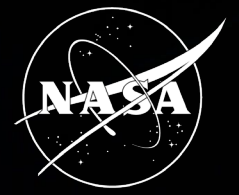
National Aeronautics and Space Administration



INTERNATIONAL SPACE STATION UPDATE

NATIONAL ACADEMIES COMMITTEE MEETING

Robyn Gatens
Director, International Space Station & Acting Director, Commercial Spaceflight Division
National Aeronautics and Space Administration (NASA), United States

ISS NATIONAL LAB (CASIS) STATUS

- Future National Laboratory Planning
  - Going forward, calling “The Institute”, full name TBD
  - NASA-internal workshops held in May 2024 and July 2024
  - Initial review by NASA leadership completed July 2024
  - Presented plan to OSTP LEO S&T IWG July 2024
  - Conducting external engagement with NSpC, the Hill, then Industry and International Partners

Station Mission Goals – The Decade of Results

Enable Deep Space Exploration

Validate Exploration Technologies and Reduce Human Health Risks

29 NASA tech demos initiated since 2018
~20 human health risks continuing to be characterized and countermeasures developed

Over **700** payloads have flown through the ISS National Lab; **80%** from the **commercial** sector
$2.2 billion of capital raised by startups post-flight
>27 In-Space Production Applications Awards to date
3 Private Astronaut Missions

Foster Commercial Space Industry

In partnership with Commercial LEO Program

Incubate in-space manufacturing, support commercial LEO facilities and customers

Conduct Research to Benefit Humanity

Life-saving medical research & applications, understanding climate change, sharing discoveries with all

> 4000 investigations
> 5000 investigators represented
> 4000 scientific results publications
~4.6 million images of Earth captured

Involves **100,000+** people at **500** contractor facilities in **37** U.S. states and **16** countries
>10 million student activities in 2024
18 million people follow social media accounts

Inspire Humankind

Broaden reach of space benefits, engage public, create diverse future STEM workforce

Enable International Collaboration

Maintain & expand international partnerships, set norms & standards

~more than 2200 international-led investigations through Expedition 69
117 countries/areas with ISS research and education participation
1st ISS increment UAE astronaut

