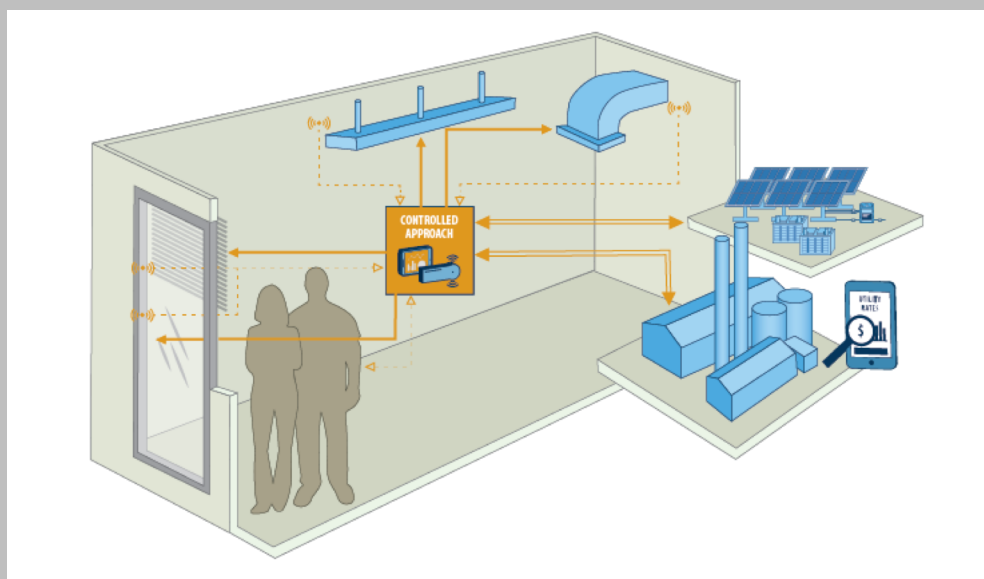


System Retrofits in Efficiency Programs: Track Record and Outlook



Webinar 8-12-20

<https://buildings.lbl.gov/cbs/getting-beyond-widgets-enabling-utility-incentive>

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Please enter questions via chat

Please make sure to keep your line muted

Challenge

The opportunity:

System retrofits can provide 50%+ additional whole building energy savings in existing buildings over 'widget' retrofits.

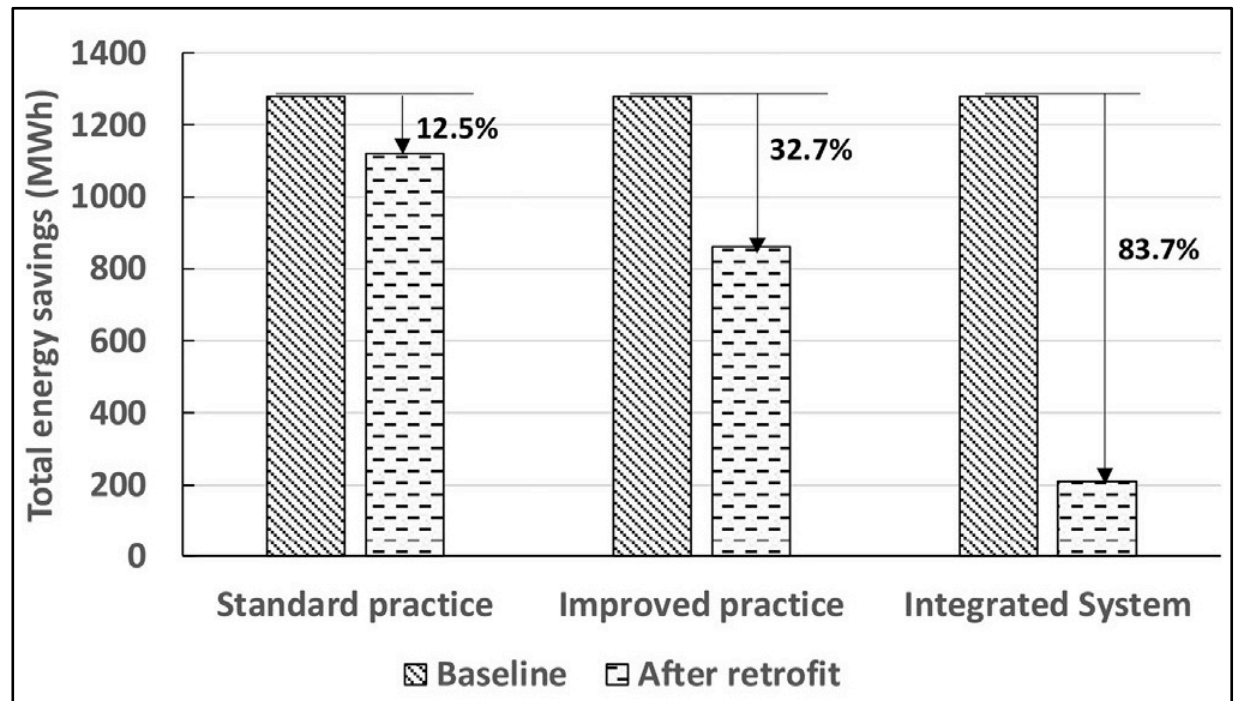


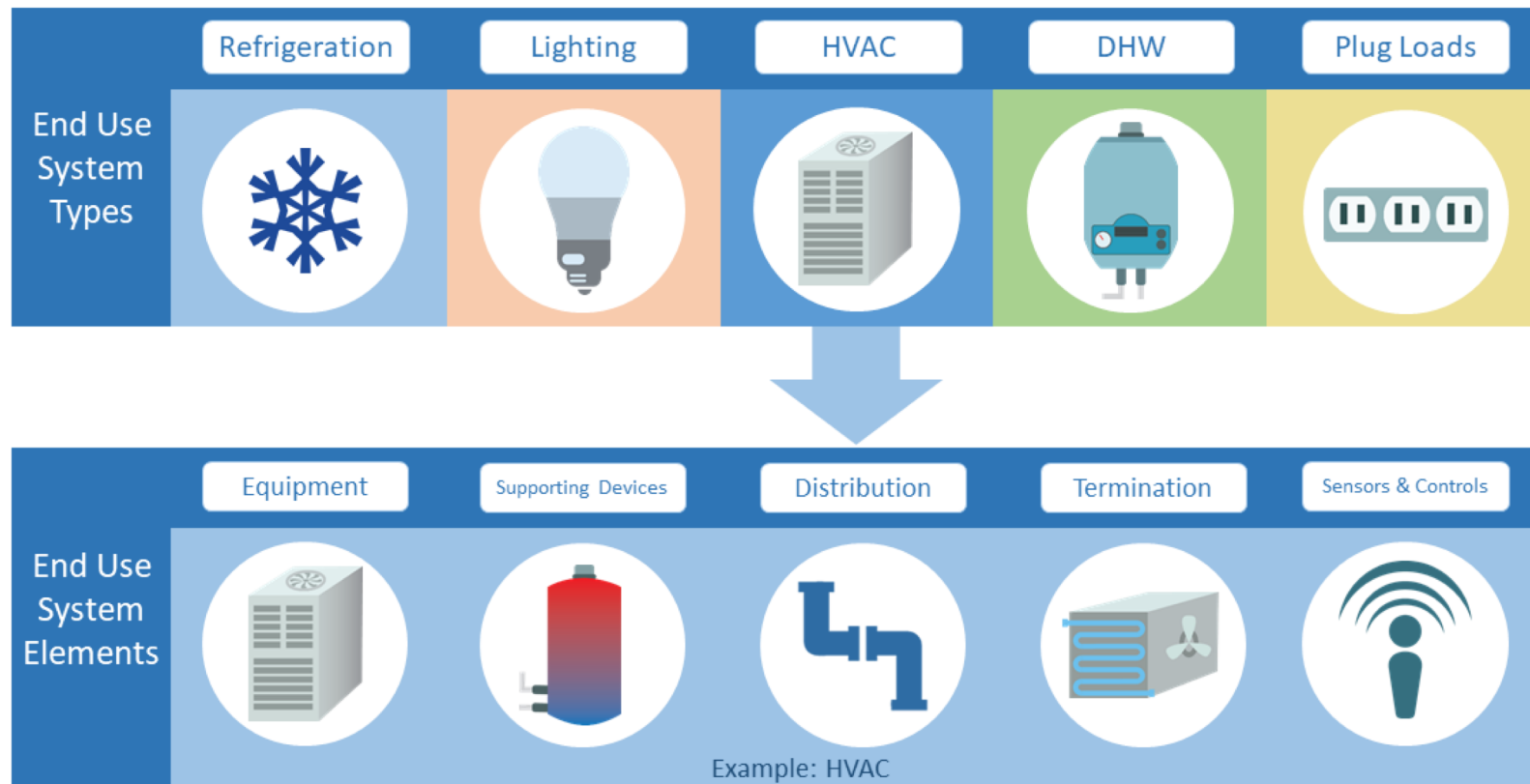
Figure – Regnier et al, Energy and Buildings, 2017 (Regnier et al, 2017)

