Save Money and the Environment

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Environmental Compliance Training for Correctional Facilities
July 15, 2009

KPPC
Kentucky's Resource Center for Environmental Sustainability

What Is KPPC?

- KPPC is a non-profit organization established in 1994 through a legislative mandate
- Statewide technical assistance & outreach programs
- Based at the *University of Louisville's* J.B. Speed School of Engineering
- Represents the *University of Louisville* as a nationally recognized Center of Excellence
- Provides hands-on training for students through the Cooperative Education Program at SSoE

KPPC

Mission

KPPC is Kentucky's primary resource to help businesses, industries and other organizations develop environmentally sustainable, cost-saving solutions for improved efficiency.

Based at the University of Louisville J.B. Speed School of Engineering, KPPC provides technical information and assistance that is free, confidential and non-regulatory.

Pollution Prevention

- **Source Reduction**
  - ✓ Purchasing food in bulk
  - ✓ Non-disposable plates, cups and silverware
  - ✓ Purchasing goods in returnable containers
  - ✓ Utilizing green products for cleaning
  - ✓ Repair and reuse of textiles
  - ✓ Repair and reuse of electronics

Pollution Prevention

- Recycling
  - ✓ Paper
  - ✓ Metal
    - Aluminum
    - Steel
  - ✓ Plastics
  - ✓ Electronics
- Composting
  - ✓ Food Waste
  - ✓ Yard Trimmings

Sampson Correctional Institution

- **Vermi-Composting**
  - ✓ Reduction of 45 tons/year of organic waste biosolids
  - ✓ 2 units handling 480-700 lbs/day food waste
  - ✓ Reduction of 5 - 8 yd^3 dumpsters per week to a 34 yd^3 compactor emptied monthly
- **Waste Reduction**
  - ✓ Kitchen staff conducted audit to reduce food waste

Sampson Correctional Institution

- **Recycling**
  - ✓ Baling and recycling of 1 ton steel, ¼ ton plastic, 1,200 tons aluminum cans and 3.2 tons cardboard
  - ✓ Revenue of $2,200 per month
  - ✓ Staff and inmates utilize plastic/glass drink containers from aluminum can revenue
- **Results**
  - ✓ 86% reduction in solid wastes resulting in $74,000/yr in cost savings

Brown Creek Correctional Institute

- **Source Reduction**
  - ✓ Bulk storage of cleaning supplies
  - ✓ Individual milk cartons replaced with bladder dispenser
  - ✓ Replacing foam cups with reusable cups
  - ✓ Electric hand dryers replacing paper towels
- **Composting**
  - ✓ Vermi, static pile, and in-vessel composting
  - ✓ Wastes from food services, vegetable garden and greenhouses, dryer lint, hair from barber shop, and eggshells

Brown Creek Correctional Institute

- **Recycling and Reuse**
  - ✓ Hand sorting and recycling of aluminum and steel cans, plastic containers, office paper, mixed paper and cardboard
  - ✓ Reuse of food service items, inmate clothing, and serviceable material
  - ✓ Old broomsticks and wood pallets used as tomato stakes
  - ✓ Recycling of meat and bone scraps, cooking grease, and used motor oil

Brown Creek Correctional Institute

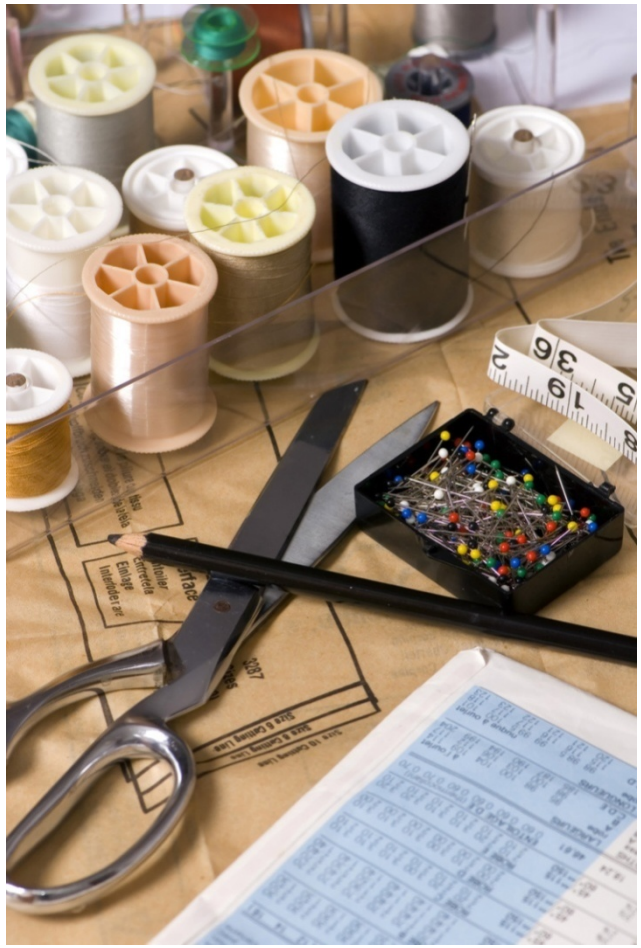
- **Cost Savings**
  - ✓ **Trash pick-ups reduced from twice weekly to once per month with $1,056/month savings**
  - ✓ **Trash quantity reduced by 67% from 28 tons to 9 tons per month**
  - ✓ **Clothing recovery reduced clothing expenditures by $48,000/year**

