DRAFT: DO NOT CIRCULATE

Energy Efficiency Financing Foundations

Training for Public-Sector Facilities Managers and Finance Officers

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Module 1

Understanding Your Building Assets and Investment Needs

Learning Objectives

1. Terminology	• Energy conservation measures (ECMs) • Energy efficiency (EE) end uses
2. When and Why	• How do EE projects differ from other capital projects? • When is the best time to implement an EE project? • What factors might impact EE project implementation?
3. What to Include	• What are the typical elements of an EE project? • How can you identify energy-saving opportunities in your building and portfolio?

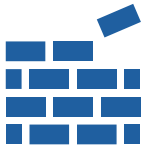
Terminology

"Energy Conservation Measures"

- "ECMs"
- "Measures"

Definition:
Building upgrades impacting total energy usage

Building Components



Building Equipment



Common Items in an Energy Efficiency Project Scope

HVAC

Water Heating

Refrigeration

Lighting

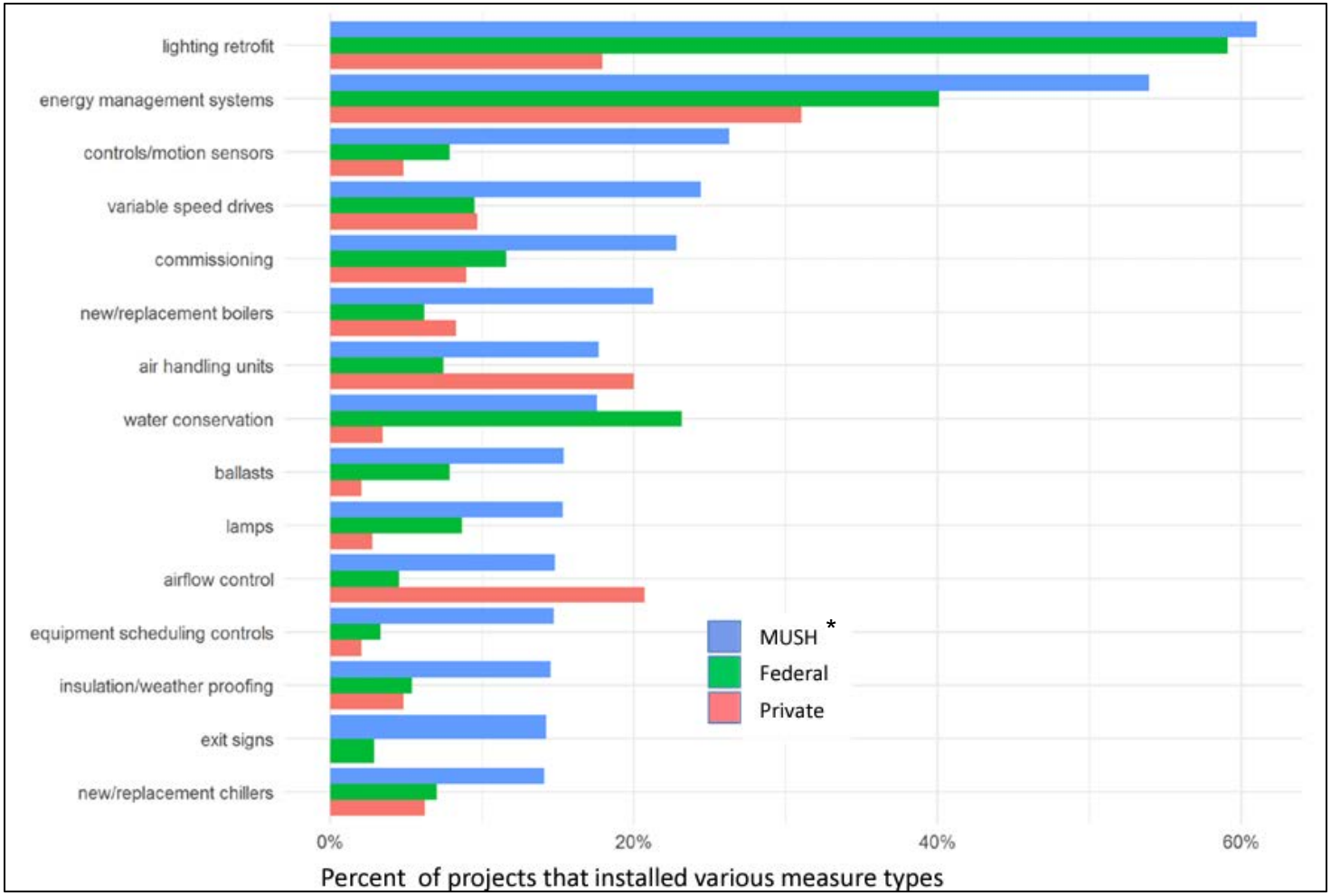
Controls

Plug Loads

Building Shell*

* (e.g., windows, insulation, air sealing)