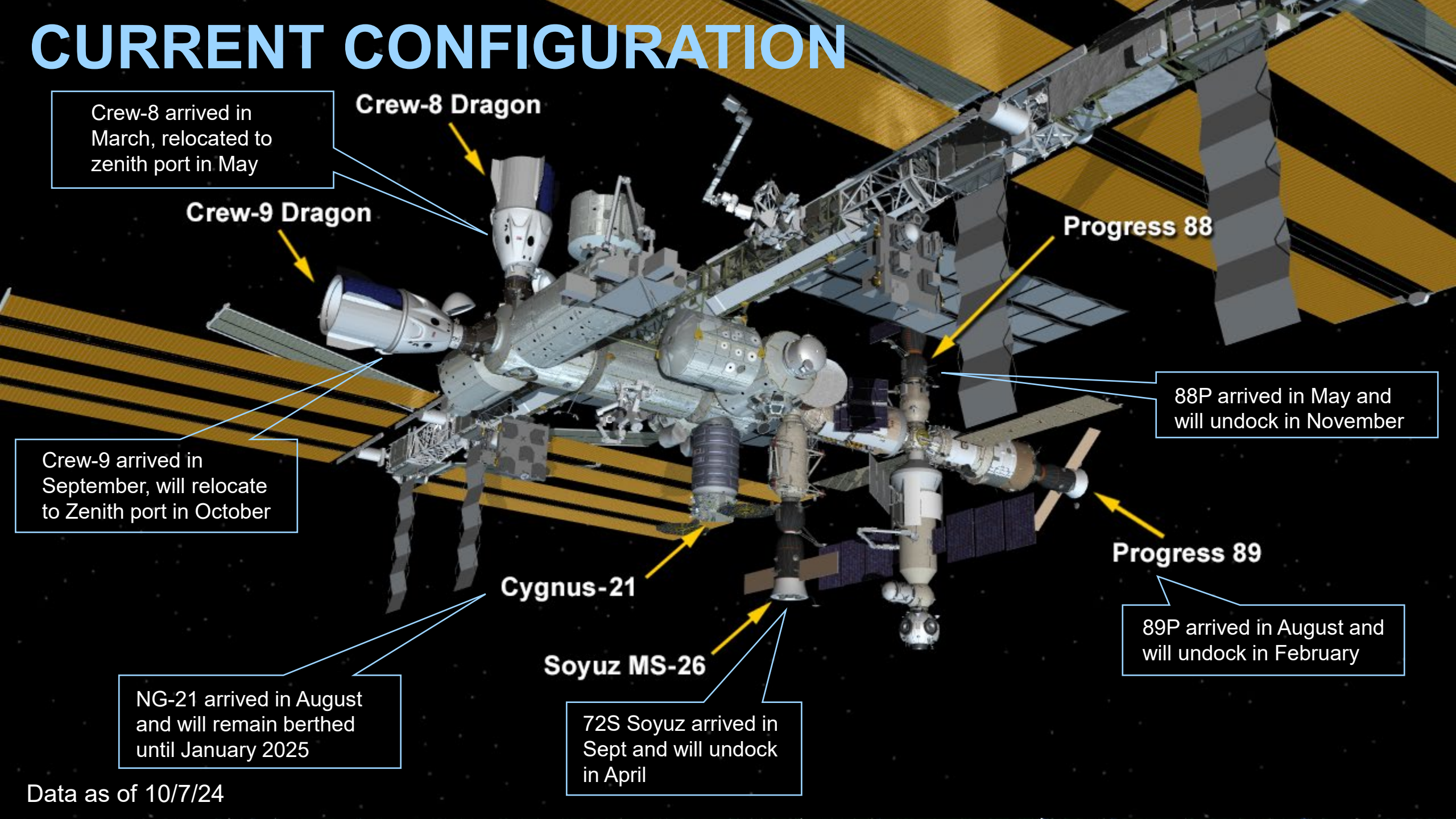
>23 years continuous presence in space
>280 cargo and crew missions to ISS

Provide a Continuous LEO Infrastructure and Destination

Ensure continuous human presence in LEO - no gap; provide destination for crew & cargo transportation

