Sustainable Waste-to-Resource Conversion in Space

Lexi Lueger, Russell C. Smith, Dr. J Whitlow, Dr. MT Reza*
Dept. of Chemistry and Chemical Engineering, Florida Institute of Technology

Abstract

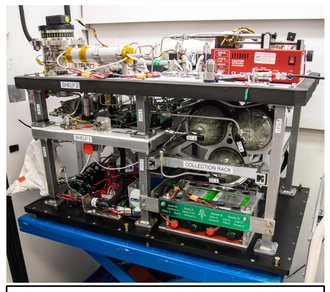
An innovative, sustainable waste management system for a lunar colony that eliminates waste while producing critical resources, such as oxygen and bio-rocket fuel, essential for long-term extraterrestrial habitation.

Novelty

- Enables **sustainable oxygen generation** through gasification of all human waste types.
- Provides a **closed-loop waste management** system critical for long-duration space missions and off world habitats.
- Advances **in-situ resource utilization (ISRU)** technologies.

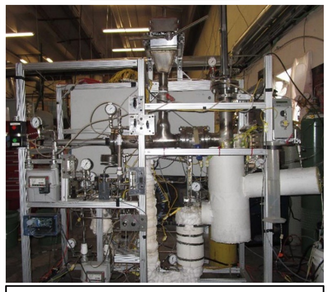
Thermochemical Conversion Options

OSCAR

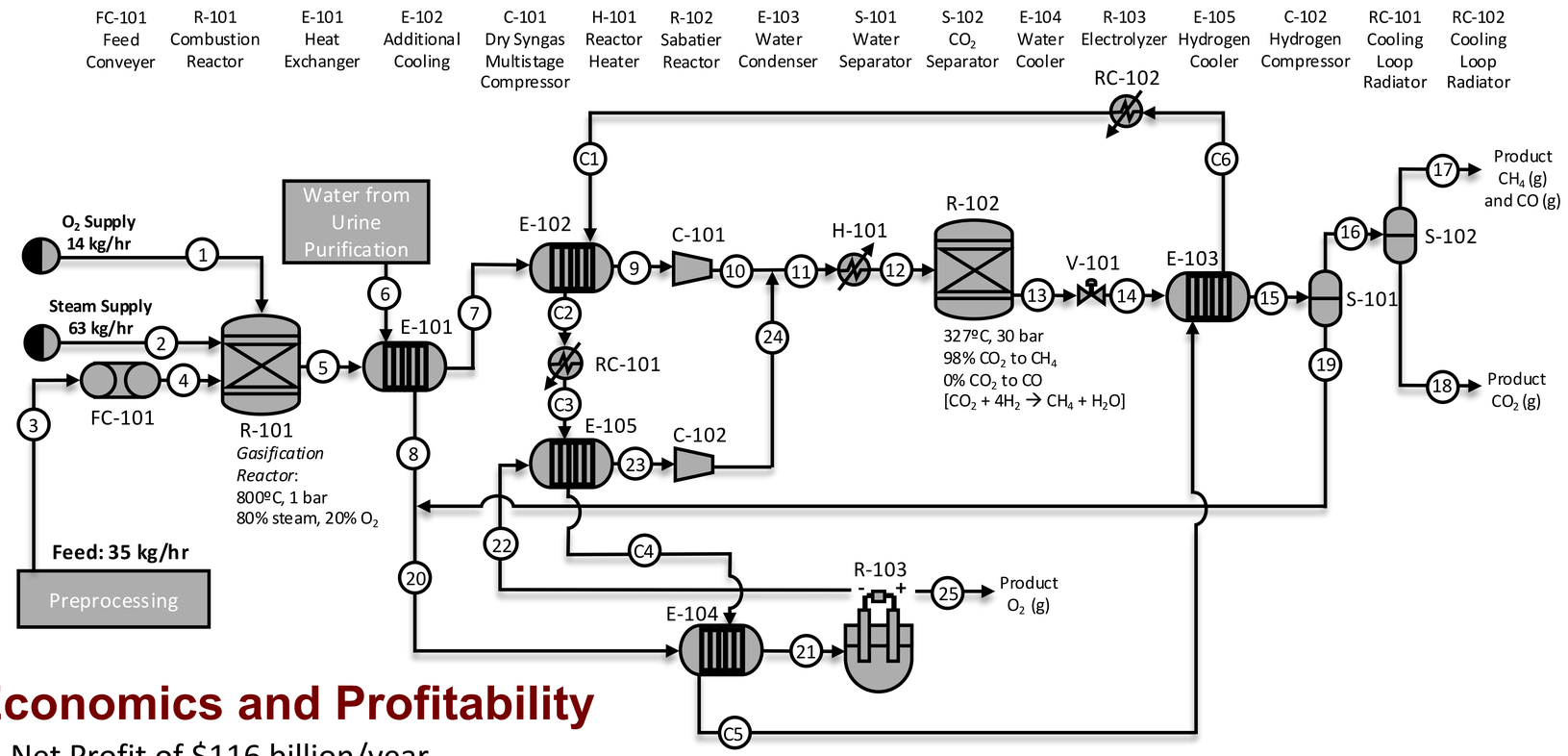


Combustion[1]

AOWG



Steam Gasifier[2]

