PACE
ACCELERATING ELECTRIFICATION

Power Electronics Accelerator Consortium for Electrification (PACE) Strategy

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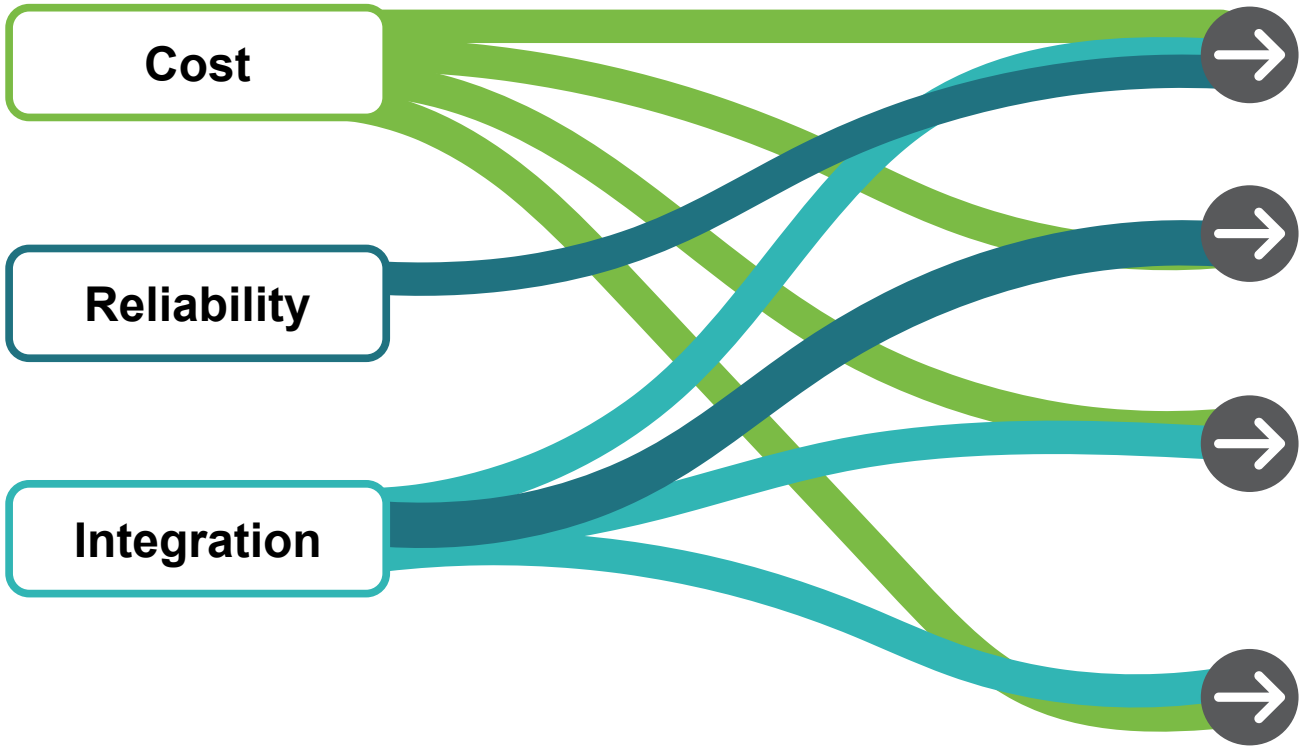
ORNL

Pathways for PACE Near Term R&D

Objectives



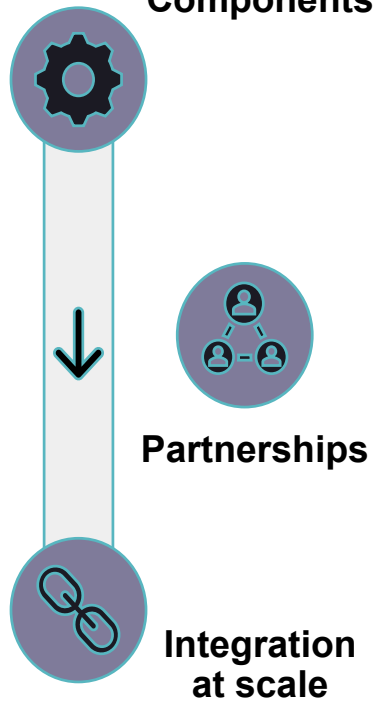
Leverage R&D and transition to field demonstration pilots

Support small companies through evaluation and prototyping in partner facilities

Incubate new, domestic, tiered-structure companies with new technologies through open service model

