

the implementation and construction of such a network. The report should be developed in coordination with relevant Federal agencies and include ally Arctic nations, as appropriate.

*Microbiome.*—The Committee requests an update from the National Science and Technology Council on the implementation of the Interagency Strategic Plan for Microbiome Research, which was developed by the Microbiome Interagency Working Group, and in particular, any proposal for the continuation of the plan at its completion in 2022. The Committee encourages OSTP to prioritize leveraging the National Microbiome Data Collaborative at the Department of Energy to ensure cross-agency collaboration and integration of microbiome datasets.

*Career Technical Education (CTE) and Science, Technology, Engineering, and Math (STEM) Education and Workforce Pipeline Strategy.*—The Committee supports improving the coordination of Federal efforts involved in growing and sustaining a robust STEM and skilled technical workforce. The Committee recognizes the Office of Science and Technology Policy’s coordinating role of federal programs and activities relating to STEM education on the Committee on STEM Education. The Committee directs the Director to participate and coordinate as an essential federal stakeholder with department secretaries working to create a national CTE and STEM Education and Workforce Pipeline Strategy.

#### NATIONAL SPACE COUNCIL

The Committee recommends \$1,965,000 for the National Space Council, which is equal to the fiscal year 2021 appropriation and equal to the request.

#### NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

The Committee recommends \$25,038,400,000 for the National Aeronautics and Space Administration (NASA), which is an increase of \$1,767,122,000 over the fiscal year 2021 appropriation and \$236,900,000 above the request.

NASA’s fiscal year 2022 request places a welcome emphasis on Earth science and aeronautics research, and STEM education, while also continuing human exploration and increasing our understanding of the solar system and beyond. NASA is meeting its responsibility to help lead a whole-of-government approach to helping Americans prepare for and respond to a changing climate. NASA’s research will dramatically improve and streamline the collection and analysis of data that is critical to enhancing our understanding of climate change and our response to it. For the first time since fiscal year 2017, the Administration’s budget submission requests funding for the Office of STEM Engagement (OSTEM), and proposes a significant increase to that account. The Committee supports this increase and includes funding to greatly expand NASA’s Office of STEM Engagement.

The Committee’s program and project recommendations for NASA are included in the consolidated funding table below and in narrative direction throughout this report. The Committee reminds NASA that any deviations from the amounts included in the table below are subject to section 505 requirements of this Act. When executing its budget for fiscal year 2022, NASA shall incorporate

the funding levels established in both the table and the narrative direction.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
(In thousands of dollars)

Program	Amount
Science:	
Earth Science .....	\$2,250,000
Planetary Science .....	3,234,800
Astrophysics .....	1,446,300
James Webb Space Telescope .....	175,400
Heliophysics .....	773,000
Biological and Physical Science .....	90,000
Total, Science .....	7,969,500
Aeronautics .....	935,000
Space Technology .....	1,280,000
Exploration:	
Orion Multi-purpose Crew Vehicle .....	1,406,700
Space Launch System (SLS) Vehicle Deployment .....	2,635,900
Exploration Ground Systems .....	690,000
Exploration Research and Development .....	2,546,700
Total, Exploration .....	7,279,300
Space Operations .....	3,961,300
Science, Technology, Engineering, and Mathematics (STEM) .....	147,000
Safety, Security and Mission Services .....	3,030,000
Construction and Environmental Compliance and Restoration .....	390,300
Office of Inspector General .....	46,000
Total, NASA .....	\$25,038,400

SCIENCE

The Committee provides \$7,969,500,000 for Science, which is \$668,500,000 above the fiscal year 2021 appropriation and \$38,100,000 above the request.

*Earth Science.*—The recommendation includes \$2,250,000,000 for Earth Science programs, which is \$250,000,000 above the fiscal year 2021 enacted level and equal to the request. NASA’s budget submission reflects a renewed focus on Earth science, which was sorely lacking in the prior Administration’s requests. Climate change is a global crisis, and this research is critical to helping Americans understand the nature of climate change and how to effectively respond.

*Earth Science Research and Analysis.*—The Committee recommends no less than \$363,800,000 for Earth Science Research and Analysis, which is equal to the requested level.

*Plankton, Aerosol, Cloud, ocean Ecosystem (PACE).*—The Committee provides \$119,400,000, which is \$25,700,000 less than the fiscal year 2021 appropriation and equal to the Administration’s request. The data to be generated by PACE builds upon a multi-dec-

ade effort by NASA and other Federal agencies to generate information from space that helps, for example, to characterize and assess the health of the fisheries environment and to more accurately assess the status of fish stocks, as well as to help identify the extent and duration of harmful algal blooms. Such unique observational information cannot be replicated elsewhere, and industry itself does not have the financial means to acquire wide scale data such as that generated by PACE and its precursor missions. The Committee directs NASA to report to the Committee within 60 days of enactment on NASA's efforts to maintain a 2022 launch date for this mission.

*Climate Absolute Radiance and Refractivity Observatory (CLARREO) Pathfinder.*—The Committee provides \$19,000,000 for this mission, \$5,500,000 less than the fiscal year 2021 appropriation and \$500,000 above the Administration's request. The Committee welcomes NASA's inclusion of adequate funding in this year's budget request, as directed by the fiscal year 2021 Committee report.

*Deep Space Climate Observatory (DSCOVR).*—The Committee supports DSCOVR's continued operations through 2023 and recommends full funding for this important inter-agency initiative to maintain the nation's real-time solar wind monitoring capabilities, which are critical to the accuracy and lead time of NOAA's space weather alerts and forecasts.

