

Overview of Advanced Research on Integrated Energy Systems (ARIES) Research

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H2-PACE: Power And Control Electronics for Hydrogen Technologies Workshop
Panel 4: Commercial Systems Development & Qualification

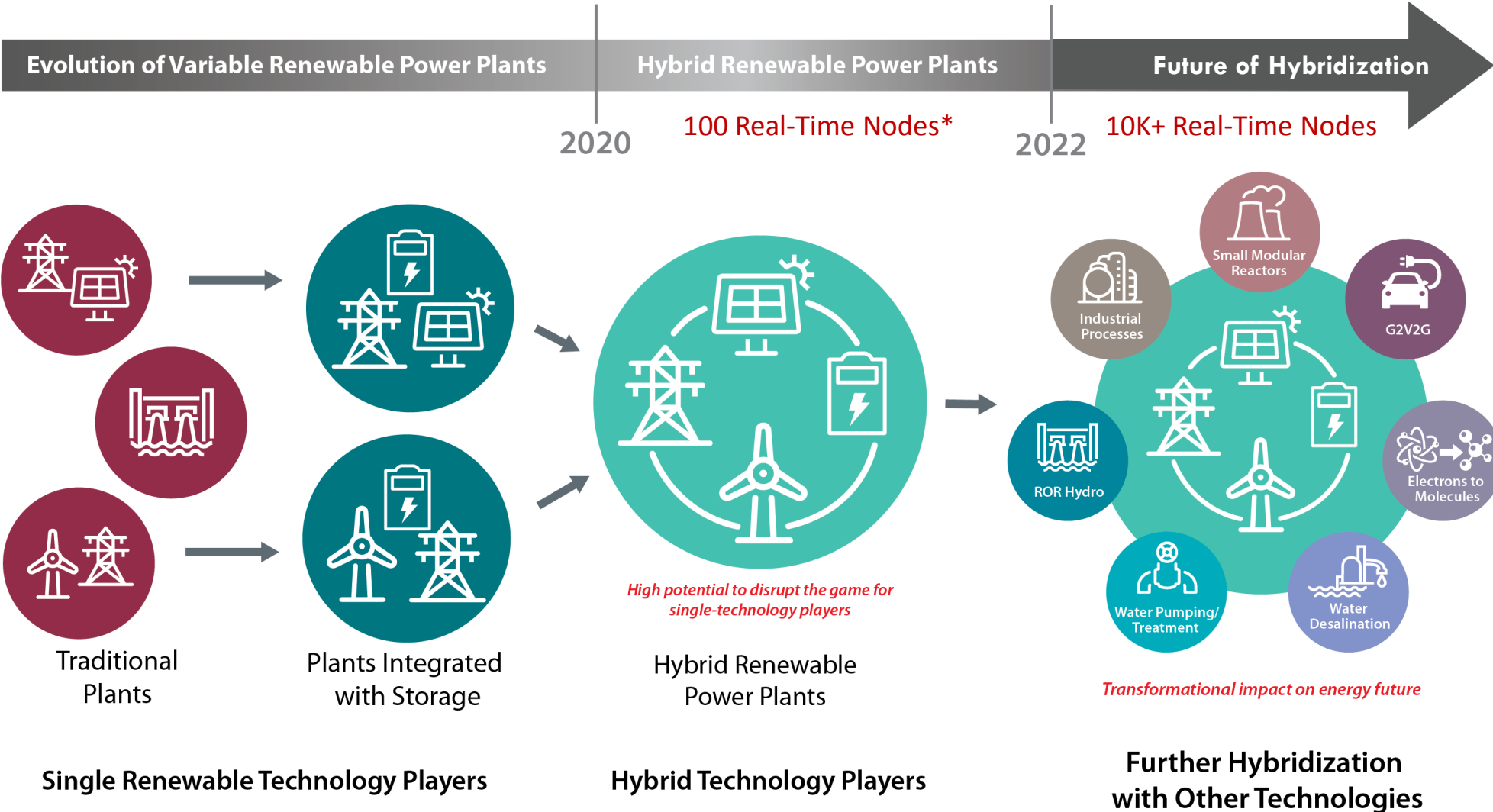


