

## TECHNICAL ASSISTANCE REQUEST

The technical assistance being requested for this project will support our efforts to develop self-cleaning technology from Technology Readiness Level (TRL) from 4 to 7 and Manufacturing Readiness Level (MRL) from 3 to 6. The national labs and members of the American-Made Network can help with testing the durability and performance of our prototype, refining our business plan, and addressing manufacturing challenges, scale up, and adoption.

Interest in solar power is increasing worldwide and with it, the demand for the photovoltaic (PV) modules that generate solar energy. PV modules are exposed to environmental temperature and humidity extremes, thereby imposing stringent performance requirements. To ensure consistent performance and safety, the modules must undergo rigorous testing to meet standards set by the International Electrotechnical Commission (IEC), Underwriters Laboratory (UL), and other organizations. This challenge needs to be addressed in partnership with our existing and future partners. Our current lab partner, National Renewable Energy Laboratory (NREL), will help us with testing and validation of our technology prototypes under realistic environmental conditions (using a laboratory soiling chamber). This will help us to correlate dust removal efficacy for improving the PV output under standard dust exposure conditions. Furthermore, our pilot industry partner, BMR Energy, will help us in understanding our technology performance in real work desert conditions at one of their project sites. We would like to utilize the American-Made Network to conduct various field testing at different geographical locations across the United States. Testing at geographically diverse sites will help us to understand the performance of our technology in different environmental and climate zones, thereby allowing us to tailor our prototypes' design to these zones.

In addition to testing, we will also need to address several manufacturing challenges. Our technology is scalable and relies on industrially adopted methods, such as Chemical Vapor deposition (CVD). The CVD technique is widely used to deposit materials for a wide range of applications. Normally the deposition rate is in the range 0.1-10  $\mu\text{m/hr}$  and the temperatures are in the range 800-1200°C. We would like to get access to CVD to deposit transparent conductive oxides on a glass substrate at temperatures from 200 to 500°C. The CVD facilities are available at our partner, Toledo solar (Industrial-scale CVD) and we would like to deposit several electrode patterns to optimize dust removal performance with small scale CVD. In our prototype, we deposited electrodes via a subcontractor, but we need to have more hands-on experience in trying various deposition conditions before scaling up using an industrial scale CVD.

Technical assistance in conducting Highly Accelerated Life Testing (HALT) is also requested. This is an important test, which should be performed during the product development cycle. The purpose of this test is to find possible flaws and ultimate design weaknesses in the product in order to avoid product failures during its commercial deployment. Highly Accelerated Stress Screening (HASS) is a non-destructive stress test performed in the manufacturing processes. The purpose of this test is to improve the durability and performance of the solar panels and assist with product development. Both HALT and HASS tests would be performed using a range of temperatures, humidity, and UV exposure levels. These accelerated tests will allow us to develop a high-quality durable glass for large-scale applications.

In summary, the voucher program will help to collaborate with National Renewable Energy Laboratory (NREL) and other partners in both prototype development and field-testing (please see a letter of support attached), while other types of technical assistance will help us to move along the pathway to large-scale manufacturing. We also hope that the members of the American-Made Network can also help us to better understand the existing solar PV ecosystem while assisting us with business plan development and tuning our value proposition.