



# AMERICAN FOREIGN POLICY COUNCIL DEFENSE TECHNOLOGY PROGRAM BRIEF

## *U.S. Space Budget Report*

*By: Anthony Imperato, Peter Garretson, Richard M. Harrison*

### BRIEFING HIGHLIGHTS

Civil and military space investments significantly benefit the U.S. economy and national security. Yet, DoD space, NASA space, and overall federal space funding are insufficient for the U.S. to compete in the new space age.

### FINDINGS

1. DoD space funding is below pre-sequestration and Cold War era levels even with the establishment of the Space Force.
2. Space Force S&T lags other services and Department of the Air Force S&T funding does not prioritize resources for space.
3. DoD lacks dedicated space basic research programs.
4. Improvements in accounting for DoD space S&T are necessary for congressional oversight.
5. U.S. total space funding remains below Cold War era and pre-sequestration levels.
6. NASA space funding post-sequestration has stayed flat even with Artemis and remains below Cold War era levels.

### RECOMMENDATIONS

1. Congress should fund DoD and civil space at commensurate levels to past periods of great power competition. An adequate DoD space budget would be around 1% of the total federal budget, which would have been \$48.3 billion in FY 2021.
2. DoD and Congress should devote at least 3.4% of the Space Force budget and overall DoD space budget to S&T.
3. Congress should establish dedicated DoD space basic research.
4. Congress should require proper and consolidated accounting for DoD space S&T.
5. Congress should task a formal national intelligence estimate of PRC space spending.

America is not funding space at a level commensurate with its promise or importance. Although the initiatives of a separate Space Force and NASA's Artemis program give the illusion of a healthy space budget, in reality both military and overall space spending are significantly below pre-sequestration and Cold War era levels. This report summarizes the current state of federal spending on space, providing findings and recommendations to Congress.

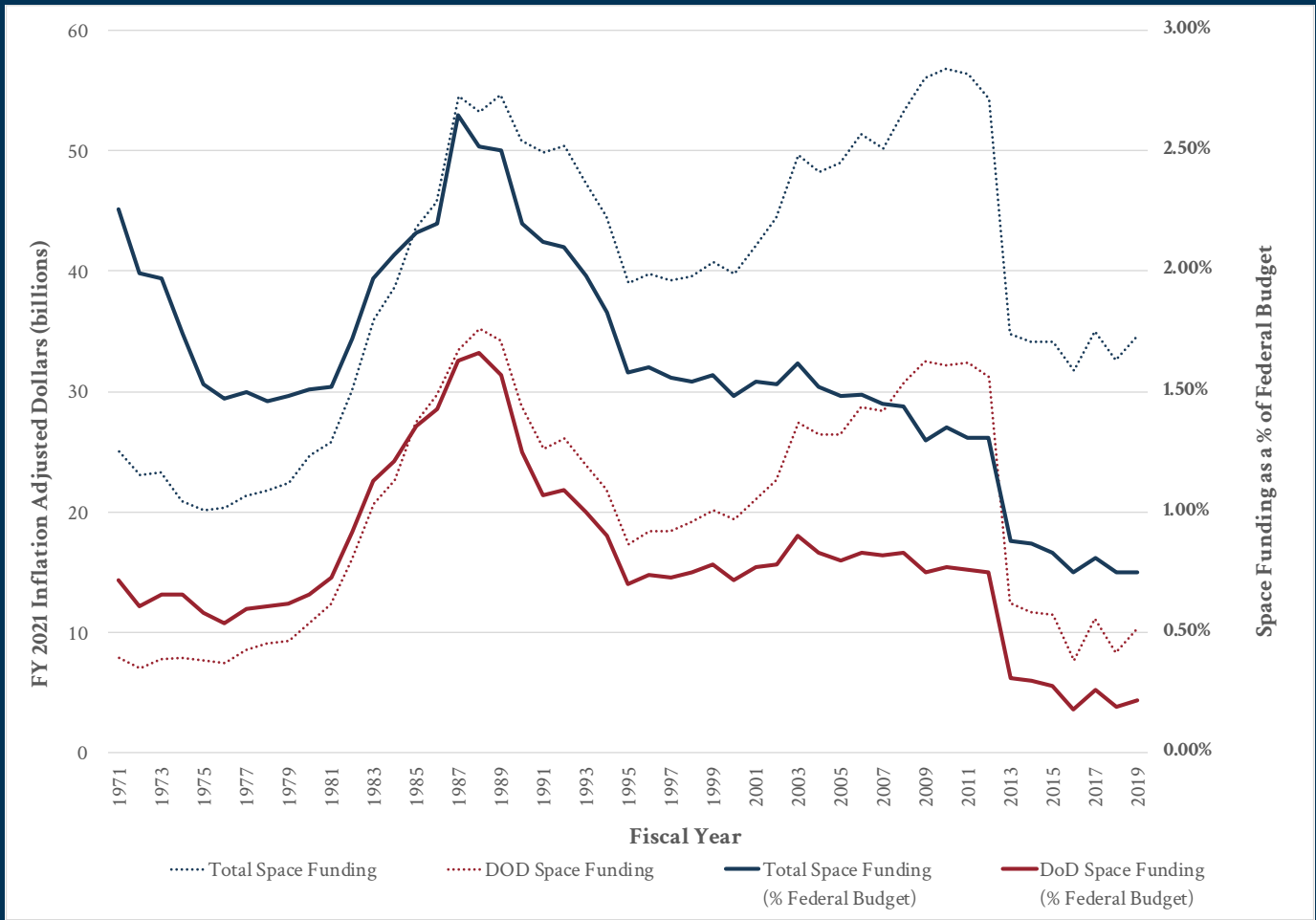
Spending on space by the Department of Defense (DoD), NASA, and the overall federal government is woefully insufficient for the U.S. to compete in the new space age. DoD space and overall federal space funding have not recovered from sequestration, and continue to fall below Cold War-era levels as a percentage of GDP and the federal budget. As a percentage of GDP and the federal budget, NASA's space funding also remains below Cold War-era levels and has stayed flat, post-sequestration. DoD space research, development, test, and evaluation (RDT&E) and science and technology (S&T) funding also continue to lag, something which is particularly problematic given that competition in space is largely driven by technological innovation. S&T funding as a percentage of the Space Force budget also remains well below that of the other services. In FY 2021, only 0.9% of the Space Force budget was allocated for S&T, significantly less than the 3.4% benchmark recommended for DoD by former Defense Innovation Board Chairman and Google CEO (and current Chair of the National Security Commission on Artificial Intelligence) Eric Schmidt.<sup>1</sup> As the Biden administration unveils its FY 2022 budget and Congress develops the FY 2022 National Defense Authorization Act (NDAA) and annual appropriations package, they must ensure that military and civil space programs are adequately funded.

