U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Transactive Energy Management

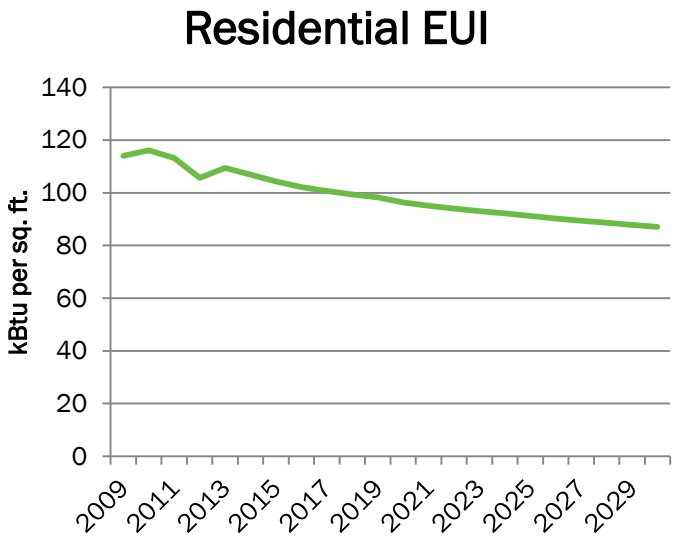
Sven Mumme, Technology Manager, Emerging Technologies

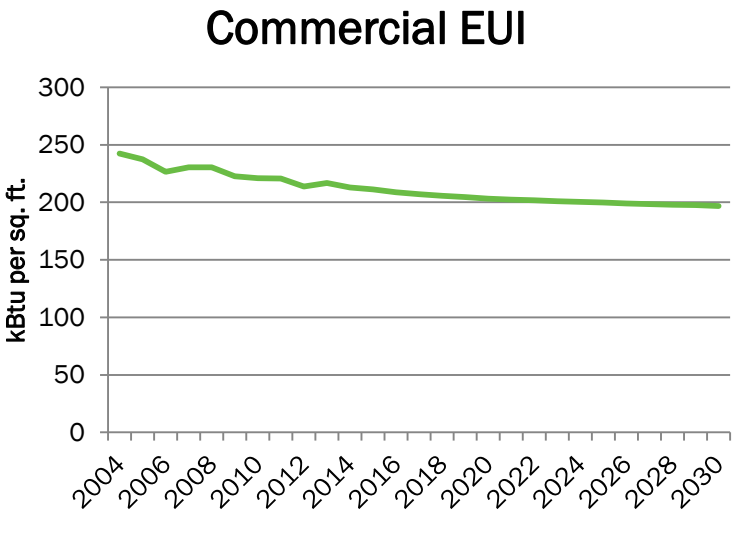
May 1, 2018

Transactive Field Validation Session Agenda

10:40-11:10	Introduction
11:10-11:40	PNNL Connected Homes Project
11:40-12:10	ORNL Connected Homes Task
12:10-12:40	ORNL Connected Neighborhoods Project
12:40-1:30	BREAK
1:30-2:00	PNNL Virtual Battery Project
2:00-2:30	ORNL Virtual Battery Characterization Task
2:30-3:30	PNNL Campus Project
3:30-4:00	BREAK
4:00-4:30	PNNL Transformer Project
4:30-500	Wrap-up with Reviewers

BTO Goal: Reduce Building Energy Use by 30% by 2030





2030 sector-wide goal: reduce energy use 30% per sq. ft.

Long term goal: reduce energy use 50% per sq. ft.

