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ENERGY EFFICIENCY ARKANSAS

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Skimming the Cream

No-Cost and Low-Cost ECMs

Eric Oliver, PE, CEM
Earthwide, LLC

Eric Oliver
Founder, Earthwide, LLC

- Earthwide, LLC
  - Energy and Sustainability Master Planning Company in McLean, VA.
  - 30 years of industry experience
  - Founded EMO Energy Solutions (1998) to address the growing need for energy efficiency services and ran the Company for 19 years until 2017.
- Academic Achievements & Licenses
  - MIT: Master's degree in Building Technology and a Bachelor of Architecture
  - PE: Virginia and Maryland
- Service to Associations
  - Former President of the National Capitol Chapter AEE
  - Former National Secretary of AEE
  - Served on the Board of Directors of the National Capitol Region USGBC Chapter
  - Former Board Chairman of the Virginia Sustainable Building Network (VSBN)
  - 2019: Mr. Oliver was inducted into the National Energy Managers Hall of Fame by the AEE for a lifetime of achievement and leadership.

Skimming the Cream: No-Cost & Low-Cost Energy Conservation Measures (ECMs)

Learning Objectives

- Understanding how Energy is Consumed, and Wasted, in Buildings
- Identifying and Implementing No-Cost and Low-Cost Energy Savings
- Understanding Retrocommissioning (RCx) and Monitoring-Based Commissioning (MBCx)
- Financing Low-Cost Energy Savings

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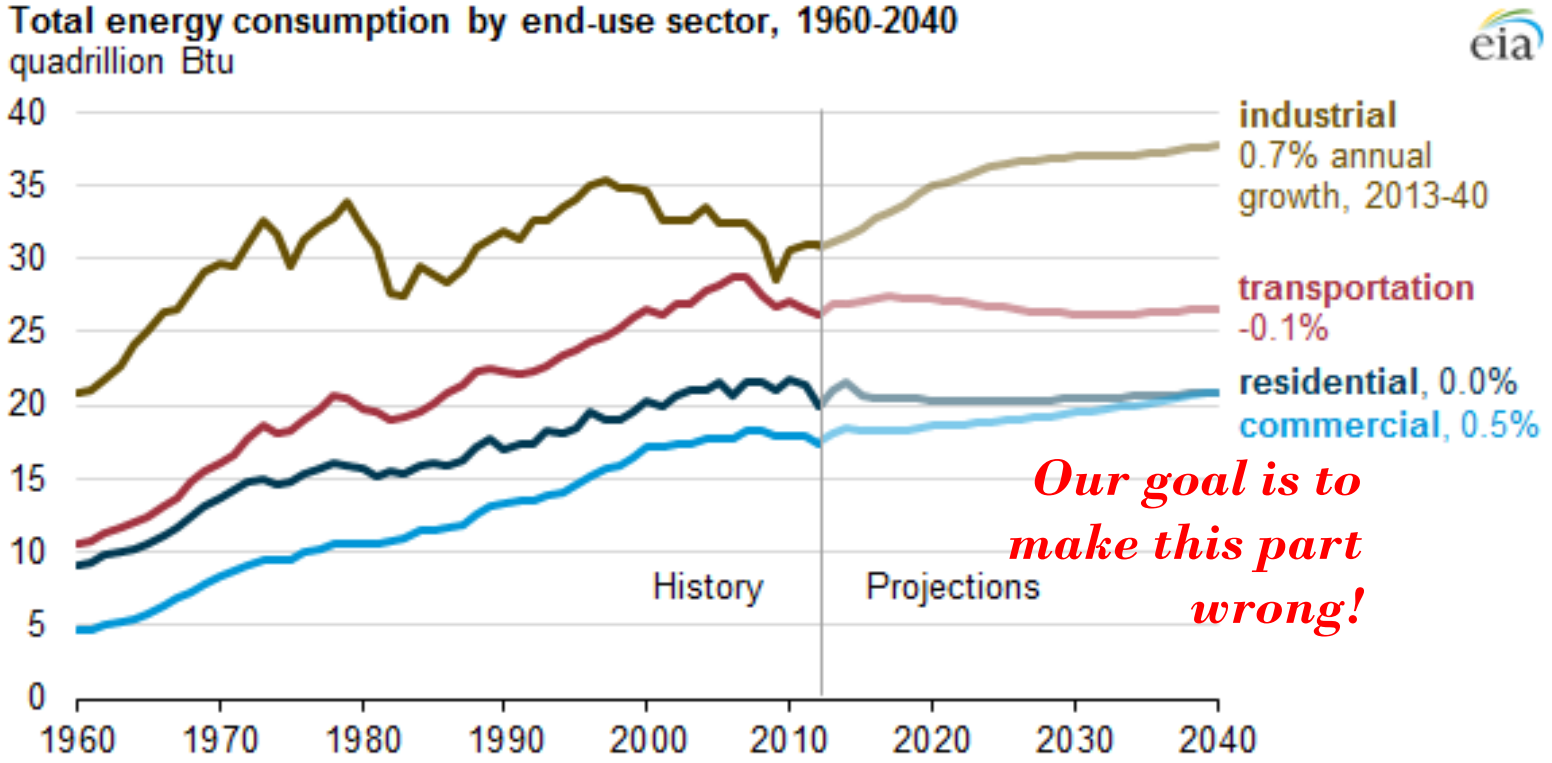
Energy Consumption Trends



Our goal is to make this part wrong!

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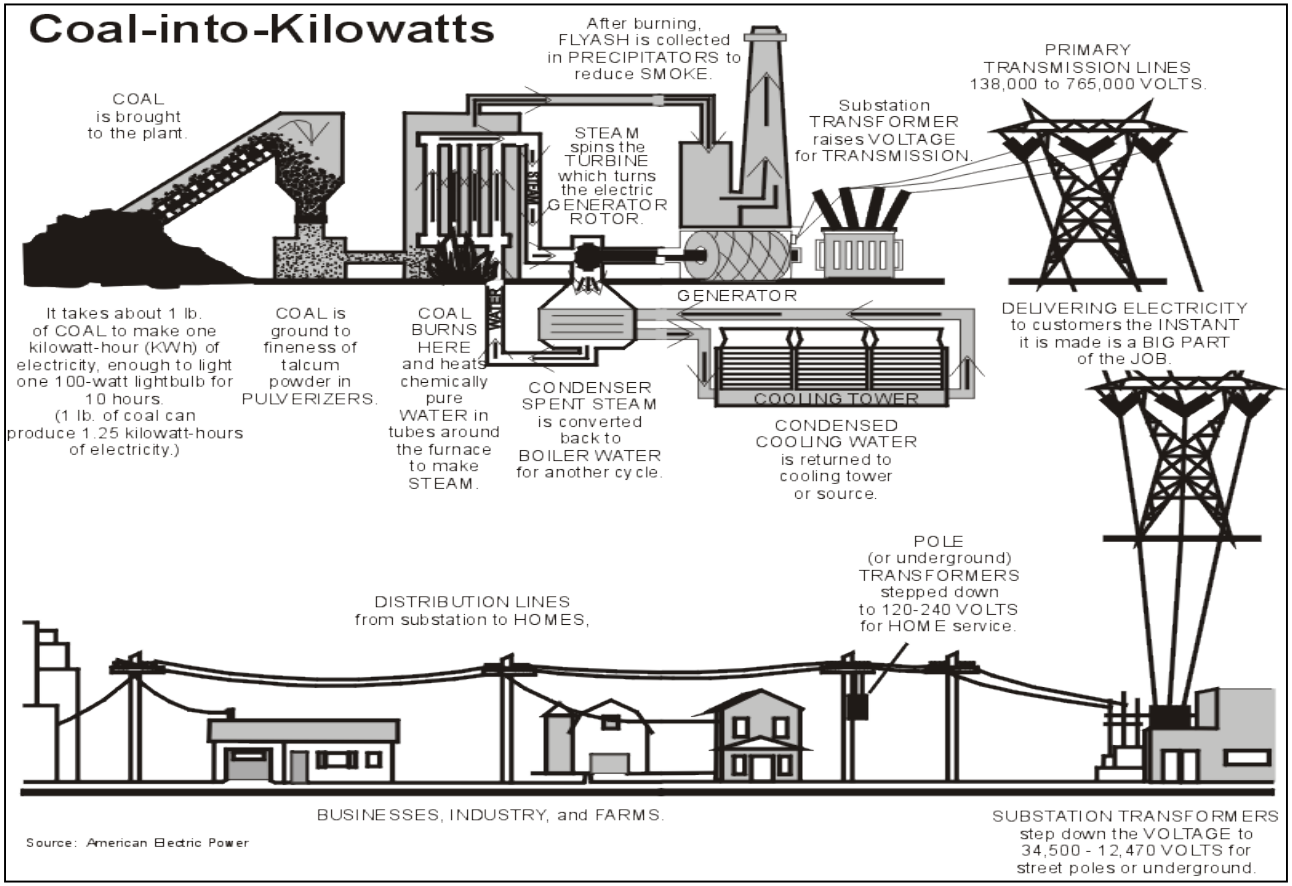
33% Efficiency of the grid

