Do-It-Yourself Energy Audit

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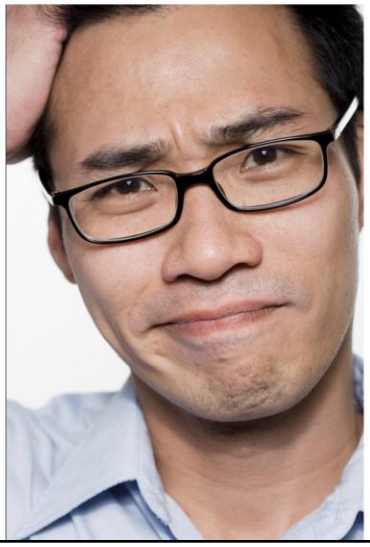
Quiz Questions:

What do you already know about energy audits?

1. What does ECRM stand for?
2. To check light counts and levels, you should do which of the following?
3. What are the two types of buildings in regard to what dominates the energy use of a building?



1. What does ECRM stand for?

A. Environmental Care Recycling Measure

B. Energy Cost Rejuvenation Monitors

C. Energy Cost Reduction Measure

D. Environmental Cost Reduction Monitors

2. To check light counts and levels, you should do which of the following?

A. Count lamps rather than fixtures

B. Identify T5, T8, and T12 bulbs by their length

C. Use a flicker checker to identify whether a ballast is magnetic or electronic without disassembling fixtures

3. What are the two types of buildings in regard to what dominates the energy use of the building?

A. Circular dominated and environment dominated

B. Envelope dominated and internal gain dominated

C. Energy dominated and internal gain dominated

D. External dominated and envelope dominated

What would you like to get out of today's online training event?

Type your response into the **Chat** window.

Getting Started

Performing a do-it-yourself energy audit is an opportunity to view your building from another perspective:

- Learn where your energy dollars are going.
- Learn how you rank against other buildings.
- Learn what no cost/low cost things you can do to save energy and dollars.
- Learn what investments you should be making to improve your buildings energy performance.
- Learn how to present your energy saving ideas in an effective manner.

Some Terminology

Term	Definition
Energy Audit	A systematic review of the building's energy usage and opportunities to reduce it
ECRM	Energy Cost Reduction Measure
ECI	Energy Cost Index ($/sf)
EUI	Energy Use Index (kBtu/sf)
kBtu	One Thousand Btu
kWh	Kilowatt hour
LPD	Lighting Power Density (W/sf)
HVAC	Heating, Ventilating, & Air-Conditioning

Defining the Level of Effort

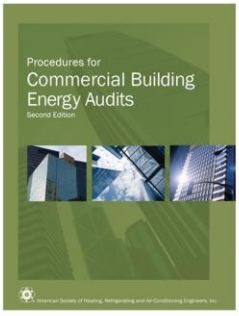
Preliminary End-Use Analysis
- Calculate kBtu/sf
- Compare to similar buildings

Level 1: Walk-Through
- Rough Costs and Savings for ECRMs
- Identify Capitol Projects

Level 2: Energy Survey & Analysis
- End-Use Breakdown
- Detail Analysis
- Cost & Savings for ECRMs
- O&M Changes

Level 3: Detailed Survey & Analysis
- Refined Analysis & Hourly Simulation
- Additional Measurements

Based upon ASHRAE's *Procedures for Commercial Building Energy Audits* September 2011