Metric: energy use intensity (EUI)

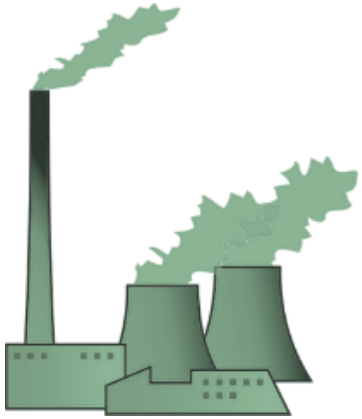
Baseline: 2010

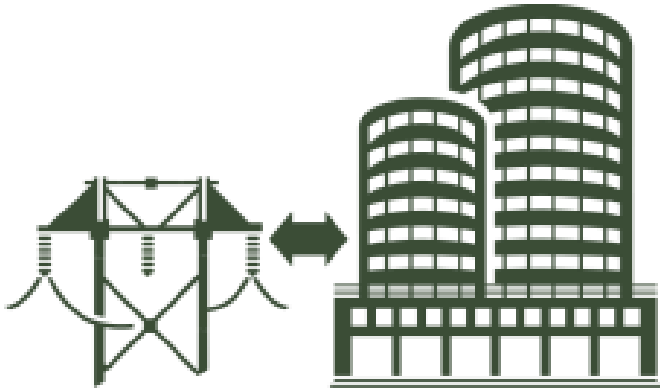
Rationale: allows comparisons across fuel types, building types, building sectors, end uses, that are more internationally relevant.

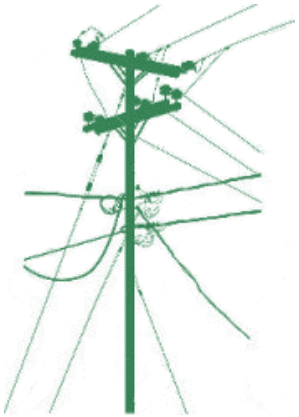
Grid-Interactive Efficient Buildings (GEB)

BTO is developing a new GEB strategy that will outline specific technical challenges and goals related to building-grid interaction.

- The concept of GEB is about the integration of energy efficiency and grid services recognizing that:
  - Building energy efficiency is an important grid resource,
  - Buildings can act as flexible, dispatchable grid resources,
  - The value of energy changes based on time and location, and
  - Buildings have a role in aggregating other DERs including electric vehicles (EVs), variable renewable energy (VRE) resources, and energy storage.
- Buildings are an underutilized resource when it comes to grid planning and operation.







Emerging Technologies

Goal

By 2030, develop cost-effective technologies capable of reducing a building's energy use per square foot by 45%, relative to 2010.

Strategy

- Use Scout to analyze building energy efficiency technology potential impacts
- Fund early-stage R&D through competitive solicitations and National Lab technical capabilities
- Work with DOE's Grid Modernization Lab Consortium (GMLC) as part of DOE's grid modernization activities