The figures listed in this report are necessarily part of the unclassified budget. The classified budget ("black budget") specific to space cannot be known with precision. In the FY 2021 budget, the Department of the Air Force received \$38.2 billion in pass-through funding, which is utilized by other agencies and not controlled or managed by the Air Force ("blue budget" is the funding managed and controlled by the Air Force).<sup>2</sup> The pass-through funding is reportedly primarily used to fund classified space systems.<sup>3</sup> The FY 2021 intelligence community budget, meanwhile, totaled \$85 billion: \$61.9 billion for the National Intelli-

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**FIGURE 1: U.S. SPACE FUNDING OVERVIEW<sup>5</sup>**



gence Program and \$23.1 billion for the Military Intelligence Program.<sup>4</sup> While some significant portion of the intelligence budget is allocated for space systems and research, it is not possible to report the exact amount. Therefore, this document focuses on the unclassified budgets, which can accurately be compared over time.

*Space in the Context of American Vitality*

The space domain is vital to America’s national security and economic prosperity. In the national security arena, space-based assets enable a range of critical capabilities including intelligence, surveillance, and reconnaissance (ISR), positioning, navigation, and timing (PNT), command and control, military communications, missile launch and nuclear detonation detection, among others.<sup>6</sup> Economically, the financial system, telecommunications, transportation, aviation, agriculture, healthcare, and a number of other sectors all depend on space assets.<sup>7</sup> The emerging space economy also presents many opportunities for America. The space economy, which was

estimated to be around \$385 billion in 2020, is projected to surpass \$1 trillion in the coming decades, and will include a host of revolutionary developments such as space tourism, Lunar and asteroid mining, in-space manufacturing, and space-based solar power.<sup>8</sup>

*Space Investments Benefit the U.S. Economy and National Security*

Both civil and military space investments benefit the U.S. economy and national security. In FY 2019, NASA activities in the U.S generated \$64.3 billion in economic output.<sup>9</sup> Given that NASA’s total budget authority was \$21.5 billion in FY 2019, this means that the agency produced a return on investment of around 200%.<sup>10</sup> The scientific research and development sector accounted for 22%, or \$14.2 billion of NASA’s generated economic output.<sup>11</sup> NASA activities also supported 312,630 jobs in the U.S. in FY 2019, 48,912 of which (16%) were in the scientific research and development sector.<sup>12</sup> In addition, NASA’s research and development often leads

