Microgrid Institute

Utility 2.0 and Dynamic Microgrids

Tools for resilience, economics, and sustainability

Michael T. Burr

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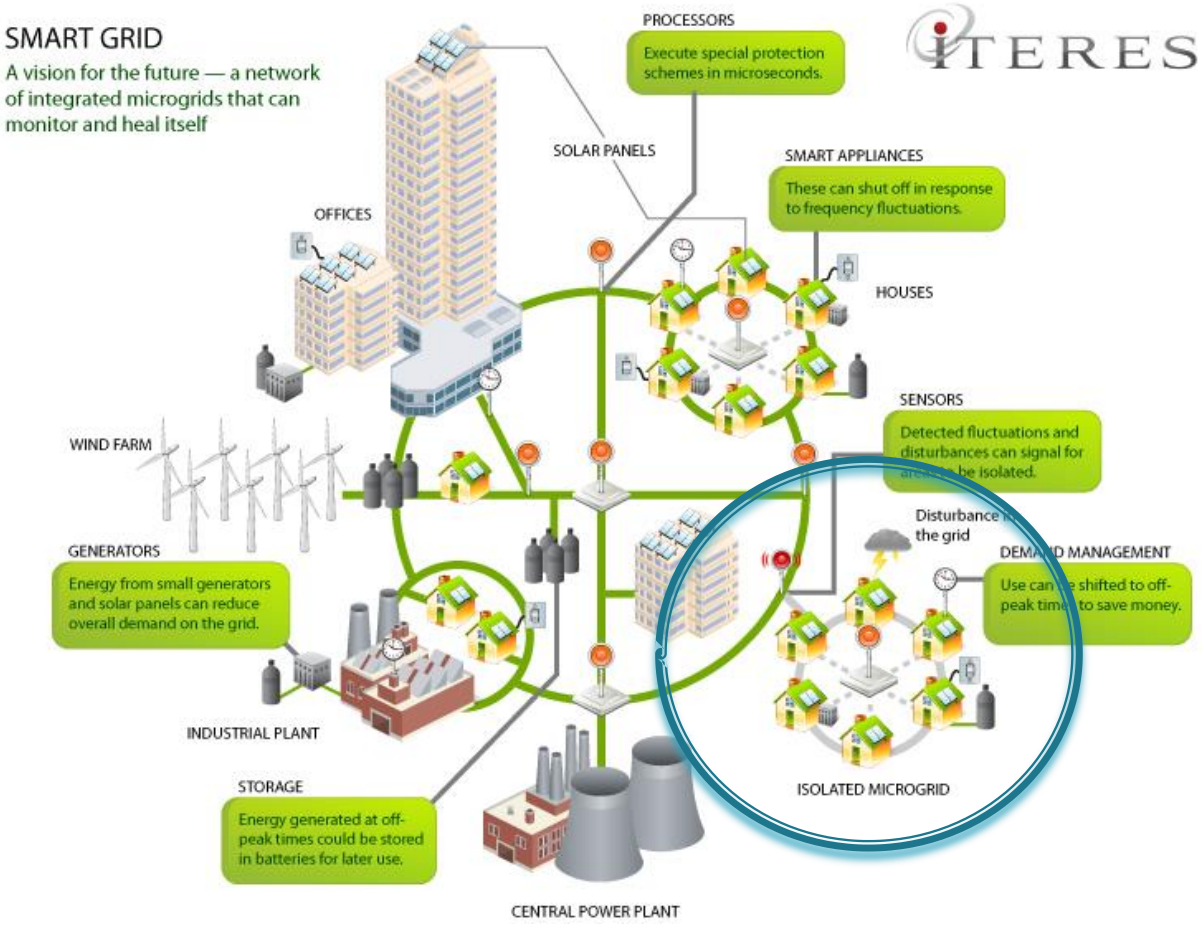
As a dynamic component of an engineered smart grid, a microgrid becomes a major asset for the utility of the future.