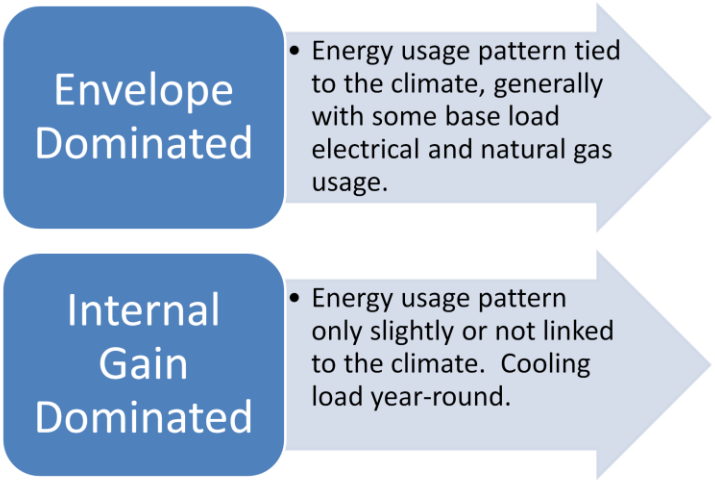
Pre-visit information gathering

- Identify Key Stakeholders (owner, operator, occupant, board of directors -- names, email address, phone numbers).
- What are the stakeholder's project interests & concerns?
- Ascertain:
  - Building function.
  - Gross square footage of floor space.
  - Two years of utility bills and climate data.
  - Building floor plan, construction documents.
  - Results of any previous energy audits.
  - Equipment lists for kitchen/store/shop.
- Schedule visit with someone with access to and knowledge of building systems (HVAC technician).

Preliminary Energy Analysis

- Analyze historical utility data and preliminary building information to gain insight into:
  - Current building operation.
  - Energy end uses.
  - Overall performance.
- Review consumption versus climate. (ftp://ftp.cpc.ncep.noaa.gov/htdocs/products/analysis_monitoring/cdus/degree_days/archives/)
- Benchmark the Building:
  - How does this building perform compared to others of a similar type and size (EUI and ECI)?
  - Determine target for energy efficiency.

Two Types of Buildings



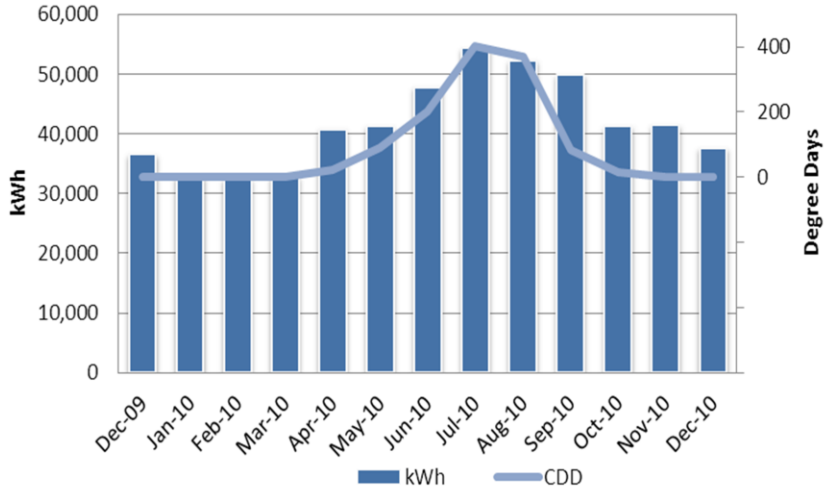
Typically small buildings are envelope dominated and large buildings are internal gain dominated – although this is not cast in concrete.

Is your business housed in an envelope dominated or internal gain dominated building?

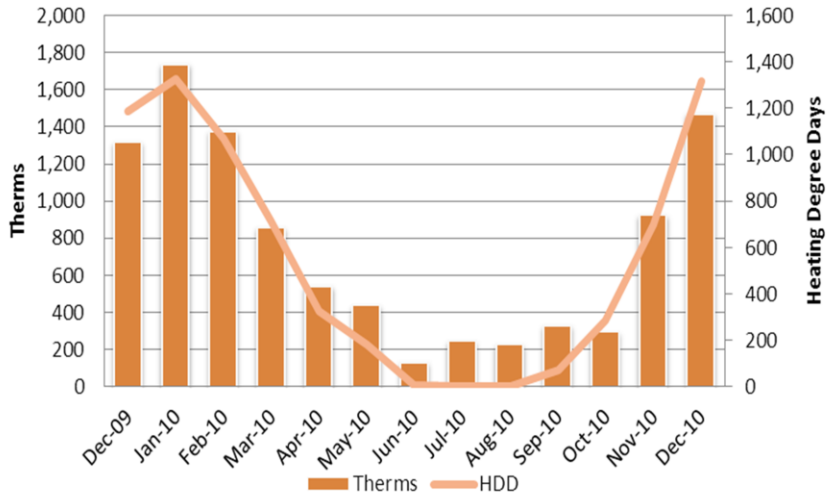
Envelope dominated: Energy usage pattern tied to the climate, generally with some base load electrical and natural gas usage.

