

Summary Edition

# "Kibo" Utilization Strategy

"Hope (Kibo)" becomes "Reality" tomorrow

A G E N D A 2 0 3 0

4th Edition

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Japan Aerospace Exploration Agency, Human Spaceflight Technology Directorate



# Overview of Kibo Utilization Strategy (4th edition)

## Government Policy and Trends

Declaration of participation on the ISS operations extended through 2030 (November 2022)

Participation in human space exploration plans (Artemis Program / Gateway) taking shape

Revision of the Basic Plan on Space Policy (June 2023)

### Low Earth Orbit (LEO) Activities

1. Expand Japanese Experiment Module JEM 'Kibo' utilization to maximize the scientific and technological outcomes
2. Expand private sectors and end-users aiming for business development in Post-ISS
3. Technology acquisition, technology demonstration, research and development of elemental technology and system.

### Post-ISS Trends

Commercial space station plans for the Post-ISS era in the U.S. and Europe taking shape

Seamless transition to commercial LEO utilization while utilizing ISS



## Revision of Kibo Utilization Strategy (4th edition)

### Vision 2035

Through Kibo utilization, establish space environment utilization in LEO as part of social and economic activities of humanity

### Assumptions of Vision 2035

- Private sectors provide part of operational and utilization services in LEO destinations to deploy commercial on-orbit services (onboard and external facilities and activities).
- On-orbit servicing cultivated through 'Kibo' operation and utilization has been inherited even after retirement of ISS to continue the Scientific utilization in commercial LEO destinations.

### Promotion of three activity areas for balanced portfolio

Maintain the scale of scientific use while expanding commercial activity through efficiency improvements by remote/automated/autonomous operations



### Five goals for Kibo utilization

1. Contribute to national research promoted by the government
2. Demonstrate certain social values of 'Kibo' through utilization by private sectors
3. Promote R&D activities for technologies for longer duration manned stay exploration in space
4. Contribute to enhancement in sciences technologies through academic research
5. Contribute to Japan's growing presence in the world

## Key Initiatives in the Three Activity Areas

### Scientific utilization

Promote Japan's problem solving and academic research

Vision for 2030: Create historically significant and highly impactful outcomes

- Steadily implement flagship missions with focused resource investment and identification of promising areas
- Expand the Kibo utilization by academia, develop advanced experimental facility, and secure international competitiveness, based on space technology strategy
- Upgrade and expand Kibo Utilization Platforms (Cell biology & Biomedical Research Platform and Advanced Combustion Research Platform)

### JAXA Program utilization

Acquire technologies for ultra-long-term manned stay exploration

- Based on the space technology strategy, enhance experimental technology, remote/automated/autonomous operations and acquire environmental control and life support (ECLSS) technologies.
- Maximize Kibo utilization as Japan's unique technology demonstration platform to ensure international competitiveness and promote technological development for the Post-ISS eras.

### Strengthening of Common Platform Technologies

Improve efficiency, effectiveness, and sustainability through enhanced remote operation, automation, and autonomy

### International Cooperation and Human Resource Development

Expand Kibo Utilization in Asia and Pacific regions, promote cooperation with the UN and Japan-U.S. partnership, and continue/expand student participation

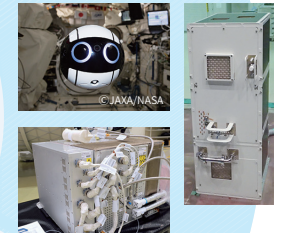
### Commercial utilization

Promote open innovation through private sector use

Vision for 2030: Private sectors to take the lead in using LEO toward Post-ISS

Efforts to expand private demand, foster businesses, and support operator independence:

- Expand tailor-made commercial utilization (e.g., commercial material shoots and other new usage fields)
- Improve environments for utilization (e.g., multimedia equipment and areas where equipment can be easily installed)
- Expand 100% resource exemptions for non-standard paid uses aimed at commercialization
- Support operation of commercialized platforms (e.g., satellite deployment, support for universities mounting small extravehicular devices)
- Strengthen support for private-sector activities based on the space technology strategy





