



Position Paper:

Space Solar Power — An Energy Solution for Tomorrow

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The United States and the rest of the world need to find alternative sources of energy besides fossil fuels. The National Space Society believes that one of the most important long-term solutions for meeting those energy needs is Space Solar Power (SSP), which gathers energy from sunlight in space and sends it to Earth. We believe that SSP can solve our energy and greenhouse gas emissions problems. Not just help, not just take a step in the right direction; solve. SSP can provide large quantities of energy to each and every person on Earth with very little environmental impact. NSS recommends that SSP be considered along with ground-based solar collectors and wind turbines as a safe, renewable, and clean energy option.

Solar energy is routinely used on spacecraft today, and the solar energy available in space is literally billions of times greater than we use today. The lifetime of the sun is an estimated 4 to 5 billion years, making SSP a truly long-term energy solution.

Space solar power can have an extremely small environmental footprint, perhaps competitive with ground-solar and wind, because with sufficient investments in space infrastructure, the SSP can be built from materials from space with zero terrestrial environmental impact. Only energy receivers need be built on Earth.

As Earth receives only one part in 2.3 billion of the sun's output, SSP is by far the largest potential energy source available, dwarfing all others combined. Development cost and time, of course, are considerable. This makes SSP a long-term solution rather than a short-term stop-gap, although there are some intriguing near-term possibilities. In any case, SSP can potentially supply all the electrical needs of our planet.

While electricity cannot power all our vehicles today, current hybrids will soon evolve into plug-in hybrids which will, in part, use electric energy from the grid. As batteries and fuel cells get better, the gasoline engine will play a smaller and smaller role in transportation. There are huge markets for power in cell phones, hybrid

vehicles and laptops that can be expected to drive battery and fuel cell technology so that electricity will eventually power the cars of tomorrow – but not unless we can generate enormous quantities of clean electrical energy.

While all viable energy options should be pursued with vigor, SSP has a number of substantial advantages over other energy sources:

- Unlike oil, gas, ethanol and coal, SSP does not emit greenhouse gases.
- Unlike nuclear power plants, SSP will not produce hazardous waste, which needs to be stored and guarded for hundreds of years.
- Unlike terrestrial solar and wind power plants, SSP can be available 24 hours a day, 7 days a week in huge quantities. It works regardless of cloud cover, daylight, or wind speed.
- Unlike nuclear power plants, SSP does not provide potential targets for terrorists.
- Unlike coal and nuclear fuels, SSP does not require environmentally problematic mining operations.
- SSP will provide true energy independence for the nations that develop it, thereby eliminating a major source of national competition for limited Earth-based energy resources.
- SSP will not require dependence on other regions to meet our global energy needs.

SSP development costs will be large, although significantly smaller than that of the American military presence in the Persian Gulf or those associated with the impacts of substantial global warming. Technologies and infrastructure expected to enhance the feasibility of SSP include:

- *Lower-cost, environment-friendly launch vehicles.* Even if lunar materials are used to construct the space segment of the SSP infrastructure, a great deal of hardware will need to be launched from Earth. For example, the first demonstration plants will almost certainly be ground launched. Current launch vehicles are too expensive, and at high launch rates may pose atmospheric pollution problems. Cheaper, cleaner launch vehicles are needed.
- *Large scale in-orbit construction and operations.* To gather massive quantities of energy, solar power satellites must be large, far larger than the International Space Station (ISS), the largest spacecraft built to date. Fortunately, solar power satellites will be simpler than the ISS, as they will consist of many identical parts, and need not support human crews.
- *Asteroidal/lunar materials extraction and space-based manufacture of components (either in Earth orbit or on the lunar surface).* The optimum environmental benefits of SSP could derive from doing most of the work outside of Earth's biosphere. This could be accomplished using asteroid-based or lunar materials that we cannot access today.

- *Power transmission.* A relatively small effort is also necessary to assess how to best transmit power from satellites to the Earth's surface with minimal environmental impact.

All of these technologies are consistent with the laws of physics, are reasonably near-term, and have multiple attractive approaches. However, a great deal of work is needed to develop economically competitive space solar power. NSS encourages both the private sector and governments to devote substantial resources toward SSP research and development.

SSP deserves a place alongside ground-based solar collectors, nuclear power plants, and wind turbines as potential solutions to energy dependence and global greenhouse-gas- induced warming. If SSP is given serious consideration, NSS expects it will play a growing, and perhaps dominant, role in providing safe, clean, renewable energy for our planet for the foreseeable future and beyond.

About the National Space Society (NSS): NSS is an independent non-profit educational membership organization dedicated to the creation of a spacefaring civilization. NSS is widely acknowledged as the preeminent citizen's voice on space, with over 50 chapters in the United States and around the world. The Society publishes *Ad Astra* magazine, an award-winning periodical chronicling the most important developments in space. To learn more, visit www.nss.org.