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BRINGING SPACE-BASED SOLAR POWER WITHIN REACH WITH NEXT GENERATION SILICON PHOTOVOLTAICS

Abstract

Space-Based solar power ("SBSP") is a promising solution to Earth's clean energy problems. However, the cost of building the infrastructure needed to support SBSP has slowed its implementation. A key driver of cost is the size and scale of solar arrays; they will require gigawatts of space-stable photovoltaics ("PV"). Already there is tremendous demand for incumbent space solar technology, III-V multijunction solar cells and panels, that vastly outpaces supply. We estimate that global production capacity for III-V PV, across all manufacturers, is limited to 1-2 megawatts ("MW") per year. The technology is also expensive; we estimate that on average, III-V PV retail for $200-$400/Watt. Launching heavy Earth-assembled solar arrays into space is costly. III-V solar panels require protective cover glass, making them rigid and heavy. Manufacturing scale, high cost, and deployment concerns show how III-V solar technology limits the implementation of SBSP. However, by considering alternative space solar technologies, we can identify a more affordable path forward for SBSP. The terrestrial solar industry uses silicon, leveraging affordable raw materials and automated manufacturing processes to produce hundreds of thousands of MW of terrestrial PV each year. While preferred on Earth, terrestrial silicon degrades rapidly in space due to radiation and other forms of degradation, resulting in reduced energy efficiency. The solution is next generation silicon PV engineered for space. Solestial's silicon solar cells support low temperature annealing of radiation damage, observed at operating temperatures as low as 65°C. Our silicon PV for space are capable of withstanding up to 10 years in LEO. Solestial is the first and only company to demonstrate this capability. We are on track to produce silicon PV for space at a run rate of 1 MW/year, a scale comparable to the annual global capacity of all III-V PV manufacturers combined, by the end of 2024. Our manufacturing process borrows from terrestrial silicon and is fundamentally scalable allowing us to increase output to 10MW, 100MW and beyond. Radiation-hardened solar cells allow us to rethink packaging. Our solar power modules do not require protective cover glass, and are thin, flexible, and low mass. There are many benefits: reduced launch costs, and flexibility that lends itself to in-space robotic assembly and roll-out solar array deployment systems. By looking to next-gen silicon solar technology for space, we envision a world where the implementation of SBSP is not hindered by limited III-V supply and can be affordably established.