
U.S. Department of Energy

Office of Electricity Delivery and Energy Reliability

# DOE Program Activities on Microgrids and Grid Resiliency

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# Defining Microgrids

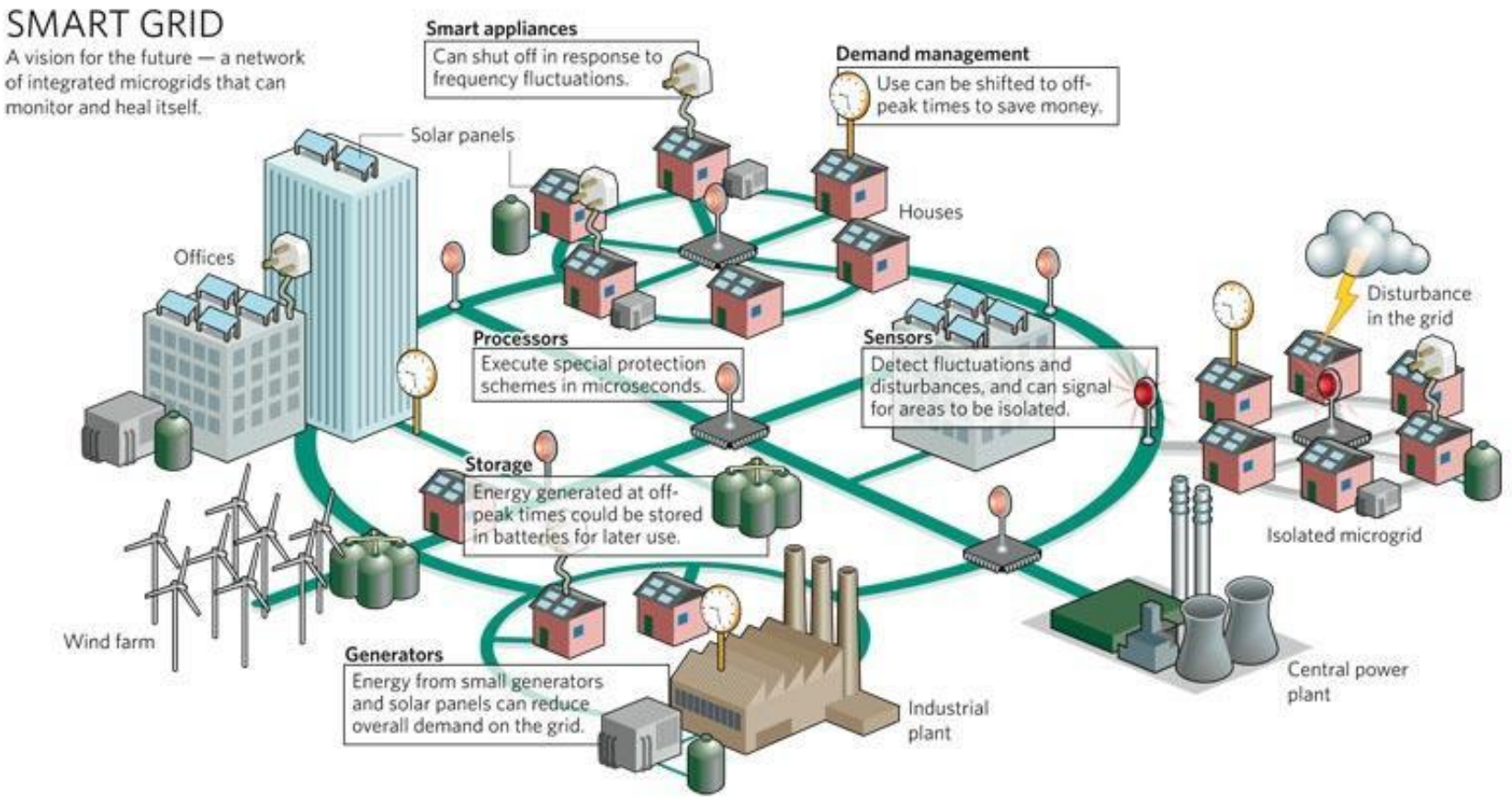
## Microgrid Definition

- A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in grid-connected or island-mode.

