



Approaches to Energy Efficiency: University & Industrial Case Study

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CIBO Technical Focus Group, Energy Committee Meeting

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- **Why are we talking about Efficiency?**
- **Approaches to Energy Efficiency**
- **Case Studies:**
 - **University Client - Performance Contract**
 - **Industrial Client – Energy Kaizen**

Why Are We Talking About This?

- **Boiler MACT Energy Assessment Requirement**
 - Boiler System & Energy Use Systems
 - Energy Use Systems Can include steam & electric systems electricity is generated on-site from boiler output
- **What is Industry already doing that can be utilized for Boiler MACT Energy Assessment requirement**

How is Energy Efficiency Being Addressed?

- **Internal Approach**

- Self Identification and Self Implementation

- **Third Party Energy Audit**

- Vendor, Utility or Consultant-provided

- **The Energy Performance Contract**

- Turnkey development and implementation of Energy project that is self-funding

- **The Energy Kaizen**

- Just Do It approach utilizing Internal and External Resources

- **Internal Approach**

- **PROS**

- Internal staff already familiar with facilities
 - No external cost
 - Can be Boiler MACT Energy Assessment compliant if utilizing qualified assessor

- **CONS**

- Tend to focus on Operation & Maintenance-related activities or equipment efficiency
 - Limited to technical capabilities of internal staff personnel
 - Limited availability of resources
 - Most often is not core responsibility = lower priority
 - Generally lacks any follow up verification (accountability)
 - Generally lacks implementation structure and support

- **Third Party Energy Audit**

- **PROS**

- Internal resources focus on core responsibilities
- Access to additional technical expertise
- Organized deliverables and documentation
- Can be Boiler MACT Energy Assessment compliant if utilizing qualified assessor

- **CONS**

- Learning curve
- Energy audits vary with respect to methodology and level of analysis
- Potential for conflict of interest

University of Missouri- Kansas City (UMKC)



- Three urban campuses in Kansas City, MO
- 27 buildings, 2 million square feet

CASE STUDY – UMKC Energy and Infrastructure Needs

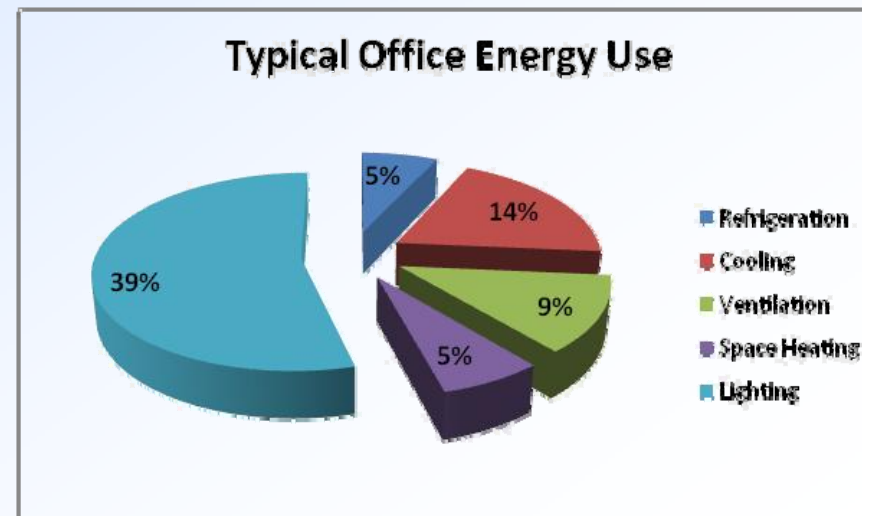
- Increasing Utility Costs
- Need to Replace Aging Chilled Water Plant
- Recruiting for Faculty & Students
- Enhance Image as Sustainability Leader in Local Community and University of Missouri System
- Limited Budget
- Need for Alternative Financing



The Energy Performance Contract
Turnkey development and implementation of
Energy project that is self-funding