*Small Satellite Launch Services.*—To enhance the breadth of research achieved using small satellite platforms and bolster NASA's overall scientific objectives, the Committee directs NASA to continue its work with commercial industry to examine ways for small satellite missions to procure launch services that are more tailored to their mission dependent orbits, locations, and schedules, while minimizing launch costs.

*University Small Satellite missions.*—The Committee supports NASA's collaborative efforts with U.S. colleges and universities to conduct research through small spacecraft missions, including CubeSat and SmallSat missions. The Committee believes these competitively selected projects led by principal investigators at institutions of higher education help train the next generation of scientists and provide much-needed research. The Committee directs NASA to provide not less than \$30,000,000 for these missions.

*Earth Science Decadal.*—The Committee supports the Administration's plan to consolidate upcoming missions recommended by the National Academy of Sciences' Decadal Survey for Earth Science and Applications from Space into its Earth Observatory System approach. As such, the Committee supports the Administration's request, which will fund the Mass Change and Surface Biology and Geology missions, as well as two missions to address Aerosols and Clouds, Convection and Precipitation.

*Planetary Defense.*—The Committee provides \$197,200,000 for Planetary Defense, which is equal to the request. The Committee recognizes NASA did not previously have the resources to invest in the capabilities required to satisfy its mandate to detect 90 percent of objects greater than 140 meters that threaten Earth by 2020. In keeping with prior congressional direction, the Committee also directs that not less than \$143,200,000 shall be for the Near-Earth Object Surveyor Mission (NEO Surveyor). The Committee wel-

comes NASA's commitment to the NEO Surveyor mission and to a 2026 launch date, and directs NASA to provide a report to the Committee, no later than 180 days after enactment of this Act, on the fulfillment of its NEO mandate and development progress of both the NEO Surveyor and DART missions.

*Double Asteroid Redirection Test.*—Within the funds provided for Planetary Defense, the Committee recommends not less than \$11,100,000, equal to the request, to ensure that the Double Asteroid Redirection Test (DART) technology demonstration mission is ready for launch in fiscal year 2022. The Committee understands that this mission can be accomplished with NASA participation only using ground-based telescopes and radars to provide the needed measurements to assess the degree of deflection resulting from the DART impactor, and that this telescope support is already baselined in the NASA mission.

*Lunar Discovery and Exploration.*—The Committee provides \$497,300,000 for Lunar Discovery and Exploration, including \$22,100,000 for continued operation of the Lunar Reconnaissance Orbiter and \$107,200,000 for the Volatiles Investigating Polar Exploration Rover (VIPER) mission to the South Pole of the Moon to search for and sample lunar water ice. These funds are equal to the request. The Committee supports NASA's commitment to utilizing public-private partnerships to advance its lunar science and exploration agenda and encourages the agency to leverage the resources and expertise of both private industry and universities in pursuit of these goals. The Committee directs that the Lunar Discovery and Exploration program adhere to the lunar science priorities established by decadal surveys and the National Research Council's Scientific Context for the Exploration of the Moon, and that activities funded within the program meet both lunar science and human exploration needs.

*Commercial Lunar Payload Services (CLPS).*—The Committee provides the full budget request for Commercial Lunar Payload Services (CLPS), which will help grow the space economy and create lasting, affordable commercial operations on the Moon. The Committee applauds the recent addition of new companies into the CLPS portfolio and the awarding of new commercial delivery contracts.

*New Frontiers missions.*—The Committee provides \$271,700,000 for New Frontiers missions, including \$201,100,000 for Dragonfly, which is equal to the budget request. The New Frontiers program explores our solar system with medium-class spacecraft missions. Within the New Frontiers program, possible mission destinations and the science goals for each competitive opportunity are limited to specific science targets announced for the competition aligned with the scientific goals and priorities as described in the Planetary Science Decadal Survey. The Committee also supports continuation of the Juno mission and urges NASA to include sufficient funding in its fiscal year 2023 budget submission to do the critical engineering and navigation calculations needed to continue the entire approved science scope of the Juno mission extension.

*Small Innovative Missions for Planetary Exploration (SIMPLEx).*—SIMPLEx are the only competitive planetary science missions that innovative commercial companies can lead, and the only planetary small spacecraft program within all of NASA. The Com-

mittee supports SIMPLEx solicitations and encourages NASA to consider ways to maximize opportunities for SIMPLEx missions, including the potential for dedicated smallsat launch, in addition to the current option of using rideshare on large launch vehicles, which will further accelerate and enhance overall planetary science mission objectives.

*Venus Technology Project.*—Within Planetary Science, the recommendation includes no less than \$10,000,000, equal to the request, for Venus Technology and technology demonstrations for Venus Discovery, including Venus surface science instrumentation work.

*Mars Exploration Program.*—The Committee provides \$267,800,000, which is \$32,600,000 below the fiscal year 2021 appropriation and equal to the requested level. This level reflects the establishment of the Mars Sample Return as a separate mission.

*Mars Sample Return.*—The Committee provides \$688,000,000 million for Mars Sample Return, \$34,800,000 above the request. The Committee does so in recognition of the important impact that the successful landing and operation of the Mars Perseverance rover is having for the nation and the scientific research community. In fulfillment of the objective to cache and return samples to Earth, and as the highest priority of the Planetary Science decadal survey, funding is provided for the Mars Sample Return mission to meet a 2026 launch window.

