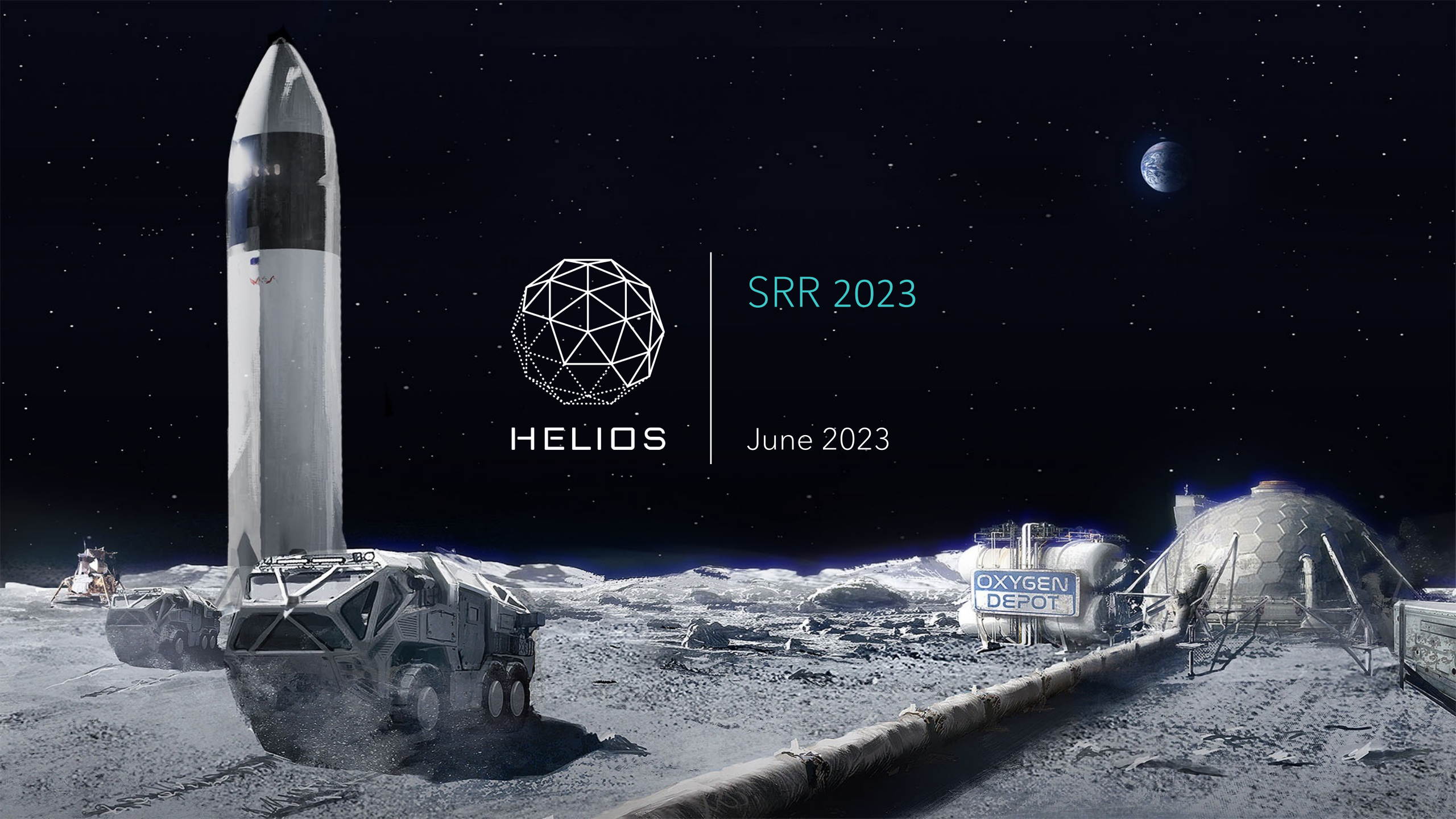




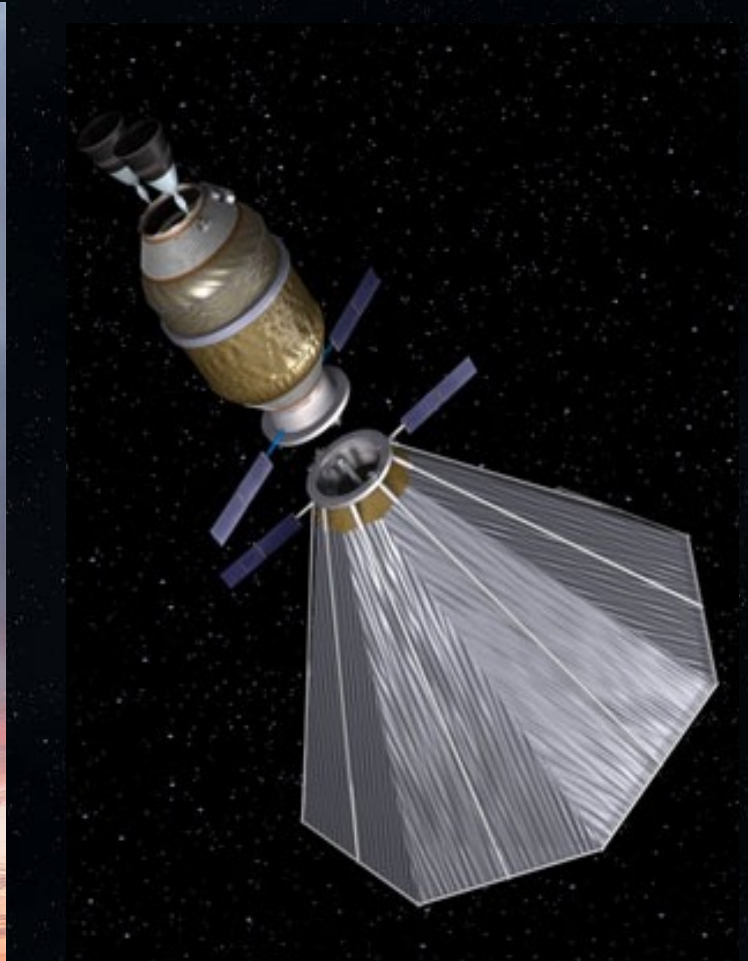
HELIOS

SRR 2023

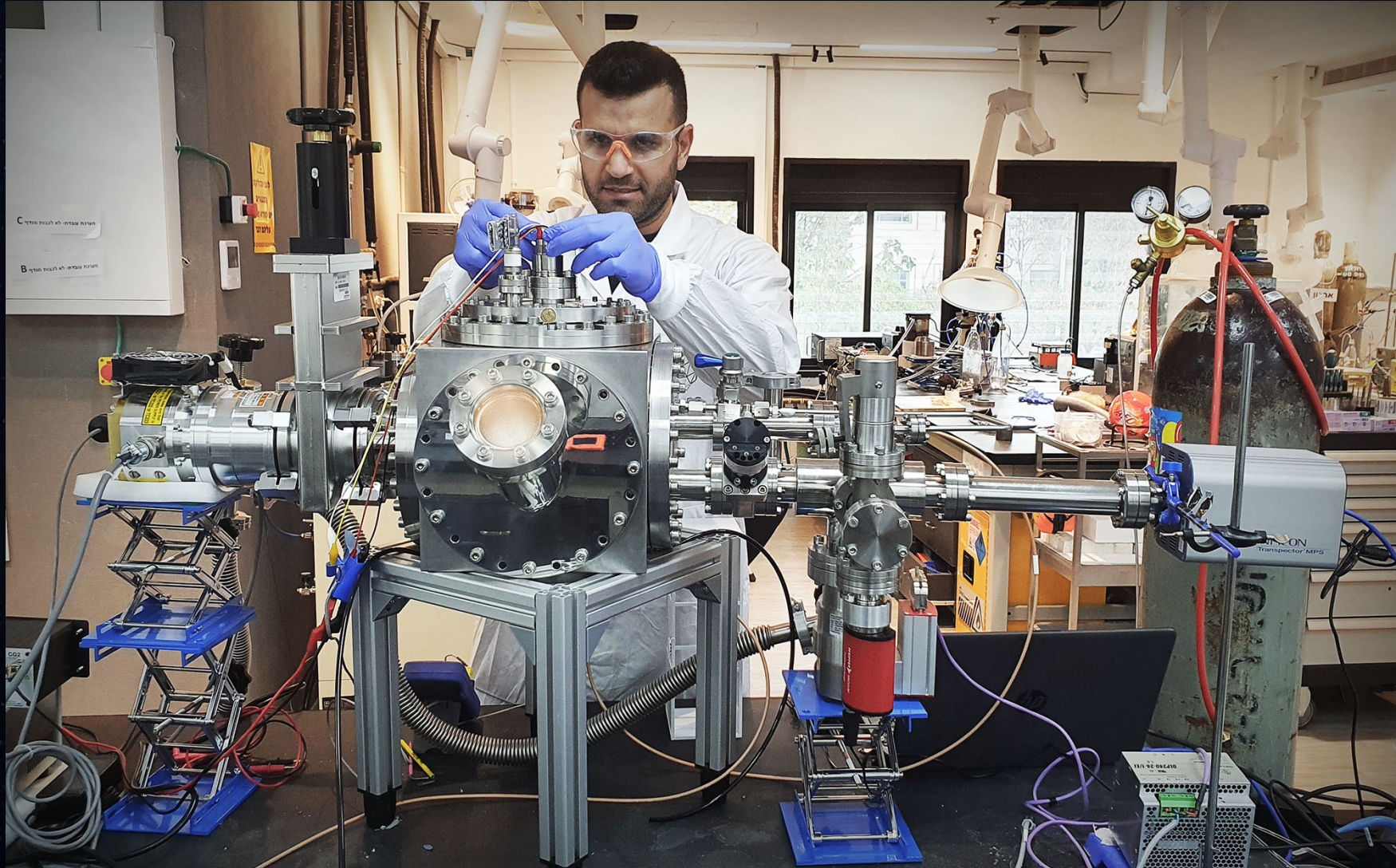
June 2023



SUBSTANTIALLY REDUCE CISLUNAR TRANSPORTATION COST



HELIOS TECHNOLOGY



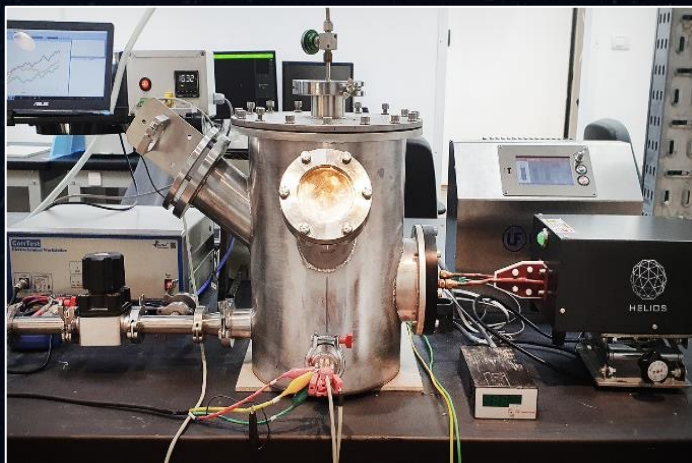
HELIOS ROADMAP TO LUNAR OXYGEN ON THE MOON



HELIOS
2028

On earth

TRL3 Batch 2022



Grams

TRL4 Semi-Continuous 2026



250 kg / month

TRL4 Continuous 2028



10 tons a month

On the moon

TRL5 Batch 2025



TRL6 Continuous 2029



TRL8 Continuous 2030s



HOW CAN A PRIVATE
SPACE COMPANY
FOLLOW THROUGH
AND FUND AN R&D
INTENSIVE GOAL A
DECADE AWAY?

HELIOS TERRESTRIAL GREEN STEEL

