Distributed Energy Development Policies and Prospects in the USA

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Presentation Overview

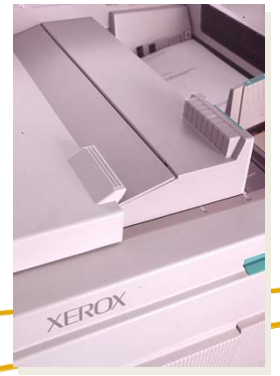
- Introduction to the Pacific Northwest National Laboratory
- The smart grid landscape in support of distributed energy
- Microgrids as a driver for distributed energy

PNNL is operated for DOE by Battelle

- Founded in 1925 as a charitable trust through the Will of Gordon Battelle
- Ohio industrialist; believed research could make American industry more competitive
  - Core Purpose

    Translate scientific discovery into innovative applications

Battelle headquarters
Columbus, OH



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PNNL's Mission & Business Facts

Mission: Perform basic and applied research in support of energy, environmental, and national security for our nation.

- ~$1.1 billion business volume
- ~4,700 staff

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Increase U.S. energy capacity and reduce dependence on imported oil

PNNL will provide science, technologies and leadership to:

Transitioning to a renewable, nuclear, and hydrogen energy base while reducing dependence on imported oil. . .

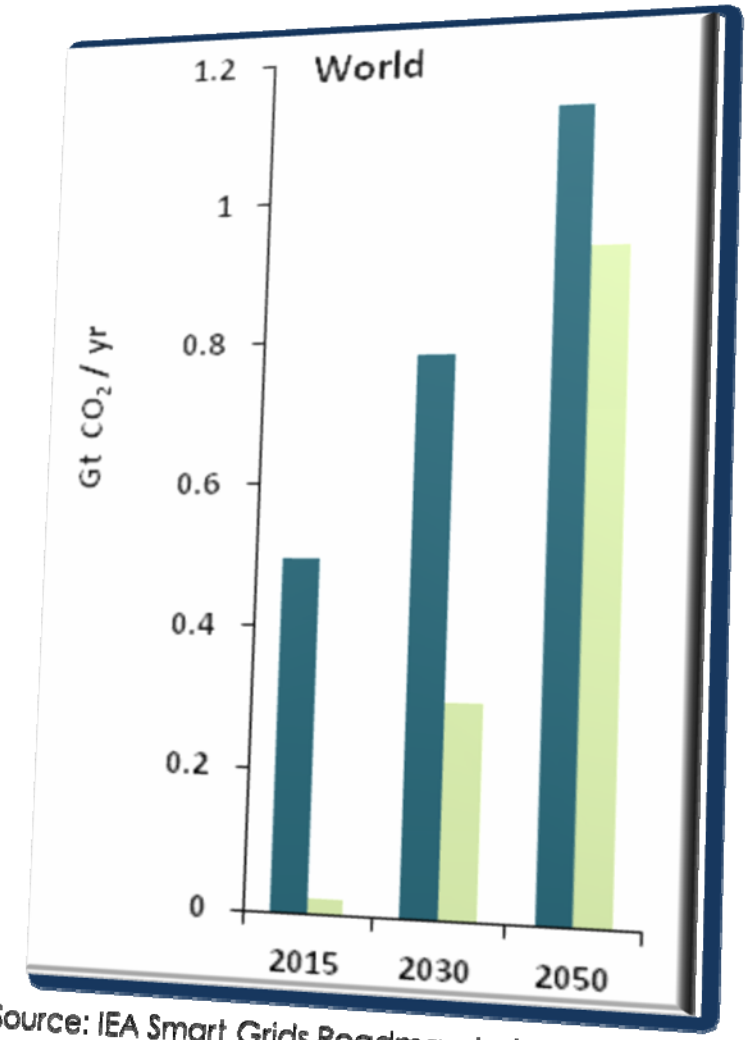
- **Energy Efficiency & Renewable Energy (EERE)**
  - Increase the efficiency of powering vehicles and buildings; and improve economic viability of biofuels
- **Clean Fossil Energy**
  - Enable economically and environmentally sustainable “air and water” neutral hydrocarbon conversion, carbon capture and sequestration
- **Electric Infrastructure**
  - Improve grid reliability and productivity
- **Nuclear Energy**
  - Enable expansion of nuclear energy through a viable closed nuclear fuel cycle