INTERNATIONAL SPACE STATION
BUSIER THAN EVER BEFORE

CURRENT CONFIGURATION



Data as of 10/7/24

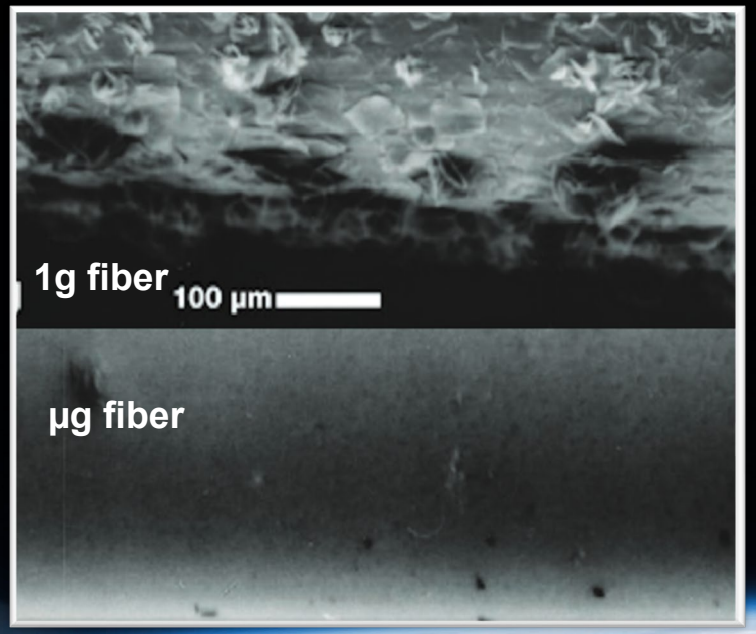
EXPEDITION 72 OVERVIEW

- SpaceX Crew-9 Launch/Dock ✓
- SpaceX Crew-8 Undock/Splashdown
- SpaceX Crew-9 Relocate
- SpaceX CRS-31
- Progress 88P Undock
- Progress 90P Launch/Dock
- Dream Chaser Cargo Mission (DCC-1)
- Northrop Grumman CRS-21 Release
- US EVAs (IROSA Prep 2A + RGA, CARD, RFG 2.5, IROSA Prep 3B)
- Progress 89P Undock
- Progress 91P Launch/Dock
- SpaceX Crew-10 Launch/Dock
- SpaceX Crew-9 Undock/Splashdown
- SpaceX Crew-32 Launch/Dock
- Soyuz 73S Launch/Dock
- Soyuz 72S Undock

The International Space Station's Expedition 72 crew.
At the top (from left) are, Alexey Ovchinin (Roscosmos), Suni Williams (NASA), and Butch Wilmore (NASA). In the middle row are, Ivan Vagner (Roscosmos) and Don Pettit (NASA). In the bottom row are, Aleksandr Gorbunov (Roscosmos) and Nick Hague (NASA).

SCIENCE HIGHLIGHTS

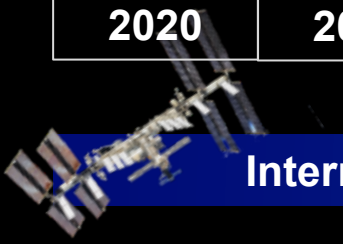
- Successful 3D Bioprint of Live Human Heart Tissue
- Printing Higher Quality Optic Fiber in Microgravity
- Detecting Malignant Self-Replicating DNA
- NASA's First Optical Link on the Space Station



COMMERCIAL LEO DESTINATION STRATEGY

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031

Goal for CLD Initial Capability ▲ Planned ISS Deorbit ▼



International Space Station (ISS) Operations — **CLD Operations**

Transition Period

CLD Phase 1: Design Maturation

Commercial Destinations for ISS (CDISS)
Axiom Space

2-year Option

Commercial Destinations Free Flyer (CDFF)
Blue Origin & Sierra Space Orbital Reef

