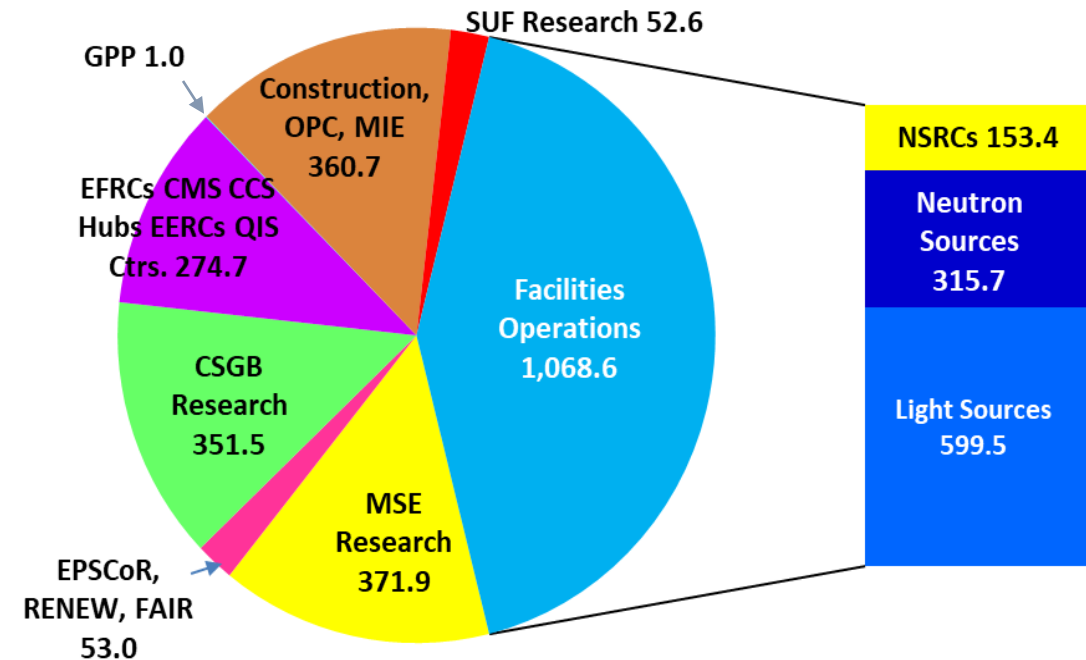
FY 2023 Enacted: \$2.534B (+\$226M, 9.8% above FY 2022 Enacted)

Research programs $\Delta = +\$103.6\text{M}$

- Research (\$777.4M,+\$77.7M) includes new and expanded investments in research for manufacturing, advanced computing, AI/ML, FAIR, Accelerate, clean energy, and RENEW
 - EPSCoR continues (\$25M)
- Computational Materials and Chemical Sciences, Energy Innovation Hubs, and National QIS Research Centers continue (~\$119M)
- Energy Frontier Research Centers continue (~\$130M)
- **Energy Earthshot Research Centers initiated (+\$25M)**

Scientific user facilities $\Delta = +\$110.2\text{M}$

- **Operations of 12 facilities continue at ~100% of rebaselined budget levels (\$1,068.6M)**
- Facilities research increases for AI/ML, BRaVE, and accelerator R&D (\$54.6M)



Construction/MIE* $\Delta = +\$12.2\text{M}$

- APS-U (\$9.2M); LCLS-II-HE (\$94M); ALS-U (\$135M); PPU (\$17M); STS (\$37M); CRMF (\$10M); **HFIR Pressure Vessel Replacement (\$2M)***; **NEXT-III (\$1.5M)**
- MIEs: NSRC Recap (\$25M); NEXT-II (\$25M)

*includes OPC

User Facility Operations

- ◆ All BES facilities provided rebaselined operations funding requests that include:
 - Impacts from inflation and supply chain issues
 - Staffing for hybrid in-person/remote operations
 - Bringing upgrades and new capabilities on-line for users
 - Required maintenance activities
- ◆ New baselines were established through an open process that involved all similar facilities for a “reality” check
 - Oversight by the Office of Science
 - Ongoing assessments through facility reviews

