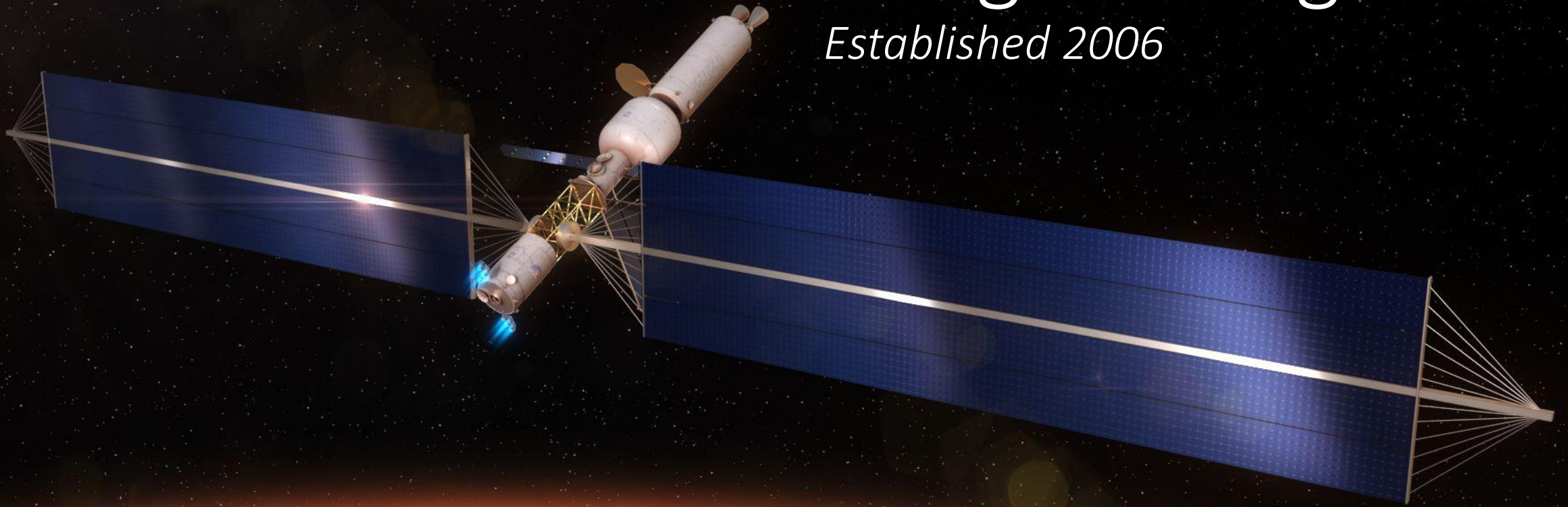




Compass

Concurrent Engineering Team

Established 2006



Thermal & Fluids Analysis Workshop

College Park, MD 20740 -August 21, 2023

Team Lead: Steve Oleson

Lead Systems Engineer: Betsy Turnbull

NASA Glenn Research Center

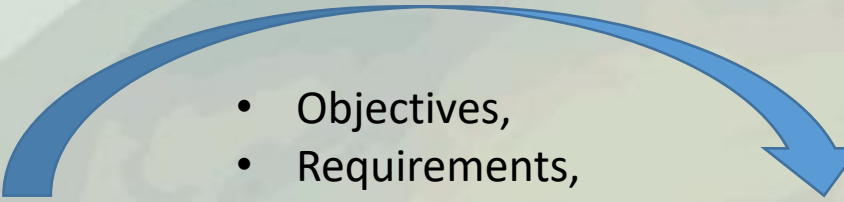
The Compass team is a multidisciplinary concurrent engineering team whose primary purpose is to perform integrated vehicle systems analysis and provide conceptual designs and trades for both Exploration and Space Science Missions.



More than 250 designs!

