U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

SOLAR ENERGY TECHNOLOGIES OFFICE

2020 SETO PEER REVIEW

Photovoltaics Reliability Portfolio

Marie Mapes, Technology Manager

SETO Reliability Strategy Main Takeaways

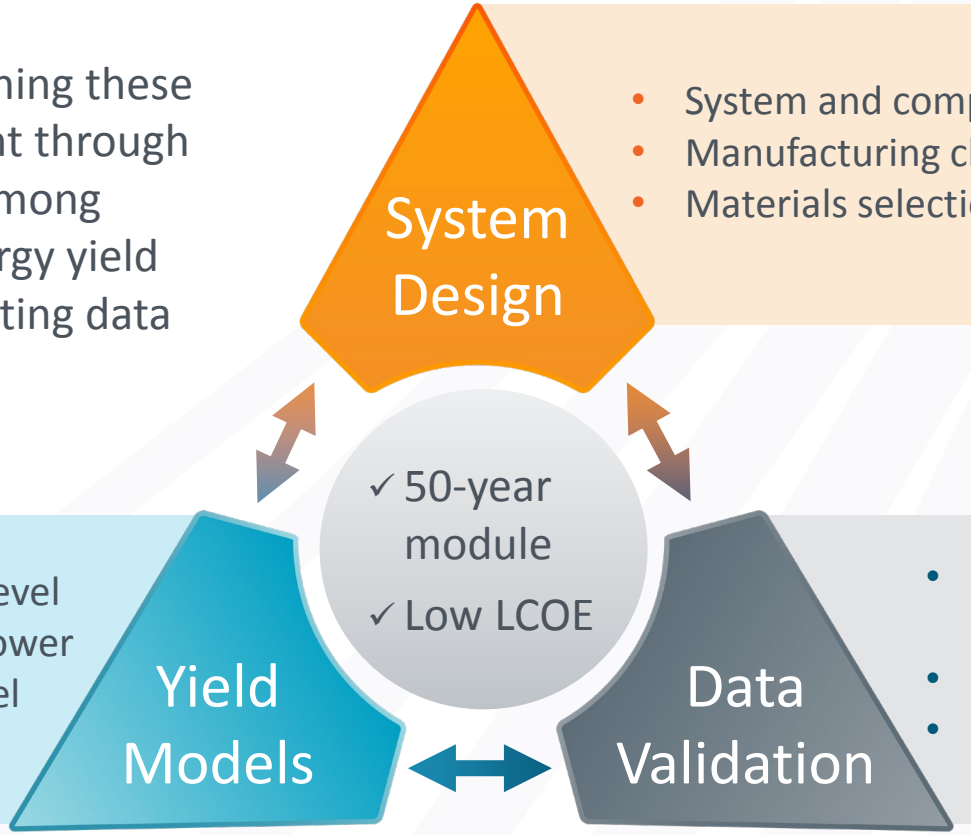
1. SETO learns from current fleet population to improve future fleet “health”
2. SETO uses iterative feedback among system design, energy yield modeling, data validation aims for authenticated trust in the value of solar assets and through that aim, a lower LCOE.
3. SETO funds projects which develop insight from micro to macro, because many problems span multiple spatial scales.

SETO learns from current fleet population to improve future fleet “health”

