



**Robert Dickey, President, National Association of
Marine Laboratories**

**Dave Carlon, Chairman, Public Policy Committee,
National Association of Marine Laboratories**

NATIONAL ASSOCIATION OF MARINE LABORATORIES

Annual Public Policy Meeting

March 16-17, 2020

Washington Marriott at Metro Center

775 12th Street NW

Washington, D.C. 20005



Briefing Book for NAML Meeting

March 16-17, 2020

Washington, D.C.

- ✓ **Meeting Schedule**
- ✓ **Federal Science Partners Public Policy Presentation**
- ✓ **Observations on the FY 2021 Budget Environment: Impact on Research & Education Programs**
- ✓ **Draft NAML Public Policy Agenda for FY 2021**
- ✓ **Background Information on Speakers and Suggested Questions**
- ✓ **FY 2021 OMB/OSTP R&D Priorities Memorandum, August 2019**
- ✓ **February 27, 2020 Testimony of Dr. Kelvin Droegemeier, Director, OSTP – Administration's R&D Budget Request for FY 2021**
- ✓ **OMB – Research and Development in the President's FY 2021 Budget**
- ✓ **Presidential Memorandum on Ocean Mapping of the United States Exclusive Economic Zone and the Shoreline and Nearshore of Alaska**
- ✓ **Membership of Key Congressional Committees for Ocean, Coastal, and Great Lakes Issues**



**National Association of Marine Laboratories
Theme: Coastal Intelligence and Workforce Development**

Virtual Meeting

Monday, March 16

Location: Virtual Meeting

8:30AM: Housekeeping issues for the virtual meeting: Brett Burk, NAML Secretariat
Opening Remarks:
Robert Dickey, NAML President
Dave Carlon, Chair, NAML Public Policy Committee & NAML President-Elect

8:45AM: Joel Widder and Meg Thompson, Federal Science Partners
Setting the Public Policy Environment for the Ocean, Coastal, and Great Lakes Research and Education Community

9:15AM: *Moderator - Robert Dickey*
RDML Timothy Gallaudet, Ph.D., Rear Admiral, U.S. Navy (Ret.)
Assistant Secretary of Commerce for Oceans and Atmosphere
Deputy NOAA Administrator

10:00AM: Administration's Ocean/Coastal Agenda -- Mr. Deerin Babb-Brott, Principal Assistant Director, Oceans and Environment, Office of Science and Technology Policy

10:45AM: *Moderator - Dave Carlon*
Discussion of NAML Public Policy Agenda for 2020 - led by Dave Carlon, Joel Widder and Meg Thompson (discussion to continue at March 17 Business Meeting); discussion points are listed below

FY 2021 Congressional Appropriations Testimony – Issues and Programs to be highlighted and collaboration with like-minded organizations:

NSF – FSML, COPE, Mid-Scale Instrumentation, Education and Training

NOAA – IOOS, Resiliency Grants, NERRA, Sea Grant, BWET and Education, aquaculture, marine debris,

EPA – National Estuary Program, other water-related programs (need specific suggestions from NAML Members)

USGS – water resources and other science programs

Other agencies/programs?

Legislative Issues

Aquaculture Legislation
Reauthorization of Magnuson-Stevens
IOOS Reauthorization
Sea Grant Reauthorization
NERRA
Digital Coast
Marine Debris (Save Our Seas)

11:30AM: Break for Lunch

11:45AM: Working Lunch: Workforce Development

Moderator - Robert Dickey

Dr. Grant Murray, Associate Professor of Marine Policy
Co-Chair, Coastal Environmental Management Program
Coastal Environmental Management
Marine Science & Conservation
Duke Marine Laboratory

Dr. Kari O'Connell, Senior Researcher
Director U-FERN (Undergraduate-Field Experiences Research Network)
Center for Research on Lifelong STEM Learning
Affiliate Faculty, Department of Forest Ecosystems and Society,
College of Education, and the Environmental Arts and Humanities Program
Oregon State University

1:15PM: **Moderator - Dave Carlon**

NOAA Education and Training Programs: Current and Future Program Directions -- Dr. Louisa Koch – K-12, Undergraduate, Graduate, and Fellowships (Davidson, Knauss, NMFS)

2:00PM: **Moderator - Robert Dickey**

NSF Ocean Coastal Research and Education: Dr. Terry Quinn, Director, Division of Ocean Sciences

2:45PM: Break

3:00PM: **Moderator - Dave Carlon**

EPA National Estuary Program: Opportunities for Collaboration with NAML Laboratories
Robert Benson, EPA program director for NEP and Partnerships;
Pam DiBona, Chairman of the Board for the Association of National Estuary Programs (ANEP);
Rich Innes, Consultant to ANEP, Meridian Group;

3:45PM: **Moderator - Robert Dickey**

Challenges Facing Improved Coastal Resiliency – Dr. Holly Bamford, Chief Conservation Officer, National Fish and Wildlife Foundation

4:30PM: *Moderator - Dave Carlon*
Nicole LeBoeuf, Acting Assistant Administrator, National Ocean Service, NOAA

5:30PM: Closing Statements Robert Dickey and Dave Carlon
Adjourn for Day

Tuesday, March 17, 2020

Location: Virtual Meeting

10:30 AM NAML Board of Directors Meeting

12:00 PM NAML Business Meeting
Call to order and Opening Remarks – Robert Dickey, NAML President

Approval of Minutes of Past Meetings

Discussion and Approval of NAML Public Policy Agenda for 2020 - led by Dave Carlon,
Joel Widder and Meg Thompson (discussion continued from previous day)

Treasurer Report
Approval of NAML Emeritus Member
Approval of New NAML Members
NAML Lobbying and Advocacy Policy and Practices
Education Committee
Membership Report
Old/New Business
Adjourn Business Meeting

2:00 PM Adjourn

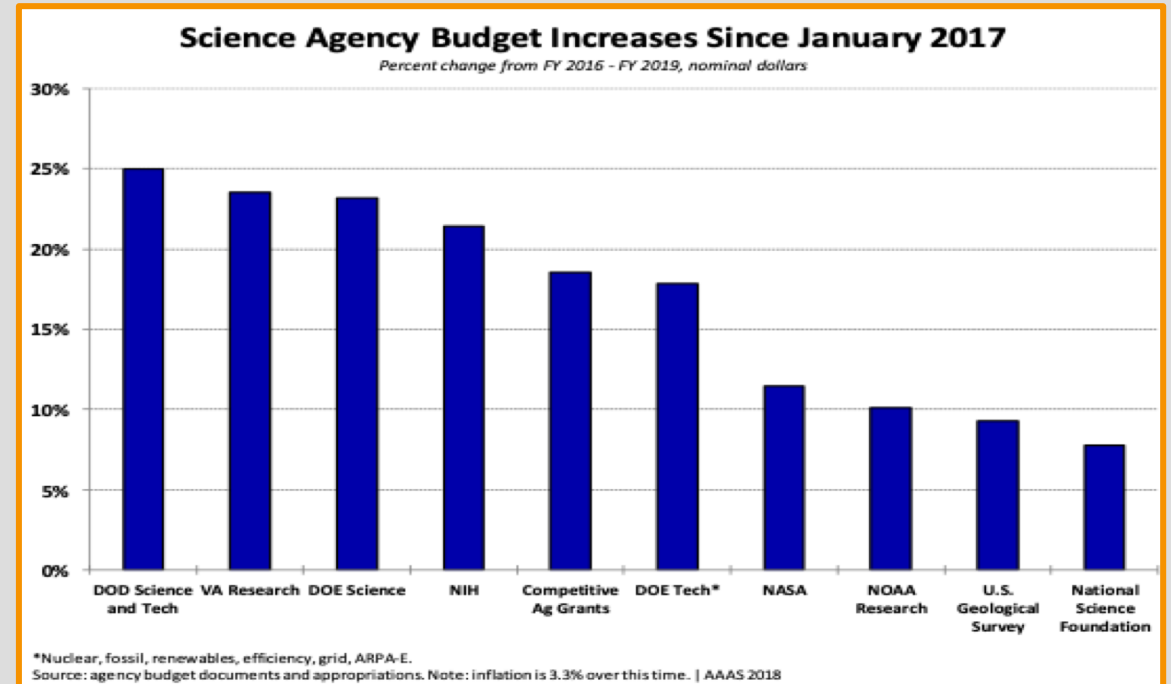
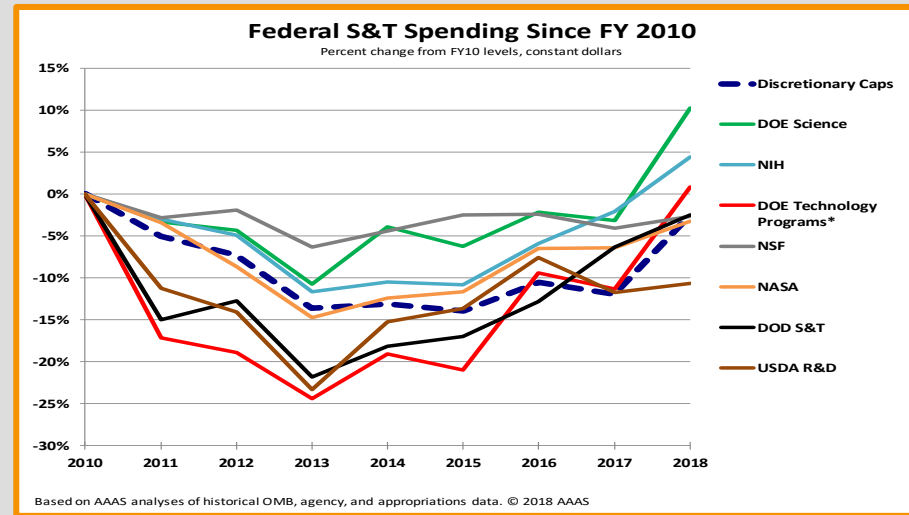
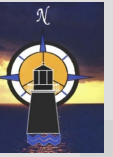
National Association of Marine Laboratories Public Policy Meeting Washington, D.C. March 2020



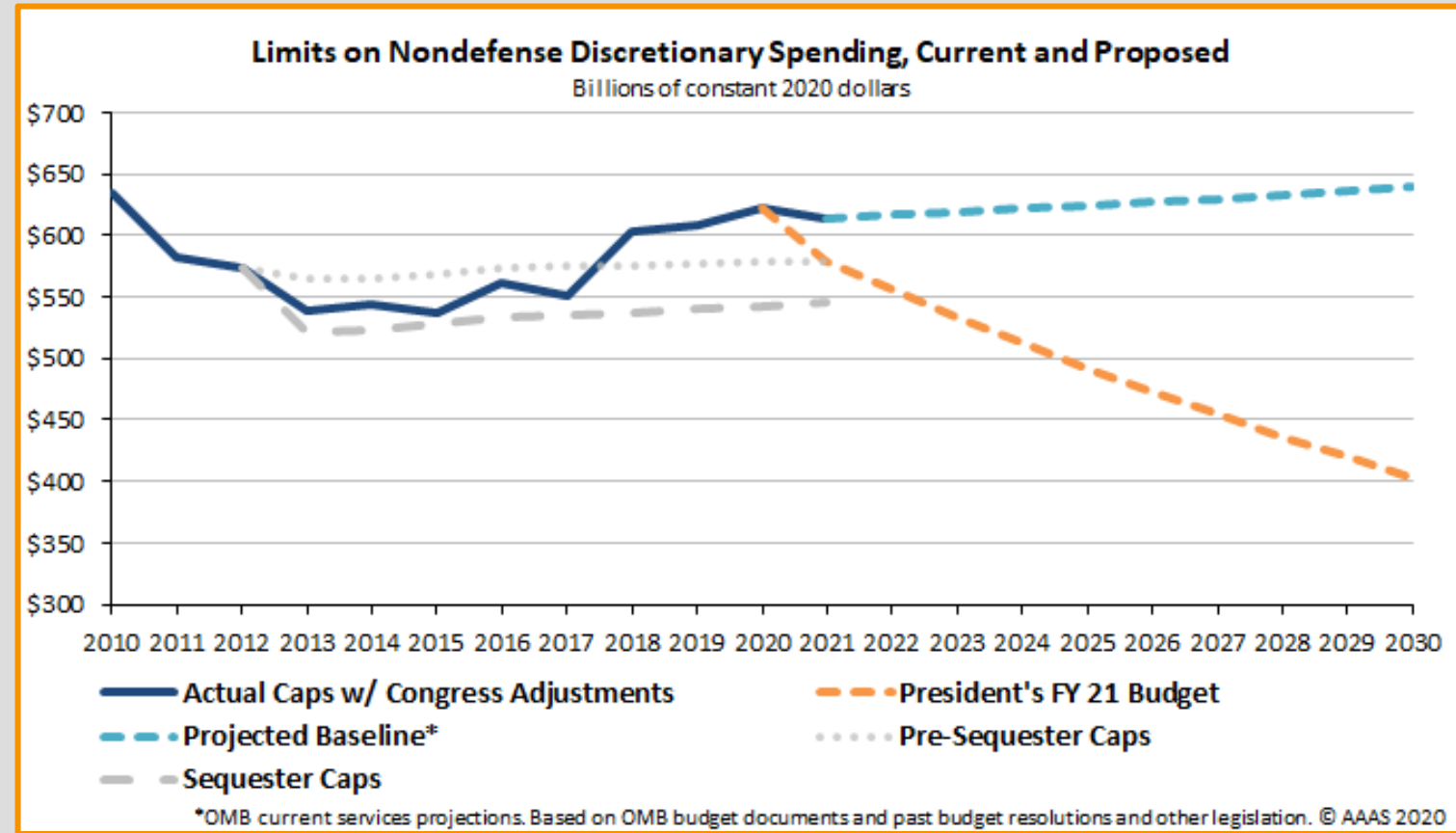
Presented by
Meg Thompson and Joel Widder
Co-Founders and Partners
Federal Science Partners



As Non-Defense Discretionary Spending Goes, So Goes R&D but not all agencies benefit

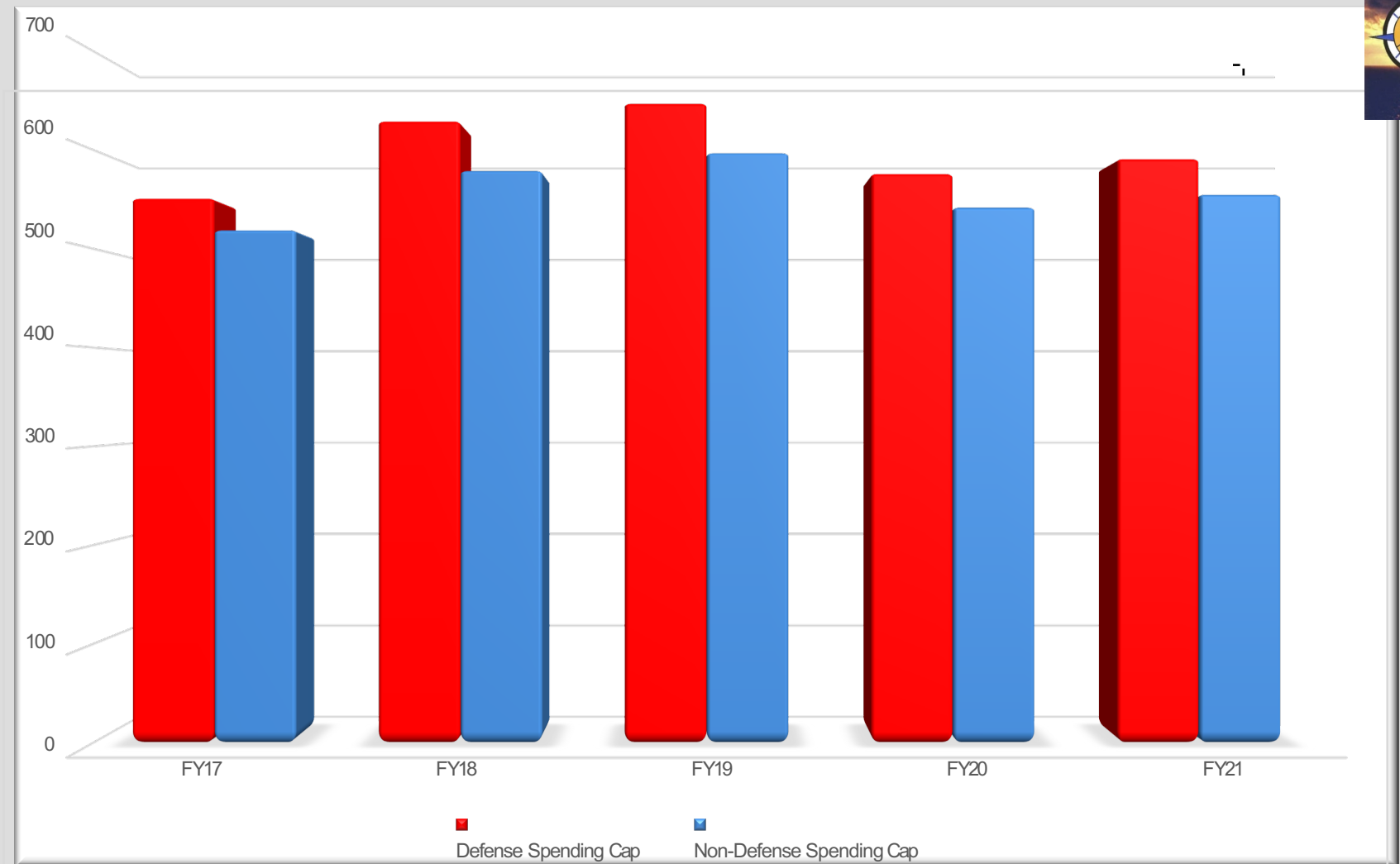


If R&D Tracks with Non-Defense Discretionary Spending, Where is Non-Defense Discretionary Going?



