



# LAUNCH AMERICA

HEO Commercial Spaceflight Development

January 2021

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## Agenda

- Commercial Crew Program Recap and Status
- Suborbital Crew Project Overview
- Commercial Low-Earth Orbit (LEO) Development Program Overview and Status
- ISS National Lab/Center for the Advancement of Science In Space (CASIS) Status

The background of the slide is a photograph of a space shuttle launch. A large, billowing plume of white smoke and fire trails behind the shuttle as it ascends into a clear blue sky. The shuttle itself is visible as a small dark object at the end of the smoke trail.

# Commercial Crew Program



## Commercial Crew Program

- NASA's Commercial Crew Program has partnered with commercial companies, Boeing and SpaceX, for human space transportation to and from low-Earth orbit and the International Space Station. NASA required the systems carry up to four astronauts and 220 pounds of cargo to the International Space Station.
  - Goal: NASA's Commercial Crew Program will provide safe, reliable and cost-effective transportation to and from the International Space Station and low-Earth orbit.
  - New Era: A new era of human spaceflight began as American astronauts launched on the SpaceX Crew Dragon spacecraft and Falcon 9 rocket – the first commercially-owned and operated American rocket and spacecraft to launch from American soil.
  - Partnerships: NASA's partnership with American private industry is changing the arc of human spaceflight history by opening access to low-Earth orbit and the International Space Station to more people, more science and more commercial opportunities.
  - Maximize Station: NASA's Commercial Crew Program enables expanded International Space Station use, additional research time and broader opportunities of discovery aboard the orbiting laboratory.





## Demonstration-2 Mission Highlights

- NASA and SpaceX delivered on the agency's goal to return human spaceflight to the United States on an American rocket and spacecraft for the first time since the retirement of the Space Shuttle Program in 2011.
- NASA astronauts Robert Behnken and Douglas Hurley are the first astronauts to launch, dock and return to Earth from the International Space Station (ISS) on a commercially built, owned, and operated American rocket and spacecraft – opening a new era of human spaceflight.
- The mission lasted 63 days, the second longest mission for a U.S. spacecraft (Skylab 4 in 1973-74 was 84 days).
- The addition of Bob and Doug allowed the ISS crew to conduct four critical spacewalks to install new batteries.
- Doug and Bob conducted over 100 hours of science experimentation while on ISS.
- All Demo-2 test objectives were successfully completed.



Astronauts Bob Behnken, Doug Hurley, and Chris Cassidy onboard the ISS



Splashdown of the Demo-2 Spacecraft on August 2





## Demonstration-2 Mission Media Highlights

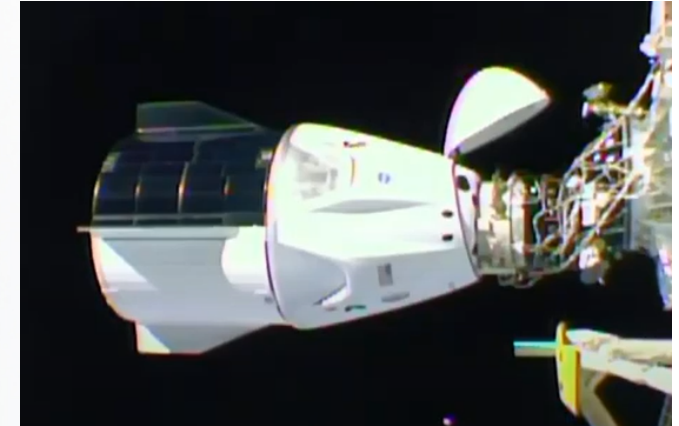
- On May 30 (launch day), peak viewership of the joint NASA/SpaceX launch TV broadcast across all viewing platforms was at least 10.3 million concurrent viewers, *the most-watched event NASA has ever tracked*.
- On May 30, a busy news day with a high volume of social media conversation, #LaunchAmerica, #SpaceLaunchLive and “Bob and Doug” trended #1, #2 and #3 respectively on Twitter in the United States.
- Since August 2 (splashdown day), SpaceX Crew Dragon’s return had over 7 thousand media mentions with an estimated reach of 40 million. 129 domestic and 14 international papers had something on their front-page regarding Demo-2 landing. If we would have paid for the coverage received since undocking, it would have been over \$8 million.



