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Space Elevator Tether and Space Mineral Resources (3)

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SPACE POWER - A KEY RESOURCES FOR SPACE RESOURCES

Abstract

Commission III recently completed a cosmic study on Space Mineral Resources and the major impacts such a capability could have on space exploration and on expanding the wealth sphere beyond the globe of the Earth to the entire solar system. It is well known that the Moons of Saturn, specifically Titan contain more hydrocarbon resources than the entirety of the Earth. A single asteroid 1986 DA is estimated to contain 87 trillion USD worth of metals. Other asteroids contain water, ammonia, carbon in various forms as well as materials which can be used for structures, parts and supplies. Recent overhead analyses of the surface of Mars confirm the existence of ubiquitous reserves of subsurface water which could cover the surface could cover the planet to a depth of 35 meters. Recently, SpaceX calculated that for every ton of resources not taken from the surface of the Earth to Mars, approximately 76 million dollars could be saved, using very optimistic costs for transportation. The more mass eschewed from the surface of the Earth, the greater the costs avoided. However, almost nothing on the surface of Mars occurs in an immediately available and usable state, the resources except for carbon dioxide when used as a feedstock gas in its pure form for plant growth, or as a precursor in some more complex chemical process require some major energy to be made available in useable products. Drilling a 4" well bore 100 meters deep could require 100s of kWh of energy to reach large water deposits. Electrolysis requires approximately 55 kWh of energy per kg of hydrogen produced. The Sabatier process requires 8 kg of hydrogen for every 16 kg of methane produced. Capturing and compressing the CO2 requires substantial energy as well. LPS recently completed a Phase I NASA SBIR on multi-physics modeling of a Nuclear Thermal Rocket engine, and has submitted a proposal for a Phase II project. LPS submitted a new Phase I NASA SBIR on using components of the NTR engine, (fuel elements, moderator, controls, etc.), for a space nuclear power system. This paper analyzes the possible power requirements for a highly robust Mars ISRU-based exploration effort and how much mass can be avoided launched from Earth. This will provide the reader with an understanding of potential costs avoided, and what would be the necessary price to charge for electrical power to make this a commercially viable venture.