



February 5, 2021

President Joseph R. Biden, Jr.
The White House
1600 Pennsylvania Avenue, NW
Washington, DC 20500

Dear Mr. President,

The Coalition for Aerospace and Science (CAS) congratulates you on becoming the 46th President of the United States of America. CAS is an alliance of over 50 industry, university, and scientific organizations united in support of robust, sustained, and balanced federal investments in and across the National Aeronautics and Space Administration (NASA).

NASA is an essential element of America's success as a global leader in science, technology, exploration, and inspiration. As you begin implementing your policies, we request you consider the following principles and recommendations.

Maintain an Ambitious Exploration Agenda

NASA's human exploration agenda – and the global visibility and prestige it confers – is an unparalleled national asset that has spurred immeasurable economic, inspirational, and geopolitical value. We urge you and your Administration to provide the political prioritization and resources required to tap into NASA's ability to fully realize the value and impact of these investments. Policy changes across successive administrations can, and have in the past, created a sense of "whiplash." With the steady stewardship by the Biden Administration, the United States is positioned to embark on a new era of scientific discovery and human deep space exploration.

NASA is implementing a joint robotic and human exploration program that will shed new light on our home planet and enable new scientific discoveries by extending the 20-year permanent human presence in low Earth orbit out to the Moon. Additionally, the exploration of Venus and Mars have informed modelling of the Earth's climate, providing boundaries and mechanisms that help tie Earth observations to potential outcomes. And studying other moons in our solar system, some of which show signs of harboring warm, liquid oceans, could shed light on how life came to be on our planet. The possibilities, some realized while many not yet known, with the integration of traditional 'science' and 'exploration' pursuits is extremely powerful and awe-inspiring in their benefits to humankind. Scientific research, for example, has revealed abundant water on the Moon that can now be further characterized and potentially used not only as a resource for human explorers and basis for a commercial space economy, but the resulting technologies used for the improvement of our daily lives.

To realize the lasting benefits of significant government investments, ensure workforce stability, and demonstrate global leadership, CAS supports the ambitious goals of the Artemis program to return humans to the lunar surface as a precursor to a sustainable presence on the Moon and as a stepping stone to future Mars missions. The Artemis program represents the boldest and most mature mission architecture since the Apollo program, and it has wide congressional bipartisan and bicameral support.

CAS recommends that your Administration support the continued development of technological and scientific milestones currently underway, including:

- Evaluation of commercial partners' Human Landing System (HLS) concepts currently in review and proceeding with the subsequent down-select in FY 2021 to maintain momentum and global leadership.
- Early procurement steps for the Artemis Lunar Terrain Vehicle (LTV) – an electric vehicle capable of crew transportation, autonomous uncrewed operations, and unmatched science, with technology alignment with Earth-bound clean energy and electrification of the federal automotive fleet.
- Complete development and transition to production for NASA's Space Launch System and Orion spacecraft designed to take humans farther into the solar system than they have ever gone before.
- Diversify the government's access to the full panoply of launch vehicles online and in development to support the Artemis mission architecture. CAS supports leveraging the complementary capabilities between longstanding commercial partners in tandem with more recent entrants to provide access to space.
- A robust cadence of robotic missions to characterize resources, study planetary processes, explore difficult terrains, and demonstrate required technologies such as mobility, resource characterization and utilization, communications, and situational awareness.

Artemis is not merely about returning to the Moon, but about building the appropriate orbital and surface infrastructure to enable the sustainable exploration of Mars. The robotic precursors to Mars (including the sample return mission initiative) in concert with the Artemis technologies being developed at the Moon are a "whole of civil space" strategy for exploration. The value of humans and robotics working together to accomplish science objectives has been well-established, and we urge the Administration to continue to take full advantage of this synergy.

Fully Leverage NASA's Role in Understanding and Tackling the Climate Crisis

Studying the only habitable planet in the solar system has always been central to NASA's mandate. The first spacecraft launched by the country in 1958, on the eve of NASA's founding, was Explorer 1, a satellite that started a revolution in our knowledge of Earth science and the Sun-Earth coupled system. Since that time, space-based observations have been essential in identifying climate phenomena that are critical for our collective survival, such as when the NASA spacecraft, NIMBUS-7, confirmed and quantified the hole in Earth's ozone layer. This discovery resulted in the banning of chlorofluorocarbons through the Montreal Protocol only a few short years later, an effort spearheaded by the United States. The world today is looking to this Administration to launch the next revolution in the understanding of our changing climate and head off the ensuing threats posed by *the* challenge of our generation.

As this Administration develops a comprehensive response informed by science, space provides a unique and necessary vantage point to understand Earth's delicate systems at a planetary scale. To make a meaningful contribution to this global challenge, the Administration can rely on NASA and its partners to play a critical role in understanding the science behind our climate in its current state and in measuring progress on global and local mitigation efforts as we build towards a healthier planet.

