

# EXPLORE HUMANS *in* SPACE

## ISS Current and Planned Transition Activities

2019 Fall Meeting of the Committee on  
Biological and Physical Sciences in Space  
National Academies

Robyn Gatens  
Oct 29, 2019

A robust low-Earth orbit economy  
from which NASA can purchase  
services as one of many customers.

# NASA's Vision for Economic Development in Low-Earth Orbit

LONG-TERM

- Private sector owns and operates LEO destinations
- Industry activities including manufacturing, marketing, and entertainment thrive in LEO
- ISS assets are completely transitioned at end of life
- NASA purchases continued R&D Services from commercial providers at lower costs than on ISS
- NASA and International Partners are freed up to shift focus and resources towards exploration

MID-TERM

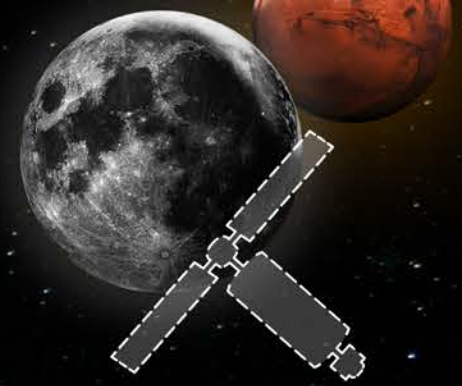
- NASA and commercial partners work together to develop and demonstrate new LEO destinations
- NASA continues to support R&D needs and ISS National Laboratory needs
- NASA incorporates International Partner commercial needs
- Phased transition from ISS to commercial platforms with attached and/or free flyers is initiated
- NASA and commercial partners work together to stimulate global demand and catalyze new markets

NEAR-TERM

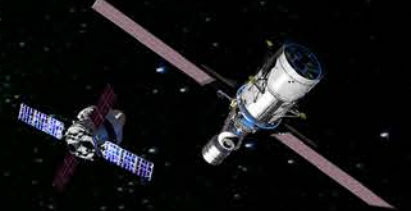
- NASA documents and shares the agency's comprehensive approach for global commercial LEO development
- NASA continues to support R&D needs and ISS National Laboratory needs
- NASA leverages ISS capabilities to stimulate demand and catalyze new markets
- NASA collaborates with International Partners on new market development
- Commercial partners begin new activities in LEO

YOU ARE HERE

EXPLORE THE PLAN AT [WWW.NASA.GOV/LEO-ECONOMY](http://WWW.NASA.GOV/LEO-ECONOMY)



