

RENEWING NASA: THE ARTEMIS CASE FOR CELESTIAL COMPETITION, WITH REVISIONS

by
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ABSTRACT

The role and scope of the National Aeronautics and Space Administration (NASA) has fluctuated throughout a number of mission-based cycles since the heightened publicity of the Apollo era. But throughout this history, NASA's joint roles as the United States' civilian research bastion on spaceflight and innovative public relations mission for American science leadership has remained unchanged. Surrounding this culture in the modern era is a new and continually-emerging commercial space sector, one which has made for the increased efficient use of often-waning federal dollars while enabling a swift timeline of revolutionary space travel. Enter the Artemis missions, originally developed as a NASA program to give use to the Space Launch System (SLS) rocket—the most powerful rocket ever built—and planned with the effort to return America's next man and first woman to the moon as a next-step program for travel to deep space. While the original goal for this human lunar landing was 2028, the Trump administration in 2019 announced a call to accelerate this timeline to a 2024 landing, releasing the updated strategy (the "Artemis Plan"), however uncertain, a year later. This memorandum outlines the importance of NASA and its space-bound missions to both our national economy and global image and proposes a revised Artemis timeline (returning to the moon in 2028) that seeks to minimize the likelihood of a very public failure in the unmet 2024 goal—while understanding the careful political opportunities presented by what may be the final "giant leap" aboard a NASA-made rocket.

Advised by Paul Weinstein.

“There is still in truth upon these great level plains a people, a community bound together by imaginative possessions, by stories and poems which have grown out of its own life, and by a past of great passions which can still waken the heart to imaginative action.”

– WB Yeats
Ideas of Good and Evil

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TO: President Joseph R. Biden, Jr.

FROM: Thomas I. Deaton

DATE: 31 MAR 2021

SUBJECT: The Artemis Case for Celestial Competition, With Revisions

I. ACTION-FORCING EVENT

In September 2020, the National Aeronautics and Space Administration (NASA) issued the “Artemis Plan,” a 74-page report outlining the forthcoming Artemis missions that intend to return humankind to the lunar surface (including the first woman to do so) by 2024, a fast-tracked timeline from the original 2028 goal.¹

II. STATEMENT OF THE PROBLEM

At an increasing pace over the last two decades, the United States has found itself in a new space race with the quickly-developing Chinese space program, among others, creating competitive threats to both American innovation and national security. However, federal funding for NASA-led research and development, though bipartisan, maintains mostly business-as-usual spending, unable to react to the capital required of the vastly accelerated efforts by the previous administration to reach the Moon by 2024. Despite the necessity for NASA to transition to new missions in the face of an aging International Space Station (ISS), even the “Artemis Plan” notes that the new, hastened timeline for the mission remains “significantly dependent on new technology

¹ “Artemis Plan: NASA’s Lunar Exploration Program Overview,” *National Aeronautics and Space Administration*, September, 2020, <https://www.cbo.gov/system/files/2019-10/55699-CBO-MBR.pdf>.

maturity,” which, even with increased commercialization, is not guaranteed.² NASA needs Artemis, but this new timeline jeopardizes its ability to fulfill its roles as flagship research agency and civilian feeder of America’s next-gen military capabilities.

Though the US developed a Moon-bound space program nearly 40 years prior to China’s first orbital launch, one can assume, as Dr. Matthew Daniels presents in a report on the subject for the Johns Hopkins Applied Physics Laboratory, that human spaceflight will maintain a certain modern “political significance” to the two nations.³ In their own way, it is suggested that space capabilities will mimic the Cold War by reprising a role as “a measure of each side’s broader military and technological capabilities”⁴ and could potentially reemerge as a domestic indicator of success in the political arena (vis-à-vis Kennedy’s ‘missile gap’ of the early 1960s).

The United States’ own U.S.-China Economic and Security Review Commission has highlighted China’s ability to pool both public support and funding to achieve “space power in all respects,” a combination which has enabled and will continue to enable China to “achieve future milestones in areas where it is lagging behind international standards on shorter timetables than when the United States accomplished similar missions.”⁵ And much like the US, China is exploring commercial spaceflight as a method to “boost efficiency,” but with a caveat: while Chinese space companies may

² “Artemis Plan: NASA’s Lunar Exploration Program Overview.”

³ Matthew Daniels, “The History and Future of US-China Competition and Cooperation in Space,” *The Johns Hopkins University Applied Physics Laboratory LLC*, 2020, <https://www.jhuapl.edu/Content/documents/Daniels-Space.pdf>.

⁴ Daniels.

⁵ Alexander Bowe, “China’s Pursuit of Space Power Status and Implications for the United States,” *U.S.-China Economic and Security Review Commission*, April 11, 2019, https://www.uscc.gov/sites/default/files/Research/USCC_China%27s%20Space%20Power%20Goals.pdf.

rely on private capital, they “enjoy close ties to the government” unlike the US, thus heightening their market power.⁶ By attempting to build a space program from unmanned spacecraft to independent space station to lunar lander in the span of just three decades (it is anticipated that the real tie-breaking milestone will be a Chinese-crewed lunar landing scheduled for 2036⁷), China has the potential to access, research, and discover more about our celestial neighbors—and beyond—than the US may have done in its entire space history.

This contrast comes even as the ISS, the American-led, internationally-cooperative orbital research bastion, faces an imminent retirement. The ISS, which has been in some form of low Earth orbit—albeit with renovations—since 1998, will need reexamining for its continued use past the end of the current decade.⁸ With no immediate successor in the works (be it commercial or otherwise), NASA may find itself “with no place for its astronauts to go,”⁹ a moment of grave pause to American low-gravity research and one which would likely result in layoffs akin to the nearly 9,000 jobs lost at the closure of the space shuttle program.¹⁰ Ending the shuttle program without an immediate stand-in created a one-sided reliance on Russian “Soyuz” rockets, our only transport to the ISS for nearly a decade until the first manned SpaceX “Dragon” launch

⁶ R. Lincoln Hines, “Is China catching up to the United States in space?,” *The Washington Post*, April 24, 2019, <https://www.washingtonpost.com/politics/2019/04/24/is-china-catching-up-united-states-space/>.

⁷ “Competing in Space,” *National Air and Space Intelligence Center*, December 2018, <https://media.defense.gov/2019/Jan/16/2002080386/-1/-1/1/190115-F-NV711-0002.PDF>.

⁸ Christian Davenport, “The International Space Station can’t stay up there forever. Will privately run, commercial replacements be ready in time?,” *The Washington Post*, December 23, 2020, <https://www.washingtonpost.com/technology/2020/12/23/space-station-replace-biden/>.

⁹ Davenport, “The International Space Station can’t stay up there forever. Will privately run, commercial replacements be ready in time?”.

¹⁰ John Couwels, “Shuttle layoffs leave some workers adrift,” *CNN*, October 1, 2010, <http://www.cnn.com/2010/US/10/01/nasa.worker.layoffs/index.html>.

in May of 2020 from Cape Canaveral, tying direct commercial interests to manned spaceflight for the first time.¹¹ Recognizing this, Artemis will be an important next step in maintaining NASA's zero-gravity real estate.

Should the ISS go offline without an American-partnered replacement or subsequent mission, we may again find ourselves forfeiting a realm of research to an anticipated Chinese-led substitute, one in which the US would be barred, under the "Wolf Amendment" to the NASA authorization bill, from participating.¹² This amendment, which was first introduced in 2011, prevents any NASA-appropriated funds from being spent on cooperative programs with China without "specific exception" from the FBI, principally in an effort to prevent theft of intellectual property or otherwise sensitive information.¹³

Under this consideration, our space-bound initiatives are likely to remain in competition, rather than cooperation, with China, a power structure which will inevitably rely more heavily on federal spending and on investments in American-led innovation. But even though American space programming entertains record-high public support 50 years on from the first Moon landing (64% of a Gallup poll's respondents indicated "the U.S. space program's costs are justifiable" in 2019),¹⁴ the December 2020 omnibus bill maintained "status quo" NASA spending, withholding a

¹¹ Geoff Brumfiel, "NASA And SpaceX Launch 1st Astronauts To Orbit From U.S. Since 2011," *NPR*, May 30, 2020, <https://www.npr.org/2020/05/30/864514995/spacex-and-nasa-try-once-more-to-launch-astronauts>.

