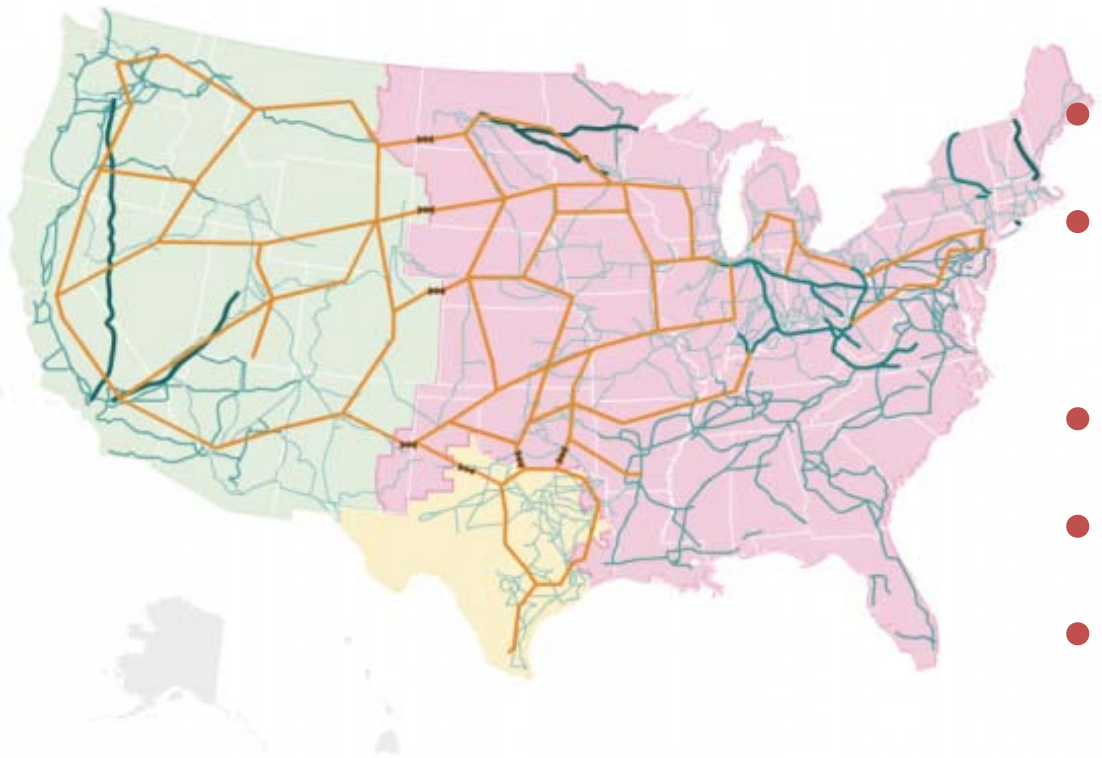
NIST
National Institute of Standards and Technology
U.S. Department of Commerce

