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TUFTS UPDATE – JANUARY 24, 2020
PREPARED BY LEWIS-BURKE ASSOCIATES LLC

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Introduction

This edition of the Tufts Washington Update for mid-January includes congressional updates, agency updates, and funding opportunities. Faculty, staff, and researchers are welcome to schedule calls with the Lewis-Burke Tufts team or meet with the team when they visit Washington, DC. Contact Amanda Bruno, Lewis-Burke Associates LLC, at amanda@lewis-burke.com with any questions or comments related to the Update's content, for more information on updates and opportunities, or to add a new recipient to the distribution list.

Congressional Updates

Senate Commerce Committee Holds Hearing on Policies to Support Industries of the Future

Calls from Congress to increase federal investments in research and development (R&D) for new technologies have grown louder, as evidenced in a January 15, 2020 Senate Commerce Committee Hearing entitled "Industries of the Future," which focused on current federal investments and efforts around artificial intelligence (AI), advanced manufacturing, quantum information science (QIS), biotechnology, and next generation wireless technologies.

This hearing coincided with Committee Chairman Roger Wicker's (R-MS) introduction of the *Industries of the Future Act of 2020,* co-sponsored by fellow committee members Senators Gary Peters (D-MI), Tammy Baldwin (D-WI), and Cory Gardner (R-CO). The bill would direct the White House Office of Science and Technology Policy (OSTP) to submit a report that would include a plan to double investments in AI and QIS by fiscal year (FY) 2022, increase investments in the industries of the future described above by $10 billion by FY 2025, elicit similar investments by industry and other organizations, and propose legislation to achieve these goals. The bill would also establish an "Industries of the Future Coordination Council" to oversee efforts to achieve the goals laid out in the bill.

During the hearing, the panel heard testimony from the following witnesses:

- Walter Copan, Under Secretary of Commerce for Standards and Technology and Director, National Institute of Standards and Technology (NIST)
- France Córdova, Director, National Science Foundation (NSF)
- Michael Kratsios, Chief Technology Officer, OSTP
- Michael O'Rielly, Commissioner, Federal Communications Commission (FCC)
- Jessica Rosenworcel, Commissioner, FCC

Surprisingly, specific R&D investments needed to support these future industries was only a small part of the discussion, with a significant focus being placed on regulatory issues, especially regarding the FCC's spectrum auction and broadband efforts in rural areas. This may potentially be a sign of the general bipartisan agreement on the importance of research, as Kratsios noted that the Trump Administration was committed to advancing "American Innovation, built by American workers, and shaped by American values." Highlights from the hearing pertaining to specific topics can be found below:

Artificial Intelligence (AI)

Chairman Wicker noted the importance of the US leading in developing AI, and that the US should lead in creating global standards in developing safe, reliable, fair, and accurate AI systems. Ranking Member Maria Cantwell (D-WA) was particularly concerned about issues stemming from the adoption and proliferation of AI systems. She asked the witnesses how the federal government was preparing for AI's role in spreading disinformation through "deepfakes," realistic looking but fabricated videos, as well as the potential impact AI may have on the U.S. workforce. Other Senators, primarily Senator Ted Cruz (R-TX), focused their questioning on what was needed to ensure that the US leads the world developing AI, noting that recent reports cited that AI could add $13 trillion in economic activity by 2030. Under Secretary Copan also stated in his written testimony that NIST intends to release a set of draft "Principles of Explainable AI," in January for public comment.

Advanced Manufacturing

Advanced manufacturing was particularly of interest to a number of the Senators whose states have strong or growing manufacturing bases. Senators Marsha Blackburn (R-TN) and Jacky Rosen (D-NV) discussed their *Advanced Manufacturing Jobs in America Act*, which would direct the Department of Labor (DOL) to establish pilot projects for education and training programs between local community and state colleges, advanced manufacturers, and Manufacturing Extension Partnership (MEP) Centers. Senator Gary Peters (D-MI) expressed concern that the U.S. has not had a government-wide manufacturing policy and urged the witnesses to consider coordination among the 58 advanced manufacturing programs across 11 agencies. NSF Director Córdova responded that the agency heads often coordinate through the National Science and Technology Council (NSTC), and discussed NSF's investments in key areas such as cyber, STEM workforce, and eco-manufacturing.

Next Generation Wireless

A considerable portion of the hearing focused on policy needs to advance fifth- (5G) and next-generation wireless technologies. FCC Commissioner Jessica Rosenworcel noted her top three recommendations to

1) Develop a plan to deploy 5G to everyone, everywhere.
2) Invest in training for the jobs of the future. She specifically noted the shortage of 20,000 tower climbers and recommended that DOL should prioritize this in its apprenticeship programs.
3) Develop network security pans. Beyond discouraging the use of Chinese equipment, she noted that FCC could encourage device manufacturers to build in cybersecurity capabilities. She also noted the need to develop open radio access networks (O-RAN).

The hearing also featured some debate between Commissioner Rosenworcel and fellow Commissioner Michael O'Reilly over a number of topics, including whether the US should focus on developing 5G for high or mid-band spectrum, and how FCC should address the increasingly congested spectrum. Commissioner Rosenworcel and Director Córdova both noted the potential for dynamic spectrum sharing to provide a solution, and that further R&D could help address this issue. Many of the Senators representing states with significant rural populations emphasized the need to ensure that rural and underserved populations have wireless access.

