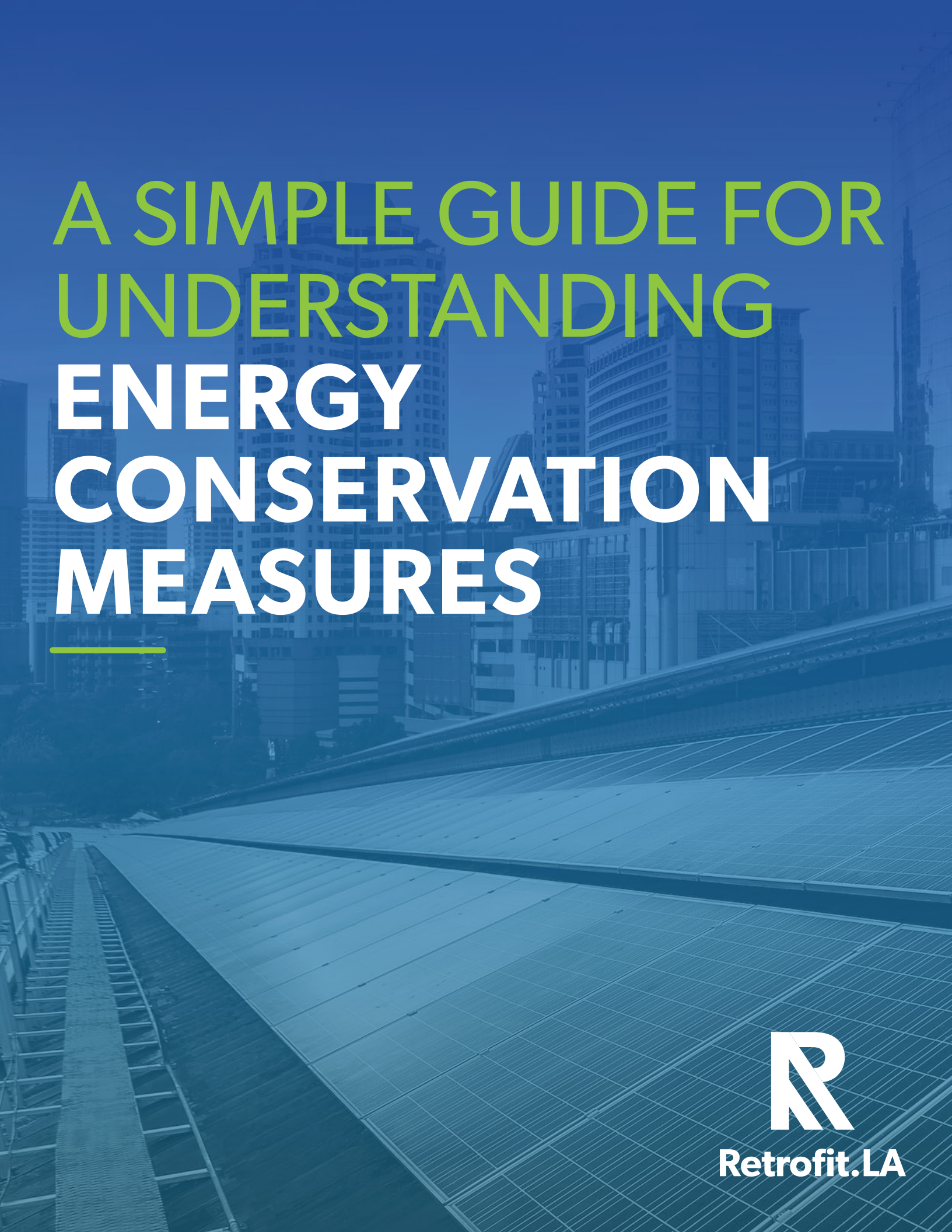
A SIMPLE GUIDE FOR UNDERSTANDING ENERGY CONSERVATION MEASURES



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Conserving energy can seem like a daunting task, but by following a few simple steps and rules of thumb, you can get a handle on how your building uses energy, where savings opportunities are, and how you can move forward.

STEPS

1. Look at the typical energy use breakdown for your type of building
2. Estimate the value of each category based on your annual energy spend ($)
3. Identify which mechanical, plumbing, and electrical systems you have in the building
4. Review applicable systems' best practices and how your systems compare
5. Understand how multiple Energy Conservation Measures (ECMs) work together and may have interactive effects

STEP 1: ENERGY USE BREAKDOWN

The table below, from the U.S. Department of Energy, reflects projected national averages for 2025 based on sample buildings. Weather has an effect on where a building spends energy. In the Southwest, cooling represents more energy use than heating as compared to the Northeast, meaning that those numbers would be adjusted accordingly. Quality of insulation is another factor that could require you to make adjustments for your building. The "SEDS" line is simply a quantification of this variability from building to building and should be allocated as appropriate to other categories for your building (i.e., added to Space Cooling in L.A.)

