Terrapin Infrastructure for Lunar Evolution (TILE)

Sustained Lunar Evolution Team

Competition

2024 NASA Revolutionary Aerospace Systems Concepts Academic Linkage (RASC-AL)

Opportunity

In the upcoming decades space will shift towards accessible and commercial private and public industry. The scientific and commercial markets on the Moon presents a lucrative opportunity to provide essential services tailored to the needs of lunar missions of all types.

The lunar market is expected to surpass $150 billion by 2040 and will be focused on three key areas:
- Transportation of humans and resources between Earth and the Moon
- Exploratory data collection on the Moon
- Resource extraction from the Moon

Goals

A service architecture has been designed, engineered, and budgeted to sustainably support this growth. The TILE infrastructure will address:
- Transportation (people and cargo)
- Scientific data retrieval
- Food supply
- Power supply
- Propellant and Metal In-Situ Resource Utilization
- Emergency evacuation needs

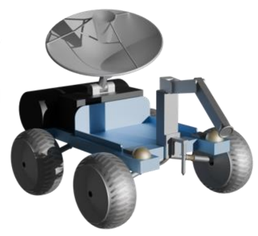
Design

Pressurized Crew Rover
- For crewed excursions around the habitat
- Holds up to 4 crew (2 suit ports)
- Airlock to link with TILE habitat
- Powered using PEMFC, PV array, and batteries

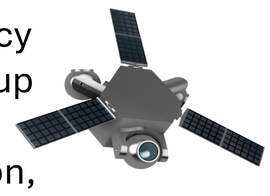
Rapid Arc Ballistic Inter-base Transport (RABIT)

- A crew unpressurized suborbital vehicle
- Reaches anywhere on lunar surface within 150 km in less than 10 minutes
- Medical Evacuation for 2 persons, 1000 kg Cargo Transport, Science and Cargo Rover Relocation
- ISRU LOX/LH2 Propellant

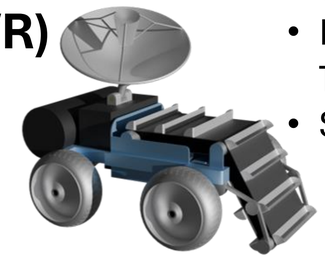
Research Oriented Fully-autonomous Lunar Rover (ROFL Rover)
- 3-DOF robotic arm, extendable drill, and 2 storage bays
- 3.7 kW-h rechargeable battery
- Rentable for 3rd party research

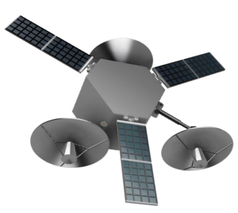


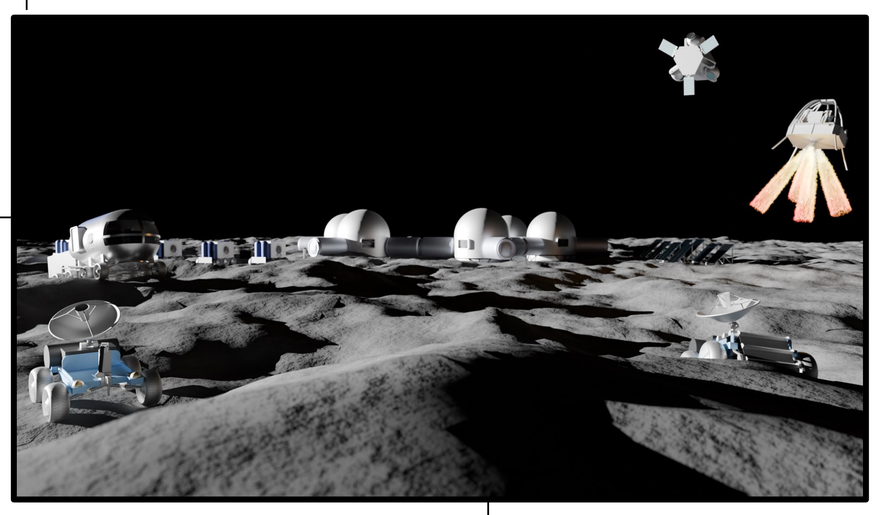
Optical Relay Communication Satellites (ORCS) Dishes, With Optical Relay Verification, And Navigation Satellite (DWORVAN)
- Uses LASERS to transmit data from Earth to Lunar Surface and back
- 200 Mb/s data at 1550 nm frequency
- K Band radio transceivers for backup communication
- Broadcast PNT (Position, Navigation, Timing) signals to provide lunar GPS service
- Slew rate less than 0.004 deg/sec



