## FY 2021 Budget Request
## Deep Space Exploration Systems
*($ Millions)*

| | FY 2019 | FY 2020 | FY 2021 | FY 2022 | FY 2023 | FY 2024 | FY 2025 |
|---|---|---|---|---|---|---|---|
| **Deep Space Exploration Systems** | **5,044.8** | **6,396.4** | **8,761.7** | **10,299.7** | **11,605.1** | **10,887.7** | **8,962.2** |
| **Exploration Systems Development** | | | **4,042.3** | | | | |
| Orion Program | | | 1,400.5 | | | | |
| Space Launch System | | | 2,257.1 | | | | |
| Exploration Ground Systems | | | 384.7 | | | | |
| **Exploration Research & Development** | | | **4,719.4** | | | | |
| Advanced Exploration Systems | | | 258.2 | | | | |
| Adv Cislunar and Surface Capabilities | | | 212.1 | | | | |
| Gateway | | | 739.3 | | | | |
| Human Research Program | | | 140.0 | | | | |
| Human Landing System | | | 3,369.8 | | | | |
| **Grand Total** | | | **8,761.7** | | | | |

The FY 2021 Budget for the Deep Space Exploration Systems account consists of two areas, Exploration Systems Development (ESD) and Exploration Research and Development (ERD), which provide for the development of systems and capabilities needed for human exploration of the Moon and Mars.

**Exploration Systems Development (ESD)**

- ESD programs work together to build the space transportation system made up of the Orion crew vehicle, the Space Launch System (SLS) rocket, and Exploration Ground Systems (EGS). This system will enable the Agency's new mission to extend human presence into the solar system, starting with a return to the Moon in 2024. The Artemis I and Artemis II launch dates are under review pending completion of the Human Exploration and Operations Mission Directorate (HEOMD) Program Status Assessment. In parallel, NASA is performing an independent technical and programmatic assessment, including a joint cost and schedule confidence level analysis of the SLS and EGS programs.

- The Orion program will continue final assembly and testing of the Artemis I crew vehicle at Kennedy Space Center (KSC) and continue hardware production of the Artemis II crew vehicle at Michoud Assembly Facility (MAF) and KSC.

- The SLS rocket's production and certification for flight will continue at MAF and Marshall Space Flight Center (MSFC) along with engine and core stage testing at Stennis Space Center (SSC). Key rocket components will be delivered to EGS at KSC for integration into the final flight launch vehicle with the Orion crew vehicle. Due to ongoing challenges in the completion of the Block 1 variant, the Budget proposes to defer work on Block 1B upgrades to ensure the safe and reliable completion of the initial Block 1.

- EGS will continue to prepare launch infrastructure and operations requirements in support of the SLS and Orion programs. Modifications to existing facility and command and control systems will be ongoing.

- NASA will explore approaches for reducing the costs of future exploration missions to enable a more sustainable and scalable exploration program.

**Exploration Research and Development (ERD)**

- ERD is comprised of five programs: the Human Landing System (HLS), Advanced Cislunar Surface Capabilities (ACSC), Gateway, Advanced Exploration Systems (AES), and the Human Research Program (HRP). The overarching goal of ERD is to infuse technologies and research into the development of human exploration capabilities using a combination of unique in-house activities, competed research, and public-private partnerships. ERD is developing and testing prototype systems, as well as planning and developing flight missions to lunar orbit and the Moon, and conducting and enabling human research that will form the basis for future human spaceflight missions.

- The major initiative in the FY 2021 President's Budget is the HLS program, utilizing essential commercial partnerships to develop and jointly deploy the integrated landing system that will transport crew to and from the lunar surface and establish a series of lunar missions that build on that capability.

- ACSC is conducting risk reduction studies to develop strategies and identify technologies to feed into lunar sustainability and future Mars efforts.

- Gateway is a platform that will orbit the Moon and support lunar landers and surface activities, to include a Power and Propulsion Element (PPE) by 2022 and the Habitation and Logistics Outpost (HALO) as well as logistics services.

- AES will continue work to identify and address knowledge gaps and deliver fundamental capabilities to provide astronauts a place to live and work with integrated life support systems, radiation protection, food, fire safety, avionics and software, logistics management, and systems to manage waste.

