

U.S. DEPARTMENT OF
ENERGY | OFFICE OF
ELECTRICITY

Microgrid Program R&D within the U.S. Department of Energy

September 2023

+ Office of Electricity

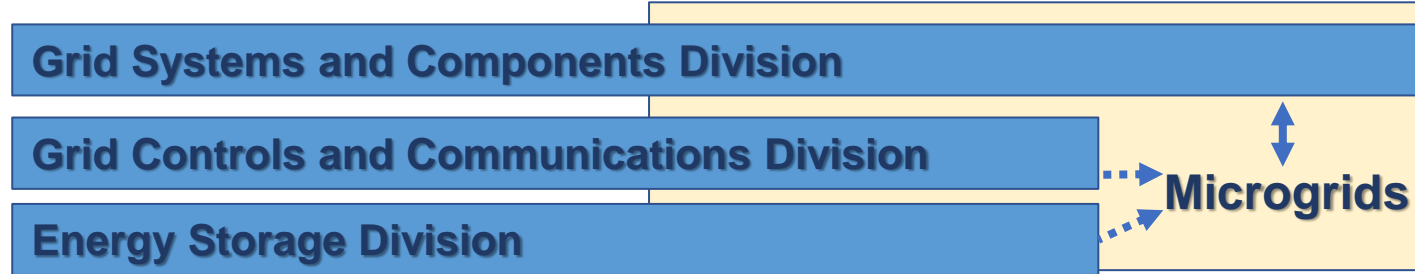
Working closely with industry and other stakeholders, the Office leads the Department's efforts to ensure that the Nation's energy infrastructure is reliable, secure and resilient to disruptions.

DOE RD&D activities drive grid technology evolution to support grid modernization and provide long-term transformational strategies to ensure that electricity delivery systems can support evolving generation and new types of loads, including distributed energy resources, while operating reliably under a variety of conditions.

