U.S. DOE Microgrid Initiative Overview

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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 both grid-connected or island-mode.

Key Attributes
1. Grouping interconnected loads and distributed energy resources
2. Can operate in both island mode or grid-connected
3. Can connect and disconnect from the grid
4. Acts as a single controllable entity to the grid
Enhancing Security and Reliability Through the Use of Microgrids

DOE’s Goal: lead national efforts to modernize the electric grid, enhance security and reliability of the energy infrastructure, and facilitate recovery from disruptions to energy supply.

**Attributes**

- **Energy Efficiency**
  - Increase efficiency of the electric delivery system through reduced energy losses.
- **System Efficiency**
  - Reduce peak price and price volatility of electricity, increased 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.

**DOE Goals**

- 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 international islanding
- High local reliability
- Energy during outages
Microgrid RD&D

To date, the bulk of work has been on microgrid demonstrations

FY 2013 and prior

- 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 – Interconnection and Interoperability

FY 2013 and beyond

- RD&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%
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.
When a disturbance to the utility grid occurs, the automatic disconnect switch enables the facility to “island” itself from the main utility grid and independently generate and store its own energy.

The distributed energy resources management system (DERMS) serves to reduce peak demand during normal grid-connected operation or during a demand response event.

- Two 1.2 MW backup diesel generators
- Distributed Energy Resources Management System (DERMS)
- 2 MW advanced energy storage system
- 1 MW fuel cell
- 1.2 MW rooftop solar photovoltaic system
- Five 2.3 kW wind turbines
- PG&E utility interconnection or “Point of Common Coupling” and static disconnect switch

Commercial Application of a CERTS Microgrid at Santa Rita Jail
Commercial Application at the White Oak Federal Center in Maryland*

- 55 MW of generation (gas turbines, steam turbines, IC engine, back start diesel generator)
- 25 KW fixed and 5 KW tracking PV arrays
- Absorption chillers and waste heat boilers
- 2 million gal. of chilled water thermal storage

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
- Standardized design tools for decision-support analysis
- Integrated controller with \( \mu \text{SCADA}/\mu\text{EMS} \) functionalities

Microgrids: Supporting 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
Microgrid Resources

- Office of Electricity Delivery and Energy Reliability

- Smart Grid
  [http://www.smartgrid.gov](http://www.smartgrid.gov)

- Sandia National Laboratory - Advanced Microgrids

- Berkley Lab (DER-CAM and International Symposium)

- Microgrid workshop results
  [http://www.e2rg.com/reports](http://www.e2rg.com/reports)
Award Title: ISGAN Award of Excellence

Award Purpose: Recognize excellence in innovation, integration, and transformation of smart grid systems

Theme: Topic or theme varies by year; each year’s award is focused on one theme

Award Recipient(s): Projects (i.e., not individuals or individual institutions)

Number of Awards: One or more, depending on caliber of nominations and jury’s preferences
**Participants**

**Contracting Parties:** 25

**Joining:** Denmark  
**Withdrawing:** UK

**Invited:** Brazil, Israel, Turkey  
**Expression of Interest:** Indonesia

- German Energy Agency
- Commonwealth Scientific and Industrial Research Organization
- Government of Canada
- Norwegian Ministry of Petroleum and Energy
- Swedish Energy Agency
- Forschungszentrum Jülich GmbH
- Tekes (Finnish Funding Agency for Technology and Innovation)
- Russian Energy Agency
- Government of Belgium
- Sustainable Energy Authority of Ireland
- Ministry of Science and Technology Department of High and New Technology Development and Industrialization
- Government of France
- Swiss Federal Office of Energy
- Government of the Netherlands, Ministry of Economic Affairs, Agriculture and Innovation
- Union Fenosa Distribución
- Ricerca sul Sistema Energetico (RSE S.p.A.)
- Government of Austria
- Energy Market Authority, Singapore
- South African National Energy Development Institute
- Government of India
- Government of Korea
- New Energy and Industrial Technology Development Organization (NEDO)
-Government of Mexico
- U.S. Department of Energy

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- Government of Mexico
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Past ISGAN Award Winners*

- **2014 Consumer Engagement & Empowerment**
  - Winner: ‘SmartView’ AMI pilot project from Entergy New Orleans

- **2015: Smart Grids for Renewable Energy Integration**
  - Winner: GRID4EU – Large-Scale Demonstration Of European Smart Distribution Networks
    - ÉlectricitéRéseau Distribution France (ERDF) (Germany, Sweden, Spain, Italy, Czech Republic, France)

*http://www.iea-isgan.org/awards/*
Past ISGAN Award Winners* (2)

- 2016 Smart Grids for Reliable Electricity Service
  - Winner: CenterPoint Energy Smart Grid (USA)

- 2018: Smart Grids for Flexibility
  - Winner: Sustainable Energy’s *Coordinating Power Control* (Sweden)

*http://www.iea-isgan.org/awards/
Recognizing the critical importance and the role of smart grids sustaining a reliable and resilient grid through integration of energy systems, ISGAN has chosen as the theme of the 2019 Award of Excellence:

**Smart Grids for Local Integrated Energy Systems (Smart Microgrids)**

**Submission Deadline: 15 November 2018**

Eligible projects include pilot, demonstration, and deployment projects. Please see the ‘Official Rules’ of the ISGAN Award of Excellence and detailed ‘Submission Forms’ for more information.

The international jury panel will select winning projects based on five key criteria:

- Potential impact (25pt),
- Economic rationale (25pt),
- Potential for replication or adaptation (25pt),
- Innovation (12.5pt), and,
- Other benefits (12.5pt).

Winners will be announced during a ceremony at the tenth Clean Energy Ministerial (CEM10) in May 2019 in Canada.

Winners will be invited to participate in the ceremony for a certificate & plaque and be recognized in ISGAN products and proceedings over the following months.
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Smart Grid:  smartgrid.gov