However, **barriers exist:**

- Systems are inherently more complex and disruptive; need simplified approaches to access savings, understand interactions
- Lack of industry awareness of how systems provide deeper savings, about the state of systems deployment in industry, and the R&D needed to increase uptake

What is a System?

“A building system is a combination of equipment, operations, controls, accessories and means of interconnection that use energy to perform a specific function.” (ASE, 2016, 2017)



Industry System Retrofit Study – System Definitions

1 End Use Systems:

Consist of equipment, supporting devices, distribution, termination and sensors/controls

- e.g. HVAC, lighting, DHW etc.

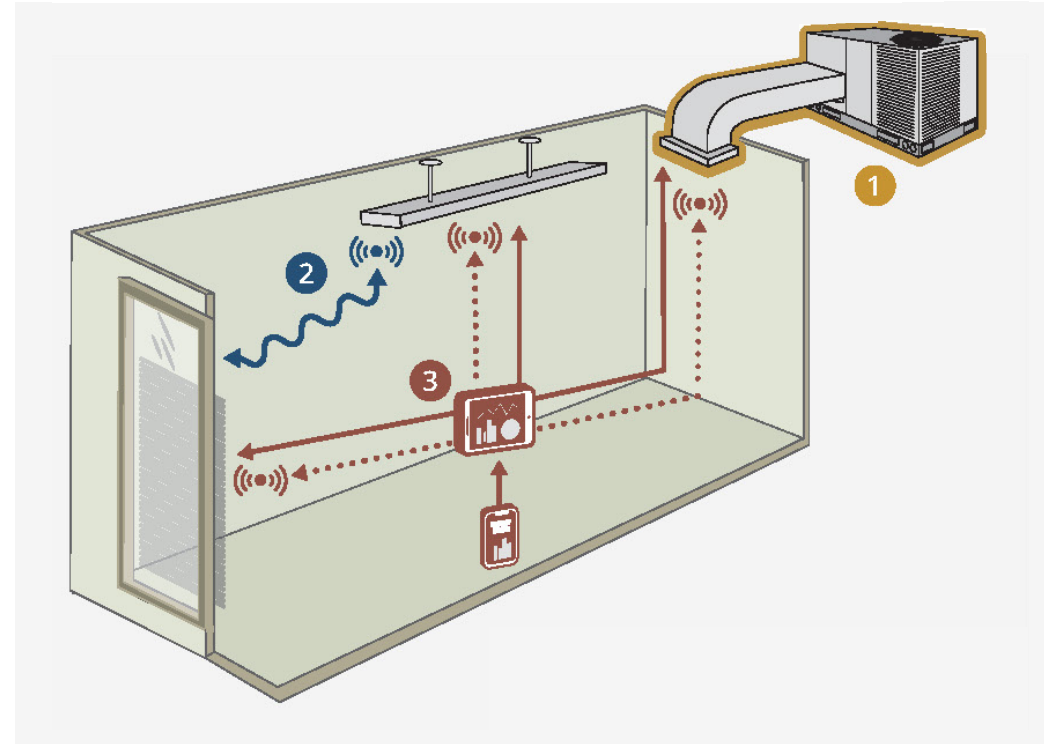
2 Interactive Systems:

- No physical communications link between end use systems
- One system responds to behavior of another via impacts to the space

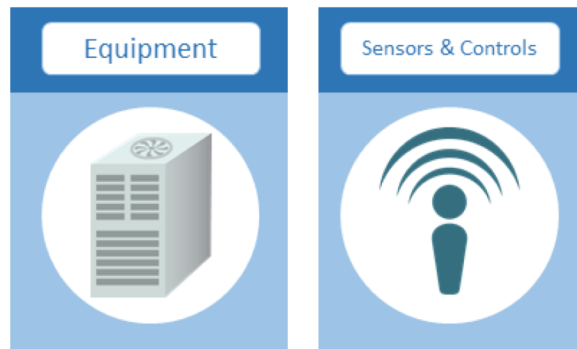
- e.g. Lighting dimming systems responding to lower daylighting due to shade operation

3 Integrated Systems:

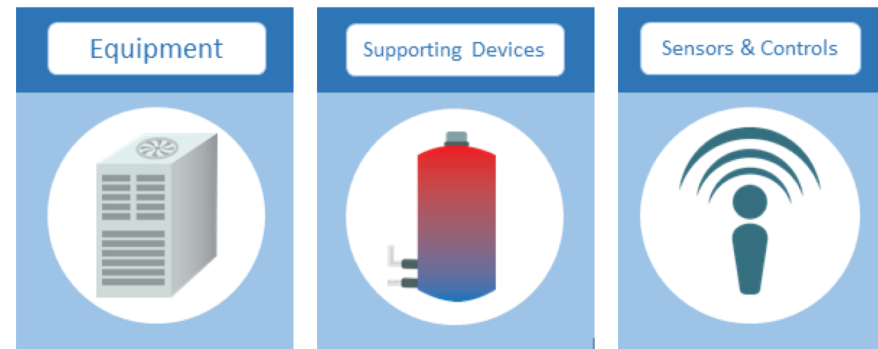
- Active controls communications between end use systems
 - e.g. Automated shading controlled to reduce HVAC energy use while optimizing daylight availability (communicates with HVAC system to determine mode of operation, cooling or heating)



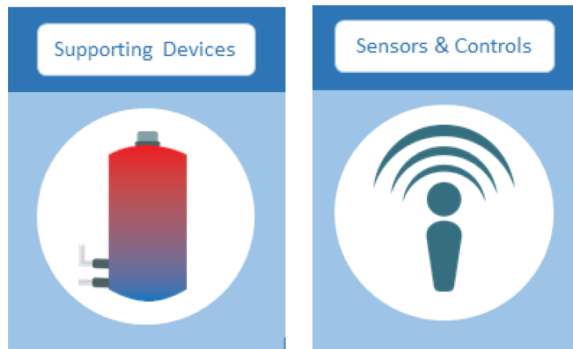
End Use System Retrofit Examples



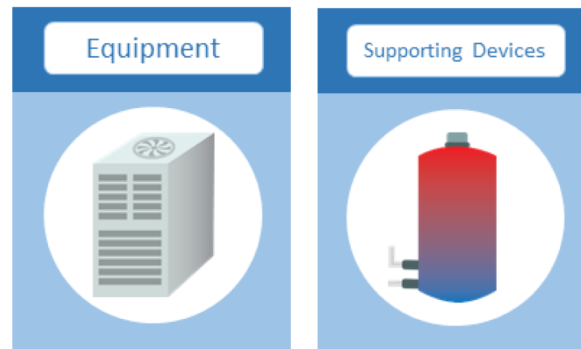
e.g. Air Source Heat Pump with Demand Control Ventilation