Internal gain dominated: Energy usage pattern only slightly or not linked to the climate. Cooling load year-round.

Bank Facility Annual Electrical Consumption

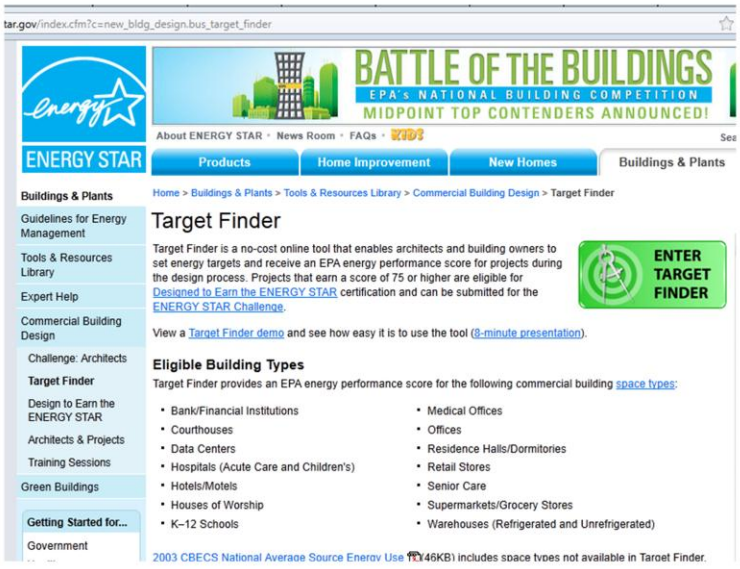


Bank Facility Annual Natural Gas Consumption



Benchmark Performance

- Energy Star Target Finder Score 1-100
- www.Energystar.gov



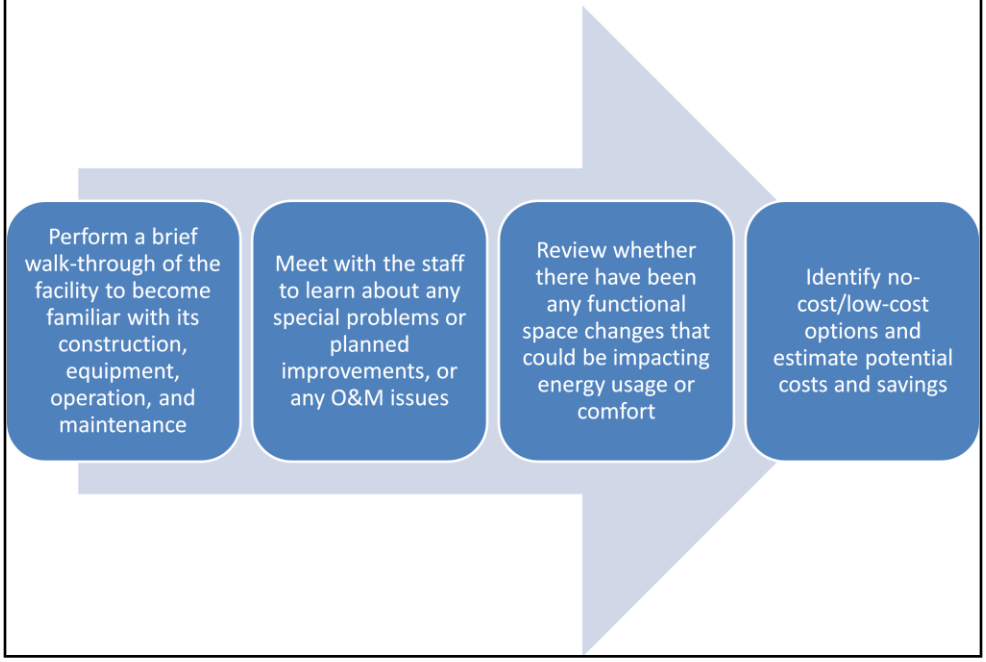
Utility Bill Analysis/Benchmarking

	Annual Consumption		Annual Costs		Average Unit Cost	
Electricity	504,000	kWh	$ 50,249	87%	$ 0.10	$/kWh
Natural Gas	8,551	therms	$ 7,236	13%	$ 0.85	$/therm
Total		**Total:**	**$ 57,485**			
Facilities Area	15,753	ft^2				
Electricity Use Intensity	32	$kWh/ft^2/yr$		**Gas Use Intensity**	0.54	$Therms/ft^2/yr$
