



Presented by

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on behalf of

FREEDM Systems Center, North Carolina State University

COST EFFECTIVE RESIDENTIAL PLUG AND PLAY PHOTOVOLTAIC SYSTEM

Solar “Plug and Play” Project Sponsors



High
Penetration

2013
Feb 13-14, San Diego, CA

Plug and Play Desired Outcomes

In 5 Years, demonstrate PnP system that

- Contractor/homeowner can install without need for special training or tools in 10 man-hours or less.
- Supports automation of:
 - > Electrical permitting and inspection
 - > Structural permitting and inspection
 - > Utility interconnection agreement.
- Delivered, installed, inspected and commissioned on same day.

Provide roadmap to demonstrate ten year goals for PnP Solar:

- Are readily available at consumer stores.
- Are accepted by both AHJs for automated permitting and inspection.
- Are accepted by utilities for automated interconnection.

Key Issues for Plug & Play

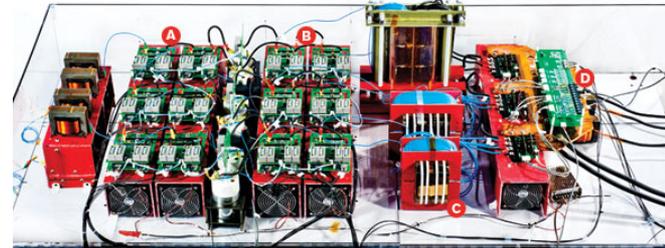
- **Advances in equipment design** (PV modules, mounting systems and power electronics/electrical interface) to reduce equipment costs and installation time
- **Streamlined/automated permitting, inspection and interconnection** procedures to reduce “soft costs” while maintaining high AHJ and utility standards for safety and reliability
- **Attention to Interoperability Standards such as MultiSpeak™** to reduce custom programming burdens on all involved parties
- **Close coordination with all stakeholder groups** including customers, AHJs, installers and utilities

Team

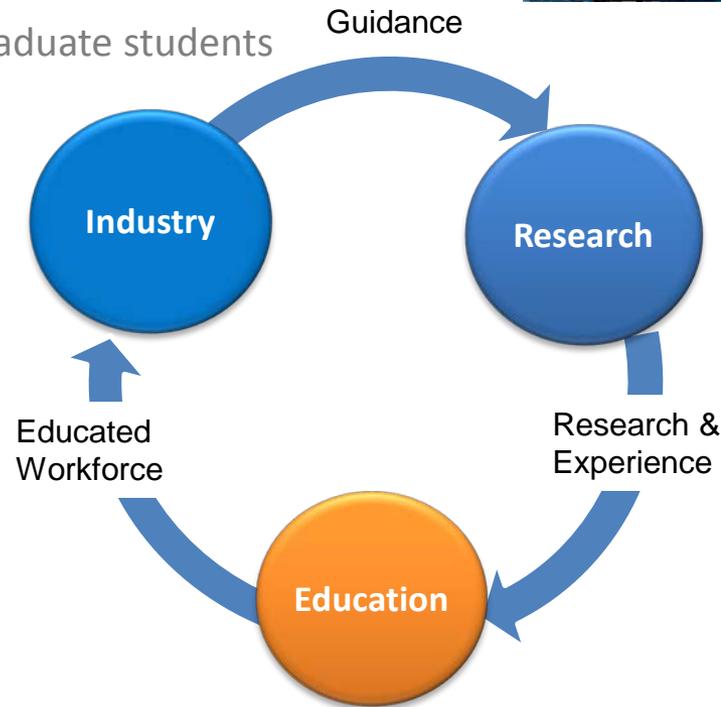


FREEDM Systems Center

- An NSF Engineering Research Center (ERC)
- Two international schools ,
- 4 US Universities
- 49 companies
- 12 NCSU faculty
- More than 100 NCSU graduate students



Strong industry & innovation program focusing on industry engagement and developing an innovation ecosystem



Focus on developing a revolutionary power grid technology suitable for plug-and-play of renewable energy, energy storage , electric vehicle and load.

Strong and comprehensive education and outreach program focusing on workforce preparation for power and energy industry

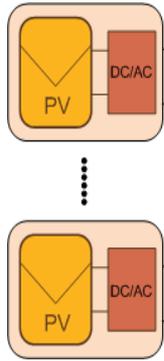
Gen I - PnP System Program

PnP Module and Structure



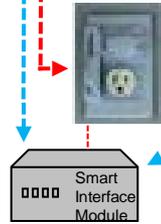
PnP Module Building Block Design, based on existing panel size

PnP Smart Inverter



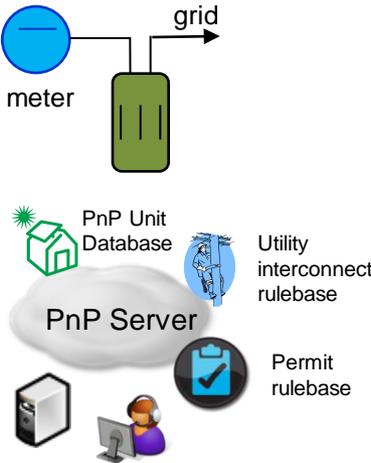
AC and DC bus microinverter versions

PnP Smart Interface



PnP Smart Interface for coms, monitoring and protection

PnP Monitoring and Approval



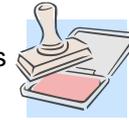
PnP Monitoring and Approval Server for Customer access, automated permitting, automated utility interconnection agreement and unit monitoring

