Efficient, Decarbonized Buildings: Context and Controls

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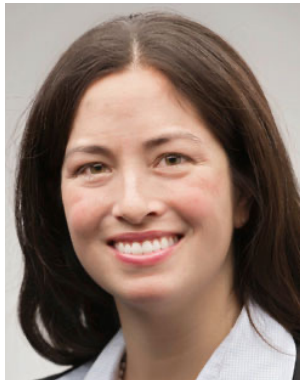

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Federal actions relevant to DERs in states

1. Infrastructure Investment and Jobs Act (2021):
   - Charging infrastructure
   - Electric vehicles
   - Grants to states (formula and discretionary)
   - Specific provisions on smart grid, integration of distributed energy resources
   - Explicit TA/partnership with state/local governments, regulators, planners

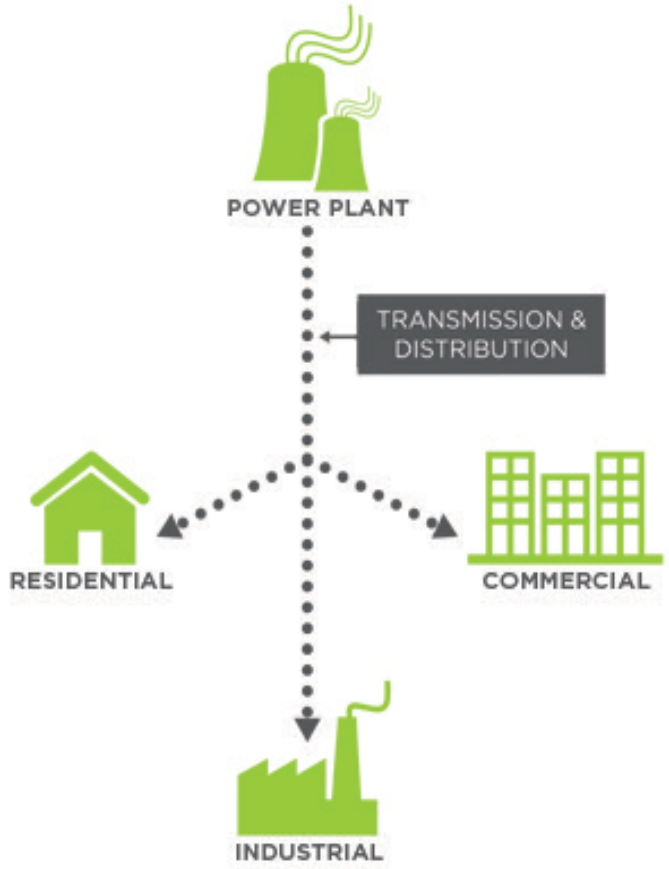
2. Inflation Reduction Act (2022)
   - Many provisions target disadvantaged communities
   - Tax credits: heat pumps, electric vehicles, U.S. clean energy manufacturing, batteries, wind, solar cells
   - Environmental justice: remediate pollution, improve resilience, reduce emissions
   - National Green Bank: ongoing public/private loans for clean projects

