Microgrid Institute

Smart, Dynamic Microgrids

Tools for resilience, economics, and sustainability

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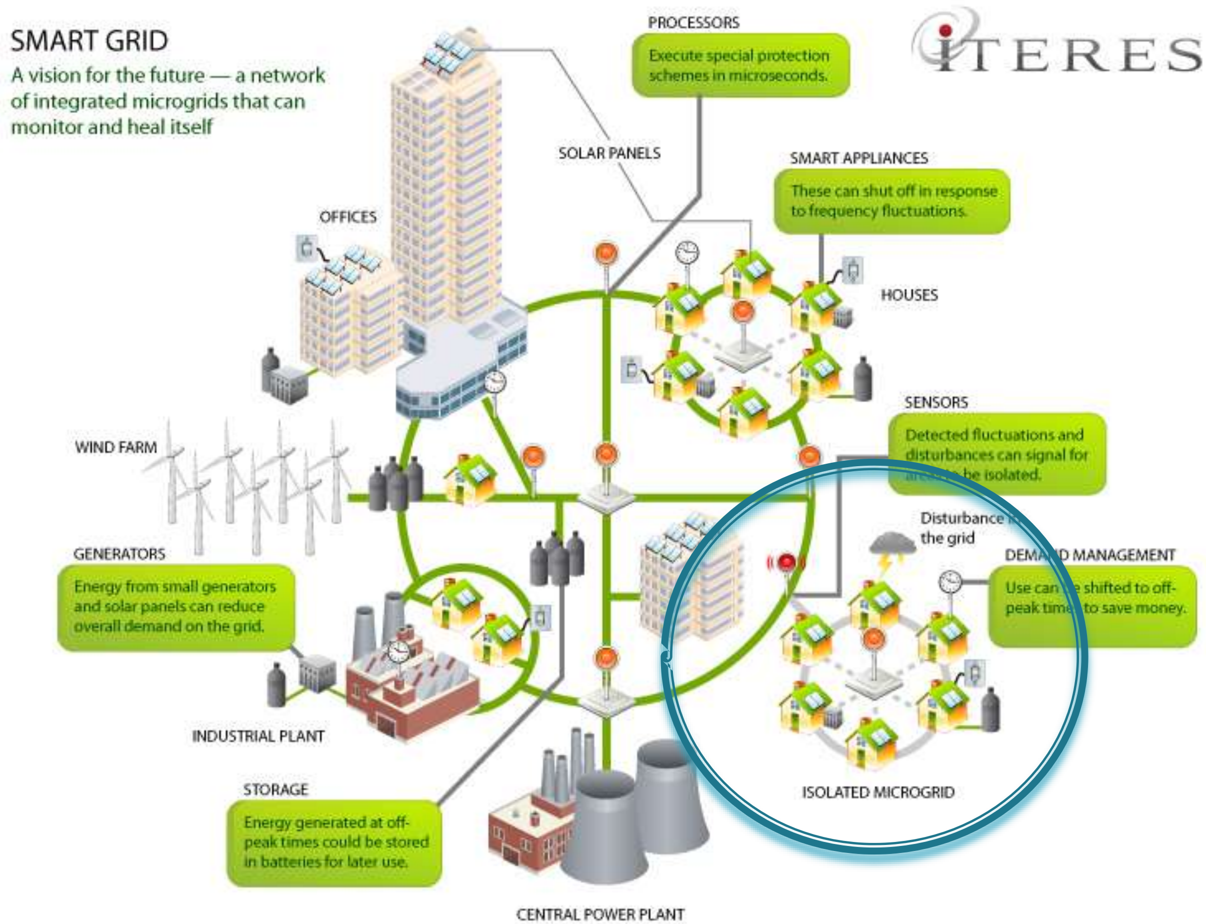
Note: This presentation has been modified from the original in the following ways: (1) Topical material was brought to the front; (2) The title was changed from the original, "Utility 2.0 and Dynamic Microgrids," to clearly distinguish it from the article "Utility 2.0 and the Dynamic Microgrid," co-authored by Mani Vadari and Gerry Stokes.