CAS recommends policy alignments that maximize NASA's capabilities, along with their industry and academic partners, to address the issue with urgency. These include:

- Reinforce and expand the role of satellite-derived Essential Climate Variables in assessing and tracking carbon emissions and air quality.
 - Continue to advance science and observations through instruments like GeoCarb and TEMPO. GeoCarb will measure near real-time terrestrial sources, sinks, and exchange processes of carbon dioxide, methane, and carbon monoxide in unprecedented detail. TEMPO will monitor daily variations in ozone, nitrogen dioxide, and other key air pollution elements.
- Further invest in improved data integration, analysis, and Global Climate Modeling capabilities that take advantage of new and existing space-based observations.
- Embrace the National Academies' 2017 Earth Science and Applications from Space (ESAS 2017) Decadal Survey. Fulfillment of several top recommendations from ESAS 2017 are underway; however, a key recommendation to establish an Earth Explorer mission concept has yet to be implemented. This mission class that maximizes industry involvement would provide innovative climate process observations in a competitive, cost-capped program, enabling a more rapid procurement and development cycle.
- Expand the role of commercial remote sensing data providers to complement NASA's fleet of remote sensing missions. By expanding the Commercial Smallsat Data Acquisition Program, the Administration can grow the role of U.S. companies to participate and expand the user community beyond NASA-funded researchers to include U.S. university students and researchers.
- Prioritize climate change considerations in assessing global security risks and include climate security as an essential element of global security, as directed in the recent Executive Order on Tackling the Climate Crisis at Home and Abroad.

We cannot adequately characterize or respond to climate change without looking at our planet as an integrated system, a perspective that only space-based observations can provide. NASA's Earth and climate science efforts are among the nation's most effective tools to understand and tackle this urgent global crisis, as well as to demonstrate the United States' renewed global commitment to leading that fight.

Promote Budgets that Enable Scientific Discovery

NASA's Science Mission Directorate (SMD) plays a unique and world-renowned role in advancing the understanding of our planet and universe. Missions to planet Earth, the Sun, throughout the solar system and beyond all contribute to a holistic understanding of humanity's place in the universe. The engineering development and scientific research enabling these missions are both groundbreaking and inspirational. Astrophysics missions, through discoveries of new solar systems and distant galaxies, help to answer humanity's most fundamental questions. Earth Science missions develop new techniques for understanding the complex environment in which we live and provide spacecraft and instruments to the National Oceanic and Atmospheric Administration and the U.S. Geological Survey for operational monitoring of our weather, vegetation, and waterways. Heliophysics helps us understand solar activity that impacts the performance and security of power grids and communications networks that are part of our daily lives. Planetary Science and Astrobiology missions provide comparative planetology data that extend the knowledge of our Earth-Moon system, inform Earth climate studies, and unlock mysteries of how the Earth was formed. All of NASA's science focus areas, particularly in combination, provide valuable contributions to our economy and national well-being.

This research – and the enabling missions – are guided by the decadal surveys, 10-year consensus-based priorities developed by the communities of individual scientific disciplines (Earth and Planetary sciences,

Astrophysics, Heliophysics, and Aeronautics) under the auspices of the National Academies of Science, Engineering, and Medicine (NASEM). Those recommended missions and/or set of science questions and objectives represent the support and *consensus* of the scientific community as to what needs to be achieved in the coming decade. Fulfillment of decadal priorities ensures America remains at the forefront of any given Earth and space science domain, as well as maintains a robust workforce of scientists and engineers. The strength of this workforce and its replenishment is proportional to the boldness of NASA's agenda.

The next several years are set to usher in a new era of robotic exploration missions, starting with the arrival of NASA's Perseverance rover to Mars this February and launch of the James Webb Space Telescope in October 2021. Perseverance will cache samples to be retrieved and returned to Earth through the Mars Sample Return program, fulfilling the top objective of past planetary decadal studies. The next great space observatory and top-ranked mission of the 2010 astronomy and astrophysics decadal survey, the Nancy Grace Roman Space Telescope (formerly WFIRST), is also underway for launch in the mid-2020s. This same period will coincide with the release of several decadal and mid-term reviews, including: Astronomy and Astrophysics Decadal Survey (Spring, CY 2021), Planetary Science and Astrobiology Decadal Survey (CY 2023), Earth Science and Applications from Space Mid-Term Assessment (CY 2023); and, Solar and Space Physics (CY 2024).

Each decadal survey report will prioritize new missions as well foundational technologies that need to be advanced from the drawing board to hardware to enable those next giant leaps in the understanding of our fragile biosphere. In the spirit of the decadal surveys, CAS recommends the Administration:

- Support and engage to the best of its ability with the National Academies decadal survey process, recognizing that the Administration's posture towards and prioritization of activities within NASA SMD will heavily influence the scientific community's level of ambition in setting its priorities.
- Provide increased support to NASA's science programs commensurate with the additional tasks placed before the agency in this era of renewed discovery.
- Commit to the longstanding decadal survey principle of programmatic balance across large, medium, and small mission classes, and leverage the best that industry has to offer to realize program and mission savings that will increase the value of each dollar spent and maximize opportunities for the research community.
- Expand competitive mission opportunities and ensure adequate programmatic funding to maintain a steady cadence of missions and avoid multi-year gaps in which there are few opportunities for early- and mid-career researchers – along with their industry partners – to engage.