Develop and demo MVAC and MVDC R&D for distribution scale grid

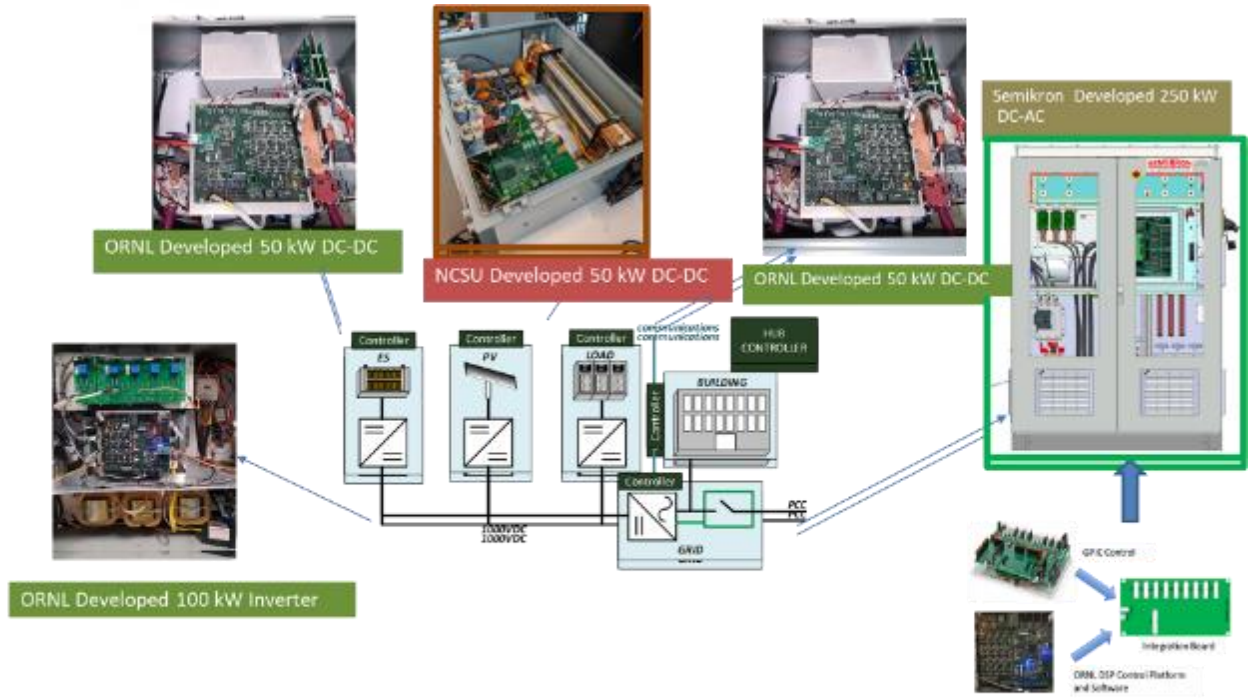
Develop metrics and roadmaps for future technologies through stakeholder engagement



Pathways Forward #1: Leverage R&D and transition to pilots

Resources

Component R&D	Sub Systems R&D	Systems R&D	Field Validation
Materials & Components, Embedded Controllers	Power Stages & Sub-System Prototypes	Auxiliary Systems, Software Platforms, Algorithms, System Prototypes	Pilot Demo Use Case
VALLEY OF CHALLENGES	VALLEY OF CHALLENGES	VALLEY OF CHALLENGES	VALLEY OF CHALLENGES
Microchip, PowerAmerica, CURENT, Oak Ridge National Laboratory	Oak Ridge National Laboratory, SEMIKRON innovation+service, NC State University	Pacific Northwest National Laboratory, Oak Ridge National Laboratory, FLEXPOWER, NREL Transforming ENERGY	Southern Company, Southern California Edison, NRECA
TRL 2–7	**TRL 3–7**	**TRL 4–7**	**TRL 5–7**
Advanced Components	480V PE Subsystems Inverters converters	Software platforms, Real-time Optimization	**Novel multi-port 480V PE system: Future pilot**



Final LV HUB Hardware: 2 x 50kW DC/DC Converters (ORNL) ,1 x 50kW DC/DC(DAB) Converter (NCSU),1x 250kW AC/DC Inverters (Semikron)

- Demonstrated plug-and play concept with commercial and academic partners
- Developed a new product for 480V in partnership with Semikron