Other issues of interest:

- Senator Todd Young (R-IN) asked Under Secretary Copan whether the *Bayh-Dole Act*, which authorizes universities to retain title to federally-funded innovations, needs to be modernized. Under Secretary Copan responded that NIST produced a green paper under its "Return on Investment Initiative," with recommendations for policies to support technology transfer, and that the Agency is working with the Committee on legislative language to enact these changes under Bayh-Dole and the *Stevenson-Wydler Act,* a similar piece of legislation pertaining to inventions stemming from federal laboratories.
- Senator Young also asked how OSTP can ensure that researchers have access to high-quality data, without infringing on privacy, to advance progress in the industries of the future.

- Chairman Wicker noted the Committee's interest in hearing an update on the implementation of the *National Quantum Initiative (NQI) Act,* though this was not discussed in depth during the hearing.
- Director Córdova noted that authorities making it easier for NSF to form public-private partnerships would allow NSF to establish more initiatives with industry to support research in these areas, such as NSF's partnership with Amazon to research fairness in AI.
- Senator Rosen pressed NSF to do more outreach to underserved and rural communities who may not be aware of NSF resources or programs.

Sources and Additional Information:

- More information on the *Industry of the Future Act of 2020* is available at https://www.commerce.senate.gov/2020/1/committee-leaders-introduce-industries-of-the-future-bill.
- A video of the hearing, as well as written testimony and opening statements from the panelists, is available at https://www.commerce.senate.gov/2020/1/industries-of-the-future.
- The NIST green paper from its "Return on Investment Initiative" is available at https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1234.pdf.

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Funding Opportunities

Army Research Laboratory Releases FOA for Scalable, Adaptive, and Resilient Autonomy (SARA) Program

The Army Research Laboratory (ARL) recently released a funding opportunity announcement (FOA) for its Scalable, Adaptive, and Resilient Autonomy (SARA) program. The SARA program will replace ARL's Robotics Collaborative Technology Alliance (CTA) and use a new program model based around annual program cycles of technology sprint topics, with a different topic released each year from fiscal year (FY) 2020-2029. Overall, the program aims to develop and accelerate "emerging research in autonomous mobility and maneuverability, scalable heterogeneous and collaborative behaviors, and human agent teaming to realize adaptive and resilient Intelligent Systems." For Cycle 1, the technology sprint topic is **Off-Road Autonomous Maneuver,** including the following subtopics:

- "Off-road autonomous 'GROUND' maneuver
- Autonomous 'AERIAL' maneuver through off-road environments
- Large scale heterogeneous autonomous systems experimentation"

Multiple awards are expected to be funded through cooperative agreements for Cycle 1, with total available funding of $3 million. The annual cycle of sprint topics being used to execute SARA is similar to the program management model used in ARL's STRONG program in 2018. Under the model, selected recipients will be awarded a cooperative agreement described as the "seedling" project. Recipients of a "seedling" agreement are then eligible for consideration to receive follow-on funding for up to three years after completing the initial project. All awardees are required to participate in bi-annual experimentation events at Camp Lejeune, NC, in April 2020 and in October 2020.

Eligible applicants include institutions of higher education, nonprofit organizations, for-profit organizations, as well as Federally Funded Research and Development Centers (FFRDC). ARL will host an opportunity webinar on **January 24, 2020,** which will be posted on https://www.arl.army.mil/sara/. Proposals for Cycle 1 should be submitted through www.grants.gov no later than **February 14, 2020**.

Sources and Additional Information:

- Additional information can be found on www.grants.gov under solicitation number "W911NF-20-S-0005" (this number will be used for all cycles, although the research topic will change each cycle).
- Additional information on the SARA program is available at https://www.arl.army.mil/sara/.
- Additional Information on the Collaborative Technology Alliance is available at https://www.arl.army.mil/business/collaborative-alliances/completed-ctas/.
- Additional Information on the STRONG program is available at https://www.arl.army.mil/strong/.

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National Institutes of Health Releases Solicitation for Biomedical Research Facilities

The National Institutes of Health (NIH) has released a solicitation for Biomedical Research Facilities Construction grants (C06). The solicitation calls for proposals to upgrade or construct new biomedical research facilities and is designed to support the development of modern research infrastructure.

Projects are expected to provide long-term improvements to institutional research infrastructure and facilities. Applicants may use the funds for the design and implementation of projects but may not use the award for regular maintenance or for regularly aging equipment. See the full solicitation for further restrictions on what is permitted for this grant.

Deadline: Letters of intent are due on **February 14, 2020,** and applications are due on **March 17, 2020**.

Award Information: While the solicitation does not specify the number of awards to be granted, proposal budgets are capped at $8 million with a $3 million minimum. It is anticipated that NIH will invest approximately $50 million in the C06 program in fiscal year (FY) 2020.

Eligibility: Any public or private institution of higher education or non-profit research institution is eligible to apply. Applications from research-intensive institutions and Institutions of Emerging Excellence are encouraged to apply. NIH has specified that at least 25 percent of available funds will be directed toward Institutions of Emerging Excellence.

Sources and Additional Information:

- The full funding opportunity can be found at https://grants.nih.gov/grants/guide/pa-files/PAR-20-086.html.
- A list of frequently asked questions regarding the C06 program can be found here https://orip.nih.gov/frequently-asked-questions-par-20-086-biomedical-research-facilities-c06.

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Department of Energy Releases $64 Million Funding Solicitation for H2@Scale Initiative

The U.S. Department of Energy (DOE) released a $64 million funding opportunity announcement to advance the H2@Scale initiative. The focus is on transformational research and development in innovative hydrogen concepts to increase the scale of hydrogen production, storage, transport, and use. DOE has found that hydrogen can add value to industrial sectors such as steel and ammonia production, spur baseload power sources such as nuclear, and accelerate the integration of renewables in the energy system. Opportunities also exist in large-energy use applications for mobility, such as trucks, rail and marine, as well as in energy storage. The funding call is open to research universities, state and local governments, and private industry. National Laboratories may be partners on proposals, but cannot be primes. Compared to last year's funding call, many of the topics are better suited for industry, but research universities can still be key partners.

