

Industrial Energy Audits



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Who is URS?

- One of the World's Leading Engineering, Architectural, Planning and Construction Services Firms
- 56,000 Employees in 34 Countries
- Recent Acquisition of Washington Group (26,000 folks)
- \$8.5 billion in revenues
- World-Class Capabilities gained on World-Class Projects
- # 1 Design Firm in U.S. – *7 years running*
- #1 Design Firm in the World – *2 years running*
- Top provider of GHG services and Sustainable Solutions across all business and industry segments
- #2 Green Design Firm in U.S. – ENR Ranking

Energy – The Big Picture

- **Energy costs represent a significant and growing percentage of the overall cost of doing business**
- **Electricity and fuel prices are expected to continue to rise, particularly in a “carbon constrained” future**
- **Energy costs represent a significant risk for many businesses**

Energy and Sustainability

- **Energy conservation and energy efficiency improvement should be key parts of a businesses Sustainability Program**
- **Reduced energy usage and improved energy efficiency results in reduced GHG emissions**
- **Some companies, such as Wal*Mart, are pushing energy conservation and energy efficiency up the supply chain through Sustainability initiatives**

What Does a Good Energy Management Program Look Like?

- Commitment to Continuous Improvement
- Assessment of Current Performance
- Setting Goals
- Creation and Implementation of an Action Plan
- Evaluation of Progress Towards Goals

Commitment to Continuous Improvement

- Appoint Energy Director or Team –
 - Important that this individual or team has the complete support of senior management.
 - Establishing this position and charging it with leadership of the overall energy program increases the visibility of energy issues.
- Establish an Energy Policy –
 - Provides the foundation for successful energy management.
 - It formalizes senior management's support and articulates the organization's commitment to energy efficiency for employees, shareholders, the community and other stakeholders.

Assessment of Current Performance

- Gathering and Tracking Energy Bills –

- You can't change what you can't (or don't) measure!
- This may also include collecting sub-meter data.
- Determining fuel oil and coal usage will involve inventory data.
- Collect production data also.

- Establish baselines and benchmarks –

- Determine base year, past performance at the facility, industry averages for similar facilities, best in class performance, and best practices.

Assessment of Current Performance

- Analysis of Data –

- Develop a list of the facility's major energy consuming equipment.
- Understand seasonal and production-related changes in usage.
- Identify and fill data gaps.

- Obtain Technical Assistance –

- Involve knowledgeable employees inside the company.
- Use resources available through Energy Star, DOE Energy Efficiency & Renewable Energy (EERE) web site, state energy offices, etc.

Energy Usage Information (% of total usage)

Manufacturing Operations –

- ▶ HVAC – 35%, Process/Equipment – 32%, Lighting – 28%, Other – 5%

Office Buildings –

- ▶ HVAC – 40%, Lighting – 29%, Process/Equipment – 15%, Other – 16%

Adapted from: Handbook of Energy Engineering, 4th edition, EIA, and NREL 2000

Assessment of Current Performance

■ Conduct Audits –

- ▶ Use self-auditing tools to perform in-house audit.
- ▶ Or get assistance from Industrial Assessment Centers, state energy offices, DOE Energy Efficiency and Renewable Energy (EERE) “Save Energy Now” Program.
- ▶ Ask your utility about auditing programs that they might have in place.

Setting Goals

- Estimating potential for improvement –
 - ▶ Review baselines, past performance, benchmarking information, best practices, audit results.

- Goals that are clear and measurable –
 - ▶ Defined reduction (e.g. 10% reduction)
 - ▶ Efficiency improvement
 - ▶ Threshold goals (reaching a certain level of performance)
 - ▶ Best-In-Class (compared to benchmarking information)

Creation and Implementation of an Action Plan

- Resources and action needed to meet goals –
 - ▶ Do you have adequate internal technical resources, or do you need help from outside the organization?
 - ▶ Be sure to access all assistance available from Energy Star, DOE EERE, state energy offices, Manufacturing Extension Partnership (SC), Industrial Extension Service (NCSU).
 - ▶ Examine alternatives for financial resources – grants, low interest loans, rebates or reduced rates from utilities, tax incentives, etc.
 - ▶ Package longer payback projects with quicker payback projects (discourage “cherry-picking” of quicker payback projects).