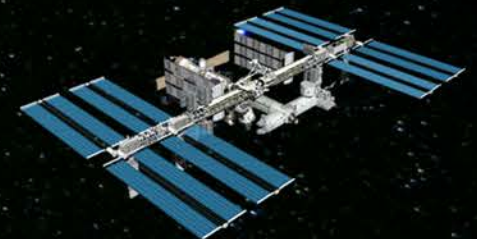
FUTURE  
COMMERCIAL  
DESTINATIONS



ARTEMIS MISSIONS

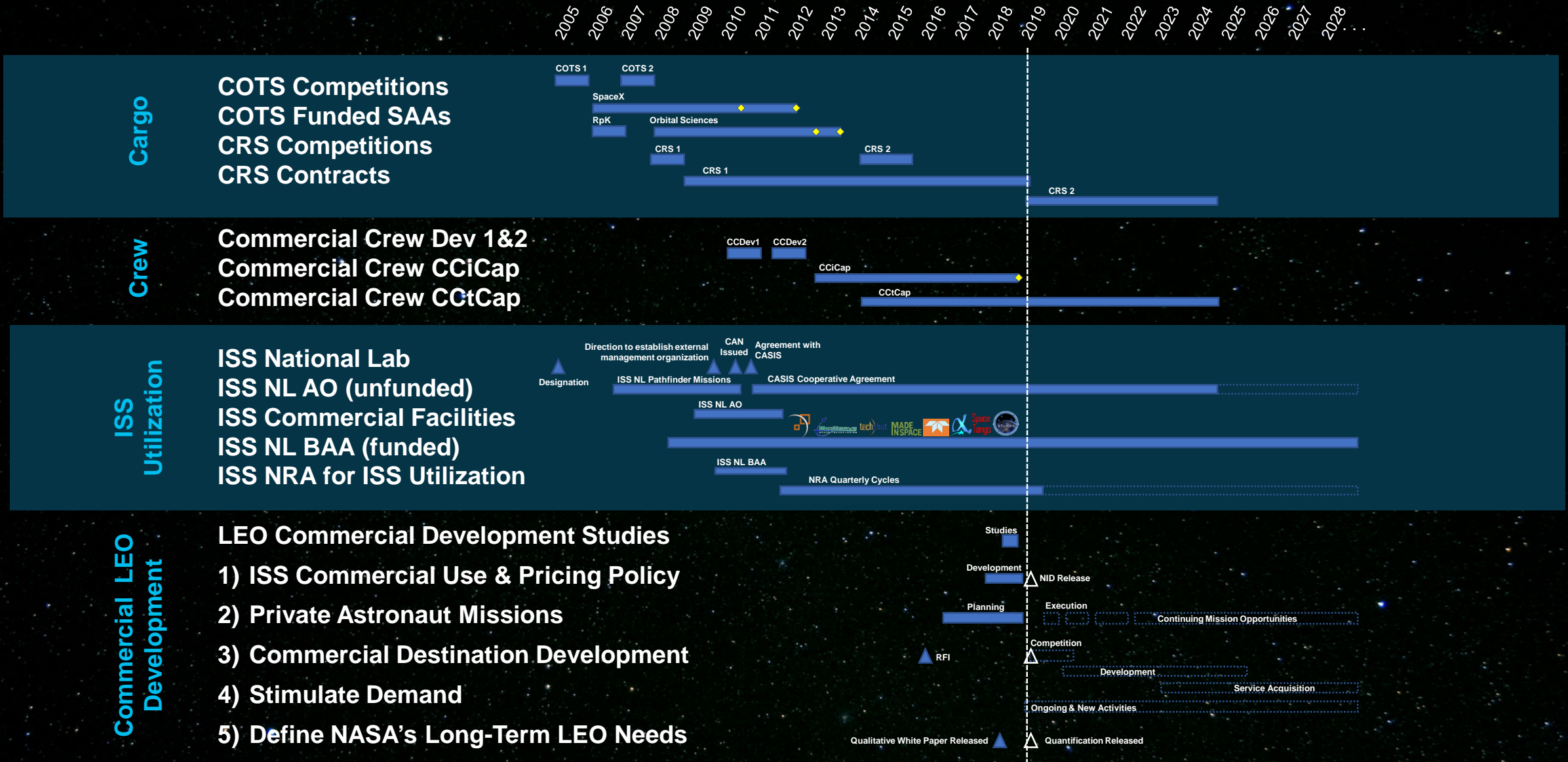


COMMERCIAL  
PARTNER  
SPACECRAFT



INTERNATIONAL SPACE  
STATION

# Commercial LEO Development



# NASA Plan for Commercial LEO Development

NASA developed a five-point plan building on the work of the last two decades. This plan includes new policies, multiple solicitations, and new information that can be found on the Leo Economy website.

1. NASA established a commercial use and pricing policy for the International Space Station (ISS)
2. Enable flight of private astronauts to the ISS with the first mission as early as 2020
3. Initiate a process for developing commercial low-Earth orbit destinations
4. Seek out opportunities to stimulate scalable and sustainable demand for LEO destinations
5. Quantify the agency's long term needs in LEO



## **NASA Plan for Commercial LEO Development**

to achieve a robust low-Earth orbit  
economy from which NASA can purchase  
services as one of many customers

### **Summary and Near-Term Implementation Plans**

June 7, 2019

<https://go.usa.gov/xym78>

# Commercial LEO Development Rollout

- NASA announced the agency's plans for commercial development of low-Earth orbit, including opening the International Space Station to expanded commercial activities on June 7, at Nasdaq in New York City.
- Key participants:
  - NASA CFO, Jeff DeWit
  - HEOMD AA, Bill Gerstenmaier
  - ISS Deputy Director, Robyn Gatens
- Reach of more than 700k from the three FB live
- More 80k+ viewers of the live press event on the NASA twitter feed
- Nearly 1,000 shares of the live press event on the NASA FB page