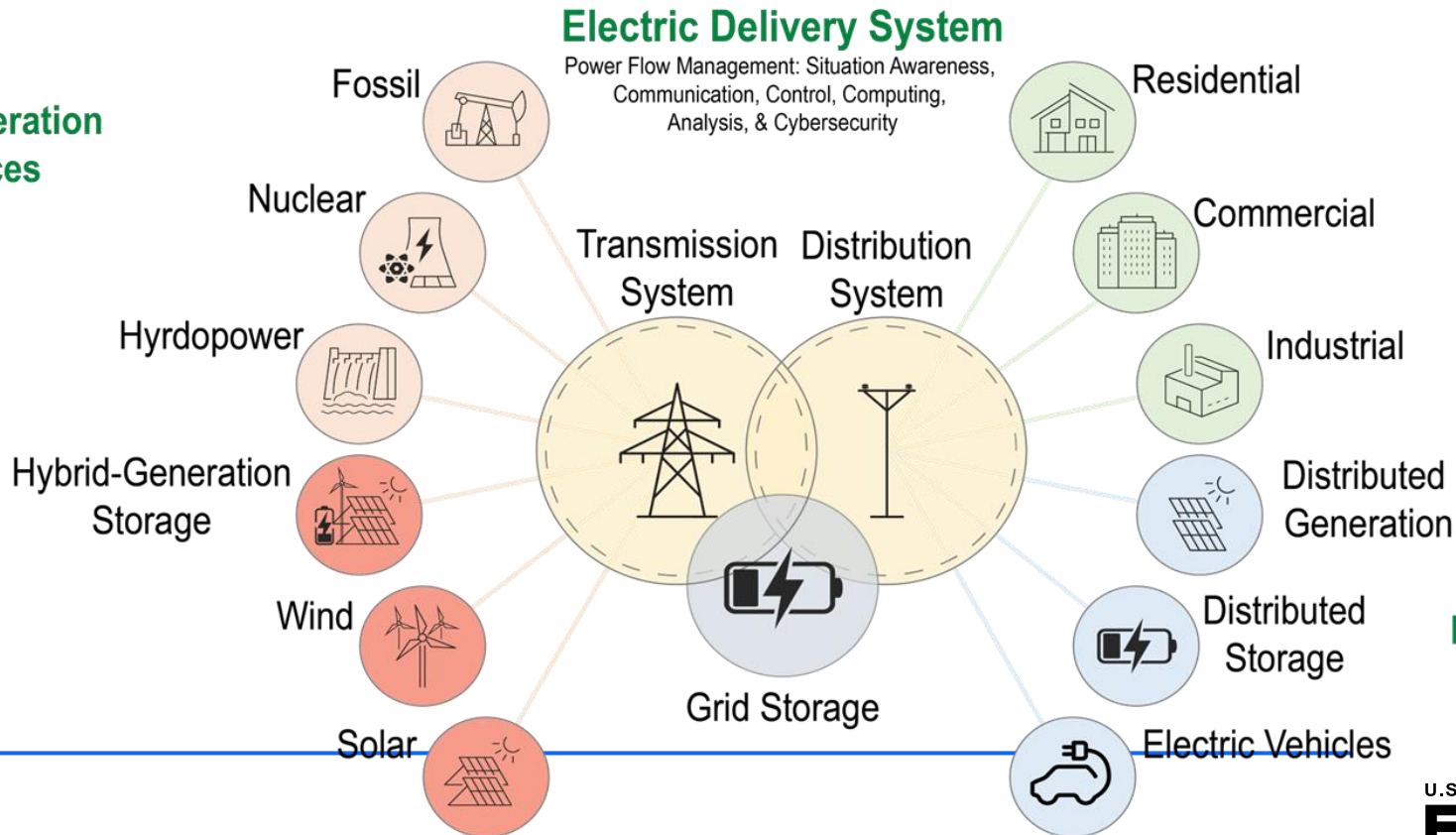




Microgrids in OE RD&D Portfolio



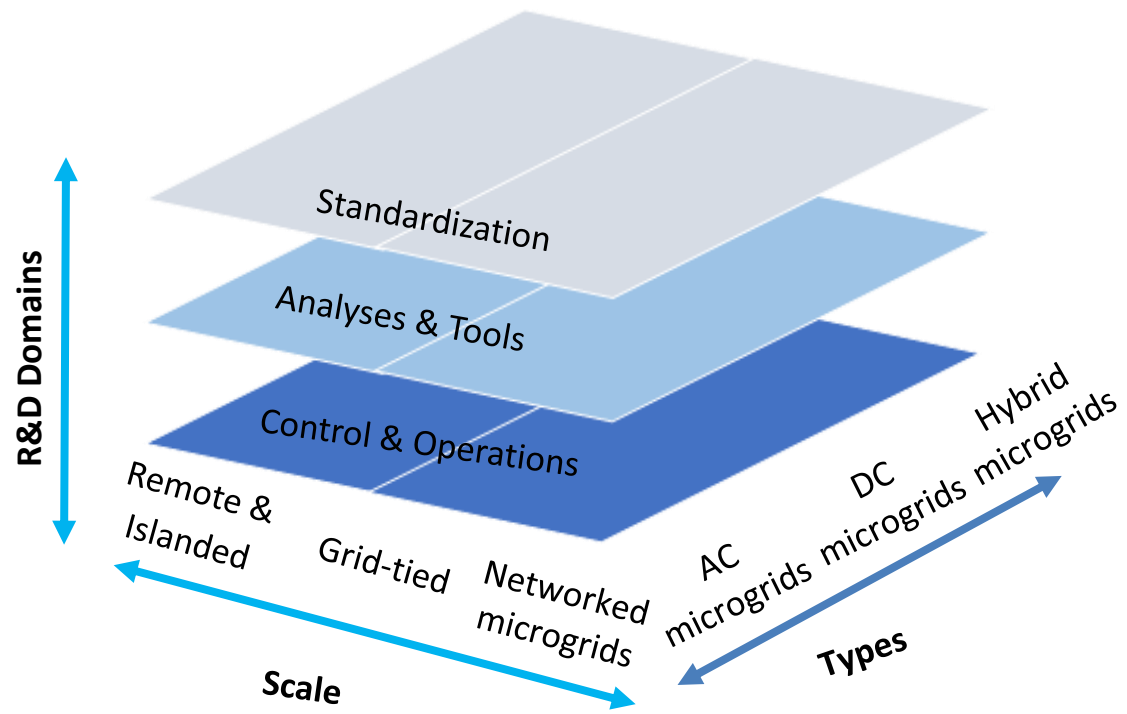
Central Generation Resources



Customers

Distributed Resources

+ DOE Microgrid Program and Its Strategy



- Topic 7: Enabling regulatory and business models for broad microgrid deployment
- Topic 2: T&D co-simulation of microgrid impacts and benefits
- Topic 6: Integrated models and tools for microgrid planning, designs, and operations
- Topic 5: Advanced microgrid control and protection
- Topic 4: Microgrids as a building block for the future grid
- Topic 3: Building blocks for microgrids