*Jupiter Europa Missions.*—The Committee provides \$472,100,000, which is \$68,600,000 above the fiscal year 2021 appropriation and equal to the request level, for the Europa Clipper Mission. The Clipper mission will explore Europa, the smallest of the four Galilean moons orbiting Jupiter, and investigate its habitability. The Committee reiterates that following a full and open competition, the Administrator is not limited to the launch vehicles listed in the NLS-II contract of the Launch Services Program as of the date of the enactment of this Act, and the Europa Clipper Mission may launch on a commercial launch vehicle, if NASA makes such an award, in order to support a 2024 launch to reduce overall mission costs and complexity and expedite science results as supported by the decadal survey.

*Icy Satellites Surface Technology.*—The Committee directs that not less than \$14,200,000 shall be for Icy Satellites Surface Technology to meet the science goals for the Jupiter Europa mission as recommended in previous Planetary Science Decadal surveys and to enable a lander and Ocean Worlds Technology mission by the next decade, based on input from the next Planetary Science Decadal survey. Investments in landing, mobility, sampling, communications, autonomous operations, and power technology for low-temperature environments should be prioritized.

*Stratospheric Observatory for Infrared Astronomy (SOFIA).*—The Committee rejects the Administration's request to terminate SOFIA and provides \$85,200,000, which is equal to the fiscal year 2021 level. SOFIA can undertake astronomical observations not possible with other ground-based or space-based telescopes available today. SOFIA has made significant recent scientific discoveries, including detecting, for the first time, helium hydride in interstellar space, which is thought to be the first molecule ever

formed in the early universe, as well as identifying compelling evidence of water on the Moon, for the first time, in its sunlit regions.

*Nancy Grace Roman Space Telescope.*—The Committee provides \$501,600,000, which is equal to the request, and supports a mission launch in 2025. This mission was included as the highest priority in the 2010 Astrophysics Decadal Survey. Within this total, the recommended amount shall include continued development of the coronagraph as a technology demonstration mission.

*Astrophysics Explorers.*—The Committee provides \$277,700,000 for the Astrophysics Explorer program. The Committee is encouraged by NASA's commitment to accelerate the cadence of Astrophysics Explorer missions and to establish a new line of small Pioneer-class missions that leverage advancements in low-cost platforms such as CubeSats and balloons to support groundbreaking science. The Committee recognizes that such activities can improve scientific understanding while simultaneously developing the scientific workforce through increased research opportunities for students and faculty.

*Astrophysics Research.*—The Committee recognizes the role of the Astrophysics Research program in supporting the development of novel astrophysics observation technologies that lay the foundation of future mission architectures, and recommends \$279,100,000. A strong research program maximizes the scientific value of space-based missions by ensuring that the data collected through such observations can continue to provide new insights into the mechanisms behind cosmological phenomena. The Committee also understands that supporting these activities through extramural grant funding contributes to the long-term viability of the U.S. astrophysics community.

*James Webb Space Telescope (JWST).*—The Committee provides \$175,400,000, which is equal to the Administration's requested level.

*Heliophysics Technology.*—The Committee appreciates NASA including this account in its fiscal year 2022 budget request, and provides the requested funding. The Committee recognizes the critical role that technology development programs play in enabling novel and transformative capabilities and mission concepts and notes the contributions of these programs in other divisions within the Science Mission Directorate. Activities supported by such programs in Heliophysics can help sustain a robust community of technologists with unique connections to the discipline while also contributing to the workforce development pipeline through funded research and technology development at universities.

*Solar Terrestrial Probes.*—The Committee recommends \$253,300,000 for the Solar Terrestrial Probes program. The Committee supports NASA's implementation of the Interstellar Mapping and Acceleration Probe (IMAP) and the Dynamical Neutral Atmosphere-Ionosphere Coupling (DYNAMIC) mission as competitively selected, cost-capped, and principal investigator-led missions in accordance with the recommendations of the Decadal Survey. The Committee also directs that within these funds, not less than \$21,400,000, \$600,000 above the request, is provided for the continuation of the Magnetospheric Multiscale (MMS) mission.

## AERONAUTICS

The Committee provides \$935,000,000 for Aeronautics, which is \$106,300,000 greater than the fiscal year 2021 appropriation and \$20,200,000 above the requested level.

*Hypersonics Technology Project.*—Within amounts provided, not less than \$50,000,000 is for NASA's ongoing Hypersonics Technology Project (HTP), which is \$10,000,000 above the request. Hypersonic flight involves speeds of Mach 5 and above and holds the potential for new military and civilian capabilities and to boost American leadership in new commercial flight technology applications. Program managers should continue to coordinate closely with partners in the Department of Defense (DOD) to enable NASA to leverage investments in ground and flight activities and to develop and validate advanced physics-based computational models as building blocks toward a long-term vision for high-speed, hypersonic and high Mach air transport. The Committee strongly encourages NASA to continue to explore additional opportunities to increase hypersonics research, including reusable vehicle technologies, hypersonic propulsion systems, and high temperature materials, including advancement of next-generation Carbon-Carbon composite and other advanced material development. No less than \$15,000,000 of HTP funds should be prioritized for collaborations with academia and industry, including potential public-private partnerships as appropriate, with the goal of advancing hypersonic and high Mach technologies that meet both NASA's strategic goals as well as industry needs, with particular emphasis on reducing the environmental and operational barriers to flight at these speeds. The committee also notes the opportunities for commercial hypersonic usage, or low-speed hypersonic flight at Mach four to Mach five to enable development of the next generation of commercial aeronautics travel.