Key dates for the FOA include:

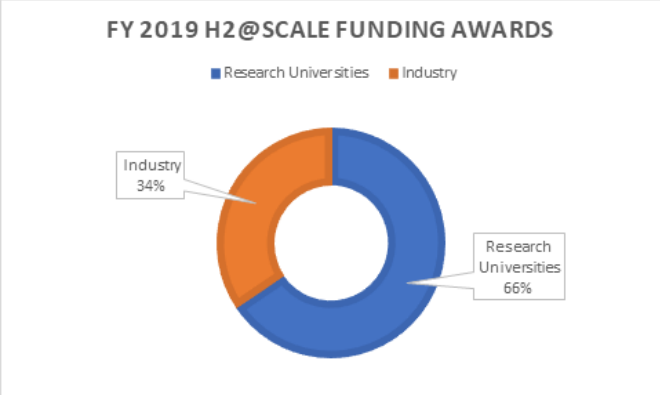
FOA Issue Date:	January 23, 2020
Submission Deadline for Concept Papers:	February 25, 2020 5:00pm ET
Submission Deadline for Full Applications:	April 20, 2020 5:00pm ET
Expected Submission Deadline for Replies to Reviewer Comments:	May 29, 2020 5:00pm ET
Expected Date for EERE Selection Notifications:	July 2020
Expected Timeframe for Award Negotiations:	July to September 2020

The main topic areas include:

- **Electrolyzer Manufacturing R&D (up to $15M):** Lowering the cost of hydrogen produced from megawatt- and gigawatt-scale electrolyzers by improving large-scale, high-volume electrolyzer manufacturing in the U.S.
- **Advanced Carbon Fiber for Compressed Gas Storage Tanks (up to $15M):** Reducing the cost of hydrogen and natural gas storage tanks by developing low-cost, high-strength carbon fiber and scaling up to industry-relevant scales.
- **Fuel Cell R&D and Domestic Manufacturing for Medium and Heavy Duty Transportation (up to $10M):** Advancing the development of domestically manufactured fuel cell components and stacks that meet the cost and performance needs of trucks and other emerging heavy duty applications.
- **H2@Scale New Markets R&D – HySteel (up to $8M):** Enabling the use of hydrogen in steel manufacturing applications, aligned with FCTO and H2@Scale priorities for fostering new markets for hydrogen.
- **H2@Scale New Markets Demonstrations in Maritime and Data Centers (up to $14M):** Developing first-of-a-kind demonstrations to jumpstart emerging new market opportunities for hydrogen in maritime and data center applications.

- **Training and Workforce Development (up to $2M):** Creating cohesive, strategic, and well-coordinated regional efforts to develop the skills necessary to support the growing hydrogen and fuel cell industry.

In FY 2019, DOE issued a $40 million funding call to support the H2@Scale Initiative and made 29 project awards ranging from $380,000 to $5.4 million to support research, development, and demonstration activities ranging from two to five years. See graphic below for distribution of H2@Scale awards in FY 2019.



Sources and Additional Information:

- The funding opportunity announcement is available at https://www.energy.gov/eere/fuelcells/h2scale.
- The funding opportunity announcement is available at https://eere-exchange.energy.gov/ under "DE-FOA-0002229."

Department of Energy Releases Bioenergy Funding Call

The U.S. Department of Energy released an applied energy funding opportunity announcement (FOA) this one focused on bioenergy. The FOA is linked below. Key dates for this $96 million funding solicitation include:

FOA Issue Date:	1/23/2020
Submission Deadline for Concept Papers:	5:00pm ET on 03/05/2020
Submission Deadline for Full Applications:	5:00pm ET on 04/30/2020
Expected Submission Deadline for Replies to Reviewer Comments:	5:00pm ET on 06/11/2020
Expected Date for EERE Selection Notifications:	07/27/2020
Expected Timeframe for Award Negotiations:	September 2020

Main topic areas include:

- **Scale-Up of Bench Applications (up to $28M):** Reducing scale-up risk of biofuel and bioproduct processes.
- **Waste to Energy Strategies for a Bioeconomy (up to $18M):** Addressing ways to use materials that are currently "waste" to make energy and new products, including strategies for municipal solid waste; wet wastes, like food and manures; and municipal waste water treatment.
- **Algae Bioproducts and CO_2 Direct-Air-Capture and Efficiency (up to $14M):** Lowering the cost of algal biofuels by improving carbon efficiency, and/or by employing direct air capture technologies.
- **Bio-Restore: Biomass to Restore Natural Resources (up to $8M)**: Quantifying the economic and environmental benefits associated with growing energy crops, with a focus on restoring water quality and soil health.
- **Efficient Wood Heaters (up to $5M):** Developing and testing low-emission, high efficiency residential wood heaters.
- **Biopower and Products from Urban and Suburban Wastes: North American Multi-University Partnership for Research and Education (up to $15M):** Developing innovative technologies to manage major forms of urban and suburban waste, with a focus on using plastic waste to make recycled products and using wastes to produce low-cost biopower.
- **Scalable CO_2 Electrocatalysis (up to $8M)**: Developing low temperature and low pressure CO_2 electrocatalysis technologies for generating chemical building blocks.

Sources and Additional Information:

- The funding opportunity announcement is available at https://eere-exchange.energy.gov/ under "DE-FOA-0002203."

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Department of Energy Releases Vehicle Technologies Funding Opportunity Announcement

The U.S. Department of Energy (DOE) released a $133 million funding opportunity announcement (FOA) for vehicle technologies. The FOA is linked below.