- Implement action plan –
 - ▶ Keep goals in front of everyone, communicate progress
 - ▶ Identify corrective actions needed to keep business on track towards goals.

Evaluation of Progress Towards Goals

■ Measure Results –

- ▶ Review energy use and cost data.
- ▶ Analyze energy efficiency improvements.
- ▶ Compare energy usage to baselines and benchmarks, as well as to the established goals.

■ Review and update the action plan –

- ▶ Get feedback from employees and technical resources.
- ▶ Identify factors that led to surpassing or missed goals and targets.
- ▶ Update action plan and set new goals as part of continuous improvement process.

Energy Audit – Basic Components

- Management Support!

- Assemble an Audit Team –
 - ▶ Plant personnel
 - ▶ Corporate personnel
 - ▶ Personnel from other facilities

- Determine Facility Audit Schedule –
 - ▶ Energy intensive facilities first
 - ▶ Make sure key personnel will be present at the facility during the audit
 - ▶ Determine the specific timeline for the audit

Energy Audit – Basic Components

- Energy Audit Toolbox –
 - ▶ Lightmeter
 - ▶ Thermometer
 - ▶ Infrared thermometer “gun”
 - ▶ Ultrasonic leak detector
 - ▶ Marking tape
- Data Collection (pre-audit) –
 - ▶ Energy and Utility Use Data
 - ▶ Get Rate Structures and Bills
 - ▶ Understand Utility Bills – Energy cost (Peak and Non-Peak), Demand charge, Power factor charge, Facility charges, Fuel adjustments, Taxes, Water cost, Wastewater surcharges, etc.

Energy Audit – Basic Components

■ Facility Data –

- ▶ Operating Hours
- ▶ Production Scheduling and Levels
- ▶ Shutdown Procedures
- ▶ Facility Layout, Conditioned Areas, Shipping Areas
- ▶ Equipment Lists

■ Conducting the Audit –

- ▶ Introductory Meeting with Management
- ▶ Audit Interviews – Facility Engineering, Maintenance
- ▶ Walk-Through Tour
- ▶ Detailed Review of Facility Components

Energy Audit – Detailed Review

■ Lighting –

- ▶ Detailed and complete inventory by quantity and type of fixtures, ballast type, wattage per lamp/fixture, hours of operation, all broken down by area of the facility
- ▶ Using lightmeter, record light intensity readings for each area, including offices
- ▶ Review the management of outdoor lighting, including use of timers and photocells
- ▶ Understand procedures for controlling lighting during shut down period, as well as presence of automatic controls

■ HVAC –

- ▶ Inventory of all HVAC systems and associated equipment
- ▶ Understand control equipment and schemes used for HVAC systems
- ▶ Collect information on cleaning and/or inspection frequency for evaporator/condenser coils, air filters, insulation. Review records of regular system efficiency checks
- ▶ Review operational practices for dock doors and other building openings in heated and cooled areas of the facility

Energy Audit – Detailed Review

■ Electric Motors –

- ▶ Determine whether facility has a complete inventory of electric motors over 1 HP
- ▶ Review facility policy for replacing versus rewinding motors, purchasing practices for motors
- ▶ Assess potential for installation of VFDs on larger motors, automatic shut-offs on other motors

■ Peak Electricity Loads –

- ▶ Review demand profile for the facility (hourly data sometimes available from utility provider)
- ▶ Working with facility personnel, attempt to determine causes of demand peaks – start-up of certain equipment?
- ▶ Assess potential for moving electrical load to non-peak time period

Energy Audit – Detailed Review

- Compressed Air Systems –
 - ▶ Collect information on compressors, system operating characteristics, uses of compressed air, and pressure requirements by process/area
 - ▶ Assess leak detection and repair program. Depending on status of the program, conduct limited compressed air leak audit using ultrasonic leak detector
 - ▶ Assess facility for in appropriate uses of compressed air
- Boiler and Steam Systems –
 - ▶ Collect system information, including operational strategies and practices
 - ▶ Determine whether facility has steam trap inventory list, steam trap audit program
 - ▶ Review combustion analysis records and boiler set-up practices
 - ▶ Collect information on condensate return percentage, location of condensate discharges not being returned