# CONTENTS

In recent years, Japan's space policy has shifted dramatically, with accelerating efforts toward the Post-ISS era and signing of an implementation agreement between Japan and the U.S. on a pressurized manned rover. This has created a major change in the environment surrounding human space technology development. To maximize Japan's R&D achievements in response to this changing environment, and to strategically and systematically promote Kibo Utilization, JAXA revised the Kibo Utilization Strategy under the Expert Committee on Kibo Utilization Promotion, an external advisory body to the Director and the General manager of the JAXA Human Spaceflight Technology Directorate, and issued the 4th edition in March 2024.

\*The original version of this strategy was formulated under the same committee in October 2018.

<b>Introduction</b> .....	<b>2</b>
<b>On Formulating the 4th Edition</b> .....	<b>3</b>
<b>Government Policy and Trends Related to the Kibo Utilization Strategy</b> .....	<b>4</b>
<b>Target Vision for Low Earth Orbit Utilization for 2035, in the Post-ISS Era</b> .....	<b>5</b>
<b>Three Areas and Portfolio to Realize the Vision</b> .....	<b>6</b>
<b>Overall Picture of Space Environment Utilization by JAXA as the Basis of this Strategy</b> .....	<b>7</b>
<b>Five Goals for Kibo Utilization</b> .....	<b>8</b>
<b>Medium-term Vision and Initiatives to Achieve the Target Vision</b> .....	<b>9</b>

# Introduction

## Introduction

The environment surround Kibo utilization has changed dramatically with the recent shift in Japan's space policy, the incorporation of JAXA as a National Research and Development Agency, and its declaration of participation in international space exploration. JAXA has used 'Kibo' to create outcomes that directly contribute to society and link those achievements to the advancement of Japan's R&D and industrial activities, thereby maximizing the Japan's research outcomes. From the standpoint of continuing space environment utilization efforts even after the retirement of the ISS, it is necessary to turn the LEO into a private-sector-led economic zone, increase private demand for use, attract private investment, and further expand private-sector activities.

- By significantly enhancing the quality, quantity, and diversity of the 'Kibo' experiment technologies, developed through government funding, based on user needs, and promoting use by a wide range of stakeholders in industry, academia, and government, 'Kibo' will contribute greatly to improving Japan's scientific and technological capabilities and advancing its comprehensive innovation strategy.
- In addition to focusing on unique outcomes of 'Kibo' we will prioritize space experiments that have been recognized as investment-worthy tools for corporate R&D (i.e., those with prior investment decisions).
- By making full use of 'Kibo' as a research and development platform that uses space as the proving ground and continuously generating outcomes beneficial to people's lives on Earth, we will respond to the expectations of society.

## What This Document Aims to Do

This document is based on the business plan of JAXA's Human Spaceflight Technology Directorate, formulated in line with JAXA's overall management and business policies. It also considered the benefits space environment utilization brings to humanity. The document summarizes the vision for LEO utilization in 2035, the phased targets toward Post-ISS transition, and specific actions. Its purpose is to guide expansion and promotion of use, requests for the development of experimental equipment, and solicitation policies aimed at maximizing outcomes.

- This document does not prescribe specific development policies for individual technologies or experimental equipment.
- Future revisions of this document are scheduled to take place sometime before 2030, once the framework for the next-generation Post-ISS station becomes clear. This utilization strategy will be broadly communicated both domestically and internationally to build understanding, and Kibo utilization will be vigorously promoted to help solve societal challenges.



## On Formulating the 4th Edition

The update was made in response to Japan's declaration to participate on the ISS operations through 2030, the formulation of the 5th Basic Plan on Space Policy, and the Space Technology Strategy, which have clarified the vision and initiatives for LEO activities beyond 2030 with a view toward the Post-ISS era. The key points of the revision are as follows.