- 10% of all CO2 emissions on Earth come from the Steel industry.
- Helios iron production technology emits ZERO direct carbon emissions at lower costs.
- Market size of over 1.5 trillion USD.
- Corresponding with over 25% of the market
- pilot plants with major steelmakers.



PAVING THE WAY
TO SPACE WITH A
GREEN STEEL ROAD



SEARCHING FOR A
CURRENT USE CASE TO
WEAN OFF OUR
DEPENDENCY ON OUR
TERRESTRIAL APPLICATION

USE CASE - EDL LOX FOR STARLINK DEPLOYING STARSHIPS



POTENTIAL CAPTURABLE VALUE



42,000 Starlink Satellites

Starlink mass: 2 [tons]

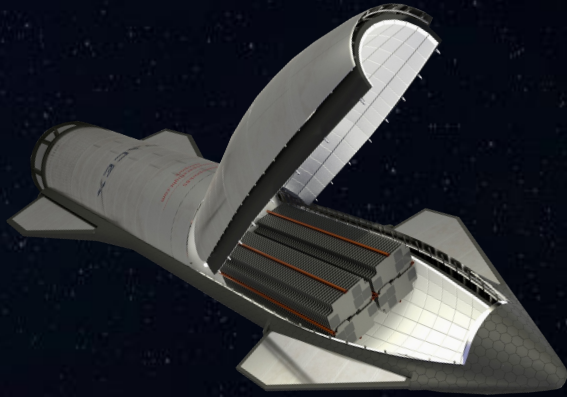
5 year deorbit regime



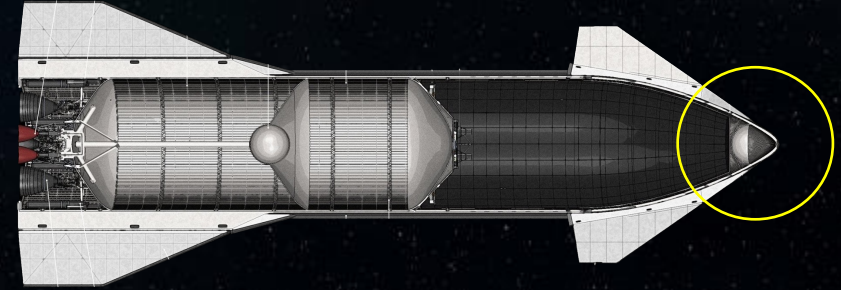
Mass to LEO per Annum:

16,800 [tons]

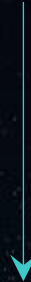
POTENTIAL CAPTURABLE VALUE



16,800
tons/Annum

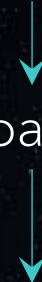


Starship Payload = 120 [tons]

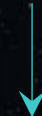


Starship flights = 140 per Annum

Starship EDL = 21 [tons]



Starship Payload = 141 [tons]



Starship flights = 119 per Annum

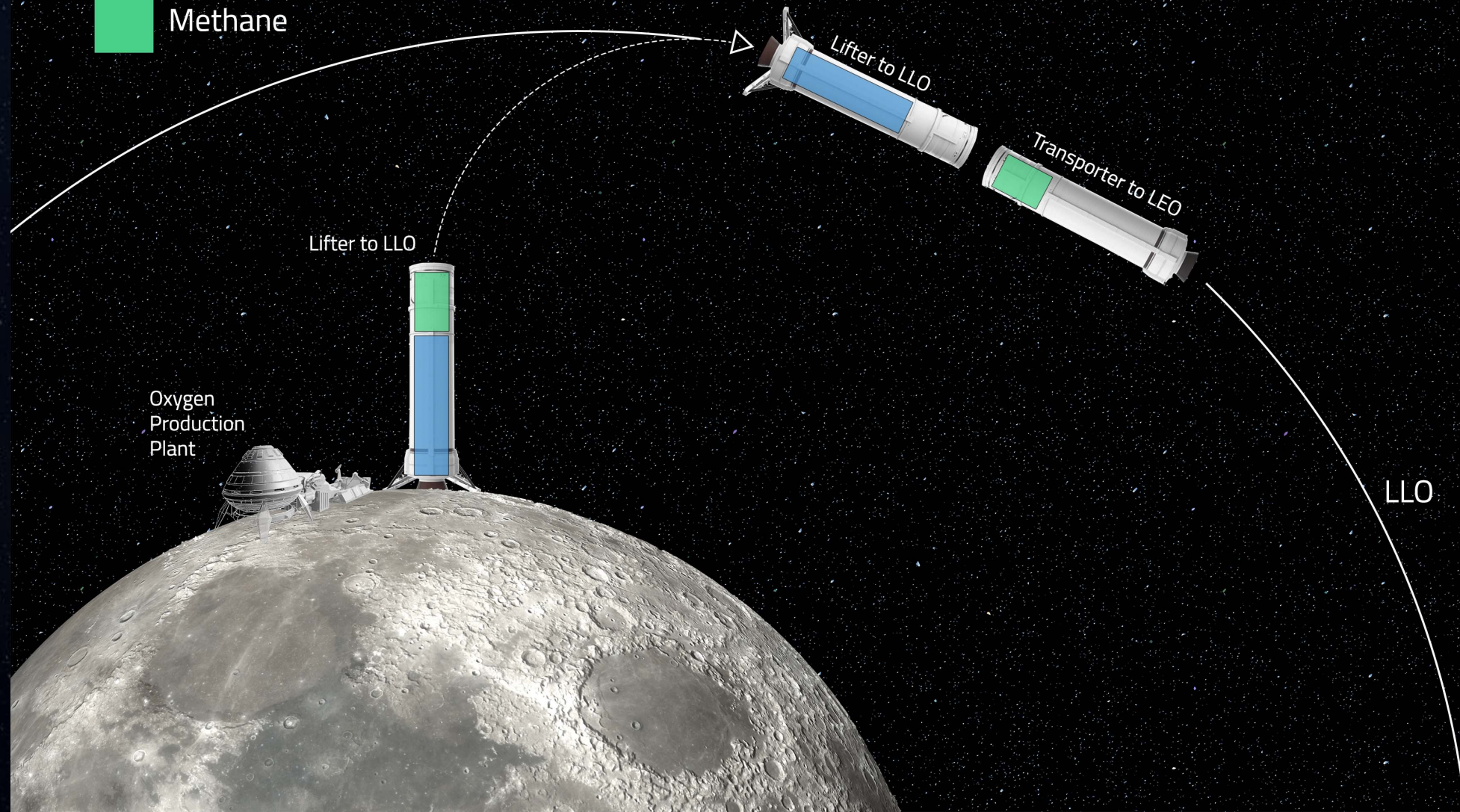
Potential Capturable Value: 21 Starship flights per annum!

BASIC ASSUMPTIONS

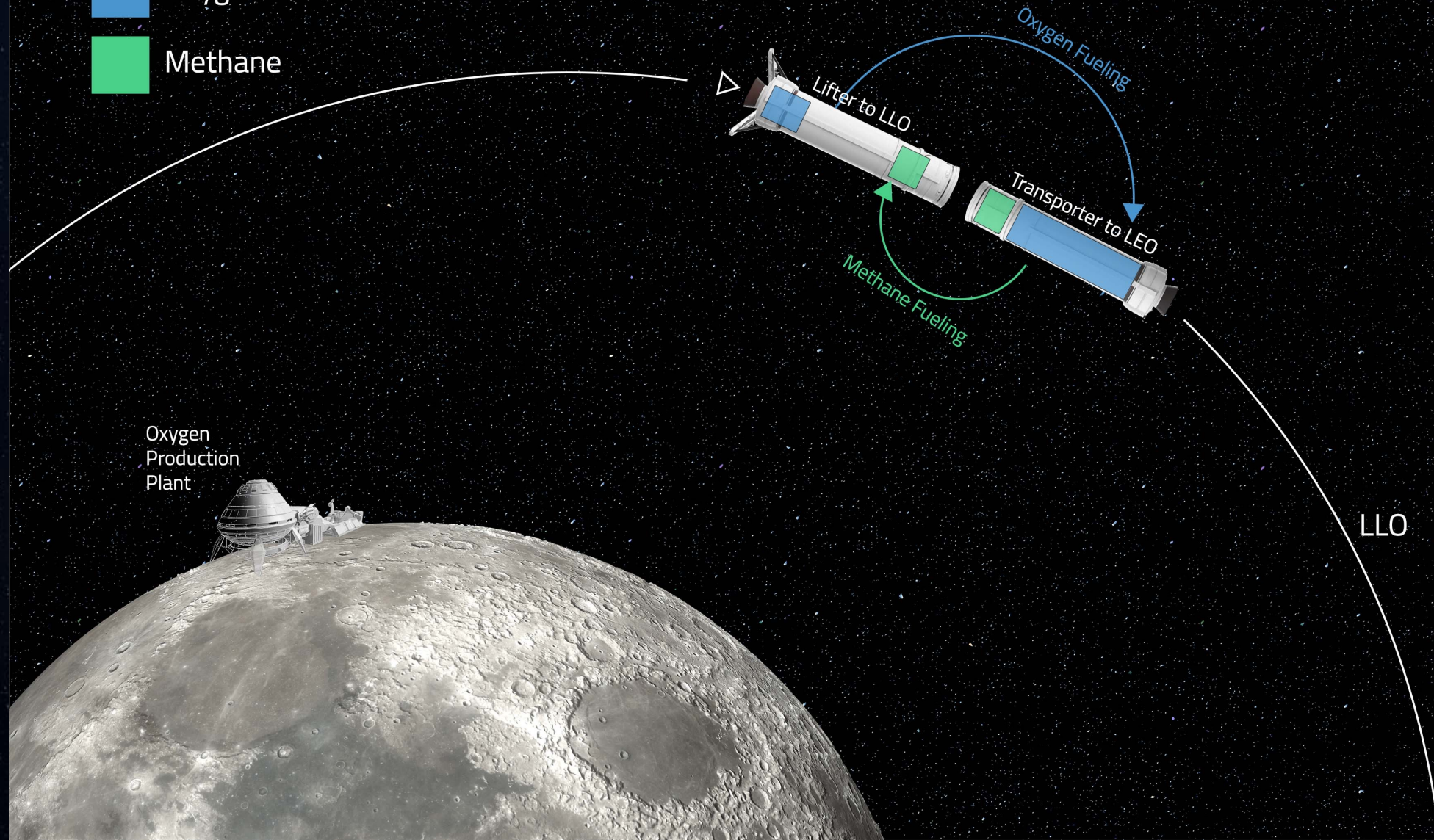
- Starship is fully operational
- Starlink has been fully deployed (42,000 satellites)
- LULOX production plant up and running on the moon
- Earth sourced methane
- LULOX is delivered to Cislunar space by tailor made Starships



