PRELIMINARY COMMERCIAL MINING OF LUNAR SURFACE RESOURCES

SRR-PTMSS Conference

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Colorado School of Mines

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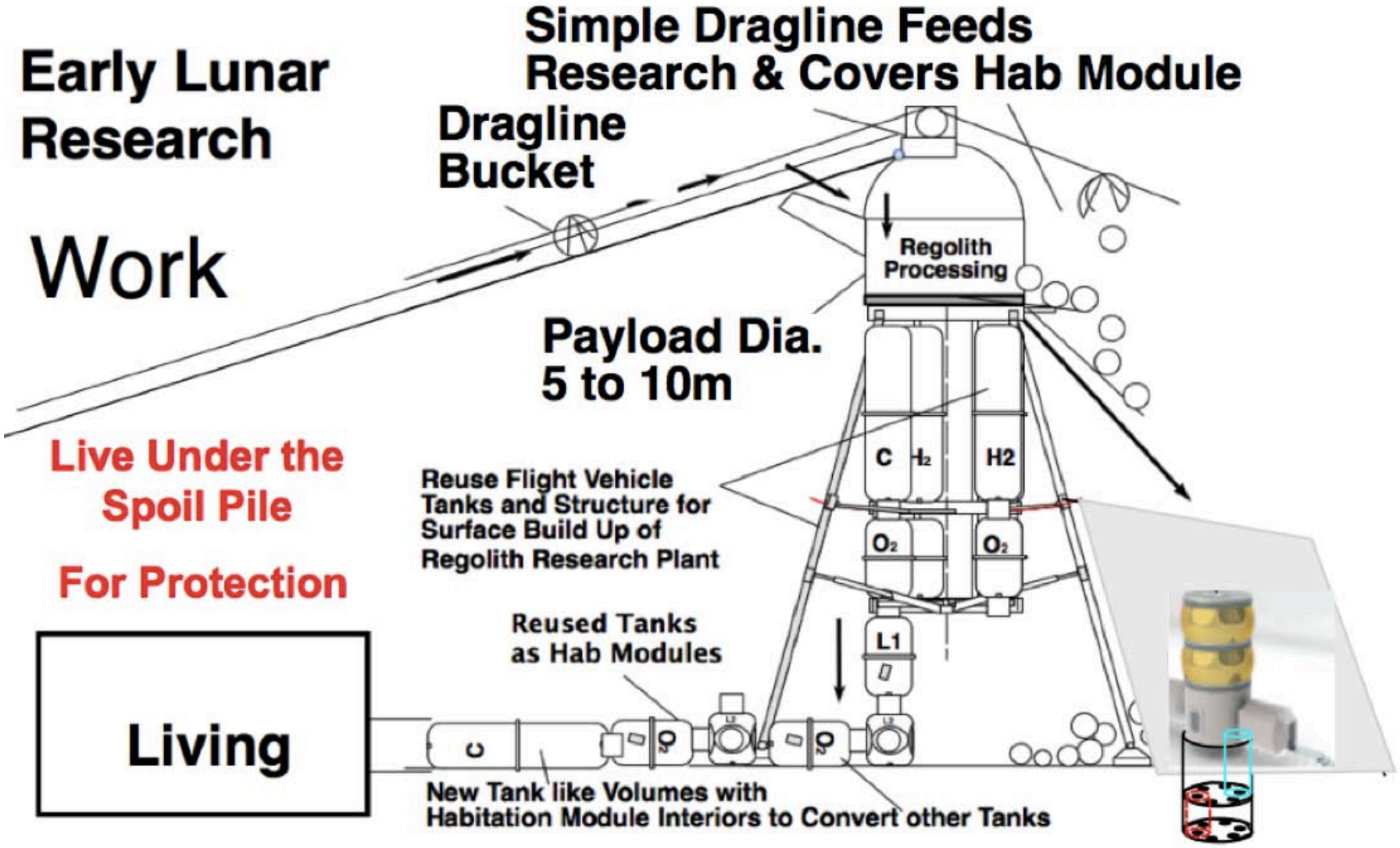
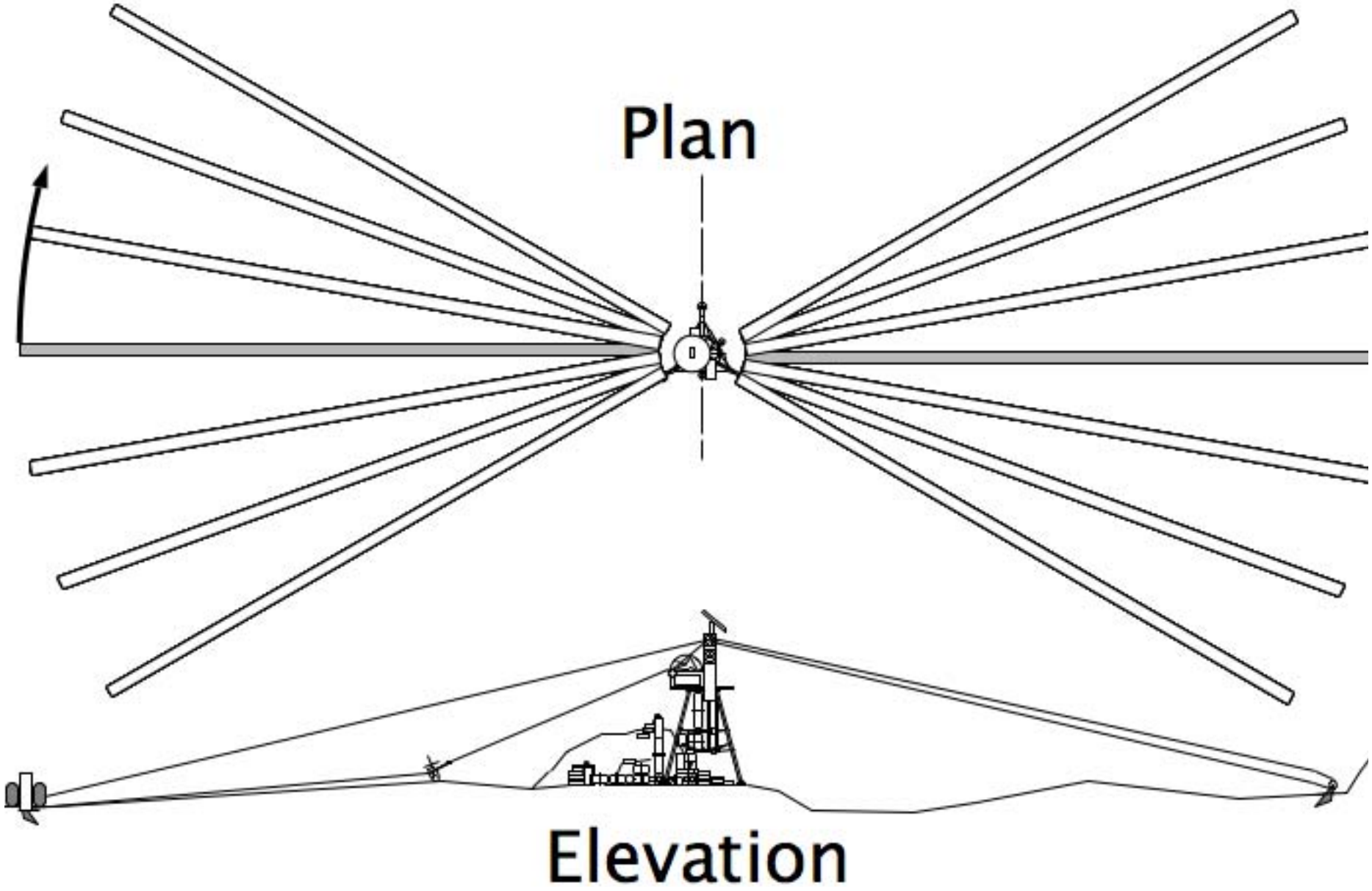
Introduction