### **① Clarification of the medium-term vision**

Assuming the continuation of space environment utilization activities, the medium-term vision for the preparation period (2028–2030) was clarified with a view to realize the long-term vision for LEO utilization, including the use of 'Kibo' that leads into the Post-ISS era, and achieving a seamless transition to Post-ISS.

### **② Updated information regarding LEO utilization**

Based on the progress of national policies and global trends, the understanding of the environment surrounding LEO utilization has been updated from the 3rd edition.

# Government Policy and Trends Related to the Kibo Utilization Strategy

JAXA sets its medium- to long-term objectives for research, development, and utilization in the space based on the Basic Plan on Space Policy stipulated in Article 24 of the Basic Act on Space, as defined under the Law Concerning Japan Aerospace Exploration Agency. The status of official documents related to the Kibo Utilization Strategy and the current LEO activities are as follows.

## Government Policy and Trends

**Declaration of participation on the ISS operations extended through 2030 (November 2022)**

**Participation in human space exploration plans (Artemis Program / Gateway) taking shape**

**Revision of the Basic Plan on Space Policy (June 2023)**

### LEO Activities

1. Expand Japanese Experiment Module JEM 'Kibo' utilization to maximize the scientific and technological outcomes
2. Expand private sectors and end-users aiming for business development in Post-ISS
3. Technology acquisition, technology demonstration, research and development of elemental technology and system.

**Post-ISS Trends**

**Commercial space station plans for the Post-ISS era in the U.S. and Europe taking shape**

**Seamless transition to commercial LEO utilization while utilizing ISS**





# Target Vision for LEO Utilization for 2035, in the Post-ISS Era

Based on the current ISS activities and with an eye toward the future, a long-term vision has been set for LEO utilization in the Post-ISS era, identifying a target state around 2035.

## Target Vision (Long-Term Vision)

Through Kibo utilization, establish space environment utilization in LEO as part of social and economic activities of humanity

### ► Specific Scenarios

- Private sectors operate parts of commercial space stations and provide unique on-orbit services (onboard and external facilities)
- Inherit on-orbit services cultivated through Kibo utilization and operation to Post-ISS era and continue availability to the Scientific utilization in Japan

### ► Effective Use of "Kibo" as platforms for Three Activity Areas

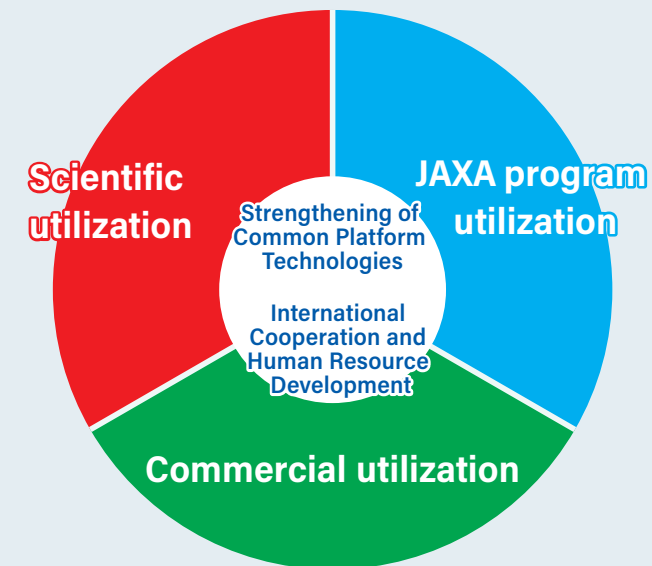
- 'Kibo' as a platform for technology demonstration and maturation
- 'Kibo' as a platform for academic and scientific research
- 'Kibo' as a platform for commercial activities

## Three Activity Areas and Portfolio to Realize the Vision

To realize this vision, JAXA has identified three key activity areas. The Kibo utilization will be promoted through strategic prioritization and concentration of limited resources. The three domains will be balanced in a 1:1:1 ratio, with efforts made to promote and maximize outcomes in each area.

