DOE Program Activities on Microgrids

Ross Guttromson for Dan Ton

Acting Deputy Assistant Secretary

Power Systems Engineering Research and Development

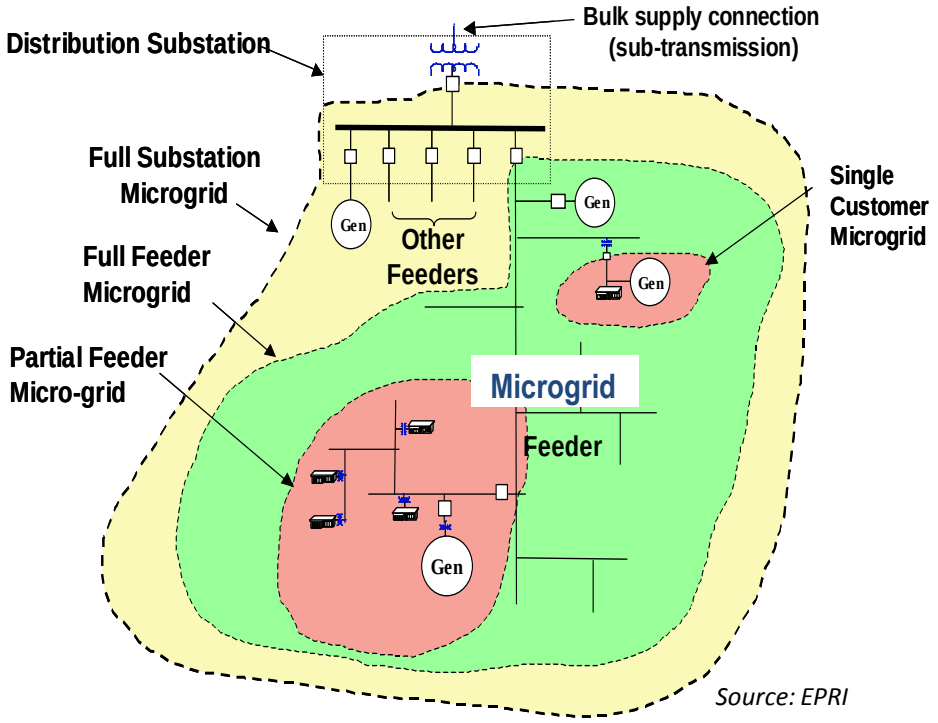
Nov2014

DOE Microgrid Program

Develop commercial scale microgrid systems capable of meeting the 2020 targets:

Residential	Less than 10-kW, single-phase
Small Commercial	From 10-kW to 50-kW, typically three-phase
Commercial	Greater than 50-kW up to 10MW

- Reduce outage time of critical loads by >98% at a cost comparable to non-integrated baseline solutions (UPS + diesel genset)
- Reduce emissions by >20%
- Improve system energy efficiencies by >20%



Source: EPRI

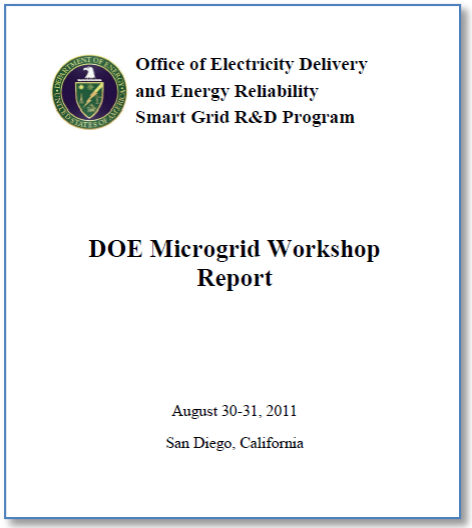
DOE Microgrid R&D Guided by Stakeholder Recommendations

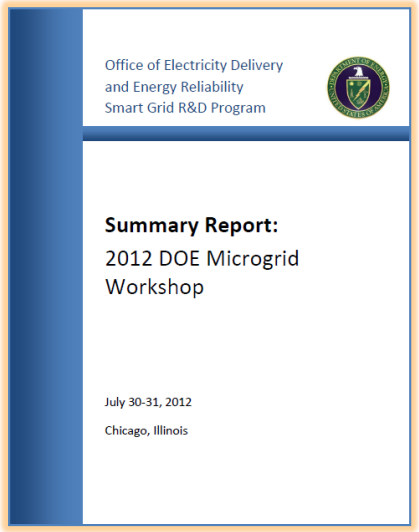
2011 Workshop

Defined the DOE 2020 targets	Recommended further integration of component- and system-level R&D areas