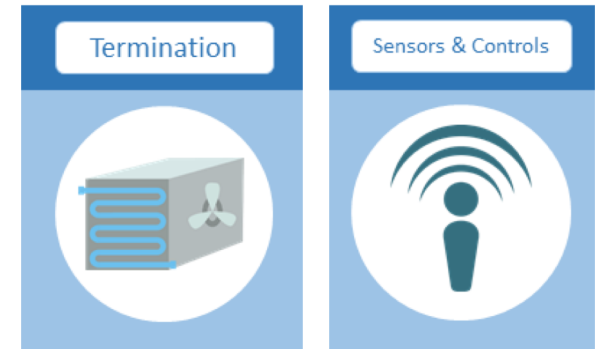
e.g. ASHP with hydronic storage and Time Of Use controls



e.g. Thermal storage and Time Of Use controls



e.g. ASHP with Heat Recovery on Relief Air



e.g. Hydronic fan coil with occupancy controls

Motivating questions

- ◆ What is the extent of systems retrofits compared to component retrofits?
- ◆ Do systems retrofits save more energy than component retrofits?
- ◆ What types of measures are used in systems retrofits?

Data and Approach

Data sources



12,255 projects

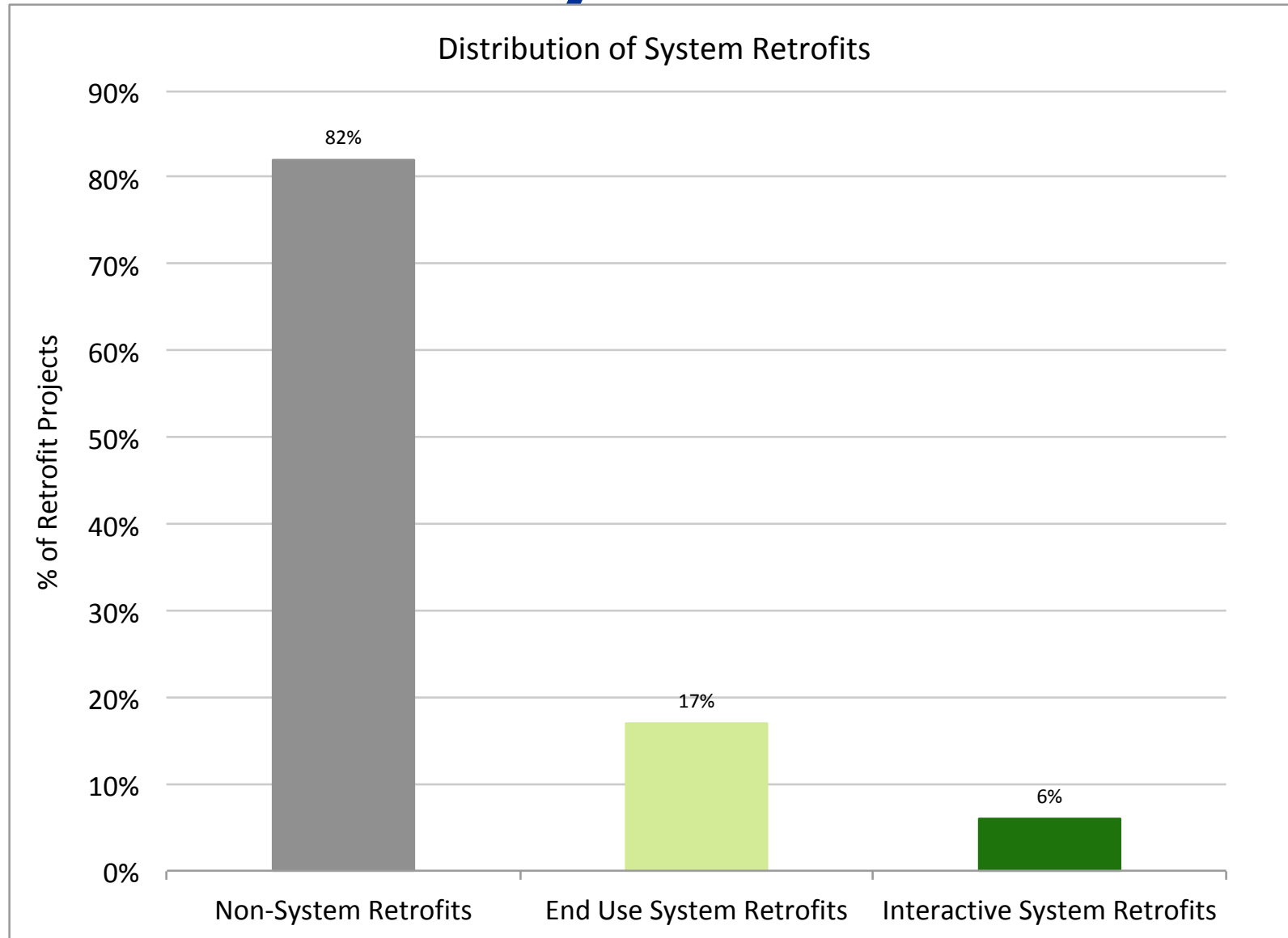
10 building types | 7 climate zones

Cohort Analysis

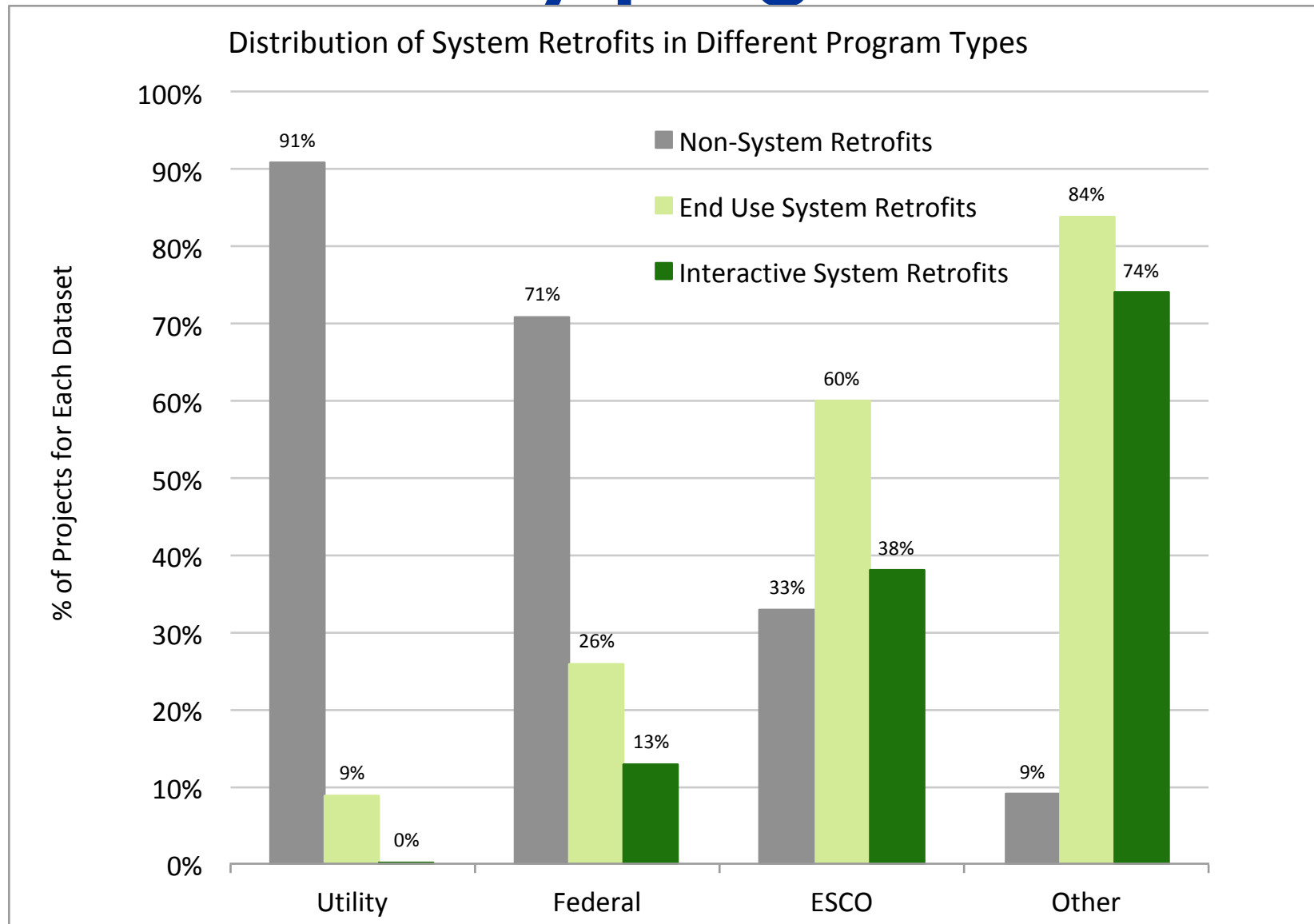
Cohort Attribute	Attribute Categories
Retrofit Type	Non-System retrofits End-Use System retrofits Interactive System retrofits Integrated System retrofits
Project Savings	Low Energy Savings projects High Energy Savings projects
Program Type	Federal NAESCO Utility Other

What is the extent of systems retrofits compared to component retrofits?

