



# Coordinating Innovative Technology Development at NASA

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**Dr. Erica Rodgers**

NASA Office of Technology, Policy, and Strategy  
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# Office of Technology, Policy and Strategy (OTPS)

## Overarching Goal – Help Support the *Why, What, and How* of NASA

Working in collaboration across NASA and the broader space community...

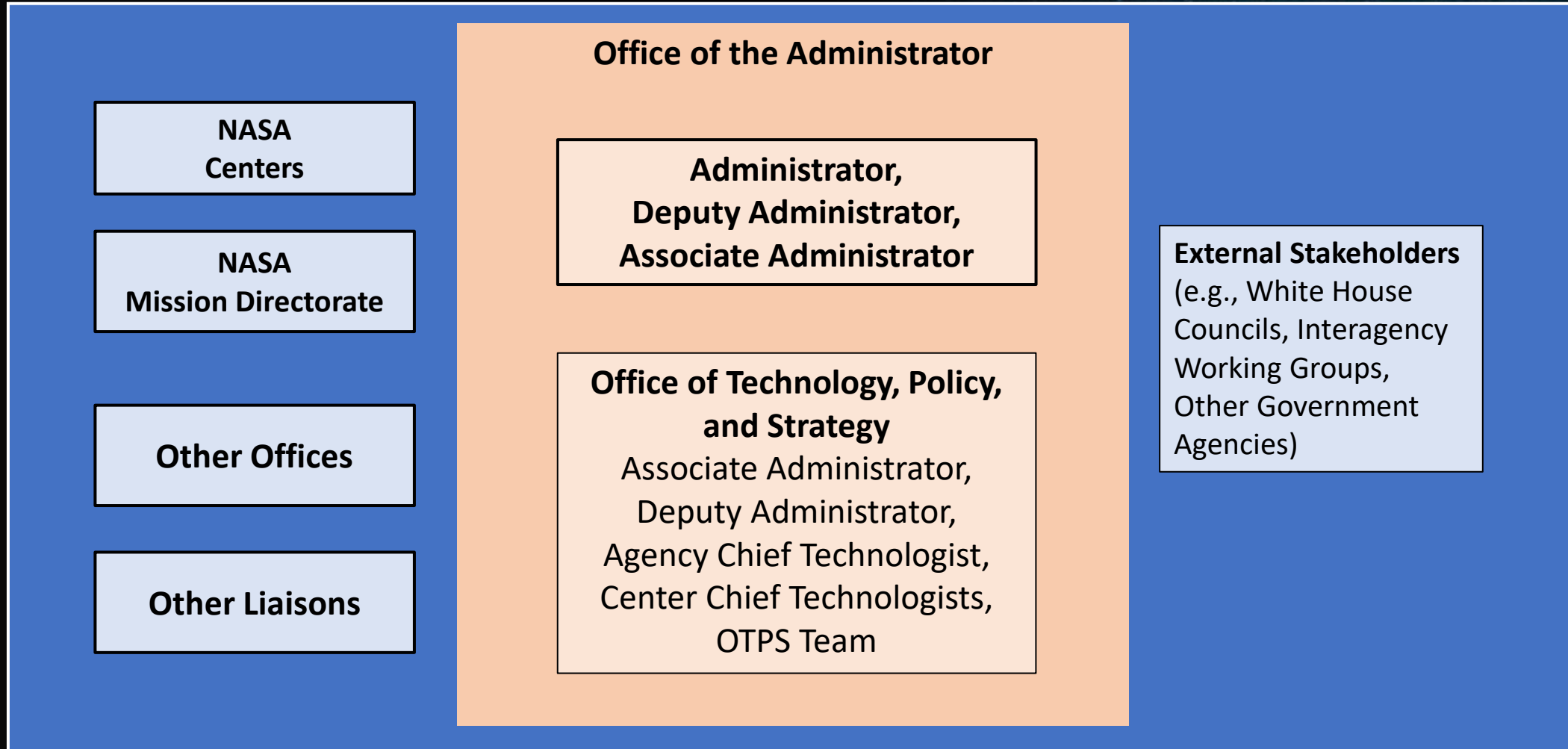
...Provide NASA leadership with data- and evidence-driven advice to develop and shape

