U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Grid-interactive Efficient Buildings Overview

Building Technologies Office, DOE

www.energy.gov/eere/buildings/geb

SERDP • ESTCP SYMPOSIUM

25 YEARS OF ESTCP

2019 | Enhancing DoD's Mission Effectiveness

US BTO approach

BTO invests in energy efficiency & related technologies that make homes and buildings more affordable and comfortable, and make the US (and beyond) more sustainable, secure and prosperous. Budget ~US$226M/year; activities include:

R&D

Pre-competitive, early-stage investment in next-generation technologies

Integration

Technology validation, field & lab testing, metrics, market integration

Codes & Standards

Whole building & equipment standards technical analysis, test procedures, regulations

Why focus on both energy efficiency and demand flexibility?

Continued electricity system reliability, resiliency & energy affordability needs

Increased focus on timing of energy use due to factors such as renewable generation and peak demand

Significant increase of connected and smart devices

Respond to innovations in the energy economy

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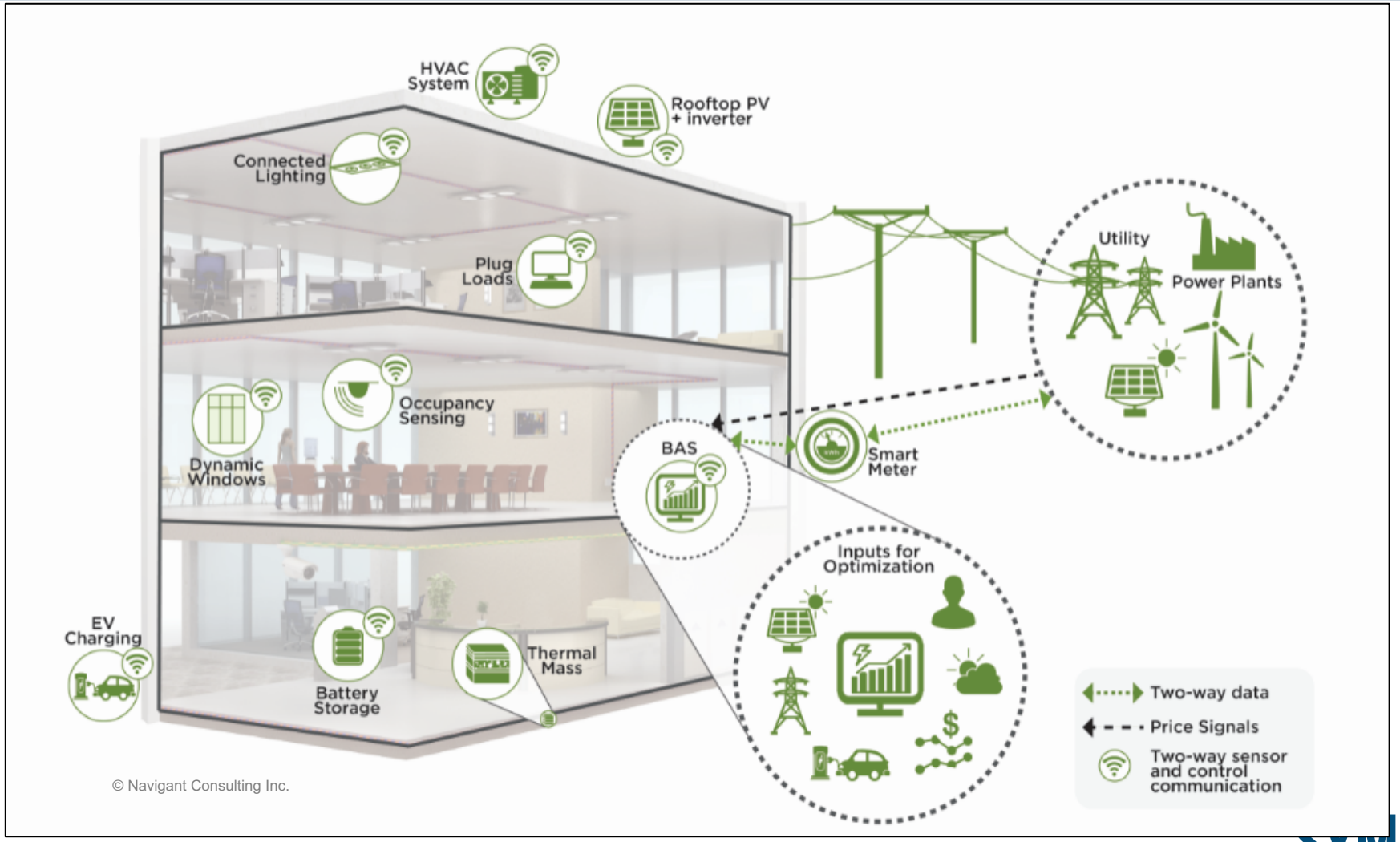
Grid-interactive Efficient Building Initiative