Systems retrofits relatively uncommon

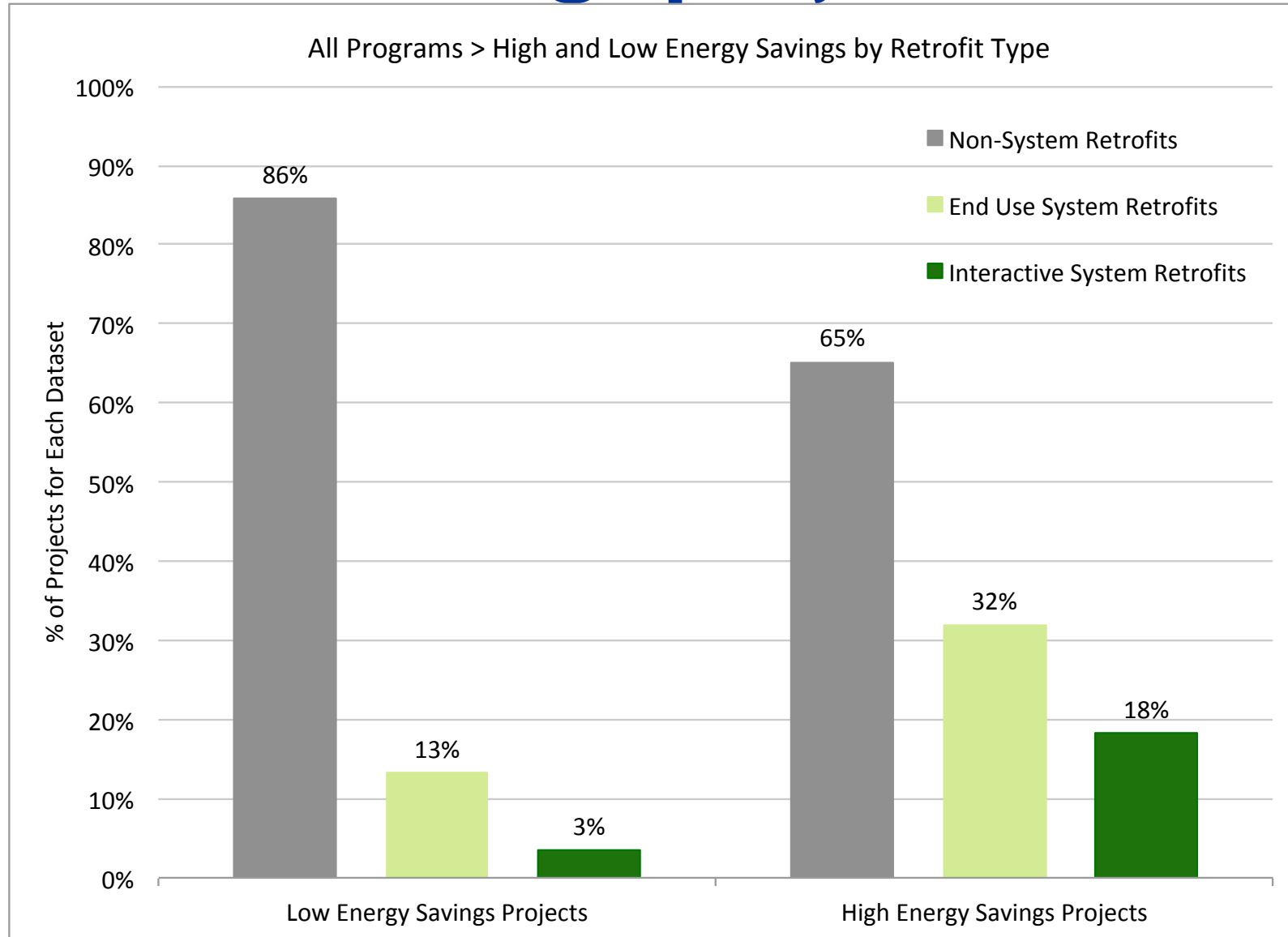


Systems retrofits less prevalent in utility programs

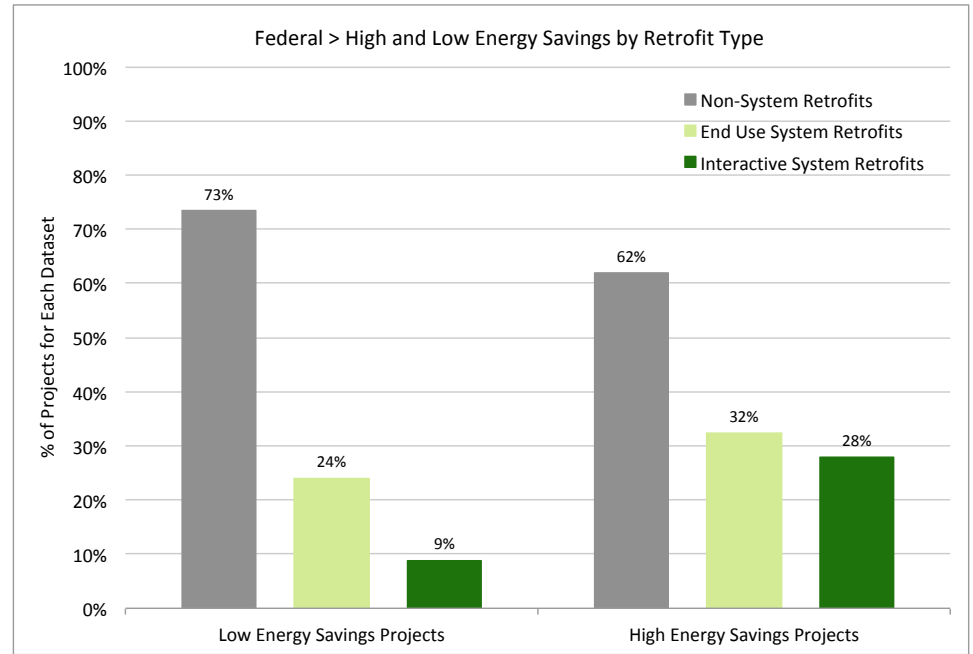
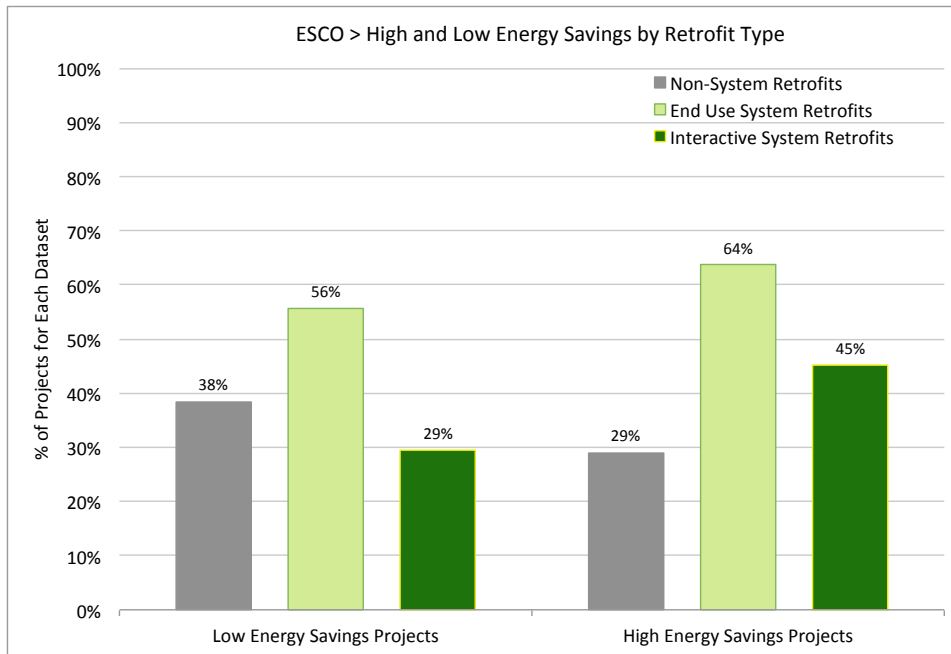


Do systems retrofits save more energy than component retrofits?

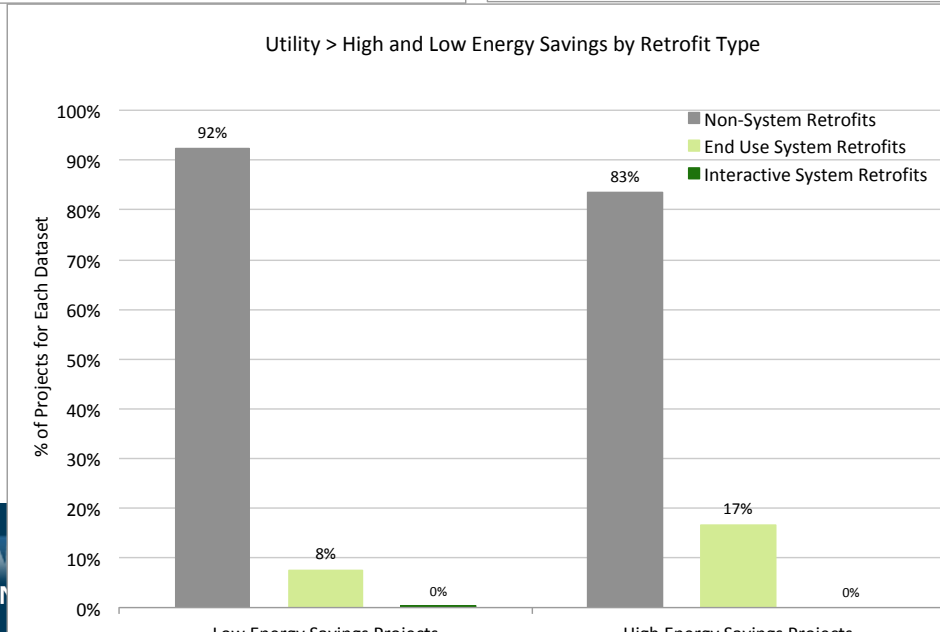
Systems more prevalent in high savings projects



