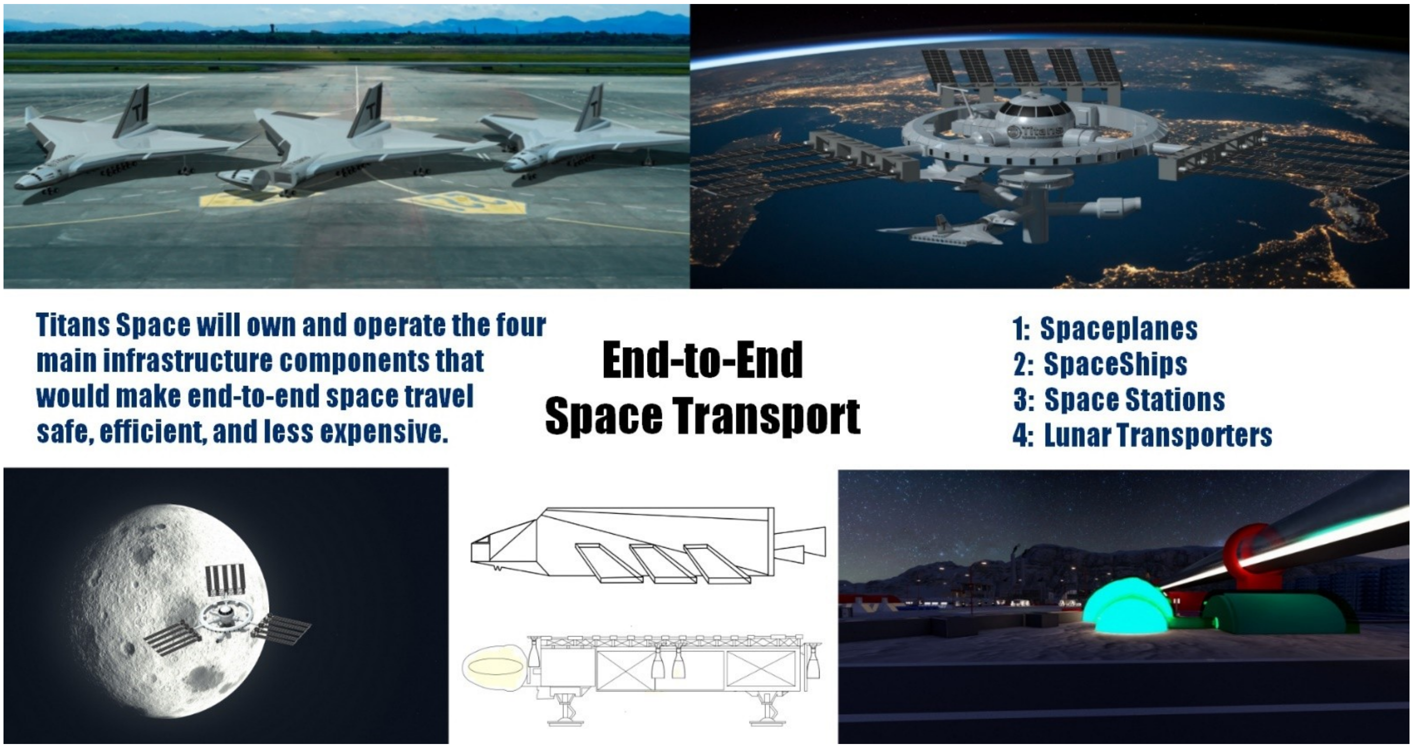
Titans Space Industries



Titans Space Industries' response to NASA's

Moon to Mars Strategy & Objectives Development

Compiled by:

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- This document is compiled on behalf of Titans Space Industries (TSI).
- This document provides in-depth information about the end-to-end space transportation systems as proposed by TSI.
- TSI's ultimate objective is to build a large commercial lunar colony that will allow lunar space tourism, lunar industrialization and R&D, and long-term human presence.
- TSI is currently solely focusing on cis-lunar projects and missions; Mars-related projects and missions will only be undertaken upon third party guarantees.

This document concerns TSI's near-term strategic outlines, which mainly involves spaceplanes, spaceships, space stations, lunar transporters, and a commercial lunar colony.

By building an end-to-end space transportation infrastructure, TSI eliminates the limitations of current space travel, including overcoming weight restrictions, allowing for more frequent launches and increased payload capacity – from essential supplies like food and water to critical cargo and oxygen. TSI's infrastructure enables the swift execution of plans and acceleration of a permanent settlement before a self-sufficient (in-situ) production infrastructure is established.

Building on the ambitious goals of NASA's Artemis program, TSI's Selene Mission takes a giant leap forward. It aspires not only to frequently land humans on the Moon but also to forge a lasting and expanding lunar colony.

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Titans Space Industries — Titania Lunar — Titans astronauts

The Selene Mission: Moon Settlement Timeline

(2027-2030)

1 **2027: Horizontal Takeoff (from a runway) to Low Earth Orbit (LEO)**
✓ Launch the reusable Single-Stage-To-Orbit (SSTO) Titans Spaceplane to LEO.

2 **H1-2028: Spaceship for Earth Orbit to Lunar Orbit Transport**
✓ Place the first Titans SpaceShip/Orbital Transporter in LEO.