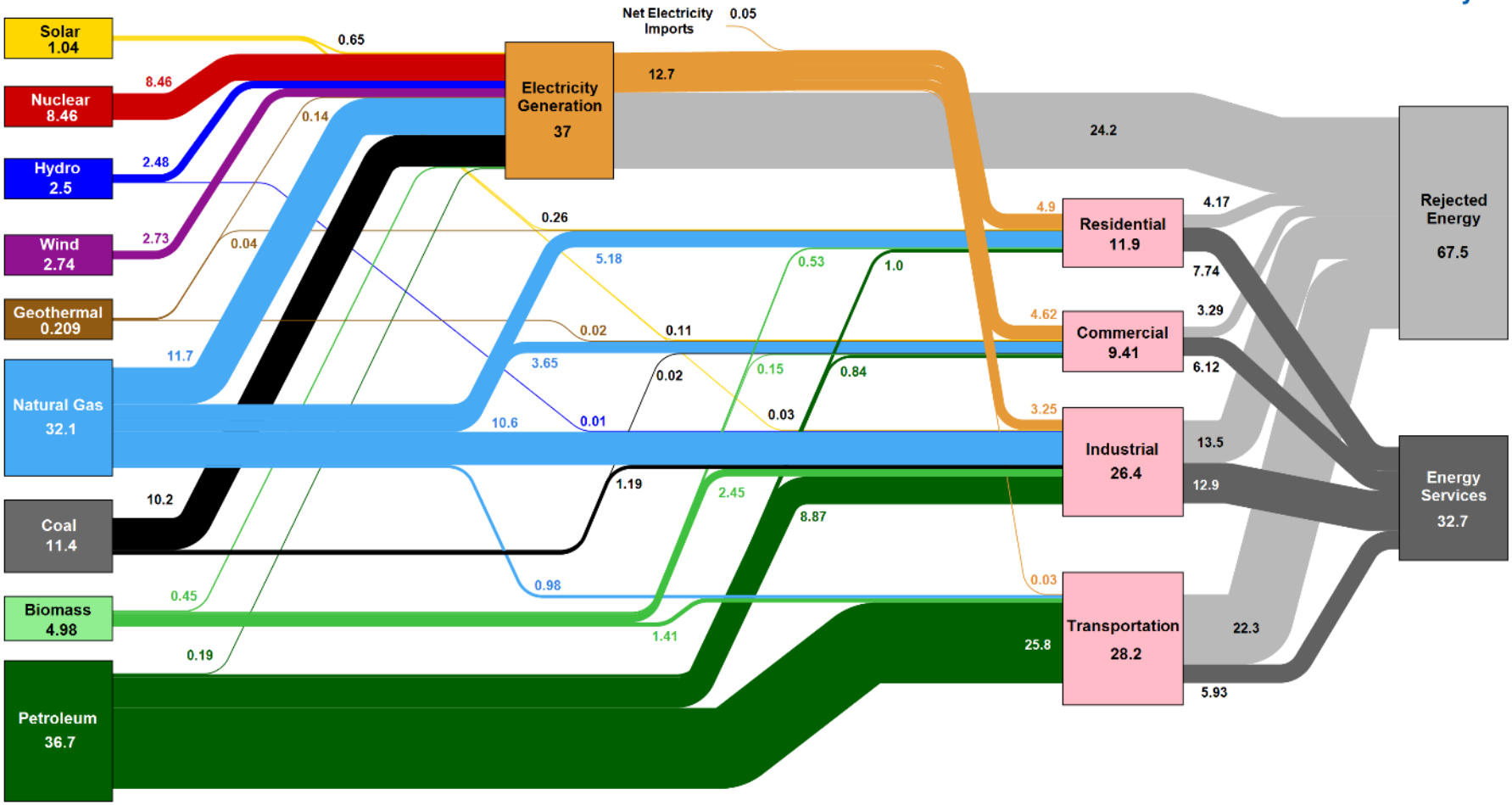


Energy Conversion Losses from Source to Electricity

- 40% – 62% is lost as waste heat at the generator
- 3% – 8% is lost in the transmission of electricity
- 1% – 2% is lost in the transformers

Estimated U.S. Energy Consumption in 2019: 100.2 Quads

Lawrence Livermore National Laboratory



Source: LLNL March, 2020. Data is based on DOE/EIA MER (2019). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant heat rate. The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential sector, 65% for the commercial sector, 21% for the transportation sector and 49% for the industrial sector, which was updated in 2017 to reflect DOE's analysis of manufacturing. Totals may not equal sum of components due to independent rounding. LLNL MI 410527

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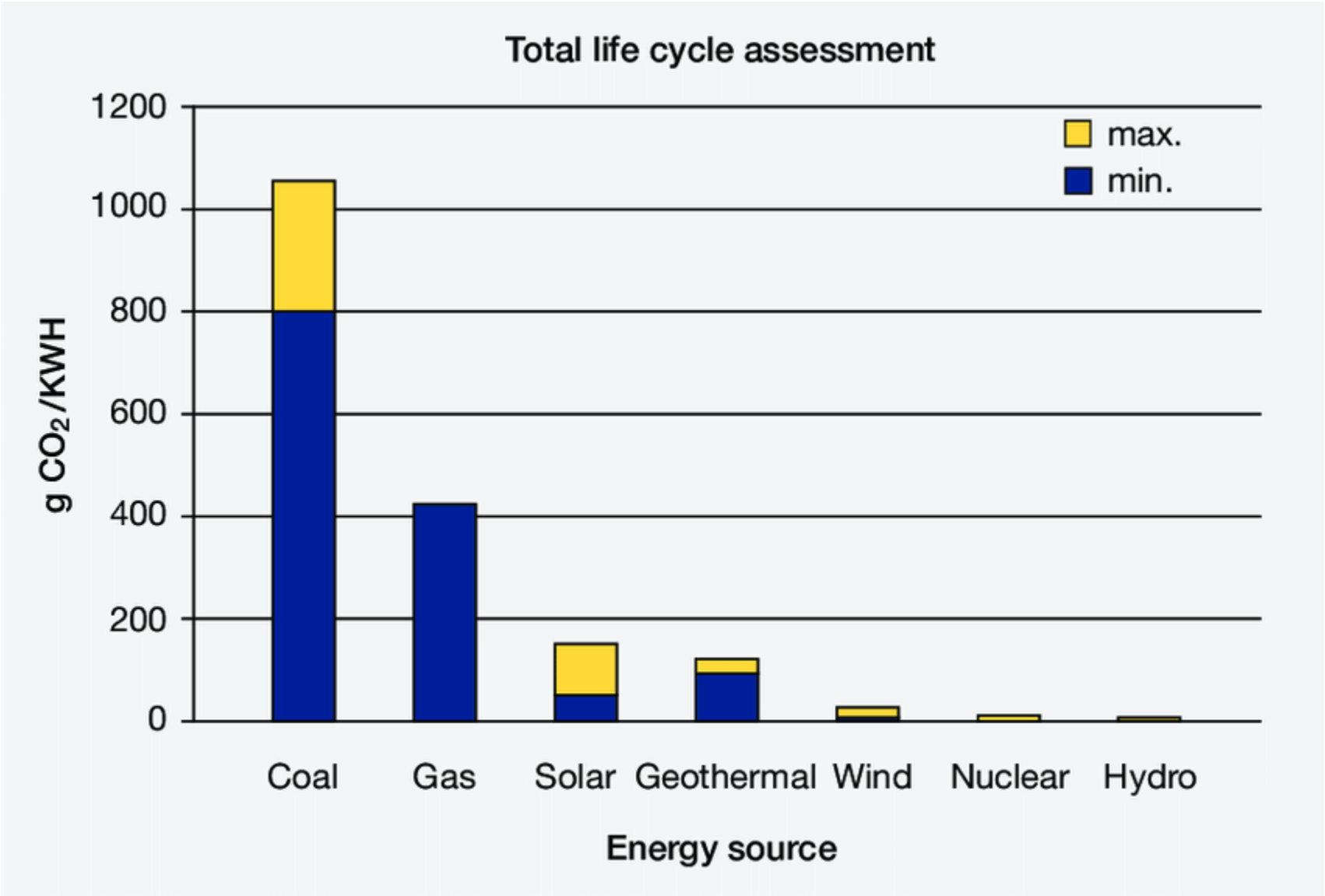

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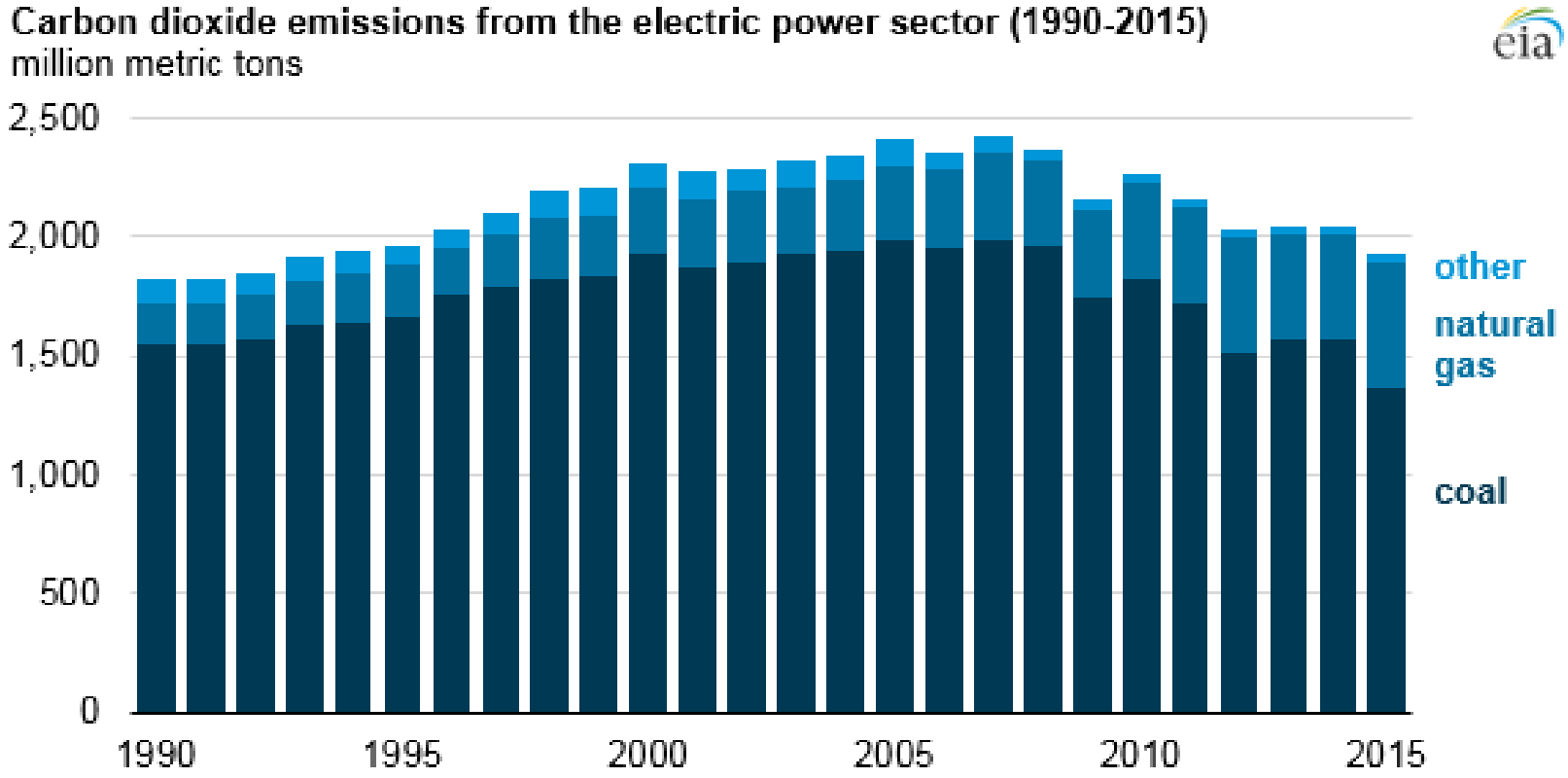