Energy Audit – Detailed Review

■ Process Heating –

- ▶ Collect information on ovens, furnaces, and other processes that are heated with electricity, natural gas, or other fuels
- ▶ Determine whether facility has program in place to minimize introduction of excessive air to heated equipment
- ▶ Assess opportunities for heat recovery from waste heat

■ Water and Wastewater –

- ▶ Review water usage practices, especially areas of high water use
- ▶ Determine potential for water reuse and reduction in water usage
- ▶ Assess opportunities for heat recovery from wastewater
- ▶ Review operation of wastewater treatment systems, if applicable, from an energy usage standpoint

Specific Energy Efficiency Opportunities

Lighting

- Do you have any incandescent lamps left in your facility?
 - ▶ Exit signs, flood lights, desk lamps
 - ▶ Replace with CFL's

- Do you have decorative outdoor lighting at your facility?
 - ▶ Building "up-lighting", lighted bollards
 - ▶ Be sure not to negatively impact safety and security
 - ▶ Use timers to turn decorative lighting off at midnight

- Are T5 or T8 fluorescent fixtures with (or without) motion sensors a good retrofit alternative for metal halide and high pressure sodium fixtures at your facility?

Best Practice Tips: Compressed Air

- Alternative Strategies for Low-Pressure End Uses
- Analyzing Your Compressed Air System
- Compressed Air Storage Strategies
- Compressed Air System Control Strategies
- Determine the Cost of Compressed Air for Your Plant
- Determining the Right Air Quality for Your Compressed Air System
- Effect of Intake Air on Compressor Performance
- Eliminate Inappropriate Uses of Compressed Air
- Engineer End Uses for Maximum Efficiency
- Maintaining System Air Quality
- Minimize Compressed Air Leaks
- Preventive Maintenance Strategies for Compressed Air Systems
- Remove Condensate with Minimal Air Loss
- Stabilizing System Pressure

http://www1.eere.energy.gov/industry/bestpractices/tip_sheets_compressed_air.html

Eliminating Inappropriate Uses of Compressed Air

Potentially Inappropriate Uses

Suggested Alternatives/Actions

Clean-up, Drying, Process cooling

Low-pressure blowers, fans, brooms, nozzles

Sparging

Low-pressure blowers and mixers

Aspirating, Atomizing

Low-pressure blowers

Padding

Low to medium-pressure blowers

Vacuum generator

Dedicated vacuum pump/central vacuum system

Personnel cooling

Electric fans

Air motor-driven mixer

Electric motor-driven mixer

Air-operated diaphragm pumps

Proper regulator/speed control; electric pump

Idle equipment

Put an air-stop valve at compressed air inlet

Abandoned equipment

Disconnect air supply to equipment

Minimize Compressed Air Leaks

- If you do not have a robust leak detection and repair program in place, it is likely that approximately 20 – 30% of the compressors output is being wasted due to leaks.
- Although leaks can occur in any part of the system, the most common problem areas are couplings, hoses, tubes, fittings, pipe joints, quick disconnects, FRLs (filter, regulator, and lubricator), condensate traps, valves, flanges, packings, thread seal-ants, and point-of-use devices.
- Cost savings from eliminating one 1/32” leak are around \$5,600 per year, and for a 1/4” leak the cost savings are over \$38,000 per year.

Steam Systems

- Does your facility have an active steam trap assessment and repair program in place?
 - ▶ Failed steam traps can cause significant energy loss
 - ▶ In steam systems that have not been maintained for 3 to 5 years, 15% - 30% of steam traps may have failed
 - ▶ An average failed steam trap costs \$6,640 per year

- Does your facility and return as much condensate as possible?
 - ▶ Do you know how much is being returned?
 - ▶ Savings from returning an additional 10,000 lbs of condensate per hour can approach \$33,700 per year

Process Heating

- Clean heat transfer surfaces frequently to maintain high heat transfer efficiency in heat exchangers and other systems that use electrical heating elements, coils, radiant tubes, and so on.
 - ▶ This can reduce energy use between 2% - 5%
- Control make-up air for ovens and other heating equipment to keep it at the minimum value required to meet process and equipment safety requirements.
- Make sure that furnace and oven walls and doors are insulated well enough to minimize heat losses and to help keep temperatures low on the outside surfaces of equipment.