¹² Jacqueline Feldscher, "Biden space advisers urge cooperation with China," *Politico*, December 20, 2020, <https://www.politico.com/news/2020/12/20/biden-china-space-448529>.

¹³ Feldscher.

¹⁴ Justin McCarthy, "50 Years After Moon Landing, Support for Space Program High," *Gallup*, July 11, 2019, <https://news.gallup.com/poll/260309/years-moon-landing-support-space-program-high.aspx>.

significant request by the previous administration for funding the human landing system included in the Artemis plans.¹⁵ The lander’s \$3.1 billion bill, which was largely a result of the accelerated timetable of returning to the Moon in 2024, was instead met with \$850 million.¹⁶

III. HISTORY/BACKGROUND

Much like the current decade, NASA was created out of a competitive environment. What had originally existed as the National Advisory Committee for Aeronautics was absorbed by and transformed into NASA by President Dwight D. Eisenhower in 1958 with the express purpose of facilitating Earth-to-space flight research.¹⁷ This was, of course, borne of the power struggle to “demonstrate technological superiority in space” in the face of Soviet efforts to the same end.¹⁸ Absorbing military-led research facilities in its earliest months, NASA was launched as the civilian agency tasked with presenting the faultless image of American innovation in launch capabilities and its accompanying ‘superiority’ in the original space race.

¹⁵ “Massive 2021 U.S. spending bill leaves research advocates hoping for more,” *Science*, December 22, 2020, <https://www.sciencemag.org/news/2020/12/massive-2021-us-spending-bill-leaves-research-advocates-hoping-more>.

¹⁶ “Massive 2021 U.S. spending bill leaves research advocates hoping for more.”

¹⁷ Steven J. Dick, “50 Years of NASA History,” *National Aeronautics and Space Administration*, May 28, 2008, https://www.nasa.gov/50th/50th_magazine/historyLetter.html.

¹⁸ Dick.

Launching the NASA Image

By 1961, President John F. Kennedy had famously challenged the agency to an end-of-decade “moonshot” goal, and the United States’ first orbital flight followed with John Glenn’s launch in 1962, an effort to match Soviet cosmonaut Yuri Gagarin’s flight the year prior.¹⁹ Despite a deadly 1968 command module fire during Apollo 1 preflight ground testing that killed three astronauts,²⁰ Americans touched down in the Sea of Tranquility on July 20, 1969, meeting the martyred Kennedy’s original challenge with months to spare. The Apollo missions, six of which landed humans on the Moon, were as scientific as they were popular; these Moon-bound journeys fulfilled (or, better yet, began) NASA research into an array of studies on lunar soil, on magnetic fields, and on solar winds, among other topic areas.²¹



Figure 1 – “On July 16, 1969, the huge, 363-foot tall Saturn V rocket launches the Apollo 11 mission from Pad A, Launch Complex 39, Kennedy Space Center, at 9:32 a.m. EDT.”
Image credit: NASA.

¹⁹ Dick.

²⁰ Sarah Larimer, “‘We have a fire in the cockpit!’ The Apollo 1 disaster 50 years later.,” *The Washington Post*, January 26, 2017, <https://www.washingtonpost.com/news/speaking-of-science/wp/2017/01/26/50-years-ago-three-astronauts-died-in-the-apollo-1-fire/>.

²¹ “The Apollo Program,” *Smithsonian National Air and Space Museum*, accessed February 22, 2020, <https://airandspace.si.edu/explore-and-learn/topics/apollo/apollo-program/>.

But, as mentioned earlier, the Apollo missions and the federal agency which designed, launched, and brought them home were not structured around research alone. These scientific breakthroughs were funded predominantly in an effort to showcase American ingenuity and leadership in the face of Cold War pressure, and the Apollo program's immediate non-scientific results were proof positive of its success. Within weeks of their return, Apollo 11 astronauts were delivered on a 24-country "goodwill tour" over 38 days, newfound diplomatic assets for the United States as tens of millions of people showed out to celebrate the Moon landing.²² Later statements



Figure 2 – "Children along the motorcade route in Bonn [West Germany] dressed as astronauts." Image credit: NASA.

from the astronauts echoed an important sentiment that was key to completing this aspect of the mission: the individuals attending the stops on their tour saw a direct link between these American men (and the

NASA personnel who delivered them to the Moon) and an accomplishment for all of humanity.²³ The transformation from niche government research agency to international gold medalist was complete.

²² John Uri, "50 Years Ago: Apollo 11 Astronauts Return from Around the World Goodwill Tour," *National Aeronautics and Space Administration*, November 5, 2019, <https://www.nasa.gov/feature/50-years-ago-apollo-11-astronauts-return-from-around-the-world-goodwill-tour>.

²³ Uri.

In 1974, on the heels of the then-dissolved Apollo program and amid a corporate-sector renaissance of 1920s modernism, NASA was given the go-ahead to call for proposals to reformulate its visual identity through the National Endowment for the Arts' "Federal Design Improvement Program."²⁴ The winning bid by Danne & Blackburn was developed to unify the agency, which operated under eleven different centers, and introduced the now-iconic "worm" logo in the process. When the official "Graphics Standard Manual" document was issued, then-Administrator James C. Fletcher wrote in the introduction: "I think the new logotype is pleasing to the eye and gives a feeling of unity, technological precision, thrust and orientation toward the future. Unity, technology, pioneering achievement—that's what NASA is all about."²⁵ Though the

"worm" logo and its accompanying standards manual would be (somewhat vengefully) retired in the 1990s, the document and visual identity that followed—from building signage to satellites which still orbit

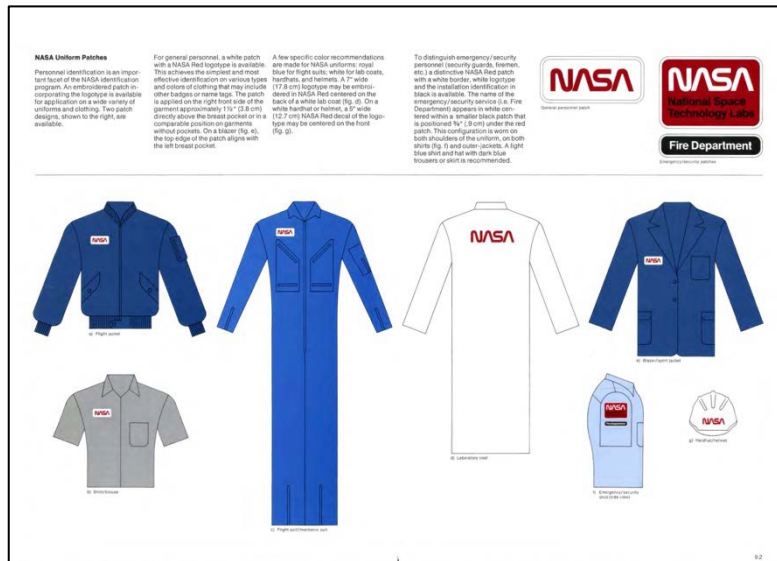


Figure 3 – NASA's 1975 "Graphics Standards Manual" reimagined everything from the logotype to document letterhead to uniform patch placement. Image credit: NASA.

²⁴ Christopher Bonanos, "Are you Team Meatball, or Team Worm?," in *1975 NASA Graphics Standards Manual*, Richard Danne and Bruce Blackburn (New York: Standards Manual, 2020).

²⁵ James C. Fletcher, "Letter from James C. Fletcher," in *1975 NASA Graphics Standards Manual*, Richard Danne and Bruce Blackburn (New York: Standards Manual, 2020).

Earth today—remain a cleverly progressive embodiment of NASA’s dual roles as both federal-level research mainstay and international public relations effort (and noticeably reappeared again in 2020 on the Crew Dragon launch).

