SPACE RESOURCE REQUIREMENTS FOR FUTURE PROPELLANT DEPOTS

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In 2000 and 2001 studies were conducted at the NASA Marshall Space Flight Center on the technical requirements and commercial potential for propellant depots in low-Earth-orbit (LEO) to support future commercial, NASA, and other Agency missions. Results indicate that propellant depots appear to be technically feasible given continued technology development, and there is a substantial growing market that depots could support.

Systems studies showed that the most expensive part of transferring payloads to geo-synchronous-orbit (GEO) is the fuel. A cryogenic propellant production and storage depot stationed in LEO could lower the cost of missions to GEO and beyond. Propellant production separates water into hydrogen and oxygen through electrolysis. This process requires a lot of power so a depot derived from advanced space solar power technology was defined. Figure 1 depicts a depot based on an Abacus configuration with large rotating arrays that track the sun and body mounted radiators covering large propellant tanks in a gravity gradient stabilized configuration. The tanks are sized to hold 500 metric tons of Liquid Oxygen (LOX) and Liquid Hydrogen (LH_2).

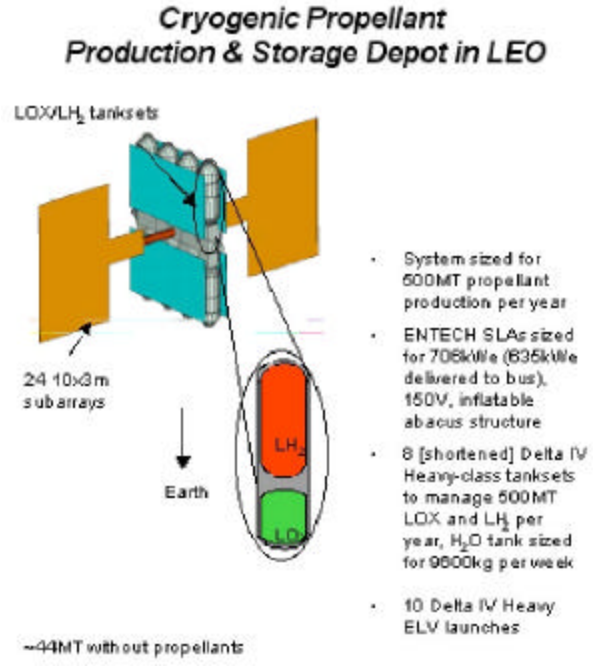

Figure 1. Propellant depot concept utilizing advanced space solar power arrays

In the scenario under study, water was delivered from Earth to docking ports forward and aft by projectiles or transfer vehicles. Electrolysis units in the center

converted the water to LOX and LH2 for storage in eight large tank sets. Docking ports at the ends of these tank sets fed transfer vehicles for refueling or propellant transfer to other spacecraft. In a parallel study the potential demand for water based propellants was determined if over time all transfer vehicles from LEO to GEO and satellite maneuvering systems were transitioned to this common system.

Results indicate that in the coming decades there could be a significant demand for water-based propellants from Earth, moon, or asteroid resources if current satellite and in-space transfer vehicles (upper stages) transitioned to water based propellant systems. This type of strategic planning move could create a substantial commercial market for space resources development, and ultimately lead toward significant commercial infrastructure development within the Earth-Moon system.