The FY21 Budget Environment Facing Science & Technology

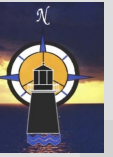
\$ in billions Of current dollars



Budget Control Act (BCA) Spending Levels as of August 2017.

Source: Congressional Research Service; *Budget Control Act: Frequently Asked Questions*, September 1, 2017; and *A New Foundation for American Greatness*; Budget of the U.S. Government FY 2018, Office of Management & Budget





What is the Administration Proposing for FY 2021?

FY 2021 Requested Budgets for Select S&T Agencies and Programs (net budget authority, millions of dollars. Contains non-R&D)					
	FY 2019 Actual	FY 2020 Enacted	FY 2021 Request	FY20 Change Amount Percent	
Dept. of Defense					
Basic Science (6.1)	2,476	2,603	2,319	-284	-11%
DARPA	3,426	3,458	3,566	108	3%
Natl Institutes of Health 1/	39,184	41,685	38,694	-2,991	-7%
Dept. of Energy					
Energy Efficiency & Renewables	2,320	2,777	720	-2,057	-74%
Fossil Energy R&D	720	750	731	-19	-3%
Nuclear Energy	1,386	1,582	1,180	-402	-25%
ARPA-E 2/	366	425	0	-425	-100%
Office of Science	6,708	7,000	5,838	-1,162	-17%
Cybersecurity & Response	118	156	185	29	19%
NASA					
Exploration Technology	927	1,100	1,578	478	43%
Science Directorate	6,887	7,069	6,307	-762	-11%
Exploration Systems	5,045	6,018	8,762	2,744	46%
Aeronautics	725	784	819	35	4%
STEM Engagement	110	120	0	-120	-100%
Total Budget	21,500	22,629	25,245	2,616	12%
National Science Foundation	8,150	8,278	7,741	-537	-6%
Dept. of Agriculture					
Agricultural Research Service	1,684	1,607	1,418	-189	-12%
Natl Inst of Food and Ag (NIFA)	1,486	1,549	1,596	47	3%
AFRI	415	425	600	175	41%
Economic Research Service	87	85	62	-23	-27%
National Ag Statistics Service	176	180	177	-3	-2%
Forest Svc Rangeland Research	301	305	249	-56	-18%
Dept. of Commerce					
NOAA Research Office 3/	558	590	353	-237	-40%
NIST	987	1,037	701	-336	-32%
Dept. of Homeland Security S&T	820	737	644	-94	-13%
US Geological Survey	1,161	1,271	971	-300	-24%
EPA Science & Technology	695	716	485	-232	-32%
VA Medical Research	779	750	787	37	5%

Source: OMB appendix and agency budget documents.

All figures rounded to nearest million. Changes calculated from unrounded figures.

1/ FY 2020 includes additional requested funding for Type I Diabetes research.

2/ The Administration recommends cancelling \$332 million in unobligated balances.

3/ Figures reflect obligations.

AAAS | 2.10.2020

NSF down 6%

NOAA R&D down by 40%

NASA Science down by 11%

EPA R&D down by 32%

USGS down by 24%

DOD basic research down by 11%

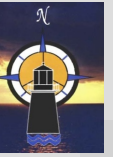
Eliminate ARPA-E

Eliminate NASA STEM ed

Eliminate NOAA Education

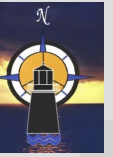
Priorities include Quantum Science, Artificial Intelligence, Space Exploration, Ocean Exploration/Mapping





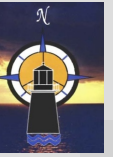
What is the Administration Proposing for FY 2021 for NSF?

- NSF Research to decline by 5.6%
- Geosciences to decline by 14%
- Ocean Sciences to decline by 8.5%
- Reduce GEO Undergraduate STEM Education by 10%
- Increase Coastlines and People from \$6M to \$15M
- Reduce Support for the Academic Fleet by 6.2%
- Reduce Environmental Biology by 2.2%
- Reduce Biological Infrastructure by 12.6%



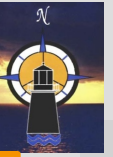
What is the Administration Proposing for FY 2021 for NOAA?

- Increase funding for Ocean Mapping...\$8.5M
- Eliminate \$\$\$ for NCCOS and NCCOS Competitive Research
- Eliminate \$\$\$ for NERRS, Title IX Coastal Resiliency Grants, CZM Grants
- Eliminate Prescott Program, Sea Grant Program, Competitive Climate Research
- Eliminate NOAA B-WET and other education programs
- Reduce IOOS from \$40M to \$19M
- Habitat Conservation & Restoration reduced from \$59M to \$39M
- Aquaculture: Reduced by \$2.4M in NMFS; Eliminated in OAR
- Marine Debris reduced by \$1.5M

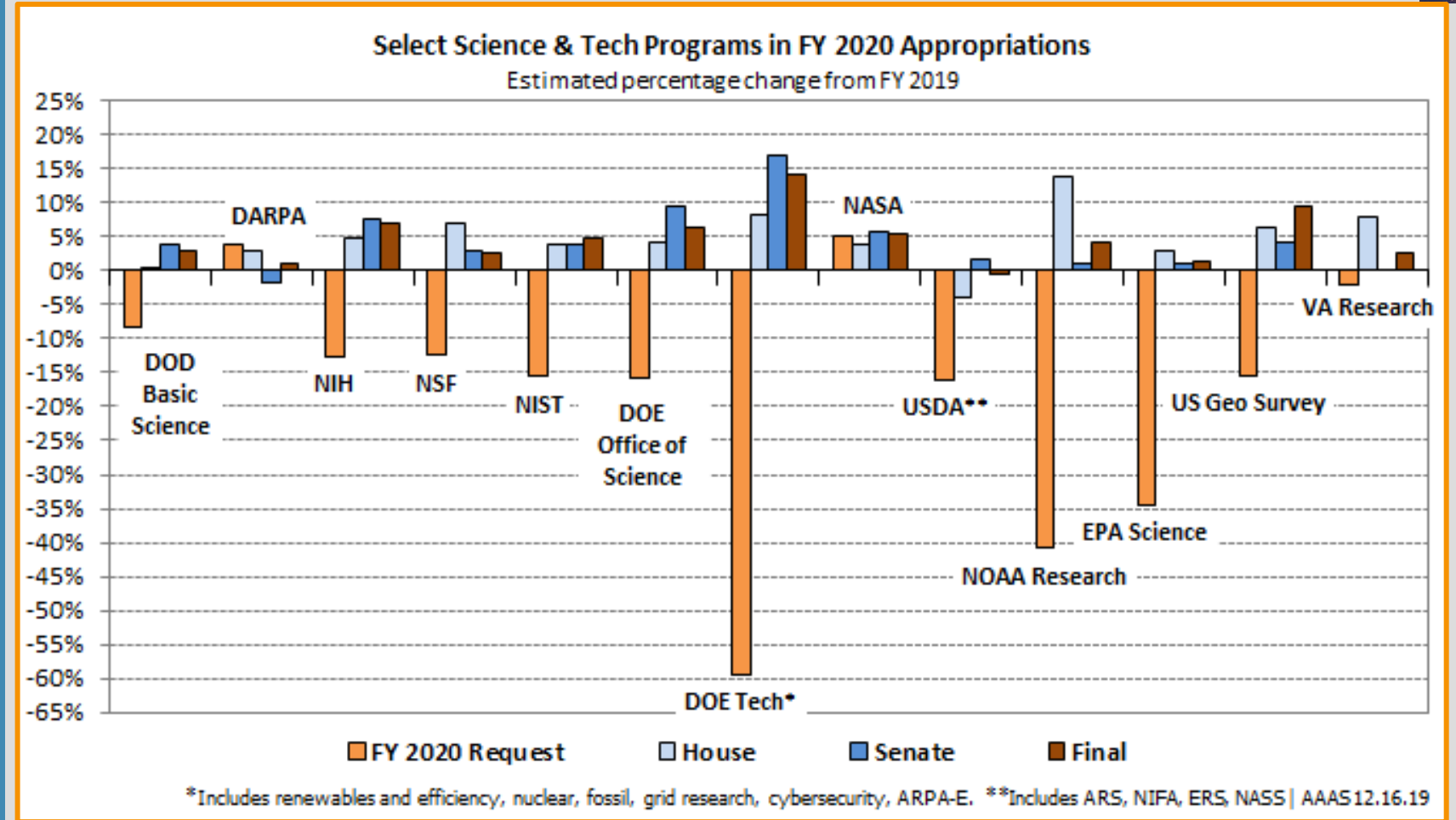


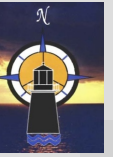
What is the Administration Proposing for FY 2021 for EPA?

- EPA R&D reduced from \$500M to \$281M – extramural research grants to universities – such as STAR – not to be funded
- Reduce Geographic Programs from \$510 to \$331 – funding only Great Lakes and South Florida and limited funding for Chesapeake Bay – all others eliminated
- Eliminates climate change
- Eliminates funding for National Estuary Program
- Eliminates funding for Beach/Fish Programs
- Eliminates environmental education
- Increases funding to reduce ocean pollution and plastic waste by \$8.4M
- Increases funding for HABs Reduction by \$22.4M including \$15m for a competitive grant program



How did Congress React to the Administration's FY20 R&D Budget Plans?





NAML Public Policy Priorities for FY21

NAML recommends expanded support for Federal agencies and programs that address :

U.S.-based aquaculture to reduce the ever-increasing demand for foreign imports, to advance seafood security and opportunities for economic growth;

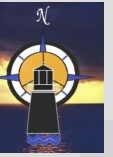
Oceanographic and geochemical exploration and associated technology development to advance national security, commerce and domestic energy independence;

Data collection and adaptive management strategies to increase productivity and sustainability of marine fisheries and social-economic productivity of U.S. exclusive economic zones;

Comprehensive understanding of ecosystems which support fisheries and other social-economic drivers;

Defining the impacts and causative factors for shifting environmental regimes to inform risk management of critical defense, transportation, civic and business infrastructure along U.S. coastlines; and

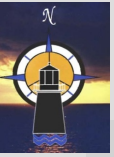
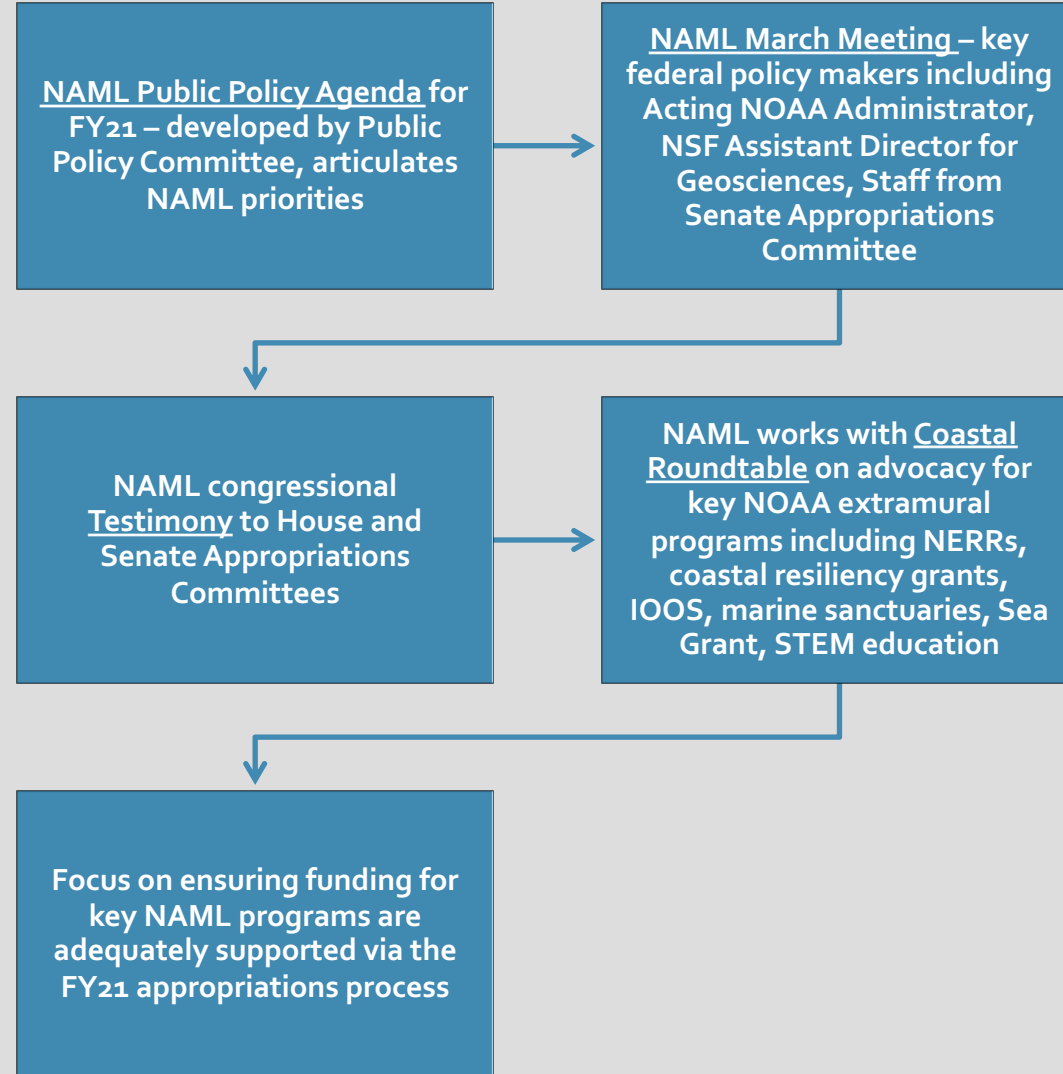
Discovery and innovation in biological, chemical, geological and physical marine sciences to support advancement of human and environment health and social-economic objectives.



Top Line Issues to be Explored with Speakers at this Meeting

- In what ways are the strengths of marine labs included in the administration's National Ocean Policy and Presidential Memo on Ocean Mapping?
- How will the FY21 budget caps impact extramural research and education programs at NSF, NOAA, ONR and other relevant Federal agencies?
- What are the major programmatic priorities agencies are likely to emphasize in their forthcoming FY20 budget plans?
- Within NSF, what is the impact of a \$500 billion reduction on core NSF research and education programs when AI, QS, and "NSF Big Ideas" are growing so dramatically?
- At NOAA, where does support for extramural research and education fit in with meeting NOAA's core missions and key priorities?
- How can NAML be most helpful and effective in its advocacy efforts

NAML Public Policy Activities: Recent and Planned





***Observations on the FY 2021 Budget Environment:
Impact on Research and Education Programs
Prepared by Meg Thompson and Joel Widder
For the National Association of Marine Laboratories
March 2020***

Non-Defense Discretionary Programs Face Tight Funding in FY 2021 – Under the budget agreement reached last summer for discretionary spending in both FY 2020 and FY 2021, the level of spending for non-defense discretionary programs (NDD) – the portion of the federal budget that includes research, technology, education, environment, climate, infrastructure, veterans’ medical care, the national parks, the census, transportation, and housing -- for 2021, the additional funding available for NDD relative to its 2020 level is about \$11 billion, before adjusting for inflation. This figure reflects the \$5 billion (about 0.8 percent) increase in the statutory limit (or cap) on NDD funding between 2020 and 2021, plus the extra funds freed up by both the drop in Census Bureau needs after completion of the 2020 decennial census and projected increases in fee income from mortgage insurance programs, which help offset other appropriations. But much, and possibly all, of this \$11 billion apparent increase is expected to be needed just to cover rising costs for veterans’ medical care, which will likely rise by \$8 to \$12 billion. Thus, almost any increases for other programs, including increases simply to counter the effects of inflation or a growing population, will require cuts elsewhere in the NDD budget.

NDD programs other than veterans’ medical care and Census will need to grow by \$13 billion over their 2020 levels just to cover inflation, so they face about a 2½ percent cut in 2021 after inflation if they receive no nominal increase. If one also accounts for population growth — since a larger U.S. population means that additional funding is needed for many NDD programs — the cut grows to about 3 percent. The challenge for Congress will be how to deal with this constrained level of funding, since protecting various priority programs or providing increases for them will require deeper cuts in other programs.

Observations on the FY 2021 National Science Foundation Budget Request – NSF’s FY 2021 Budget Request is \$7.7 billion, a 5% reduction from the FY 2019 level and a 6.5%, or \$537 million reduction from the FY 2020 appropriated level. Despite this proposed reduction of over \$500 million, the NSF plans to invest \$868 million in artificial intelligence (AI) (+\$403 million above FY 2019 level) and more than double its support of quantum information science (QIS) to \$226 million (+\$120 million above FY 2019 level) in FY 2021. These priorities are in line with the Administration’s R&D priorities by focusing research investments on Industries of the Future (IoF).

NSF investments in AI span fundamental research in machine learning, computer vision, and natural language processing, along with the safety, security, robustness, and explainability of AI systems; translational research at the intersection of AI and various science and engineering domains as well as economic sectors such as agriculture, manufacturing, and personalized medicine; and education and learning, including growing human capital and institutional capacity to nurture a next generation of AI researchers and practitioners. NSF FY 2021



investments in AI will include support for a set of National AI Research and Development (R&D) Institutes, which will further AI through multi-disciplinary, multi-institution teams to focus on larger-scale, longer-term challenges in both foundational and translational AI. NSF will increase support for QIS to consolidate and expand the U.S.' world-leading position in fundamental quantum research and deliver proof-of-concept devices, applications, tools, or systems with a demonstrable quantum advantage over classical counterparts.