Cost and Commercialization

In the modern era, NASA budget requests remain generally stagnant across administrations. Though the passing of time trends toward increased expenditures but a smaller percentage of the federal budget, presidential administrations from both parties and their congressional counterparts have largely continued to fund NASA’s expenses with little change, particularly over the last two decades (with the exception of the Shuttle program closure in 2011, which lowered NASA’s budget noticeably in the few years after, and the previous administration’s efforts to defund earth science

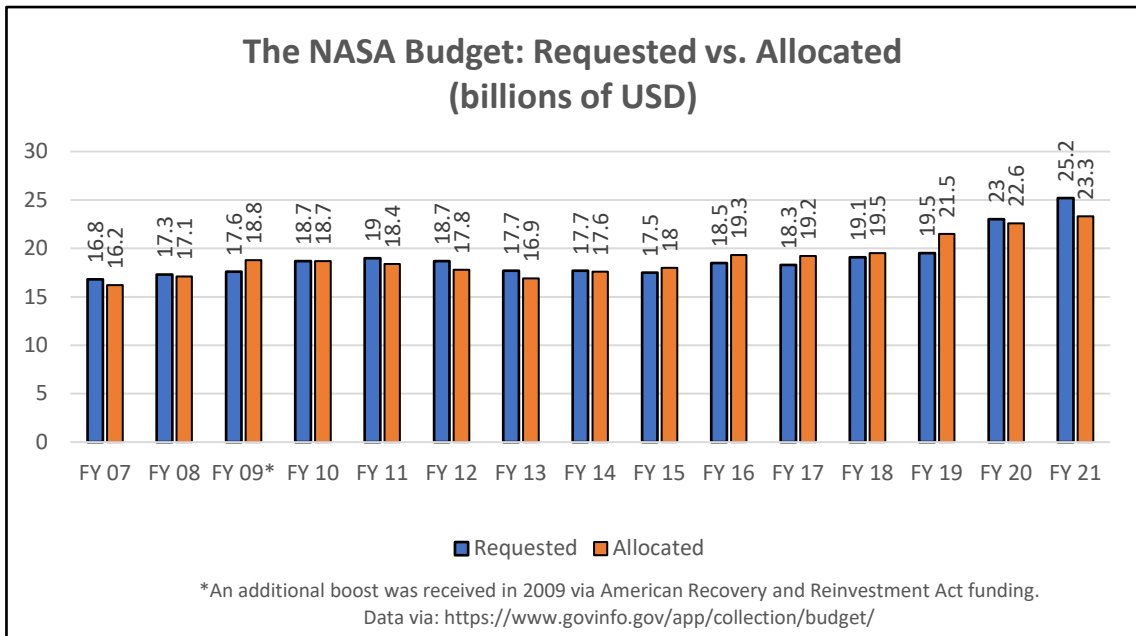


Table 1 – NASA budgets have fluctuated, but Congress largely tends to continue funding the agency over time.

research, most visible in FY2019²⁶). As evidenced by the heightened spending requests in recent years, new research and launch programs like the Artemis missions will require advanced spending. This expense, though a minimal percentage of the total federal budget, becomes harder to justify when the return on investment is several years away—and, to an extent, has little tangible effect on American’s everyday lives.

In 2012, SpaceX became the first private company to successfully dock at the ISS, marking a major step toward significant cost reductions to NASA’s operations—or, at least, the ability to stretch federal funding farther per dollar. This commercialization continued into 2014, when NASA awarded two contracts to “ferry” astronauts to the ISS, selecting Boeing and SpaceX to return human spaceflight to American soil.²⁷ By last year, the Soyuz rockets which had been used since the end of the shuttle program had reached a soaring cost of \$90 million per seat, paid to Russia, a tab which had continued rising significantly.²⁸ At the time of the first crewed SpaceX mission in Florida in 2020, it was estimated that these new “Dragon” launches cost \$55 million per seat, nearly cutting this expense in half.²⁹ This highly publicized launch, at the onset of the COVID-19 pandemic, was historic in more ways than one, but the cost savings alone helped

²⁶ Ethan Siegel, “Trump’s Plan To Destroy NASA Science Laid Bare In FY2020 Budget,” *Forbes*, March 12, 2019, <https://www.forbes.com/sites/startswithabang/2019/03/12/trumps-plan-to-destroy-nasa-science-laid-bare-in-fy2020-budget/?sh=3cbe1f3f5818>.

²⁷ Christian Davenport, “NASA awards space contracts to Boeing and SpaceX,” *The Washington Post*, September 16, 2014, <https://www.washingtonpost.com/news/the-switch/wp/2014/09/16/nasa-awards-space-contract-to-boeing-and-spacex/>.

²⁸ Davenport, “NASA awards space contracts to Boeing and SpaceX.”

²⁹ Michael Sheetz, “Why the first SpaceX astronaut launch marks a crucial leap for NASA’s ambitions,” *CNBC*, June 3, 2020, <https://www.cnbc.com/2020/06/03/first-spacex-astronaut-launch-marks-crucial-leap-for-nasa-ambitions.html#:~:text=NASA%20awarded%20SpaceX%20with%20%242.4,or%20%2455%20million%20per%20astronaut>.

mark the new commercial era of American spaceflight and visually unlocked the potential for missions like Artemis to reach the Moon—and beyond—without impossible increases in budget.

While most modern presidencies have often delivered renewed space platforms that were never fully realized, at least in the short term, the previous administration’s efforts to fast-track their initial Moon-bound mission from 2028 to 2024 left NASA “scrambling” to restructure for their new target³⁰—and Congress all but ignoring the financial need required of such a pace.³¹ Former NASA Administrator Jim Bridenstine was largely successful in securing bipartisan (and international) support for Artemis, meaning the project is viewed favorably and seen as an important apolitical mission for the agency,³² but missing funding and confusion about mission progress at the end of his tenure is evidence of the hesitancy the new timeline has created (scheduled technology tests have continued, however, into 2021). Though total financial estimates for the two timelines were comparable, the abbreviated 2024 plan required a significant immediate expense of nearly \$4 billion in FY2021, a staggering investment against the 2028 plan’s \$1.5 billion estimated expense for the same year.³³

³⁰ Christian Davenport, “NASA is scrambling to meet the White House mandate to return astronauts to the moon by 2024,” *The Washington Post*, April 1, 2019, https://www.washingtonpost.com/technology/2019/04/01/nasa-is-scrambling-meet-white-house-mandate-return-astronauts-moon-by/?itid=lk_inline_manual_4.

³¹ Christian Davenport, “Trump pushed for a moon landing in 2024. It’s not going to happen.,” *The Washington Post*, January 13, 2021, <https://www.washingtonpost.com/technology/2021/01/13/trump-nasa-moon-2024/>.

³² Davenport, “Trump pushed for a moon landing in 2024. It’s not going to happen.”

³³ “Artemis Plan: NASA’s Lunar Exploration Program Overview.”

Artemis will mark the end of a nearly 50-year gap since the United States' last Moon mission touched down in 1972, engaging both the vast technological advancements developed in the decades since the Apollo program and the financial advantages of NASA's new commercial partnerships (including more than just rockets³⁴) to accomplish this goal. This combination is expected to provide heightened economic sustainability, increased safety for American astronauts, and continued US-led research into the Moon and beyond—a critical presence in the face of a fresh space race, this time with China.³⁵

China Enters Our Orbit

After that last American lunar landing, it would be another 30 years before China reached orbit in a manned spacecraft.³⁶ But since doing so in 2003, China's space program has progressed rapidly. They completed a spacewalk in 2008, constructed a docking space lab in 2011, and delivered several unmanned missions and probes to the Moon between 2013 and 2020, one of which marked the first time any country has landed on the Moon's "dark side."³⁷ In the last year, China also completed their Beidou satellite system, a "navigation network" intended to rival the American-led GPS.³⁸ This is one of the most recent developments in a slew of largely military-based motivations for

³⁴ National Aeronautics and Space Administration, "NASA Names Companies to Develop Human Landers for Artemis Moon Missions," News release, April 30, 2020, <https://www.nasa.gov/press-release/nasa-names-companies-to-develop-human-landers-for-artemis-moon-missions>.