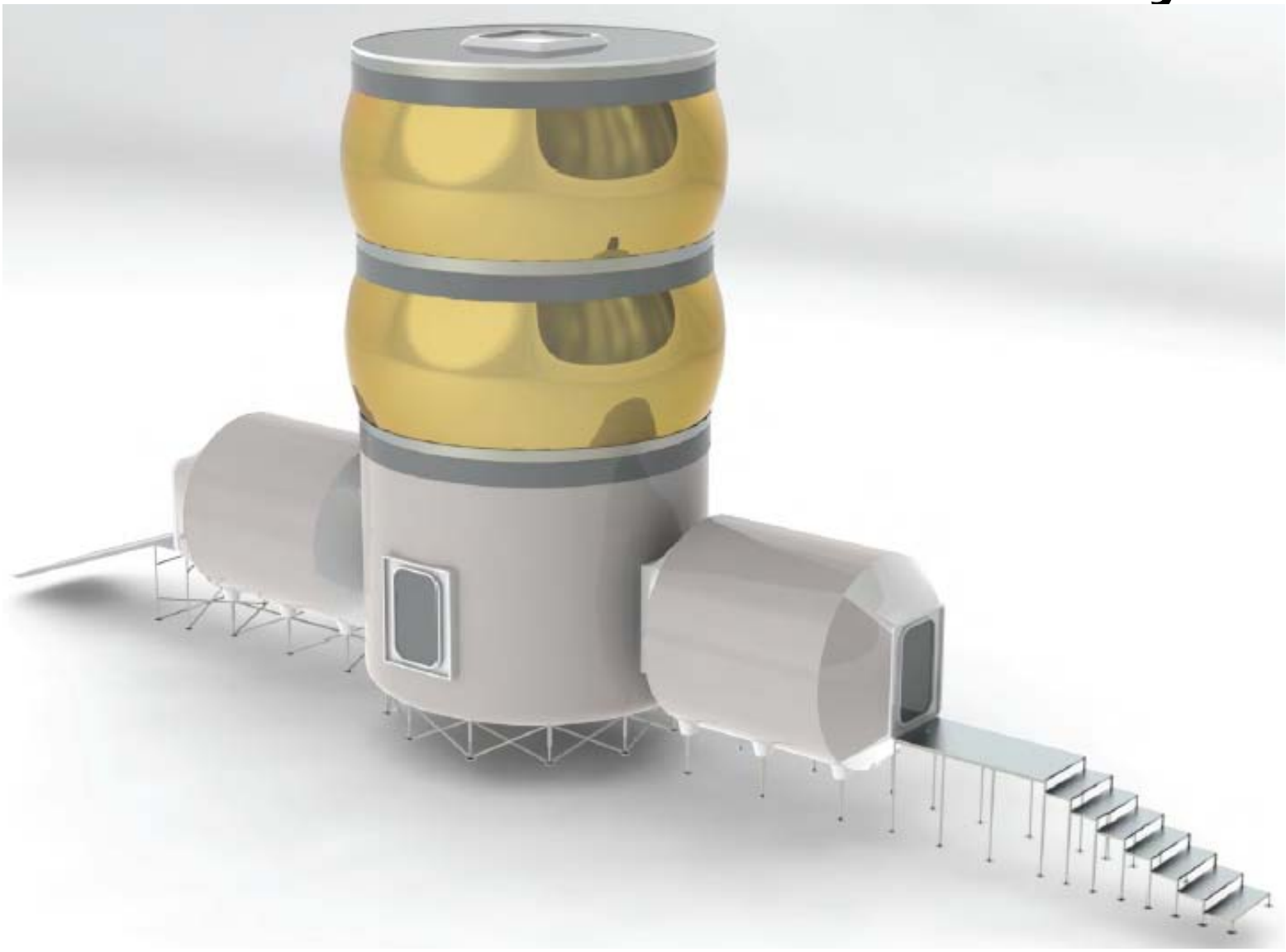
- LTS has Vehicle Concept & Commercial Business
- Raise Capital & Innovation to START Trade Route
- Entrepreneurs Explore Future Markets, Cut Costs & Increase Market Share, to make $ & More Effective
- After 45 years it is Time to Mine the MOON
- Helium3 is $6-15B/ton, Mined & a Trade Route
- Trade Routes Transport Value in both Directions
- Governments Stimulate other Industries, why not the space mining