As a dynamic component of an engineered smart grid, a microgrid becomes a major asset for the utility of the future.



definition:*

Microgrid

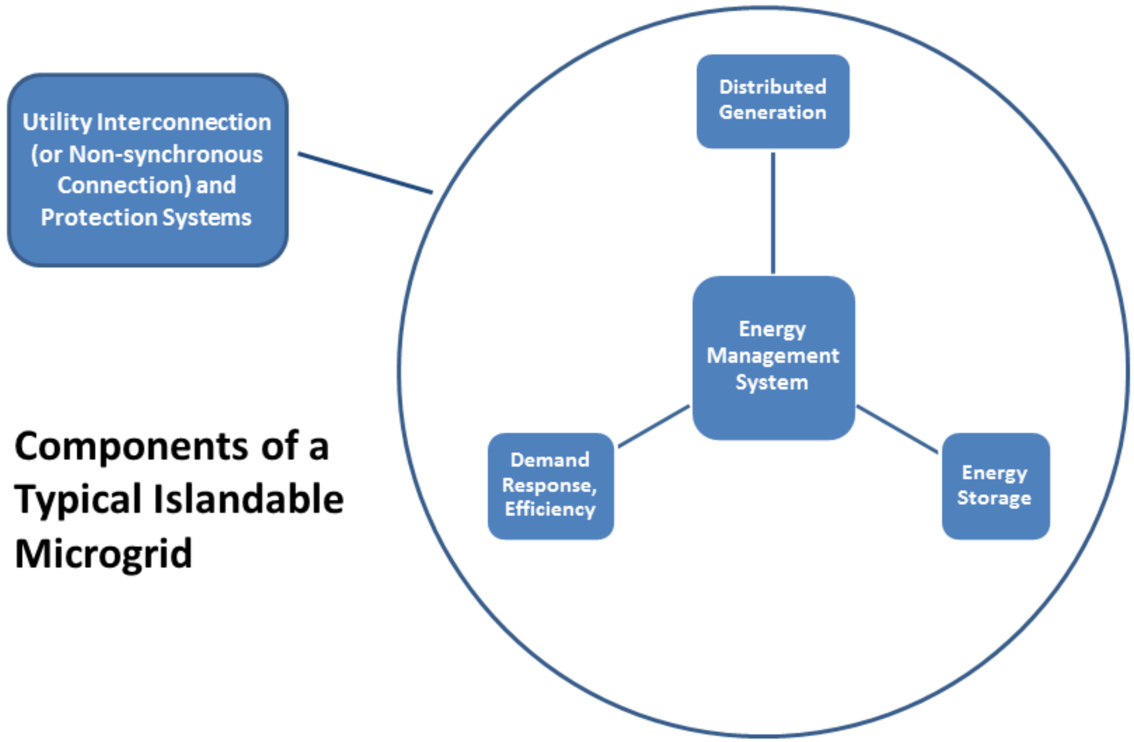
A local energy system capable of balancing captive supply and demand resources to maintain stable service within a defined boundary.

Microgrids are **defined by their function**, not their size.

Microgrids combine various distributed energy resources (DER) to form a whole system that's greater than its parts.

Most microgrids can be further described by one of three categories:

- **Isolated microgrids,** including those on **islands** and at **remote inland sites**, *not connected* to a local utility.
- **Islandable microgrids** that are fully interconnected and capable of both consuming and supplying grid power, but can also maintain some level of service during a utility outage.
- **Non-synchronous microgrids** are connected to utility power supplies, but they aren't *inter*connected or synchronized to the grid. Such non-synchronized microgrids are capable of consuming power from the grid, but they aren't capable of supplying it.



Components of a Typical Islandable Microgrid

*Source: Microgrid Institute
www.microgridinstitute.org

Microgrid Drivers in Industrialized Markets

► **"Supply Surety"†**
especially at mission-critical and outage-sensitive facilities

- Military and government installations
- Institutional campuses (universities, hospitals, prisons)
- C&I sites (data centers, corporate campuses, factories, processing plants)
- Communities that repeatedly endure extended outages (NE, Florida, etc.)

† Government agencies and laboratories in the U.S. use the terms "surety" and "assurance" in describing energy supply priorities. Related engineering and regulatory concepts involve resilience, reliability, and power quality.