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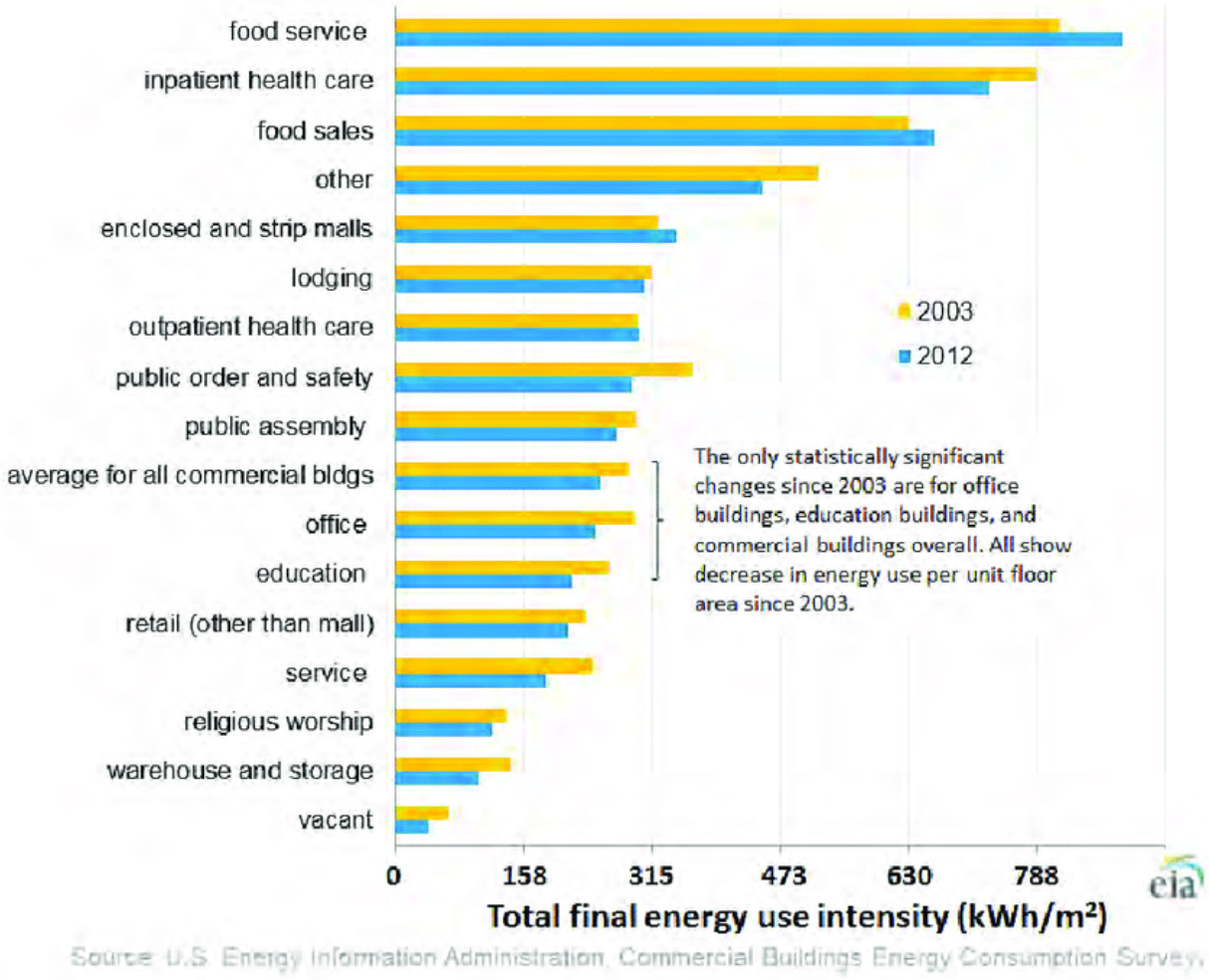
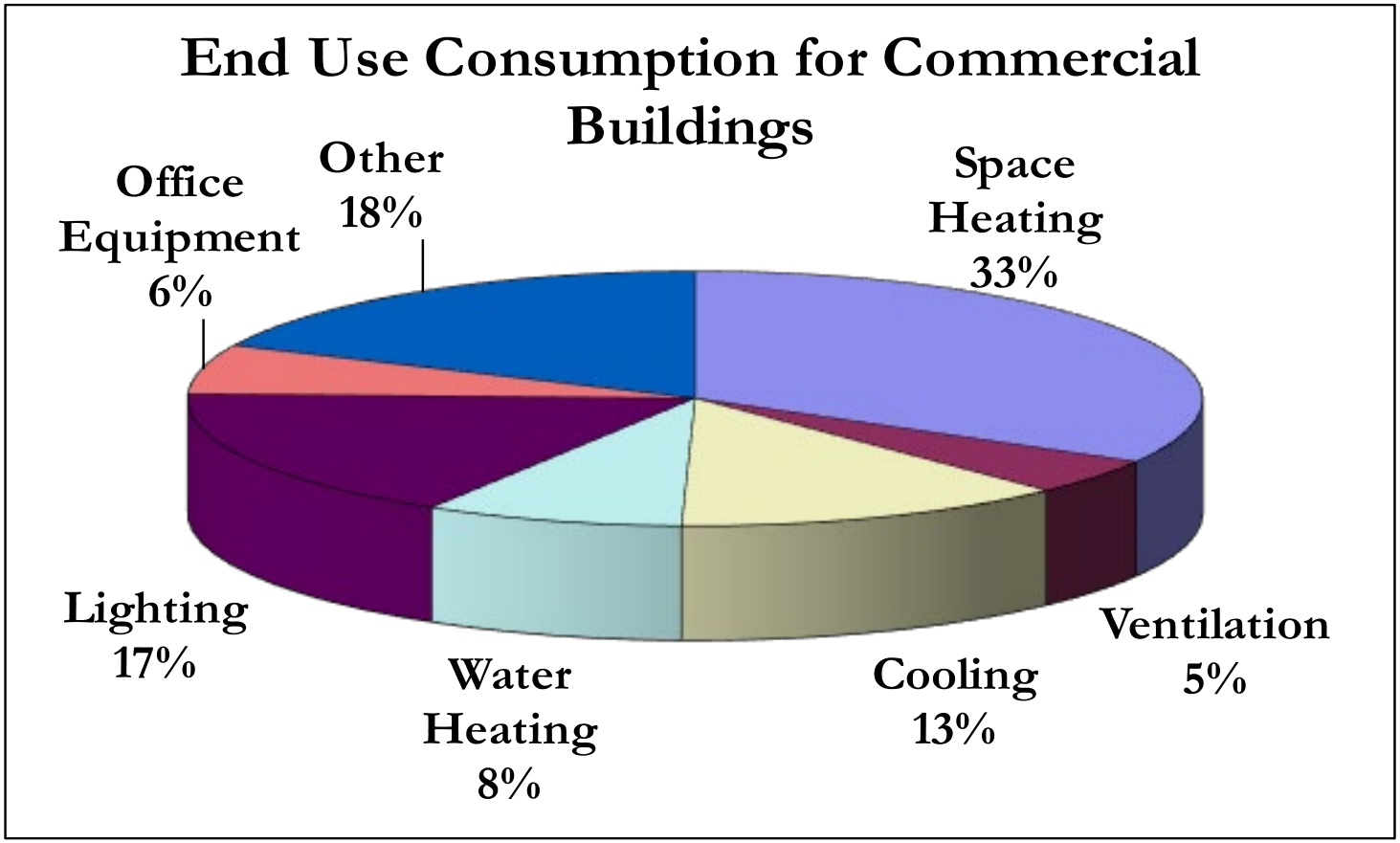
Commercial Energy Intensity

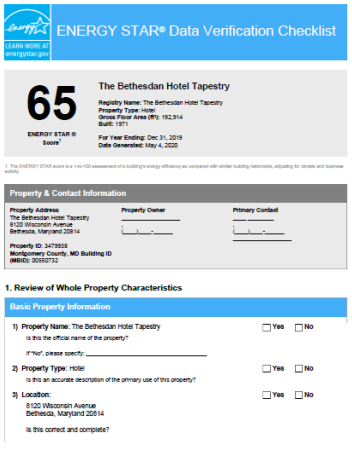


Typical Commercial Energy Consumption Breakdown



Energy Star Scoring

- 1-100 scale based on 12-months of consumption
  - Weather and occupancy normalized
  - Compared to other buildings of its type
- 75 or higher are Energy Star Certified
  - Top 25% in efficiency of its type
  - Recognition with Energy Star plaque



ENERGY STAR® Data Verification Checklist

65

ENERGY STAR® Score

The Bethesda Hotel Tapestry

Registry Name: The Bethesda Hotel Tapestry
Property Type: Hotel
Gross Floor Area (ft²): 192,914
Built: 1971

For Year Ending: Dec 31, 2019
Date Generated: May 4, 2020

Property & Contact Information

Property Address
The Bethesda Hotel Tapestry
8120 Wisconsin Avenue
Bethesda, Maryland 20814

Property Owner

Primary Contact

Property ID: 3479936
Montgomery County, MD Building ID (MBID): 20550732

1. Review of Whole Property Characteristics

Basic Property Information

1) Property Name: The Bethesda Hotel Tapestry ☐ Yes ☐ No
Is this the official name of the property?
If "No", please specify: _____

2) Property Type: Hotel ☐ Yes ☐ No
Is this an accurate description of the primary use of this property?

3) Location: ☐ Yes ☐ No
8120 Wisconsin Avenue
Bethesda, Maryland 20814
Is this correct and complete?

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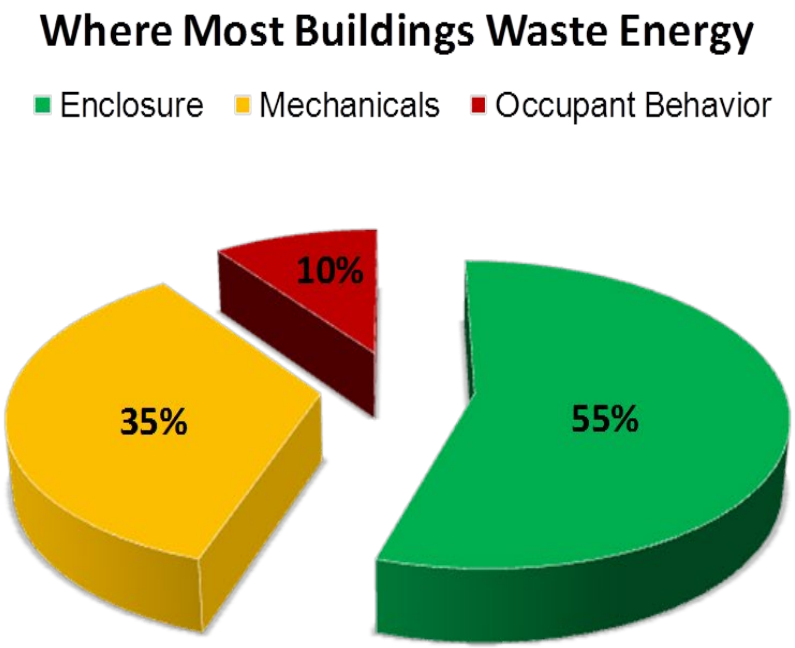
Energy Star Scoring

ES Score	Approach at Various Scores
>75	Energy Star certified, but still opportunities for energy savings
50-75	Likely low-cost / no-cost opportunities to get to Energy Star
<50	Would likely need cost-effective capital improvement measures to get to Energy Star

Energy Waste in Buildings

- 75% of computer electricity consumption occurs when no one is in front of the computer
- 35% of outdoor lighting is wasted upward, becoming light pollution
- 30% building energy waste = $200,000,000,000/yr