- policy (what NASA should do and why),
- strategy (how should NASA do what it does), and
- technology (how to best develop/leverage the right technology)



# Office of Technology, Policy, and Strategy (OTPS)

## Stakeholders



Every activity has technology, innovation, policy, and strategy components

# Smart innovation at NASA

- NASA missions span decades
  - ISS: Presidential policy (1984), first modules launched (1998), crewed ops began (2000)
  - JWST: Next Generation Space Telescope Workshop (1989), formal recommendation for next-gen infrared telescope (1996), construction began (2004), launched (2021)
- Innovation has a unique role in NASA missions
  - New technologies are critical to enable inspiring missions in science, exploration, and aeronautics
  - However, innovation cycles in industry can be months to years
  - Smart innovation is necessary to leverage emerging technologies or disruptive breakthroughs
- Smart innovation is a key element of sustainability at NASA
  - Programs proactively plan technological on-ramps to remain resilient to unanticipated challenges
  - Improves coordination throughout the full program lifecycle



ISS, (Oct 4, 2018)  
Credit: NASA

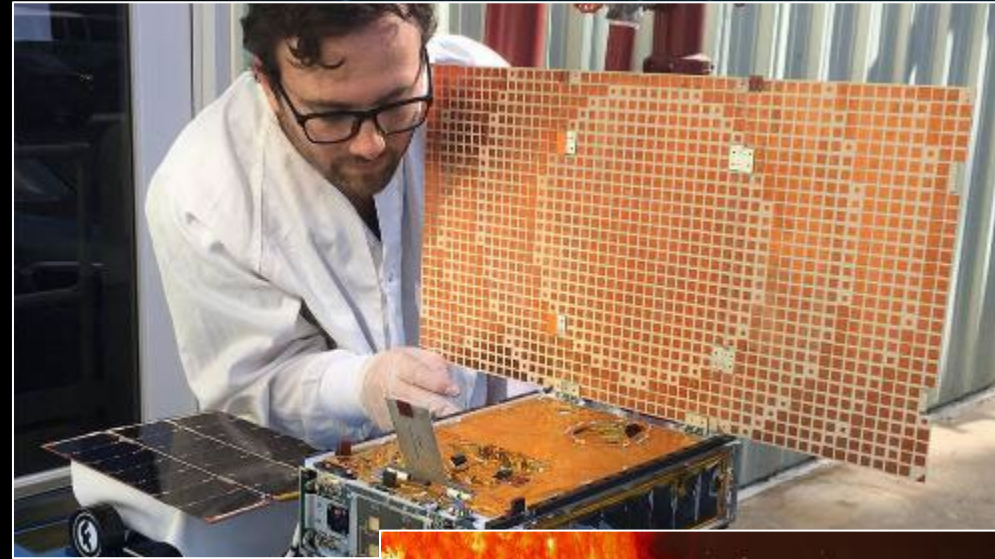


JWST Deep Infrared Image  
Credit: NASA, ESA, CSA, STScI

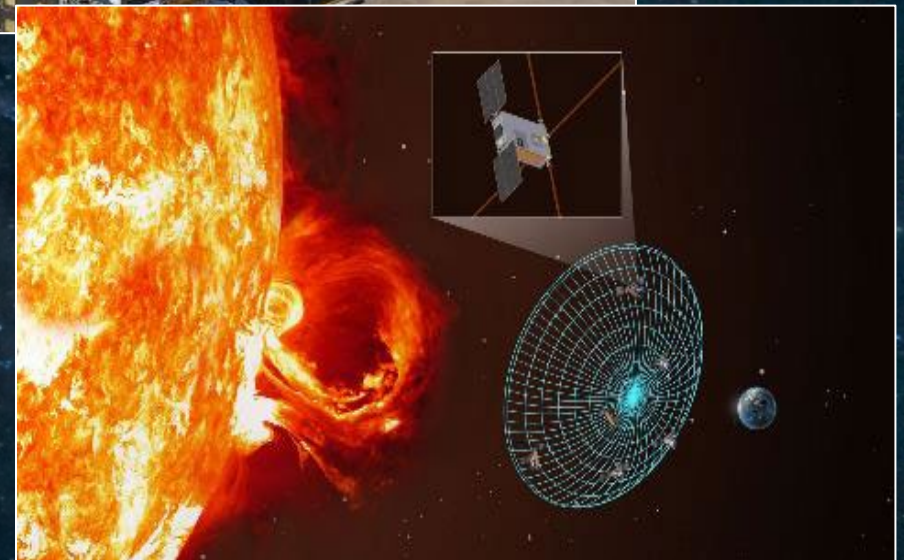


# Hitching a ride to Mars

- 2018: Mars Cube One
  - Technology demonstration of interplanetary CubeSats
  - Rapid process
- Pathfinder for other interplanetary CubeSats
  - Sun Radio Interferometer Space Experiment (SunRISE) – Expected launch 2024-2025



Mars Cube One (MarCO) spacecraft  
Credit: NASA

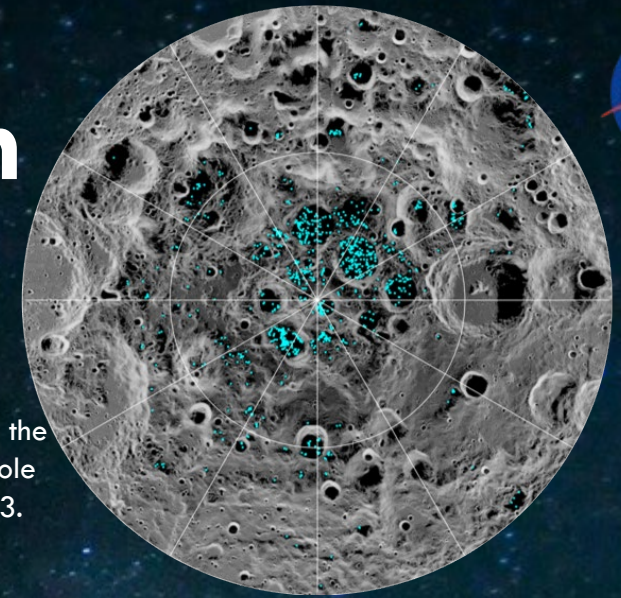


SunRISE Artist Concept  
Credit: NASA JPL

# Prospecting for water on the Moon

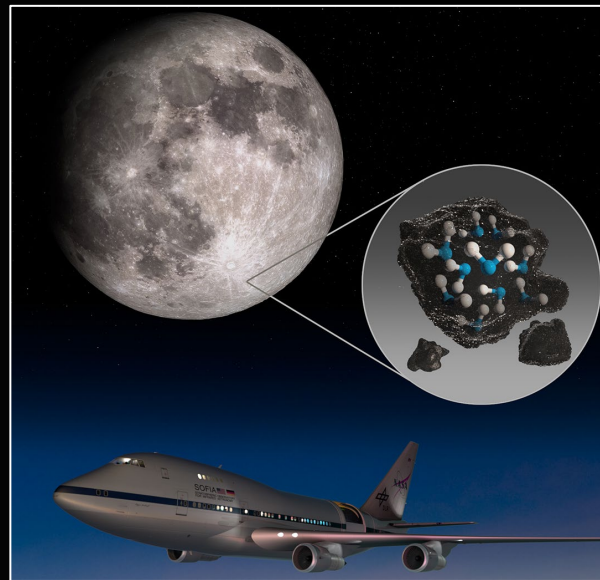


- 2018: NASA's Moon Mineralogy Mapper (M3) on ISRO Chandrayaan-1 showed promise of south pole

