

Dream Chaser for Research in Commercial LEO

National Academies Committee on Biological and Physical Sciences in Space

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Dream Chaser for Research in LEO

snc SIERRA
NEVADA
CORPORATION™

Cargo
Module
Launch System



Uncrewed
Dream Chaser
Vehicle

*The Best Commercial
Payload Services Solution
in the World*

Capable: 5,500kg upmass,
both pressurized &
unpressurized

Safe: Gentle reentry,
runway landing, all non-
toxic propulsion

Responsive: Both runway
return with immediate
post-land access & cargo
disposal on every mission

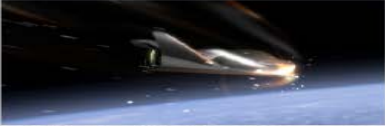





Affordable: Highly (90%)
reusable (15x), broad
commercial services

Flexible: Cargo Disposal +
runway return, both
docking & berthing,

Mature: Leverages 40+
years of Shuttle/X-plane
experience

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SNC's Lifting Body: SAFER By Design

| | Dream Chaser | Capsules |
|---|--|--|
|  | Low-g reentry (less than 1.5) | • High-g reentry (Soyuz nominal 4 g, emergency descent 11–15 g) |
|  | Runway landing (standard aircraft commercial runway >7,200 ft.) | • High speed parachute deployment • Water or land landing with recovery operations |
|  | Reusable with minimal processing (15+ missions per vehicle) | • Limited reusability with impact loads • Salt water corrosion • Higher reentry heat • No prior capsule has been reused |
|  | No solid rocket motors or hazardous fuels | • Hazardous fuels |
|  | Atmospheric flight capability provides large cross range for landings (>1,000 nmi) | • Limited atmospheric flight or cross-range capability |
|  | Can abort to runway landing at any time from launch to orbit | • High abort loads • Water landing required • Delayed crew recovery • Potential rough sea recovery |

Safe Affordable Flexible Evolvable Reliable
(SAFER by Design)