³⁵ William J. Broad, "How Space Became the Next 'Great Power' Contest Between the U.S. and China," *The New York Times*, January 24, 2021, <https://www.nytimes.com/2021/01/24/us/politics/trump-biden-pentagon-space-missiles-satellite.html?searchResultPosition=12>.

³⁶ "Timeline: Major milestones in Chinese space exploration," *Reuters*, December 1, 2020, <https://www.reuters.com/article/us-space-exploration-china-moon-timeline/timeline-major-milestones-in-chinese-space-exploration-idUSKBN28B5GE>.

³⁷ "Timeline: Major milestones in Chinese space exploration."

³⁸ "Timeline: Major milestones in Chinese space exploration."

China's pursuing space programs; it put everyone on alarm in 2007 by testing anti-satellite technology on a defunct satellite, blasting 150,000 "whirling shards" into orbit from the impact of the blunt projectile—and putting other satellites and the ISS in danger from the debris.³⁹

This is where the 'new NASA' comes in. In the coded way the United States could flex its launch capabilities by experimenting with rockets and satellites in the Cold War under the guise of a civilian agency, the second-term Obama Administration was able to respond to these

increasing Chinese moves with adaptations to the innovation afforded by NASA's growing list of commercial partners.⁴⁰ New launch competencies like the reusable booster of SpaceX's "Falcon 9" rocket (which successfully launched for the second time on the same booster in 2017 by hoisting a telecommunications satellite into orbit⁴¹) allow for fast US-based launches and a new level of affordability—traits expected to be particularly critical in potential military applications.⁴² This and other fast-progressing American space technologies, developed initially for the civilian NASA's research-based



Figure 4 – "A SpaceX Falcon 9 rocket with the company's Crew Dragon spacecraft onboard is seen on the launch pad at Launch Complex 39A as preparations continue for the Crew-1 mission, Saturday, Nov. 14, 2020," the first mission with four crew members on board. Image credit: NASA.

³⁹ Broad.

⁴⁰ Broad.

⁴¹ Kenneth Chang, "Recycled Rockets Could Drop Costs, Speed Space Travel," *The New York Times*, March 30, 2017, <https://www.nytimes.com/2017/03/30/science/space-x-reuseable-rockets-launch.html>.

⁴² Broad.

applications, ISS missions, and, next, Artemis, have become an increasingly invaluable resource for maintaining American dominance in both sectors (that is, the military and civilian worlds). Future investment in programs like Artemis, a top-to-bottom collaboration of federal and private dollars, will be required for maintaining such a lead and such security—a relationship with the potential to beat NASA at its own game.

IV. POLICY PROPOSAL

Proposal Goal & Policy Method

The goal of this policy is to provide realistic, timeline- and technology-based support for the Artemis missions to ensure NASA can follow through on its growing commercial and international partnerships and maintain an important hegemony in space—all without massive year-over-year cost increases that threaten Artemis’ congressional survival. This policy will be implemented via the administration’s first budget request to Congress (FY 2022), measured by its ability to complete the mission by the revised timeline. This follows on the upward trajectory of increases in NASA’s budget allocations in recent years while eliminating the ‘sticker shock’ of the previous administration’s expedited 2024 goals. As demonstrated in Table 2, featured in the “Artemis Plan,” NASA was forced to justify the accelerated timeline by planning to maintain the same overall cost but with the assumption that the initial spike (and all subsequent expenses) would largely disappear by FY 2026.⁴³ This assumption—without much certainty—was largely unanswered by Congress, lending itself to serious

⁴³ “Artemis Plan: NASA’s Lunar Exploration Program Overview,” *National Aeronautics and Space Administration*, September, 2020, <https://www.cbo.gov/system/files/2019-10/55699-CBO-MBR.pdf>.

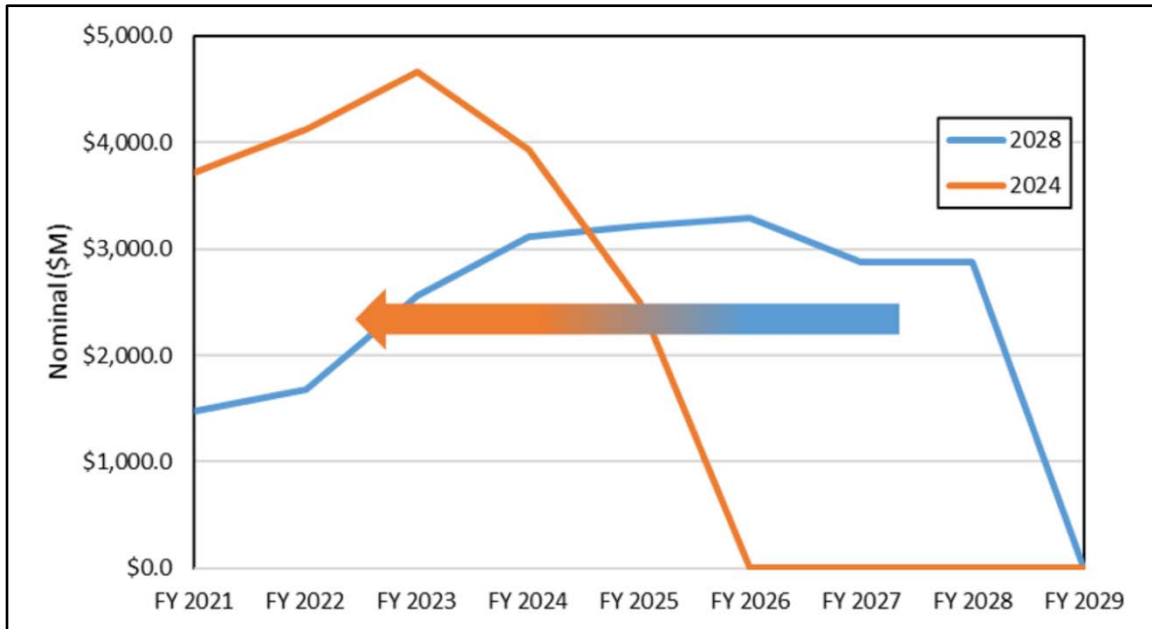


Table 2 – In the “Artemis Plan” (2020), NASA’s previous leadership used this graph to justify the initial cost increases of the accelerated timeline: “Artemis Phase 1 funding requirements represent a more efficient and direct plan than NASA’s previous concept of the 2028 landing. While the funding requirements are accelerated and near-term amounts have comparatively increased, overall funding requirements for the 2024 Phase 1 effort are not higher and sustained lunar presence and future exploration are accelerated.” Table credit: NASA.

reevaluation in the first budget request of this administration. The Space Launch System (SLS) rocket core, for example, NASA’s Boeing-contracted method of reaching the Moon, is already under scrutiny for delays and budget overruns, but it reached the “hot-fire” testing stage on January 16 of this year,⁴⁴ an important progress indicator that helps justify its continuation. Though the funding required of this proposal would, as always, be implemented by Congress, utilizing the president’s budget as a policy tool assists in demonstrating administration support for NASA’s newest mission (and scientific discovery more broadly) while reinforcing an awareness of cost and technological need.

⁴⁴ Valerie Buckingham, Kathryn Hambleton, Tracy McMahan, “NASA Conducts Test of SLS Rocket Core Stage for Artemis I Moon Mission,” *National Aeronautics and Space Administration*, January 16, 2021, <https://www.nasa.gov/press-release/nasa-conducts-test-of-sls-rocket-core-stage-for-artemis-i-moon-mission>.

Proposal Cost & Timeline

This request will be delivered with the administration's FY 2022 budget (in spring of this year) at an initial line-item cost of \$5.4 billion for "Deep Space Exploration Systems," which returns funding for the Moon mission and completion of the SLS to original estimates at the start of the program (for reference, see NASA's original FY 2020 request⁴⁵ from before the timeline amendment). It should be noted that this expense is nearly halved from the budget request provided by the previous administration, which estimated nearly \$10.3 billion for the same line item in 2022 based on the new timeline.⁴⁶ It is proposed to be implemented so soon as a result of the ongoing Artemis mission work and the general necessity of including NASA funding in the administration's first budget, regardless of support for Artemis.