*includes OPC

Energy Earthshot Scientific Foundations

- ◆ **Overview:** Team projects to provide scientific foundations DOE Energy Earthshots' goals and address key research challenges at the interface between SC-supported fundamental research and applied R&D supported by DOE technology offices
 - Emphasis on cross-cutting topics relevant to multiple Energy Earthshots
 - Lead institution must be a university, but collaboration with National Laboratory and/or industrial team partners encouraged
- ◆ **FOA Issued:** 03/21/2023
- ◆ **Estimated Funding:** Subject to availability of funds, a total of up to \$150 million in current and future fiscal year funds. Support from three SC programs: ASCR, BER, BES
- ◆ **Award size and duration:** \$500K/year to \$2M/year; 3-year awards
- ◆ **Pre-application due date:** 04/25/2023 (Pre-applications required; limit of three per lead institution)
- ◆ **Application due date:** 06/21/2023
- ◆ **Energy Earthshots Initiative:** <https://www.energy.gov/policy/energy-earthshots-initiative>
- ◆ **FOA:** https://science.osti.gov/bes/-/media/grants/pdf/foas/2023/SC_FOA_0003003.pdf

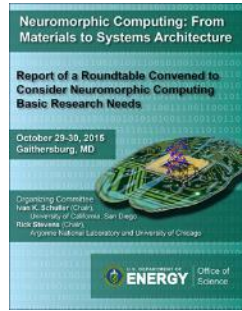
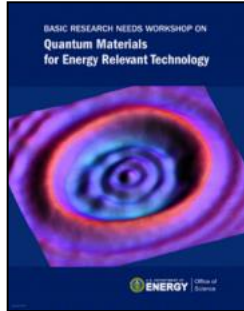
Strategic planning is essential to maintain health of the BES research portfolio

Formal and informal mechanisms for strategic planning are providing insights to determine:

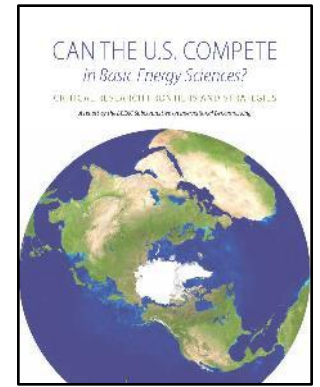
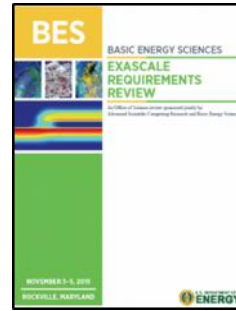
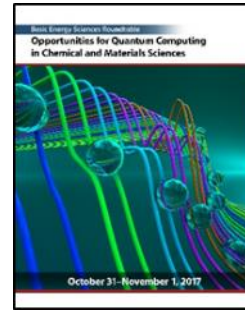
- ◆ What topical areas should be expanded and what areas should be reduced
- ◆ Assess the balance and health of university and lab programs
- ◆ When and how to support high risk, potential high impact research
- ◆ How to balance challenging scientific knowledge gaps that require long term support with potential shorter term research projects
- ◆ A vibrant and adaptive vision that looks towards fundamental scientific challenges just now appearing on the horizon and that recognizes longstanding scientific knowledge gaps where research is still critical

Defining Research Priorities: Basic Research Needs Strategic Planning Workshops and Roundtables

Quantum Science

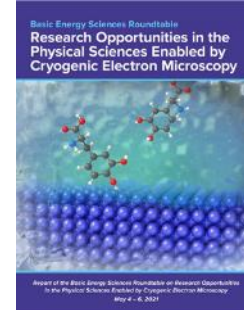
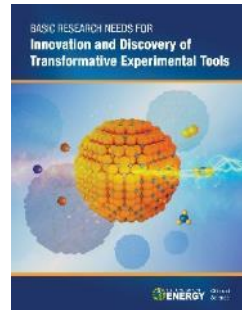


Theory, Modeling, and Computation

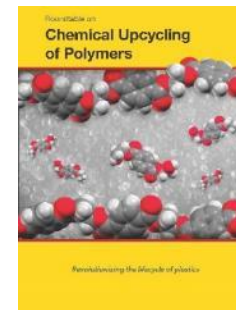


BESAC: International Benchmarking

Characterization



Synthesis



SC Biopreparedness & Response

Cross-cutting Energy

