Space Opportunities and 2021 Budget Allocations by Major Space Research Organizations

PRESCOUTER

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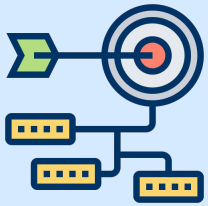
The purpose of this report is to highlight funding opportunities in aerospace and defense for 2021 that can be leveraged by commercial players in the Aerospace & Defense Industry, as defined by major funding governmental institutions globally.

PreScouter's 2021 focus opportunities for funding were derived based on budget allocations by different institutions for 2021.



Key Insights

ARPA-E (energy focus) is focused in 2021 with key development areas in electricity generation (batteries, grids, etc.), transmission, waste recovery, and transportation

NASA's top expense areas includes science and planetary science, space operations with focus on safety security and mission services and lunar lander under exploration

ESA focus for 2021 has been majorly on Earth observations and planetary science missions, with additional opportunities for commercial partners developing specific space-based technologies (satellite navigation, earth observation, satellite telecommunication, space weather, space technologies)

ISRO's focus is on spacecraft missions and space applications with wide range of private companies working under each sub-segment

Half of JAXA's budget is focused on education, with the second half focused on the lunar exploration program and development of a novel information gathering system

Acronym List

ARPA-e	Advanced Research Projects Agency–Energy
NASA	National Aeronautics and Space Administration
ESA	European Space Agency
ISRO	Indian Space Research Organisation
JAXA	Japan Aerospace Exploration Agency
FOA	Funding opportunity announcement
STEM	Science, technology, engineering, and mathematics
DAC	Direct air capture
DOC	Direct ocean capture
ROSES	Research Opportunities in Space and Earth Sciences
WFIRST	Wide Field InfraRed Survey Telescope
SMD	Space Mission Directorate
BPS	Biological and Physical Sciences
GDC	Geospace Dynamics Constellation
XRISM	X-Ray Imaging and Spectroscopy Mission
MMX	Martian Moons eXploration
ARCSIX	Arctic Radiation Cloud-Aerosol-Surface Interaction Experiment
ARTES	Advanced Research in Telecommunications Systems
LEO	Low Earth Object
DoS	Department of Space
IGS	Information Gathering Satellite
LUPEX	Lunar Polar Exploration
SLIM	Smart Lander for Investigating Moon


arpa·e

ARPA-E OPEN 2021 FOCUS

ARPA-E technology programs are classified into:

Grids

Transportation

Building efficiency

Power generation and energy production

Power generation: Renewable

Bioenergy

Other energy technologies

Areas of research responsive to this FOA include (but not limited to):

1. Electricity generation by both conventional and renewable means
2. Electricity transmission, storage, and distribution; energy efficiency for buildings, manufacturing and commerce, and personal use
3. All aspects of transportation, including the production and distribution of both renewable and nonrenewable fuels, electrification, and energy efficiency in transportation.

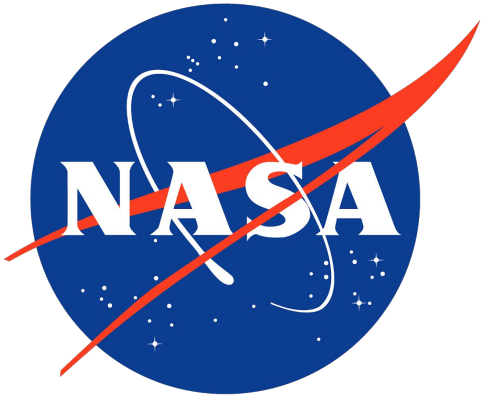
ARPA-E OPEN 2021 FOCUS

ARPA's focus on energy creation has increased by investing in projects such as:

- Accelerated geomineralization for long-term carbon sequestration
- Data center cooling technologies
- CO_2 mineralization to enhance the extraction of critical and commodity minerals
- Fast-charging lithium metal battery technology
- Electricity transmission technologies
- Negative emissions technologies such as direct air capture (DAC) and direct ocean capture (DOC)
- Fusion energy with advanced fuels
- Urban waste recovery

Novel approaches and interest toward energy technologies include:

- Batteries
- Flow-batteries
- Fuel-cells
- compressed air (non-traditional)
- superconducting magnetic storage
- ultra-high energy density flywheels
- localized fluid pumping
- high-scale ultracapacitors
- A combination of novel technologies to economically meet grid-scale storage energy and power requirements.