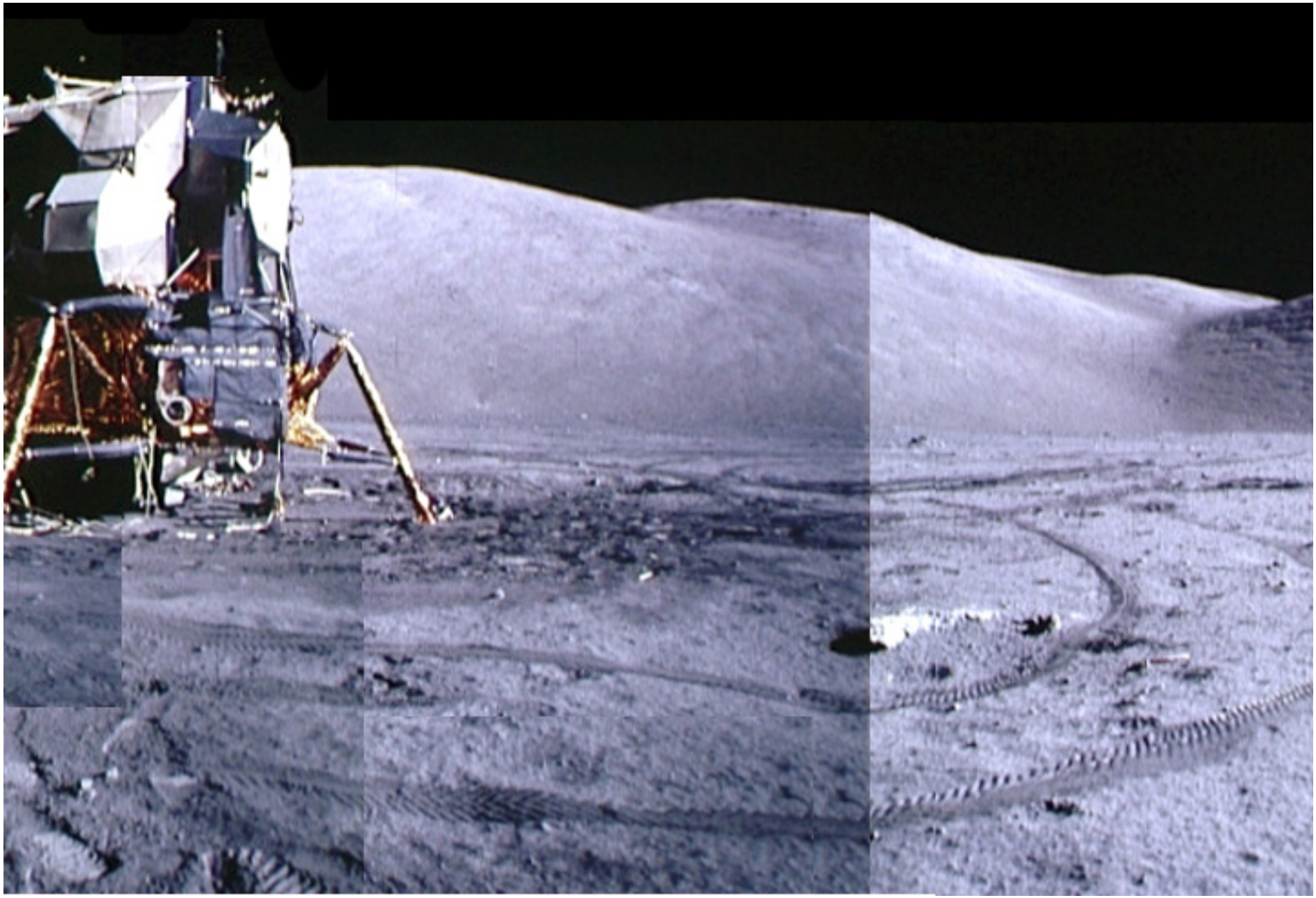
Add Habitat for Workers

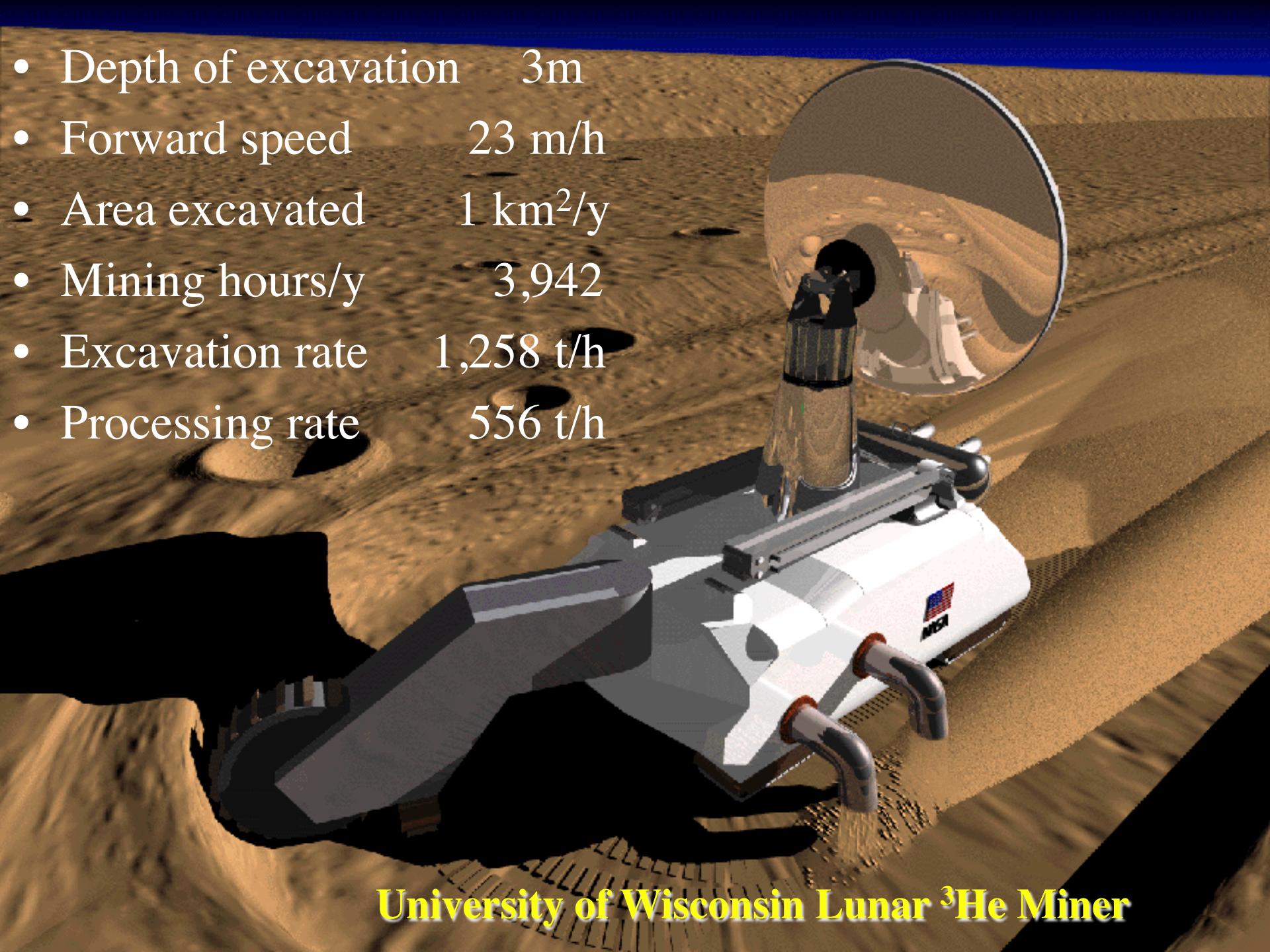



Plan
Elevation

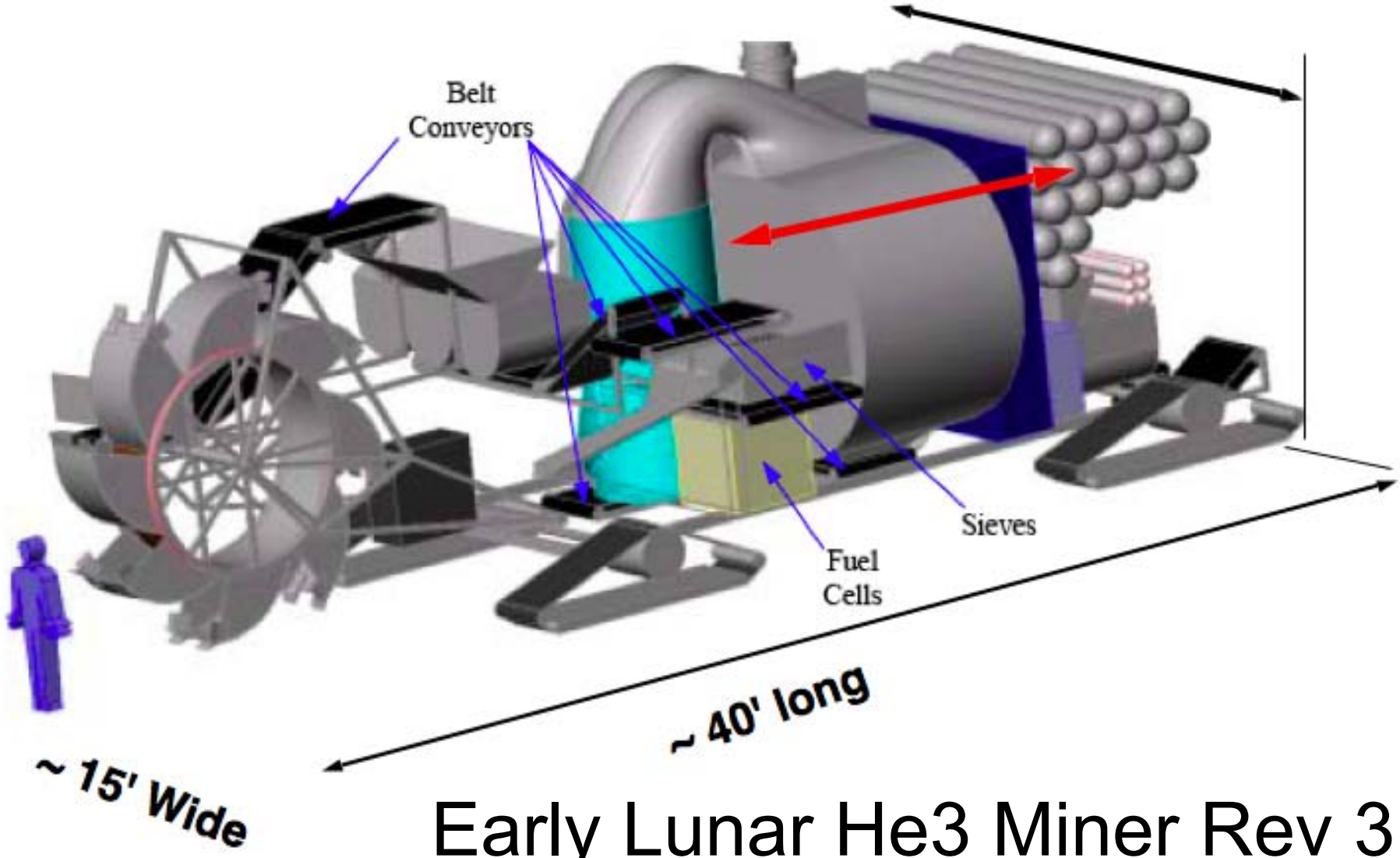
MFHE Lunar Hab - Early






• Depth of excavation 3m
• Forward speed 23 m/h
• Area excavated 1 km²/y
• Mining hours/y 3,942
• Excavation rate 1,258 t/h
• Processing rate 556 t/h
University of Wisconsin Lunar ³He Miner