Miscellaneous

- Are dock doors and other doors left open when not in use, letting conditioned air out and cold or warm air in?
- Do wall fans, roof fans, and other openings to the outside close properly when not in use?
- Do you have controllable thermostats on your HVAC systems such that temperatures can be set back at night and on weekends, or at other appropriate times?
- Are your HVAC systems serviced and maintained on a regular basis to ensure efficient operation.
 - ▶ Consider having your system evaluated to determine whether it needs to be “retro-commissioned” to get back to the original design operational set-up

Audit Findings

- Review findings with facility engineering, maintenance personnel, and others to be sure that energy conservation opportunity is viable for the facility from an operations and business strategy standpoint
- Determine potential savings for identified energy conservation opportunities, develop estimate of capital cost to implement
- Calculate simple paybacks for energy conservation opportunities, compare to payback “hurdle” for the facility
- Summarize audit findings, rank by payback. Consider grouping potential projects together to blend short payback and longer payback items
- Present findings and recommendations to management
- Investigate options for financing implementation of energy conservation opportunities

Resources Available to You

- DOE Energy Efficiency and Renewable Energy – Industrial Technology Program
 - ▶ <http://www1.eere.energy.gov/industry/>
 - ▶ LOTS of information, tools, data, guidance, case studies...

- Energy Star
 - ▶ <http://www.energystar.gov>
 - ▶ LOTS of information, tools, data, guidance, other information
 - ▶ No cost to join

- State Energy Offices
 - ▶ Tools, assessments, strategies, resources, training
 - ▶ <http://www.energync.net/>
 - ▶ <http://www.energy.sc.gov/>

- Utilities
 - ▶ Some have energy efficiency incentives, more are coming
 - ▶ Ask your customer service representative for information

Resources Available to You

- DOE Save Energy Now assessment program
 - ▶ <http://www1.eere.energy.gov/industry/saveenergynow/index.html>
 - ▶ Goal is to reduce energy usage by 25% in 10 years
 - ▶ For larger industrial facilities
 - ▶ Results to date have been impressive (\$\$ savings)

- Industrial Assessment Centers
 - ▶ <http://www1.eere.energy.gov/industry/bestpractices/iacs.html>
 - ▶ Available for small to mid-sized facilities
 - ▶ North Carolina State, Georgia Tech

- Industrial Extensions Service (NCSU)
 - ▶ Low-cost/subsidized energy audits and assessments available. Can be targeted to specific areas, such as compressed air

Contact Information

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ENERGY MANAGEMENT RESOURCES

- ✘ North Carolina State Energy office
 - + <http://www.energync.net/>
- ✘ NC Industrial Extension Service
 - + <http://www.ies.ncsu.edu/index.htm>
- ✘ Waster Reduction Partners
 - + <http://www.landofsky.org/wrp/>
 - + Russ Jordan, Energy Program Manager, russ52@alltel.net
- ✘ Energy Star
 - + <http://www.energystar.gov/>
- ✘ *Duke Energy*
 - + www.duke-energy.com/environment/energy-efficiency.asp
- ✘ *Piedmont Natural Gas*
 - + <http://www.piedmontng.com>
- ✘ *PSNC Energy*
 - + <http://www.psncenergy.com/en>

ENERGY MANAGEMENT RESOURCES

- ✘ South Carolina Energy Office
 - + <http://www.energy.sc.gov/>
- ✘ Clemson Extension
 - + <http://www.clemson.edu/extension/>
- ✘ SCANA
 - + <http://www.scana.com/en/>
- ✘ South Carolina Electric & Gas (SCE&G)
 - + <http://www.sceg.com/en/about-sceg/>
- ✘ South Carolina Manufacturing Extension Partnership
 - + <http://www.scmep.org/>
- ✘ South Carolina Office of Regulatory Staff (Dept. of Natural Gas)
 - + <http://www.regulatorystaff.sc.gov/ORSCContent.asp?pageID=631&menuID=422>