Energy Use Intensity	**163**	**$kBtu/ft^2/yr$**		**Energy Cost Intensity**	**$ 3.65**	**$\$/ft^2/yr$**

Target Finder Results	Bank		Average		ENERGY STAR Certified	
Energy Performance	31	Percentile	50	Percentile	70	Percentile
Energy Use Intensity	163	kBtu/ft2/yr	104	kBtu/ft2/yr	82	kBtu/ft2/yr

ENERGY STAR® Target Finder was consulted for a comparison with similar buildings. Target Finder uses a large collection of building energy data to provide an estimate of an average building's energy consumption, taking into account its location, size and use.

Level 1 Walk-Through Analysis



Use a Checklist and/or Forms

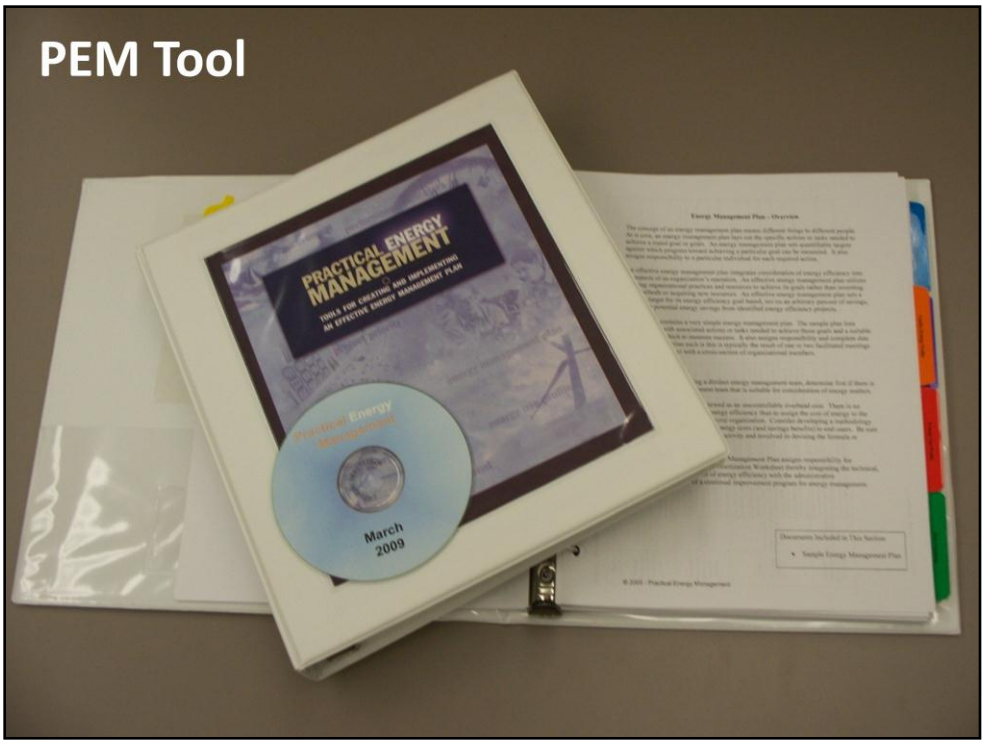
Forms make it easier to go through the building and guide you to many options:

- Washington State University Energy Auditor Checklist (2011-09-15)
- Washington State University Energy Program Energy Audit Workbook
- Rocky Mountain Institute Sample Forms

COOPERATIVE EXTENSION
WASHINGTON STATE UNIVERSITY
ENERGY PROGRAM

http://retrofitdepot.org/EnergyAuditForms_More

http://www.energy.wsu.edu/Documents/audit1.pdf



Another tool for creating an effective energy management plan and conducting an energy audit is the Practical Energy Management tool, or PEM tool. The PEM tool consists of a template of spreadsheets and forms to use to develop and administer a program.

- PEM Uses continual improvement approach
- PEM is designed to meet ANSI/MSE 2005 standard for energy management
- For Ameren Illinois business customers the PEM tool is free
- A program representative can come to your facility to show you the PEM binder and discuss how best to use it

The sections in the PEM Tool include:

1. Management Plan
2. Facility Profile
3. Energy Use Profile
4. Best Practices

5. Project Prioritization
6. Project Management
7. Key Performance Indicators
8. Continual Improvement

Walk-through Methods

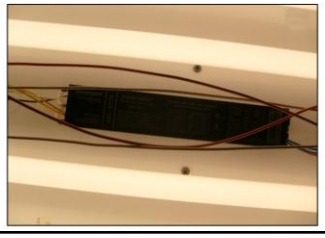
- Note **conspicuous malfunction –** less than optimal function (room very hot and window open, heating and cooling at the same time, light coming through cracks, lights on nobody home).
- Make a **list of potential** energy efficiency improvements for further investigation on the **same day** as the site visit while information is fresh in your mind. Measures should maintain comfort while reducing energy use.
- **Float ideas** of possible efficiency measures to with colleagues.
- Take a million pictures.

Data Gathering -Lighting Counts and Level

- **Check reflected ceiling plans** with installed fixtures.
- Identify T5, T8, & T12s by diameter.
- **Count fixtures** not lamps,
- Maintenance **closet** may have sample lamps and ballasts.
- Labeling of lamps may be confusing F32 could mean 32W or replaces 32W lamp (such as 28W, 25W), gathering make, model and lamp code can allow for further investigation.

Data Gathering - Lighting Counts and Level

- Ballasts may be hidden under lamps and cover plate. The make and model can be used to check the type.
- A flicker checker allows identification of magnetic/ electronic ballasts w/o disassembling fixtures.
- Compute LPD (w/sf) -- should be 0.7-2. Use ceiling tiles to estimate room sizes.
- Light levels at work surface. (No meter, poll occupants for under/over lit conditions.)



No-cost / Low-cost Options

Some no or low-cost opportunities:

- Temperature settings and setback/up opportunities.
- Air sealing (caulking and foaming).
- Ventilation shutdown at night.
- Lighting change-outs (CFL or LEDs for incandescent, T12 to T8, LED exit signs).
- Tune-ups of HVAC equipment (boilers, furnaces, A/C units, steam traps, etc.).
- Changing utility rates (ARES).