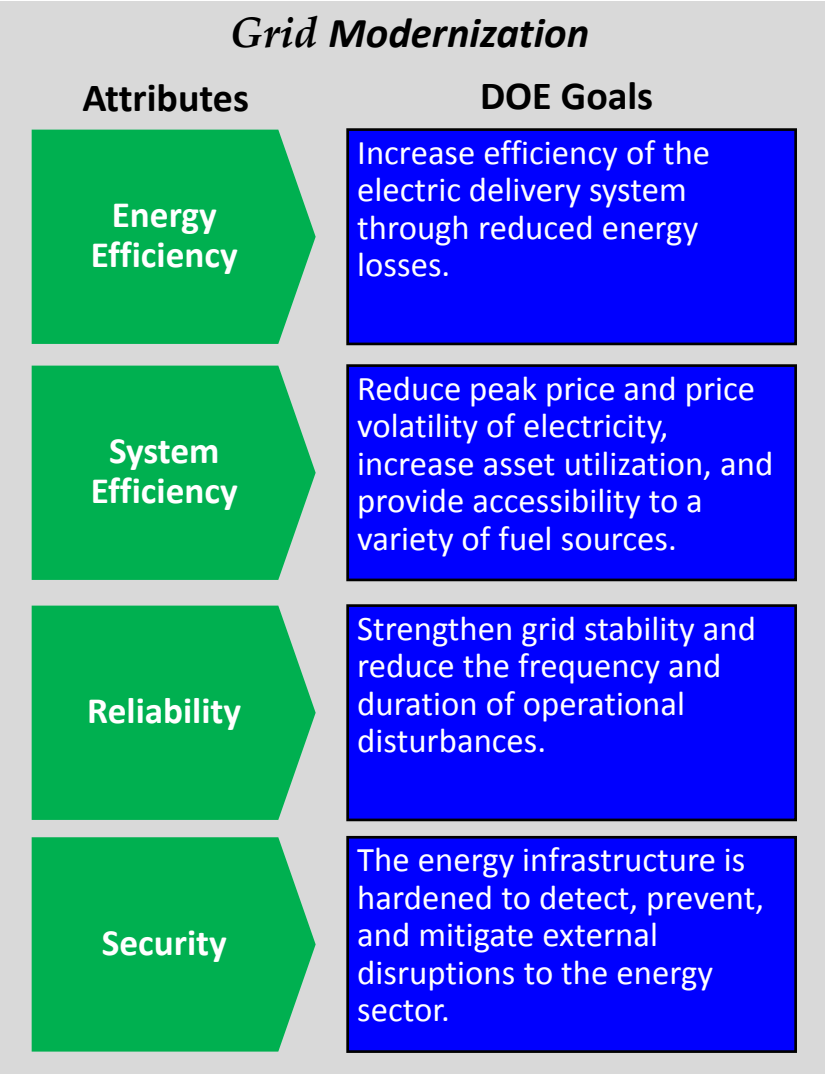
## Key Attributes

- Grouping interconnected loads and distributed energy resources
- Can operate in island mode or grid-connected
- Can connect and disconnect from the grid
- Acts as a single controllable entity to the grid

# Microgrids: Integral Part of a Smart Grid



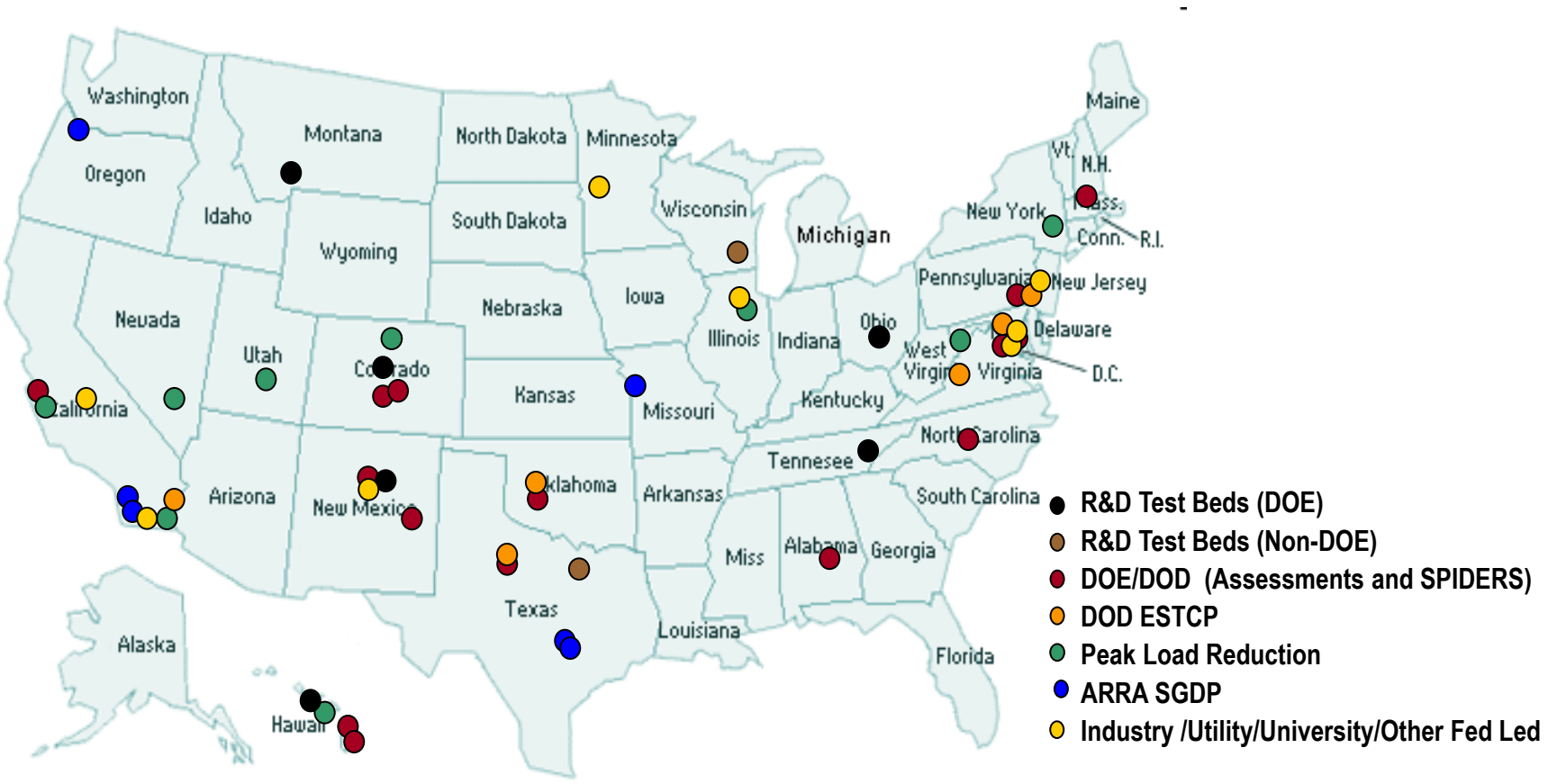
# Microgrids:
# Contributing to DOE's Grid Modernization Efforts