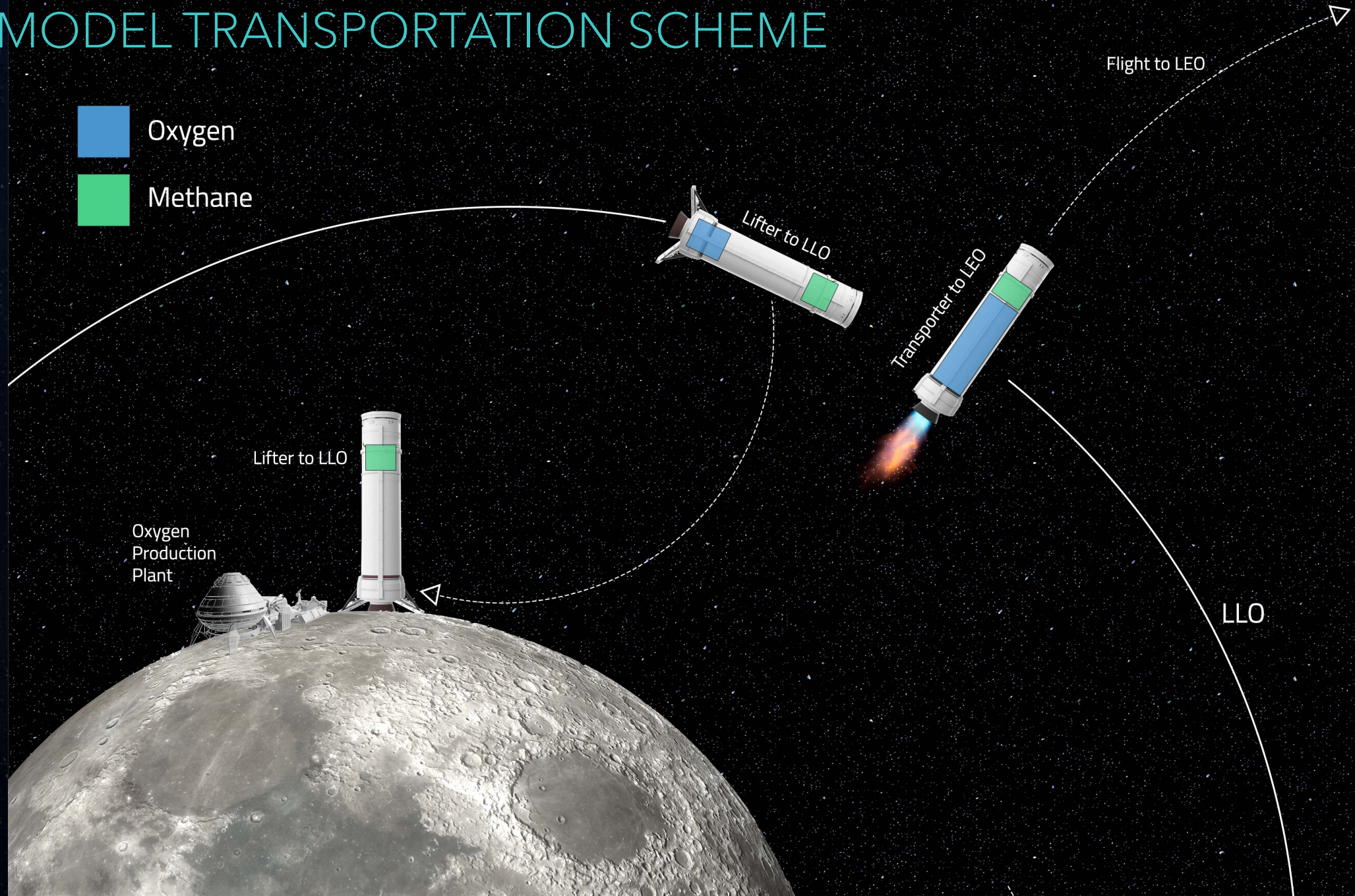
MODEL TRANSPORTATION SCHEME



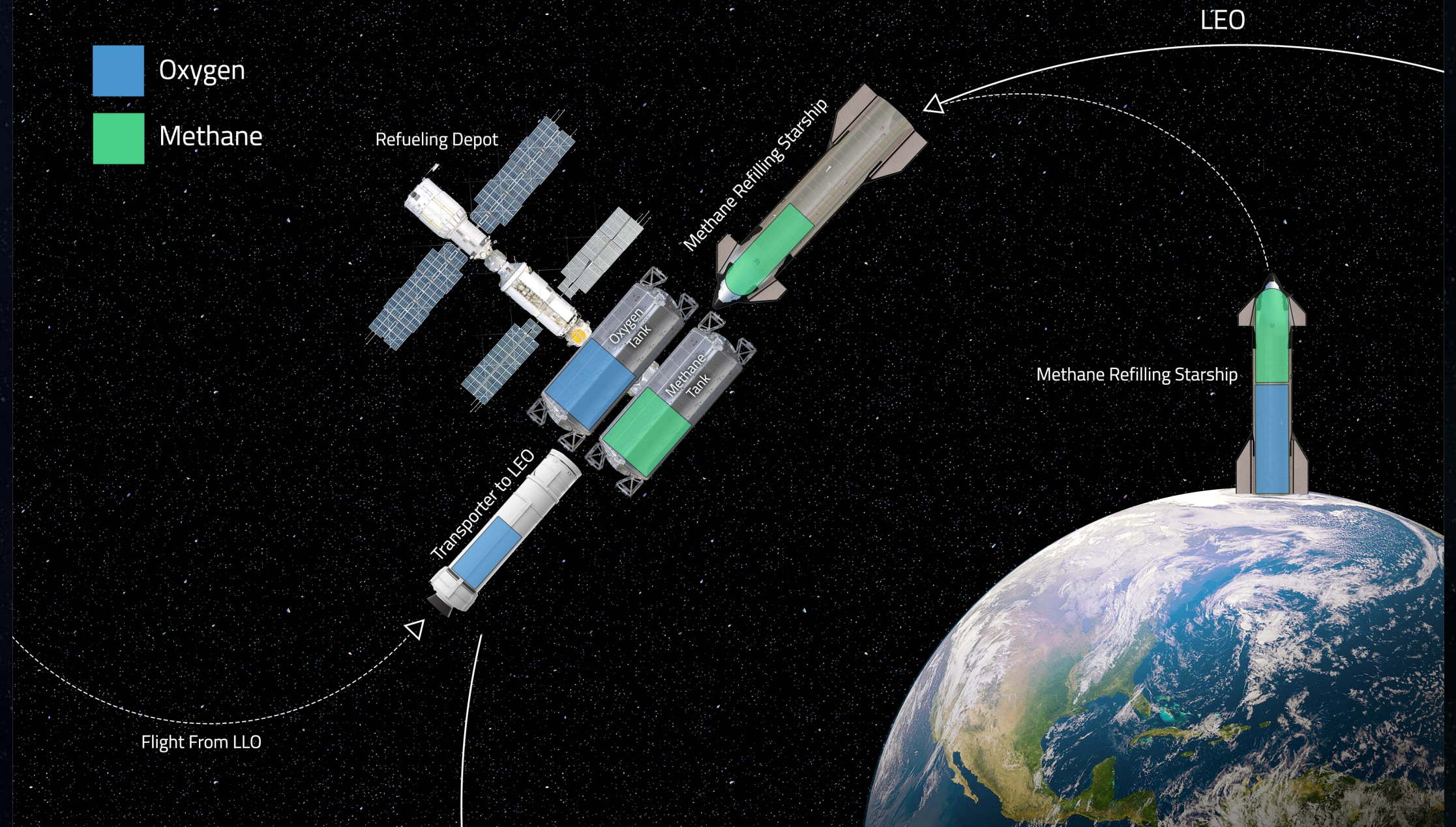
MODEL TRANSPORTATION SCHEME



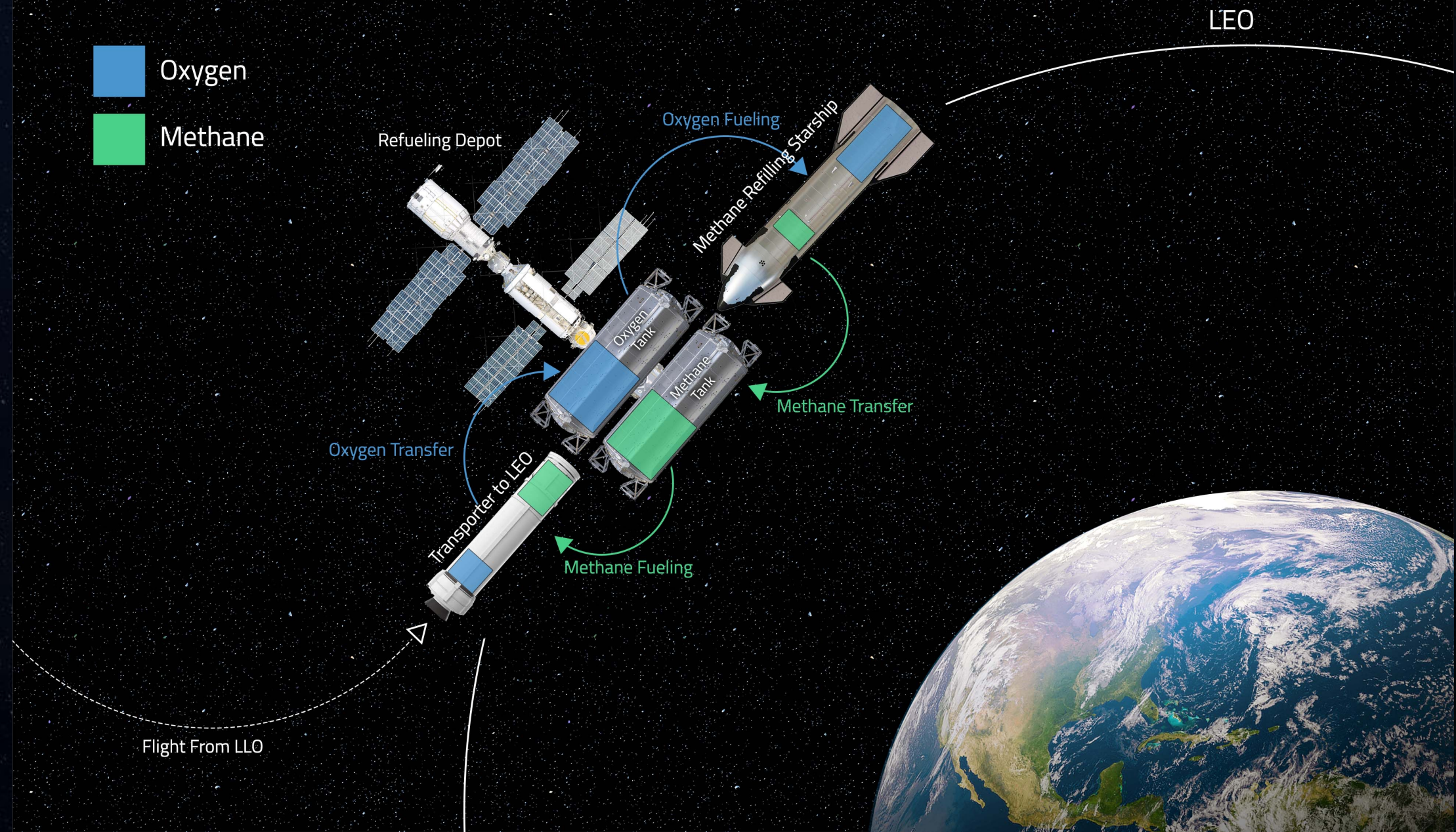
MODEL TRANSPORTATION SCHEME



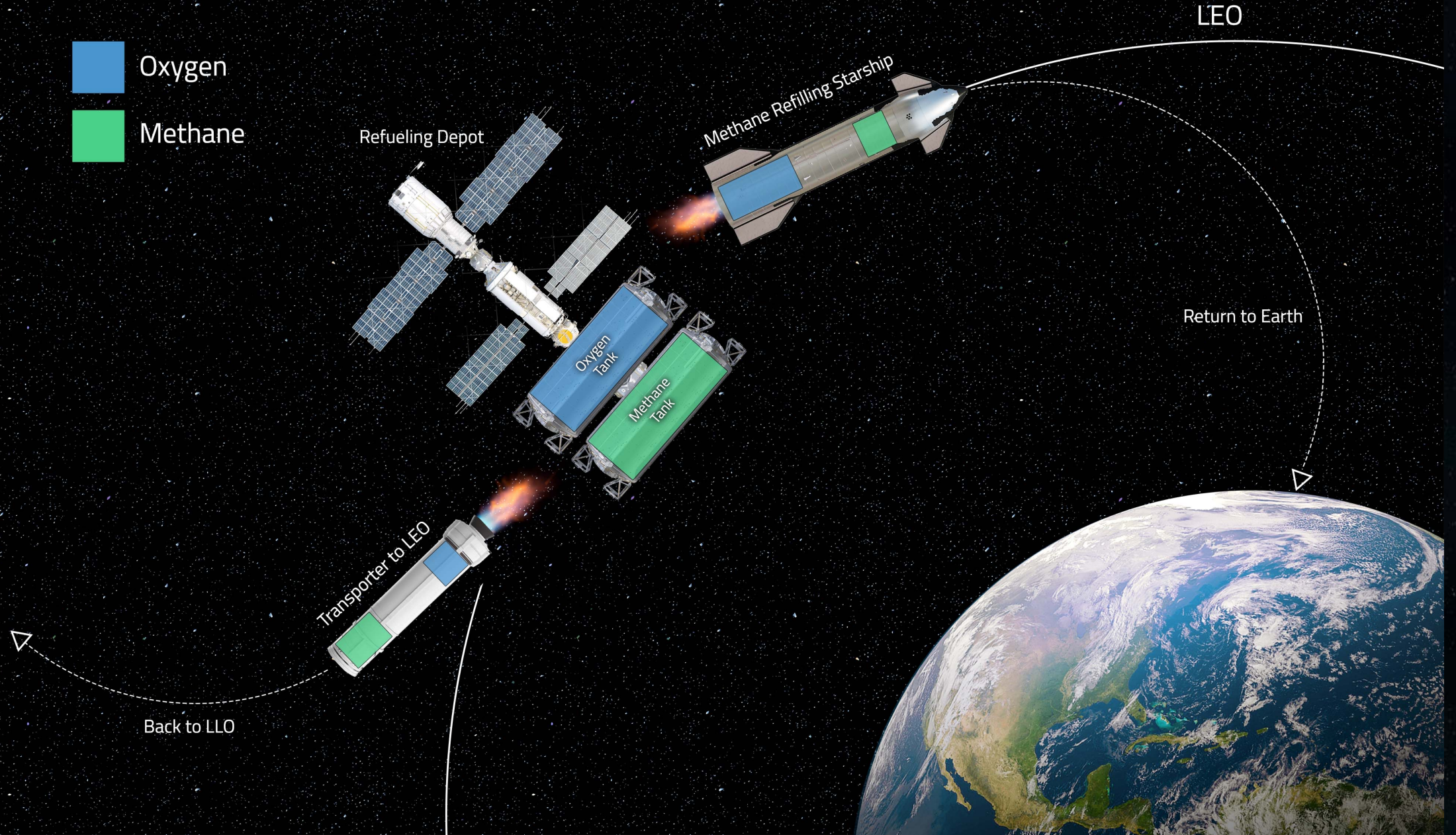
MODEL TRANSPORTATION SCHEME



MODEL TRANSPORTATION SCHEME



MODEL TRANSPORTATION SCHEME





TRANSPORTATION ORBITAL MECHANICS

We can achieve net positive mass deliveries to LEO from the Moon using terrestrial CH₄ and Lunar LOX