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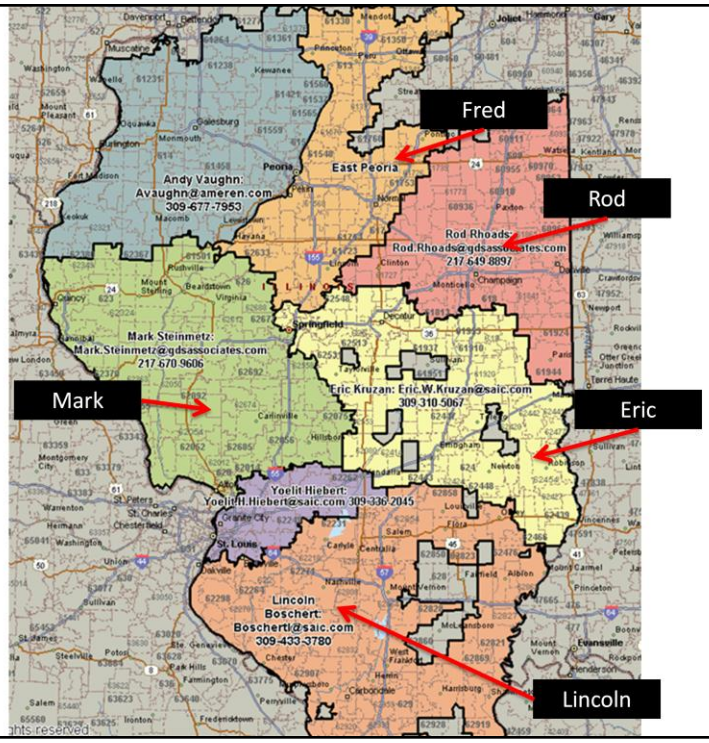
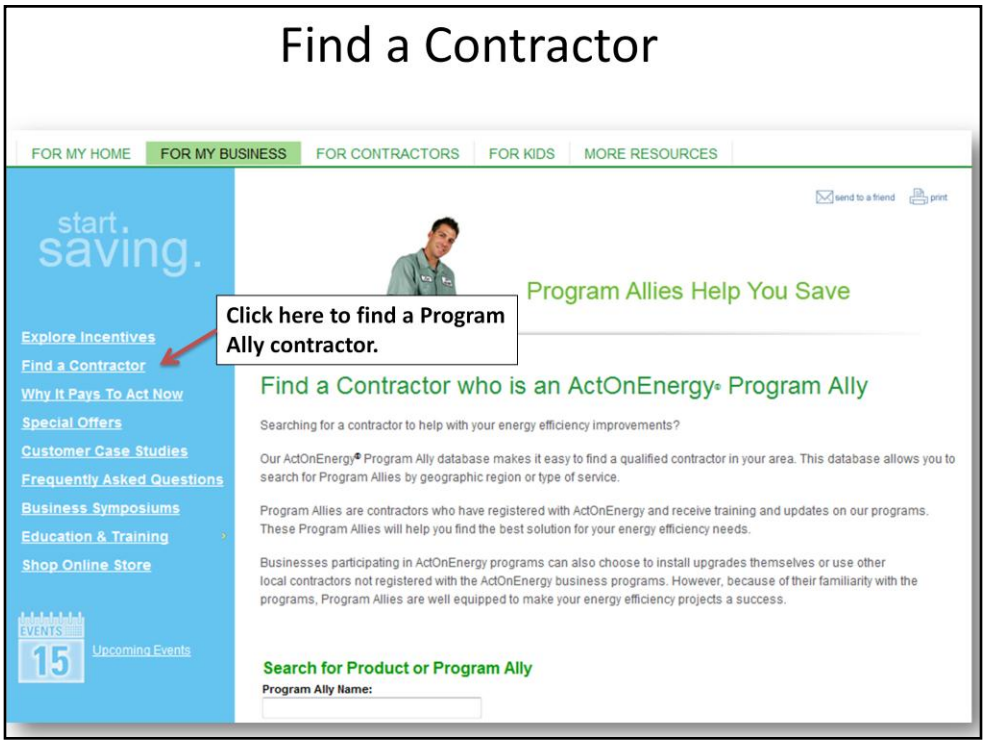
Energy Advisors



Find a Contractor



One way to find a contractor to perform an energy audit is to contact a Program Ally Program. Allies have been trained in how the program works and have experience in conducting projects with the ActOnEnergy program. You can find a list of Program Allies on the ActOnEnergy Website.

Have you performed an energy audit in the past?

Develop the Level 1 Report

- Quantify savings from rate changes
- Discuss results of utility bill analyses and benchmarking
- Discuss any special problems or needs identified from the walk-though, including any needed O&M changes
- List ECRMs and estimated savings
- List any potential capital improvements with an initial rough cost estimate and savings

Level 2 Energy Survey & Analysis

Review mechanical and electrical system design, installed condition, maintenance practices, and operating methods

Review existing O&M problems and recommended improvements

Describe and analyze the energy-using systems of the building – based on observations, measurements, calculations, etc.

