PACE

ACCELERATING ELECTRIFICATION

# Medium Voltage Resource Integration Technologies (MERIT)


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| Team Lead Lab ORNL: | PI: Madhu Chinthavali, co:PI- Prasad Kandula |
| Co-Lead Lab NREL: | co-PI: Gab-Su Seo |
| Partner Lab SNL : | co-PI: Jacob Mueller |
| Partner Lab PNNL: | co-PI: Rohit Jinsiwale |

# Overall Objective

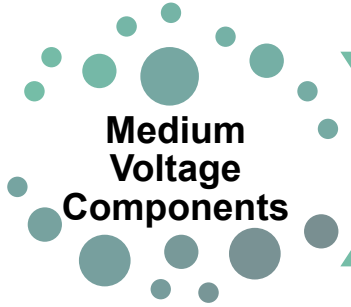
- **The overall goal for this project is to** address the gaps in 'smart' medium-voltage (MV, 4.16kV-34.5kV) electrical interfaces through development of a medium-voltage power and control electronics sub-system and system level impact analysis to achieve: **>97% efficiency 40 year+ targeted lifetime at 90% up-time**

- **Technical objective** :design, develop, and demonstrate foundational technologies and capabilities for scalable, modular and cost-effective subsystems and systems and provide performance targets and metrics.

- Provide support to several of the DOE Energy EarthshotsTM (such as Hydrogen, Long-Duration Storage, Industrial Heat, Floating Offshore Wind, among others)

## Leverage Existing Technologies: Identify Opportunities & gaps for power electronics systems

# Overall Approach



**Medium Voltage Components**

- Establish testing practices and protocols for semiconductors
- **Evaluating early-stage reliability of the subsystem components**
- Identification of gaps in MV (> 3.3 kV ) devices
- Advanced magnetics with high insulation and low PD (partial discharge) while maintaining compact size/weight that will ensure reliable component life
- Identification of gaps in MV passive devices (magnetics)

**Medium voltage Power blocks development**

- **Library of power stages:** Standardization techniques to achieve Plug-n-play
- Novel topologies that can improve performance through efficiency improvements or/and control simplifications

**Power electronic converter prototyping**

- **Novel topologies** that can achieve efficiency improvements, cost reduction or/and control simplifications
- Converter control architecture to handle multiple modules

**Grid Integration**

- **Software architecture** and platforms for resource integration
- Real time management of resources
- Multiple control schemes for multiple grid services for autonomous or coordinate secondary control

**System level Impact Analysis : Medium voltage grid application use case**

- **Use cases** for MV applications
- Real time, CHIL and PHIL test beds for use case validation for medium voltage systems
- MV technology evaluation capabilities

**Gap Analysis**

# Tasks Overview

| Tasks | Phase 1 | Phase 2 | Phase 3 |
|---|---|---|---|
| Stakeholder Engagement | Meetings and workshops with stakeholders (ORNL, NREL, SNL, PNNL) | Meetings and workshops with stakeholders (ORNL, NREL, SNL, PNNL) | Meetings and workshops with stakeholders (ORNL, NREL, SNL, PNNL) |
| Hardware/Software Design | MV Converter Development: Topology and control simulation(ORNL, NREL, SNL ) | | |
| | | MV Converter CHIL Verification (ORNL, NREL, PNNL) | |
| | | Resource Integration Layer Development (ORNL, SNL) | |
| | | | Controls for Grid integration (ORNL, NREL, SNL, PNNL) |
| Hardware/Software Implementation | Component Characterization and Reliability Testing (SNL, ORNL) | | |
| | | Subsystem Development (ORNL, SNL) | |
| | | | Integrated MV System Testing (NREL, PNNL ) |
| Impact Analysis | | System Impact Studies (PNNL) | System Impact Studies (PNNL,NREL) |
| Gap Analysis | | | Identification of barriers for adoption of the MV sub-system (ORNL, SNL) |