COALITION for AEROSPACE and SCIENCE

Ensuring US Leadership in Aerospace and Science

NASA and the Coalition for Aerospace and Science

We reach for new heights and reveal the unknown for the benefit of humankind.
- *Vision for NASA*

The Coalition for Aerospace and Science (CAS) is an alliance of industry, university, and science organizations united in our support for robust and sustained federal support for the National Aeronautics and Space Administration (NASA). As a group, we believe that increasing federal investments and maximizing the efficiency and effectiveness for this vital agency will ensure our nation's scientific, industrial, and academic leadership long into the future.

Strong funding, a balanced portfolio, and policies that encourage innovative collaborations for NASA are essential to our Nation's leadership in aeronautics, space and Earth science, human exploration and development of new space technologies. NASA's long history of transformative advances in science and technology have positioned the U.S. as a world leader across many fields, driving strong U.S. exports, supporting high wage jobs, and drawing the best and brightest students to American universities to learn. As the nation addresses new problems and challenges, robust support for NASA is critical. A necessary part of maximizing the potential of NASA is the appointment of a science advisor and NASA Administrator who are nationally respected leaders with the appropriate engineering, scientific, management and policy skills necessary for these critically important roles.

Actions Needed to Maximize the Potential of NASA

Predictable budgets with robust growth are vital to NASA's ability to successfully and efficiently execute its mission. CAS recommends 5% or more real growth for NASA's topline and each of its directorates.

Despite waning purchasing power, NASA continues to deliver impressive successes. In the past year, OSIRIS-REx launched on an Atlas-V rocket to travel to the asteroid Bennu, where it will collect a sample and return to Earth. The Juno probe arrived at Jupiter to begin its in-depth investigation into the origins and inner workings of the gas giant planet. In December 2014, NASA's human exploration program conducted the first launch and successful re-entry of the Orion Crew Capsule, demonstrating the substantial progress in its development. In 2013, NASA launched a new Landsat Data Continuity Mission to monitor and understand the resources on Earth. The Solar Dynamics Observatory launched in 2010 to monitor the Sun and improve predictions of space weather. The 2009 launch of the Kepler satellite began a period of discovery of thousands of planets beyond our Solar

System. NASA's research into aeronautics, the science of flight, has paved the way for the safe, reliable and efficient air travel industry that Americans enjoy today. These recent accomplishments, however, mask the agency's current budget shortfalls since funding for many missions begins five to ten years before launch. In time, without increased funding, NASA's mission tempo will gradually slow and the grand achievements of our space explorers will diminish.

NASA suffers from chronic underfunding—not just compared to the Apollo era, when NASA funding was a significant priority in the federal budget, but even compared to where it was in the mid 1990's. The last two decades, NASA's real budget has declined while the index of aerospace costs—a measure of inflation—has risen. From 1994 to 2014, NASA lost nearly 11% of its purchasing power (figure 1). The cumulative effects of sub-inflationary budgets—despite otherwise low inflation—has significantly reduced NASA's ability to execute programs in a timely manner; delayed the agency's progress with crewed deep space missions; underfunded important Earth and space science programs; and hampered its ability to fund transformative research.