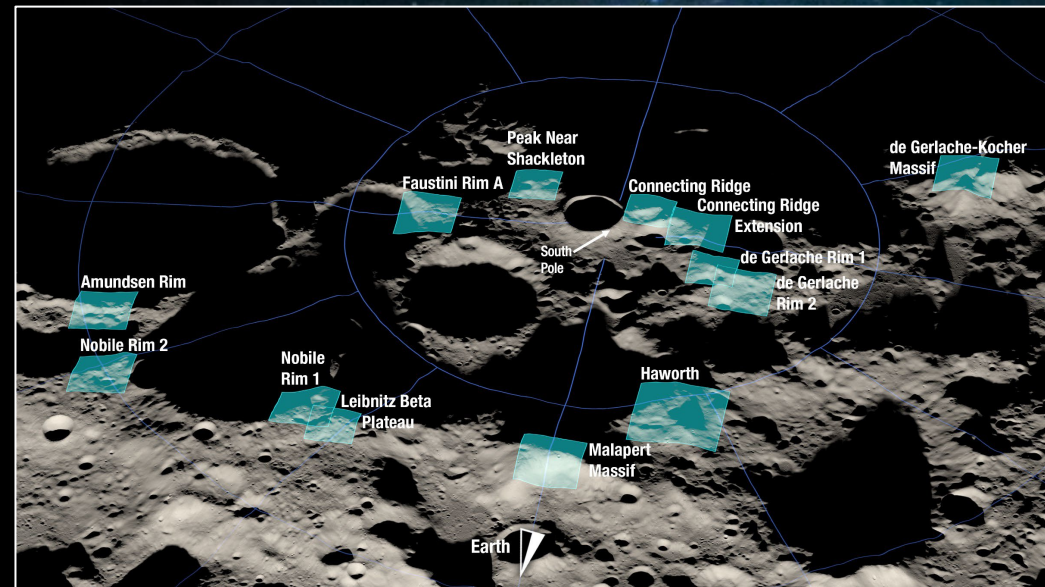


Ice locations at the Moon's south pole detected by M3. Credit: NASA

- 2020: SOFIA captured lunar water cycle, informs future ISRU



SOFIA and illustration of H<sub>2</sub>O molecules on the lunar surface. Credit: NASA



Rendering of 13 candidate landing regions for Artemis III. Credit: NASA

# Challenge: Connecting knowledge to future objectives and opportunities



- Challenge: NASA is planning today for missions that will be enabled by technologies we may not be able to envision
- NASA connects experience and vision to NASA programs
- NASA relies on expert input from a broad community of stakeholders
- To leverage expert input NASA mission directorates have created coordinated processes to inform future programs.



