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DEFENSE SCIENCE AND TECHNOLOGY (S&T) PRIORITIES FOR THE BIDEN ADMINISTRATION

BACKGROUND

The Coalition for National Security Research (CNSR) is a broad-based alliance of more than 100 members from industry, academia, scientific and professional associations, and non-profits conducting vital scientific research to create new and improve existing technologies and capabilities to support the U.S. Department of Defense's (DoD) operations. In FY 2018, CNSR members conducted more than $5.8 billion in DoD-sponsored scientific research[1]. Primarily with funding from the Defense Science and Technology (S&T) program, the research and development (R&D) being undertaken by CNSR members is supporting the advancement of capabilities in important areas such as hypersonics; artificial intelligence(AI)/machine learning (ML); quantum information science (QIS) and computing; and directed energy[2] among many other key technologies critical to ensuring continued U.S. military global dominance.

More broadly, given that approximately 69 percent of DoD research, development, testing and evaluation (RDT&E) is conducted extramurally, DoD relies on its National Security Innovation Base (NSIB) partners, such as CNSR members, to generate new technologies to support U.S. military activities and operations. Furthermore, universities and colleges play a particularly important role in DoD innovation. Universities and colleges perform about 54 percent of all DoD-sponsored fundamental research[3]. It is new discoveries made from fundamental research that ultimately lead to the creation of future technologies and new or enhanced military capabilities[4]. Fundamental research also attracts some of the world's most creative and brightest minds in scientific fields of vital interest to DoD and our national security[5].

If the U.S. is to maintain its global military and technological superiority, the Biden Administration will need to dramatically increase investment in the Defense S&T program, including the defense fundamental research programs, support policies that strengthen the NSIB workforce including the DoD laboratories, and promote openness and the free exchange of ideas in the research environment.

Priority 1: Overall Investment in the Defense S&T Program

The Defense S&T program seeks to support the scientific research that leads to advancements in technological capabilities[6]. Technological advancements are critical to future U.S. military

[1] https://ncsesdata.nsf.gov/herd/2018/html/herd18-dt-tab059.html
[2] https://s28043.pcdn.co/wp-content/uploads/2019/09/CNSR-Priority-Technology-Areas-Examples.pdf
[3] https://ncsesdata.nsf.gov/fedfunds/2018/html/ffs18-dt-tab009.html
[4] https://apps.dtic.mil/dtic/tr/fulltext/u2/a554738.pdf
[5] Ibid
[6] https://comptroller.defense.gov/Portals/45/Documents/defbudget/fy2019/FY2019_Budget_Request_Overview_Book.pdf

dominance[7]. Investing in the Defense S&T program can ensure the U.S. military has the technical superiority it needs to succeed. Furthermore, with so many near-peer competitor nation's vying for dominance in certain technology sectors, investing in the Defense S&T program will ensure that the U.S. is not overmatched by a competitor or adversary that developed a capability first[8].

Prior investments in Defense S&T has resulted in military capabilities such as laser technologies, microelectronics, stealth and counter-stealth capabilities, precision munitions, nanotechnology, near-real time delivery of battlefield information, military drones and speech recognition. Previous investments in fundamental and applied R&D within the Defense S&T program have resulted in dramatic increases in military capabilities that contributed to successful outcomes in conflicts[9]. In the era of great power competition, now more than even we need to use limited federal resources wisely to maintain the U.S. military's global technological superiority.

In addition, investments in defense R&D have many spillover effects that help strengthen the economy and improve public health. Specifically, defense R&D has led to improved fuel efficiency, better engine technology, the Internet, speech recognition, various smartphone technologies, kidney matching programs, LED lighting and advanced prosthetics. Further, a recent study concluded that federal defense R&D investment supported approximately 701,000 jobs and contributed nearly $84 billion to GDP[10].

As noted by experts from the Center for a New American Security (CNAS), DoD is not adequately investing in the Defense S&T program to maintain its global military technological advantage[11]. The Defense Science Board (DSB)[12], National Academies[13], bipartisan House Armed Services Committee Future of Defense Task Force[14], CNAS[15] and Council on Competitiveness[16] all recommend that Defense S&T funding equal at least 3 percent of the DoD budget to sustain long-term U.S. military supremacy. Unfortunately, simply using the DoD base budget rather than its entire budget, the Defense S&T program budget is currently billions of dollars below the recommended levels:

FY 2019 Enacted (Base Budget of $606.5 billion)	**FY 2020 Enacted (Base Budget of $622.7 billion)**
FY 19 S&T Enacted: $15.959 billion	FY 20 S&T Enacted: $16.073 billion
3% S&T Funding Goal: $18.195 billion	3% S&T Funding Goal: $18.681 billion
Difference: -$2.235 billion	*Difference: -$2.607 billion*

[7] http://www.dtic.mil/dtic/tr/fulltext/u2/a433761.pdf
[8] Ibid
[9] https://apps.dtic.mil/dtic/tr/fulltext/u2/a387244.pdf
[10] https://www.breakthroughenergy.org/wp-content/uploads/2020/09/BE-PwC-Report-09162020.pdf
[11] https://www.cnas.org/publications/commentary/sharpening-the-u-s-militarys-edge-critical-steps-for-the-next-administration
[12] http://www.dtic.mil/dtic/tr/fulltext/u2/a403874.pdf
[13] https://www.nap.edu/catalog/11463/rising-above-the-gathering-storm-energizing-and-employing-america-for
[14] https://armedservices.house.gov/_cache/files/2/6/26129500-d208-47ba-a9f7-25a8f82828b0/6D5C75605DE8DDF0013712923B4388D7.future-of-defense-task-force-report.pdf
[15] https://www.cnas.org/publications/commentary/sharpening-the-u-s-militarys-edge-critical-steps-for-the-next-administration
[16] https://www.compete.org/reports/all/202

In addition to the billions of dollars below recommended levels outlined above, Defense S&T program funding is not keeping pace with inflation. Using a simple inflation calculation, funding for Defense S&T provided in the FY 2020 enacted Defense Appropriations bill is nearly $1.5 billion below levels appropriated in 2005. As noted by the DSB, inadequate levels of Defense S&T funding could threaten U.S. military dominance and leadership in the future[17].

We urge the Biden Administration to put forth budgets that request funding for the Defense S&T program at 3 percent or higher of the DoD budget to support developing future military technologies and capabilities needed to maintain global technological dominance.

Priority 2: Overall Investment in Defense Fundamental Research

DoD funds fundamental research to exploit new knowledge that is the basis of future military capabilities[18]. Countless technologies that have helped to ensure our military superiority were funded by defense fundamental research - stealth and counter stealth; night vision; global positioning technology; precision munition; radar; sonar; nanotechnology; military drones; jet engines; superconductivity; and biological detection capabilities just to name a few. Developing future military capabilities could be jeopardized by lack of sustained support for defense fundamental research[19].

Similar to funding for the Defense S&T program, the National Academies[20], and Council on Competitiveness[21] have recommended increasing defense fundamental research funding to equal at least 20 percent of the Defense S&T program budget. Alternatively, the DSB encouraged one-third of the Defense S&T budget be dedicated to revolutionary programs such as the defense fundamental research programs[22]. Unfortunately, current defense fundamental research budgets are more than a billion dollars below the lowest of the recommended levels.

FY 2019 Enacted (S&T Budget of $15.959 billion)	**FY 2020 Enacted (S&T Budget of $16.073 billion)**
FY 19 Fundamental Research Enacted: $2.529 billion	FY 20 Fundamental Research Enacted: $2.607 billion
20% Fundamental Goal: $3.639billion	20% Fundamental Research Funding Goal: $3.736 billion
Difference: -$1.109 billion	*Difference: -$1.132 billion*

In addition to enabling the discoveries for future military capabilities, defense fundamental research is vital to the NSIB workforce. In so many technical cases, fundamental research is the only way to solve difficult problems and it often requires an expert community that DoD can tap into when necessary[23]. These expert communities in science and engineering are often sustained by DoD's investment in fundamental research[24]. Through these communities, fundamental research supports training students in fields of critical interest to DoD[25].

[17] Ibid
[18] https://apps.dtic.mil/dtic/tr/fulltext/u2/a554738.pdf
[19] https://www.nap.edu/catalog/11463/rising-above-the-gathering-storm-energizing-and-employing-america-for
[20] https://www.nap.edu/catalog/11463/rising-above-the-gathering-storm-energizing-and-employing-america-for
[21] https://www.compete.org/reports/all/202
[22] http://www.dtic.mil/dtic/tr/fulltext/u2/a433761.pdf
[23] https://apps.dtic.mil/dtic/tr/fulltext/u2/a554738.pdf
[24] Ibid
[25] Ibid

We urge the Biden Administration to put forth budgets that request at least 20 percent of the Defense S&T program budget be dedicated to the defense fundamental research programs, which will make the necessary discoveries for the U.S. military to maintain its global and technological superiority.

