



## **Fostering Scalable, Resilient Utility Infrastructure for Cislunar Space**

Fifty-Eighth session of the Scientific and Technical Subcommittee  
of the Committee on the Peaceful Uses of Outer Space

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<http://space.nss.org>

# National Space Society (NSS)

- **NSS is an international non-governmental organization:** in consultative status with the United Nations Economic and Social Council since 1996, permanent observer status with COPUOS, and ongoing participant in both the COPUOS Science and Technical as well as Legal Subcommittees.
- **NSS Vision:** “People living and working in thriving communities beyond the Earth, and the use of the vast resources of space for the dramatic betterment of humanity.”
- **NSS Mission:** “to promote social, economic, technological, and political change in order to expand civilization beyond Earth, to settle space and to use the resulting resources to build a hopeful and prosperous future for humanity.”
- **NSS Reach:** over 700,000 members, affiliates, donors, Ad Astra magazine subscribers, web & social media followers, conference/chapter/fora participants, and students in programs & contests.

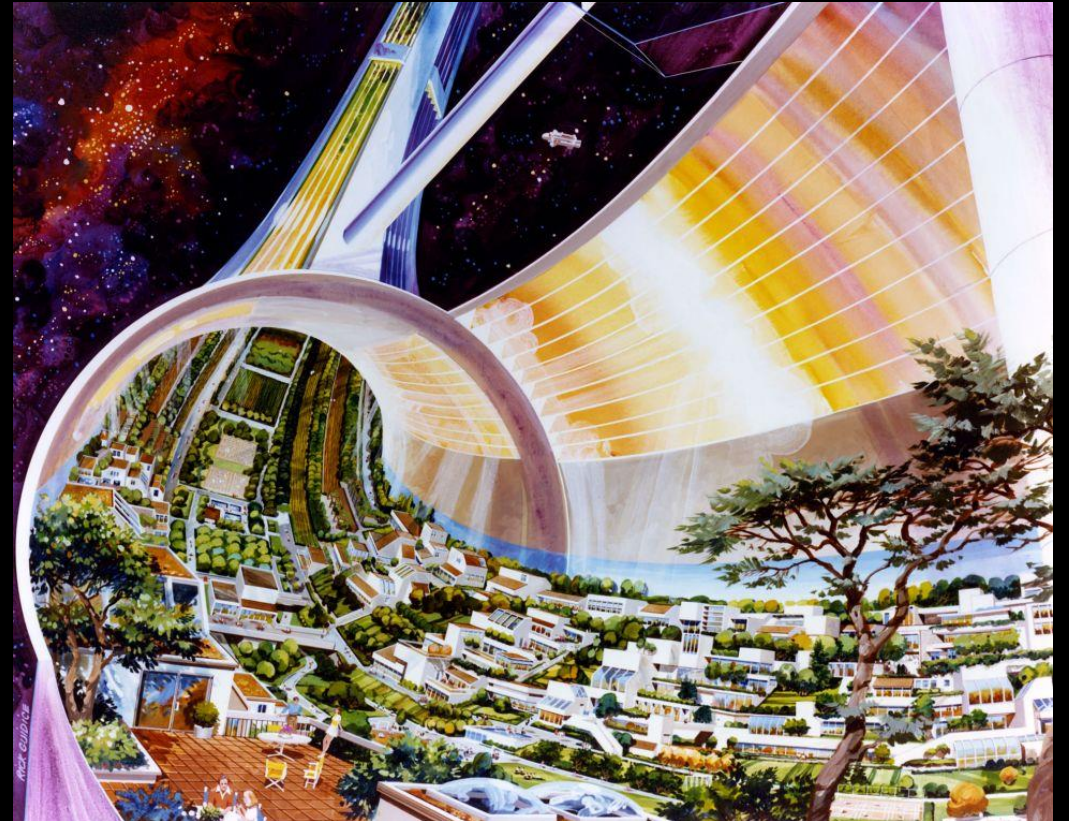


Image Credit: Rick Guidice



# NSS Primary Themes for Strategic Action

- **Defending Earth against Asteroids and Comets**

- See <https://space.nss.org/planetary-defense/>

- **Space Development**

- e.g. Space Solar Power, LEO commercialization, lunar In Situ Resource Utilization (ISRU), to benefit everyone on Earth

- **Space Settlements**

- Space settlement is the general process of developing and living in space. A space settlement is a specific place in space where people live, work, and raise families.