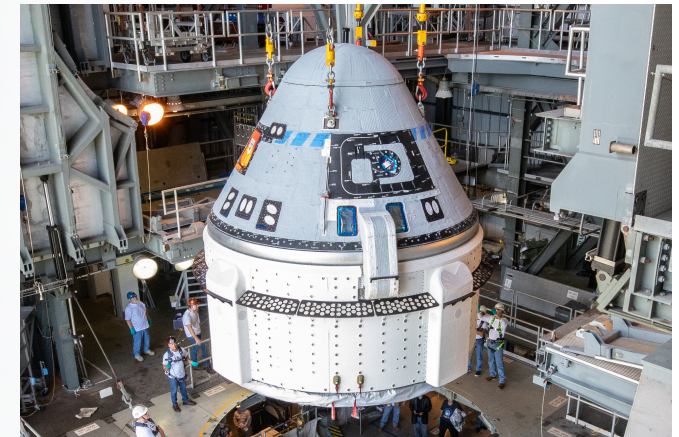


## Looking Ahead...

- The first operational crewed mission to the ISS, called Crew-1, launched on November 15, 2020 for a 5-6 month mission on the ISS.
- Boeing's CST-100 Starliner launches on a United Launch Alliance Atlas V rocket from Space Launch Complex 41 on Cape Canaveral Air Force Station in Florida.
  - Boeing has completed a pad abort test, an uncrewed orbital flight test, and will fly a second uncrewed test. Boeing's Orbital Flight Test-2 will be an end-to-end flight test of the system from launch to docking to return to Earth. It is targeted for March 29, 2021.
  - Boeing also will fly a Crewed Flight Test to the International Space Station. This test flight is targeted for later in 2021.
  - Following those test flights, NASA will certify the Starliner/Atlas system for operational missions to the ISS, giving the United States redundant human access to space for the first time in our history.



The Crew-1 Dragon Spacecraft docked to the ISS



Boeing Starliner Spacecraft

The background of the slide is a photograph of a rocket launch. A thick, white plume of smoke and fire trails behind the rocket as it ascends into a clear blue sky. The rocket itself is visible as a small, dark object at the top of the plume. The overall scene conveys a sense of power and upward motion.

# Suborbital Crew Project



## Suborbital Crew (SubC)



### ISS

Days, Months, Years of  
Microgravity



### Parabolic Flight

~20 Seconds of  
Microgravity



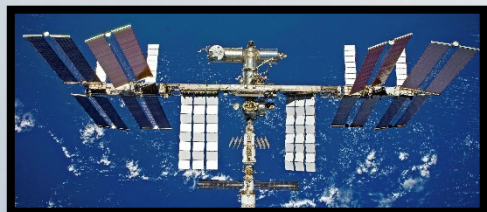
### Drop Towers

Several Seconds of  
Microgravity

Increasing Duration, Complexity, Cost, Lifecycle



## Suborbital Crew (SubC)



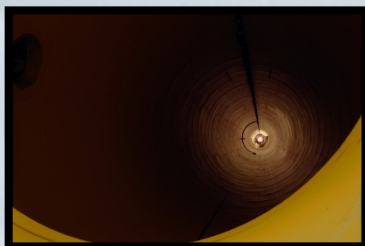
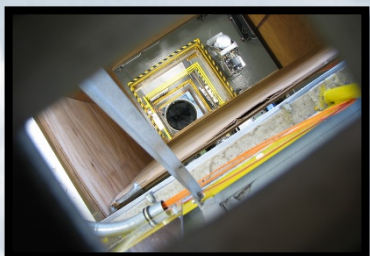
**ISS**  
Days, Months, Years of  
Microgravity



**Suborbital Vehicles**  
Several Minutes of  
Microgravity



**Parabolic Flight**  
~20 Seconds of  
Microgravity



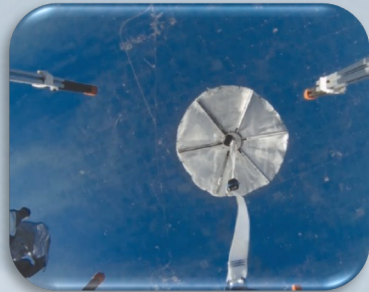
**Drop Towers**  
Several Seconds of  
Microgravity

Increasing Duration, Complexity, Cost, Lifecycle

## SubC – Potential Applications



- Human-Tended Microgravity Research
  - In-flight engineering and science experiments including
  - Materials processing
  - Life sciences experiments
  - Research payloads
  - Experiments for planetary sciences



- Testing and Qualification of Spaceflight Hardware
  - In-flight testing of hardware (equipment, tools, etc.)
  - Provide confidence in new systems & components to support qualification