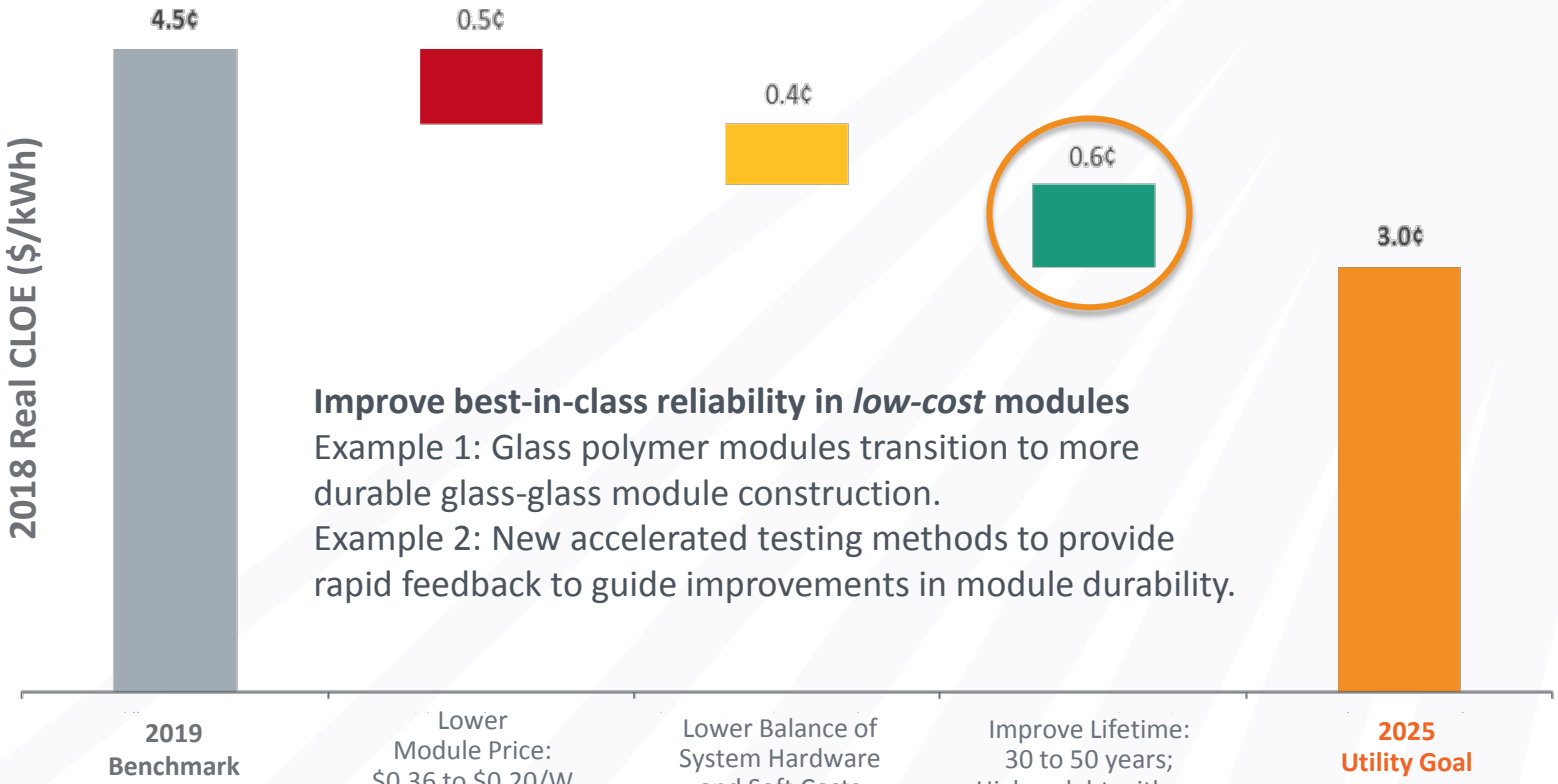
- The fleet of deployed photovoltaics worldwide is a diverse set of product technologies and generations

SETO PV Reliability Portfolio Approach

The method of reaching these goals is improvement through iterative feedback among system designs, energy yield modeling and validating data from field and lab.



SETO Reliability Portfolio is a Critical Pathway to $0.03/kWh….

