

Smart Grid Technologies

The Greening of the Electric Grid Villanova University

Presented by
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The Smart Grid

- What is the Smart Grid:
 - *An enhanced electric transmission or distribution network that extensively utilizes sensors, controls, data communications and information technologies to improve reliability, economics and security of the power system, while accommodating a greater levels of demand response, distributed and intermittent generation and storage resources, and the overall automation.*



Drivers

- The utility industry is undergoing tremendous change driven by a number of forces:
 - Flattening to declining load growth
 - Society demands increased levels of energy efficiency, technology transforms how electricity is used, and distributed generation becomes more ubiquitous over time.
 - Banning of the incandescent light bulb. About 17 percent of residential demand is from lighting, and the percentage of commercial demand from lighting is somewhat higher.

Drivers

- Flattening to declining load growth
 - Energy efficient appliances and attendant technology improvements will continue to reduce demand
- The cost of solar and other distributed generation technologies are rapidly declining
- Aging workforce and infrastructure

Drivers

- The cost of energy storage is also declining, and penetration of the automotive market by plug-in hybrid electric vehicles and pure electric vehicles over the coming years will accelerate the deployment of energy storage on our system and further heighten our need for information and control to operate the electric delivery system



Mobile Utility Battery Storage

Drivers

- Energy security concerns and high gasoline prices will further stimulate energy efficiency, deployment of indigenous renewables, and electrification of transportation
- Concerns regarding global climate change and CO2 will put increasing pressure on our existing generation fleet
 - If CO2 costs are incorporated into electricity costs in the U.S. but not in developing countries, the need for our economy to become the most energy efficient in the world will be a requirement for us to remain competitive in global markets

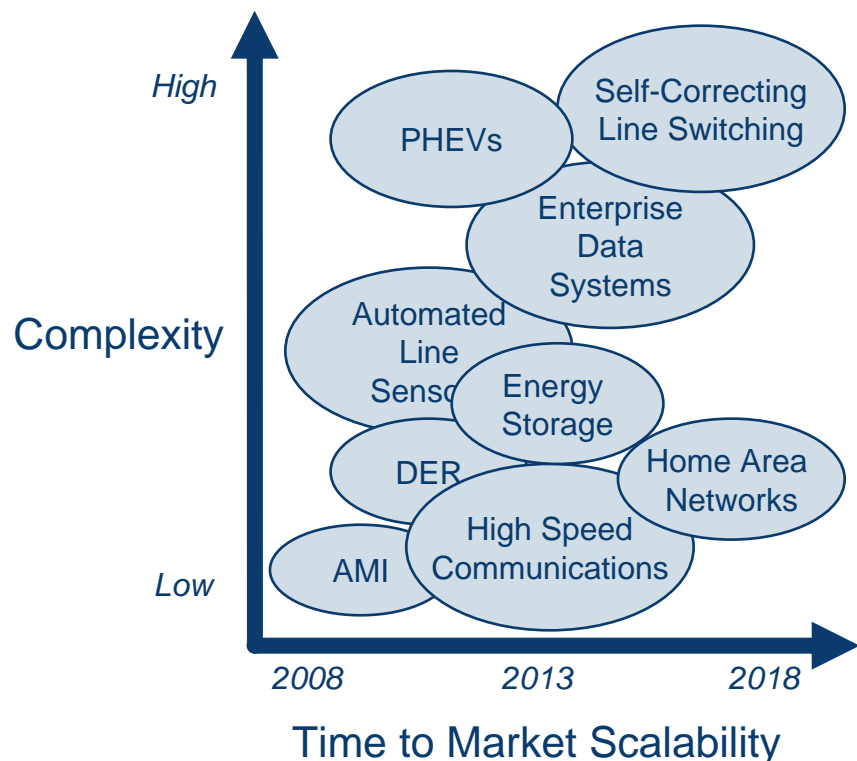
Drivers

- In the world of Blackberries, TiVo, Google, on-line purchasing, and on-line banking, with the instant gratification of a connected, always-on world. Utility customers are amazed to find out their utility does not know if their power is out until they call, or that they cannot tell them when it will be back on. In simple terms, utility customers want four things from their electric utility:
 - The lights come on when you flip the switch
 - It is cheap and predictable.
 - You do not have to think or do much about it beyond that.
 - You do not have to feel guilty about it.

Smart Grid

When does the “Smart” grid become truly intelligent?