The *DOE Microgrid Program Strategy*, with its 7 white papers, is available for download from OE website.

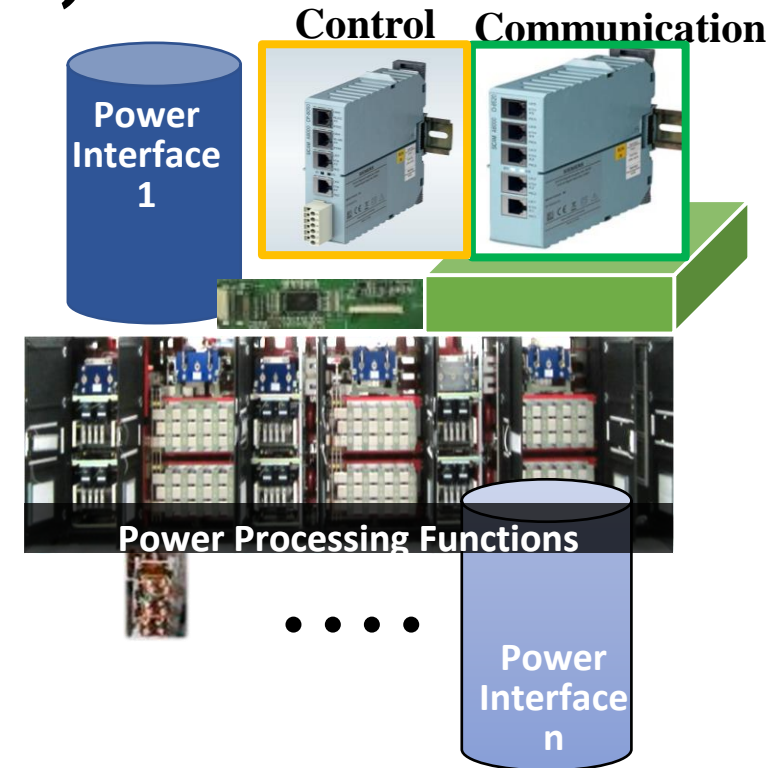
+ Microgrid Building Blocks (MBB)

Modular and standard design of MBB to:

- Reduce cost and time of microgrid deployment
- Interface with utility systems as well as generation, load, and controls
- Provide a low-cost standard approach for a wide range of microgrids

Technical Scope

- MBB design and prototype development
- Modeling and simulation of MBB, Performance requirements and evaluation
- MBB modularization, standardization, validation and testing
- MBB Demonstration
- Planning of technology transfer and commercialization