Energy Conservation Measures in the MUSH*, Federal, and Private Sector

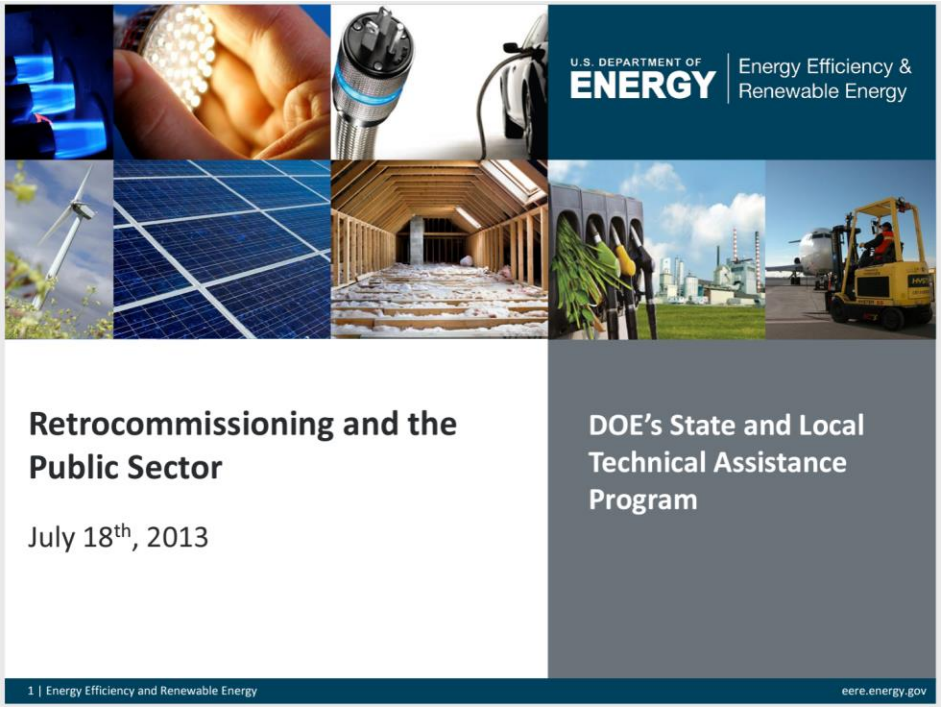


* Municipalities, Universities, Schools, and Hospitals

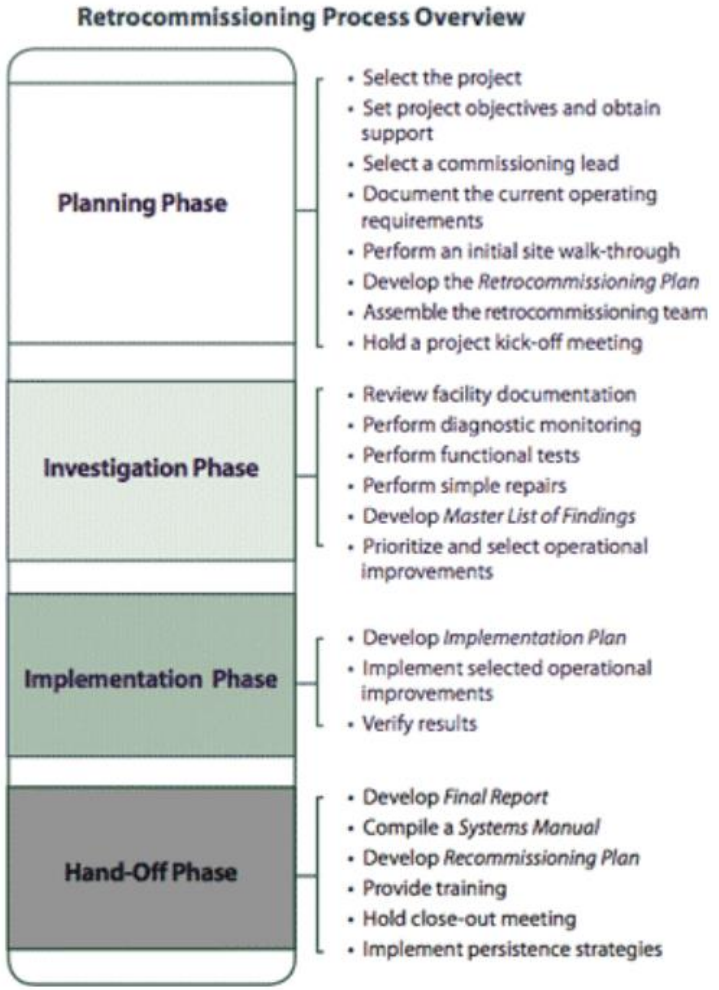
Source: LBNL/NAESCO project database

Retrocommissioning
(A Different Type of Energy-Saving Project)

