

A black and white photograph of space. On the left, a large, curved portion of Earth is visible, showing cloud patterns. On the right, a crescent moon is seen against the dark background. In the bottom left corner, there is a bright star or light source with a lens flare effect.

Trash to Supply Gas (TtSG) Project Overview: Space Logistics Panel

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Space Logistics Strategies: Multi-Mission Spacecraft,
Repurposed Hardware and Recycle Materials

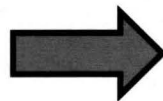
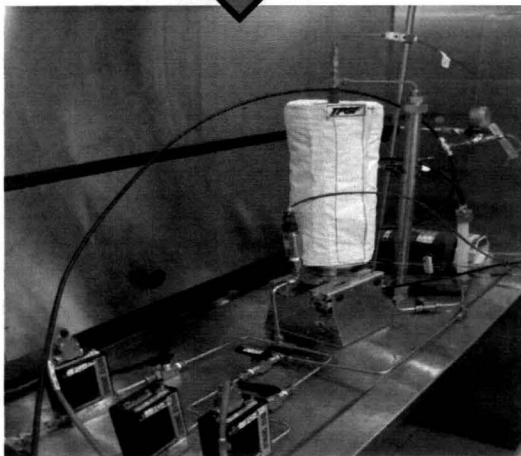
AIAA Space 2012 Conference & Exposition



Agenda



- Logistics, Reduction and Repurposing (LRR) Project Overview
- TtSG overview





LRR Overview



- Summary
 - Logistics Reduction and Repurposing (LRR) will utilize a cradle-to-grave approach to logistics to reduce total mission logistical up mass.
 - LRR will demonstrate efficient methods to repurpose hardware originally designed for other uses, reduce packaging volume, and using common system elements for multiple mission applications.
 - Minimize intrinsic logistics mass.
 - Direct logistics component repurposing for on-orbit outfitting.
 - Compact and process logistics to useful components and products.
 - Enable long term stable storage and disposal
 - Enable logistics sharing between vehicles in different mission phases
- Goals: new capabilities and exploration affordability
 - Reuse and repurposing will reduce initial up mass and volume because it will reduce the number of dedicated crew outfitting items.
 - Compacted/processed logistical material available for radiation shielding, water, or propellant.
 - Enable more hygienic crew environments through waste stabilization.
 - Increase habitable volume over mission duration through compaction.
 - Reduced mass will reduce vehicle cost.



LRR Overview



- LRR has four hardware oriented tasks and a systems engineering task
- Six NASA centers are participating
 - HMC: ARC/JSC/MSFC/KSC/GRC
 - TTSG: KSC/GRC/ARC/JSC
 - ACS: JSC/WSTF
 - LTL: JSC/JPL/ARC





TtSG Overview



- What is it?
 - A series of space technology alternatives for converting trash and other waste materials from human spaceflight into high-value products that might include propellants, power system fuels or oxygen and water for life support.
- Products: This activity investigates promising lower TRL technologies that process waste (trash & human waste) all the way to gases which can be reused, thus saving launch mass.
- Methane, hydrogen and oxygen are all candidates for use in propulsion. Hydrogen and oxygen can also be reused for ECLSS.
- Systems Engineering Analysis task will guide the testing and selection of these technologies, which will come primarily from SBIR and other past work.



XCOR Aerospace testing methane rocket engine, January 16, 2007



TtSG Overview



- Why TtSG?
 - Reduce volume of trash - Current human spaceflight missions either carry trash during the entire round-trip mission or discard trash inside a logistic module which is de-orbited into Earth's atmosphere for destruction.
 - Produce something useful from a waste product
- Challenges
 - Miniaturization
 - Operation with minimal human interaction
 - Do not produce hazards
 - Gas cleaning and purification



KSC-01PP-0726: Workers in the Space Station Processing Facility are removing contents from the Multi-Purpose Logistics Module (MPLM) Leonardo to begin removing the contents after STS-102. The MPLM brought back nearly a ton of trash and excess equipment from the Space Station. 6