Team Partners

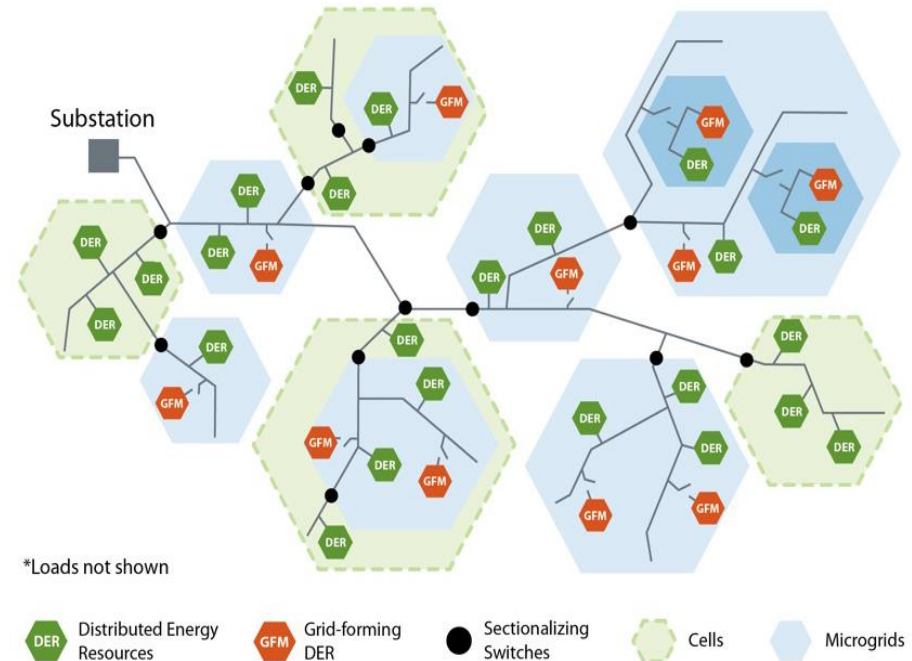
- ✓ Virginia Tech (Lead)
- ✓ PNNL, ORNL, NREL
- ✓ ABB
- ✓ Industry Advisory Board



Dynagrid: A concept to enable dynamic formation of microgrid boundaries for optimized operations

Develop a framework for dynamic formation of networked microgrids for optimized operations under both normal and emergency conditions. This project **addresses major research challenges:**

- improve T&D system real-time **resilience**
- integrate and efficiently leverage large amounts of **renewables and DERs**
- allow wide-scale **electrification**
- increase **distributed and decentralized decision making**
- improve **equity and energy justice**



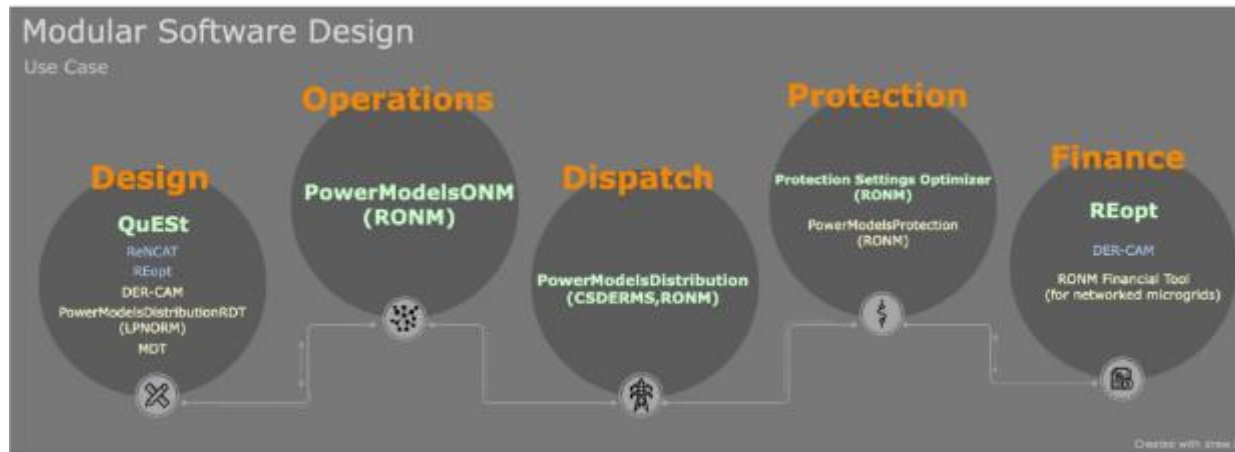
Team Partners

- ✓ NREL (Lead)
- ✓ LANL, LLNL, SNL, University of Wisconsin-Madison
- ✓ Industry Advisory Board