The Smart Grid Enables CO_2 Reduction on a Global Basis

Deployed globally, smart grids have the potential to help reduce global CO_2 emissions by over 2 gigatonnes per year by 2050

Direct Reductions: Energy savings from peak load management, continuous commissioning of service sector loads, accelerated deployment of energy efficiency programs, reduced line losses, and direct feedback on energy usage

Enabled Reductions: Greater integration of renewables and facilitation of EV and PHEV deployment

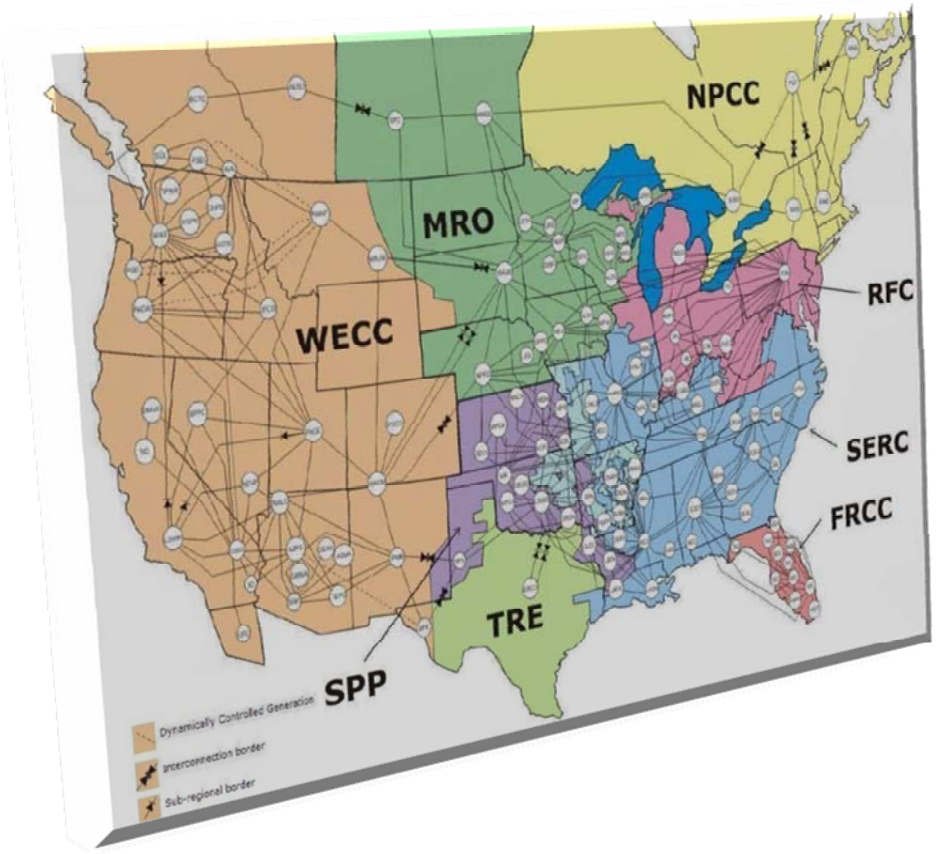


Source: IEA Smart Grids Roadmap Insights, 2011