Credit: NASA

STMD Strategic Framework			
LEAD	THRUSTS	OUTCOMES	CAPABILITIES
<p><b>Ensuring American global leadership in Space Technology</b></p> <ul style="list-style-type: none"> <li>Lunar Exploration building to Mars and new discoveries at extreme locations</li> <li>Robust national space technology engine to meet national needs</li> <li>U.S. economic growth for space industry</li> <li>Expanded commercial enterprise in space</li> </ul>	<p><b>Go</b> Rapid, Safe, &amp; Efficient Space Transportation</p> <ul style="list-style-type: none"> <li>Enable Human Earth-to-Mars Round Trip mission durations less than 750 days.</li> <li>Enable rapid, low cost delivery of robotic payloads to Moon, Mars and beyond.</li> <li>Enable reusable, safe launch and in space propulsion systems that reduce launch and operational costs/complexity and leverage potential destination based ISRU for propellants.</li> </ul>	<ul style="list-style-type: none"> <li>Cryogenic Fluid Management &amp; Propulsion</li> <li>Advanced Propulsion</li> </ul>	
	<p><b>Land</b> Expanded Access to Diverse Surface Destinations</p> <ul style="list-style-type: none"> <li>Enable Lunar and Mars Global Access with ~20t payloads to support human missions.</li> <li>Land Payloads within 50 meters accuracy while also avoiding local landing hazards.</li> </ul>	<ul style="list-style-type: none"> <li>Human &amp; Robotic Entry, Descent and Landing</li> <li>Precision Landing</li> </ul>	
	<p><b>Live</b> Sustainable Living and Working Farther from Earth</p> <ul style="list-style-type: none"> <li>Conduct Human/Robotic Lunar Surface Missions in excess of 28 days without resupply.</li> <li>Conduct Human Mars Missions in excess of 800 days including transit without resupply.</li> <li>Provide greater than 75% of propellant and water/air consumables from local resources for Lunar and Mars missions.</li> <li>Enable surface habitats that utilize local construction resources.</li> <li>Enable intelligent robotic systems augmenting operations during crewed and un-crewed mission segments.</li> </ul>	<ul style="list-style-type: none"> <li>Sustained human life support systems</li> <li>Operate in Extreme Environments</li> <li>Advanced Materials, Structures and Manufacturing</li> <li>Sustainable Power</li> <li>In-situ Propellant and Consumable Production</li> <li>Intelligent/Resilient Systems &amp; Advanced Robotics</li> </ul>	
	<p><b>Explore</b> Transformative Missions and Discoveries</p> <ul style="list-style-type: none"> <li>Enable new discoveries at the Moon, Mars and other extreme locations.</li> <li>Enable new architectures that are more rapid, affordable, or capable than previously achievable.</li> <li>Enable new approaches for in-space servicing, assembly and manufacturing.</li> <li>Enable next generation space data processing with higher performance computing, communications and navigation in harsh deep space environments.</li> </ul>	<ul style="list-style-type: none"> <li>Extreme Access</li> <li>On-orbit Servicing, Assembly and Manufacturing</li> <li>Small Spacecraft Technologies</li> <li>Advanced Avionics</li> <li>Advanced Communications &amp; Navigation</li> </ul>	

Note: Multiple Capabilities are cross cutting and support multiple Thrusts. Primary emphasis is shown

Credit: NASA



# Technology Taxonomy

- NASA's 2020 Technology Taxonomy provides a standard framework for communicating about technologies
- Incorporates input from across NASA centers, internal experts, and external review
- Taxonomy is updated over time to include new technologies relevant to NASA and to re-align technology areas

<https://www.nasa.gov/offices/oct/taxonomy/index.html>

<https://techport.nasa.gov/>







# Science and Technology Partnership Forum

**Vision: Technology solutions to joint problems.  
Multi-agency collaboration on cross-cutting S&T solutions to benefit the Nation.**

Established in 2015

Strategic forum established to identify synergistic efforts and technologies.

Focus on key pervasive and game-changing technologies across government space

## S&T Topic Areas

### Prior

- Small Satellite Technology
- Big Data Analytics
- In-Space Assembly
- Cyber Resilient Space Systems
- Cis-lunar Capabilities
- Radiation-Hardened, High-Performance Electronics for Space Assets

### Ongoing

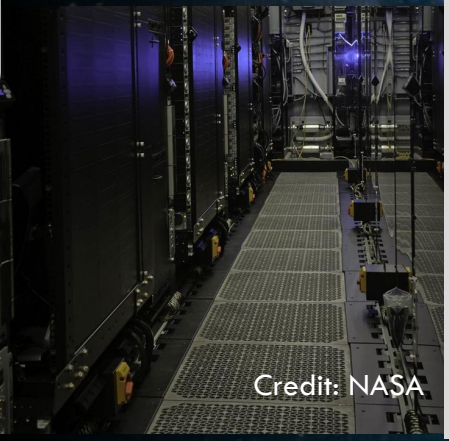
- Space Trusted Autonomy
- Cyber Space Mission Assurance

## S&T Partnership Goals

- Enable interagency collaboration
- Leverage synergies
- Influence agency portfolios

## S&T Partnership Objectives:

- Leverage
- Encourage
- Connect
- Coordinate and Champion
- Identify
- Remove Interagency Barriers