1970

1980



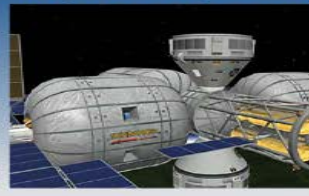

1990

2000

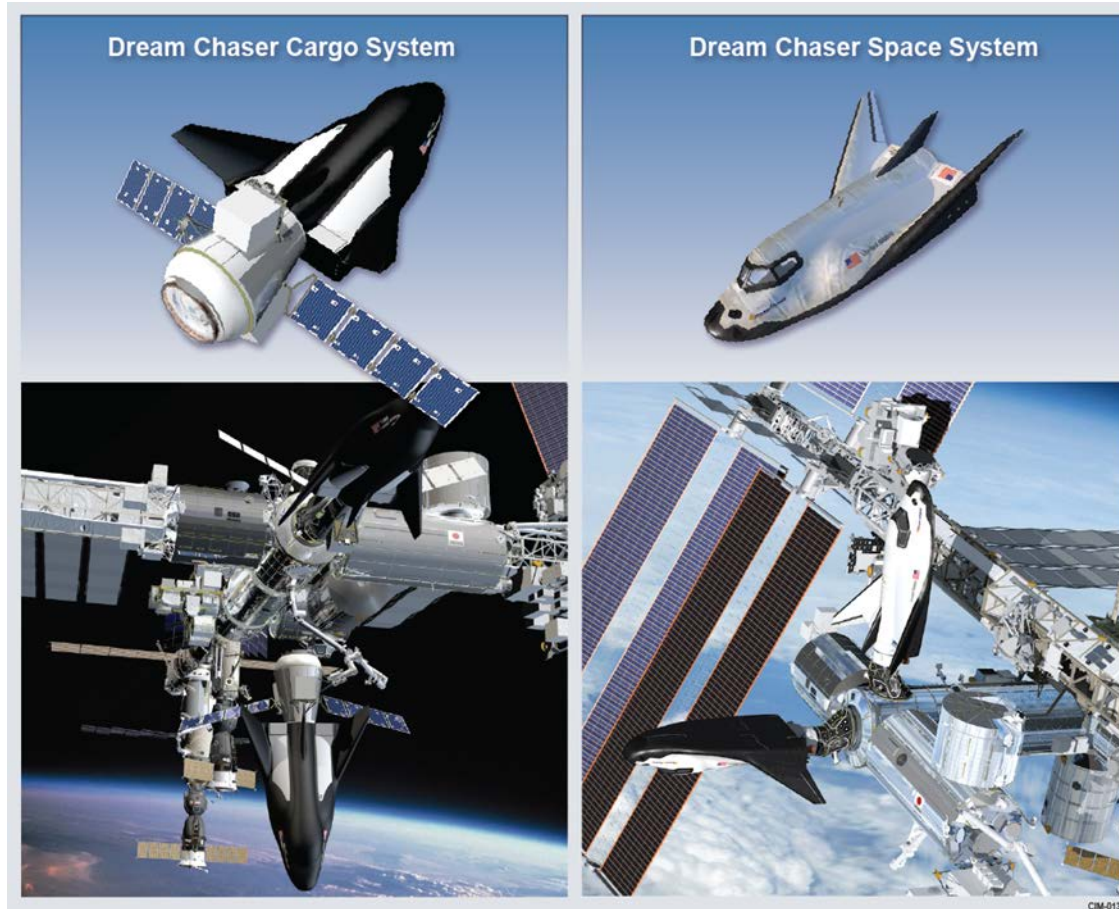
2010



The Dream Chaser Advantage: Providing the Capability to Address the Broader LEO Market