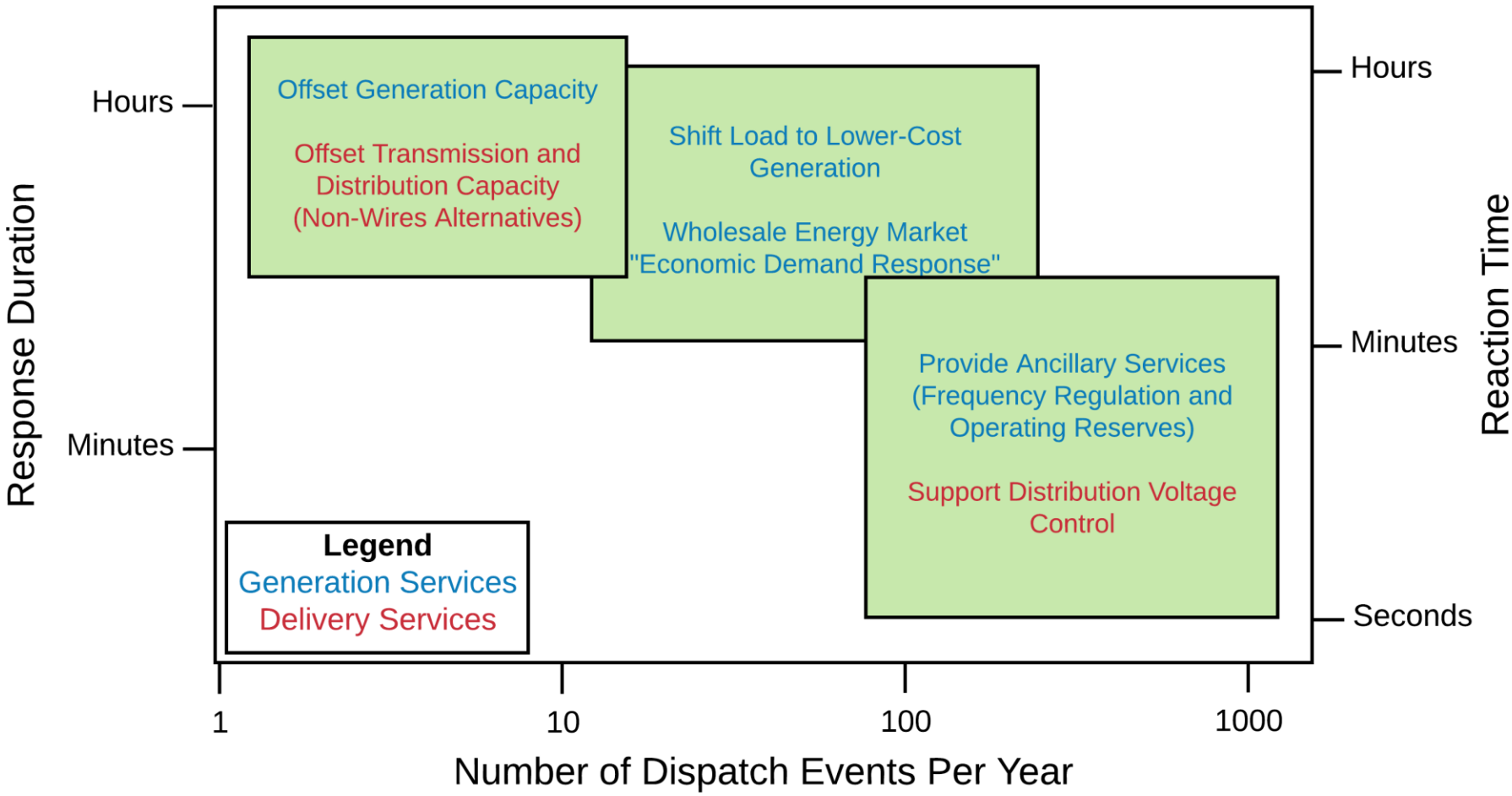
Technology Areas

What are grid services?