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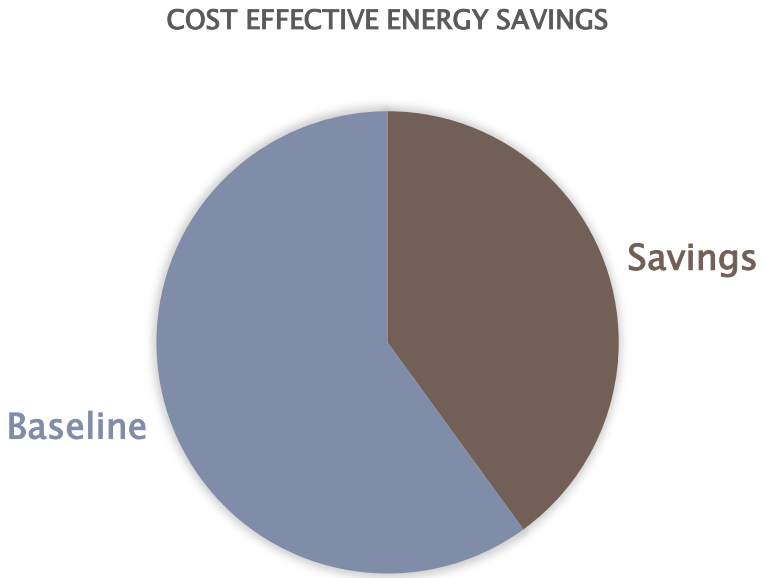
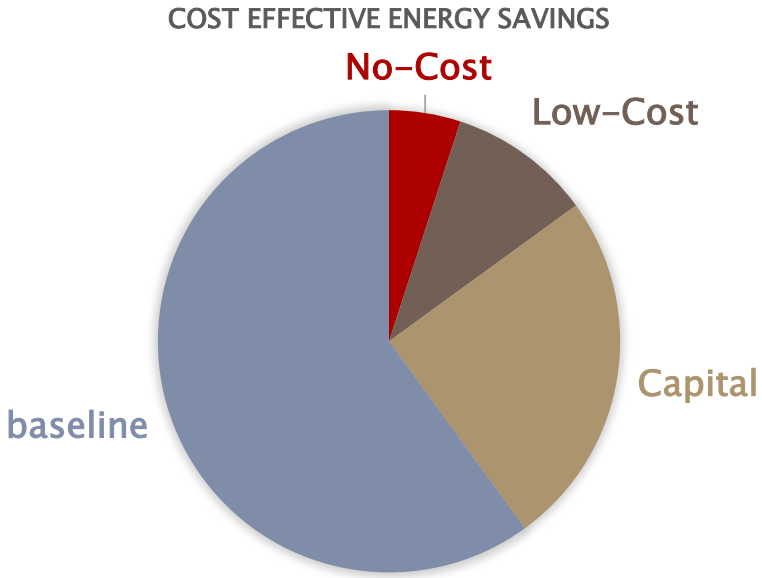
Potential for Cost-Effective ECMs





No-cost ECMs	1% – 5%
low-cost ECMs	5% – 15%
Capital Intensive ECMs	15% – 40%
	Up to 40%

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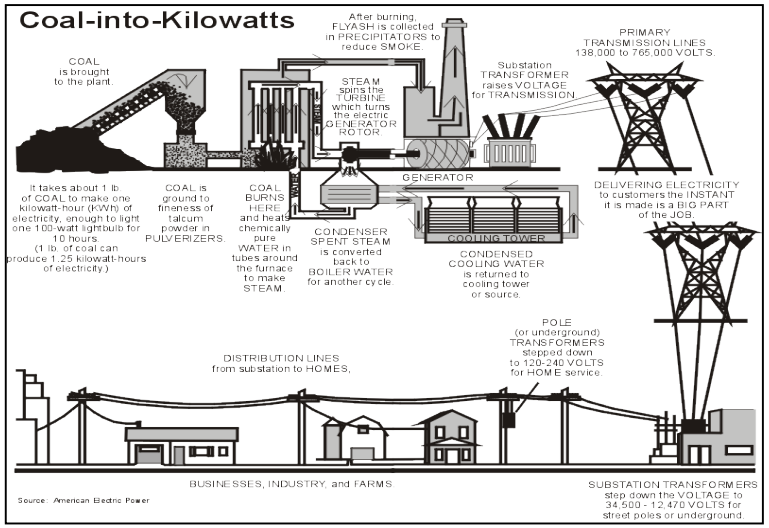
Polling Question

Polling Question

- What percentage of embodied input energy at utility plants becomes useful energy at the outlets ?

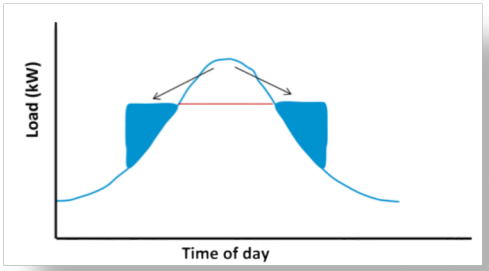
A. 10%
B. 33%
C. 67%
D. 100%



Potential No-Cost/Low-Cost ECMs

Low-Cost ECMs

- Lighting
- Temperature control
- VFDs
- Daylighting
- Retro-commissioning



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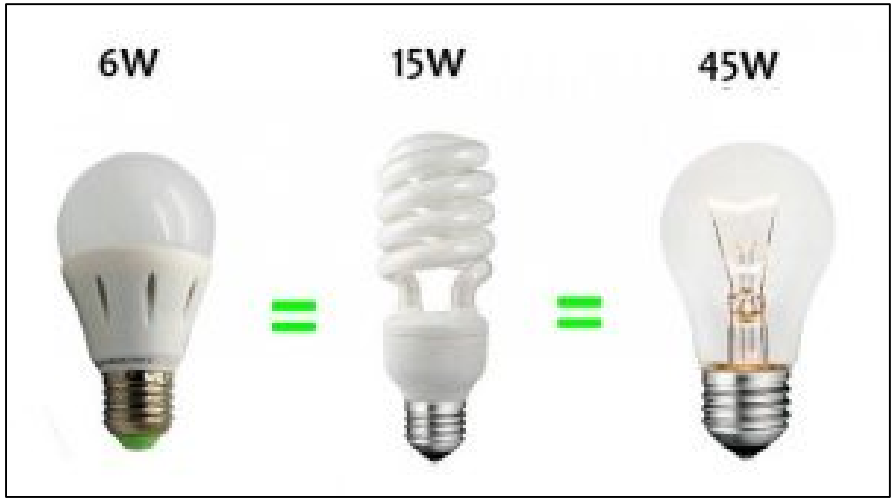
No-Cost/Low-Cost ECMs

LED Retrofits

Even compared to fluorescent technology, ROI of 15% – 100%



	Watts	hours	kWh/yr	Cost/yr
Halogen	50	6,000	300	$36
LED	6	6,000	36	$5

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Lighting Controls

Occupancy Sensors
Detect motion or heat and initiate or shut off lighting

Photocells
Monitor light levels to adjust lighting intensity when daylight is available

Programmable Thermostats

To replace fixed temp manual t-stats

Set back temperatures 6° - 10° F during unoccupied hours

	Occ	Unocc
Summer	74	80
Winter	68	60

No-Cost/Low-Cost ECMs

Variable Speed Drives

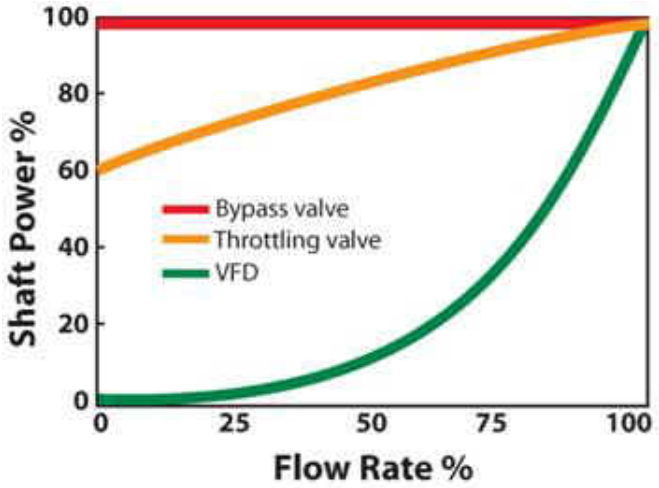
- Fans
- Pumps

Power through VSD is proportional to % of flow (or speed) cubed

- **% Input = (% speed)^3**

@ 50% speed: *12.5%* input kW

Costs down to $1,500 – $4,000



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No-Cost/Low-Cost ECMs

Pipe Insulation

- Chilled and hot water supply and return pipes
- DHW supply and return
- Valves

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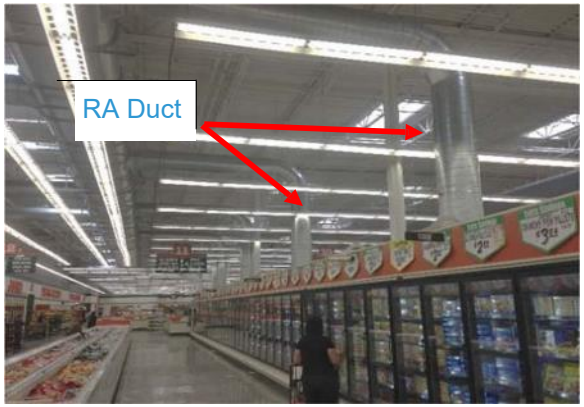
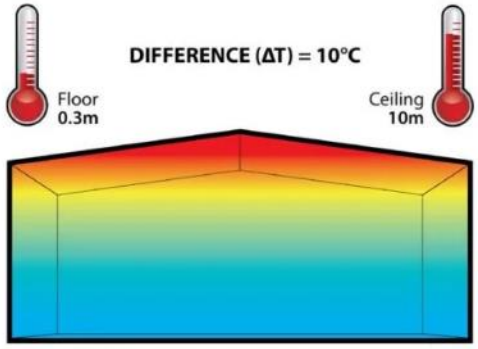
No-Cost/Low-Cost ECMs

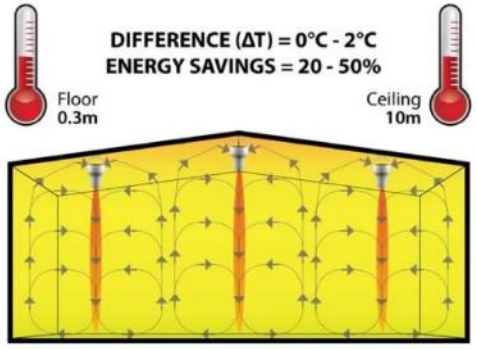
Cold and Warm exhaust air recovery

Example: Pull return air in supermarket from display cases in cooling mode

Example: Pull return air from ceiling in warehouse in heating mode







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No-Cost/Low-Cost ECMs

Refrigerant Suction line Insulation

- When located outside, can gain unwanted heat
- Can cause HP to lose 2-5% efficiency

No-Cost/Low-Cost ECMs

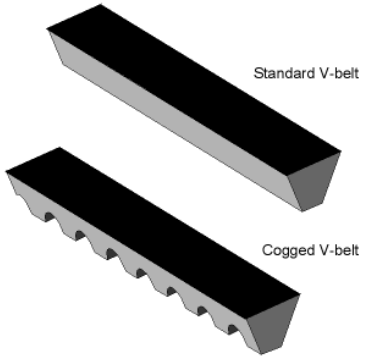
Walk-in evaporator fan controllers

- Fans typically run constantly
- Can cycle down or off when compressor cycles off

No-Cost/Low-Cost ECMs

Cogged V-Belts

- Reduce slippage at pulleys
- Can improve motor efficiency by 2%



V-Belt % Efficiencies			
Belt Type	Wrap	Cog	Savings
A	94.1	95.5	1.4
B	94.4	96.5	2
C	97.4	99.6	2.2
D	96.9	97.4	0.5

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No-Cost/Low-Cost ECMs

Weathersealing

- Gaps around doors and windows
- Missing or damaged insulation

Retro-Commissioning (RCx)

Detailed investigation, diagnostic testing, and improvement implementation of mechanical, electrical, and plumbing systems

- Return equipment to proper operation
- Identify energy waste
- Improve energy efficiency of systems

- Typcal Cost **$0.15 – $0.30/ft²**
- Typical **5% – 15%** Savings

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Retro-Commissioning (RCx)

Includes performance testing

- Does equipment turn on when called for?
- Does equipment shut off when setpoints are met
- Do valves and dampers react to temperatures correctly?
- Do field measurements match BAS readouts?