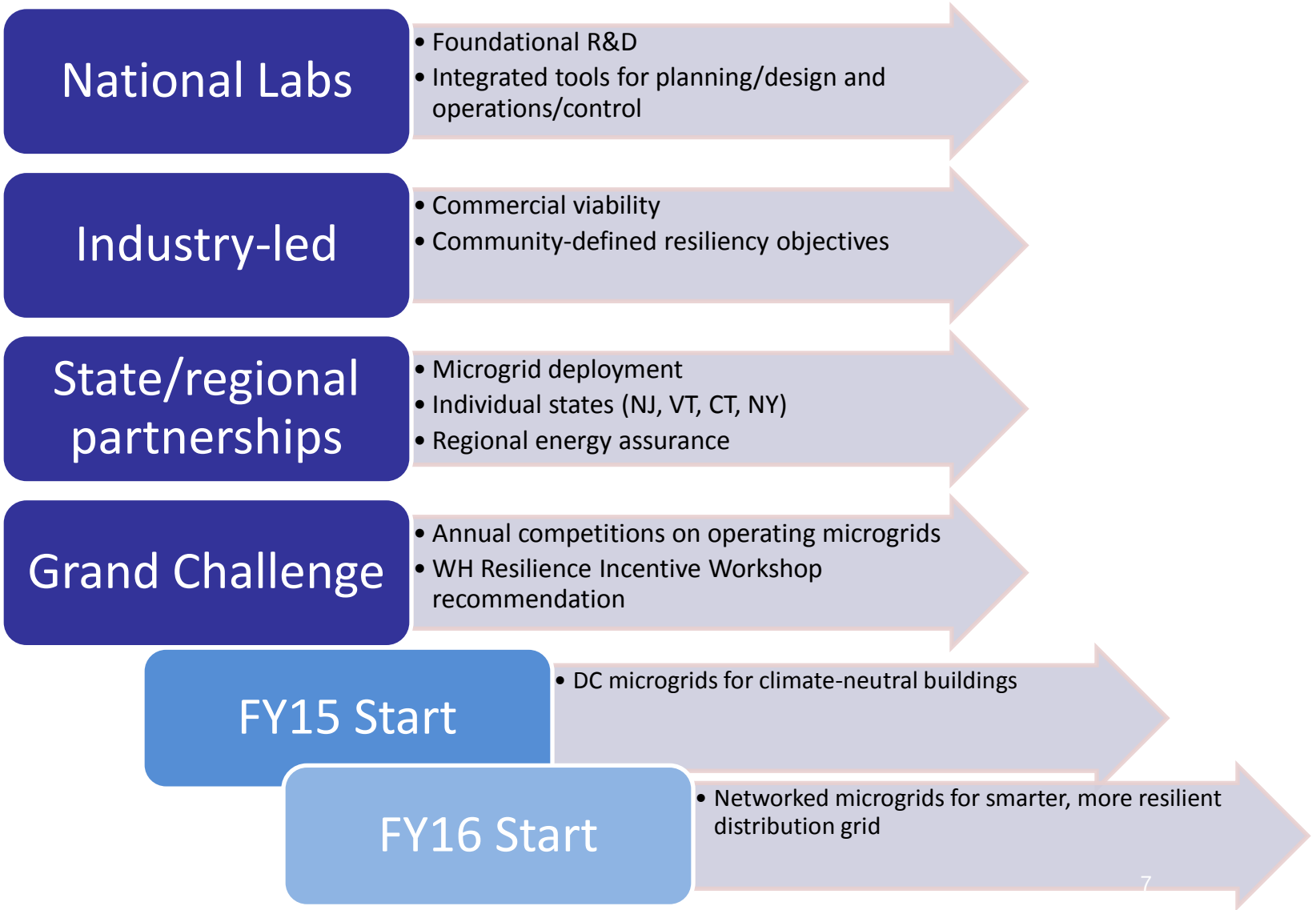
2012 Workshop

Prioritized R&D topics in planning/design	Prioritized R&D topics in operations/control