- HRP is responsible for understanding and mitigating the highest risks to astronaut health and performance to ensure crews remain healthy and productive during long-duration missions beyond low-Earth orbit (LEO).

## FY 2021 Budget Request
## LEO and Space Flight Operations
*($ Millions)*

| | FY 2019 | FY 2020 | FY 2021 | FY 2022 | FY 2023 | FY 2024 | FY 2025 |
|---|---|---|---|---|---|---|---|
| **LEO and Spaceflight Operations** | **4,640.4** | **4,285.7** | **4,187.3** | **4,147.3** | **4,147.3** | **4,147.3** | **4,147.3** |
| **International Space Station** | | | **1,400.7** | | | | |
| **Space Transportation** | | | **1,877.8** | | | | |
| Commercial Crew Program | | | 99.7 | | | | |
| Crew and Cargo Program | | | 1,778.1 | | | | |
| **Space and Flight Support (SFS)** | | | **758.7** | | | | |
| 21st Century Space Launch Complex | | | 0.0 | | | | |
| Human Space Flight Operations | | | 89.9 | | | | |
| Launch Services | | | 91.9 | | | | |
| Rocket Propulsion Test | | | 47.6 | | | | |
| Communications Services Program | | | 23.4 | | | | |
| Space Communications and Navigation | | | 506.0 | | | | |
| **Commercial LEO Development** | | | **150.0** | | | | |
| **Grand Total** | | | **4,187.3** | | | | |

The FY 2021 Budget for the LEO and Spaceflight Operations account consists of four areas: International Space Station (ISS), Space Transportation, Space and Flight Support (SFS), and Commercial LEO Development.

### International Space Station (ISS)

- NASA is working to foster a robust commercial ecosystem in low Earth orbit (LEO). Through the ISS, NASA meets its own requirements for research and technology development while also supporting a burgeoning community of non-NASA users. Over time, NASA has been and will continue to transition various aspects of human spaceflight operations in LEO to the private sector. This includes changes to the funding model supporting ISS and the use of commercial space stations, when they become available.

- As the world's only current crewed space-based multinational research laboratory and technology test bed, ISS supports the emerging commercial ecosystem in LEO as well as the future of deep space human exploration. The ISS:

  - Promotes commerce in space through public-private partnerships as new commercialization concepts are explored;

  - Advances exploration of the solar system and enables scientists to identify and quantify risks to human health and performance, develop countermeasures, and develop and test technologies that protect astronauts during extended human space exploration;

  - Supports unique research and development opportunities in the areas of biological and physical science processes;

  - Maintains the ISS international partnership that has brought together many spacefaring nations in peaceful cooperative activity; and

  - Supports current and planned Earth and Space Science observation missions.

**Space Transportation**

- Continues NASA's partnership with U.S. commercial space industry to develop and operate safe, reliable, and affordable systems to transport crew to and from the ISS and LEO. This strategy will lay the foundation for more affordable and sustainable future human space transportation capabilities, bolster American leadership, reduce our current reliance on foreign providers for this service, and help stimulate the American aerospace industry.

- Sustains NASA's ISS cargo supply function in partnership with American private industry.

- Continues to advance commercial spaceflight and generate American jobs.

**Space and Flight Support (SFS)**

- Provides mission-critical space communications and navigation services to customer missions, including human spaceflight, science, and commercial crew and cargo missions.

- Advances next-generation space communication technologies, including optical communications, Delay/Disruption Tolerant Networking, and autonomous navigation, to reduce costs and improve performance.

- Begins projects demonstrating the use of commercially-provided satellite-based communication services to support NASA missions.

- Supports the readiness and health of the crew for all NASA human spaceflight endeavors.

- Provides safe, reliable, and cost-effective launch services for civil sector missions, as well as launch-related support to NASA missions in development.

- Continues to strategically manage NASA's rocket testing core capability to meet U.S. rocket testing requirements.

**Commercial LEO Development**

- Stimulates a commercial LEO space economy by partnering with U.S. private industry to enable development of LEO capabilities.

- Focuses on maintaining a continuous U.S. human presence in LEO – both with Government astronauts and with private citizens – to support the utilization of space by U.S. citizens, companies, academia, and international partners.