TtSG Overview



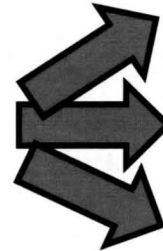
- Recycling of Elements



Human
Metabolic
Waste



Carbon
Hydrogen
Oxygen
Nitrogen
Sulfur
Aluminum



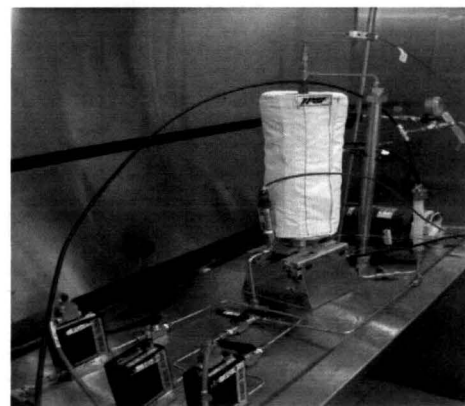
Methane

Hydrocarbons through
Fischer-Tropsch process

Oxygen, Water for life
support

Carbon Dioxide, fertilizer
for plants

???



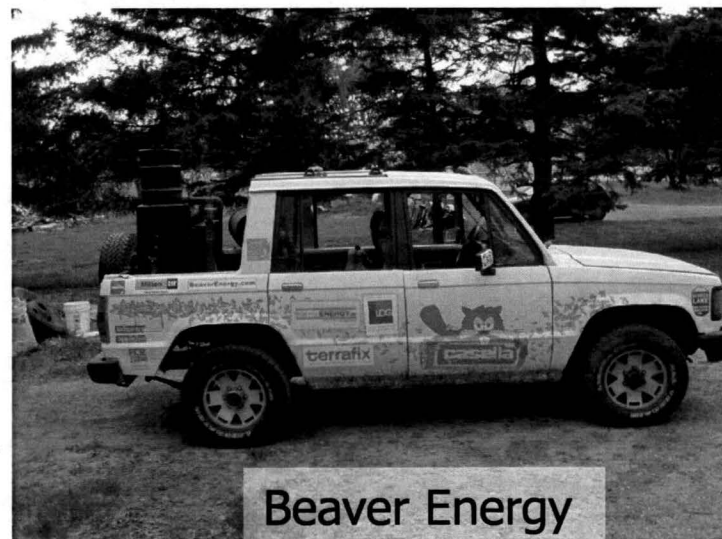
Thermal oxidation
reactor at KSC



TtSG Overview



- Wood gas car, Biofuel power generation



Beaver Energy



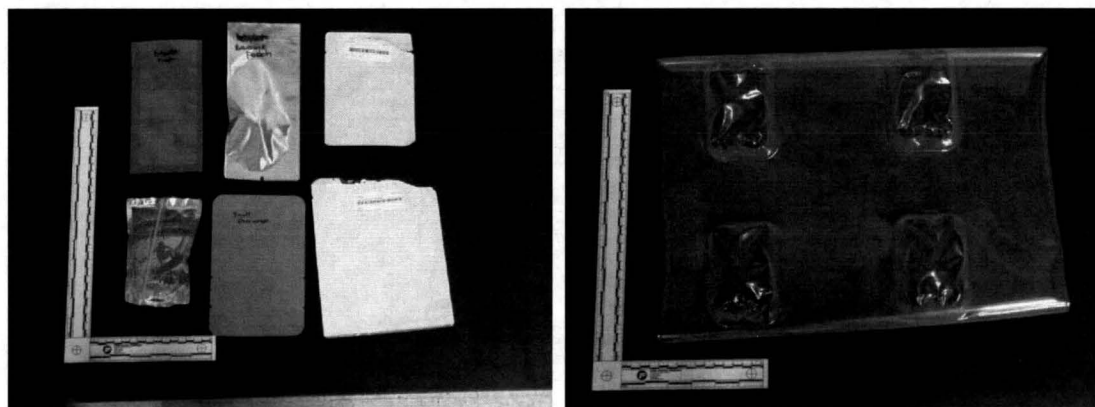
LowTechMagazine.com



TtSG Overview



- Terrestrial waste conversion technologies are currently moving towards smaller systems that operate at the generation source of waste
- TtSG ideally will accept all types of organic wastes, including microbial contaminated waste, without sorting



Food Packaging

- Thanks!
 - Thanks to collaborators at KSC, JSC, GRC and ARC