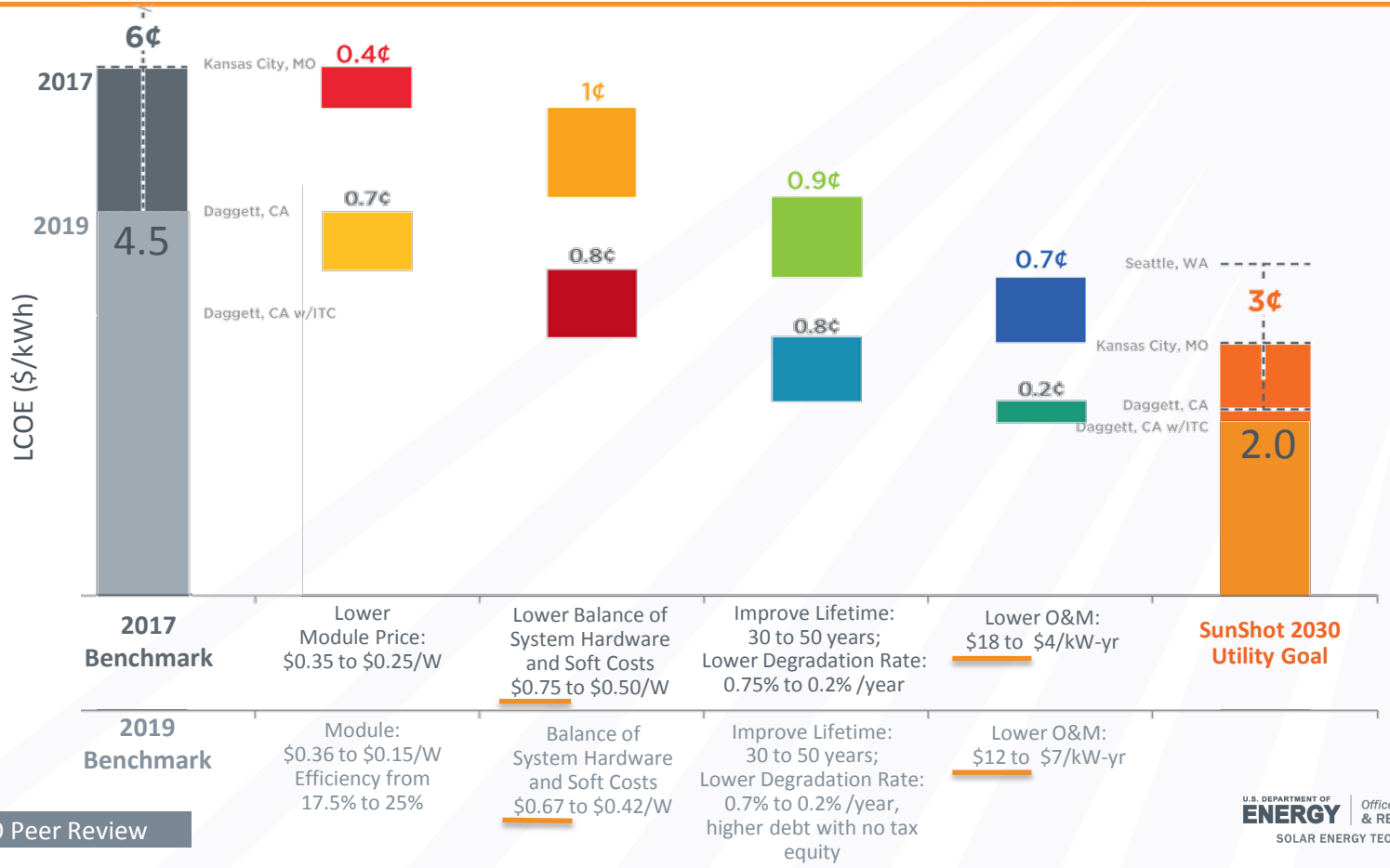


Improve best-in-class reliability in *low-cost* modules

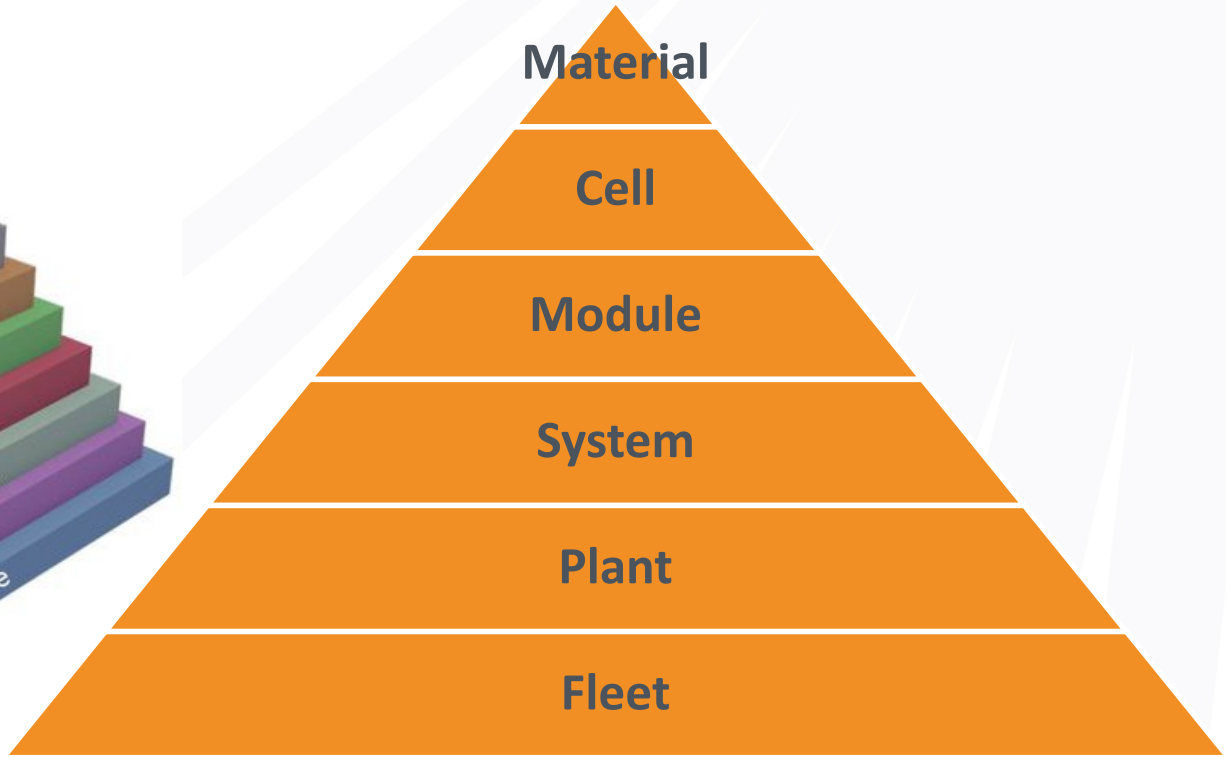
Example 1: Glass polymer modules transition to more durable glass-glass module construction.