Key dates include:

FOA Issue Date:	01/23/2020
Submission Deadline for Concept Papers:	2/21/2020
Anticipated Date of Concept Paper Notifications:	3/17/2020
Submission Deadline for Full Applications:	4/14/2020
Anticipated Date for EERE Selection Notifications:	July 2020
Anticipated Timeframe for Award Negotiations:	August 2020

Final topic areas include:

- Batteries and Electrification (up to $40 million)
    - Lithium-ion batteries using silicon- based anodes

        - Low cost electric traction drive systems using no heavy rare earth materials utility managed smart charging supporting projects that will demonstrate managed and controlled charging loads for a large number of vehicles.
- Advanced Combustion Engines and Fuels (up to $27.5 million)
    - Platinum group metals content reduction to enable cost-effective after-treatment for gasoline and diesel engines
    - Improved efficiency of medium- and heavy-duty natural gas and propane (LPG) engines
    - Energy-efficient off-road technologies directly applicable to agriculture sector and/or other off-road vehicles
    - Two-stroke, opposed-piston engine research and development
- Materials Technology (up to $15 million)
    - Lightweight and high-performance fiber-reinforced polymer composites for vehicle applications
- Energy Efficient Mobility Systems (up to $13.5 million)
    - Improving transportation system efficiency through better utilization
    - Enabling vehicle and infrastructure connectivity
    - Improving mobility, affordability, and energy efficiency through transit
- Technology Integration (up to $36 million)
    - Gaseous fuels technology demonstration projects
    - Alternative fuel proof-of-concept in new communities and fleets
    - Electric vehicle and charging community partner projects
    - Technology integration open topic
- Transportation and Energy Analysis (up to $1.2 million)

Sources and Additional Information:

- The funding opportunity announcement is available at https://eere-exchange.energy.gov/ under "DE-FOA-002197."

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Department of Energy Releases Funding Call for National Quantum Information Science Research Center

The U.S. Department of Energy (DOE) recently released a funding opportunity announcement for National Quantum Information Science Research Centers. These large-scale, quantum-focused research and development centers are consistent with congressionally-mandated centers in the National Quantum Initiative Act and similar in scope to the May 2019 DOE Notice of Intent and Request for Information for Quantum Information Science Centers. DOE plans to fund between two and five centers ranging from $10 million to $25 million per year over five years, with the option of another five year renewal. In the final fiscal year 2020 appropriations in December 2019, Congress provided $75 million to establish these new centers. Beyond the initial award, there may be opportunities in future years to grow funding for the centers and DOE has announced that it may spend up to $625 million to support these centers over the next five years, subject to congressional appropriations. The funding opportunity announcement is linked below. A required pre-application is due on **February 10, 2020**.

The purpose of these multi-institutional, multi-disciplinary centers is to "accelerate the transformation advances in basic science and quantum-based technology needed to develop world-leading capabilities

in Quantum Information Science (QIS)" and to "push the current state-of-the-art science and technology toward realizing the full potential of quantum-based applications, from computing, to communication, to sensing." The main scientific and engineering thrusts are in five areas: quantum communication, quantum computing and emulation, quantum devices and sensors, materials and chemistry for QIS systems and applications, and quantum foundries. What distinguishes these centers from the current base program in quantum information science that supports single Principal Investigators and small groups and quantum-focused Energy Frontier Research Centers, is the size and scope of the challenge. These centers must have significant national impact, attack problems of "sufficient difficulty and urgency to warrant a large, multi-institutional, multi-disciplinary effort to be jointly supported by multiple" Office of Science program offices, and assemble a team of experts in multiple disciplines that "blend basic scientific research" with early stage technology development, engineering design and prototype development.

A distinguishing feature from prior Office of Science-funded large-scale centers is the focus on engineering and technology development, more often associated with DOE's applied energy programs. While fundamental research is a key element of these quantum centers, there is also an emphasis on developing the first generation of quantum-enabled devices, systems, and prototypes across a range of applications. There is also a requirement to demonstrate a technology transition path to private industry partners to help them bring these devices to market. These centers must also demonstrate a more direct and clear commitment to workforce development that other prior DOE centers. Unlike the National Science Foundation, DOE indirectly supports workforce development through research grants and the opportunities those provide to students who work on those research projects. These quantum centers must submit a workforce development plan that outline training an education programs that prepare the future workforce.

DOE is also very sensitive to intellectual property issues. U.S. leadership in QIS and its technology applications is considered a critical national interest. To this end, each center must make a commitment that "any products embodying any subject invention or produced through the use of any subject invention will be manufactured substantially in the United States, unless the applicant can show to the satisfaction of DOE that it is not commercially feasible to do so." DOE refers to this commitment as the U.S. Competitiveness Provision.

Below is more detailed information on key requirements for center applications and the review process.

Key Dates

FOA Issue Date:	**01/10/2020**
Submission Deadline for Letters of Intent:	**Not Applicable**
Submission Deadline for Pre-Applications:	**02/10/2020 at 5 PM Eastern Time** **A Pre-application is required**
Pre-Application Response Date:	**03/10/2020**
Submission Deadline for Applications:	**04/10/2020 at 5 PM Eastern Time**

Award announcements are expected around September 1, 2020.

Essential Components of Center Application

A center proposal must include five "Essential Components:"

- **Science and technology innovation chain and co-design**. A center must address at least three of the four innovation chain levels (applications, prototypes, systems, and devices), incorporate fundamental science as a core element, and leverage basic research, engineering, and technology development in a co-design framework.