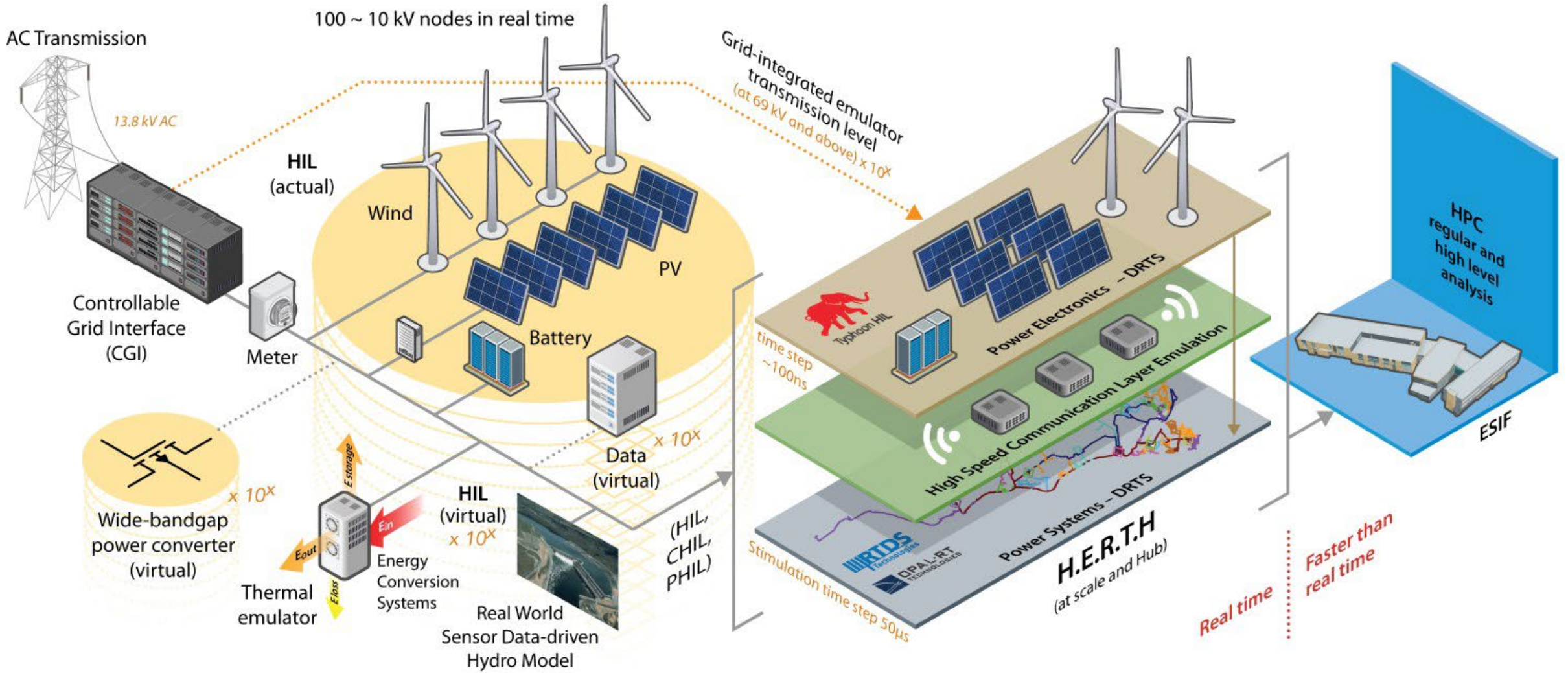
ARIES

ARIES is a research platform designed to de-risk, optimize, and secure current energy systems and to provide insight into the design and operation of future energy systems. It will address the fundamental challenges of:

