



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.

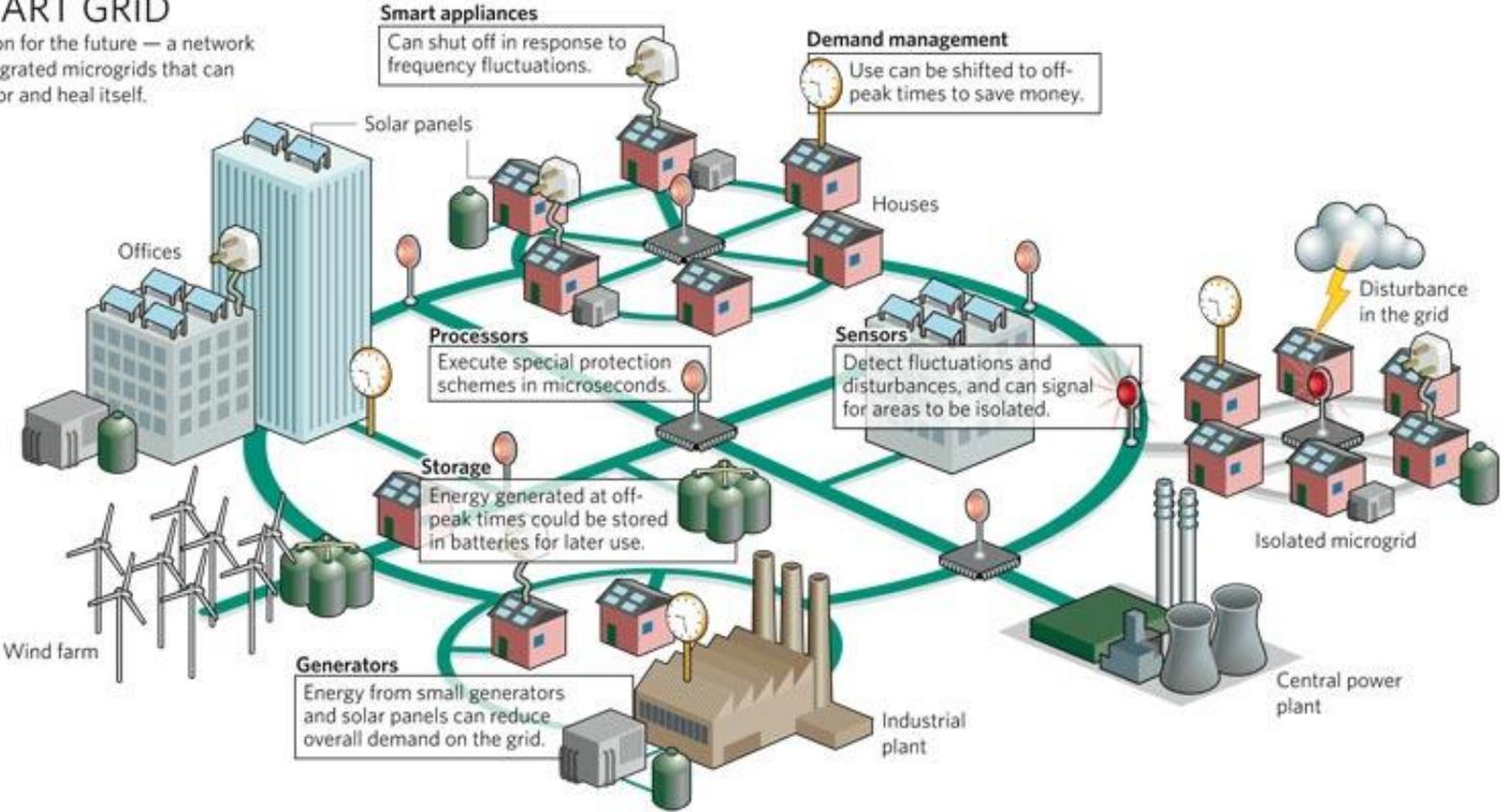
Key Attributes

- 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

SMART GRID

A vision for the future — a network of integrated microgrids that can monitor and heal itself.