Priority 3: Investments in Transformational Fundamental Research Programs

While overall funding for defense fundamental research has kept up with inflation, key transformational programs remain dramatically underfunded. For example, the Multidisciplinary University Research Initiative (MURI) regularly sponsors university fundamental research that produces revolutionary new military technologies[26]. MURI fundamental research has enabled new domestic semiconductor manufacturing capabilities, advances in quantum computing and communication, military drones, sensors enabling navigation in GPS compromised environments, counter-steal capabilities, enhanced optical sensing for intelligence, surveillance, and reconnaissance (ISR) mission, biological detection capabilities and explosive detection capabilities[27]. In FY 2020, the MURI program reported receiving 365 proposals but was only able to make 26 awards – leaving 339 potentially revolutionary proposals unfunded[28]. In FY 2019, only 24 MURI awards were made after receiving 295 proposals – leaving 271 potentially game-changing proposals unfunded[29]. Using a simple inflation calculation, the MURI program is currently funded at about the same as level as in 2005. The MURI program has become an essential skunkworks for creating innovation[30] and will be vital to enabling the technological discoveries required to win the great power competition.

Given that colleges and universities perform about 54 percent of DoD-sponsored fundamental research[31], therefore being the primary entities conducting the research to generate new capabilities for the military, it is imperative that academic institutions have the unique equipment needed to conduct cutting edge fundamental research of importance to DoD. The Defense University Research Instrumentation Program (DURIP) does just that by funding through a competitive process the purchase of equipment and infrastructure necessary for high-quality, DoD-relevant scientific research. However, DURIP remains dramatically underfunded. In FY 2020, the program received 724 proposals requesting nearly $295 million but was only able to make 172 awards totaling just $49 million – a significant under-utilization of innovation and creativity aligned to defense needs[32]. Similar to the MURI program, DURIP funding is not keeping up with inflation. Simply put, DoD innovation will dramatically suffer if U.S. colleges and universities cannot perform the game-changing R&D necessary to excel in the era of great power competition.

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[26] https://www.ida.org/idamedia/Corporate/Files/Publications/IDA.../STD/D-5361.pdf
[27] Ibid
[28] https://www.defense.gov/Newsroom/Releases/Release/Article/2099273/fiscal-year-2020-university-research-funding-awards/source/GovDelivery/
[29] https://www.defense.gov/Newsroom/Releases/Release/Article/1804268/dod-announces-fiscal-year-2019-university-research-funding-awar%C3%A2%E2%82%AC%C2%A6/
[30] https://www.ida.org/idamedia/Corporate/Files/Publications/IDA.../STD/D-5361.pdf
[31] https://ncsesdata.nsf.gov/fedfunds/2018/html/ffs18-dt-tab009.html
[32] https://www.defense.gov/Newsroom/Releases/Release/Article/2021937/dod-awards-489-million-to-universities-for-major-research-equipment/source/%E2%80%A6/

Furthermore, with many of the national security challenges we face being social or have social elements to them, we want to highlight the importance of the Minerva Research Initiative (Minerva). Acting as DoD's signature social science basic research program, Minerva funds university-led teams to address problems of strategic importance. Minerva's priorities are already aligned to address great power competition. Recently funded projects include "Russian Disinformation and Propaganda Campaigns" and "Empirical Analysis for Meeting Great Power Challenges" have given DoD unique insights that help shape future national security policies and better position the warfighter in a complex global environment. The National Academies concluded that Minerva-sponsored research has made important contributions to national security policymaking and strengthened the connections between the DoD and social science research community[33]. The improved connections and dialog enabled by Minerva with DoD officials and social science researchers cannot be underestimated in its importance given DoD's reliance on its NSIB partners. Unfortunately, in FY 2018, Minerva only had sufficient resources to fund 12 projects despite receiving approximately 175 applications[34]. By only funding 7 percent of applications, we are potentially missing out on new social science ideas that will enable us to maintain U.S. superiority during the great power era and more astutely predict and deter the precursors of conflict.

We urge the Biden Administration to put forth budgets that request dramatically more resources for the MURI, DURIP and Minerva including addressing the dramatic underfunding and keeping pace with inflation in the future years.