Tennessee Dept. Of Corrections

- **Computer Recycling**
  - ✓ 65 tons of computers refurbished
  - ✓ Repairing 2,332 PC units from 3 computer repair and reuse centers
  - ✓ Computers were placed into public schools
- **Composting**
  - ✓ Composted 1,600 tons of organic materials
  - ✓ Utilized compost on-site
  - ✓ Saved $460,433 in disposal and compost costs

Tennessee Dept. Of Corrections

- **Reuse**
  - ✓ **Conserved 13 tons of textiles by repairing inmate clothing**
    - **8,422 pairs of blue jeans**
    - **7,882 shirts**
    - **1,077 jackets**
    - **38 sweatshirts**
  - ✓ **Saved $100,000 in new clothing purchases**



Georgia Dept. Of Corrections

- **Composting and Recycling at 6 Prisons**
  - ✓ **Food waste and yard trimmings composted**
  - ✓ **Recycling of aluminum, cardboard, paper, plastics and steel**
  - ✓ **Revenues from recyclables offset program costs**
  - ✓ **Diverted 8,564 tons from the landfill saving $357,000 in landfill tipping fees**
  - ✓ **Compost saved $100,000/yr on fertilizer costs**
  - ✓ **Inmates involved in the program gained marketable job skills**

Energy Efficiency

Energy efficiency is a true "pollution prevention" technique, because at its core is source reduction and improved production efficiency. Improvements to process efficiency result in the decreased use of materials, labor, and wastes. The efficient use of energy results in decreased use of resources, less air pollution, and therefore, cost savings.

-Virginia Department of Environmental Quality

KPPC's Energy Assistance Model

- **Phase 1: "Tabletop" Assessment - 12-month energy bill analysis:**
  - ✓ **Billing errors**
  - ✓ **Tariff comparison/evaluation**
  - ✓ **Interruptible power**
  - ✓ **Contract demand**
  - ✓ **Load shifting, load shedding**
  - ✓ **Power factor penalties/correction**
  - ✓ **Minimum billing provisions**

KPPC's Energy Assistance Model

- **Phase 2: on-site walk through to evaluate facility energy subsystems such as:**
  - ✓ **Lighting**
  - ✓ **Facility heating/cooling**
  - ✓ **Ventilation**
  - ✓ **Boilers**

Includes energy use breakdown by process area and/or energy subsystems

Energy Bill Analysis

- **Essential component of any energy management program**
  - ✓ **Continuing account of energy use and cost**
  - ✓ **Keeping up-to-date records of monthly energy consumption and associated costs**
  - ✓ **A separate record will be required for each type of energy used, i.e., gas, electric, oil, etc.**
  - ✓ **A single energy unit should be used to express the heating values of the various fuel sources (MMBtu)**

If you can't measure it, you can't manage it!

Energy Units – Electricity Analogy

- **Electrical Charges typically have two metered components:**

1. **Demand (Power)**
2. **Consumption (Energy)**

Billing & Rate Structure

- **Utility companies classify electric and natural gas service according to Rate types**
  - ✓ **Potential Rate Examples: Residential; General Service; Commercial; Industrial**
- **Riders modify the structure of a Rate and based upon specific qualifications of the customer**
  - ✓ **Potential Rider Examples: Interruptible; HLF (High Load Factor);TOD (Time-of-Day); Green Energy**
- **Tariff Rates & Riders:**
  - ✓ **State Public Service Commission Websites**
  - ✓ **Utility Website**

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Customer Service: 1-800-383-5582 Mon-Fri 7AM-6PM(EST)
Walk-In Center Hours: Mon-Fri 8AM-5PM(EST)
Telephone Payments: (800) 807-3596
www.eon-us.com

DUE DATE	AMOUNT DUE
02/18/09	$14,145.25

See the Important Information section for details about your new rates.

ACCOUNT INFORMATION

Account Number:
Account Name:
Service Address:

ELECTRIC CHARGES

Rate Type: PS-SECONDARY PF ADJ

Customer Charge	75.00
Energy Charge	5,885.54
Demand Charge ($7.65 x 743.40 kw)	5,687.01
88.30% PF Adj to 90.00% ($7.65 x 14.3 kw)	109.40

Other Charges For Above Rates

Fuel Adjustment ($.00409 x 179328 kwh)	733.45
Program Cost Recovery ($.00006 x 179328 kwh)	10.76
Environmental Surcharge (6.500% x $12,501.16)	812.58
Merger Surcredit (1.013% CR x $13,313.74)	-134.87
Total Electric Charges	**$13,178.87**

Customer Service 1-800-383-5582

PLEASE RETURN THIS PORTION WITH YOUR PAYMENT

Account Number	Previous Balance	Payment Due Date	Total Amount Due	Winter Care Donation	Amount Enclosed
	$68.95	02/18/09	$14,145.25		$