Pathways Forward # 1: Leverage R&D and transition to pilots

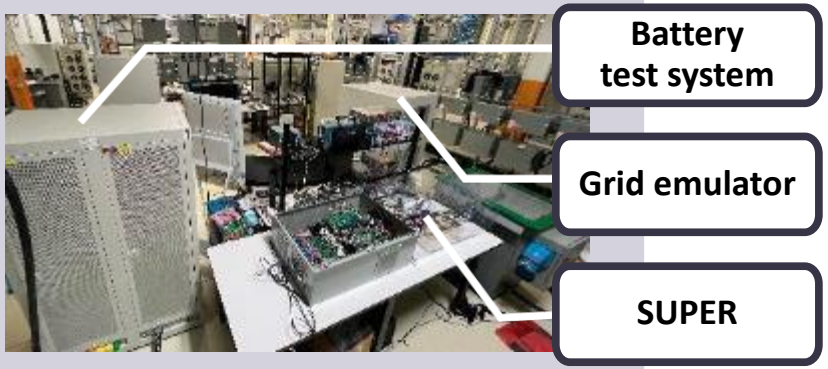
Modular, interoperable power electronics systems to enhance reliability, integration, intelligence, and automation

7 university partnerships; 20 pubs and 5 patents

"SUPER" Building Block: **S**mart **U**niversal **P**ower **E**lectronics **R**egulator; to inform maintenance needs in near real time

- Standardized data and power interconnects
- In-situ diagnostics, prognostics, and communication controls

Integration of SUPER block in grid-tied battery system demonstrated remote control and real-time intelligence of equipment health

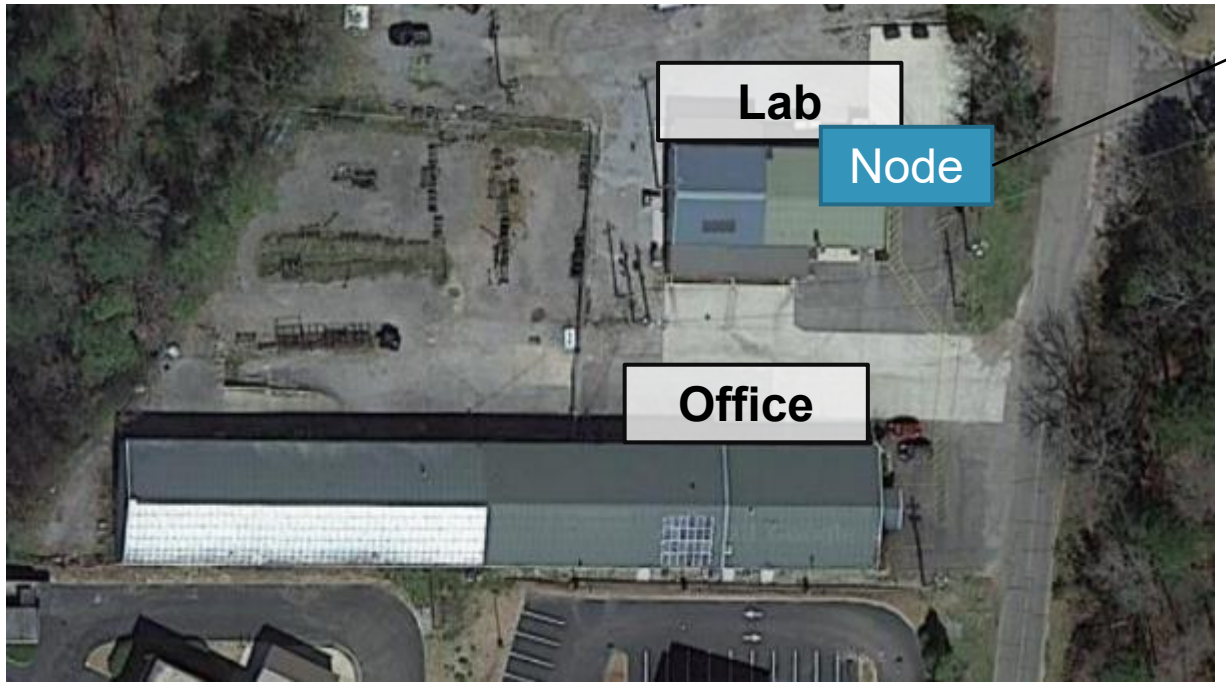


SUPER: Gatekeeper between the grid and each power source or load to minimize black outs

Oak Ridge National Laboratory
University of Arkansas
Stony Brook University
Texas
VT
Florida State University
Ohio State
UNC Charlotte

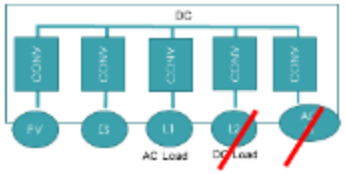
SSPS Node Demonstration at Southern Co.: Pilot

- Leveraging R&D demonstration through GMLC partnership with ORNL
- Initial concept validated in GRID-C at ORNL



