Proposed New Testing Facility for Cold and Operational Long Duration Testing of Lunar and Mars ISRU and Mobility

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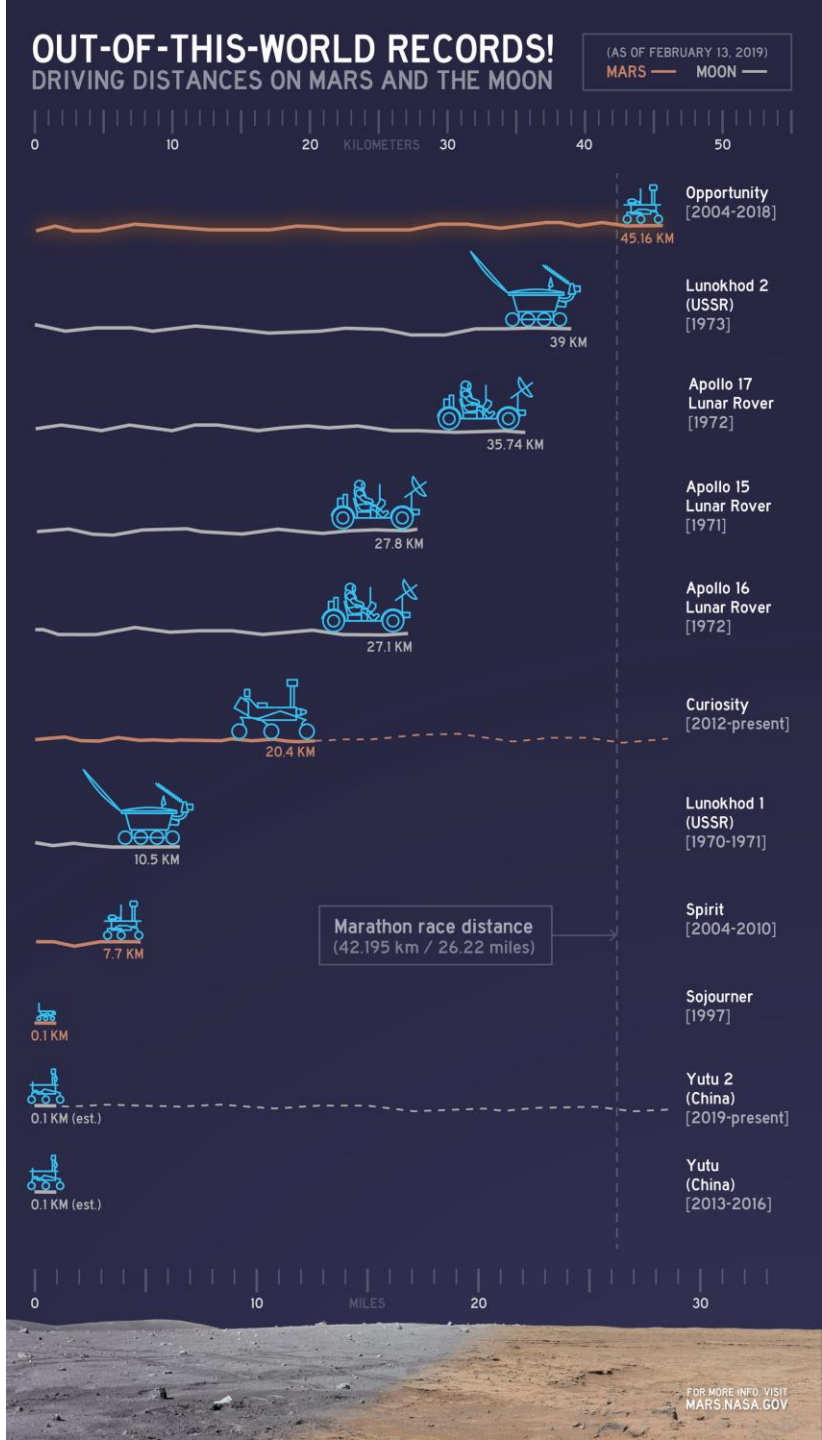
What is needed for a space economy

- Recoverable Resource
- Technology
- Customer(s)

Travel Perspective

Case	# RASSOR-class loads (@80 kg/load)	Distance from Ore to Plant, typical	# RASSOR – class Excavators used (@ 60% On-Duty)	Travel Distance (km in 480 sols)
D1 – Regolith @425K	>25,000	~100 m	**3** excavators	**5,000 (3) [1,667 (1)]**
D2 – Regolith @ 575K	>15,800	~100 m	**2** excavators	**3,160 (2) [1,580 (1)]**
C – Smectite (proximity)	>7,000	~100 m	**1** excavator	**1,400**
B - Gypsum	>2,000	**~100 m**	**1** excavator	**400**
B - Gypsum	(same)	**~1,200 m**	**1** excavator	**4,800**
B - Gypsum	(same)	**~3,000 m**	**2** excavators	**12,000 (2) [6,000 (1)]**