Regolith Acquisition and Wrangling Rover (RAWR)
- 150 kg max payload with an extraction rate of 0.5 kg/s
- Rentable for 3rd party mining operations

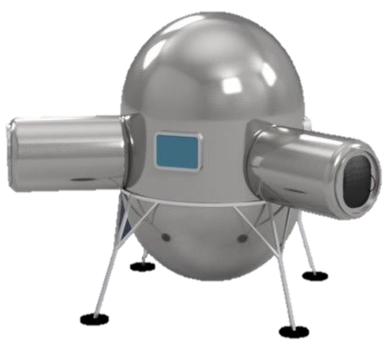






Cargo Rover
- 500 kg max payload with interior shelves and 1 m^3 OX and H_2O storage tanks
- For TILE use to transport
- goods
- Autonomous
- Towing capabilities

LunaHab & LunaFarm
- 5 aluminum crew habitats connected via airlocks and pressurized walkways
- Supports 4 crew on 1 year mission cycles
- Aeroponic tower farming produces 2500 kg food per 12 weeks, sold at a profit to Lunar customers



Business and Timeline

Phase 1
- **Satellites (ORCS& DWARVAN)**
- 2024-2027 DDT&E and production
- 2027 Launch of satellites into ELFO (Falcon 9)
- 2027 Start selling services

Phase 2
- **Rovers (ROFL & RAWR)**
- 2027-2030 DDT&E and production
- 2030 launch of rovers to lunar surface (Starship 1)
- 2030 start selling services

Phase 3
- 2030-3035 DDT&E and production
- 2033 launch Nuclear Reactor and ISRU (Starship 2)
- 2033 launch 3 cargo rovers and 1 habitat(Starship 3)
- 2034 launch 3 cargo rovers and 1 habitat (Starship 4)
- 2034 launch crew rover, 1 habitat, power grid (Starship 5)
- 2035 launch 1 habitat, 1 RABIT, remainder of ISRU mass (Starship 6)
- 2035 launch 1 habitat, solar panels (Starship 7)
- 2035 launch blue moon lander (Starship 8)
- 2035 crew launch to lunar surface for setup
- End of 2035 start selling all services

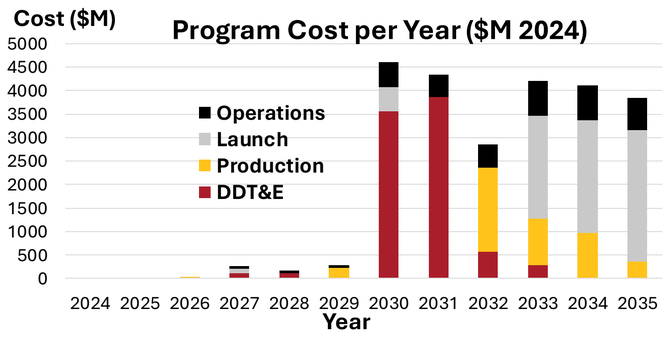
$24.4 billion

Budget ('24 - '35)

4 years

Est. time till break-even

Total Budget
- **DDT&E & Production: $ 13.4B**
- **Launch & Delivery: $ 6.9B**
- **Operations: $ 4.1B**
- **Total cost: $ 24.4B**



Lunar Site
- Lunar South Pole Region (>85° South)
- Surface base at Connecting Ridge
- Industrial Zone (Power plant, mining, factory) near Sverdrup Crater