This Administration has the opportunity to lift up the Earth and space science communities, and in doing so translate decadal survey aspirations into enduring technological and scientific legacies that further cement America's unchallenged role in pioneering Earth and space science research.

Diversify and Modernize NASA's Workforce and Partnerships with Stakeholders

NASA is currently engaged in efforts to diversify their STEM workforce and to ensure that their practices are in line with and in support of bringing more diverse perspectives into leadership roles at the agency. Millennials, for instance, now constitute over a third of the U.S. workforce and in the next few years will grow to half of the workforce. NASA must attract, fully engage, and retain the best talent available in the face of stiff competition from other science and technology sectors. This includes being viewed as an employer of choice for a diverse workforce, and NASA should continue building on the successes that have

led it to be ranked the best place to work in the U.S. government 8 years in a row. CAS recommends the continued execution of NASA's Diversity and Inclusion Strategic Implementation Plan, to:

- Fully integrate diversity and inclusion into the strategic decision-making of the Agency to enhance organizational effectiveness, help achieve mission goals, and meet the challenges of tomorrow.
- Strategically utilize and expand workforce talents, skills, and opportunities to maximize individual potential and productivity agencywide.

CAS also recommends NASA support and expand the efforts of SMD to increase diversity in space mission leadership. NASEM is developing a report that will "examine the current mission proposal system at NASA SMD and identify humanistic elements of the system that may present impediments to applicants, limiting the diversity of the competitive pool." This study, undertaken at the request of SMD, will recommend specific actions to improve diversity.

NASA SMD's Astrophysics Division also recently implemented a dual-anonymous peer review for research opportunities to eliminate bias in the proposal selection process and focus on the merits of the science, not the individual researcher. CAS applauds this process shift, which resulted in more female-identifying principal investigators being selected, and a selection cohort whose makeup is proportional to that of the applicant pool. CAS encourages NASA to implement this process across the agency as part of a broader NASA strategy.

Lastly, academic programs such as Space Grant help make space-related careers a reality by providing scholarships and fellowships for students pursuing careers in STEM, as well as curriculum enhancement and faculty development. Other NASA education programs, such as the Minority University Research and Education Project, help ensure the diversification of our workforce by supporting STEM programs at U.S. Historically Black Colleges and Universities and Minority Serving Institutions.

NASA should also look to non-traditional partners and organizations who can help broaden its messaging and recruitment outside of the bubble of the space community to show the wide range of career paths available to underserved populations who do not typically consider pursuing a STEM career.

Leverage Industry Partnerships to Maximize Impact & Value of Federal Support

Maximizing the impact of taxpayer-supported research and development requires healthy government and industry investments. The curiosity-driven research conducted at NASA often requires the development of innovative technologies. Industry partnerships are vital to this technology development. In fact, every NASA mission in recent history has relied on industry partners to successfully complete the mission. Based on these successes, NASA should continue to support industry partnerships in its missions.

As NASA strives to make the most of limited budgets, CAS recommends:

- Prioritizing the purchasing of hardware, data, and services from the commercial sector when available.
- Enabling commercial companies to provide products, services, and data in fields that have commercial markets and use cases, which in turn enables NASA to prioritize its workforce and funding to develop programs and technologies that advance NASA's scientific and mission capabilities yet do not currently have robust commercial markets.

America's space industry relies on a broad network of innovators and suppliers to accomplish its missions. When NASA leverages its commercial partners, it builds much-needed collaborations between the space sector and other industries that benefit the nation and our entire economy.

These industries benefit from NASA's Technology Transfer Program, which facilitates the transfer of technology to the private sector to support the commercialization of technological innovation. For example, NASA utilizes the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. These programs encourage domestic small businesses and nonprofit research institutions to engage in federally supported research and development. SBIR/STTR can serve as a potential source of seed funding for small businesses to further develop those technologies that have the potential for commercialization.

CAS recommends that NASA continue to ensure adequate mechanisms for technology transfer from federal agencies to the private sector and to provide opportunities for small businesses (with emphasis on broadening access for women- and minority-owned businesses) and nonprofit research institutions to participate in technology development.

A central theme of your Administration has been what Americans can achieve when united. For all the challenges facing this nation, our space program demonstrates time and again that nothing can stop Americans when they come together to achieve great things. NASA provides not only hope for a better future for all but allows us to reach beyond ourselves to transform our challenges into opportunities. Few things can provide inspiration to our youth and a much-needed view to the future as the promise of a secure environment, scientific discovery, and exploration.

Thank you for your consideration of these recommendations. CAS stands ready to work with your Administration on these NASA priorities.

Sincerely,

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Co-Chairs
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