Buildings Energy Data Book: 3.3 Commercial Sector Expenditures *March 2012*

3.3.6 2025 Commercial Energy End-Use Expenditure Splits, by Fuel Type ($2010 Billion) (1)

		Natural	Petroleum							
	Percent	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal (3)	Electricity	Total
Lighting	15.2%								30.1	30.1
Space Heating	13.3%	17.1	2.8	1.5		0.1	4.4	0.2	4.5	26.1
Electronics	5.7%								11.2	11.2
Space Cooling	7.4%	0.3							14.3	14.6
Water Heating	4.3%	5.2	0.8				0.8		2.5	8.5
Computers	2.8%								5.5	5.5
Refrigeration	4.8%								9.4	9.4
Ventilation	8.4%								16.6	16.6
Cooking	1.4%	2.1							0.6	2.7
Other (4)	21.5%	4.8	0.3		4.3	1.7	6.3		31.2	42.3
Adjust to SEDS (5)	15.2%	5.9	4.9				4.9		19.2	30.0
Total	**100%**	**35.5**	**8.9**	**1.5**	**4.3**	**1.9**	**16.5**	**0.2**	**145.0**	**197.1**

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating ($0.1 billion) and motor gasoline other uses ($1.7 billion). 3) Coal average price is from AEO 2011 Early Release, all users price. 4) Includes service station equipment, ATMs, medical equipment, telecommunications equipment, pumps, lighting, emergency electric generators, and manufacturing performed in commercial buildings. 5) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A3, p. 6-8 for prices, and Table A5, p. 11-12 for energy consumption; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; and EIA, Supplement to the AEO 2012 Early Release, Jan. 2012, Table 32.

In simplified terms, here in Los Angeles you might expect a breakdown like this:

1. **Lighting 20%** (plus or minus a few percent depending the eficiency of your lighting)
2. **Heating 15%** (could be much less if you have high plug loads and old lighting)
3. **Cooling 30%** (could be higher if you have high plug loads and old lighting)
4. **Domestic Hot Water 3%** (pretty standard, but will be higher if you have a kitchen or gym)
5. **Everything Else 32%** (this is your plug loads and tenant systems)

STEP 2: ESTIMATE YOUR ANNUAL VALUES

Allocate the dollars from your annual energy bill according to your estimated energy use breakdown. For instance, if you spend a $1,000,000 a year in energy, you likely spend somewhere around $200,000 a year in lighting energy. Then, when a technology states a typical savings of 25% in lighting, you can estimate that will be worth $50,000 in annual savings to you (25% x $200,000 / year).

STEP 3: IDENTIFY YOUR MECHANICAL, ELECTRICAL, AND PLUMBING SYSTEMS

Answer the questions below to help you identify potential savings opportunities. This list is brief and there are many other possibilities, so ask someone who knows the building very well to identify the following:

Lighting | do you have…

Incandescent lamps?	○
T-12 tube fluorescent lamps?	○
Older 32 watt T-8 lamps, or BIAX type fluorescent lights?	○
HID parking garage or pole lights?	○
Old exit signs?	○

HVAC | do you have…

Package units on the roof?	○
Heat-pumps in the building with a cooling tower and boiler?	○
Air handlers for fan-coil units with chilled water and a central plant with chillers?	○
An old 'double-duct' system, or is it newer VAV style?	○
Electric heating or do you use boilers?	○

Plumbing and Pumps | do you have…

Pumps over 5 horsepower and if so, do they have VFDs on them?	○
Natural gas or electric water heating?	○
Low flow faucets?	○
Toilets and urinals that are high efficiency "HET" style or are they older?	○
A cooling tower? Does it have good filtration and water treatment?	○
Efficient landscape irrigation? (ie., drip irrigation.)	○

Controls | do you have…

Timers or occupancy sensors for your lights?	○
Programmable thermostats for your air conditioning system?	○
Internet connected irrigation controls or just a timer?	○
A full building automation system or energy management system?	○
Sub-metering on supplemental loads or tenants?	○
Elevators that are controlled by a computer instead of old relay panels?	○