Commercial Destinations Free Flyer (CDFF)
Nanoracks & Voyager Space Starlab

CLD Phase 2: Certification and Services

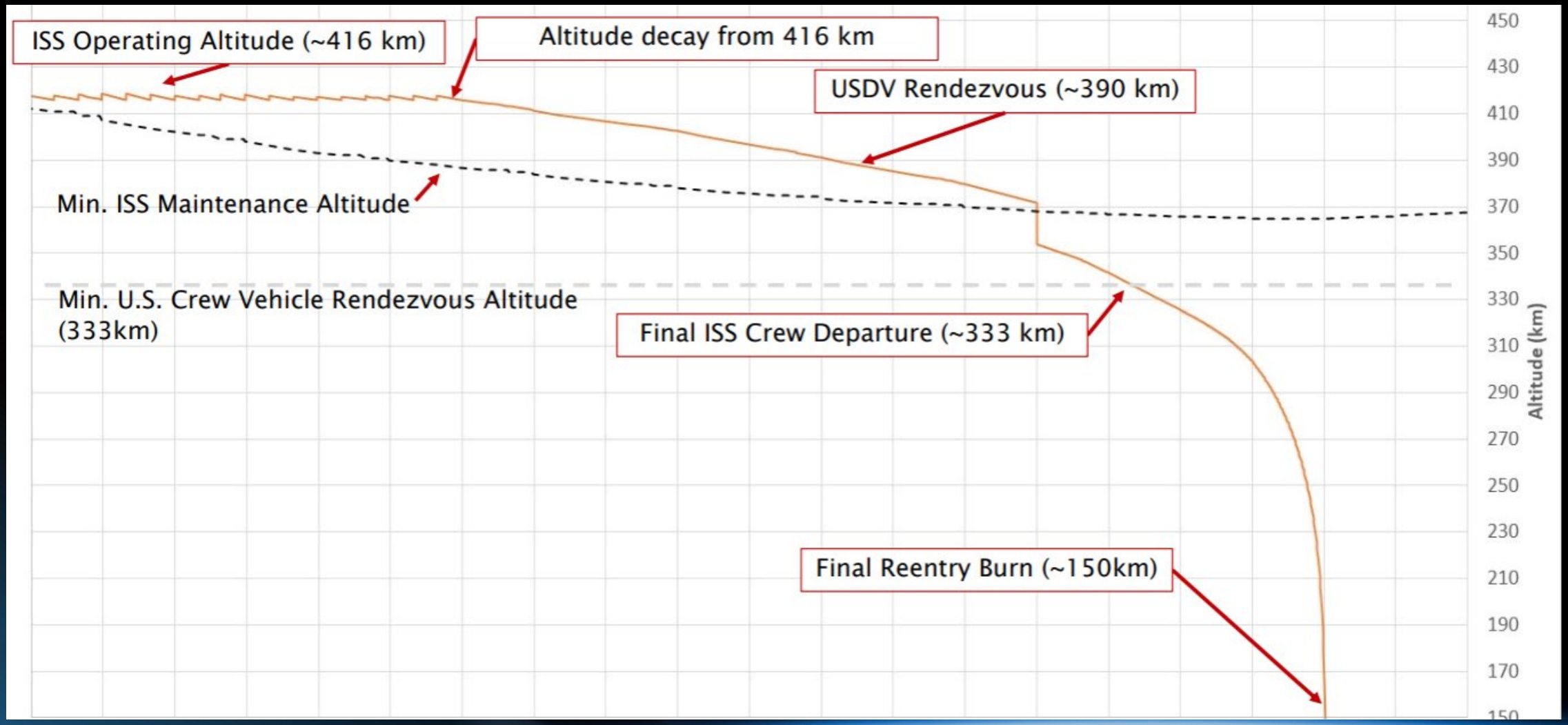
NASA Certification of CLD(s) and Purchase Services
Full and open competition, one or more awards

WHY IS DEORBIT NECESSARY?

Alternate options to deorbiting the International Space Station were considered, including:

- Uncontrolled re-entry
- Disassembly and return to Earth
- Disassembly and repurposing in low Earth orbit
- Disassembly and deorbit in smaller pieces
- Boosting to a higher orbit
- Decomposition of the station while in space
- Transitioning to a commercial operator
- Continuing operations beyond 2030