- **Technical areas of interest**. A center must address the science needs of at least two of the six Office of Science program offices and integrated elements from multiple technical areas of interest. To meet this requirement, a center proposal must address topics in at least two of the five technical areas of interest, which include:
    1. Quantum communications,
    2. Quantum computing and emulation,
    3. Quantum devices and sensors,
    4. Materials and chemistry for QIS systems and applications, and/or
    5. Quantum foundries.

- **QIS ecosystem stewardship**. A center must articulate clear plans for forming partnerships and leveraging existing capabilities of other DOE-funded centers, user facilities, and national laboratories as well programs funded by other federal agencies and submit a workforce development plan. This includes a number of elements:
    - A plan describing how a center will utilize existing research, technologies, capabilities, resources, and facilities, especially DOE-funded research and facilities. In particular, a center proposal should be explicit on how it plans to utilize DOE's Nanoscale Science Research Centers, the Energy Frontier Research Centers, the Energy Innovation Hubs; DOE national laboratories and user facilities; programs funded by other federal agencies such as the National Science Foundation's Quantum Leap Challenge Institutes and the National Institute of Standards and Technology's Quantum Economic Development Consortium (QEDC); investments by academic institutions; and private sector support.
    - A strategy for understanding industry needs, capabilities, and readiness, and how to transfer technology to the private sector. The strategy should be explicit on how the center plans to work with the QEDC on technology transfer.
    - A workforce development plan which may include "educational/training programs; opportunities for students, postdoctoral fellows, and visiting researchers; initiatives that facilitate engagement among industry, university, and lab researches; and outreach activities in which the Center interacts with the public."

- **Well-designed management structure**. Based on best practices from other DOE-funded centers, key elements for the successful management of a center must include:
    - A clear lead institution with strong scientific leadership, a core location for the center, and demonstrated experience managing complex interdisciplinary research and development teams. The lead institution must be a domestic organization.

- A clear organization and management plan with each center designating a Center Director, Deputy Center Director, and Lead Principal Investigators for each major thrust area.

- **Instrumentation and facilities.** A center proposal must be clear on how it plans to leverage existing facilities and instrumentation at research universities, national laboratories, and industry labs. A portion of research funding can be used to develop new tool and technologies that are not currently available to overcome scientific challenges. Some initial funding may also be used for infrastructure improvements and allowable costs includes those "necessary to house the Center (including a possible lease for the first five years of the project), to renovate laboratories as needed, and to purchase research equipment and instrumentation." New construction, such as new buildings or additions to existing buildings, is not allowed.

All of these essential components must be addressed in an application prior to a comprehensive merit evaluation.

Limitation on the number of applications: An institution may be the Lead institution on only one application. There are no limits on the number of applications in which an institute may participate. An individual may be the Center Director on only one application.

Cost share: DOE is seeking a waiver for all cost-sharing requirements for both fundamental and applied research funded under this solicitation. Only for-profit entities would be required to provide at least 20 percent cost share for both basic and applied research and development activities, whether participating as a lead organization or team member.

Merit Review and Selection Process

DOE will select external peer reviewers to review full applications based on their scientific expertise and the absence of conflict-of-interest issues. DOE will rely on a combination of academics, officials and program managers across federal agencies and federal labs, industry, and international partners.

Peer reviews will use seven criteria, listed in descending order of importance, to evaluate an application:

- Scientific and/or technical merit of the project;
- Appropriateness of the proposed method or approach;
- Competency of applicant's personnel and adequacy of proposed resources;
- Reasonableness and appropriateness of the proposed budget;
- Justification for center-scale effort, including cohesion and integration of the research activities;
- Benchmarks, deliverables, and metrics; and
- Strength of the center management plan and QIS ecosystem stewardship.

As part of the merit review process, DOE may schedule face-to-face meetings between the center teams and merit reviewers to answer questions and provide additional information. Following the peer review, federal program managers will review the applications and evaluations of the merit reviewers, and conduct an independent review based on eight program policy factors:

- Availability of funds,
- Relevance of the proposed activity to Office of Science priorities,
- Ensuring an appropriate balance of activities within the Office of Science programs, and the relationship of the proposed Center to other research programs in DOE,
- Potential for developing synergies between the proposed Center and other Centers or other ongoing Office of Science research activities,
- Performance under current awards,
- Participating with multi-institutional teams,
- Demonstrations of institutional or third-party commitments to the proposed Center, and
- Strength of impact on U.S. competitiveness.

DOE will likely do site visits as part of the selection process to ask clarifying questions regarding the proposed center. This information will be used to refine their evaluation of the strengths and weaknesses of the application. All of this information will then go to the DOE-designated Selection Official to make final awards.

Sources and Additional Information:

- The funding opportunity announcement is available at https://science.osti.gov/-/media/grants/pdf/foas/2020/SC_FOA_0002253.pdf.

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Department of Energy Highlights Upcoming Opportunities and Future Research Directions for Advanced Scientific Computing Research

The report below provides advance intelligence on future research directions for the Department of Energy (DOE) Office of Science (SC) in applied math, computer science, and high-performance computing. The analysis is based on information from the January 13-14 Advanced Scientific Computing Advisory Committee (ASCAC) meeting and discussions with DOE program managers. ASCAC provides advice to SC to advance the research and infrastructure priorities of the Advanced Scientific Computing Research (ASCR) program.

Funding Opportunities

In fiscal year (FY) 2020, ASCR is expected to focus even more resources on quantum information science (QIS) and artificial intelligence (AI), both major priorities of the Administration. ASCR's major focus over the next month will be on the National Quantum Information Science Research Centers competition:

Quantum Information Science – DOE plans to fund between two and five National Quantum Information Science Research Centers ranging from $10 million to $25 million per year over five years, with the option of another five-year renewal. While $75 million will be available for this effort across all six SC program offices, ASCR's share will be $29 million to fund centers that support research in quantum computing and emulation. The funding opportunity announcement is currently open, with pre-application materials due February 10. 2020. In addition to these large-scale, center-based efforts, ASCR will continue to fund smaller awards focused on foundational research relevant to QIS.