The North American Electric Grid

U.S. Figures

22% of world consumption



3,200 electric utility companies

17,000 power plants

800 gigawatt peak demand

165,000 miles of high-voltage lines

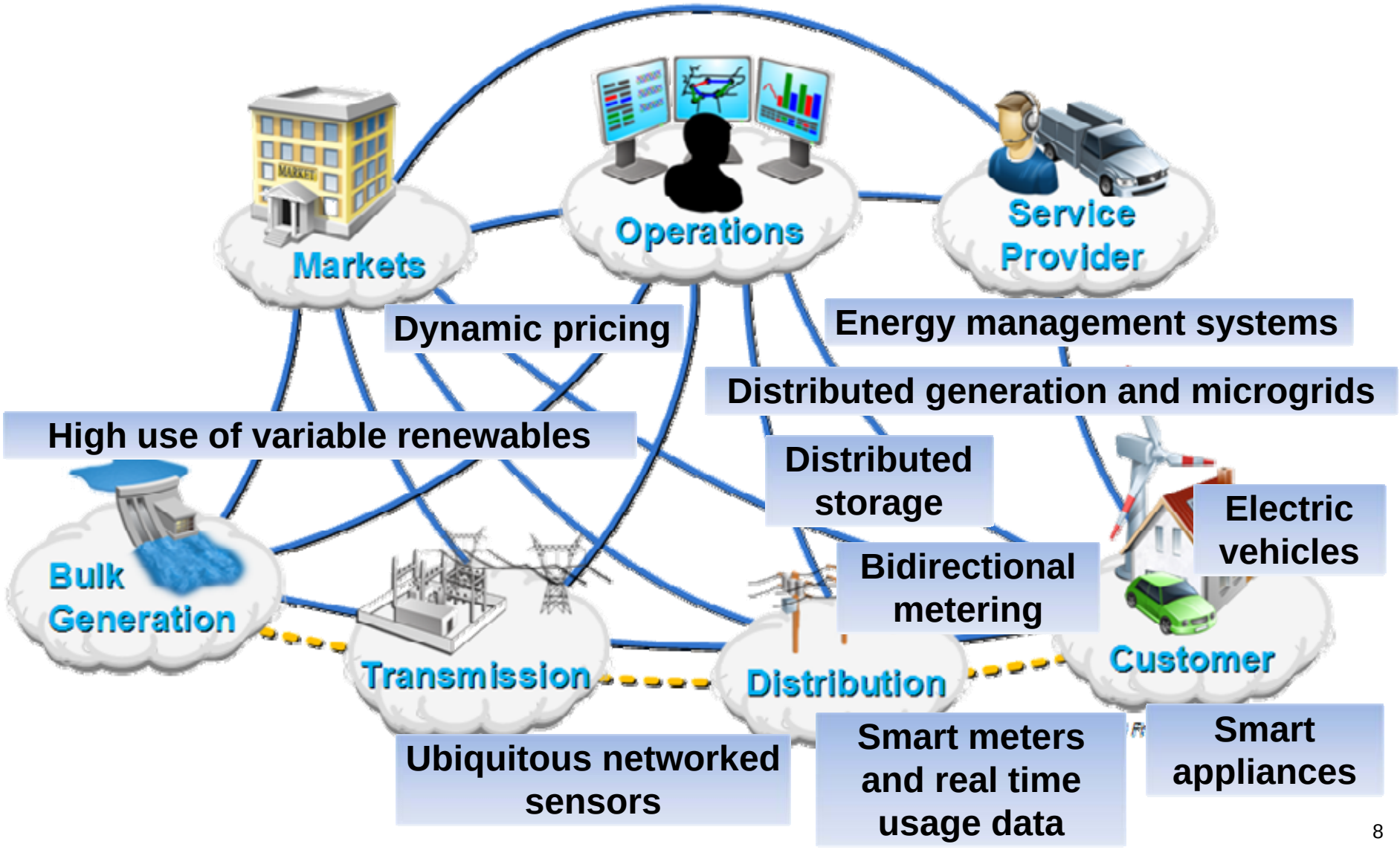
6 million miles of distribution lines

140 million meters

$1 trillion in assets

$350 billion annual revenues

The Smart Grid Supports Distributed Resources



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 coordinated 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 coordinated entity to the grid