One has to ask, if AI and QIS are increasing at these proposed levels within a total budget proposed to decline by more than a half of a billion dollars, what is being lost or severely reduced in other key NSF research and education programs?

It is currently difficult to answer this question with specificity by comparing the differential of this proposed budget with the amounts provided in FY 2020 for NSF directorates, divisions, and specific programs and NSF-wide initiatives, such as NSF's *Big Ideas*. This is because NSF has not yet released its detailed spending plan for FY 2020 to be drawn from the \$8.3 billion appropriation it received in P.L. 116-93 on December 20, 2019. NSF has chosen to compare the details of its FY 2021 budget request with its FY 2019 levels for directorates, divisions, programs, and NSF-wide initiatives.

Comparing the FY 2021 Budget Request by directorate with the comparable level for FY 2019 provides some sense of the impact of the major FY 2021 Administration priorities could have on the core disciplinary research and education programs of NSF. For example, under the FY 2021 budget plan, the Biological Sciences Directorate (BIO) would decline by 10% from its FY 2019 level. Computing and Information Science and Engineering (CISE) would rise by nearly 8%. The Geosciences Directorate would decline by almost 14% and Mathematical and Physical Sciences (MPS) would decline by almost 3%.

The biggest reductions in BIO are found in Emerging Frontiers (down by 18.5%) and Biological Infrastructure (down by nearly 13%). In the Geosciences, atmospheric sciences would decline by almost 23% though a great deal of that reduction is explained by a specific, one time \$27 million investment to upgrade facilities at the National Center for Atmospheric Research. NSF support for Earth Sciences would decline by 7.5% and support for Ocean Sciences declines by 8.5%. Within GEO, support for undergraduate STEM education would decline by nearly 10% while the new Coastlines and People (CoPE) program grows from \$6 million to a proposed \$15 million in FY 2021.

Funding for NSF's *Big-Ideas*, (including NSF Convergence Accelerator), which are NSF-wide investments in emerging areas, continues to receive priority support within the FY 2021 Budget Request. Overall support for this set of NSF-wide activities would increase from \$323.9 million in FY 2019 to a proposed \$432.8 million in FY 2021 – an increase of \$109 million or 34%. Funding for Major Research Equipment and Facilities would be sufficient to maintain support for ongoing construction and acquisition activities. NSF's Mid-Scale Research Infrastructure program would grow from \$60 million in FY 2019 to nearly \$100M in FY 2021.



If we knew the comparable figures for these programs in FY 2020 and given that FY 2020 is higher than FY 2019, the percent changes described above would probably all be even more notable when compared to the FY 2021 budget request.

Many in the research and education advocacy community are expecting the Congress to do what it has done for the past three years with similar NSF budget requests proposing steep reductions – ignore it and restore funding to NSF at levels at least comparable to where the FY 2020 appropriations process concluded. At the same time, there are a number of proposals in the Congress that propose substantial increased investment in basic research and in research supportive of the IoT concept related to AI and related fields – such as the proposal offered by Senate Minority Leader Schumer or legislation introduced by Representative Frank Lucas in the House. NSF is included in these and other proposals. Yet these are just that -- *proposals*.

Recall the non-defense discretionary spending cap for FY 2021 is less than 1% higher than it was for FY 2020 – and substantial additional resources are already slated for veterans' medical care, border security, and a few other high-profile initiatives. Congress' restoration of NSF to at least the FY 2020 level is far from a certain outcome. It would be a big mistake for the research advocacy community to even appear to be complacent and assume Congress will automatically provide sufficient funds for NSF research and education. Moreover, even if Congress can set-aside the reductions proposed by the Administration and restore the NSF budget, to what extent will that restoration not just support AI, QIS, NSF's Big Ideas, but also the more traditional core basic research, instrumentation, and education disciplinary programs within NSF that have to be under duress in the FY 2021 Administration budget proposal?

Observations on the FY 2021 National Oceanic and Atmospheric Administration Budget

Request -- On Friday, February 28, 2020 NOAA finally made available on their website a copy of their detailed budget request for FY 2021. Until now, most of the information on NOAA's FY 2021 budget was limited to broad summary information contained in overview documents released by OMB and the Department of Commerce.

For FY 2021, NOAA is requesting a budget of \$4.6 billion, a decrease of nearly three quarters of a billion dollars below the FY 2020 appropriated level. NOAA's budget request is built about the goals of reducing impacts of extreme weather and water events via continued implementation of the Weather Research and Forecasting Innovation Act of 2017 and the National Integrated Drought Information System (NIDIS) Reauthorization Act of 2018 and maximizing the economic contributions of ocean and coastal resources for purposes of the blue economy. The NOAA budget also includes additional support to advance space innovation through new approaches to NOAA's satellite missions and provides in-house mission support for key NOAA activities related to its core missions. Most of the reductions in the budget request fall on ocean, coastal, and Great Lakes extramural programs, climate research and coastal resiliency activities, STEM education, Prescott and other grant programs, and programs often increased or funded by the Congress in the FY 2020 appropriations process.



NOAA's National Ocean Service is proposed to decline from a total level of \$640M in FY 2020 to \$404M in FY 2021, a reduction of 37%. The biggest proposed reductions would come from IOOS Regional Observations (-\$19.6M); Terminate the National Centers for Coastal Ocean Science (NCCOS) Coastal Science, Assessment, Response, and Restoration (-\$37M); Competitive Research would be eliminated with a reduction of \$19M; Coastal Management Grants would be eliminated via a reduction of \$77M; Title XI Fund (the coastal resiliency grants program administered by the National Fish and Wildlife Foundation) would be eliminated via a reduction of \$33M; funding for the National Estuarine Research Reserve System (NERRS) would be eliminated (-\$27.5M) as would funding for research grants for monument; and the marine debris program would be reduced by \$1.5M. Increases within NOS are proposed for ocean mapping the EEZ and charting Alaska and the Arctic (+\$8.5M); and increase funding for regional ocean data platforms (+\$2.5M).

The Ocean Mapping initiative is a result of the November 2019 summit the Administration held on ocean science and technology. Following the summit, the White House issued a Presidential Memorandum (PM) on Ocean Mapping the U.S. Exclusive Economic Zone (EEZ) and the Shoreline and Nearshore of Alaska. NOAA's work will be guided by the National Strategy for mapping, exploring, and characterizing the U.S. EEZ that is required by the PM.

NOAA Fisheries (NMFS) would decline from a total of just over \$1 billion in FY 2020 to a level of \$870M in FY 2021. Reductions in NMFS' programs include -\$10.4M for fisheries surveys and stock assessments; -\$6.2M for fisheries science activities; -\$5M for sustainable habitat management; -\$4M from the national catch share program; -\$3M for electronic monitoring and reporting implementation; -\$2.4M from aquaculture; and -\$1.2M from seafood import monitoring program (SIMP) implementation (leaving about \$2.4M in base funding). Programs proposed for elimination or termination in NMFS include the Prescott Grant program, Antarctic research, and fisheries habitat grants.

In NOAA Research (OAR), the line office's budget would be reduced from nearly \$600M in FY 2020 to \$353M in FY 2021. Within OAR, elimination of all funding for the National Sea Grant Program and its aquaculture research effort and climate research are proposed. Slated for significant reductions in OAR are: the Joint Technology Transfer Initiative (-\$12M); ocean exploration (-\$10M); sustained ocean observation and monitoring (-\$8M); NOAA's network of climate, air, and ocean/coastal laboratories and cooperative institutes would be reduced by a total \$18.7M; the U.S. Weather Research Program declines by \$6.5M; tornado research declines by \$1M. Arctic research, the Vortex-Southeast Research project, and the Mississippi State Partnership would all be terminated under the NOAA budget proposal. Increases in OAR are concentrated in the Earth Prediction Innovation Center (EPIC) which would grow by \$7M and a tornado warning improvement and extension program with an increase of \$3.2M. The National Oceanographic Partnership Program would see an increase of \$500K. Under the NOAA budget proposal all NOAA Education programming would be terminated.

In the National Weather Service, the FY 2021 budget takes a comparatively modest hit declining from \$1.2 billion to \$1.1 billion. The NWS budget proposes to reduce the NWS workforce with



a \$15M reduction; reduce the tsunami warning program by \$11M, reduce the National Mesonet program by \$4.2M, reduce the investment in numerical weather prediction modeling by \$2M; reduce support for the Office of Water Prediction by \$.1.5M; reduce NEXRAD radome and tower maintenance by \$1M and service life extension for Next Generation Weather Radar by \$550K. Programs or activities proposed for termination in NWS include: hydrology and additional water resources (-\$6M); terminate COASTAL Act (-\$5M); eliminate integrated water prediction high performance computing (-\$4.2M) and terminate aviation science to operations by a total of \$2.8M.

It should be noted that many of these budget proposals – namely the major program terminations, eliminations, and major reductions – have been proposed by the Administration in prior budgets. Congress, in nearly all cases, has seen fit to restore and sometimes even increase funding for these very programs. Most observers expect Congress will reject these proposed reductions once again. However, it is important to appreciate that the non-defense discretionary spending cap for FY 2021 is less than 1% higher than it was for FY 2020 – and substantial additional resources are already slated for veterans’ medical care, border security, and a few other high-profile initiatives. Congress’ restoration of NOAA to at least the FY 2020 level is far from a certain outcome. It would be a big mistake for those who advocate on behalf of NOAA to appear complacent and assume Congress will automatically restore funding for Sea Grant, NOAA Education, NERRS, Prescott, or coastal resiliency grants – just to name a few. Moreover, even if Congress can set-aside the reductions proposed by the Administration and restore NOAA budget, to what extent will that restoration go into the areas most decimated by the budget request or into areas related to the blue economy, implementing the weather act, or internal NOAA operational priorities?



NATIONAL ASSOCIATION OF MARINE LABORATORIES
FY 2021 PUBLIC POLICY AGENDA
March 2020

The National Association of Marine Laboratories (NAML) was established in 1989 to support the vital role of Marine and Great Lakes Laboratories in the Nation's Ocean and Coastal Enterprise -- This national network of place-based marine and Great Lakes laboratories is a unique and national asset. The geographic reach of this network includes estuaries, the coastal zone, the Great Lakes and inland watersheds, the oceans of the world including polar regions, and the sea floor. They connect scientists, students, public and civic leaders with leading edge science, environmental and coastal intelligence and professional training that contributes to the understanding, management, and stewardship of our oceans, coastal zones and Great Lakes.

The intersection of ocean, coastal zone and Great Lakes natural resources and U.S. economic activity is complex and highly interdependent. The U.S. depends on healthy marine and freshwater resources, yet many human activities and natural events impact these resources, thereby jeopardizing jobs, wages, our gross domestic product, human health, and well-being. Marine laboratories operate at this interface of human socioeconomics and the natural aquatic world and provide access to the full spectrum of marine and Great Lakes environmental resources.

Marine and Great Lakes science laboratories play pivotal roles in the national priorities identified in [Memorandum on Ocean Mapping of the United States Exclusive Economic Zone and the Shoreline and Nearshore of Alaska](#), [Science and Technology for America's Oceans: A Decadal Vision](#), [Sea Change: 2015-2025 Decadal Survey of Ocean Sciences](#), and [Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century](#). These documents emphasize the need to understand the ocean in the earth system, promote the blue economy, and advance monitoring and predictive modeling capabilities. NAML laboratories bring a high degree of relevance to these critical efforts at lower cost, higher return on investment and with the important benefit of training succeeding generations of marine and related science professionals.

The Importance of Oceans, Coasts, and Great Lakes to National, Economic, and Environmental Security -- The ocean, our coasts, and the Great Lakes are among the United States' most treasured resources. They are an integral part of our national identity and our Nation's future. The ocean covers 71% of the Earth's surface and hundreds of millions of people rely on a viable ocean. A healthy, productive, and resilient ocean is inextricably linked to Earth's climate and weather patterns and contributes significantly to our quality of life. The ocean provides and creates jobs, gives mobility to our national commerce and Armed Forces, helps feed our Nation, secures our borders, fuels our economy, and provides places for recreation and solace. Understanding the physical, chemical, biological, and geological changes in the ocean is vital to the survival and prosperity of humanity.

In the United States, the ocean and its wealth of natural resources have played a critical role in fueling American prosperity and energy independence, protecting our country, generating over 3 million jobs, sustaining industries, and contributing to 2% of the nation's gross domestic product. Our coastal ports and ocean transport systems are the engines of world trade, facilitating a thriving U.S. economy through the maritime enterprise. The biological diversity and productivity of the ocean sustains the health of coastal communities and promotes a vibrant national economy. At the same time, coastal communities that drive the ocean economy are also vulnerable to events such as hurricanes, tsunamis, sea level rise, floods, over-development and surging coastal population growth. Many of these stressors to our oceans and coastal zones, and by extension the services they provide, are evidenced by human observations of changing coastlines and ecosystems, navigation routes, water quality, species diversity, the timing and occurrence of pathogen outbreaks, the rising burden of marine debris, and flat-lined or declining populations of commercially and ecologically important marine species.

America currently imports more than 90% of its seafood, about one-half from over-seas aquaculture production, leading to a \$14 billion seafood trade deficit. Given that the World Bank projects a nearly 50% increase in worldwide fish consumption between 2006 and 2030, the Nation has an opportunity to meet this demand and

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ensure food security by creating new aquaculture industries and actively managing our wild-capture fisheries to maximize long-term sustainable harvests.

Much of the U.S. commercial and industrial base, defense infrastructure, and population is located along the U.S. coastline. An improved understanding of the vulnerabilities and threats to those vital areas resulting from changes to broad-scale weather and environmental conditions as well as anthropogenic activities is crucial to enhance coastal economic, environmental resilience, and homeland security.

America's coastlines and offshore areas contain untapped renewable and non-renewable energy sources to help power the Nation and much of the world. In addition to generating electricity, power generated at sea (from waves, currents or wind) could be used to power the needs of existing and emerging ocean industries (aquaculture, ocean mineral mining, oceanographic research or military missions).

The ocean science and technology (S&T) enterprise -- through its use and support of marine and Great Lakes laboratories -- can provide the knowledge and the education and training needed to address these and other important and complex challenges while also providing fact-based information for decision makers that will ultimately strengthen our Nation and its communities.

NAML Research and Education Priorities for FY 2021 -- To support the vital role of marine and Great Lakes laboratories in the ocean S&T enterprise, NAML requests that our Nation's leaders fully fund the Federal Government's investment in extramural, merit-based, competitive research, infrastructure, observing and education programs at NSF, NOAA, NASA, EPA, DOI, USGS, and other ocean, coastal and Great Lakes related agencies. Investments through these agencies are essential for the development of knowledge, a diverse workforce, an ocean-literate society, and the technological innovations needed to power the Nation's economy, improve human health, and sustain a strong national defense and vibrant society. NAML urges expanded support in the form of research, infrastructure, observations, and education focused on:

- U.S.-based aquaculture to reduce the ever-increasing demand for imports, to advance seafood security and to expand opportunities for economic growth;
- The impacts and causative factors of shifting environmental regimes such as harmful algal blooms, hypoxia, and ocean acidification to improve coastal resilience and inform risk management of critical defense, transportation, civic and business infrastructure along U.S. coastlines;
- Ocean exploration, research, and technology development needed to advance national security, commerce and domestic energy independence;
- Data collection, comprehensive understanding of ecosystems, and adaptive management strategies to increase productivity and sustainability of marine fisheries and the social-economic productivity of U.S. exclusive economic zones;
- Marine infrastructure including ships, autonomous marine vehicles, laboratory refurbishment, data analysis and observational capabilities, and instrumentation development; and
- Discovery, education and training in biological, chemical, geological and physical marine sciences to support advancement of human and environment health and social-economic objectives.

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**Background Information on and Suggested Questions for Speakers
NAML Public Policy Meeting
March 16-17, 2020**

RDML Tim Gallaudet, Ph.D., UNS Ret. -- Timothy Gallaudet, Ph.D., was confirmed by the U.S. Senate on October 5, 2017, as the assistant secretary of commerce for oceans and atmosphere for the Department of Commerce in the National Oceanic and Atmospheric Administration. Dr. Gallaudet was previously a rear admiral in the U.S. Navy, where his most recent assignment was Oceanographer of the Navy and Commander of the Navy Meteorology and Oceanography Command. During his 32 years of military service, Dr. Gallaudet has had experience in weather and ocean forecasting, hydrographic surveying, developing policy and plans to counter illegal, unregulated and unreported fishing, and assessing the national security impacts of climate change. He has led teams of Navy sailors and civilians performing such diverse functions as overseeing aircraft carrier combat operations, planning and conducting humanitarian assistance and disaster response efforts, assisting Navy SEAL Teams during high visibility counter-terrorism operations, and developing the Navy's annual \$52 billion information technology, cyber security and intelligence budget. Dr. Gallaudet holds a bachelor's degree from the U.S. Naval Academy and master's and doctoral degrees from Scripps Institution of Oceanography, all in oceanography.

Suggested Issues/Questions to Raise with RDML Gallaudet

For the past three years – including the new FY 2021 budget request, the Administration has proposed to either eliminate or drastically reduce its support for various ocean, coastal, and Great Lakes extramural research and education programs – such as the Prescott program, Sea Grant, NOAA education programs and aquaculture research in OAR. Each time, however the Congress has restored funding for most of these programs. For NAML, these extramural programs are very important sources of support that allow us to conduct research and educate and train the next generation of people for our ocean, coastal, and Great Lakes enterprise. Can you help us understand why the Administration continually proposes to eliminate funding for these important partnership programs? Do you expect Congress will restore these programs in the FY 2021 appropriations process?

