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A SOUTH POLE SOLAR ENERGY INFRASTRUCTURE TO POWER UP THE LUNAR ECONOMY

Abstract

A recent NASA Innovative Advanced Concepts (NIAC) report, titled TransFormers for Lunar Extreme Environments, determined that a set of solar reflectors placed at strategic locations around Shackleton Crater, at the lunar South Pole, receive solar illumination for a combined total duration of over 99 percent during the year. The network of reflectors would be able to redirect solar energy in a coordinated way, into 'oases of energy', inside the permanently shaded crater (or at locations outside, if needed). Specific energy network designs allow trade-offs of network parameters, between number of heliostat reflectors, their locations, size of reflectors, height above ground to which reflectors are raised, etc. The oases of energy, under redirected sunlight, would allow sunlight heated equipment to be face only mild terrestrial temperatures, and power operation of ISRU equipment that mines and extracts hydrogen and oxygen. Exploration rovers could roam around in 'moving oases' changing location as the pack performs exploration; a single reflector powers an entire team of robots, unlike an RTG, which only powers a single robot. Humans, in hotels, or habitats, would be in thermal comfort within the sunlit oases, despite the below 100K temperatures a short distance away. The solar infrastructure would extend tens of kilometers from the South Pole, including peaks with positions favorable for sun-tracking reflectors and permanently shaded regions where resources are in most abundance. The solar energy infrastructure would in effect power up a lunar economy. In its literal meaning the infrastructure would ensure the power to data/information services and science robotic missions, communication equipment and sensor networks, to robots performing mining and construction work, to businesses providing tourist accommodation and travel at attractive destinations. It could power electromagnetic launchers that would place payloads in lunar orbit. In a figurative way, the powering up of economy is linked to lowering barriers of entry to businesses. As opposed to the existing mode of operation in which every asset comes with its own power/heater, a new business model emerges where power/thermal is provided as an utility service and payment is at use time, based on need/consumption. Businesses entering the lunar economy would not incur upfront costs for thermal and energy needs, charged regardless the mission arrives successfully at destination or crashes at landing, but instead start incurring costs only when mission is on the lunar surface and ready to operate.