STEP 4: BEST PRACTICES AND CONSERVATION MEASURES FOR YOUR SYSTEMS

System	Description of Energy Saving Idea	Estimated Savings on the Specific Equipment (not entire category)	Simple Payback Period (years)	Potential Costs (rule of thumb)	Secondary Benefits	Incentive(s)
Lighting	Ceiling lighting improvements	10-50% on lighting power. Applications: • Retrofit existing fixture • Commercial grade (lensed) – new fixture • Architectural grade – new fixture	1-4	$100-$200 / kit – installed $175 / fixture – installed $250 / fixture – installed	Improved color rendering reduces eye strain and improves employee productivity while reducing absenteeism	-LADWP CLIP for lighting-only projects. -LADWP CPP for projects that include lighting + additional measures.
Lighting	Outdoor lighting improvements	25-60% on lighting power and better visibility. Applications: • Area / site lighting • Floodlighting • Wall mount (wallpack)	2-5	**Installed area / site lighting** • $1000 area fixture <400W • $1500 area fixture >400W **Installed floodlighting** • $500 large area fixture • $350 small landscape fixture **Installed wall mount (wallpack)** • $350 area fixture • $250 small egress fixture	Improves contrast and color rendering improving visibility on security cameras. Improved distribution of light reduces dark areas and is more likely to provide lower light pollution levels and improve "dark sky" performance	-LADWP CLIP for lighting-only projects. -LADWP CPP for projects that include lighting + additional measures.
Lighting	Garage lighting improvements	25-80% on lighting power and better visibility • Linear LED solution • Canopy LED solution	1-4	$100 / linear ft. - installed $500 / fixture - installed	Improved security camera appearance and improved safety due to more even and higher quality light	-LADWP CLIP for lighting-only projects. -LADWP CPP for projects that include lighting + additional measures.
Lighting	Change 50W MR16 bulb to LED approximate ly 7-9W	About 60-75% on lighting lower and longer life (over 100% if including HVAC costs)	0-2	$30-$45 installed	Greatly reduced heat, longer life reduces maintenance costs up to 80%, no discernable color or brightness difference between halogen and LED	-LADWP CLIP for lighting-only projects. -LADWP CPP for projects that include lighting + additional measures.
Lighting	Exit sign replacements	50 -100% - some exit signs require no power • LED solution (< 5 watts) • Tritium solution (0 watts)	0-2	$50 / fixture - installed $300 / fixture - installed	Reduces maintenance greater than 80% and gives a fresh, clean look	-LADWP CLIP for lighting-only projects. -LADWP CPP for projects that include lighting + additional measures.
Lighting	Stairwell lighting improvements	30-80% on lighting power • Sensored / vandal resistant • Non-sensored / non-vandal resistant commercial solution	1-3	$400 / fixture - installed $200 / fixture - installed	Improved safety due to higher quality light and longer life producing fewer burned out lights	-LADWP CLIP for lighting-only projects. -LADWP CPP for projects that include lighting + additional measures.
AC	Cooling tower fan VFDs	20-50% on the fans with some benefit to the chillers	2-3	Retrofit to NEMA 3R VFD: $450/HP w/controls connection, retrofit indoor wall mount basic $250/HP	Varying the speed of VFDs stabilizes the condenser water and slightly increases chiller efficiency	LADWP CPP

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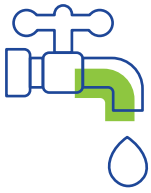
AC	Condenser water pump VFDs	10-30% and helps chiller, but requires BAS	3	Retrofit to NEMA 12 VFD: $250/HP w/controls connection	Enables tight control of water flow and slightly increases chiller efficiency	LADWP CPP
AC	Chilled water pump VFDs	20-50% on chilled water pumps	1-2	Retrofit where no VFD prior, connect to existing control system, NEMA 12:$250/HP	Increases control of water flow and provides greater air handler efficiency	LADWP CPP
AC	Chiller VFDs	15–30% on the chillers	3-6	Minimum 300 ton chiller to retrofit to VFD, w/controls connection & new control panel: $125-$200/HP	When accompanied by pump and tower VFDs, can reduce noise, extend life, improve redundancy	LADWP CPP
AC	VFDs on air handlers and other fans	20-40% in fan HP	2-4	Retrofit to VFD, controls connection, NEMA 12: $250/HP	Reduces noise, improves tenant comfort	LADWP CPP
AC	Discharge air & supply water temp reset	2-5% on HVAC	1-2	$1200/AHU and $10,00 per central plant	Reduces demand of your mechanical equipment, potentially extending service life	LADWP CPP
AC	Outside air economizer	3-7% on HVAC	2-4	$3,0000 per AHU to repair and $500 to reprogram	Has added benefit of providing extra outdoor air for purging building of airborne contaminants and creating a healthier indoor environment	LADWP CPP
AC	Night time setback	2-5% on HVAC	1	$1200-$10,000 per building depending on systems	Reduces demand of your mechanical equipment, potentially extending service life	LADWP CPP
AC	CO sensors on parking garage fans	30 – 80% in garage fans	2-6	$.35-$.40/ square foot on average depending on size	Reduces demand of your mechanical equipment, potentially extending service life	LADWP CPP
AC	Replace old motors with premium efficiency motors	2-10% motors consume huge amounts of energy, so a little goes a long way	2-8	$460/ HP, includes drive side sheaves and new belts, OT labor	When located in the conditioned air stream, they produce less heat lowering the load on your HVAC equipment as well	LADWP CPP
AC	Complete chilled water system balancing	5-10% on pumping costs	1	$1000-$5,000 depending on size of systems	Returns heat exchangers and coils to proper working flow rates improving heat transfer and reducing demand on mechanical equipment	LADWP CPP
Plumbing and Pumps	Faucet aerators	About 1 gallon per person per day	1	$5-$10 each	In addition to saving water, they also save hot water which also reduces heating energy	See Water Rebate Summary