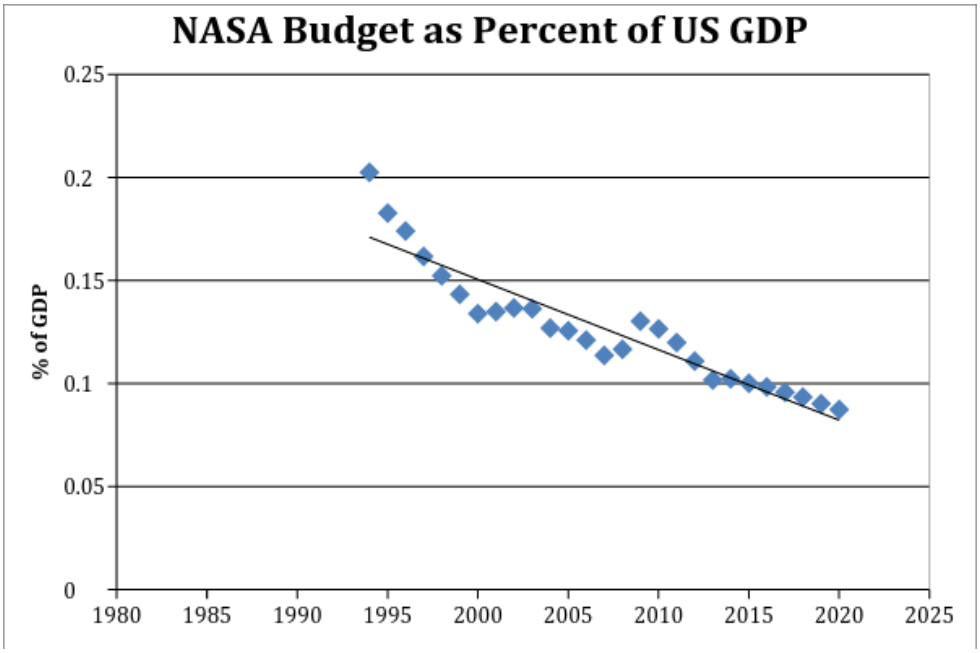

Figure 1 NASA budget as a percentage of the US gross domestic product (GDP) over time. In the period from 1994 to 2014, NASA's budget as a percentage of GDP has decreased resulting in an 11% decrease in purchasing power.

Considering the reduction in purchasing power impact since 1994, NASA's current budget is more than $2.2 billion below the levels of the mid 1990's. Those lost billions are enough to support a new flagship-level space science mission, or nearly three additional commercial spaceflight programs. Budgetary losses on this scale are not trivial. The current

NASA budget is preventing us from advancing our space and aeronautical ambitions, leading to decisions to cancel programs while underfunding other needed investments for over a decade. As a result, the US is losing its position as a world leader. The new Administration should work with Congress to support robust, long-term research and technology initiatives and fund them at a level that will ensure US leadership in aeronautics, exploration, and science. Fortunately, Congress has demonstrated a bipartisan commitment to increasing NASA's budget in recent years, appropriating more than $1.3 billion beyond the President's requests since 2015. *The new Administration must address NASA's current budget shortfalls and continue this recent trend of growth in the future.*

Maintaining a balance across the NASA portfolio that is based on the consensus of the stakeholders is necessary to ensure the long-term health of the program.

NASA leaders can best leverage investments in the United States space program by *continuing to develop a balanced portfolio for aeronautics, space exploration, and space science across the directorates*. The NASA Authorization Act of 2010 states that NASA "is and should remain a multi-mission agency with a balanced and robust set of core missions in science, aeronautics, and human space flight and exploration." It is essential to maintain a strong commitment to all of the agency's missions – small, medium and flagship missions. The optimal balance will inevitably change over time as new science discoveries and technological improvements are made. That adds to the inherent difficulty of optimizing the NASA portfolio, however, the science, engineering, and technology communities make an effort to reach a consensus within their community on what that balance should look like. It is then up to NASA and the administration to *use the community consensus as a guide when making decisions about how to invest resources. NASA should avail itself of communities like the National Academies and the NASA Advisory Councils to determine the community consensus*

Improve opportunities for cross-directorate collaboration to maximize the potential of NASA's programs and the return on investment.

Revolutionary discoveries in science have led to new interdisciplinary fields and the extraordinary advances in technology have further enabled our explorations of these fields. The increasing interdisciplinary nature of science means that directorates have an increasing level of overlapping interests in any given mission. Coordination between directorates within NASA is vital to facilitate the optimal allocation of resources. There are already some such coordination efforts in place, like the standing Federal Advisory Committee Act (FACA) advisory committees that provide expert community advice. *These experts, including the program managers in the relevant directorates, should be consulted to maximize both the potential of the mission and the investment.*

The heavy-lift capability of SLS has the potential to enable bolder science missions such as bigger and faster missions to Europa and other outer solar system destinations as well as large geometry space telescopes. But the SLS will only be of use to the science communities if the launch costs are not prohibitively high. *The new administration should encourage the SLS program to work with the science user communities to minimize the launch costs to NASA's science division and ensure that the development costs and schedule do not become burdensome*.