910 KM DEPOT



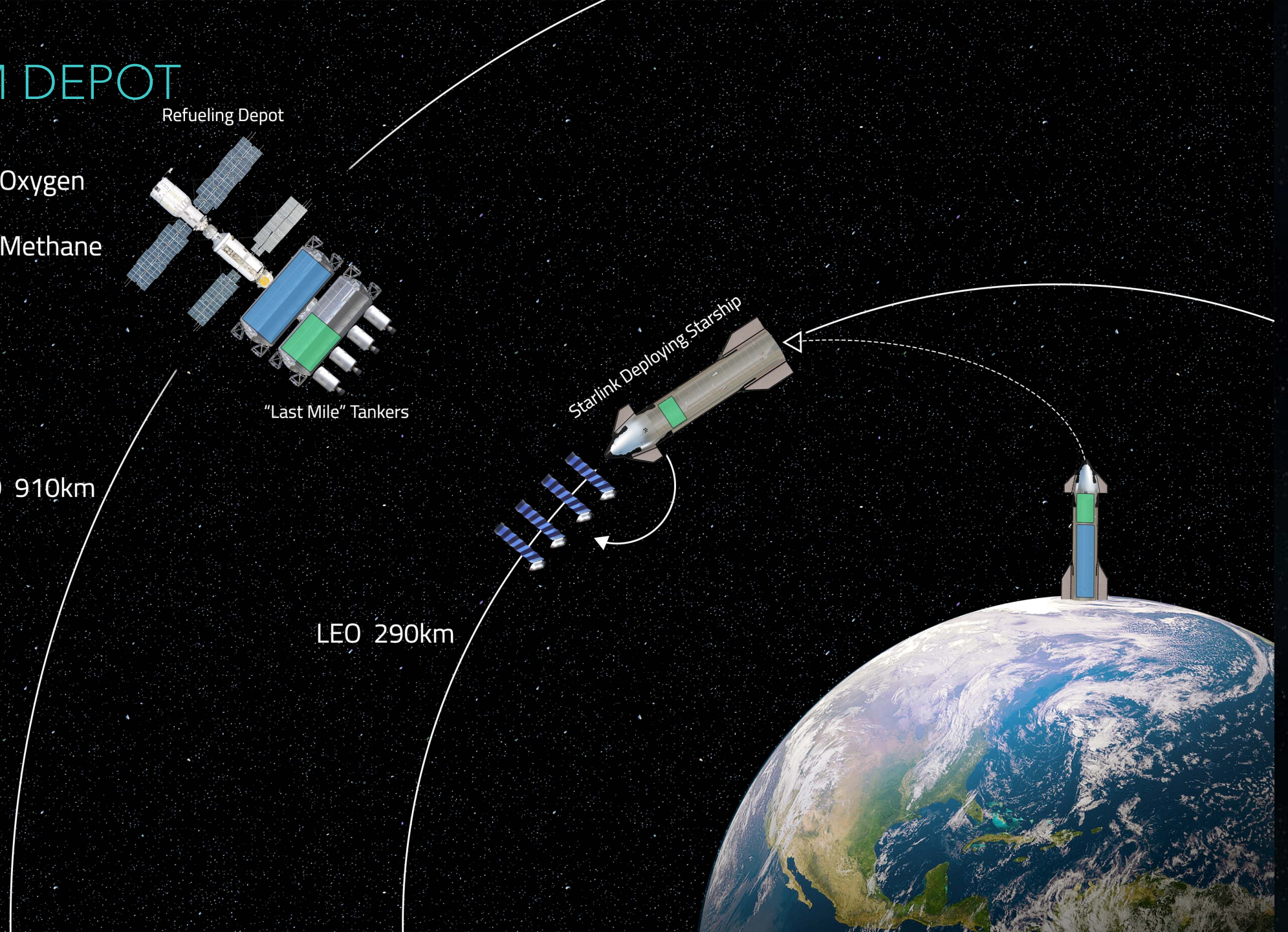
Refueling Depot

"Last Mile" Tankers

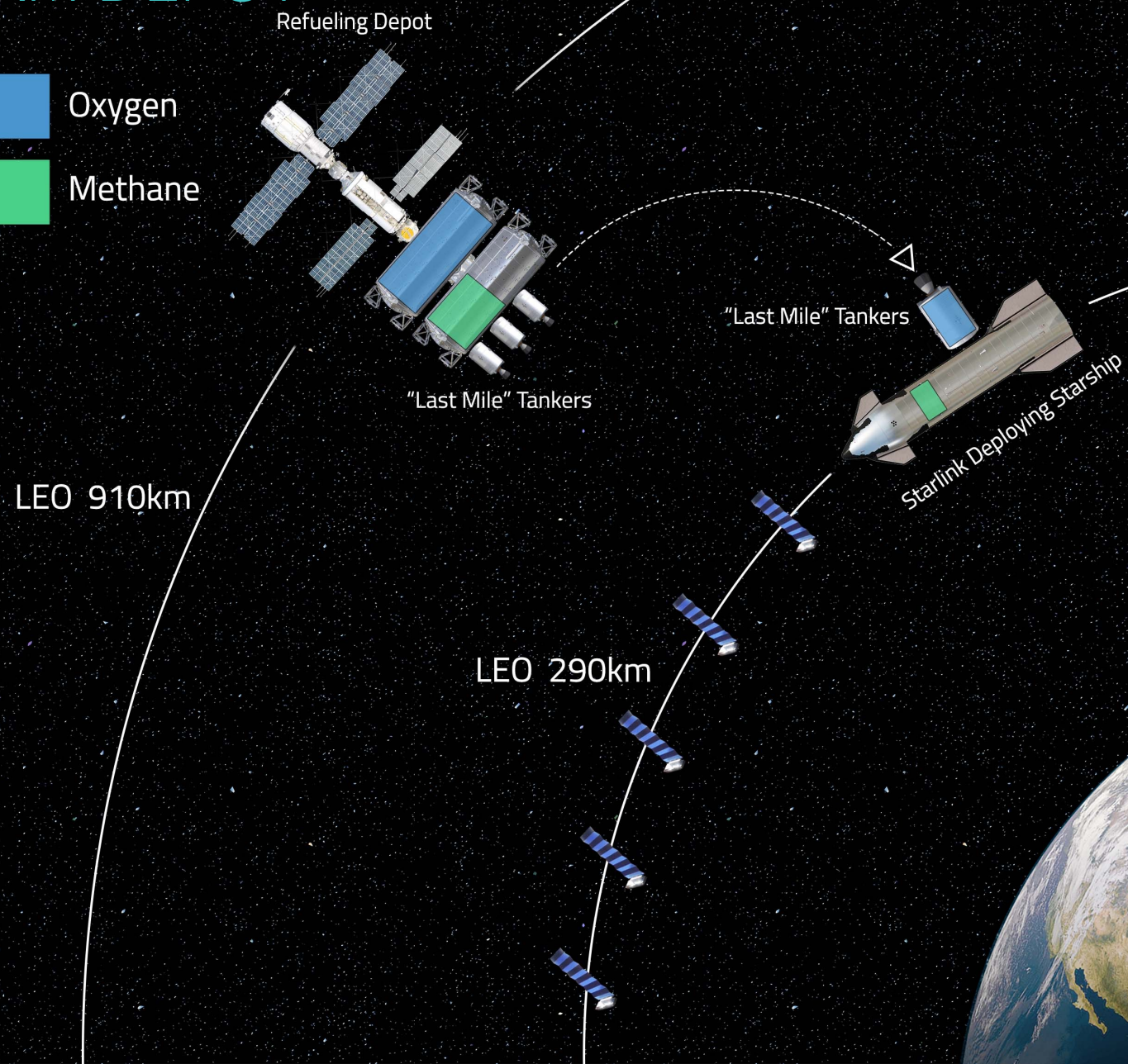
Starlink Deploying Starship

LEO 910km

LEO 290km

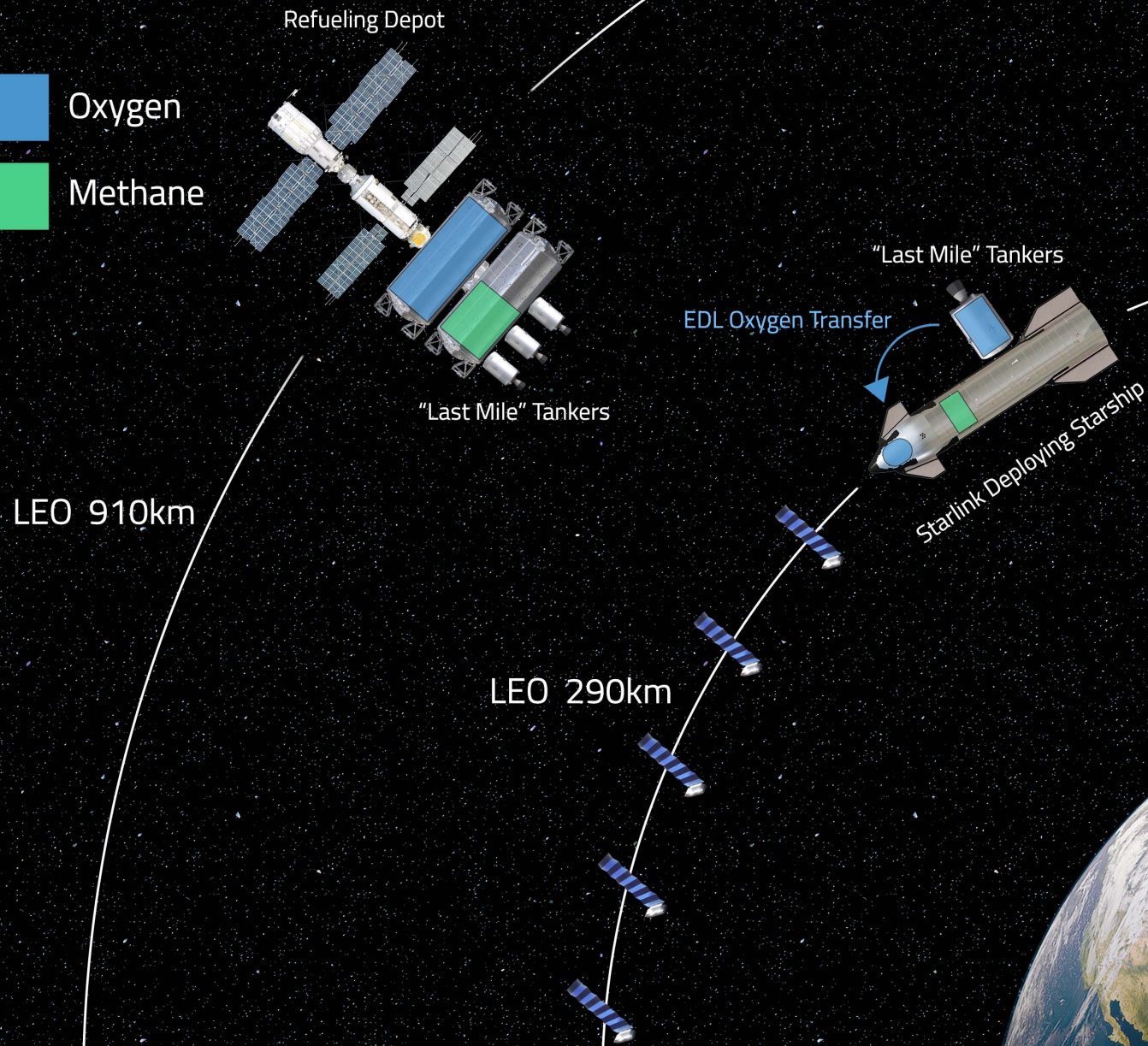


910 KM DEPOT



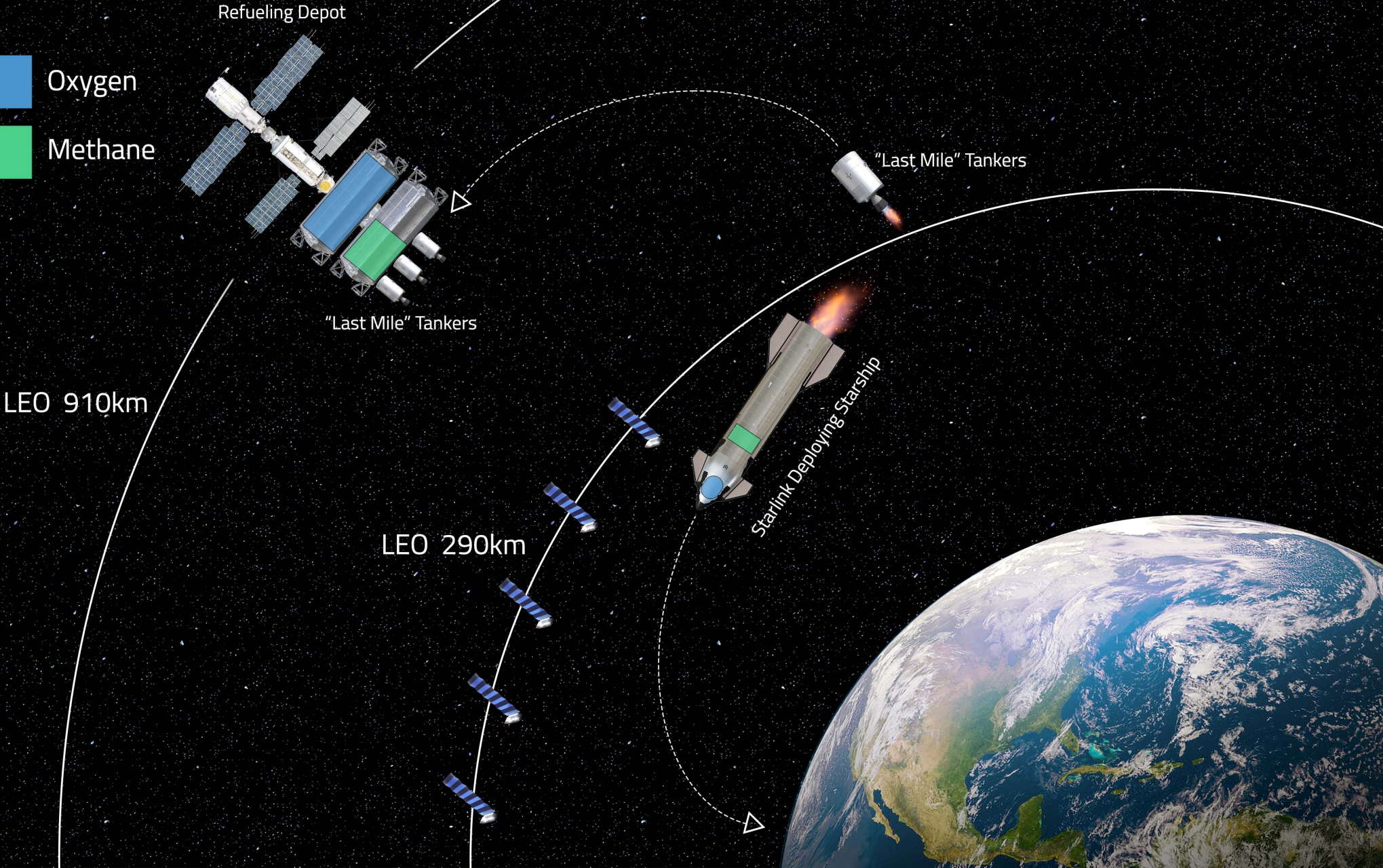
910 KM DEPOT

- Oxygen
- Methane



910 KM DEPOT

-  Oxygen
-  Methane



RESULTS

- Low Energy transfers forced in both direction (TEI, TLI).
- Cadence matches SpaceX's deployment schedule.

Delivery of **887** tons of LULOX at the following expenses:

707 tons of Earth sourced Methane

2,544 tons of LULOX burned in the process



RESULT ANALYSIS

887 LULOX / **707** Methane while burning **2,544** LULOX

Complex rendezvous operations

Undefined "last mile" tankers

Also...

The amount of oxygen delivered to the Depot is much more than the oxygen required

24 starships populate 1 shell, at a 20% replacement rate, we need EDL LOX for only 5 starships ($24 \times 20\%$)

Each Starship requires 21 tons of EDL LOX, so not more than **105** tons of LULOX is required (21×5)

887 [tons] is overkill..



PATHS TO IMPROVEMENT

Smaller transportation vehicle

Oxygen rich engines

Two stage transport - one per gravity well

High Orbit Depot (0.25GTO, 4GTO) + High
Depot to 910km Depot transporters

Syncing the new SS GTO market with SS
Starlink deployment EDL market

???

Input from the community
would be highly
appreciated!



PAVING THE WAY
TO SPACE WITH A
GREEN STEEL ROAD



AD ASTRA!

Alice Miller – VP Space, Helios

alice@project-helios.space

