IAF SPACE POWER SYMPOSIUM (C3)
Wireless Power Transmission Technologies and Application (2)

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LASER-MICROWAVE ENERGY TRANSMISSION: A HYBRID SBSP SOLUTION FOR SUSTAINABLE ANTARCTIC APPLICATION

Abstract

In the last decade, the CO 2 pollution level and the excessive exploitation of fossil fuels brought out the need of renewable sources. Nevertheless, at high latitudes even these show several problems such as the unreliability to use wind turbines, because of strong winds and freezing temperatures, and solar panels, due to poor lighting conditions. Taking into account the prohibitive delivered costs of fuels and in order to fulfill a complete transition to "green" energy sources, a space based solar power system (SBSP) seems to be the optimal solution to overcome these limits. Currently, the main SBSP concepts involve the use of either microwaves or laser for power transmission on Earth. Both are not feasible in the upcoming future, the former due to extremely large sizes of the space segments for long distance transmission and the latter because of atmospheric attenuation and safety issues concerning humans and infrastructures. In the presented work the challenging problem has been tackled by comparing the above-mentioned technologies, their pros and cons and how they can be combined. Considering the short-term feasibility and how the orbital parameters affect the performances, a hybrid modular solution has been chosen by reason of subsystem analysis. This concept comprises GEO satellites that harvest solar energy and transmit it via laser to a polar LEO constellation. The LEO satellites perform a double conversion,

i.e., laser to DC and DC to microwaves that will be then received by a ground rectenna. The choice of laser for space-to-space power transmission allows to reduce the space segment sizes and to take advantage of its high efficiency. On the other hand, microwaves are best suited to transmit energy to the ground because they are less affected by atmospheric disturbances As a case study a mission aiming to energy supply research antarctic bases is considered. However, the system modularity and the future development of the technologies might allow its application to high-energy-demanding scenarios. Moreover, the laser segment could be adapted to orbit servicing purposes. In conclusion, the choice focuses on a concept that favors the short-term feasibility rather than a high efficiency, which losses don't lead to a huge waste due to the free-limitless primary energy source.