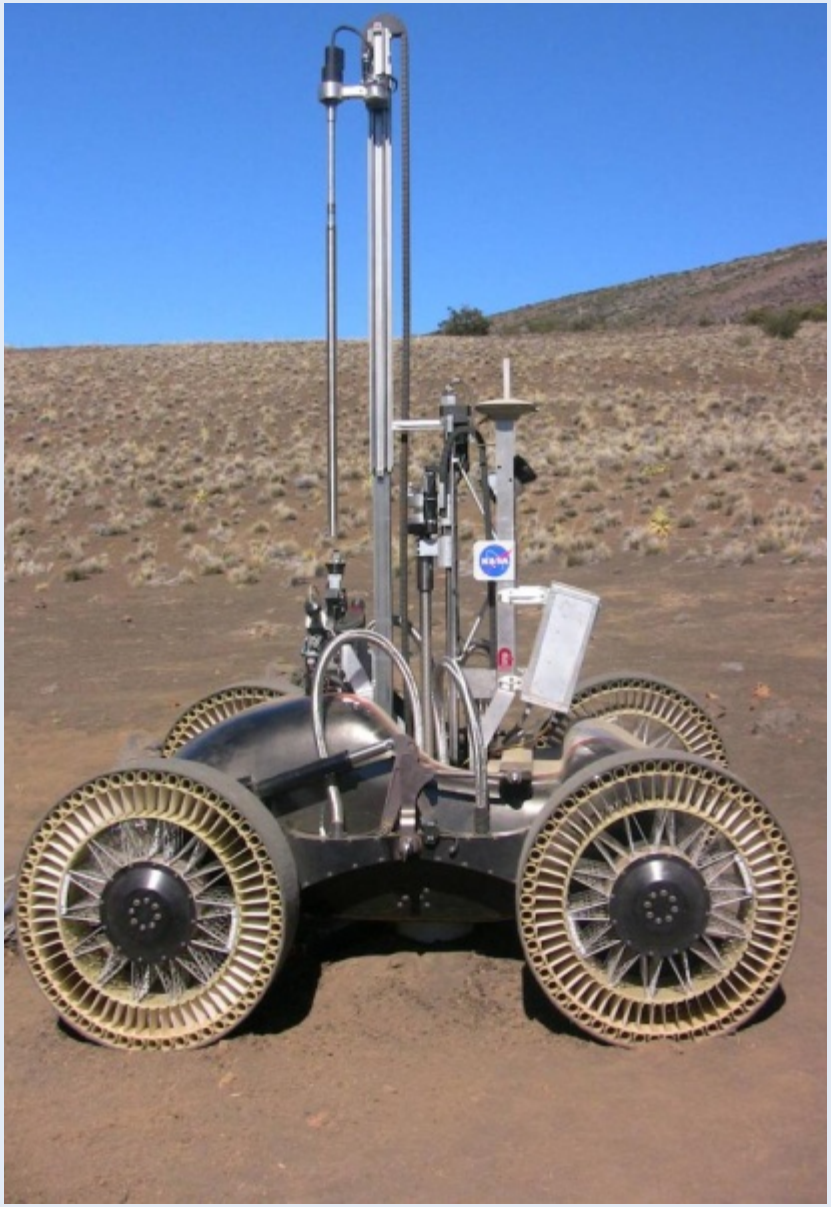
In-Situ Resource Utilization

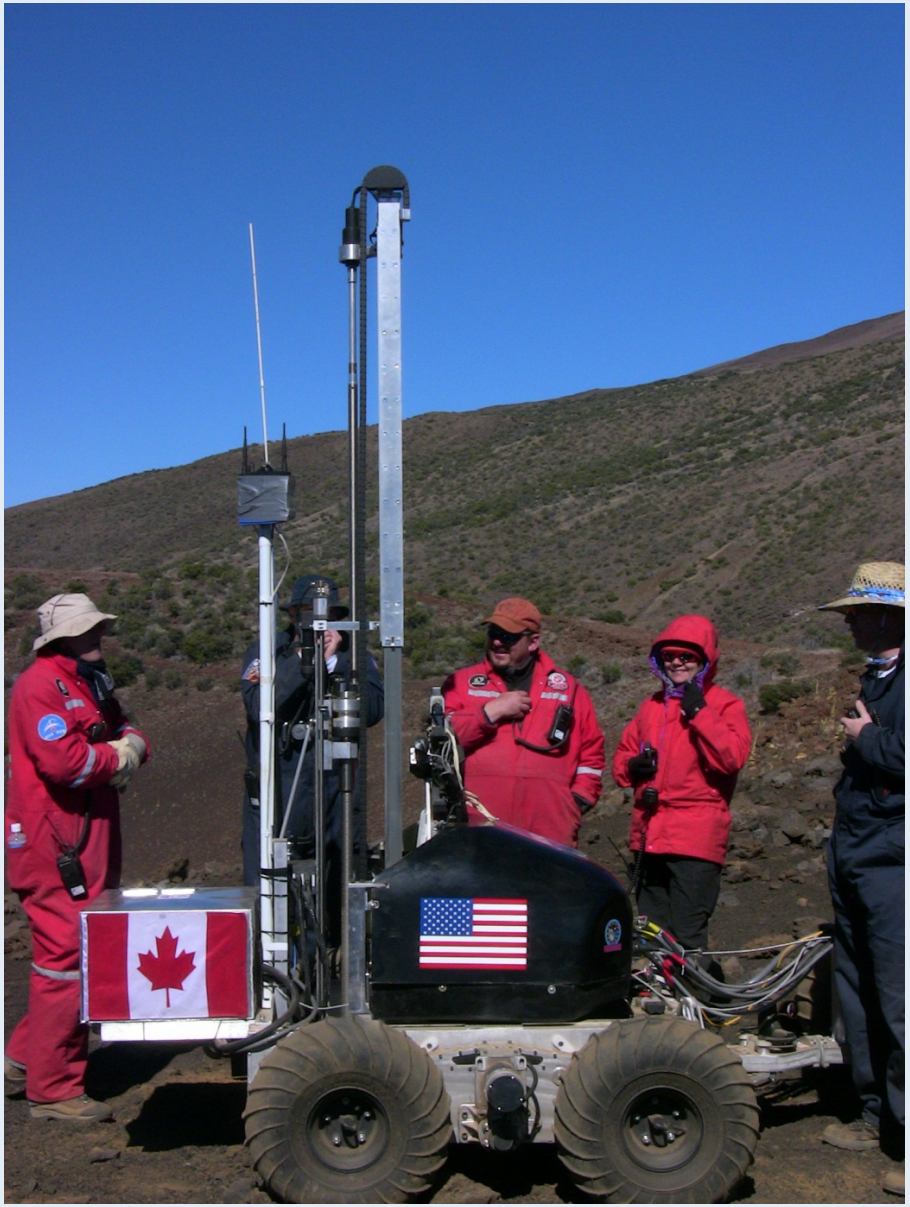
Enabling Technology for the Exploration of Space

- Extracting resources at our exploration destinations is a key capability needed for sustained human exploration beyond LEO.
- There have been substantial investments in ISRU technology over the last 5 years.
- NASA and the Canadian Space Agency working with PISCES have conducted two successful field demonstrations