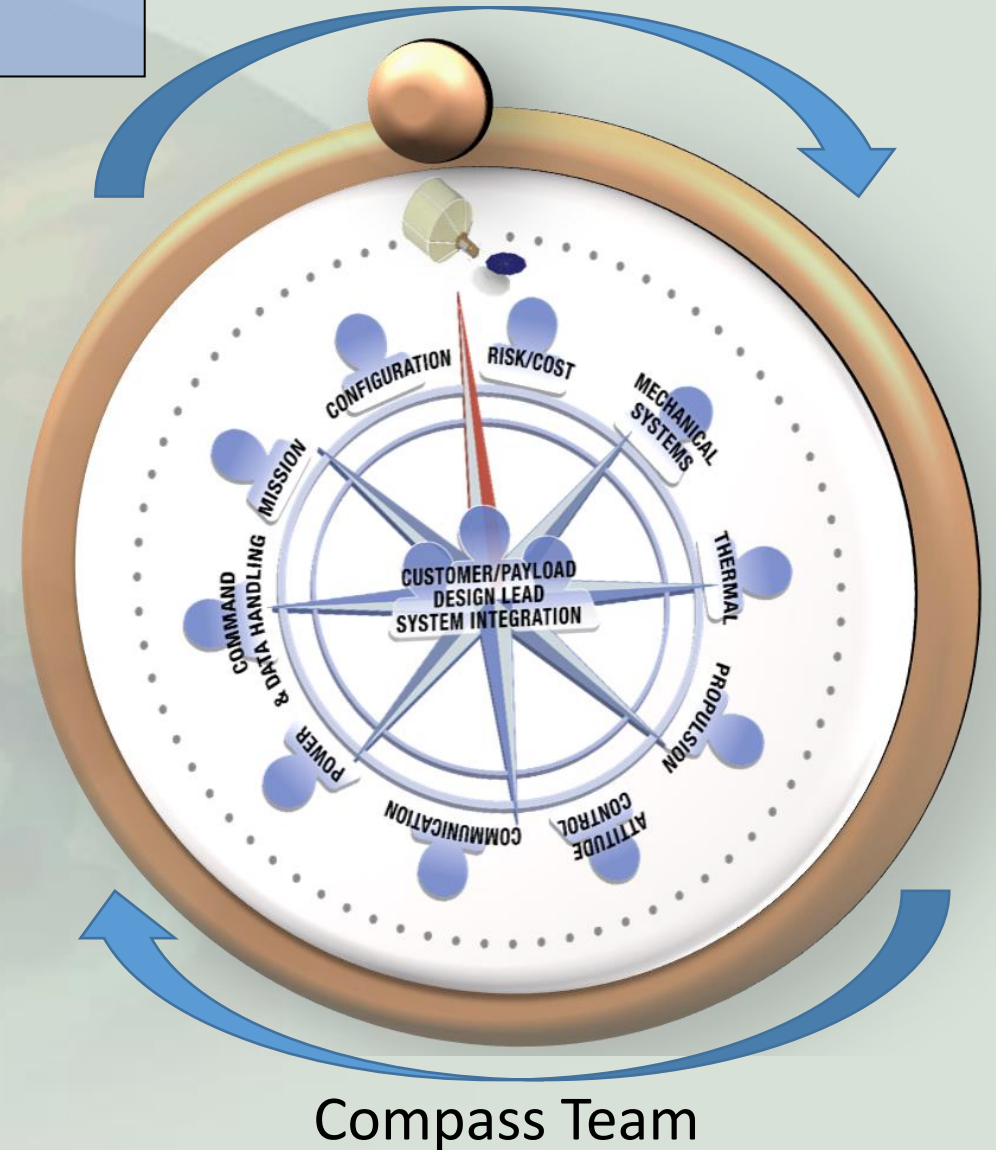
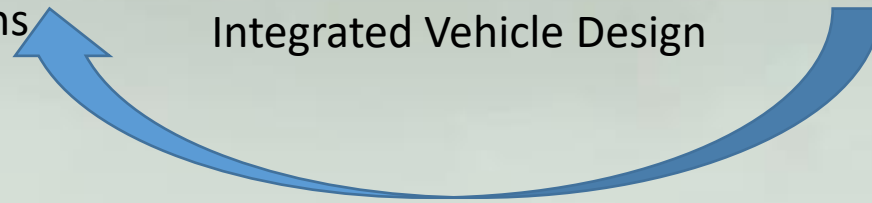
Selection of Recent Customers