University of Wisconsin - Madison



Early Lunar He3 Miner Rev 3

Process for Extracting Helium-3 from Lunar Regolith

80 deg F

300 °K

Radiator/ Condenser

- 370 deg F

50 °K

Isotopic Separation

- 456.97deg F

1.5 °K

1 tonne Helium-3

- 223 deg C

6100 tonnes

3300

500

1700

1600

1900

3100

H_2

H_2O N_2 CO_2 CH_4 CO

Helium-4

Fuel

Life Support

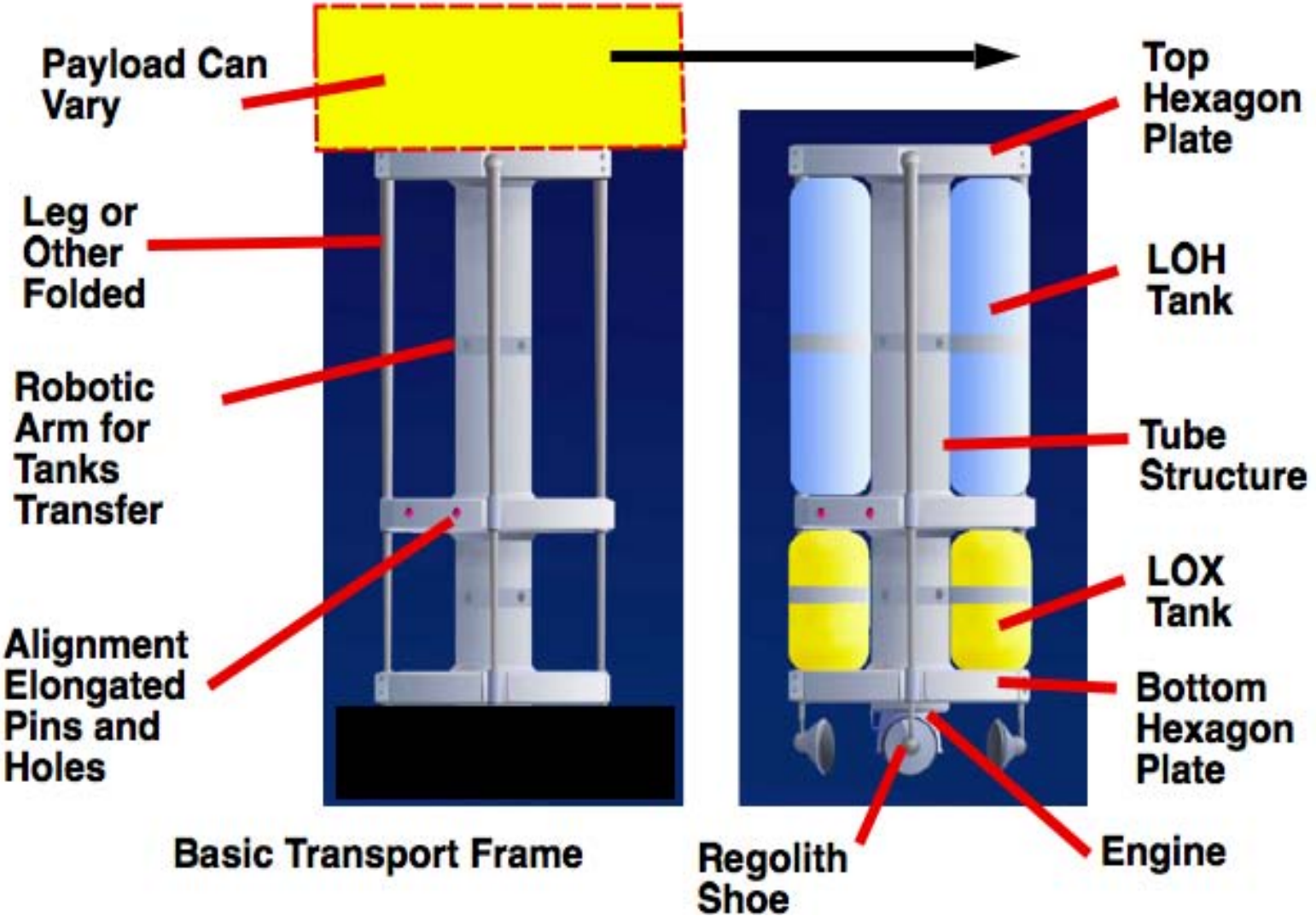
Cryogenics

Clean Fusion Energy on Earth

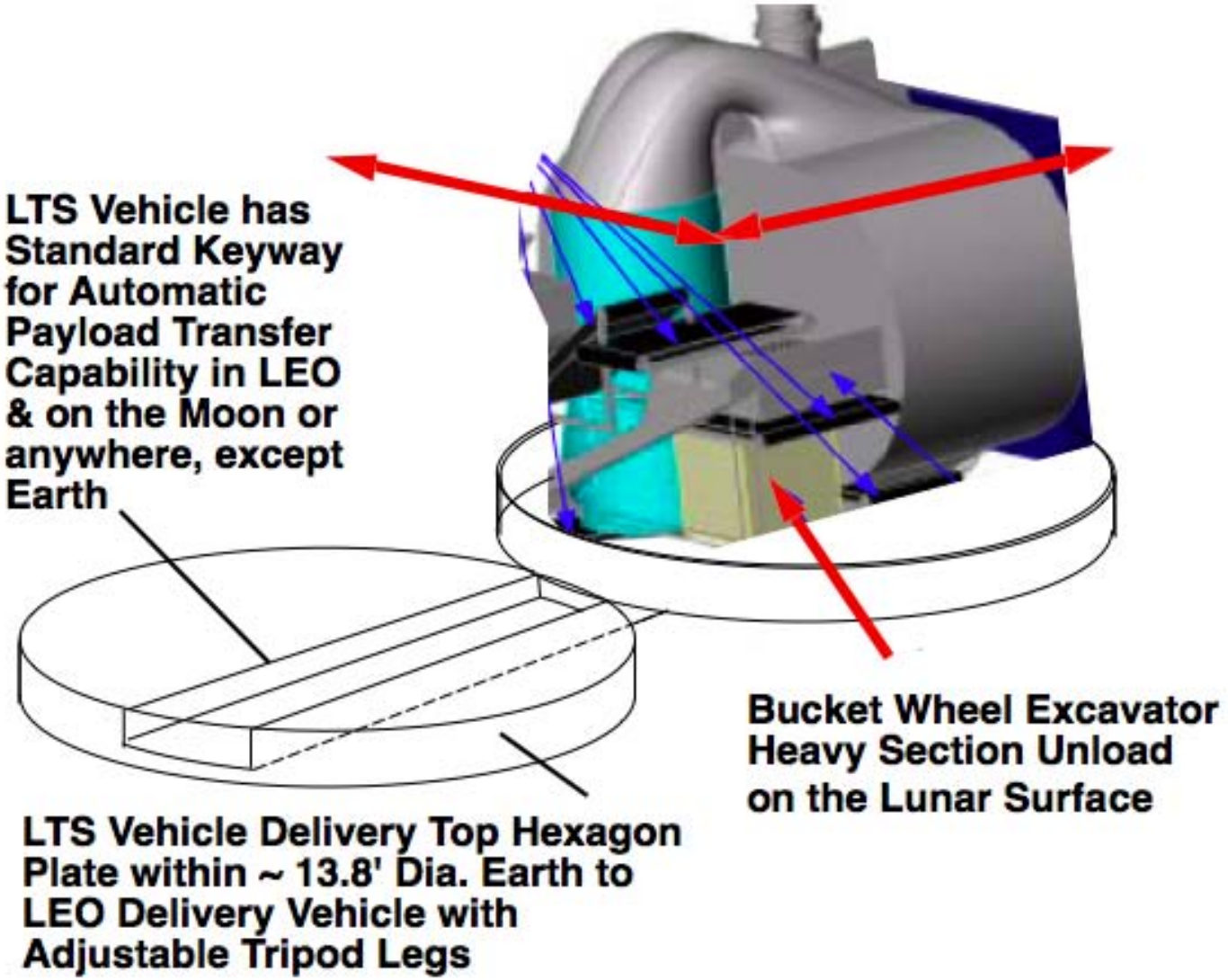
From Univ of Wisc-Madison

Reduce Cost of Commercial Transportation

& Construction Methods

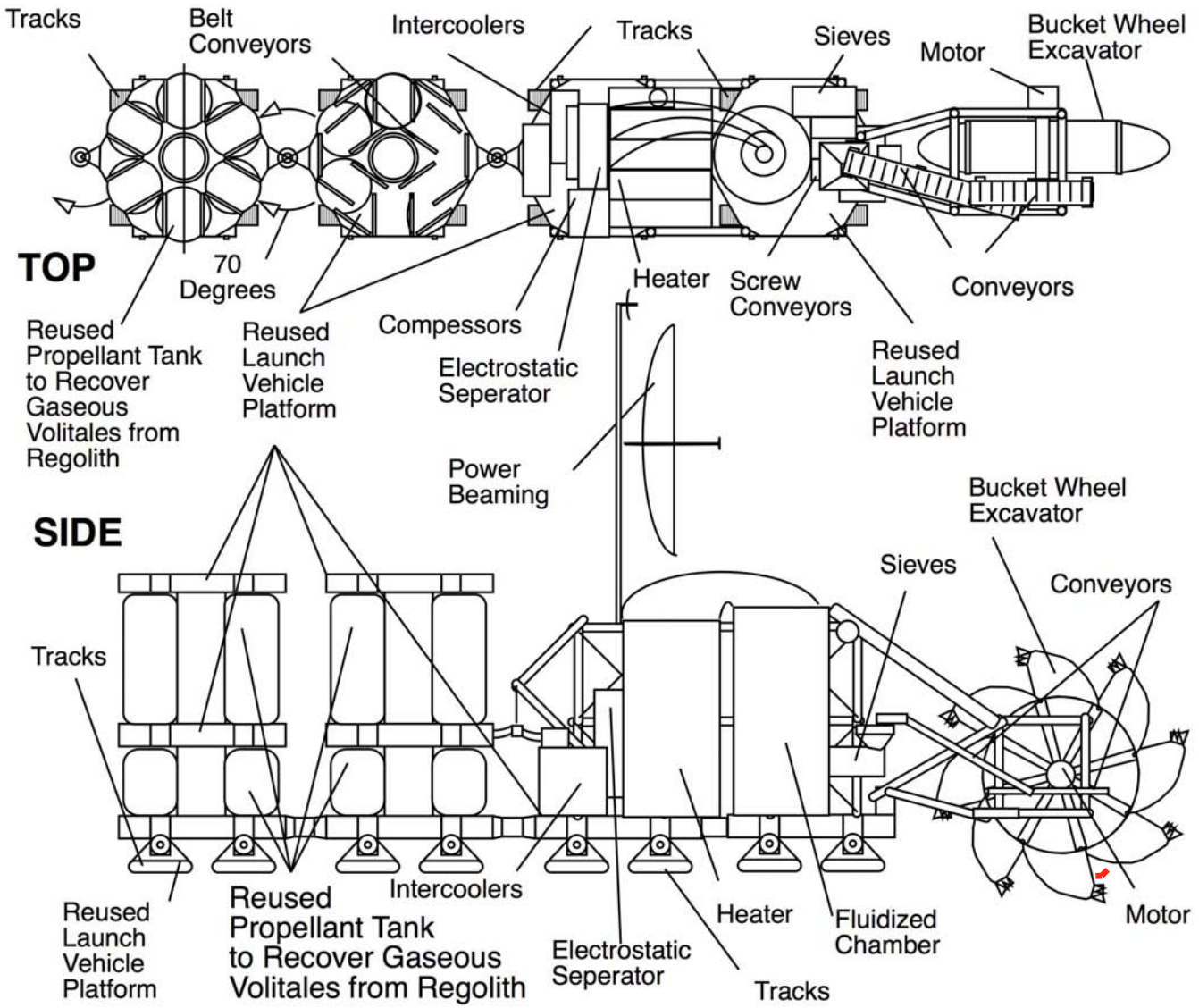


He3 Excavator Heavy Parts



Process Regolith in Place with Reused Equipment

Std. LTS Frame becomes 12 Pack Frame

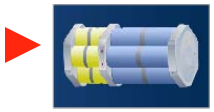


Std. LTS Tanks , Transport Gases. Cryo, Water And Use LTS Robotics , To change tanks

Lunar Lander

1

Propellant Transporter



2

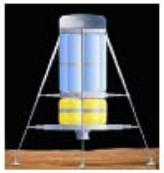
Propellant Dispenser

3

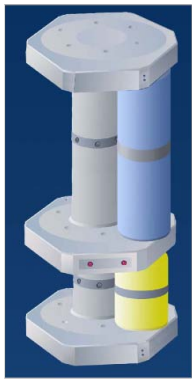