- Supports enabling, developing, and deploying commercial orbital platforms that NASA can use for research and technology demonstration purposes; and stimulates non-NASA demand for such platforms.

- Develops policies and practices that define commercial ISS usage and pricing and address possible competition between NASA or ISS National Laboratory activities and capabilities provided by the private sector.

# FY 2021 Budget Request
# Exploration Technology
*($ Millions)*

| | FY 2019 | FY 2020 | FY 2021 | FY 2022 | FY 2023 | FY 2024 | FY 2025 |
|---|---|---|---|---|---|---|---|
| **Exploration Technology** | **926.9** | **1,146.3** | **1,578.3** | **1,765.4** | **1,906.2** | **1,954.2** | **2,038.2** |
| **Exploration Technology** | | | **1,578.3** | | | | |
| Early Stage Innovation and Partnerships | | | 169.2 | | | | |
| SBIR and STTR | | | 402.8 | | | | |
| Technology Maturation | | | 469.1 | | | | |
| Technology Demonstration | | | 537.2 | | | | |
| **Grand Total** | | | **1,578.3** | | | | |

Exploration Technology is essential for the long-term success of the Artemis Moon to Mars activities. These technology investment decisions are driven by the following Technology Thrusts and desired outcomes:

- **Go**: Rapid, safe, and efficient space transportation, emphasizing reusable in-space transportation between Earth, the Moon, Mars and beyond;
- **Land**: Expanded access to diverse surface destinations, routinely landing crew and cargo on the Moon and eventually Mars; safely and efficiently returning large payloads to Earth;
- **Live**: Sustainable living and working farther from Earth working toward a sustainable human presence on the Moon and eventually Mars, production of propellant and consumables from local resources, and including technologies to survive and operate through the lunar night; and
- **Explore**: Transformative missions and discoveries to reach challenging sites and resources on the Moon, Mars and beyond; and enable rapid, low cost missions to the Moon, Mars and beyond.

Exploration Technology funds the **Lunar Surface Innovation Initiative,** which accelerates the creation of novel technologies needed for lunar surface exploration, targeting:
In Situ Resource Utilization, Sustainable Surface Power, Surface Excavation/Construction, Lunar Dust Mitigation and other Extreme Environments and access capabilities to operate through lunar surface and subsurface conditions.
Exploration Technology supports exploration-related technology and research activities that have relevance to other lunar exploration activities and Mars “tall pole” technology needs, including:

- Solar Electric Propulsion and public-private partnerships to flight demonstrate in-space manufacturing and robotic assembly technologies used to build large structures in a space environment;
- Space Nuclear Technologies to support the near-term need of surface power as well as the longer-term interest in space propulsion advancement;
- Cryogenic Fluid Management through Tipping Point partnerships with industry; and
- Laser Communications Relay Demonstration which launches in January 2021 to demonstrate optical communications for near Earth application.

*The Exploration Technology account includes the following programs:*

- **Early Stage Innovation and Partnerships** support research and early technology development to spur innovations that transform future capabilities.
- **Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR)** programs leverage the Nation’s innovative small business community to support early-stage research and development in support of NASA's mission in human exploration, science and aeronautics.
- **Technology Maturation** advances disruptive exploration technologies that may eventually support exploration and potentially other missions from proof of concept to demonstration, maturing transformational and foundational technologies that primarily reside between early stage research and flight demonstration.
- **Technology Demonstration** conducts system level ground-based testing to determine feasibility, as well as space flight demonstrations of technologies and systems to effectively transition technologies and new capabilities for NASA exploration missions and for use by other government agencies and industry.

# FY 2021 Budget Request
## Science
*($ Millions)*

| | FY 2019 | FY 2020 | FY 2021 | FY 2022 | FY 2023 | FY 2024 | FY 2025 |
|---|---|---|---|---|---|---|---|
| **Science** | **6,886.6** | **7,138.9** | **6,306.5** | **6,553.5** | **6,575.7** | **6,705.2** | **6,766.9** |
| **Planetary Science** | | | **2,659.6** | | | | |
| **Astrophysics** | | | **831.0** | | | | |
| **James Webb Space Telescope** | | | **414.7** | | | | |
| **Heliophysics** | | | **633.1** | | | | |
| **Earth Science** | | | **1,768.1** | | | | |
| **Grand Total** | | | **6,306.5** | | | | |

- Includes four major science areas. Note: James Webb Space Telescope is separate from Astrophysics.