*University-led Aeronautics Materials Research.*—Within funding for the Aeronautics, the Committee provides up to \$10,000,000 to advance university-led aeronautics materials research for structural applications. With this funding, the Committee encourages NASA to partner with academic institutions that have strong capabilities in aviation, aerospace structures, inspection and the associated predictive life-cycle performance, and materials testing, inspection, and evaluation, to reduce material system time to acceptance.

*Aerosciences Evaluation and Test Capabilities.*—The Committee fully funds the Aerosciences Evaluation and Test Capabilities wind tunnel management program at the Administration request, and directs NASA to report to the Committee within 90 days of enactment regarding NASA's Aerosciences Evaluation and Test Capabilities (AETC) portfolio, which includes NASA wind tunnels, propulsion test facilities, and specialty tunnels. Because the Committee is aware that NASA is coordinating with DOD to repair the Hypersonics Tunnel Facility (HTF), such report should include a status of the NASA/Department of Defense coordinated assessment of the HTF.

*Integrated Aviation Systems Program (IASP).*—The Committee provides \$311,700,000 for IASP, which is \$10,200,000 above the request. These funds support components of NASA's critical work on

the Sustainable Flight National Partnership (SFNP), Low-Boom Flight Demonstration Mission, and the Advanced Air Mobility Mission. Taken together, these efforts have the potential to significantly reduce aircraft emissions and improve the efficiency of air travel.

*Sustainable Flight Demonstrator Project.*—The Committee strongly supports NASA’s planned Sustainable Flight Demonstrator Project (SFD) development and production of the Transonic Truss Brace Wing (TTBW) Subsonic X-Plane, which will demonstrate critical new structures, including the TTBW and high rate composites manufacturing, as well as new propulsion technologies on a national flight demonstrator platform. The Committee directs NASA to provide a report on the Agency’s roadmap, technologies, and milestones for the program from development to flight, not later than 60 days after the enactment of this Act.

*Electric Aircraft.*—With the development of the X-57 electric aircraft, the Committee is encouraged by the capabilities that this aircraft brings to NASA and the agency’s efforts to help develop the electric aircraft market. Because of the national significance of this program, the Committee directs NASA to provide a report to the Committee, not later than 60 days after the enactment of this Act, on NASA’s plans to test and validate this aircraft’s electronic power system, as well as its strategy for continued flight testing. The report should include a description of any additional infrastructure necessary, the estimated cost of the needed infrastructure, and recommendations that would assist NASA in testing and further developing this cutting-edge technology.

*Electric Air Flight.*—The Committee encourages NASA to strengthen its collaborations with the Department of Energy and national laboratories to overcome energy storage challenges for mobility such as electric air flight. The Committee is encouraged by NASA’s efforts within its Electrified Powertrain Flight Demonstration project, which focuses on flight demonstrations that advance the state-of-the-art in megawatt-class more-electric aircraft to enable enduring leadership of the U.S. aviation industry for the benefit of the country and the U.S. flying public.

*Electrified Aircraft Propulsion Demonstrator.*—The Committee encourages NASA to accelerate research and development for next generation commercial engine technologies for Electrified Aircraft Propulsion, Electrified Aircraft Propulsion Demonstrator (EAPD), and Hybrid Thermally Efficient Core (HyTEC). The Committee also encourages NASA to accelerate research and development for the Small Core Gas Turbine and High-Rate Composite, which will offer both fuel consumption and carbon emission savings for Single Aisle aircraft.

*Autonomous Aircraft Systems.*—Autonomous aircraft systems are an emerging technology that benefits the civil, scientific, and defense sectors. NASA’s efforts to test these systems have helped pave the way in assisting the Federal Aviation Administration in developing autonomous aircraft standards and will provide much-needed data to safely integrate this technology into the National Airspace System. NASA is directed to report to the Committee within 60 days of enactment on NASA’s strategy on furthering autonomous aircraft system technology, including addressing flight testing resources, protocols, and operations. The report should also

include information on how NASA plans to work with the Federal Aviation Administration on validating and regulating these systems to safely coexist with other air traffic, including air traffic from the Department of Defense.

*High-Performance Chase Aircraft.*—The Committee understands the value of high-performance chase aircraft, such as F/A–18 and F–15 aircraft, which enhance NASA’s unique research capabilities. The Committee is aware that some of NASA’s current chase aircraft are having end-of-life issues, and maintenance costs are increasing to sustain the aging aircraft for test requirements. Within 30 days of enactment of this Act, the Committee directs NASA to provide a briefing to the Committee on the strategy NASA is taking to resolve this issue in a timely manner, ensuring relevant NASA Centers have the necessary chase aircraft to support its testing mission. The Committee also directs NASA, within 180 days of enactment of this Act, to begin providing quarterly status updates to the Committee on the progress being made, challenges, and approaches to resolve this issue.

#### SPACE TECHNOLOGY

The Committee recommends \$1,280,000,000 for Space Technology, which is \$180,000,000 above the fiscal year 2021 appropriation and \$145,000,000 below the request. Investments in Space Technology hold promise for solving some of the biggest challenges facing the space economy, including improving space situational awareness, orbital debris management and spacecraft power. The Committee directs NASA to collaborate with universities to develop technologies applicable to forthcoming, scheduled missions.