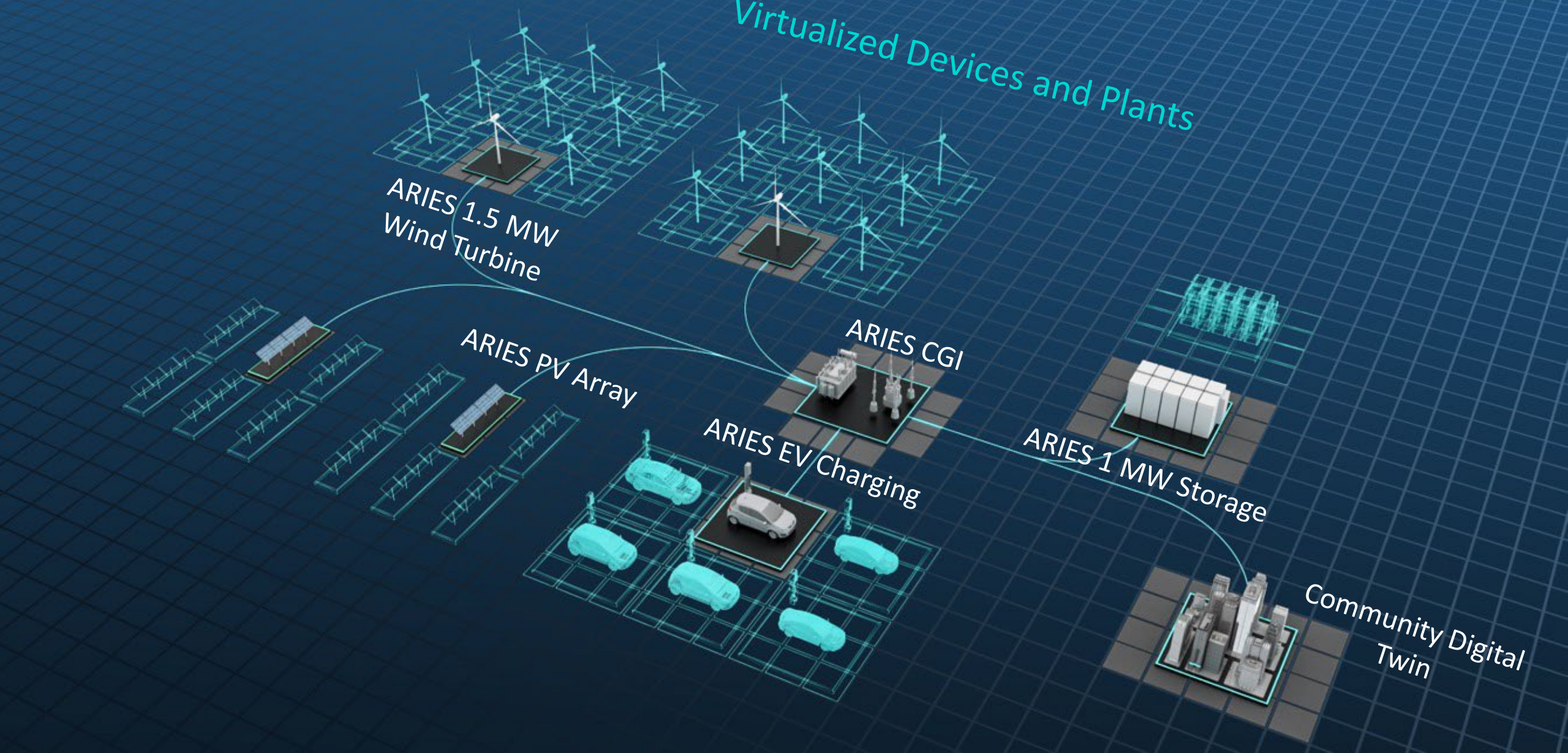
- Variability in the **physical size** of new energy technologies being added to energy system
- Controlling **large numbers** (millions to tens of millions) of interconnected devices
- Integrating **multiple diverse technologies** that have not previously worked together