The SLS plan was unveiled in 2011 (replacing the Bush-era Constellation program, which was canceled to much congressional ire in 2010⁴⁷) and developed as a heavy-lift rocket to deliver the thrust capabilities required of the nearly 240,000 mile journey to the Moon. Small-journey projects like SpaceX's Falcon 9 may be successful, but the lengthy Moon trip (nearly 1000 times that of distance to the ISS) requires a "monster rocket,"⁴⁸ and NASA maintains hope that the first successful (unmanned) launch may come later this year or early next, one decade after its initial introduction.

⁴⁵ "FY 2020 Full Budget Request (Congressional Justification)," *National Aeronautics and Space Administration*, March 11, 2019, <https://www.nasa.gov/content/fy-2020-budget-request>.

⁴⁶ "FY 2021 Full Budget Request (Congressional Justification)," *National Aeronautics and Space Administration*, February 10, 2020, <https://www.nasa.gov/news/budget/index.html>.

⁴⁷ Paul Rincon, "Nasa's giant SLS rocket: a guide," *BBC News*, November 13, 2020, <https://www.bbc.com/news/science-environment-54156798>.

⁴⁸ Rincon.

Following this initial “Artemis I” launch—even with the denied budget requests of the previous administration—appropriate next steps can be taken to build on its successes or failures in due time, leading to the first crewed mission around the Moon (Artemis II) in late 2023 or shortly after, on schedule with the original timeline and on board the world’s most powerful rocket ever.

Policy Authorizing/Authorization Tool

The primary effort of this proposal is to use the presidential budget as a starting block for supporting a thorough, renewed space exploration policy. Even still, this policy could be rolled out as an interesting mix of traditional authorization methods. While largely based on carrot-style targeted federal funding, there also remain several opportunities for sermon-style public behavioral shifts to influence greater congressional favor for space spending, building on public support for space programs and the reemergence of space travel in popular culture in recent years.

V. POLICY ANALYSIS

The policy expense of big-budget scientific investment like Artemis can be viewed largely from the perspective of opportunity cost. And while the product of these investments requires nearly a decade of development, the expense is immediate. This is universal whether operating on the 2024 or 2028 goal, but the likelihood of the program’s success for both financial and technological reasons is significantly more varied between the two—though conceding to the slower timeline does not mean a loss of the program’s success so far, nor should it be viewed as a cut to the broader agency or mission.

Advantages

A significant (and perhaps primary) advantage to the policy of returning Artemis to the original 2028 lunar goal is that it allows for technological maturation. As mentioned in Section II, even “The Artemis Plan” itself, the official agency overview of the 2024 timeline, notes that NASA’s Human Exploration and Operations Mission Directorate assessed the status of the revised program as relying heavily on technology keeping pace with the new goal.⁴⁹ NASA works to judge mission success based on technology readiness level (TRL), and this early report left uncertainty about the “high TRL systems” that will be required for Artemis II and III, the manned missions around the Moon and to the Moon’s surface, respectively.⁵⁰ By reducing the technological stress on NASA teams and their commercial partners, the 2028 timeline helps to build on the advancements of recent years while allowing for the proper development and evolution of what is yet to be completed, setting up the mission for success rather than (very

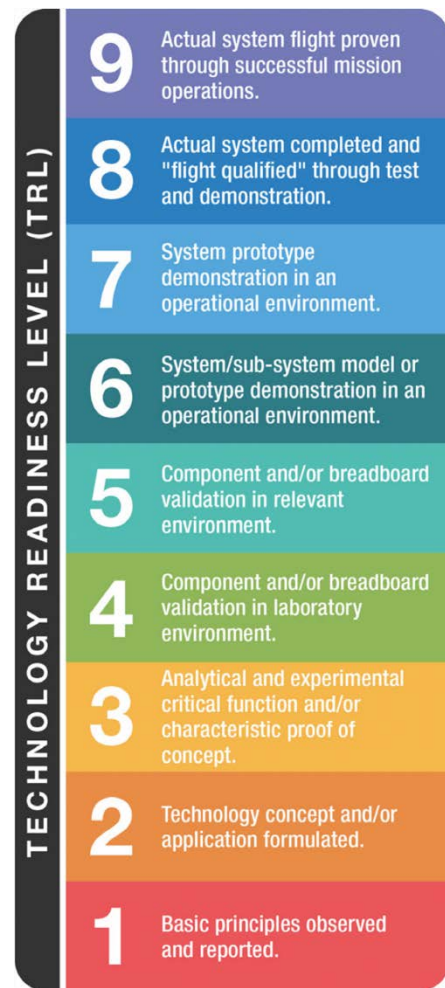


Figure 5 – NASA utilizes a Technology Readiness Scale (TRL) to determine whether available or upcoming technology will support mission success. Chart credit: NASA.

⁴⁹ “Artemis Plan: NASA’s Lunar Exploration Program Overview.”

⁵⁰ “Artemis Plan: NASA’s Lunar Exploration Program Overview.”

public) failure due to unmet goals and a large, expedited research tab.

Secondly, continuing the Artemis mission sets the United States up for a lunar presence should China complete its 2030s lunar goal. When the Chinese landed their first Yutu rover on the lunar surface in late 2013, they ended the international lunar exploration gap, with deep space investigations having ceased—even for robotic missions—in 1976.⁵¹ But with their most significant and recent mission to the Moon’s far side in 2019, their deep space infrastructure became increasingly complex by utilizing a lunar satellite to relay data from the Yutu 2 rover, which would have been otherwise blocked by the Moon itself.⁵² In a way, this system represents a simplified model of Artemis’ structure, where a Moon-orbiting gateway serves as a docking base to support trips to and from the lunar surface, serving as an intermediary between Earth and Moon. It is not science fiction, then, to posture that China could produce and deploy a human lander (and perhaps even a “gateway” of their own) in the near future, utilizing the complex technological capabilities of the 21st century to build a more permanent human lunar presence than was possible in our Apollo days—and on a far shorter timeline. With Artemis, even on the 2028 timeline, the United States enables itself to develop a permanent lunar presence ahead of any Chinese accomplishments to the same end. They—or any other able country—may put their citizens on the surface, but the United States would be there to welcome them, providing a reasonable amount

⁵¹ Colin Stuart, “Race to the Moon: Inside China’s plans to build a lunar base,” *Science Focus*, November 15, 2019, <https://www.sciencefocus.com/space/inside-chinas-plans-to-build-a-lunar-base/>.

⁵² Stuart.

of accountability for any actions taken on the lunar surface as dictated by international treaty.

Economically, space programs are often seen as jobs-creating policies, and Artemis is no different. Artemis-supporting NASA centers maintain a physical footprint in 12 states to supplement every stage of the mission from wind-tunnel testing to human-critical technologies like exploration spacesuit development.⁵³ Beyond these sites, NASA’s partner corporations in Aerojet Rocketdyne, Boeing, Jacobs, Lockheed Martin, and Northrop Grumman are supported by “over 3,800 suppliers contributing to Orion, the SLS rocket, and the lunar spaceport at Kennedy.”⁵⁴ This brings the national footprint of supporting companies—from small businesses to market leaders—to nearly all of the 50 states, a staggeringly long list of companies when viewed in print. NASA’s



Figure 6 – Each pin represents one company supporting any of NASA’s “Prime Contractor” partner corporations across all aspects of Artemis development. Image credit: NASA/Google Maps.

own reports suggest the ongoing “Moon to Mars initiative” (which includes Artemis) “supports more than 69,000 jobs, \$14 billion in economic output, and \$1.5 billion in tax revenue” in

FY2019,⁵⁵ a significantly efficient payout that accounts for just 22% of NASA’s broader

⁵³ “Artemis Plan: NASA’s Lunar Exploration Program Overview.”

⁵⁴ “Artemis Partners,” *National Aeronautics and Space Administration*, August 20, 2020, <https://www.nasa.gov/content/artemis-partners>.

