Sandia National Laboratories

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Solar Prize Round 5

National Laboratories' Capabilities to Support Voucher Work

AMERICAN MADE SOLAR PRIZE

U.S. DEPARTMENT OF ENERGY

Round 5

National Laboratories' Capabilities to Support Voucher Work

Solar Prize Voucher Team

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National Renewable Energy Laboratory

Agenda

- Working with the National Laboratories
- Solar Prize Voucher Overview
- National Labs' Capabilities
- Voucher Process
- Q&A

1 month to go!

April 22, 2022, 11 a.m. MDT
Won
R5 Software Track Set Contest Winner Announcement

April 22, 2022, 1 p.m. MDT
Enter
Solar Prize Round 5 Software Track Go Contest Submission Opens

July 29, 2022, 11:17 a.m. MDT
You are here

Aug. 25, 2022, 3 p.m. MDT
Submission Deadline
R5 Software Track Go Contest Submission Deadline at 5 PM ET.

Sept. 19, 2022, 7 a.m. MDT
Anticipated R5 Software Track Go Contest Demo Day
Anticipated R5 Software Track Go Contest Submission Demo Day

Sept. 21, 2022, 11 a.m. MDT
Anticipated R5 Software Track Go Contest Winner Announcement
Anticipated R5 Software Track Go Contest Winner Announcement

Finish

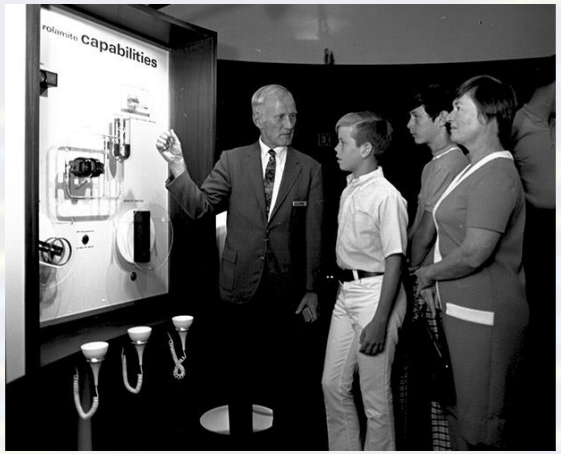
Voucher scoping slide is included with your final submission!

The two winners receive a $50k voucher.

What Are the National Labs?

- The National Labs are the R&D wing of the US Dept of Energy (DOE); the oldest labs go back to the 1950s.
- They tackle some of the most complex and pressing challenges related to energy and national security.
- Many possess instruments and facilities that are found nowhere else in the world.
- They hire researchers who are among the best in the world in their fields.
- They have a multidisciplinary approach that places an emphasis on innovation.