Use Case #1: Resiliency

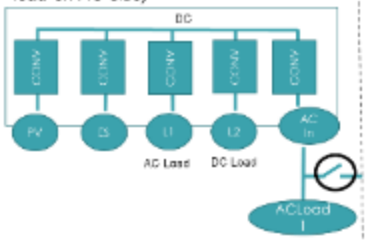
Goal: *Maximum sustaining of a specified load (here, AC Panel)*



Metric of Success: *A subset of lab sustains a maximum-hour, loss-of-grid event without initial interruption of operations*

Use Case #2: Reliability

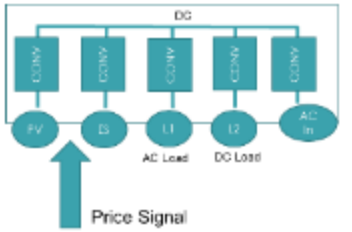
Goal: *Support of entire load for an outage duration (including existing load on AC side)*



Metric of Success: *Island entire facility load for 30 minutes and seamlessly resynch with the grid*

Use Case #3: Economic

Goal: *Price signal optimization (price signal from utility, self optimization)*



Metric of Success: *The SSPS node successfully reduces the lab power bill by x% or $x/month, TBD*

OAK RIDGE National Laboratory

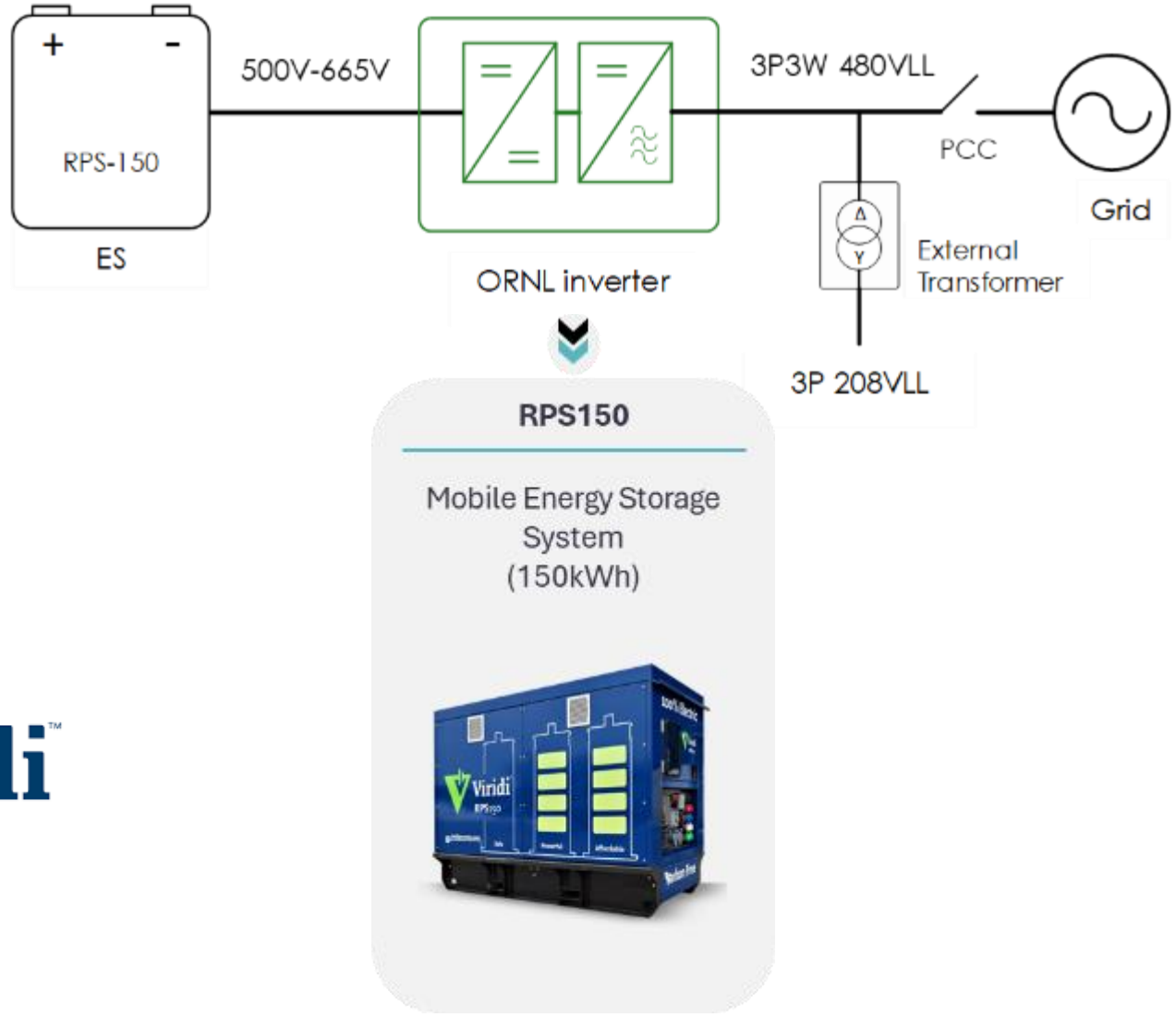
Southern Company

Viridi™

U.S. DEPARTMENT OF ENERGY | OFFICE OF ELECTRICITY

Pathway Forward # 2: Support small companies through evaluation and prototyping at partner facilities

- Develop an inverter prototype for the RPS-150 Unit and provide reference design
- Replace the current vendor inverter with ORNL prototype
- Demonstrate the RPS 150 full system prototype with ORNL developed inverter



OAK RIDGE National Laboratory

Viridi™

Pathway Forward #3: Develop and demonstrate MVAC and MVDC R&D: Transition to pilot demonstration

Objective