*“Each year, GPS generates \$70 billion for the U.S. economy (nearly five-fold the cost of the entire FY 2021 \$15.4B Space Force budget)”*

to the creation of new technologies that can be used on Earth. Over the last forty-plus years, NASA has documented over 2,000 spinoff technologies that have been developed by the agency or with its assistance.<sup>13</sup> These spinoff technologies include memory foam, digital image sensors, nanofiber water filters, invisible braces and advanced cardiac pumps, among many others.<sup>14</sup> Military space investments also immensely benefit the U.S. economy. The Global Positioning System (GPS), which is operated by the Space Force, has generated \$1.4 trillion for the U.S. economy since becoming publicly available in the 1980s.<sup>15</sup> Each year, GPS generates \$70 billion for the U.S. economy (nearly five-fold the cost of the entire FY 2021 \$15.4B Space Force budget).<sup>16</sup> GPS-guided navigation has also facilitated a 15% to 21% reduction in fuel expenditures, which has assisted the U.S. in meeting its emission reduction commitments.<sup>17</sup> As previously noted, space technology also enables a range of capabilities critical to U.S. military power.<sup>18</sup> The bottom line is that space should not be seen as a bill to pay, but rather as an investment with tangible returns many times the investment.

### *Space in the Context of Adversarial Competition*

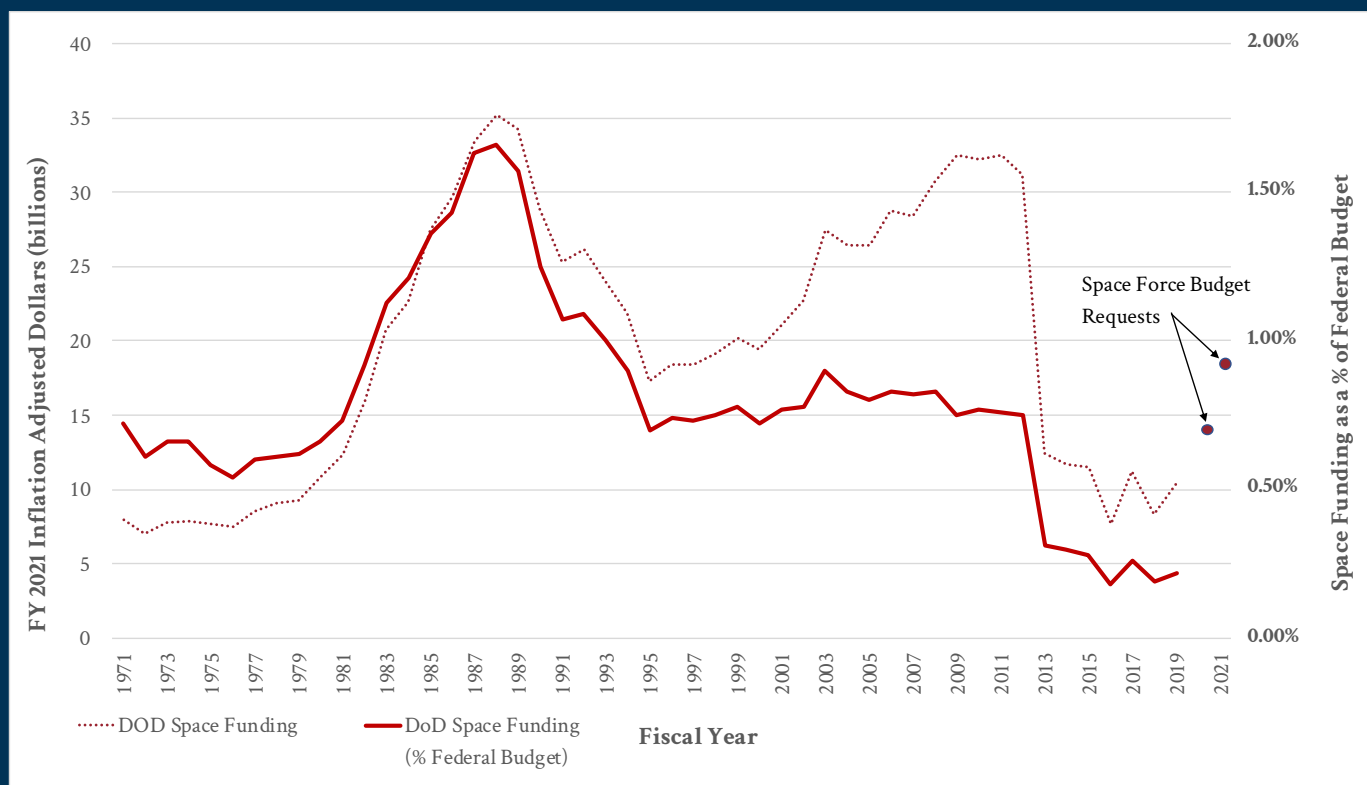
While the U.S. has long been considered the global leader in space, the space domain is becoming increasingly contested. Adversaries such as China have developed counterspace weapons that threaten U.S. space assets.<sup>19</sup> China also aims to supplant the U.S. as the leading space power by 2045, establish an Earth-Moon space economic zone by 2050 that could generate \$10 trillion annually, and has made significant strides in civil space exploration.<sup>20</sup> China’s overall space expenditures trail only the U.S. It is estimated that China’s annual space expenditures total between \$8 billion and