- Objectives,
- Requirements,
- Constraints,
- Figures of Merit



The concurrent engineering process produces solid engineering designs quickly without the rework needed by isolated teams
 Design cycles take approximately 2-3 weeks

Integrated Vehicle Design

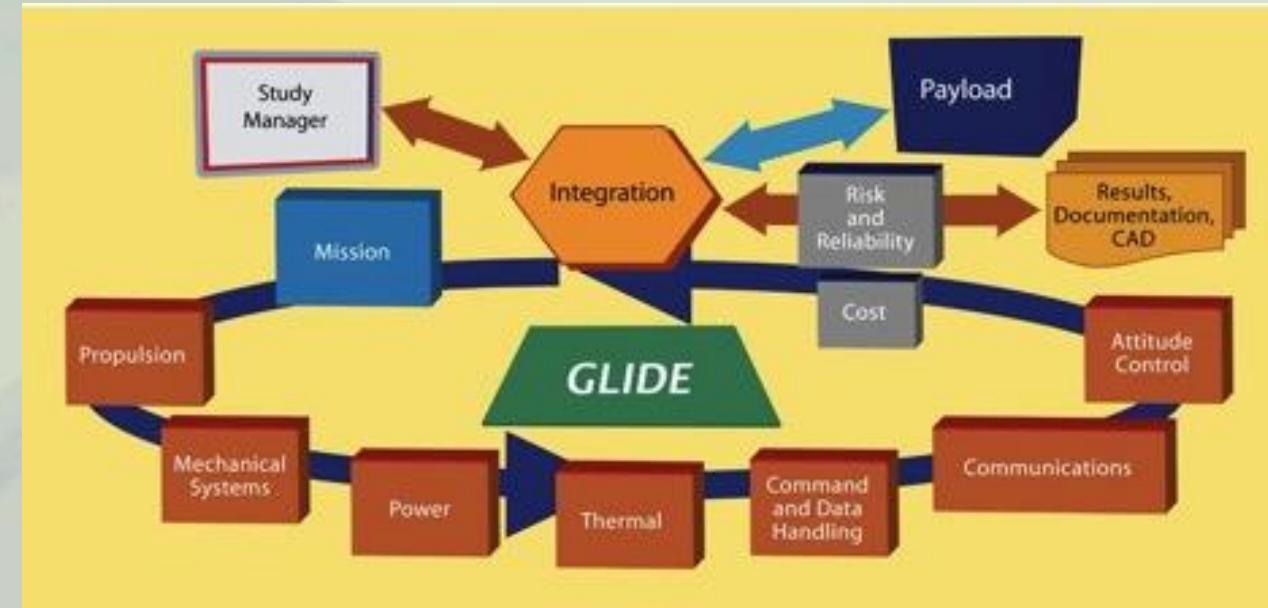
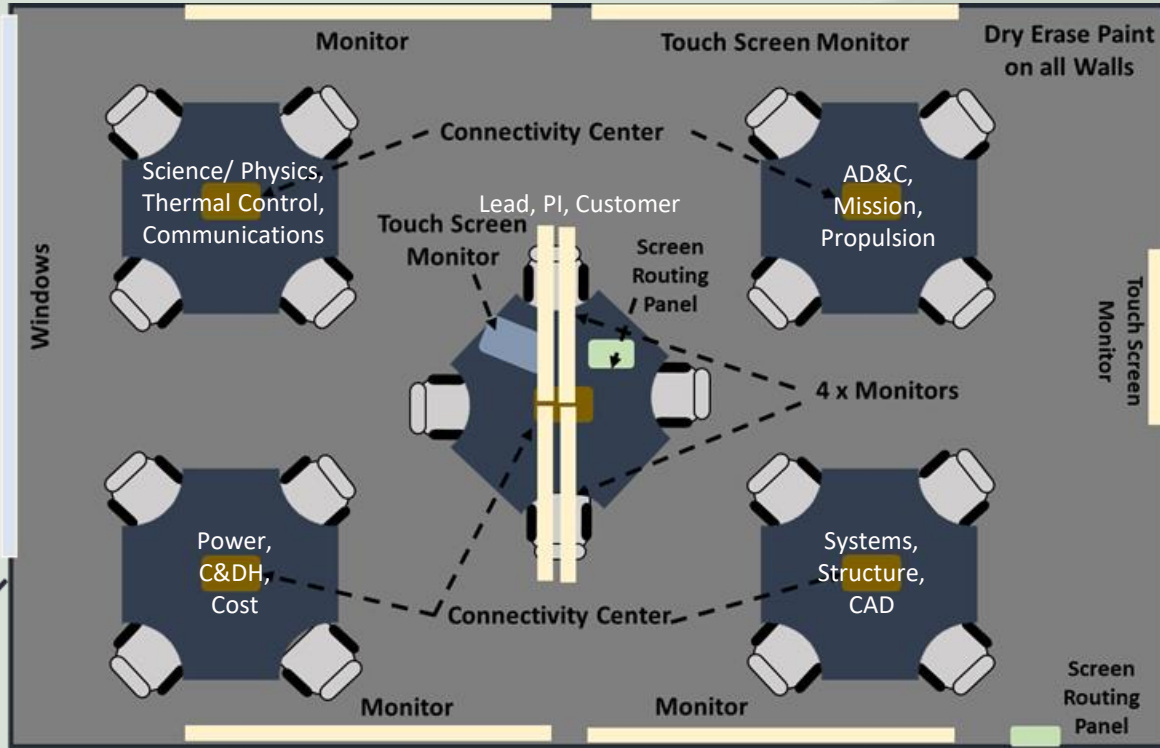