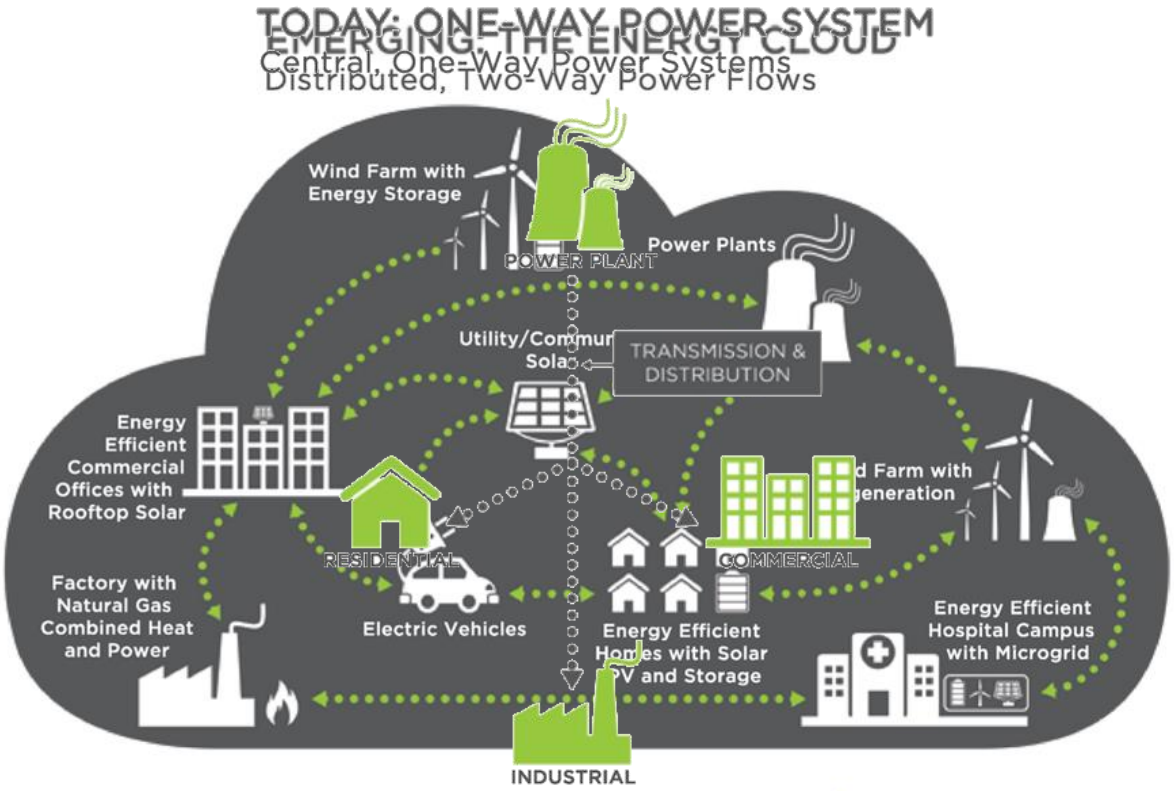
- **In the context of buildings, grid services are actions buildings can take in response to real-time grid conditions that provide value through avoided costs.**

- **Grid services can be subdivided into services that:**
  - Avoid **generation** costs by offsetting generation capacity investments, load-shifting to lower-cost generation, or providing ancillary services (frequency regulation and operating reserves)
  - Avoid **delivery** costs by offsetting transmission and distribution capacity investments, or supporting distribution-level voltage control