Example 2: New accelerated testing methods to provide rapid feedback to guide improvements in module durability.

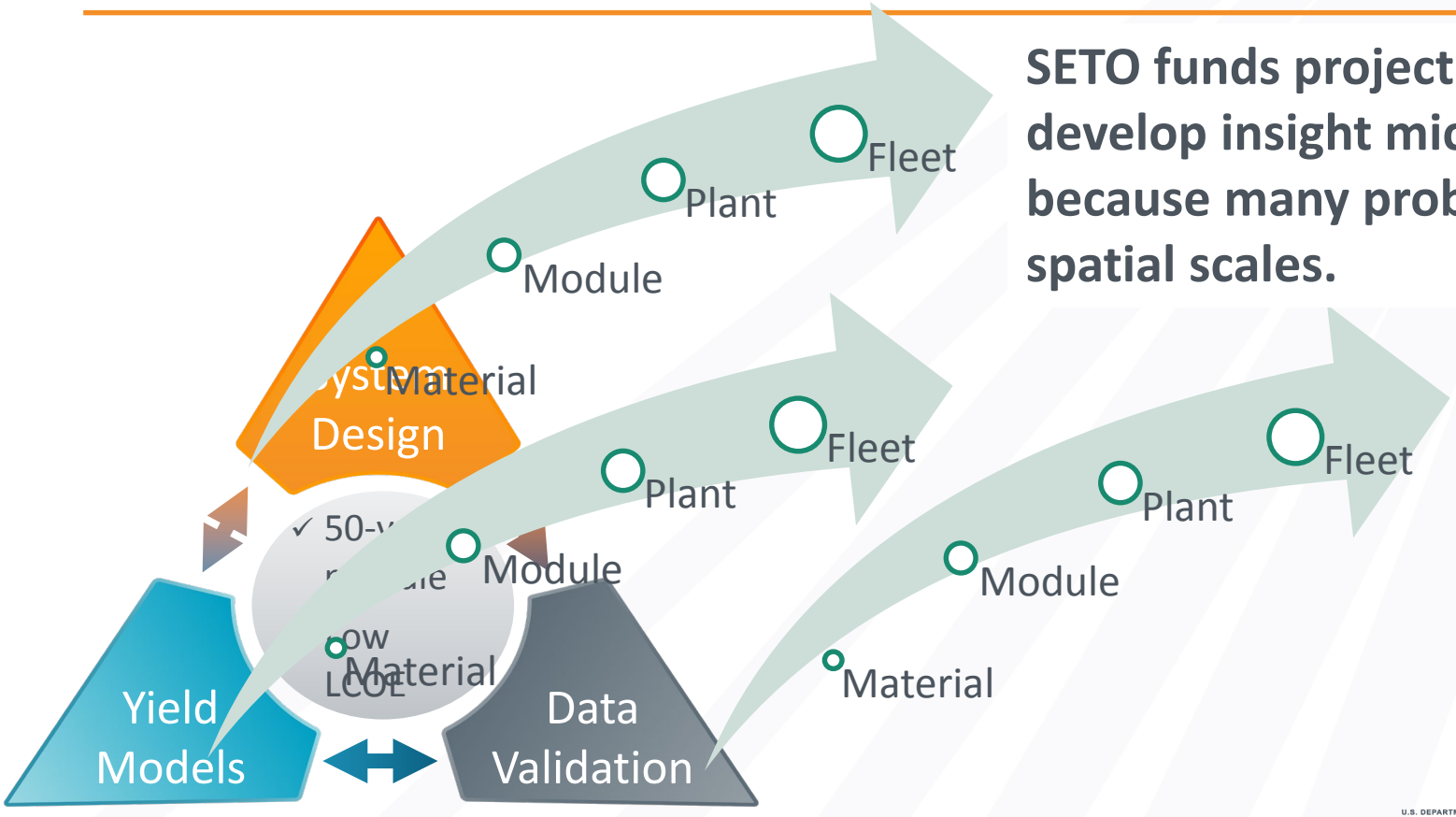
….Reliability continues to be important at $0.02/kWh