Compass Team



- NASA
- Government Organizations
- International Partners
- Industry
- Academia

The Team and How We Work

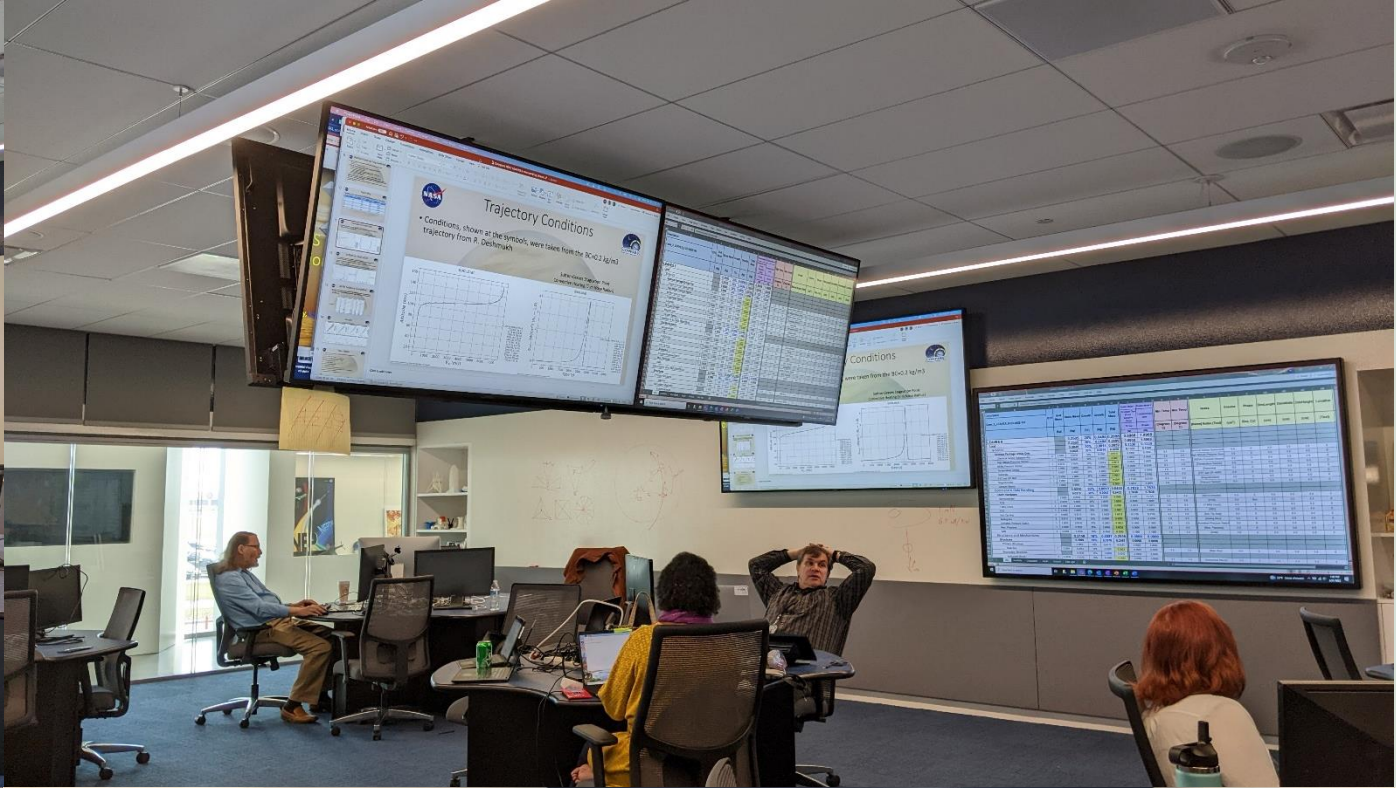


Global Integrated Design Environment (GLIDE)

is an engineering tool designed to allow users to share data across local computer networks as well as the internet, enabling multi-site collaboration

The **Compass** team includes experts from each discipline of space vehicle and mission design, matrixed from branches across the Center. This provides depth and peer review.







Compass Staffing

The Compass team is made up of Subject Matter Experts (SMEs) who are matrixed in from their respective specialty areas. Compass only supports two or three engineers full time (Lead, LSE, and CAD).

Compass Team members 2006-2016



- Typical Compass Team Consists of:

- Lead
- Lead Systems Engineer
- Mission/Trajectory
- Science/Physics
- Attitude Determination and Control
- Command and Data Handling
- Communications and Tracking
- Electrical Power Systems
- Thermal Control
- Propulsion (Chemical and Electric)
- Structures and Mechanisms
- Configuration (CAD)
- Cost Estimation

- When required for a design, we add in SMEs from specialty areas, such as:

- Cryogenic Fluid Management
- Nuclear Power (Fission and RPS)
- Mobility Systems
- In-Situ Resource Utilization (ISRU)