*Space Technology Mission Directorate.*—The Committee reaffirms its support for the independence of the Space Technology Mission Directorate and recognizes that its current status enables it to support the development of a wide array of various technologies. This diverse portfolio contains technology development activities that have broad applications beyond human exploration and that help to meet the agency’s science objectives, establish new commercial and academic partnerships, and stimulate the growth of the Nation’s technology sector. This approach also ensures that NASA technologists and their external partners maintain the ability to address long-term strategic goals rather than only focusing on short-term, mission-specific objectives. In addition, the Directorate’s direct engagement with the academic community is supporting the development of the next generation of space technologists. The Committee directs NASA to preserve the Directorate’s focus across NASA and in support of each of the mission directorates.

*Regional Economic Development.*—The Committee provides \$8,000,000, which is equal to the fiscal year 2021 appropriation. NASA’s regional economic development program focuses on partnerships with State and regional economic development organizations as they expand space-related commercial opportunities designed to address NASA mission needs. To ensure that the Agency has a vision and metrics for success with these funds, NASA is directed to report to the Committee within 120 days of enactment on how it will use these funds. Such a report shall contain clear metrics for success, including an accounting of the partnerships

with economic development entities for Federal, state, and regional economic development agencies with experience in this area.

*Solar Electric Propulsion.*—The Committee provides \$40,000,000 to continue work on solar electric propulsion activities, which is \$8,700,000 below the fiscal year 2021 appropriation and \$15,800,000 above the requested level. According to NASA, high-powered solar electric propulsion can efficiently propel more ambitious robotic science and human exploration missions beyond the Earth and into deep space. Solar electric propulsion will enable more efficient orbit transfer of spacecraft and accommodate the increasing power demands for government and commercial satellites. The Committee also encourages the Agency to begin envisioning the next generation Solar Electric Propulsion thruster systems.

*On-Orbit Servicing, Assembly, and Manufacturing.*—The Committee provides \$227,000,000, which is equal to the fiscal year 2021 appropriation and the request, for the On-Orbit Servicing, Assembly, and Manufacturing-1 (OSAM-1) mission, formerly known as Restore-L. The Committee encourages NASA to provide funding for On-orbit Servicing, Assembly, and Manufacturing-2 (OSAM-2, Archinaut) at not less than the requested level. The Committee recognizes the potential of on-orbit satellite servicing to NASA, its Federal agency partners and the private sector, and thus urges NASA to consider future opportunities to develop Operational Demonstration, On-Orbit Robotic Assembly and Manufacturing of RF Antennas (OSAM-3), and to report to the Committee on planned funding in fiscal year 2022 to be used for these activities, given the potential benefit of OSAM-3 capabilities to Earth Science missions. The Committee further directs NASA to continue to work with the interagency community and commercial partners to assess opportunities for the collaborative development and adoption of OSAM capabilities.

*Flight Opportunities Program.*—The Committee provides \$30,000,000, which is \$3,000,000 above the fiscal year 2021 appropriation and \$5,000,000 above the request for the Flight Opportunities Program, to enable NASA to continue to partner with commercial industry to advance technologies for sub-orbital and orbital launch vehicles for small payloads, with the aim to increase affordability of those technologies and to allow for more frequent access to relevant launch environments, including low-Earth orbit. As a growing number of commercial space companies are providing low-cost and frequent access to suborbital space for humans and research payloads, the Flight Opportunities Program should also expand its contributions to NASA's broader science and technology development missions. An increase in funding will allow NASA to leverage additional commercial capabilities offered in the market and provide a channel for frequent and cost-effective research to support exploration and understanding our home planet.

*Nuclear Thermal Propulsion.*—The Committee provides \$110,000,000, which is equal to the fiscal year 2021 enacted amount, and \$110,000,000 more than the Administration's requested level, for continued development and demonstration of a nuclear thermal propulsion system. The Committee looks forward to receiving the agency's plan for the design of an NTP flight demonstration system that was required in Public Law 116-260, and strongly encourages the continued design of an NTP flight dem-

onstration program. Not later than 180 days after the enactment of this Act, the Committee directs NASA to provide a report detailing whether the establishment of a Nuclear Thermal Propulsion and Nuclear Power Office in the Human Exploration and Operations Mission Directorate could accelerate NTP development to prepare for future deep space missions.

*Nuclear Electric Propulsion (NEP).*—The Committee is encouraged by the great potential for space nuclear propulsion technologies relating to nuclear electric propulsion. As the National Academies identified in a February 2021 report, a multi-year research program would need to include subsystem development, prototype systems, ground testing, and cargo missions as a means of flight qualification prior to first crewed use. The agency is directed to respond to the National Academies conclusion and shall indicate its plans to develop consistent metrics and technical expertise to allow for opportunities to utilize NEP to meet space exploration mission requirements. The Committee also notes that key partners in the national laboratories possess capabilities needed to reach the frontiers of scientific development for nuclear electric power. The Committee provides that at least \$10,000,000 shall be utilized to begin a systematic approach to Nuclear Electric Propulsion, to chart the basic framework needed in this frontier of investment. Within 180 days of the enactment of this Act, NASA, in coordination with other relevant Federal departments and agencies such as the Department of Energy, shall submit a multi-year plan for in-space propulsion-system demonstration for NEP.

*Fission Surface Power.*—The Committee supports NASA's efforts to complete research, design work, test plan, and cost analysis for a Low-Enriched Uranium space power reactor. The Committee notes the importance of utilizing surface fission power to facilitate long term habitation on the Moon and Mars. As part of the fiscal year 2023 budget submission, NASA should provide the Committee with a long-term plan on how it intends to implement an achievable Fission Surface Power program.