### Three Activity Areas

- ① Promote national and academic research (Scientific utilization)
- ② Promote open innovation through private sector use (Commercial utilization)
- ③ Promotion of the acquisition and development of technologies for longer duration manned stay exploration (JAXA program utilization)

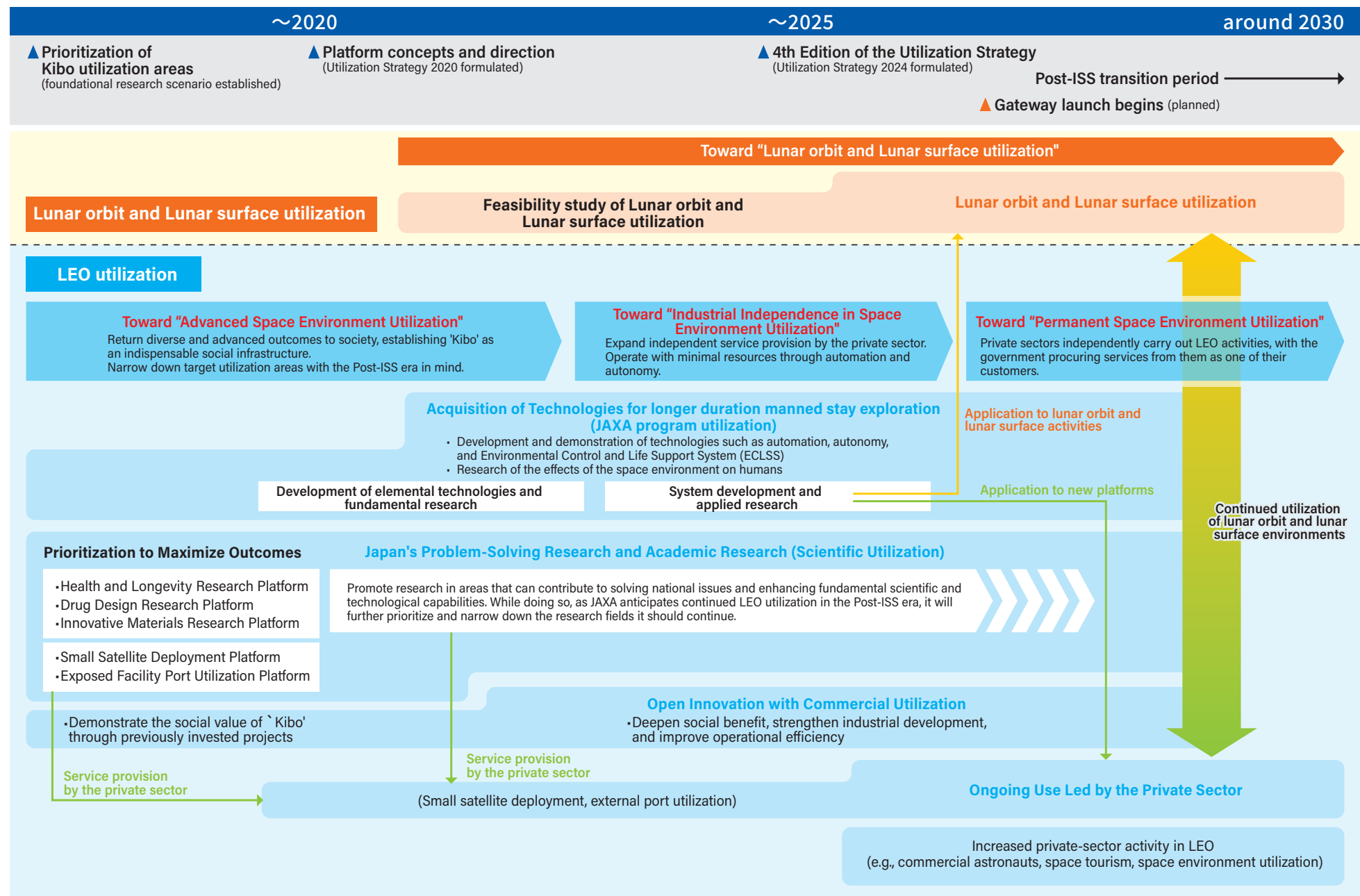


For well-balanced (1:1:1 balance), JAXA increase Commercial utilization and sustain Scientific utilization and JAXA program utilization by enhancing efficiency through automation and autonomous experimental technologies.