NASA

NASA - Overview of grants and top spending areas for 2020-21

	2020 Enacted	2021 PBR	% Change
NASA	**$22,629**	**$25,246**	**0.12**
Science	**$7,139**	**$6,307**	**-12%**
Planetary Science	$2,713	$2,660	-1.90%
Earth Science	$1,972	$1,768	-10%
Astrophysics	$1,306	$831	-36%
WFIRST	$511	$0	-100%
JWST	$423	$414.70	-2%
Heliophysics	$725	$633	-13%
Exploration	**$6,018**	**$8,762**	**0.46**
Orion Crew Vehicle	$1,407	$1,400	-0.50%
SLS	$2,586	$2,257	-13%
Lunar Gateway	$450	$739	0.64
Lunar Lander	$600	$3,370	4.62
Space/Exploration Technology*	**$1,100**	**$1,578**	**0.43**
Space Operations	**$4,140**	**$4,187**	**0.011**
Aeronautics	**$784**	**$819**	**0.045**
STEM Engagement	**$120**	**$0**	**-100%**
Safety, Security, & Mission Services	**$2,913**	**$3,010**	**0.033**
Construction and Environmental Compliance	**$373**	**$539**	**0.45**
NASA Inspector General	$41.70	$44.20	0.06

NASA technology programs are classified into:

Science and planetary science

Space operations with focus on safety and security mission services

Lunar lander under exploration

Notable changes:

- With budget cuts compared to 2020, WFIRST and STEM engagements were totally stopped with no projects to be funded
- ROSES-2021 will receive ~5000 proposals across all program elements and will select/award ~1250 projects totaling ~$600 million over the lifetime of the awards

NASA ROSES - 2021 Categories

NASA's Science Mission Directorate (SMD) research and technology development activities are organized into five Science Divisions corresponding to the first five Appendices of ROSES:

The Earth Science Research, Applied Sciences, Technology, and Data Systems Programs sponsor integrative research to advance knowledge of and to explore interactions among the major components of the Earth system - continents, oceans, atmosphere, ice, and life - to differentiate natural from human-induced causes of change, to understand and predict the consequences of change, and to apply that knowledge to benefit the lives of people everywhere.

The Heliophysics Research Program sponsors research to understand the Sun and its interactions with the Earth and the Solar System, including space weather.

The Biological and Physical Sciences Research Program sponsors research to understand how biological and physical systems respond to and accommodate spaceflight environments.

The Planetary Science Research Program sponsors research to explore the Solar System to study its origins and evolution, including the origins of life within it.

The Astrophysics Research Program sponsors research to explore the Universe beyond the search for planets to the origin, evolution, structure, and destiny of the Universe itself.

NASA ROSES - 2021 Focus

In Appendix A (Earth Science), the Atmospheric Composition Radiation Sciences Program will be soliciting in 2021 for a specific field campaign:
Arctic Radiation Cloud-Aerosol-Surface Interaction Experiment ARCSIX (The overarching goal of ARCSIX is to quantify the contributions of surface properties, clouds, aerosol particles, and precipitation to the Arctic summer surface radiation budget and sea ice melt during the early melt season)

In Appendix C **(Planetary Science)** new participating scientist programs for Juno and JAXA's **Martian Moons eXploration (MMX) Mission** a project to explore the two moons of Mars, with a planned launch in the mid-2020s) will be solicited.

Appendix E is now devoted to the Division of **Biological and Physical Sciences (BPS)** focuses on using the spaceflight environment to conduct experiments that cannot be conducted on Earth., formerly of HEOMD, which is new to SMD (Space Mission Directorate)