Design, develop, and demonstrate foundational technologies to address the gaps in 'smart' medium-voltage (MV, 4.16kV–34.5kV) electrical interfaces

Technical target

>97% efficiency for 40+ year lifetime at 90% up-time

Background

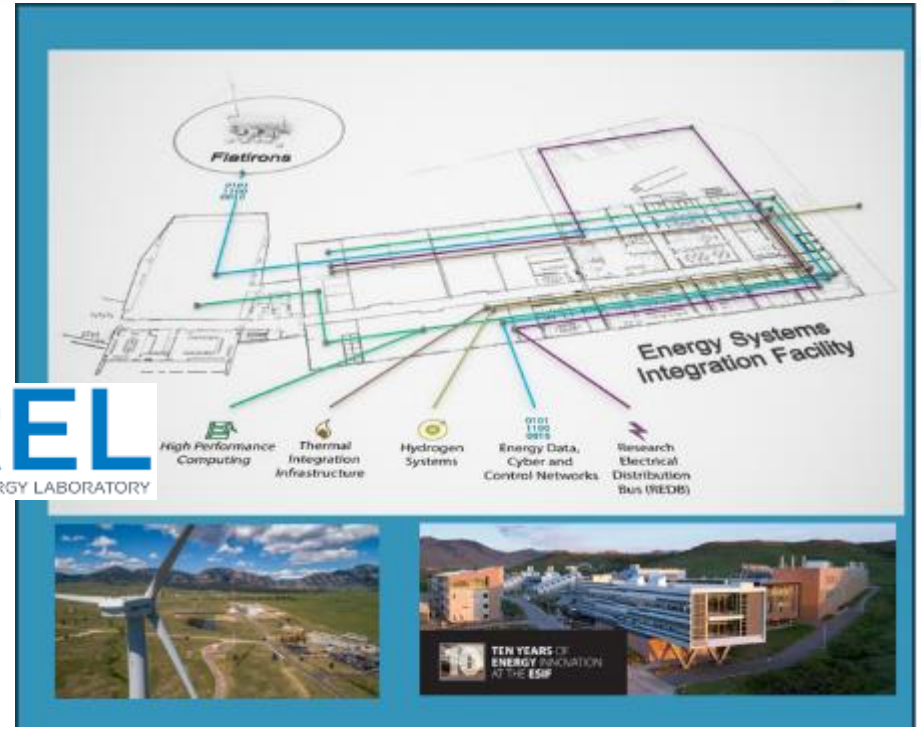
Support DOE Energy Earthshots (such as Hydrogen, Long-Duration Storage, Industrial Heat, & Floating Offshore Wind, among others)

Resources

Advanced Components and Power Stages	Advanced Converter Systems	Resource Integration& Management Systems	Grid Integration and Demonstration@scale
Materials & Components, Embedded Controllers	Power Stages & Sub-System Prototypes	Auxiliary Systems, Software Platforms, Algorithms, System Prototypes	Demo Use Case
VALLEY OF CHALLENGES	VALLEY OF CHALLENGES	VALLEY OF CHALLENGES	VALLEY OF CHALLENGES
Sandia National Laboratories; Wolfspeed; SEMIKRON innovation+service; Microchip; HITACHI	OAK RIDGE National Laboratory; VT Virginia Tech; University of Colorado Boulder; University of Arkansas; Virginia State University; Sandia National Laboratories	OAK RIDGE National Laboratory; ViridiParente; EATON; NREL Transforming ENERGY	NREL Transforming ENERGY; Pacific Northwest National Laboratory; Southern Company; OPAL-RT TECHNOLOGIES
TRL 2–7	**TRL 3–7**	**TRL 4–7**	**TRL 5–7**
Advanced Components	MV PE Subsystems Inverters converters	Software platforms, Real-time Optimization	**Novel multi-port Medium Voltage PE System: Future pilot**