\$11 billion.<sup>21</sup> However, China’s space budget figures can be misleading, and are likely much higher. Although the Chinese government contains civil space entities, the People’s Liberation Army has historically been and continues to be responsible for running the nation’s space program.<sup>22</sup> China’s spending, particularly in the defense realm, is notoriously opaque and lacking in transparency.<sup>23</sup> China’s reported space and defense-related budget figures also do not account for purchasing power parity. In addition, China benefits from lower personnel costs, underreports its defense-related R&D expenditures, is able to more easily leverage private sector innovation through its civil-military fusion strategy, and engages in rampant intellectual property theft to advance its national security and economic interests.<sup>24</sup> Moreover, China’s top defense and aerospace companies, such as China Aerospace Science and Technology Corporation (CASC) and China Aerospace Science and Industry Corporation (CASIC), are state-owned and not reflected in China’s defense and space budgets.<sup>25</sup> These factors make it challenging to accurately assess China’s military and civil space expenditures. In contrast to China, the U.S. lacks a long-term space strategy, and if current funding trends continue, the U.S. will not be able to retain the mantle of the dominant space power.



ZHUHAI, CHINA- NOVEMBER 6, 2018: Mockups of the New Generation Launch Vehicles of Long March Family are on display during the 12th China International Aviation and Aerospace Exhibition

**FIGURE 2: DOD SPACE BUDGET AUTHORITY  
(FYS 1971 – 2019, BUDGET REQUEST FYS 2020 – 2021)<sup>26</sup>**



*Findings*

**Finding 1: DoD space funding is below pre-sequestration and Cold War era levels even with the establishment of the Space Force.**

DoD space funding, calculated in current and inflation-adjusted dollars and as a percentage of GDP and the total federal budget, has not recovered from sequestration. In addition, since 2013, when the Budget Control Act of 2011 (BCA) sequester went into effect, DoD space funding has fallen below 1990s levels—an era in which overall defense spending was reduced and the U.S. in many respects was the uncontested global superpower.<sup>27</sup> Current DoD space funding trails Cold War era levels as well. During the Cold War, annual DoD space funding typically hovered around 0.2% of GDP and 1% of the federal budget. DoD space funding currently remains below those two benchmarks, and would have to increase significantly in order to be commensurate with Cold War-era levels. As an example, the overall federal budget request for FY 2021 was \$4.83 trillion.<sup>28</sup> That would

mean that DoD space funding should roughly translate to approximately \$48.3 billion in order to be in line with Cold War-era levels. However, in FY 2021, DoD requested just \$18.0 billion for space, \$15.4 billion of which was for the Space Force.<sup>29</sup> Sadly, although space is recognized as a key theater of military competition, in FY 2021, the Space Force accounted for approximately 2% of the overall DoD budget (\$705.4 billion).<sup>30</sup>

Accordingly, DoD space RDT&E funding suffered following the implementation of the BCA spending caps, and has only recently begun to recover. Prior to the establishment of the Space Force, the Air Force was the primary military space service. The Air Force’s space entity, Air Force Space Command, was the precursor to the Space Force.<sup>31</sup> In FY 2009, the Air Force budget included \$4.86 billion for space RDT&E.<sup>32</sup> By FY 2015, the Air Force budget included just \$900 million for space RDT&E.<sup>33</sup> Finally, in FY 2018, the Air Force budget included \$4.4 billion for space RDT&E, representing the beginning of a return to pre-sequestration levels.<sup>34</sup> The Space Force was established by the 2020 NDAA, and received its own separate budget for the first time in FY 2021.<sup>35</sup> In FY 2021, the Space Force budget included \$10.3 billion for

RDT&E; however, differences in accounting give an illusion of a more substantial increase than was the case as programs were simply moved from Air Force Space Command to the U.S. Space Force.<sup>36</sup>