3. Connected Communities: vision, success criteria, summary of projects

Moving toward the grid of the future

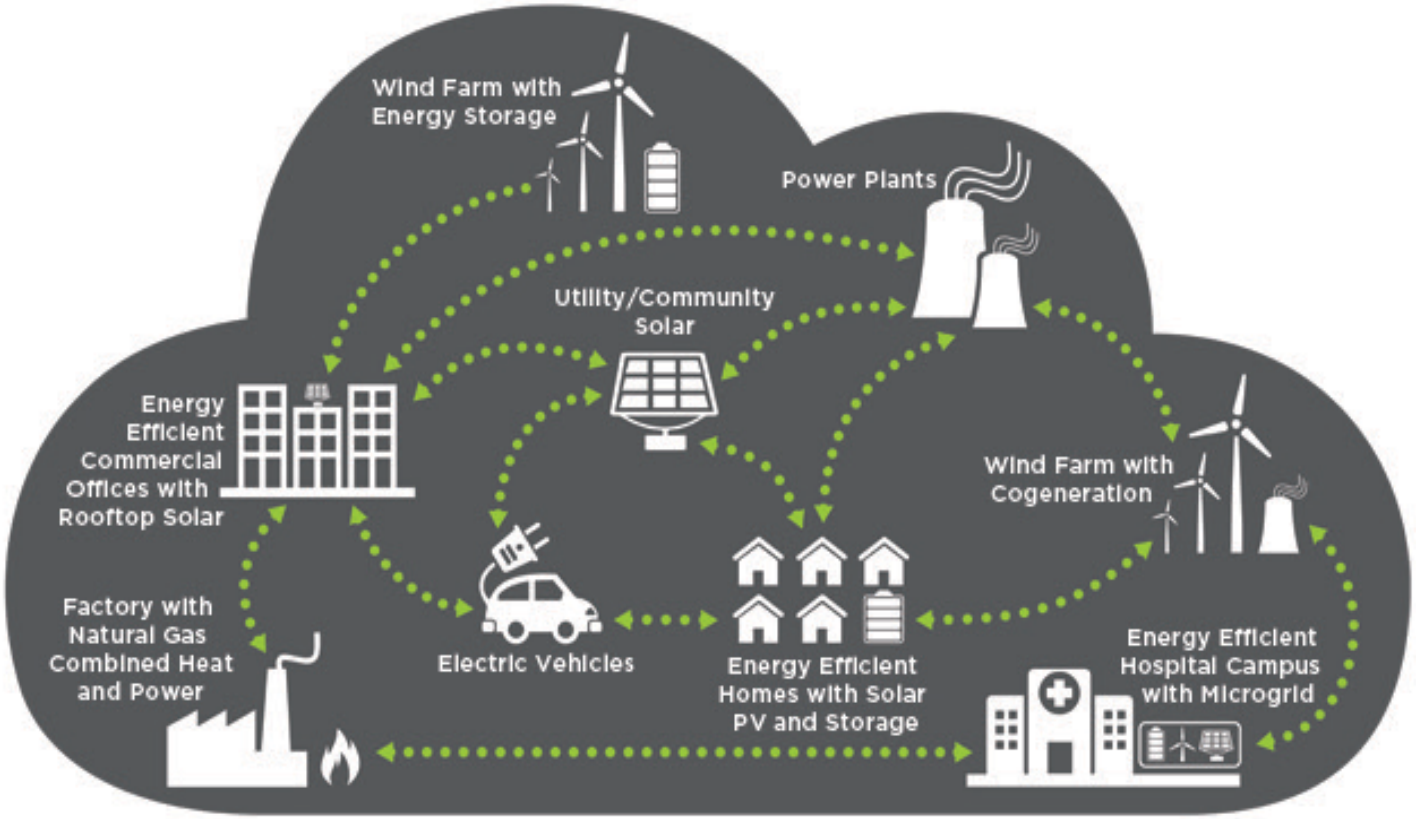
TODAY: ONE-WAY POWER SYSTEM

Central, One-Way Power Systems



EMERGING: THE ENERGY CLOUD

Distributed, Two-Way Power Flows



(Source: Navigant)

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

Grid-Edge Decarbonization

(Goal to enable 24x7 carbon free)

Connected Communities

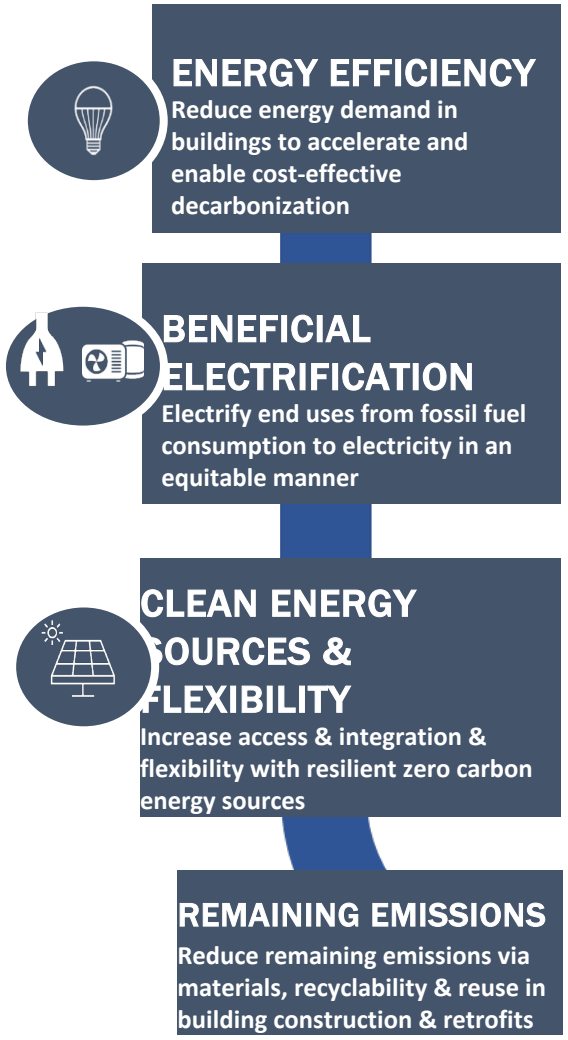
The demonstration work will focus on grid integration at the edge of the grid that enables decarbonization and demand flexibility from buildings

Grid-Efficient Buildings

The GEB initiative will continue with a focus on research oriented to understand value of EE and Building technologies to the grid

Key Pillars to Drive Building Decarbonization

These key pillars and objectives address all core principles of deep decarbonization but with varying levels of emphasis within DOE EERE's role in the buildings sector.



