# In-Situ Electric Power Generation To Support Solar System Exploration and Colonization: Manufacture of Thin Film Silicon Solar Cells On The Moon

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The long-term exploration and colonization of the solar system for scientific research and commercial development is critically dependent on the availability of large amounts of electrical energy. Robotic and human presence in space requires self-sufficiency, including a self-sustaining electrical power system, which can be attained through the development of autonomous processing and fabrication systems that utilize indigenous off-Earth resources.

The use of indigenous planetary materials to create productive capacity on another planet is the basis of the concept called "bootstrapping." Within this concept, silicon solar cell energy systems can be produced and erected on the Moon and, eventually, on Mars, using indigenous materials. This capability is entirely consistent with deployment by small robotic missions that can be undertaken in the next decade. This demonstration of bootstrapping shall change the way in which we approach the development of human and/or robotic outposts on the Moon and Mars.

Thin film silicon-based solar cells would be vacuum deposited directly on the surface of the Moon by a facility that incorporates regolith processing to produce PV-grade silicon and has the capacity to fabricate a 1 MW power system over a period of several years. This unique approach for the emplacement of a safe electric power system would require the transportation of a much smaller mass of equipment to the Moon than would otherwise be required to install an equivalent power system. It would result in a power system that is repairable/replaceable through the simple fabrication of more solar cells.

Our paper discusses how thin film silicon solar cells can be fabricated by vacuum deposition of indigenous silicon, iron and other materials generated by the processing of the lunar regolith and/or minerals; the production of the required elements in the appropriate purity by chemical means, including carbothermal reduction; and the step wise deposition of layered components which can produce silicon solar cells of sufficient efficiency directly on the lunar surface and/or suitable substrates for the installation of 1MW of power on the Moon over a period of years.