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SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (4)

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DEFINING A SUCCESSFUL COMMERCIAL ASTEROID MINING PROGRAM

Abstract

Continued growth in world's Gross Domestic Product (GDP) depends on continued growth in affordable energy and technology development. Both are endangered by serious future shortages. The world currently depends on fossil fuels for 81 percent of its primary energy, but oil is at, or near, peak production, and coal is being phased out to reduce global warming. We need affordable renewable sources of energy, but non-hydroelectric renewables provided only 2 percent of the world's energy consumption in 2010. The problem is cost and risk. Renewable energy can't compete head to head with fossil fuels because many of the key technologies are either too expensive or unproven. They are too expensive because they rely on critical metals that are very expensive, because of poor ores and expensive infrastructure. Our technology development is endangered for the same problem, i.e. the rising cost of key rare earth elements in near future. Computer chips and flat screens need trace amounts of various scarce elements and reserves of these elements are in such short supply that costs have been doubling every year. Many of the critical metals required were deposited on the Earth's crust by meteor impacts after the crust cooled, so the supply is limited. These elements are primarily: gold, cobalt, iron, manganese, molybdenum, nickel, osmium, palladium, platinum, rhenium, rhodium, ruthenium,and tungsten. Logic says that at some time in the future, space resources will become competitive with ground-based resources as nonrenewable earth resources are depleted. The purpose of our paper is to project how soon that might happen To do that, we have designed a space transportation architecture specifically aimed at putting mining equipment on selected near earth asteroids for the lowest Life Cycle Cost (LCC) possible. The major elements we are currently analyzing are: the ETO system (both reusable and low cost expendable), the LEO Space Operations Center (SOC), where payloads are collected and redistributed, the earth-to-asteroids transportation system (both high-thrust and low-thrust two-way systems are being considered), the asteroid payloads (mining equipment and habitats), and finally the mining product return element (a variety of robot reentry capsules are being analyzed). We are basing costs on the results of previous NASA-funded studies and some commercially-developed cost estimating tools. Planetary Resources is a local company and they are helping us with business insight and technical data.