⁵⁵ Bettina Inclán, Matthew Rydin, Karen Northon, “NASA Report Details How Agency Significantly Benefits US Economy,” *National Aeronautics and Space Administration*, September 25, 2020, <https://www.nasa.gov/press-release/nasa-report-details-how-agency-significantly-benefits-us-economy>.

economic output. From this position, it may be particularly appealing to engage a policy with roots in so many communities across the country, which will be addressed further in Section VI. But by facilitating this economic impact, NASA is also able to use Artemis as a method for helping regulate the rising commercial space industry and create mission-derived jobs, rather than allowing the industry to evolve without any ability for federal government oversight.

An additional positive that carries forward from the buildup to the Artemis program is the reintroduction of the National Space Council in 2017. While the Council has its detractors and has only functioned in an on-again-off-again capacity since Kennedy, the ability of a directed effort like Artemis is expected to function better—and perhaps see completion—under guidance from within the administration. By bringing back the National Space Council in the Artemis era, George Washington University space policy expert John Logsdon sees the benefits of this oversight in the face of a still-murky space policy: “if there is to be a national strategy for space, it must come from the center of government.”⁵⁶

Disadvantages

On balance, reintroducing the National Space Council as part of the Artemis platform could prove troublesome. Some of the Council’s strongest detractors in previous administrations were NASA leaders themselves, many of whom saw the body as added bureaucratic oversight on top of the “already convoluted endeavor” of a space

⁵⁶ Sarah Kaplan, “President Trump relaunches the National Space Council,” *The Washington Post*, June 30, 2017, <https://www.washingtonpost.com/news/speaking-of-science/wp/2017/06/30/trump-relaunches-the-national-space-council/>.

program⁵⁷ or even that it came between senior NASA leadership and their presidents.⁵⁸ Notably missing from the revived Council under the previous administration were figureheads from the newest commercial space names, like Elon Musk, whose own rockets would deliver American astronauts to space just under three years after the initial Council announcement. The trade association for this startup-heavy industry, the Commercial Spaceflight Federation, responded with a simple tweet to the 2017 announcement, noting it was “encouraged” but also hoping “the innovation and value of commercial space is adequately represented on council.”⁵⁹ The Commercial Spaceflight Federation represents at least two of NASA’s Artemis landing system partners in Jeff Bezos’ Blue Origin and Musk’s SpaceX.⁶⁰ Adding to the complexities of our newfound public-private space era, analysts also suggest the Council is most burdensome “under presidents and vice presidents who have little interest in space.”⁶¹ Citing space historian and National Research Council program officer Dwayne Day, *The Atlantic* staff writer Marina Koren notes that for the council to be effective, “the decision-makers have to actually want its advice.”

A primary disadvantage of continuing the Artemis program, above the bureaucratic, is the tremendous cost, even on the 2028 timeline. Though miniscule

⁵⁷ Kaplan.

⁵⁸ Marina Koren, “The History Behind the Long-Dead Space Council Trump Wants to Revive,” *The Atlantic*, March 24, 2017, <https://www.theatlantic.com/science/archive/2017/03/national-space-council-donald-trump/520725/>.

⁵⁹ Commercial Spaceflight Federation (@csf_spaceflight), “Encouraged to see WH est. space council today. Hope the innovation and value of commercial space is adequately represented on council,” Twitter, June 30, 2017, https://twitter.com/csf_spaceflight/status/880876389037158401.

⁶⁰ “Members,” *Commercial Spaceflight Federation*, <http://www.commercialspaceflight.org/members/>.

⁶¹ Koren.

when compared to the approximately \$283 billion (in today's dollars) spent on Apollo, NASA's estimates from last year still count Artemis program expenses at \$28 billion through completion.⁶² Yes, this proposal lessens the year-to-year financial burden of Artemis, but it still requires an increase in NASA spending from scarce and competitive tax payer dollars. For context, one year of a domestic social service program like the National School Lunch Program, which feeds 29.4 million children every day, costs \$14.1 billion,⁶³ a program with a significant and daily impact that can outshine the less-than-universal image of a dozen individuals visiting the Moon for double the cost. In the face of looming post-pandemic stimulus expenditures and large-scale administration spending goals on domestic fixes like infrastructure, the cost increases required of even such a small percentage of the federal budget can seem superfluous, begging the question: when there is much to fix at home, should we start looking for a new one hundreds of thousands of miles away?

Finally, viewing the Artemis program as a method for competitive advantage, as this proposal suggests, has a potentially permanent drawback. As University of Massachusetts Amherst professor Paul Musgrave notes bluntly for *Foreign Policy*, "The moonshot was always a myth."⁶⁴ The idea that built NASA's previously mentioned function as the nation's public relations arm of humanitarian discovery was really, even

⁶² Jamie Carter, "8 Reasons Why NASA's \$28 Billion Moon Return Is The Bargain Of The Century," *Forbes*, September 23, 2020, <https://www.forbes.com/sites/jamiecartereurope/2020/09/23/8-reasons-why-nasas-28-billion-moon-return-is-the-bargain-of-the-century/?sh=c36eb2a3b242>.

⁶³ "National School Lunch Program," *United States Department of Agriculture Economic Research Service*, October 1, 2020, <https://www.ers.usda.gov/topics/food-nutrition-assistance/child-nutrition-programs/national-school-lunch-program>.

⁶⁴ Paul Musgrave, "There's Not Much For the United States Up in Space," *Foreign Policy*, March 12, 2021, <https://foreignpolicy.com/2021/03/12/space-race-moon-mars-soviets-nasa/>.

to Kennedy, an expensive way to prove ourselves against the Soviet Union and communism more broadly. With space now playing a constant—if invisible—role in our daily lives, the competition is not so easily defined as the



Figure 7 – Astronaut John Glenn Jr. speaks after being honored by President John F. Kennedy following Glenn's historic three-orbit flight, Mercury-Atlas 6. Image credit: NASA.

United States versus China,

and who accomplishes a task first. The benchmark moves daily, based on our industrial and defense needs. To expect that public support for this expense (returning to the Moon) will come from the need to beat the Chinese over doing it for “climate change, asteroid defense, and scientific research” is poor judgement.⁶⁵ Committing to this new lunar race means potentially repeating the opportunity cost mistakes of the Apollo era; at the expense of sending Americans to the Moon, true humanitarian accomplishments (to use Musgrave’s examples: “desalination or curing cancer”⁶⁶) were left unsolved.

VI. POLITICAL ANALYSIS

While the role NASA occupied in the foundational decades described in preceding sections was inherently a political one, NASA’s now-cemented roots in creating a kind of space-industrial complex have further tied the agency’s necessity to

⁶⁵ Musgrave.

⁶⁶ Musgrave.

our political futures, and the intranational nature of the Artemis program is a fitting example of its far-reaching implications in the political arena. While the Biden administration has voiced its intention to support Artemis, it has not confirmed the mission timeline, either with revisions or as set by the previous administration.⁶⁷

Advantages

As in any significant government investment in the modern era, one word has greater political weight than few others: jobs. When the Obama administration unveiled a NASA program rewrite in 2010 that canceled an Artemis-like mission via the Constellation rocket, significant uproar rattled the decision and forced a fast-paced replacement, led mostly by congressional leaders from Texas and Florida (whose districts' employers include NASA centers and their myriad contractors) but also by those from within the NASA community, including household names like Neil Armstrong, who called the cancellation "poorly advised," among other remarks.⁶⁸ The revision (the Space Launch System described in Section IV) came one year later, largely at the request of the frustrated congresspeople and answering their main call to save jobs, but it introduced new goals that both revived some projects (the Orion capsule,

⁶⁷ Paul Rincon, "Artemis: Biden administration backs US Moon shot," *BBC News*, February 5, 2021, <https://www.bbc.com/news/science-environment-55949250>.

⁶⁸ Tariq Malik, "Neil Armstrong blasts Obama's plan for NASA," *The Christian Science Monitor*, May 14, 2010, <https://www.csmonitor.com/Science/2010/0514/Neil-Armstrong-blasts-Obama-s-plan-for-NASA>.

which is still featured in the SLS used for Artemis) and altogether surpassed others (an asteroid landing or orbiting Mars, for example).⁶⁹ In the end, this compromise on NASA's departure from one project and strikingly-familiar transition to another held onto the jobs that have further linked NASA's success to that of our national economy while opening the door for its greatest cost-saving measure yet: commercialization.