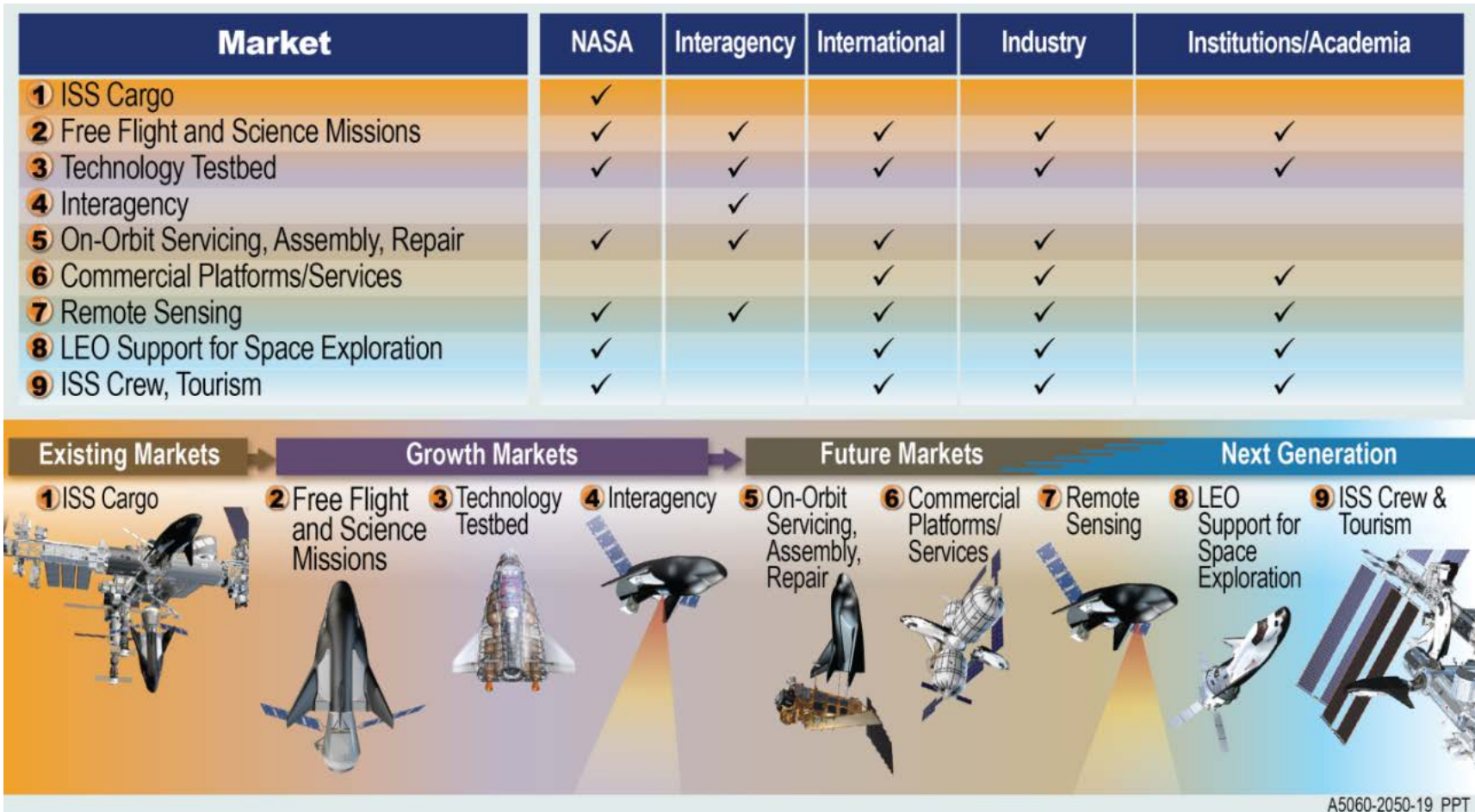


- **Objective: Build-upon the Dream Chaser Cargo System CRS2 Baseline and Extend Mission & Market Capture Using this Funded System Capability and Customer-Driven Variants**



Multiple Missions, Markets & Clients

- Dream Chaser Reusable Space Utility Vehicle (SUV) Enables Missions & Markets
- A Common SUV Platform Enables Multi-Mission Capability, Flexibility, Affordability
- 4 Market Types (Existing, Growth, Future, NextGen) and 9 Mission Markets are Planned



Multiple Launch Options – Atlas V Baseline

- **DCCS Assures Access to the ISS with Multiple Launch Options**



The image shows four different launch vehicles standing side-by-side on a blue gradient background. From left to right, they are: the DCCS Baseline Atlas V, the Alternate Ariane 5, the Alternate Falcon 9 Heavy, and the Alternate H-III. Each rocket is shown in a full-length view, highlighting its unique design and color scheme.

- Fault-tolerant folded wing design allows the Dream Chaser to fit inside Atlas/Ariane standard 5 meter fairings
- Compatible with multiple launch vehicles/ground systems
 - Atlas V
 - Falcon 9 Heavy
 - European Ariane 5/6
 - Japanese H-III
- Responsive cargo access and designed for multiple mission reusability exceeding the life requirements for ISS