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Retro-Commissioning (RCx)

- Stuck dampers
- Malfunctioning controls
- Inaccurate thermostats
- Steam system leaks
- Compressed air leaks
- Clogged filters/coils

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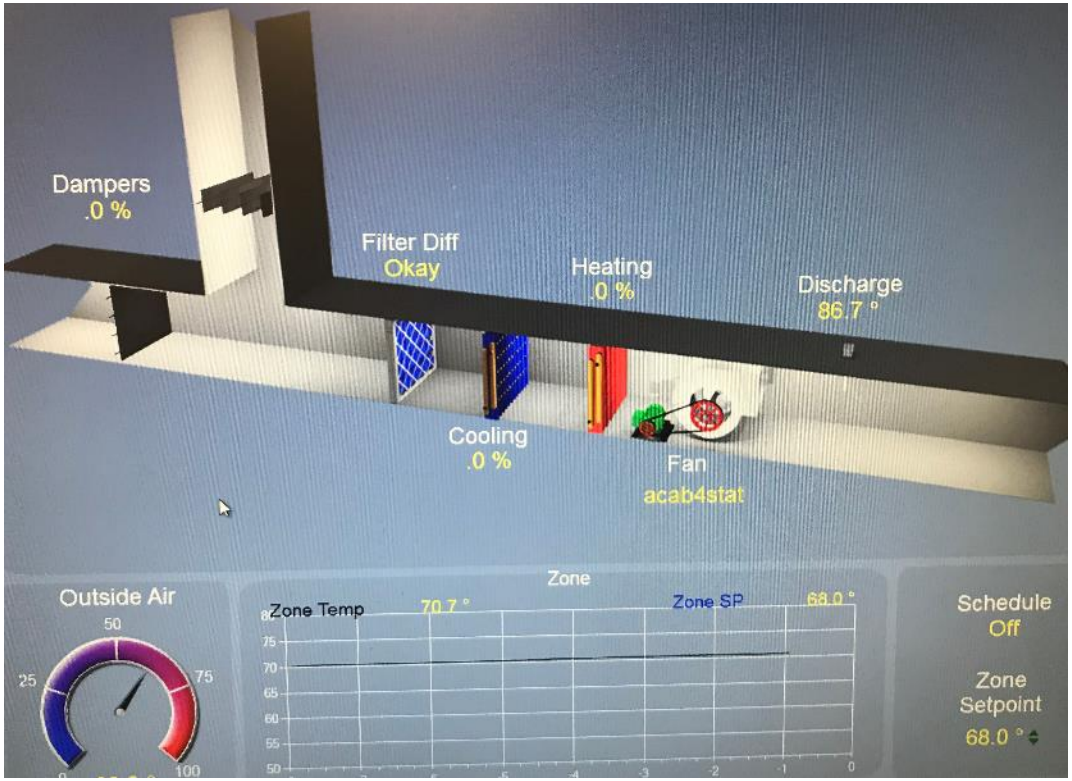
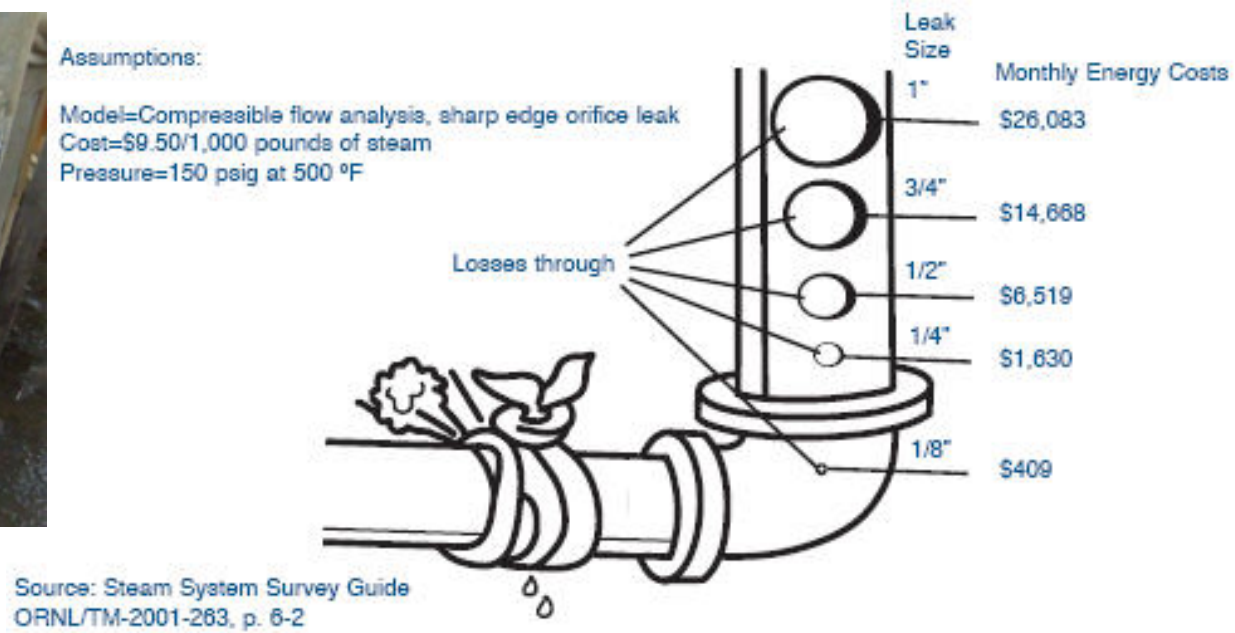
Retro-Commissioning (RCx)

- Inaccurate sensors and readouts can cause equipment to run excessively



Retro-Commissioning (RCx)

- Steam leaks can cost $1,000 a day



Source: Steam System Survey Guide
ORNL/TM-2001-263, p. 6-2

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Retro-Commissioning (RCx)

- Industrial Compressed air system leaks waste compressor energy and can prevent setpoints from holding

Costs of Compressed Air Leaks

Hole Diameter (in)	Energy Loss at Pressure (kWh/year)		
	110 psi	100 psi	90 psi
3/8	226,100	208,100	190,000
1/4	100,500	92,500	86,300
1/8	25,100	23,100	21,100
1/16	6,300	5,800	5,300
1/32	1,600	1,400	1,300

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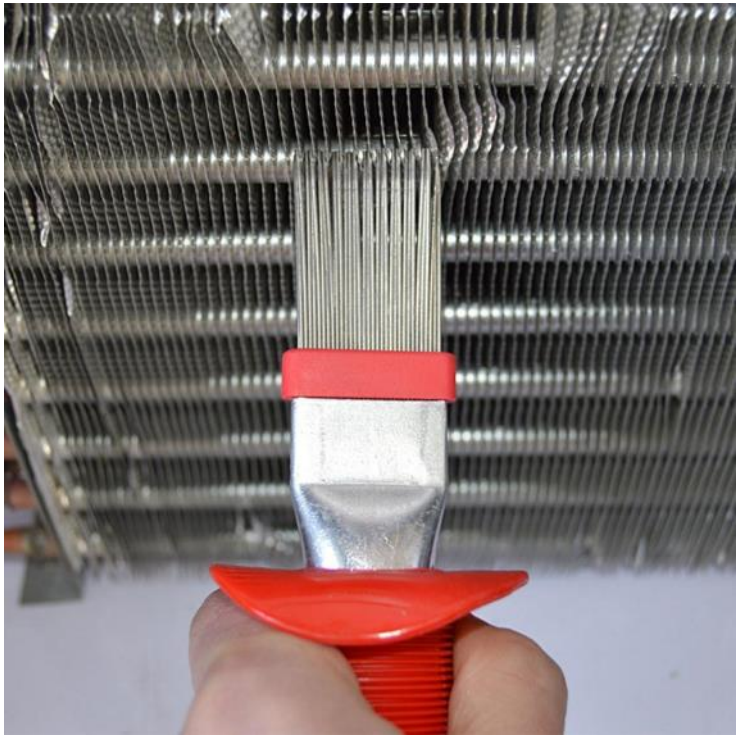
Retro-Commissioning (RCx)

- Bent and damaged fins can decrease condenser efficiency 3–5%



Polling Question

Polling Question

- True or False: Steam Leaks can cost as much as $1,000 a day

A. True
B. False

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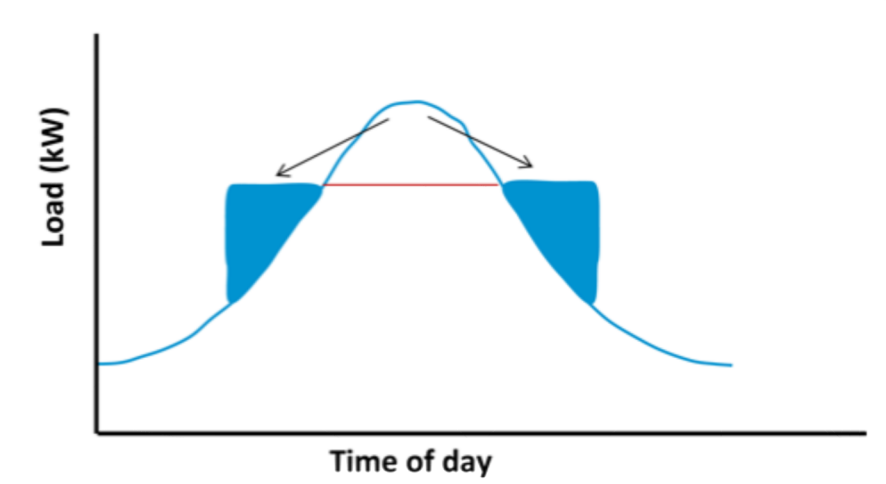
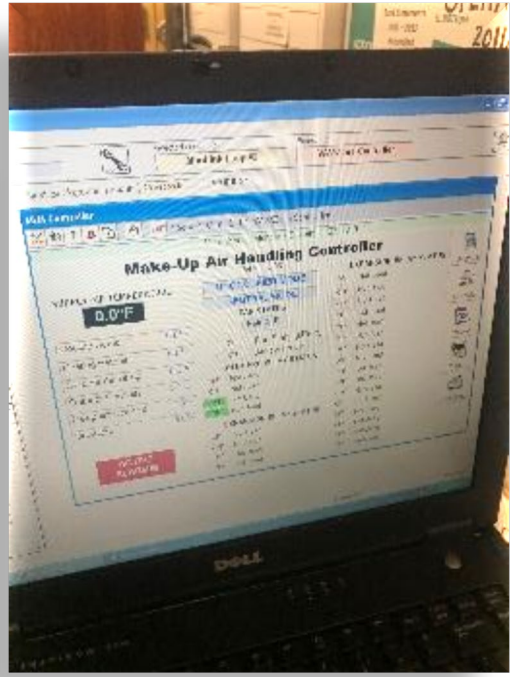
Potential No-Cost/Low-Cost ECMs