PnP Design for Market



Stakeholder Engagement

Permit Procedures and Model Codes



PnP Requirements and Use Cases



Automation of permitting and interconnection agreement, Use cases and requirements for PnP, consumer friendly process and system

Testing & Demonstration



Test Protocols



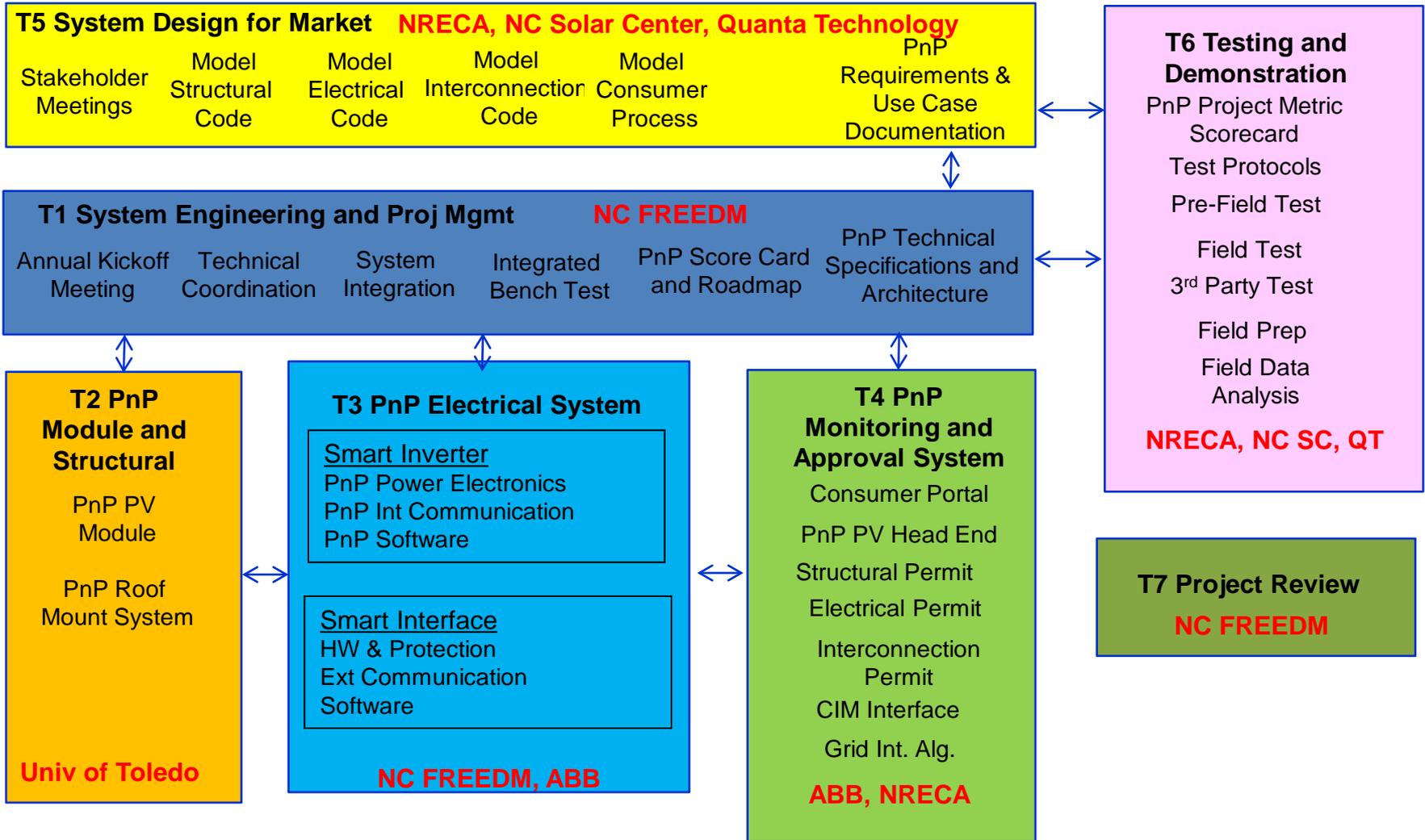
Project Scorecard



10 Site Demo

10 site utility residential demonstration

Gen I – Task Overview



Key Deliverables

Phase I – FREEDM Center/NC Solar Center

- Year 1 – Electrical testing of 2.5 – 5 kW systems
- Year 1 and 2 – Integrated structural and electrical testing

Phase II – Initial field testing – Wake Electric

- Starting Year 2 -- Field testing at 10 houses for a total of 25 kW, Wake Electric Cooperative, North Carolina

Phase III – Final field testing – Multiple Cooperatives

- Field testing at a minimum of two co-ops – one or more in North Carolina and one or more in the southwest
- Combination of at least 20 2.5 kW to 5 kW systems

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THANK YOU!