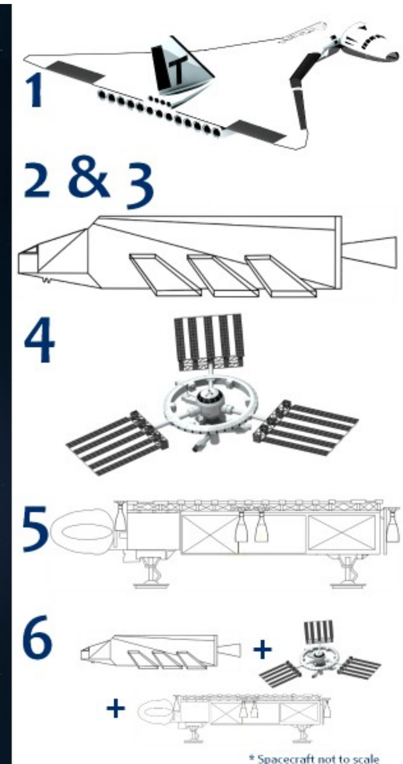
3 **H2-2028: Bridge to the Moon**
✓ Deploy an uncrewed Orbital Transporter from LEO to Lunar Orbit and back, paving the way for human missions.

4 **H1-2029: Building Blocks in Space: Titans OrbitalPort Space Stations (TOPSS)**
✓ Assemble two large space stations: one in LEO and another in Lunar orbit.

5 **H2-2029: First Crewed Lunar Mission: Rendezvous with the Lunar TOPSS**
✓ Deliver cargo and Lunar base modules to the Lunar surface using the Lunar Transporter (two or three drops), return to LEO.

6 **2030: One Giant Leap for Mankind: Settling the Moon Permanently**
✓ Full Moon Mission; Astronauts start building out Titania Lunar for Commerce and Science

www.TitansSpace.com/Selene-Mission



Lunar Flight Plan - From Earth to the Moon and Back

(Frequently from 2031 onwards)

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A — Earth Escape and Lunar Trajectory

- ✓ Titans Spaceplane transports astronauts from air/spaceport to the LEO Titans OrbitalPort Space Station (LEO TOPSS).
- ✓ Spaceplane docks with LEO TOPSS.
- ✓ Astronauts transfer from spaceplane to LEO TOPSS.
- ✓ Astronauts transfer from LEO TOPSS to Orbital Transporter.
- ✓ Orbital Transporter conducts a translunar injection (TLI) maneuver that precisely targets a specific velocity and direction, initiating a trajectory towards the lunar sphere (of influence).

B — Lunar Orbital Rendezvous

- ✓ After approximately three days, as the Orbital Transporter nears the moon, another crucial maneuver, a Lunar Orbit Insertion (LOI), will be executed. This delicate burn will gently lower the Orbital Transporter's speed, allowing it to remain into a Lunar orbit, a critical staging point.
- ✓ The Orbital Transporter docks with the Lunar Titans OrbitalPort Space Station (Lunar TOPSS).

C — Lunar Descent and Ascent

- ✓ Astronauts transfer from the Lunar TOPSS to the Lunar Transporter
- ✓ The Lunar Transporter separates from the Lunar TOPSS and embarks on its powered descent to the Lunar surface. This intricate descent involves gentle maneuvers and precise engine burns to ensure a safe and controlled touchdown.
- ✓ Lunar Transporter lands on pad near Lunar habitat.
- ✓ Astronauts transfer from Lunar Transporter to habitat.
- ✓ After a predetermined stay, astronauts transfer back from the habitat to the Lunar Transporter.
- ✓ The takeoff maneuver requires precisely calculated thrust and trajectory adjustments to achieve rendezvous and docking with the Lunar TOPSS.
- ✓ Astronauts transfer from Lunar TOPSS to Orbital Transporter.

D — Earthbound Homecoming

- ✓ Orbital Transporter undocks from Lunar TOPSS in a Trans-Earth Injection (TEI) burn, propelling it out of Lunar orbit and onto a trajectory back towards Earth.
- ✓ Orbital Transporter deploys Hypersonic Inflatable Aerodynamic Decelerator (HIAD) as it approaches Earth.
- ✓ Orbital Transporter skims upper atmosphere to slow down from Lunar return velocity to LEO speed (24,000 mph down to 17,500 mph).
- ✓ After achieving stable LEO, the Orbital Transporter detaches the HIAD, then docks with LEO TOPSS.
- ✓ Astronauts transfer from Orbital Transporter to LEO TOPSS.
- ✓ Shortly after, astronauts transfer from LEO TOPSS to Titans Spaceplane.
- ✓ Spaceplane returns astronauts to Earth.

www.TitansSpace.com/Selene-Mission

The Selene Mission:

✓ Leveraging NASA's incredible Apollo and Artemis missions

✓ Leaner, more budget-conscious solution

✓ Large-scale permanent settlement of the Moon

✓ Earlier and at a significantly lower cost

✓ Mostly funded by Titans Astronauts

In this document we introduce our solutions and offerings while using the template as per the NASA Moon to Mars Mission objectives described in the Transportation and Habitation section of NASA's Moon to Mars Strategy & Objectives Development document.

About Titans Space Industries (TSI)

- Access to capital: First round financing (Phase 1) valued TSI at US$2 billion
- Able to develop large scale projects at a fraction of the costs of other spacecraft builders/developers
- Governed by a Supervisory Board and a special Board of Integrity, Transparency, and Ethics
- Access to numerous airport/spaceport and support facilities worldwide
- Global network of space and aerospace experts
- Primary funding model based on support from ultra-wealthy Titans Astronauts
- Primary revenue model based on multiple space tourism offerings

------------- Titans Space's response to NASA starts on the next page ---------------

Transportation and Habitation Goal: Develop and demonstrate an integrated system of systems to conduct a campaign of human missions to the Moon and Mars, living and working on the lunar and Martian surface, and a safe return to Earth.

