

SPACE POWER SYMPOSIUM (C3)
Wireless Power Transmission Technologies, Experiments and Demonstrations (2)

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CRITERIA FOR COMPARING POWER BEAMING DEMONSTRATIONS

Abstract

Power beaming, alternately known as long-distance wireless power transmission, is a critical element for the vast majority of solar power satellite concepts. The vision of space solar entails the collection in space of unimpeded sunlight for wireless transmission to earth for terrestrial consumption. Depending on the orbit employed, the distance the wireless power link must span may be hundreds, thousands, or hundreds of thousands of kilometers. While many compelling demonstrations of power beaming capabilities have been accomplished in the preceding decades, a meaningful basis for the comparison and assessment of their applicability for space solar and other applications has yet to become widespread. Because the requirements for precursor demonstrations of space solar techniques and technologies will in large part be informed by the wireless power link's constraints, this void must be filled. This paper endeavors to lay out a basis of comparison for past and future demonstrations of power beaming capabilities. The challenge is heightened by the wide range of frequencies and technologies that could be employed for such links, each with disparate advantages and disadvantages. For microwave frequencies, the advantages of comparatively low power density and weather outage resistance are counterbalanced by severe spectrum allocation challenges. For laser wavelengths, the advantages of smaller aperture sizes and avoidance of the radio spectrum are counterbalanced by geopolitical challenges. For any electromagnetic power beaming link, considerations of beam efficiency, device conversion efficiencies, and atmospheric effects must be assessed as well. By reviewing and comparing notable historical power beaming demonstrations, the most fruitful areas for forward development may be identified and pursued.