+ Integrated Workflows and Tools for Microgrid Design and Analysis (RAVENS)

Develop a data exchange standard for tools developed under DOE programs to support effective integration internally and externally

- Support plug-and-play architectures and ease of adoption by industry
- Ready integration with utility planning/analysis
Validated workflows for designing microgrids for cost-benefit analysis, implementation feasibility, and protection coordination



Technical Scope

1. **API development:** Standard for ingesting and exchanging information between tools
2. **Use case development:** demonstration of practical value of API with an integrated tool use case
3. **Adoption by legacy tools:** Demonstration of how legacy tools can be compatible to the API
4. **Interactive microgrid tool catalog:** Living documentation of capabilities that are compatible with the API
5. **Prototyping integration with ADMS**

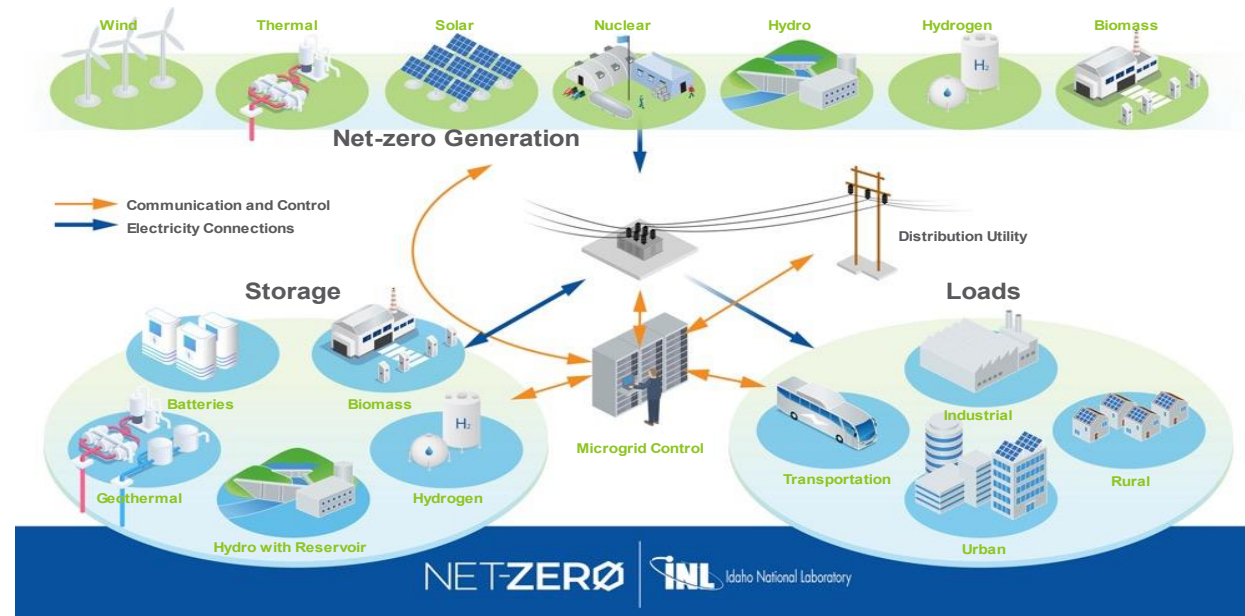
Team Partners

- ✓ LANL (Lead)
- ✓ NREL, SNL, LBNL
- ✓ NRECA
- ✓ Industry Advisory Board

+ Net-zero Microgrids

Conduct cross-cutting research to accelerate the removal of carbon-emitting generation from microgrids