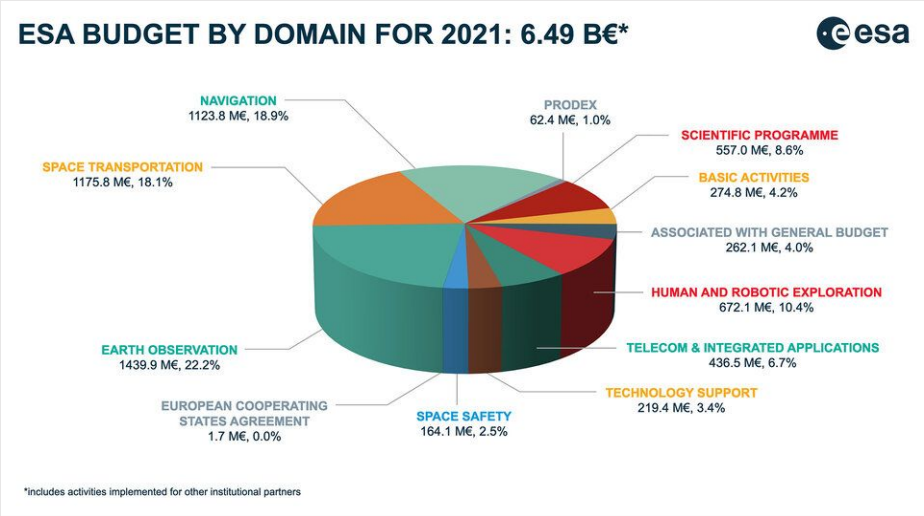
In Appendix B (Heliophysics), there will be two new program elements:

- B.15 **Geospace Dynamics Constellation (GDC) Interdisciplinary Scientists** (Geospace Dynamics Constellation (GDC) is a mission concept to study the coupling between the magnetosphere and the ionosphere/thermosphere (IT) system, and how that coupled system responds to external energy input.)
- B.16 **Heliophysics Mission Concept Studies**. (This program will fund six-month-long mission concept studies that are part of community preparation for the next Solar and Space Physics Decadal Survey)

In Appendix D (Astrophysics), a new program element for Guest Scientists for the **X-Ray Imaging and Spectroscopy Mission - XRISM** - (X-ray astronomy satellite of the Japan Aerospace Exploration Agency to provide breakthroughs in the study of structure formation of the universe, outflows from galaxy nuclei, and dark matter) is planned for this year in D.12, and Nancy Grace Roman Space Telescope Research (**The Nancy Grace Roman Space Telescope**, formerly the Wide Field InfraRed Survey Telescope (WFIRST), is a NASA observatory designed to settle essential questions in the areas of dark energy, exoplanets and infrared astrophysics.)and Support Participation Opportunities is planned for this year as D.16

European Space Agency

ESA Focus Categories



ESA's focus for the coming years is on Earth observation, space transportation and navigation

Description of top 5 funding categories for ESA in 2021:

- In 2021, the European Space Agency (ESA) allocated over €2.5 billion for **earth observation and space transportation** domains. [ESRIN, known as the ESA Centre for Earth Observation, is the ESA establishment responsible for managing the operation and exploitation of ESA's Earth Observation satellites]
- **Space Transportation (€1175.8 mil)** - ensure availability and foster the competitiveness and reliability of missions such as Ariane, Vega and Soyuz from Europe's Spaceport
- **Navigation (€1123.8 mil) - Holds two major missions one fully functional other in the development stage**. EGNOS (European Geostationary Navigation Overlay Service) – a pan-European augmentation system, complementing GPS to deliver sharpened reliability and integrity information to users. Galileo – a fully autonomous and interoperable satellite navigation system, broadcasting global navigation signals for high-performance services.
- During that period, ESA's budget allocated €672.1 million for **human and robotic explorations**. It represents a large expansion to the contribution Europe is already making to Artemis, the NASA program to land the first woman and the next man on the Moon during 2024.
- **Scientific Programme (€557 mil)** - Development of Cosmic Vision program providing answers to four fundamental questions of astronomy, Solar System science and fundamental science.