- Government Astronaut Training
  - In-flight opportunities to train NASA astronauts
  - Tasks or techniques for ascent, microgravity, or reentry operations
  - Development of training techniques and material for potential NASA missions



## System Qualification Philosophy

*There are a range of potential approaches to ensuring the safety of NASA personnel while flying on commercial suborbital systems*



- Neither end of this spectrum is feasible for SubC
  - “Traditional NASA Verification & Validation” method is overly invasive and time consuming for commercially developed systems that are mostly complete
  - NASA policy to formally review and approve NASA participation in hazardous work must be satisfied
    - Informed Consent method does not likely meet this requirement
- New method of qualification needs to be developed
  - Likely between informed consent and traditional NASA Verification & Validation
  - Accounts for wide variety of ways system design can achieve effective results
  - Compliant with government requirements
  - Leverages flight experience



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# Commercial LEO Development Program

## Commercial LEO Development Program

- It is the policy of the United States to “achieve a continuous U.S. presence in LEO and to maintain a permanent American foothold there.”
- Congress has directed “an orderly transition for United States human space flight activities in low-Earth orbit from the current regime, that relies heavily on NASA sponsorship, to a regime where NASA is one of many customers.”
- It is not possible for ISS to operate indefinitely; the ISS could have an unrecoverable major contingency at any time.
- The next LEO destinations after ISS retires will not be government-owned and operated.



