Technical Assistance Request:
Improving PV Module Efficiency with Thermal Mass

SolaBlock LLC
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Summary

SolaBlock's Solar Masonry Unit (SMU) wall systems provide solar electric generation for buildings and other structures. Technology risks are associated with the use of a thermally-bonded mass for lumped thermal-mass cooling. Codes and standards challenges result from the mass of the block and its design for vertical orientation. Manufacturing challenges arise from the non-standard form-factor and materials selection.

SolaBlock is interested in working with NREL and Sandia National Laboratory personnel to address the solar performance challenges, while Oak Ridge National Laboratory would be a valuable resource for assistance with manufacturing technology development for our products.

Introduction

SolaBlock SMUs provide wall-based solar electric generation for buildings and other structures. Our block products are built with permanently-bonded back-contact PV at 7 to 10 Watts peak DC, and up to 12 kWh each year per block, depending on location. We provide all the masonry and accessories for the systems, including interconnects between blocks plus leads into the building.

Impact-resistant and permanently bonded to concrete, SolaBlock wall systems are the longest lasting and most theft-and vandal-resistant solar solutions we can envision—at incremental costs close to conventional brick walls, providing the lowest potential life-cycle cost and greatest productivity--to achieve the highest customer value of any façade-based solar option.

SolaBlock wall systems are easy to install. Masons install the block systems and electricians follow afterward, commissioning the system and removing protective labels to power-up the wall. Work tasks of the masonry and electrical trades are separated. Training and certification programs are provided.

Depending on location, SolaBlock energy production can provide three-quarters to equivalent energy production compared to tilted solar. SolaBlock does better in the winter and where there's reflected light. A building with south-side SolaBlock can meet most residential electrical loads, and may even achieve net-zero energy status when SolaBlock is installed on three sides.

Key Technologies

SolaBlock is like no other solar. The PV module is permanently bonded to the concrete. The concrete base serves as the frame and protection for the imbedded solar module. Blocks interconnect electrically by front-mounted junction boxes. A bypass diode in each block re-routes current in the event of shadowing and a pass-through conductor provides wiring choices for installers.

Technical Challenges

Despite its first impression as “just a solar module imbedded into a concrete block”, SolaBlock has taken five years of iteration to arrive at the current design. SolaBlock Solar Masonry Units are not convectively-cooled, but instead rely on lumped-thermal mass cooling for efficient operation and longevity. Third -party review will be necessary for this feature. Most codes and standards testing practices are based on conventional module design and tilted operation, a common problem shared among BIPV technologies. If our products are installed as planned, we estimate they may maintain at least 80% of initial efficiency for 50 years, based on a rainflow-based solar damage model from 35-year tilted solar adjusted to vertical solar.

We would like assistance with validating the lumped-thermal mass properties of a SolaBlock wall system. The EES-based thermal modeling, UMass engineering studies and Intertek testing have resulted in positive results, but detailed assessments by national laboratory researchers would be valuable in addressing any remaining concerns in the market.

Finally, we welcome any input with help in developing high-volume manufacturing processes for our modules, as they are significantly non-standard in wiring, materials, and assembly methods.

Technology Assistance Targets

SolaBlock has been developed by a team of designers with over 40 years of combined experience in renewable energy technologies and masonry applications. But we have been limited in our access to outside expertise, laboratory facilities and integration specialists. Specifically, we would like to work with:

- Experts in evaluating solar longevity
- Laboratory facilities involved in long-term testing
- Experts in integrating building-integrated photovoltaics into codes and standards practices
- Performance testing to validate the effectiveness of our lumped-thermal mass cooling methods
- Integration specialists who can independently monitor performance of demonstration walls
- Manufacturing specialists who can assist in development of novel manufacturing processes required by our unconventional form-factors and materials choices.

Connector Targets

One of the founders of SolaBlock is a former Senior Analyst at NREL, and has worked with various NREL and DOE EERE programs with great success in the past, and is comfortable fit with lab personnel. SolaBlock would benefit from working with the following centers of excellence:

- National laboratories, specifically Sandia Laboratories and the NREL solar sites, specifically with technologist working to assess performance and longevity,
- Oak Ridge National Laboratory, for assistance with manufacturing,
- NREL again for assistance with BIPV codes and standards compliance, and
- Greentown Labs of Somerville, MA, for help in startup business development.