National Aeronautics and Space Administration

NASA

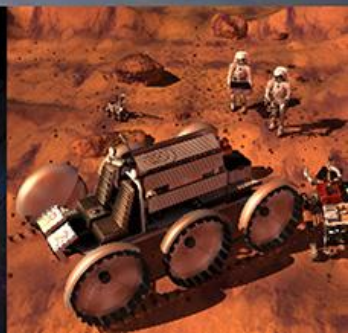
TFAWS ISRU

# Water Capture from Soil

Aaron Paz



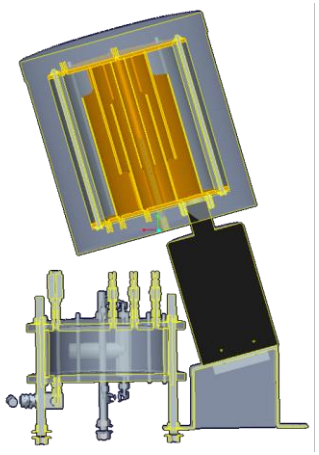




# Previous ISRU Water Capture Systems

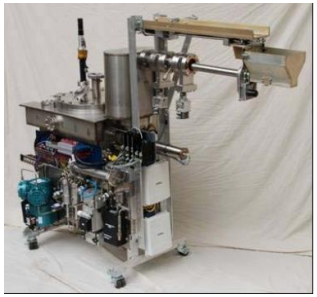
## 2005-2008

**PILOT – Lockheed Martin[1]**

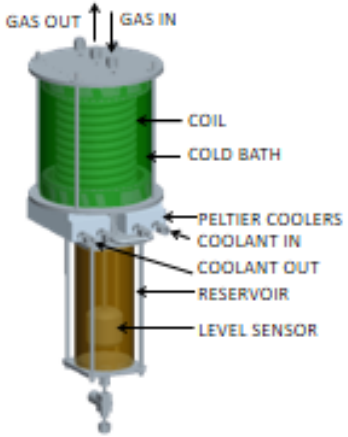