CASE STUDY – UMKC Utility Analysis

- Evaluate Utility History (36 month)
 - Electric, Natural Gas, Water
- Establish Baseline – starting point to measure progress
- Benchmark – Compared Facilities
 - Energy Use Intensity (EUI) in terms of Btu/sq. ft.
 - ENERGY STAR Rating
- Analysis and Evaluation
 - Understand your energy use, patterns and trends
 - Technical Assessments and Audits



- On-Site Auditing & Equipment Inventory
- Energy Conservation Measures (ECMs) Development
 - Boiler/Steam Systems
 - Chilled Water Systems
 - Compressed Air
 - Motors/pumps/fans)
 - Facility HVAC systems
 - Building envelope
 - Lighting systems
 - Water Systems
- Cost, Savings & Environmental Impact Analysis
 - Rebates & Incentives
- Measurement & Verification Plan



CASE STUDY – UMKC Scope of Work

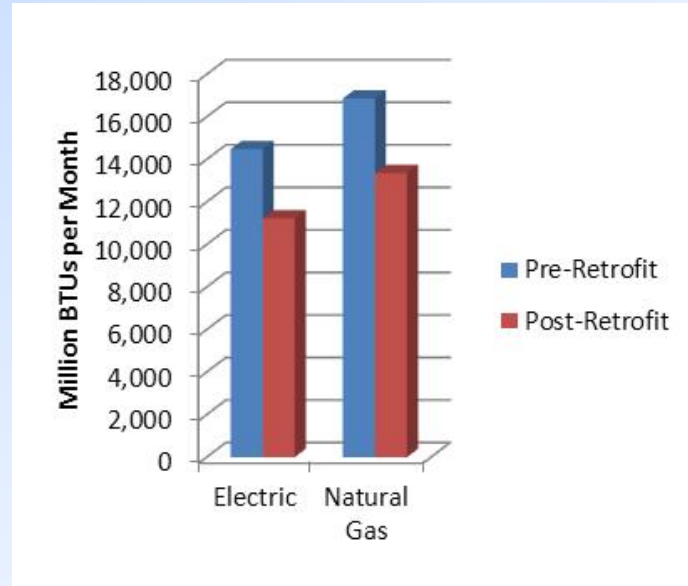
- New central chilled-water plant
- Variable flow, occupancy-based fume-hood exhaust controls
- Expanded energy-management-system controls High-efficiency lighting retrofits
- Variable-frequency drives
- Constant-volume air handlers to variable air-volume
- Low-flow-plumbing retrofits
- Steam-leak surveys
- Steam-line repairs
- Chilled-water system optimization

Project Cost: \$19.4 Million
Annual Savings: \$1.3 Million
Payback: 15 years



CASE STUDY – UMKC Measured Results

Emissions Reductions	
Category	Tons
CO ₂	57,090
VOC	1.4
SO ₂	164
CO ₂	9.6
NO _x	79.6
PM10	2.2
Mercury	0.002



The Sierra Club
named UMKC one
of the country's top
100 Green
Campuses



	Measured Savings			
	\$	kWh	kW/Mo	Therms
Construction (28 mo.)	\$1,894,996	18,642,980	1,187	710,803
Year 1	\$1,330,872	14,363,527	1,782	477,015
Year 2	\$1,510,813	14,701,506	1,780	570,039
Total	\$4,736,681	47,708,013	1,472	1,757,857

	Project-to-date Totals			
	\$	kWh	kW/Mo	Therms
Baseline	\$22,083,660	212,123,799	454,896	8,432,717
Actual	\$17,346,979	164,415,786	381,296	6,674,860
% Reductions	21.4%	22.5%	16.2%	20.8%

- **The Energy Performance Contract**
 - **PROS**
 - Use as a funding mechanism
 - Provides for project aggregation
 - Defined performance verification protocol
 - Can be Boiler MACT Energy Assessment compliant if utilizing qualified assessor
 - **CONS**
 - Tends to focus on capital projects
 - Often limited to “low-risk” opportunities
 - Can be a lengthy process

