SPACE POWER SYMPOSIUM (C3)
Architectures, concepts and systems for space power (3)

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A REAL OPTION ANALYSIS OF THE FINANCIAL VIABILITY OF SPACE BASED SOLAR POWER VENTURES

Abstract

Space Based Solar Power (SBSP) has been idealized as a clean, abundant and cost-conscious form of future energy. While it is rather straightforward to conceptualize the clean and abundant descriptors, financial viability has been elusive. Recently, the authors determined that given a salutary regulatory environment, three primary factors influence the cost of SBSP. These include, in order: 1) the cost of converting photons to electricity, thence microwaves in space; 2) the cost of integrating space hardware for SBSP on Earth and subsequent in-space assembly of extremely large structures; and 3) cost of launch to orbit. Heliosat and its partners have been on the forefront of tackling these issues and have developed a technical approach to two of these items that appears poised to make a dramatic difference in SBSP cost structuring.

Historically, SBSP has had to contend with the associated costs of developing an entire infrastructure in order to fit into a highly competitive utility environment. Furthermore, SBSP had no historic transitional or interim markets, consequently, it was faced with the Gordian knot of either zero watts or gigawatts, with the latter having low prices per watt in a competitive environment, making an investment case exceptionally difficult. However, given the military's recent focus on total system costs, the costs associated with electrical power generation at remote sites has become acute. It is into this niche, but non-trivial market that SBSP might find its first home, leaving larger systems for later insertion if, and when feasible.

In this paper we develop a robust financial valuation model of a startup company that will develop, build and operate a set of SBSP systems designed to supply forward military bases with electricity. Our financial model adds several contributions to the existing literature analyzing the business case for SBSP. First, we explicitly take into account two salient features of a private SBSP venture that have not been previously modeled – 1) the capital investments to develop a functioning SPSP system are made not in one lump-sum but spread over a significant period of time and at every point of time investments can be increased, decreased or even abandoned depending on market conditions; and 2) if a company becomes successful in building and operating a small-scale SBSP system for military needs, it can then raise significant amounts of private capital and develop larger scale systems for base-load power generation, again only if the future market conditions make such investments profitable. Both features add significant flexibility to respond to future market conditions and allow the company to capture substantial profits when market developments are positive with limited downside when market developments are negative. We use real option analysis to model the flexibility of a SBSP venture to respond to future developments without making large upfront commitments. The real option framework shows that the large uncertainty associated with SBSP, which previously has been cited as one of SBSP's major drawbacks, actually increases the value of the enterprise.

Second, we utilize the latest technological advances made by Heliosat Inc, in order to provide a realistic cost basis for military-use systems. We incorporate the latest information from Heliosat's partner,

Lockheed Martin Space Systems to analyze the impact of large-scale space systems production cost minimization based on the Iridium program. The use of combined cycle solar dynamic systems appears to possess true advantages in terms of cost, mass and most importantly, risk allocation. The same is true for Heliosat's innovative hybrid launch architecture. Each of these systems seems to exhibit the virtues of employing basic advances to existing technologies to reduce cost, while employing them with unique technologies and in modes that dramatically improve efficiency, cost and mass.

Our real option valuation model built around Heliosat's technological advancements demonstrates that, under a large set of feasible parameters, a SPSP venture supplying energy to forward military bases has strictly positive net value. We therefore conclude that SBSP is economically viable and can be developed by a privately-financed company.