**ROxygen Freezer – JSC[1]**

## 2008-2010



**Carbothermal Reduction System-Orbital Technologies Inc.[2]**

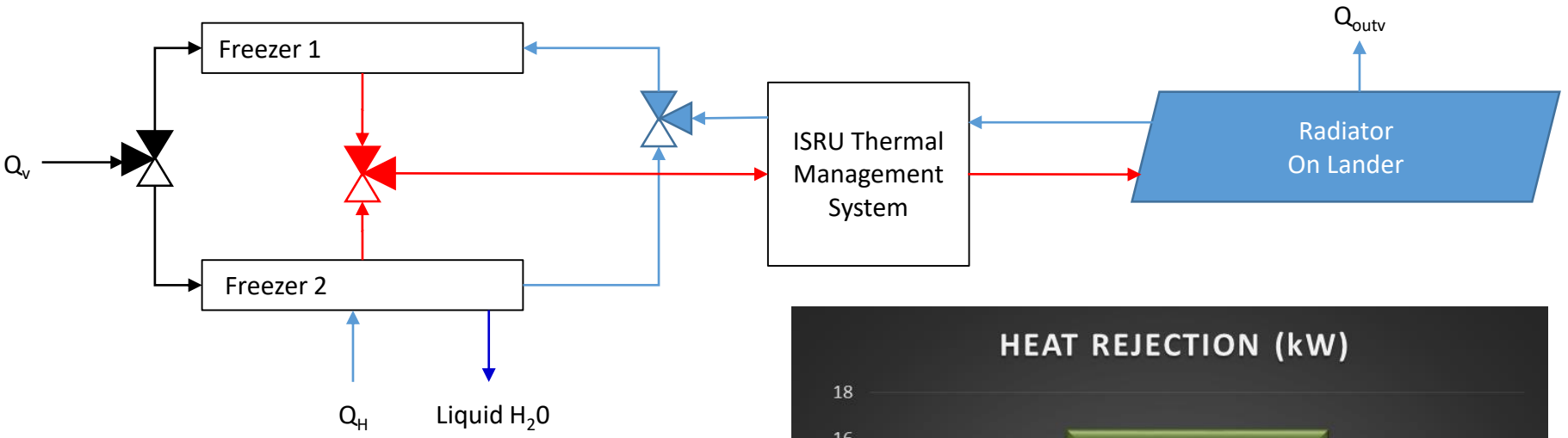



**ROxygen 2 Condenser- JSC**

## 2010-2015

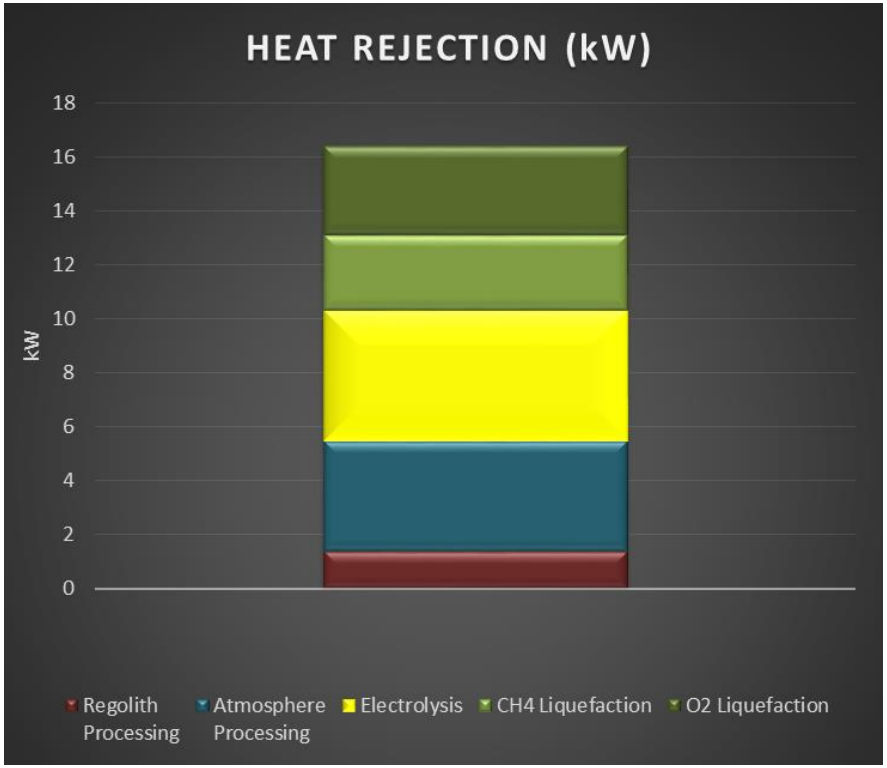
**HESTIA Soil Processing Module - JSC**

# Assumptions for 2016 EMC study




$Q_v$ = Heat load from incoming vapor
$Q_H$ = Power required to thaw ice.
$Q_{outv}$ = Heat rejected from radiator = $Q_v$

