Power Electronics Accelerator Consortium for Electrification (PACE)

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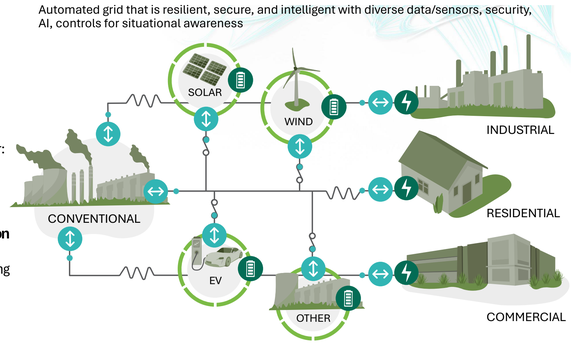
Motivation

Current Drivers for Power Electronics Systems Integration

- **Interfacing**
  Power conditioning and grid integration: DER and energy storage
- **Delivery**
  Long distance power transfer: Off-shore wind, utility-scale solar
- **Management and conversion**
  Megawatt-Gigawatt scale Hydrogen production, charging infrastructure, industrial processes and equipment



What is PACE?

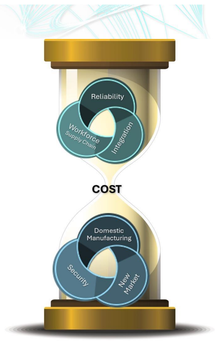
PACE is a U.S. Department of Energy cross-cut initiative, currently supported by the DOE OE's Transformer Resilience and Advanced Components (TRAC) program, EERE Hydrogen and Fuel Cell Technologies Office(HFTO) in coordination with GMI and other offices

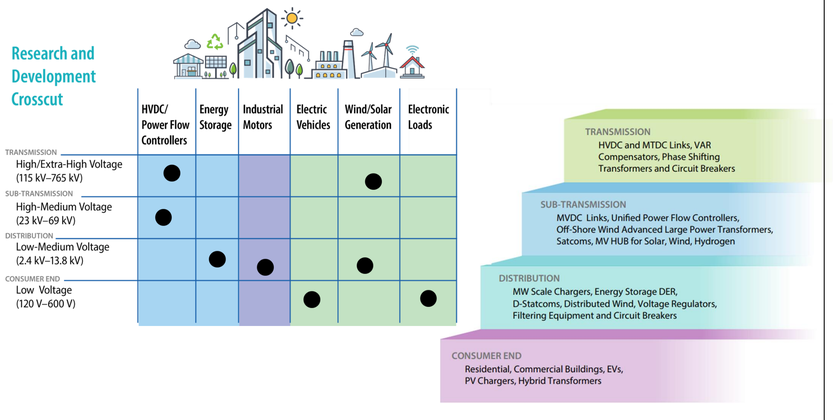
PACE is a coalition of partner research institutions, utilities, and industry manufacturers working to take innovative research in power electronics to grid-level pilot demonstration.

Vision: Accelerate the development and demonstration of integrated grid systems with power electronics technologies for electrification

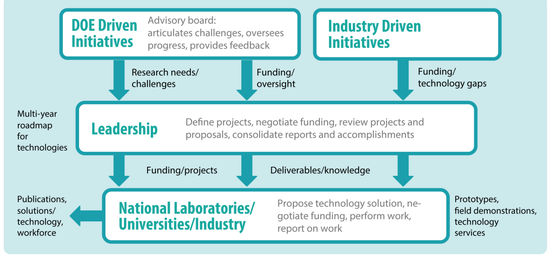
Focus: Solve power electronics and grid hardware barriers of **cost, integration, and reliability**

Impact: Increase in adoption of power electronics technologies, create domestic manufacturing, and enable new market opportunities





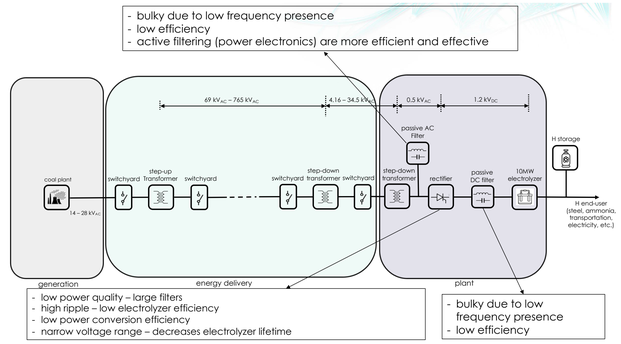
PACE Execution Framework



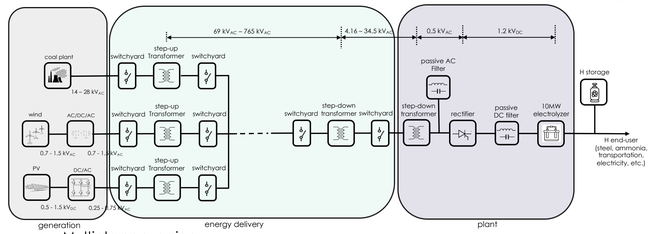
Systems Integration Technologies: Green Hydrogen Production Use case