**Planetary Science** to explore the planetary bodies of our solar system. The Budget increases funding for the Lunar Discovery and Exploration program that supports public-private partnerships and innovative approaches to achieving human and science exploration goals, such as the eventual return of humans to the Moon. The Budget maintains support for the Planetary Defense program for near-Earth object detection and mitigation. It also continues funding for the Europa Clipper, Mars 2020, Lucy, Psyche, Dragonfly, and DART missions, as well as the VIPER lunar mission and a Mars Sample Return mission, which will launch as early as FY 2026 and bring samples collected by Mars 2020 to Earth. The Budget initiates work on a Mars Ice Mapper mission that will study and profile the near-surface (3-15 meters) water ice.

**Astrophysics** to study the universe and search for Earth-like planets. The Budget keeps on track the IXPE and GUSTO missions and the recently selected SPHEREx mission. . The Budget provides no funding for WFIRST, as NASA focuses on the launch and deployment of the Webb Telescope. The Budget proposes termination of the SOFIA mission, which costs more than $80 million per year and has not proven to be as scientifically productive as other missions.

**The James Webb Space Telescope** will explore all phases of our cosmic history – from within our solar system to the most distant observable galaxies in the early universe, to everything in between. Webb will seek the first stars that formed in the early universe, observe the formation of galaxies and protoplanetary systems, and explore potentially habitable exoplanets. The Budget supports a launch in March 2021.

**Heliophysics** to study the Sun and its influence throughout the solar system, including the recently selected Interstellar Mapping and Acceleration Probe, the ICON mission, which launched in October 2019, and the Solar Orbiter Collaboration with ESA, which is scheduled to launch in February 2020. The Budget includes funding to support two new Explorer SMEX missions, pre-Phase A studies for the Geospace Dynamics Constellation mission, as well as the DRIVE initiative and interagency efforts to improve space weather predictive capabilities, all priorities in the Decadal Survey.

**Earth Science** to understand Earth as an integrated system leading to a greater understanding of our planet's natural processes. The Budget begins formulation of the first Designated Observable mission, consistent with the Decadal Survey. Consistent with the FY 2020 budget, it assumes termination of two Earth science missions: PACE and CLARREO Pathfinder.

- Supports approximately 100 space missions:
  - Approximately 35 missions preparing for launch and approximately 65 operating missions
  - In addition, ongoing flights of sounding rockets, aircraft, and high-altitude balloons
- Focuses on three interdisciplinary objectives:
  - Discovering the secrets of the universe;
  - Searching for life in the Solar System and beyond; and
  - Safeguarding and improving life on Earth.
- Invests in developing advanced technologies, for example by:
  - Providing novel partnership opportunities between commercial partners and NASA through the Lunar Discovery and Exploration program, a CubeSat/SmallSat initiative targeted at specific high-priority science goals, and other efforts;
  - Developing optics and detectors to characterize habitable planets around other stars, instruments to look for signs of past or present life on Mars and other planetary bodies, and instruments to take the pulse of our planet; and
  - Engaging industry, academia, and other Government labs via open, competitive solicitations.
- Supports more than 10,000 U.S. scientists:
  - More than 3,000 openly competed research awards with universities, industry, and Government labs
  - World-leading research, frequently highlighted on the covers of *Science*, *Nature*, and major newspapers
- Includes partnerships with 12 other Federal agencies and 60 other nations, for example by:
  - Collaborating with other science agencies and agencies that need science results, including NSF, DOE, NOAA, USGS, FAA, USDA, DOI, EPA, and DOD;
  - Partnering with longstanding and newly space-faring nations; and
  - Building and launching the nation's weather satellites for NOAA.
- Provides benefits to our nation and our planet, for example by:
  - Leading the scientific exploration of the Earth, the solar system, and the universe beyond;
  - Enhancing economic growth and improving quality of life via high-tech jobs and new technologies; and
  - Assisting responses to national and international disasters.

