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Technology

ENABLING GLOBALLY AVAILABLE POWER ON DEMAND AT THE MOON

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ABSTRACT

The key to enabling continuing human and robotic access to the surface of the moon for science, exploration, settlement, and economic development is readily available power on demand. The state of the art for providing this power relies on the use of either photovoltaic (PV) arrays and/or radioisotope thermoelectric generators (RTGs). Unfortunately, surface assets anywhere other than within a small region near the lunar south pole can be expected to experience up to 14 days of consecutive darkness making PV use at that time impossible. For most users, RTGs are financially prohibitive. Without power from one of these sources, a lander, rover, or human habitat has a very high likelihood of not surviving the lunar night.

NASA's Moon2Mars Blueprint Objectives (September 2022) call for "LI-1: Develop and incremental lunar power generation and distribution system that is evolvable to support continuous robotic/human operation and is capable of scaling to global power utilization and industrial power levels." Many of the currently proposed technologies to meet this goal will not be capable of providing "global power" nor will they enable "continuous" access to power for multiple, distributed surface assets. This need is universal and applies to NASA, our international partners, other government agencies, and commercial space interests.

The recently-released NASA report on Space-Based Solar Power mentions the possibility of using beamed power on the moon to meet the aforementioned needs. In response, NASA MSFC, in collaboration with our partners, performed a preliminary concept feasibility study of placing a spacecraft in low lunar orbit capable of beaming energy from space to multiple surface assets using either RF or optical power beaming systems. The study produced a non-optimized concept proving the development of a space-based continuous-power solution is feasible using the adaptation of existing terrestrial power beaming systems.

The goal of this study was to inform a possible future NASA lunar power beaming infrastructure that would make abundant power available to users across the moon, including during the lunar night. Products of the study to be described include: 1) a better understanding of the needs of the potential user community, 2) identification of key technology challenges, 3) highlighted overlap of needs and capabilities that exist

with efforts at other organizations, specifically those within the U. S. Department of Defense, 4) an assessment of the feasibility and potential issues associated with creating a commercial lunar power utility, and 5) recommended next steps.