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# SOLAR SOLUTION FOR A GEO MEGASTRUCTURE HOSTING POWER INTENSIVE PAYLOADS

**Abstract**

To accommodate high energy consumption payloads for a 50-year mission in geostationary orbit, an unmanned megastructure is one solution. Our student team put forth a concept of such a megastructure called the Hestia Hub. The geometry of such spacecraft will pose specific challenges in terms of solar power solutions. Degradation, operational longevity, continuous power supply and shadows cast by the hosted payload will require innovative approaches to solve them due to the nature of the mission. Moving away from conventional flat solar panels, this report will explore the use of arc-shaped configurations, integrating multi-junction solar cells for efficiency and optimization. However, the limited lifetime of these cells raises critical questions that require innovative solutions.

On one hand, this study examines the problems intrinsic to hub circular geometry, focusing on the complexity of maintaining solar power efficiency over the course of a half-century mission. One of these problems is the shadowing effect caused by the deployment of payloads, which prevents the optimal placement of solar panels. Another is the inevitable degradation and wear of the solar cells. To overcome this problem, a proactive strategy of progressive replacement of the solar panels will be studied to ensure an uninterrupted and reliable power supply to the hosted payloads. This strategic approach aims to maximize the operational life of the multi-junction solar cells while guaranteeing a constant power supply to the hosted payloads in a sustainable way. The high level study provides a detailed analysis of the technical complexities involved in implementing this progressive replacement, addressing the performance characteristics, logistical challenges and integration issues associated with the new solar panels.

The results not only address the unique challenges of the mission, but also offer a model for overcoming similar obstacles in the future development of space infrastructure for long-duration space missions. Serving as a guide for space engineers and planners, the study proposes proactive strategies for ensuring continuous, reliable solar power in the demanding environment of geostationary orbit.