TH1

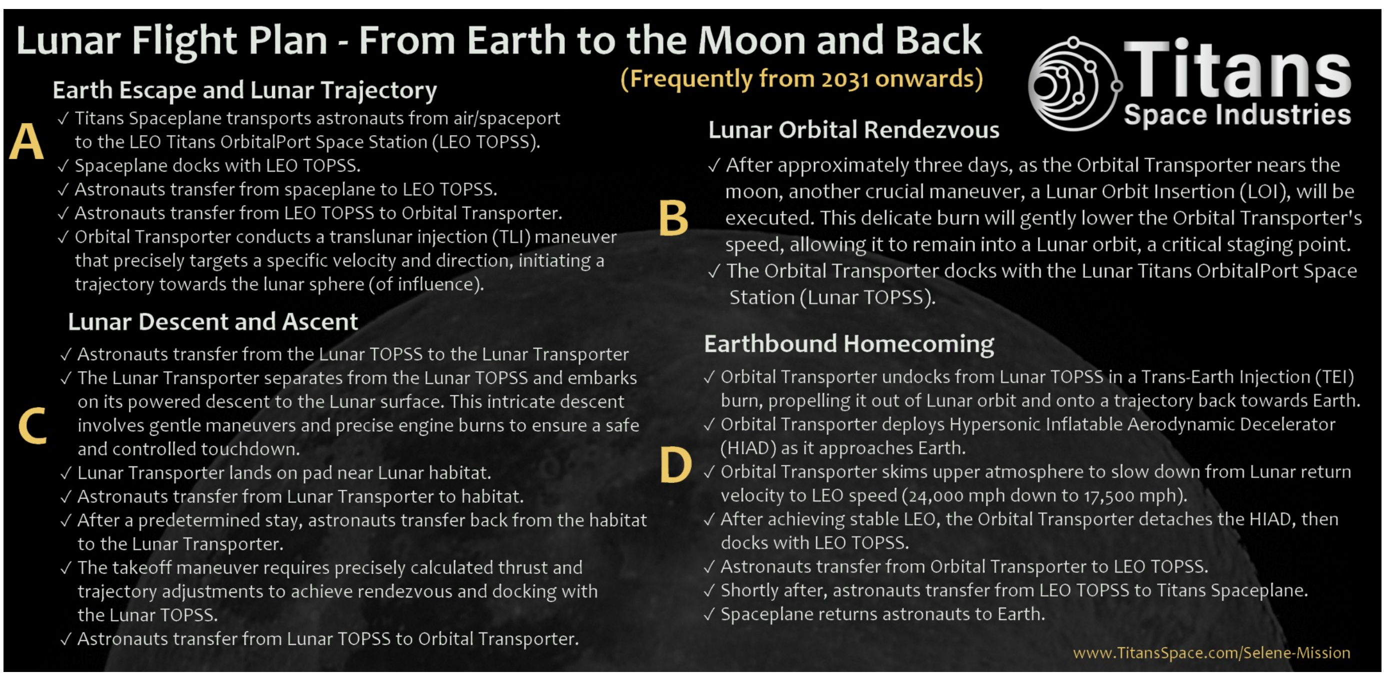
☐ TH-1: Develop cislunar systems that crew can routinely operate to lunar orbit and lunar surface for extended durations.

Notwithstanding ambitious developments such as SpaceX Starship, improvements in rocketry will remain limited for the foreseeable future, and as such, large-scale space travel, space exploration, and space commercialization would remain a near-impossible feat for humanity. Scientific and commercial missions will always remain constricted to the frequencies and efficiencies that rockets allow.

This is where TSI brings about a true paradigm shift.

Last year (2023), TSI finalized its two-year (design review) effort for a horizontal take off/horizontal landing (HTHL), single-stage-to-orbit (SSTO) spaceplane (inspired by Rockwell's Star-Raker) that enables ultra-frequent, ultra-safe, ultra-efficient, and ultra-low-cost transportation of humans and cargo to Low-Earth Orbit. Please, read this analysis to understand our view on the topic of rockets versus spaceplanes, and watch the Titans Spaceplanes video here, or the presentation here.

Since TSI finalized the spaceplanes and spacecraft Critical Design Reviews, the company has been finalizing plans for development and testing facilities at several facilities including at its own upcoming spaceport and another, renowned spaceport in the USA.



PLEASE NOTE: These are concept drawings and artist's impressions, and do not necessarily depict final designs.