To project this lesson onto Artemis, it would create an unnecessary congressional showdown to cancel Artemis at this stage of the project. With astronaut candidates named,⁷⁰ the long-term goals of SLS⁷¹ reaching successful final tests,⁷² and deep space commercial rockets still blowing up at various stages of launch,⁷³ there is reason to believe the Artemis mission may actually be NASA's next—if not last—successful homegrown rocket mission. By working to see Artemis through to a successful completion without the burdened 2024 goal, the administration can find a



Figure 8 – This configuration of the SLS, with the Exploration Upper Stage, will provide in-space propulsion to send astronauts in NASA's Orion spacecraft and heavy cargo on a precise trajectory to the Moon. Image credit: NASA.

⁶⁹ Pete Spotts, "Despite uproar, Obama holds firm on NASA space exploration plans," *The Christian Science Monitor*, April 14, 2010,

⁷⁰ National Aeronautics and Space Administration, "NASA Names Artemis Team of Astronauts Eligible for Early Moon Missions," News release, December 9, 2020, <https://www.nasa.gov/press-release/nasa-names-artemis-team-of-astronauts-eligible-for-early-moon-missions>.

⁷¹ Rand Simberg, "NASA's Space Launch System Unveiled: Analysis," *Popular Mechanics*, September 14, 2011, <https://www.popularmechanics.com/space/a11833/nasas-space-launch-system-unveiled-analysis-6432937/>.

⁷² National Aeronautics and Space Administration, "NASA Mega Moon Rocket Passes Key Test, Readies for Launch," News release, March 18, 2021, <https://www.nasa.gov/press-release/nasa-mega-moon-rocket-passes-key-test-readies-for-launch>.

⁷³ William Harwood, "Another SpaceX Starship prototype lost in test flight explosion," *CBS News*, March 31, 2021, <https://www.cbsnews.com/news/spacex-starship-prototype-explosion-test-flight/>.

new outlet for supporting both its campaign and post-election promises of building up American manufacturing jobs, small businesses, and cutting edge science alike, perhaps one of the few policy opportunities that allows such a combination. And if NASA, via “Moon to Mars,” can tout the staggering number of an ongoing 69,000 jobs, it would seem, to paraphrase Armstrong from a decade ago, ill advised to cut it.

In the Senate, 11 Democratic leaders (including new Senate Commerce subcommittee head for science and space John Hickenlooper) in February wrote the administration urging for the continued funding of the lunar lander required of the Artemis program, citing opportunities for “important international collaboration and healthy competition,” calling China by name.⁷⁴ These senators see the bipartisan possibilities provided by the success of a multi-presidency policy like those required in Artemis, writing:

Major space exploration efforts have faced disruption as administrations have changed and priorities shifted. It is now time for stability if the nation is to make progress on these initiatives. NASA has made significant progress through the Artemis Program and we strongly believe that those efforts should continue in FY 2022. ... We recommend robust funding in FY 2022 for continuation of the [Human Landing System] program and the timely selection of companies to advance to the next stage of development and demonstration contracts.

Maintaining competition in this program to the maximum practical extent

⁷⁴ Patty Murray et al to Joe Biden, February 3, 2021, *The Washington Post*, https://www.washingtonpost.com/context/senators-urge-biden-to-support-lander/bbc55f8e-1e03-444b-a759-7be0975db690/?itid=lk_inline_manual_38.

encourages innovation, controls costs, and ensures the nation has assured access to deep space.⁷⁵

For these Senators to provide such clear support for a program embraced by the previous administration demonstrates the political opportunities presented within this mission, especially for the purpose of creating unifying, high-visibility legislation that can coexist with more debate-likely bills on infrastructure and healthcare.

This bipartisan future of American space is further elevated by the administration's recent naming of former Senator Bill Nelson as nominee for NASA



Figure 9 – The space shuttle Columbia (STS 61-C) can still be seen in this distant scene, with Biden-nominated NASA Administrator Bill Nelson on board. The scene was recorded around 7 a.m. (EST), Jan. 12, 1986. Image credit: NASA.

Administrator.⁷⁶ The former Democratic senator from Florida (who lost reelection in 2018), himself a former Space Shuttle astronaut (in 1986, flight STS 61-C), received swift bipartisan praise following the announcement from both unlikely sources (Senator Ted Cruz) and his immediate predecessor (former Administrator Bridenstine), and will bring with him a record of vehement support for NASA leadership in space.⁷⁷ Nelson was a proponent of the SLS throughout his final years in the Senate,⁷⁸ indicating a strong

⁷⁵ Murray et al.

⁷⁶ Jacqueline Feldscher, "Nelson wins bipartisan praise in bid for top NASA job," *Politico*, March 19, 2021, <https://www.politico.com/news/2021/03/19/nelson-bipartisan-praise-nasa-job-477169>.

⁷⁷ Feldscher.

⁷⁸ Feldscher.

likelihood he will remain an adamant supporter of seeing the program through.

Weighing Nelson's confirmation with the bipartisan calls for Artemis' continuation, the political success of both navigating Congress and placing America's largest ever rocket in lunar orbit would seem worthy goals for this new administration.

Finally, public support continues to overwhelmingly value continued space exploration. A Pew Research Center study from 2018, for example, notes that about "seven-in-ten Americans (72%) say it is essential for the U.S. to continue to be a world leader in space exploration, and eight-in-ten (80%) say the space station has been a good investment for the country," with 65% of respondents noting the importance of NASA leadership when compared with that of private corporations (33%).⁷⁹

Additionally, 58% of those surveyed noted Astronaut-led missions to space as "essential" versus those who did not consider it essential (41%).⁸⁰

Disadvantages

Despite this momentum, with the recently-announced rollout of the "American Jobs Plan" and its \$2 trillion investment in the domestic infrastructure required of a 21st century economy, continuing an upward trajectory for NASA's budget year over year loses political weight. As mentioned in Section V, though it remains small in comparison to many other facets of our complex national budget, stretching NASA into the mid-\$20 billion spending mark can become a superfluous ask. Two years of NASA spending at

⁷⁹ "Majority of Americans Believe It Is Essential That the U.S. Remain a Global Leader in Space," *Pew Research Center*, June 6, 2018, <https://www.pewresearch.org/science/2018/06/06/majority-of-americans-believe-it-is-essential-that-the-u-s-remain-a-global-leader-in-space/>.

⁸⁰ "Majority of Americans Believe It Is Essential That the U.S. Remain a Global Leader in Space."

this level is a parallel amount to the \$40 billion the American Jobs Plan earmarks for public housing infrastructure, for example.⁸¹ While Artemis itself is not the entirety of NASA's budget, its price tag remains in the billions of dollars, a leftover priority from the previous administration that could threaten legislative spending on new urgencies. Moreover, despite significant public support for American leadership in space, the same Pew survey results ranked Moon- or Mars-bound missions lower in priority than other NASA initiatives, like monitoring climate or developing "technologies that could be adapted for other uses," though all priorities in the survey received a majority of responses for "important" or better.⁸² A Monmouth poll conducted this year with similar ranked choice priorities found that respondents want to retain American space leadership but are less likely to want additional lunar or Martian travel (33% said sending "human astronauts to the moon or Mars should be a 'top' or 'important but lower' priority").⁸³

By answering the spending call of those Democratic senators or even just to continue SLS, funding Artemis also gives credence to the idea that American leadership is still required in space, that another country's presence in this still-expanding frontier (namely China) is indeed worthy of offsetting, even beating. This competition, while it brings advantages, commits the United States to fighting a conflict which has not yet

⁸¹ The White House, "FACT SHEET: The American Jobs Plan," News release, March 31, 2021, <https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/>.

⁸² "Majority of Americans Believe It Is Essential That the U.S. Remain a Global Leader in Space."