Last November the Administration held an ocean science and technology summit. Out of that summit came a Presidential Memorandum on ocean mapping. Can you provide any insight into where you see the ocean mapping initiative going and what role, if any, do you envision for marine laboratories such as the ones represented in this room today?

Can you update us on the state of the NOPP program that seems to be re-emerging within NOAA and what does that mean, if anything, for marine labs in terms of supporting the kind of partnerships NOAA envisions?

Each year – usually in the early spring – NAML issues or updates its public policy agenda and priorities that we believe enable marine labs to contribute significantly the health of our ocean, coastal, and Great Lakes enterprise. Our most recent statement, which will be formally considered by the NAML membership in tomorrow's business meeting. NAML's priorities for FY 2021 call for strengthened support for aquaculture; understanding the factors and impacts of shifting environmental regimes, ocean research and technology to advance national security and economic competitiveness; support for data, observations, marine infrastructure, new technologies, research and education. Would you comment on NAML's priorities and how they compare to NOAA's overall mission as it relates to our ocean, coasts, and Great Lakes?

Mr. Deerin Babb-Brott is the Principal Assistant Director for Oceans and Environment at the White House Office of Science and Technology Policy. He also serves as the Executive Director of the Ocean Policy Committee, established by Executive Order 13840 to coordinate Federal agency engagement in ocean policy matters. Deerin previously served as the first Director of the National Ocean Council and led development of the final U.S. National Ocean Policy Implementation Plan. Between terms at the White House, he was a senior partner at SeaPlan, where he provided technical and policy support for public and private sector ocean and coastal management initiatives. Previously, Deerin was Assistant Secretary for Ocean and Coastal Zone Management in Massachusetts, where he directed the state coastal program and led teams that developed the Massachusetts Ocean Management Plan and Federal Wind Energy Areas. He also served as Assistant Secretary for Environmental Impact Review in Massachusetts, where he managed the review of development projects, including joint state-Federal review of major marine infrastructure such as Cape Wind and offshore LNG terminals. Deerin received a B.A. in Government and Environmental Studies from Bowdoin College.

Suggested Questions for Mr. Deerin Babb-Brott

Now that the Administration has held its ocean science and technology summit and issued a Presidential Memorandum on ocean mapping, can you give us an update on how Dr. Droege-meier and the rest of OSTP is proceeding in the development and execution of its national ocean policy?

Can you talk about the ocean science and technology priorities of the Administration and highlight some initiatives in the Administration's R&D budget request for FY 2021 that we – NAML – should pay particular attention?

What role do you see for NAML particularly as it relates to the next steps stemming from the November 2019 ocean summit?

Mr. Matthew (Matt) Womble is a professional staff member of the U.S. Senate Appropriations Committee, where he works on the Subcommittee on Commerce, Justice, Science, and Related Agencies. In this role, Womble oversees funding for agencies at the Department of Commerce,

including the National Oceanic and Atmospheric Administration (NOAA) and the National Institute of Standards and Technology, among others. Womble was a 2016 John H. Knauss Sea Grant Fellow, during which he worked in the office of the NOAA Chief Scientist and spearheaded efforts to evaluate and improve NOAA's Research and Development portfolio. Following the fellowship, Womble remained at NOAA and worked in the Office of the NOAA Administrator and at the National Water Center in Tuscaloosa, Alabama. Mr. Womble is originally from Ocean Springs, Mississippi. He earned his BSc in Wildlife, Fisheries, and Aquaculture Science from Mississippi State University in 2012, and an MSc in Parasitology from Auburn University School of Fisheries, Aquaculture, and Aquatic Sciences in 2015.

Mr. Blaise Sheridan is a Professional Staff Member on the Senate Appropriations Subcommittee on Commerce, Justice, and Science under the leadership of Senator Jeanne Shaheen. His portfolio includes the Department of Commerce and the related trade agencies, including the National Oceanic and Atmospheric Administration. Previously he served as a Legislative Assistant in the Offices of U.S. Senators Tina Smith (D-MN) and Al Franken (D-MN), where his portfolio included the Great Lakes, climate change, energy, agriculture, and innovation issues. He also served as the lead advisor to the Senators on the Committee on Energy and Natural Resources. Prior to this position, he served as Legislative Aide for Senator Chris Coons (D-DE), where he covered ocean, energy, environment, and transportation issues. Before his Senate tenure, he worked at the Environmental and Energy Study Institute (EESI) as a Climate and Energy Policy Associate. He has a Master's Degree in Marine Policy from University of Delaware and a B.S. in Engineering from Swarthmore College.

Suggested Questions for Matt Womble and Blaise Sheridan

Can you give us a sense of the FY 2021 budget constraints the Congress will be confronting and how those pressures may impact the research and education programs important to NAML?

Which ocean and coastal issues seem to be at the top of the "To Do" list of your Members, at least as it relates to the appropriations process? Are there ways NAML might better serve the information needs of your committee or Members in general?

How does the overall cap or ceiling on domestic discretionary spending for FY21 impact the CJS subcommittee? With domestic discretionary spending for FY21 essentially level with FY20, what does that mean for the ocean and coastal programs under your jurisdiction – particularly the ones the Administration has proposed to eliminate or drastically reduce?

How can we go about increasing bipartisan support for the ocean, coastal and Great Lakes enterprise and what can NAML members do to expand awareness of and support for ocean research and education?

Dr. Grant Murray is Associate Professor of Marine Policy at the Duke University Marine Lab. As a marine social scientist, Dr. Murray leads and participates in theoretically-informed, problem-oriented and community-relevant research projects that effectively mobilize knowledge in several focal areas, including: 1) the relationships between protected areas and adjacent communities; 2) seafood production systems; and 3) the relationships between local ecological knowledge, science, and social-ecological change. He draws on theoretical insights specific to these three areas, but also cross-cutting theory and concepts drawn from sociology, anthropology and geography including political ecology, local/traditional ecological knowledge, and well a bundle of allied concepts that help frame our thinking about social impacts and dynamics, including values, well-being, and poverty.

Dr. Kari O’Connell joined the Oregon State University STEM Research Center in 2016 as a Senior Researcher. Dr. O’Connell also holds affiliate faculty appointments in the College of Forestry, the College of Education, and the Environmental Arts and Humanities Program at OSU. She has spent her career at OSU working closely with the Andrews LTER program in multiple capacities, first as a Postdoctoral Research Associate studying long-term forest carbon dynamics, next as Director of the H.J. Andrews Experimental Forest where she coordinated the research and education programs, and then with a faculty position in Forestry and Natural Resources Extension which focused on professional development for middle and high school teachers. Dr. O’Connell’s research interests include ecological data literacy of K-12 teachers and students, art-science collaborations, the undergraduate field experience, and collaborative STEM education networks. She has a Ph.D. in Forestry with a minor in soils from the University of Wisconsin-Madison and a B.A. degree in Biology from Gustavus Adolphus College in St. Peter, MN.

Ms. Louisa Koch NOAA’s Director of Education, educates and inspires the public and future workforce about the Earth System working with NOAA’s amazing array of people, partners, places and information. Ms. Koch served as NOAA’s acting Deputy Under Secretary and Deputy Assistant Administrator for Research. Before joining NOAA, Ms. Koch worked for Office of Management and Budget, the Department of Defense and the Joint Economic Committee, U.S. Congress. Ms. Koch earned a Master’s in Electrical Engineering from the Massachusetts Institute of Technology and a Bachelor’s in Physics from Middlebury College. She lives in Maryland with her husband and two daughters.

Suggested Questions for Ms. Koch

Why does the Administration always propose to terminate NOAA education programs when they must know the Congress is unlikely to support that proposal?

Could you discuss the current eligibility requirements for participating in the B-WET program and does NOAA have plans to expand eligibility beyond the regions and/or institutions that currently receive support?

What role can NAML play in messaging the importance of ocean science and literacy to policy makers?

Dr. Terry Quinn began serving as Director of the Division of Ocean Sciences at the National Science Foundation in July 2018. He is on leave from the University of Texas at Austin where he is a Professor in the Jackson School of Geosciences. Terry served as the director of the University of Texas Institute for Geophysics (UTIG) from 2009-2018. Terry completed his undergraduate degree at SUNY-Oneonta and earned his Ph.D. at Brown University. Following a post-doc at the University of Michigan, he started his academic career at the University of South Florida, where he was promoted to the rank of Professor in the College of Marine Science before moving to Texas. Dr. Quinn's area of research expertise is paleoceanography and paleoclimatology, focused in the tropical and sub-tropical oceans. He has written or co-authored over 75 peer-reviewed papers, many of them with his graduate students. He was a lead author of a chapter in the 5th Assessment Report (AR5, 2013) of the Intergovernmental Panel on Climate Change. Dr. Quinn has served on several executive committees of the Integrated Ocean Discovery Program, and he has participated in three IODP expeditions in his career. He was a member of the Board of the Consortium for Ocean Leadership (COL) from 2008-2018. Dr. Quinn was named an Alumni of Distinction by SUNY-Oneonta in 2016.

Suggested Questions for Dr. Quinn

NSF's budget for FY 2021 proposes an overall reduction of over \$500 million from the level Congress just appropriated in December of last year. And within that reduced budget ceiling, there are substantial increases proposed for artificial intelligence and quantum computing while the Geosciences would decline by almost 14% and ocean sciences (within GEO) would decline by 8.5%. What impact does this budget proposal have on the traditional individual investigator support for research and related instrumentation in the ocean sciences and related programs within NSF?

Can you talk about NSF's plans for the new CoPE initiative in both FY20 and FY21?

The NSF FSML program (Field Stations and Marine Laboratories) is jointly administered by BIO and GEO and provides infrastructure support for marine laboratories and related institutions. Can you discuss how this modest program fits into the newer, larger mid-scale infrastructure initiative?

With the new regional class vessels soon to join the academic fleet, and in the face of these constrained, even shrinking budgets, what impact will that have on the state of the fleet overall and NSF's ability to support the operations and maintenance of this fleet?

Mr. Robert Benson is the Acting Chief, Partnership Programs Branch, Office of Water, Environmental Protection Agency. In this position he is the leader of three national water partnership programs: the National Estuary Program (28 estuarine watersheds), the Urban

Waters Program (20 municipal watersheds), and the Trash Free Waters Program (addressing trash pollution in marine and freshwater systems). These programs support collaborative problem-solving to address major environmental challenges across the U.S. The National Estuary Program (NEP) is an EPA place-based program to protect and restore the water quality and ecological integrity of estuaries of national significance. Currently, 28 estuaries located along the Atlantic, Gulf, and Pacific coasts and in Puerto Rico are designated as estuaries of national significance. Each NEP focuses within a study area that includes the estuary and surrounding watershed. The NEPs are located in a variety of institutional settings, including state and local agencies, universities and individual nonprofits. In overseeing and managing the national program, EPA provides annual funding, national guidance and technical assistance to the local NEPs.

Ms. Pam DiBona is the Executive Director at the Massachusetts Bays National Estuary Partnership and serves as Chair of the Board of Directors of the Association of National Estuary Programs (ANEP). Ms. DiBona is a science policy professional with broad and deep experience in water resource management, inclusive organizational development, and effective collaboration across multiple sectors for maximum impact. ANEP works with NEPs to educate key stakeholders, including elected officials, about the value and importance of clean water and healthy estuaries to coastal communities and their economies. ANEP works nationally to promote and improve the effectiveness of NEPs.

Dr. Holly Bamford is Chief Conservation Officer at the National Fish and Wildlife Foundation (NFWF). Dr. Bamford is responsible for advancing the Foundation's mission through the creation and implementation of a comprehensive conservation vision, strategy and a metrics-based evaluation system for NFWF's grant-making programs. She serves an important role in creating and leading NFWF's conservation strategy by setting national and regional cross-cutting strategies, and by leading design, development and fundraising planning for the conservation strategy, as well as guiding the conservation policies and practices of the Foundation. Prior to joining NFWF, Dr. Bamford was acting assistant secretary for conservation and management for the National Oceanic and Atmospheric Administration (NOAA). In that role, she drove administration policy, programming, and investments for NOAA's ocean, coastal and fisheries management. Her responsibilities spanned coastal resilience, marine protected areas, protected species, sustainable fisheries and coastal services. Dr. Bamford worked closely with members of Congress, other agency leaders, partner organizations, and local communities to develop policies and take conservation actions to ensure coastal and ocean stewardship. Dr. Bamford earned her doctorate in Organic Environmental Chemistry from the University of Maryland.

Suggested Questions for Dr. Bamford

Can you update NAML on the coastal resiliency grants program NWFS is administering for NOAA? What are the priorities NFWF has for this program and what role does science and planning play in NFWF's priorities for coastal resiliency?

Ms. Nicole R. LeBoeuf is Acting Administrator for NOAA's National Ocean Service (NOS). Nicole LeBoeuf has over 20 years of scientific and program management experience, with emphasis on the connections between science and policy. Currently, she is the Acting Assistant Administrator at NOAA's National Ocean Service. The National Ocean Service (NOS) is the nation's most comprehensive ocean and coastal agency. Its mission is to provide science-based solutions through collaborative partnerships to address evolving economic, environmental and social pressures on our oceans and coasts. The agency observes, measures, assesses, and manages the nation's coastal, ocean, and Great Lakes areas; provides critical navigation products and services; and conducts response and restoration activities to protect vital coastal resources. As Acting Assistant Administrator, Ms. LeBoeuf provides strategic vision for NOS. She leads the implementation of activities that support NOS's priorities of safe and efficient transportation and commerce; preparedness and risk reduction; and stewardship, tourism and recreation. She serves as the focal point for conveying the value of NOS products and services within NOAA and to the Department of Commerce, the Office of Management and Budget, and Congress. Ms. LeBoeuf actively establishes and grows partnerships with other federal agencies, non-governmental organizations, and industry. Previously, Ms. LeBoeuf served as the NOS Deputy Assistant Administrator. In this role, she oversaw the financial, administrative, and performance activities of an agency that includes more than 1,700 staff located across more than 50 places around the country.

Suggested Questions to Raise with Ms. LeBoeuf

Given the Administration's FY 2021 budget plan for NOAA, can you describe the priorities of the NOS? Can you help us understand the Administration's rationale for scaling back the IOOS program and proposing the elimination of NERRS and the coastal resiliency grants program?

What is the status of the ad hoc Coastal Roundtable your predecessor had initiated and is there a role for NAML to participate in that coastal roundtable or other similar discussions?

Beyond the coastal roundtable, in what ways can NAML be of assistance to you and the National Ocean Service – i.e. such as service on advisory panels or conducting workshops on matters of mutual interest?

Can you describe the role of NOS within the Administration's ocean mapping initiative?



EXECUTIVE OFFICE OF THE PRESIDENT
WASHINGTON, D.C.



August 30, 2019

M-19-25

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: RUSSELL T. VOUGHT 
ACTING DIRECTOR, OFFICE OF MANAGEMENT AND BUDGET

DR. KELVIN K. DROEGEMEIER 
DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY

SUBJECT: Fiscal Year 2021 Administration Research and Development Budget Priorities

"We stand at the birth of a new millennium, ready to unlock the mysteries of space, to free the Earth from the miseries of disease, and to harness the energies, industries, and technologies of tomorrow."

President Donald J. Trump, 2017 Inaugural Address

America's rise as the global leader in science and technology (S&T) began shortly after World War II, during which the Federal Government began investing significantly in basic and applied research, infrastructure, and education across many disciplines. From then until now—during America's First Bold Era in S&T—these Federal investments helped create a massive, multisector American S&T enterprise consisting of Federal agencies, world-leading colleges and universities, private industry, non-profit organizations, and Federal and National Laboratories.

The resulting extraordinary discoveries and innovations laid the foundation for today's Second Bold Era in S&T—one characterized by unprecedented knowledge, access to data and computing resources, ubiquitous and instant communication, and technologies that allow us to peer into the inner workings of atomic particles as well as the vastness of the universe. Unfortunately, this Second Bold Era also features new and extraordinary threats which must be confronted thoughtfully and effectively.

The Trump Administration is firmly committed to continuing American S&T leadership in the Second Bold Era. Success will depend, in large part, on our ability to leverage—in entirely new and creative partnership and collaborative frameworks—the multisector S&T enterprise that emerged during the First Bold Era. It will depend upon striking a balance between the openness of our research ecosystem and the protection of our ideas and research outcomes. It will depend upon ensuring that our research environments are diverse, safe, inclusive, and accommodating as well as free from unnecessary administrative burdens. Success will depend upon ensuring that research is conducted with integrity and respect, which are foundational not only to the research process, but to the trust placed in the research enterprise by American taxpayers and reflective of America's values.

This Fiscal Year 2021 (FY2021) R&D Budget Priorities memorandum provides direction to enable this Second Bold Era as part of a longer-term, multisector, national strategy to advance bold, transformational leaps in S&T, build a diverse workforce of the future, solve previously intractable grand challenges, and ensure America remains the global S&T leader for generations to come.

GENERAL GUIDANCE FOR FY2021

For FY2021, the *five R&D budgetary priorities* in this memorandum ensure that America remains at the forefront of scientific progress, national and economic security, and personal well-being, while continuing to serve as the standard-bearer for today's emerging technologies and Industries of the Future. This memorandum also describes *five high-priority crosscutting actions* that span all five R&D budgetary priorities and require departments and agencies to coordinate, collaborate, and partner with one another and with the other sectors of the S&T enterprise to maximize success.

R&D BUDGETARY PRIORITIES

1. American Security

The 2018 *National Defense Strategy* calls for leadership in research, technology, invention, and innovation to "ensure we will be able to fight and win the wars of the future."¹ As adversaries leverage emerging and disruptive technologies to threaten the Nation, it is imperative that we invest in R&D to remain at the leading edge of S&T, maintain military superiority, remain agile in the face of existing and new threats, and keep the American people safe.