# (1) ISS Commercial Use and Pricing Policy

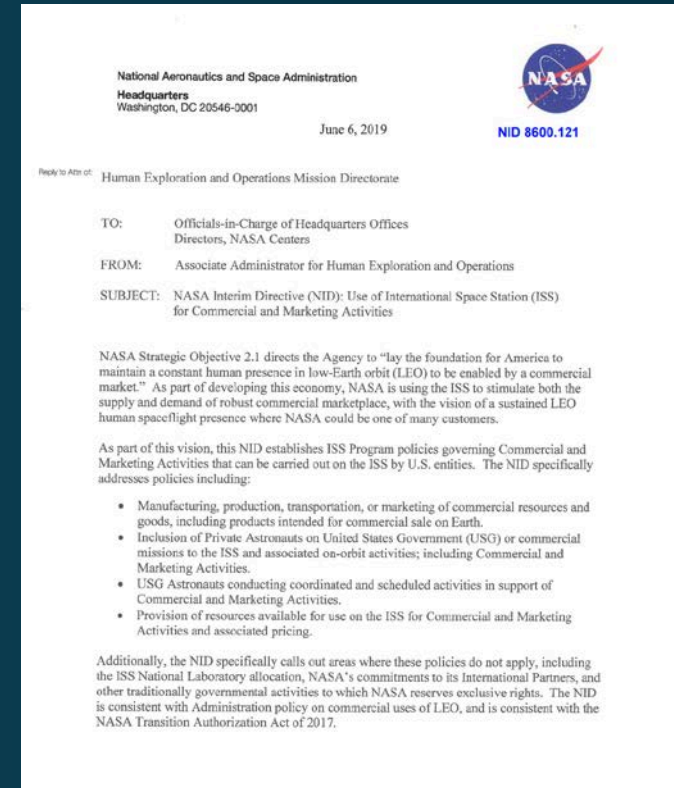
NASA released a NASA Interim Directive (NID) for Use of ISS for Commercial and Promotional Activities

**Purpose:** to clarify NASA's policy for expanded commercial use of ISS (within the agency's existing authorities) consistent with congressional and administration policy direction

**Goal:** enable commercial activities in low Earth orbit leading to sustainable LEO economy with NASA as one of many customers

Document includes:

- Requirements commercial and promotional activities must follow in order to be flown
- Pricing of NASA resources (reduced below actual cost to enable market development)
- Amount of NASA committed resources for commercial and promotional activities
- Limit of resources one commercial entity can acquire at a time