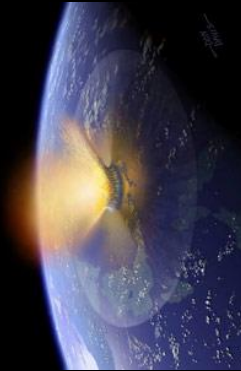


Image Credit Don Davis

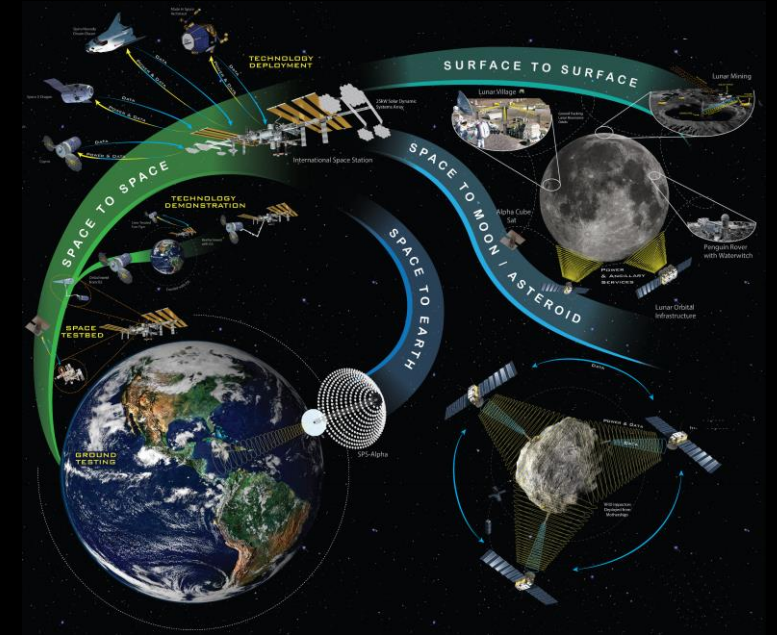


Image Credit Aaron Cohen



Image Credit: Rick Guidice

# Understanding the Problem/Solution Space

- **What you can learn to do really does matter . . .**
  - *Defending Earth against Asteroids and Comets*
  - *Space Development*
  - *Space Settlements*
- **Why your doing it can matter just as much if not more . . .**
  - *The consequences of extinction level events are irreconcilable.*
  - *Bringing new resources (energy, material resources, and habitable area) to the table for use in space and on Earth for the dramatic betterment of humanity provides options for a positive future.*
  - *Understanding how to build and maintain viable space settlements is a microcosm of providing for all life as we know it.*

# TD<sup>3</sup> Missions

- **Technology Development**

- *Spans the spectrum from research sandboxes to applications engineering*

- **Technology Demonstration**

- *Spans the spectrum from spectacle to practical tests of fitness for purpose*

- **Technology Deployment**

- *Spans the spectrum from supporting the first users of a service to fielding scalable, resilient utility infrastructure*

*Effective TD<sup>3</sup> mission development entails combining technology “push” and mission requirements “pull” to realize new capabilities.*

# Mission Development Matters

- **Successful TD<sup>3</sup> missions:**

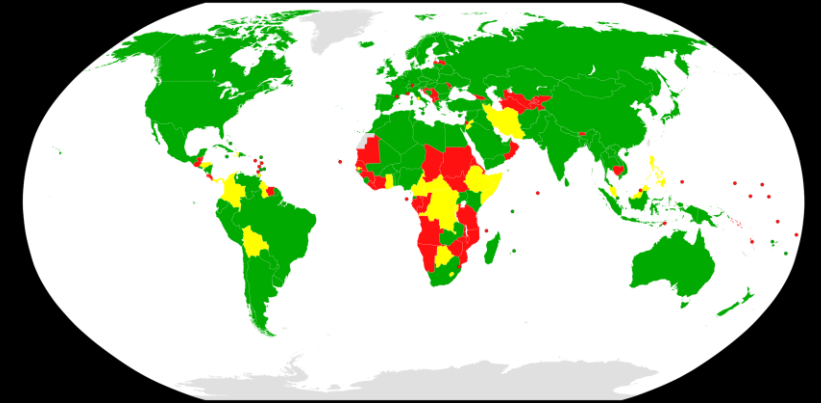
- Need to be *biased towards success* by design
- Define both the *problem and solution spaces*
- Integrate *iterative* trials and *recursive* spirals
- Foster *cooperation, collaboration, and* allow for *competition*
- Provide a means to *clarify expectations* based on *articulated interests* and shared *understanding of the follow-through*