Level 2 Energy Survey & Analysis

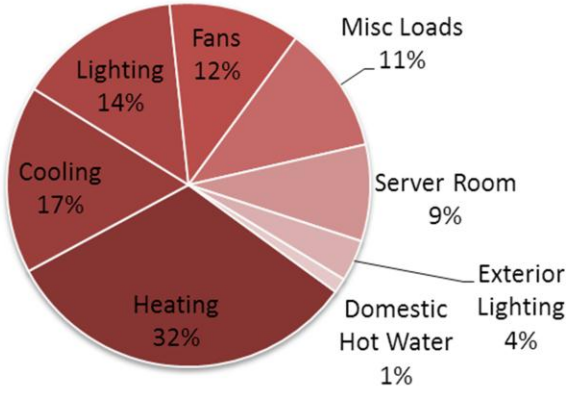
- Include the following systems:
  - Envelope
  - Plug loads
  - Laundry
  - Refrigeration
  - Pools/saunas/spas
  - Domestic Hot Water
  - Lighting
  - HVAC
  - Food preparation
  - Conveying
  - Process loads

- Prepare a breakout of annual energy uses in the facility by energy and costs.
- Use forms to assemble data & info on systems.

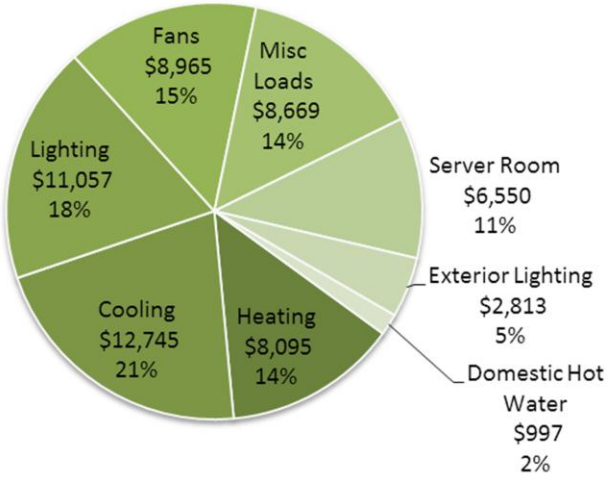
Estimating Energy Breakouts

- End-use estimates can be based on the following:
  - Detailed measurements over time.
  - Spot measurements with estimates of run times on an annual basis.
  - Detailed calculation or hourly simulations based on building drawings and specifications (calibrated model).
  - Assumption of typical end-use densities (CBECS or other sources).
- Accuracy decreases as you go down the list.

Bank Energy Usage Breakout



Bank Energy Cost by Load Type



Present Info on ECRMs

Energy Cost Reduction Measure	Yearly Energy Savings					
	kWh	Therms	kW	Energy %	$	% Cost
Lighting Wattage Reduction	27,890	(21)	10	4%	$2,763	5%
Lighting Controls	27,065	(21)	-	4%	$2,681	5%
Thermostat Replacement	26,563	2,379	1	13%	$4,661	8%
Testing and Balancing	18,551	311	-	4%	$2,112	4%
Demand Control Ventilation	10,238	775	-	4%	$1,677	3%
VFD on Air Handling Unit	17,447	631	-	5%	$2,273	4%
Computer Power Management	14,397	(92)	-	2%	$1,358	2%
Beverage Cooler Energy Use	1,870	-	-	0%	$186	<1%
Package of Measures	117,682	3,260	11	29%	$14,491	26%

Energy Cost Reduction Measure	Annual Cost Savings	Initial Investment	Internal Rate of Return (IRR)	Net Present Value (NPV)
Lighting Wattage Reduction	$2,763	$12,750	17%	$3,842
With Incentives		$10,334	24%	$6,441
Lighting Controls	$2,681	$6,000	43%	$9,519
With Incentives		$5,400	50%	$10,457
Thermostat Replacement	$4,661	$5,000	93%	$31,532
Testing and Balancing	$2,112	$6,000	33%	$6,345
Demand Control Ventilation	$1,677	$10,300	10%	$1
With Incentives		$8,963	13%	$1,217
VFD on Air Handling Unit	$2,273	$4,000	66%	$9,574
With Incentives		$3,438	119%	$10,961
Computer Power Management	$1,358	$0	-	-
Beverage Cooler Energy Use	$186	$160	116%	$896
With Incentives		$60	311%	$987
Package of Measures	$14,491	$44,210	32%	$60,012
With Incentives		$39,195	37%	$64,571