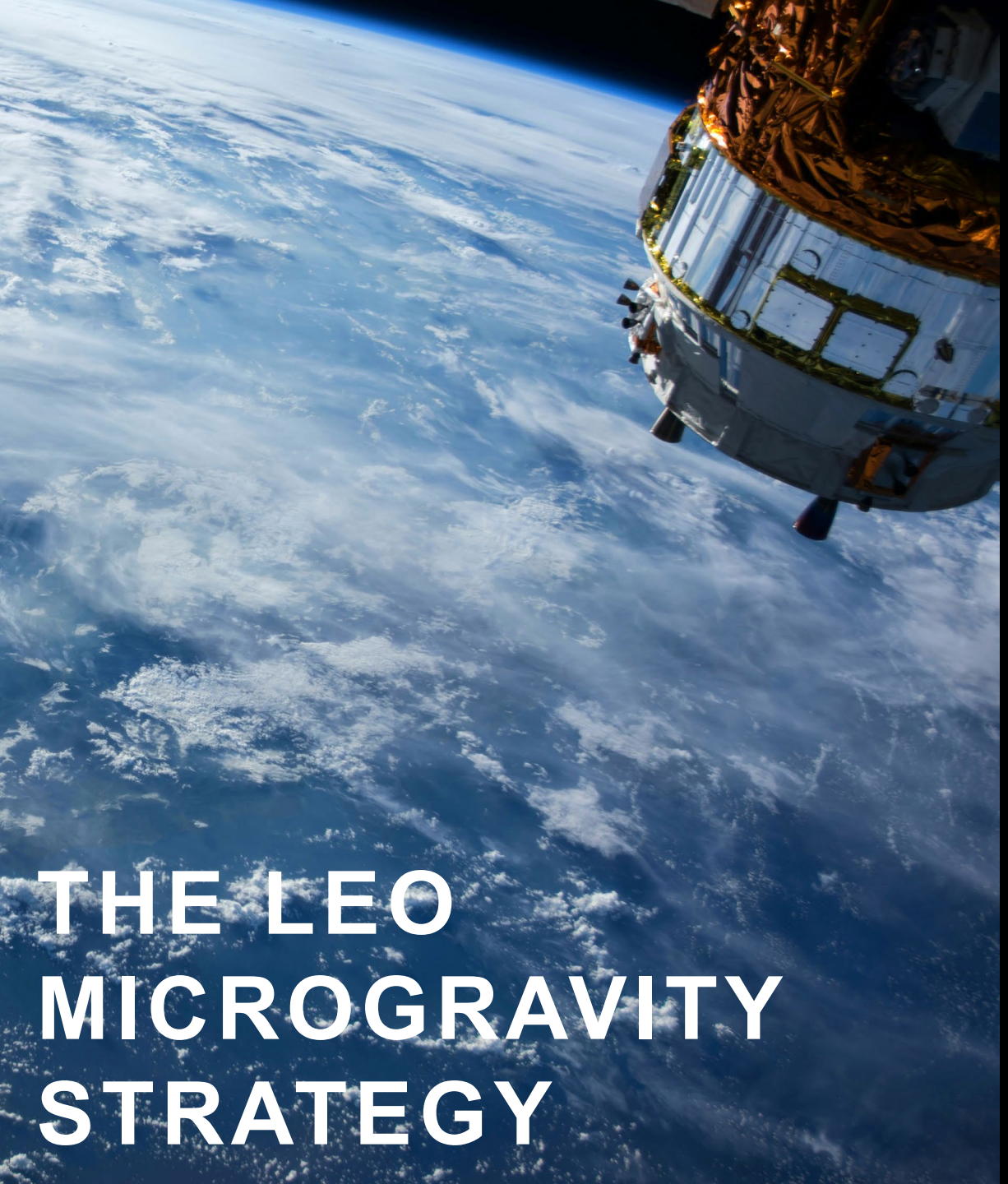
NOTIONAL DEORBIT PLAN



A HUMAN SPACEFLIGHT LEGACY

NASA’s flagship human spaceflight programs have built upon each other, expanding our knowledge and experience of humans living and working in space.

However, a key question exists: What comes next for humans in low Earth orbit?



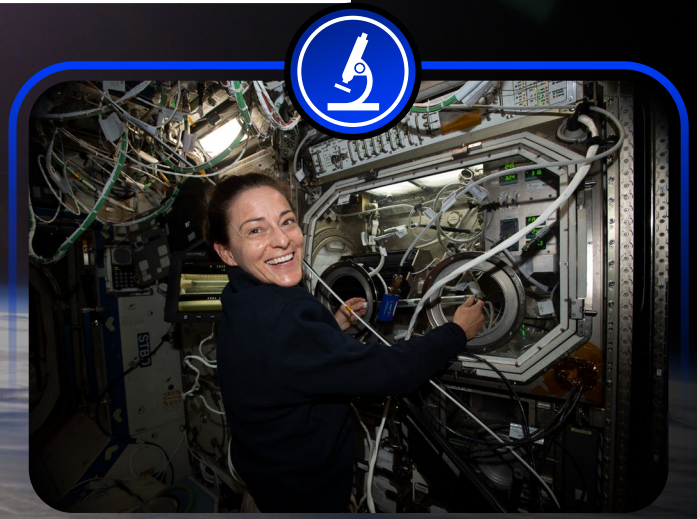
THE LEO MICROGRAVITY STRATEGY

- **ADVANCE** GLOBAL SCIENCE & TECHNOLOGY GOALS
- **FOSTER** INTERNATIONAL PARTNERSHIPS
- **REVOLUTIONIZE** A COMMERCIAL LOW EARTH ORBIT ECONOMY
- **INSPIRE** FUTURE GENERATIONS TO IMPROVE THE WORLD THROUGH SPACE ENDEAVORS

WHY GO?