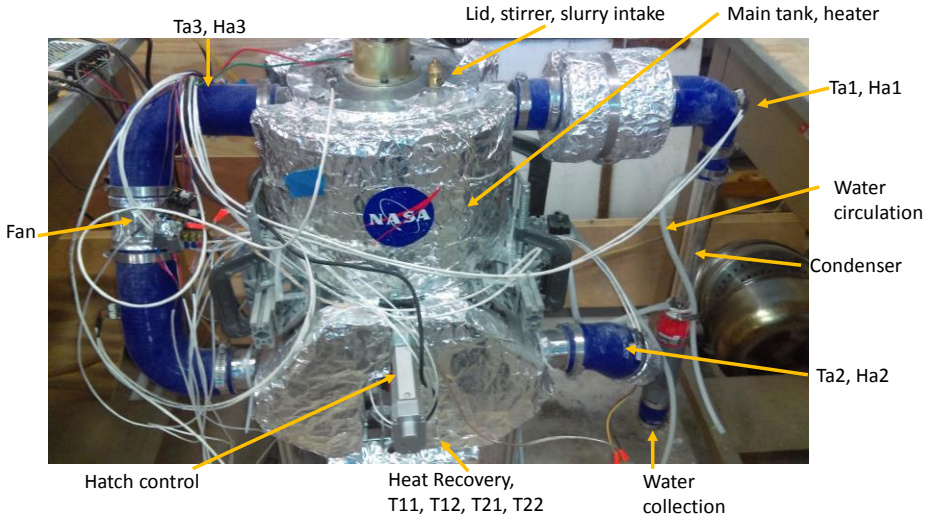
- Design of machines needs to be done as part of the overall system of systems
- The ‘right’ size can vary enormously based on target resource, target production(rate) and distance to site
- **These are NOT science machines, they are industrial grade production machines**
- Repetitive actions, yet hard to automate
- Batch vs. continuous
- Specialization vs. Swiss Army Knife approach

- DUST will get everywhere
- ROCKS!

- Different design paradigm

Initial start: testing in relevant environment

- Small to medium scale and short to long duration
  - MTU Planetary Surface Technology lab
    - Currently working on water extraction from gypsum rock for Mars ISRU
    - Lunar Frozen icy regolith water extraction
    - Landing pad and other site construction Subsystem or small system testing
  - NASA Early Stage Innovation grant
  - Co-I on NASA ISRU BAA NextSTEP : RedWater
  - Co-I on NASA SSERVI CLASS



New Dusty Thermal Vacuum Chamber (Fall)

