**Space Solar Power to Solve the Climate Crises**

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**Abstract**

Climate change represents an existential threat to human civilization. Tragically, society has yet to develop either the binding legislation or the technological innovation required to fulfill the necessary steps of (1) reducing greenhouse gas (GHG) emissions and (2) scaling up carbon capture, utilization and storage (CCUS) of current atmospheric GHGs at sufficient scale to prevent global ecological disaster and economic catastrophe. This paper aims to introduce one promising solution to the climate community which could assist with both of those requirements: “Space Solar Power”. This proposed technology would harvest solar energy in orbit and transmit it down wirelessly to receiving stations on Earth via microwaves or lasers, for distribution to existing utility infrastructure. Space Solar Power would offer a clean, sustainable, essentially unlimited power source, free for the taking and vastly more efficient than terrestrial solar power, providing baseload power for any desired customers worldwide. SSP offers the tantalizing prospect of replacing fossil fuel use by offering lower costs per watt, and of powering CCUS to remove GHGs without adding any additional terrestrial waste heat or pollution. Some SSP development efforts are currently underway in China, Europe, UK, and the USA but nationally-organized plans and substantial government support are required to accelerate development in time. Technical summaries, risks, barriers to advancement, and recommended next steps are presented to set out a path forward for government support.

**Keywords**

Space solar power; climate change; climate solutions; technology innovation

**Introduction**

 - Discuss the climate threat

 - Discuss attempts at legislation, and their limits

 - Review other technological solutions proposed and their flaws (ie. geoengineering)

 - Fusion power: it might happen, but we are still waiting and can’t rely on hope

 - SSP is a tech whose time may have finally come

**What is Space Solar Power?**

 - Explain the technical

**How can Space Solar Power Help?**

 - Clean, more efficient, and baseload = cost competitive with existing

 - Provide a clean alternative to fossil fuels (cars are going electric, planes will eventually)

 - Vastly improved efficiency than terrestrial solar power (never night, no clouds, above atmosphere)

 - Baseload (so no batteries required, and can honestly replace coal and nuclear)

 - Thus, economically competitive with existing options

**Additional Benefits of Space Solar Power**

 - Energy independence for each nation

 - End the growing fight over diminishing energy resources

 - Energy stability (no more radical price fluctuations)

 - Lift over 1 billion people out of poverty

 - Democratize global access to energy

 - Springboard to space development, space mining, colonization, and protection of Earth from asteroids

**History of Space Solar Power Development**

 - Tesla did some stuff, but that’s not what we’re talking about

 - Distinction between magnetic inductive coupling (localized) and long-distance radiative

 - Bill Brown, 1960s, rectenna, serious tech demos

 - Peter Glaser and SSP, 1968

 - Goldstone, 1975, still the gold standard / benchmark test demo

 - US Government did some studies

 - Various tests since, around the world

**Various designs in Space Solar Power**

- Describe some proposed designs (ie. SPS ALPHA*,* CASSIOPeiA, etc.)

**Latest Efforts in Space Solar Power**

 - Efforts are ramping up (motivation: climate AND energy independence AND space supremacy)

 - China tests and promises

 - UK plans, some funding

 - ESA recent announcement

 - USA: Northrup, Caltech, USAF, with SpaceX launch

**What is still required technologically**

 - Lower launch costs (happening with SpaceX and others)

 - Demonstrate wireless power transfer over long distances, at high power, safely

 - Beam steering and targeting over vast distances

 - Power beam not interrupting comms (side lobe levels)

**Risks and barriers**

 - Upfront cost

 - Long development timeline, politically vulnerable to cancelation

 - Technological viability (can it be done?)

 - Defense concerns (misuse, protecting from attack, dependence on a space asset)

 - Health and safety concerns (people in pathway, atmosphere, environment, wildlife)

 - Bandwidth and interference concerns (jamming)

**Pathway to Accelerating Development**

 - In Western world, the costs must be justifiable to the spenders

 - Businesses need near-term profits

 - Governments need to serve public interests

 - Elected officials need political wins, control, exposure, advancement, and re-election

 - For businesses to get involved, they need the prospect of profit, such as advance contracts for energy production, or contracts for the component technologies as near-term products and services

 - For governments to get involved, they need to be serving near-term public needs. Those needs could be met through defence products and services

 - Cost is large, so governments should fund first steps (component pieces as interim products)

**Requirements from Government to Move Forward**

 - Dedicated government commitment to funding, planning for at least two decades

 - Champions within government to start, scale, and maintain these projects

 - Global commitments to frequency allocations

**Recommended Next Steps**

 - The space solar power community needs champions in government who will advocate and navigate the halls of power to secure funding

 - Governments should fund development of the component technologies of space solar power, with each serving a near-term economic need (economically viable stepping stones)

 - In the United States for example, funding formats could include: (1) a dedicated research center to advance the economic use of space, focusing first on space solar power; (2) OTA (Other Transaction Authority) funding through various consortium managers, (3) SBIR / STTR to engage the innovative strength of small businesses, and (4) industry funding through the Department of Defense (DoD), such as US Air Force and Space Force

*USE THIS SOMEWHERE:*

*Space solar power is a critical stepping stone for the future of humanity -- the preliminary infrastructure absolutely needed in order for our species to expand out and achieve space mining, space colonization, defending Earth against asteroids, space exploration, and much more.*