U.S. DEPARTMENT OF
ENERGY
Office of Electricity

U.S. Department of Energy Microgrids R&D Program

NASEO 2020 Conference

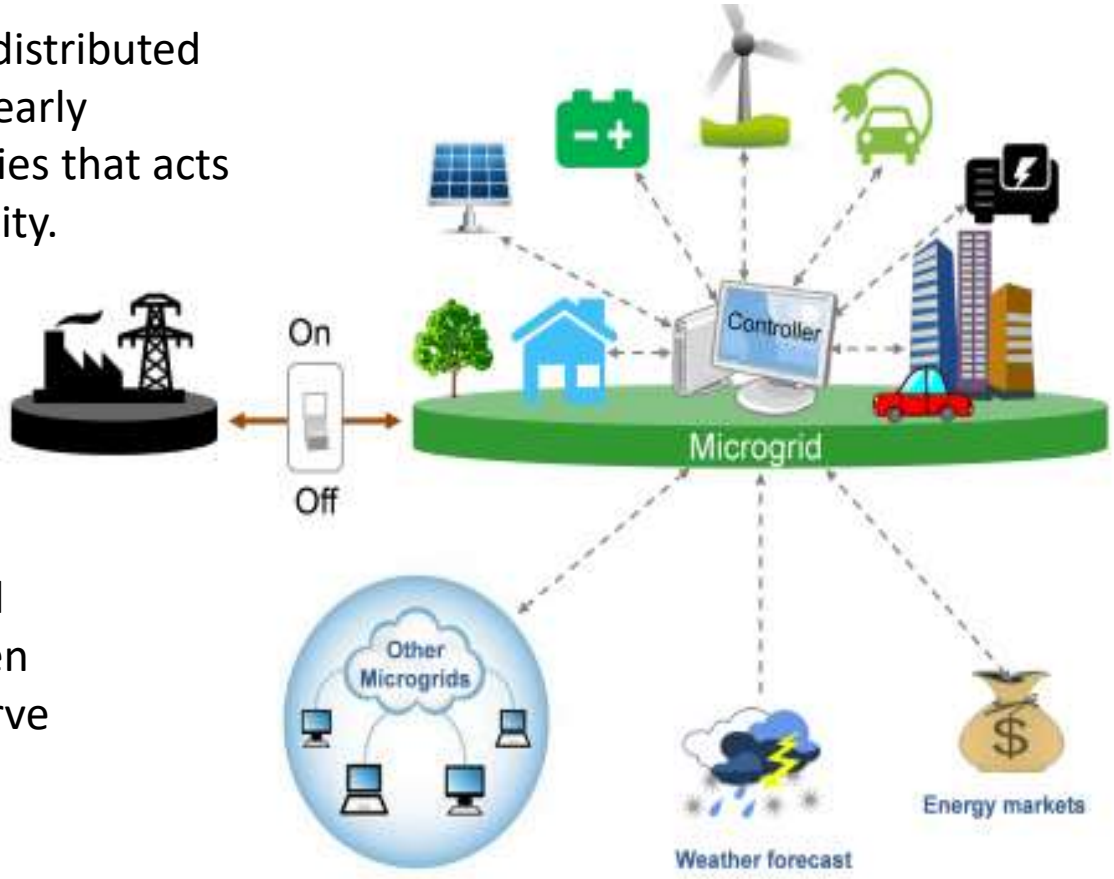
February 2020

Dan Ton

DOE – Office of Electricity

Defining Microgrids

A **microgrid** is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity.



Microgrids can operate in grid-connected or islanded modes, and switch between modes. Microgrids also serve remote and island loads.

Application Space

TYPES OF MICROGRIDS

- ✓ Remote/island
- ✓ Grid-Connected: Singular and multiple networked
- ✓ AC, DC, hybrid
- ✓ Scale: kW to 10s of MW

MARKET SEGMENTS & OWNERSHIP

- ✓ Defense and civilian critical infrastructure
- ✓ Industrial, commercial, community, feeder
- ✓ Customer and utility owned

Remote, Off-Grid Microgrids

Meet community-specific goals. In Alaska, the goal is to achieve a reduction in total imported fuel usage by 50%, while lowering system life-cycle cost and improving reliability and resiliency.