BENEFITS TO HUMANITY

The pursuit of exploration yields invaluable scientific discoveries, serves as a catalyst for global cooperation, and inspires future generations to dream big.



OUR VISION

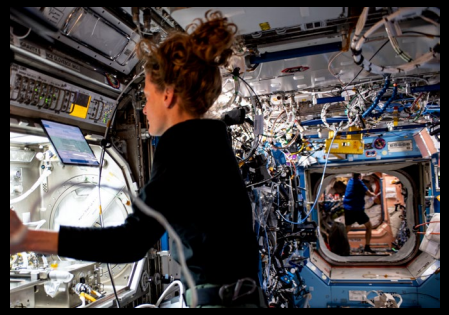
“Leading the next generation of human presence in low Earth orbit to advance microgravity science, technology, and exploration.

A WHOLISTIC APPROACH

LMS TEAM

Participants from the mission directorates, mission support offices, and cross-agency federated board are engaged as part of a working group to develop goals and objectives for the LEO Microgravity Strategy (LMS).

Each organization was tasked to develop goals and objectives for their assigned bucket.



SCIENCE

What human-enabled science that is unique to the microgravity environment will we do in LEO?

COMMERCIAL LEO INFRASTRUCTURE

What role should the private sector play?

EXPLORATION-ENABLING RESEARCH & TECHNOLOGY

What technologies should NASA develop, test, demonstrate in LEO?

INTERNATIONAL COOPERATION

How should NASA expand and strengthen international relationships in LEO?

OPERATIONS

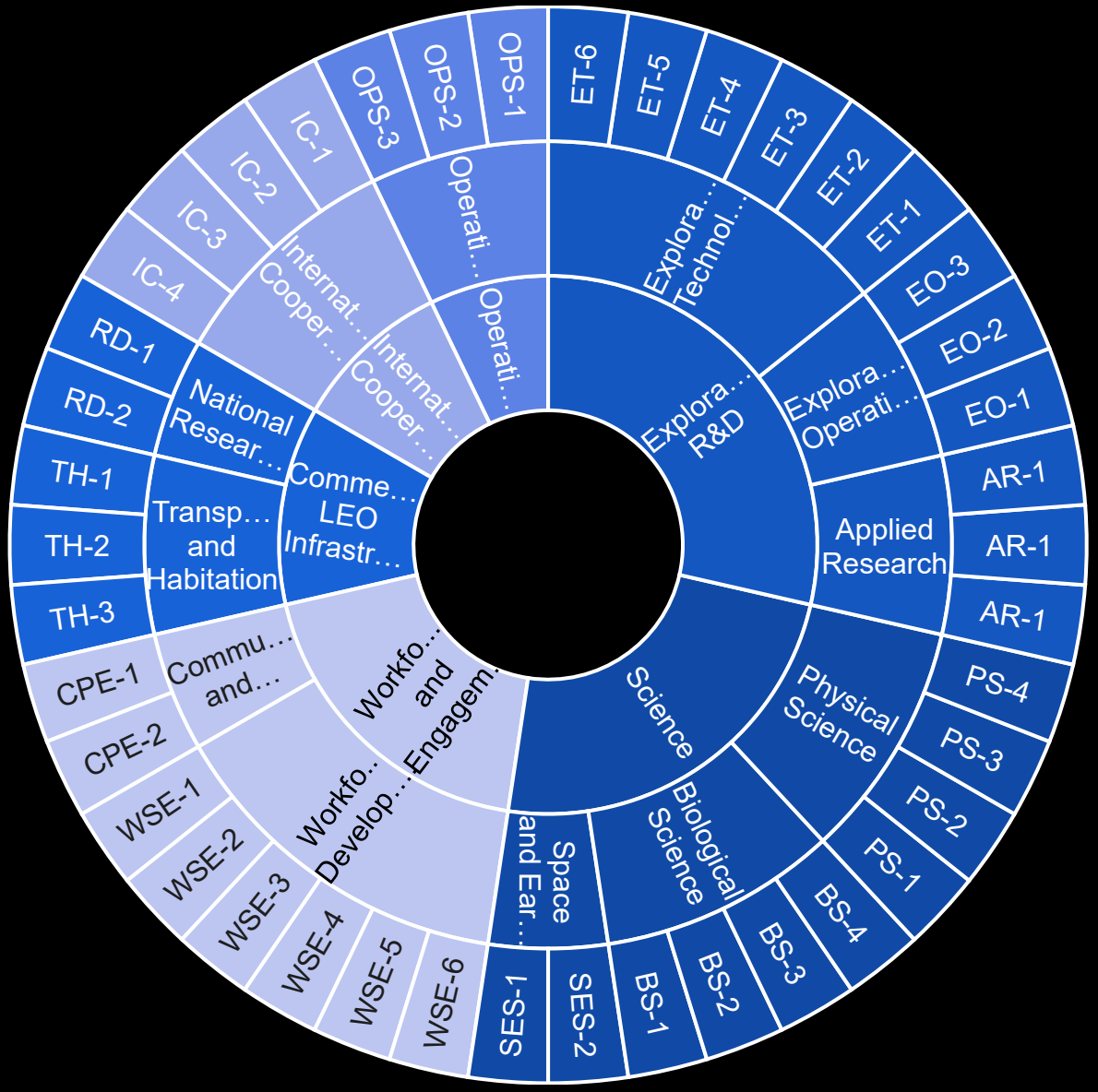
What operational skills should NASA preserve, especially looking ahead to the Moon and Mars?

