

Policy Issues for Retail Beamed Power Transmission

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Research Question

This paper discusses the interaction of technology and policy in enabling widespread rural access to clean solar electric power using retail delivery of beamed power. Recent advances in power beaming have made it possible to deliver electric power to off-grid locations using millimeter-wave beams and compact, efficient transmitters and receivers. The research question is how to bring about the public policy initiatives needed to enable widespread adoption of this clean and sustainable contribution to meeting energy needs. It is seen that this question leads to synergy between three national priorities: (a) the campaign to control global climate change, (b) the drive to improve air quality, and (c) the need for increased availability of energy for development.

Our solution includes a unique combination of space and ground based technologies to achieve the needed efficiency and cost effectiveness in beamed power systems. Furthermore, we propose a modular and scalable approach to beamed power transmission on the ground, which aids in the reduction of costs throughout the lifecycle of the grid system components. This concept will facilitate realizing the vision of the National Energy Technology Laboratory of the United States for the modern power grid.

Currently, most electric power on Earth is transmitted using wired power transmission systems. In this system, electrical power is transmitted from the source of power generation to the point of power consumption through an appropriately shaped conductive material. In contrast, beamed (wireless) power transmission uses electromagnetic radiation (microwave or lasers) for power transfer. First demonstrated in 1897 by Nikola Tesla using radio frequencies, and using microwaves in 1964 (Brown, 1992), wireless transmission was extended to tens of kilowatts by NASA in 1975. In the 1980s, beams of up to 1GW were considered (and possibly demonstrated) under the Strategic Defense Initiative (aka “Star Wars”). The concept of bringing solar power from large satellites in space or on the Moon, have been explored since the 1960s, both in the USA and outside, notably in Japan. These concepts have generally been stymied by the very large infrastructure needed to convert and transmit microwave beams over very large distances Komerath et al (2,3).

The idea of linking the Space Solar Power concept and the terrestrial renewable energy market came from the “8th Continent Chamber of Commerce” project where space commercialization concepts were studied. Given the large needs for energy in agriculture, farms were identified as ideal locations to receive retail beamed power from spacecraft, aircraft or other transmitters /

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relays of power from renewable power plants. Chowdhary and Gadre studied the **Beamed Power Transmission System (BPTS)** (5) to see how to synergize its various attractive features with the needs and opportunities in rural communities and farms. In this paper, we describe the public policy aspects of this research.

NETL vision and BPTS

The National Energy Technology Laboratory of the US has put forward a vision for the new US grid infrastructure (4). Under this vision the modern grid is expected to be sufficiently flexible to handle distributed energy generation both in large and small scale. It needs to be reliable and robust against attacks. It needs to be self-healing, and it needs to have integrated capability of communicating with users. Furthermore, the modern grid needs to be “green”, that is, there should be a minimum waste of material and emission of hazardous byproducts in its construction and maintenance. BPTS provides ideal solutions for these issues. It can be cost effective over a short distance. It requires considerably less material, infrastructure and land for its operation. BPTS demands relatively low maintenance. It is less susceptible to attacks and accidental power outage. It is also very conducive “smart” technologies including auto fault diagnosis and fault tolerance, advanced communication with end users, and rapid adaptation to varying demands. The modularity afforded by independent transmitting and receiving units makes fault diagnosis and fault tolerance as well as changing the grid topology relatively easy. The cost effectiveness of BPTS is also compelling, especially if one considers the long term costs. Furthermore, since BPTS is conducive to “green” technologies and it is inherently less wasteful than wired power transmission, BPTS users can avail themselves of proposed “green credits” which can be used to offset some initial costs.

Public Policy Issues: Retail beaming of millimeter waves raises several issues, such as ensuring safety (and removing superstitions regarding cooked chickens etc), frequency band allocation, ITAR issues of millimeter wave technology, land co-use and line-of-sight / airspace access issues, and policies to encourage synergy between global warming control policy, renewable power generation, agriculture, and technology development issues.

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