ASCR also plans to release additional funding opportunities announcements between February and May:

Scientific Discovery through Advanced Computing (SciDAC) Institutes – In FY 2020, ASCR plans to recompete the SciDAC Institutes, which use teams of applied mathematicians, computational scientists, and researchers from other disciplines to advance the multidisciplinary application of high-performance computing. The anticipated recompetition will enable ASCR to shift the focus of the program toward new AI and machine learning (ML) algorithms and tools. There are currently two SciDAC Institutes funded at $12 million in total.

Scientific Machine Learning – In FY 2019, ASCR released its first solicitation aimed at responding to the needs articulated in the report entitled *Basic Research Needs for Scientific Machine Learning: Core Technologies for Artificial Intelligence*, which itself was based on the findings of a workshop ASCR hosted in January 2018. ASCR received over 90 full proposals in response to the solicitation, which focused on uncertainty quantification for validating ML- and AI-enabled predictions and was able to fund three awards at $2 million total. Given the high level of interest in this topic from the research community as well as the increased funding available for AI- and ML-oriented activities in ASCR's fundamental research programs, additional funding opportunities focused on uncertainty quantification, domain-awareness, and intelligent automation and decision-support for complex systems are anticipated in FY 2020.

Future Research Directions

Quantum Internet – ASCR is hosting an invitation-only Quantum Internet Blueprint Workshop on February 5-6, 2020 at the SUNY Global Center in New York City. The focus is on exploring the feasibility of building a nationwide quantum internet, identifying research and engineering gaps, and a possible schedule for advancing this new technology.

5G-enabled Energy Innovation – ASCR is hosting a workshop on March 10-12 in Chicago, Illinois focused on identifying research and innovation opportunities "enabled by 5G and similar technologies such as WiFi 6, 6G, etc." The ultimate objective of the workshop will be to produce a report "highlighting basic R&D, applications, technology transition, infrastructure, and demonstration opportunities in support of the U.S. DOE mission." Specific technical areas to be considered include advancing science missions, cybersecurity, critical infrastructure, extreme environments, scientific user facilities, edge computing, distributed instruments, new science exploration paradigms, software architectures, and data management. Those interested in participating are encouraged to submit a one- or two-page white paper by January 31, 2020.

AI for Science – ASCR and ASCAC are currently engaged in two separate visioning exercises, respectively, focused on establishing research directions for AI. First, between July and October 2019, ASCR held four townhall meetings to help identify future research directions at the intersection of AI and the scientific priorities of SC. Over 1,300 scientists from national laboratories, research universities, and industry attended the townhalls to help shape ASCR's future plans for leveraging the integration of modeling and simulation, data science, and machine learning toward accelerating research and development in several domains and crosscutting areas. The former includes materials, chemistry, nanoscience, earth systems, biology and life sciences, fundamental physics, engineering manufacturing, smart energy infrastructure, computer science, and fusion. Some of the latter that are being addressed are data life cycle and infrastructure, hardware architectures, AI for experimental facilities, and AI at the edge. A

final, comprehensive townhall report will be submitted to ASCR leadership by the end of January with recommendations for more specific Basic Research Needs workshops in future years to contribute to funding decisions.

Separately, the SC Director, Dr. Chris Fall, has charged ASCAC with forming a Subcommittee on AI/ML, Data-intensive Science, and High-Performance Computing. The purpose of the Subcommittee will be to evaluate the myriad outputs from relevant workshops and other activities, including the AI for Science townhalls, and identify AI/ML challenges and opportunities for ASCR and SC. Specifically, Dr. Fall requested that the subcommittee issue a report that:

- "Assesses the opportunities and challenges from Artificial Intelligence and Machine Learning for the advancement of science, technology, and Office of Science missions.
- Identifies strategies that ASCR can use, in coordination with the other SC programs, to address the challenges and deliver on the opportunities."

Membership of the Subcommittee is still being decided, but the intent is to have a diverse group of participants from DOE, academia, other SC advisory committees, the National Science Board, and different industrial sectors including pharmaceuticals and information technology. Initial briefings will begin in February 2020 with the goal of having a completed report by August 2020.

While ASCR has assumed leadership over AI/ML-related activities across SC, these efforts are being undertaken as part of a larger, Department-wide initiative being led by the AI and Technology Office (AITO). Formed in 2019, AITO has developed a plan of action for DOE that includes five separate components:

- Develop a DOE AI Strategic Plan and an accompanying longer-term AI Roadmap;
- Institute the AI Exchange which will track DOE's progress in meeting its AI goals and objectives while ensuring coordination of activities;
- Develop and implement AI leadership training to enhance the AI knowledge of DOE's stakeholders;
- Conduct workshops to identify future directions and spur new collaborations; and
- Prioritize and develop partnerships with other federal agencies, external sectors, and international entities.

ASCAC Subcommittee on Exascale Transition – As reported by Lewis-Burke in September 2019, ASCR charged ASCAC with retrospectively examining the Exascale Computing Project (ECP) and developing recommendations for retaining its best practices, sustaining exascale hardware and software in the long term, and reinvigorating ASCR's foundational research programs. The Subcommittee responsible for carrying out these activities issued its report at the January 2020 ASCAC meeting. The findings and recommendations focused on four areas: Advancing and Building on ECP; Advancing ASCR Research; Current and future Workforce; and National and International Leadership.