Advanced Military Capabilities: Relevant departments and agencies should invest in R&D to deliver the advanced military capabilities that will help meet emerging threats and protect American security into the future, including offensive and defensive hypersonic weapons capabilities, resilient national security space systems, and modernized and flexible strategic and nonstrategic nuclear deterrent capabilities.

Critical Infrastructure Resilience: Departments and agencies should invest in critical infrastructure R&D that improves resilience to natural disasters and physical threats, including extreme terrestrial events, cyber and electromagnetic pulse attacks, and exploitation of supply chain vulnerabilities. Departments and agencies should prioritize investments in space weather R&D according to the 2019 *National Space Weather Strategy and Action Plan*² and, where applicable, pay specific attention to improving research to operations and operations to research capabilities.

¹ Department of Defense. "Summary of the 2018 National Defense Strategy of the United States of America." <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>.

² NSTC. "National Space Weather Strategy and Action Plan." <https://www.whitehouse.gov/wp-content/uploads/2019/03/National-Space-Weather-Strategy-and-Action-Plan-2019.pdf>.

Semiconductors: Departments and agencies, working in collaboration with industry and academic partners where appropriate, should prioritize investments that will enable whole of government access to trusted and assured microelectronics for future computing and storage paradigms, consistent with the *Executive Order on Securing the Information and Communications Technology and Services Supply Chain*.³

Critical Minerals: The *Executive Order on a Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals* identifies innovation and R&D as key to reducing vulnerabilities and building supply chain resilience for rare earths and critical minerals.⁴ Priorities include developing recycling and reprocessing technologies, identifying substitute materials, and developing new and improved processes for critical mineral extraction, separation, refining, and alloying.

2. American Leadership in Industries of the Future

The Trump Administration continues to prioritize the technologies that power Industries of the Future (IoF). These industries promise to fuel American prosperity, improve quality of life and national security, and create high-paying jobs for American workers. Sustained, strategic R&D investment in these emerging technologies and the materials, manufacturing, and computing that support them will advance American S&T leadership in the short term and catalyze discoveries and innovations that will shape the global S&T landscape for the decades ahead.

Artificial Intelligence, Quantum Information Science, and Computing: Departments and agencies should prioritize basic and applied research investments that are consistent with the 2019 *Executive Order on Maintaining American Leadership in Artificial Intelligence*⁵ and the eight strategies detailed in the 2019 update of the *National Artificial Intelligence Research and Development Strategic Plan*.⁶ Consistent with the 2018 *National Quantum Initiative Act*⁷ and the 2018 *National Defense Authorization Act*,⁸ departments and agencies should prioritize R&D advancing fundamental QIS, building and strengthening the workforce, engaging industry, and providing infrastructure supporting QIS while coordinating relevant activities to ensure intelligence, defense, and civilian efforts grow synergistically. In terms of computing, departments and agencies should work together to explore new applications in and support R&D for high performance future computing paradigms, fabrication, devices, and architectures

³ Executive Order on Securing the Information and Communications Technology and Services Supply Chain.
<https://www.whitehouse.gov/presidential-actions/executive-order-securing-information-communications-technology-services-supply-chain/>.

⁴ A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals.
<https://www.commerce.gov/news/reports/2019/06/federal-strategy-ensure-secure-and-reliable-supplies-critical-minerals>.

⁵ Executive Order on Maintaining American Leadership in Artificial Intelligence.
<https://www.whitehouse.gov/presidential-actions/executive-order-maintaining-american-leadership-artificial-intelligence/>.

⁶ NSTC. "The National Artificial Intelligence Research and Development Strategic Plan: 2019 Update."
<https://www.nitrd.gov/pubs/National-AI-RD-Strategy-2019.pdf>.

⁷ Public Law 115-368.

⁸ Public Law 115-91.

alongside sustainable and interoperable software; data maintenance and curation; and appropriate security.

Advanced Communications Networks and Autonomy: Departments and agencies should support the development and deployment of advanced communications networks by prioritizing R&D consistent with the National Spectrum R&D Strategy. They should prioritize R&D to lower barriers to the deployment of surface, air, and marine autonomous vehicles with a focus on developing operating standards, integration approaches, traffic management systems, and defense/security operations. Departments and agencies should prioritize R&D that enables electric vertical-takeoff-and-landing and civil supersonic aircraft, including for type certification, the creation of over-land supersonic flight noise standards, and low-sonic-boom aircraft research.

Advanced Manufacturing: Department and agency R&D investments should support the goals in the National Science and Technology Council (NSTC) report, *Strategies for American Leadership in Advanced Manufacturing*.⁹ Priorities include smart and digital manufacturing and advanced industrial robotics, especially systems enabled by the industrial internet of things, machine learning, and AI. Departments and agencies should focus on methods for low-cost distributed manufacturing and continuous manufacturing, including investments in bio-based manufacturing to ensure domestic access to needed medicines.

3. American Energy and Environmental Leadership

Advancing energy technologies, understanding our unexplored ocean and expanding use of ocean data, and improving our Earth system prediction capabilities are Administration priorities that will enhance the nation's economic vitality, national security, and environmental quality.

Energy: Departments and agencies should invest in early-stage, innovative research and technologies that show promise for harnessing American energy resources safely and efficiently, inclusive of nuclear, renewable, and fossil energy. Federally funded energy R&D should continue to reflect an increased reliance on the private sector to fund later-stage research, development, and commercialization of energy production and storage technologies, including supporting user facilities that can improve multisector collaboration. Relevant department and agencies should invest in nuclear energy R&D, including further development of advanced reactor technologies and reestablishing an American fast neutron irradiation capability through the versatile advanced test reactor.

Oceans: Departments and agencies should prioritize new and emerging technologies and collaborative approaches to efficiently map, explore, and characterize the resources of the U.S. exclusive economic zone. Departments and agencies should also focus on processing and making publically available data that characterize natural resources and human activities and on

⁹ NSTC. "Strategy for American Leadership in Advanced Manufacturing."
<https://www.manufacturing.gov/news/announcements/2018/10/strategy-american-leadership-advanced-manufacturing>.

R&D that improves understanding of and supports effective responses to changes in the ocean system.

Earth System Predictability: Knowing the extent to which components of the Earth system are practicably predictable – from individual thunderstorms to long-term global change – is vitally important for physical understanding of the Earth system, assessing the value of prediction results, guiding Federal investments, developing effective policy, and improving predictive skill. Departments and agencies should prioritize R&D that helps quantify Earth system predictability across multiple phenomena, time, and space scales. Strategic coordination and leveraging of resources across agencies on research and modeling efforts is needed to accelerate progress in this area. Additionally, agencies should emphasize how measures of and limits to predictability, both theoretical and actual, can inform a wide array of stakeholders. They also should explore the application of AI and adaptive observing systems to enhance predictive skill, along with strategies for obtaining substantial improvements in computational model performance and spatial resolution across all scales.

4. American Health & Bioeconomic Innovation

American medical and biotechnology breakthroughs have enhanced the quality and longevity of life for countless people around the world. The Trump Administration continues to focus R&D on key research breakthroughs and solutions that improve the health of our veterans and individuals of all ages, while enabling new opportunities in the Bioeconomy.

Biomedicine: Departments and agencies should prioritize R&D investments aimed at combatting the opioid crisis, rapid detection and containment of infectious diseases, anti-microbial resistance, chronic disease prevention and treatment, gene therapy, neuroscience, medical countermeasures and public health preparedness, eradicating HIV/AIDS once and for all, and enhancing the independence, safety, and wellness of aging Americans and individuals with disabilities. Departments and agencies should coordinate and collaborate with each other and with public and private stakeholders to ensure that existing and new sources of medical and health-related data are handled in the best interest of patients with regards to security, interoperability, privacy, accessibility, and portability.

Veteran Health and Wellness: The *President's Roadmap to Empower Veterans and End a National Tragedy of Suicide* (PREVENTS)¹⁰ directs research on the social determinants of health and underlying risk factors to prevent veteran suicide. Departments and agencies should identify R&D investments, consistent with the *Executive Order on a National Roadmap to Empower Veterans and End Suicide*, that focus on cohesive, cross-agency efforts; leverage data sharing and integration to derive new insights into brain health and suicide from existing studies or data sets; and seek opportunities for immediate knowledge translation and real-world application.

¹⁰ Executive Order on a National Roadmap to Empower Veterans and End Suicide.

<https://www.whitehouse.gov/presidential-actions/executive-order-national-roadmap-empower-veterans-end-suicide/>

Bioeconomy: The American Bioeconomy represents the infrastructure, innovation, products, technology, and data derived from biologically-related processes and science that drive economic growth, promote health, and increase public benefit. The increasing economic value and public benefits derived from the research, innovation, and applications in the biological and agricultural sciences need to be better measured, promoted, and safeguarded. Departments and agencies should prioritize evidence-based standards and research to rapidly establish microorganism, plant, and animal safety and efficacy for products developed using gene editing, to better accelerate biotechnology product adoption and socially responsible use. Additionally, departments and agencies should focus on R&D that enables biotechnology, omics, scientific collections, biosecurity, and data analytics to drive economic growth across multiple sectors including healthcare, pharmaceuticals, manufacturing, and agriculture.

5. American Space Exploration and Commercialization

R&D investments should continue to leverage efforts underway at American universities and in the private sector and focus on ensuring American leadership in space by supporting the Trump Administration's call for a return of Americans to the Moon's surface by 2024 and utilizing the Moon as a proving-ground for a future human mission to Mars.

Departments and agencies should prioritize in-situ resource utilization on the Moon and Mars, cryogenic fuel storage and management, in-space manufacturing and assembly, and advanced space-related power and propulsion capabilities. Departments and agencies should also prioritize activities that ensure an industrial base for commercial activity in space and that will broadly speed private-sector progress in meeting stated Government goals and furthering the space economy. Finally, departments and agencies should seek opportunities to work with advanced materials, additive manufacturing, and machine learning capabilities that have broad potential applications in space and on Earth.

PRIORITY CROSSCUTTING ACTIONS

1. Build and Leverage a Diverse, Highly Skilled American Workforce

The Trump Administration's 2018 report, *Charting a Course for Success: America's Strategy for STEM Education* (STEM Strategy), articulates a vision that "all Americans will have lifelong access to high quality STEM education and the United States will be the global leader in STEM literacy, innovation, and employment."¹¹ Achieving this vision depends on a multisector seamless STEM education and training ecosystem that can meet the needs of all Americans from all backgrounds and ZIP codes and can adapt to the changing, and often growing, demands for STEM knowledge and skills in both the workplace and in everyday life.

¹¹ NSTC. "Charting A Course For Success: America's Strategy for STEM Education." <https://www.whitehouse.gov/wp-content/uploads/2018/12/STEM-Education-Strategic-Plan-2018.pdf>.

Departments and agencies should prioritize efforts to build strong foundations for STEM literacy, to increase diversity, equity, and inclusion in STEM, and to prepare the STEM workforce, including college-educated STEM workers and those working in skilled trades that do not require a four-year degree.

In addition, relevant departments and agencies should identify and implement strategies to: help build R&D capacity at institutions that serve high proportions of underrepresented or underserved groups, such as Historically Black Colleges and Universities (HBCUs), tribal colleges and universities, and Hispanic Serving Institutions; foster collaboration and coordination among higher education institutions, the private sector, and nonprofits to meet the objectives described in the STEM Strategy and the 2017 *Executive Order on The White House Initiative to Promote Excellence and Innovation at Historically Black Colleges and Universities*;¹² facilitate the advancement of early career R&D professionals; and assess the capabilities of their own workforces, and leverage resources that provide upskilling and entrepreneurial training.

2. Create and Support Research Environments that Reflect American Values

To advance S&T progress and ensure maximum return on taxpayer investment in R&D, the laboratory, the factory, the field, and any other setting where R&D is performed must welcome all individuals without prejudice and enable them to work safely, efficiently, ethically, and with respect, consistent with the American values of free inquiry, competition, openness, and fairness. Four high-priority areas related to research environments require significant attention:

- Reducing administrative burdens on Federally-funded research;¹³
- Improving rigor and integrity in research;
- Creating safe and inclusive research environments; and
- Protecting American research assets.

Departments and agencies should ensure that their R&D investments promote intra- and extra-mural research environments that address these four actions and rapidly improve or eliminate programs and activities that do not; and actively coordinate and collaborate with other R&D departments and agencies, via the NSTC Joint Committee on the Research Environment (JCORE), to ensure that R&D investments and policies are aligned with the four priority areas.¹⁴

¹² Established by the 2017 Executive Order, The White House Initiative on HBCUs is charged with working with “agencies, private-sector employers, educational associations, philanthropic organizations, and other partners to increase the capacity of HBCUs to provide the highest-quality education to an increasing number of students.” <https://www.whitehouse.gov/presidential-actions/presidential-executive-order-white-house-initiative-promote-excellence-innovation-historically-black-colleges-universities/>.

¹³ In addition, the PMA CAP Goal 8—“Results-Oriented Accountability for Grants”—is tackling how to streamline burdensome administrative requirements associated with all federal grant programs and move towards the current compliance paradigm towards demonstrating results. These efforts include attention to R&D grants and the burdens upon the research community.

¹⁴ Agencies should also actively participate on the PMA CAP Goal 8 workgroups to help build shared solutions that would contribute to reducing administrative burden and improving results.

3. Support Transformative Research of High Risk and Potentially High Reward

Many of the greatest advances in S&T—for example, the first direct detection of gravitational waves—can be traced to Federal support of R&D that is intellectually challenging but has the potential to transform society in profound and positive ways. In order to remain the world leader in S&T, America must continue to support bold thinking and potentially transformative research ideas.

Departments and agencies should support risk taking in their R&D investments and within the communities they support, and they should ensure that review processes fully consider the possible rewards, risks, and benefits of failure for potentially transformative research. Departments and agencies should describe how their investments support transformative research, and the impact these investments could have on American prosperity and security.

4. Leverage the Power of Data

The President's Management Agenda (PMA) Cross-Agency Priority (CAP) Goal 2, "Leveraging Data as a Strategic Asset,"¹⁵ describes three objectives: develop a long-term, enterprise-wide Federal Data Strategy to better govern and leverage the Federal Government's data; enable Government data to be accessible and useful for the American public, businesses, and researchers; and improve the use of data for decision-making and accountability for the U.S. Government, including for policy-making, innovation, oversight, and learning.

Department and agency investments should reflect and support the objectives of CAP Goal 2 and the Federal Data Strategy framework. Priorities include improving data accessibility and security, leveraging AI and other emerging technologies, and building a data-skilled workforce. Departments and agencies should coordinate and collaborate with each other and with the private sector and nonprofits to leverage data and data tools, consistent with all applicable laws and regulations governing data use and sharing.

5. Build, Strengthen, and Expand Strategic Multisector Partnerships

Partnerships between and among R&D departments and agencies, academic institutions, established and startup businesses, nonprofit institutions, and others involved in the U.S. S&T enterprise are instrumental to building and leveraging our Nation's innovation capacity and lie at the core of success for the Second Bold Era of S&T.

Departments and agencies should prioritize investments and policies that facilitate or strengthen multisector partnerships, including partnerships that engage institutions seeking to build S&T capacity, such as R2 ("high research activity") institutions, HBCUs, and community

¹⁵ The Federal Data Strategy. <http://strategy.data.gov>

colleges; advance regional collaboration for innovation economies, such as those in Opportunity Zones; support research infrastructure; and further the objective of CAP Goal 14 to “Improve Transfer of Federally-Funded Technologies from Lab-to-Market.”¹⁶ Departments and agencies should work together to leverage existing and create new partnerships, share best practices, data, user facilities, and other resources to the extent possible. Departments and agencies should define measures of success and describe how relevant R&D investments improve the number, variety, and quality of partnerships. They should also consider methods to reduce regulatory and administrative barriers and align incentives to facilitate multisector engagement.

¹⁶ Improve Transfer of Federally-Funded Technologies from Lab-to-Market. <https://www.performance.gov/CAP/lab-to-market/>



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Before the
Committee on Science, Space, and Technology
United States House of Representatives

on
“The President’s FY 2021 Budget Request for Research & Development”

February 27, 2020

Chairwoman Johnson, Ranking Member Lucas, and Members of the Committee, it is a privilege to be here with you today to discuss the President’s Budget for science and technology (S&T) research and development (R&D) in Fiscal Year (FY) 2021.

In his State of the Union Address, President Trump declared that “We are pioneers” who “look at tomorrow and see unlimited frontiers just waiting to be explored.” Hearing these words, I was reminded of the words written in 1945 by Vannevar Bush, President Roosevelt’s *de-facto* science advisor. Dr. Bush wrote: “The pioneer spirit is still vigorous within this nation. Science offers a largely unexplored hinterland for the pioneer who has the tools for his task. The rewards of such exploration both for the Nation and the individual are great.”

Since Dr. Bush, the architect of America’s post-World War II research framework, wrote these words in his treatise, *Science—The Endless Frontier*, America has experienced nearly uninterrupted growth in combined public, private, academic, and nonprofit research and development investment. Our Nation has created educational and training pathways into STEM for hard working, creative, and entrepreneurial Americans from every zip code, and we’ve attracted the best and brightest from every country. We have built the best discovery and innovation engine in history on bedrock American values, such as free inquiry, competition, and inclusion. And as Dr. Bush predicted, the rewards indeed have been great for our Nation and the world.

The Multisector American S&T Enterprise

Seventy five years later, America is the unquestioned global leader in S&T. The foundation of our success is the ability of the Federal government, private sector, academia, and nonprofits to not only make substantial investments in R&D—an estimated total of \$580 billion in 2018¹—but also work in mutually complementary ways to discover, innovate, educate, and train. The Federal government serves as a catalyst for innovation by investing in early stage basic and applied research, particularly in areas where little or no commercial incentive exists. The Federal government also facilitates discovery and innovation by removing barriers, streamlining processes, and avoiding the creation of unnecessary regulatory hurdles.