Lunar Lander

Low Lunar Orbit

Empty Spacecraft Mass - 1 metric ton
Propellant Mass - 5 metric tons
Total Mass - 6 metric tons
Spacecraft Size - 5.0 m height; 2.7 m diameter
Payload Mass - Up to 10 metric tons (transferred in LEO)
Launch Vehicle to LEO - Delta II Heavy class



Lunar Lander



Payload Dispenser

4

Propellant Transporter

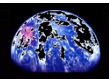
LLO

Mission Profile 1 - LEO to Lunar Surface Direct - 800 kg
Mission Profile 2 - LEO to L1, Refuel, to Lunar Surface - 3.2 tons
Mission Profile 3 - LEO to MEO, Refuel, to L1, Refuel, to Lunar orbit, Refuel, to Lunar Surface - 10 tons

L1

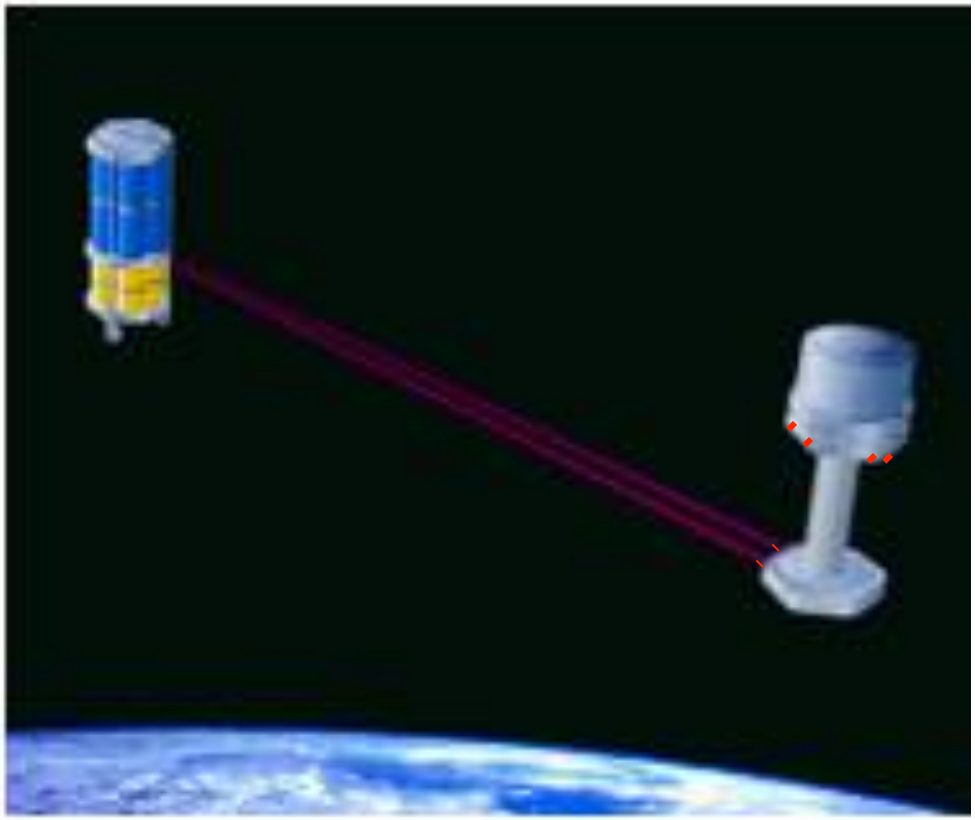
MEO

A Propellant Depot increases our Payload Capacity



Autonomous Rendezvous and Soft Berthing

- Cargo uses EELV's
- 1st cycle is already **Commercial**
- LTS Units find each other with a laser ranging system & RCS at Left
- Logistics Service available & unmanned
- **99% of the cargo could go on a non-critical affordable workhorse vehicles**