Power Factor

- **Low Power Factor (PF) Penalty**
  - ✓ Typically caused by using magnetic devices such as light ballasts, motors, transformers…
  - ✓ Assessed when below 80% or 90%
- **Three Effects of Low PF(<80%)**
  - ✓ Robs the Distribution System of Capacity
  - ✓ Higher Currents = High Voltage Drop & Electrical System Losses
  - ✓ Billing Penalty ($)
- **Improvements:**
  - ✓ Capacitors, High-PF Motors and Lighting Ballasts

Other Clauses And Considerations

- **Contract Demand – minimum monthly billing demand and excess demand charge**
- **Demand Ratchet – billing mechanism that selects the highest demand from the current month or previous month(s)**
  - ✓ **Sometimes a percentage of the highest demand recorded in the previous 11 months is used.**

Other Clauses And Considerations

- **Minimum Energy Charge – typically based upon a contract demand.**
  - ✓ **Ex. Contract Demand 500 kW x 400 Hours = 200,000 kWh**
  - ✓ **200,000 kWh x Energy Price (~$0.06 kWh) = $12,000**

- **Time of Day**
  - ✓ **Establishes a daily time period in which the peak demand is measured**
  - ✓ **Can also be used to establish peak and non-peak energy usage charge (Time of Use)**

Natural Gas Service

- **Natural Gas Charges typically have two components on the bill:**
  - ✓ **Supply – The purchase cost for the physical natural gas supplied by the utility (local distribution company).**
  - ✓ **Distribution/Transportation – The cost to deliver the physical natural gas through the utility's distribution system to the customer.**

LG&E
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Walk-In Center Hours: Mon-Fri 8AM-5PM
www.eon-us.com
Telephone Payments: (800) 780-9723

DATE DUE	AMOUNT DUE
05/24/07	$488.49

Want to save time? Join the club! Sign up for our Automatic Bank Club! Check the Important Information section of your bill for more information.

ACCOUNT INFORMATION

Account Number:
Account Name:
Service Address:
Next Read Date: 06/06/07

Averages for Billing Period	This Year	Last Year
Average Temperature	58°	63°

BILLING SUMMARY

Previous Balance		0.00
Payments as of 05/08		0.00
Balance as of 05/08		0.00
Gas Charges	474.26	

GAS CHARGES

Rate Type: COMMERCIAL

Customer Charge	117.00
Gas Distribution Charge	61.07
Gas Supply Component ($.65666 x 319 ccf) Prev Rate 25 days	209.47

TAXES AND FEES

Rate Increase For School Tax (3.00% x $474.26)	14.23
Total Taxes and Fees	**$14.23**

Please see reverse side for additional charges. **Please bring entire bill when paying in person.**

Customer Service **(502) 627-3313**

PLEASE RETURN THIS PORTION WITH YOUR PAYMENT

Account Number	Payment Due Date	Amount Due By Due Date	Amount Due After Due Date	Winter Help Donation	Amount Enclosed
	05/24/07	$488.49	$488.49	$	$

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Natural Gas Service

- Generally, in the State of KY you have to take utility-supplied gas, unless you are behind a utility that offers third-party supply for "large" customers
- "Large" is defined separately by each participating utility
  - ✓ i.e., LG&E requires that you average 50 MCF/day through a single meter or 50,000 MCF/yr
- Either way, you will still have to pay the utility for transporting the gas to you