NIST Smart Grid Interoperability Program

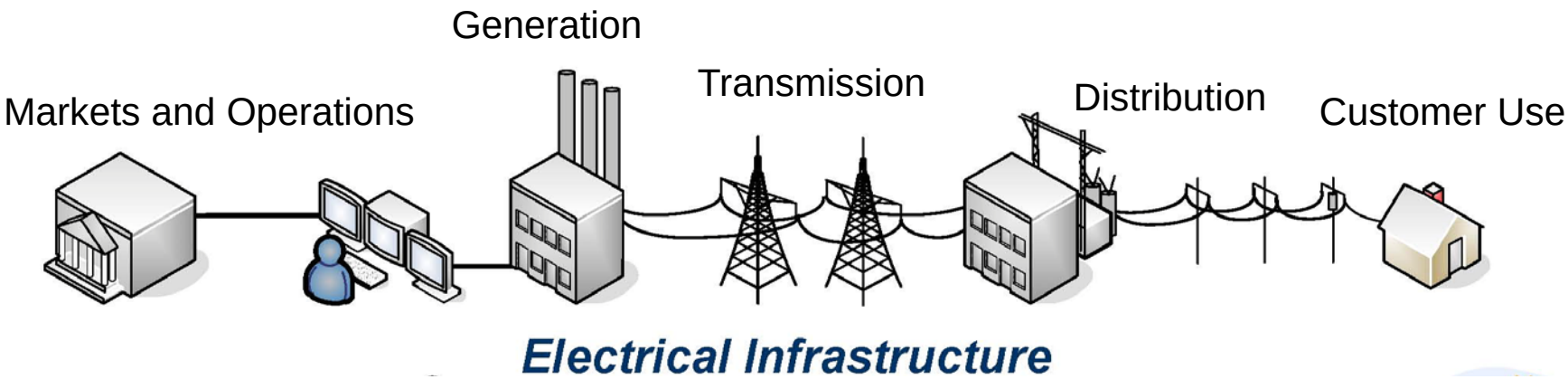
Steven T. Bushby
Engineering Laboratory

U.S. Electric Grid



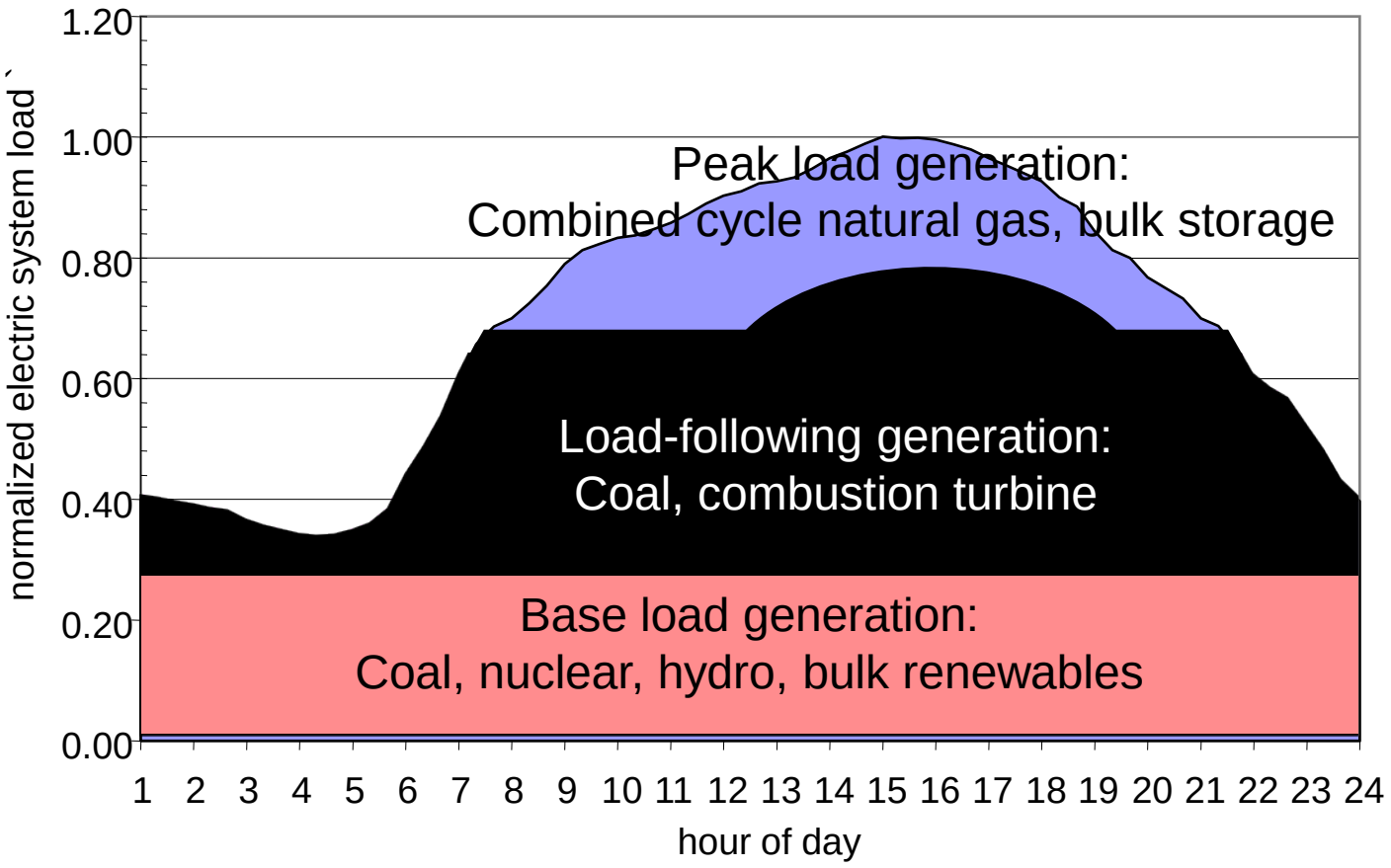
- 3,100 electric utility companies
- 10,000 power plants
- 157,000 miles of high-voltage lines
- 140 million meters
- $800 billion in assets
- $247 billion annual revenues