<https://go.usa.gov/xym7f>

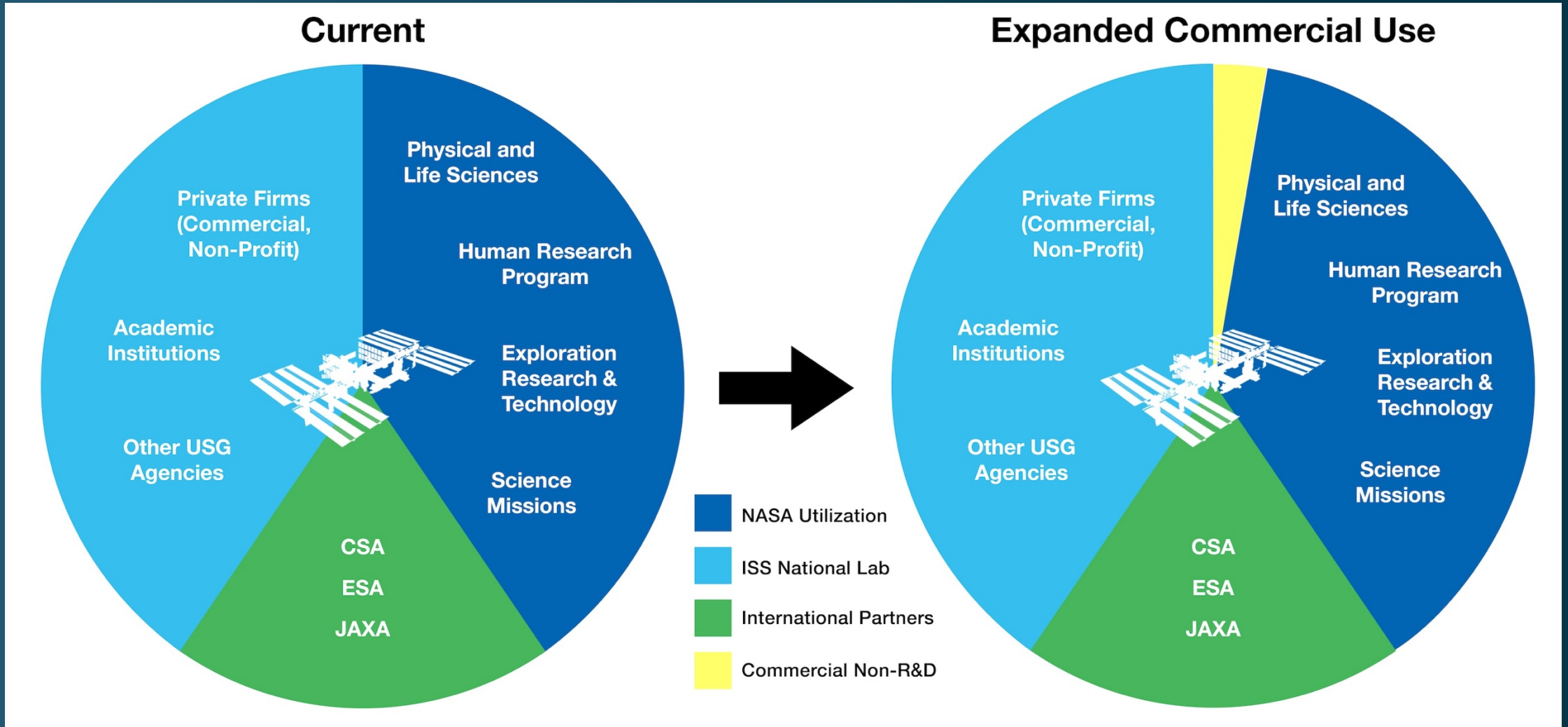
# Commercial Use Policy Overview

Under the NASA Interim Directive on Use of International Space Station (ISS) for Commercial and Marketing Activities, U.S. Entities will have the ability to pursue:

- Manufacturing, production, transportation, or marketing of commercial resources and goods, including products intended for commercial sale on Earth
- Inclusion of private astronauts on USG or commercial missions to the International Space Station and associated on-orbit activities, including commercial and marketing activities
- U.S. government astronauts conducting coordinated and scheduled activities in support of commercial and marketing activities
- Purchase resources available for use on the International Space Station for commercial and marketing activities

Read more at [nasa.gov/leo-economy/commercial-use/](https://nasa.gov/leo-economy/commercial-use/).

# Commercial Resource Allocation



## (2) Private Astronaut Missions

### Historical Precedent

- Russia sold seats on Soyuz for 8 private astronaut missions of 7-13 days duration to the ISS between 2001-2009 for ~\$25m-45m per mission, and has sold 1 seat to UAE Space Flight Participant (SFP) for flight in September 2019

### Current NASA Plans

- NASA is planning to enable private astronaut missions to the ISS using vehicles developed by SpaceX and Boeing under NASA's commercial crew program (CCP)
  - Goal is all Commercial "Charter" Flight – Commercial Provider (CP) sells an entire mission to SFPs for sortie mission to ISS, independent of NASA's commercial crew program
  - Private companies may offer to fly NASA astronauts under these agreements
- Initial mission could potentially be as early as 2020
- NASA can accommodate up to 2 'sortie' flights to come to ISS per year
- NASA will encourage foreign governments to work through US companies
- NASA has released a new Focus Area 4 in the ISS Utilization NRA
  - Private Astronaut Missions to the International Space Station (ISS)