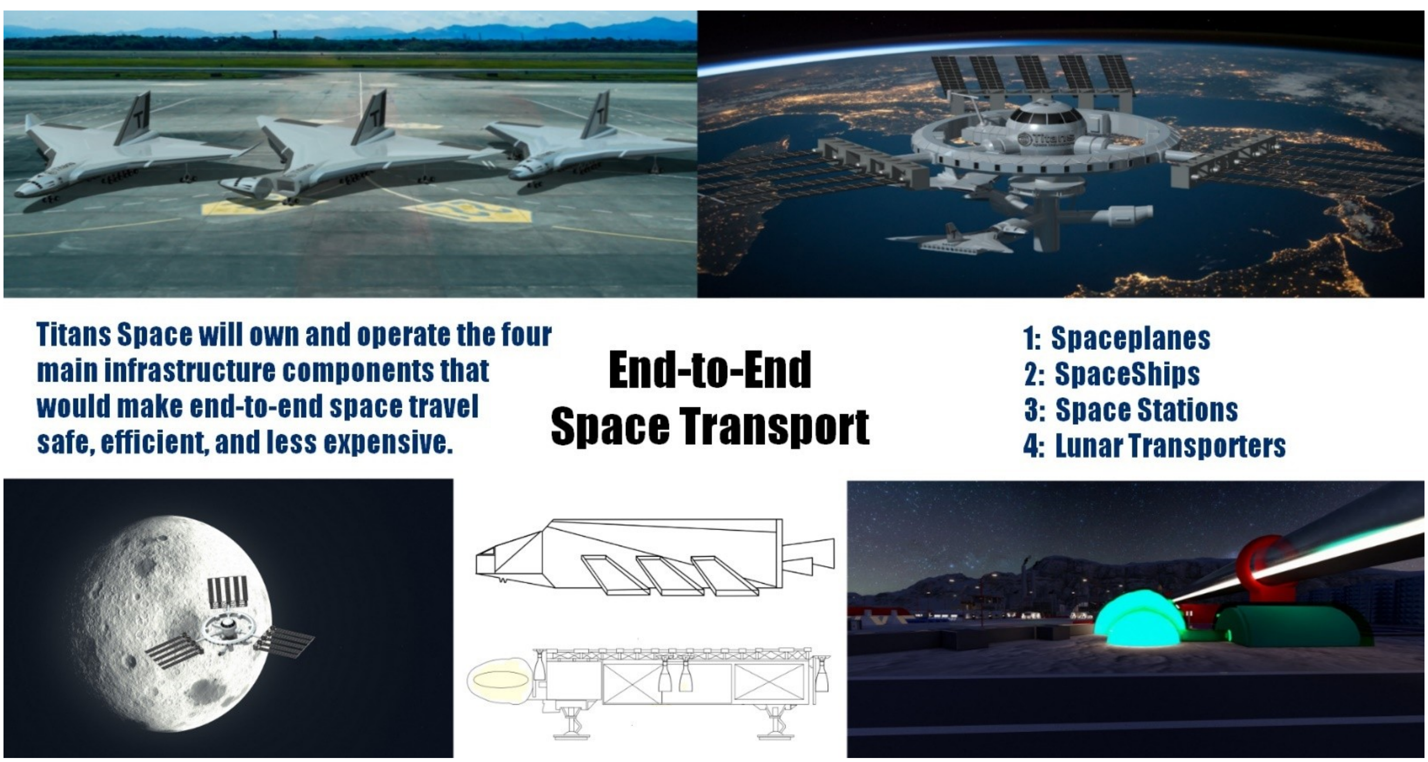
Using spaceplanes and spaceships instead of rockets dramatically increases efficiencies and possibilities of large-scale space travel, space exploration, and space commercialization.

- There will no longer be a need for rocket launches from Earth to reach LEO, GEO, or deep space. Our spaceplanes and spaceships can do this safer and more efficient (and with much bigger payloads)

- Fueling and refueling is possible, safer, and more efficient with our infrastructure

- Virtually unlimited and quick supplies from Earth (food, liquids, oxygen, water, materials, and machines), and industrial scale transport of cargo/materials and metals arriving from Moon to Low-Earth Orbit

TSI also believes in the future of nuclear propulsion rocketry. Further information about this particular system will be shared in due time after signing relevant NDAs.



TH2

☐ **TH-2: Develop systems that can routinely deliver large surface elements to the lunar surface.**

1. TSI's lunar space station, the Lunar Titans OrbitalPort Space Station (hereafter (Lunar TOPSS) will also be the docking station for the Titans Lunar Yacht Transporter (hereafter Lunar Transporter), which will serve as the lunar surface descend and ascend system as well as a point-to-point transporter (distance radius depends on fuel load).
2. The unprecedented frequency of our cislunar space transportation systems allows for the establishment and continuous expansion of a large lunar colony.
3. Spaceships that travel back and forth in cislunar space will deliver materials and modules to the space station for its continuous construction and expansion. Until the Lunar TOPPS is operational, Titans SpaceShips will function as the "space station" and rendezvous with the Lunar Transporter in Lunar orbit.
4. Once a small fleet of spaceships and frequently reusable Lunar Transporters becomes operational, (large-scale) industrialization of the Moon will become a reality.