No-Cost ECMs

- Control Strategies
- Temperature optimization
- Off-peak energy reduction
- Demand reduction





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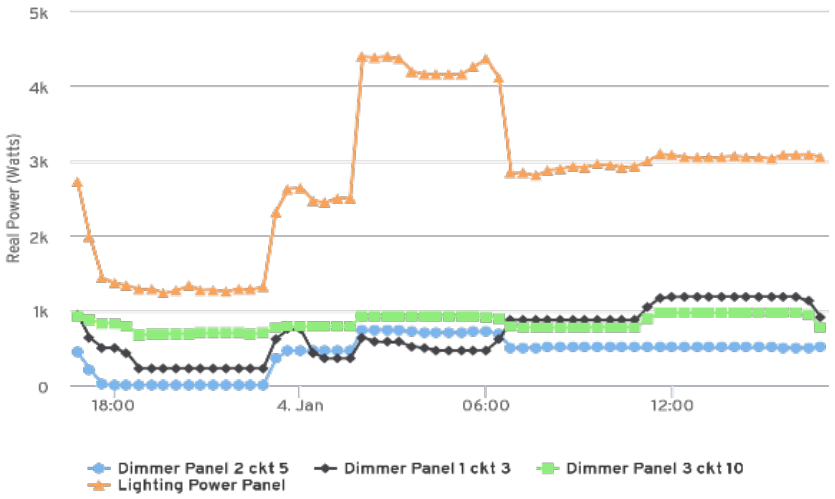
No-Cost/Low-Cost ECMs

Off-Peak reduction

Example: Reducing restaurant off peak lighting during cleaning crew hours



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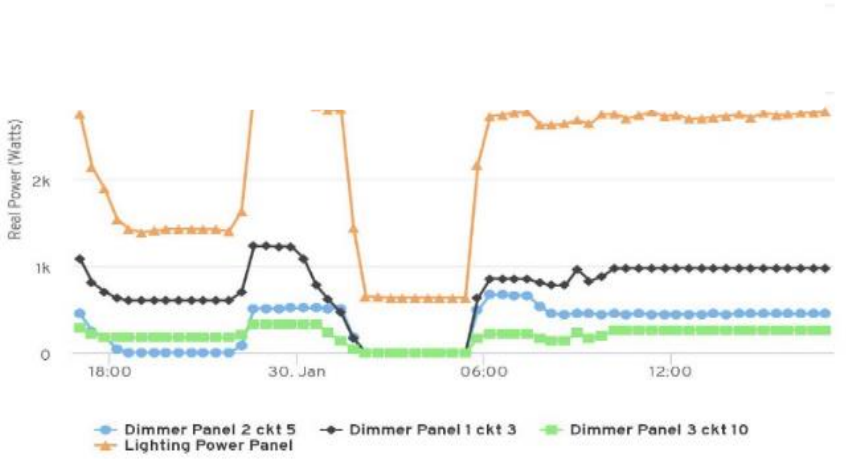
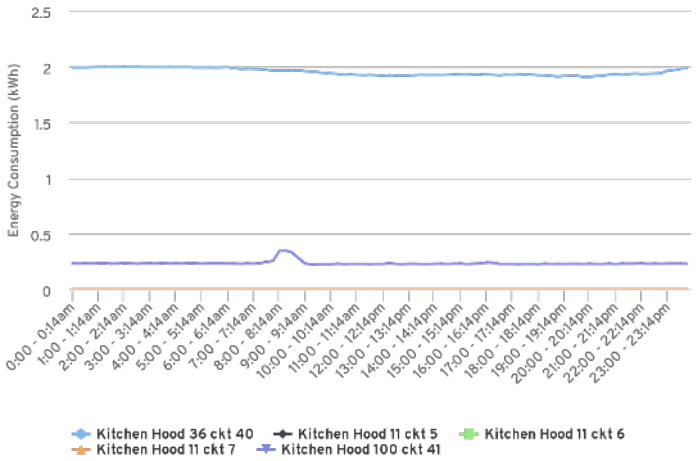


after

No-Cost/Low-Cost ECMs

Off-Peak reduction

Example: Reducing restaurant off peak hood exhaust fan consumption



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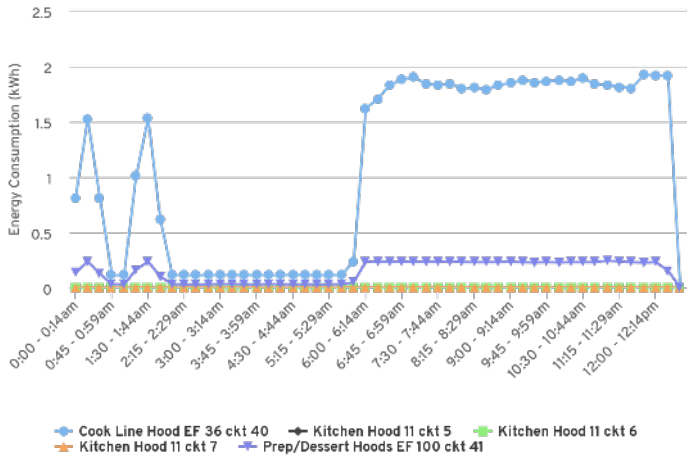

after

No-Cost/Low-Cost ECMs

Enhanced coil and filter maintenance

- Coils cleaned 2x / year
- Filters replaced every 3 months or when pressure drop indicates problem
- Clean intake grilles as needed

No-Cost/Low-Cost ECMs

Direct Sunlight control

No-Cost/Low-Cost ECMs

- Reset DHW temperature
  - Typically set to 125°F – 140°F
  - Minimum 120° to inhibit bacterial growth

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No-Cost/Low-Cost ECMs

Delamping

- Identify overlit areas and strategically remove lamps (and ballasts if possible)

No-Cost/Low-Cost ECMs

Vacant Zone Isolation

- When tenant spaces or entire floors become unoccupied, set all AHUs, VAV boxes, FCUs off or to unoccupied settings

No-Cost/Low-Cost ECMs

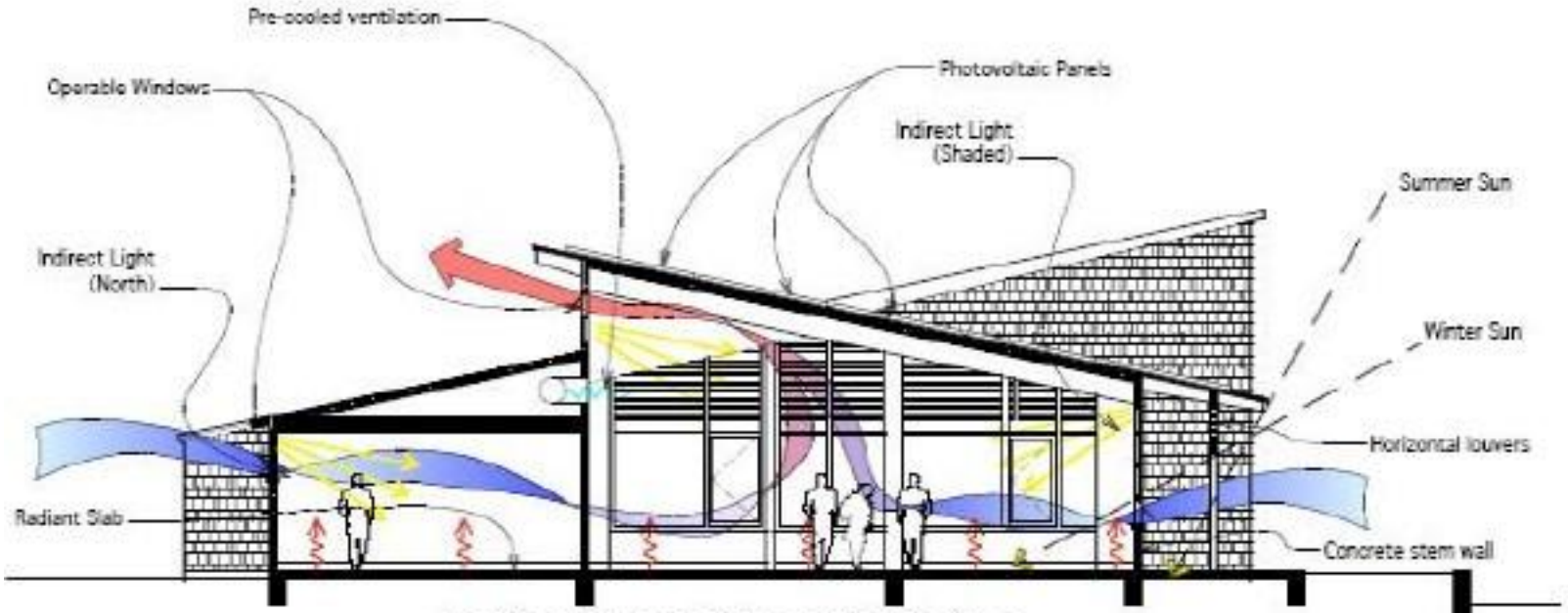
Walk-in consolidation

If several walk-in coolers are only partially full, consolidate and shut some down

No-Cost/Low-Cost ECMs

Natural ventilation

- When OAT < Room temp in cooling mode



Section Through Library: Adult Area

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Polling Question

Polling Question

- Filters in Air Handling Units (AHU) should be replaced at a minimum every

A. month
B. 3 months
C. 9 months
D. year

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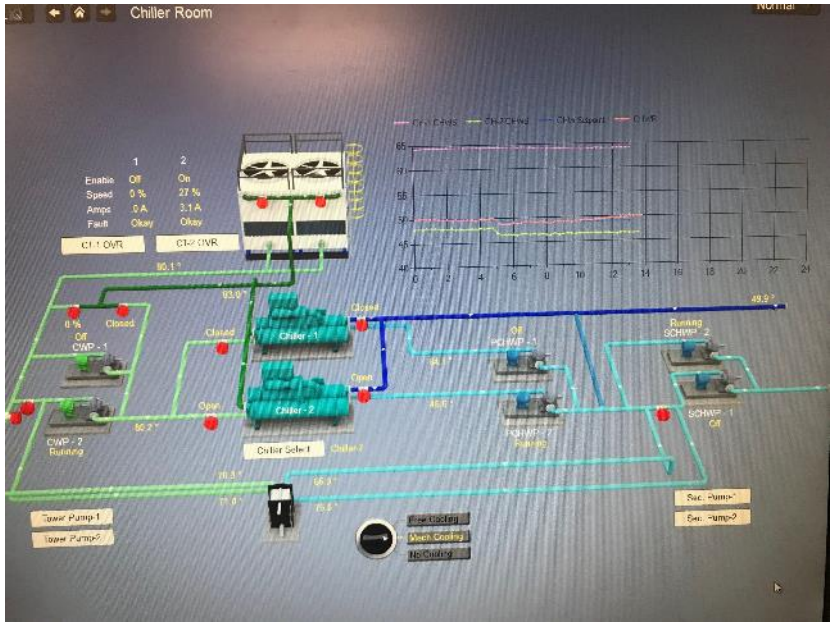
Enhanced Control Strategies

