



# Ultra-Light, Low-Cost Solar Concentrator Offers Unparalleled Efficiency and Performance

*Affordable Green Energy Technology from NASA/Entech Solar*



Technology developed through multiple, related Small Business Innovation Research (SBIR) contracts with Entech® Solar, Inc. in partnership with NASA's Glenn Research Center has produced a high-performance, ultra-light solar concentrator for space and ground applications. The Stretched Lens Array (SLA) uses a thin film lens to concentrate a large area of sunlight onto a small area of photovoltaic (PV) cells, with simple waste heat rejection performed by a thin sheet of thermally conductive material beneath the cells. This record-breaking technology offers unprecedented performance and cost-effectiveness by employing flexible Fresnel lenses for optical concentration, minimizing solar cell area, mass, and cost. The SLA has been optimized for the best performance, reliability, and efficiency through NASA's award-winning space demonstration on Deep Space 1. On the ground, the same basic concept is now being used with the commercial launch of Entech Solar's new terrestrial product, the SolarVolt™ module.

## Benefits of Technology Transfer

- Record-breaking solar array efficiencies of approximately 30 percent will be achieved in SLA space-optimized designs.
- PV material will be reduced by more than 90 percent, compared to one-sun modules, significantly reducing concentrator system cost for both space and ground applications.
- Dramatic decreases in cost per watt will be realized due to PV material reduction, making the SolarVolt module a reliable, low-cost green energy system.
- Powerful concentration (10X for space missions and 20X for terrestrial uses) will deliver unparalleled performance across a broad range of applications.
- U.S.-based jobs will be created as Entech Solar implements its mass production plan for the SolarVolt manufacturing facility. In addition, hundreds of construction jobs would be created to build each utility-scale PV power plant using this NASA-derived technology.

SSS  
EES  
OOS  
OOS  
RNS  
SS

## On the Record

“The story of this technology is absolutely about the Entech-NASA partnership. It was NASA’s need for a smaller, lighter weight, inexpensive technology that drove the work and pushed the envelope to achieve these extraordinary results.” — *Rosbanak Hakimzadeh, Deputy Chief Technologist, NASA’s Glenn Research Center*

“What makes this technology interesting and applicable for both ground and space is its use of low-cost, very thin, extremely error-tolerant, and mass-producible lenses to capture and focus sunlight a number of times onto smaller solar cells.” — *Mark O’Neill, Chief Technology Officer, Entech Solar, Inc.*

“The SLA is a spectacularly enabling technology for electric propulsion in space.” — *Tim Glover, Director of Development, Ad Astra Rocket Co.*

## About Entech Solar, Inc.

Entech Solar of Fort Worth, Texas, is a leading developer of solar energy technologies and sustainable daylighting solutions. The company designs, manufactures, and markets concentrating PV solar modules that produce electricity from sunlight. Headquartered in Fort Worth, Texas, the Entech Solar team has been developing, field testing, refining, and commercializing Fresnel lens concentrators for more than three decades.

## Technology Origins

The SLA is a unique technology that uses ultra-thin arched Fresnel lens concentrators to focus sunlight onto high-efficiency solar cells. Although the materials are different, the fundamental design is similar for space and ground PV concentrators. In space, the need is to minimize weight, while the focus on the ground is to reduce cost. The material efficiency of the SLA is critical to both. Space modules have used specially-qualified silicone lenses focusing sunlight onto multi-junction solar cells mounted to thin carbon-fiber composite radiators. The terrestrial SolarVolt module (40” x 65” x 6”) uses lower cost acrylic lenses focusing sunlight onto high-efficiency, low-cost crystalline silicon cells. Hundreds or thousands of SolarVolt modules can be installed in large arrays for utility-scale applications.

Commercial applications for the SLA technology include utility-scale power plants, distributed energy for smart grid systems, communications systems, industrial building power systems, and military power systems. Space applications include NASA exploration missions, solar power high radiation environments, orbit raising or lowering of spacecraft for science missions around the Earth, moon, and asteroids, and solar electric propulsion to advance thruster systems that minimize chemical use.

## The Transfer Process

In the late 1970s and early 1980s, Entech Solar (then Entech, Inc.) developed a solar power concentrator for terrestrial applications that was spun into a space concentrator in the late 1980s. Collaborative work between NASA, the Ballistic Missile Defense Organization, and Entech continued through the 1990s, culminating in the Solar Concentrator Array with Refractive Linear Element Technology (SCARLET) design, which was used on NASA’s New

Millennium Deep Space 1 mission (1998-2001). That highly successful asteroid/comet rendezvous mission demonstrated the performance and long-term durability of the solar array design and laid the foundation for further improvements. Additional NASA-funded programs in the 2000s enabled Entech and its development partners from NASA, the Department of Defense, and the aerospace industry to refine the SLA for space applications.

The benefits of SLA technology have led to its spin-out for terrestrial use (the SolarVolt module), as well as continued exploration of its use in space, especially for solar electric propulsion applications, deep space missions, and high radiation environments.

Spanning three decades and counting, the NASA-industry SBIR collaborative work on the SLA continues as NASA Glenn innovators work with Deployable Space Systems, Inc. (DSS), based in Goleta California, to develop the Stretched Optical Lens Architecture on Roll-Out Solar Array (SOLAROSA), a fusion of the Entech Solar SLA concentrator technology with DSS’s lightweight deployable structural platform. Ad Astra Rocket Co. of Webster, Texas is interested in using the SOLAROSA to support its Variable Specific Impulse Magnetoplasma Rocket (VASIMR™) engine, an advanced plasma propulsion system with the potential to support an emerging in-space transportation market.

## Gearing Up for Commercialization

Entech Solar is planning to commercialize the SolarVolt module in 2012. The technology is currently undergoing International Electrotechnical Commission (IEC 62108) certification testing and is protected by a number of issued and pending patents. The company is completing manufacturing scale-up plans, both in-house and at key suppliers, which will create U.S.-based jobs as it implements its mass production plan.

## For More Information

For more information about this and other technology licensing opportunities, please visit:  
Office of Technology Partnerships and Planning  
NASA’s Glenn Research Center  
E-mail: [ttp@grc.nasa.gov](mailto:ttp@grc.nasa.gov)  
Phone: 216-433-3484  
<http://technology.grc.nasa.gov>