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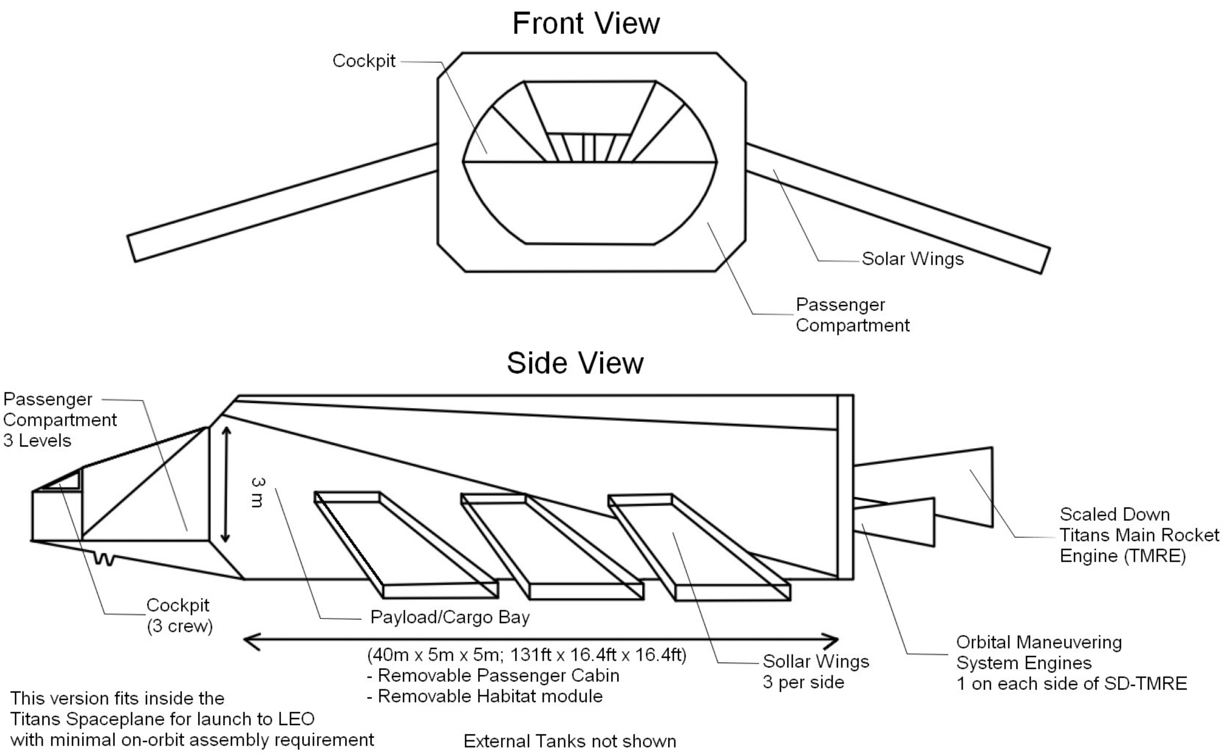
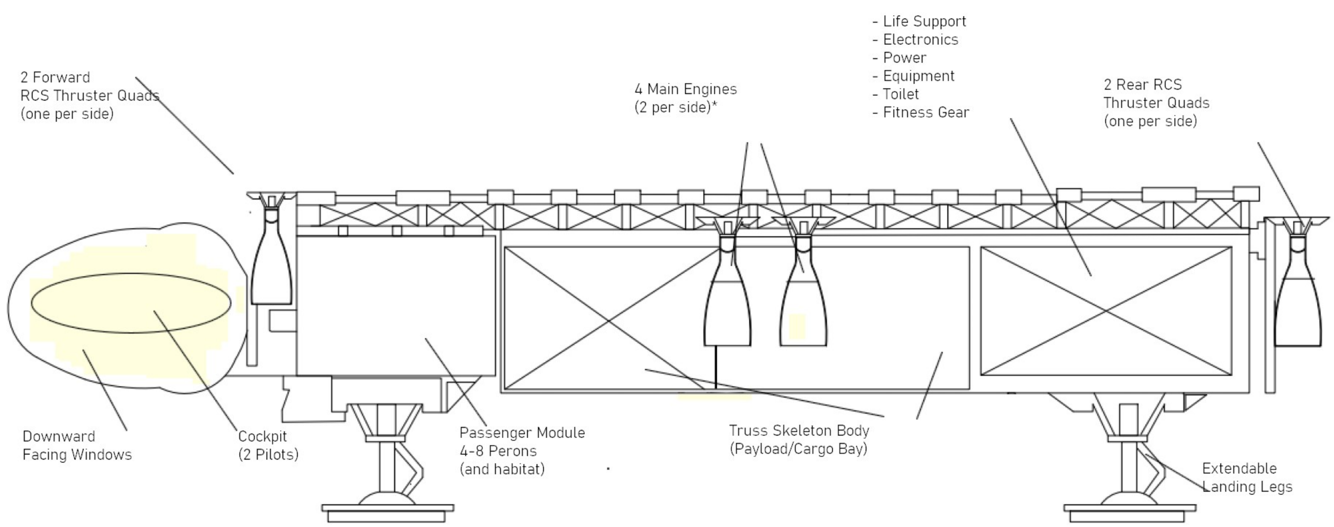