## FY 2021 Budget Request
## Aeronautics
*($ Millions)*

| | FY 2019 | FY 2020 | FY 2021 | FY 2022 | FY 2023 | FY 2024 | FY 2025 |
|---|---|---|---|---|---|---|---|
| **Aeronautics** | **724.8** | **783.9** | **819.0** | **820.7** | **820.7** | **820.7** | **820.7** |
| **Aeronautics** | | | **819.0** | | | | |
| Airspace Operations and Safety Program | | | 90.4 | | | | |
| Advanced Air Vehicles Program | | | 212.7 | | | | |
| Integrated Aviation Systems Program | | | 269.0 | | | | |
| Transformative Aero Concepts Program | | | 129.9 | | | | |
| Aerosciences Eval. & Test Capab. Program | | | 117.0 | | | | |
| **Grand Total** | | | **819.0** | | | | |

NASA Aeronautics conducts research to advance the safety, capacity, and efficiency of the air transportation system and to sustain U.S. technological leadership in the aviation industry. The budget request supports five programs within the Agency's aeronautics portfolio:

- **Airspace Operations and Safety Program** (AOSP) works in close partnership with the Federal Aviation Administration (FAA) and the aviation community to enable modernization and transformation of the national air traffic management system. The program is on the leading edge of research on increasingly autonomous aviation systems, including innovation in the management of Unmanned Aircraft Systems (UAS) traffic at low-altitude and other novel aviation vehicles. The program is also pioneering the integration and analysis of data to support in-time system-wide safety assurance. In FY 2021, AOSP will:

  - Complete the close out of the Airspace Technology Demonstration Project and transfer the final research documentation to the FAA; and

  - Demonstrate in-time safety monitoring for an on-demand/urban air mobility (UAM) integrated flight test in relevant airspace.

- **Advanced Air Vehicles Program** (AAVP) conducts research to meet the nation's growing long-term civil aviation needs. The program works in close partnership with academia, industry, and other government agencies to pioneer fundamental research and to mature the most promising technologies and concepts for transition to the user community. In FY 2021, AAVP will:

  - Complete a Pre-Flight Prediction Capability Review supporting timely and accurate pre-flight exposure planning for the Low-Boom Flight Demonstration community response testing; and

  - Conduct testing of a flight-weight, flight-like electric inverter at Megawatt-class power level under simulated altitude conditions of 30,000 feet at the NASA Electric Aircraft Testbed (NEAT) facility.

- **Integrated Aviation Systems Program** (IASP) includes the Low-Boom Flight Demonstrator Project that will pave the way for eventual over-land commercial supersonic flight. The program explores, assesses, and demonstrates the benefits of the most promising technologies at an integrated system level in relevant environments, including in flight. The program develops and tests technologies to enable routine access of UAS into the National Airspace System (NAS). In FY 2021, IASP will:

    - Complete the Flight Readiness Review of the Low-Boom Flight Demonstrator in anticipation of first flight in January 2022;

    - Conduct focused research in key areas, such as autonomy, that will be required to achieve NASA's vision for urban air mobility;

    - Complete the final flight test preparations of the all-electric X-57 aircraft with electric motors moved to the wingtips on a new optimized wing and with integrated distributed electric propulsion motors; and

    - Begin the implementation phase of the Electrified Powertrain Flight Demonstration Project.

- **Transformative Aeronautics Concepts Program** (TACP) demonstrates initial feasibility of concepts supporting the discovery and development of new transformative solutions supporting the NASA Aeronautics strategy. In FY 2021, TACP will:

    - Begin autonomous systems research that will involve developing human-autonomy teaming solutions for future aviation applications, including simplified vehicle operations for UAM and remote supervisory operations for air cargo flights; and

    - Initiate flight testing of flexible, low-temperature, shape-memory alloys that will allow for cost-effective fuel burn reduction on transport aircraft.

- **Aerosciences Evaluation and Test Capabilities Program** (AETCP) manages NASA's versatile and comprehensive portfolio of aerosciences ground test capabilities and assets. Among these assets are subsonic, transonic, supersonic, and hypersonic wind tunnels, propulsion test facilities, and specialty tunnels at Ames Research Center (ARC), Glenn Research Center (GRC), and Langley Research Center (LaRC). In FY 2021, AETCP will:

    - Improve the integration of Computational Fluid Dynamics and Experimental testing, which will allow for more efficient and optimized testing and provide a strong basis in future capability sustainment; and

    - Complete fabrication and installation of a new Mach 6 nozzle in the LaRC 8-foot High Temperature Tunnel, which will provide high-fidelity, true enthalpy, and true pressure Mach 6 test environments for durations of up to five minutes. This environment is required to meet future NASA and DoD hypersonic vehicle ground test requirements.