- Model microgrid with microreactor module for use cases with multiple DER configurations; identify operational issues for microgrids with microreactor to provide grid services
- Develop a microgrid corridor project that connects community and transportation microgrids with other local renewable and non-carbon energy resources, for cumulative economic, resilience, and environmental justice benefits



+ Robust, Autonomous and Fault-tolerant DC Microgrid Development

Project Scope: Utilize microgrid design, simulation tools, and dynamic models previously developed for rural islanded grids (St. Mary's) and DC microgrids (electric ships, Kirtland AFB DC microgrid) to develop robust, autonomous, and fault-tolerant *hierarchical DC Microgrids* for sustained living, transportation, and surface exploration activities in space.

Goal: Evaluate system performance of *hierarchical DC microgrids* for space-based applications to ensure operations under “blue sky” and ”black sky” scenarios

- Develop appropriate asset/load models (with NASA)
- Develop *autonomous control schemes* robust to comm. latency/failure
- Utilize Sandia HIL/hardware *testbeds* to validate controls/models
- Evaluate fault tolerance on Kirtland DC demo microgrid
- Demonstrate flexible routing of power to critical nodes (space/time) on Kirtland microgrid



NASA Goal: Crewed Lunar operations by 2024 (Artemis)

+ NARUC-NASEO Microgrid State Working Group

Working Group co-led by NARUC and NASEO, in partnership with DOE OE, to enhance microgrid deployment across the States

- Develop and deliver briefing papers for regulators and state energy offices
- Develop a policy/regulatory framework on standardized rules and practices for microgrids
- Provide the venue for regular stakeholder engagement
 - ✓ Workshop
 - ✓ Technical webinars
 - ✓ Site visit

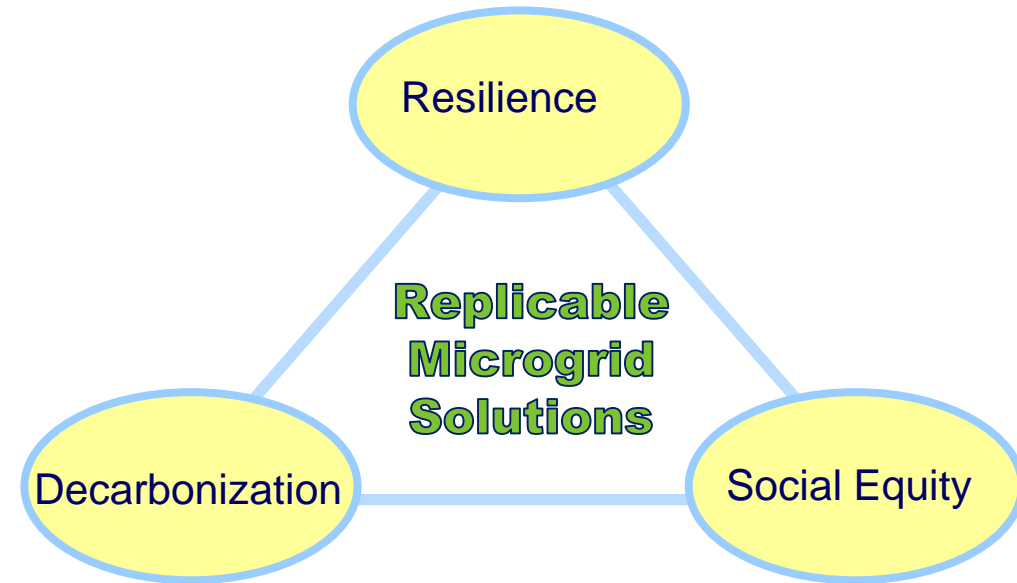


<https://www.naseo.org/issues/electricity/microgrids>



Funding Opportunity Announcement for Underserved and Indigenous Community Microgrid Research, Development, and Demonstration in Remote, Rural, and Island Regions (released on July 18th, 2023 for an estimated total of \$14.7M in Federal Funding)