American academic institutions, which include many of the world’s best research universities, performed an estimated \$74.7 billion in R&D in 2018, including 48 percent of all U.S. basic research.² Between 1996 and 2017, academic R&D led to over 13,000 start-ups (with 6,518 operational as of 2018), more than 200 drugs and vaccines, 420,000 invention disclosures, and 100,000 U.S. patents, contributing \$865 billion to the U.S. gross domestic product (GDP) and an astounding \$1.7 trillion in gross industrial output.³ Additionally, R&D performed at our Nation’s colleges and universities helps prepare the next generation of researchers, technicians, engineers, and millions of other STEM-capable workers who together are building America’s future.

The private sector leverages the discoveries and talent resulting from Federal and academic investments to fuel its own massive R&D capacity. As of 2018, businesses were responsible for funding over two-thirds of U.S. R&D, including nearly 29 percent of all U.S. basic research⁴. The industries that perform the vast majority of private sector R&D, such as the aircraft, pharmaceutical, motor vehicle, IT services, and computer products industries, together account for 11 percent (\$2.3 trillion) of U.S. GDP, employ nearly 10 million workers, and produce many of the innovations transforming our lives.⁵ For example, in October 2019, researchers from Google reportedly demonstrated, for the first time, that a quantum computer could perform a calculation impossible for a standard computer (quantum supremacy). This breakthrough has the potential to accelerate advancements in security, health, and many other areas and was made possible through collaborations with NASA Ames Research Center, Oak Ridge National Laboratory, and international researchers and built on the results of federally-funded research.

Nonprofits funded an estimated \$22.7 billion in R&D in 2018, which represents the third highest level of funding behind the private sector and Federal government and slightly more than the \$21.1 billion funded by colleges and universities themselves. Non-federal government R&D spending contributed another \$4.7 billion to the U.S. total.⁶

¹ National Science Foundation, National Center for Science and Engineering Statistics 2019. National Patterns of R&D Resources: 2017–18 Data Update. NSF 20-307. Alexandria, VA. Available at <https://ncses.nsf.gov/pubs/nsf20307>

² National Science Foundation, National Center for Science and Engineering Statistics 2019. National Patterns of R&D Resources: 2017–18 Data Update. NSF 20-307. Alexandria, VA. Available at <https://ncses.nsf.gov/pubs/nsf20307>

³ https://autm.net/AUTM/media/Surveys-Tools/Documents/AUTM_FY2018_Infographic.pdf

⁴ National Science Foundation, National Center for Science and Engineering Statistics 2019. National Patterns of R&D Resources: 2017–18 Data Update. NSF 20-307. Alexandria, VA. Available at <https://ncses.nsf.gov/pubs/nsf20307>

⁵ National Science Board, National Science Foundation. 2020. Production and Trade of Knowledge- and Technology-Intensive Industries. Science and Engineering Indicators 2020. NSB-2020-5. Alexandria, VA. Available at <https://ncses.nsf.gov/pubs/nsb20205/>

⁶ National Science Foundation, National Center for Science and Engineering Statistics 2019. National Patterns of R&D Resources: 2017–18 Data Update. NSF 20-307. Alexandria, VA. Available at <https://ncses.nsf.gov/pubs/nsf20307>

Although America is the global S&T leader, continued leadership is far from guaranteed. Extraordinary opportunities and profound challenges confront our country daily. From defending against threats to American economic and national security, to promoting international R&D collaborations, to ensuring that Americans are prepared to navigate the impact of technology both at home and in the workplace, our global S&T leadership will only become more important in an unpredictable future. This is why the Administration has prioritized substantially increasing the ability of the four sectors of our S&T enterprise to coordinate, collaborate, and partner to leverage resources and share expertise, data, and infrastructure *well beyond* that of the past and present.

The President's FY 2021 Budget

R&D represents the seed corn of innovation, and thus of our economic prosperity, quality of life, and national security. Most of the technologies we enjoy today—from streaming online services to wayfinding apps to medical diagnostics and treatment—trace their roots to R&D. The Trump administration recognizes the actions our Nation takes now in laying a strong foundation for R&D will pave the road ahead, and we are committed to taking the wise and necessary steps to ensure that America remains the world leader in S&T research and education for generations to come. The FY 2021 Budget reflects this commitment by investing \$142.2 billion in Federal R&D. This represents a 6 percent increase compared to the President's FY 2020 Budget and a 20 percent increase from the President's FY 2019 Budget.

The FY 2021 Budget demonstrates responsible leadership by prioritizing areas with the most potential to benefit all Americans, combined with thoughtful reallocations in lower-priority areas. It does this by focusing on the basic and applied research, as well as experimental development, that fuel critical Industries of the Future (IoTF)—artificial intelligence (AI), quantum information science (QIS), 5G/advanced communications, biotechnology, and advanced manufacturing. These industries, which rely on basic research discoveries, promise to open new frontiers in sensing and computation, promote health through advances in medical diagnostics, create high-paying jobs and entirely new industries, transform the way Americans communicate and travel, and keep the Nation and its people safe and prosperous.

AI and QIS, in particular, hold enormous potential as they intersect with nearly every field of science, technology, and health and can act as innovation force multipliers. As such, the FY 2021 Budget includes major increases in QIS and non-defense AI R&D as part of a commitment to double Federal investment in these areas by 2022. For example:

- The FY 2021 Budget brings spending for AI R&D and interdisciplinary research institutes at the National Science Foundation (NSF) to more than \$830 million. This represents a more than 70 percent increase over the President's FY 2020 Budget.
- NSF investment in QIS research will double to \$210 million.
- The Department of Energy's (DOE) Office of Science will invest \$125 million in AI research, a \$54 million increase over the FY 2020 Budget.
- DOE Office of Science spending on QIS research will increase to \$237 million, which will boost QIS efforts at the National Laboratories and in academia and industry. The Budget also includes \$25 million to support early stage research for a quantum internet.

- The Budget includes an additional \$100 million for the Department of Agriculture’s Agriculture and Food Research Initiative (AFRI) to support AI, promote advanced manufacturing in the food and agricultural sciences, and continue efforts in robotics and application of big data that are required to advance precision agriculture.
- The Budget provides a \$25M increase for AI focused work at NIST, effectively doubling their current investment.
- The Budget allocates \$50 million for new research at the National Institutes of Health on chronic diseases using AI and related approaches.

The President’s commitment to double AI and QIS R&D by 2022 punctuates a three year effort that include the enactment of bipartisan legislation, the creation of national strategies, and presidential actions and initiatives. For example, under President Trump, the United States launched the U.S. national strategy for AI leadership—the American AI Initiative—by Executive Order, proposed the first-ever AI regulatory guidance for the use of AI in the private sector, and worked with Congress to pass the National Quantum Initiative Act.

The Budget also includes critical investments in education and job training that will equip more Americans with the skills necessary to support and advance AI and QIS. For example, at NSF an additional \$50 million will go toward workforce development in these two areas, with a focus on community colleges, Historically Black Colleges and Universities (HBCUs), and minority serving institutions (MSIs). Also, to bolster the STEM academic pathways aligned with the local business community and improve public-private partnerships, the Budget for the Department of Education requests \$150 million for the Minority Science and Engineering Improvement Program to fund STEM activities led by HBCUs and MSIs located in Opportunity Zones.

Beyond these investments in AI, QIS, and other IoT areas, the President’s FY 2021 Budget directs R&D efforts to achieve sustainable human exploration in deep space, beginning with returning to the lunar surface where we will develop the skills, systems, and operational experience to enable human missions to Mars. The Budget provides robust funding for the National Aeronautics and Space Administration (NASA) programs, including \$3.4 billion for the development of lander systems, over \$700 million to support lunar surface activities, and \$233 million for robotic precursor missions to Mars that would also conduct cutting-edge science.

Research and partnerships in ocean S&T remain an Administration priority. The FY 2021 Budget advances coordinated and systematic ocean mapping and research so that our Nation can start to better understand the vast resources in our oceans. To support these activities, the Budget increases National Oceanic and Atmospheric Administration’s funding by over 10 percent for its participation in the National Oceanographic Partnership Program and increases funding by more than 60 percent for regional data portals that provide public access to maps and information about the ocean environment.

Leveraging the Full Capabilities of America’s S&T Enterprise – Research Environments

The Trump Administration recognizes that continued global leadership requires not only strategic R&D investments, but also that research environments reflect American values. This means research environments that are safe, inclusive, operate with maximum integrity, appropriately

balance openness and international collaboration with security, and make efficient use of taxpayer dollars by not encumbering researchers, agencies, or institutions with unnecessary administrative work. U.S. policies and practices must evolve thoughtfully and appropriately to meet current and future challenges.

That is why nearly ten months ago I launched the National Science and Technology Council (NSTC) Joint Committee on the Research Environment (JCORE). JCORE is taking an integrative, whole-of-government approach to develop policy recommendations on four interrelated topics:

- Strengthening the security of American research enterprise;
- Creating safe and inclusive research environments;
- Reducing administrative burdens on Federally-funded research; and
- Improving rigor and integrity in research.

I will focus on the first two in my testimony.

To maintain our global leadership, America must *balance protecting* its research enterprise while *promoting* the openness that has been and will continue to be critical to our success. America's S&T enterprise attracts, educates, and trains some of the world's most creative, innovative, and determined students and researchers, which has led to significant discoveries and innovations. Many countries recognize our success and are imitating us by building their own innovation capacity by making significant investments in R&D and higher education. For those that share America's values, we celebrate their participation in a global S&T enterprise, as this creates new knowledge and new opportunities for international collaborations and partnerships.

Unfortunately, some countries have sought S&T progress through illicit means, including unapproved transfer or outright theft of American research, ideas, and intellectual capital. In particular, the government of the People's Republic of China (PRC) continues to steal technology and surreptitiously influence research in the United States for their own economic and military gains. Some U.S.-based researchers also have violated longstanding conflict of interest rules by failing to disclose foreign financing, affiliations, companies, and IP – often at the behest of the PRC government. These actions undermine the integrity of our research enterprise not to mention pose risks to our economic and national security. Universities will need to better protect academic and research program integrity, key interests of the United States, by providing full transparency regarding foreign funding, as current law requires, through their semiannual reporting.

The JCORE Subcommittee on Research Security is the primary mechanism for Federal agencies to share and coordinate different policies and practices to strengthen the security of America's research enterprise. The Subcommittee aims to protect America's research enterprise without comprising our values or weakening America's long-standing competitive advantages, such as the open and collaborative nature of our system or our ability to attract the best talent from around the globe. The Research Security Subcommittee brings together over 20 Federal departments and agencies, including R&D funding agencies, the Departments of State and Education, the law enforcement and intelligence communities, and National Security Council staff.

The Subcommittee is focused on four areas:

- Appropriate and effective risk management;
- Consistent, coordinated, and effective outreach to and engagement with academic and research institutions, at home and abroad;
- Developing guidance to Federal agencies; and
- Developing best practices for academic and research institutions.

America's continued S&T leadership depends not only on balancing security and openness but also creating research environments that are safe and inclusive. There have been numerous reports detailing the persistence of harassment and its detrimental consequences. A 2018 National Academies report, *Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine*, found that 20 to 50 percent of female students and greater than 50 percent of female faculty and staff experienced sexually harassing behavior in academia. This is unacceptable. Harassment can silence or limit career opportunities for both victims and bystanders, resulting in a costly loss of talent, squandered resources, and the erosion of public trust.

To address this issue, the Office of Science and Technology Policy (OSTP) created the JCORE Subcommittee on Safe and Inclusive Research Environments. Sixteen departments and agencies across Government are collaborating to address the conditions that generate harassment and bias within research environments. The Subcommittee is completing a comprehensive inventory of all Federal agencies' policies and practices targeted at addressing harassment *of all forms* in the research environment. Through this policy inventory, the Subcommittee will identify best practices, which will eventually lead to a Coordinated Federal Action Plan. This plan will present a Government-wide approach to addressing harassment in the research environment.

In President Trump, our innovators have a champion in the White House who will fiercely defend their interests and the American research system at the foundation of our success. Through JCORE, we are protecting the Nation's research enterprise, leading globally with our principles and American values, and empowering our citizens to more fully participate in and benefit from innovations in science and technology.

Leveraging the Full Capabilities of America's S&T Enterprise – Partnerships

Federal investments in R&D are critical, but the real power of American S&T enterprise is that it leverages the combined investments, infrastructure, and creative talent of government, industry, academia, and nonprofit organizations in interdependent and mutually complementary ways. Partnerships create the connective tissue between these sectors and serve as force multipliers, enabling partnering organizations to achieve higher returns on investment, reduce unnecessary duplication, create efficiencies, leverage assets, and advance their respective missions. The August 2019 Memorandum on the Administration's FY 2021 R&D Budget Priorities encouraged agencies to "build, strengthen, and expand strategic multisector partnerships," including partnerships that build S&T capacity at institutions seeking to do so, such as R2 ("high research activity") institutions and HBCUs; support research infrastructure; and improve transfer of federally-funded technologies from "lab-to-market."

To advance this goal, the President’s Council of Advisors on Science and Technology (PCAST) is currently exploring ways to engage industry, academia, and the DOE National Labs collaboratively to further national priorities, such as advancing the Industries of the Future and creating a diverse, highly skilled workforce. During the first ever official meeting between PCAST and the National Science Board (NSB) on February 4, 2020, the collective group identified the need to strengthen and leverage multisector partnerships as a key to unlocking the full innovation capacity of our S&T enterprise, and they agreed to work collaboratively on this topic.

Additionally, on February 10, 2020, OSTP established an NSTC Fast Track Action Committee (FTAC) on Partnerships. The FTAC will include representation from across the entire Federal government, not just agencies involved in R&D activities, and has been charged with identifying within 90 days actions that will improve the ability of departments and agencies to partner with each other and non-federal entities on S&T research, development, and education.

Leveraging the Full Capabilities of America’s S&T Enterprise – People

The American people have been and will continue to be our Nation’s greatest resource. The Trump Administration recognizes this and has made building the workforce of the future a central priority. In December 2018, the Administration released a 5-year strategic plan for STEM education, *Charting A Course For Success: America’s Strategy for STEM Education*. The plan identified three goals:

1. Build Strong Foundations for STEM Literacy by ensuring that every American has the opportunity to master basic STEM concepts and to become digitally literate.
2. Increase Diversity, Equity, and Inclusion in STEM and provide all Americans with lifelong access to high-quality STEM education, especially those historically underserved and underrepresented in STEM fields and employment.
3. Prepare the STEM Workforce for the Future—both college-educated STEM practitioners and those working in skilled trades that do not require a four-year degree—by creating authentic learning experiences that encourage and prepare learners to pursue STEM careers.

Federal departments and agencies are continuing to implement the goals of the strategic plan and, in October 2019, OSTP released a report detailing their progress. Although the Federal government plays a key role in STEM, preparing *all* Americans with the knowledge and skills necessary to adapt and thrive in a constantly evolving workforce demands a multisector approach. To engage the private sector, one example includes the President’s National Council for the American Worker, which has asked companies and trade groups throughout the country to sign the *Pledge to America’s Workers*—a commitment to expand programs that educate, train, and reskill workers from high-school age to near-retirement. To date, more than 400 companies and organizations have signed the Pledge to deliver nearly 15 million career and training opportunities to American workers. Likewise, the PCAST Subcommittee on Meeting National Needs for STEM Education and a Diverse, Multi-Sector Workforce is collaborating with the NSB to address this topic. These and other actions will ensure that as S&T transform every aspect of our lives, no American is left behind.

S&T Highlights during the Trump Administration

Each year, America's scientists and engineers make new discoveries and create innovations that justify the confidence placed by the public in the research enterprise for 75 years. Just this past year, numerous Federal agencies joined the Event Horizon Telescope—an international collaboration that captivated the world with the first-ever image of a black hole. Previously thought to be impossible, this achievement demonstrates the type of discovery that strong partnerships can achieve.

Under the Trump Administration, our researchers and medical professionals are making great strides in health. For the first time, we eliminated the DNA of the virus responsible for AIDS from the genomes of living animals. We are now producing reliable and reproducible amounts of Actinium-225, a previously scarce alpha emitter thought to be one of the most potentially effective treatments for metastasized cancers because of its capacity to target malignant cells while leaving healthy tissue unharmed. Through the President's Roadmap to Empower Veterans and End a National Tragedy of Suicide (PREVENTS), researchers are using AI and machine learning technologies to more accurately and swiftly identify veterans at risk of suicide.

This Administration continues to recognize the importance of oceans to the U.S. economy, national security, and environment. We are continuing to implement President Trump's 2018 Executive Order on Ocean Policy to Advance the Economic, Security, and Environmental Interests of the United States. In November 2019, the President signed a Memorandum directing the Ocean Policy Committee to coordinate the development of a national strategy for mapping, exploring, and characterizing the U.S. Exclusive Economic Zone and the shoreline and nearshore of Alaska. New and emerging ocean science and technologies, developed and deployed in partnership with the ocean S&T community, will play a critical role by allowing us to more efficiently explore and understand the ocean at a level of detail and at a geographic scale never before possible. This knowledge will significantly advance the conservation, management, and balanced use of our Nation's oceans to the benefit of all Americans.

We are continuously improving our scientific abilities, such as providing high quality elevation data nationwide by 2025 to find our natural water storage through advanced U.S. Geological Survey maps, and improving natural disaster preparations like we did in October 2019 with the first-ever statewide public testing of earthquake early warning systems. From new applications to combat transnational human smuggling such as the Department of Homeland Security's Igloo Program to the National Institute of Standards and Technology's use of blockchain technology in providing tamper-proof transmission of manufacturing data, our S&T enterprise is protecting America's people and institutions from emerging and intensifying threats.