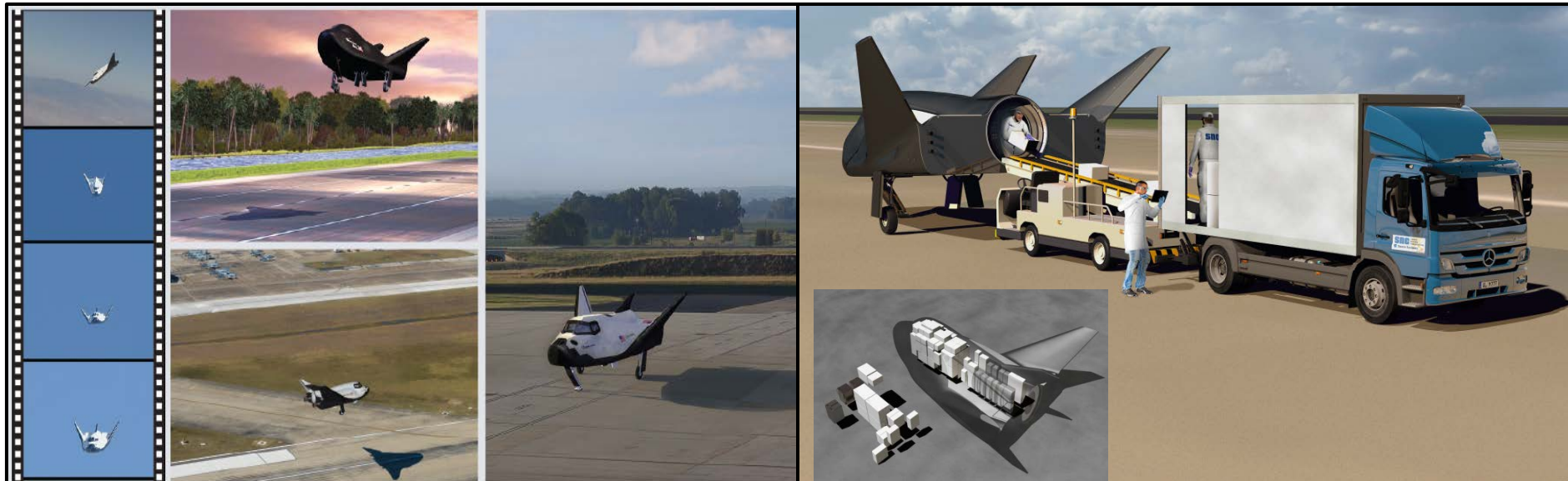


An inset image in the bottom right corner shows two smaller rockets, the Ariane 62 and the Ariane 64, standing side-by-side. They are white with black and blue accents.

DCCS Baseline Atlas V **Alternate Ariane 5** **Alternate Falcon 9 Heavy** **Alternate H-III**

Unique Features of DCCS Provide Operational & Research Benefits

- Gentle 1.5g re-entry and runway landing protects sensitive payloads
- Immediate post-landing access to critical science (< 3 hour handover)
- Non-toxic/non-hypergolic fluids support late cargo loading and accelerated access to science post-launch, immediately post-landing
- Only vehicle optimized for responsive return of sensitive microgravity, biology, space & life science payloads → Live mice up/down!



ORBITEC & SNC: Delivering Enabling R&D Capability

Environmental Control Life Support / Thermal Systems

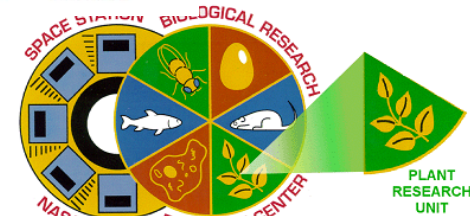
Provide value-oriented ECLS/TCS solutions

- Full subsystems for permanent habitation in Space
- Commercial Crew subsystems and systems
- Full Human Flight development, verification and testing

Human and Navigation Solid State Lighting

Flight Navigation lighting

- Commercial Crew opportunities
- Special military applications



Environmental Control, Accommodations, and Systems for Science

ISS flight systems

- Proven flight plant systems NASA and International customers
- Developing advanced plant habitat systems with NASA
- Rodent flight systems for science in microgravity

Instrumentation and Control Systems

Commercial and flight control systems

- Integrating controls at the subsystems and system level
- Instrumentation and Controls for integrated systems
- Instrumentation for commercial products

VEGGIE/VEG-01 First Flight



Hydrogen-Oxygen Production System Demonstrator



Environmental Controls and Life Support



Plant and Biotech Experiments



ECLS and Thermal Subsystems for
Boeing CST-100 (with UTAS lead)

Prime Supplier of ECLS / Thermal Sierra Nevada Dream Chaser



Dream Chaser Multi-Mission Solutions

Customer-Defined Research Missions in LEO

Designed for Science Missions

- Selection of:
 - Launch Vehicle
 - Desired Landing Site
 - Orbit and Inclination
 - Mission Duration
 - Standard or Customized Hardware
 - Crewed, Uncrewed, or Tele-operational
- Frequent Flight and Re-Flight Opportunities
- Expedited and Cooperative Payload Integration
- Flexible Operating Requirements and Environments
- IP Control



**Biotech and
Pharmaceuticals**



**Biology and Life
Science**



**Material and
Fluid Science**



**Technology
Demonstration**



Pressurized Cargo: 5,000kg Max

- **Powered payloads**
 - Single and double lockers
 - Requires power, cmd/data, thermal services
- **Conditioned passive cargo in Double Cold Bags**
 - Access time requirements
- **Passive cargo**
 - 7 standard bag sizes
 - Conformal bags