All our matrixed SMEs work supporting other projects the rest of their time. This keeps them up to date on the latest developments and reduces overhead costs. Also means you ‘get the whole branch’.

Compass Baseline Design Process



Establishing the Study Definition

Customer meetings:
FOMS, Requirements

Mission
architecture
studies

Configuration:
Initial cut

Mass Properties:
Initial cut

Pre-work

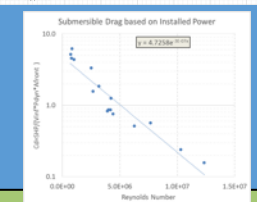
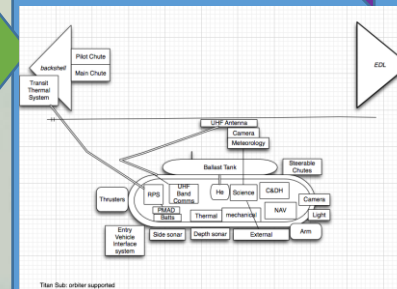
Gather the
team

Improve tools

Establish the
schedule

Design Study with Concurrent Team

Initial cut at
design



Brainstorming

Iteration and
design
improvements

Final design
meeting
customer
requirements

Post-work

Final design
products

Final design
presentation

Final report
generation



Design sessions, M,W,F, 1-4:30 pm, splinters as needed

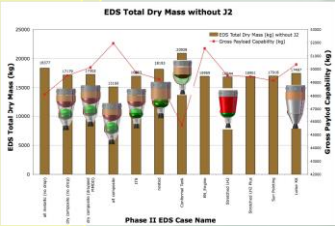
Compass Design Products and Capabilities



WBS based
Master
Equipment List
and Power
Equipment List

- The products from a design study depend on the scope of the design and the customer agreed upon products.
 - At a minimum the team produces a comprehensive chart package detailing the CONOPS, system and subsystem designs, configuration, risk, and cost.
- The customer establishes the depth and fidelity of the results before the study is begun.
- A full Compass final report can be prepared if additional time and funds are provided.