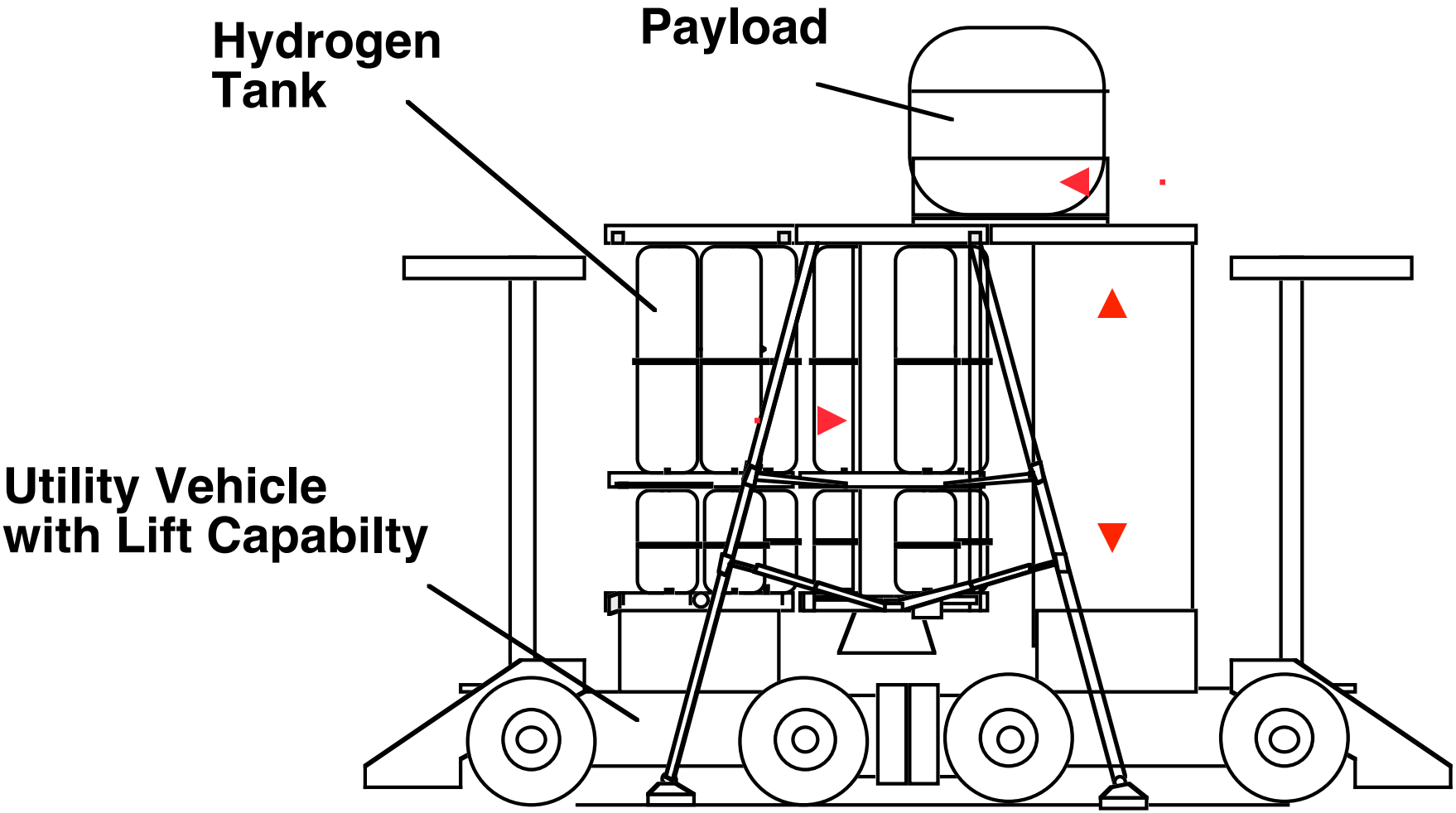
Lunar Lander

Laser Range Finder

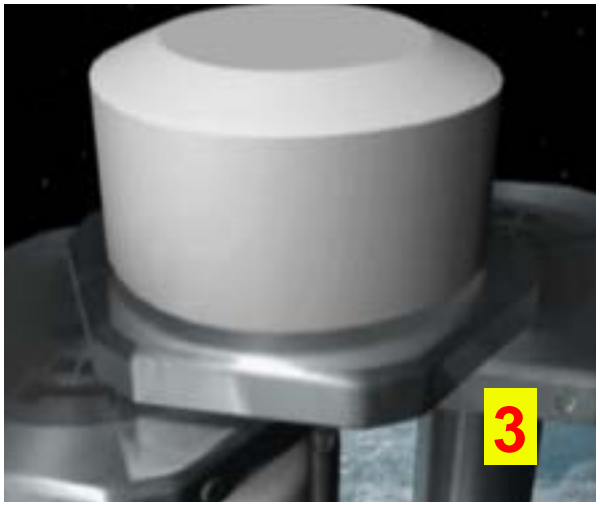
Payload BTF with Strut Reuse

Reloading LTS Vehicles

Multi-Use Equipment



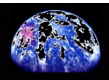
Payload Transfer Anywhere



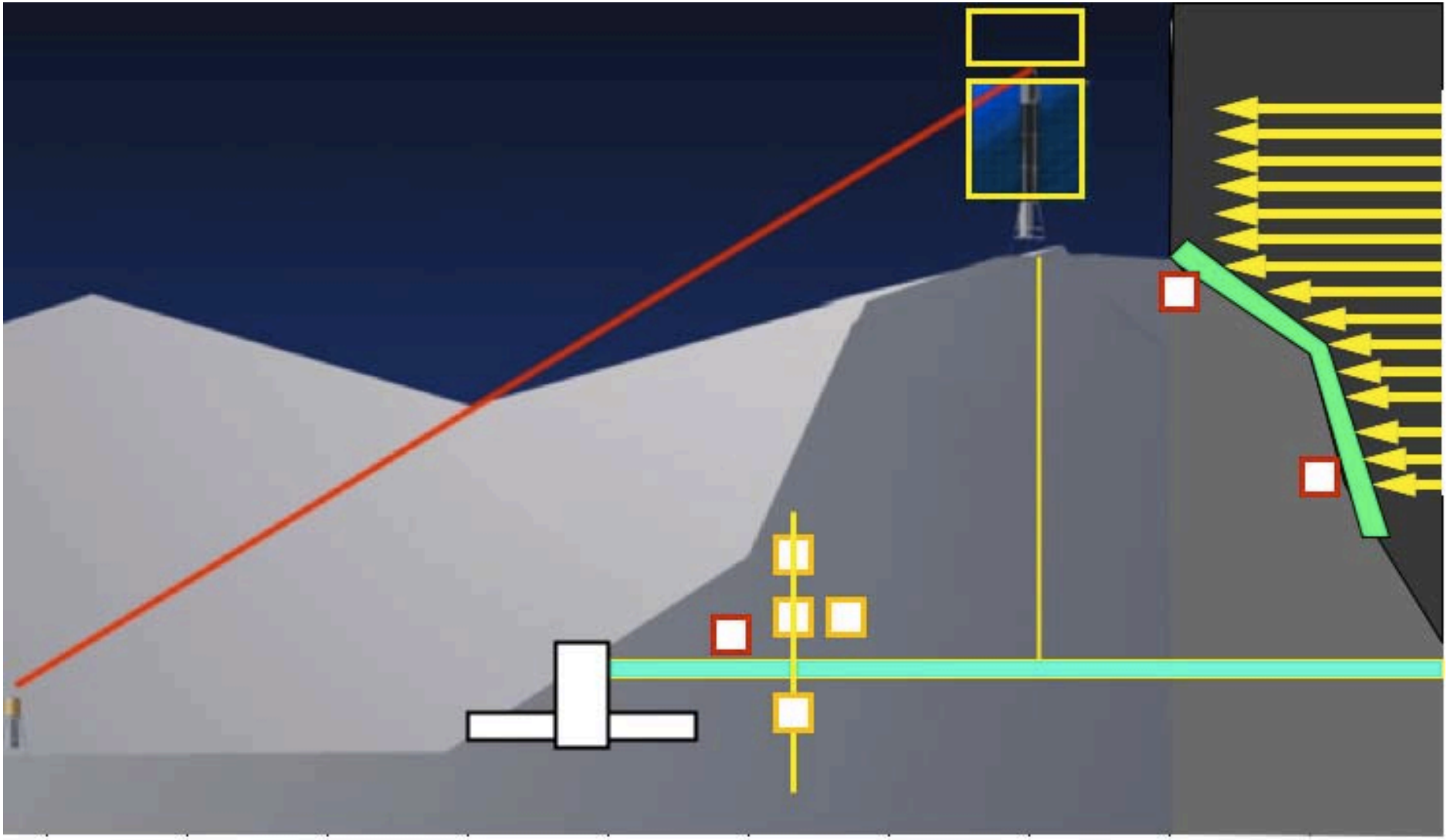
Transfer Payloads & Tanks Any Size in LEO & in Route

Reduce Commercial Transport $

- Separate Humans from Cargo Vehicles
- Start Expendable toward Reusable Hardware
- Learn from other industries-labor saving
- Practice “Living of the Land” Cost Reduction
- Understand the Earth Orbit is like a Shoreline
- Be a Propellant Depot, if Others are Slow
- Joint Venture between Aerospace & Mining
- Competitors Pool Resources like Big Oil does