Single Locker on ISS



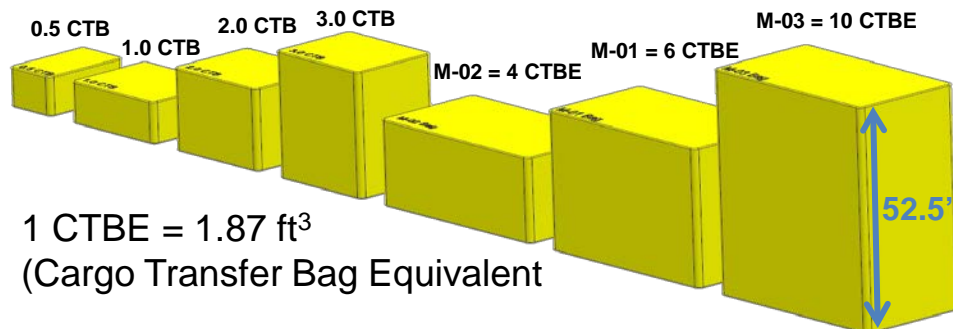
Single Locker



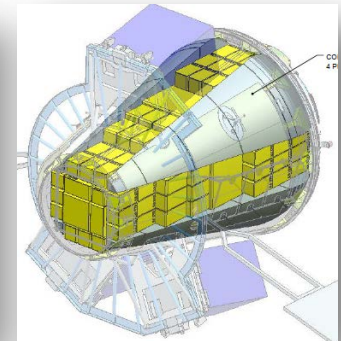
Double Locker



Double Cold Bags



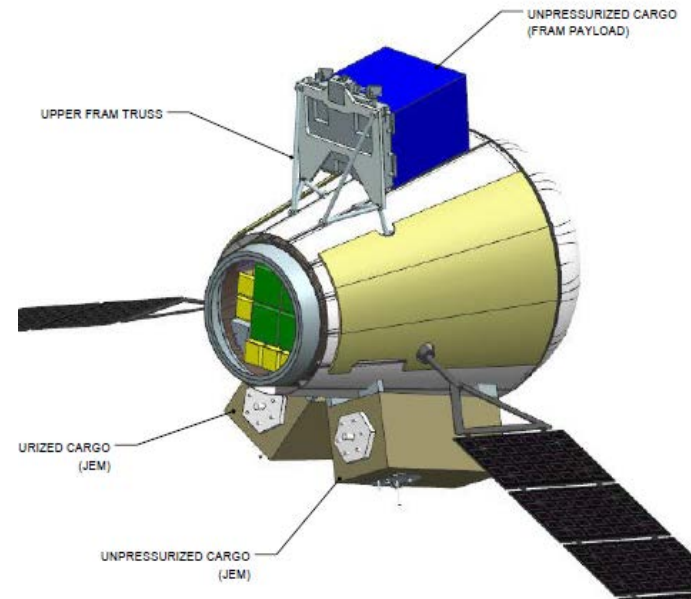
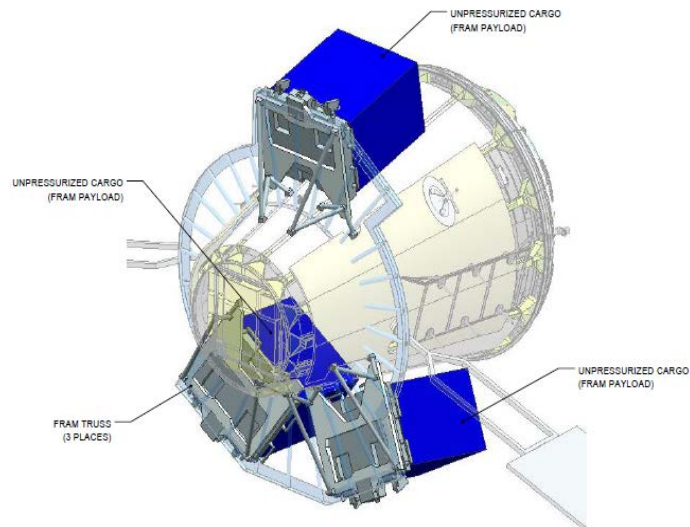
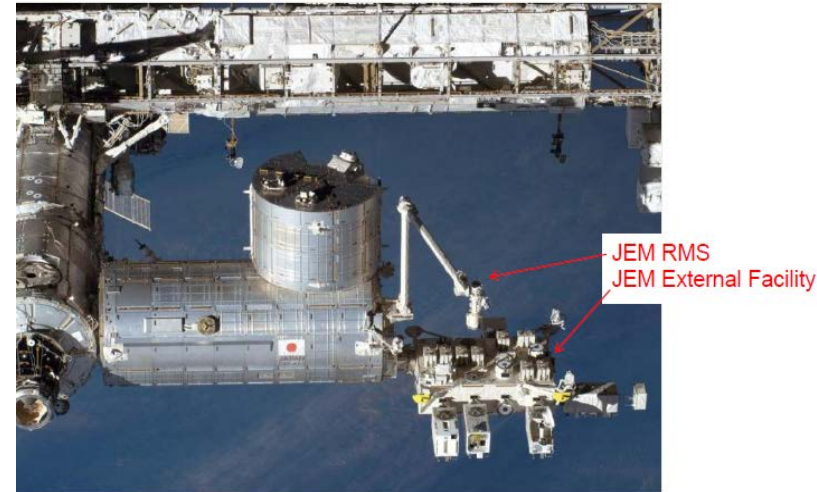
Standard Cargo Bags