Priority 4: National Security Scientific Workforce

DoD employs more than 100,000 scientists and engineers to support the United States' national defense[35]. More than 40 percent of those scientists and engineers work in one of the Department's Laboratories, Warfare Centers and Engineering Centers[36]. It is vitally important to DoD's future that a vibrant scientific workforce is not only available to fill positions directly at DoD but also having a robust community of scientists outside of DoD that can support the Department's mission. As noted by CNAS, the "secret sauce of the U.S. military and the DoD more broadly has long been its people[37]."

In addition to the defense fundamental research programs that fund graduate students and research assistants who are future researchers, DoD administers several programs to help cultivate and grow its future scientific workforce. With competitor nations such as China investing heavily in talent recruitment/development, now more than ever we need to increase our investments in research and education efforts that will support a twenty-first century national security innovation base with a state-of-the-art ready workforce.

We urge the Biden Administration to put forth budgets that request significantly more resources for the following programs that support and strengthen the national security

[33] https://sites.nationalacademies.org/DBASSE/BBCSS/Assessing-the-Minerva-Research-Initiative/index.htm
[34] https://www.defense.gov/Newsroom/Releases/Release/Article/1787646/dod-announces-fy2018-minerva-research-initiative-awards/
[35] https://dsb.cto.mil/reports/2010s/Defense_Research_Enterprise_Assessment.pdf
[36] Ibid
[37] https://www.cnas.org/publications/commentary/sharpening-the-u-s-militarys-edge-critical-steps-for-the-next-administration

scientific workforce across the entire research and technology enterprise triad –laboratories, universities and industry.

- National Defense Science and Engineering (NDSEG) Fellowship: supports those pursuing a doctoral degree in one of 15 supported STEM disciplines of interest to DoD.

- Young Investigator Programs (YIPs): each Service and DARPA award funds to academics who recently completed their PhDs with the goal of seeding those faculty to work with DoD for the rest of their careers.

- Science, Mathematics and Research for Transformation (SMART) Scholarship: supports undergraduate and graduate students pursuing technical degrees in STEM disciplines in exchange for serving in a DoD facility for a period of time.

- Vannevar Bush Faculty Fellowships: prestigious single-investigator award for research that has the potential for transformative impact. Fellows serve as experts to DoD officials.

- Laboratory University Collaboration Initiative (LUCI): supports collaborations between DoD lab scientists and DoD-funded academics with the goal of introducing academics to the DoD research environment.

- Manufacturing Engineering Education Program (MEEP): supports better positioning the current and next-generation manufacturing workforce to produce military systems and components that assure technological superiority for DoD.

- Defense Enterprise Science Initiative (DESI): supports university-industry collaboration on accelerating the impact of basic research on defense capabilities.

Priority 5: Reaffirm National Security Decision Directive 189 (NSDD-189)

In 1985 President Ronald Reagan issued National Security Decision Directive 189 (NSDD-189) to establish "a national policy for controlling the flow of science, technology, and engineering information produced in federally funded research at colleges, universities, and laboratories[38]." This directive has been reaffirmed by Secretary of State Condoleezza Rice in 2001[39] and Undersecretary of Defense Ashton Carter in 2010, who wrote that "NSDD 189 makes clear that the products of fundamental research are to remain unrestricted to the maximum extent possible. When control is necessary for national security reasons, classification is the only appropriate mechanism[40]." Furthermore, in a 2019 report to the National Science Foundation on *Fundamental Research Security*[41] JASON concluded that the "framework set forth in NSDD-189 continues to be relevant" and that "continued adherence to NSDD-189 as a framework for control of information" is important for securing the U.S. fundamental research enterprise.

[38] https://fas.org/irp/offdocs/nsdd/nsdd-189.htm
[39] https://fas.org/sgp/bush/cr110101.html
[40] https://fas.org/irp/doddir/dod/research.pdf
[41] https://www.nsf.gov/news/special_reports/jasonsecurity/JSR-19-2IFundamentalResearchSecurity_12062019FINAL.pdf

Research universities and professional societies share the federal government's interest in ensuring intellectual property, proprietary information, sensitive data, and other classified and/or otherwise controlled government information developed or housed by universities is not vulnerable to exfiltration or espionage. We urge the Biden Administration to restore proper balance between the need for securing federally funded research and the need to make new scientific knowledge publicly accessible to ensure continued scientific progress. NSDD-189 has enabled the government to strongly protect a narrow set of key technologies when imposing information security controls, while still ensuring the widespread, public, and open dissemination of research results. This clear policy avoids ambiguous measures that make it difficult for U.S. universities to comply with federal security controls.

We urge the Biden Administration to reaffirm NSDD-189, which makes clear that fundamental research should remain unrestricted to the fullest extent possible.