1. **REDUCE DEMAND.** *Energy efficiency is core to the strategy - **first reduce energy demand**, especially via building envelope upgrades, to help lessen risk to the pace of grid decarbonization and enable more cost-effective building decarbonization*

2. **ELECTRIFY END USES.** ***Replace equipment with all-electric / low voltage options** at typical turnover cycle. Focus electrification efforts where beneficial today. (Benefits will increase as the electric grid becomes cleaner).*

3. **INTEGRATE & FLEX.** ***Enable building integration and flexibility** with clean energy sources (e.g., building PV, utility-scale PV and wind), electric vehicles, energy storage, and make grid-interactive.*

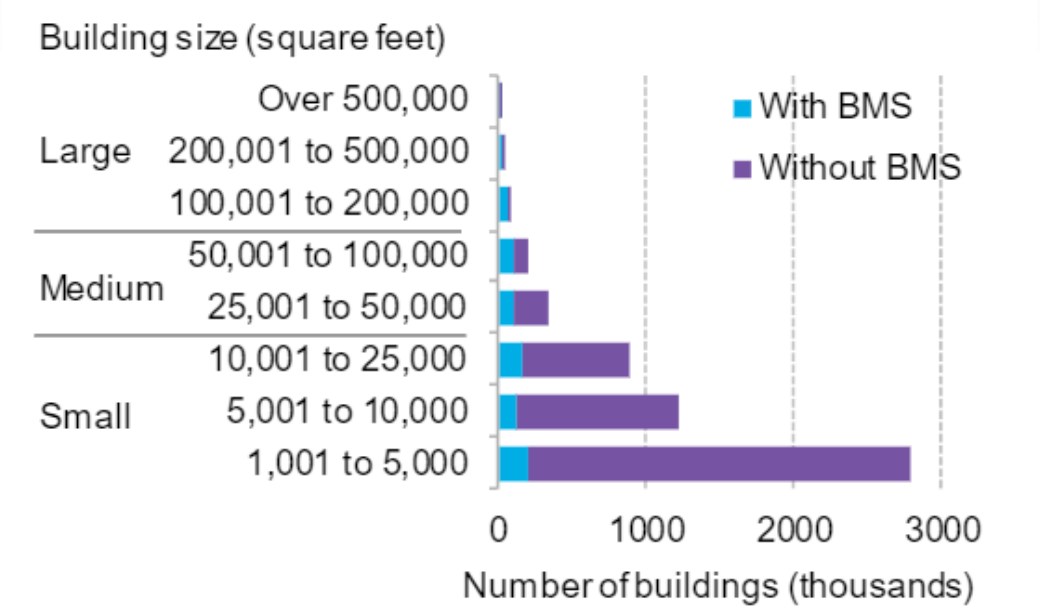
4. **ADDRESS REMAINING EMISSIONS.** *Identify the biggest opportunities for reducing remaining emissions and the best federal role in the mid- to long-term*

Building Controls

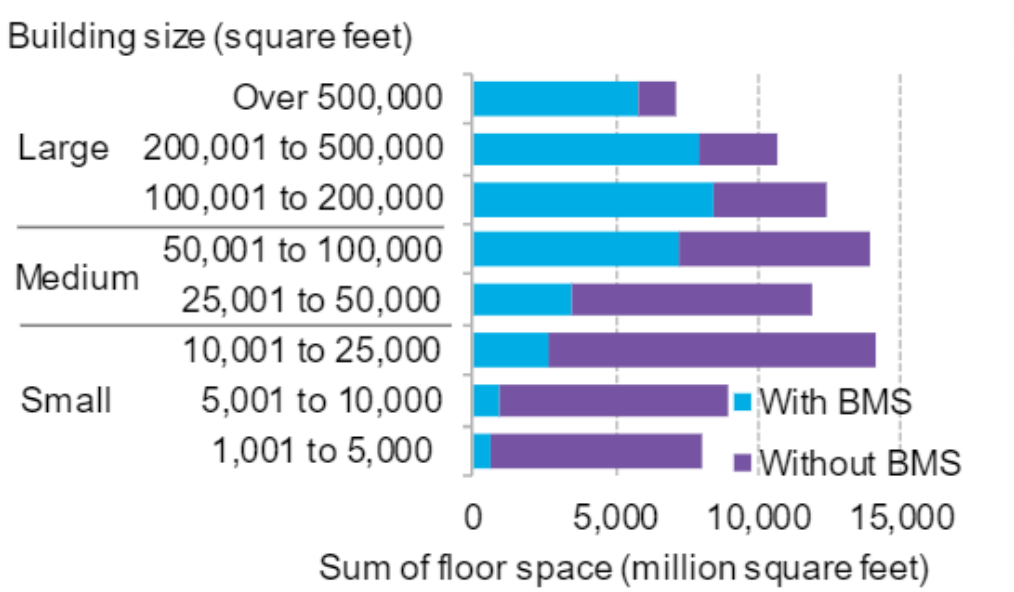
Focus on Small and Medium Commercial Buildings