CASE STUDY - Industrial Client



**Confidential International
Pharmaceutical
Company**

- Headquartered outside of North America



- Employs ~100,000 people in over 100 countries
- Internal Energy Team





CASE STUDY – Industrial Client Energy Needs

- Corporate Mandated Energy and Carbon Reduction Targets
 - 10% Reduction by 2015
- Concern with Rising Energy Costs
- Desire for Renewable Energy
- Energy Expertise needed to come along side plant/facility personnel to help Achieve Targets

The Energy Kaizen

Just Do It approach utilizing Internal and External Resources

CASE STUDY – Industrial Client Energy Kaizen

- **Kaizen is a continuous improvement approach in which instances of waste are eliminated one-by-one at minimal cost**
 - An accelerated approach for process improvement
 - The key is to:
 - Use a cross-functional team and involve stakeholders (include suppliers and customers if needed)
 - Have clear deliverables within a defined time line (typically less than a week for the hands-on portion)



CASE STUDY – Industrial Client Energy Kaizen

- **Action-based**
 - Don't analyze to death, just try it
- **Creativity before capital expenditure**
 - Do what you can with what you've got - before resorting to spending money
- **Employee involvement**
 - Involvement and mutual respect encourage rapid improvement

CASE STUDY – Industrial Client Energy Kaizen

Pre-work

Data Collection: Utility Bills, Site Information, Past Reports, Drawings, Equipment Inventory, etc.