Different grid services have different technical requirements



Moving Towards the Grid of the Future

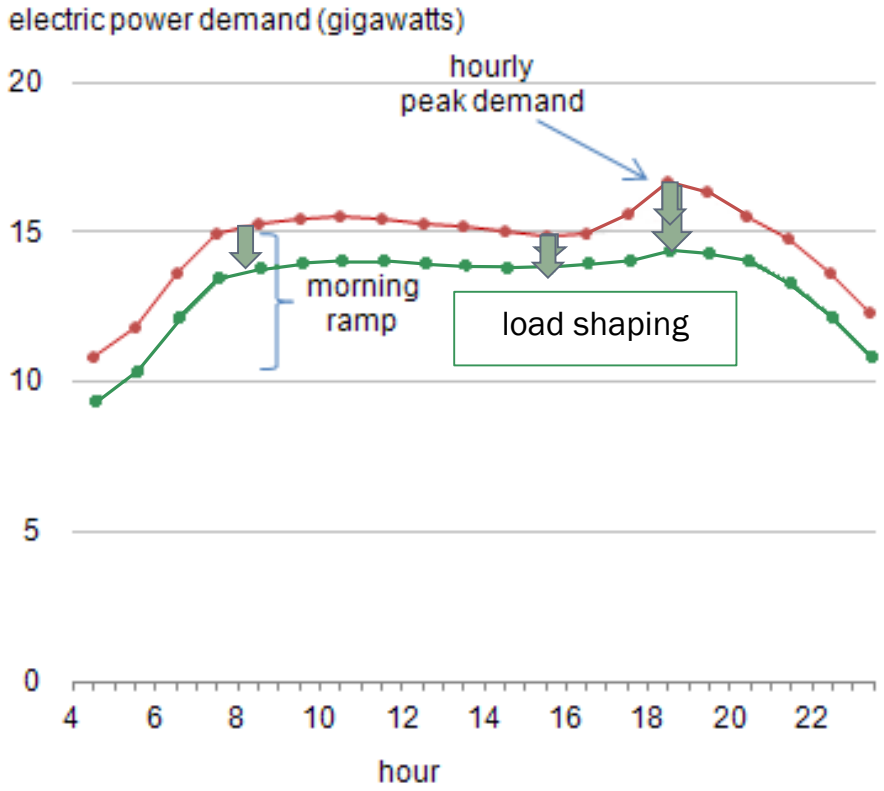


Source: Navigant

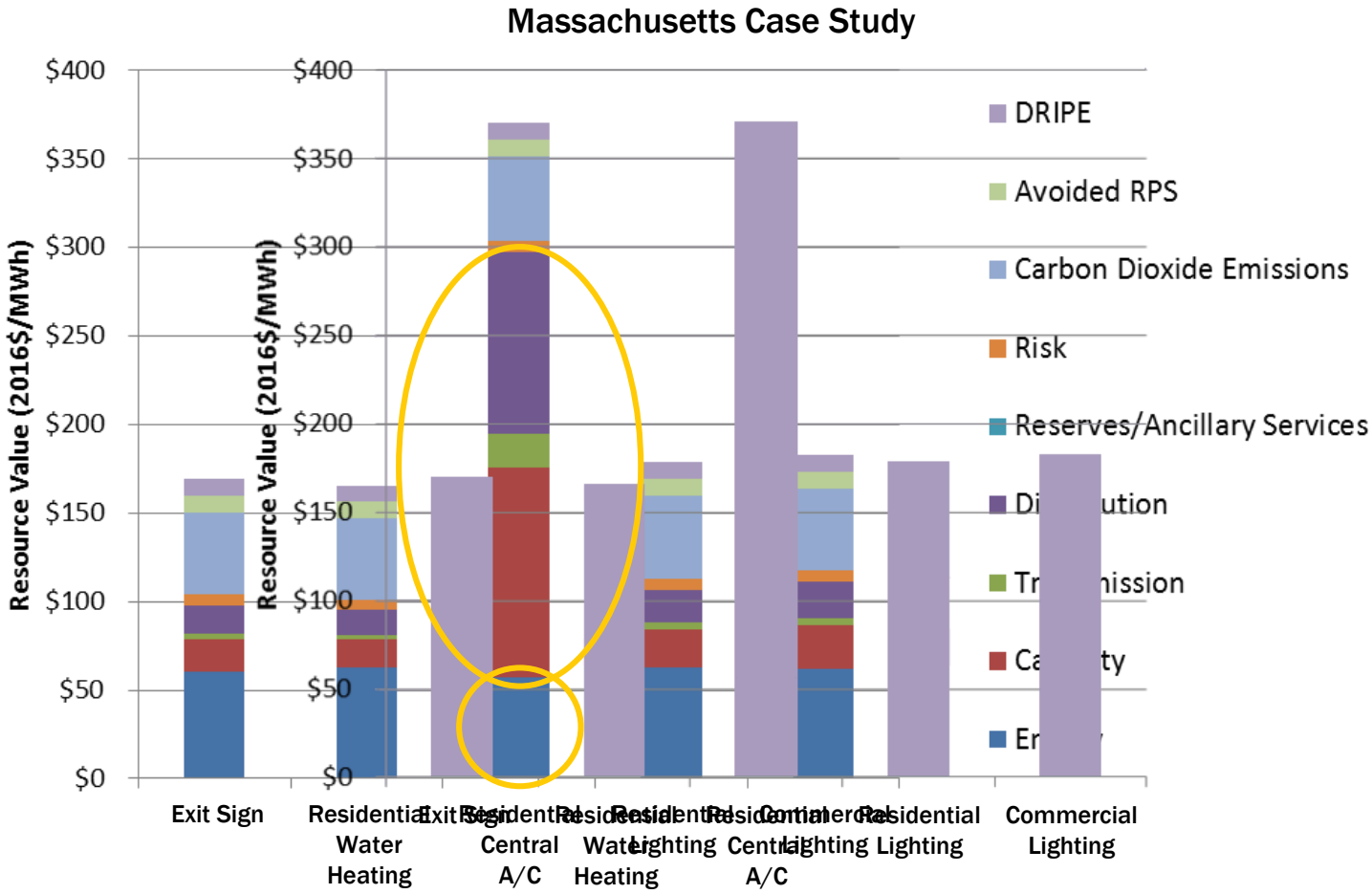
Energy Efficiency can be Key Responsive Grid Resource