- Analyzing and optimizing building operations
- Adding and adjusting controls
- Maintaining HVAC and other equipment



Source: U.S. Department of Energy, "Retrocommissioning and the Public Sector"



Source: Lawrence Berkely National Lab, "Building Commissioning"

Non-Energy Upgrades

- EE projects may also require non-energy upgrades (e.g., asbestos remediation)
  - Challenge: can add complexity and cost; may be ineligible for discounted energy-related financing
  - Opportunity: may provide motivation for energy-related upgrades; some energy financing products allow a portion of the capital to be used for non-energy upgrades, especially to address health and safety issues

2021 International Energy Conservation Code (IECC)

CHAPTER 5 [CE] EXISTING BUILDINGS

C501.3 Maintenance.

Buildings and structures, and parts thereof, shall be maintained in a safe and sanitary condition. Devices and systems required by this code shall be maintained in conformance to the code edition under which they were installed. The owner or the owner's authorized agent shall be responsible for the maintenance of buildings and structures. The requirements of this chapter shall not provide the basis for removal or abrogation of energy conservation, fire protection and safety systems and devices in existing structures.

Source: International Code Council, 2021 International Energy Conservation Code (IECC)

Energy Efficiency Projects: When and Why

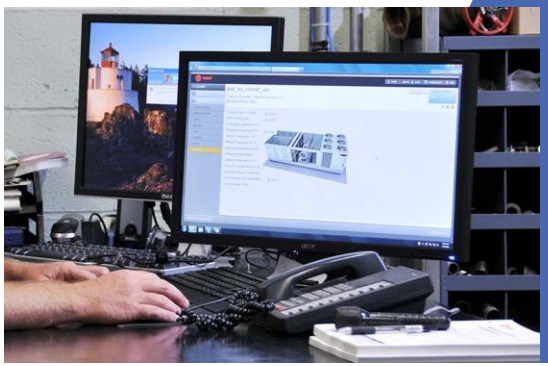
Reactive Project Motivations:

- End of useful life
- Equipment failure
- Savings from more efficient measure than standard baseline replacement measure
- Alternatively, savings from standard baseline measure compared with repairing old equipment to extend beyond expected useful life

Proactive Project Motivations:

- High efficiency gains/high returns compared to existing equipment
- Low replacement/installation costs for new equipment
- High repair costs for existing equipment
- Improved non-energy benefits (comfort, air quality, health and safety, etc.)
- Reduced maintenance

Identifying EE Investment Needs



Professional Energy Audit

- Use qualified third-party professionals
- Identify energy and cost-saving potential
- Follow standard industry protocols

https://www.ashrae.org/technical-resources/bookstore/procedures-for-commercial-building-energy-audits

In-House Audit

- Self-Identify EE upgrade opportunities
- See EPA Treasure Hunt

https://www.energystar.gov/industrial_plants/treasure_hunt

Energy Benchmarking

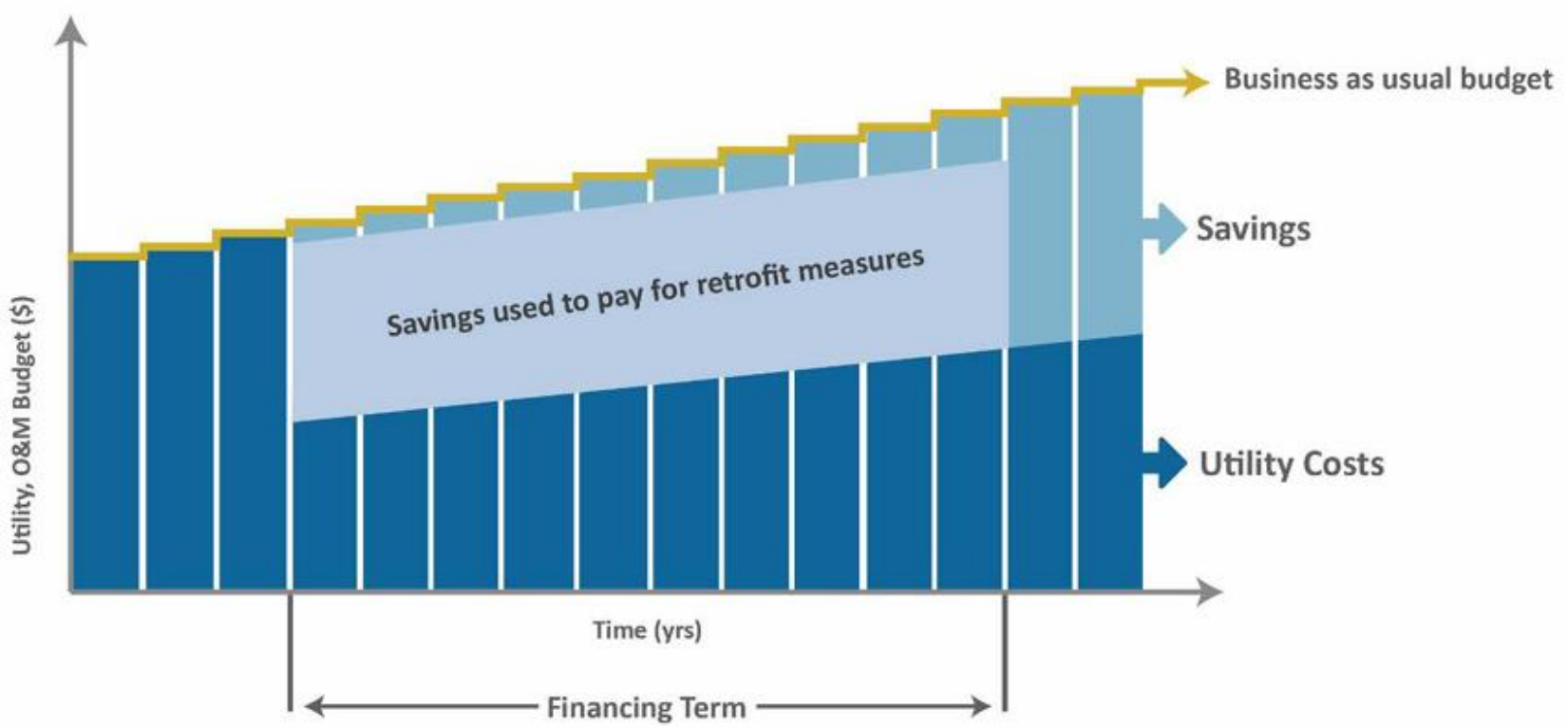
- Compare usage to other buildings
- See ENERGY STAR Portfolio Manager