Recommendations that are particularly relevant to the academic community include the following:

- Broaden ASCR's industry and academic engagement, including by extending the *xForward* program, which facilitated ECP-focused technology development through external partnerships.

- Substantially reinvest in its fundamental research programs, especially in computer science and applied mathematics, and support interdisciplinary, high risk/high reward activities through regularly released funding opportunities.
- Strengthen ties to academia by reinvigorating basic research at universities and making high risk/high reward research opportunities available to investigators across experience levels—especially for early career researchers in order to strengthen the workforce development pipeline.
- Provide for the wider distribution of research software.
- Prioritize support for a diverse workforce to encourage fresh perspectives.

Funding Outlook for ASCR

In FY 2020, Congress appropriated $980 million to ASCR, an increase of $44.5 million or 4.8 percent above FY 2019. In a departure from recent years, the majority of the increase would be allocated to the Mathematical, Computational, and Computer Sciences research account. The large amount of additional research funding—18.6 percent above FY 2019—would support expanded research efforts in AI and QIS while also maintaining stable spending levels on core research activities that are not directly tied to Administration priorities. This represents an expanding opportunity for universities as these are typically the most accessible ASCR programs for academic researchers.

FY 2020 is also the first year in which funding for ECP decreased. This reflects the fact that ASCR is now making the final procurements in advance of the deployment of the Department's first exascale systems, scheduled for 2021. It is expected that funding for ECP will continue to decline in the coming years, which would free up additional resources for more future-focused research activities. This is consistent with the recommendations of the ASCAC subcommittee report.

The chart below includes a detailed breakdown of ASCR's budget, and includes comparisons between the FY 2019 enacted levels, the Administration's FY 2020 request, and the figures included in the final FY 2020 spending package.

ASCR FY 2020 President's Request
in thousands

	FY 2018 Enacted Approp.	FY 2019 Enacted Approp.	FY 2020 Request	FY 2020 House Mark	FY 2020 Senate Mark	FY 2020 Enacted Approp.
Mathematical, Computational, and Computer Sciences Research						
Applied Mathematics	34,104	28,206	41,500			41,500
Artificial Intelligence and Big Data (Non Add)	*(...)*	*(...)*	*(14,281)*			*(14,281)*
Computer Science	29,508	22,000	38,700			38,700
Artificial Intelligence and Big Data (Non Add)	*(6.402)*	*(2,000)*	*(9,719)*			*(9,719)*
Quantum Information Science (Non Add)	...	(3.000)	(5,000)			(5,000)
Computational Partnerships	49,910	75,667	60,959			69,142
Artificial Intelligence and Big Data (Non Add)	*(3.500)*	*(13,000)*	*(12,000)*			*(12,000)*
Quantum Information Science (Non Add)	*(6,349)*	*(16,214)*	*(16,708)*			*(20,680)*
SBIR/STTR	4,301	4,768	5,347			5,658
Total, Mathematical, Computational, and Computer Sciences Research	117,823	130,641	146,506	155,000	168,944	155,000
High Performance Computing and Network Facilities						
High Performance Production Computing (NERSC)	94,000	104,000	85,000	100,000	115,000	110,000
Leadership Computing Facility at ANL (ALCF)	110,000	140,000	150,000	150,000	165,000	150,000
Exascale (Non Add)	*(110,000)*	*(140,000)*	*(150,000)*	*(150,000)*	*(150,000)*	*(150,000)*
Leadership Computing Facility at ORNL (OLCF)	162,500	199,000	210,000	225,000	235,000	225,000
Exascale (Non Add)	*(62,500)*	*(100,000)*	*(125,000)*	*(125,000)*	*(125,000)*	*(125,000)*
Total, Leadership Computing Facilities	272,500	339,000	360,000	375,000	400,000	375,000
Research and Evaluation Prototypes	24,260	24,452	39,453	25,620	42,000	39,000
CSGF	*(10,000)*	*(10,000)*	*(10,000)*	*(10,000)*	*(12,000)*	*(10,000)*
Quantum Information Science (Non Add)	*(14,260)*	*(14.452)*	*(29,453)*	*(15,620)*	*(30,000)*	*(29,000)*
High Performance Network Facilities and Testbeds (ESnet)	79,000	84,000	80,000	90,000	90,000	90,000
SBIR/STTR	17,417	20,701	21,194	22,185	24,321	22,265
Total, High Performance Computing and Network Facilities	487,177	572,153	585,647	612,805	671,321	636,265
Exascale Computing						
17-SC-20 Office of Science Exascale Computing Project (SC-ECP)	205,000	232,706	188,735	188,735	188,735	188,735
Total, Advanced Scientific Computing Research	**647,000**	**935,500**	**920,888**	**956,540**	**1,029,000**	**980,000**

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Source: DOE

In keeping with the Senate's initial appropriations mark, the final FY 2020 appropriations package provided $195 million for QIS research activities across SC, including $75 million for large-scale national QIS research centers, $26.5 million above the Administration's request. Within ASCR, $29 million in QIS funding has been designated to support the abovementioned large-scale research centers while $26 million will be allocated for more fundamental research activities in the Computational Partnerships (SciDAC) and Computer Science programs.

The bill also provided the requested level of $71 million for SC-wide AI activities. Of the total, $36 million would be housed within ASCR and funded through each of the three component programs of the Mathematical, Computational, and Computer Sciences account. Applied Mathematics would incorporate the largest share of that funding—$14 million—into its budget to support foundational research relevant to AI in areas such as uncertainty quantification, and optimization.

The chart below outlines how funding for the Administration's priority areas has been allocated across all six SC program offices.