## Microgrid Enhanced Distribution

- Ease of CHP application
- Supports increase of renewables—firms intermittent resources
- Arbitrage of energy price differentials
- Enhance G&T by use of plug-and-play DER for peak shaving
- Enhance reliability with intentional islanding
- High local reliability
- Energy during outages

# Current Microgrid Landscape




**Federal programs, institutions, and the private sector are increasing microgrid development and deployment. The number of successfully deployed microgrids will verify the benefits and decrease implementation risks, further expanding the market for microgrids.**

# Microgrid R&D

## FY 2012 and prior – largely on demonstrations

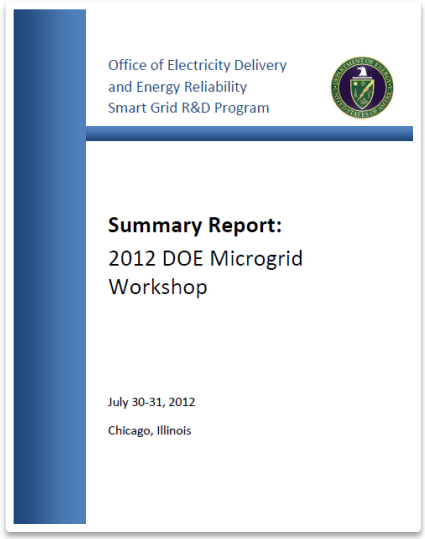
- Renewable and Distributed Systems Integration
- Consortium for Electric Reliability Technology Solutions (CERTS)
- The Distributed Energy Resources Customer Adoption Model (DER-CAM)
- Energy Surety Microgrids
- Smart Power Infrastructure Demonstration for Energy, Reliability, and Security (SPIDERS)
- Standards Development

## FY 2013 and beyond

- R&D to reach 2020 microgrid performance targets* on costs, reliability, system energy efficiencies, and emissions

*Develop microgrid systems capable of reducing outage time of required loads by >98% ; cost comparable to non- integrated baseline solutions (UPS + diesel genset); reduce emissions by >20%; improve system energy efficiencies by >20%

# National Lab R&D Addressing DOE 2020 Microgrid Performance Targets




Workshop report available at: http://energy.gov/oe/articles/2012-microgrid-workshop-summary-released

Workshops to engage stakeholders for R&D planning

- 2011 workshop affirmed DOE 2020 targets and defined R&D areas for component and system integration technologies
- 2012 workshop integrated R&D areas (from 2011) into Planning/Design and Operations/Control and prioritized R&D topics in each

National lab R&D focusing on addressing priorities of workshop findings

- Use case development to define performance requirements and technology specifications
- Cost and benefit analysis to ID high-impact R&D for investments
- Development of Microgrid Design Toolset (MDT) for decision-support analysis
- Integrated controller with µSCADA/µEMS functionalities