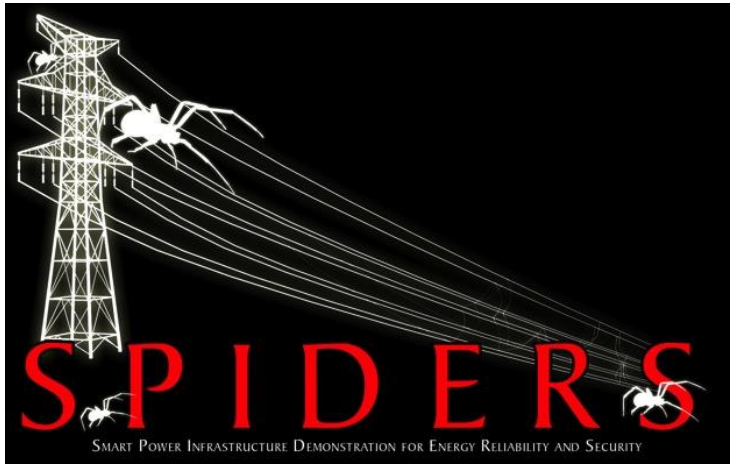


Implementation Pathway for Achieving Commercial Viability, DOE Performance Targets, and Community-Defined Resiliency Objectives



Smart Power Infrastructure Demonstration for Energy, Reliability, and Security (SPIDERS)

- SPIDERS is building three microgrids, each with increasing capability, which will function as permanent energy systems for their sites