# Benefits of Private Astronaut Missions

- Allow commercial industry to purchase commercial services and gain insight into the costs associated with owning and operating a platform in the future
- Reduce market risk to commercial LEO destination developers by demonstrating the market
- Expands range of commercial activities that can be performed on ISS
- Potential to increase flight rate and strengthen the market for commercial crew launch service providers
- Potential to increase available crew time on orbit for NASA, commercial, and other R&D activities





# (3) Commercial LEO Destination Solicitations

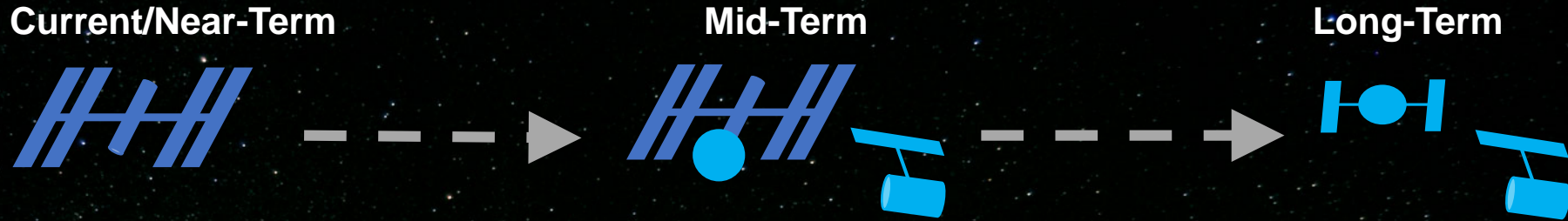
## NASA Objectives – Move fast to:

- Partner with US industry to facilitate development of LEO Destinations that are safe, cost effective, and available for Government and other customers
- Enable the eventual purchase of commercial services to meet NASA's need for continued operations in LEO as one of many customers, once the capability is matured and available

## Attributes

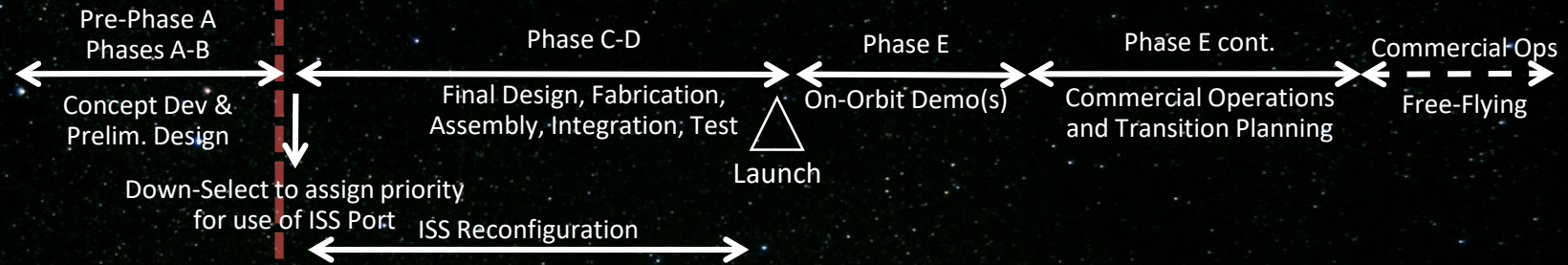
- Not taking delivery of hardware or services at this time, availability of initial services not anticipated for several years.
- Continue to let providers maintain as much ownership of their data and invention rights as possible
  - NASA does not need data other than for confirmation of milestone completion and safety/interfaces
- Treat the providers as **partners** and not suppliers
  - Minimal NASA oversight (insight only) with small team and avoidance of bureaucracy
  - Need maximum flexibility for industry to innovate
  - The company will be required to get significant non-NASA investment
  - NASA has a desire for significant non-government customers
- Minimize industry and investor uncertainty and reduce risk of commercial failure
- Performance-based milestones in order to obtain NASA funding