In support of these three areas, foundational technologies will be developed and applied. For tasks that can be performed without astronaut, R&D will be carried out to enable automation/autonomy of space environment utilization and operation, and remote operation technologies (e.g., coping with communication delays, improving sensing functions for precision tasks, promoting automation on the target side). These technologies will also be applied to future space explorations and also beneficial for activities on the ground.



# Overview of JAXA's Utilization of Space Environment (as the basis for this Strategy)



## Five goals for Kibo utilization

In promoting the three activity areas with selective prioritization under limited resources, the following five goals (carried over from the original edition) will be upheld. Goal 5 has been clarified based on the newly formulated Basic Plan on Space Policy.

### Five Goals

- ▶ **Goal 1:** Contribute to national research promoted by the government
- ▶ **Goal 2:** Demonstrate the social value of 'Kibo' through utilization by private sectors
- ▶ **Goal 3:** Promote R&D of longer duration manned stay exploration in space
- ▶ **Goal 4:** Contribute to enhancement in sciences technologies through academic research
- ▶ **Goal 5:** Contribute to Japan's growing presence in the world and human resource development in the space field



## Medium-term Vision and Initiatives to Achieve the Target Vision

This fourth edition defined a medium-term vision to guide the maintenance and evolution of LEO activities, including Kibo utilization, during transition phase into Post-ISS era from 2028 to 2030. This vision will be pursued in order to achieve the desired outcomes.

### Vision for 2028-2030 (Post-ISS Transition Phase)

#### ► **Medium-term Vision 1:**

Create Outcomes with Lasting Impact and Historical Significance

#### ► **Medium-term Vision 2:**

Private Sectors to Take the Lead LEO utilization for Post-ISS

# Medium-term Vision and Initiatives to Achieve the Target Vision

## Medium-term Vision 1: Create Outcomes with Lasting Impact and Historical Significance

To realize the vision of "Create Outcomes with Lasting Impact and Historical Significance," through the Scientific utilization promotion, the staged scenario assumptions and initiatives are outlined below.

### Staged scenario assumptions

#### ▶ 2028 (Interim State)

JAXA has established basic technologies to promote publicly solicited research themes such as flagships, and conducts space experiments on adopted scientific themes.

#### ▶ 2030 (End of ISS Operations)

After experiment completion, external scientific review panels evaluate the outcomes and recognize them as highly impactful scientific outcomes.

#### ▶ 2035 (Target Outcome Based on Efforts through 2030)

Flagship mission themes are established as new platforms for high-impact research and are recognized as part of the societal infrastructure.

### Initiatives toward Realizing the Vision

- In 2023, 13 research target areas were established under the categories of "research contributing to solving social issues or generating new knowledge using 'Kibo'" and "research contributing to humanity's advance into space (especially to the Moon and Mars)," and research proposals were selected for each area. Research planning and technical review are underway to enable space experiments around 2028.
- Promotion of new experimental environments and improvement of research capabilities on 'Kibo,' with the aim of achieving world-leading Kibo utilization outcomes as part of the All-Japan initiative, and efforts to give back to society and deliver tangible benefits for activities on the ground.