Evolution of Hybridization of Energy Systems





ARIES Integrated Energy Systems At-scale



Hybrid Energy Systems – Emulating complex virtual systems with actual physical devices and At-scale using 100x digital multiplier

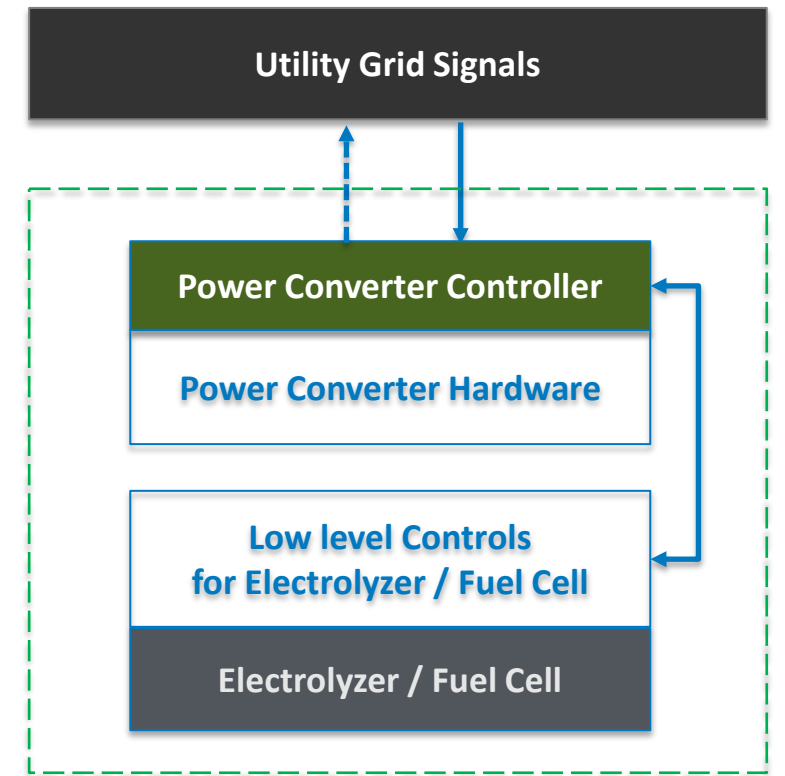
At-scale Validation of Future Hydrogen Systems

Validate integration of hydrogen electrolyzers and fuel cells.

- **Integration of hydrogen system:** hydrogen devices (electrolyzer/fuel cell stack, balance of plant, low-level controls), power electronics, and advanced grid functions.
- Electrolyzers as a fast, controllable, smart load participating in grid services; Fuel cell as a generation resource capable of grid forming.

Integration of hydrogen systems for **hybridization** with other generation and storage assets.