ESA Focus on Earth Observations and Planetary Science

European Space Agency

Current Missions

Name	Purpose	Description
Aeolus	Earth observation	(1) ESA's wind mission
BepiColombo	Planetary science	(1) Mercury explorer
Cluster II	Science	(4) Earth's magnetic environment
CryoSat	Earth observation	(1) ESA's ice mission
ExoMars/TGO	Planetary science	(1) Orbiting Mars - delivered the Schiaparelli entry, descent and landing demonstrator
Gaia	Science	(1) Galactic surveyor
Integral	Science	(1) Gamma-ray observatory
Mars Express	Planetary science	(1) Europe at Mars - delivered the Beagle lander
OPS-SAT	Technology demonstration	(1) Orbiting testbed for innovative new technologies
Sentinel 1	Earth observation	(2) Europe's Copernicus programme - Sentinel-1A, 1B (radar)
Sentinel 2	Earth observation	(2) Europe's Copernicus programme - Sentinel-2A, 2B (optical)
Sentinel 5P	Earth observation	(1) Europe's Copernicus programme - Sentinel-5 Precursor (atmosphere)
Solar Orbiter	Science	(1) Expanding our knowledge of solar physics
Swarm	Earth observation	(3) Geomagnetic surveyor
XMM	Science	(1) X-ray observatory

Future Missions

Name	Purpose	Description
Biomass	Earth observation	Measuring forest biomass
EarthCARE	Earth observation	ESA's cloud, aerosol and radiation mission
Euclid	Science	Mapping the dark universe
ExoMars RSP	Planetary science	ExoMars rover and surface science platform
Flex	Earth observation	Fluorescence Explorer to map vegetation fluorescence & quantify photosynthetic activity
Juice	Planetary science	Exploring the Jupiter system
Plato	Science	Discover extrasolar planetary systems and terrestrial planets
Sentinels/Copernicus	Earth observation	Europe's Copernicus programme - Sentinel-6B

ESA Focus Categories - Funding for Commercial Initiatives

ESA Business Applications offers funding and support to businesses from any sector that intends to use space (satellite navigation, earth observation, satellite telecommunication, space weather, space technologies) to develop new commercial services. The table below presents the different key technology programs.

Proptech (property technology)	The real estate sector is huge and among the last to implement technological change and the innovation that comes with it.
	Property Technology, or "PropTech," is a term that encompasses the application of information technology and platform economics to real estate markets.
	Recent breakthroughs in technologies spanning cloud computing, machine learning, smartphones, and improved connectivity capabilities are spurring further activity in the PropTech space
New education	The European Space Agency's "New Education" Kick-Start offers support and funding to companies developing services to help improve the digitisation of education and to demonstrate the potential of space to add value
Immersive reality	This proposed Kick-Start focuses on the following types of immersive technologies and themes: mixed reality, simulation, digital twinning and holograms.
	In particular, this topic has become even more relevant since the COVID outbreak, with many businesses using immersive solutions to run simulations, for staff training and inductions courses.
TRP - Innovation Triangle Initiative	Supports the identification, validation and development of disruptive space innovations based on new concepts and ideas
TRP - Startiger	This initiative aims at fast concurrent prototyping of advanced technology.

In addition, to the following 3 programs: ESA Telecom ARTES Competitiveness and Growth, ESA Telecom ARTES Advanced Technology, and Technology Transfer Initiative.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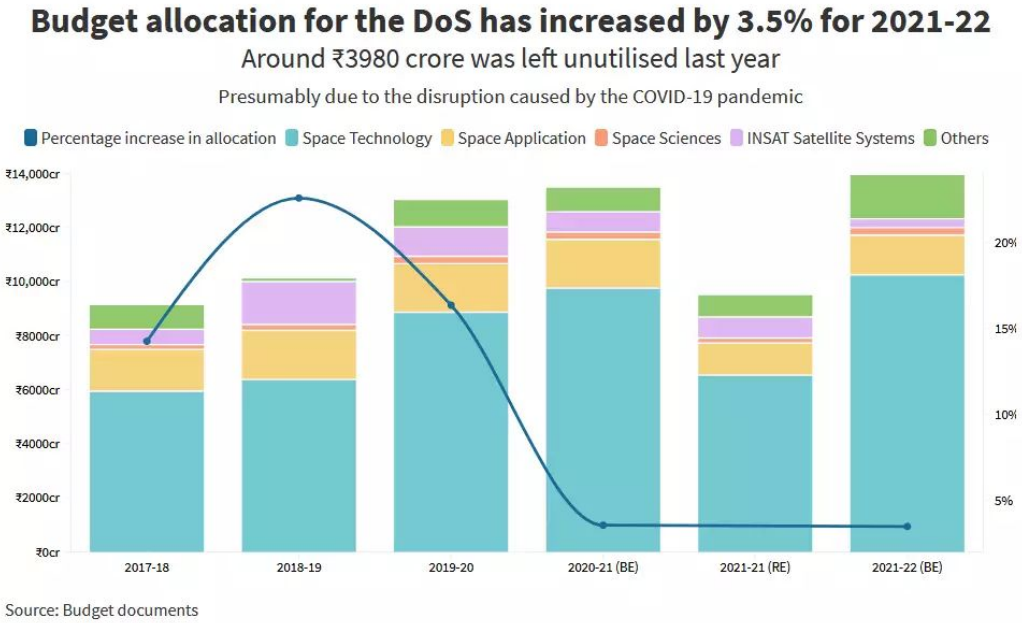
ISRO Budget 2021