# Notional LEO Destinations Roadmap



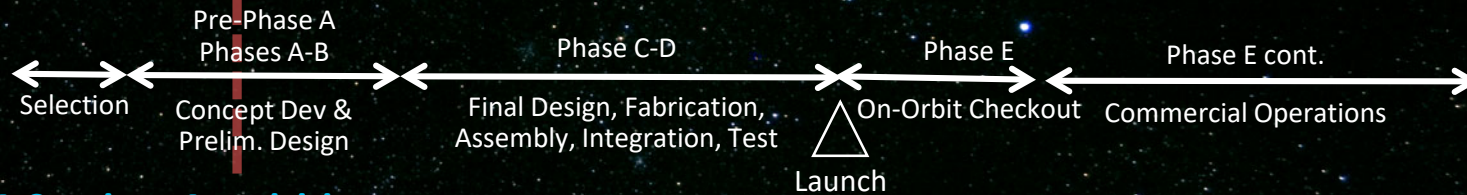
**NextStep 2 BAA Appendix I**  
*June 21, 2019 Solicitation*

## ISS Port Path



**NextStep 2 BAA Appendix K**  
*Oct 3, 2019 Draft Solicitation*

## Free Flyer Path



**Service Acquisition Competitions**

## NASA Services Acquisition



# (4) Stimulate Sustainable Demand

- **ISS National Lab accommodating many industry R&D projects**
  - Promising projects will transition from ISS NL post-R&D to enter production
- **In Space Manufacturing Projects underway (funded by ISS to date):**
  - Exotic Optical Fibers (3 projects)
    - 2 on NG-11 (April 2019)
    - 1 on SpX-16 (December 2018)
  - Bio-printing
    - on SpX-18 (July 2019)
  - Industrial Crystallization
    - NET SpX-20 (March 2020)
  - Super Alloy Casting
    - NET NG-12 (October 2019)
  - Ceramic Stereolithography
    - NET SpX-19 (December 2019)
- **New ISS Utilization NRA Thrust Areas now open for new projects leading to scalable, sustainable demand**
  - In-space manufacturing, regenerative medicine/bioengineering, other concepts
  - Commercial concepts to create “space lab” research capabilities that mirror ground lab capabilities
- **Intent is to continue building a pipeline of projects through ISS life, migrate successful projects to commercial lab(s) in LEO**

# Stimulate Sustainable Demand (cont.)

- **Seeking targeted studies to better understand real and perceived barriers of potential new market entrants, and to address broad ideas which could help stimulate demand (e.g. reducing launch cost, etc.)**
  - Issued solicitation to gather industry ideas as Appendix J of the NextSTEP2 BAA (proposals in eval)
- **Seeking to expand feeder pipeline of potential new entrants into use of LEO environment**
  - Planning to coordinate across microgravity access community to strengthen integration, simplify user access, and reduce real and perceived barriers to entry
    - Drop Towers
    - Parabolic and Suborbital Flights (e.g. Flight Opportunities Program)
    - ISS (e.g. SLPSRA and ISS National Lab)
  - Coordinate outreach with consistent messaging to magnify and expand awareness of potential benefits of microgravity research in industrial and academic research communities

# Commercial Hardware on ISS

- NanoRacks: Internal & External platforms; sat deployers; airlock 
- Teledyne Brown Engineering: MUSES External precision pointing platform 
- Bigelow Aerospace: Expandable module 
- Alpha Space: MISSE-FF External materials exposure platform 
- BioServe: Space Biology platforms and services 
- Space Tango: TangoLab space biology platforms 
- Techshot: Bone densitometer, MVP centrifuge facility 
- Made In Space: Additive Manufacturing Facility 
- STaARS: Space biology platform 
- Sierra Nevada Corp: Small mass measurement device 