WORKFORCE AND ENGAGMENT

How does NASA ensure we inspire the next generation?

LEO MICROGRAVITY STRATEGY

Goals and Objectives



TOTAL OBJECTIVES

42

Science and Exploration-Enabling Research and Technology Development make up over 50% of the total objectives. Workforce and Engagement have nearly 20%.

TOTAL GOALS

12

Science and Exploration-Enabling Research and Technology Development each have three goals, making up half of the total goals.

LEO MICROGRAVITY STRATEGY

Broad Stakeholder Inputs

Space Sustainability

Ensure the next stages of LEO science and exploration is safe and sustainable to the overall space environment

Articulating the “Why”

Enhance goals further with rationale on why low Earth orbit is important and why humans are needed

Commercial LEO Infrastructure

Highlight the importance in goal categories; Transportation and Habitation in critical path

Continuous Human Presence

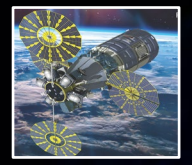
Address the need and meaning of continuous human presence

VISION FOR LEO ECONOMY:

A WORLD OF NEW POSSIBILITIES

- NASA is one of many customers in a robust low Earth orbit economy
- Commercially-owned and operated transportation for cargo and crew
- Commercially-owned and operated LEO destinations that are safe, reliable, and cost-effective
- Regular production, distribution, and trade of goods and services
- Ongoing research and science activities including a LEO National Lab
- Continuation of human spaceflight exploration objectives
- Sustained presence and U.S. leadership in LEO

COLLABORATIONS FOR COMMERCIAL SPACE CAPABILITIES


Northrop Grumman


Blue Origin


Sierra Space


SpaceX


Special Aerospace Services


ThinkOrbital Inc.