*Tipping Point Solicitations for Lunar Infrastructure.*—The Committee supports NASA's efforts to advance a wide range of technologies with benefits for many missions across the agency. In particular, the Lunar Surface Innovation Initiative (LSII) plays a key role in supporting infrastructure technologies that will enable robust robotic and human exploration activity on the Moon. The Committee supports the LSII's broad engagement with industry from across the country and urges NASA to advance a new round of lunar infrastructure-related solicitations in Fiscal Year 2022.

*Moon-to-Mars Landing Demonstrations.*—To support Moon-to-Mars specific technologies, crosscutting applications for the commercial space economy, as well as science and robotic exploration toward other planetary bodies and destinations, within Space Technology, the Committee provides no less than \$75,000,000 for demonstration efforts to allow industry to compete for public-private partnership opportunities focused on high-level, NASA-defined objectives.

*Personal Protective Equipment Manufacturing.*—The Committee is aware of the unique manufacturing requirements for certain personal protection equipment used on the International Space Station (ISS). The Committee therefore encourages NASA to explore ways

to sustain or enhance domestic manufacturing of personal protection equipment for the ISS and commercial stations.

#### EXPLORATION

The Committee provides \$7,279,300,000 for Exploration, which is \$1,147,000,000 above the fiscal year 2021 appropriation and \$398,600,000 above the requested level.

*Orion.*—The Committee provides \$1,406,700,000, which is equal to the fiscal year 2021 enacted level and equal to the requested level for Orion. With advanced life support, communications and navigation capabilities, the Orion spacecraft will take humans deeper into space than ever before, and thus is an integral part of the Artemis program. NASA shall keep the Committee informed of the status of activities related to Orion, the European Service Module, and ongoing activities related to integration of Orion with Space Launch System and associated ground infrastructure.

*Space Launch System (SLS).*—The Committee provides \$2,635,900,000, \$50,000,000 above the fiscal year 2021 appropriation, and \$148,900,000 above the Administration's request. Within the amount provided, not less than \$579,000,000 is provided for SLS Block 1B Development, which is \$100,000,000 above the Administration's request. Additionally, the Committee encourages NASA to study the procedures required to designate an integrator for private sector customers who wish to acquire an SLS vehicle. The Committee also directs NASA to engage an independent reviewer with aerospace production management experience to conduct a review of SLS completion costs and provide such reviewer with direct access to SLS program managers and production and pricing data, to determine how the cost of future flights of the SLS can be reduced. Further, the Committee directs NASA to undertake all work necessary in fiscal year 2022 toward completion of the SLS Block 1B as though the Block 1B were in the critical path for Exploration Mission-3.

*Exploration Ground Systems (EGS).*—The Committee provides \$690,000,000, which is \$100,000,000 more than the fiscal year 2021 appropriation and \$100,000,000 greater than the requested level, for Exploration Ground Systems (EGS). Within this amount, the Committee provides \$165,300,000 for the Second Mobile Launcher (ML-2). The Committee is troubled by NASA's failure to provide details on the rising cost of the ML-2 in its budget proposal, and directs NASA to report to the Committee within 30 days of enactment with a revised cost estimate, both phased and in total.

*Advanced Exploration Systems.*—The Committee provides \$195,000,000, which is equal to the request, for Advanced Exploration Systems. Within funding provided, the Committee encourages NASA to advance the study and applicability of ionic liquid-based sorption advanced technologies in addition to the potential benefits of non-planar continuous composite fiber molding for high-volume parts needed in space. The Committee also provides up to \$10,000,000 to support Advancing Assembly of Deep-Space Long Duration Habitation and Exploration Systems within the NextSTEP Habitation program.

*Advanced Cislunar and Surface Capabilities.*—As part of the formulation of the fiscal year 2023 budget request, the Committee directs NASA to evaluate the need, timing, and procurement of

Human Landing Systems for transport of useful heavy cargo to the lunar surface in support of a sustainable Moon to Mars program.

*Human Landing System (HLS).*—The Committee includes no less than \$1,345,000,000 for the HLS, which is no less than \$150,000,000 above the request. While the Committee has elected not to further fence or condition funds for the Human Landing System program at this time due to the current Government Accountability Office (GAO) protest on the HLS Appendix H selection, the Committee urges NASA to bolster competition in lander development and production and improve the United States' prospects for landing astronauts on the Moon in 2024.

*Human exploration programs.*—The Committee directs GAO to continue its review of NASA's human exploration programs, specifically the SLS program, the Orion program, and Exploration Ground Systems, to include the mobile launch platforms, and the Human Landing Systems program, and to include integration and software development issues that cut across these programs. In addition, the Committee directs GAO to review NASA's lunar-focused programs, including the Gateway program and other programs or projects that are expected to have an estimated life-cycle cost over \$250,000,000, as part of GAO's semiannual assessment of NASA major projects. Separately, the Committee directs GAO to continue conducting in-depth reviews of NASA's lunar-focused programs. GAO shall report on the acquisition progress of these programs, as well as any challenges NASA faces in implementing its lunar efforts, as applicable. GAO shall provide periodic updates to the Committee on these reviews.

#### SPACE OPERATIONS

The Committee provides \$3,961,300,000 for Space Operations, which is \$26,900,000 below the fiscal year 2021 appropriation and \$56,100,000 below the requested level.

*Commercial Crew and Cargo Program.*—The Committee strongly encourages NASA to invest these funds into a diverse group of cargo suppliers, with varying capabilities, to be able to meet future mission sizes, needs, and goals.