Titans Lunar Yacht

* Propellant tanks not shown

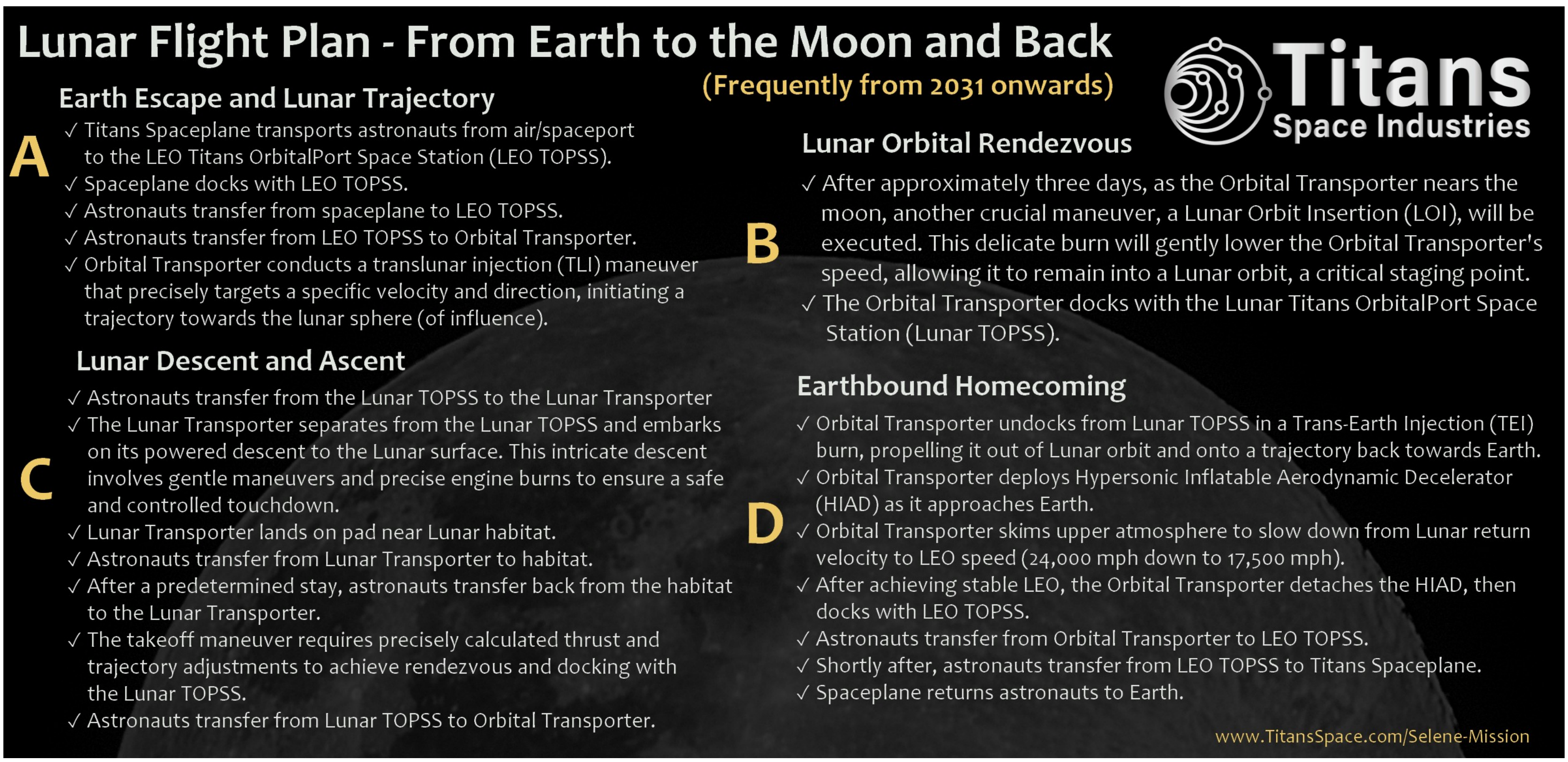
TH3

TH-3: Develop systems to allow crew to live and operate safely on the lunar surface and lunar orbit for extended periods of time with scalability to continuous presence to visit areas of interest for scientific research, conduct Mars analog activities, support industrial utilization, and conduct utilization activities.

TSI is committed to constructing a large colony on the Moon that will allow activities of all sorts. The entire TSI philosophy is developed around this premise.

We share the vision of pioneers like Dr. Gerard O'Neill that industrializing space will benefit humanity on- and off-planet. We believe that commercializing the Moon's resources can benefit Earth and all its living creatures.

An Earth-to-Moon-and-Back journey would unfold as following:



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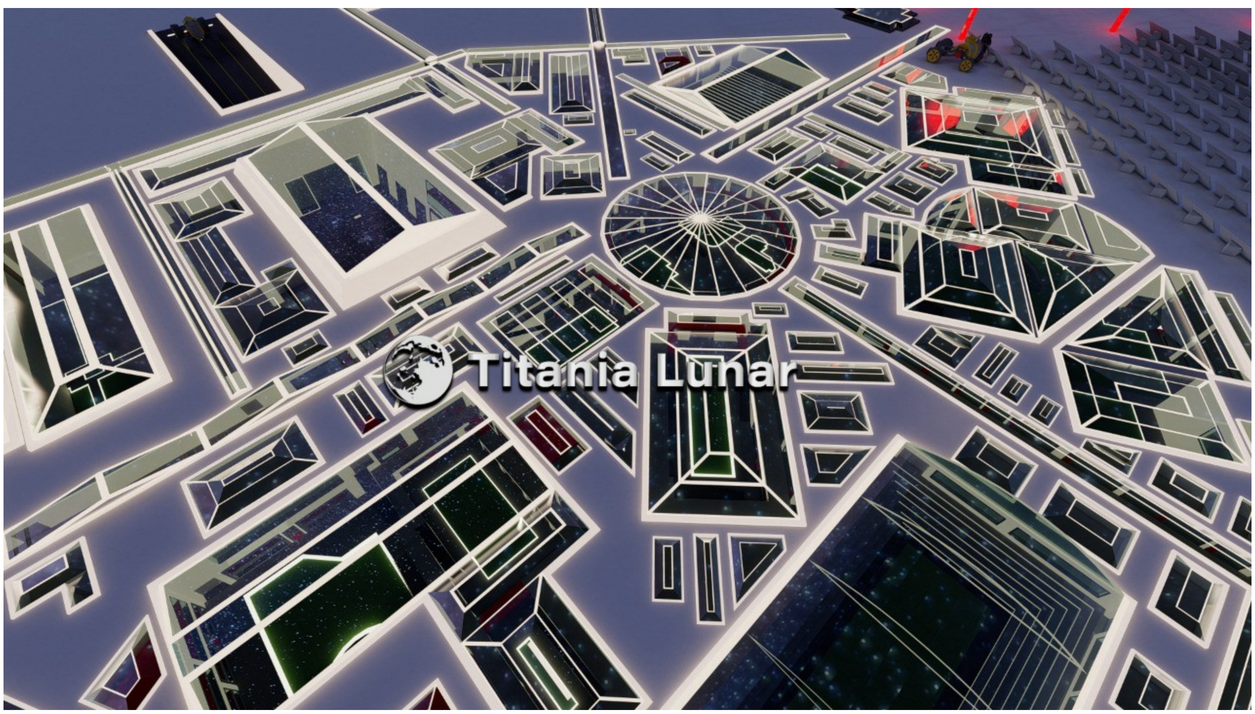

Mass Driver at Titania Lunar

TH4

TH-4: Develop a habitation system for crew in deep space for extended durations, enabling future missions to Mars.

TSI offers several options for habitation:

On the Lunar TOPSS (10-30 persons), at the Titania Lunar colony (large-scale), and inside the Lunar Transporter (for short stays).

TH5

TH-5: Develop a transportation system that crew can routinely operate from the Earth-moon vicinity to Mars orbit and Martian surface.

Titans Spaceships could possibly go to Mars and return without any need of Mars-based ISRU systems, and the Lunar Transporter can be modified for Martian circumstances.

TSI, however, has no established plans for Mars missions. While Titans Spaceships will be capable of long duration missions, we will only develop the required systems for a mission to Mars upon guaranteed agreements.