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Key Characteristics of GEBs

EFFICIENT

Persistent low energy use minimizes demand on grid resources and infrastructure

CONNECTED

Two-way communication with flexible technologies, the grid, and occupants

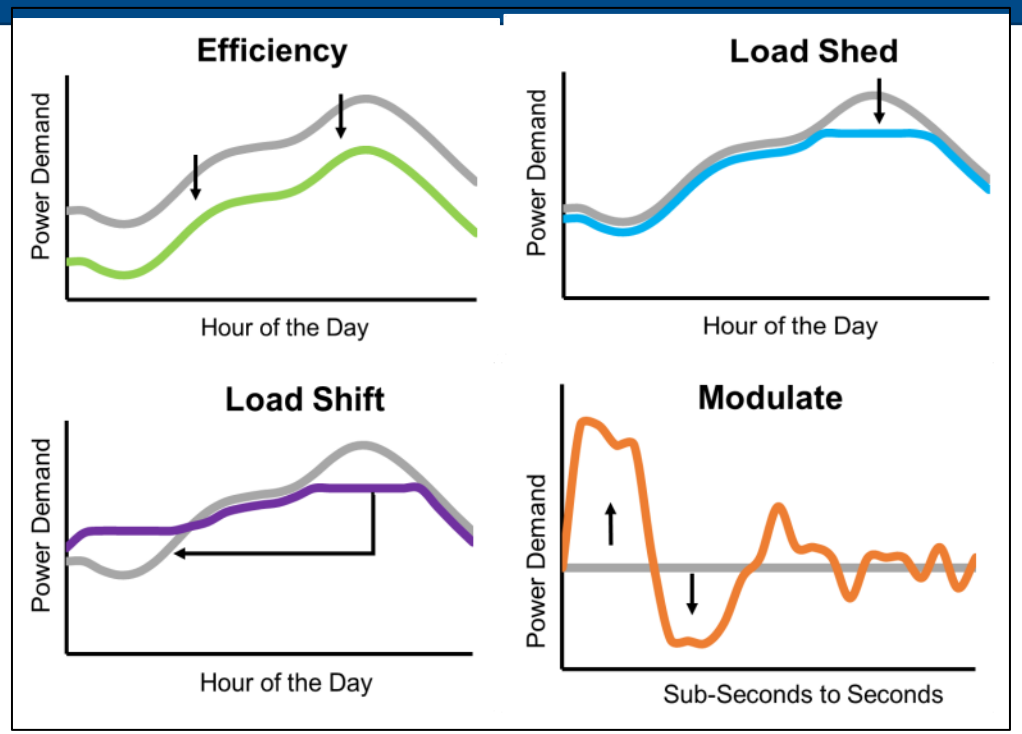
SMART

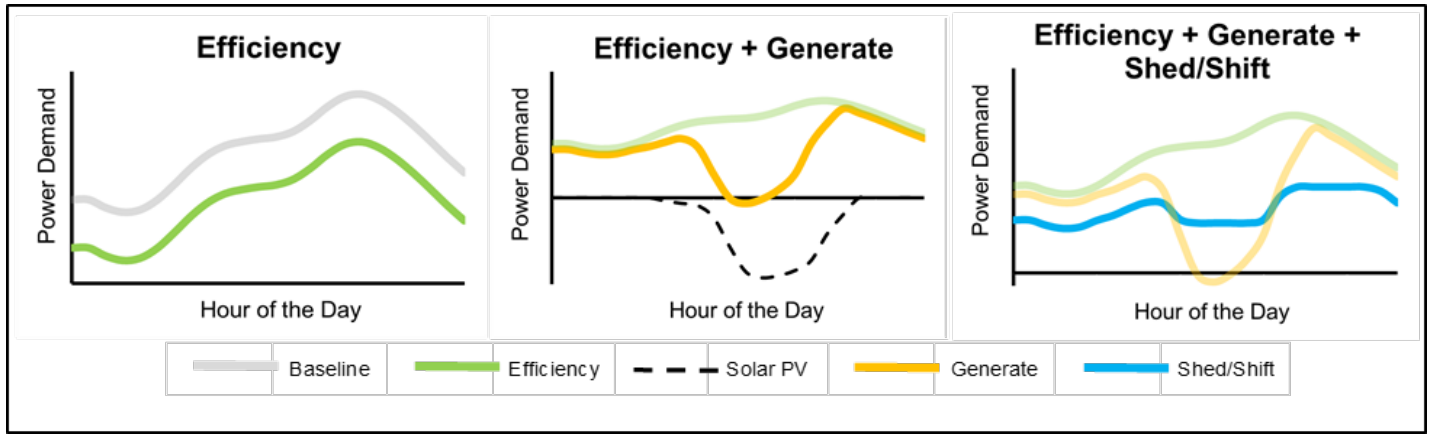
Analytics supported by sensors and controls co-optimize efficiency, flexibility, and occupant preferences

FLEXIBLE

Flexible loads and distributed generation/storage can be used to reduce, shift, or modulate energy use

Demand Flexibility Provided by GEB





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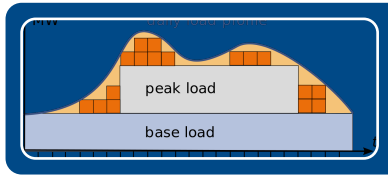
Potential Benefits of Flexible Building Loads