SETO Reliability Portfolio spans Micro ↔ Macro



System Design, Yield Modeling, Data validation: Micro ↔ Macro

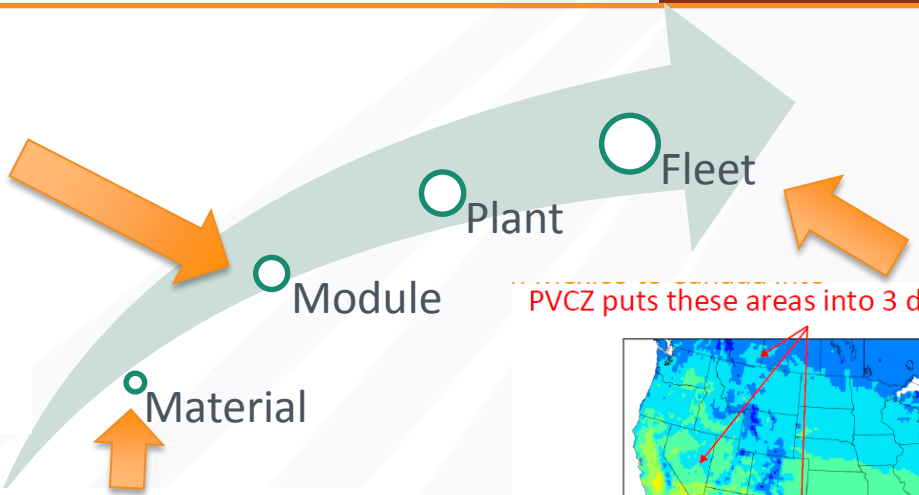


SETO funds projects which develop insight micro ↔ macro, because many problems span spatial scales.

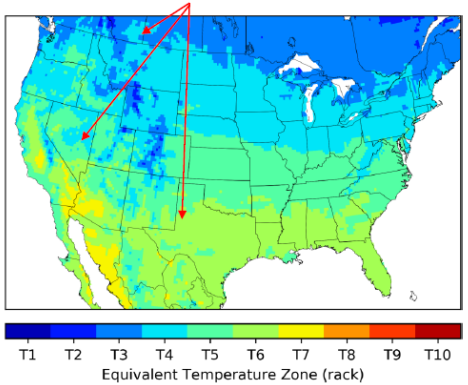
Examples of SETO Reliability Portfolio Strategies:

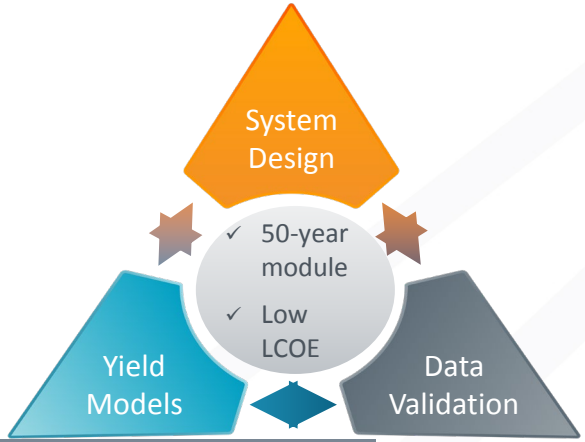
DuraMAT
Durable Module Materials Consortium

NREL
Transforming ENERGY

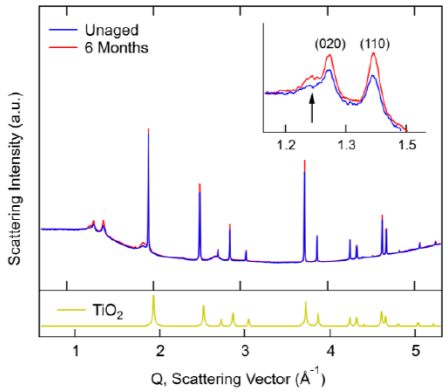


PVCZ puts these areas into 3 different zones.