This past summer, we celebrated our budding research workforce by awarding 314 early-career professionals with the Presidential Early Career Award for Scientists and Engineers (PECASE). In October, I welcomed 215 teachers and 15 mentors to the White House and awarded them with the Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST) and the Presidential Awards for Excellence in Science, Mathematics and Engineering Mentoring (PAESMEM). These leaders in research and STEM are the heirs of the legacy forged by the great American pioneers and trailblazers of yesteryear, and we will continue to recognize their accomplishments.

We will be highlighting these and other achievements in the annual S&T Highlights document now in preparation and scheduled for release in early March.

In conclusion, I believe the Nation's R&D investments, strategies, and policies must reflect and address the urgent opportunities and challenges confronting the Nation and make use of every tool, asset, and competitive advantage at our disposal. Federally-funded R&D remains an essential building block for discovery, innovation, and education. But Federal investment is only one part of a much larger enterprise that unites, inspires, and rallies people and organizations from every sector to a common cause—to improve the health, security, and prosperity of the Nation. There indeed are “unlimited frontiers waiting to be explored” and the President's FY 2021 Budget in concert with the other actions I have summarized ensure that America continues to lead the way.

17. RESEARCH AND DEVELOPMENT

Over the past 70 years, America has emerged as the unquestioned global leader in science and technology (S&T). Nearly uninterrupted growth in combined public, private, academic, and nonprofit research and development (R&D) investment—together with the freedom to chase bold ideas; a diverse, highly-skilled, and entrepreneurial U.S. workforce; and world class universities and Federal and National laboratories—have resulted in the discoveries and innovations that have fueled improvements in national health, prosperity, and security. Today, the world is faced with extraordinary opportunities and profound challenges that require U.S. leadership. From leveraging international R&D collaborations and partnerships, to countering global threats to our economic and national security, to navigating the impact of technology both at home and in the workplace, we must commit to taking the wise and bold steps necessary to ensure America remains the global S&T leader for generations to come.

The Administration is deeply committed to this important goal by investing \$142.2 billion in Federal R&D. For 2021, the Administration is prioritizing the science and technology that underpin the Industries of the Future

(IoT)—artificial intelligence (AI), quantum information science (QIS), 5G/advanced communications, biotechnology, and advanced manufacturing. Relative to the 2020 President's Budget, this includes major increases in QIS and non-defense AI R&D as part of a commitment to double Federal AI and QIS R&D investments by 2022. R&D investments in AI and QIS, in particular, act as innovation multipliers and employment drivers, not only by promoting S&T progress across many disciplines, but also by helping to build a highly-skilled American workforce. Other IoT areas, such as biotechnology and advanced manufacturing, are poised for potentially transformative advances. Together, IoT investments are vital to the Nation's global competitiveness and the health, prosperity, and security of the American people.

These and other high priority investments, combined with thoughtful reallocations in lower priority areas, will revolutionize our ability to solve previously intractable problems, foster new industries and jobs, and keep the American people safe while remaining responsible stewards of taxpayer dollars. Table 17-1 shows a breakout of 2021 R&D funding.

Table 17-1. TOTAL FEDERAL R&D FUNDING BY AGENCY AT THE BUREAU OR ACCOUNT LEVEL

(Mandatory and Discretionary Budget Authority^{1,2}, Dollar Amounts In Millions)

	2019 Actual	2020 Estimate ³	2021 Proposed	Dollar Change: 2020 to 2021	Percent Change: 2020 to 2021
By Agency					
Agriculture	3,026	2,941	2,769	-172	-6%
Agriculture Research Service	1,702	1,625	1,435	-190	-12%
Animal and Plant Health Inspection Service	39	40	40	0	0%
Economic Research Service	88	85	62	-23	-27%
Forest Service	306	309	255	-54	-17%
National Agricultural Statistics Service	9	9	9	0	0%
National Institute of Food and Agriculture	882	873	968	95	11%
Commerce	1,959	1,948	1,506	-442	-23%
Bureau of the Census	122	155	163	8	5%
National Institute of Standards and Technology	763	807	653	-154	-19%
National Oceanic and Atmospheric Administration	1,066	978	678	-300	-31%
National Telecommunications and Information Administration	8	8	12	4	50%
Defense⁴	54,691	64,544	59,831	-4,713	-7%
Military Construction	22	1,853	0	-1,853	-100%
Military Personnel	441	437	447	10	2%
Defense Health Program	1,716	1,979	308	-1,671	-84%
Research, Development, Test, and Evaluation	52,512	60,275	59,076	-1,199	-2%
Education	248	259	230	-29	-11%
Institute of Education Sciences	230	241	213	-28	-12%

Table 17–1. TOTAL FEDERAL R&D FUNDING BY AGENCY AT THE BUREAU OR ACCOUNT LEVEL—Continued(Mandatory and Discretionary Budget Authority ^{1,2}, Dollar Amounts In Millions)

	2019 Actual	2020 Estimate ³	2021 Proposed	Dollar Change: 2020 to 2021	Percent Change: 2020 to 2021
Office of Innovation and Improvement	0	1	0	-1	-100%
Office of Postsecondary Education	1	1	1	0	0%
Office of Special Education and Rehabilitative Services	14	14	14	0	0%
Office of Career, Technical, and Adult Education	3	2	2	0	0%
Energy	18,271	19,219	16,051	-3,168	-16%
Fossil Energy Research and Development	682	709	696	-13	-2%
Science	6,640	6,924	5,760	-1,164	-17%
Electricity	136	155	175	20	13%
Nuclear Energy	1,293	1,161	1,082	-79	-7%
Energy Efficiency and Renewable Energy	1,796	2,054	672	-1,382	-67%
Advanced Research Projects Agency--Energy	366	425	-311	-736	-173%
Cybersecurity, Energy Security, and Emergency Response	49	36	62	26	72%
Defense Environmental Cleanup	25	30	28	-2	-7%
National Nuclear Security Administration	7,280	7,723	7,885	162	2%
Power Marketing Administration	4	2	2	0	0%
Environmental Protection Agency	489	492	318	-174	-35%
Science and Technology	473	473	299	-174	-37%
Hazardous Substance Superfund	15	18	18	0	0%
Inland Oil Spill Programs	1	1	1	0	0%
Health and Human Services	38,511	40,818	37,875	-2,943	-7%
Administration for Children and Families	5	5	4	-1	-20%
Centers for Disease Control and Prevention	466	435	435	0	0%
Centers for Medicare and Medicaid Services	20	20	20	0	0%
Departmental Management	7	18	18	0	0%
Food and Drug Administration	491	410	410	0	0%
Health Resources and Services Administration	23	23	23	0	0%
National Institutes of Health ⁵	37,499	39,907	36,965	-2,942	-7%
Homeland Security	668	532	450	-82	-15%
Science and Technology	510	422	357	-65	-15%
Transportation Security Administration	21	23	30	7	30%
United States Coast Guard	4	1	10	9	900%
United States Secret Service	3	11	0	-11	-100%
Management Directorate	3	0	0	0	0%
U.S. Customs and Border Protection	67	0	0	0	0%
Cybersecurity and Infrastructure Security Agency	13	14	6	-8	-57%
Countering Weapons of Mass Destruction Office	47	61	47	-14	-23%
Interior	958	973	725	-248	-25%
Bureau of Land Management	25	21	21	0	0%
Bureau of Reclamation	129	115	76	-39	-34%
Bureau of Safety and Environmental Enforcement	27	27	25	-2	-7%
Department-Wide Programs	3	3	3	0	0%
National Park Service	27	26	26	0	0%
Office of Surface Mining Reclamation and Enforcement	1	1	1	0	0%
United States Fish and Wildlife Service	15	15	15	0	0%
United States Geological Survey	640	660	460	-200	-30%
Bureau of Ocean Energy Management	86	100	93	-7	-7%
Bureau of Indian Affairs	5	5	5	0	0%
National Aeronautics and Space Administration	10,698	14,057	13,334	-723	-5%
Science	6,154	7,019	6,261	-758	-11%
Aeronautics	565	575	630	55	10%
Low Earth Orbit and Spaceflight Operations	1,586	1,551	1,496	-55	-4%
Safety, Security and Mission Services	272	237	245	8	3%
Deep Space Exploration Systems	1,288	3,576	3,139	-437	-12%
Construction and Environmental Compliance and Restoration	117	54	48	-6	-11%

Table 17–1. TOTAL FEDERAL R&D FUNDING BY AGENCY AT THE BUREAU OR ACCOUNT LEVEL—Continued(Mandatory and Discretionary Budget Authority ^{1,2}, Dollar Amounts In Millions)

	2019 Actual	2020 Estimate ³	2021 Proposed	Dollar Change: 2020 to 2021	Percent Change: 2020 to 2021
Exploration Technology	716	1,045	1,515	470	45%
National Science Foundation	6,586	6,752	6,328	–424	–6%
Research and Related Activities	5,823	6,033	5,613	–420	–7%
Education and Human Resources	467	476	485	9	2%
Major Research Equipment and Facilities Construction	296	243	230	–13	–5%
Transportation	1,071	1,134	594	–540	–48%
Federal Aviation Administration	501	533	447	–86	–16%
Federal Highway Administration	375	404	0	–404	–100%
Federal Motor Carrier Safety Administration	9	9	12	3	33%
Federal Railroad Administration	45	44	45	1	2%
Federal Transit Administration	28	36	33	–3	–8%
National Highway Traffic Safety Administration	76	68	19	–49	–72%
Office of the Secretary	13	16	14	–2	–13%
Pipeline and Hazardous Materials Safety Administration	24	24	24	0	0%
Smithsonian Institution	339	330	328	–2	–1%
Veterans Affairs	1,370	1,313	1,351	38	3%
Medical Care Support	591	563	563	0	0%
Medical and Prosthetic Research	779	750	788	38	5%

¹ This table shows funding levels for Departments or Independent agencies with more than \$200 million in R&D activities in 2021.² The Experimental Development definition is used in this table across all three fiscal years.³ The FY 2020 Estimate column applies the main FY 2021 President's Budget volume approach of using FY 2020 enacted appropriations.⁴ Totals for Experimental Development spending in FY 2019–2021 do not include the DOD Budget Activity 07 (Operational System Development) due to changes in the definition of development. These funds are requested in the FY 2021 Budget request and support the development efforts to upgrade systems that have been fielded or have received approval for full rate production and anticipate production funding in the current or subsequent fiscal year.⁵ NIH includes Agency for Healthcare Research and Quality (AHRQ) funding as the FY 2021 Budget proposes that AHRQ be consolidated within NIH as a new institute.

I. PRIORITIES FOR FEDERAL RESEARCH AND DEVELOPMENT

The President's Budget provides support for Federal R&D to keep America prosperous, resilient, healthy, and safe. This section highlights key R&D priorities in the 2021 Budget, with a focus on strategic investments in AI, QIS, and national security.

American Leadership in the Industries of the Future

America's multisector U.S. R&D enterprise continues to enable the Nation to pursue, realize, and lead in critical and emerging areas of S&T. Private industry working in a robust free market can bring the best ideas forward, leading to new and better products and processes and in some cases creating entirely new industries. These innovations often start with Federal contributions in early-stage R&D, particularly in S&T areas that require sustained support before becoming ready for private sector investment. Beginning in 2017, the Administration identified several S&T areas critical to advancing America's leadership in the IotF and since then has made R&D investments, and enacted several key policies, to realize their full promise to improve the prosperity, health, and security of the American people.

Artificial intelligence (AI) is transforming every segment of American life, with applications ranging from medical diagnostics and precision agriculture, to autonomous transportation, job reskilling and upskilling and

national defense, and beyond. The Administration has taken a forward-looking approach to fortify American leadership in AI, including considerations about its effective and trustworthy use. In 2019, the President signed an Executive Order launching the American AI Initiative, the national AI strategy of the United States, which is taking a multipronged approach to accelerating our national leadership in AI. The Administration also released the National AI R&D Strategic Plan: 2019 Update to define priority areas of Federal investment in AI R&D, and the 2016–2019 Progress Report on Advancing AI R&D to document the depth and breadth of agency investments that are transforming the state of the field, consistent with the strategic research plan. The 2021 Budget includes a major increase in non-defense AI funding compared to the 2020 Budget and is on a path to double Government-wide spending on AI R&D by 2022. The Budget includes over \$850 million for AI R&D at the National Science Foundation (NSF), which represents a 70-plus percent increase over the 2020 Budget. This increase will advance NSF's ability to invest in both core and AI-related research, and it will enable NSF to create several National AI Research Institutes, in collaboration with the Departments of Agriculture, Homeland Security, Transportation, and Veterans Affairs. These institutes serve as focal points for multisector, multidisciplinary research and workforce efforts among academia, industry,

Federal agencies, and nonprofits, helping to ensure that America remains the global AI leader.

QIS promises to enable new technologies and opportunities for the Nation over the next two decades. Researchers will be able to tackle previously unsolvable problems and explore new domains of communication, sensing, and computation. QIS will improve our industrial base, creating new jobs and entirely new industries in the process, while helping keep America safe. Recognizing the potential of QIS, in late 2018 the President signed into law the National Quantum Initiative Act. The 2021 Budget greatly bolsters Federal QIS R&D funding with aggregate investment across key agencies increasing by over 50 percent compared to the 2020 Budget on the path to doubling by 2022. NSF investment will more than double with an additional \$120 million supporting the National Quantum Initiative. The Department of Energy (DOE) will bolster quantum information efforts at the national laboratories and in academia and industry with an approximate increase of \$75 million. Additional efforts at the National Institute for Standards and Technology (NIST) will ensure the standards and science for engineering quantum systems can progress while enabling supporting technology from industrial investments. Expanded QIS defense and intelligence R&D will enable new applications and improve industrial engagement while sustaining their multi-decade effort to encourage quantum information science and technology. Initial funding is included to allow NASA to explore the potential for a space-based quantum entanglement experiment.

The Administration is also prioritizing other S&T areas critical to American leadership in IoT. Advanced manufacturing—which includes both new manufacturing methods and the production of new products enabled by cutting-edge technologies—is an engine of America’s economic power and a pillar of its national security. For example, NIST will invest \$20 million for a new Manufacturing USA Institute—a public-private partnership that brings together industry, academia, and Government partners to nurture manufacturing innovation and accelerate commercialization. In addition, the 2021 Budget puts an additional \$100 million into the Department of Agriculture’s flagship competitive grants program (AFRI), which will be invested in artificial intelligence and machine learning to promote advanced manufacturing in the food and agricultural sciences, as well as continue efforts in robotics and application of big data required for future advancements in precision agriculture. In terms of biotechnology, the Budget will support AFRI’s continued investments in areas such as gene editing to improve production traits and enhance resistance to disease in crops and livestock. Finally, though not categorized as R&D, investments in STEM education and workforce are critical to creating a diverse, highly skilled, and entrepreneurial workforce that can discover, invent, build, and transform the Industries of the Future. The 2021 Budget will help empower the workforce of the future by investing an additional \$50 million at NSF compared to the 2020 Budget Request on education and workforce development for AI and QIS, with focused ef-

forts in outreach to community colleges, Historically Black Colleges and Universities, and Minority Serving Institutions.

American Security

The 2018 National Defense Strategy calls for leadership in research, technology, invention, and innovation to “ensure we will be able to fight and win the wars of the future.” As adversaries leverage emerging and disruptive technologies to threaten the Nation, it is imperative that we invest in R&D to remain at the leading edge of S&T, maintain military superiority, remain agile in the face of existing and new threats, and keep the American people safe. The President’s 2021 Budget continues to prioritize R&D in technologies that contribute to the security of the American people. The Department of Defense (DOD) will invest more than \$59 billion in research, engineering, and prototyping activities in 2021 to enable advanced military capabilities that will help meet emerging threats and protect American security into the future, including offensive and defensive hypersonic weapons capabilities, resilient national security space systems, and modernized and flexible strategic and nonstrategic nuclear deterrent capabilities.

In addition to DOD funding, the 2021 Budget also supports critical investments to protect the Nation. For instance, at the Department of Homeland Security, the 2021 Budget requests \$83 million in R&D funding to further detect and defend against radiological, nuclear, chemical, and biological threats; \$44 million in R&D to improve resilience to natural disasters and physical threats, for first responder technologies and public safety, and for fundamental R&D to ensure cross-border threat screening and supply chain defense; and \$38 million for cybersecurity R&D. To enhance border security, the 2021 Budget will invest \$89 million in R&D for air security technologies, to gain efficiencies in immigration service technology, and for ensuring the security of land and maritime borders.

American Space Exploration and Commercialization

In December 2017, the President signed Space Policy Directive 1 which called for the “United States [to] lead the return of humans to the Moon for long-term exploration and utilization”. Subsequently in March 2019, the Vice President on behalf of the President declared “it is the stated policy of this [A]dministration and the United States of America to return American astronauts to the Moon within the next five years.” Given these policy objectives, the 2021 Budget focuses R&D efforts to accomplish the goal of sustainable deep space exploration, starting with the lunar surface with an eye to Mars.

Within the 2021 Budget, a substantial commitment is made to promote innovation, such as the Lunar Surface Innovation Initiative. Technologies are prioritized that enable a sustainable presence on the lunar surface that also feed forward directly to Mars including in-situ resource utilization, cryogenic fuel storage and management, surface excavation, manufacturing and construction, and advanced space power (e.g. small nuclear fission reactors).