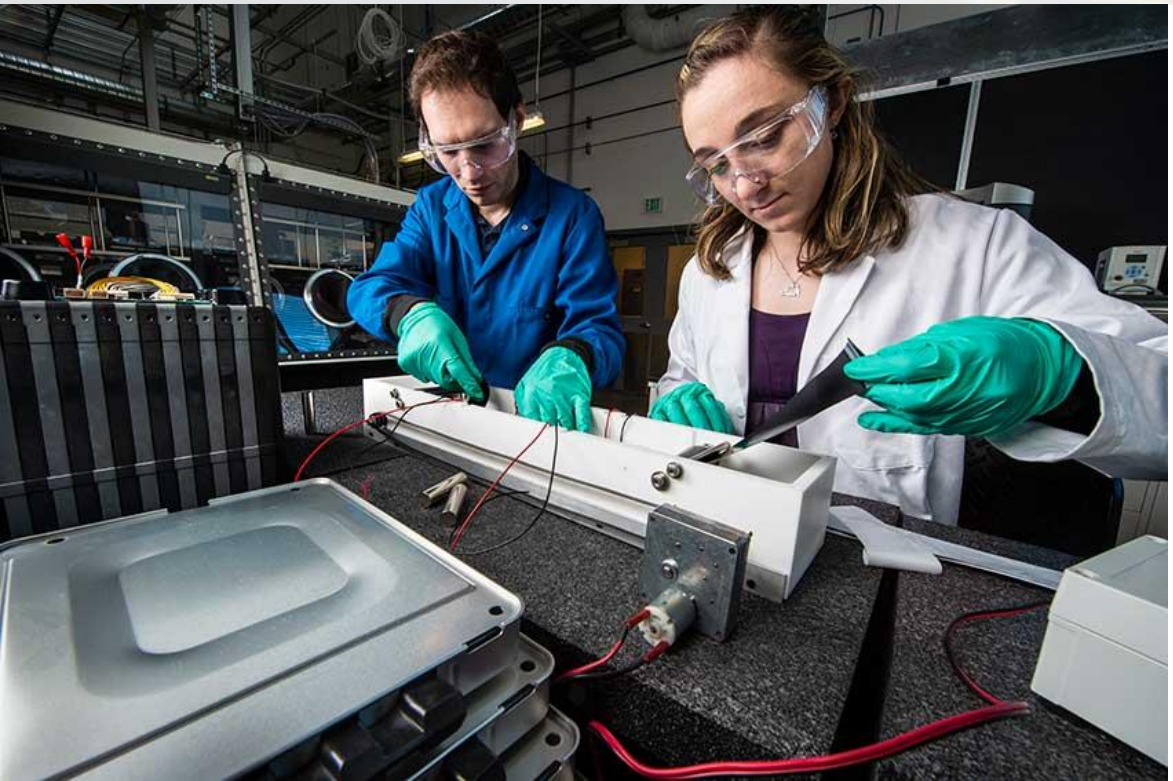
The National Labs Supporting Vouchers

- All labs can support vouchers but the **focus** of the Solar Prize is on the labs with the **broadest capabilities in solar energy and grid modernization.**
- Sandia was founded in 1948 and began work on solar cells in the early 1970s. Sandia is the largest of the national labs, with research capabilities that support a **broad portfolio of energy research**.
- NREL was founded in 1974 as the Solar Energy Research Institute and became a national lab in 1991. NREL is the only national lab entirely **dedicated to renewable energy research**.



What is a Voucher?

An award mechanism, provided by DOE through various programs, that provides an innovator with a defined dollar amount that can be redeemed and utilized for technical assistance, testing, validation, analysis, or other technical support at a National Lab.



Sandia National Laboratories

NREL Transforming ENERGY

Pacific Northwest NATIONAL LABORATORY

Voucher Benefits:

- Allows researchers and innovators to gain access to expertise and facilities in a streamlined fashion
- Enables quick technical development to speed innovation
- Supplements other prizes and funding mechanisms
- Sets the stage for additional work with the labs
- Gives lab researchers the chance to work with new innovators that have never worked with DOE before and have the potential to develop game-changing solutions

Working with the National Labs

*Leading scientific innovation and contributing to the nation's resilience, security, viability, and sustainability for more than **70 years***

By working with the labs, you can gain access to:

- National resources to help meet your science and technology challenges
- Large-scale government-funded state-of-the-art facilities
- Some of the best engineering and scientific minds in the world

For services other than what the national labs can provide…

- Business development
- Finding customers
- Finding investors
- Marketing/promotion help (directly)
- Legal services

Utilize the American-made network!



American-Made Solar Prize, Round 5

Prepared for *Team Name, voucher point of contact*
Responding national lab or facility, technical expert name and contact information

Objective:

Anticipated scope of work:

Tasks:

Deliverables:

SAMPLE ONLY – A TEMPLATE POWERPOINT WILL BE PROVIDED TO YOU VIA EMAIL; PLEASE FILL OUT AND RETURN WITH YOUR SET! SUBMISSION PACKAGE

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American-Made Solar Prize, Round 5

Sandia National Laboratories | NREL NATIONAL RENEWABLE ENERGY LABORATORY

Prepared for *SolaRocks, Team POC: John Jones*
Sandia National Lab, Bruce King, king@xxxxx.gov

Objective: Module characterization of solar cells under shading conditions. Full outdoor characterization of performance parameters including standard test conditions and temperature coefficients. The field-tests will verify the enhanced performance of the Team's technology in real-life conditions.

