Geophysical Research Abstracts
Vol. 19, EGU2017-1665, 2017
EGU General Assembly 2017

Solar Power Satellites: Reconsideration as Renewable Energy Source Based on Novel Approaches

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Solar power satellites (SPS) are a solar energy generation mechanism that captures solar energy in space and converts this energy into microwave for transmission to Earth-based rectenna arrays. They offer a constant, high integrated energy density of ∼200 W/m2 compared to <10 W/m2 for other renewable energy sources. Despite this promise as a clean energy source, SPS have been relegated out of consideration due to their enormous cost and technological challenge. It has been suggested that for solar power satellites to become economically feasible, launch costs must decrease from their current $20,000/kg to <$200/kg. Even with the advent of single-stage-to-orbit launchers which propose launch costs dropping to $2,000/kg, this will not be realized. Yet, the advantages of solar power satellites are many including the provision of stable baseload power. Here, I present a novel approach to reduce the specific cost of solar power satellites to ∼$1/kg by leveraging two enabling technologies – in-situ resource utilization of lunar material and 3D printing of this material. Specifically, we demonstrate that electric motors may be constructed from lunar material through 3D printing representing a major step towards the development of self-replicating machines. Such machines have the capacity to build solar power satellites on the Moon, thereby bypassing the launch cost problem. The productive capacity of self-replicating machines favours the adoption of large constellations of small solar power satellites. This opens up additional clean energy options for combating climate change by meeting the demands for future global energy.