Energy efficiency projects remove energy loads from the grid, reducing the energy supply required.

- Defers or eliminate investments in new electric generation capacity or the T&D system; and
- Reduces peak demand and the strain placed on existing T&D infrastructure.



Not All Energy Efficiency is Equally Valuable



Time-varying value of energy efficiency savings by load shape

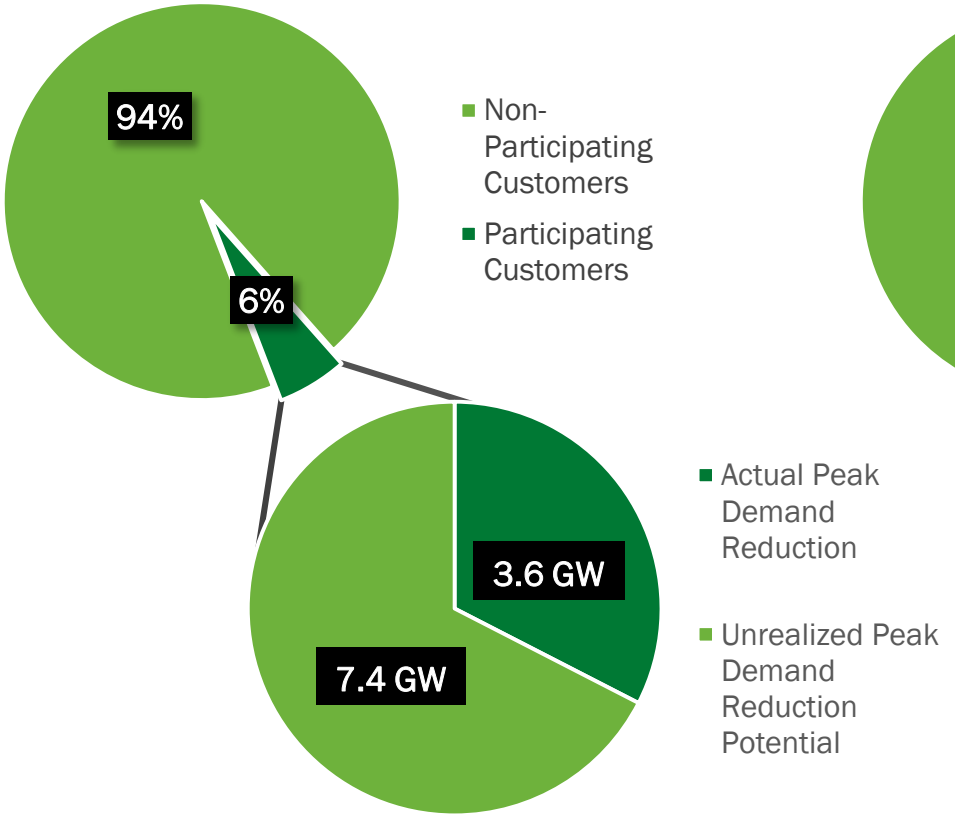
(reflects publicly available data only)