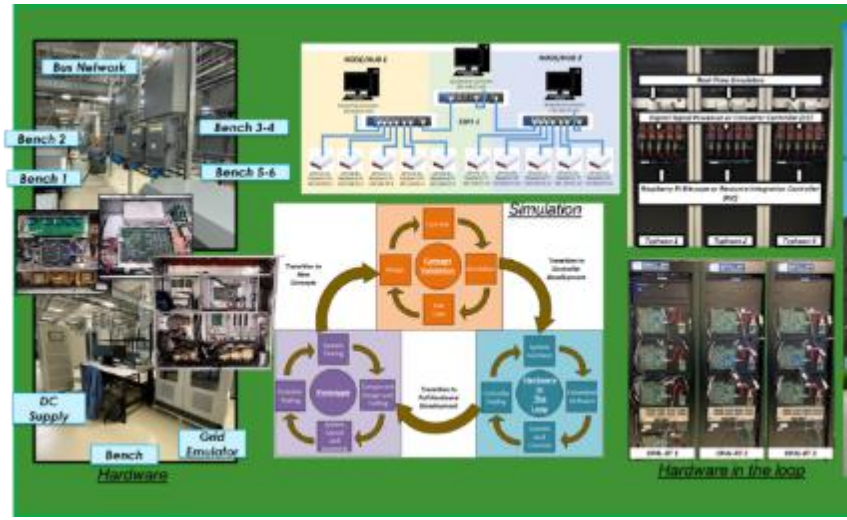
National Lab Capabilities

NREL
NATIONAL RENEWABLE ENERGY LABORATORY



Sandia National Laboratories

Pacific Northwest
NATIONAL LABORATORY

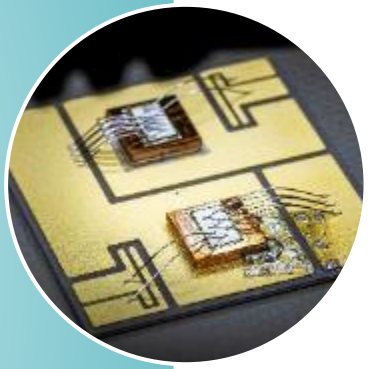


OAK RIDGE
National Laboratory

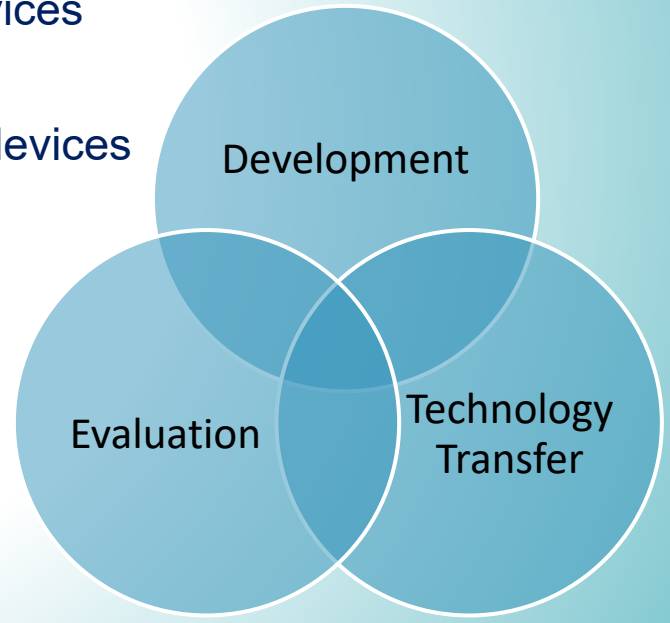
Pathway Forward #4: Incubate new U.S. companies with new technologies through open service model

Approach & Technology Focus

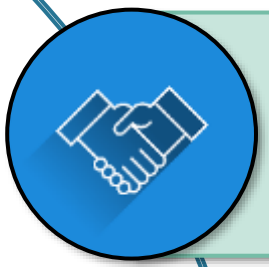
Collaborate with industry to **investigate**, **improve**, **develop**, and **deploy** innovative integrated and resilient grid resources for further intelligent electrification at the grid interfaces. The primary focus is to target projects that will impact the following technical areas:



- **Materials & Components:**
  For grid devices, power electronics systems, grid storage devices
- **Embedded Controllers**
  Integrated advanced analog and digital electronics, sensing devices
- **Subsystems Devices and Interfaces:**
  Converter, Inverter, controls and protection, prototypes, solid state components protection, transformers
- **Resource Integration & Management Systems:**
  Multi-stage converters, software platforms, algorithms
- **Grid Modelling and Transient Analysis**
- **Grid Systems Architecture:**
  Real time systems modelling and evaluation



Pathway Forward #4: Technical Collaboration Program Structure



1:1 Cost Shared Projects

- No funds change hands
- Industrial partner's cost share is "in-kind"

(can be labor, materials, travel, equipment, subcontract costs)

Phased Approach

Phase 1 up to $100K*/20% cost share

Phase 2 up to $200K*/50% cost share

"Open Call" Opportunity

- 6–8 page proposal template (co-developed between ORNL and industry partner)
- Project proposals submitted to DOE-OE every 2 weeks
- Proposal review/decision provided ~2-4 weeks after submission

Agreements between Industry & ORNL:

• Cooperative Research and Development Agreement (CRADA)

Technical Collaboration:
Services/Opportunities for Collaborative Projects

PACE

Design
Hardware, Software, Architecture, and/or Modeling

- Reference design
- Circuit topology
- Control/Comms strategy
- Use case considerations
- Model libraries

Development
Hardware, Software, Architecture, and/or Modeling

- Physical layout and component selection
- Circuit model, I/O, sub-system controls, gate driver controls
- Model evaluation

Initial Prototype
Hardware, Software, Architecture, and/or Modeling

- POC construction for control boards, drivers, power modules, inverters/converters
- Control integration and emulation
- Model Simulation
- Use case analysis

Evaluation & Testing
Hardware, Software, Architecture, and/or Modeling

- Inverter/Converter test bed evaluation
- Component performance testing
- Controls and communications protocols interaction with power electronics test units
- Use case boundary conditions
- CHIL model evaluation and verification
- Modeling and simulation for PE, use cases, components

Technical Collaboration Program

PACE

OAK RIDGE National Laboratory

Science Areas ∨ Work With Us ∨ About Us ∨ Careers News

Grid Research Integration and Deployment Center

About Grid-C Labs

Work with Us: Tech Collaboration Program with GRID-C

ORNL's Tech Collaboration Program (TCP) engages industry partners to participate in short-term, collaborative projects to accelerate the development of new energy efficient manufacturing technologies. The opportunity provides selected participants access to ORNL's experienced staff and unique equipment and capabilities at the MDF to demonstrate advanced concepts with intent to develop and deploy new manufacturing processes or materials in U.S. manufacturing industries.

This program provides open, affordable, and convenient access to national lab infrastructure, hosted resources, tools, and expertise to facilitate rapid development and adoption of

Contract Opportunity

General Information

Classification

Description

Attachments/Links

Contact Information

History

Award Notices

Follow

Grid Research Integration and Deployment Center Technology Collaborations for US Power Electronics Industries

ACTIVE

Contract Opportunity

Notice ID
ORNL-GRIDC-TC-2024

Related Notice

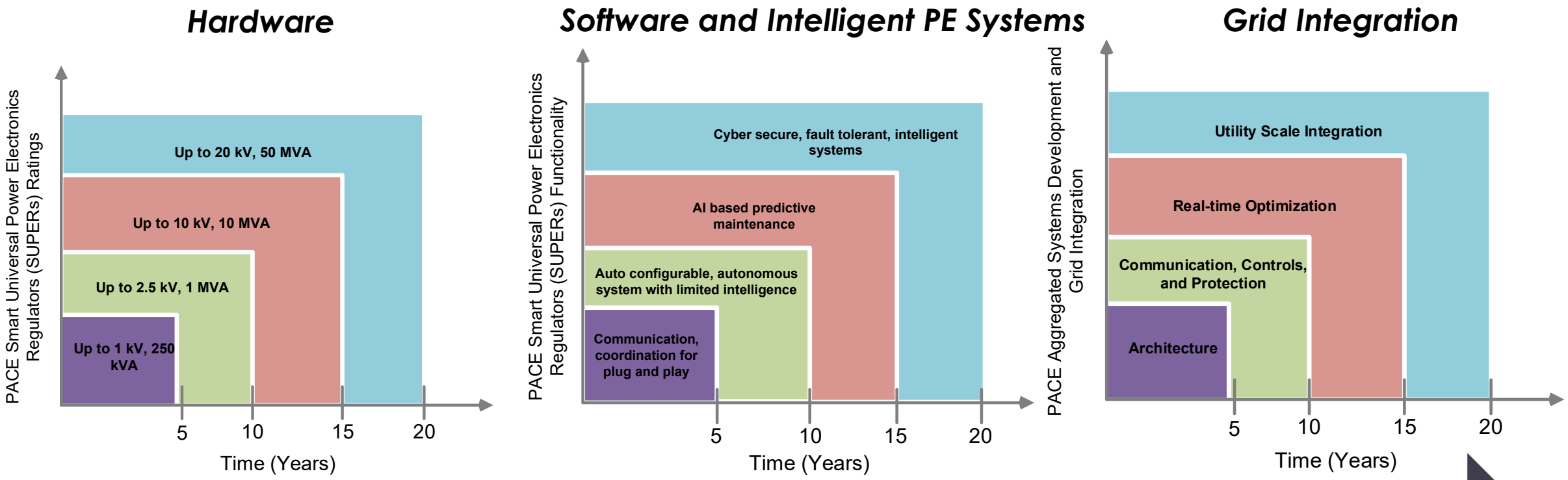
Department/Ind. Agency
ENERGY, DEPARTMENT OF
Sub-tier
ENERGY, DEPARTMENT OF
Office
ORNL UT-BATTELLE LLC-DOE CONTRACTOR