Today's Electric Grid

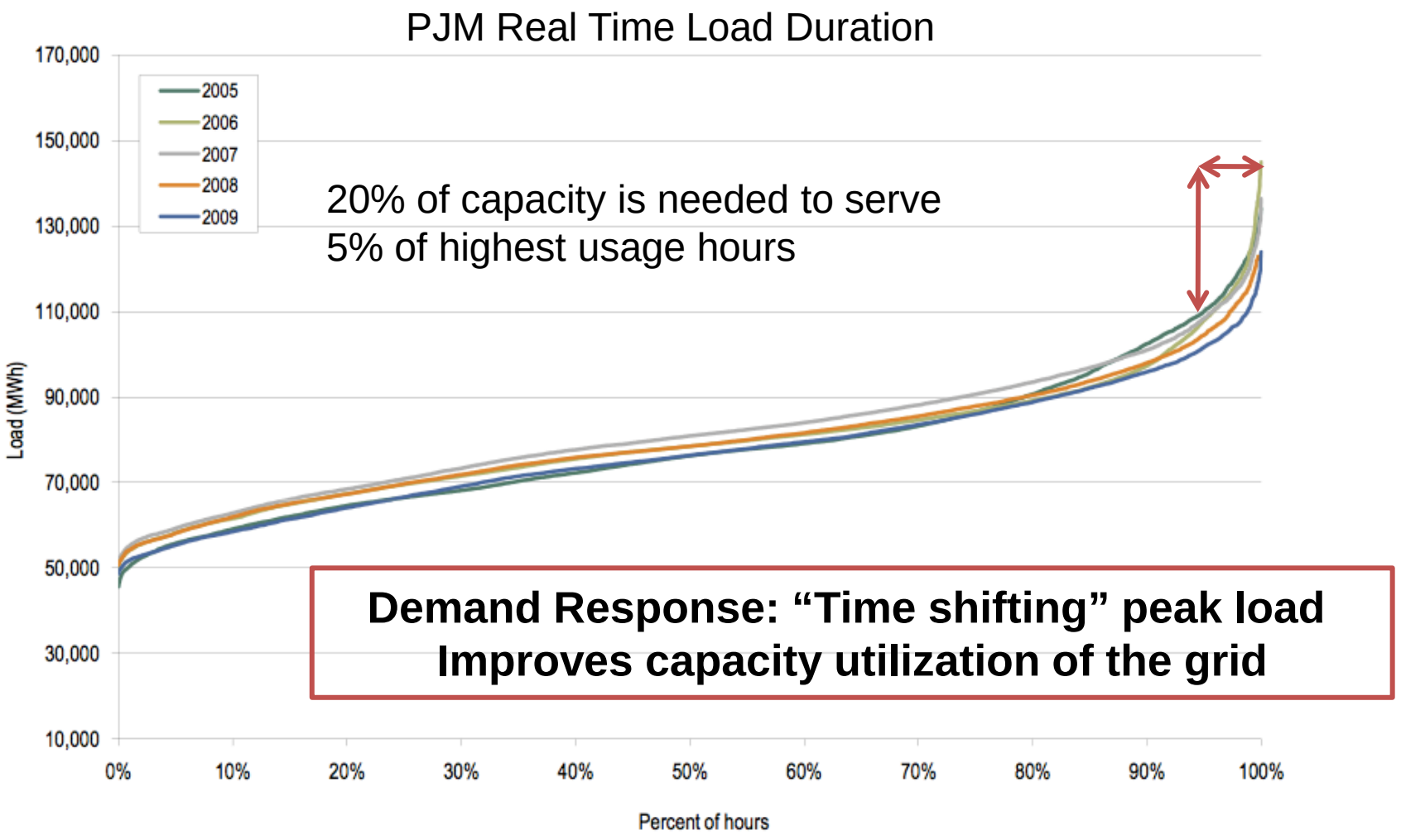


- *Centralized, bulk generation, mainly coal and natural gas in U.S.*
- *Responsible for 40% of human-caused CO_2 production*
- *Controllable generation and predictable loads*
- *Limited automation and situational awareness*
- *Lack of customer-side data to manage and reduce energy use*