Source: ***Time-Varying Value of Electric Energy Efficiency*** *June 2017* N.Mims, T.Eckman & C.Goldman, LBNL, for BTO

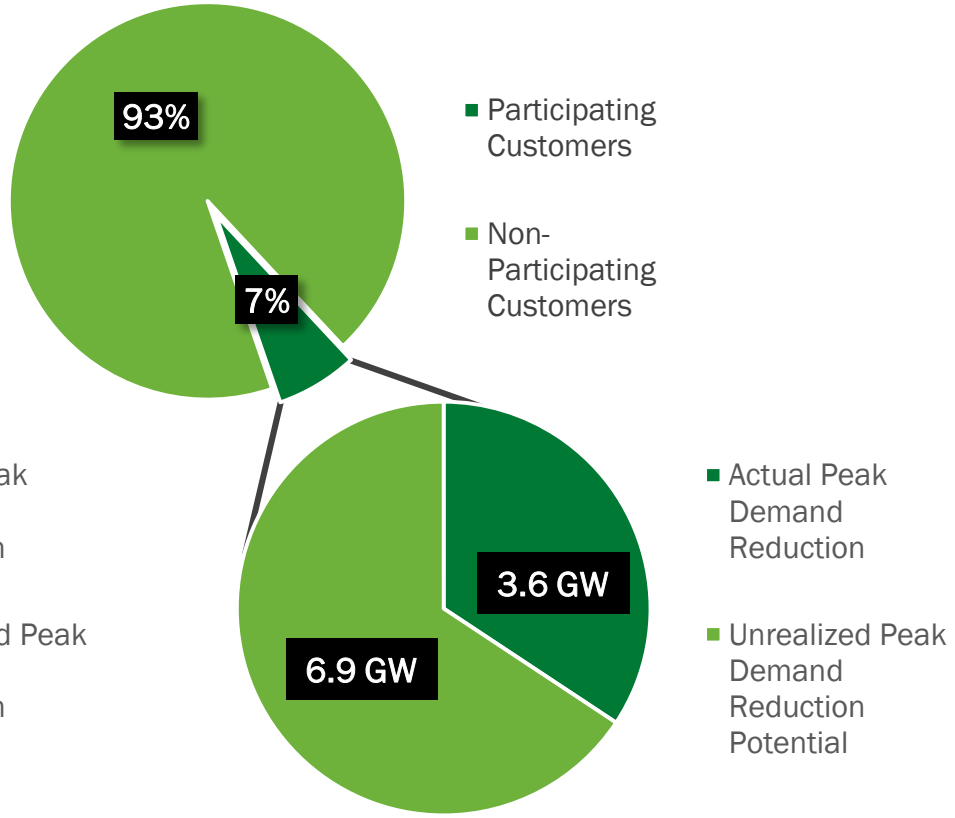
Today's Grid-Responsive Buildings

In 2009, FERC estimated 138 GW of *achievable* participation in grid demand response (DR) programs by residential, commercial, and industrial customers.

Commercial (2016)