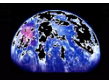


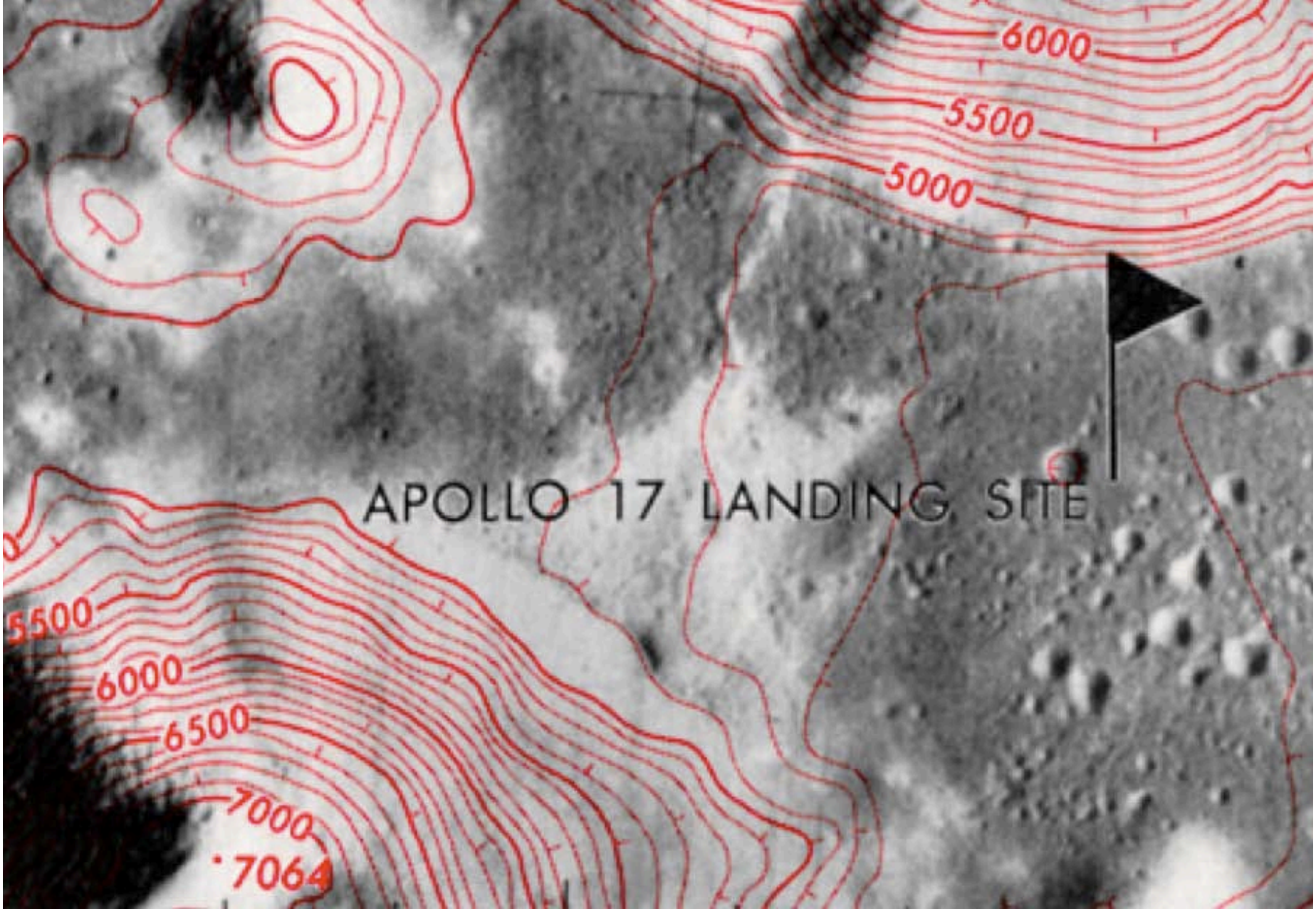
Mining the Moon 7/7



Conclusions - Market Stimulation

- Market Types - Pick 3 $ Levels of Lunar Resources Price Based on Expense to Produce each Group
  - Used on Moon Surface, Water, Oxygen.etc **<$ from Earth**
  - Used in Space like Cryogenic Propellants < same
  - Valuable enough to bring to Earth like He3 $6-15B/ton
- Accelerate Commercial Financing & Space Resource Development by Stimulating Markets
- Use He3 to Generate Innovation on Earth
- It is Time to Move into the "Near Earth Universe" commercially & Build an Economy on the Moon
- Governments can Stimulate Movement OFF-Planet by Setting a Price for He3 Delivered to Earth




6000
5500
5000
APOLLO 17 LANDING SITE
5500
6000
6500
7000
7064

Questions

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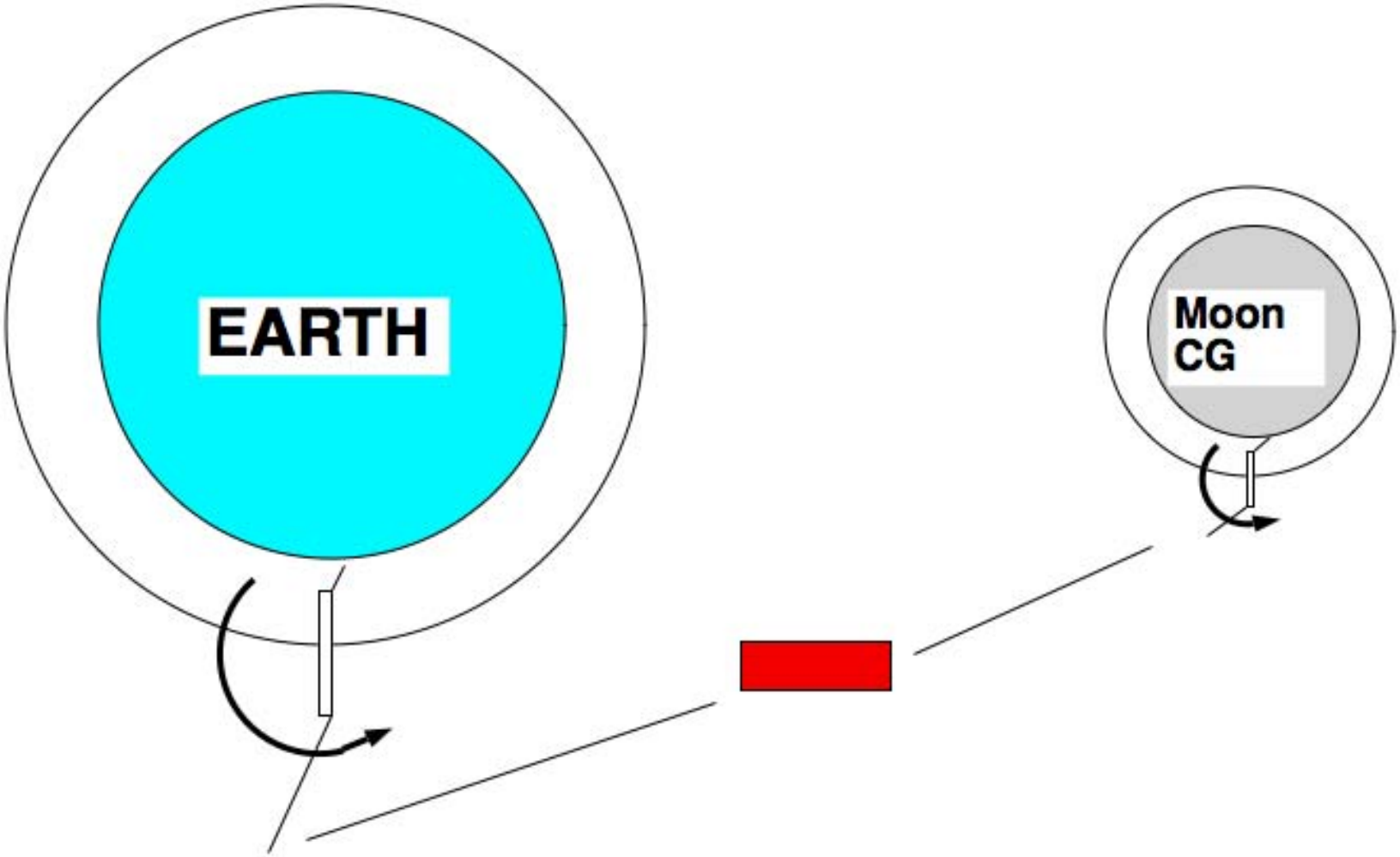
7 minute video LTS animation on UTUBE by Bob Citron