Load and Generation in Today's Grid



Current Grid is Inherently Inefficient

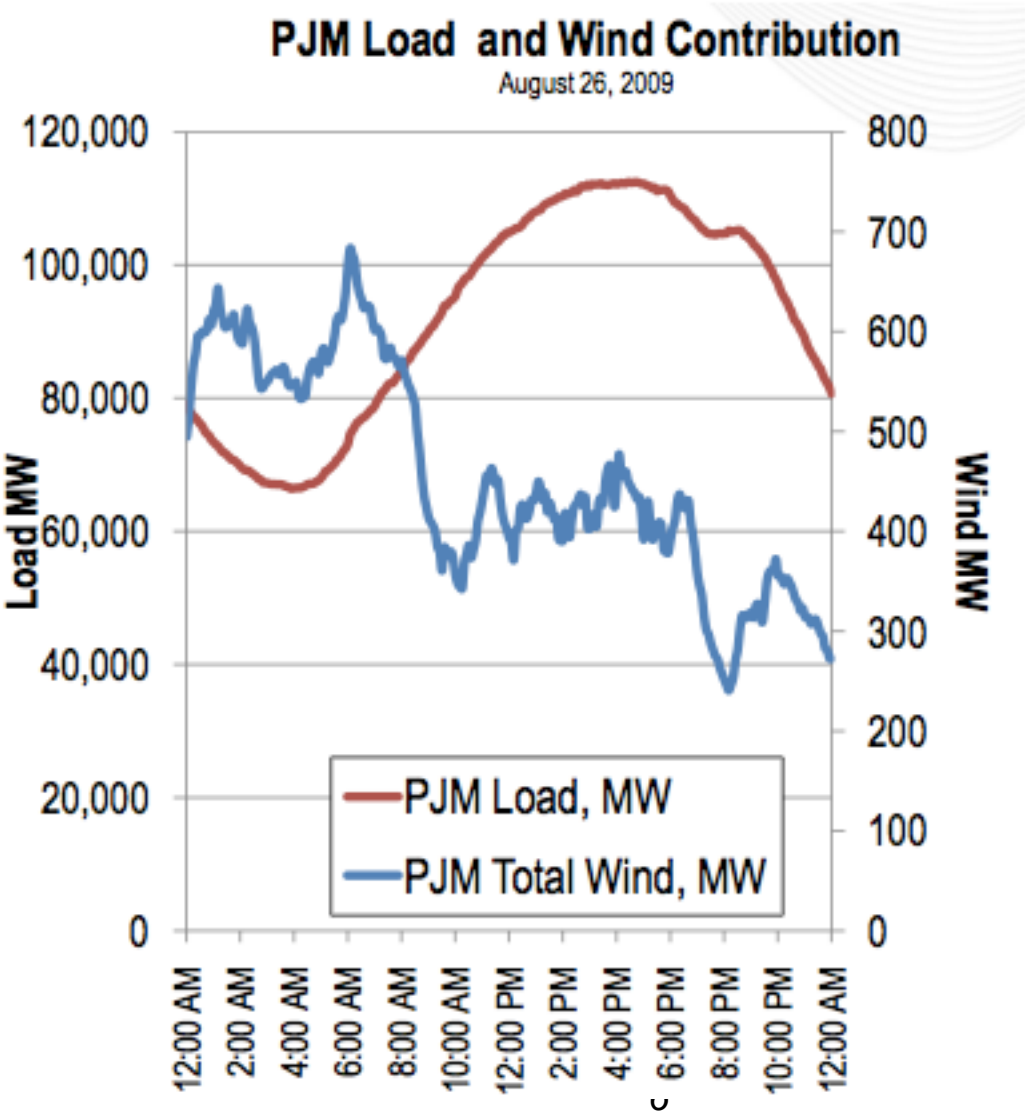


Demand Response: "Time shifting" peak load
Improves capacity utilization of the grid