https://portfoliomanager.energystar.gov

Source of Graphics

What is different about EE vs. other capital projects?

Financing EE can potentially have a positive budgetary impact if savings exceed financing costs



Source: U.S. Department of Energy, "Energy Savings Performance Contracting: A Primer for K-12 Schools"

Contextual Factors Can Influence Whether and When to Move Forward with EE Projects

Usage

- Primary usage of building
- Safety issues
- Construction impact on usage

Timing

- Proactive vs. reactive
- Timing of grants and other funding opportunities

Prioritization

- Building age
- Building condition and level of deferred maintenance

Examples of Energy Efficiency Projects In Public Buildings

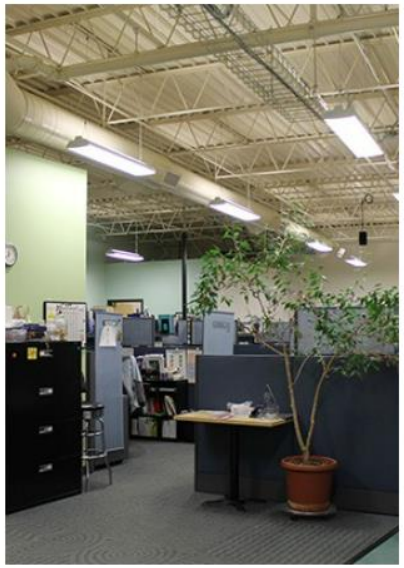
Example: Lighting and Retrocommissioning Columbia, MO Health and Human Services Building

Energy Conservation Measures:

- Retro-commissioning of HVAC systems
- Lighting fixtures
- Daylighting

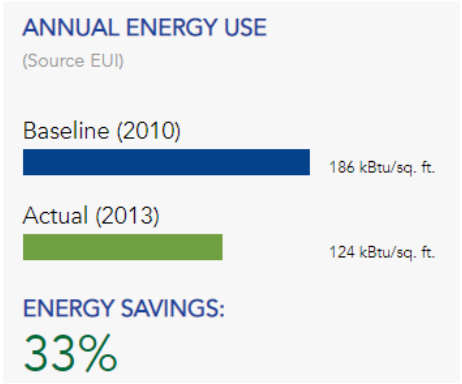
Benefits:

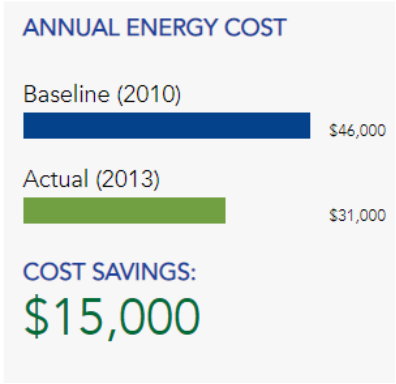
- Reduced energy usage and cost
- Improved comfort
- Reduced frequency of lighting maintenance



Energy-efficient fixtures in office area

Entryway lights off due to daylighting





Source: U.S. Department of Energy, Better Buildings Solution Center

Example: Lighting and Integrated Controls Washington State Department of Commerce

Energy Conservation Measures:

- LED fixtures
- Occupancy sensors
- Integrated lighting and HVAC controls

Benefits:

- Reduced energy usage and cost
- Comfort (temperature controls; lighting quality controls)

Pacific Tower, Seattle, Wash.