# Commercial Research on ISS



## (5) NASA's Long-Term LEO Forecast

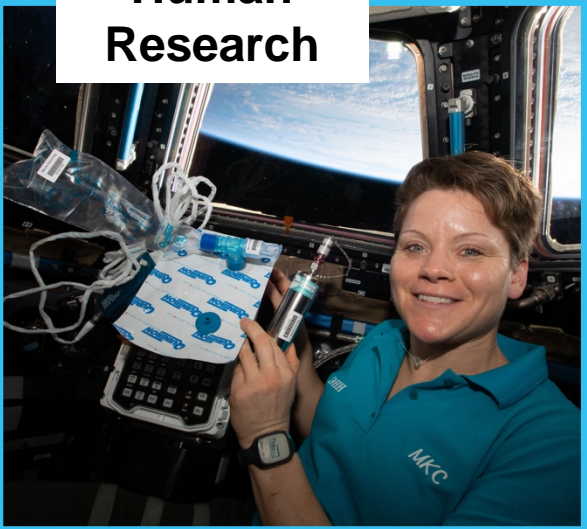
- **Purpose**: Define NASA's minimum long-term LEO requirements as basis for commercial destination providers business case assessments
- Helps the US portion of the ISS to transition away from direct federal funding
- White paper published last fall defined high-level NASA projected LEO needs but did not attempt to quantify
- NASA has updated this white paper to include a quantification of the demand forecast, representing the type and amount of services that NASA intends to purchase in the future when those services become commercially available

Forecasting Future NASA Demand in Low-Earth Orbit: Revision Two – Quantifying Demand (June 7, 2019)

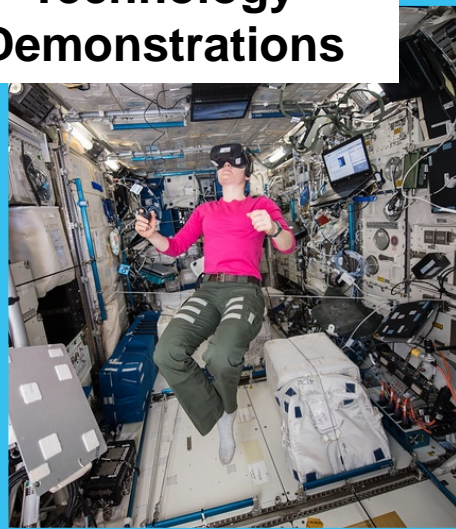
[https://www.nasa.gov/sites/default/files/atoms/files/forecasting\\_future\\_nasa\\_demand\\_in\\_low-earth\\_orbit\\_revision\\_two\\_-\\_quantifying\\_demand.pdf](https://www.nasa.gov/sites/default/files/atoms/files/forecasting_future_nasa_demand_in_low-earth_orbit_revision_two_-_quantifying_demand.pdf)

# NASA's Future LEO Demand

**Human Research**



**Technology Demonstrations**



**Crew Accommodations & Training**



**Science**



**Physical & Biological Research**



**National Lab Services**



# Budget - LEO and Spaceflight Operations: Commercial LEO Development

(\$M)	2019	2020	2021	2022	2023	2024	Total FY19-24
<b>Commercial LEO Development</b>	<b>\$40.0</b>	<b>\$150.0</b>	<b>\$175.0</b>	<b>\$200.0</b>	<b>\$225.0</b>	<b>\$225.0</b>	<b>\$1,015</b>
<b>Up to 75% for supply</b>	<b>\$30.0</b>	<b>\$112.5</b>	<b>\$131.3</b>	<b>\$150.0</b>	<b>\$168.8</b>	<b>\$168.8</b>	<b>\$761.3</b>

- Assists commercial space industry to develop a sustained commercial low earth orbit presence.
- Continues transition of low Earth orbit human space flight operations to commercial partners.
- Encourages commercial development of platforms and capabilities for use by the private sector and NASA to enable a seamless transition from ISS.
- Increases efforts to develop a commercial space economy in LEO.