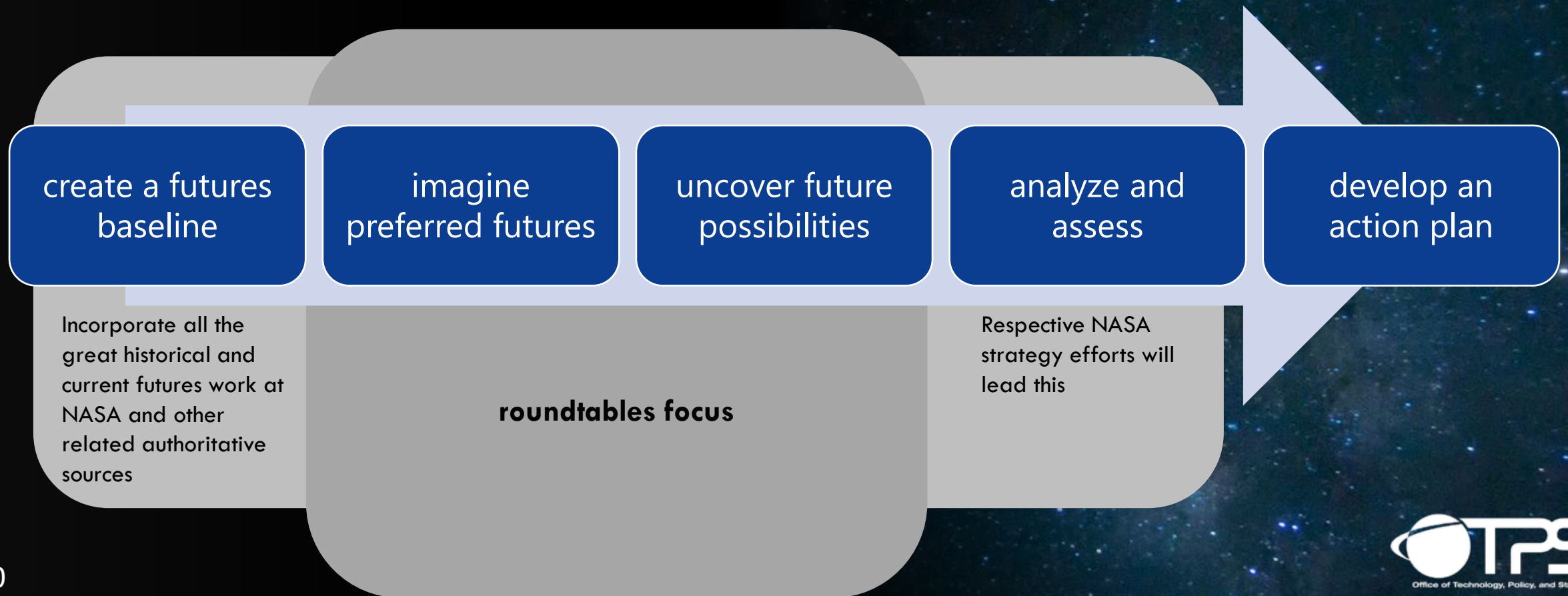
## Customers

- NASA Mission Directorates
- NASA Centers
- Technology Transition and Mission Support Offices
- Service Laboratories
- Research and Engineering Centers
- Other Technology Centers of Excellence



# Envisioning the aeronautics and space enterprise for the next 20-50 years: NASA futures study

Goal: Inspire and prepare NASA leadership to move towards achieving its preferred futures and to be prepared for a variety of future states that could come to realization.





# Conclusions

- NASA relies on coordinated processes to enable smart innovation
  - Each mission directorate develops tailored processes
  - These processes incorporate technology onramps across long mission timelines
- Expert input is critical to smart innovation at NASA
  - NASA relies on expert input to help anticipate and respond to unanticipated challenges
  - Input is critical to enabling sustainability and resiliency across the agency
- As an independent office, OTPS helps enable coordinated innovation



**Thank you!**

**Questions,  
Comments,  
Feedback**



**Dr. Erica Rodgers**

S&T Partnerships Lead

NASA, OTPS

Email: [erica.m.rodgers@nasa.gov](mailto:erica.m.rodgers@nasa.gov)

Phone: 202.358.0063

<https://www.nasa.gov/offices/otps/home/index.html>