Source: Northwest Energy Efficiency Alliance (NEEA), "Better Bricks"

BY THE NUMBERS:

- **2,000 LED fixtures** were installed along with the Enlighted system
- Pacific Tower is seeing **80% energy savings** compared to the previous system
- The building's lighting **energy use is 27% better** than Seattle's already progressive energy code

The Enlighted lighting controls system was the ideal choice for building system integration and lighting flexibility.

Example: Efficiency's Impact on Energy System Costs Hospital in Nashville, TN

Energy Conservation Measures:

- Mix of measures reducing annual electric usage by 20%

Benefits:

- Cost savings on electric usage

- Cost savings on sizing of backup microgrid

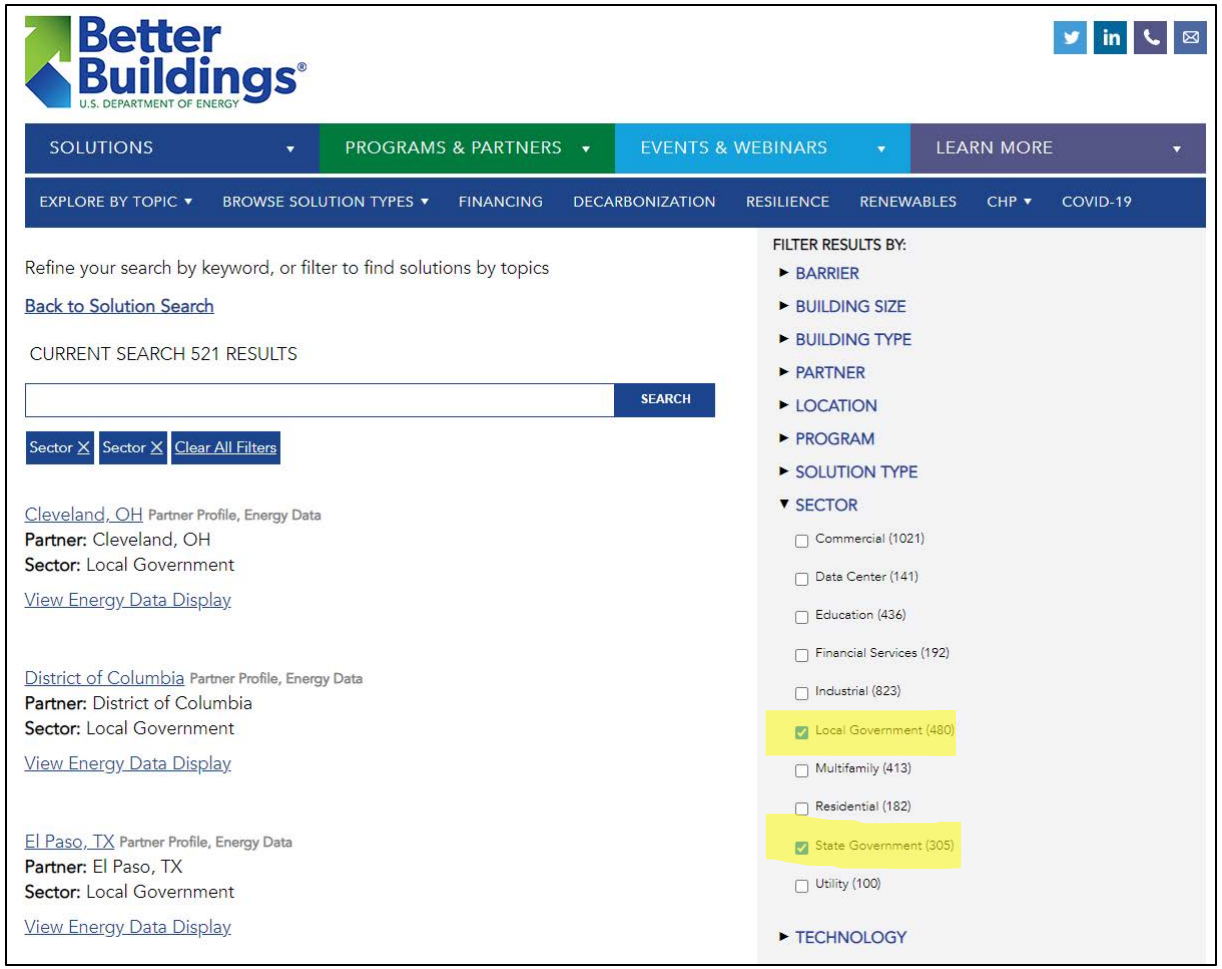
Hospitals are high-priority sites for ensuring a resilient power source is available during an outage. In this example, a hospital would reduce its investment cost by nearly $2 million by pursuing energy efficiency measures to achieve 20% energy savings before sizing its microgrid to run critical loads during a 48-hour grid outage.