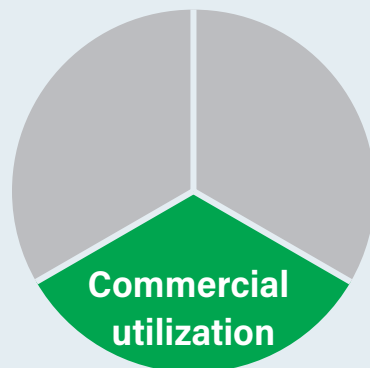


# Medium-term Vision and Initiatives to Achieve the Target Vision

## Medium-term Vision 2: Private Sectors to Take the Lead LEO utilization for Post-ISS

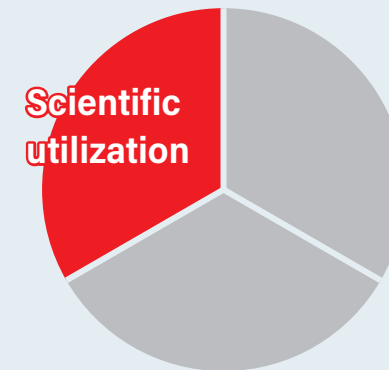
JAXA has defined the second vision expecting that the private sectors will expand their roles in the transition phase to the Post-ISS era and take on not only commercial utilization activities, but also Scientific utilization operations. Discussions and deliberations will continue regarding the division of role and responsibility between JAXA and the private sector, as well as the formation of joint implementation and evaluation frameworks.

### ① A vision where "private sectors lead commercial utilization activities in LEO"



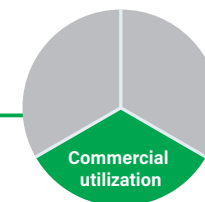
### ② A vision where "private sectors lead Scientific utilization in LEO"

In considering a future where private sectors lead Scientific Utilization of the LEO, it is necessary to clarify the prerequisites. Three key factors, "policy," "implementation capability," and "quality assurance" have been identified, and assumptions for each have been made.



# Medium-term Vision and Initiatives to Achieve the Target Vision

## ① Private sectors lead commercial utilizations in LEO



### Staged scenario assumptions

#### ▶ 2028 (Interim State)

- In preparation for the Post-ISS, private sectors are conducting trial operations.
- JAXA has created opportunities that encourage private sectors to utilize 'Kibo' and provides appropriate support to promote their proactive participation.

#### ▶ 2030 (End of ISS Operations)

- Private sectors have established independent commercial businesses, either having completed technology transfer from JAXA or providing services to end-users using their own technology and operational knowledge.
- JAXA has completed the transfer of essential expertise required for LEO business and system operations and provides opportunities for on-orbit demonstrations.

#### ▶ 2035 (Target Outcome Based on Efforts through 2030)

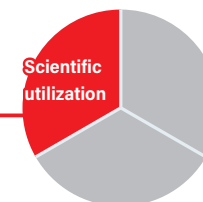
- Private sectors independently conduct commercial utilizations in LEO, with those activities being established as sustainable enterprises.

### Initiatives toward Realizing the Vision

- To realize this vision, three key approaches will be prioritized: "to increase private demand," "to foster businesses," and "to support operator independence."
- Based on the Space Technology Strategy, support for private-sector technological development and activities will be strengthened. Quotas for use and access will be expanded, and certain activities previously led by JAXA will be gradually transferred to private sectors in preparation for the Post-ISS era.

# Medium-term Vision and Initiatives to Achieve the Target Vision

## ② Private sectors lead Scientific utilization in LEO



### Staged scenario assumptions

#### ► 2028 (Interim State)

**Policy:** Japan maintain and secure Scientific utilization in LEO for academic research in a certain area (e.g., at least one of Drug-design Research Platform, Health and Longevity Research Platform, Innovative Material Research Platform, etc.).

**Implementation capability:** The technologies and expertise required for conducting these space experiments are transferred to private sectors.

**Quality assurance:** There is a function for defining relevant research fields, selecting solicited themes, and evaluating academic outcomes.