definition:*

Microgrid

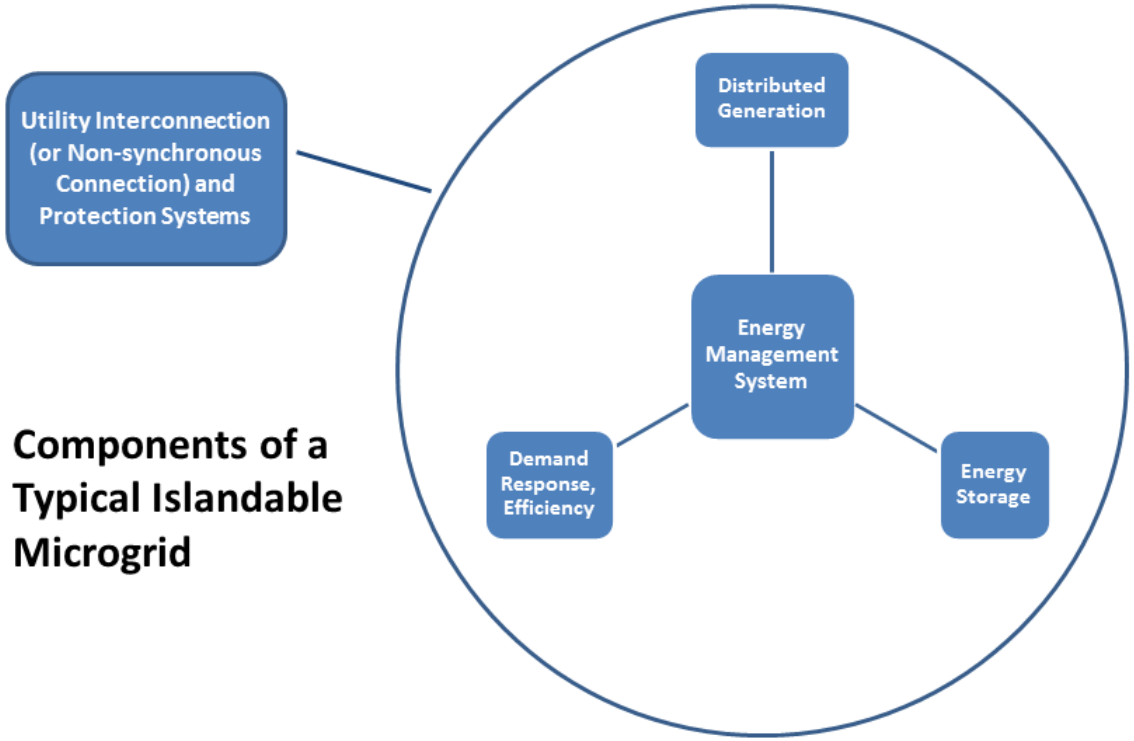
A local energy system capable of balancing captive supply and demand resources to maintain stable service within a defined boundary.

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.

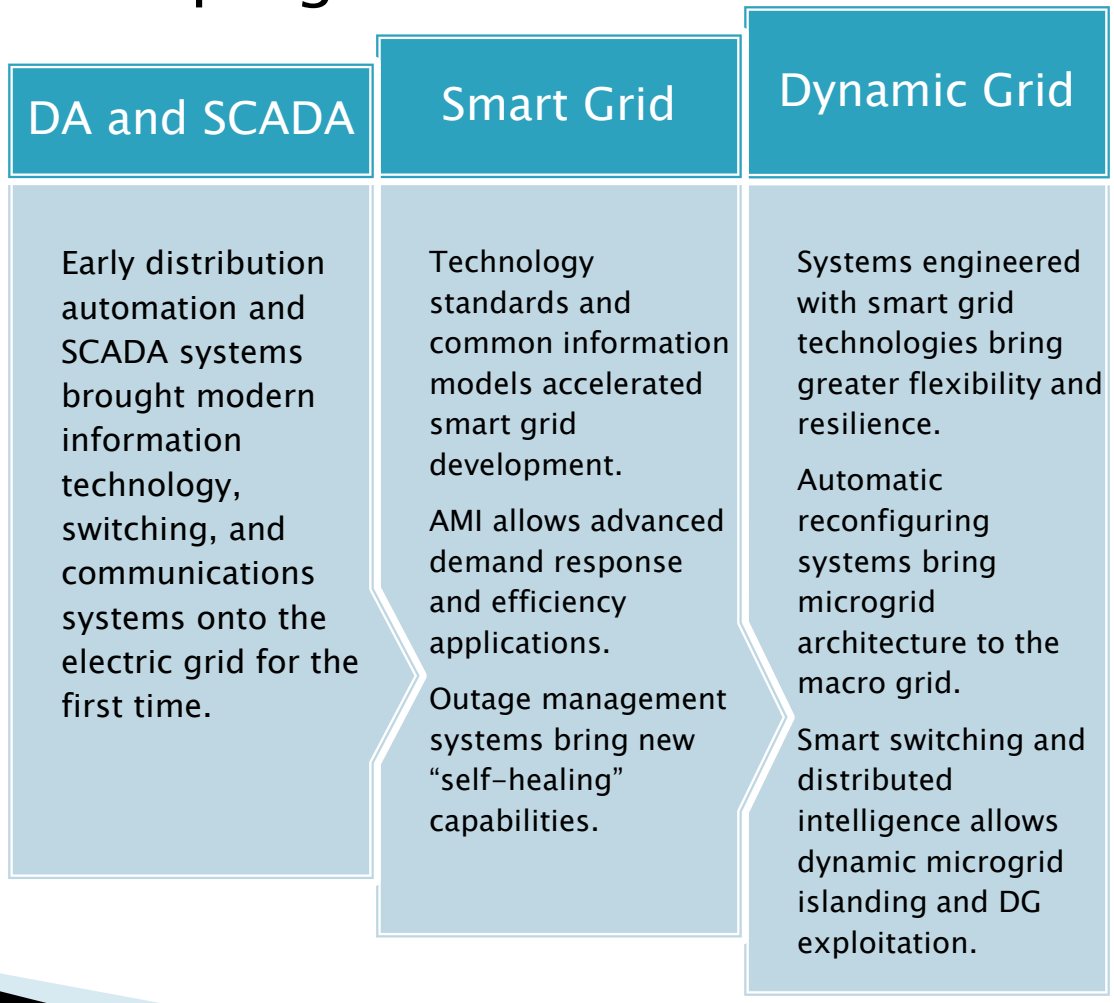
► **Social Policy**
Environmental liability, jobs/economic development in various jurisdictions – states, cities, and economic development zones