Electricity Use Scenario	Solar Generation Capacity	Battery Storage Capacity	System Cost[16]
Baseline Annual Usage: 8.9 million kWh	*4,065 kW*	*6,944 kWh*	*$9,308,000*
20% Energy Savings: 7.1 million kWh	*3,252 kW*	*5,555 kWh*	*$7,446,000*

Graphic source (with additional examples)

Install energy efficiency measures → Reduce annual electric usage and cost → Reduce sizing and system cost for backup microgrid

More Examples: Better Buildings Solution Center

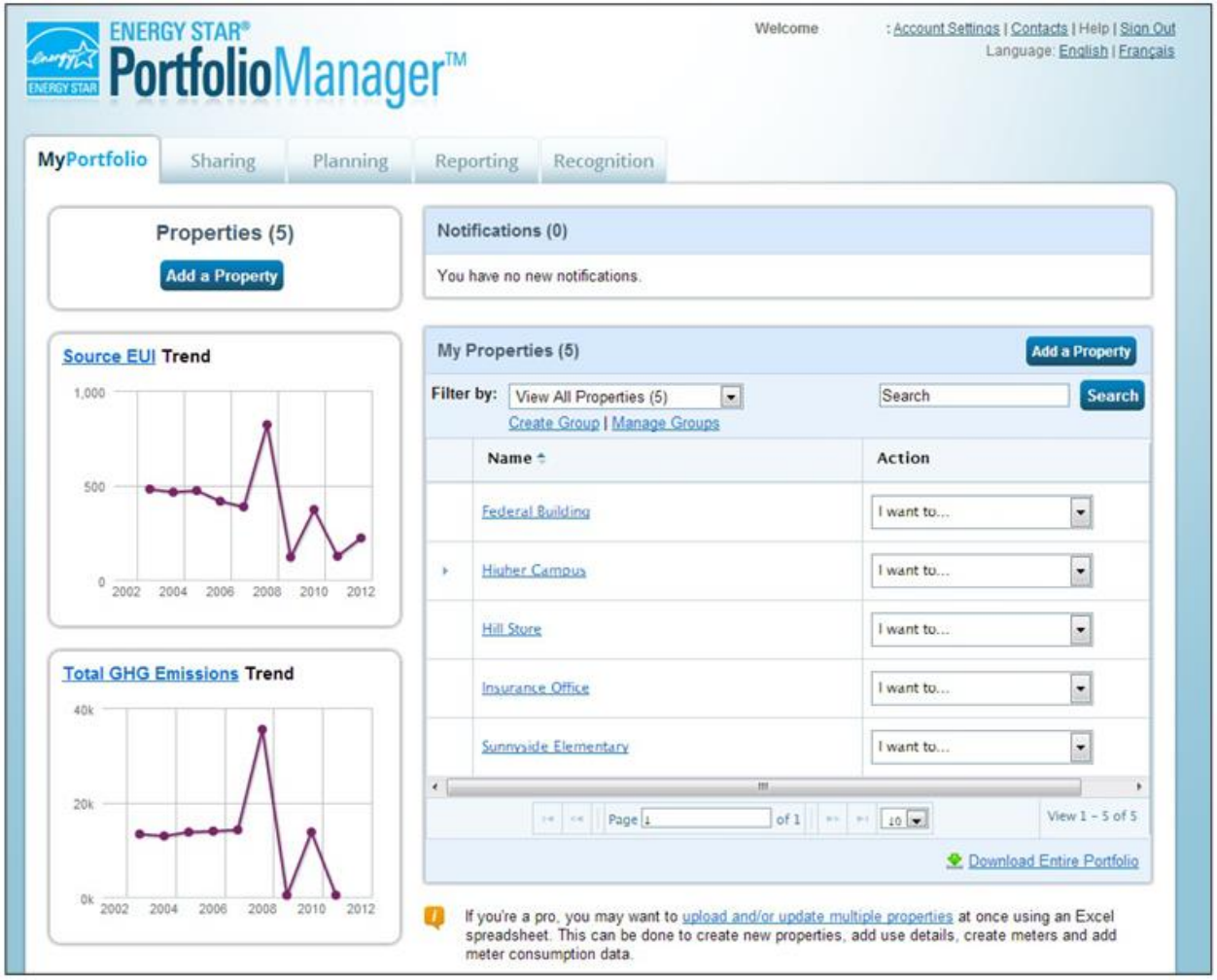


Source: U.S. Department of Energy, Better Buildings Solution Center

Building Energy Assessment Tools

Resources: ENERGY STAR Portfolio Manager

- Compare your building's energy to similar buildings, past consumption, or a reference performance level
- Identify underperforming buildings to target for efficiency improvements
- Share and report performance