#### ► 2030 (End of ISS Operations)

**Policy:** Japan maintains a facility in LEO where academic research equivalent to that conducted on 'Kibo' can be carried out (Scientific utilization). JAXA can present data and provide support to justify the funding scale required to maintain this state (using indicators such as annual crew time or the number of scientific themes).

**Implementation capability:** The technologies and expertise required for space experiments are transferred to private sectors (measured by the number of scientific platforms transferred and operational).

**Quality assurance:** There are functions for defining relevant research fields, select themes through solicitation, and evaluate academic outcomes, with the potential to produce outcomes comparable to current levels. JAXA establishes a framework of ensuring research quality.

#### ► 2035 (Target Outcome Based on Efforts through 2030)

The private sectors, responsible for public funding, operate new on-orbit science missions that contribute to solving social issues and creating knowledge, providing justification to taxpayers for continued investment. More private sectors get actively involved and contribute to generating outcomes.



# Medium-term Vision and Initiatives to Achieve the Target Vision

## Initiatives toward Realizing the Vision

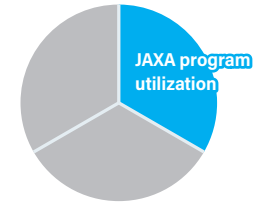
As private sector activities are expected to expand in the transition to the Post-ISS era, taking on not only Commercial utilization but also Scientific utilization operations, it will be necessary to clarify the following prerequisites for leading Scientific utilization. Discussions on this will continue moving forward.

### [ Clarification of Prerequisites ]

- Users of Scientific utilization are expected to include universities and research institutions, maintaining the current scale of space experiments and space utilization will require significant annual public funding, including costs for maintaining on-orbit facilities. JAXA must provide data to justify the required level of funding and support its acquisition ("Policy").
- Unlike entertainment-related commercial utilization, scientific missions require meticulous preparation for experiments in space. Therefore, tasks currently conducted by JAXA must be gradually transferred to private sectors ("Implementation Capability").
- From the standpoint of accountability for public funding, functions must be in place for defining relevant research fields, selecting solicited themes, and evaluating academic outcomes. In addition, conflict-of-interest management must be ensured ("Quality Assurance").