Conformal Bags





Unpressurized Cargo: 1,500kg Max

- Requires power, command/data, thermal services
- Flight Releasable Attachment Mechanism (FRAM)-based cargo
- Direct Mount
 - Japanese Experiment Module Exposure Facility (JEM-EF) cargo
 - Other cargo



Next Generation Space Exploration

Space Utility Vehicle Future Configurations

| <i>Dream Chaser Space Utility Vehicle Future Configurations.</i> | | | <i>Images Below: Renderings</i> |
|--|---|--|--|
| Working in Space Space Servicing | Extended Duration (ED) Science—Space Discovery | Long Duration (LD) Science—Space Observation | Next-Generation Space Exploration |
|  |  |  |  |
| <ul style="list-style-type: none"> Mission: Satellite servicing, deployment, refueling, retrieval, and deorbit/debris removal | <ul style="list-style-type: none"> Mission: Microgravity laboratory for in situ science & technology investigation | <ul style="list-style-type: none"> Mission: Direct Earth or space observation missions from LEO | <ul style="list-style-type: none"> Mission: Deep Space Exploration support missions from LEO |
| <ul style="list-style-type: none"> Duration: 1–10 days | <ul style="list-style-type: none"> Duration: Up to 28 days | <ul style="list-style-type: none"> Duration: Up to 1 year | <ul style="list-style-type: none"> Duration: Flexible |
| <ul style="list-style-type: none"> Configuration: Crewed Dream Chaser modified to meet unique mission needs (e.g., robotic arms, airlock, satellite deployment capabilities) | <ul style="list-style-type: none"> Configuration: Extended-duration Cargo vehicle modified to support internal science for up to 3 weeks and return | <ul style="list-style-type: none"> Configuration: Long-duration uncrewed Cargo Vehicle modified to support Earth observation, space, and astronomical missions for up to 1 year and return | <ul style="list-style-type: none"> Configuration: Dream Chaser Cargo or Crewed Vehicle modified to support Beyond LEO exploration missions (outfitting, test, sample curation) and return) |

Dream Chaser: Dare to Dream – It's Your World!

www.SNCspace.com

Thank you!



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NASA CRS2 Provides Flight Options