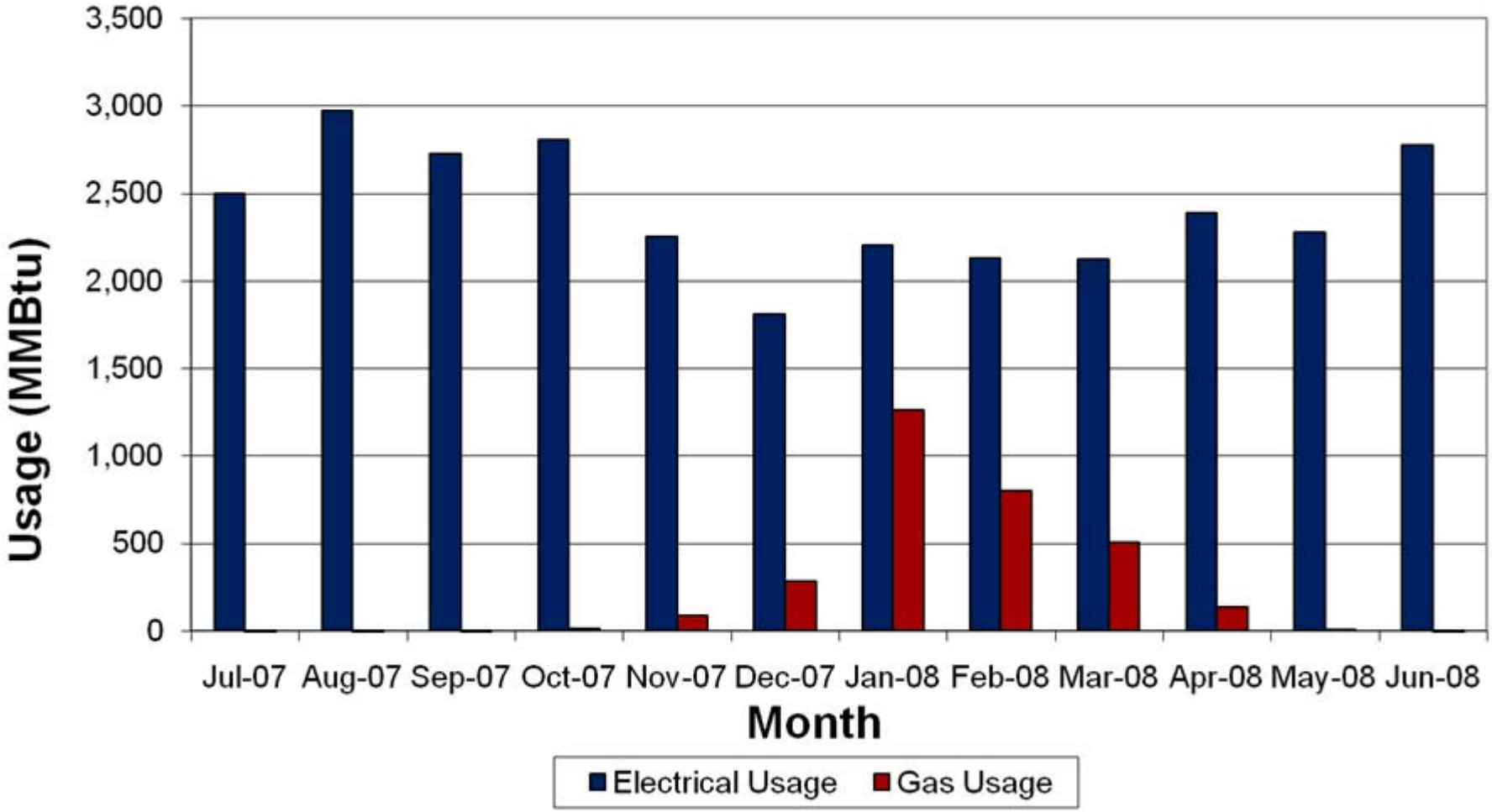
Billing & Rate Structure

"As a result of your analysis, ICS did switch to a more economical electrical rate structure that will save us over $11,000 per year. The Vice President of Operations was able to get a rebate in excess of $13,000 and have our two companies metered together so that we can enjoy the optimal rate structure as well with an estimated savings of $17,800 for the upcoming year for both companies."

Energy Bill Analysis Leads Where?

- Trends and irregularities in energy usage and costs can be detected
- Track energy use, demand and cost
  - ✓ Normalize to occupancy/production/temperature
- Common tools:
  - ✓ Spreadsheets
  - ✓ Energy Star Portfolio Manager
  - ✓ Utility websites
  - ✓ Energy Service
    - Web-based utility tracking & reporting services
    - Real-time energy tracking services

Spreadsheet – Energy Usage



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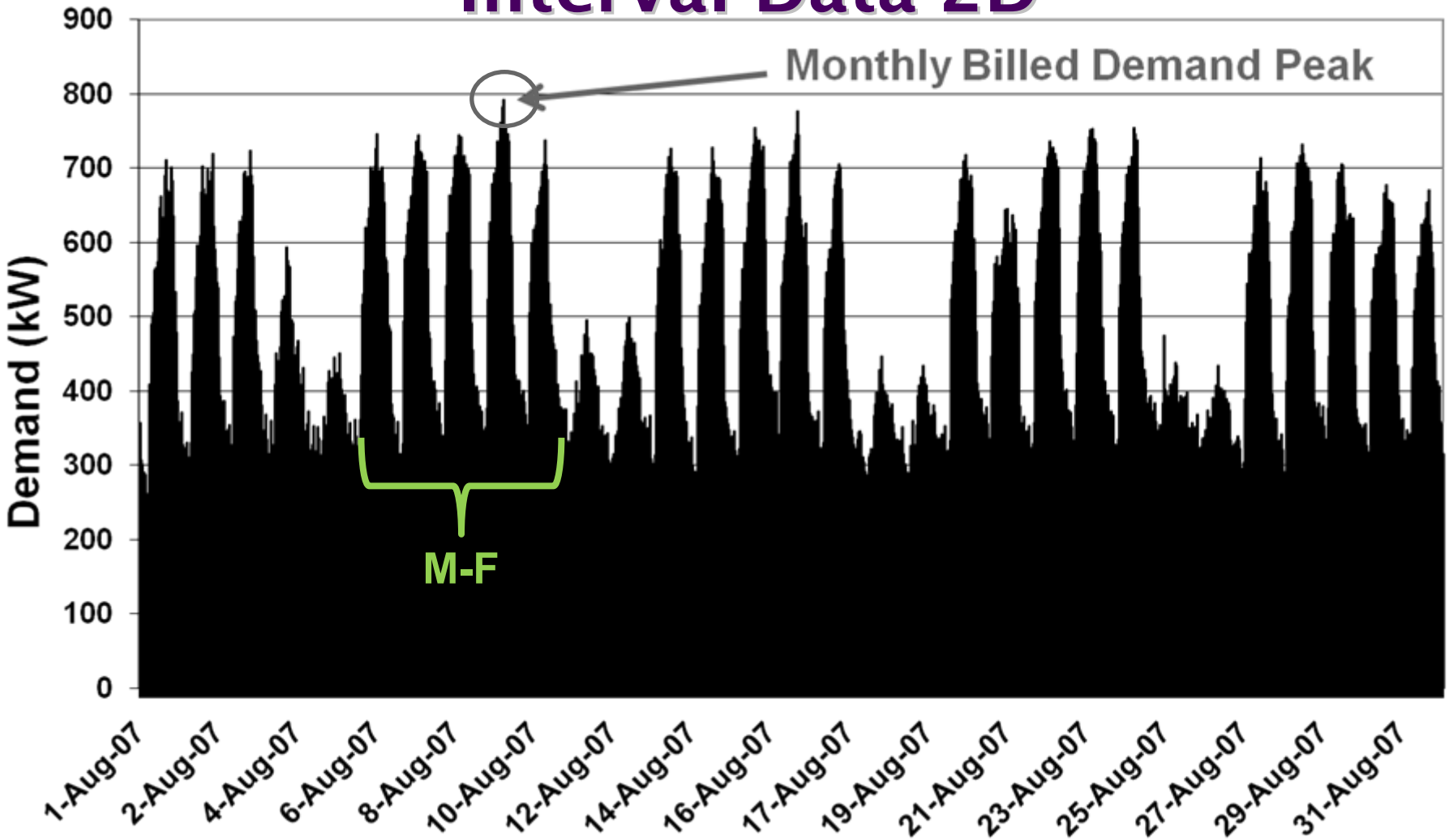
Spreadsheet – Monthly Demand Interval Data 2D