A robust and competitive commercial space sector is vital to continued progress in space and will enable the expansion of America's economic sphere of influence to low Earth orbit, the Moon and then beyond. To that end, space exploration activities will focus on maximizing pub-

lic-private partnerships. Allowing American industry to innovate will benefit the American taxpayer by increasing the capability of private companies to provide quality space services but at a lower cost.

II. FEDERAL R&D DATA

R&D is the collection of efforts directed toward gaining greater knowledge or understanding and applying knowledge toward the production of useful materials, devices, and methods. R&D investments can be characterized as basic research, applied research, development, R&D equipment, or R&D facilities. The Office of Management and Budget (OMB) has used those or similar categories in its collection of R&D data since 1949. Starting with the 2018 Budget, OMB implemented a refinement to the categories by more narrowly defining "development" as "experimental development" to better align with the data collected by the National Science Foundation on its multiple R&D surveys, and to be consistent with international standards. An explanation of this change is included below. Please note that R&D crosscuts in specific topical areas as mandated by law will be reported separately in forthcoming Supplements to the President's 2021 Budget.

Background on Federal R&D Funding

More than 20 Federal agencies fund R&D in the United States. The character of the R&D that these agencies fund depends on the mission of each agency and on the role of R&D in accomplishing it. Table 17-2 shows agency-by-agency spending on basic research, applied research, experimental development, and R&D equipment and facilities.

Basic research is systematic study directed toward a fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind. Basic research, however, may include activities with broad applications in mind.

Applied research is systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met.

Experimental development is creative and systematic work, drawing on knowledge gained from research

and practical experience, which is directed at producing new products or processes or improving existing products or processes. Like research, experimental development will result in gaining additional knowledge.

Research and development equipment includes acquisition or design and production of movable equipment, such as spectrometers, research satellites, detectors, and other instruments. At a minimum, this category includes programs devoted to the purchase or construction of R&D equipment.

Research and development facilities include the acquisition, design, and construction of, or major repairs or alterations to, all physical facilities for use in R&D activities. Facilities include land, buildings, and fixed capital equipment, regardless of whether the facilities are to be used by the Government or by a private organization, and regardless of where title to the property may rest. This category includes such fixed facilities as reactors, wind tunnels, and particle accelerators.

Comprehensive Government-wide efforts are currently underway to increase the accuracy and consistency of the R&D budget via a collaborative community of practice of Federal agencies, which have been working to identify best practices and standards for the most accurate classification and reporting of R&D activities. For example, to better align with National Science Foundation R&D surveys and international standards, starting with the 2018 Budget OMB narrowed the definition of development to "experimental development." This definition, unlike the previous definition of development, excludes user demonstrations of a system for a specific use case and pre-production development (i.e., non-experimental work on a product or system before it goes into full production). Because of this earlier change, the experimental development amounts reported are significantly lower than the development amounts shown in past Budgets.

Table 17-2. FEDERAL RESEARCH AND DEVELOPMENT SPENDING(Mandatory and Discretionary Budget Authority¹, Dollar Amounts In Millions)

	2019 Actual	2020 Estimate ²	2021 Proposed	Dollar Change: 2020 to 2021	Percent Change: 2020 to 2021
By Agency					
Defense⁴	54,691	64,544	59,831	-4,713	-7%
Health and Human Services	38,511	40,818	37,875	-2,943	-7%
Energy	18,271	19,219	16,051	-3,168	-16%
NASA	10,698	14,057	13,334	-723	-5%
National Science Foundation	6,586	6,752	6,328	-424	-6%
Agriculture	3,026	2,941	2,769	-172	-6%
Commerce	1,959	1,948	1,506	-442	-23%
Veterans Affairs	1,370	1,313	1,351	38	3%
Transportation	1,071	1,134	594	-540	-48%
Interior	958	973	725	-248	-25%
Homeland Security	668	532	450	-82	-15%
Smithsonian Institution	339	330	328	-2	-1%
Environmental Protection Agency	489	492	318	-174	-35%
Education	248	259	230	-29	-11%
Other	1,249	661	495	-166	-25%
TOTAL³	140,134	155,973	142,185	-13,788	-9%
Basic Research					
Defense	2,492	2,628	2,331	-297	-11%
Health and Human Services	19,082	20,492	19,154	-1,338	-7%
Energy	5,103	5,514	5,461	-53	-1%
NASA	4,948	6,880	6,110	-770	-11%
National Science Foundation	5,139	5,322	5,018	-304	-6%
Agriculture	1,213	1,264	1,256	-8	-1%
Commerce	232	242	208	-34	-14%
Veterans Affairs	600	559	576	17	3%
Transportation	0	16	18	2	13%
Interior	80	82	65	-17	-21%
Homeland Security	42	47	27	-20	-43%
Smithsonian Institution	269	276	281	5	2%
Environmental Protection Agency .....	.....	.....	.....	.....	.....
Education	60	70	70	0	0%
Other	56	68	63	-5	-7%
SUBTOTAL	39,316	43,460	40,638	-2,822	-6%
Applied Research					
Defense	6,071	6,288	5,506	-782	-12%
Health and Human Services	19,110	20,026	18,336	-1,690	-8%
Energy	8,318	8,351	6,526	-1,825	-22%
NASA	2,743	3,002	3,409	407	14%
National Science Foundation	784	807	787	-20	-2%
Agriculture	1,126	1,154	1,150	-4	-0%
Commerce	976	1,046	809	-237	-23%
Veterans Affairs	738	725	745	20	3%
Transportation	705	736	314	-422	-57%
Interior	710	717	533	-184	-26%
Homeland Security	203	165	71	-94	-57%
Smithsonian Institution .....	.....	.....	.....	.....	.....
Environmental Protection Agency	415	416	250	-166	-40%
Education	118	126	117	-9	-7%
Other	947	371	252	-119	-32%
SUBTOTAL	42,964	43,930	38,805	-5,125	-12%
Experimental Development³					
Defense⁴	46,106	53,775	51,994	-1,781	-3%

Table 17-2. FEDERAL RESEARCH AND DEVELOPMENT SPENDING—Continued(Mandatory and Discretionary Budget Authority¹, Dollar Amounts In Millions)

	2019 Actual	2020 Estimate ²	2021 Proposed	Dollar Change: 2020 to 2021	Percent Change: 2020 to 2021
Health and Human Services	76	35	35	0	0%
Energy	2,606	2,982	1,935	-1,047	-35%
NASA	2,890	4,121	3,767	-354	-9%
National Science Foundation .....	.....	.....	.....	.....	.....
Agriculture	165	176	172	-4	-2%
Commerce	267	263	200	-63	-24%
Veterans Affairs	32	29	30	1	3%
Transportation	326	344	234	-110	-32%
Interior	162	172	125	-47	-27%
Homeland Security	356	320	329	9	3%
Smithsonian Institution .....	.....	.....	.....	.....	.....
Environmental Protection Agency	74	76	68	-8	-11%
Education	70	63	43	-20	-32%
Other	239	222	180	-42	-19%
SUBTOTAL	53,369	62,578	59,112	-3,466	-6%
Facilities and Equipment					
Defense	22	1,853	0	-1,853	-100%
Health and Human Services	243	265	350	85	32%
Energy	2,244	2,372	2,129	-243	-10%
NASA	117	54	48	-6	-11%
National Science Foundation	663	623	523	-100	-16%
Agriculture	522	347	191	-156	-45%
Commerce	484	397	289	-108	-27%
Veterans Affairs .....	.....	.....	.....	.....	.....
Transportation	40	38	28	-10	-26%
Interior	6	2	2	0	0%
Homeland Security	67	0	23	23	.....
Smithsonian Institution	70	54	47	-7	-13%
Environmental Protection Agency .....	.....	.....	.....	.....	.....
Education .....	.....	.....	.....	.....	.....
Other	7	0	0	0	0%
SUBTOTAL	4,485	6,005	3,630	-2,375	-40%

¹ This table shows funding levels for Departments or Independent agencies with more than \$200 million in R&D activities in 2021.² The FY 2020 Estimate column applies the main FY 2021 President's Budget volume approach of using FY 2020 enacted appropriations.³ The total uses the Experimental Development definition across the three fiscal years.⁴ The totals for Experimental Development spending in FY 2019-2021 do not include the DOD Budget Activity 07 (Operational System Development) due to changes in the definition of development. These funds are requested in the FY 2021 Budget request and support the development efforts to upgrade systems that have been fielded or have received approval for full rate production and anticipate production funding in the current or subsequent fiscal year.

III. OTHER SOURCES OF FEDERAL SUPPORT FOR R&D

The President's 2021 Budget seeks to build on strong private sector R&D investment by prioritizing Federal investments in areas that industry is not likely to support in comparison to later-stage applied research and development that the private sector is better equipped to pursue. This complementary relationship is enhanced by public-private partnerships. Partnerships between Federal departments and agencies and industry and multisector partnerships facilitated by Federal funding can serve as force multipliers, enabling partnering organizations to achieve higher returns on investment, create efficiencies, and advance their respective missions. In addition, a key means of stimulating private sector investment and bridging Federal Government research with industry development is through the transfer of technology. Federal technology transfer seeks to help domestic companies develop and commercialize products derived from Government-funded R&D, which can lead to greater productivity from U.S. R&D investments and ultimately promote the Nation's economic growth. Recognizing the benefits of this mechanism, the 2021 Budget sustains funding for technology transfer efforts where appropriate. In addition, the Administration is working to enable and enhance the Federal Government's transition of discoveries from laboratory to market through a Cross-Agency Priority Goal under the President's Management Agenda.

Because much of the federally funded R&D is conducted outside of the Government, the Administration seeks to reduce the associated workload on funding recipients and partners in order to promote greater effectiveness and efficiency in our Federal spending. A significant effort to reduce the administrative and regulatory workload associated with Federal R&D funding is currently underway through an interagency working group on research regulation (as required by the Research and

Development Efficiency Act). More broadly, beyond just R&D, the Administration is working under a President's Management Agenda Cross-Agency Priority Goal to reduce administrative burdens for all Federal grant recipients and promoting results-oriented accountability.

The Federal Government also stimulates private investment in R&D through tax preferences. Historically, dating back to the 1950s, the private sector has performed the majority of U.S. R&D. As of 2018, it is estimated that businesses performed 73 percent of total U.S. R&D.¹ Businesses have also been a predominant source of U.S. R&D funding since the 1980s with an estimated \$404.2 billion invested by this sector in 2018, which accounts for about 70 percent of total U.S. funding.² The research and experimentation (R&E) tax credit, which was made permanent through the Protecting Americans from Tax Hikes Act of 2015 (P.L. 114-113) and modified in the Tax Cut and Jobs Act of 2017 (P.L. 115-97), essentially provides a credit to qualified research expenses. R&E tax credit claims have at least doubled over the past two decades, growing from an estimated \$4.4 billion in 1997 to \$12.6 billion in 2014.³ The manufacturing and the professional, scientific, and technical services sectors account for about 70 percent of total claims in 2014.

¹ NSF National Center for Science and Engineering Statistics (Jan 2020). National Patterns of R&D Resources: 2017-2018 Data Update. NSF 20-307.

² NSF National Center for Science and Engineering Statistics (Jan 2020). National Patterns of R&D Resources: 2017-2018 Data Update. NSF 20-307.

³ IRS Statistics of Income Division (Nov 2019). SOI Tax Statistics – Corporate Research Credit.



PRESIDENTIAL MEMORANDA

Memorandum on Ocean Mapping of the United States Exclusive Economic Zone and the Shoreline and Nearshore of Alaska

— ENERGY & ENVIRONMENT | Issued on: November 19, 2019



MEMORANDUM FOR THE SECRETARY OF STATE
THE SECRETARY OF DEFENSE
THE ATTORNEY GENERAL
THE SECRETARY OF THE INTERIOR
THE SECRETARY OF AGRICULTURE
THE SECRETARY OF COMMERCE
THE SECRETARY OF TRANSPORTATION
THE SECRETARY OF ENERGY
THE SECRETARY OF HOMELAND SECURITY
THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION
AGENCY
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THE ASSISTANT TO THE PRESIDENT FOR ECONOMIC POLICY

THE DIRECTOR OF THE OFFICE OF SCIENCE AND
TECHNOLOGY POLICY

THE CHAIRMAN OF THE COUNCIL ON ENVIRONMENTAL QUALITY

THE DEPUTY ASSISTANT TO THE PRESIDENT FOR
HOMELAND SECURITY AND COUNTERTERRORISM

SUBJECT: Ocean Mapping of the United States Exclusive
Economic Zone and the Shoreline and Nearshore of
Alaska

By the authority vested in me as President by the Constitution and the laws of the
United States of America, I hereby direct the following:

Section 1. Policy. It is the policy of the United States to act boldly to safeguard
our future prosperity, health, and national security through ocean mapping,
exploration, and characterization. Data and information about the ocean help to
advance maritime commerce, domestic seafood production, healthy and
sustainable fisheries, coastal resilience, energy production, tourism and
recreation, environmental protection, national and homeland security, and other

interests. Such activities contribute more than \$300 billion per year of economic activity, 3 million jobs, and \$129 billion in wages.

On March 10, 1983, President Reagan issued Proclamation 5030 (Exclusive Economic Zone of the United States of America), which established the United States Exclusive Economic Zone (U.S. EEZ) to advance the development of ocean resources and promote the protection of the marine environment. With more than 13,000 miles of coastline and 3.4 million square nautical miles of ocean within our territorial jurisdiction, our country's EEZ is among the largest in the world and is larger than the combined land area of all 50 States. The U.S. EEZ contains a vast array of underutilized, and likely many undiscovered, natural resources, including critical minerals, marine-derived pharmaceuticals, energy, and areas of significant ecological and conservation value. However, only about 40 percent of the U.S. EEZ has been mapped and significantly less of the area has natural resources and ocean systems that have been characterized, including identification and evaluation, by executive departments and agencies (agencies).

The Nation is poised to harness cutting-edge science, new technologies, and partnerships to unlock the potential of our oceans through increased ocean mapping.

Maps and charts that present accurate and contemporary coastal elevation data support economic growth, resource management, and the safety and security of coastal residents. Completed mapping is especially lacking for Alaska and for the Alaskan Arctic, which lack the comprehensive shoreline and nearshore maps available for much of the rest of the Nation.

To improve our Nation's understanding of our vast ocean resources and to advance the economic, security, and environmental interests of the United States, it is the policy of the United States to support the conservation, management, and balanced use of America's oceans by exploring, mapping, and characterizing the

U.S. EEZ, including mapping the Arctic and Sub-Arctic shoreline and nearshore of Alaska. Further, to ensure that these activities produce the broadest possible benefits and provide the greatest return on investment of Federal resources, it is the policy of the United States to support these activities, when appropriate, in collaboration with non-United States Government entities.

Sec. 2. National Strategy for Mapping, Exploring, and Characterizing the U.S. EEZ. Mapping, exploring, and characterizing the U.S. EEZ is necessary for a systematic and efficient approach to understanding our resources. Mapping will reveal the terrain of the ocean floor and identify areas of particular interest; exploration and characterization will identify and evaluate natural and cultural resources within these areas. This knowledge will inform conservation, management, and balanced use of the U.S. EEZ.

To advance these objectives, the Director of the Office of Science and Technology Policy (Director) and the Chairman of the Council on Environmental Quality (Chairman), who serve as co chairs of the Ocean Policy Committee established by Executive Order 13840 of June 19, 2018 (Ocean Policy to Advance the Economic, Security, and Environmental Interests of the United States), shall coordinate the development of a national strategy for mapping, exploring, and characterizing the U.S. EEZ, and for enhancing opportunities for collaboration among interagency and non-United States Government entities with respect to those activities.

Specifically, within 180 days of the date of this memorandum, the Ocean Policy Committee, working through its Ocean Science and Technology Subcommittee and in coordination with the Administrator of the National Oceanic and Atmospheric Administration, shall develop a proposed strategy to map the U.S. EEZ, to identify priority areas within the U.S. EEZ, and to explore and characterize the priority areas, and shall submit it to the Director and the Chairman.

Sec. 3. Strategy for Mapping the Arctic and Sub-Arctic Shoreline and Nearshore of Alaska. Within 180 days of the date of this memorandum, the Administrator of the

National Oceanic and Atmospheric Administration, in coordination, as appropriate, with the State of Alaska and the Alaska Mapping Executive Committee, shall develop a proposed strategy to map the shoreline and nearshore of Alaska and shall submit it to the Director and the Chairman to inform actions of the Ocean Policy Committee and relevant agencies.

Sec. 4. Efficient Permitting of Mapping, Exploration, and Characterization Activities. The United States Government, in coordination with non-United States Government entities, conducts hundreds of ocean exploration, mapping, and research activities every year across the U.S. EEZ. These activities improve our understanding of our oceans, including by identifying potential new sources of critical minerals, biopharmaceuticals, energy, and other resources. These activities frequently require multiple environmental reviews, consultations, permits, and other authorizations under Federal laws and regulations that protect resources such as maritime heritage sites and sensitive or protected marine natural resources. In order to reduce duplication and promote efficiency across agencies, within 180 days of the date of this memorandum, the Ocean Policy Committee, working through its Ocean Resource Management Subcommittee, shall identify opportunities and recommend actions to the Director and the Chairman to increase the efficiency of the permitting and authorization processes for ocean research, mapping, and characterization activities across agencies.

Sec. 5. General Provisions. (a) Nothing in this memorandum shall be construed to impair or otherwise affect:

(i) the authority granted by law to an executive department or agency, or the head thereof; or

(ii) the functions of the Director of the Office of Management and Budget relating to budgetary, administrative, or legislative proposals.

(b) This memorandum shall be implemented consistent with applicable law and subject to the availability of appropriations.

(c) This memorandum is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person.

(d) The Secretary of Commerce is hereby authorized and directed to publish this memorandum in the Federal Register.

DONALD J. TRUMP

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