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Lunar electrical power utility: Key to lunar development

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Abstract

The global acceptance of the International Lunar Decade (ILD) will enable infrastructure projects like the lunar electrical power utility [1] to be constructed ahead of the emergence of demand for the electrical power. Availability of electrical power has been a primary driver of economic development. One example: The Tennessee Valley Authority (TVA), was launched by an act of the U.S. Congress in 1933, resulting in hydropower plants being built throughout the Tennessee Valley to provide power to seven southeastern US states. Future demand was hard to forecast insofar as the region had been largely without electrical power. TVA built the dams and industry emerged in the region to use the generated power. In WWII aluminum production was located in the region as well as a significant share of the Manhattan project that required huge amounts of electrical power.

Important uses of electrical power on the Moon include power for ISRU to process lunar regolith and other lunar materials into products including oxygen, metals, silicon for solar cells, basalt fiber, and other uses. The ready availability of electrical could double the productivity of rovers and other equipment on the lunar surface by enabling operating during the two weeks of lunar night without requiring large-scale power storage. A highly promising use of electrical power could be to make possible low-cost launch from the lunar surface using one of several options that require significant electrical power including beam launch, rail-gun derived electromagnetic launch and others. Low-cost launch from the lunar surface in turn would enable vastly increased use of lunar materials enabling the construction of large-scale facilities in outer space that otherwise would be impossibly expensive if launched from Earth. Even launched from the Moon with conventional technology would be impractical.

Our power generating approach of choice is space-based solar power (SBSP) as proposed by NASA researcher Jim Schier [2]. In Schier's concept two SBSP systems in halo orbits about the Moon could cover the entire surface of the Moon.

Given that the system with two satellites is financed and firmly in the forward plan with sufficient power generating capacity to power rovers, pilot ISRU production operations, and experiments with low-cost launch from the Moon, then such equipment could be designed to receive the power from the SBSP system. Standards could emerge for power-beaming and receiving equipment contributing to moderate and lower costs. Avoiding the cost of landing equipment with sufficiently large battery systems to power equipment through the lunar night would further contribute to declining costs.

Utilities serving customers on Earth have developed financing mechanisms for projects that require a decade or more to start generating electricity and selling power to rate paying customers. The lunar power utility could be seen as analogous to such terrestrial utilities. It is plausible that a consortium of utilities could find such a project of considerable interest. First, it would attract favorable public attention establishing them as technology leaders. Second, the development and the piloting of the technology in lunar applications can position the utilities to apply similar technologies to meet needs of customers on Earth.

Government guarantees, and risk management instruments are likely to be required to encourage private investment in such a venture. But such arrangements are not uncommon.

We argue that the lunar power utility should be an early project in the development of lunar industries fulfilling the vision of “Build it, and they will come!

References

[1] The concept of a private lunar power utility in this paper first presented in V. Beldavs, D. Dunlap, J. Crisafulli, and B. Foing 2015 "The lunar electrical power utility", The Space Review, retrieved from http://www.thespacereview.com/article/2860/1

[2] Jim Schier 2015 “Concept for a Lunar Power and Communications Utility”, http://spirit.as.utexas.edu/~fiso/telecon/Schier_10-14-15/Schier_10-14-15.pptx