# Supporting and Investing in Creation of a Smarter and More Resilient Community

Microgrid R, D, & System Design FOA

- **Advance microgrid system designs (<10MW) and control functionalities for implementation by communities to support achievement of:**
  - **Communities-defined resilience objectives**
  - **DOE program targets**: reducing outage time of critical loads by >98%; cost comparable to non-integrated baseline solutions (UPS + diesel genset); reduce emissions by >20%; improve system energy efficiencies by >20%
- **FOA open from 31 Jan to 28 Apr**
  - **$7M DOE funding for ~6 awards** ($1.2M per award)
  - PoP: 2 years, including 18-month R&D and 6-month **testing, data collection, and analysis**
- **Field demonstrations of system designs w. advanced controllers** (potential FOA topic in FY16-17)

# Testing of Microgrid System Design with Controller

**Preliminary test plan for technical feasibility and economic performance of the system design/controller, due with each application submission**
Test plan to cover test methodology and scenarios, and technique for data gathering and analysis (FOA evaluation criterion)

**Full and detailed test plan for submission for DOE review, due 9 months after the start of an award**

**Review by DOE Technical Advisory Group (TAG) to ensure consistency in testing and analyzing performance of microgrid design/controller**

**Six months of testing and data analysis, per the DOE-approved test plan**

**Final technical report including test data and analysis of test results, due 90 days after expiration of the award**

**Will work jointly with NIST in reviewing and implementing final test plans to consistently test all microgrid system designs and controller functions from FOA projects**

# Microgrid Grand Challenge Competition
## (under planning)

**To recognize the current best operational microgrid in each competition application sector**

**Support the DOE-led grand challenges to banish blackouts by making the U.S. grid resilient**

**Award cash prizes for microgrids as a clean, efficient, cost-effective, and resilient power system**

**Plan to launch the Competition in late March 2014**

Further information to be available online (http://energychallenge.energy.gov/)

# Other Microgrid Activities to Support Communities in Preparing for Climate Impacts

***Short-term***

- Partner with States (CT, NY, NJ) to deploy microgrids for rebuilding electric infrastructure by providing technical assistance and advanced R&D products
- Examples: partnerships with NJ on a stronger and more resilient transit system (TRANSITGRID) and on rebuilding electric grid in the Hoboken region, in the aftermath of Hurricane Sandy

***Mid-term***

- Expand multi-state and regional partnerships to promote microgrids for enhanced recovery and resilience of electric grid

***Long-term***

- Fully integrate a network of microgrids at customer sites and varying scales (feeders, substations) to support achieving a self healing distribution and transmission system

# Microgrids:
# Supporting Grid Reliability and Resilience

## Reduced incidents of outages

- Microgrids will provide energy surety to critical loads and will reduce outages for other loads

## Enhanced reliability

- Microgrids will support faster restoration during power disturbances that cost American businesses (and all of us) billions

## Reduced vulnerability

- Microgrids will enhance resiliency of electric power system against both cyber and physical threats

Four CHP units equipped with CERTS microgrid technology provided the Brevoort co-op building with heating, hot water, and electricity during the week of utility outages caused by Superstorm Sandy

# Resilient Electric Distribution R&D
## (Planned for FY15 and Beyond)

***Goal***: Develop tools, technologies, and practices to dramatically lower the cost of ensuring that no one is without power for more than 3 days following extreme events, while maintaining critical loads for public health and safety

| Enhanced System Design | Preparation & Planning | Operational Response | System Repair and Recovery |
|---|---|---|---|
| • Design and optimization tools<br>• Novel architectures such as microgrids | • Modeling tools with weather forecasting for damage prediction and response<br>• Advanced monitoring and data fusion for situational awareness | • Advanced analytics for operational decisions<br>• Novel control algorithms driven by all-hazard impact assessments | • Metric-based optimization tools for restoration prioritization<br>• Data mining, data analytics, and adaptive controls for decision support in disaster recovery |

Work elements in alignment with GTT recommendations for Grid Modernization Initiative

# Grid Resiliency Workshop in 2014

**Engaging stakeholders to**

- Refine grid resiliency goal envisioned by DOE and national labs
- Define performance metrics for grid resiliency
- Identify project areas of priority

**In conjunction with the 2014 Smart Grid Peer Review Meeting in June or July 2014**

- Open for your participation in the workshop planning and the workshop

# Microgrid Resources

Smart Grid
http://www.smartgrid.gov

Office of Electricity Delivery and Energy Reliability
http://www.oe.energy.gov
*Peer Review*
http://events.energetics.com/SmartGridPeerReview2012/agenda.html

Sandia National Laboratory – Energy Surety Microgrid™
http://energy.sandia.gov/?page_id=819

Berkley Lab (DER-CAM and International Symposium)
http://der.lbl.gov/

Microgrid workshop results
http://www.e2rg.com/reports

# Contact Information

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