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Department of Electrical & Electronics Engineering



**SEMINAR REPORT 2020-21**

**Semester: I**

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| **Seminar Title** | | | Space Based Solar Power | |
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**ABSTRACT:**

Space-based solar power (SBSP) is the concept of collecting solar power in space (using an "SPS", that is, a "solar-power satellite") for use on Earth.   In conventional solar power generation a considerable fraction of incoming solar energy (55–60%) is lost on its way through the Earth’s atmosphere by the effects of reflection and absorption. Space-based solar power systems convert sunlight into microwaves outside the atmosphere thus avoiding these losses.

**INTRODUCTION:**

Every hour more solar energy reaches the earth than humans use in a year. About 30% of this energy is reflected back into the space by the atmosphere. Space-based solar power (SBSP) is the concept of collecting solar power in space (using an "SPS", that is, a "solar-power satellite") for use on Earth. It has been in research since the early 1970s. SBSP would differ from current solar collection methods in that the means used to collect energy would reside on an orbiting satellite instead of on Earth's surface. Some projected benefits of such a system are a higher collection rate and a longer collection period due to the lack of a diffusing atmosphere and night time in space. Part of the solar energy (55-60%) is lost on its way through the atmosphere by the effects of reflection and absorption. Space-based solar power systems convert sunlight to microwaves outside the atmosphere, avoiding these losses, and the downtime due to the Earth's rotation.

**HISTORY AND DEVELOPMENTS:**

(1973)

 The SBSP concept, originally known as satellite solar-power system (SSPS), was first described in November 1968. In 1973 Peter Glaser was granted U.S. patent number 3,781,647 for his method of transmitting power over long distances (eg. from an SPS to Earth's surface) using microwaves from a very large antenna (up to one square kilometer) on the satellite to a much larger one, now known as a rectenna, on the ground.

**Satellite Power System Concept Development and Evaluation Program (1978-1986)**

Between 1978 and 1986, the Congress authorized the Department of energy (DoE) and NASA to jointly investigated the concept. They organized the Satellite Power System Concept Development and Evaluation Program. Several reports were published investigating the engineering feasibility of such an engineering project. They include:

* Resource Requirements (Critical Materials, Energy, and Land)
* Financial/Management Scenarios
* Public Acceptance
* State and Local Regulations as Applied to Satellite Power System Microwave Receiving Antenna Facilities
* Student Participation
* Potential of Laser for SBSP Power Transmission
* International Agreements
* Centralization/Decentralization
* Mapping of Exclusion Areas for Rectenna Sites
* Economic and Demographic Issues Related to Deployment
* Some Questions and Answers
* Meteorological Effects on Laser Beam Propagation and Direct Solar Pumped Lasers
* Public Outreach Experiment
* Power Transmission and Reception Technical Summary and Assessment
* Space Transportation

The project was not continued with the change in administrations after the 1980 US Federal elections.  The Office of Technology and Assessment concluded that "Too little is currently known about the technical, economic, and environmental aspects of SPS to make a sound decision whether to proceed with its development and deployment.

**NASA’s "Fresh Look” Study: (1997)**

**The IAA Study of Space Solar Power: (2011)**

The International Academy of Astronautics (IAA) has conducted the first broadly based international study of the concept of space solar power. The goals of the study were to determine what role space solar power (SSP) might play in meeting the rapidly growing need for abundant and sustainable energy during this century, to assess the technological readiness and risks associated with the SSP concept, and (if appropriate) to frame a notional international roadmap that might lead to the realization of this visionary concept.

Some of the findings of IAA were:

1: Solar Power Satellites appear to be technically feasible as soon as the coming 10-20 years using technologies existing now in the laboratory (at low- to moderate- TRL) that could be developed / demonstrated (depending on the systems concept details).

2: There are several important technical challenges that must be resolved for each of the three SPS systems types examined by the IAA study. S

3 : Low-cost Earth-to-orbit transportation is an enabling capability to the economic viability of space solar power for commercial baseload power markets. energy reaches

### Japan Aerospace Exploration Agency (2015):

The May 2014 IEEE Spectrum magazine carried a lengthy article by Susumu Sasaki. The article stated, space-based solar power could at last become a reality—and within 25 years, according to a proposal from researchers at the Tokyo -based Japan Aerospace Exploration Agency (JAXA)."

JAXA announced on 12 March 2015 that they wirelessly beamed 1.8 kilowatts 50 meters to a small receiver by converting electricity to microwaves and then back to electricity. This is the standard plan for this type of power.[[37]](https://en.wikipedia.org/wiki/Space-based_solar_power#cite_note-ATarantola-37)[[38]](https://en.wikipedia.org/wiki/Space-based_solar_power#cite_note-PKT-38) On 12 March 2015 Mitsubishi Heavy Industries demonstrated transmission of 10 kilowatts (kW) of power to a receiver unit located at a distance of 500 meters (m) away.

**DESIGN AND WORKING:**

Space-based solar power essentially consists of three elements:[[2]](https://en.wikipedia.org/wiki/Space-based_solar_power#cite_note-DOE-SBSP-2)

1. Collecting solar energy in space with reflectors or inflatable mirrors onto solar cells or heaters for thermal systems.
2. Wireless power transmission to Earth via microwave or laser.
3. Receiving power on Earth via a rectenna, a microwave antenna
4. Collecting solar energy in space:

r panel equipped, energy transmitting satellites collect high intensity, uninterrupted solar radiation by using giant mirrors to reflect huge amounts of solar rays onto smaller solar collectors. This radiation is then wirelessly beamed to Earth in a safe and controlled way as either a microwave or laser beam.

Every hour, more solar energy reaches the Earth than humans use in a year