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POWERING THE GLOBAL ECONOMY WITH SUNLIGHT, WATER, AND ASTEROIDS

Abstract

Space-Based Solar Power could be the ultimate clean solution to humankind's energy needs. However, the energy return on energy invested (EROEI), if components are launched from Earth's surface, through Earth's atmosphere, is poor. A superior solution is to launch factories that can produce tens or hundreds of times their own mass in powersat components from in situ resources, such as asteroids. Furthermore, electric power from space can meet immediate demand, but energy storage is required for mobile and portable applications. Hydrogen storage can be superior to batteries because the hydrogen ion holds the same charge as as a lithium ion, but has a mass 6.9 times smaller. Nighttime delivery of power from space that exceeds immediate needs can be used to electrolyze water to produce hydrogen. That hydrogen can be stored in catalytically-modified porous silicon at low pressures and low cost, then released as needed into a fuel cell. Both storage and conversion of hydrogen require a catalyst, such as platinum, that is abundant in certain asteroids. Retrieving resources from asteroids will require nuclear thermal rockets (NTR), but launch of such from Earth is unpopular in the extreme. A superior solution is to transmute lunar thorium to fissile uranium-233. A non-radioactive NTR built on, and launched from, Earth receives its nuclear fuel from the Moon, along with hydrogen reaction mass, stored in the same porous silicon media mentioned above. From carbonaceous asteroids can be harvested silicon and carbon, useful to make semiconductor crystals for solar panels and power electronics. A novel method of transistor fabrication allows manufacture of high-performance devices from a zero-g fab. In-space methods of metals extraction can produce aluminum for wiring and titanium for structural materials, such that complete powersats can be created using materials already in orbit. Positioning such at GEO can provide baseload, pollution-free power to nearly every human on the planet, and everyone in cislunar space, via wireless power transfer. A recent breakthrough in far-field power beaming eliminates off-axis sidelobes, preserving the spectrum for communication everywhere except inside the beam itself. Taken together, these interconnecting resource arcs can provide carbon-free power for the entire global economy using sunlight, water, and asteroids.