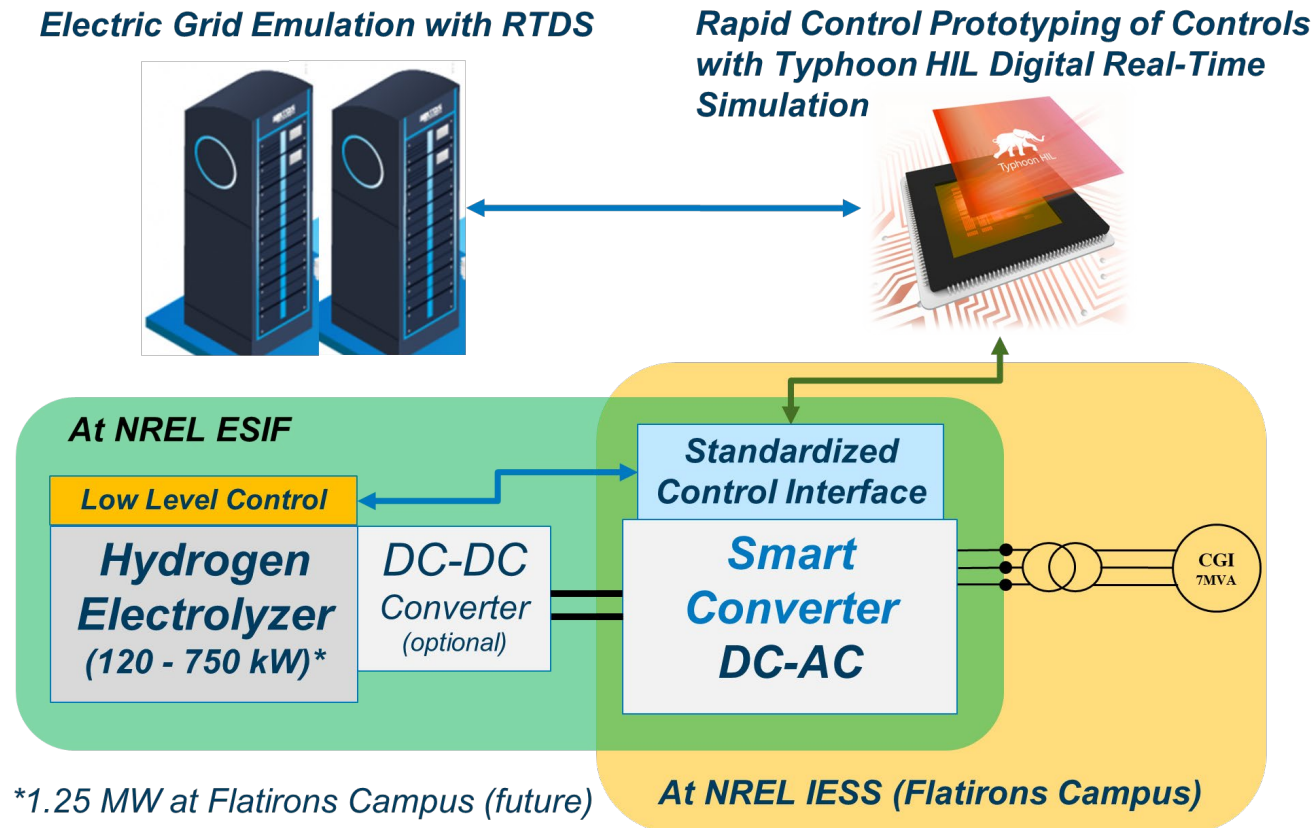
- **Grid codes and standards** for participation in grid services.



System-level Functional Control Architecture

Hardware-in-the-Loop Validation Environment at ARIES

- Electrolyzer Smart Power Converter Controls with advanced functionalities.
- Compatibility development and at-scale validation for operational scenarios.
- Integration with renewables, energy storage, controllable loads (commercial buildings, electric vehicles).