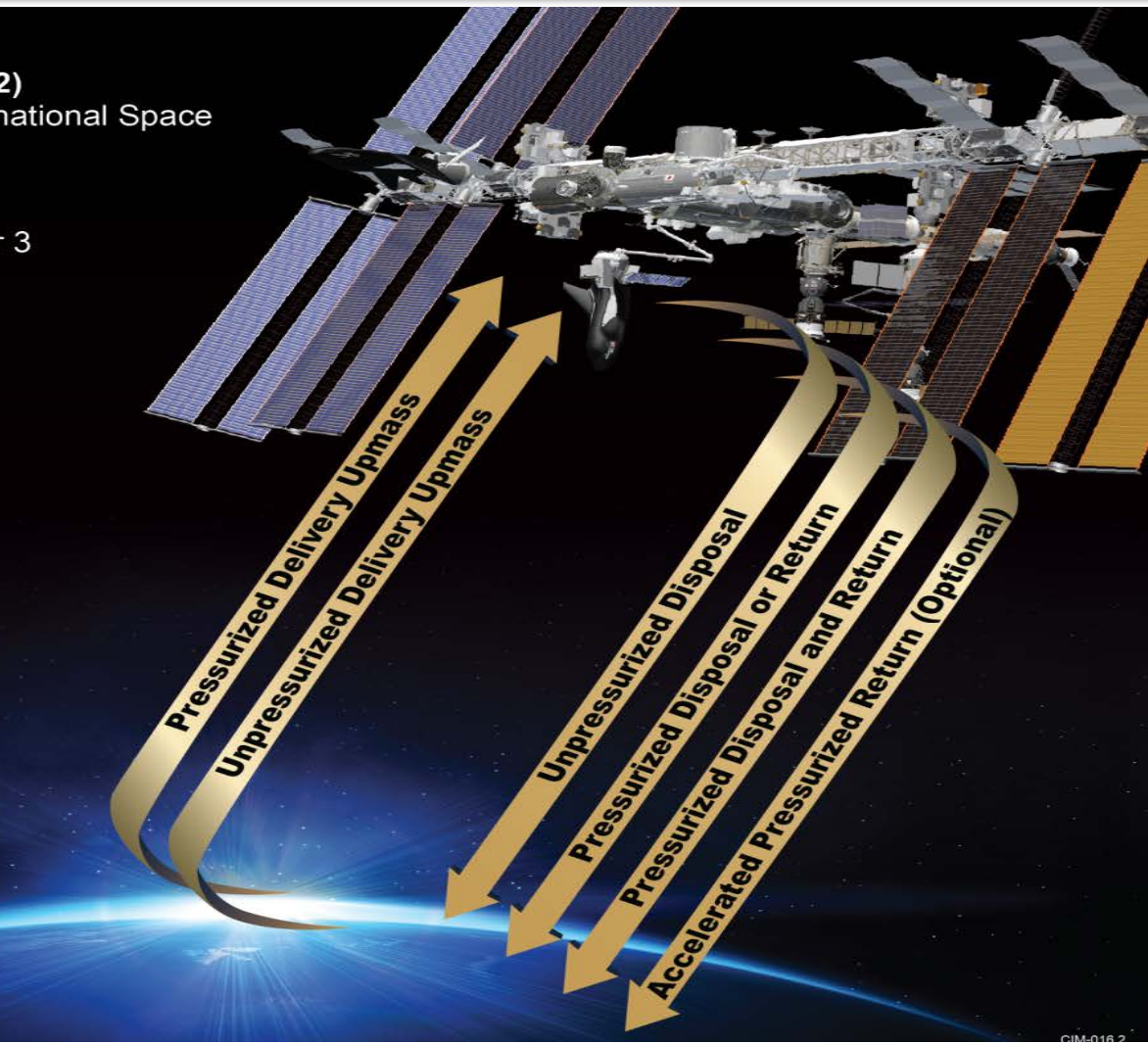
Program

- **Commercial Resupply Services (CRS2)**
 - Resupply cargo mission(s) to the International Space Station (ISS)
 - \$14 billion contract award, Jan 2016
 - Flight rate: 4 to 5 missions per year
 - Budget – \$1.0B-\$1.4B per year for 2 or 3 potential providers

Customer

- **NASA Johnson Space Center (JSC)**
 - Competitive procurement
 - Multiple awards
 - Minimum of 6 flights guaranteed
- **Award Date: Jan 2016**
- **Missions: 2019 - 2024**

| Capability | Per Flight Range (kg) |
|---|-----------------------|
| Pressurized Upmass Delivery | 2500-5000 |
| Pressurized Downmass Return | 2500-5000 |
| Pressurized Downmass Disposal | 2500-5000 |
| Accelerated Pressurized Downmass Return | Subset of 2500-5000 |
| Unpressurized Upmass and Disposal | 500-1500 |



CRS2 Only Uses 6 Flts of the 30+ Flt Dream Chaser Capability with 2 Airframes, thus leaving 24+ Flts available in 10 yrs (2020-2030)