Event Week

Develop Opportunities to Save Energy & Implement Those That Make Sense



Follow-up

Verify Calculations, Implement Action Plan



CASE STUDY – Industrial Client Event Week

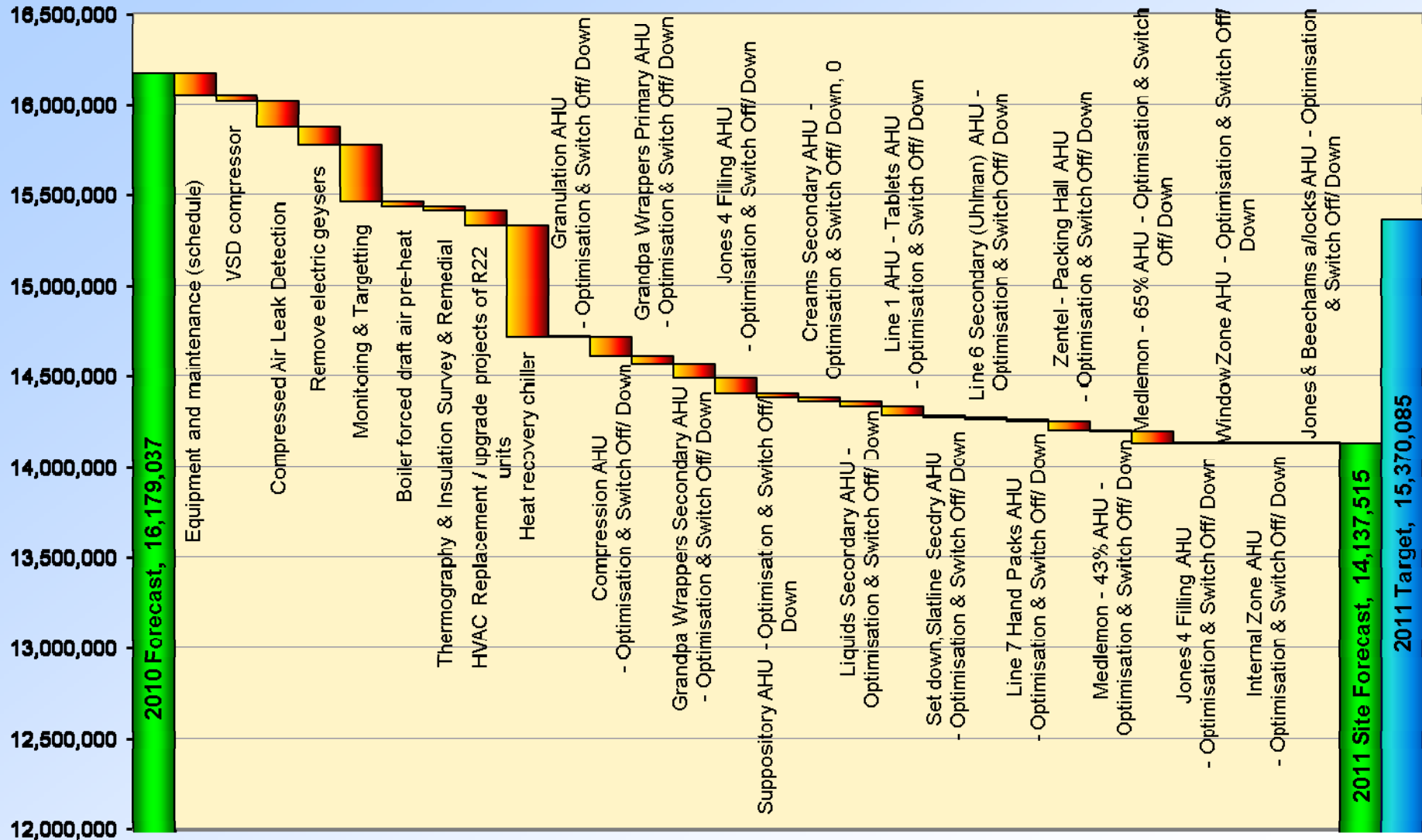
Time	Monday	Tuesday	Wednesday	Thursday	Friday
0800 - 0830	Site Safety Training	Recap of previous day			
0830 - 0900	Room Set Up	Prioritize systems	Root cause investigation Improvement brainstorming Action Plan development Action plan execution business case analysis	Root cause investigation Improvement brainstorming Action Plan development Action plan execution business case analysis	Action Completion, Presentation Prep
0900 - 0930		Assign teams to systems			
0930 - 1000	Opening Remarks	System specific work: Problem statement Objectives			
1000 - 1030	Kickoff Presentation				
1030 - 1100	Break				
1100 - 1130	Group Exercise				
1130 - 1200					SLT/Management Kaizen Report Out
1200 - 1230	<i>Lunch</i>	<i>Lunch</i>	<i>Lunch</i>	<i>Lunch</i>	
1230 - 1300	Floor Walk	Root cause investigation Improvement brainstorming Action Plan development Action plan execution business case analysis	Root cause investigation Improvement brainstorming Action Plan development Action plan execution business case analysis	Root cause investigation Improvement brainstorming Action Plan development Action plan execution business case analysis	Travel
1300 - 1330					
1330 - 1400	Data Review				
1400 - 1430					
1430 - 1500	System Reviews				
1500 - 1530					
1530 - 1600		Champion Daily Outbrief	Champion Daily Outbrief	Champion Daily Outbrief	
1600 - 1630		Team Working Time	Team Working Time	Team Working Time	
1630 - 1700					
1700 - 1730					
Evening Session					



CASE STUDY – Industrial Client Event Week - Output

- Event Week Investigations List
- List of Just Do It projects
- List of Strategic projects
- Supplier Alliances next steps
- Project Cost/Savings Estimates
- Waterfall Energy Reductions Chart
- Summary of Key Benefits

CASE STUDY – Industrial Client Waterfall Diagram



- **The Energy Kaizen**

- **PROS**

- Utilizes both Internal and External Expertise
 - Evaluates both Operations & Maintenance and Capital Improvement Opportunities
 - Realizes immediate benefits from “Just Do It” Activities
 - Provides cost/savings justification

- **CONS**

- Requires significant time investment of internal resources
 - Does not provide financing
 - Does not provide final written report, this would be needed for Boiler MACT Energy Assessment compliance



Energy Efficiency in Industry

Energy Efficiency in Industry:

Internal Focus

Third Party Energy Audit

The Energy Performance Contract

The Energy Kaizen

Current approaches to energy efficiency could be compliant with Boiler MACT Energy Assessment Requirements with slight modifications

Boiler MACT Energy assessment must include:

- Visual inspection
- Inventory of major energy-consuming systems
- A review of available architectural and engineering plans
- A review of the facility's energy management practices
- A list of major energy conservation measures
- A list of energy savings
- A comprehensive report detailing the ways to improve efficiency



Thank You!

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