In the 2016 NDAA, Congress established Major Force Program 12: National Security Space (MFP-12), in part to better account for and track space funding across the military services and DoD entities.<sup>37</sup> The FY 2021 DoD budget included \$7.2 billion for MFP-12 RDT&E.<sup>38</sup>

development programs. Additionally, although space is acknowledged as a key area of technology competition, in FY 2021, Space Force S&T accounted for just 0.9% of the overall DoD S&T budget (\$14.1 billion), and just 0.02% of the total DoD budget.<sup>50</sup>

The FY 2021 Department of the Air Force “blue budget,” which is composed of both the Air Force and Space Force budgets and excludes pass-through funding for other agencies, was \$169.0 billion (Air Force - \$153.6 billion and Space Force - \$15.4 billion).<sup>51,52</sup> The Air Force’s S&T budget was \$2.7 billion, which amounts to 1.6% of the total Department of the Air Force “blue budget.” Conversely, as previously noted, the Space Force’s S&T budget was \$130.9 million, which amounts to just 0.1% of the total Department of the Air Force “blue budget.”

**TABLE 1: FY 2021 SPACE FORCE, AIR FORCE, ARMY, & NAVY S&T BUDGETS (\$MILLIONS)**

	Space Force	Air Force	Army	Navy (Including Marine Corps)
<b>Total Budget</b>	15,382 <sup>39</sup>	153,596 <sup>40</sup>	177,996 <sup>41</sup>	207,073 <sup>42</sup>
<b>Basic Research (6.1)</b>	None	492	463	603
<b>Applied Research (6.2)</b>	131	1,410	923	953
<b>Advanced Technology Development (6.3)</b>	None	779	1,204	760
<b>Total S&amp;T</b>	<b>131<sup>43</sup></b>	2,681 <sup>44</sup>	2,590 <sup>45</sup>	2,316 <sup>46</sup>
<b>S&amp;T % of Total Budget</b>	<b>0.9%</b>	1.7%	1.5%	1.1%

*Finding 2: Space Force S&T lags other services and Department of the Air Force S&T funding does not prioritize resources for space.*

As mentioned above, providing solid funding for S&T is critical for development. Unfortunately, Space Force S&T (Basic Research 6.1, Applied Research 6.2, and Advanced Technology Development 6.3) funding as a percentage of its overall budget is the lowest among each of the military branches. In FY 2021, just 0.9% of the Space Force budget was devoted to S&T, compared to 1.7% for the Air Force, 1.5% for the Army, and 1.1% for the Navy (including the Marine Corps). DoD allocated just \$130.9 million for Space Force S&T in the FY 2021 budget.<sup>47</sup> By way of comparison, if the Space Force attempted to match the Air Force S&T budget it should have allocated around \$261.8 million (1.7% of the Space Force Budget - \$15.4 billion). Congress ultimately authorized \$146.9 million for Space Force S&T in the FY 2021 NDAA.<sup>48</sup> Additionally, as opposed to the other services, the Space Force only had one S&T program in its budget: 1206601SF Space Technology, which is an applied research program.<sup>49</sup> The Space Force budget did not contain any basic research or advanced technology