  - Site 1 (Joint Base Pearl Harbor Hickam) is complete
  - Site 2 (Fort Carson) is complete
  - Site 3 (Camp Smith): completed preliminary design, demo in FY15
- The project will promote adoption of microgrid technology for DoD through:
  - Design and requirements methodology
  - Cyber security architecture



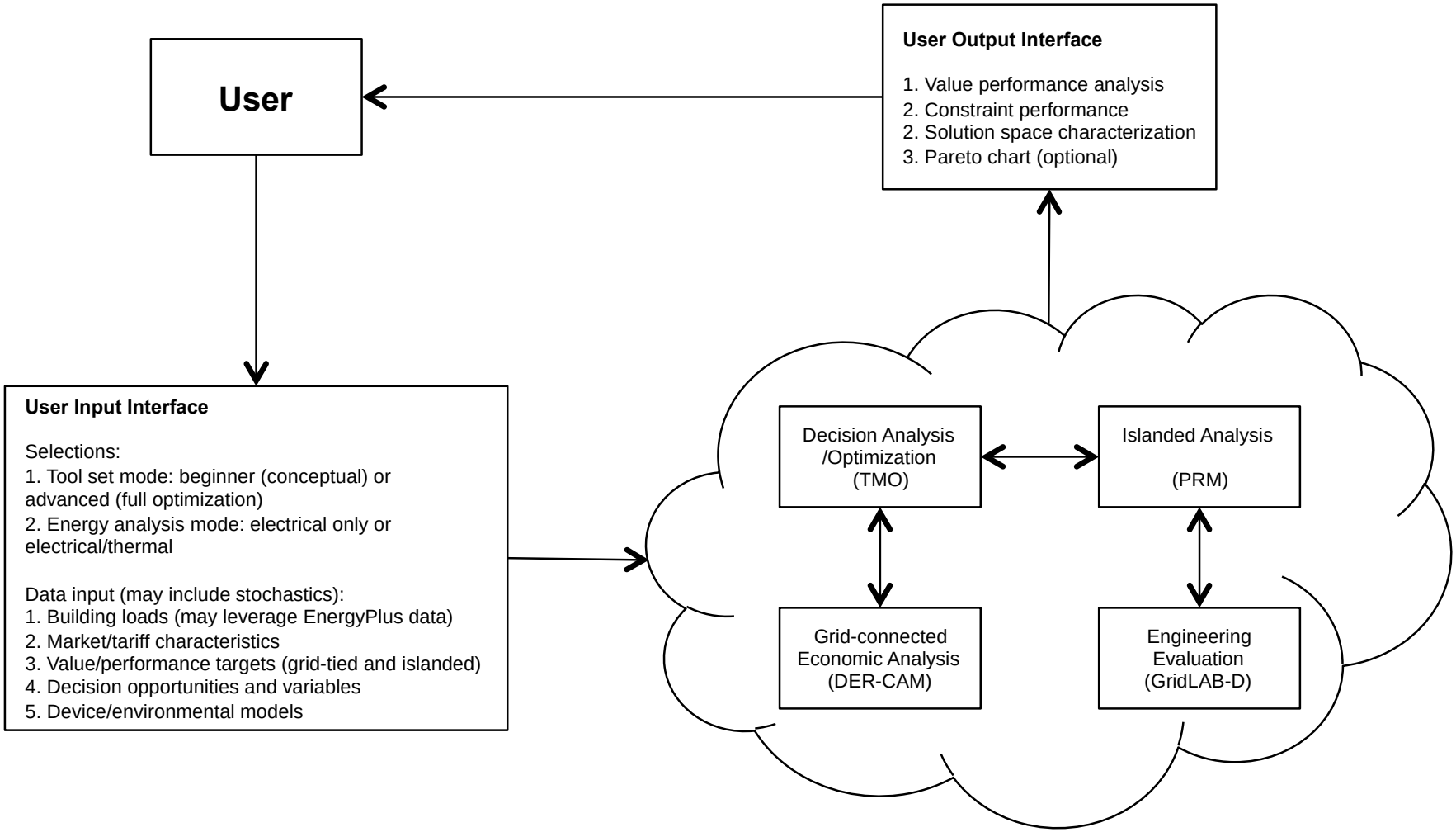
Selected Energy Surety Microgrid Projects
(Funded by DOE OE, DOE FEMP, and DoD)