⁸³ Sam Sabin, "Nearly Half the Public Wants the U.S. to Maintain Its Space Dominance. Appetite for Space Exploration Is a Different Story," *Morning Consult*, February 25, 2021, <https://morningconsult.com/2021/02/25/space-force-travel-exploration-poll/>.

arisen—and without the privacy of hushed conversations at the Pentagon. It would become a potential lasting marker of this administration to see Artemis through its first unmanned launch, its expense too great to be unlinked from any administration’s priorities—but especially one with big spending goals. To fund and then launch a series of financially burdensome—however technologically advanced—rockets, eventually with American souls on board, is not only a domestic marker of accomplishment, but an internationally permanent signal of our dedication to sovereignty in space at nearly any cost.

And this argument—which could be read as a positive or a negative depending on the audience—is fraught with symbolism. Each of our space-bound efforts, including the argument presented in this policy, uses space as a proving ground for the American experience. Historical figures as far back as John Quincy Adams have called for American astronomical initiatives, questioning how the United States could lag behind the European powers-that-be, finding out second-hand information about the cosmos while “the earth revolves in perpetual darkness to our unsearching eyes.”⁸⁴ The idea that we might carry forward our American experience was not, of course, limited to observing the stars, for it is this same pushing forward which wrought our westward expansionist vision of America—at the expense of what remained ‘untouched’ by our hand, to the tune of entire native populations and landscapes—that we tend to overlook having once been religious refugees or colonial subjects ourselves.

⁸⁴ Marina Koren, “The Surprising Space Ambitions in Colonial America,” *The Atlantic*, June 27, 2017, <https://www.theatlantic.com/science/archive/2017/06/space-exploration-colonial-america/531774/>.

What the previous administration, then, referred to as our “manifest destiny in the stars” should not be overlooked when analyzing the political significance of our continued exploration beyond the atmosphere.⁸⁵ Artemis goals can be misconstrued as ways of ‘settling’ or ‘colonizing’ celestial objects, risking the repetition of the exploitative mindset and language of our frontier era past, particularly at the core of the mineral extraction possibilities provided by further exploring our Moon. NASA’s commercial partners, both current and future, can play a role in this. Jeff Bezos’ Blue Origin corporation, for example, a potential Artemis lunar lander contractor, has often provided renderings of space-bound communities, usually orbital in nature (as opposed



Figure 10 – Apollo 17 Mission Commander Eugene A. Cernan adjusts the American flag during the final Apollo mission in 1972, with Earth in the background. Image credit: NASA.

to those on planets, like Elon Musk’s Mars dreams). As Marc Miller (an assistant professor at the Penn State Landscape Architecture Stuckeman School) points out, the vision presented by these renderings echoes the art created in the 19th century expansion into the greater Northeastern United States, which “celebrated agriculture and other methods of organizing nature to the benefit of European colonizers.”⁸⁶ When Buzz Aldrin

⁸⁵ Donald J. Trump, “Address Before a Joint Session of the Congress on the State of the Union,” (speech, Washington, DC, February 4, 2020), U.S. Government Publishing Office, <https://www.govinfo.gov/content/pkg/DCPD-202000058/pdf/DCPD-202000058.pdf>.

⁸⁶ Marc Miller, “Decoding the colonial history behind Blue Origin’s space settlements,” *The Architect’s Newspaper*, July 19, 2019, <https://www.archpaper.com/2019/07/decoding-colonial-history-blue-origin-space-settlements/>.

planted an American flag in the “dusty lunar rocks” of 1969, this image became a reality.⁸⁷ It would be politically wise to carefully evaluate the darker sides of our new race to the Moon and beyond, and to navigate Artemis with a responsible lexicon.

VII. RECOMMENDATION

NASA plays a wide-ranging role in regional economies across the country (and globe) and has regularly dazzled the public with an increasing number of high-profile achievements in the last half decade, from the first contracted commercial flight with humans on board in 2020 to the recent broadcasting of the first-ever live video landing of a rover on another planet. With Artemis, NASA has the potential to take humans deeper into space than ever before, revisit the lunar surface with an immensely greater technological skillset than Apollo missions, and support its small business and corporate partners in ongoing developments that continue to reduce the fiscal weight of this and forthcoming missions, building a financially sustainable future for Artemis and its successors. And finally, the bipartisan support of Artemis—for multiple stages of the mission—presents the opportunity for a congressional success in the face of other decidedly difficult legislative priorities. It is the recommendation of this memorandum that the Biden administration continue the Artemis missions with the goal of landing the first woman and next man on the moon by 2028. By continuing the mission, though revised, the administration supports the program while preventing the public failure of a hard push toward the previous administration’s impossible deadline.

⁸⁷ Gabrielle Cornish, “How imperialism shaped the race to the moon,” *The Washington Post*, July 22, 2019, <https://www.washingtonpost.com/outlook/2019/07/22/how-imperialism-shaped-race-moon/>.

In a way, it is a common misconception that NASA, overshadowed by the software giants who have quickly and publicly reached low earth orbit in recent years, is a dying agency. Left for a decade without the continuing press of a mission like the 30-year shuttle program and unable to always present the sleek—and popular culture—appeal of its commercial counterparts in recent years, particularly online,⁸⁸ NASA has fallen victim to the transparency provided by the internet, a new era of anxious expectation that cannot be assuaged by the symbolic placement of a moonrock in the Oval Office alone.⁸⁹ Millions of Twitter users and Googlers can keep up with the repetitive launches of SpaceX rockets and the ongoing “West Texas” testing at Blue Origin; they can see and share, more easily than ever, the exact dollar amounts required of NASA missions across its entire spectrum of research efforts (as opposed to the unlisted expenditures of private space companies, for example); and they can endlessly question a lack of instantaneous communication from the space agency, like the stream of tweets and articles in February that probed the perceived delay in releasing



Figure 11 – NASA catalogue image of the lunar sample currently on loan to the Oval Office, originally collected in 1972 by Apollo 17. Image credit: NASA.

⁸⁸ Mark Matousek and Avery Hartmans, “Elon Musk tweeted that the Egyptian pyramids were built by aliens. Here are 39 of the most outrageous things he’s said over the years.,” *Insider*, August 5, 2020, <https://www.businessinsider.com/elon-musk-shocking-quotes-tweets-2018-10>.

⁸⁹ Miriam Kramer, “What to know about the Moon rock in Biden’s Oval Office,” *Axios*, January 26, 2021, <https://www.axios.com/moon-rock-oval-office-biden-edc82c0d-0255-4384-81fe-8d5959e104f0.html>.

the RAW images of the Martian surface from the Perseverance mission (options include that Perseverance must have “exploded” or “NASA is backing down from its historical commitment to transparency,” reasoned one article⁹⁰).

But this new culture aside, NASA is the very agency fostering the increasingly-popular commercial developments in Earth orbit (and their potential for future applications for national defense), providing the valuable funding contracts and payloads required to build a rocket company and the research conducted at the ISS end of their journey. In reality, there is no competition between the agency and commercial space, and Artemis affirms this. Programs like Artemis need commercial partnerships to see through the massive scale of mission details like the gateway or the human landing system, while commercial partnerships need programs like Artemis to help finance ambitious research and development that may, in the near future, replace the need for NASA rocket-reliant missions like Artemis. For now, with no viable commercial alternative, continuing Artemis means seeing out NASA’s most powerful rocket, and likely for the last time. As a recent *New York Times* essay from journalist David W. Brown concludes, “Whether the Space Launch System program ends next year or next decade, unlike the end of the space shuttle or Saturn 5, it will not be the end of a chapter, but the end of a book. NASA will be out of the rocket business.”⁹¹

⁹⁰ Tony Tran, “Why Isn’t NASA Releasing RAW Images from Perseverance? We can think of a few reasons why.,” *Futurism*, February 21, 2021, <https://futurism.com/nasa-raw-images-perseverance>.

⁹¹ David W. Brown, “NASA’s Last Rocket,” *The New York Times*, March 17, 2021, <https://www.nytimes.com/2021/03/17/science/nasa-space-launch-system.html>.

CURRICULUM VITAE

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