Phase II - Where Does the Energy Go?

Lights?

Kitchen?

Hot Water?

AC?

Computers?

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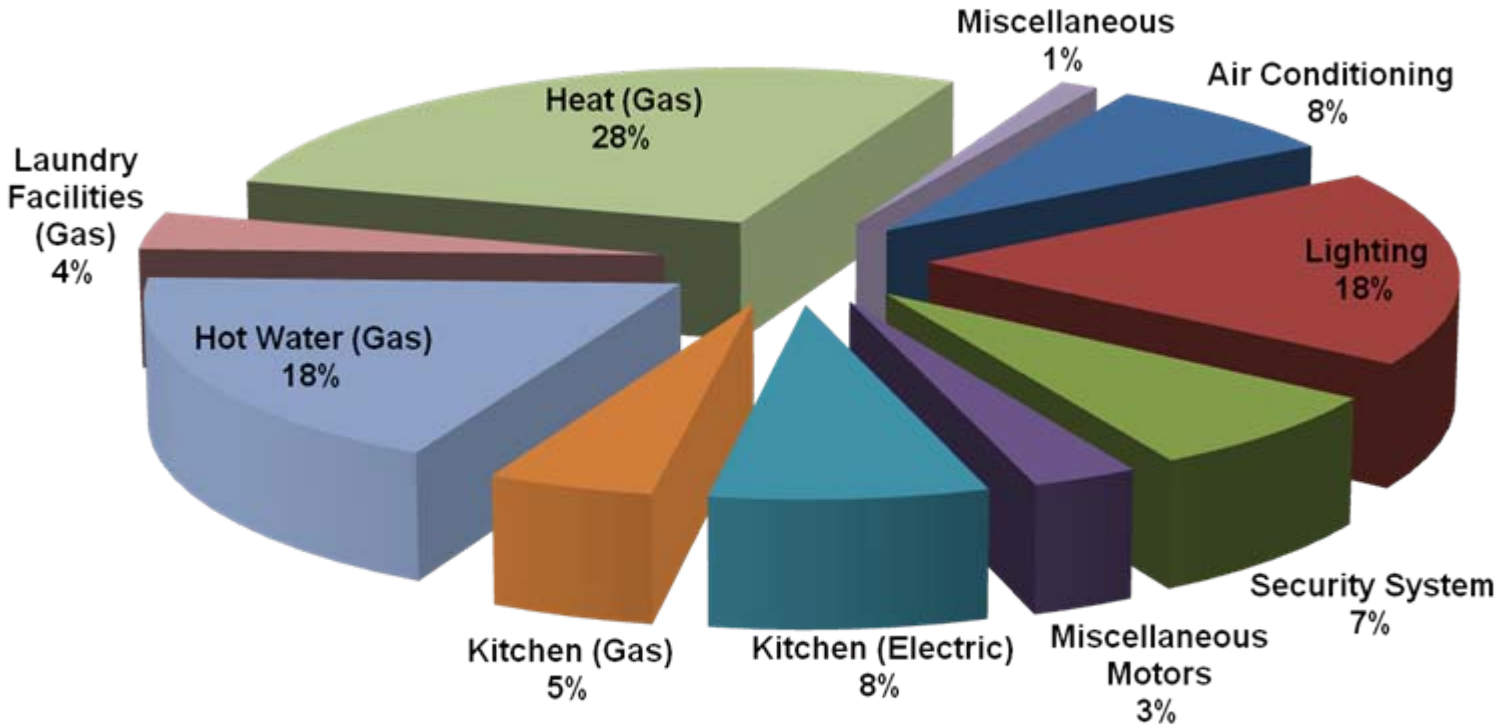
Typical Energy Use Breakdown – KY County Prison



Conduct An Energy Efficiency (E2) Audit

- Identify and form an E2 audit team
- Gather pre-assessment information
- Conduct on-site facility visit
- Identify energy conservation measures (ECMs)
  - ✓ Include both energy and cost savings
- Determine if ECMs are economically feasible

Assessment Benefits

- Economic
  - ✓ Lower energy bills (usage and demand)
  - ✓ Lower operating and maintenance (O&M) costs
- Improve occupant environment
- Improve comfort level
- Reduce environmental impact
- Develop benchmarks
  - ✓ Energy ($/production unit, $/ft^2)
  - ✓ Demand (kw/month)

Who's On The E2 Audit Team?