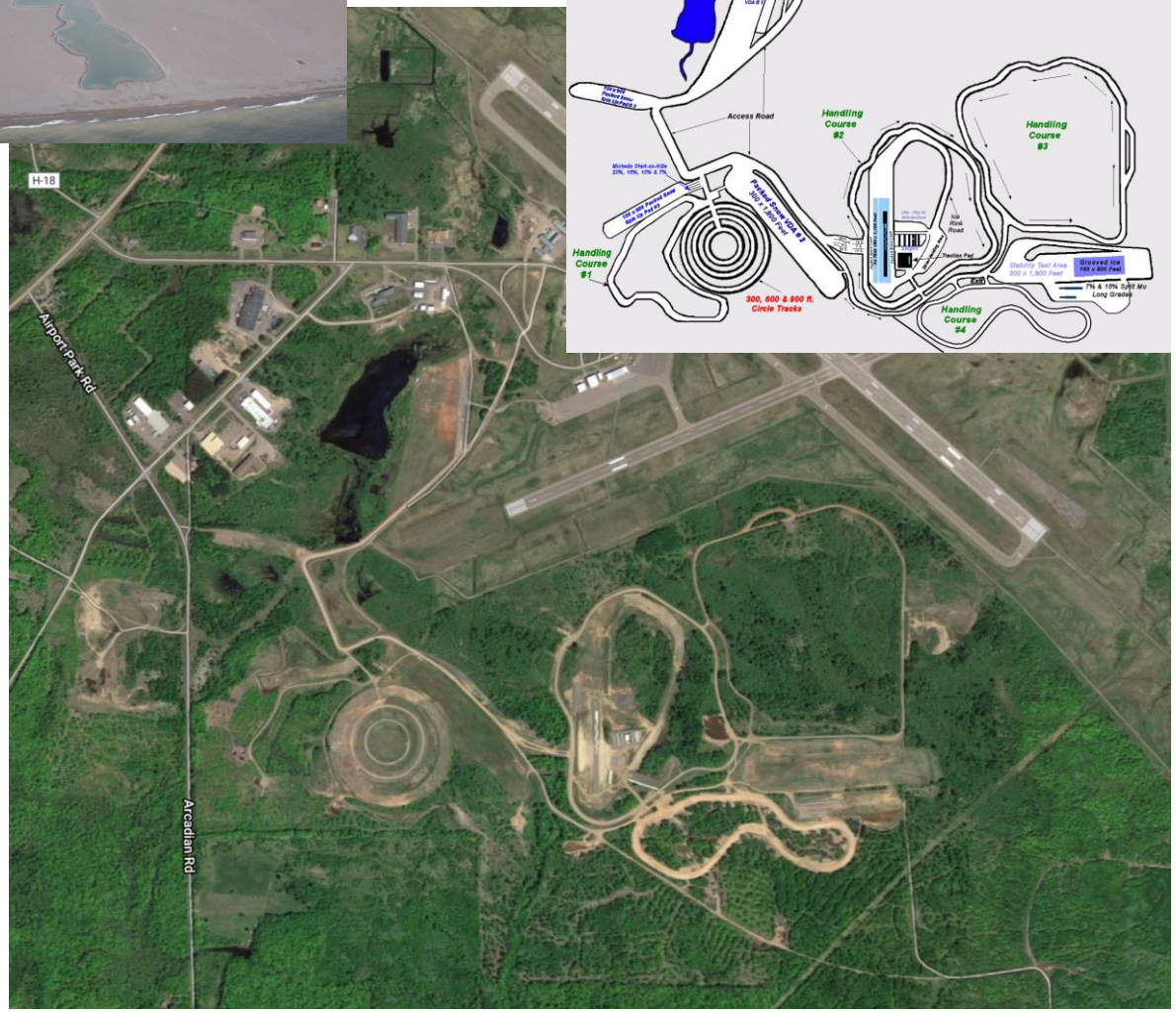
- interior dimension of 60x60x80 inches
- with an internal thermal shroud and thermal base plate.
- The effective internal space 50x50x60 in
- 10^{-4} to 10^{-6} torr (roughing and turbo pump with dust protection)
- cooled by LN_2 (3000 gal LN_2 tank - can test for many days in a row, with refills even weeks if needed).
- The temperature range: -196 C to +150C.
- Several feedthroughs (data & power up to 3 phase 440V)
- Built in LED lighting and several windows (upgrade to vertical height)
- Regolith bin of entire bottom surface, height as desired (12 in min)

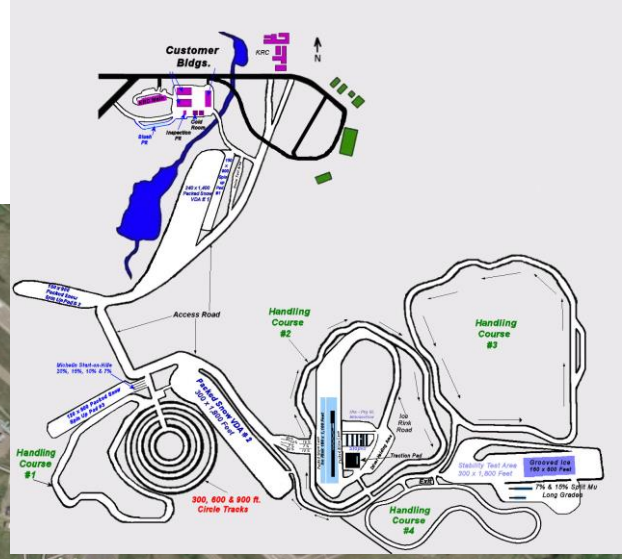
Future – Industrial Large Scale, Long Duration ISRU Testing

KRC

- 900 acres test terrain (all year)
- Cold, ice, snow, winter testing
- Many different terrains, slopes, surface features
- 30x40ft Bays temp controlled to -40 C
- Mobility, robotics, detection etc.
- Basalt quarry

<u>Expansion of facilities to include Lunar temps and Mars Environment for long duration ISRU testing</u>





- **<u>Need for such a facility?</u>**
- **<u>Could be part of National ISRU lab / consortium / (virtual) Institute</u>**
- **<u>Capabilities?</u>**

Abstract due August 9

https://www.earthspaceconference.org/

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