ESCOs have more high savings system projects



ESCO Projects

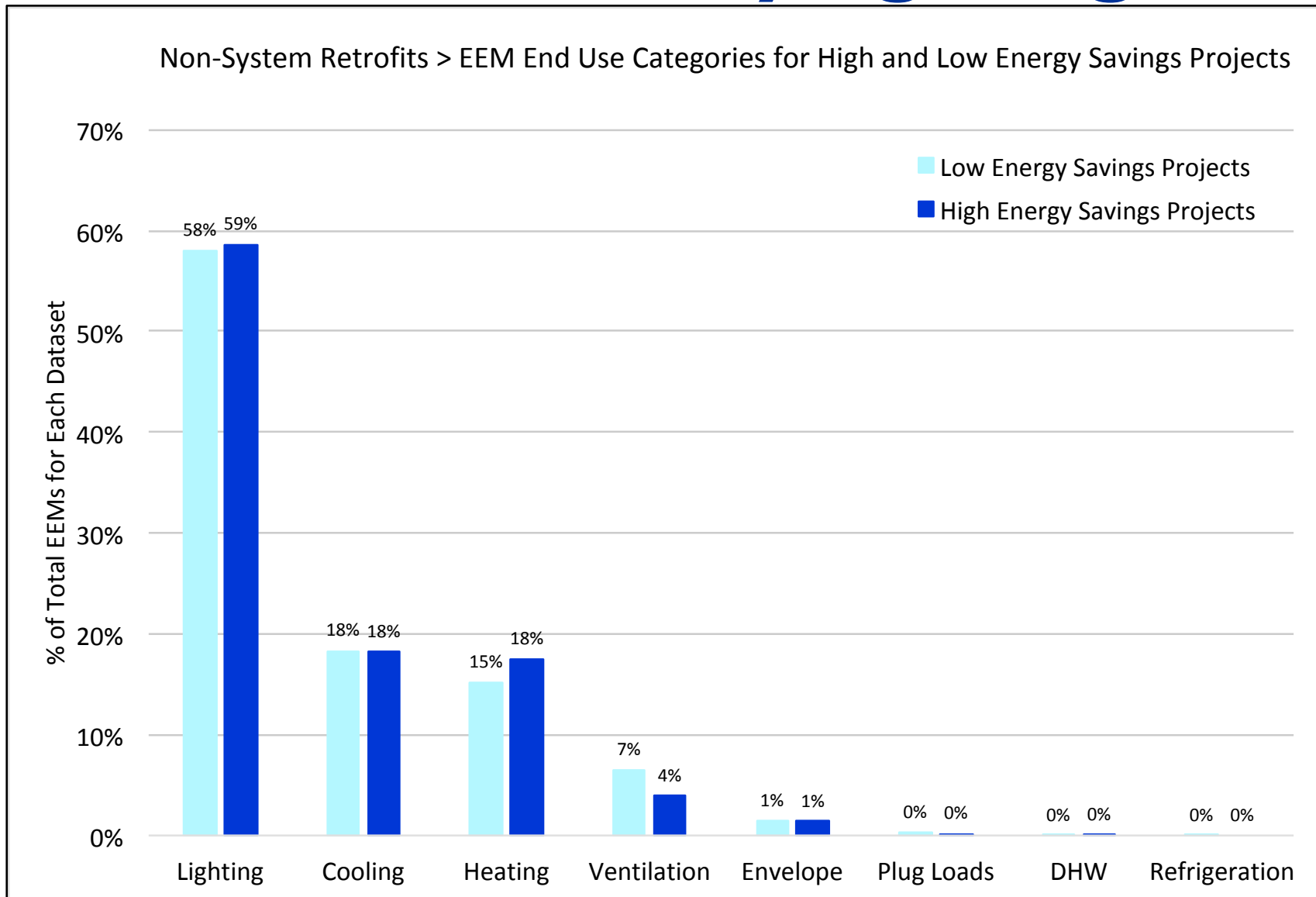


Federal Projects

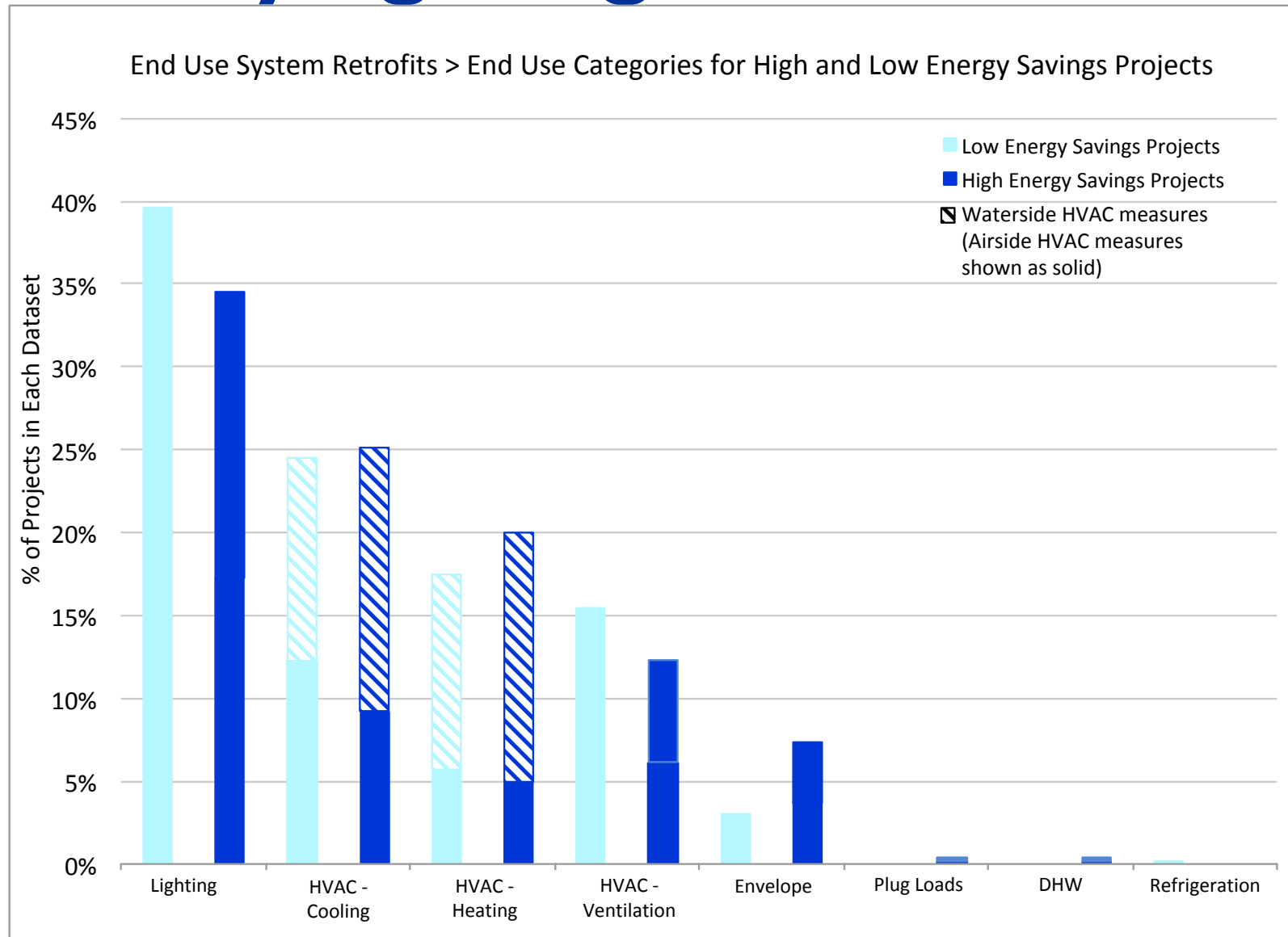