Source: Budget documents

ISRO comes under the DoS (Department of Space) and has outlined its plan for the next decade where it plans to work on developing:

- Heavy-lift launch vehicle
- Semi-cryogenic stage, Reusable launch vehicle
- Advanced propulsion
- Next-generation avionics
- Advanced materials
- Dynamic space applications and efficient integration of space-based services
- Advanced space science missions.

It will also be focusing on three main missions:

- Gaganyaan (aims to demonstrate India's human space flight capability by carrying three crew members to Low Earth Orbit - LEO - and safely bringing them back)
- Mangalyaan-2 (India's second interplanetary mission planned by the Indian Space Research Organisation to Mars)
- Shukrayaan (a proposed orbiter to Venus, is expected to be launched either in 2024 or 2026)

ISRO 2021 Opportunities Focus

The Indian Space Research Organisation is turning into a facilitator as it looks for the private sector to play a bigger role in space technology in the "second space age."

	Launch Vehicle
A	Aerospace Engineering
B	Propulsion
C	Propellants, Polymers & Chemicals
D	Materials & Metallurgy
E	Transducers and Sensors
F	Mechanical Design & Analysis
G	Control, Guidance & Simulation
H	Composites, Launch Vehicle Structures
I	Avionics
J	Advanced Inertial Systems
K	Launch Vehicle Tracking System, Range Operation and Safety Engineering
L	Testing of Liquid Propulsion Systems
M	Rocket systems including Human Space Probes
N	Electronics and Measurement for Testing Rocket Systems
O	Management

	Earth Observations
A	Remote Sensing, Signal and Image Processing and Software Development
B	Mission Development and Remote Sensing-Sensor Technology
C	Remote Sensing Applications in Geosciences
D	Microwave Remote Sensing Applications in Agriculture, Soil Moisture, Forestry & Wetland Ecosystem
E	Information Extraction and Geospatial Modelling
F	Satellite Data Reception and Ground Station
G	Earth, Ocean, Atmosphere, Planetary Sciences and Applications
H	Water Resources Studies
I	Geoinformatics
J	Aerial Remote Sensing
K	Earth and Climate Sciences
L	Disaster Management

	Satellite Communication
A	SATCOM & Navigation Payload
B	SATCOM and SATNAV Applications and Associated Technologies
C	Antenna Systems
D	Electro-Optical Sensor Technology
E	Microwave Sensor Technology
F	Electronics and Microelectronics Design, Fabrication and Testing Technologies
G	Mechanical Engineering Systems
H	Systems Reliability
I	Mission Development
J	Communication & Power
K	Integration & Checkout
L	Controls and Digital
M	Reliability and Components
N	Production of Spacecraft Systems
O	VLSI Design
P	Process Technology
Q	Compound Semiconductor Technology
R	MEMS Design & Process Technology
S	IC Package Design & Development
T	Human Spaceflight Programme

ISRO stats on the missions

111 Spacecraft Missions

80 Launch Missions**

12 Student Satellites

2 Re-entry Missions

342 Foreign Satellites***


JAXA

JAXA 2021 Budget Focus

Japan's **proposed space budget**, which encompasses planned space activities of 11 government ministries, includes:

51.4B Yen (~472M USD) — set aside for the Japan Aerospace Exploration Agency (JAXA) to participate in NASA's Artemis lunar exploration program

- 37B Yen (~334M USD) will be used to develop a new space station resupply vehicle dubbed HTV-X
- Some 6.1B Yen (~$55M) will be used to develop technologies for the lunar Gateway, a planned small space station in lunar orbit intended to serve as a solar-powered communications hub, science laboratory, short-term habitation module and holding area for rovers and other robots.