Small & medium commercial buildings: <100k sq.ft.

- **Comprise 97% total commercial building stock**
- Only 26% of small **& medium** commercial building floor space have BAS/BMS



Number of U.S. commercial buildings with BMS by building size, 2012



U.S. commercial floor space with BMS by building size, 2012

Source: EIA data, published by BNEF

Supervisory controls pose barriers to adoption

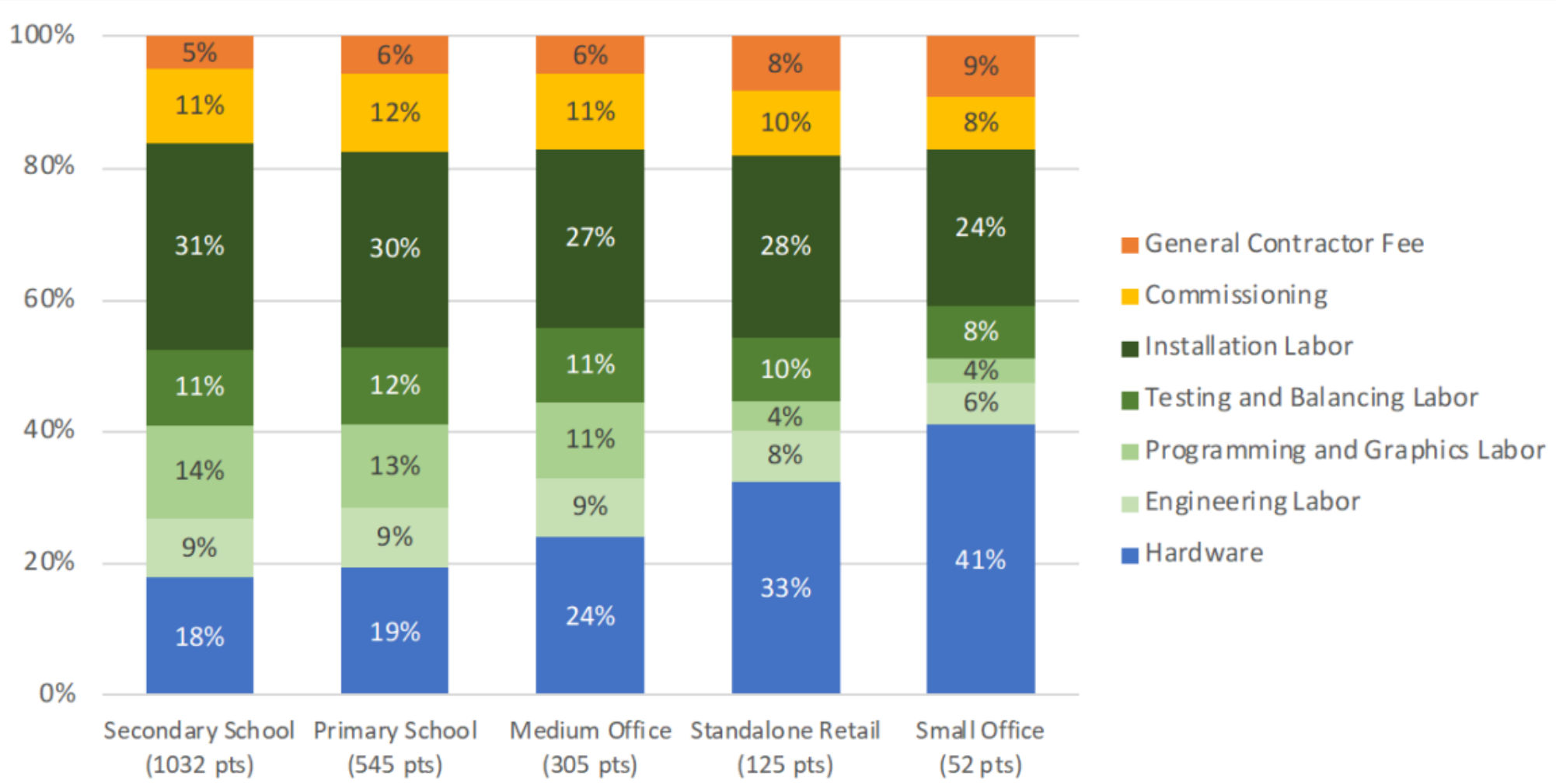
Supervisory controls have been around for decades and save a lot of energy.