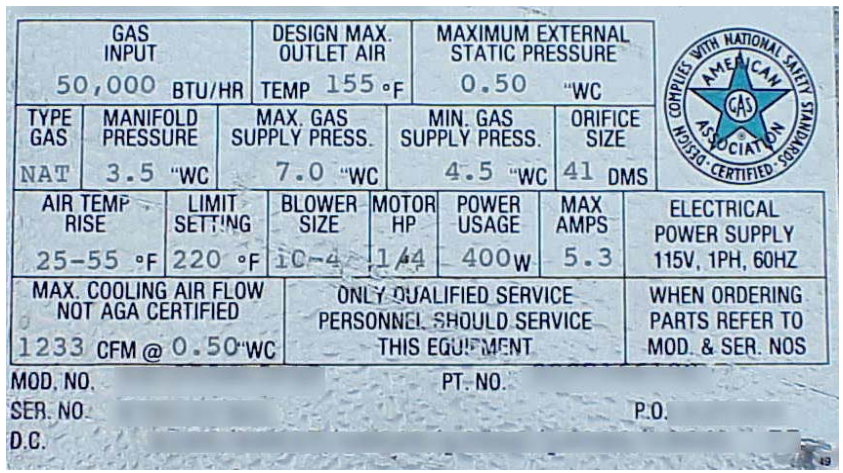
- Facility Personnel
  - ✓Energy manager
  - ✓Plant/building manager
  - ✓Maintenance/custodial manager
  - ✓Production manager
  - ✓Maintenance/custodian
  - ✓Billing/accounting
- Equipment Vendors and Suppliers
- Technical Assistance Provider or Consultant

Confirm The Priorities

- Save money?
- Improve comfort?
- Improve indoor air quality?
- Increase employee productivity?
- Opportunities to showcase?
- Reduce environmental impact?

Gather Site Information

- Talk with facility personnel to determine operating schedules and any known energy issues
- Conduct lighting, HVAC, and plug load equipment inventories, if not already completed
- Read equipment nameplates



GAS INPUT	DESIGN MAX. OUTLET AIR	MAXIMUM EXTERNAL STATIC PRESSURE
50,000 BTU/HR	TEMP 155 °F	0.50 "WC

TYPE GAS	MANIFOLD PRESSURE	MAX. GAS SUPPLY PRESS.	MIN. GAS SUPPLY PRESS.	ORIFICE SIZE
NAT	3.5 "WC	7.0 "WC	4.5 "WC	41 DMS

AIR TEMP RISE	LIMIT SETTING	BLOWER SIZE	MOTOR HP	POWER USAGE	MAX AMPS	ELECTRICAL POWER SUPPLY
25-55 °F	220 °F	10-4	1/4	400W	5.3	115V, 1PH, 60HZ

MAX. COOLING AIR FLOW NOT AGA CERTIFIED	ONLY QUALIFIED SERVICE PERSONNEL SHOULD SERVICE THIS EQUIPMENT	WHEN ORDERING PARTS REFER TO MOD. & SER. NOS
1233 CFM @ 0.50 "WC		

MOD. NO. PT. NO.
SER. NO. P.O.
D.C.

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Energy Opportunities

- **No Cost**
  - ✓ Incidental activities
  - ✓ No purchases required
  - ✓ Minimal labor required
- **Low Cost**
  - ✓ Purchases within existing O&M budget
  - ✓ Some dedicated labor needed
- **Capital Cost**
  - ✓ Sometimes it takes money to save money

Establish And Communicate A Policy

- Connect it to the business plan
- Objectives, roles, responsibilities, guidelines
- Temperature set points
- Computer use
- Benchmarking
- Awareness and training
- Energy efficiency committee

Benchmark Your Facility

- Portfolio Manager
- Energy Watchdog
- Advantage IQ
- MS Excel

Obtain And Analyze Load Profiles

- Benchmark all buildings first
- Select high energy-consuming building areas (kBtu/ft, kWh/production unit, etc.)
- Request a load profile from utility company
  - ✓ You can also build a load profile if they only will give you the raw interval data
- Analyze power demand patterns
- Look for load-shedding and/or load-shifting opportunities

Motors

- Target large motors with high annual operating hours
- Consider Variable Frequency Drives (VFDs) and other controls
- Look for improperly sized motors
- Establish a motor policy
  - ✓ Include rewind vs. replace decision guidelines
  - ✓ Account for electricity cost, annual operating hours, critical motors

Ensure Key Maintenance Activities Are Performed

- ❑ Filter changing
- ❑ Fan belt replacements
- ❑ Coil cleaning
- ❑ AC condensation drip pans
- ❑ Duct leak prevention
- ❑ Boiler system maintenance
  - ✓ Air/fuel mixture
  - ✓ Condensate recovery
  - ✓ Pipe insulation
  - ✓ Steam traps