Source: PJM

NIST National Institute of Standards and Technology

Integration of Renewables Presents New Challenges due to Variability

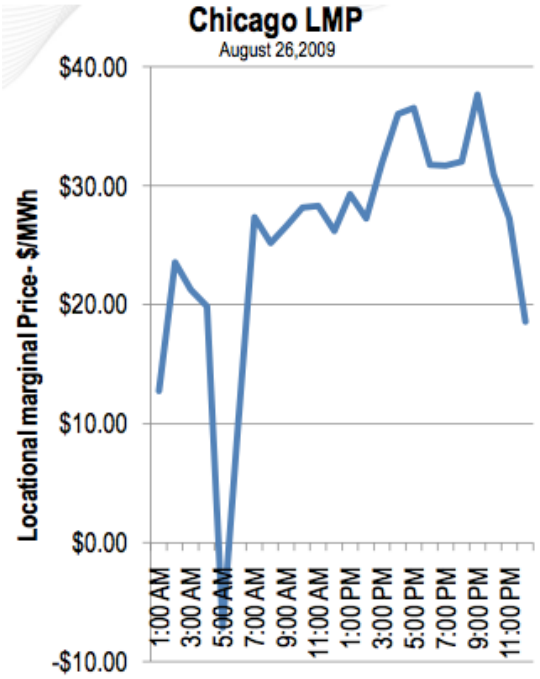


Source: PJM

NIST National Institute of Standards and Technology

New Paradigms May Radically Change the Characteristics of Load on the Grid

Dynamic pricing



Smart Meters

Smart appliances that respond to prices

Whirlpool Aims for Smart Appliances in 2011

Smart appliances will need home control systems to store user preferences.

May. 12, 2010 — by Steven Castle

Whirlpool says by 2011 it will have "smart" appliances that can connect to smart meters and the smart grid.

Whirlpool representatives at the Alliance to Save Energy's EE (Energy Efficiency) Global Forum in Washington, D.C. say the company will have its Energy Smart water heater, with an external hookup for connection to a smart meter, available by the end of 2010.

The company also says smart laundry appliances will be available in 2011.

Whirlpool will release smart laundry appliances in 2011.

Electric vehicles

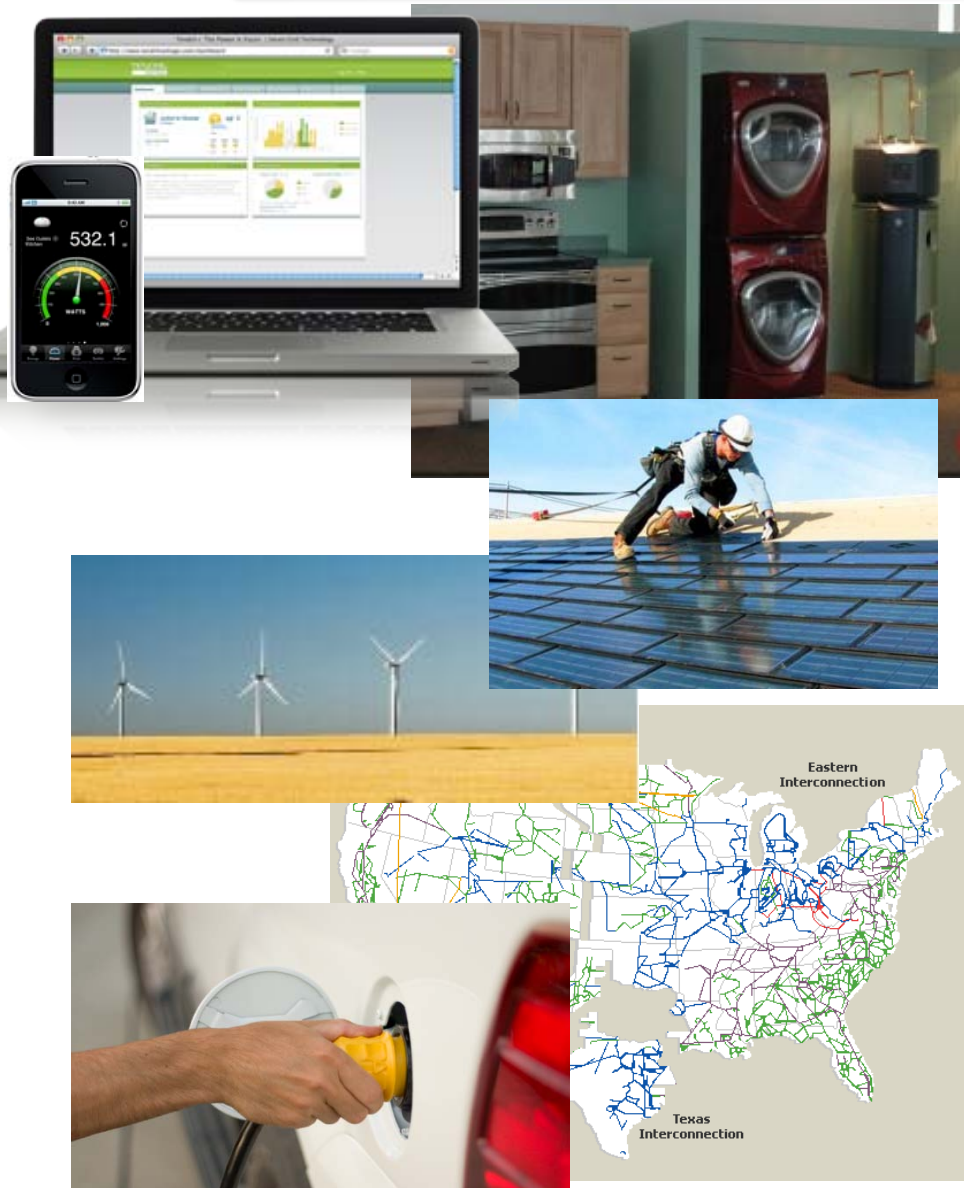
NIST National Institute of Standards and Technology