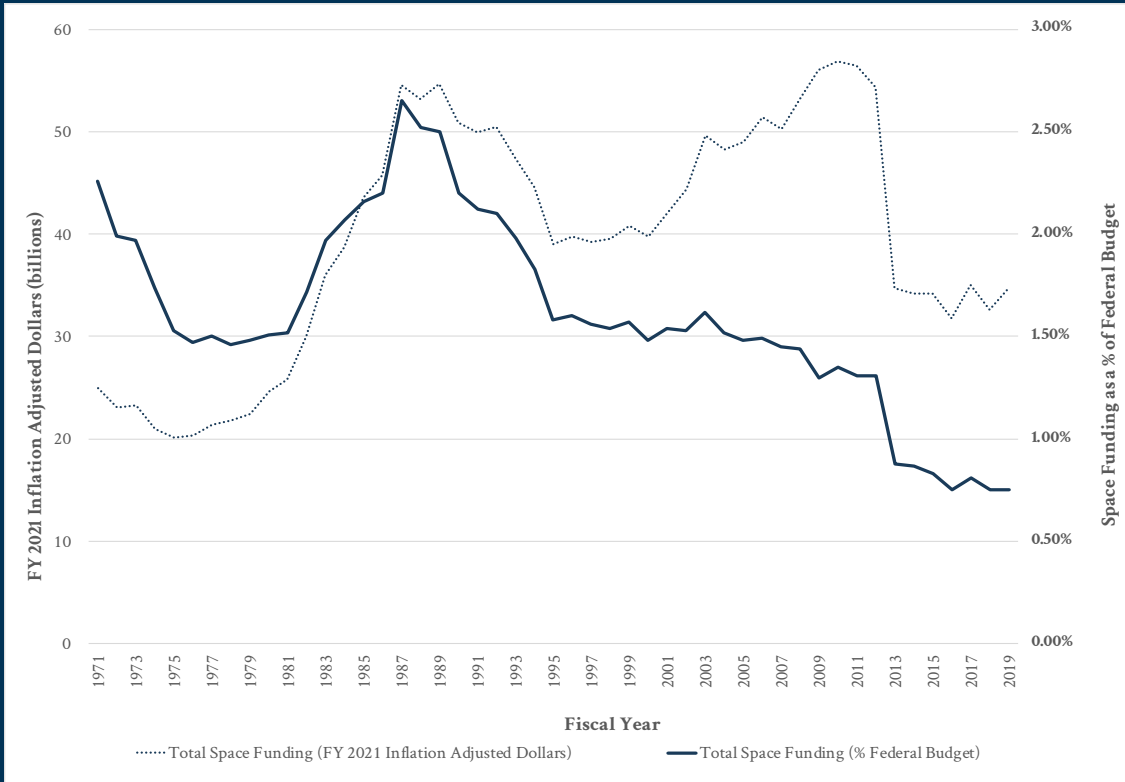
*Finding 3: DoD lacks dedicated space basic research programs.*

DoD does not currently have any dedicated space basic research programs. DoD’s current space S&T programs fall under either applied research or advanced technology development [see Finding 4]. Additionally, in FY 2021, the Space Force was the only military branch without basic research funding in its budget [see Table 1].

*Finding 4: Improvements in accounting for DoD space S&T are necessary for congressional oversight.*

As the U.S. braces for an era of great power competition in space, one that will largely be defined by technological innovation, it will be important for Congress to have the resources to review DoD space S&T programs and spending in order to adjust funding levels accordingly. DoD’s RDT&E budget documents do not include a breakdown of MFP-12 S&T funding. Additionally, there are S&T programs in the DoD budget that are space-related but are not categorized as MFP-12 programs. The FY 2021 DoD budget included only two programs specifically categorized as MFP-12 S&T programs: 1206601SF Space Technology (6.2, Space Force, \$130.9 million FY 2021 Budget, \$146.9 million FY 2021 NDAA) and 1206310SDA Space Science and Technolo-

**FIGURE 3: U.S. TOTAL SPACE BUDGET AUTHORITY (FYS 1971 – 2019)<sup>56</sup>**



gy Research and Development (6.3, Space Development Agency, \$72.4 million FY 2021 Budget & NDAA).<sup>53</sup> DARPA and the Air Force also had space-related S&T programs: 0603287E Space Programs and Technology (6.3, DARPA, \$158.4 million FY 2021 Budget & NDAA), 0603401F Advanced Spacecraft Technology (6.3, Air Force, none FY 2021 Budget, \$57.3 million FY 2021 NDAA), and 0603444F Maui Space Surveillance System (6.3, Air Force, none FY 2021 Budget, \$12.1 million FY 2021 NDAA).<sup>54</sup> However, these programs were categorized as MFP-06 Research and Development programs, not MFP-12 programs.<sup>55</sup> Both of these factors make it difficult to track and account for DoD space S&T funding, and to conduct congressional oversight of it.