Why isn't every building using them?

Limited adoption (14% of commercial overall, 26% of small and medium commercial building floor space (≤100k sq.ft.)

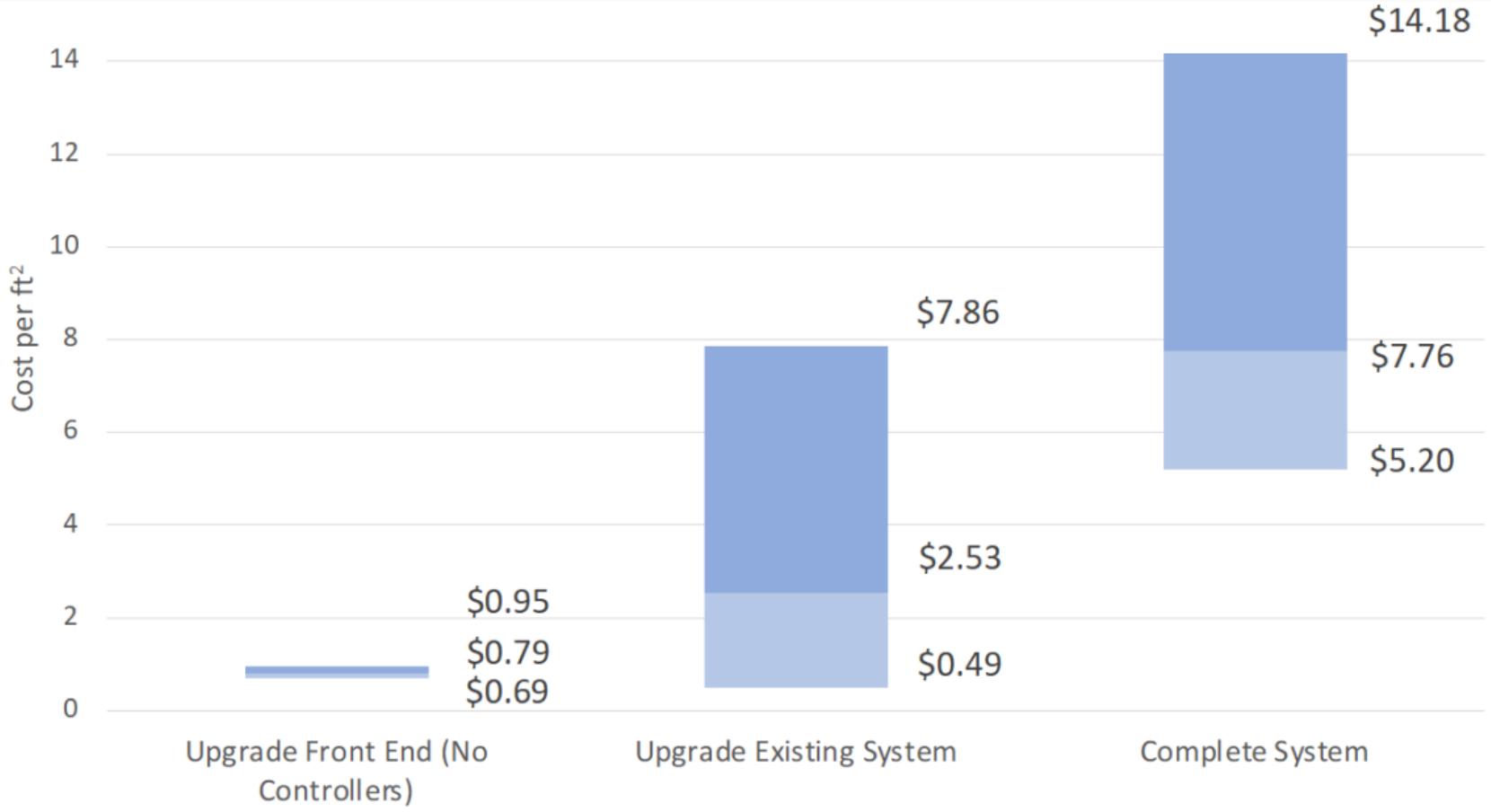
Labor, especially commissioning + installation, drives control costs

- Hardware costs benefit more from scale
- Major focus: Reducing complexity, barriers to installation
- Example 1: embedding controls in field devices, at the edge
- Example 2: improving interoperability



What does it mean to bring demand flexibility to buildings?