Vast Space LLC

COMMERCIAL CARGO & CREW TRANSPORTATION

Operational


Northrop Grumman


SpaceX

Final Dev


Sierra Space

Operational


SpaceX

Final Dev


Boeing

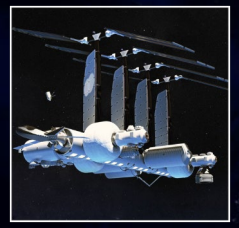
Concept Maturation


Sierra Space


Blue Origin

COMMERCIAL LEO DESTINATIONS


Axiom Station
Axiom Space


Orbital Reef
Blue Origin


Starlab
Airbus, Nanoracks, Northrop Grumman, Voyager Space

MORE ELEMENTS OF A STRONG LEO ECONOMY


Private Astronaut Missions & Space Tourism


Commercial Marketing, Advertisement & Entertainment Activities


Inspiration for Student STEM Activities


Technology Demonstrations


In-Space Manufacturing & Production


LEO National Lab


Human Research


NASA
SPACE OPERATIONS MISSION DIRECTORATE
@NASASpaceOps

DESTINATION: LOW EARTH ORBIT

With the Space Shuttle Program and International Space Station, NASA took the next steps to learn how to sustain life off Earth long-term through life-changing scientific advancements, while also igniting the spark of the next economic revolution.

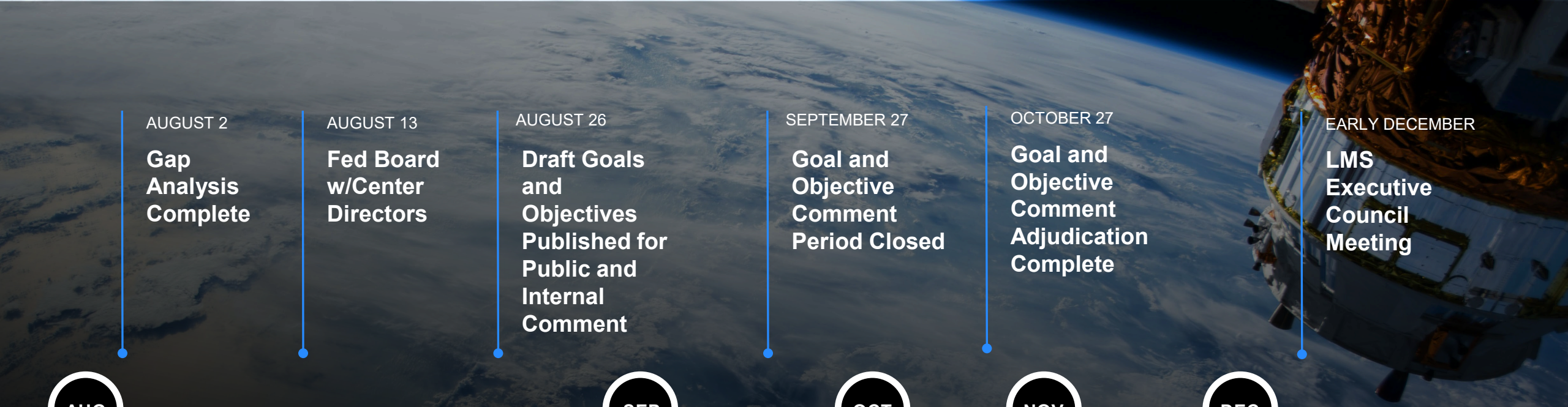
WHY NOW

The next economic revolution is in space and NASA's work in low-Earth orbit continues to propel an emerging space economy that will power and empower countless future generations and create new jobs and industries.

WHY NASA

Since construction began on the International Space Station in 1998, NASA has garnered unparalleled experience and expertise in low Earth orbit operations.

LMS Timeline



AUG

AUGUST 2
Gap Analysis Complete

AUGUST 6
Fed Board review

AUGUST 13
Fed Board w/Center Directors

MID-AUGUST
U.S. Government Stakeholder Engagement

AUGUST 26
Draft Goals and Objectives Published for Public and Internal Comment

SEP

SEPTEMBER 6 & 13
International and Industry Workshops

SEPTEMBER 27
Goal and Objective Comment Period Closed

OCT

OCTOBER 27
Goal and Objective Comment Adjudication Complete

NOV

MID-NOVEMEBER
Acquisition Strategy Meeting for Commercial LEO Destinations

DEC

EARLY DECEMBER
LMS Executive Council Meeting

DECEMBER 15
Finalized Goals and Objectives Published