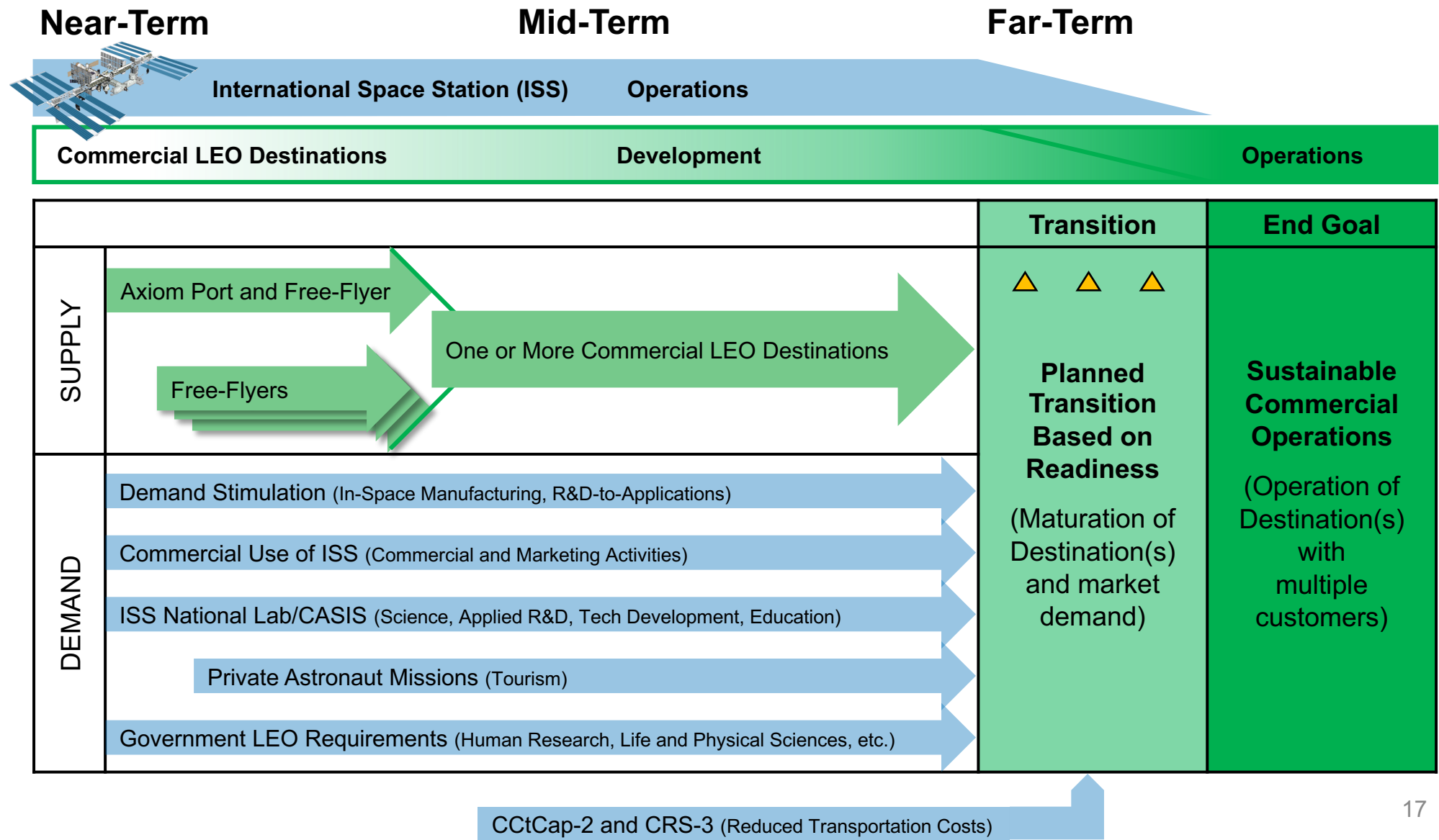
## Commercial LEO Strategy

- Establish dedicated management structure for Commercial LEO Development Program.
- Prioritize free-flyer development but continue to pursue all the other Commercial LEO activities (e.g., Demand Stimulation Awards, Private Astronaut Missions, Commercial Port Module, etc.).
- For ISS to operate beyond 2025, we will need to award CRS-3 contracts and CCtCap-2 contracts. This presents a tremendous opportunity to address one of the primary barriers to successful Commercial LEO – *high transportation costs*.
  - Make cost reductions an explicit requirement of CRS-3 and CCtCap-2.
- Developing new human spaceflight systems takes time, so we need to start now, or we risk having an extended gap in U.S. human LEO presence.
- Replanning program activities based on FY21 budget levels (\$17M).





# Commercial LEO Roadmap



## Commercial LEO Accomplishments

- Commercial LEO Program and ISS have finalized roles and responsibilities and are completing transition.
- FY2021 budget re-planning in progress based on \$17M appropriations.
- Establishment of Commercial LEO Program Board and Working Panel.
- Working with multiple companies to establish Private Astronaut Missions.
- Completed almost a dozen agreements to fly “Commercial Use” items to the ISS.
- Completed the first two milestones of the Axiom contract for a Commercial Port module.
- Awarded eight Demand Stimulation contracts (e.g., glass optics and alloys, semiconductor ship manufacturing, retinal implants, regenerative medicines, etc.).



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ISS National Lab/CASIS

## ISS National Lab/CASIS Status

- In 2019, an Independent Review Team (Chaired by Dr. Betsy Cantwell) was initiated by Administrator Bridenstine to review the management of the ISS National Lab by NASA and CASIS. Its findings were critical of both NASA and CASIS's management, and its recommendations were important for affirming and informing NASA's forward plan as outlined in six actions:
  1. Work with CASIS on the best roles and composition of the CASIS Board of Directors and leadership
  2. Support CASIS' establishment of a User Advisory Committee to provide input to the organization about how best to manage resources
  3. Create transparent project and program evaluation and prioritization processes
  4. Identify an ISS National Lab program executive at NASA Headquarters as the primary liaison to CASIS
  5. Update strategic priorities for the ISS National Lab on an annual basis
  6. Work with CASIS to optimize the allocation of ISS National Lab resources to meet strategic priorities



## ISS National Lab/CASIS Progress

- New CASIS Board of Directors in place (Dr. Betsy Cantwell chair and a majority of new members) (Action #1)
- Interim CASIS Executive Director selected (James Crocker) and search for Permanent Executive Director underway (Action #1)
- ISS National Lab User Advisory Committee charter established (comprised of five subcommittees aligned to ISS National Lab programmatic goals), subcommittee members selected (Action #2)
- New solicitations with new evaluation processes, based on best practices, planned for FY21 (Action #3)
- ISS National Lab Program Exec position established and filled (Dr. Alex Macdonald) (Action #4)
- New Annual Performance Goals (APGs) for CASIS for FY21 finalized (Action #5)
- APGs aligned to the five ISS National Lab program goals / CASIS 'lines of business' (Action #6)

## Wrap-Up

- NASA's commercial LEO strategy supports multiple NASA policy mandates:
  - Achieves a continuous U.S. presence in LEO
  - Promotes the fullest possible commercial use of space
  - Purchases services from the private sector where feasible
  - Uses innovative, non-traditional arrangements
  - Does not compete with private industry
- With commercial crew, cargo, and destination(s), an “ecosystem of space commerce” could be created – one that is sustainable, cost effective, and safe.
  - No gap in U.S. human presence in LEO
  - No, or minimal, reduction in NASA's ability to perform required microgravity research
  - Expanded ability to fund NASA's Moon/Mars exploration initiatives without increased Appropriations