Why are building controls important for the Smart Grid?

- **72% of electricity is consumed in buildings (40% commercial, 32% residential)**
- **As we approach national goals of net-zero energy buildings, renewable generation sources connected to buildings will become increasingly important**
- **As the nation migrates to electric vehicles, they will be plugged in to buildings**

Buildings will no longer be a dumb load at the end of the wire. They will become an integral part of the grid

Smart Grid Goals

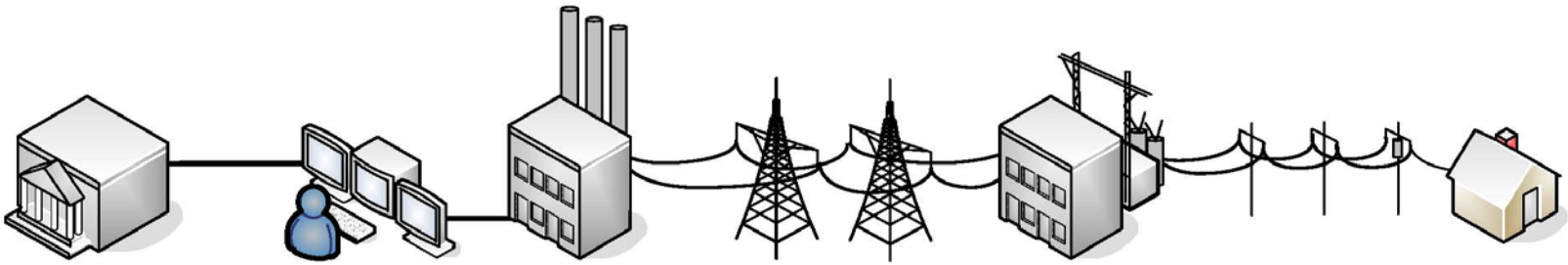


- Enable customers to reduce average and peak energy use
- Increase use of renewable sources
- Improve reliability and security
- Facilitate infrastructure for electric vehicles

What Will the Smart Grid Look Like?

- High use of renewables – some jurisdictions as high as 35% by 2020
- Distributed generation and microgrids
- Bidirectional metering – selling local power into the grid
- Distributed storage
- Smart meters that provide near-real time usage data
- Time of use and dynamic pricing
- Ubiquitous smart appliances communicating with the grid
- Energy management systems in homes as well as commercial and industrial facilities linked to the grid
- Growing use of plug-in electric vehicles
- Networked sensors and automated controls throughout the grid

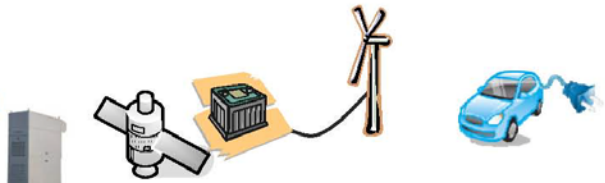
Smart Grid: The "Energy Internet"