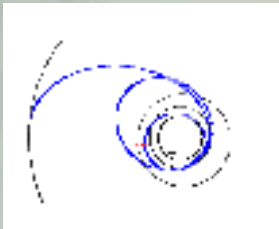
Trade Space
Investigation



System
Integration

CONOPS

Trajectory Optimization



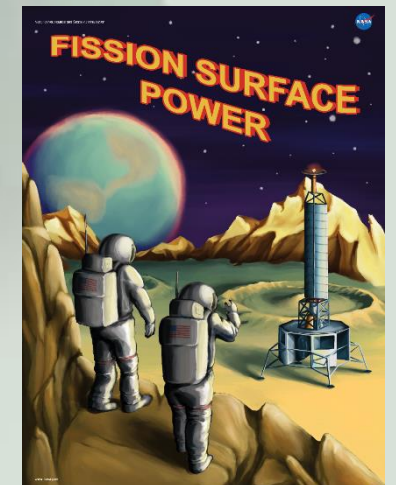
Comprehensive Presentation Package



Detailed Final Report (upon request)



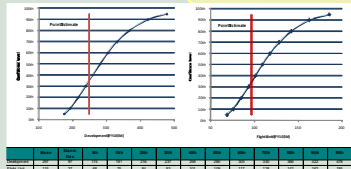
Conceptual Artwork, videos and 3-D models (upon request)



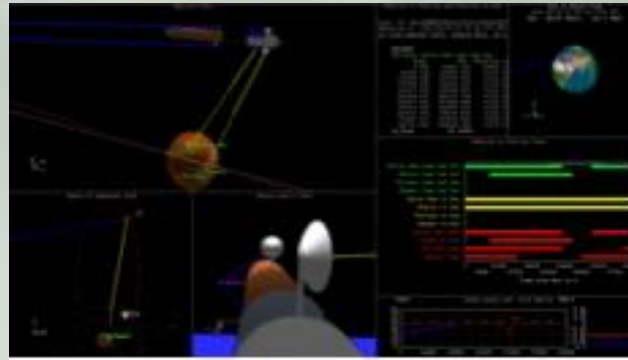
Solid Modeling
Packaging and
Configuration