Strategies using an existing EMS



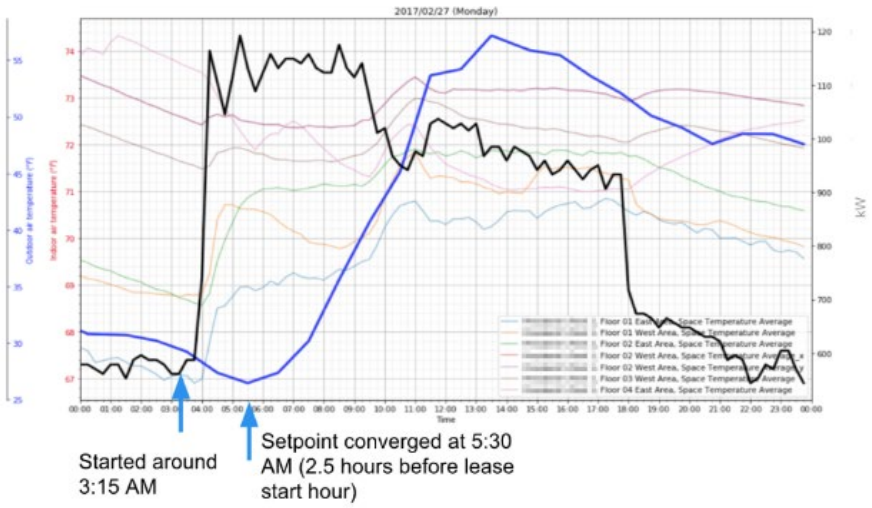
- Chiller optimization
- Economizer
- Boiler optimization
- Smart start/stop
- Chilled Water/Hot water reset

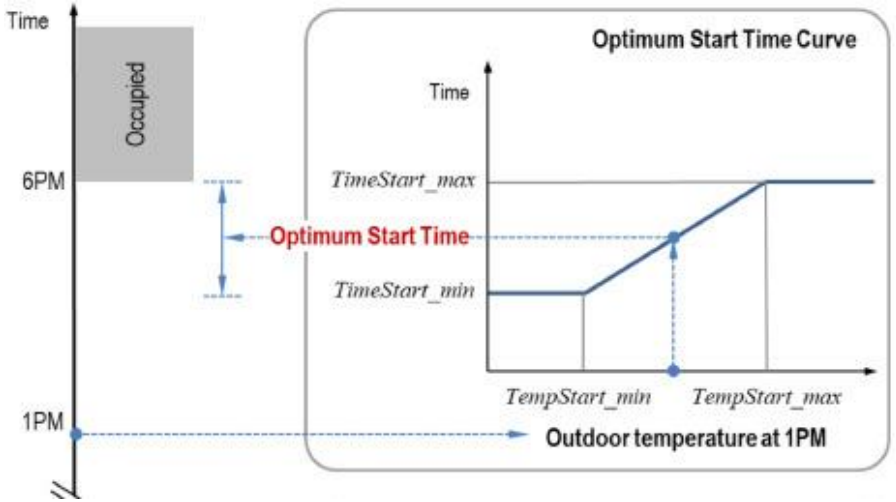
No-Cost/Low-Cost ECMs

Enhanced Control Strategies

Optimal Start

- Calculating the optimal start time for AHUs to get the zones to occupied temp
- Minimal time each day based on OAT, setpoint, previous start up times, building load





- Definition for start control

$TimeStart_{max}$	Start time at high threshold outdoor temperature
$TempStart_{min}$	Low threshold outdoor temperature
$TimeStart_{min}$	Start time at low threshold outdoor temperature
$TempStart_{max}$	High threshold outdoor temperature

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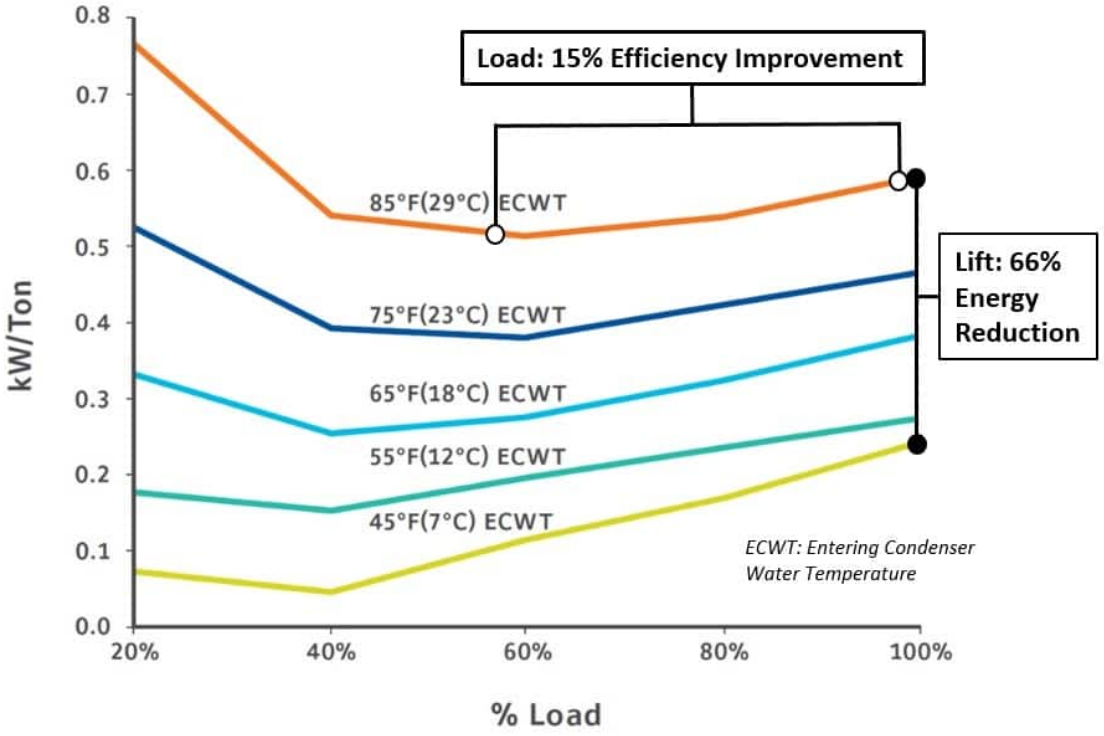
No-Cost/Low-Cost ECMs

Enhanced Control Strategies

- Floating Condenser Water control



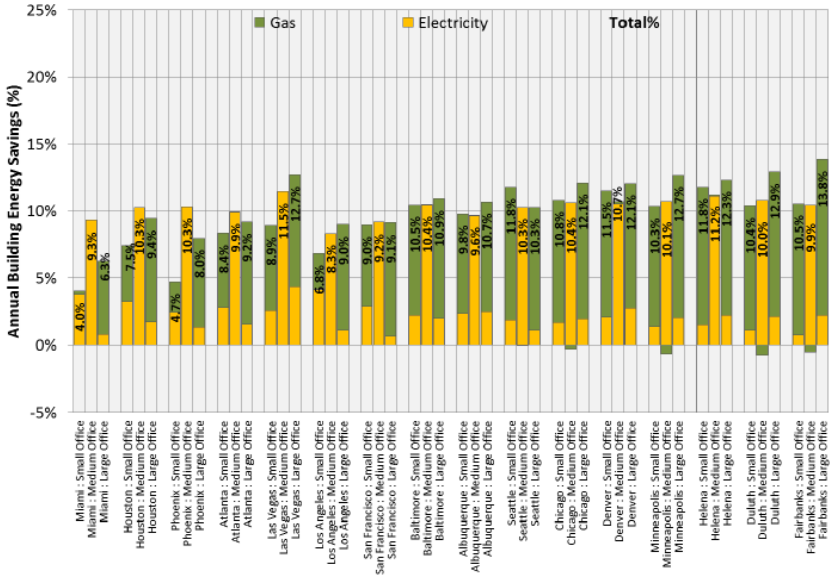
No-Cost/Low-Cost ECMs

Enhanced Control Strategies

Wider deadbands and Night Purge

- Increase deadbands around setpoint from 1-2°F to 3-4 °F
  - Reduces run time
- When building is anticipated to be in cooling mode during the day, flush building with 100% OA at night
  - whenever OAT < inside temp

Range
4% - 12% savings



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No-Cost/Low-Cost ECMs

Enhanced Control Strategies

Chilled Water Reset

Basic Outdoor Air / Chilled Water Temperature Reset Schedule	
Outdoor Air Temperature (OAT)	**Chilled Water Supply Temperature**
60°F	48°F
65°F	47°F
70°F	46°F
75°F	45°F
80°F	44°F
85°F+	43°F
90°F	43°F

Hot Water Reset

Heating Control | Hot Water Reset Schedule	
Outdoor Air Temperature (OAT)	**Hot Water Supply Temperature**
60°F	140°F
55°F	145°F
50°F	150°F
45°F	155°F
40°F	160°F
35°F	165°F
30°F	170°F
25°F	175°F
20°F	180°F

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No-Cost/Low-Cost ECMs

Enhanced Control Strategies

Match HVAC hours to occupancy

- Compare occ/unocc schedules to actual occupancy

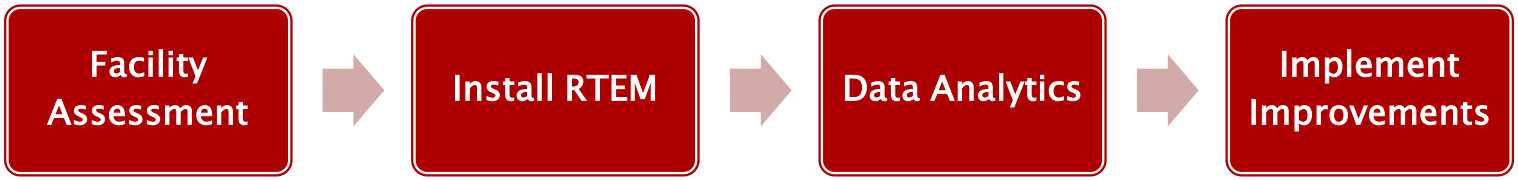
Example: Restaurant with fixed 6:00 on /11:30 off schedule

<u>New HVAC Schedule</u>

- Kitchen: 6:00 on / 11:00 off
- All other areas: ½ hr before opening on / closing off

Monitoring-Based Commissioning (MBCx)

Monitoring and analyzing equipment-based data to optimize performance and energy efficiency



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Monitoring-Based Commissioning (MBCx)

