Discover, Develop, and De-Risk module materials, architectures, accelerated testing protocols,data analytics, and financial models to reduce the LCOE of solar energy

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Capability 5: Field Deployment for Reliability

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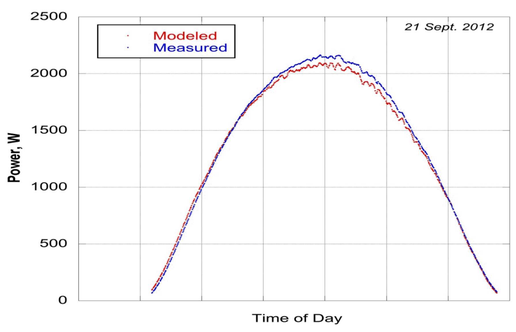
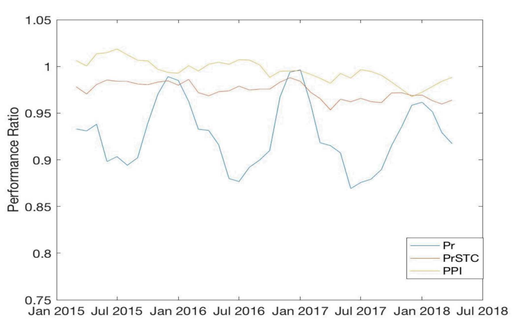
Fielded PV Systems Research



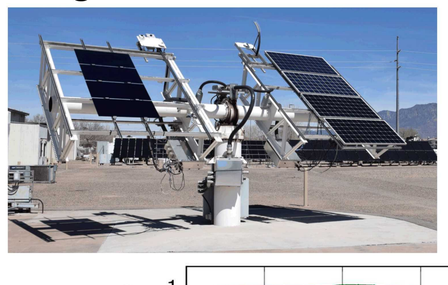


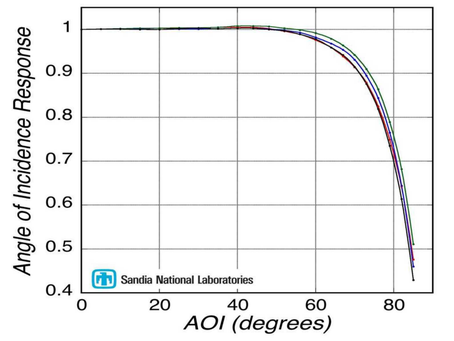
- Tracker Testing - Full electrical performance (IV curves, temperature coefficients, angle of incidence)
- System Instrumentation - DC Voltage and Current, In-situ IV curves, local irradiance
- Combine measured PV system performance with modeled power predictions
  - Evaluate system reliability and degradation rates
  - Evaluate technology improvements
  - Validate energy yield calculations

Emerging Technology Characterization Examples

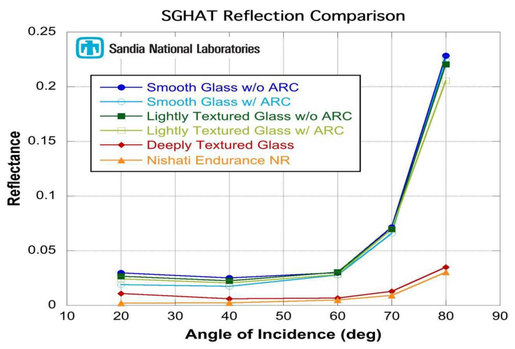
Roofing Products - BIPV

Influence of Coatings on Angle of Incidence

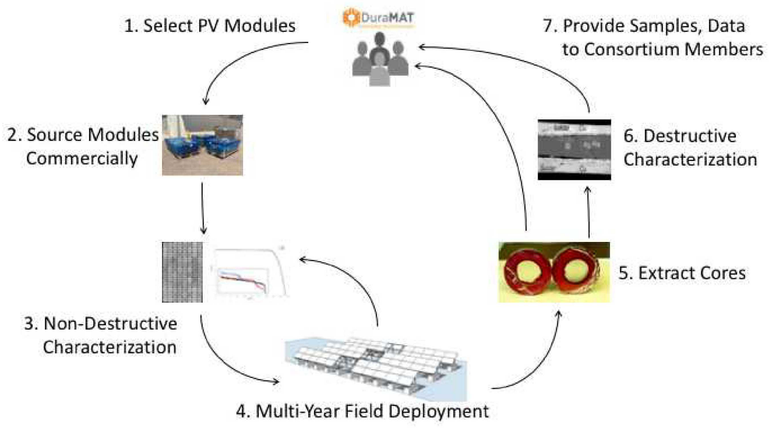




Optimization of Novel Packaging Methods



Field-Aged Module Library

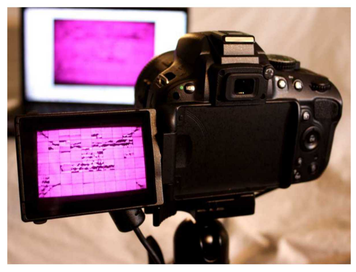


1. Engage **DuraMAT stakeholders** to identify relevant commercial PV modules for long-term field aging
2. **Source Modules** from commercial vendors
3. **Non-destructive characterization** prior to deployment and annually throughout project
4. **Multi-year field deployment** alongside operational sister systems (PV Lifetime)
5. Extract **sample cores** from pristine modules and annually from fielded modules
6. **Destructive Characterization** to identify materials baseline and degradation
7. Provide **sample cores and data** to DuraMAT Stakeholders

Group	Manufacturer	Model	Cell Type	Status
1	Jinko	JKM270PP-60	Multi-Si	Installed
	Canadian Solar	CS6K-300MS Quintech	Mono-Si	Installed
	Hanwa Q-Cells	Q.Peak-G4.1 300	Mono-Si	Installed
	LG	LG320N1K-A5	Mono (N)	Installed
	Panasonic	VBHN330SA17 HIT	HIT N-type	Installed
2	Mission Solar	MSE300SQ5T	Mono PERC	Installed
	TBD			

Non-Destructive Field Evaluation Capabilities

Field Electroluminescence



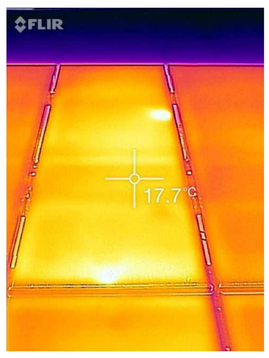
- Acquired fieldable EL camera from Brightspot Automation (7/18)

Additional Capabilities under consideration:

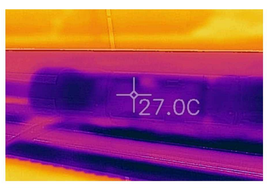
- Hand-held FTIR (commercial)
- Hand-held RAMAN
- Reflectivity
- Flash/Reflected UV imaging (under development)

Infrared (IR) Imaging (existing capability)

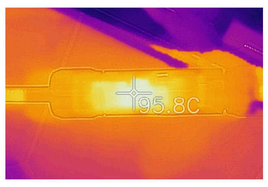
- FLIR A6700 Mid-Wave IR camera for high end inspection (1-5 μm)
- FLIR One Long-Wave IR for quick inspection (8-14 μm)



Module Hotspot



Normal Connector



Failing Connector

Field LED Flash Tester

- LED simulator for in situ IV characterization
- Full-size, up to 72-cell modules
- AAA
- 30 m/s pulse
- Expected delivery FY19