

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS (D2)  
Upper Stages, Space Transfer, Entry and Landing Systems (3)

Author: Dr. Dana G. Andrews  
Andrews Space, United States

Mr. Thomas Kessler  
Boeing Space & Communications Group, United States

Mr. Jess Sponable  
Defense Advanced Research Projects Agency(DARPA), United States

SPACE EXPLORATION SOONER AND CHEAPER USING REUSABLE SOLAR ELECTRIC TUGS  
(RESETS)

**Abstract**

NASA's Constellation Exploration Program has recently been delayed indefinitely due to future lack of funding. This has initiated studies to find ways to explore space with less infrastructure and overhead. An architecture, that looks particularly interesting, uses transportation nodes in Low Earth Orbit (LEO) and another in High Earth Orbit (HEO) or around the moon as Space Operational Nodes (SONs) to depot propellants and to collect and assemble payloads. The assembled spacecraft are then transported to their eventual use area using a low-thrust Reusable Solar Electric Tug (ReSET). The primary advantage of this architecture is that it can conduct exploration missions up to and including some human exploration missions using existing COTS launch vehicles, upper stages, and ground infrastructure. This eliminates years and billions of dollars of heavy lift launch vehicle development and test. This architecture also allows heavier payloads to be transported to exploration sites and this allows enhanced safety and reliability. Those features are described and the improvements enumerated in the paper. The ReSET Architecture is described in detail including a planned ReSET vehicle development program to grow from the initial 30 kWe FAST Array flight demonstrator, to a 200 kWe commercial reusable tug, and eventually to a 1000+ kWe reusable tug capable of human exploration missions beyond the moon. Example exploration missions for each class of ReSET element are presented with; start dates, ideal delta velocities, payload capabilities, and tug return dates. Electric thrusters suitable for various ReSET missions are also shown and design data included. The bottom line is reduced time and cost to move from where we are today, to a position where we have the data and the knowledge to determine the future role of humans in space. To document these claims, a comparison between the planned Constellation Program cost and schedules and the proposed ReSET Program cost and schedules is presented.