NASA SBIR/STTR Small Business Innovation Research / Small Business Technology Transfer

NASA SBIR 2020 Phase I Solicitation

S3.01 Power Generation and Conversion

Lead Center: GRC

Participating Center(s): ARC, JPL

Technology Area: TA3 Space Power and Energy Storage

Scope Title

Photovoltaic Energy Conversion

Scope Description

Photovoltaic cell and blanket technologies that lead to significant improvements in overall solar array performance by increasing photovoltaic cell efficiency greater than 30%, increasing array mass specific power greater than 300W/ kg, decreased stowed volume, reduced initial and recurring costs, long- term operation in radiation environments, high power arrays and a wide range of space environmental operating conditions are solicited.

Photovoltaic Energy Conversion: advances in, but not limited to, the following: (1) Photovoltaic cell and blanket technologies capable of low intensity, low-temperature operation applicable to outer planetary (low solar intensity) missions, (2) Photovoltaic cell, and blanket technologies that enhance and extend performance in lunar applications including orbital, surface and transfer, (3) Solar arrays to support Extreme Environments Solar Power type missions, including long-lived, radiation tolerant, cell and blanket technologies applicable to Jupiter missions, and (4) Lightweight solar array technologies applicable to science missions using solar electric propulsion.

Current missions being studied require solar arrays that provide 1 to 20 kilowatts of power at 1 AU, greater than 300 watts/kilogram specific power, operation in the range of 0.7 to 3 AU, low stowed volume, and the ability to provide operational array voltages up to 300 volts to enable direct drive electric propulsion systems for science missions.

References

Solar Power Technologies for Future Planetary Science Missions, found at: https://solarsystem.nasa.gov/resources/548/solar-power-technologies-for-future-planetary-science-missions/

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NASA outlines New Lunar Science, Human Exploration Missions, found at:
https://www.nasa.gov/feature/nasa-outlines-new-lunar-science-human-exploration-missions

NASA Science Missions, found at:
https://science.nasa.gov/missions-page?field_division_tid=All&field_phase_tid=3951

Expected TRL or TRL range at completion of the project 3 to 5

Desired Deliverables of Phase II

Prototype, Analysis, Hardware, Research

Desired Deliverables Description

Phase I deliverables include detailed reports with proof- of- concept and key metrics of components tested and verified.
Phase II deliverables include detailed reports with relevant test data along with proof- of- concept hardware and components developed.

State of the Art and Critical Gaps

State of the Art photovoltaic array technology consists of high efficiency, multijunction cell technology on thick honeycomb panels. Lightweight arrays are just beginning to be developed. There are very limited demonstrated technology for High Intensity High Temperature (HIHT), Low Intensity Low Temperature (LILT), Solar Electric Propulsion (SEP) missions and Lunar orbital, surface or transfer applications.

Significant improvements in overall solar array performance are needed to address the current gaps between SOA (Sate of the Art) and many mission requirements for photovoltaic cell efficiency greater than 30%, array mass specific power greater than 300W/ kg, decreased stowed volume, reduced initial and recurring costs, long- term operation in radiation environments, high power arrays and a wide range of space, lunar, and planetary environmental operating conditions.

Relevance / Science Traceability

These technologies are relevant to any space science, earth science, planetary surface, or other science mission that requires affordable high-efficiency photovoltaic power production for orbiters, flyby craft, landers and rovers.

Specific requirements can be found in the references listed above, but include many future Science Mission Directorate (SMD) missions. Specific requirements for orbiters and flybys to Outer planets include: LILT capability (>38% at 10 AU and <?140°C), radiation tolerance (6e15 1 MeV e-cm^2), high power (>50 kW at 1 AU), low mass (3× lower than SOP), low volume (3× lower than SOP), long life (>15 years), and high reliability.

These technologies are relevant and align to any Space Technology Mission Directorate (STMD) or Human Exploration and Operations Mission Directorate (HEOMD) mission that requires affordable high-efficiency photovoltaic power production.

NASA outlines New Lunar Science, Human Exploration Missions, found at:
https://www.nasa.gov/feature/nasa-outlines-new-lunar-science-human-exploration-missions

NASA Science Missions, found at:
https://science.nasa.gov/missions-page?field_division_tid=All&field_phase_tid=3951

NASA has plans to purchase services for delivery of payloads to the Moon through the Commercial Lunar Payload Services (CLPS) contract. Under this subtopic, proposals may include efforts to develop payloads for flight demonstration of relevant technologies in the lunar environment. The CLPS payload accommodations will vary depending on the particular service provider and mission characteristics. Additional information on the CLPS program and providers can be found at this link: https://www.nasa.gov/content/commercial-lunar-payload-services. CLPS missions will typically carry multiple payloads for multiple customers. Smaller, simpler, and more self-sufficient payloads are more easily accommodated and would be more likely to be considered for a NASA-sponsored flight opportunity. Commercial payload delivery services may begin as early as 2020 and flight opportunities are expected to continue well into the future. In future years it is expected that larger and more complex payloads will be accommodated. Selection for award under this solicitation will not guarantee selection for a lunar flight opportunity.