Pathways Forward # 5: PACE Stakeholder Engagement

- Stakeholder meetings: Mitsubishi, TVA, Shell, Infineon, Beneficial Electrification League
- Tennessee Valley Authority presentation: May 2, 2024
- Annual Merit Review: May 7–8, 2024
- Annual PACE Meeting: August 14–15, 2024
- Engage OE and EERE,CESER leadership

Pathway Forward #6: Develop metrics and roadmaps for future technologies through stakeholders engagement

PACE: Technology Metrics and Targets



Expanding capabilities of PE system building blocks achieved over several phases

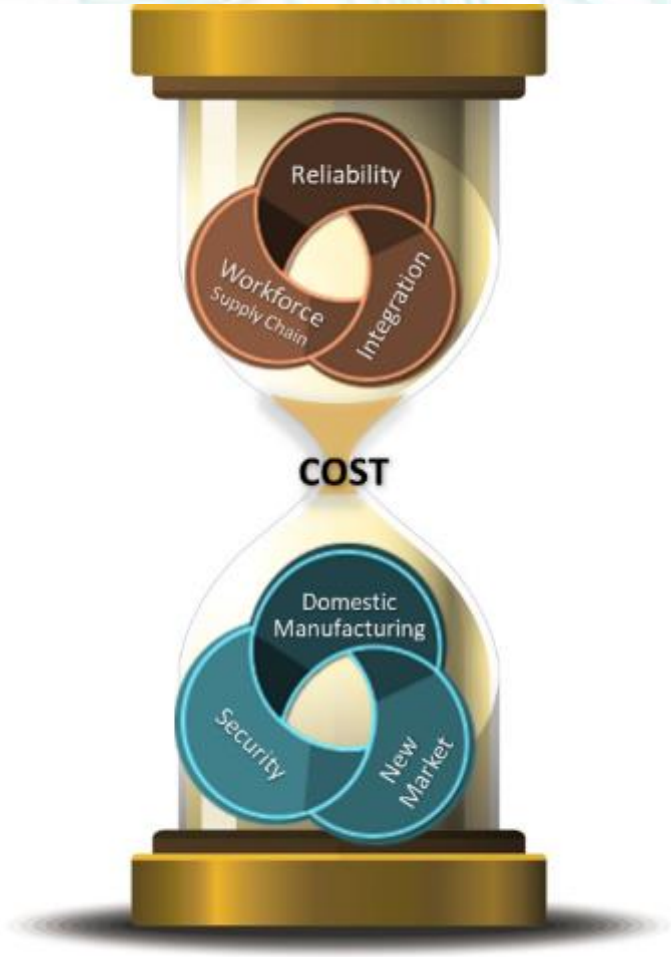
COST

RELIABILITY

INTEGRATION

Impact and Outcomes

- **Roadmap that provides pathways** to solve barriers of cost, integration, and reliability for power electronics-based systems tied to the grid
- **Standards and guidelines** for hierarchical integration of sources and loads with interoperable, hardware-agnostic software platforms for power electronics systems
- **Acceleration** of the development and deployment of integrated grid systems with power electronics technologies to enable electrification and clean energy expansion
- **Increased adoption** of power electronics technologies, creation of a domestic manufacturing ecosystem, and stimulation of new market opportunities



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