http://www.youtube.com/watch?v=26Y5w0vqtIU

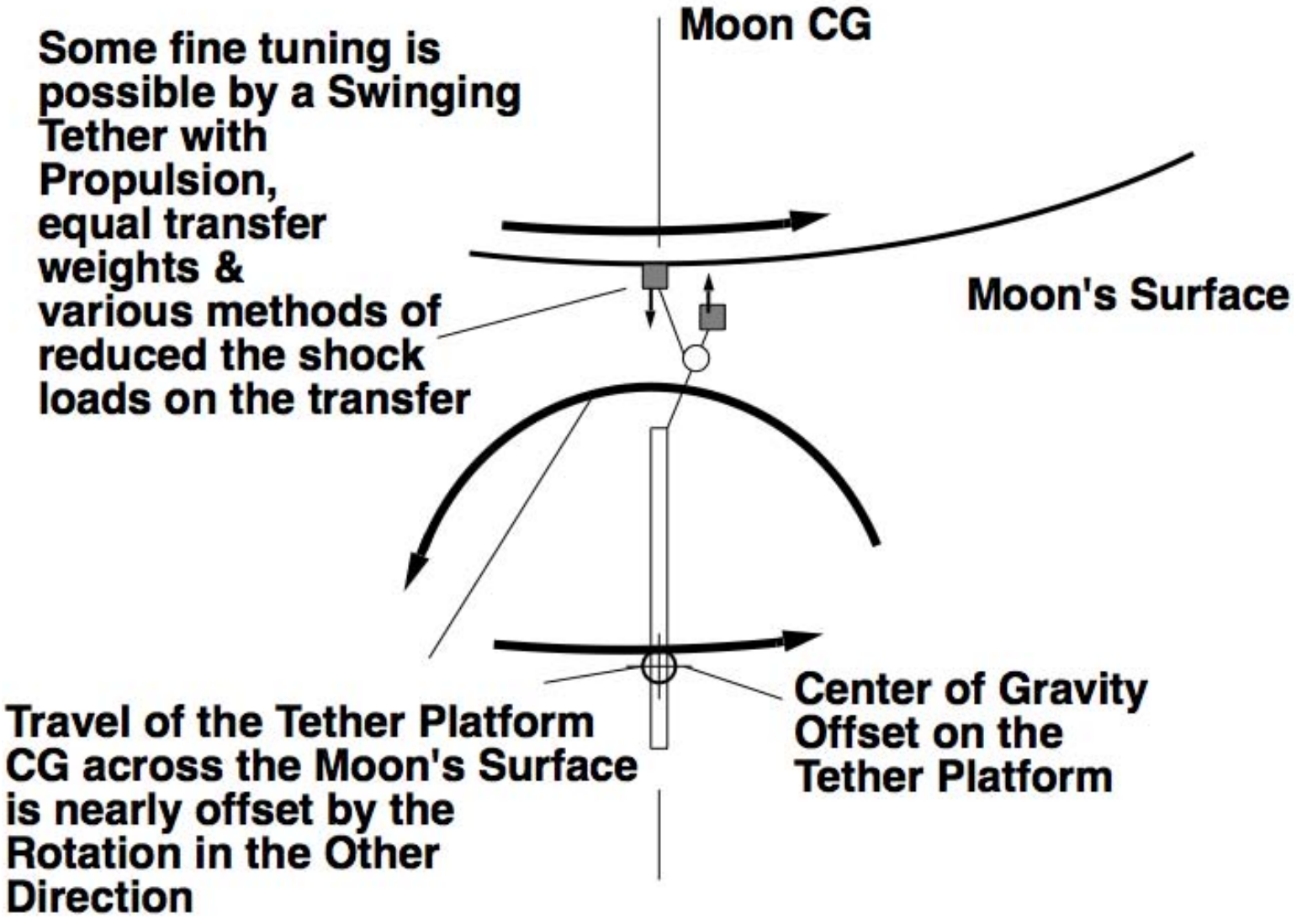
Finish

Backup Slides

Future Evolution Tethers 1/2



Future Evolution - Tethers 2/2



Reduce Upload Shock on Tether

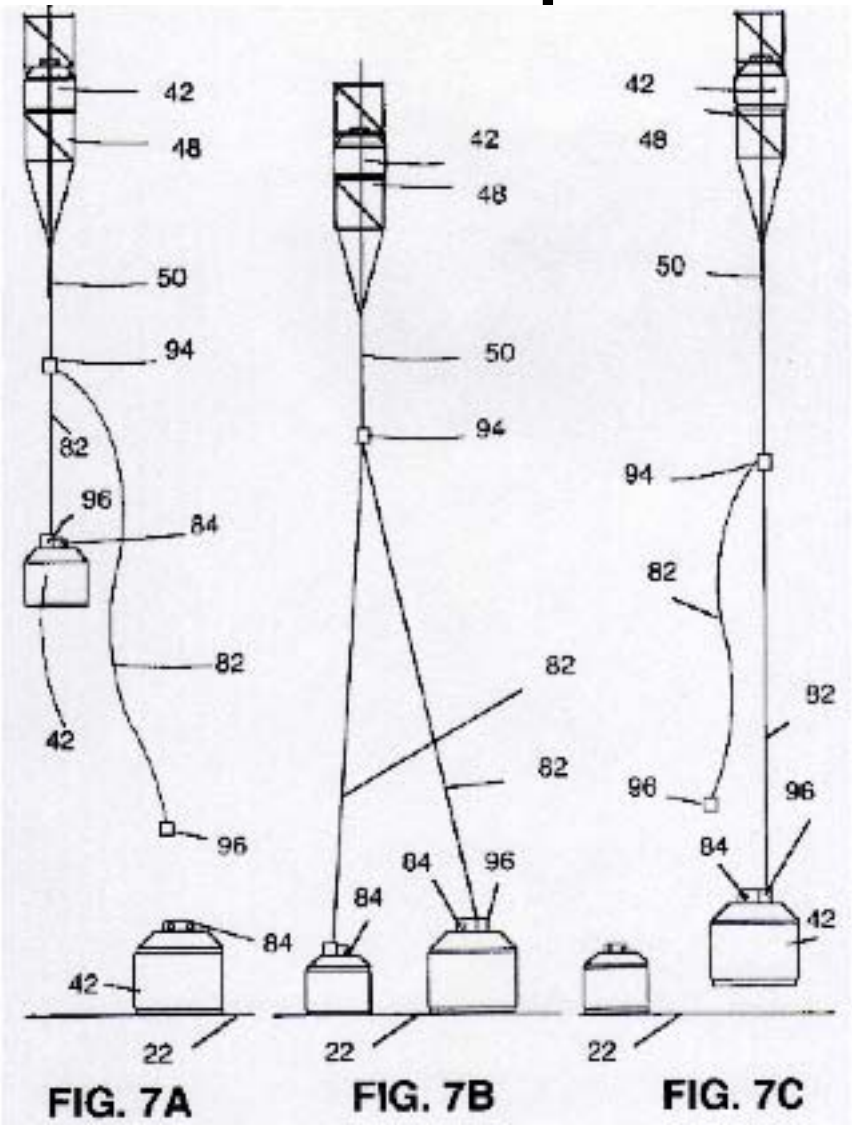


FIG. 7A

FIG. 7B

FIG. 7C

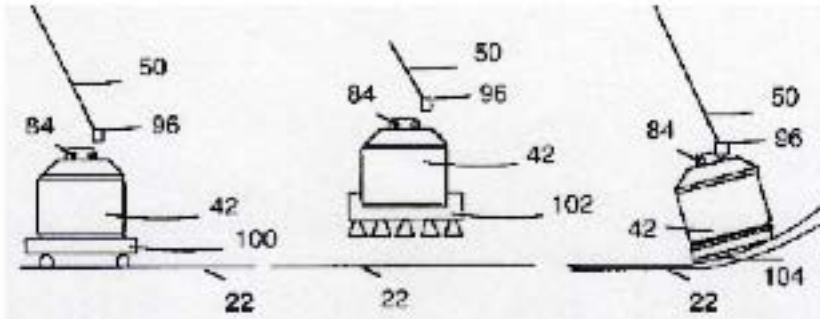


FIG. 8A FIG. 8B FIG. 8C

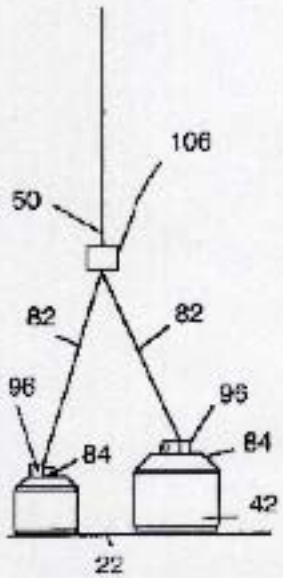


FIG. 8D

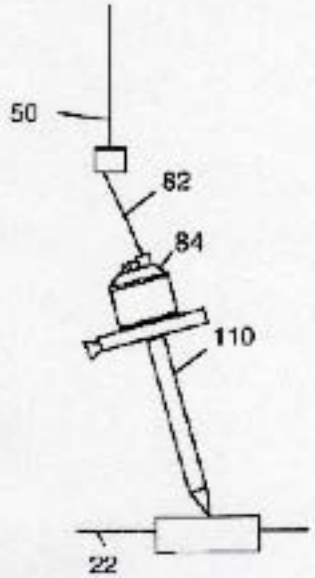


FIG. 8E