St. Mary's, AK. Pop. 550
Peak load: 600 kW (winter night time)

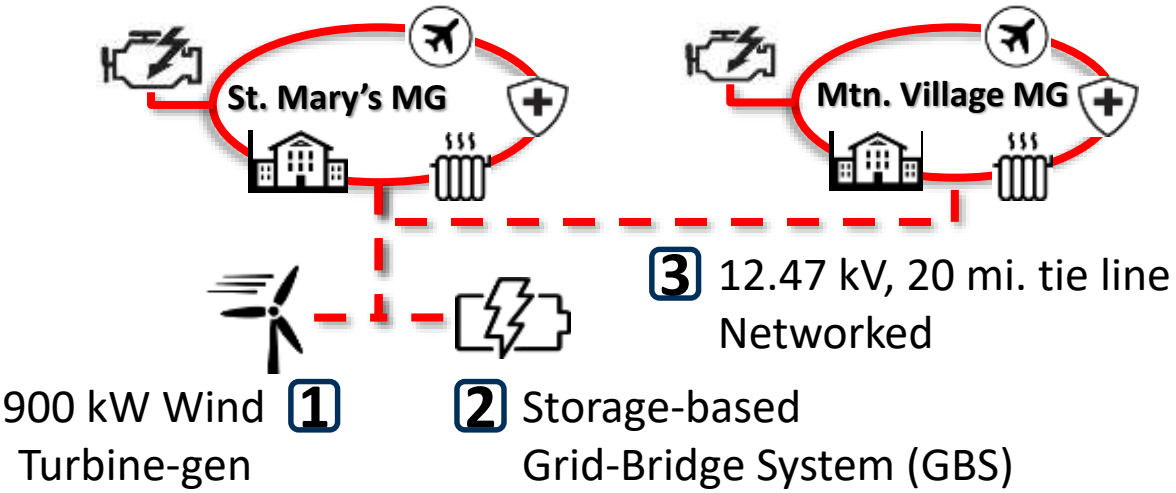
Mountain Village, AK. Pop. 820
Peak load: 500 kW (winter night time)

Energy Resilience Challenges Facing Two Alaskan Communities:

- Both villages are rural microgrids supplied by diesel gensets
- Diesel fuel shipped up Yukon River, impassable August-April
- Life threatening issues if diesel runs out during winter
- High energy cost, >25% of average household income

Advanced Power Converters for Microgrids

A power-electronics solution to increase the resiliency and efficiency of remote and island microgrids for civilian and defense critical applications.

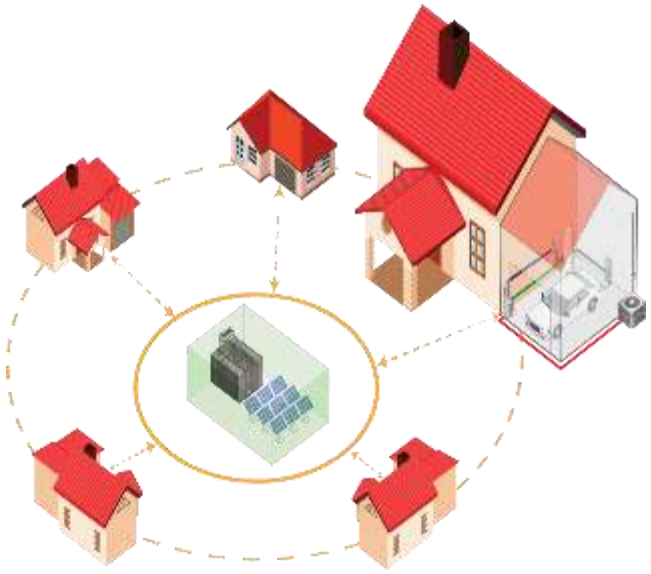


- **Three-stage plan to lower costs and increase reliability and resilience**
  1. Wind turbine-generator to reduce fuel use
  2. Storage-based grid bridge system (GBS) for spinning reserve
  3. Network St. Mary's MG with Mountain Village MG via 12.47 kV tie-line
- **Eventual goal to run in diesels-off mode**