Provide Energy Efficiency Training

- Types of Training
- Awareness – policies, practices, projects, general concepts
- Education – methods, techniques, procedures, technical concepts
- Job-specific technical – maintenance, custodians, food service, admin, teachers, non-instructional staff
- Task-specific technical – designated person, checklist, specific instructions, schedule

Assign Responsibility For Common Areas

- ❑ Hallways
- ❑ Multi-purpose rooms
- ❑ Cafeterias
- ❑ Auditoriums
- ❑ Restrooms
- ❑ Production areas
- ❑ Meeting areas
- ❑ Warehouse
- ❑ Storage areas

ACME Company Common Areas Checklist	
Space:	Cafeteria
Monitor:	Anita Jones
X	Lights
X	Doors/Windows
N/A	Computers
X	Temperature Settings
N/A	Water Fixtures
N/A	Exhaust Fans
Notes:	

Control Exhaust Fans

- **If the facility's ventilation system is off, the exhaust fans can create negative air pressure**
  - ✓ **Outside air seeps in through openings in the building envelope and brings in air that affects building temperature and humidity**

Upgrade Lighting

- T-12s to T-8s
  - ✓ About a 20% reduction in power requirements
- Incandescents to CFLs
- T-5 high-bay lighting
- Lighting controls
- Induction lighting
- LED

Establish A Plug Load Plan

- PC power settings
- PC security patch management
- Vending machine power control
- Standby power
  - ✓ Use of power strips
  - ✓ Unplug if not using
  - ✓ Office equipment
  - ✓ ENERGY STAR rated
- Seasonal shutdown
- Refrigerators
- Kitchen equipment
- Water heaters

ENERGY STAR PARTNER

Replace Exit Signs With LED

- Can be done with in-house maintenance staff
- Add to your Preventative Maintenance program
- Can be done in conjunction with retrofit projects
- Life cycle is more than 200,000 hours
- You probably have more than you think, and the savings are 24/365

Install Programmable Thermostats

- Identify good candidate areas
  - ✓ Restrooms
  - ✓ Other common areas
- Check for compatibility with HVAC system
- Ensure optimal settings, setbacks, and time scheduling
- Consider reasonable overrides

Every 1°F ≈ 1% Savings

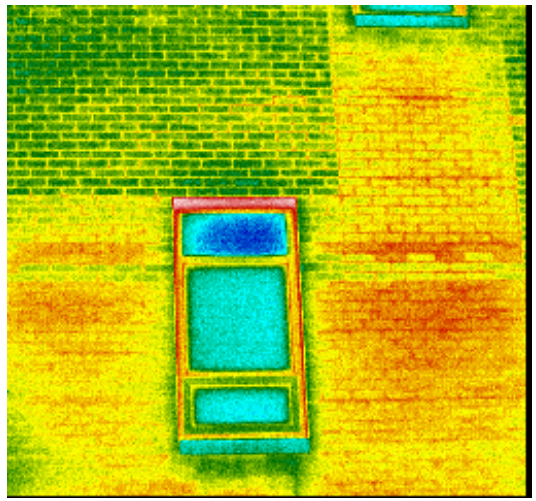
Install Timers And Occupancy Sensors

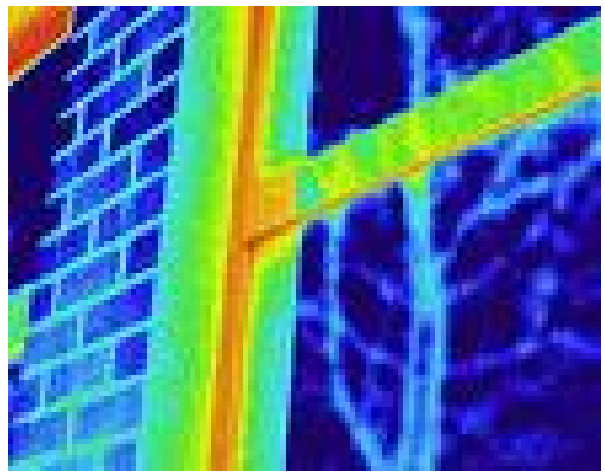
- Vending machines have a captive audience
  - ✓ Why light them?
- Lighting occupancy sensors

Application	Energy Savings
Offices (Private)	25-50%
Offices (Open Spaces)	20-25%
Rest Rooms	30-75%
Corridors	30-40%
Storage Areas	45-65%
Meeting Rooms	45-65%

Use Enhanced Auditing Tools

- Upgrades BAS to enable trending analysis
- Utility bill analysis
- Submetering
- Power monitoring
- Data loggers
- Infrared thermography
  - ✓ Roof & walls
  - ✓ HVAC ducts
  - ✓ Electrical system





Implement Building Commissioning

- Can cost from $25k - $85k, but still have paybacks of 1 - 3 years
- Can uncover multiple issues
  - ✓ Simultaneous heating and cooling
  - ✓ Defective or out-of-calibration sensors
  - ✓ BAS not programmed effectively
  - ✓ Operating systems not optimized
  - ✓ Owners operating requirements not followed
  - ✓ Set points incorrect or overlapping
  - ✓ Improper control of outside air
  - ✓ Building envelope failures
  - ✓ Space use changes
- Consider building automation system (BAS) to maintain commissioned settings