DOE and DOD jointly fund Sandia National Laboratory to work with military bases to develop energy surety microgrid conceptual designs

Conceptual Designs/Assessments	Small Scale Microgrid Demos	Large Scale Microgrid Demos	Operational Prototypes
• Philadelphia Navy Yard – FY11, DOE OE/PIDC • Camp Smith – FY10, DOE FEMP • West Point FY12, DoD/DOE • Indian Head NWC – FY09, DOE OE/DoD • Ft. Sill – FY08, Sandia LDRD • Ft. Bliss – FY10, DOE FEMP • Ft. Carson – FY10, DOE FEMP • Ft. Devens (99th ANG) – FY09, DOE OE/DoD • Ft. Belvoir – FY09 DOE OE/FEMP • Cannon AFB – FY11, DOE OE/DoD • Vandenberg AFB – FY11, DOE FEMP • Kirtland AFB – FY10, DOE OE/DoD • Maxwell AFB – FY09, DoD/DOE	• Maxwell AFB – FY09, DoD • Ft. Sill – FY09, DoD w/ SNL ser advisor	• SPIDERS JCTD – FY11, DOE/DoD • Camp Smith	• H.R. 5136 National Defense Authorization Act

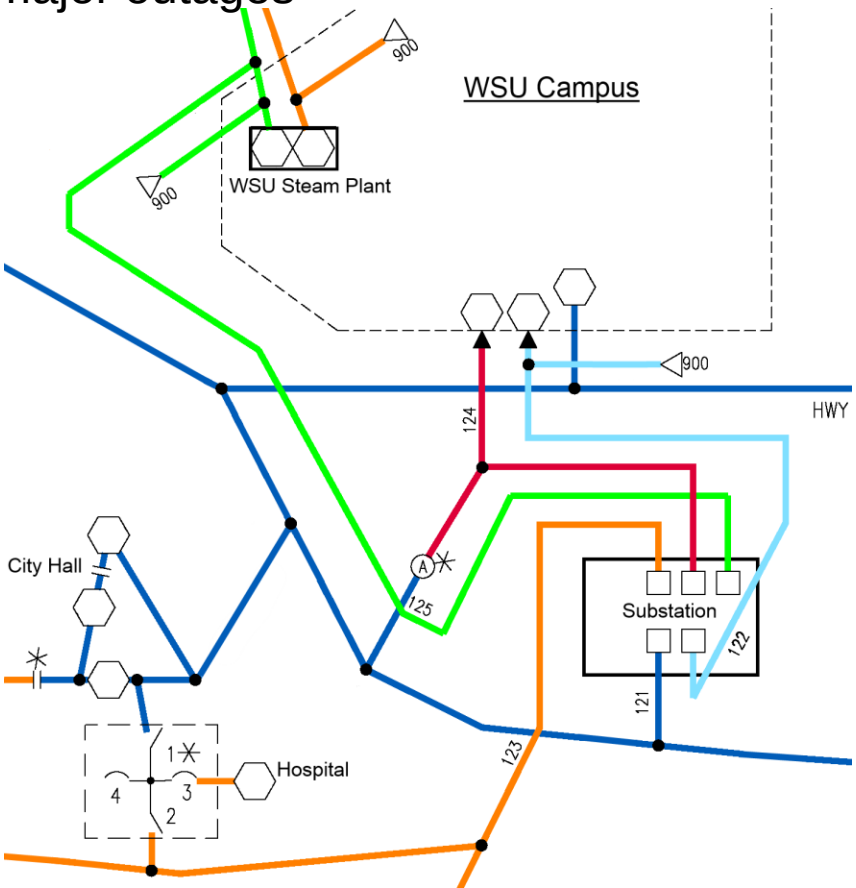
Microgrid Design Toolset (MDT) for Use by Microgrid Designers and Planners, with Embodiment of the ESM Methodology

MDT Architecture



Microgrids as a Resiliency Resource

Demonstrating the WSU-Pullman microgrid capable of reducing switching operations for faster restoration and picking up more interrupted load during major outages



Brevoort Co-op, Manhattan

"CERTS microgrid-cogen system from Tecogen comes through for Greenwich Village Co-op building during supperstorm Sandy."

"The CERTS microgrid control technology is the most radical of all options-as well as the lowest cost-as it is embedded into a 100-kW CHP system offered by Tecogen"

Peter Asmus, Navigant.

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 2020 targets**
- **FOA closed on 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**
  - **Awards NLT the end of September 2014**
- **Field demonstrations of system designs w. advanced controllers** (potential FOA topic in FY16-17)

State Partnerships Supporting the CAP Strategy

(Rebuilding and Learning From Hurricane Sandy Memo)

NJ TransitGrid Project

- Microgrid to enhance grid-rail resiliency to serve over 900,000 riders/day
- Key evacuation service for Manhattan & N. New Jersey
- MOU between DOE and State of NJ
- **Completed the feasibility study of a microgrid to fortify the public transportation network**

Hoboken ESDM Project

- Provide electrical power to support critical functions up to 7 days for 52,000 residents in 1.2 sq. mi.
- Key evacuation route for Manhattan
- DOE-Hoboken-BPU-Sandia-PSEG Partnership
- **Completed a microgrid conceptual design for Hoboken, NJ, to enhance system resilience post-Sandy**

Microgrid Grand Challenge Competition

FY14: Award the current best operational microgrid in each critical facility segment

FY15&16: Award microgrids with performance exceeding the higher-setting threshold each year

Support:
The DOE-led grand challenges to make the U.S. grid resilient; The DOE implementation of the President's Climate Action Plan