NASA's Journey to Mars is its most ambitious ever and given its cost and complexity, *it should be designed from the start to incorporate science into its missions*. Today, there is no short-term need to race another nation to Mars, instead there is considerable motivation for us to lead a group of international partners on this mission. This advances our goals and can help maximize value for taxpayers. Assuring that human exploration incorporates science from the start as a primary objective is essential for mission success and for enabling further exploration in the future.

Encourage innovative industry partnerships to maximize the impact of federal support.

Maximizing the impact of taxpayer supported research and development requires the healthy government investments and industry investments. The curiosity-driven research conducted at NASA often requires the development of innovative technologies. Industry partnerships have been necessary 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.*

NASA's Technology Transfer Program, within the Office of the Chief Technologist, facilitates the transfer of technology developed during these missions to the private sector by engaging with businesses and industrial sectors 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. *NASA should continue to ensure adequate mechanisms to transfer technology from federal agencies to the private sector and to provide opportunities for small businesses and nonprofit research institutions to participate in technology development.*

Continue global engagement and international collaborations to develop and sustain effective international relationships.

More than 100 nations have some type of space program, with fourteen operating their own launch vehicles, but the U.S. remains the recognized world leader. However, NASA's decreased purchasing power threatens that leadership position in a number of areas. The inevitable growth in complexity and cost of new projects has required expanded international cooperation at all stages from project conception through the prime mission. Furthermore, the emergence of international partnerships on all scales, from individual collaborations to major multinational projects, means that space science and exploration agendas are converging. There are many advantages to this including: reducing duplication of effort; marshaling the best technological expertise globally; and providing unique geographic advantages for ground-based projects, which makes it possible to complete projects that would otherwise be out of reach for any one nation. Global engagement also gives US-based scientists, engineers, and researchers the opportunity to contribute to space science and aeronautics programs in other nations. These collaborations have the potential to further other goals in international engagement and promoting U.S. leadership.

However, multiple international partners increase the complexity of decision-making, regulatory oversight, management, which can translate to higher project costs. NASA needs to manage the bureaucratic requirements and delays that can result from overly complex decision-making and management processes. International partnership should be regarded as an element of a broader strategy to coordinate construction and support of and access to facilities worldwide and to build scientific capability around the world. *The United States, in collaboration with its international and commercial partners, should sustain and build upon our national space commitments and investments with a continuity of purpose to advance recent achievements of space exploration and space science.*

The International Trade in Arms Regulations (ITAR), which controls the export of certain hardware, designs, or design and development information, can also cause schedule delays in project development. *Efforts within the government to streamline and rationalize the process for review and approval of exports should continue to minimize impediments to opportunities to enhance science and reduce costs without compromising security concerns.*

Commit to build the next generation workforce to ensure to continued excellence of NASA.

NASA plays a critical role in encouraging young people to pursue science, technology, engineering, and mathematics (STEM) disciplines and to strengthening the nation's workforce in these fields. NASA's K-12 education and outreach programs help inspire students early. 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 (MUREP), help ensure the diversification of our workforce by supporting STEM programs at U.S. minority serving institutions.

Beyond these outreach and education programs, NASA's research programs carried out at colleges and universities play a dual role in providing valuable research and infrastructure for NASA, while training the next generation science and engineering workforce. NASA provides unique, hands-on opportunities to students through principal investigator-led missions. These programs provide invaluable experiences for undergraduates and graduate students in short time frames and make for more attractive future hires for NASA and its partners. Under budget pressure, however, the cadence of these programs has slowed and competition for these programs has grown, with many government and commercial partners vying for awards that have traditionally fed the college and university pipeline. *Reduced and/or redirected NASA's awards should be addressed to avoid the commensurate loss in workforce development opportunities through higher education*.

NASA has also seen a decrease in research and analysis (R&A) grants, which allow college and university investigators to explore the necessary concepts, technology, techniques, calibration, validation, and analysis required for success throughout a mission's lifecycle. Low grant success rates lead many scientists, especially early career scientists to spend an inordinate amount of time writing proposals rather than conducting the research that is so critical to NASA's success. *R&A grants programs should be supported to ensure that success rates return to a healthy level. Further, increased support for NASA's education and public outreach programs, PI-led missions, and R&A grants, NASA and its partners is necessary to face increasing challenges in hiring a capable and informed technical workforce to ensure our future success in space.*