FY 2020 Priority #1 Research Initiatives

Dollars in Thousands

Research Initiative	ASCR	BES	BER	FES	HEP	NP	Total
Machine Learning / Artificial Intelligence	36,000	10,000	3,000	7,000	15,000		**71,000**
Biosecurity			20,000				**20,000**
Quantum Information Science	51,161	52,503	12,000	7,520	38,308	7,000	**168,492**
Exascale Computing	463,735	26,000	10,000				**499,735**
Microelectronics		25,000					**25,000**
Isotope Development and Production for Research and Applications						47,500	**47,500**
U.S. Fusion Program Acceleration				4,000			**4,000**
Total	**550,896**	**113,503**	**45,000**	**18,520**	**53,308**	**54,500**	**835,727**

Source: DOE

Sources and Additional Information:

- The funding opportunity announcement for the National Quantum Information Science Research Centers is available at https://science.osti.gov/-/media/grants/pdf/foas/2020/SC_FOA_0002253.pdf.
- Additional information for the Scientific Discovery through Advanced Computing (SciDAC) Institutes is available at https://www.scidac.gov/institutes.html.
- The ASCR report *Basic Research Needs for Scientific Machine Learning: Core Technologies for Artificial Intelligence* is available at https://www.osti.gov/biblio/1478744-workshop-report-basic-research-needs-scientific-machine-learning-core-technologies-artificial-intelligence.
- Additional information on the 5G-enabled Energy Innovation program can be found at https://www.orau.gov/5GScience/.
- For further reference, the ASCAC meeting agenda, including presentations, is available at https://science.osti.gov/ascr/ascac.

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Department of Energy Releases Fifth Funding Call Under the Biological and Environmental Research Program

The U.S. Department of Energy (DOE) recently released the fifth funding call under its biological and environmental research program and the second for its biological sciences program. This $15 million funding opportunity announcement ($75 million total over 5 years) is for "Systems Biology Research to Advance Sustainable Bioenergy Crop Development" aimed at developing sustainable bioenergy crops tolerant of environmental stress and resilient to changing environmental conditions. The focus is on better understanding of the genetic and physiological mechanisms influencing plant productivity, resource use, and resistance to environmental stress. Applications are open to research universities, industry and nonprofit institutions. National laboratories and other federal agencies can be collaborators.

DOE expects to make from five to 15 awards ranging from $1 million to $3 million per years over five years. Key dates include:

FOA Issue Date:	**December 23, 2019**
Submission Deadline for Letters of Intent:	**N/A**
Submission Deadline for Pre-Applications:	**January 27, 2020** **A Pre-Application is required**
Pre-Application Response Date:	**February 3, 2020**
Submission Deadline for Applications:	**March 26, 2020**

Sources and Additional Information:

- The funding opportunity announcement is available at https://science.osti.gov/-/media/grants/pdf/foas/2020/SC_FOA_0002214.pdf.

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Department of Transportation Exploratory Advanced Research Announces Forthcoming BAA

The Department of Transportation's (DOT) Exploratory Advanced Research program (EAR) has published a Notice of Intent (NOI) to open a Broad Agency Announcement (BAA) for fundamental transportation research. The BAA, once released, will support cooperative agreements and contracts in three distinct research topics:

- Blockchain technology for highway transportation;
- Artificial intelligence for highway transportation;
- Compatibilization of waste plastic to enhance mechanical properties of asphalt cement.

DOT has delayed the final release of the BAA, but intends to publish the solicitation by the end of the month though there is no firm timeline. When reviewing the notice, keep in mind that the response date will be updated based on the final publishing date of the solicitation and will be roughly 30 days after the publication of the solicitation.

Sources and Additional Information:

- The notice of intent can be found at https://beta.sam.gov/opp/e64cd20e43794349b32de3911e20ab66/view.

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Agency Updates

Department of Defense Announces Proposers' Day for SynBio Manufacturing Institute

The Department of Defense (DOD) announced that it would hold a Proposers' Day on **March 5, 2020 in Arlington, Virginia** to provide further insight on its Synthetic Biology (SynBio) Manufacturing Innovation Institute (MII). In December, DOD released a Notice of Intent for this new institute that the agency says will "foster an end-to-end 'ecosystem' in the U.S. for Synthetic Biology including cohesive scale-up manufacturing and downstream processing capabilities, integrated test & evaluation capacity, and data operationalized for design for manufacturing, all coupled with workforce development and a focus on ethics and biosecurity." The Proposers' Day, which is free to attend, provides an opportunity to learn more about DOD's vision for the SynBio MII and to ask questions about the solicitation, which is expected to be released around February 24 prior to the event.

As previously reported by Lewis-Burke, the institute will scale up critical bio-manufacturing processes and related biotechnologies in partnership with industry and academia. The NOI specifically notes that the institute will "enable universities and small to medium enterprises to participate in and benefit from the MII's manufacturing advances." The institute is expected to create new opportunities for U.S. manufacturers due to the applicability of SynBio manufacturing to both defense priorities and the commercial potential of such innovations in food, agriculture, fuel, pharmaceuticals, and other consumer products. The MII should be structured to address both DOD and commercial applications, with a focus on maturing the technology from Technology Readiness Level (TRL) 4, which means component-level technology validated in a laboratory, to TRL 7, a system prototype demonstration in an operational environment.

Sources and Additional Information:

- Additional information on the Proposers' Day can be found at https://synbio.anser.org/.
- The announcement of the Proposers' Day can be found at https://beta.sam.gov/opp/98951a543588444daf61a53e2d49914c/view.
- The solicitation can also be accessed through https://beta.sam.gov/ by searching for Notice ID "FA8650-20-S-5028."
- The Notice of Intent is available at https://beta.sam.gov/opp/f87127393cb84157b8da1957ec686d16/view?keywords=FA8650-20-S-5028.

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