✓ Energy Affordability



✓ Improved reliability

✓ Reduced grid congestion

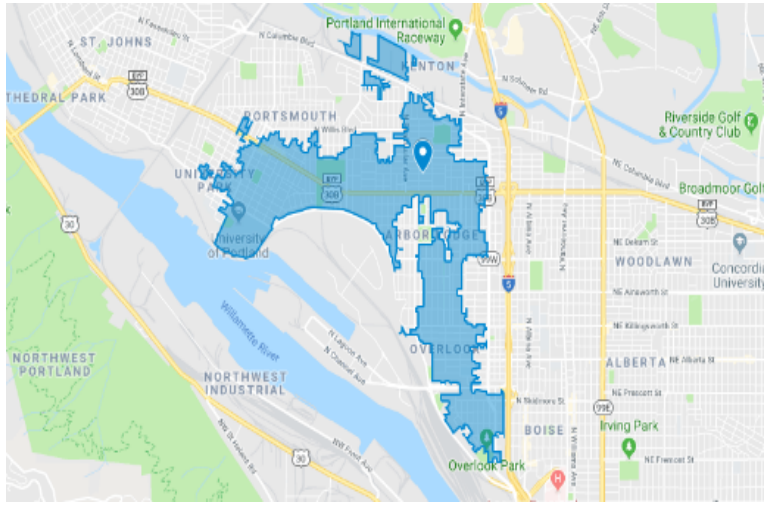
✓ Enhanced services

✓ Environmental benefits

✓ Customer choice

Example utility pilot #1: Portland General Electric Test Bed

- Demand flexibility during summer/winter peak events
- Identify coordination opportunities for co-deployment of energy efficiency and demand response
- Residential customers
  - T'stats, direct load control, heat pump water heaters, EV chargers, battery storage
  - Value propositions
  - Peak time rebate
- Small and medium businesses
  - Direct installation of smart thermostats
  - Plans to add EV charging and storage
  - Coordinating with Energy Trust of Oregon on efficiency and solar incentives