*If you do not know where you are trying to go and why . . .  
it is a whole lot harder to get there!*

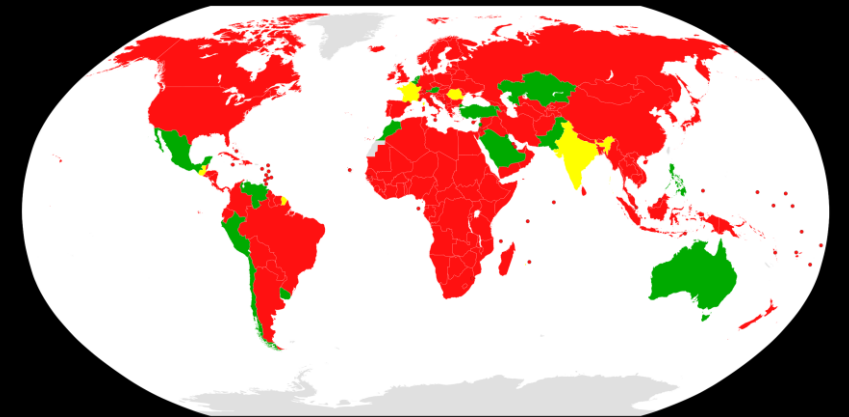


# OUTCOMES MATTER

- *Efforts in statecraft that are based on a confluence of interests that are clearly defined tend to be widely ratified/adopted*
  - *1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.*
  - *ratified by all states that engage in self-launched human spaceflight or have plans to do so.*
    - Number of Parties: 107    Number of Signatories: 89
- *Efforts in statecraft that are based on aspirations without a foundation of clearly articulated interests tend to flounder*
  - *1979 Moon Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*
  - *not ratified by any state that engages in self-launched human spaceflight or has plans to do so.*
    - Number of Parties: 18    Number of Signatories: 11
- *Accordingly, lending our efforts to drawing out, articulating, and affirming confluences of interests where they can be found seems the most prudent and logical course of action.*



Parties    Signatories    Non-parties



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# OPPORTUNITIES – Fostering Better Outcomes

*Scalable, resilient utility infrastructure for Cislunar space is realizable for:*

- ***Interoperable Network Communications Architectures (INCA)***
  - *Pervasively Networked Quality of Service (QoS) based Communications*
  - *Cislunar Spatial Positioning & Navigation Markers and Beacons*
  - *Unified Time Base*
- ***Space Solar Power and ancillary services Beaming (SSPB)***
  - *Power when and where it is needed across multiple venues*
  - *Space-to-space, Surface-to-surface, Space-to-lunar surface, Space-to-Earth*
- ***Management Operations Control Applications (MOCA)***
  - *Autonomous Navigation*
  - *Situational Awareness*
  - *Electro-optical Interferometry*
  - *Orbital Debris Mitigation & Remediation*