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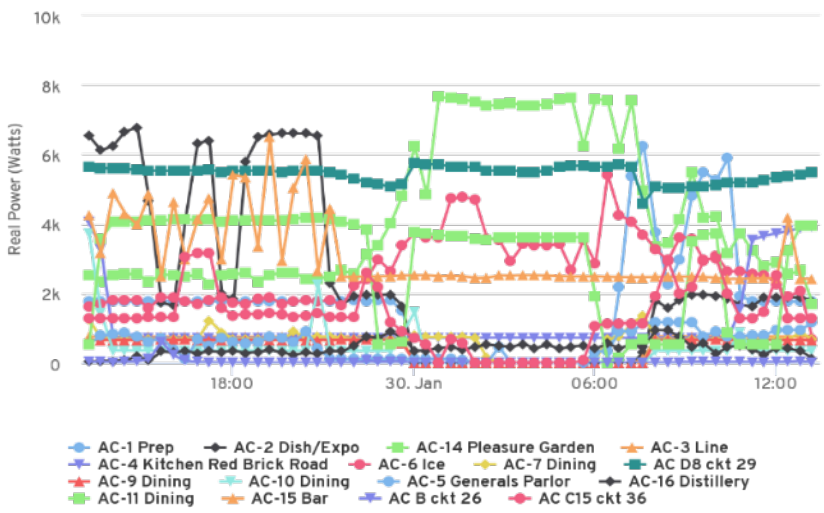
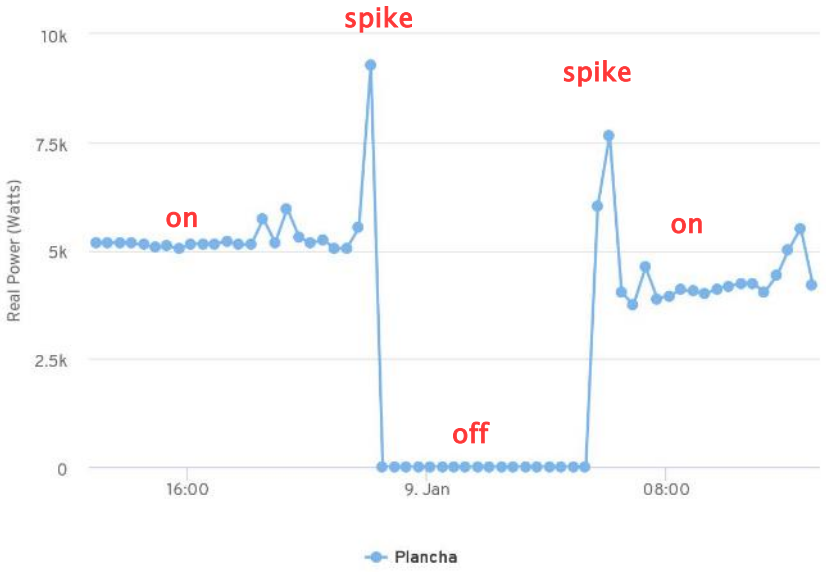
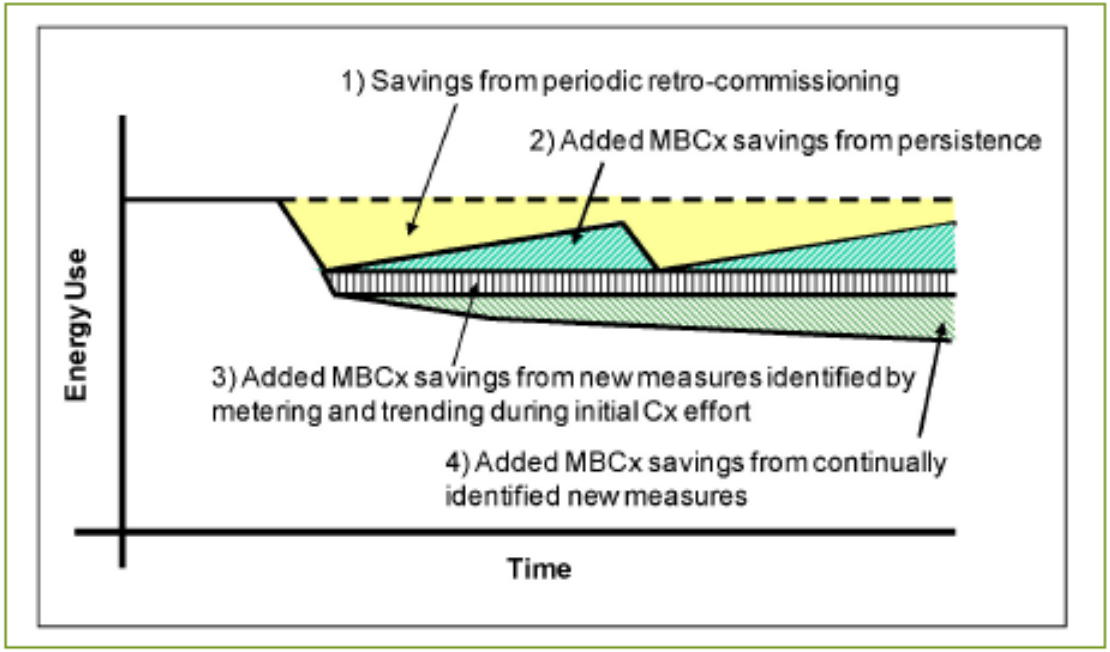




Monitoring-Based Commissioning (MBCx)

MBCx provides three streams of additional energy savings relative to RCx.



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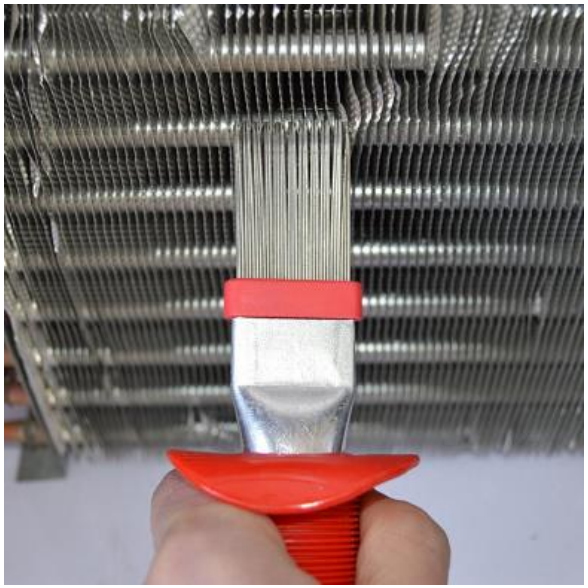
Polling Question

Polling Question

- True or False: Retrocommissioning typically includes implementing improvements identified

A. True
B. False

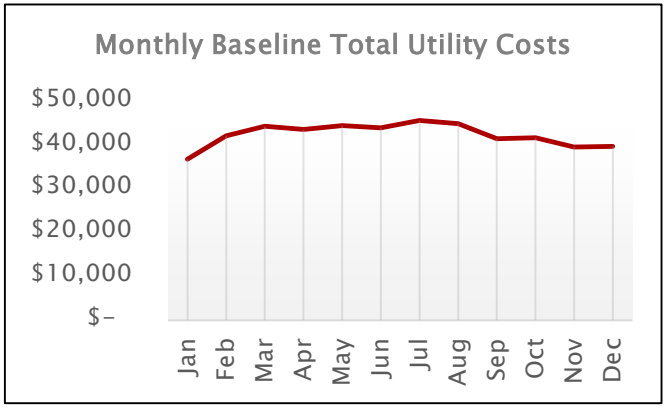


Financing LC/NC ECMs

Guaranteed Savings Service Contracts:

upgrades financed using Savings

- **Step 1**: Baseline annual utility expenditures ($/yr)
- **Step 2**: 12-month energy management service contract
  - Monthly fees equal to 5%-10% of baseline
- **Step 3**: Fees will be used to fund improvements (no additional cost)
- **Step 4**: Annual Guarantee
  - *If annual cost reduction does not exceed the fees after 12 months, the difference will be refunded*



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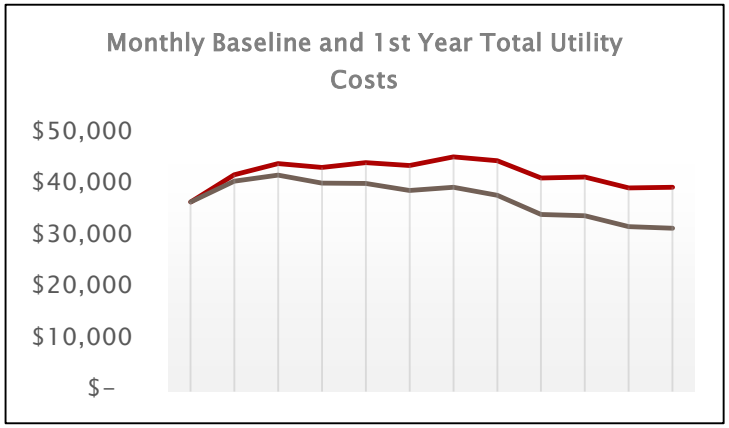
Financing LC/NC ECMs

Guaranteed Savings Service Contracts:

- Example Medium size building
- $525,000 Baseline utility costs (electric/gas/water)
- Fees 10% of baseline ($4,375/month)
- 1st year savings $52,500 Guaranteed
- Additional and Future savings locked in with no additional fees



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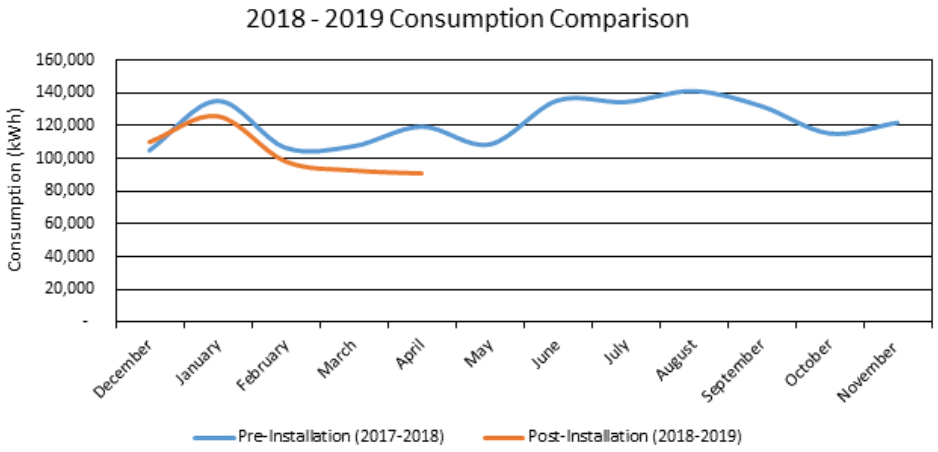
Case Study

10,000 ft² Restaurant

Initiatives Undertaken

- LED retrofits
- Off peak lighting reduction
- Duct heater shutoff
- Off peak temperature setbacks
- Kitchen hood night settings
- Baseboard heater tstats
- Dishwasher booster heater retrofit
- Exhaust fan tstat
- Reduce Hot water temperature



- **$11,900 saved after 5 months (16% of baseline)**

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Learning Assessment

- We will be providing 10 questions via poll format
- 5 minutes to answer questions
- Your participation will be logged in order to receive Continuing Education Units (CEU's)

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Learning Assessment – Answers

1. Which fuel source has the highest CO_2/kWh emissions? Coal
2. What Energy Star Score will get you recognized as an Energy Star Building? 75
3. Occupancy sensors detect either motion or heat to initiate or shut off light fixtures. True
4. Which of the following are potential opportunities for pipe insulation energy improvements? All of the above
5. Cogged V-belts save energy over standard belts by: Reducing slippage at the pulleys
6. Retrocommissioning includes performance testing mechanical equipment. True
7. Cooling and heating coils need to be cleaned at least twice a year. True
8. Chillers operate more efficiently at Lower condenser water temperature. True
9. Natural Ventilation can offset mechanical cooling. True
10. Which of the following is NOT a step in Monitoring Based Commissioning (MBCx). Report Energy Star score

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Surveys

- We will be emailing you a survey to submit to provide us feedback on todays presentation

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Questions? / Thank you!

Eric Oliver PE, CEM, LEED^{AP}
Earthwide, LLC

emo@earthwidellc.com

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