System	Description of Energy Saving Idea	Estimated Savings on the Specific Equipment (not entire category)	Simple Payback Period (years)	Potential Costs (rule of thumb)	Secondary Benefits	Incentive(s)
Plumbing and Pumps	Shower heads in bathrooms	About 10 gallons per clean person	1	$5-$20 each	In addition to saving water, they also save hot water which also reduces heating energy	See Water Rebate Summary
Plumbing and Pumps	Toilet/flush valves	About 2.5 gallons per person on compatible toilets	4-5	$500-$600 each	Some new toilets and flush valves are of very high quality and durability reducing maintenance costs as well	See Water Rebate Summary
Plumbing and Pumps	Waterless urinals	About 2 gallons per male person per day	1-3	$500-$700 each	While requiring slightly greater maintenance for cleaning, they rarely require repair	See Water Rebate Summary
Controls	Install building automation	10-30% all mechanical systems	3-7	$25,000-$200,000 depending on system $1000-1500/zone in DDC depending on system	When planned correctly, also enables recovery of monies from providing over-standard services	LADWP CPP
AC	Insulate bare piping for chillers and boilers	1-3%, but has no maintenance and long life	2	$3 - $8 / foot depending on repairs and size	Typically just for energy savings, but does present a more upscale appearance	LADWP CPP
Operations & Maintenance	Fix steam leaks	10-25% on steam costs	1	$1,000 and up depending on size of system	When located in conditioned areas, this saves substantial HVAC cooling energy as well	LADWP CPP
Operations & Maintenance	Repair air compressor leaks	25-50% on compressor costs	1	$1000-$5,000 depending on size and complexity	Reducing the load on compressors extends service life and reduces life cycle costs	LADWP CPP
Envelope	Window film	Improved tenant comfort and 5-15% on HVAC	2-5	Good=$4 per SF Better=$6 per SF Best=$10 per SF	Also provides a cleaner outward building appearance and reduces tenant complaints of discomfort from the sun	LADWP CPP
Operations & Maintenance	Laundry operations and water optimization	20-40%	2-3		Reduces demand on heating equipment and ventilation systems, potentially extending life expectancy	LADWP CPP
Operations & Maintenance	Retro-commissioning	20% on all systems retro-commissioned	1-2	$0.25 per SF	Designed to put all systems back into peak performance, this reduces unnecessary load on all equipment and reduces repair costs, increases life expectancy, and improves performance potentiall reducing tenant complaints	LADWP CPP

STEP 5: UNDERSTANDING ENERGY CONSERVATION MEASURE INTERACTIVE EFFECTS

Measures, such as lighting in the occupied space, have interactive effects with other systems. It is important to understand what adds to your savings and what diminishes it. For instance, lighting produces heat that your air conditioning has to remove. Therefore, saving on your indoor lighting wattage will reduce how much cooling you need to provide in summer, but slightly increase your need for heating in winter.



Another example is installing faucet aerators. You save money in water, but you also save a little energy as tenants use less domestic hot water.

Retrofitting your central plant might save you a lot of money and have a good payback; however, installing window film, setting your thermostats up in summer, and retrofitting your lighting all help reduce the load on your central plant. Let's say your plant costs $500,000 a year to run and you plan a central plant retrofit to save you 20% or $100,000 a year. However, you already are retrofitting the lighting, windows, controls, and ventilation — all of which will reduce the demand of your central plant by $100,000 a year. This means that when you install your central plant retrofit, 20% is now only $80,000 and the retrofit payback may no longer meet your investment criteria.

Consider interactive effects when picking and prioritizing ECMs. Engaging the right project manager and project engineer can help you maximize your return on investment by guiding you to retrofits that work well together as a package. Quite often, spending money in one area can help preserve your capital dollars in another area by maximizing the interactive synergies of multiple retrofits. You may find that you do not need that million dollar chiller plant after all.