Microgird Opportunities and Drivers

- Opportunities
  - Hospitals and other critical facilities
  - Universities
  - Military Installations
- Drivers
  - Energy Security and Reliability
  - Renewable Energy Mandates and Directives
  - Costs (peak load reduction, demand charges)

Current U.S. DOE Distributed Systems Integration (RDSI) Projects

- 9 demonstration projects in 8 states to integrate use of distributed energy resources to provide at least 15% peak demand reduction on distribution feeder or substation
- Projects are either microgrids or are developing technologies that will advance microgrids
- Systems must be capable of operating in both grid parallel and islanded modes
- $55 million of DOE funds over five years (total value of awards will exceed $100 million, including participant cost share

U.S. DOE RSDI Projects (1)*

- **Chevron Energy Solutions**—CERTS Microgrid Demo at the Santa Rita Jail - large-scale energy storage, PV, fuel cell (California)
- **SDG&E**—Borrego Springs Microgrid - demand response, storage, outage management system, automated distribution control, AMI (California)
- **U of HI**—Transmission Congestion Relief, Maui - intermittency management system, demand response, wind turbines, dynamic simulations modeling (Hawaii)
- ***UNLV***—*"Hybrid" Homes - Dramatic Residential Demand Reduction in the Desert Southwest - PV, advanced meters, in-home dashboard, automated demand response, storage (Nevada)*
- **ATK Space System**—Powering a Defense Company with Renewables - Hydro-turbines, compressed air storage, solar thermal, wind turbines, waste heat recovery system (Utah)

*http://www.smartgrid.gov

U.S. DOE RSDI Projects (2)

- **City of Fort Collins**—Mixed Distributed Resources - PV, bio-fuel CHP, thermal storage, fuel cell, microturbines, PHEV, demand response (Colorado)
- **Illinois Institute of Technology**—The Perfect Power Prototype - advanced meters, intelligent system controller, gas fired generators, demand response controller, uninterruptable power supply, energy storage (Illinois)
- **Allegheny Power**—WV Super Circuit Demonstrating the Reliability Benefits of Dynamic Feeder Reconfiguration - biodiesel combustion engine, microturbine, PV, energy storage, advanced wireless communications, dynamic feeder reconfiguration (West Virginia)
- **Con Ed**—Interoperability of Demand Response Resources - demand response, PHEVs, fuel cell, combustion engines, intelligent islanding, dynamic reconfiguration, and fault isolation (New York)

U.S. DOE Smart Grid R&D Program

Dollars in Thousands	
FY 2011	FY 2012
23,000	19,924

Promotes development of an efficient, fully integrated "smart" grid through the adaptation and integration of digital information and communication technologies into the Nation's electricity delivery system.

Guided by MYPP* focusing R&D on:

- **DER/DR/PEV integration**
- **Distribution automation**
- **Microgrids**
- **Standards & best practices**

Plus crosscut efforts on:

- **Communications and Outreach (inc. support of the President's Green Button Initiative)**

* DOE Multi-Year Program Plan 2011-2015 (MYPP) available at: http://www.smartgrid.gov/sites/default/files/oe_mypp.pdf

Microgrid Development at DOE was Supported by Workshops in 2011 and 2012

- RD&D to reach 2020 targets on costs, reliability, system energy efficiencies, and emissions, as defined at the August 2011 DOE Microgrid Workshop*

- Definitization of RD&D priority and technology performance specifications were discussed at the July 30-31, 2012, DOE Microgrid Workshop**

*http://www.e2rg.com/reports

**http://e2rg.com/events/

The Smart Grid Can Be a Key Enabling Technology for Distributed Energy Systems

- The smart grid enables energy efficient technologies on the demand side and increased use of renewable energy on the supply side
- The smart grid provides accountability

- The smart grid brings bidirectional communication flow to all aspects of electricity supply and demand
- The smart grid allows consumers to fully understand the impact of their energy choices and understand the value of distributed energy systems

Thank you for your attention!

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