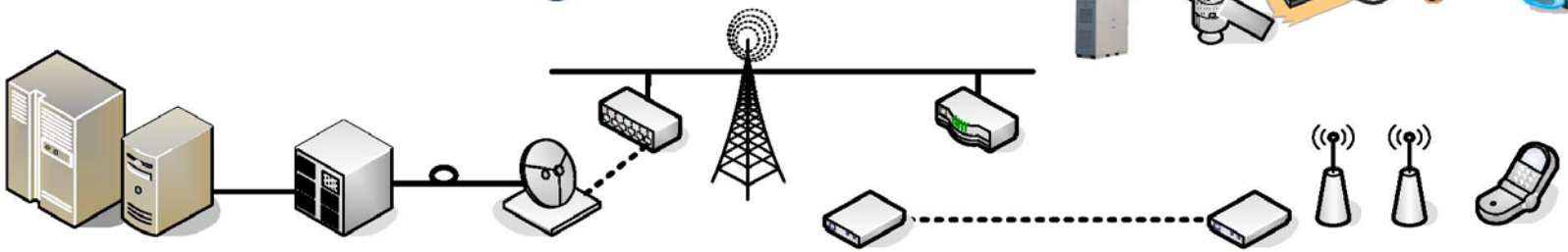


Electrical Infrastructure

2-way flow of electricity and information

"Intelligence" Infrastructure





Graphics courtesy of EPRI

NIST National Institute of Standards and Technology

Smart Grid – A U.S. National Priority

"It is the policy of the United States to support the modernization of the Nation's electricity [system]… to achieve…a Smart Grid." Congress, EISA 2007

"We'll fund a better, smarter electricity grid and train workers to build it…"
President Barack Obama

"To meet the energy challenge and create a 21st century energy economy, we need a 21st century electric grid…" Secretary of Energy Steven Chu

"A smart electricity grid will revolutionize the way we use energy, but we need standards …" Secretary of Commerce Gary Locke

NIST National Institute of Standards and Technology

NIST Role

- Under Title XIII, Section 1305 of EISA, NIST has

  "primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems…"

- Congress directed that the framework be "flexible, uniform, and technology neutral"
- Use of these standards is a criteria for DoE Smart Grid Investment Grants
- Input to FERC and state PUC rulemaking

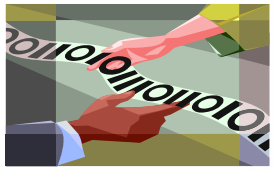
The Need for Standards is Urgent

Whirlpool Corporation To Produce One Million Smart Grid-Compatible Clothes Dryers by the End of 2011…

40 million smart meters to be deployed in the next several years in US

Standards for data communication,
price information, schedules,
demand response signals




NIST Three Phase Plan

PHASE 1
Identify an initial set of existing consensus standards and develop a roadmap to fill gaps

PHASE 2
Establish public/private Interoperability Panel to provide ongoing recommendations for new/revised standards

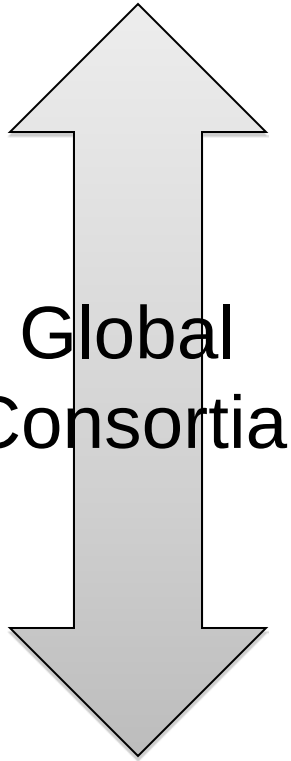
PHASE 3
Testing and Certification Framework

March 2009 September 2010

15

Standards Come From Many Sources

International



Global Consortia

Regional and National

IEC

ISO

ITU

IETF

IEEE

SAE International

ZigBee Alliance

OGC
Open Geospatial Consortium, Inc.