Cost and Risk



Trajectory Simulation and Visualization



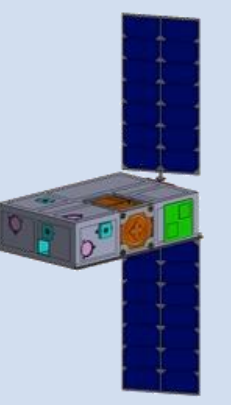
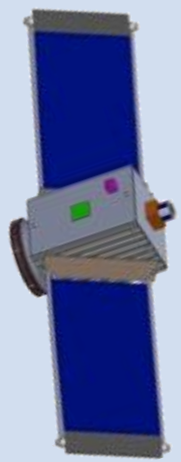
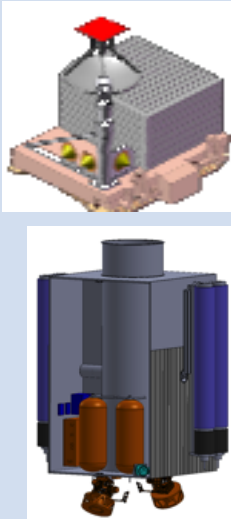
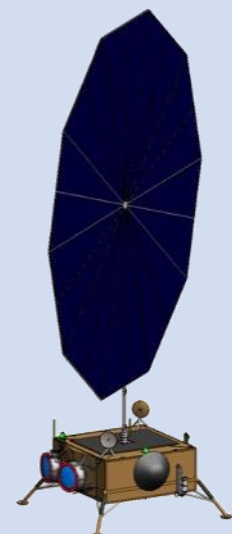
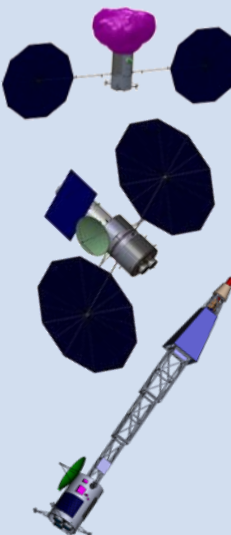
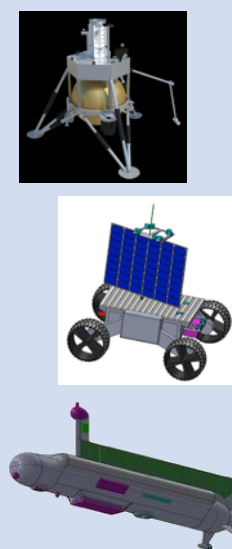
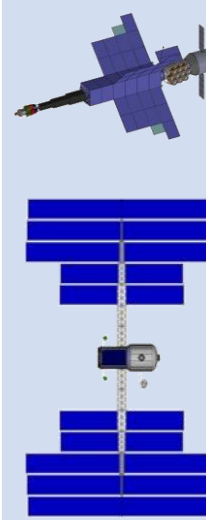
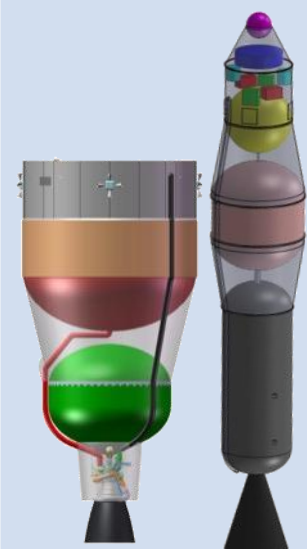
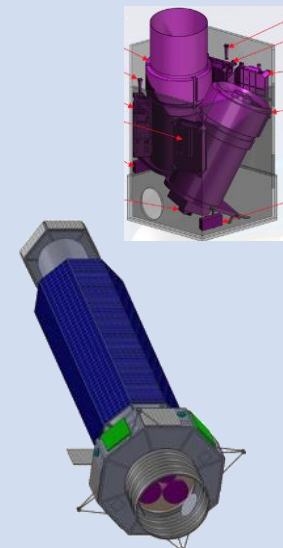
- Compass has produced more than 250 designs

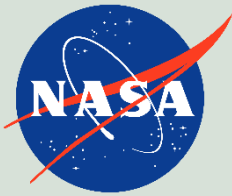
- Designs span in size from cubesats to ISS-scale, deep space human exploration spacecraft
- Destinations include all the planets, many moons, small bodies and their surfaces
- Mission Types include technology demonstrator missions, to science missions, to design reference missions (DRMs)



10TH ANNIVERSARY
COMPASS SOLAR SYSTEM TOUR

- MERCURY • SEP for Mercury Lander
- VENUS • Venus Lander ALIVE • Landsailer Zephyr
- EARTH • Ares V Earth Departure Stage (EDS) • Ship Sat • SHARPS
- MOON • ILN • LNS • Moonraker • SPAGETI • LEPRECAN
- ISS • CoNNeCT
- MARS • MAV • MERV • Mars Sample Return • HERRO • Hybrid SEP • Cargo SEP
- ASTEROIDS • Fetch • NEARER • SAMBA • DAVID
- JUPITER • Europa Ice Sounder (EIS)
- SATURN • Titan Submarine • TSSM
- URANUS • Uranus RPS Decadal
- NEPTUNE • Triton Hopper
- KUIPER BELT • Kuiper Belt Object Orbiter (KB00)

Microsats	Smallsats	Technology Demonstrators	Sample Return	Science Sats	Landers, Rovers, Extraterrestrial Submarines	Crewed	Launchers/ Stages	Instruments
								