**Finding 5: U.S. total space funding remains below Cold War era and pre-sequestration levels.**

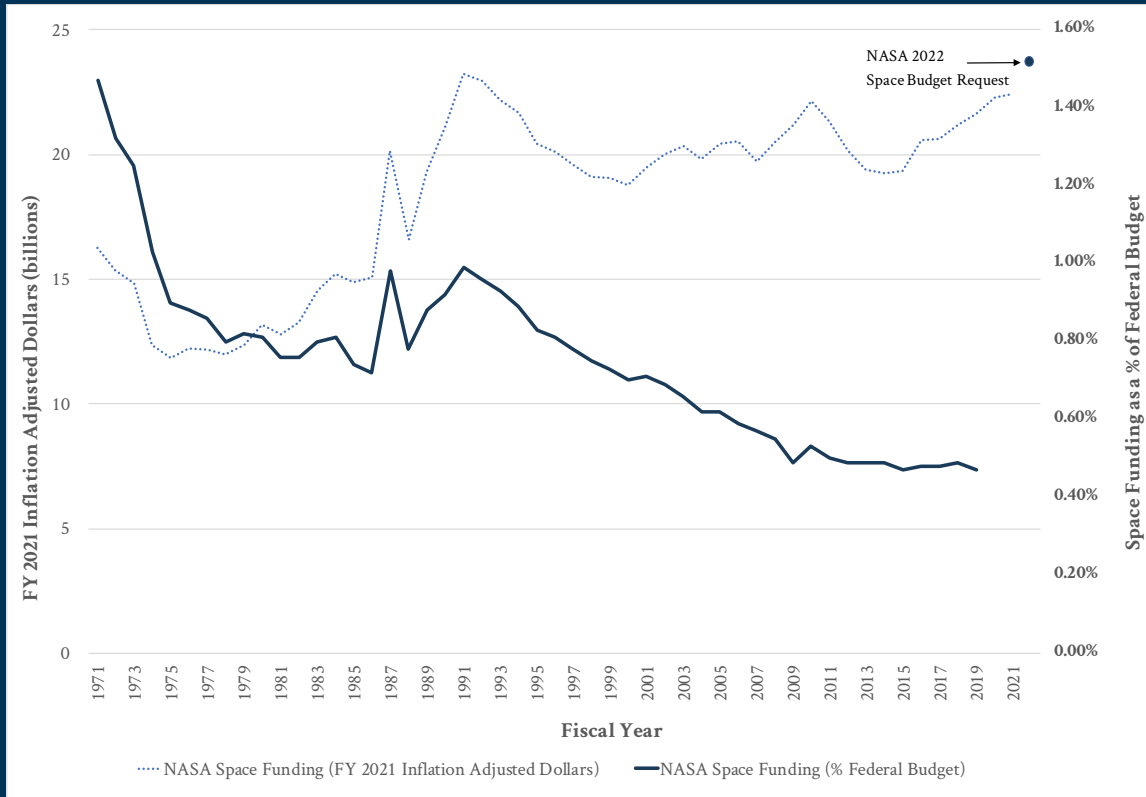
U.S. overall space funding as a percentage of GDP and the federal budget remains below Cold War-era levels. During the Cold War, annual total space spend-

ing typically hovered around 2% of the federal budget and between 0.3% and 0.55% of GDP, with outlier years in the mid- to late-1960s at the height of the Space Race. As evidenced by the precipitous decline demonstrated in Figure 3, in FY 2019, overall space funding amounted to just 0.75% of the federal budget (0.16% of GDP). In FY 2021, total space funding would have needed to be \$96.6 billion in order to meet the 2% Cold War-era benchmark. Furthermore, annual overall space funding, in current and inflation adjusted dollars and as a percentage of GDP and the federal budget, remains below pre-sequestration levels.

**Finding 6: NASA space funding post-sequestration has stayed flat even with Artemis and remains below Cold War-era levels.**

In addition to contributing to science and technology, NASA also contributes to U.S. national security in this era by promoting norms, strengthening alliances, scouting for resources, securing presence, and conducting public diplomacy to portray the U.S. as a capable

**FIGURE 4: NASA SPACE BUDGET AUTHORITY (FYS 1971 – 2021, FY 2022 REQUEST)<sup>57</sup>**



and inspirational leader and partner. Unfortunately, as a percentage of GDP and the federal budget, NASA space funding (NASA overall budget minus aeronautics) post-sequestration has essentially remained flat, even with the launch of the Artemis program in 2017.<sup>58</sup> In recent years, NASA’s space budget has hovered around 0.10% of GDP and between 0.47% and 0.49% of the total federal budget. In FY 2020 and FY 2021, NASA received \$21.8 billion and \$22.4 billion in space funding respectively.<sup>59</sup> President Biden’s FY 2022 discretionary budget request includes \$23.8 billion for NASA space.<sup>60</sup> In addition, NASA space funding remains below Cold War era levels as a percentage of GDP and the federal budget. For most of the Cold War, NASA space funding tended to hover around 0.2% of GDP and 1% of the federal budget. In FY 2021, NASA space funding would have needed to be \$48.3 billion to meet the 1% Cold War era benchmark.

*Recommendations*

**Recommendation 1:** Congress should fund DoD and civil space at commensurate levels to past periods of great power competition.

The U.S. should aim for both DoD space and NASA space funding to separately account for 1% of the federal budget, and for overall space funding to account for 2% of the federal budget. These benchmarks would be in line with Cold War era space funding levels. In the FY 2021 budget, total space would have needed to be \$96.6 billion, and DoD and NASA space would each have needed to be \$48.3 billion to meet these Cold War era benchmarks. In order for the U.S. to compete in this new era of great power competition and retain its position as the dominant space power, Congress must ensure adequate funding for military and civil space programs.