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

Inaugural Competition Launched in June 2014

DC Microgrid Scoping Study for New Projects in FY15

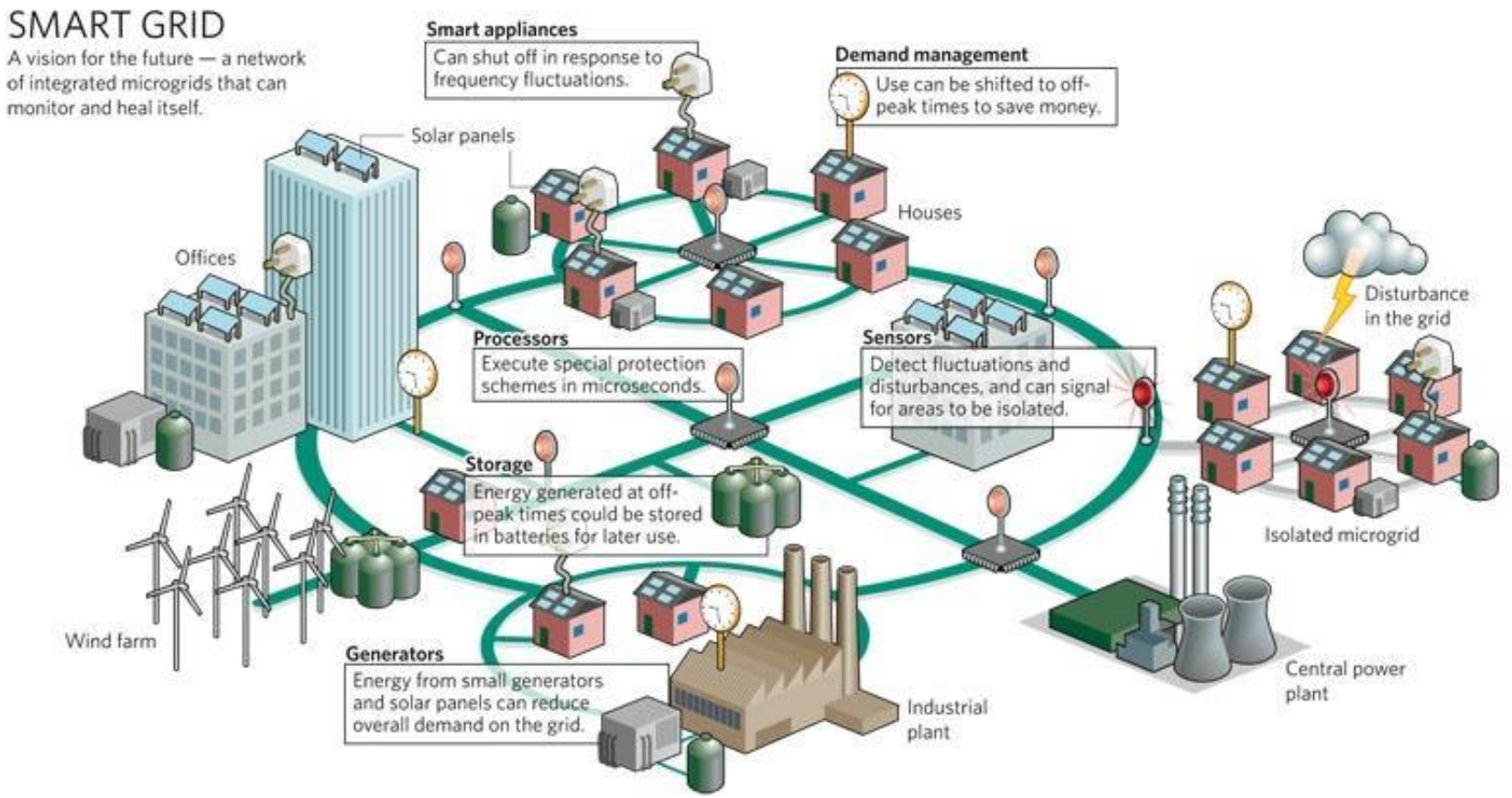
Eight potential application areas identified:

- Low power networks like Power over Ethernet (PoE)
- Hybrid AC/DC systems for buildings
- Mobile and remote applications
- Data centers
- Coupling a DC microgrid to a HVDC line
- High survivability DC microgrids
- DC microgrid for integration of DC-native loads and DC-based generation and storage
- EV for backup/emergency power

Quantitative assessment underway in the following categories:

- Reliability
- Power quality
- EE
- Operations costs
- Engineering costs
- Environment
- Safety and protection
- Resilience

Looking Forward: Developing a Smarter, More Resilient Grid by Integrating a Network of Microgrids



Picture courtesy of: Smart Grid 2030

Summary of Microgrid Value Attributes

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 and emergency conditions

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, 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.
Resiliency & Security	The energy infrastructure is hardened to detect, prevent and mitigate external disruptions to the energy sector.

Microgrid Resources

Office of Electricity Delivery and Energy Reliability
http://www.oe.energy.gov

Microgrids
http://energy.gov/oe/role-microgrids-helping-advance-nation-s-energy-system

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