TH6

TH-6: Develop a transportation system that can deliver large surface elements from Earth to the Martian surface.

TSI's space transportation systems infrastructure enables frequent transportation of humans and cargo to and from the Moon, and with some modifications, it would be able to do the same for Mars missions.

There would be no need for rocket launches to and from the Martian surface.

Virtually unlimited and quick supplies from Earth or Titania Lunar (of food, oxygen, liquids, water, materials, and machines) to Mars, and virtually unlimited transport of materials and metals to Mars from the LEO TOPSS and/or Lunar TOPSS, and vice versa.

TH7

TH-7: Develop systems for crew to live, operate, and explore on the Martian surface to address key questions with respect to science and resources.

TSI has no plans for a Martian surface habitat. This may change when/if so agreed with third parties.

TH8

TH-8: Develop a system monitors crew health and performance and provides medical care to the crew during long communication delays to Earth and in an environment that does not allow emergency evacuation nor terrestrial medical assistance.

This will be developed with partner specialists, companies, agencies, and institutions.

TH9

☐ **TH-9: Develop integrated human and robotic systems with inter-relationships that enable maximum science return from the lunar surface and from lunar orbit.**

This will be developed with partner specialists, companies, agencies, and institutions.

TH10

☐ **TH-10: Develop integrated human and robotic systems with inter-relationships that enable maximum science return from the Mars surface and from Mars orbit.**

This will be developed with partner specialists, companies, agencies, and institutions.

TH11

☐ **TH-11: Develop systems capable of returning large cargo mass from the lunar surface to the Earth, including the capabilities necessary to meet scientific sample return objectives.**

TSI's space transportation systems infrastructure enables virtually unlimited transportation of humans and cargo to and from the Moon, this includes scientific missions and sample returns.

TH12

☐ **TH-12: Develop systems capable of returning large cargo mass from the Martian surface to the Earth, including the capabilities necessary to meet scientific sample return objectives.**

See our answer to TH4-TH7.

Lunar and Mars Infrastructure

Lunar Infrastructure (LI) Goal: **Create Global Lunar Utilization infrastructure where U.S. industry and international partners can maintain continuous robotic and human presence on the lunar surface for a robust lunar economy without NASA as the sole user, while accomplishing Mars testing and science objectives.**

LI1

☐ **LI-1: Develop an incremental lunar power grid that is evolvable to support continuous human/robotic operation and is capable of scaling to global power utilization and industrial power levels.**

The Lunar TOPSS and the Titania Lunar Colony allows the most efficient ways and locations to build large-scale power grids (ranging from solar to nuclear).

TSI emphasizes and focuses on large-scale commercialization of the Moon. We are less interested in asteroid mining than Moon mining, and we will empower scientific research by partners, without getting involved in it ourselves too much. *Also, see our answers to TH2 and TH3.*

LI2

☐ **LI-2: Develop Lunar surface, orbital, & Lunar to Earth communications, position, navigation and timing architecture capable of scaling to support long term science, exploration, and industrial needs.**

This will be developed with partner specialists, companies, agencies, and institutions.

LI3

☐ **LI-3: Demonstrate autonomous construction, precision landing, surface transportation, industrial scale ISRU and Advanced Manufacturing capabilities in support of future continuous human lunar presence and a robust lunar economy.**

The entire TSI philosophy is developed around this premise. We share the vision of pioneers like Dr. Gerard O'Neill that industrializing space will benefit humanity on- and off-planet. We believe that commercializing the Moon's assets can benefit Earth and all its living creatures.

LI4

☐ **LI-4: Demonstrate technologies supporting cislunar orbital/surface depots, construction and manufacturing maximizing the use of in-situ materials, and support systems needed for continuous human/robotic presence.**

The activities at Titania Lunar Colony will include these technologies. We will partner with industry and institutions to research and develop these possibilities.

Also, see our answer to L13, above.

Mars Infrastructure (MI) Goal: **Create essential infrastructure to support initial human Mars demonstration.**

MI1

☐ **MI-1: Develop Mars Surface Power sufficient for the initial human Mars demonstration mission.**

TSI has no plans for a Martian surface habitat. This may change when/if so agreed with third parties.

MI2

☐ **MI-2: Develop Mars surface, orbital, & Mars to Earth communications to support the initial human Mars demonstration mission.**

See our answer to M1.

MI3

☐ **MI-3: Develop and demonstrate entry, descent, and landing (EDL) systems capable of delivering crew and large cargo to the Martian surface.**

The most efficient, quickest, and safest EDL system is the Space Station and Transporter combination, which we have developed for TSI's on Moon missions.

Operations

Operations Goal: **Conduct human missions on the surface and around the Moon followed by missions to Mars. Using a gradual build-up approach, these missions will demonstrate technologies and operations to live and work on a planetary surface other than Earth, with a safe return to Earth at the completion of the missions.**

OP1

- [ ] **OP-1: Conduct human research and technology demonstrations on the surface of the Earth, low Earth orbit platforms, cislunar platforms, and on the surface of the moon, to evaluate the effects of extended mission durations on system performance, reduce risk, and shorten the timeframe for system testing and readiness prior to the first human mission to Mars.**

We will work with third parties to achieve this.

OP-2

- [ ] **OP-2: Optimize operations, training and interaction between crew, the support team on Earth, orbital support and a Martian surface team considering communication delays, autonomy level, and time required for an early return to the Earth.**

We will work with third parties to achieve this.

OP3

- [ ] **OP-3: Characterize accessible lunar resources, gather scientific research data, and analyze potential reserves to satisfy science and technology objectives and enable ISRU on successive missions.**

We will work with third parties to achieve this.

OP4

☐ **OP-4: Establish command, control and coordination and processes that will support expanding human missions at the Moon and Mars.**

We will work with third parties to achieve this.