Research Collaborations



GE
Power Conversion



SUNSPEC
ALLIANCE



Hitachi Energy

Thank You

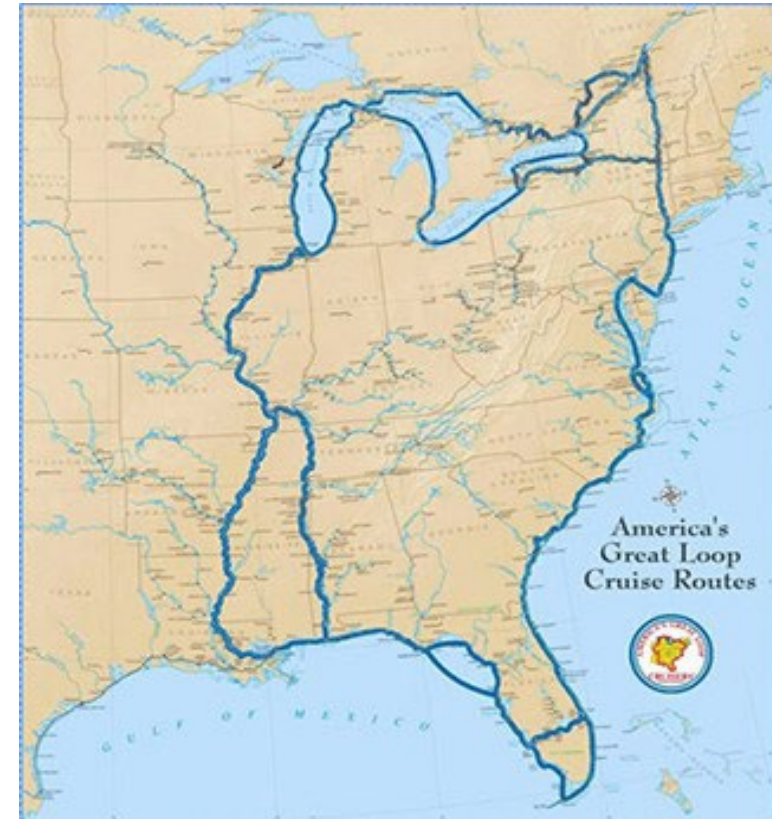
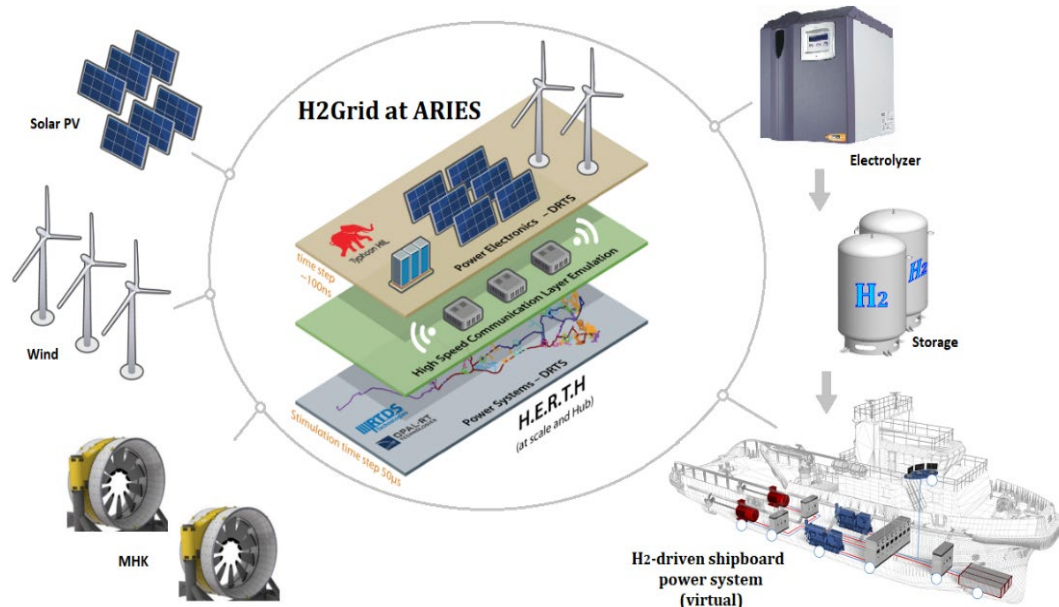
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Hydrogen-based Green Infrastructure for Decarbonization of Marine Intracoastal Applications (H2GRID)

- Develop and evaluate renewable-based hydrogen production for intracoastal marine applications.
- Decarbonization opportunities for intracoastal marine applications.
- Intracoastal ports in the **Great Loop** are diverse communities that have endured lower air and water quality due to emissions and lacked green job opportunities.



Team: NREL, MIT-Sea Grant, Keuka Energy, Baker-Hughes (Nexus Controls), Georgetown County*, Avangrid, Crowley Maritime, McAllister Towing and Transportation, Moran Towing, NRECA, Blue Sky Marine Coalition, W. Leigh and Associates**

*Port city community

**Women-owned tugboat operation company