Anticipated scope of work:

Tasks: Sandia National Labs will perform the following tasks for Team SolaRocks:

- Outdoor performance validation of 3 SolarRocks modules and 3 reference modules, including time-series DC data time synchronized with irradiance and other meteorological data
- Shading experiments to collect data on performance of novel module technology when fully and partially shaded Indoor and outdoor characterization of modules before and after field tests including flash testing

Deliverables: Sandia National Labs will provide Team SolaRocks the following:

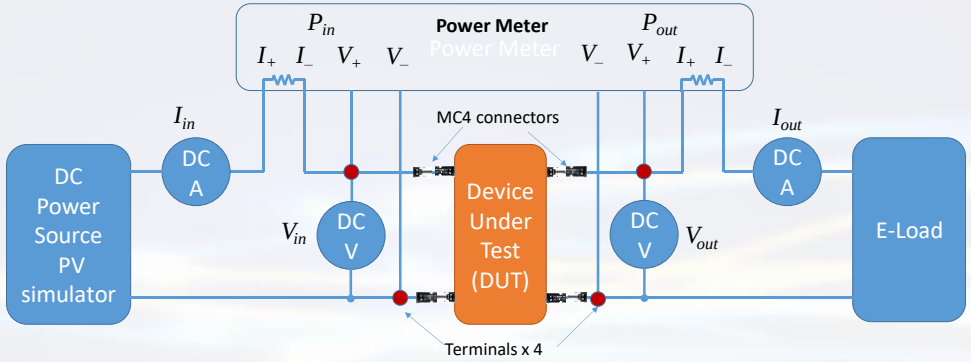
- Field-report documenting the experimental design, including monitoring equipment and data being collected. the data, A final report summarizing the data, along with analysis and recommendations for product improvement if any.

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Voucher Success Stories





Company name: Enertronics, Inc.
Project name: Paralleled Type Power Optimizer Testing
National Lab Partner: NREL
National Lab Partner PI: Andy Walker

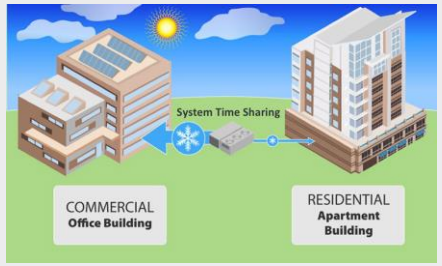
Project Description: Test efficiency and parallelability of the paralleled type power optimizers under different irradiance conditions.

Lessons learned and advice: We are very lucky to have a partner with excellent test facility and knowledgeable staff.

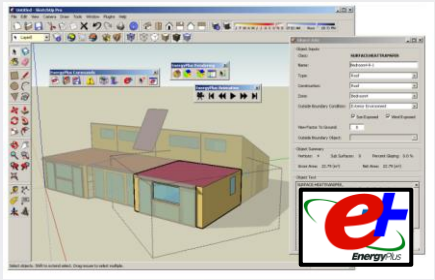
- Get your prototypes ready sooner and fully tested in your lab before sending them to the partner
- Describe test condition and define the goal clearly
- Specify all required instrumentations, making sure they cover the test range,
- Label all the connections, specify tools, and send the connectors to your partner early
- Participate in monthly calls and respond partner's requests timely
- Avoid testing your competitor's product and just focus on testing your product's performance
- Complete National Lab's safety training as soon as they set it up, *and* keep safety in mind all the time

Capabilities: Computational Analysis

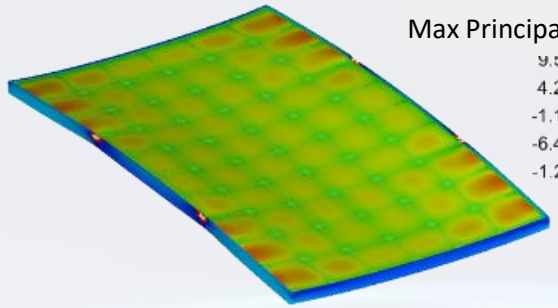
City/District scale



UrbanOpt

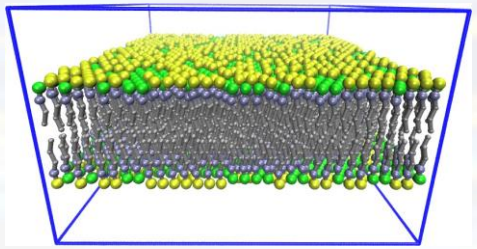


EnergyPlus
Multiphysics



Finite Element
Analysis

Atomic scale



LAMMPS
Molecular
dynamics

Building energy simulations

- Energy use prediction for emerging technologies, including building envelope materials, windows, HVAC systems

Technoeconomic analysis:

- PV
- CSP
- Storage
- Solar water heating
- Financial models
- LCOE calculation

PV Performance Modeling Collaborative (PVPMC)

- Open source functions for PV performance modeling and data analysis
- Extended Series of Workshops
- International (USA, Germany, Switzerland, China)

System Advisory Model

https://sam.nrel.gov/

https://youtu.be/NhWJ5A2fxZU

PV capabilities: PV Characterization & Performance Analysis

Outdoor Module Characterization





Dual Two-Axis Trackers
- Characterize behavior under real-world operating conditions
- Supports technologies from bare cells to mock roofs
- Generates data for performance models

Types of Characterization
- I-V Curves, Thermal Performance, Angle of Incidence

Instrumentation
- Global and Diffuse POA irradiance
- Comprehensive weather station nearby (including EKO spectroradiometers)

Systems and Component Reliability





Purpose
- 1-month to multi-year installations
- Validate energy performance
- Evaluate materials reliability and degradation

System Monitoring
- High frequency sampling of Voltage and Current, in situ IV sweeps
- GPS time synchronized with other measurement data

Site Capacity
- ~ 5 acres dedicated to PV deployment
- ~ 750 kW grid interconnect

Indoor Module Lab





1-Sun Flash Tester
- Spire 4600SLP, Class AAA
- Characterize IV behavior of modules as a function of irradiance
- Monitored for long-term stability, supports reliability research

Custom Dark Room
- Co-located visual, electroluminescence, IR and UV Fluorescence Inspection Systems
- Non-destructive module defect mapping