WAXS of PVDF after C-AST



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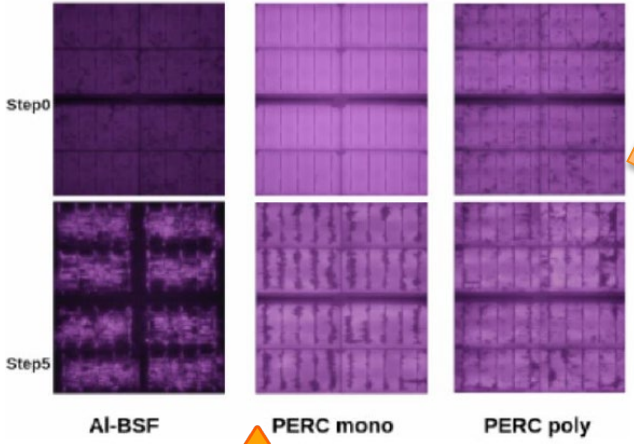
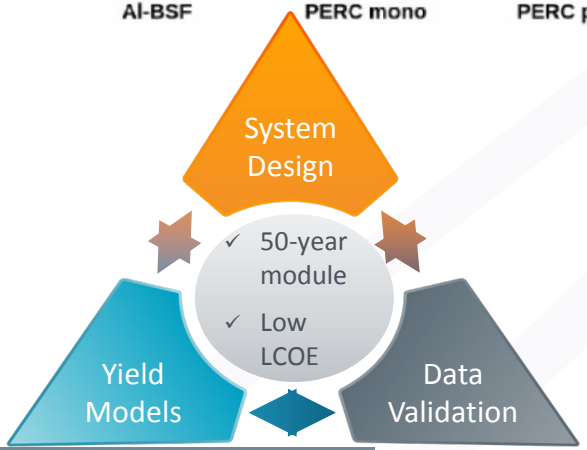
Examples of SETO Reliability Portfolio Strategies:



EL images at 0 and 2500 hours of exposure shows busbar corrosion for all samples through mDH exposure. Al-BSF being the most affected



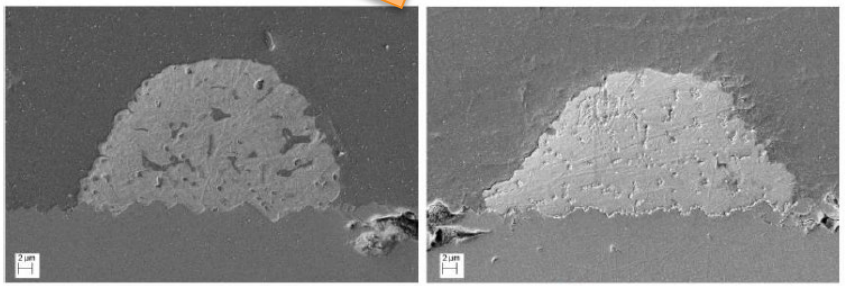
Fleet

Plant

Module

Material

SEM image of back contact cross-sections at baseline and after 3200 hr DH exposure. Particle accumulation as contact base, possibly a void region that was filled with particulate during sample polishing



Good Contact

Degraded Contact

Conclusions and Summary

- SETO has several strategies around funding photovoltaics reliability projects
  - Learning from past and current deployed technologies to improve outcomes for future deployments
  - Iterating among system designs, yield modeling, and data validation
  - Connecting multiple scales for technology insights
- There are many improvements we can make in this field, so reliability focused projects will be a portfolio mainstay for the forseeable future

Thank you!

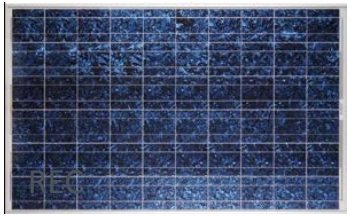
Questions?