Utility Projects

What types of measures are used in system retrofits?

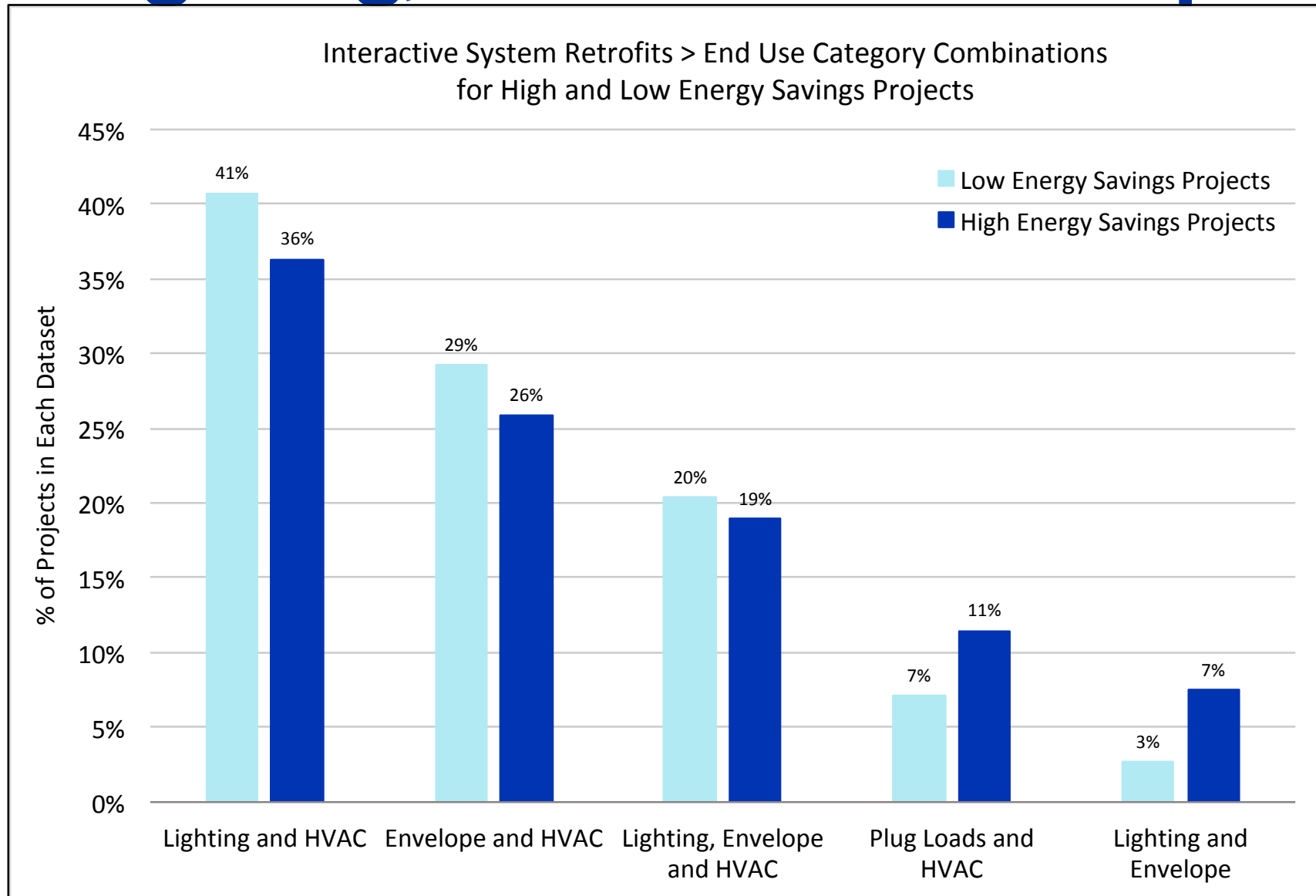
Non-system projects highly dominated by lighting