► **Social Policy**
Environmental liability, jobs/economic development in various jurisdictions – states, cities, and economic development zones

- Renewable mandates
- Environmental constraints
- Sustainable/domestic fuel preferences
- Local self-reliance

► **Transmission congestion**
Siting challenges, load pockets, least-cost regional planning

► **Economic competitiveness**
vs. high-cost utility power. Where DG is near grid parity, microgrids can optimize capacity and add value.

Dynamic Grid:
A work in progress

DA and SCADA	Smart Grid	Dynamic Grid
Early distribution automation and SCADA systems brought modern information technology, switching, and communications systems onto the electric grid for the first time.	Technology standards and common information models accelerated smart grid development. AMI allows advanced demand response and efficiency applications. Outage management systems bring new “self-healing” capabilities.	Systems engineered with smart grid technologies bring greater flexibility and resilience. Automatic reconfiguring systems bring microgrid architecture to the macro grid. Smart switching and distributed intelligence allows dynamic microgrid islanding and DG exploitation.

Dynamic Microgrids

"Dynamic microgrids have the potential to be a key element of the ultimate self-healing grid – the Holy Grail of the smart grid. They allow the grid [during an outage or adverse event] to divide itself into smaller self-sustaining grids, which can then be stitched back to form the regular distribution grid."

–Mani Vadari, Modern Grid Solutions
(forthcoming article in *Public Utilities Fortnightly,* November 2013)

Dynamic Microgrid:
A work in progress

Backup Power Systems

Diesel/gas backup power systems are rudimentary microgrids.

Their primary function is to provide supply surety for host facilities.

Utility tariffs for interruptible power brought added value for backup power systems.

Islandable Microgrids

Microgrid technologies bring together DR, storage, and DG with the capability to operate in isolation.

Demand-side technologies reduce overall energy costs and improve service levels during island operation.

Utilities begin planning for microgrids.

Dynamic Microgrids

As part of a planned smart grid, microgrids bring greater resilience and faster outage restoration.

Advanced microgrids bring voltage support and dispatchable load and generation.

Non-transmission alternatives (NTA) defer high-voltage transmission costs.

Utilities develop the dynamic grid.

DG Technology Trajectory

Manufacturing scale economics vs. system scale economics

Dispatchable demand response

Aeroengines, diesel gensets, and backup generators

Aggregated DR and market transactions

Gas-fired engines, **packaged CHP**

Rooftop PV

Battery storage, EV smart charging

Dynamic, integrated, energy management systems.

Fuel cells, microturbines, V2G

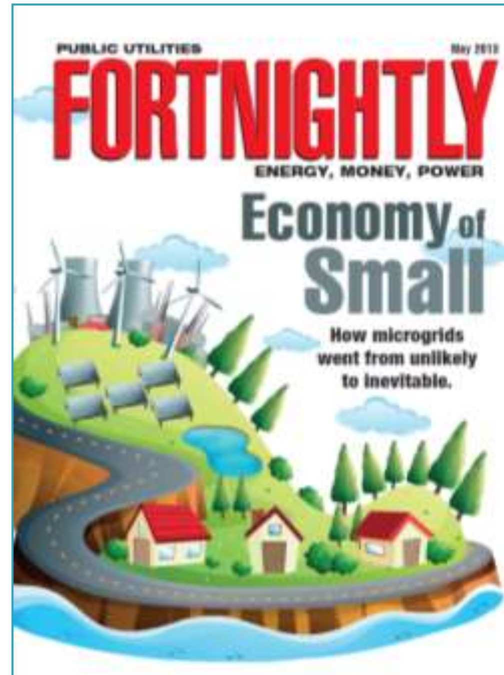
Microgrid Regulation & Markets:

More works in progress

Regulation	Customers	Finance
Outdated and discriminatory standards Disincentives in utility revenue models. Inadequate and unclear policy treatment.	Resistance to adopt new energy technologies. Short memory and low budget for perceived “premium” energy services. Distrust of upstart/non-utility energy companies.	Complex commercial arrangements. Perceived technology risk. Regulatory barriers = complicate financing structures. Institutional resistance = increased risk for investors.

For more information …

"**Economy of Small**: How DG and Microgrids Change the Game for Utilities,"
by Michael T. Burr, *Public Utilities Fortnightly,* May 2013
http://ow.ly/mZczd



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