Backup Slides

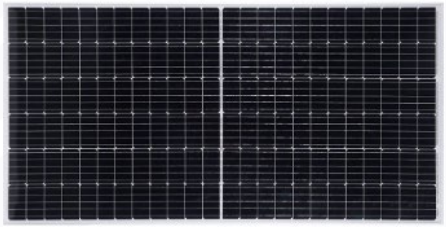
Current Projects

Commercial PV global production

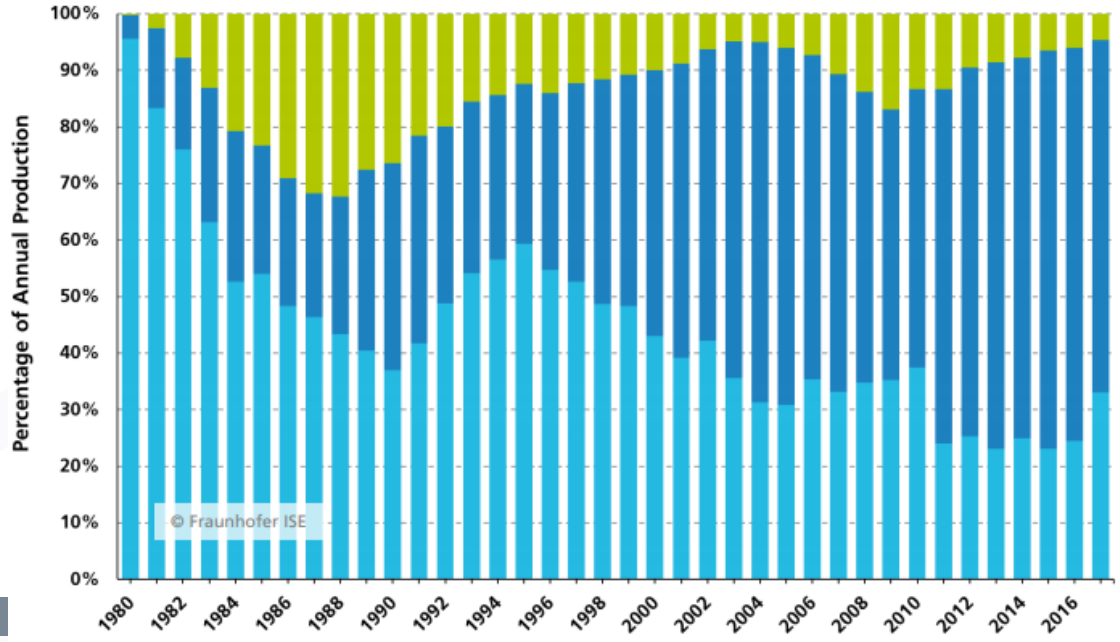
BP Solar



First Solar

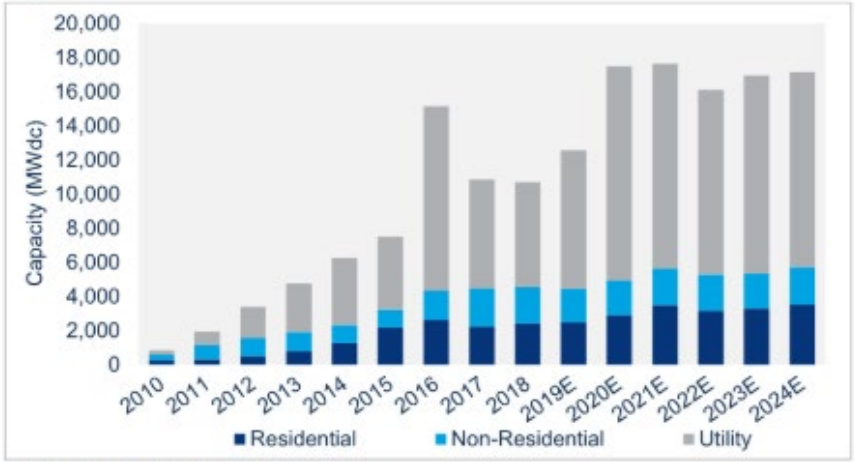


Vikram

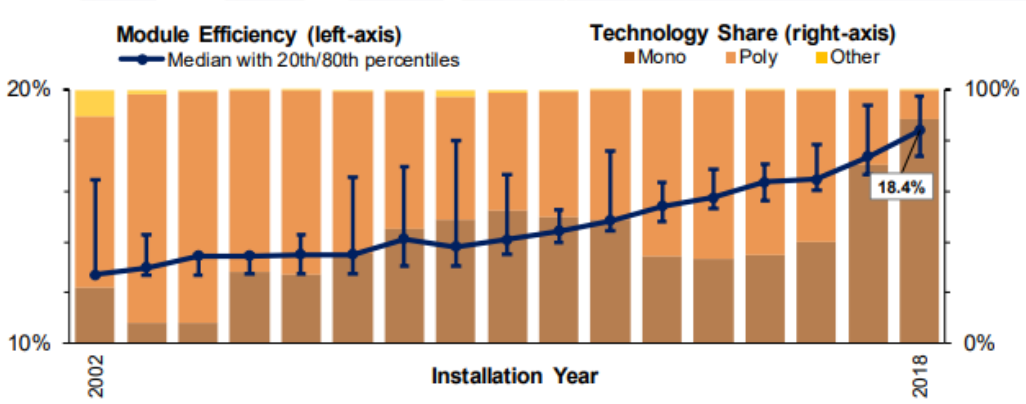


Production 2017 (GWp)	
Thin film	4.5
Multi-Si	60.8
Mono-Si	32.2

Installed in US



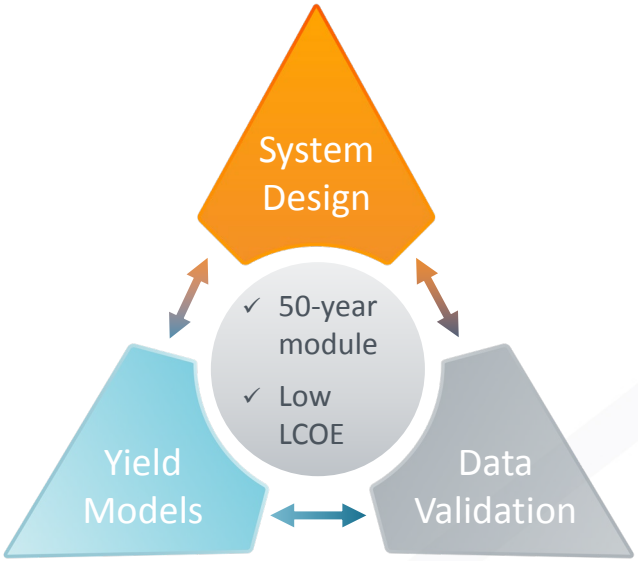
Source: Wood Mackenzie Power & Renewables



Tracking the Sun 2019.
LBL

Tracking the Sun 2019. LBL

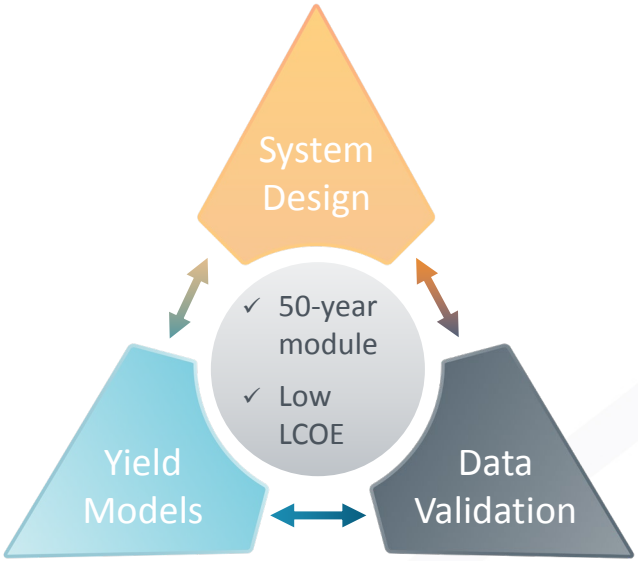
PV Hardware Reliability Portfolio



System Design