*Commercial Crew Program.*—The Committee supports NASA's efforts to enhance human research capabilities on the International Space Station and acknowledges the increased crew transportation capability offered through NASA's Commercial Crew Program partners. The Committee directs NASA to continue assessing the Commercial Crew manifest for opportunities to conduct additional research and report on these findings no later than 180 days after the enactment of this Act.

*Sub-Orbital Crew Program.*—Within the funds provided for the Commercial Crew and Cargo program, NASA is provided up to \$10,000,000 for Sub-Orbital Crew. With this funding, and through the Flight Opportunities program in the Space Technology account, the Committee directs NASA, to the greatest extent practicable, to support flights for non-NASA personnel. Further, as NASA works to develop its Suborbital Crew Program, the Committee encourages NASA to assess whether it should establish a relevant program office to qualify commercial U.S. suborbital vehicles and procure flights for NASA personnel, while prioritizing safety and avoiding

duplicative existing Federal Aviation Administration (FAA) vehicle licensure processes.

*21st Century Launch Complex Program.*—Within the amounts provided for Space Operations, the recommendation includes up to \$20,000,000 for the 21st Century Launch Complex Program. The Committee remains concerned with efforts directed toward filling critical maintenance, capacity, and range safety gaps at NASA launch facilities, and further urges NASA to take into consideration the full potential of all NASA-owned launch complexes in awarding the funds.

*Rocket Propulsion Test program.*—The recommendation includes the requested amount of \$47,800,000 for the Rocket Propulsion Test program, which is \$200,000 greater than the fiscal year 2021 appropriation. The Committee encourages NASA to prioritize facility and fixed infrastructure improvements specific to infrastructure that is shared among users of the facility in a continued effort to attract and facilitate commercial partnerships at NASA's test centers. NASA is directed to report to the Committee, not later than 180 days after the date of enactment, on the specific uses of Rocket Propulsion Test Program funds over the past three fiscal years and expected uses in fiscal year 2022, including allocations of resources to specific NASA centers.

*Space Communications and Navigation (SCaN).*—The recommendation includes \$42,000,000 for the Communications Services Program (CSP), consistent with the budget submission, to begin deploying and testing the use of commercial services in the next generation LEO space communications system. With the proliferation of satellites capable of providing for NASA's communications needs, this program represents a significant opportunity to deliver more economical and efficient services. However, the Committee is concerned that NASA lacks a clear long-term vision for this program and is concerned about the proposal to consolidate CSP under SCaN. Therefore, NASA is directed to report to the Committee on its delineation of responsibilities for the program, CSP independence, and an explanation of how the program goals differ from those of SCaN.

*Domestic Launch Services.*—The Committee recognizes that global competition in the spaces launch market is increasing, and the United States remains the only nation with domestic competition in this field. The Committee also recognizes that NASA is dependent on a healthy domestic industrial base and first-rate space transportation infrastructure for United States launch providers, and that the U.S. Government has made and continues to make major, strategic investments in the Nation's space transportation capabilities. Therefore, the Committee underscores the value of using domestic launch providers, U.S.-manufactured launch vehicles, and U.S. launch sites.

*Commercial Low-Earth Orbit Development.*—The Committee recommends \$45,000,000, which is \$28,000,000 above the fiscal year 2021 appropriation and is \$56,100,000 below the request. The Committee is concerned that NASA lacks clear goals and metrics for the transition away from the International Space Station (ISS). Therefore, NASA is directed to report to the Committee within 180 days of enactment of this Act on its plans for the transition away from the ISS, including an assessment of future requirements for

maintaining a continuous human presence in low-Earth orbit, an overview of current industry capabilities, and NASA's plans for ensuring government-sponsored continued on-orbit science research. Such report should also discuss expectations for how NASA will sustain global leadership in space science research in the absence of a NASA-owned and operated station. The Committee appreciates receiving the report directed in House Report 116–455 assessing the costs, benefits, and challenges of repurposing launch vehicle upper stages as free-flying platforms for habitation or industrial modules. In fiscal year 2022, the Committee directs the Agency to consider making funding within Commercial LEO Development available to support free-flying robotic LEO Commercial Space platform development and related technologies.

SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM)  
ENGAGEMENT

The Committee provides \$147,000,000 for Science, Technology, Engineering, and Mathematics (STEM) Engagement, which is \$20,000,000 greater than the fiscal year 2021 appropriation and equal to the budget request. STEM is consistent with NASA's mission to inspire America's students, create learning opportunities, and enlighten inquisitive minds.

*National Space Grant College and Fellowship Program.*—The recommendation includes \$60,000,000 for the Space Grant program. This amount will allow each State consortium to receive \$1 million in base funding, which shall be allocated to State consortia for competitively awarded grants in support of local, regional, and national STEM needs.

*Established Program to Stimulate Competitive Research (EPSCoR).*—The recommendation includes \$26,000,000 for EPSCoR, consistent with the budget request.

*Minority University Research and Education Project (MUREP).*—The recommendation includes \$48,000,000 for MUREP.

*Next Generation STEM.*—The recommendation includes \$13,000,000 for Next Generation STEM. The Committee appreciates NASA's relationships with TEAM II participants, museums, and planetariums through STEM Education and Accountability Projects (SEAP), as well as the productive use of cooperative agreements with NASA Visitor Centers, and encourages NASA to continue these successful partnerships. The Committee also encourages NASA to continue using OSTEM funding to support STEM partnerships.