OP5

☐ **OP-5: Operate surface mobility systems using extra-vehicular activity (EVA), suits, tools and vehicles.**

We will work with third parties to achieve this.

OP6

☐ **OP-6: Evaluate, understand, and mitigate the impacts on crew health and performance of a long deep space orbital mission, followed by partial gravity surface operations on the Moon.**

We will work with third parties to achieve this.

OP7

☐ **OP-7: Validate readiness of systems and operations to support crew health and performance on the first human mission to Mars.**

We will work with third parties to achieve this.

OP8

☐ **OP-8: Demonstrate the capability to find, service, upgrade, or utilize instruments and equipment from robotic landers or previous human missions on the surface of the Moon and Mars.**

We will work with third parties to achieve this.

OP9

☐ **OP-9: Demonstrate the capability of integrated robotic systems to support and augment the work of crew members on the lunar surface, and in orbit around the Moon.**

See our answers TH2-TH7.

We will work with third parties to achieve this.

OP10

☐ **OP-10: Demonstrate the capability to remotely operate robotic systems that are used to support crew members on the Lunar or Martian surface, from the Earth or from orbiting platforms.**

See our answers TH2-TH7.

We will work with third parties to achieve this.

OP11

☐ **OP-11: Demonstrate the capability to use commodities produced from planetary surface or in-space resources to reduce the mass required to be transported from Earth.**

Please see our answers above.

Science

Exploration Science (ES) Goal: **Conduct science on the Moon and in cislunar space, using integrated human and robotic methods and advanced techniques, to address high priority U.S. scientific questions about the Moon and to**

demonstrate methods for future science by astronauts beyond the Earth-Moon system.

ES1

☐ **ES-1: Conduct human field geology on the surface and select high priority sample specimens for return to Earth.**

While TSI isn’t involved in the scientific realm, we will empower third parties to achieve this.

ES2

☐ **ES-2: Demonstrate advanced techniques and tools to enable Earth-based scientists to remotely guide astronaut surface activities.**

While TSI isn’t involved in the scientific realm, we will empower third parties to achieve this.

ES3

☐ **ES-3: Enable in-situ research by delivering science instruments to the lunar surface at various locations and returning high priority samples to Earth.**

While TSI isn’t involved in the scientific realm, we will empower third parties to achieve this.

ES4

☐ **ES-4: Survey sites, conduct in-situ measurements, and identify/stockpile samples for later astronaut evaluation or retrieval.**

While TSI isn’t involved in the scientific realm, we will empower third parties to achieve this.

ES5

☐ **ES-5: Demonstrate retrieval of frozen volatile deep core samples from permanently shadowed regions on the Moon.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

ES6

☐ **ES-6: Establish methods and systems to allow a large number of science instruments to conduct planetwide long-term measurements.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

ES7

☐ **ES-7: Establish a scientific laboratory at the lunar South Pole to conduct high value lunar surface science.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

ES8

☐ **ES-8: Utilize Mars Sample Return (MSR) mission results to optimize human-led science sampling campaigns on Mars, sample return to Earth and characterize landing sites.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

Lunar/Planetary Science (LPS) Goal: **Address those high priority planetary science questions which are best accomplished by on-site human explorers on the Moon and Mars, aided by robotic systems.**

LPS-1

☐ **LPS-1: Conduct studies of planetary processes (e.g., impact, volcanism, tectonism, regolith formation, and atmosphere dynamics) to understand the dynamics and chronology of planet evolution.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

LPS-2

☐ **LPS-2: Collect fundamental data to understand the origin, distribution, abundance, composition, transport, and sequestration of volatiles throughout the solar system.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

LPS-3

☐ **LPS-3: Conduct analyses to constrain the chronology and dynamics of early Solar System history, including planetary differentiation, early bombardment history, and the formation of the Earth-Moon system.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

LPS4

☐ **LPS-4: Collect samples over a long traverse/duration in the South Pole Aitken Basin and deliver the samples to astronauts for return to Earth.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

Heliophysics Science (HS) Goal: **Address those high priority heliophysics science and space weather questions which are best**

accomplished using a combination of human explorers and robotic systems on the Moon and in cislunar space.

HS1

☐ **HS-1: Understand space weather phenomena to enable improved prediction of the dynamic space environment for deep space exploration.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

HS2

☐ **HS-2: Remotely observe the Sun and Geospace and conduct in-situ measurements in the deep magnetotail and pristine solar wind, to understand the dynamics of the connected Sun-Earth system.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

HS3

☐ **HS-3: Discover and characterize fundamental plasma processes including dust-plasma interactions, using the cis-lunar environment as a laboratory.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

Biological and Physics Science (BPS) Goal: **Understand fundamental biological effects when organisms are present in fractional-gravity and deep-space environments, to gain new scientific understanding and information to guide system development.**

BPS1

☐ **BPS-1: Understand the fundamental biological effects of short and long duration exposure to the lunar environment on human physiology and disease.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

BPS2

☐ **BPS-2: Understand the fundamental biological effects of short and long duration exposure to the lunar environment on plants used to provide crew nutrition/behavioral health.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

BPS3

☐ **BPS-3: Understand the fundamental biological effects of short and long duration exposure to the lunar environment on the survival and adaptation of microbes associated with the crew, plants, and the built environment.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

BPS4

☐ **BPS-4: Understand transient or permanent physiological changes on several generations of organisms.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.

Astrophysics Science (AS) Goal: **Preserve the far side of the Moon as a "radio-free zone" for future radio astronomy experiments.**

AS1

☐ **AS-1: Monitor the radiofrequency environment on the lunar far side to enable future far side radioastronomy activities.**

While TSI isn't involved in the scientific realm, we will empower third parties to achieve this.