OASIS

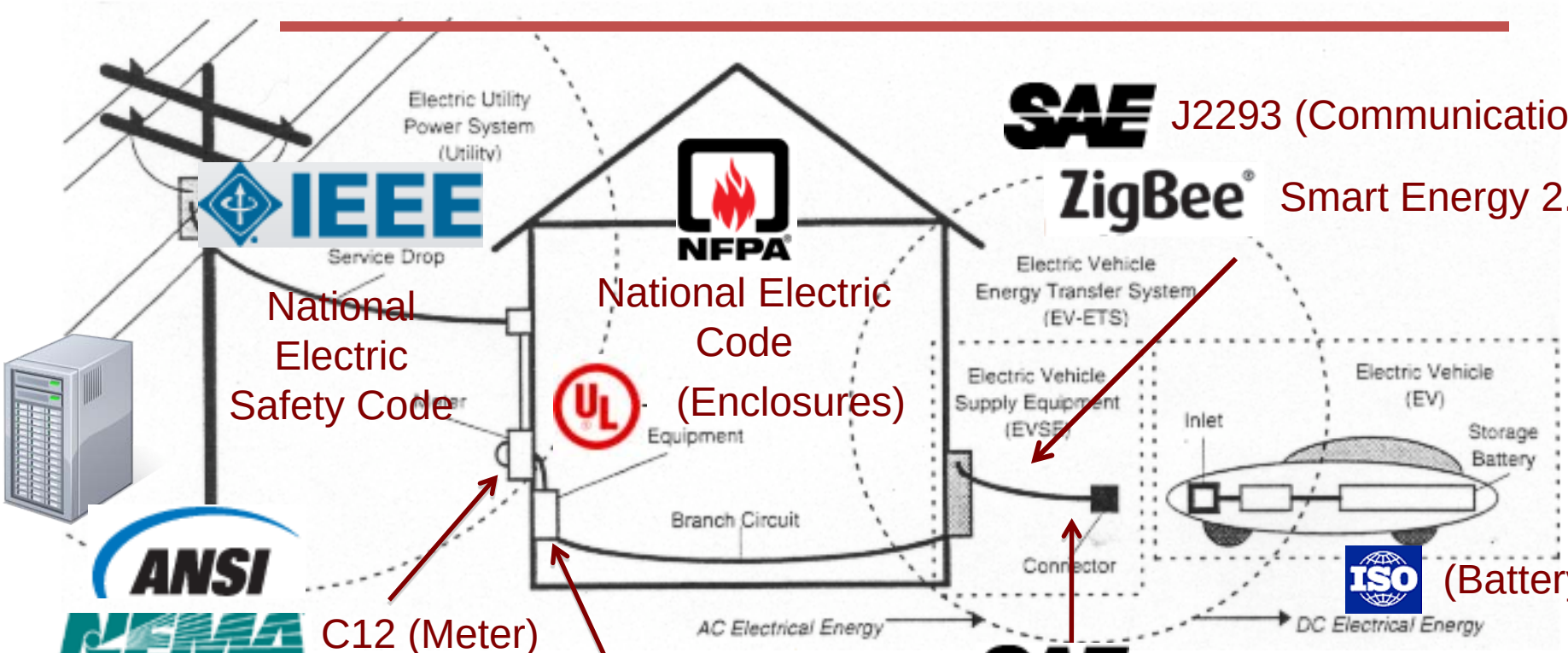
ANSI
American National Standards Institute

NAESB

NEMA

NIST
National Institute of Standards and Technology

Electric Vehicles Require Many Standards



IEEE Service Drop

National Electric Safety Code

NFPA National Electric Code (Enclosures)

UL

SAE J2293 (Communication)

ZigBee® Smart Energy 2.0

ANSI

NEMA C12 (Meter)

ISO (Battery)

SAE J1772 (Connector)

IEEE 1547 (Distributed energy interconnection)

IEC 61850 and 61970/61968 Information models

NAESB OASIS Demand response & price signaling

NIST National Institute of Standards and Technology

ASHRAE's Role (PAP17)

SPC 201P Facility Smart Grid Information Model (Co-sponsored by NEMA)

PURPOSE: The purpose of this standard is to define an abstract, object-oriented information model to enable appliances and control systems in homes, buildings, and industrial facilities to manage electrical loads and generation sources in response to communication with a "smart" electrical grid and to communicate information about those electrical loads to utility and other electrical service providers.

This standard will be by standards development organizations to develop or enhance protocol specific implementations of the model, e.g. BACnet.

Goal: Published Standard in 2011

Further Information

- NIST Web portal: http://www.nist.gov/smartgrid
- ASHRAE SPC 201P http://spc201.ashraepcs.org/