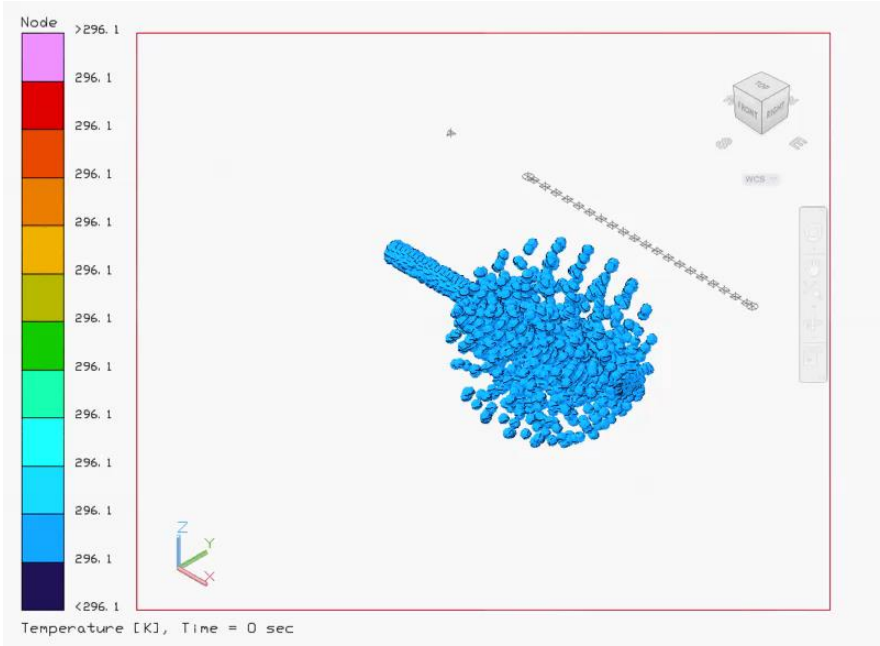
EMC Freezer Concept



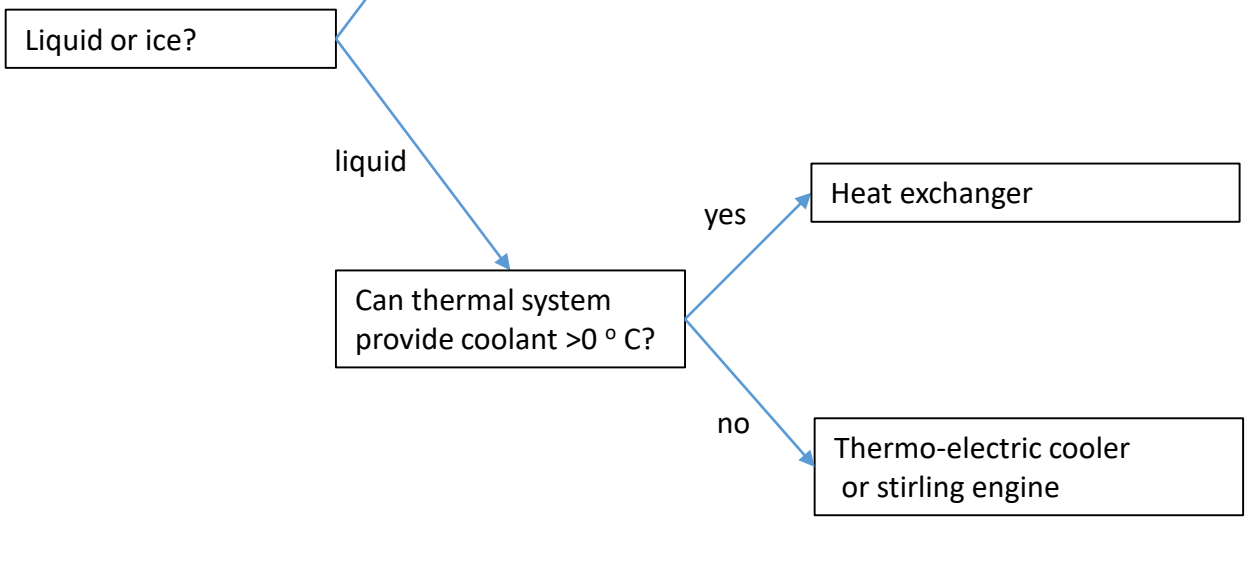

EMC Study Heat Rejection Results

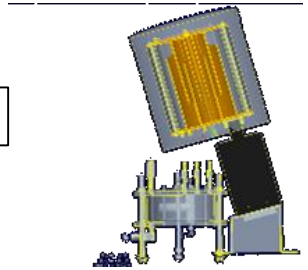
# Forward Considerations

- The rate of condensation/deposition will determine the rate vaporization within the soil processing module if it is a passive system.
- The temperature of the condenser/freezer cold surface will drive the rate of condensation/deposition
- Requirements need to capture the thermal management architecture. For example:
  "heat shall be removed from ISRU components using mechanically pumped _____ refrigerant with a temperature range of -___ to + ___C and a flow rate of ____ lpm"
  Or
  "ISRU components shall include a means to reject heat directly to the Martian atmosphere"

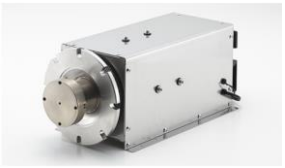



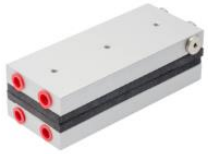
# Decision Tree



PILOT/HESTIA approach





What about sorbants?

- Unless we electrolyze vapor, sorbants still require a condenser at some point

# References

1)Sanders, G. B., & Larson, W. E. (2012). Progress made in lunar in situ resource utilization under NASA's exploration technology and development program. In *Earth and Space 2012: Engineering, Science, Construction, and Operations in Challenging Environments* (pp. 457-478).
2)Gustafson, R., White, B., Fidler, M., & Muscatello, A. (2010). Demonstrating the solar carbothermal reduction of lunar regolith to produce oxygen. In *48th AIAA Aerospace Sciences Meeting Including the New Horizons Forum and Aerospace Exposition* (p. 1163).
3) Kleinhenz, J. E., & Paz, A. (2017). An ISRU propellant production system for a fully fueled Mars Ascent Vehicle. In *10th Symposium on Space Resource Utilization* (p. 0423).