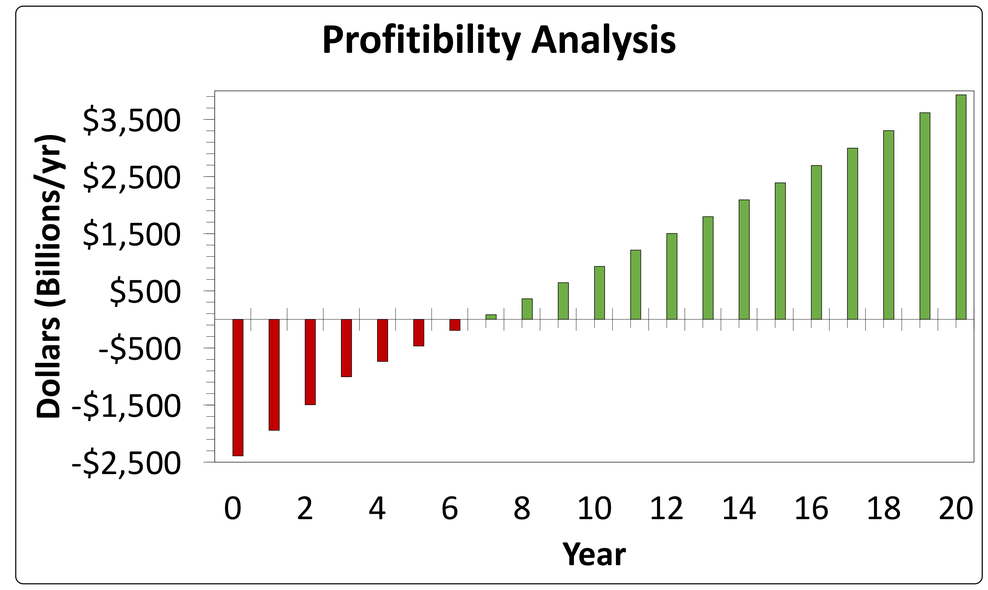


Economics and Profitability

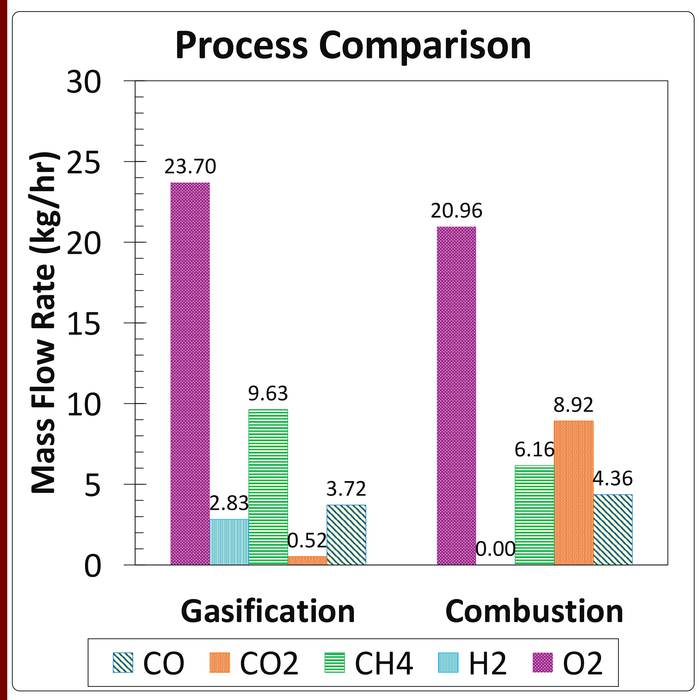
- Net Profit of $116 billion/year.
- One-time capital cost of $1.5 trillion.
- Breakeven point between year 6 and 7.
- Annual operating cost $650 million/year.

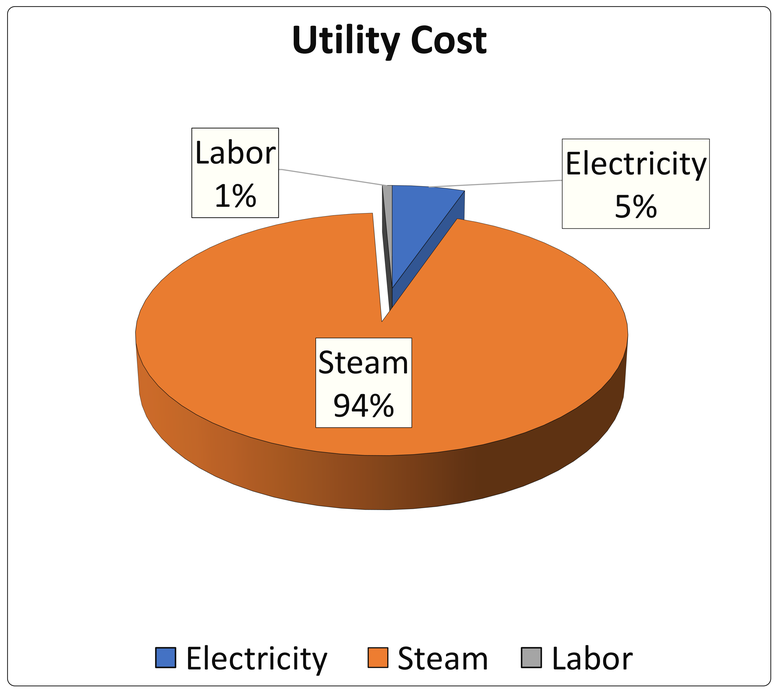
Moon-Specific Economics

- Shipping cost $1.2 million/kg.
- Electricity utility: $27 million/year.
- Steam utility: $472 million/year.



Results





References

1. NASA. OSCAR: Orbital Syngas Commodity Augmentation Reactor. https://www.nasa.gov/oscar-orbital-syngas-commodity-augmentation-reactor/
2. Levri, J. A.; Hogan, J. A. Comparative Evaluation of Waste Processing Technologies for Long Duration Space Missions. NASA/CR—2001-210939,https://ttuir.tdl.org/handle/2346/1150

Acknowledgements

- Dr. A Meier – Kennedy Space Center (NASA)