- System design -> component design -> manufacturing and materials choices

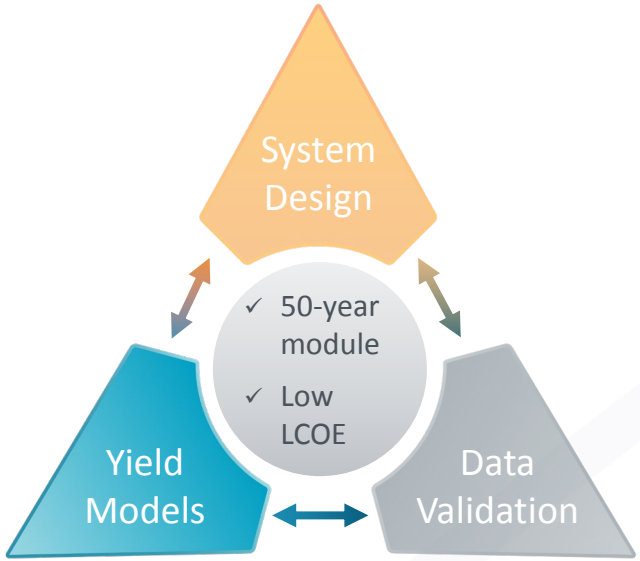
PV Hardware Reliability Portfolio



Data Validation

- Field Data (online and offline)
  - Performance data (current, voltage, power)
  - Status data (alerts, temperature)
  - Meteorological (irradiance, temperature, wind speed)
  - Additional monitoring/diagnostics (O&M, drone or in person data collection)
- Laboratory Data
  - Accelerated testing

PV Hardware Reliability Portfolio



Yield Models

- Power prediction at the plant level
- Long term degradation and modeling degradation at the level of chemical and physical mechanisms