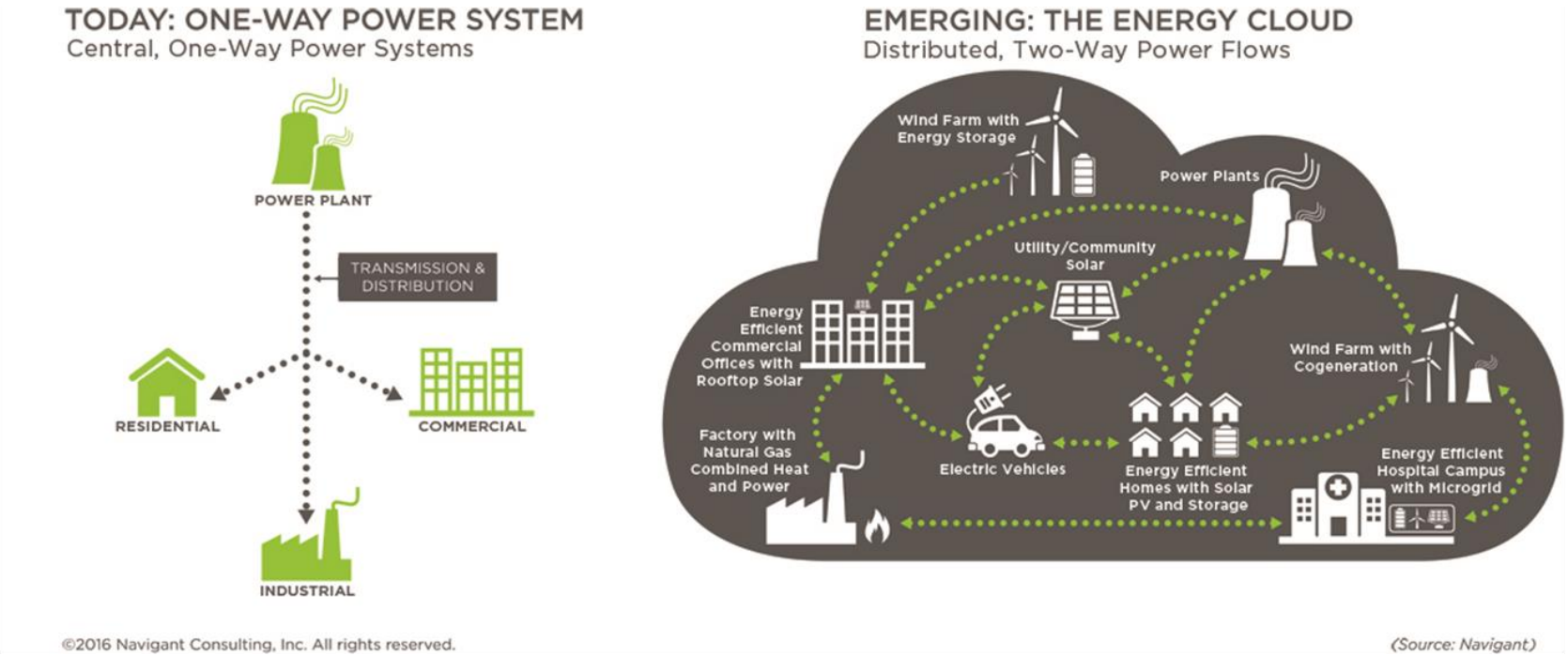


Residential (2016)



Source: U.S. Energy Information Administration, Electric Power Annual, Table 2.1, 10.8

Changing Energy System Means Changing How We Think About Buildings



- Large central dispatchable generation facilities
- Designed for one-way energy flow
- Rules-based and labor intensive operation of infrastructure by utilities
- Technologically inflexible
- Simple market structures and transactions
- Highly regulated with costs passed to rate base

- Renewable and distributed energy resources
- Multiple inputs and users, supporting two- way energy flows
- Digitalization of the electro-mechanical infrastructure (e.g., smart meters, internet of things, distribution automation) with near real-time condition monitoring
- Technologies are adaptable and scalable
- Supports dynamic market structures and transactional platforms
- Adaptive regulations for evolving mix of service providers and customers needs

Projects being reviewed today

PNNL Connected Homes Project – Nora Wang

ORNL Connected Homes Task – Helia Zandi

ORNL Connected Neighborhoods Project – Michael Starke

PNNL Virtual Battery Project – Di Wu

ORNL Virtual Battery Characterization Task – Jeff Munk

PNNL Campus Project – Srinivas Katipamula

PNNL Transformer Project – Jianming “Jamie” Lian & Klaehn Burkes

Sven Mumme

Technology Manager, Emerging Technologies
DOE Building Technologies Office
sven.mumme@ee.doe.gov