Source: ENERGY STAR Portfolio Manager

Public Service Property Types in Portfolio Manager

Source: ENERGY STAR Portfolio Manager, "U.S. Property Types, Definitions, and Use Details"

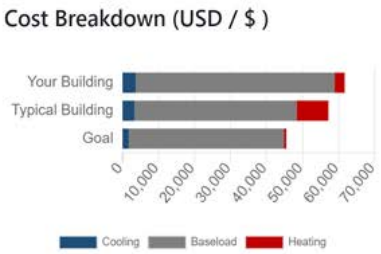
Resources: BETTER (better.lbl.gov)

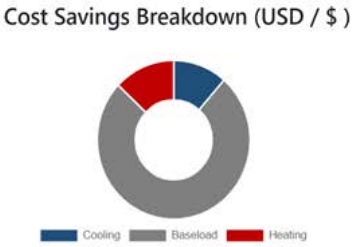
Portfolio Analysis

- Compare and rank buildings across a portfolio according to annual electricity and fossil EUI and annual cost savings potential.
- Buildings with high cost savings potential are good candidates for audits and further analysis.
- Buildings with high fossil EUI represent opportunities for electrification and decarbonization.

Utility Cost & Savings Breakdowns

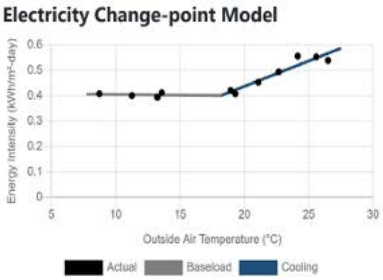
- Assess the breakdown of annual utility costs and potential savings by load type (e.g., cooling, baseload, and heating).
- Prioritize the highest cost-saving energy efficiency improvements in a building.

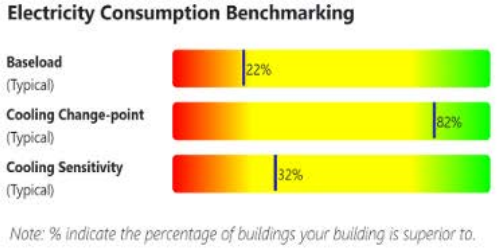




Change-Point Models & Benchmarking

- Investigate electricity and fossil fuel change-point models.
- See how model coefficients benchmark against peers to further evaluate energy savings.





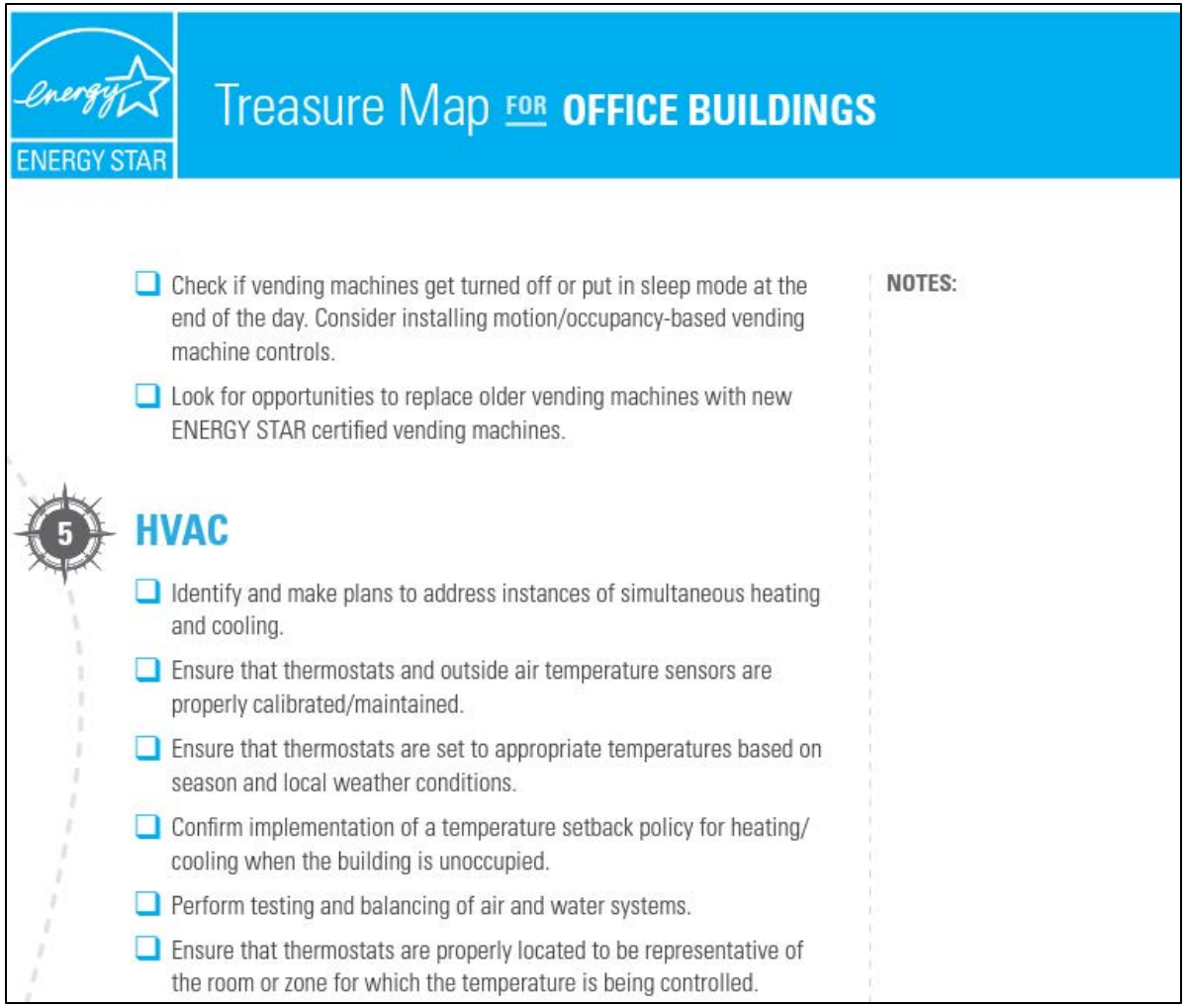
Source: U.S. Department of Energy, "Building Efficiency Targeting Tool for Energy Retrofits (BETTER)"