## FY 2021 Budget Request
## Safety, Security, and Mission Services
*($ Millions)*

| | FY 2019 | FY 2020 | FY 2021 | FY 2022 | FY 2023 | FY 2024 | FY 2025 |
|---|---|---|---|---|---|---|---|
| **Safety, Security, and Mission Services** | **2,755.0** | **2,967.6** | **3,009.9** | **2,998.5** | **2,998.5** | **2,998.5** | **2,998.5** |
| **Mission Services & Capabilities** | | | **1,952.0** | | | | |
| Information Technology (IT) | | | 553.9 | | | | |
| Mission Enabling Services | | | 705.0 | | | | |
| Infrastructure & Technical Capabilities | | | 693.1 | | | | |
| **Engineering, Safety, & Operations** | | | **1,057.9** | | | | |
| Agency Technical Authority | | | 184.0 | | | | |
| Center Engineering, Safety, & Operations | | | 873.9 | | | | |
| **Grand Total** | | | **3,009.9** | | | | |

Safety, Security, and Mission Services (SSMS) provide the capabilities, workforce, and facilities that enable NASA's ambitious portfolio of missions, including sending astronauts back to the Moon and on to Mars. It is essential that the Agency modernize support capabilities and optimize operations to support the national space policy priorities of scientific discovery, human presence in space, and technology development.

These missions are accomplished by integrating critical operations at NASA Centers and facilities in 10 states and the District of Columbia (Headquarters) and by providing independent oversight that reduces risk to life and mission for all NASA programs. NASA is committed to ensuring these operations are effective, efficient, and safe, and that they meet the Agency's statutory, regulatory, and fiduciary responsibilities.

In FY 2021, NASA will complete the transformation to an enterprise model for the delivery of mission-enabling services. Enterprise functions include: Financial and Resources Management, Human Capital Management, Information Technology, Legislative Affairs, Strategic Infrastructure, Communications, Procurement, Protective Services, Small Business Programs, General Counsel, International and Interagency Relations, and Diversity and Equal Opportunity. The enterprise model provides standardized services to customers and employees regardless of geographic locations, reduces or eliminates duplicative capabilities, provides opportunities for employees to work across geographic boundaries, and allows greater flexibility to adjust to evolving demands and meet surge requirements.

To fully realize the benefits of this new model, NASA has developed a new, more efficient SSMS budget account structure to improve insight and accountability for formulating and executing the associated enterprise budgets. Prior to FY 2021, SSMS consisted of two budget themes that divided resources along organizational lines: Center Management and Operations; and Agency Management and Operations. Beginning in FY 2021, SSMS will consist of two budget themes that divide resources along functional lines: Mission Services and Capabilities; and Engineering, Safety, and Operations.

**Mission Services and Capabilities (MSaC)** provides enterprise solutions to workforce, infrastructure, information technology, and business operations required to enable NASA's mission. MSaC funds the offices, programs and related capabilities for efficient and effective administration across all NASA Centers, including:

> **Information Technology** (IT) funds the information services needed to fulfill NASA's multifaceted missions and operations. IT helps improve Agency outcomes by providing technology and tools that drive discoveries, accelerate productivity, share NASA's data and discoveries, and increase quality, resiliency, and cost-effectiveness. Reliable, adaptable, and secure cloud-based IT is a key enabler of

NASA’s Artemis Program to safely return astronauts to the lunar surface by 2024. The IT program supports over 250 applications that empower scientific research and mission support and the processing of approximately 4.3 million inquiries per year about NASA's Scientific and Technical Information (STI), providing the scientific community the information needed to achieve new discoveries, including those required for Artemis. In FY 2021, the Mission Networks/Legacy Space Communications and Navigation (SCaN) program will transfer from the Human Exploration and Operations (HEO) to the IT Program. SCaN provides standardized services across the Mission and Corporate Wide Area Networks (WAN).