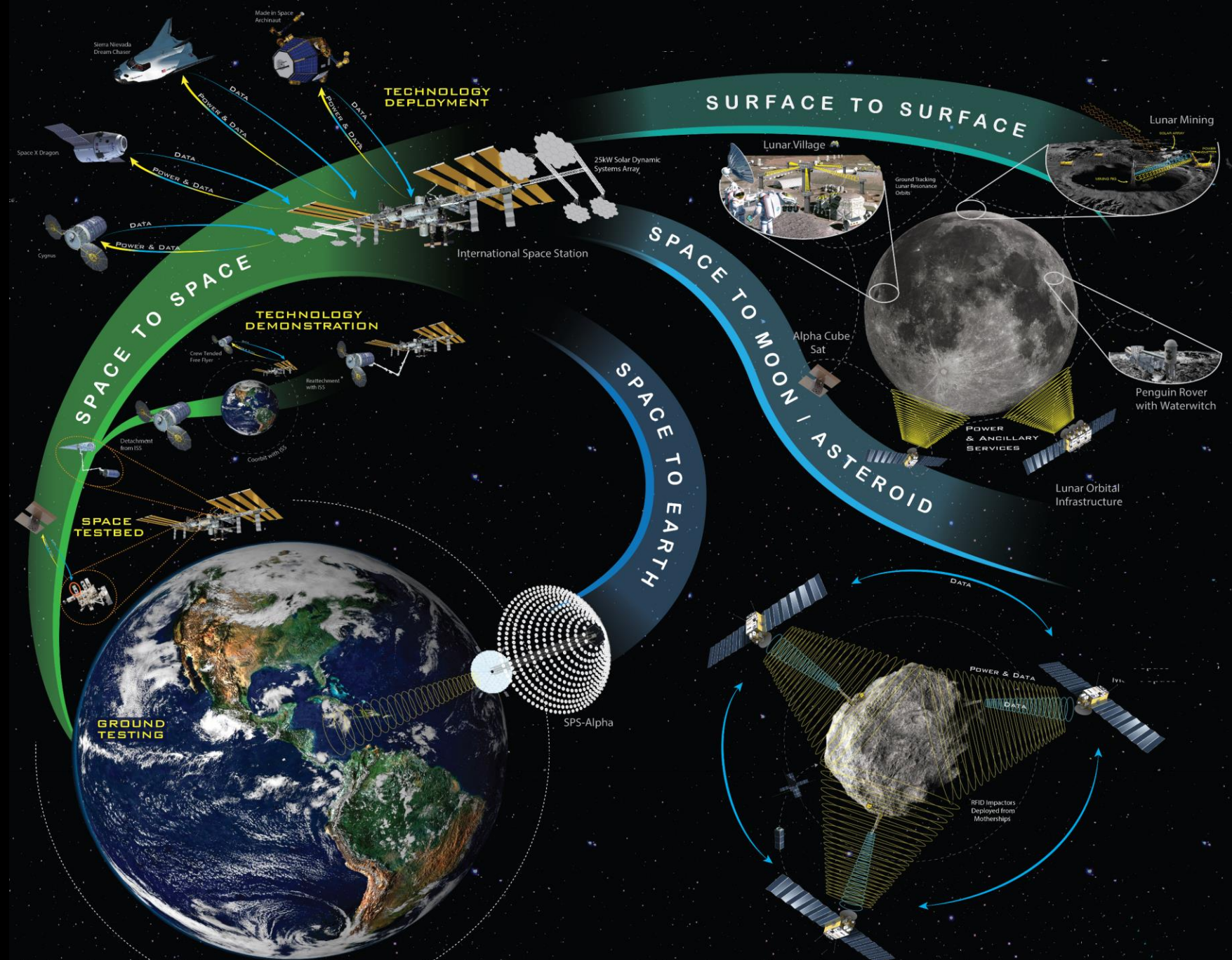
# OPPORTUNITIES – Fostering Better Outcomes

- **Capital Infrastructure**
  - enables more economical satellite and science operations in space
    - Satellite servicing and repair
    - Fuel depots
    - Standardized rendezvous and docking hardware
- **Commodities Infrastructure**
  - enables practical human activities in space
    - Air and water production from asteroid and lunar resources
    - Agriculture and food production
    - Recycling systems
    - Commodities production for daily living, e.g., clothing, cleaning products, and personal hygiene (toilet paper, toothpaste, ...)
- **And a myriad more . . .**

*TD<sup>3</sup> missions can foster scalable, resilient utility infrastructure for Cislunar space*



# Flows of People, Material, Energy & Information



# Next Steps

Mars

Asteroids

Moon



Art Credit  
SpaceX/Elon Musk

Starship



Orion MRCV

Art Credit NASA

- *INCA . . .*  
*Support the cooperative orchestration of interoperability practices and standards.*
- *SSPB . . .*  
*Add scope to one or more COPUOS Subcommittees to address the problem and solution space.*
- *MOCA . . .*  
*Draw out the confluence of interests necessary to support integrated functions and services in realizable infrastructure.*
- *Space is our future . . .*  
*Let's not wait for it, let's build it!*

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