Grid-Connected Microgrids: Connected Communities

Develop and demonstrate microgrid controls with transactive load control in two residential microgrid architectures

Centralized Generation (Birmingham, AL)



Distributed Generation (Atlanta, GA)

Project Partners

Southern Company

Oak Ridge National Laboratory

Centralized Generation (Birmingham, AL)

Distributed Generation (Atlanta, GA)

Alabama Power

Power Secure

Georgia Power

PulteGroup

EPRI Electric Power Research Institute

vivint. SmartHome

SkyCentrics

Delta

LG Chem

FLAIR

Signature Homes

SAMSUNG

A.O. Smith. Innovation has a name.

SiteSage by Powerhouse Dynamics

at&t

vivint.

Clean Power Research

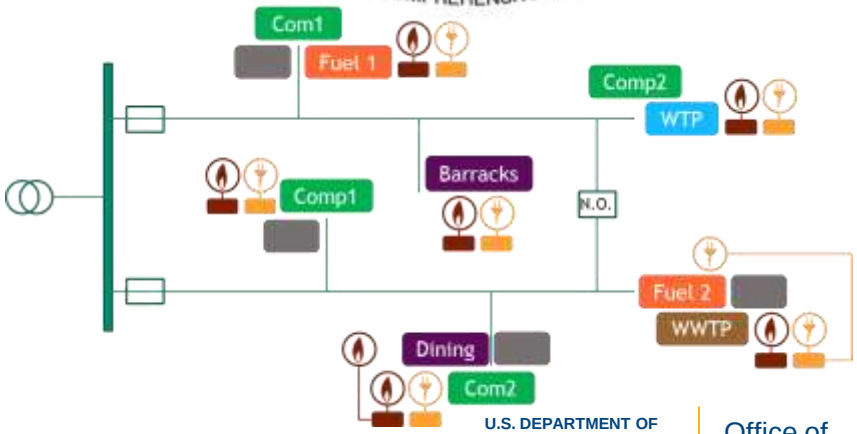
Energy Master Planning and Microgrid Feasibility Analysis

Energy Master Planning:

- Holistically considers all energy interventions for a district
  - Thermal and Electrical
  - Supply-side and Demand-side
  - Efficiency, sustainability, & resilience

Microgrid Feasibility Analysis:

- Weighs the costs and benefits of alternative microgrid designs
- Performs ~50% design level engineering analysis
  - Suitable for RFP or A&E firm involvement
- Incorporates resilience as a goal or requirement



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A Suite of Tools Applicable for Energy Master Planning and Microgrid Feasibility Analysis

SMPL-NZP Tool™

"Blue Sky" Analysis

- Minimum CapEx + OpEx
- Maximum ROI

"Black Sky" Analysis

Threat-inclusive:
- Targeted Energy Availability
- Minimum Impact to Mission Assurance

Simulation

- Is the design operationally feasible under islanded and grid-tied scenarios?

Threat-agnostic:
- Minimum hours out per year
- Minimum VoLL loss

Thermal + Electrical

- No single tool truly co-optimizes the microgrid design for **resilience + efficiency + sustainability** and ensures the design is physically feasible/realistic
- **REopt, DER-CAM, and MDT** to be presented at the NARUC-NASEO Microgrid State Working Group Roundtable next week
- DER-CAM being applied to assess the **13 microgrid feasibility studies** under the NJ Board of Public Utilities Town Center Distributed Energy Resource Incentive Program

NARUC-NASEO Microgrid State Working Group

Working group co-lead by NARUC and NASEO for a 2-year effort, in close collaboration with DOE, to explore state needs for resilient microgrids, barriers to broader deployment, and strategies to increase microgrid adoption

KEY ACTIVITIES

- Conduct state-specific microgrid needs assessment.
- Identify and explore types of opportunities for states to strengthen microgrid deployment
- Develop broadly applicable use cases and design configurations for microgrids, with the targeted audience being state regulators and energy program officials
- Provide the venue for regular stakeholder engagement (annual in-person meetings, quarterly calls, etc.)

Working Group Roundtable: February 12-13 in Washington, DC

(All commissioners, commission staff, state energy directors, and state energy office staff are invited to attend)

Questions?