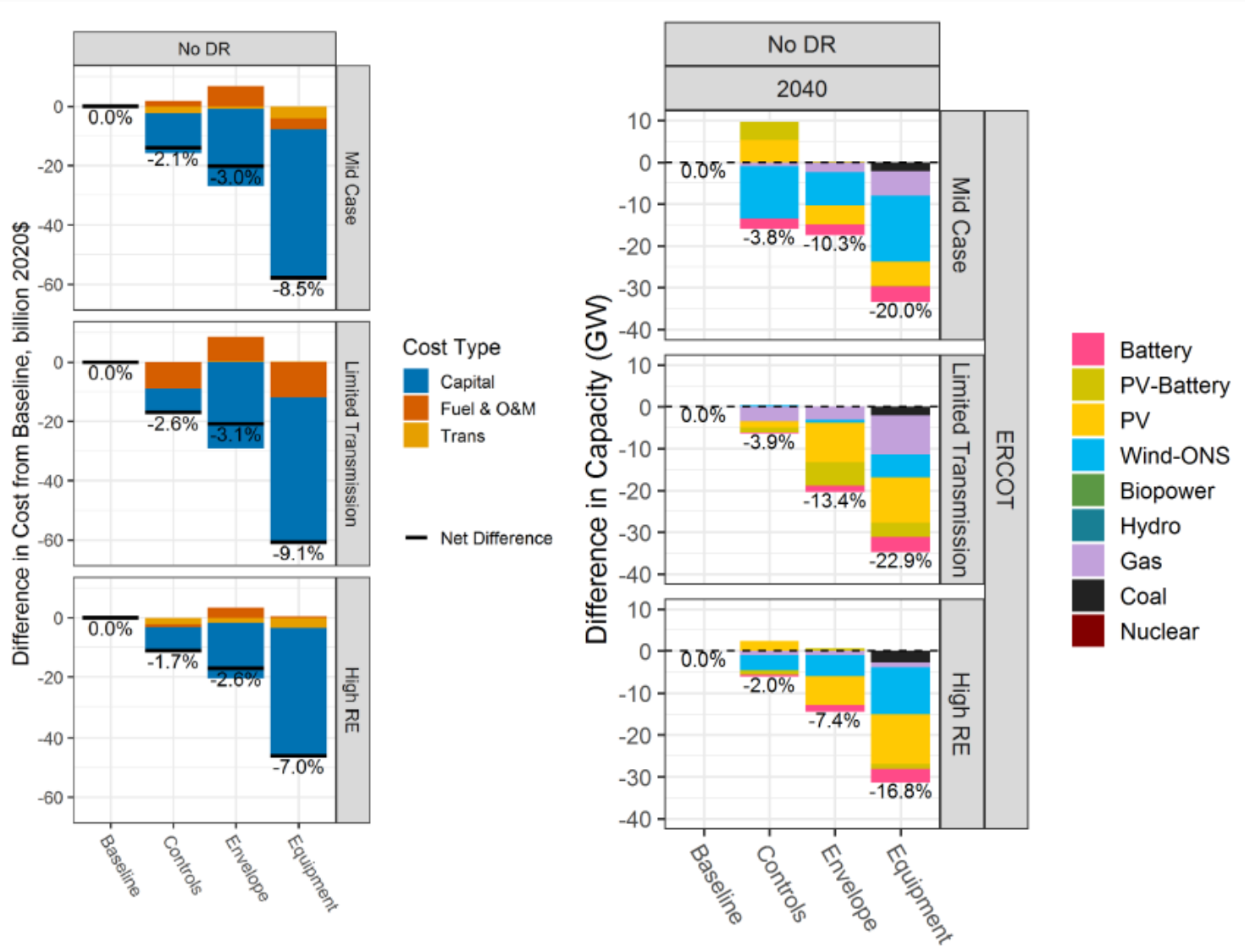
- Potentially higher first costs + quicker payoff
- Limited off-the-shelf options
- Case study: 8-building campus
- 5-month payback
- Does grid flexibility play well with energy contracting based on efficiency?