Intelligent Grid Technologies¹

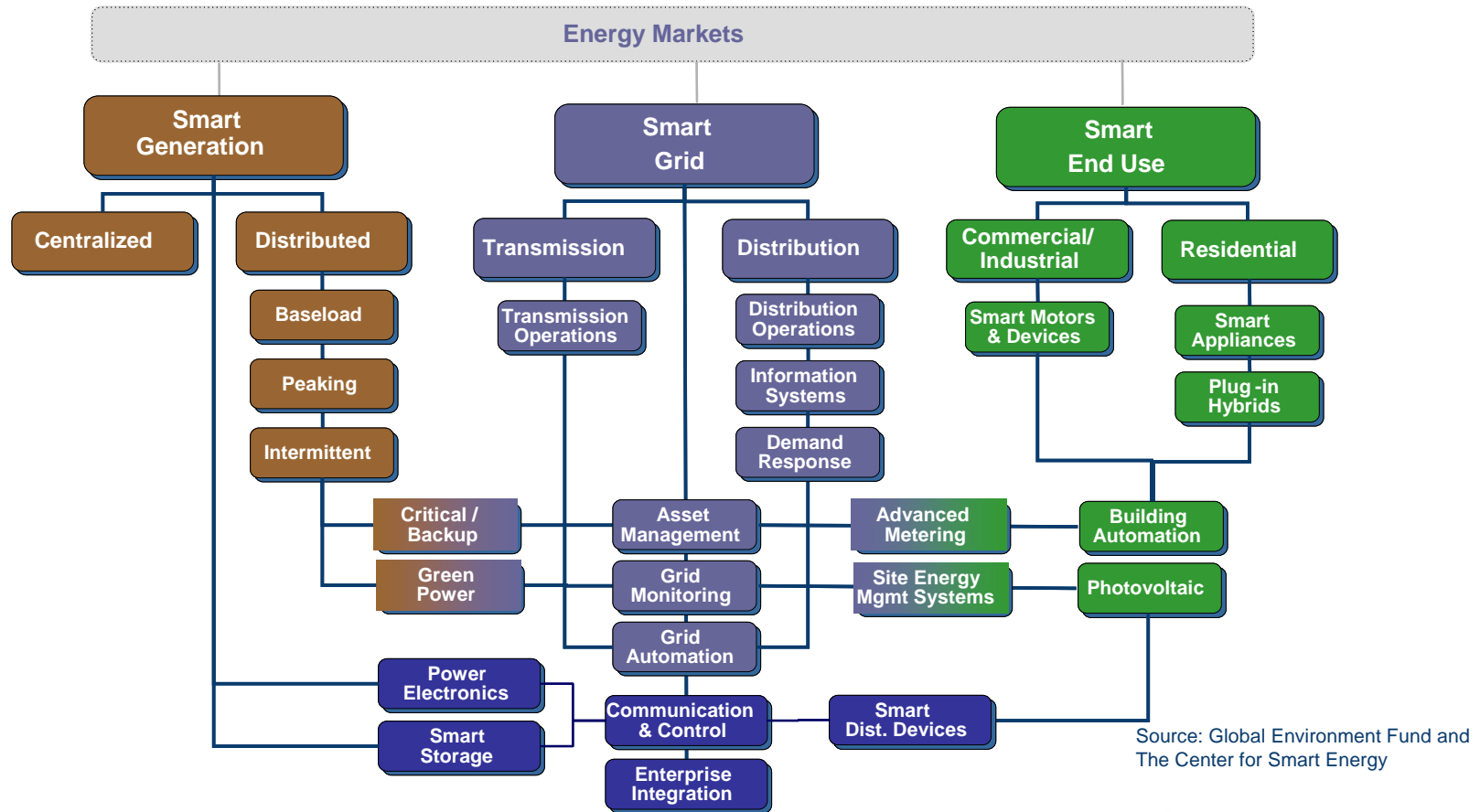


Intelligent Grid Characteristics

- Sensors and controls become truly autonomous, driven by self-correcting, intelligent algorithms, operationally embedded
- Utilities and energy providers are making the investment decision a priority, with intelligent controls a design standard for asset management
- New stakeholders and market participants offer a larger array of new products and services
- Regulators and policy makers enable effective cost recovery schemes, not tied to the current regimes
- Consumers demand the flexibility and fully engage as active participants
- Highly secure

Note 1: Partial listing

The Smart Grid concept varies among individual users – The strategy taken will depend on in part on the boundaries set:



Smart Grid

Will operate as an Intelligent Network, with a portfolio of technologies and advanced communications



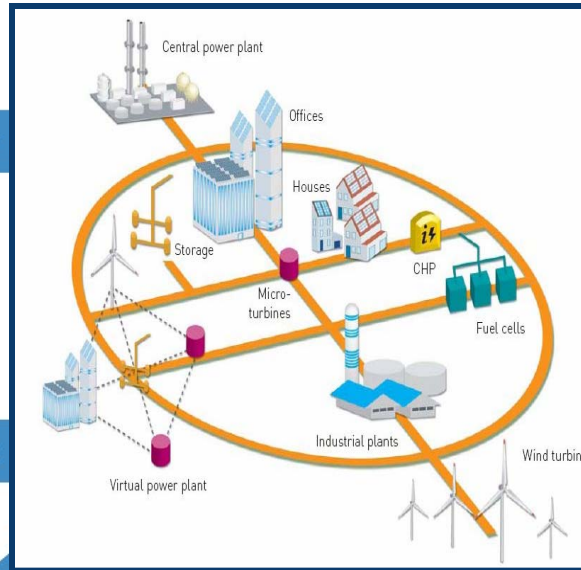
Efficiency in Buildings, Industry and End-Use Products



Vehicles: Efficiency, Hydrogen Fuel Cells



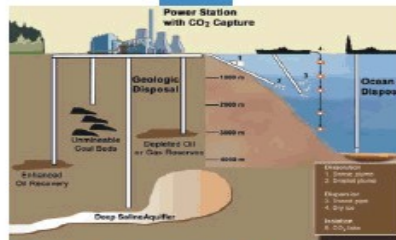
Advanced Power Generation and Grids



Renewable Energy Technologies



Biomass, Synfuels, CHP



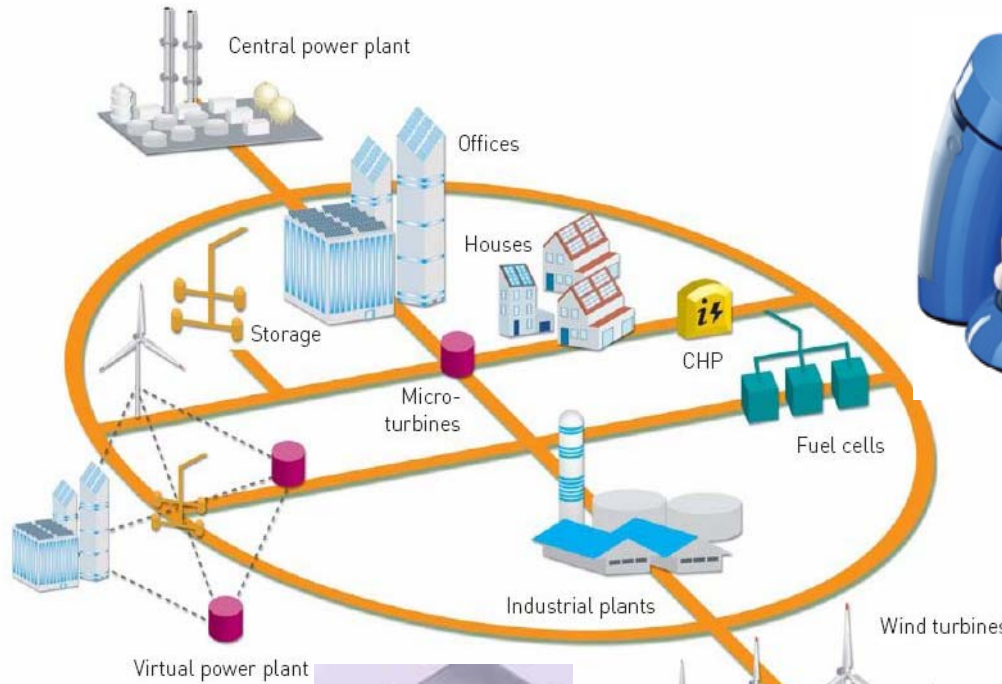
CO₂ Capture and Storage



Advanced Nuclear Fission and Fusion

Smart Grid

This will, in turn, drive the development of new generation technologies and products



Convenience & health



Smart power electronics



Mini- and micro turbines



Stimulus

- The government has awarded \$3.4B to utilities to initiate the work towards developing the smart grid that will transform the electric grid – work will be starting soon

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Thanks for your Attention

Any Questions?