**Recommendation 2:** DoD and Congress should devote at least 3.4% of the Space Force budget and overall DoD space budget to S&T.

Competition in the space domain is primarily driven by technological innovation, and in order for the U.S. to protect and advance its national security and economic interests in space, more funding must be provided for Space Force and DoD space S&T. In FY

2021, just 0.9% (\$130.9 million) of the Space Force budget was devoted to S&T [see Table 1]. Devoting at least 3.4% of the Space Force budget to S&T would be in line with the recommendation of Eric Schmidt. In his testimony before the Senate Armed Services Committee in February, Schmidt stated that S&T funding should account for at least 3.4% of the defense budget, “with a focus on emerging and disruptive technologies.”<sup>61</sup> In its FY 2021 budget, the Space Force should have allocated \$523.6 million for S&T to meet this benchmark. Additionally, 3.4% of the overall DoD space budget should also be devoted to S&T. Based upon the assumption that 1% of the federal budget is a reasonable allocation for military space spending (~\$48.3B in FY2021), and 3.4% is a reasonable investment of that budget in S&T, a minimum viable level of DoD space S&T investment should be \$1.6B, which would still trail all other services by nearly a billion dollars.

*“If 1% of the federal budget is a reasonable allocation for military space spending (~\$48.3B in FY2021), and 3.4% is a reasonable investment of that budget in S&T, a minimum viable level of DoD space S&T investment should be \$1.6B, which would still trail all other services by nearly a billion dollars.”*

***Recommendation 3: Congress should establish dedicated DoD space basic research.***

DoD currently does not have any space basic research programs. Congress should direct DoD to establish space basic research programs to encourage technological innovation in the space domain, increase understanding of the scientific and technological possibilities of space, ensure that it leads in the discovery of advanced space concepts and technologies, and help cultivate an S&T workforce for the new space age. This portfolio should include all elements necessary for in-space logistics and industrial advantage, including advanced power and propulsion, in-situ research utilization, in-space manufacturing, on-orbit servicing and refueling, and power beaming.

***Recommendation 4: Congress should require proper and consolidated accounting for DoD space S&T.***

In order to better track and account for DoD space S&T programs and funding, Congress should require

the Department to include funding levels for MFP-12 basic research, applied research, and advanced technology development in its annual budget request. Congress should also require DoD to provide a list of all space-related S&T programs that are not categorized as MFP-12 programs and their respective funding levels. Additionally, Congress should direct DoD to develop clear guidelines for the categorization of MFP-12 S&T programs. Congress would also benefit from an accounting of the amount of the black budget spent on classified space programs. Additionally, because significant innovation is also taking place through prototype and demonstration funding (6.4 & 6.5) and other transaction authority (OTA) vehicles such as via the Defense Innovation Unit (DIU), Congress would similarly benefit from a consolidated list of space prototype, demonstration, contest and innovation funding in order to capture the aggregate contributions of the Air Force Rapid Capabilities Office (AFRCO), Space Rapid Capabilities Office (SpRCO), Space Systems Command Development Corps (SSC/DCI), Space Development Agency (SDA), and the Defense Innovation Unit (DIU).

***Recommendation 5: Congress should task a formal national intelligence estimate of PRC space spending.***

For the U.S. to assess its relative position in the unfolding competition with China in space, it requires a more accurate understanding of the PRC space budget. The intelligence community should be tasked with providing an estimate of total PRC space and military space spending, its space technology investment and R&D spending, and defense and aerospace state-owned enterprise spending, and thereafter apply adjustments for purchasing power parity and personnel costs to annually provide a useful figure for comparison.



### Conclusion

The U.S. is currently ill-prepared to compete in the new space age. In addition to lacking a long-term space strategy, the U.S. has allowed overall space funding, as well as allocations at DoD and NASA, to languish. DoD space and overall space funding continue to fall below Cold War-era levels, and have not recovered from sequestration. NASA space funding also remains below Cold War-era levels and has stayed flat post-sequestration. Investments in DoD space RDT&E and S&T remain insufficient as well. While the U.S. has long been the world's dominant space power, it is increasingly being challenged in this domain by China. China aims to supplant the U.S. as the leading space power by 2045, and to this end has developed counterspace weapons that threaten U.S. space assets, and has bolstered its civil space capabilities. Going forward, the U.S. must prioritize space in order to retain its leadership position in the space domain, safeguard its national security interests, and benefit from the revolutionary possibilities of the emerging space economy.

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## ENDNOTES

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# DEFENSE TECHNOLOGY PROGRAM BRIEF

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