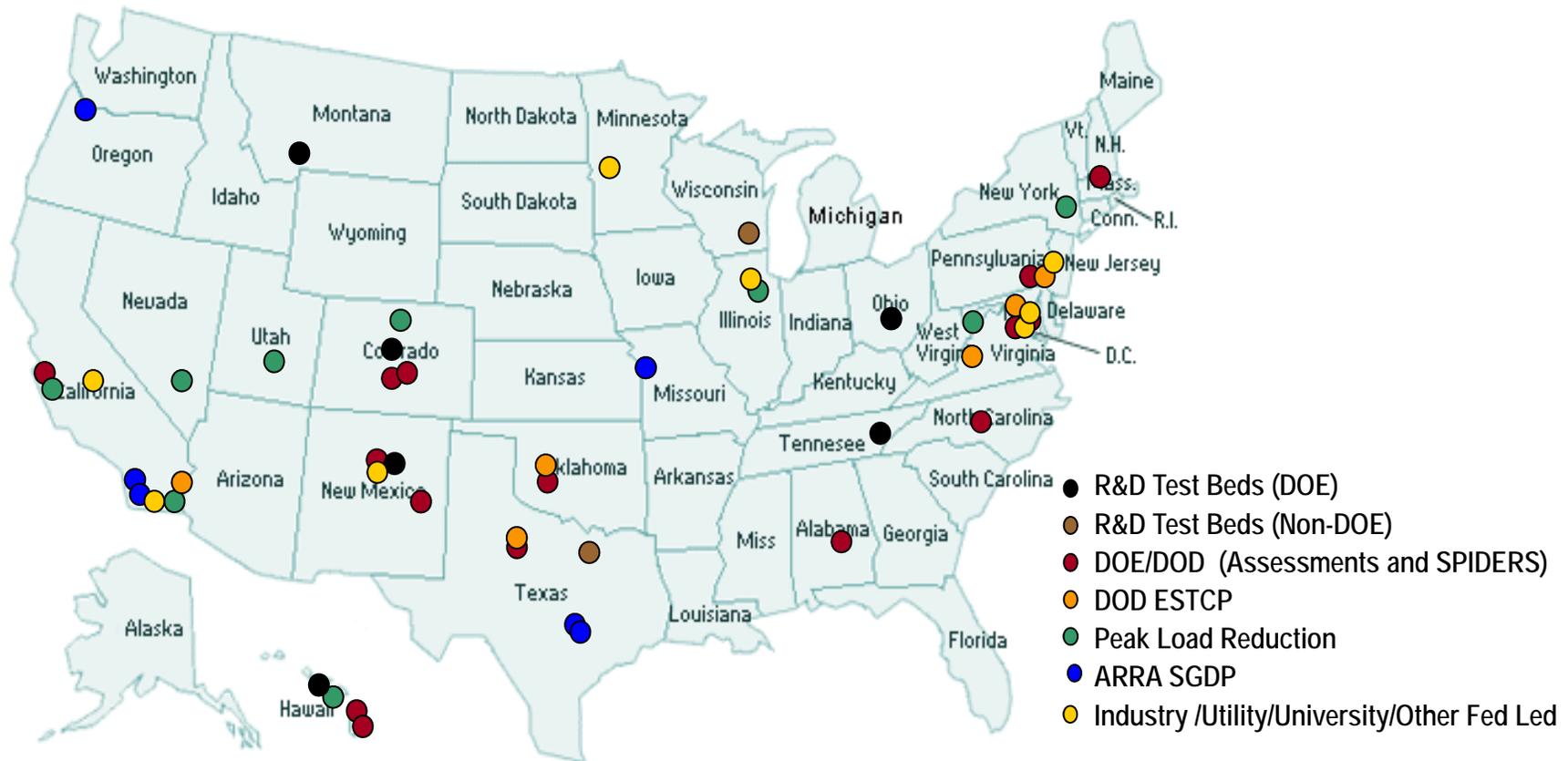
Microgrids: Contributing to DOE's Grid Modernization Efforts

<i>Grid Modernization</i>	
Attributes	DOE Goals
Energy Efficiency	Increase efficiency of the electric delivery system through reduced energy losses.
System Efficiency	Reduce peak price and price volatility of electricity, increase asset utilization, and provide accessibility to a variety of fuel sources.
Reliability	Strengthen grid stability and reduce the frequency and duration of operational disturbances.
Security	The energy infrastructure is hardened to detect, prevent, and mitigate external disruptions to the energy sector.

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

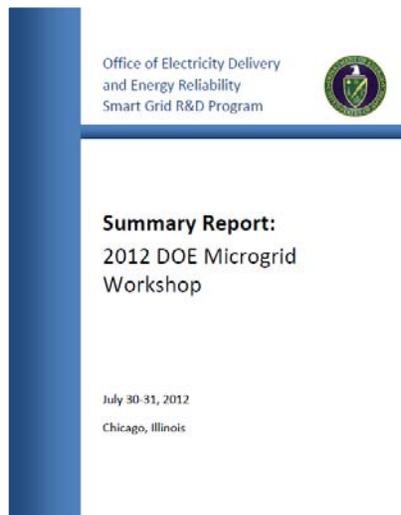
- Renewable and Distributed Systems Integration
- Consortium for Electric Reliability Technology Solutions (CERTS)
- The Distributed Energy Resources Customer Adoption Model (DER-CAM)
- Energy Surety Microgrids
- Smart Power Infrastructure Demonstration for Energy, Reliability, and Security (SPIDERS)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



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

Office of Electricity Delivery
and Energy Reliability

<http://www.oe.energy.gov>

Peer Review

[http://events.energetics.com/
SmartGridPeerReview2012/ag
nda.html](http://events.energetics.com/SmartGridPeerReview2012/agenda.html)

Smart Grid

<http://www.smartgrid.gov>

Sandia National Laboratory –
Energy Surety Microgrid™

[http://energy.sandia.gov/?page
id=819](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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For more information:

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