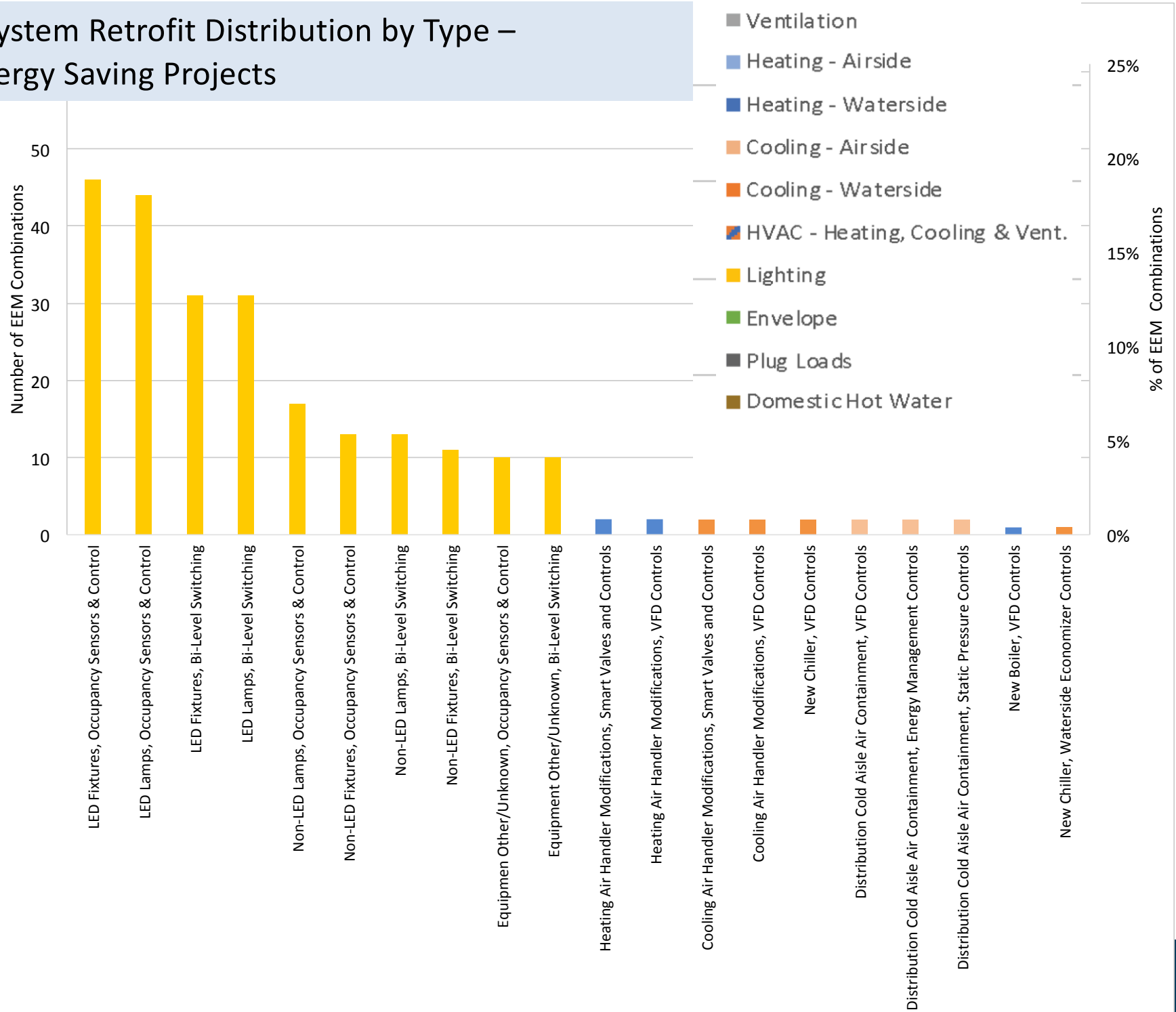
End-use system retrofits dominated by lighting and HVAC



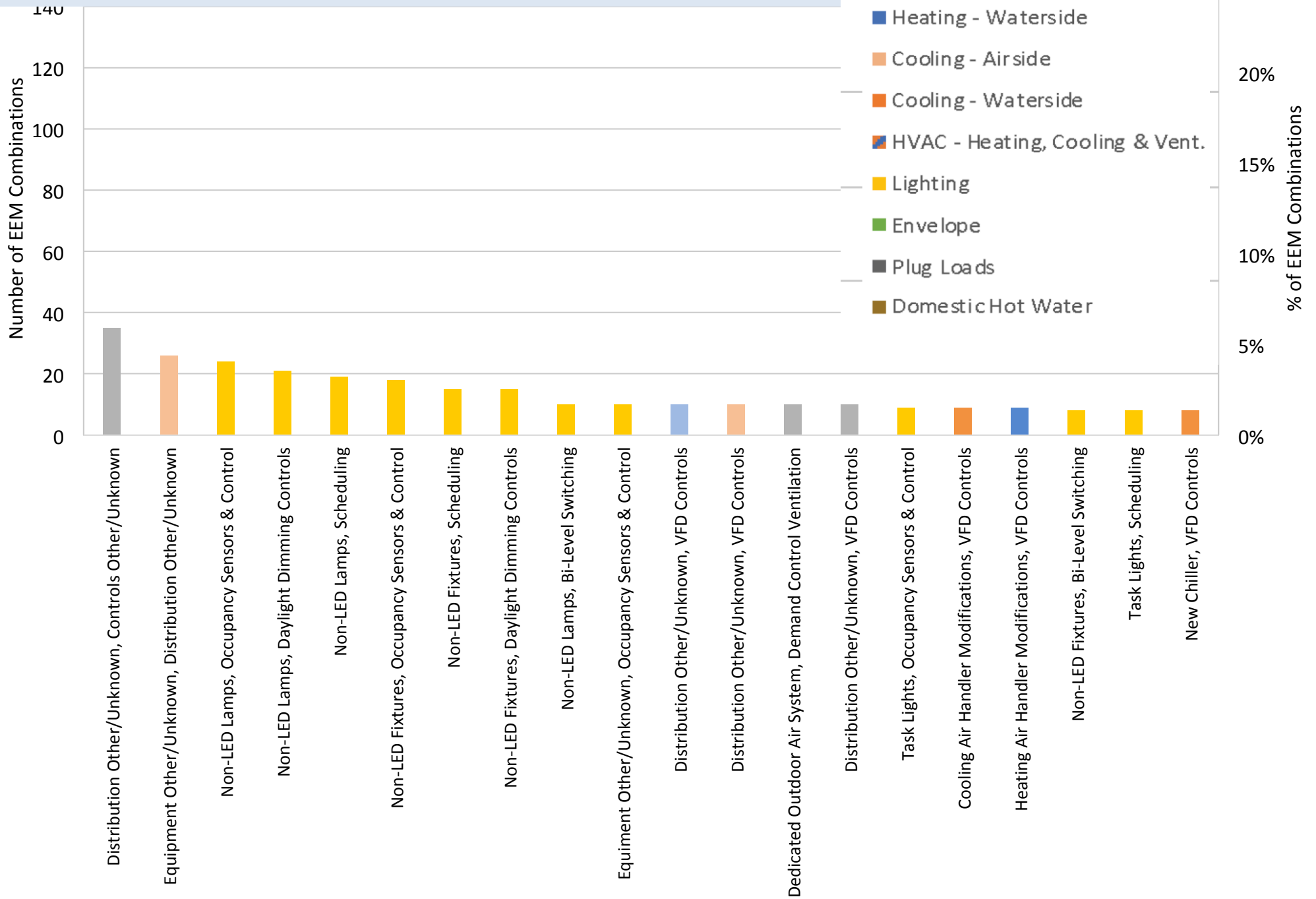
Interactive system retrofits include lighting, HVAC and envelope