Resources: EPA Treasure Hunt

- In-house identification of energy savings opportunities

- Includes general building occupants along with facilities staff and outside experts

- Culminates in presentation to management and a plan and timeline for implementation



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Treasure Map FOR OFFICE BUILDINGS

- ❑ Check if vending machines get turned off or put in sleep mode at the end of the day. Consider installing motion/occupancy-based vending machine controls.
- ❑ Look for opportunities to replace older vending machines with new ENERGY STAR certified vending machines.

NOTES:

5

HVAC

- ❑ Identify and make plans to address instances of simultaneous heating and cooling.
- ❑ Ensure that thermostats and outside air temperature sensors are properly calibrated/maintained.
- ❑ Ensure that thermostats are set to appropriate temperatures based on season and local weather conditions.
- ❑ Confirm implementation of a temperature setback policy for heating/cooling when the building is unoccupied.
- ❑ Perform testing and balancing of air and water systems.
- ❑ Ensure that thermostats are properly located to be representative of the room or zone for which the temperature is being controlled.

Source: ENERGY STAR Treasure Hunt

Resources: "Achieving Energy Savings in Small- and Medium-Sized Public Facilities: A Strategic Approach to Prioritizing and Financing"

A strategic, step-by-step approach to financing building energy upgrades:*

Step 1: Energy Assessments	Step 2: Energy Audits	Step 3: Building Upgrades
Purpose: Obtain actionable information. Understand energy usage patterns across a portfolio of buildings and benchmark performance against similar buildings.	**Purpose:** Obtain information that can support a financial investment. Identify building components with most opportunity for energy savings.	**Purpose:** Execute building upgrades to capture energy savings, improve comfort, etc.
Scope: All buildings and facilities in your portfolio.	**Scope:** Only facilities with the highest potential for energy savings based on Step 1 results.	**Scope:** Targeted buildings and building components based on Step 2 results (i.e., audit).
Confidence in Energy Savings: Low confidence.	**Confidence in Energy Savings:** Medium confidence based on results of energy assessments (Step 1).	**Confidence in Energy Savings:** High confidence based on results of energy audits (Step 2).
Cost: No or low cost supported with staff and available energy usage data.	**Cost:** Low to high cost depending on the scope of the energy audit.	**Cost:** Higher costs that vary depending on project scope, technology, etc.
Financing Options: Not applicable.	**Financing Options:** ESPCs, Utility- and State-Supported Programs, Internal Funding.	**Financing Options:** Internal Funding, Leases, Loans, ESPCs, Bonds, ESAs.
Outcome: A reduced set of buildings meriting further exploration through an energy audit.	**Outcome:** A specific set of energy conservation measures and projected energy savings.	**Outcome:** Energy and cost savings, improved building performance and comfort.

*Note—ESPC: Energy Savings Performance Contract; ESA: Energy Service Agreement

Source: U.S. Department of Energy, "Achieving Energy Savings in Small- and Medium-Sized Public Facilities"

Additional Resources

- Database of State Incentives for Renewables and Efficiency (DSIRE) https://www.dsireusa.org
- Energy Data Management Guide https://www.eere.energy.gov/energydataguide
- Building Energy Asset Score https://www.energy.gov/eere/buildings/building-energy-asset-score
- A Guide to Energy Audits https://www.pnnl.gov/publications/guide-energy-audits

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