Top-10 Recommendations

SEDAC's most common energy efficiency measures that either have a short payback or drastically reduce energy:

1. Efficient lighting (T8, T5, vacancy controls, LED exit signs)
2. Weatherization/air sealing
3. Commissioning and retro commissioning of HVAC equipment
4. Temperature setbacks/setups
5. Efficient boilers/furnaces and tune-ups
6. High-efficiency cooling system
7. Ventilation adjustments (demand control: schedule, CO2)
8. Electric motor controls (variable frequency drives)
9. Insulation upgrades
10. Window upgrades

Forms & Spreadsheets from ASHRAE

- ASHRAE PEA Template (2011-09-21)
- ASHRAE Formulas and Unit Conversions (2011-09-21)
- ASHRAE PCBEA Sample Forms (2011-09-21)
- ASHRAE Sample End-Use Breakdown (2011-09-21)
- EEMs to Consider (2011-09-15)
- ASHRAE EEM Summary Table (2011-09-21)
- ASHRAE Hourly Simulation Checklist (2011-09-21)
- Washington State University Energy Auditor Checklist (2011-09-15)

http://www.ashrae.org/PCBEA

Other Tools and Resources

- Energy Guide self audit tool (40 business types, interactive and self-advancing): http://www.energyguide.com/audit/BAintro.asp
- Smart Energy Design Assistance Center: www.sedac.org
- Energy Education Council (Energy Efficiency Resource Center): http://efficiencyresource.org/
- EPA Energy Star Commercial Building Resources: http://www.energystar.gov/index.cfm?c=business.bus_index

Illinois Smart Energy Design Assistance Center

- Web site: www.sedac.org
- Contact: info@sedac.org
- 1-800-214-7954

Resources

- Website: ActOnEnergy.com
- Phone: 866-800-0747
- Fax: 309-677-7950
- Email: ActOnEnergyBusiness@Ameren.com

ActOnEnergy.com

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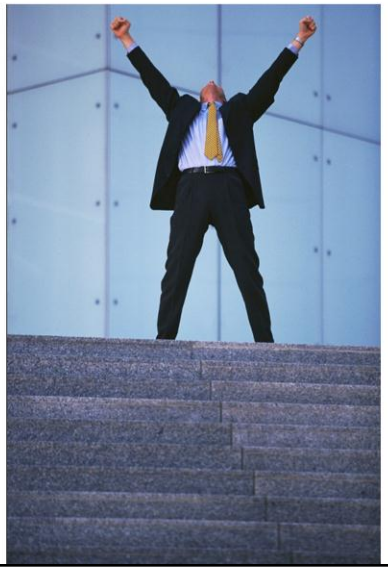

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answers, click the submit button. You'll have about a minute to submit your responses.

Certified Energy Manger Training

Ameren Illinois and the Association of Energy Engineers (AEE) are partnering to host Certified Energy Manager training.

Dates:	March 26 - March 30, 2012
Time:	8:00 a.m. to 5:00 p.m.
Location:	Ameren Illinois 300 Liberty Street Peoria, Illinois 61602
Cost:	**$1695.00 by Feb. 24, 2012** $1795.00 after Feb. 24
Contact:	Mary Bentsen 309.677.5703 mbentsen@ameren.com

Since its inception in 1981, the Certified Energy Manager (CEM) credential has become widely accepted and used as a measure of professional accomplishment within the energy management field.

Reserve your spot now and take advantage of Early Bird pricing! Limited seats available.

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- Web site: www.sedac.org
- Contact: info@sedac.org
- 1-800-214-7954