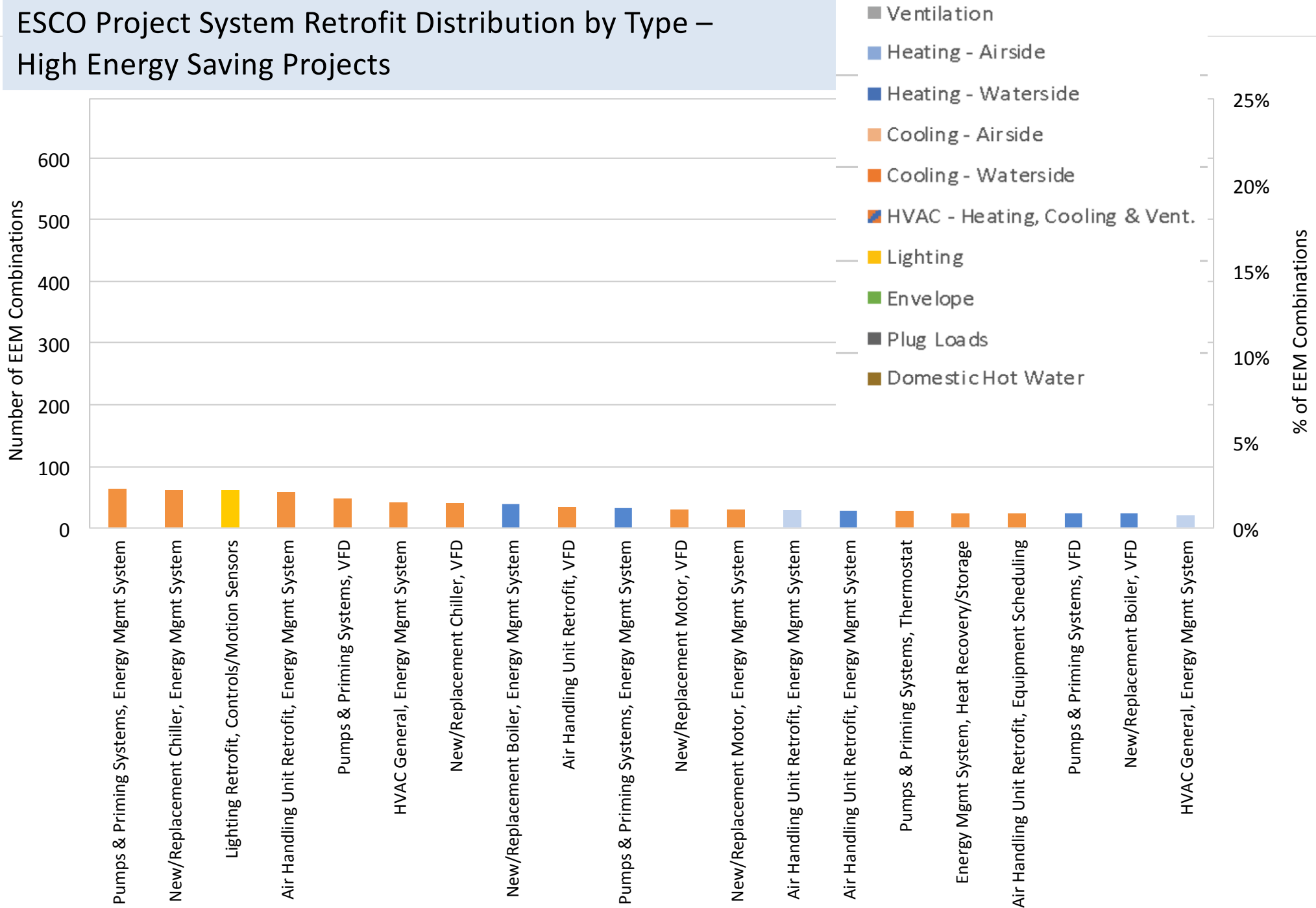
Utility System Retrofit Distribution by Type – High Energy Saving Projects



Federal Retrofit Program System Retrofit Distribution by Type – High Energy Saving Projects



ESCO Project System Retrofit Distribution by Type – High Energy Saving Projects





Stakeholder Insights



Stakeholder Insights

- ◆ Less than 10% of implementers/programs currently address systems
- ◆ Lighting most common retrofit due to ease and cost
- ◆ Larger buildings more likely to do system retrofits
- ◆ Key sectors: offices, schools, healthcare, datacenters, biotech
- ◆ Barriers real and perceived:
 - ❑ Systems are too complex
 - ❑ Systems have poor cost effectiveness
 - ❑ Utility programs still highly "widget" oriented
 - ❑ Lack of training for vendors and service providers

Recommendations

Technology

- ◆ Bundle with low-cost measures for cost-effectiveness.
- ◆ Systems that "work right out of the box"
- ◆ Reduce complexity and cost of design and implementation
- ◆ Ease controls integration with standards, plug and play.

Policy and Programs

- ◆ Lower touch "deemed"-style programs
- ◆ Expanding financing options
- ◆ Incentivize based on lifetime savings
- ◆ Flexibility in existing building baselines

Education

- ◆ Case studies comparing systems vs. component approaches
- ◆ Awareness through professional and trade associations

Takeaways

- ◆ **Systems are an underutilized EE strategy**, that can provide substantial energy savings over individual widgets.
- ◆ **Utilities remain a largely untapped resource for systems** and they are motivated to deploy them.
- ◆ **Systems can be cost effective**, but demand assistance to reduce complexity, increase ease in deployment. **Need R&D** in technology development and methods to reduce transaction cost

Systems Resources – Beyond Widgets Program

3 Systems: Simplified, validated assessment tools (excel based) available for all three systems, including system specifications and test results: cbs.lbl.gov/beyond-widgets-for-utilities

ACEEE 2018 Summer Study paper: ‘Beyond Widgets: Validated Systems Energy Savings and Utility Custom Incentive Program Systems Trends’
<https://aceee.org/files/proceedings/2018/index.html#/paper/event-data/p122>

3 Systems vs Component based upgrade comparison paper
<https://eta-publications.lbl.gov/publications/energy-cost-savings-systems-based>



Lawrence Berkeley National Laboratory

Energy Cost Savings of Systems-Based Building Retrofits: A Study of Three Integrated Lighting Systems in Comparison with Component Based Retrofits

Cindy Regnier, Paul Mathew, Alastair Robinson, Peter Schwartz, Jordan Shackelford, and Travis Walter

Energy Technologies Area
October, 2018



ENERGY TECHNOLOGIES AREA