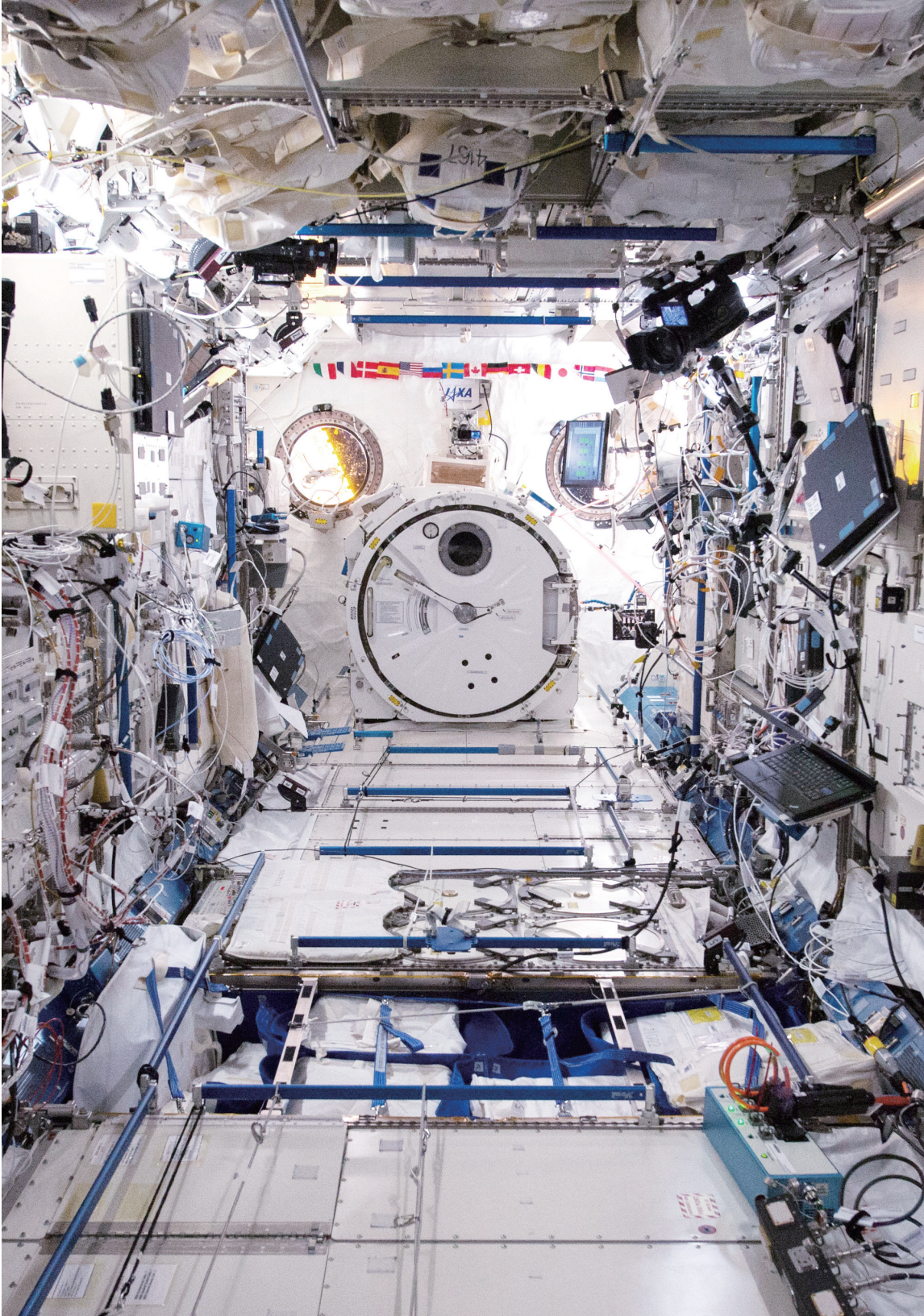
# Ensuring Continuity of Space Environment Utilization and Developing Technologies for Longer-Duration Manned Stay Missions and Deep Space Exploration

- For Post-ISS, we identify the areas of space environment utilization that Japan as a country should continue to establish the technologies. This will involve maximizing the use of ground-based robotics, remote operation technologies, and artificial intelligence (AI) to enable autonomous operation without human presence.
- To support the development of technologies related to longer-duration space habitation and deep space exploration, research and demonstration will focus on technologies required for sustaining humans stay in space for extended periods—both in LEO and beyond. This comes amid growing prospects, such as Japanese astronauts participating in lunar exploration programs and rising demand for commercial astronauts driven by the expansion of private space activity. A central focus of this will be research into the effects of the space environment on the human body, addressing health risks associated with the prolonged stays in space.



The Space Technology Strategy identifies the development of technologies for manned space habitation and base systems—including technologies for remote operation, automation, and autonomy as essential. It also emphasizes the importance of inheriting and advancing the unique and internationally competitive capability of space environment utilization cultivated through 'Kibo'. By identifying and prioritizing the missions to be conducted on 'Kibo' from among these initiatives, JAXA will use its 'Kibo' program operations to promote the acquisition of longer-duration human spaceflight and exploration.





If you have questions about this document or wish to make an inquiry into the JEM 'Kibo,' send e-mail to:

**Kibo Utilization Promotion Office** | [Z-KIBO-PROMOTION@ml.jaxa.jp](mailto:Z-KIBO-PROMOTION@ml.jaxa.jp)

**Kibo Utilization Strategy** | <https://humans-in-space.jaxa.jp/kibouser/information/scheme/>

#### **Community activities**

**Kibo Utilization Network** | <https://humans-in-space.jaxa.jp/kibouser/community/>

**Official X account** | [@JAXA\\_Kiboriyo](https://twitter.com/JAXA_Kiboriyo)