- **Mission-Enabling Services** (MES) provides an enterprise approach to managing services for NASA's business operations and protective services. Missions rely on these institutional capabilities to provide the business services and skilled staff required to accomplish their objectives. Services include: Financial and Resources Management, Human Capital Management, Information Technology, Legislative Affairs, Strategic Infrastructure, Communications, Procurement, Protective Services, Small Business Programs, General Counsel, International and Interagency Relations, and Diversity and Equal Opportunity.

- **Infrastructure and Technical Capabilities** (ITC) program ensures the right infrastructure is available to meet mission requirements. This mission is accomplished through effective management of assets and capabilities, proactive coordination with mission directorates, enhanced institutional planning, ongoing regulatory compliance, and a reduction in current and future infrastructure-related risks. The ITC program provides sustainment, operations, and maintenance for facilities and technical capabilities. It provides oversight and management of real property assets, environmental program activities, aircraft operations, and logistics functions. The FY 2021 Budget provides $488 million, an increase of $65 million from NASA’s 2019 Operating Plan, for facility maintenance to address NASA’s extensive maintenance backlog and reduce expensive emergency repairs.

**Engineering, Safety, and Operations** (ESO) provides for the ongoing management, operations, and safety of Headquarters, the nine Centers, and numerous component facilities. ESO supports scientific and engineering activities and contributes to the reduction of program risks by ensuring that technical skills and assets are ready and available to meet program and project milestones.

- **Agency Technical Authority** (ATA) develops policy and procedural requirements and makes recommendations to the Administrator, mission directorates, Center Directors, and program managers who are responsible for the safety and mission success of all NASA activities and the safety and health of the workforce. ATA resources provide the foundation for NASA’s system of checks and balances, enabling effective application of the strategic management framework and the technical authorities defined in NASA’s Strategic Management and Governance Handbook. ATA provides training and maintains a competent technical workforce within the disciplines of system engineering, including system safety, reliability, and quality, as well as space medicine. The FY 2021 Budget provides $14 million, an increase of $10 million from NASA’s 2019 Operating Plan, for the Health and Medical Technical Authority to address capability and capacity gaps identified in NASA’s 2019 Strategic Plan assessment.

- **Center Engineering, Safety, and Operations** (CESO) provides Agency and Center leadership and management the capabilities needed for engineering assessment and safety oversight pertaining to the technical readiness and execution of NASA programs and projects. It also sustains NASA’s analysis, design, research, test services, and fabrication capabilities to enable efficient implementation of the programs and projects conducted at the Centers.

## FY 2021 Budget Request
## Construction & Environmental Compliance Restoration
*($ Millions)*

| | FY 2019 | FY 2020 | FY 2021 | FY 2022 | FY 2023 | FY 2024 | FY 2025 |
|---|---|---|---|---|---|---|---|
| **Construction & Envrmtl Compl Restoration** | **372.2** | **600.4** | **539.1** | **530.3** | **530.3** | **530.3** | **530.3** |
| **Construction of Facilities** | | | **464.4** | | | | |
| Institutional CoF | | | 395.1 | | | | |
| Exploration CoF | | | 22.3 | | | | |
| Science CoF | | | 23.1 | | | | |
| Space Operations CoF | | | 23.9 | | | | |
| Aeronautics CoF | | | 0.0 | | | | |
| **Environmental Compliance and Restoration** | | | **74.7** | | | | |
| **Grand Total** | | | **539.1** | | | | |

The Construction & Environmental Compliance Restoration (CECR) budget directly enables NASA's portfolio of missions in aeronautics and space exploration. With installations in 14 states, NASA collectively manages $39 billion in constructed assets with an inventory of more than 5,000 buildings and structures. The FY 2021 Budget provides significant investments necessary to renew and sustain the Agency's underlying infrastructure that support missions at all NASA Centers. The request for NASA supports ongoing missions through the replacement of outdated operating systems within key facilities, safety repairs, renovations, and new construction. NASA's budget also supports efforts to divest of unneeded, older, costly real property while reducing the Agency's overall facility footprint.