80B Yen (~722M USD) — for the nation's Information Gathering Satellite (IGS) program

18.9B Yen (~170M USD) — for the development and advancement of the H3 rocket

JAXA 2021 Budget Focus

Additional funding for lunar landers

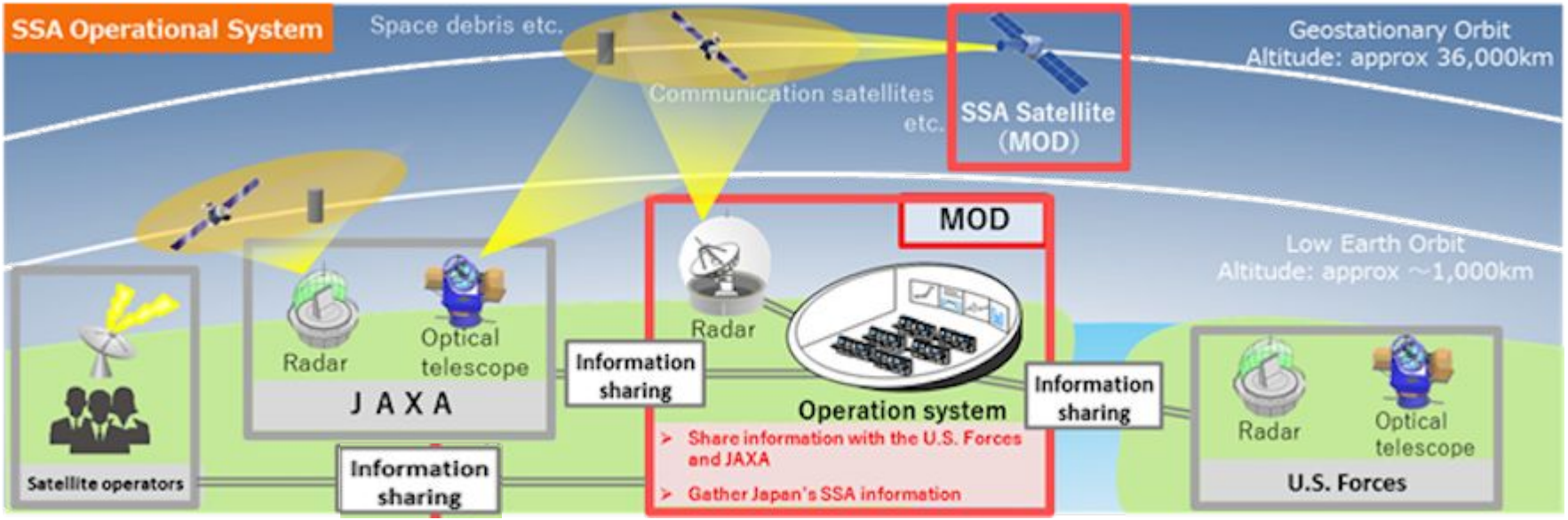
The budget documents also state while 3.4B Yen (~30M USD) will be used to develop the Smart Lander for Investigating Moon (SLIM), a lunar lander being developed by JAXA, 2.8B Yen (~25M USD) will be invested in the Lunar Polar Exploration (LUPEX), a joint project between JAXA and its Indian counterpart, the Indian Space Research Organisation, aimed at exploring the moon's south pole in 2023.

Additional funding to maintain space competitiveness

Education ministry will spend 5B Yen to sharpen Japan's technological competitiveness, including:

- 4.5B Yen (~40M USD) to develop Engineering Test Satellite-9
- 200M Yen (~1.8M USD) for research and development of future space transportation systems
- 300M Yen (~2.7M USD) for technologies that streamline the development cycle of microsatellites

JAXA 2021 Budget Focus



Source: MOD

Nearly half the space budget, or 212.4 billion yen, is set to go to the Ministry of Education, Culture, Sports, Science and Technology, which controls JAXA.

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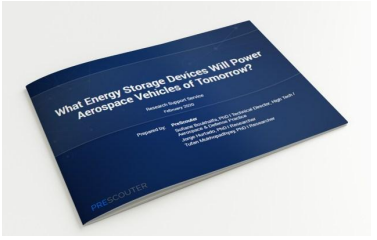

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