# Status Summary

## Overall Plan, NASA Demand Forecast, RFI on overall plan released June 7, 2019

- RFI Inputs received July 9, 2019, comments under assessment

## NextSTEP-2 Broad Agency Announcement

### Appendix I – Port Solicitation

- Solicitation released June 21, proposals in evaluation

### Appendix J – Demand Stimulation

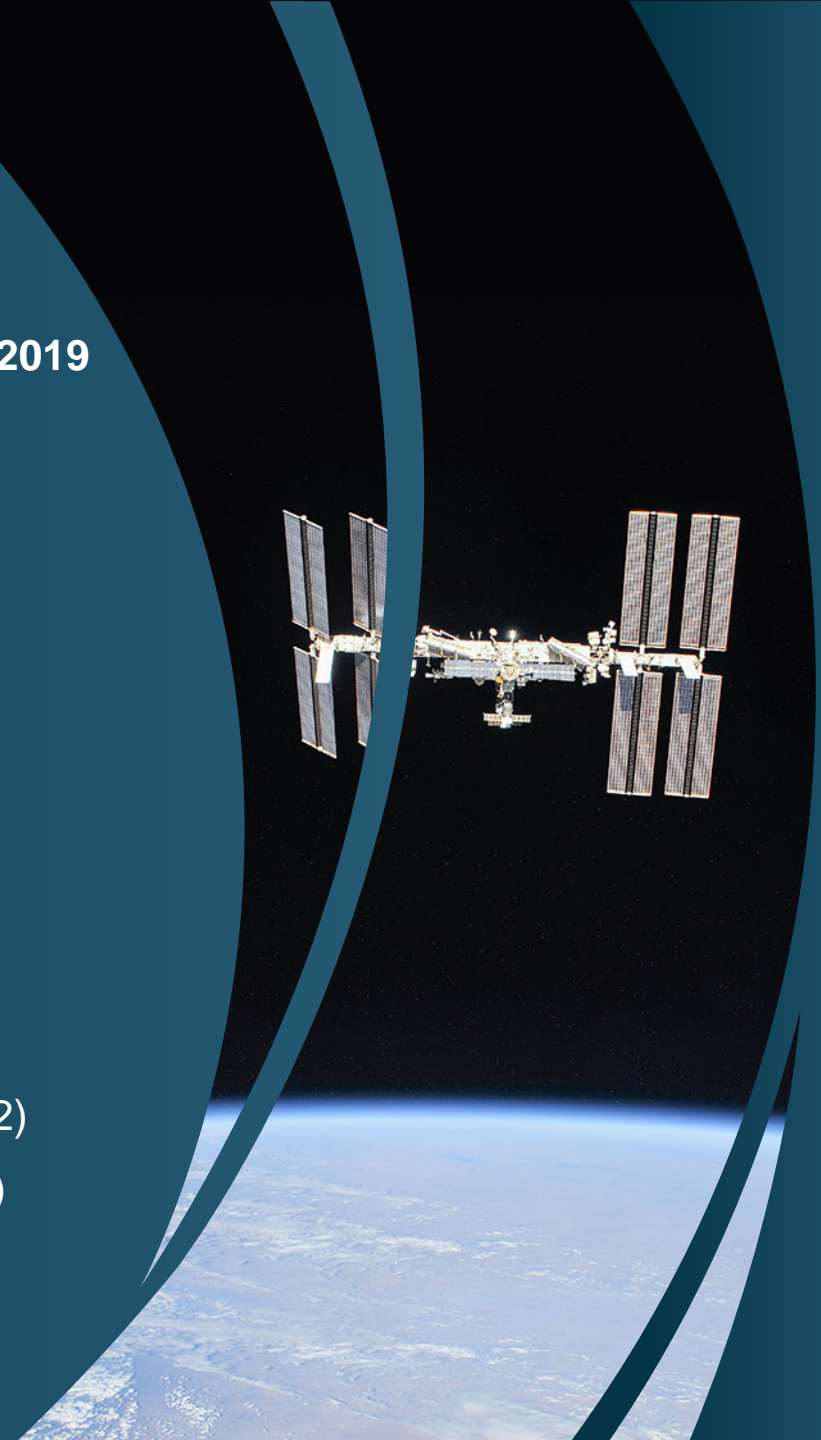
- Solicitation released July 3, proposals in evaluation

### Appendix K – Free Flyer

- Draft Solicitation released Oct 3; industry day Nov 7 & 8

## ISS Utilization NRA

- Focus Area 1 – Manufacturing (multiple rounds, round 3 proposals due Nov 22)
- Focus Area 2 – Lab in Space (multiple rounds, round 3 proposals due Nov 22)
- Focus Area 3 – Commercial Activities (open)
- Focus Area 4 – Interest in Private Astronaut Missions (open)



A large, detailed image of the Moon in space, showing its craters and maria. A small satellite is visible in the upper left. A dark blue horizontal band is overlaid across the middle of the image.

Learn more at [www.nasa.gov/leo-economy](http://www.nasa.gov/leo-economy)