*K–12 Designed Payloads.*—The Committee encourages NASA's Office of STEM Engagement to work in coordination with the Space Technology Mission Directorate to create opportunities for students in K–12 to fly payloads onboard commercial suborbital vehicles and to ensure that these opportunities focus on a wide demographic of students, especially those in underrepresented areas.

SAFETY, SECURITY AND MISSION SERVICES

The Committee provides \$3,030,000,000 for Safety, Security, and Mission Services, which is \$93,500,000 above the fiscal year 2021 appropriation and \$19,200,000 less than the requested level.

*Working Capital Fund (WCF) reporting.*—NASA shall continue to submit quarterly reports to the Committee on the expenditures and unobligated balances of NASA’s WCF.

*Cybersecurity.*—Within Safety, Security and Mission Services, the Committee directs NASA to provide not less than \$612,200,000 for Information Technology, consistent with the request.

*Science, Space, and Technology Education Trust Fund.*—The Department of Housing and Urban Development-Independent Agencies Appropriations Act of 1989 (Public Law 100–404) established and funded the Science, Space, and Technology Education Trust Fund, with the funds required to be subsequently invested in special issue securities, earning interest from the corpus fund to be credited to the Trust Fund for the purpose of making grants for programs directed at improving science, space, and technology education in the United States. Recipients of these grants are required to provide matching funds from non-Federal sources. The Committee is aware that, due to current interest rates, interest derived from the corpus fund may soon be insufficient to meet the levels of legally required disbursements of funds, as specified in the original Act. Therefore, up to \$1,000,000 is made available from amounts under this heading.

*Mission Support Future Architecture Program.*—The Committee directs the Administrator to report to the Committee on impacts and operating losses experienced by NASA Centers, as well as any efficiencies gained, as a result of implementation of the Mission Support Future Architecture Program (MAP) program, not later than 30 days after the date of enactment of this Act.

*IV&V Program.*—The Committee directs that within the amounts provided, not less than \$39,400,000 is for NASA’s IV&V Program and, if necessary, NASA is directed to fund additional IV&V activities from within the mission directorates that make use of IV&V services.

*Community Projects.*—Within the appropriation for Safety, Security and Mission Services, the Committee recommendation also provides funds for the following Community Projects:

NASA COMMUNITY PROJECTS

Recipient	Recipient	Amount
Louisiana State University, National Center for Advanced Manufacturing.	Aerospace Systems and Technology Development ....	\$5,000,000
Oklahoma State University .....	6G Innovations .....	\$1,000,000
Oklahoma State University .....	Rapid Assured Fully Transparent Integrated Circuit Platform Project.	\$1,200,000
Rancho Cucamonga Public Library .....	Second Story and Beyond Project .....	\$1,000,000
Rush University Medical Center .....	REACH for Information Technology Training .....	\$650,000

CONSTRUCTION AND ENVIRONMENTAL COMPLIANCE AND RESTORATION

The Committee provides \$390,300,000 for Construction and Environmental Compliance and Restoration, which is \$38,200,000 below the fiscal year 2021 appropriation and equal to the requested level.

*Construction.*—The recommendation includes \$315,600,000 for Construction of Facilities, minor revitalization, planning and design, and demolition, including the highest repair priorities described in the Administration’s request.

*Environmental Compliance and Restoration.*—The recommendation includes \$74,700,000, which is \$31,200,000 less than the fiscal year 2021 appropriation and equal to the requested level, for Environmental Compliance and Restoration activities. NASA's Environmental Compliance and Restoration (ECR) program cleans up hazardous materials and waste products released to the surface or groundwater at NASA installations, NASA-owned industrial plants supporting NASA activities, current or former sites where NASA operations have contributed to environmental problems, and other sites where the Agency is legally obligated to address hazardous pollutants.

*Santa Susana Field Laboratory.*—The Committee is pleased with the progress of building demolition at the Santa Susana Field Laboratory but remains concerned about soil remediation. The Committee understands that NASA is working with the State of California under the 2007 Consent Order and 2010 Administrative Order on Consent regarding soil and groundwater cleanup at the site and on expediting the State's environmental impact report. The Committee encourages NASA to continue working with the State of California on cleanup of the site.

#### OFFICE OF THE INSPECTOR GENERAL

The Committee recommends \$46,000,000 for the Office of the Inspector General, which is \$1,800,000 above the fiscal year 2021 appropriation and equal to the requested level.

#### ADMINISTRATIVE PROVISIONS

##### (INCLUDING TRANSFERS OF FUNDS)

The Committee has included the following administrative provisions for NASA:

The bill includes a provision that makes funds for any announced prize available without fiscal year limitation until the prize is claimed or the offer is withdrawn.

The bill includes a provision that establishes terms and conditions for the transfer of funds.

The bill includes provisions that require NASA to submit its agency spending plan at the activity level and subjects both the spending plan and specified changes to that plan to reprogramming procedures under section 505 of this Act.

The bill includes a provision that limits the availability of funds for certain activities until a plan is submitted.

The bill allows for the transfer of funds from Exploration to Construction.

The bill includes a provision that provides NASA with additional flexibility to ensure completion of construction projects undertaken with fiscal year 2021 funds.

#### NATIONAL SCIENCE FOUNDATION

The Committee recommends \$9,634,036,000 for the National Science Foundation (NSF), which is \$1,147,277,000 above fiscal year 2021 and \$535,264,000 below the request.

In addition, the American Rescue Plan Act of 2021 (Public Law 117–2) included \$600,000,000 for the National Science Foundation to fund or extend new and existing research grants, cooperative