RESOLVE Field Tests

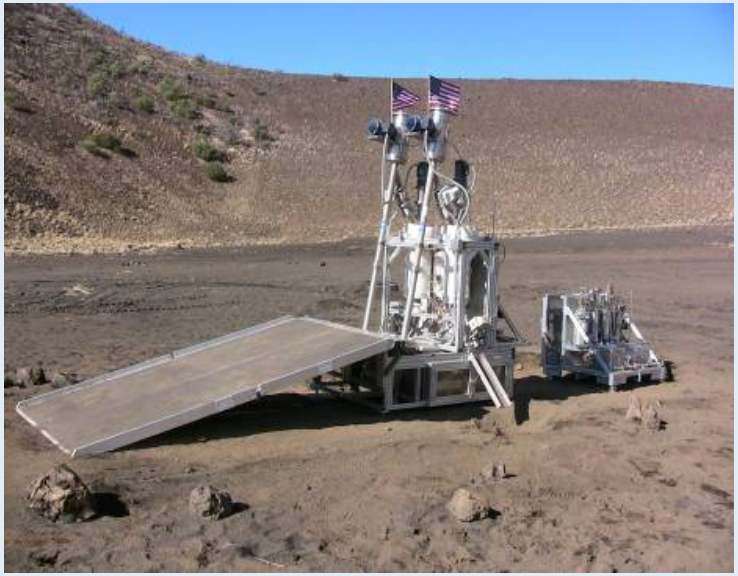


RESOLVE 2008 CMU Rover

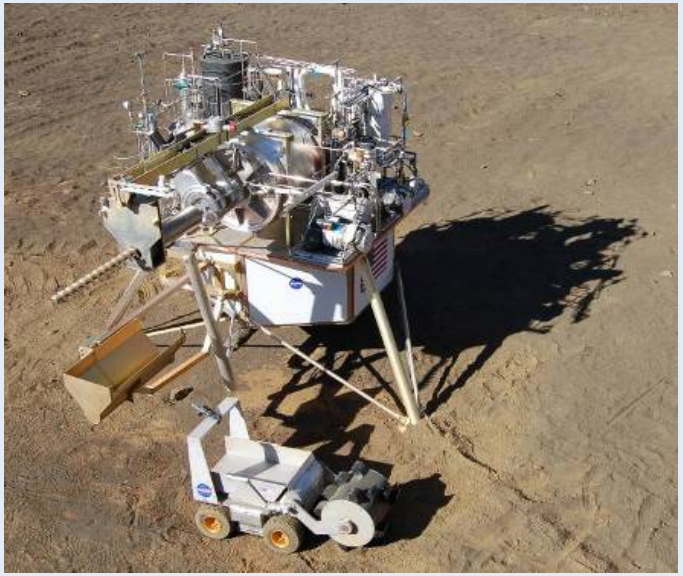


RESOLVE 2010 Canadian Rover

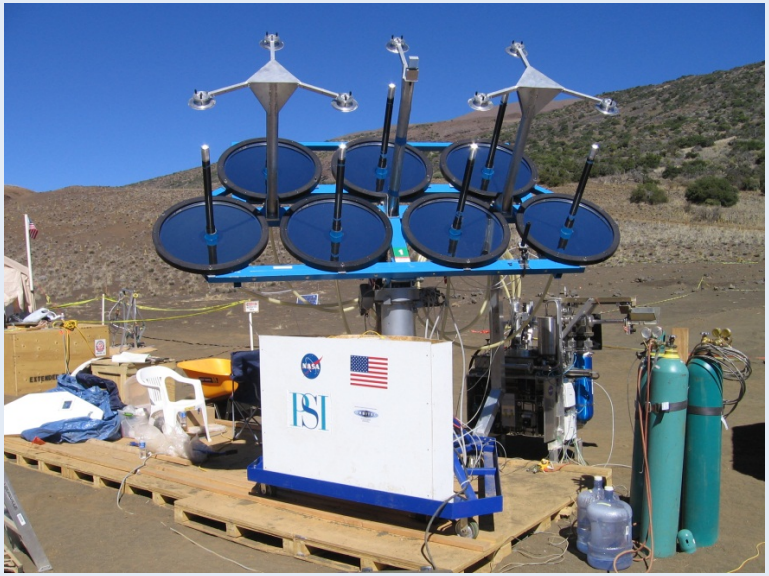
Oxygen Production Field Test Hardware



JSC Designed Oxygen Production System
2008 Field Test



Lockheed Martin Oxygen Production System
2008 Field Test



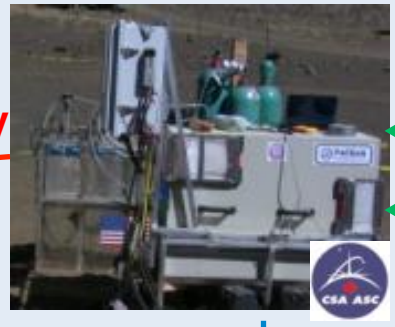
Carbothermal Reduction Process for Oxygen Production: February 2010

Closing the ISRU Loop

Solar Concentrator Array

Sunlight

Electricity



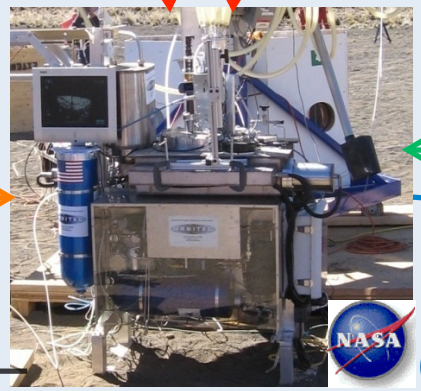
Fuel Cell

O_2 (air)

H_2 (gas)

Load-Haul-Dump Rover

Tephra



Processed Tephra

H_2O (liquid)

H_2 (gas)

H_2 Hydride Storage

H_2O (liquid)

Carbothermal Reduction Reactor

H_2 (gas)

Water Electrolysis and GO_2 Storage

O_2 (gas)

LO_2/CH_4 Storage and Thruster

Chart Credit: Jerry Sanders

ISRU and the Lunar Research Development Park

- ISRU needs flight testing to be accepted by mission architects and commercial corporations
- Important to understand that what congress authorizes is different from what they appropriate.
  - Robotic Precursor Program is authorized, but will not receive enough money to do many missions
  - Moon Lander is not currently within reach due to NASA's budget.
- Therefore partnerships are crucial to demonstrating and implementing ISRU on the moon.
  - International Space Agencies have Landers in their plans
  - Google X-Prize will likely yield commercial providers that could carry ISRU payloads
  - Water on the Moon opens up interesting opportunities for a commercial market in cis-lunar space
- Lunar Research & Development Park could be the catalyst to tie NASA together with these partners