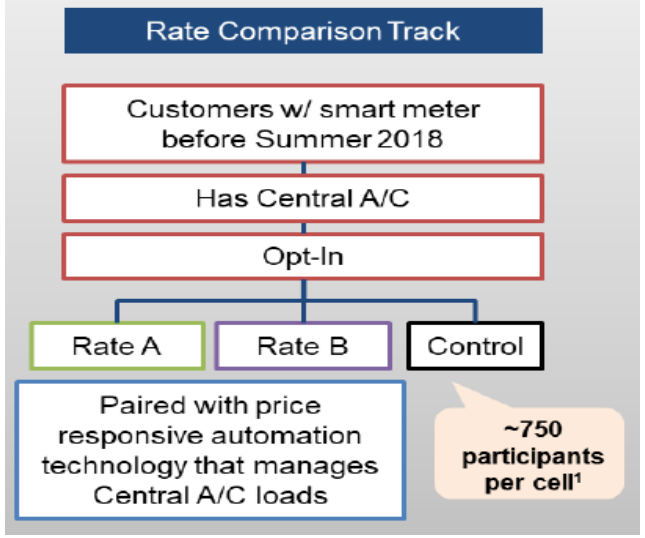


- Focusing on neighborhoods served by 3 distribution substations
- Targeting 69 MW in summer and 77 MW in winter to fill a 2021 capacity gap identified in Integrated Resource Plan

https://www.portlandgeneral.com/our-company/energy-strategy/smart-grid/smart-grid-test-bed
https://edocs.puc.state.or.us/efdocs/UAA/uaa173123.pdf
https://www.portlandgeneral.com/-/media/public/documents/rate-schedules/sched_013.pdf

Example utility pilot project #2: ConEd and Orange & Rockland utilities Smart Home Rate

- **The Smart Home Rate, is examining how tariff rate structures can use demand flexibility to optimize value for customers and grid services.**
- Control platform automatically manages devices based on dynamic pricing signals
  - New rate: $/kWh tied to day-ahead hourly wholesale rate, daily kW charge, and peak events



- **Track 1: Optimize and automate CAC loads using smart thermostats**
  - Customer can participate in 1 or 2 rates:
    - Demand charges for Rate I are based on the customer's peak demand during each day's designated peak period.
    - Rate II participants "subscribe" for a specified number of kilowatts and are charged an overage rate for any incremental demand during the event period
- **Track 2: Optimize and automate solar energy using batteries**
  - These participants may take part only in Rate I, but are eligible for a number of credits for exporting power to the grid during events.

BTO's grid-interactive efficient buildings portfolio

VALUATION

How do *time & the interaction of flexibility options* impact value?

Identify values to stakeholders, quantification of national value.

TECHNOLOGY OPTIONS

Which end use technologies provide solutions to specific grid needs?

Prioritize technologies / solutions based on grid services.

OPTIMIZATION

How to maintain or improve services while optimizing for flexibility?

Solutions that meet grid operator & building occupant needs.

VALIDATION

Do technologies perform as predicted and meet grid & occupant needs?

Verification of technologies / strategies, increasing confidence in the value of energy flexibility.

Buildings to Grid Working Group

- Better Buildings Alliance Renewables Integration Team

- **Focus areas: Optimizing demand management for building portfolios**
  - Strategic integration of renewables
  - Energy storage
  - Building load flexibility
  - Grid coordination
  - Business models and procurement options

- **Time Commitment:**
  - Bimonthly
  - 1-hour conference calls

- Will be performing analysis across two diverse portfolios to better understand load flexibility potential

Technology Characterization & Options

GEB Technical Report Series:

- Overview
- Heating, Ventilation, & Air Conditioning (HVAC); Water Heating; and Appliances
- Lighting & Electronics
- Building Envelope & Windows
- Sensors & Controls, Data Analytics, and Modeling

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1 Establish Frameworks

- Defines grid-interactive efficient buildings and demand flexibility
- Establishes potential grid services and some basic requirements for buildings to provide needed flexibility

2 Assess Flexibility Potential

- Evaluate state-of-the-art and emerging building technologies that have the potential to provide grid services
- Considers implementation attributes

3 Discuss Research Opportunities

- Identify major research challenges of technologies with significant potential for grid benefits and opportunities for additional technology-specific research and development.

Questions & Challenges

- How do grid-interactive efficient buildings fit into broader renewables integration and grid modernization?
- What are the top priority benefits that buildings provide the grid?
- How critical are better
  - Technologies? Analytics? Policies & programs?
- What are key barriers to adoption of advanced controls, technologies, practices?
  - Making the case? Complexity? Cybersecurity concerns?
- Will efficiency get its 'fair share'?
- Is this a 'bridge too far' (at least today) for buildings, utilities, utility regulators, governments?
- How to best work with other national, state governments

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