- 1-GW green-hydrogen plant for steel/ammonia production
  - Electrolyzers and wind turbines are at tens of MW scale → 1GW scale plant must be achieved by grouping them, along with PVs and batteries
  - Other components (power electronics systems, transformers, protection, etc) are also required to deliver/compatibilize energy from the sources to electrolyzers
  - Example:
    - 25 groups of 40 MW subsystem to reach 1 GW
    - 40 groups 1MW electrolyzers to reach 40 MW subsystem
    - Multiples Wind turbines, PV arrays, battery packs, are combined to reach the 40 MW
    - Multiple blocks of power electronics at 100's KW scale required to convert to DC Voltage for the electrolyzer

Standard AC Grid-connected hydrogen production plant: MW Scale

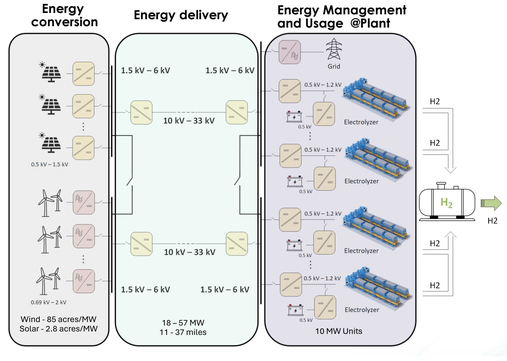


AC Grid-connected **Green** Hydrogen production plant: MW Scale



- Multiple conversion
  - Wind path: AC → DC → AC → DC
  - Solar and energy storage path: DC → AC → DC
- Low efficiency, Low reliability
- Higher cost with power electronics components

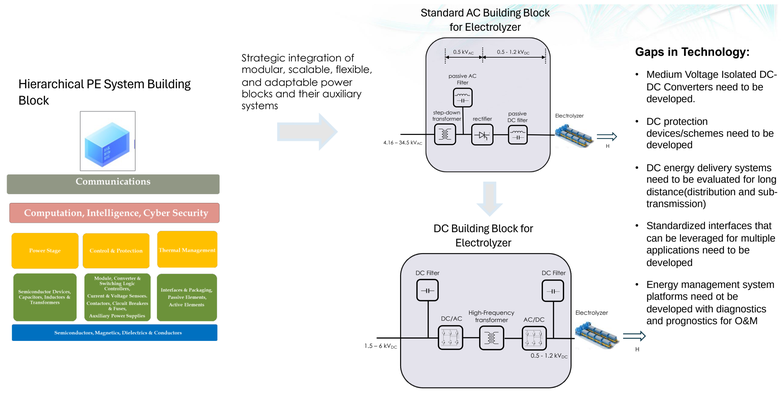
DC **Green** Hydrogen production Ecosystem Medium Voltage



Benefits:

- **Off-grid MVDC for MW-Scale** Wind+Solar green H2 production : **accelerated deployment** in comparison to grid connected solution (long permitting time)
- MVDC Distribution -> **Increased efficiency** with DER Integration
- MVDC Links -> Capacity expansion in congested areas while **deferring infrastructure investments**
- Higher stability provided by DC system

PACE Overall Approach: Power Electronics System Integration Ecosystem



Gaps in Technology:

- Medium Voltage Isolated DC-DC Converters need to be developed.
- DC protection devices/schemes need to be developed
- DC energy delivery systems need to be evaluated for long distance(distribution and sub-transmission)
- Standardized interfaces that can be leveraged for multiple applications need to be developed
- Energy management system platforms need ot be developed with diagnostics and prognostics for O&M

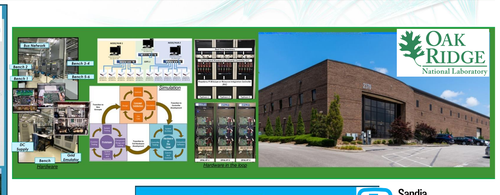
Consortium Framework

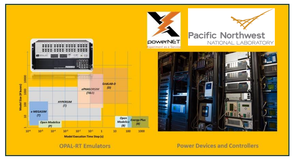
Addressing the technical challenges in the MV modular approach through the current Consortia of stakeholders(4 national labs, 5 Universities, 7 industries)

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	ORNL, Sandia National Laboratories, Virginia Tech, University of Colorado Boulder, University of Arkansas, Purdue University	ORNL, Viridi Parente, 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**

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

Collaboration and National Lab Capabilities





Acknowledgements

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