Energy efficiency reduces costs on bills and capacity

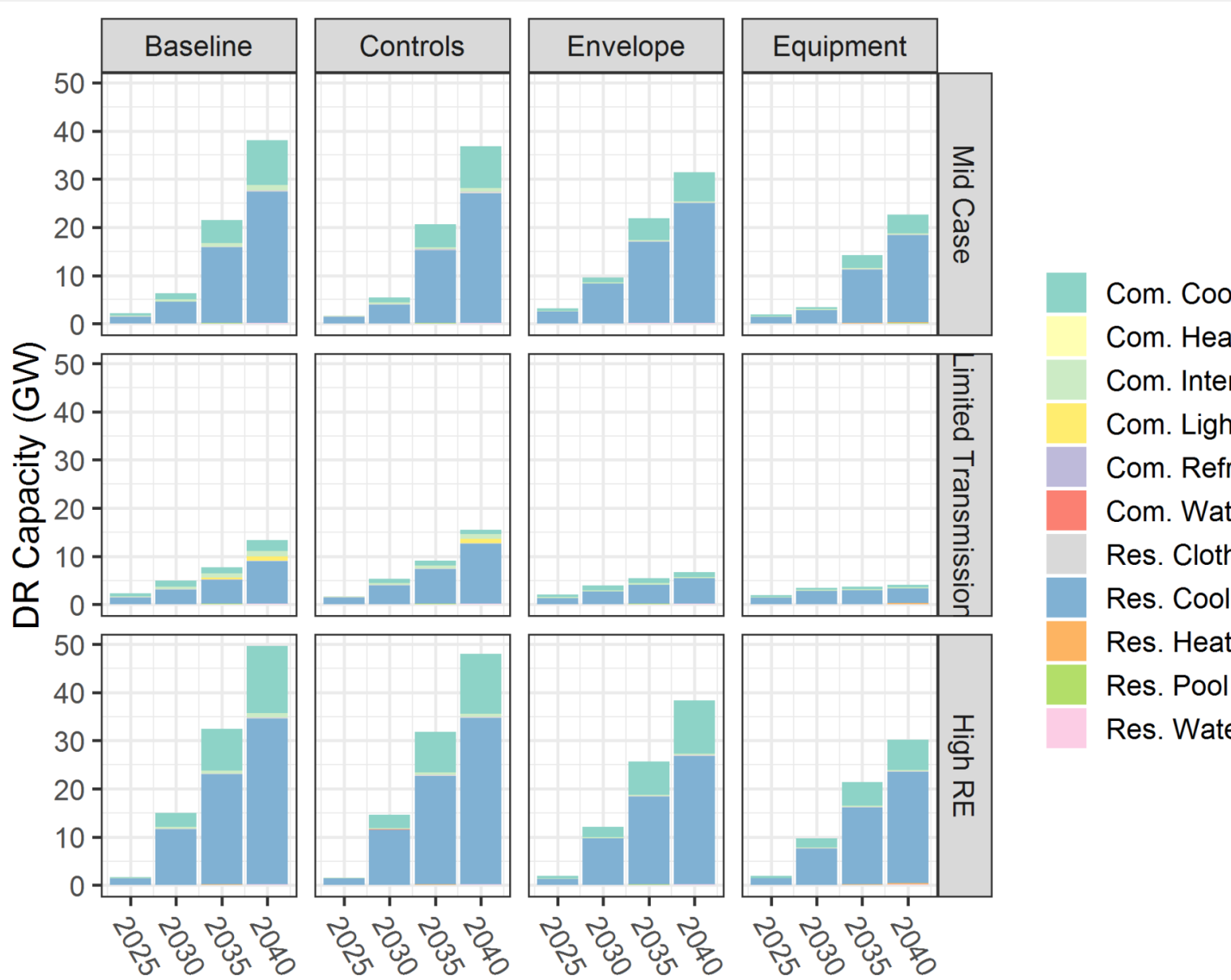
- Energy efficiency measures (controls, envelope, equipment upgrades) all decrease costs
- Cost savings mostly driven by load reduction
- Savings also influenced by grid costs
- Valuable to utilities to postpone new generation or storage, or to accelerate retirements
- EE is most valuable when moving power is hard (e.g. high transmission costs)

https://emp.lbl.gov/publications/assessing-interactive-impacts-energy



During most DR events, shedding comes from cooling

- EE reduces peak demand, decreases supply and need for shed DR
- Residential and commercial cooling drive summer peaks