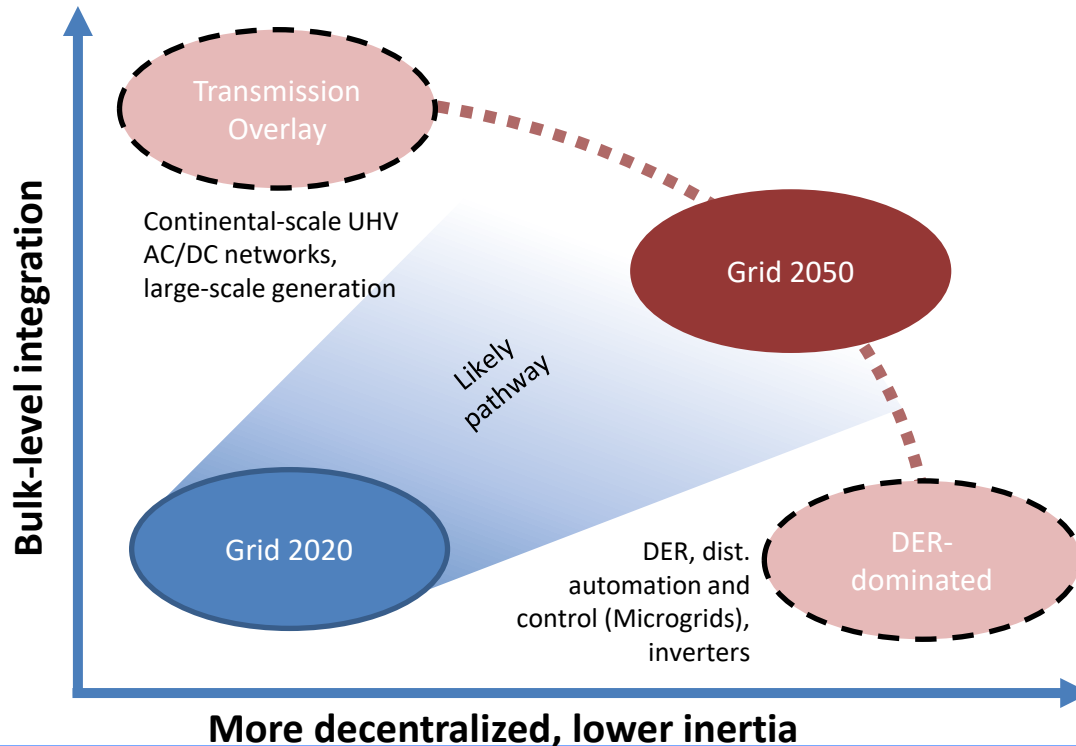
- **Topic 1:** Modular Microgrid Systems with Standardized Control/Communication Functionalities for a Range of System Sizes and Renewable Contributions
(5-6 awards anticipated, each with up to \$1.45M DOE investment)
- **Topic 2:** Multi-port Medium Voltage DC (MVDC) Converter R&D for Integration of Microgrids and Clean Energy
(1 award anticipated, with up to \$2M DOE investment)
- **Topic 3:** Regional Initiatives to Support Microgrid Deployments within Underserved and Indigenous Communities
(4-5 awards anticipated, each with up to \$800K DOE investment)



The FOA is available at <http://www.fedconnect.net/fedconnect/?doc=DE-FOA-0002934&agency=DOE>

+ Microgrids R&D in Outyears

- Implementing the DOE Microgrid Program Strategy to enable microgrids as a key part of the future Electric Delivery System
 - Current DER wave: PV, smart buildings/appliances
 - Next DER wave: energy storage, EVs, IoT



- *Microgrids are poised to become the default platform for the integration and operational optimization of DER*
- *Microgrids are evolving from niche applications to becoming integral to a modern grid of the future*

Dan Ton

Manager, Microgrids R&D
Grid Systems & Components



www.energy.gov/oe/



Twitter



LinkedIn



Facebook



Sign Up for Office of
Electricity Email Updates