- 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



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	Islandable Microgrids	Dynamic Microgrids
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.	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.	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

Aeroengines, diesel gensets, and backup generators

Dispatchable demand response

Gas-fired engines, **packaged CHP**

Rooftop PV

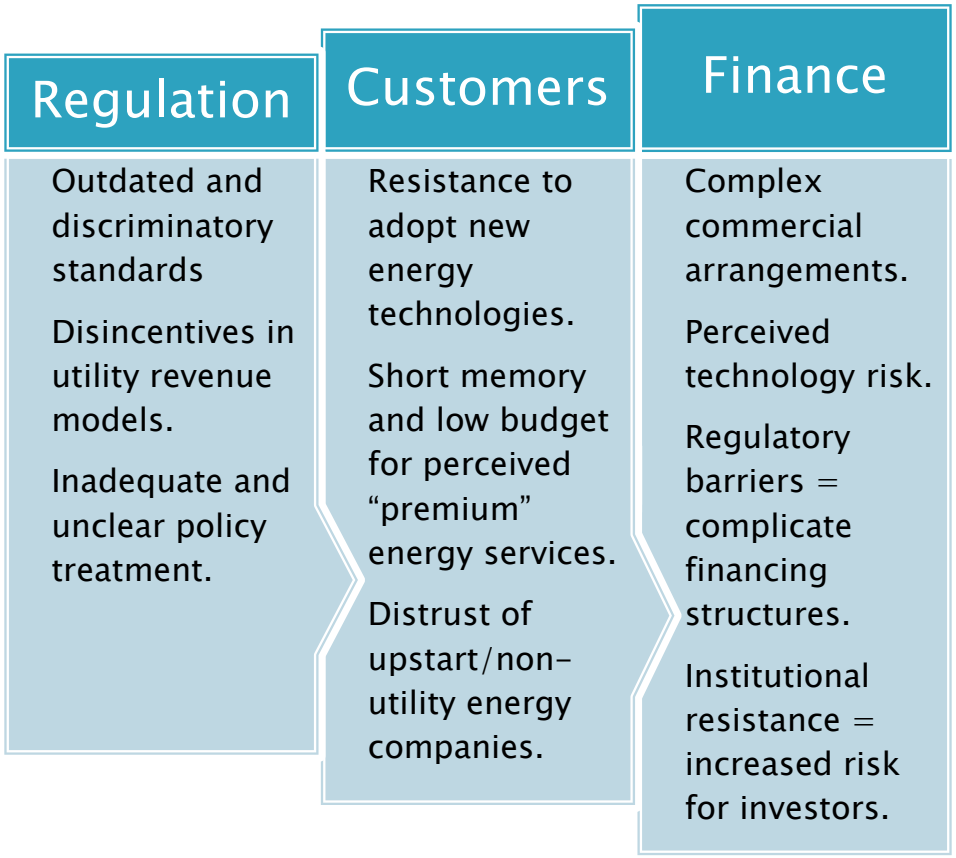
Aggregated DR and market transactions

Battery storage, EV smart charging

Dynamic, integrated, energy management systems.

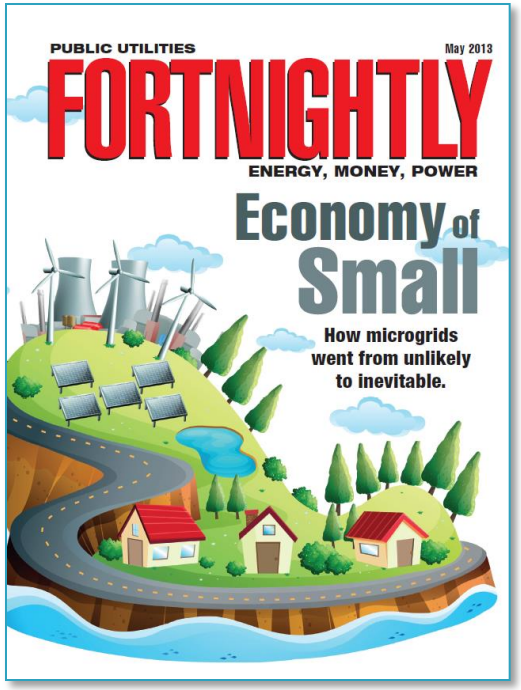
Fuel cells, microturbines, V2G

Microgrid Regulation & Markets:
More works in progress



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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