- **Institutional Construction of Facilities** (CoF) funds capital repairs and improvements to ensure Center infrastructure critical to achieving NASA's space and aeronautics programs is safe, secure, environmentally-sound, and operating efficiently. NASA's Repair and Revitalization Program funds repairs and upgrades to the Agency's institutional facilities and horizontal infrastructure to include projects such as water, electrical, and natural gas distribution system repairs and upgrades, chiller replacements, seismic bracing, fire alarm upgrades, arcflash electrical safety upgrades, canal lock system repairs, and propellant systems improvements. NASA's New Construction program seeks to achieve a sustainable and energy-efficient infrastructure by replacing old, inefficient, deteriorated buildings with new, efficient, high-performance buildings while also reducing the footprint. New construction projects funded in FY 2021 include:

  - Construction of Ames Research Center's $67 million, 60,000-square-foot Engineering and Mission Operations facility. This state-of-the-art facility will consolidate engineering and laboratory activities currently housed in antiquated and inefficient facilities. It will support innovative engineering, design and development, the manufacture, assembly, and operation of complex mechanisms, avionics, and materials research. The Engineering and Mission Operations facility's advanced instrumentation and systems support NASA missions in ways not possible with the current WWII-era facilities. The project includes the demolition of 10 buildings totaling more than 90,000 square feet.

  - The request also provides $16.7 million for construction of the Armstrong Flight Research Center's Vehicle and Aerospace Ground Equipment Maintenance Facility. The new facility will consolidate the operations of six old and degraded prefabricated buildings from across the site into a single Leadership in Energy and Environmental Design (LEED) Silver facility. Once the Vehicle and Aerospace Ground Equipment Maintenance Facility is operational, the prefabricated buildings that previously housed its functions can be demolished. The new facility will serve as the central support hub for aircraft ground equipment and vehicles in support of NASA missions.

- The request also provides $25 million for repair of a portion of the massive 43-acre Michoud Assembly Facility roof system. NASA devised a multi-year phased project to replace the roof system, which currently comprises wood trusses and concrete panels from the 1940s. This replacement roof project will address significant deficiencies while ensuring availability of NASA's long-term capability to manufacture large-scale aerospace components/vehicles, continue to build the Space Launch System (SLS), and support U.S. capabilities for manned spaceflight.

- **Programmatic Construction of Facilities** funds projects to carry out specific Science, Exploration, and Space Operations programmatic requirements. Funding in this category is realigned from the mission directorates to the CECR budget in accordance with statutory direction that all NASA construction projects be funded in the CECR account.

  - A key Exploration project will consist of $8.8 million combined with $25 million from Institutional CoF to complete the second phase of modifications to launch infrastructure, including the Convertor Compressor Facility, the Environmental Control Systems, and the Emergency Egress System for the Kennedy Space Center (KSC) Launch Complex. Funding also supports continued upgrades to the Deep Space Network (DSN), including the DSN Aperture Enhancement Project, which addresses demand and oversubscription issues with existing antennae. The enhanced DSN will enable communication with the growing number of interplanetary spacecrafts, including planetary robotic missions and pre-cursor robotic missions for Human Exploration.

  - A key Science Mission Directorate project in FY 2021 ($19.5 million) is the construction of a LEED-certified annex to Johnson Space Center (JSC) Building 31 for Astromaterials Research and Exploration Science. The project will erect a 20,000-square-foot addition to provide critical laboratory space to support NASA's core planetary science and curation requirements as we conduct missions to the Moon and analyze return samples from asteroids, the Moon, and Phobos. This project will consolidate research staff from across multiple locations at JSC and provide a state-of-the-art curation facility to augment the existing facility, which is already at capacity. This project will demolish 25,000 square feet across the Center.

- **Environmental Compliance and Restoration** supports cleanup of hazardous materials and waste released to the surface or groundwater at NASA installations, NASA-owned industrial plants supporting NASA activities, current or former sites where NASA operations contributed to environmental problems, and other sites where the Agency is legally obligated to address hazardous pollutants. The FY 2021 budget provides $74.7 million for remedial investigations and soil and groundwater cleanups at Santa Susana Field Laboratory, White Sands Test Facility, KSC, and Marshall Space Flight Center and continued operations of treatment systems and monitoring at the rest of the NASA Centers and facilities.