Examples: Compass Designs for Moon to Mars



LUNAR RETURN

TO MARS

HIGH POWER TRANSPORTATION AND HABITAT IN MICROGRAVITY

COMMUNICATIONS RELAY

MARS TRANSIT

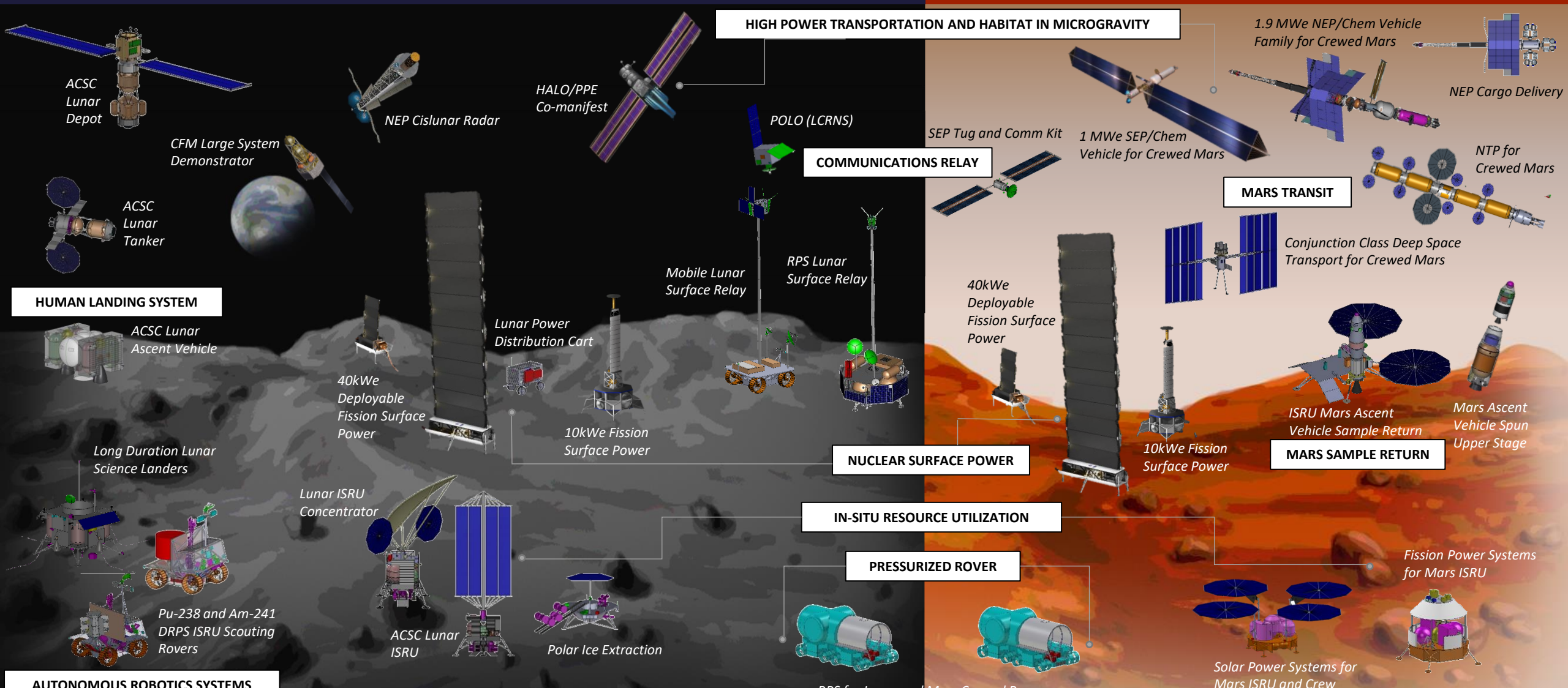
NUCLEAR SURFACE POWER

IN-SITU RESOURCE UTILIZATION

PRESSURIZED ROVER

HUMAN LANDING SYSTEM

AUTONOMOUS ROBOTICS SYSTEMS



*images are not to scale

What's to come?



So many places to explore!



Questions?

Contact: Betsy Turnbull

elizabeth.r.turnbull@nasa.gov

Website: <https://www1.grc.nasa.gov/facilities/compass-lab/>