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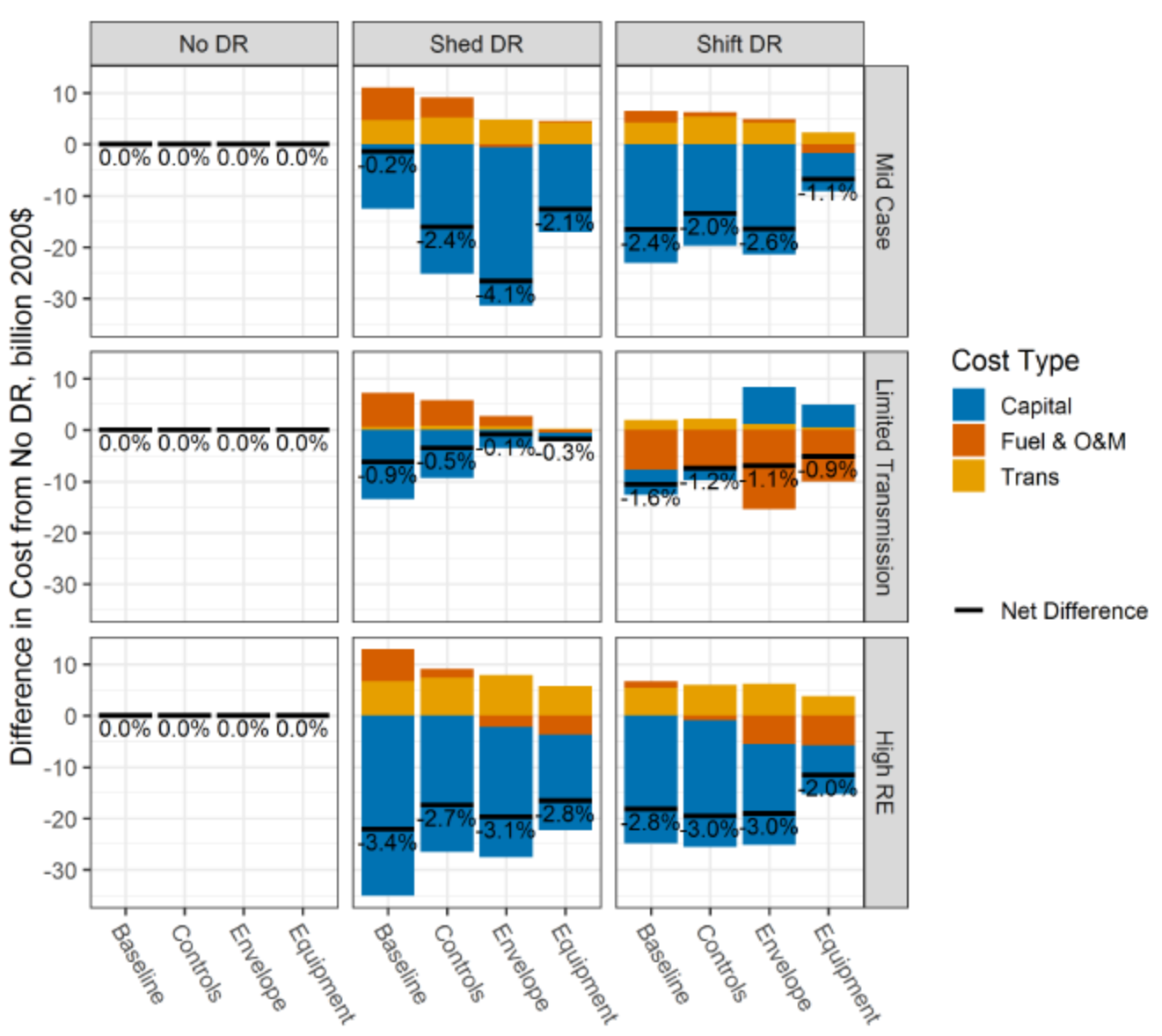
Even when DR competes with EE, we expect it to pay off

- Competition arises because EE reduces the availability of DR resources
- EE and shifting DR tend to compete in isolation. Under mid case: EE enhances shed DR value
- Except when transmission is limited, all DR works well with envelope upgrades



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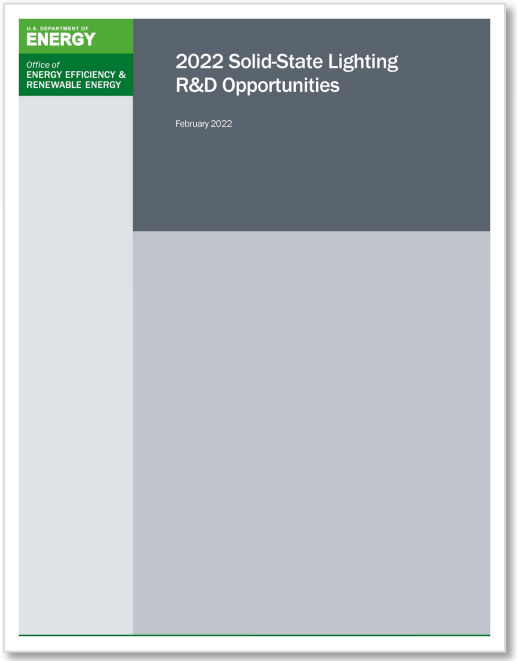
DOE's planning process offers many opportunities to engage

Community input from stakeholders shape questions, priorities, and solicitations



DOE targets push industry to levels of efficacy and performance that might not otherwise be achieved.

Analysis of emerging products prompts improvements, informs R&D priorities.