Install Mechanical System Upgrades

- System controls (occupancy, CO2, etc.)
- Variable Speed Drives (VSDs) for fans and pumps
- Upgraded AC systems
- Upgrade to properly sized, high-efficiency boiler
- Install a flue gas analyzer to adjust boiler mix ratio
- Repair leaking steam traps
- Install a heat recovery system

Building Envelope Projects

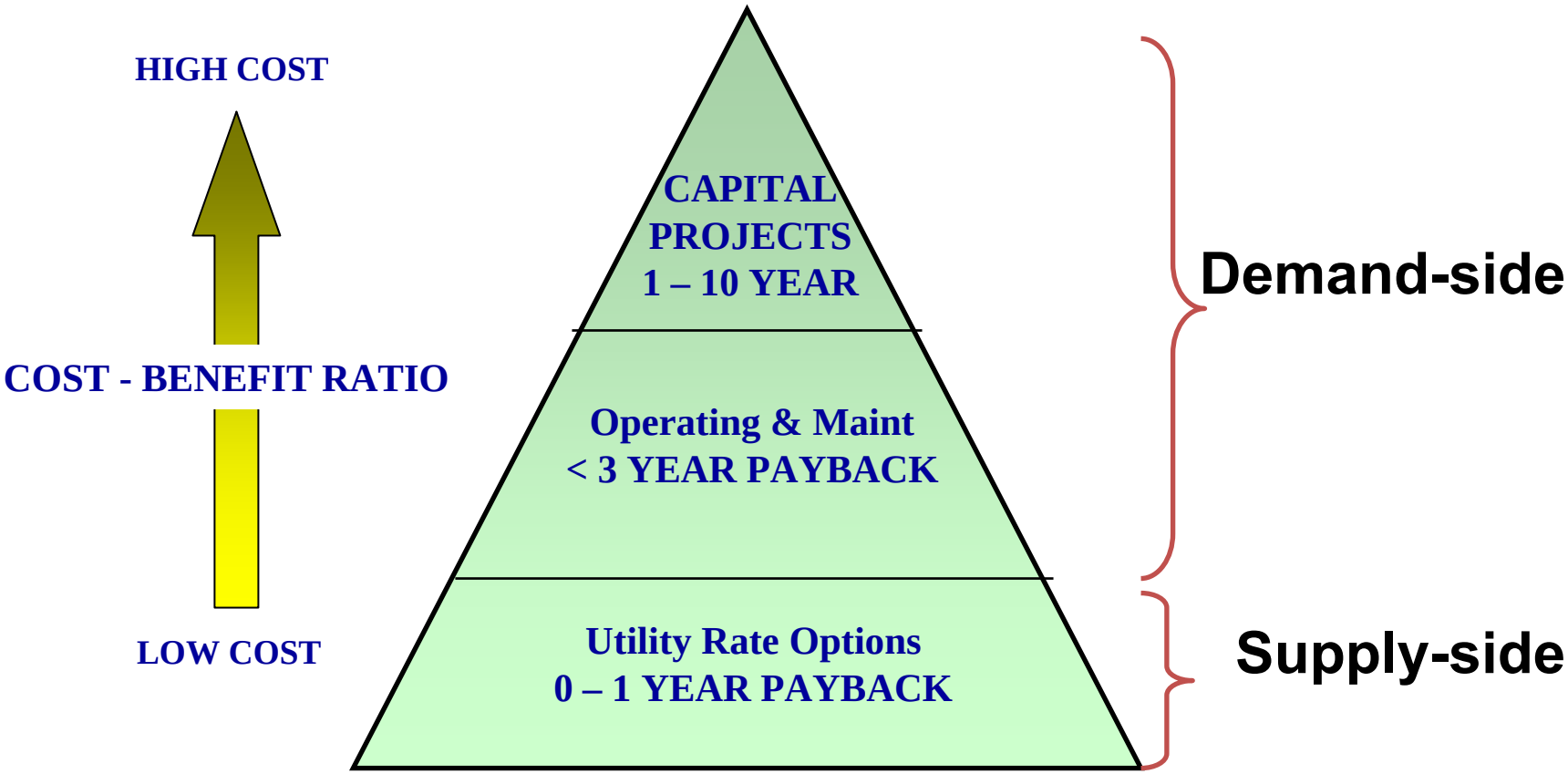
- Outside air dampers
- Cool roofs
- Solar tube daylighting
- Window films
- Insulation repairs/upgrades
- Air duct sealing/insulation

Due to possibly longer payback periods, consider bundling these with other projects

Adopt A Preventative Maintenance Program

- Move beyond reactive and routine maintenance
- PM program components
  - ✓ Overview – objectives, cost, benefits
  - ✓ Systems and equipment inventory
  - ✓ Inspection program – evaluate physical and functional conditions, note optimization needs
  - ✓ PM schedule
  - ✓ Hazard awareness
  - ✓ Standard operating process for work orders

Prioritize Appropriately



Move up the opportunity hierarchy!

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