Indoor Cell Lab

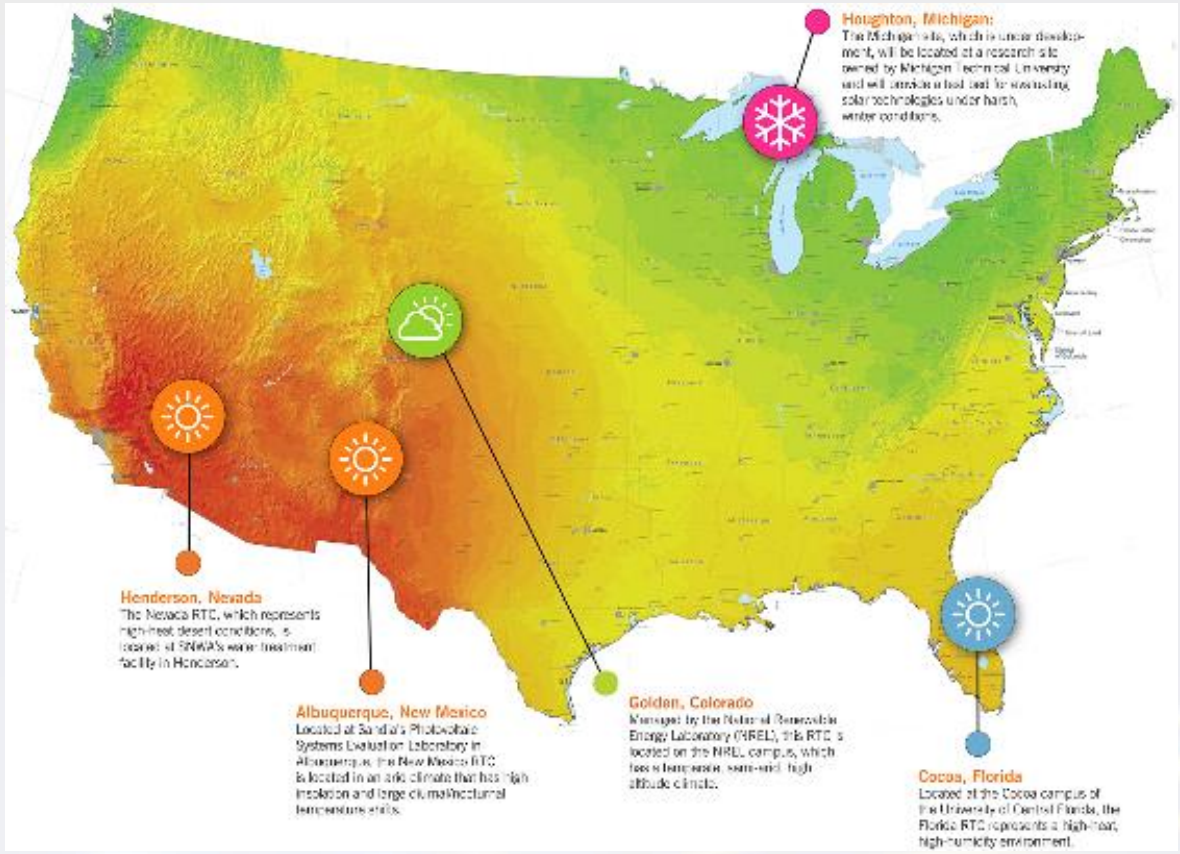


1-Sun Cell Tester
- Oriel Sol-3 Class AAA light source
- Characterize IV behavior of cells at various irradiance, temperature levels

Solar Cell Spectral Response
- PV Measurements QEX10
- Characterize electrical response of cells as function of wavelength

Reflectance and Transmission
- Cary 5000/DRA 2500
- Characterize reflection & transmission of materials as a function of wavelength, orientation

PV Capabilities: Regional Test Centers



Cross-climate services provided:

- Validation of emerging technologies
- Reliability assessments of field components/systems
- Photovoltaics R&D

Multiple Sites:

- *NM, FL, NV, MI, CO*

Common Technical Platform:

- *Irradiance instrumentation* (GHI, DHI, DNI, POA)
- *Meteorological instrumentation* (precipitation, windspeed and direction; barometric pressure; rel. humidity; ambient air temp)
- *Reference PV System*
- *High-fidelity DC energy monitoring*
- *Automated data acquisition system*
- *RTC data dashboard*

Common O&M Protocols







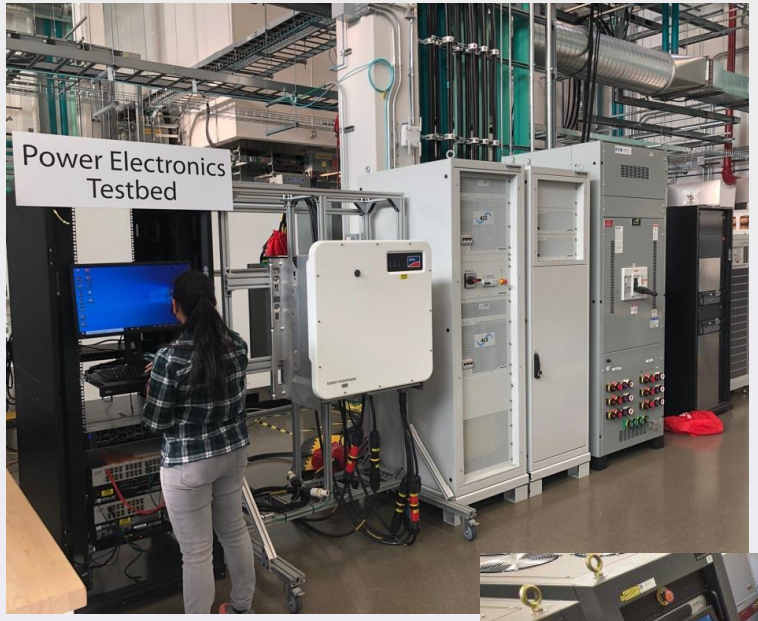
PV Capabilities: Power Electronics

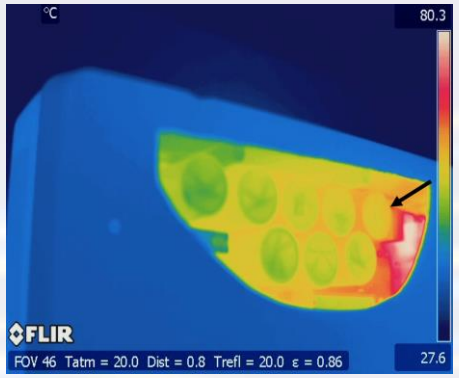
Research Experts

- Modeling and analysis of grid-connected and hybrid systems
- Research on advanced power electronics application
- Key guidance on design and controls

Engineering and Operations Experts

- Engineering staff for experiment design
- Expertise in data acquisition
- Leverage power supply interfaces, integration and digital real-time simulation (DRTS)
- Extremely robust safety approach+





Thermal image of DC-bus link capacitors through a provisional port to identify hottest capacitor

Distributed Energy Technologies Laboratory (DETL)



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Q & A



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