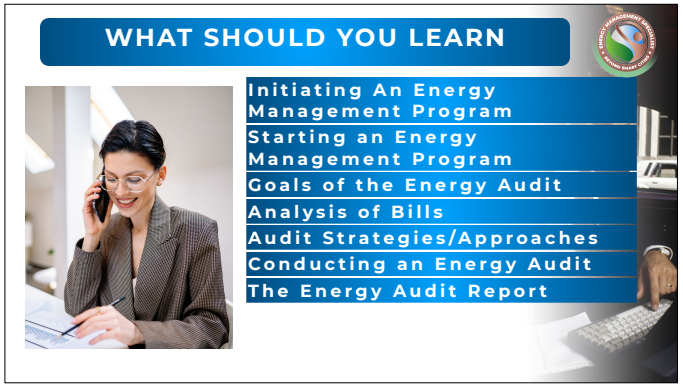
BEYOND
SMART CITIES
ENERGY MANAGEMENT AND AUDIT - CEM
REFRESHER TRAINING COURSE
KRISHNAJI PAWAR, LEED AP BD+C,GSAS CGP,ISO 14001:2015,GCP
CEM REFRESHER TRAINING COURSE

BEYOND
SMART CITIES
ENERGY AUDIT
FOR ENERGY PROFESSIONALS
KRISHNAJI PAWAR, LEED AP BD+C,GSAS CGP,ISO 14001:2015,GCP
ENERGY SPECIALIST CURRICULUM COURSE


WHAT SHOULD YOU LEARN
Initiating An Energy Management Program
Starting an Energy Management Program
Goals of the Energy Audit
Analysis of Bills
Audit Strategies/Approaches
Conducting an Energy Audit
The Energy Audit Report

INITIATING AN ENERGY MANAGEMENT PROGRAM

Designate an energy manager/energy management team. Energy managers must have support from top management to get cooperation from the maintenance and operating personnel
Management must provide support for:

- ☑ Funding to implement the most cost-effective improvement
- ☑ Collecting energy use and cost data

DEALING WITH ENERGY COSTS IN OVERHEAD

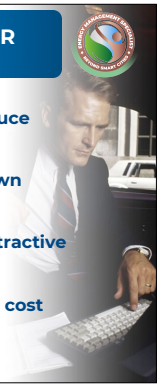
A difficult problem for an energy manager: Trying to reduce energy costs for a facility when these costs are accounted for as part of general overhead.

Best solution to this problem: Top management should allocate energy costs down to "cost centers“ in the company or the facility.

Managers then have a direct incentive to control energy costs to improve the overall cost-effectiveness of the production center.

ALLOCATION OF ENERGY COSTS FOR MULTI-TENANT BUILDINGS

- ☑ Large buildings are often "master metered" to reduce utility fixed charges and reduce rates.
- ☑ Each tenant should receive a bill and pay for its own energy consumption.
- ☑ "Master metering" plus submetering can be an attractive approach.
- ☑ Utility grade sub-meters are readily available and cost effective.



STARTING AN ENERGY MANAGEMENT PROGRAM

1. Put administrative and management structure in place.

2. Conduct an energy audit. An energy audit (or energy survey) is a study of how energy is used in a facility and an analysis of what alternatives could be used to reduce energy costs.

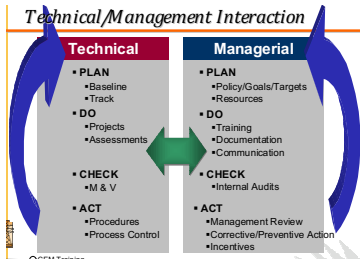
☑ Use your facility people, utility services, or consultant or ESCO services.

ISO 50001 : ENERGY MANAGEMENT SYSTEM

ISO 50001, the global energy management systems standard, specifies requirements for establishing, implementing, maintaining, and improving an Energy Management Standard. The standard is based upon the Plan-Do-Check-Act management system, which is familiar to many manufacturing plants that have implemented other ISO standards.

The U.S. Department of Energy's 50001 Ready program recognizes facilities and organizations that attest to the implementation of an ISO 50001-based energy management system.

ANSI / MSE 2000:2008



BENEFITS OF ANSI / MSE 2000:2008

- ☑ Lower Energy costs
- ☑ Provides greater over Environmental impacts
- ☑ Results in world -class management system
- ☑ Sustains improvements
- ☑ Incorporate continual improvement

ANSI / MSE 2000:2008 IMPLEMENTATION PROGRAM

- ☑ Strategic Energy Plan
- ☑ Software tools
- ☑ Guidance Documents
- ☑ Training and individualised coaching
- ☑ Online assistance
- ☑ Assessments

GOALS OF THE ENERGY AUDIT

Clearly identify types and costs of energy use

Understand how energy is being used--and possibly wasted

Identify and analyze more cost-effective ways of using energy
- improved operational techniques
- new equipment, new processes or new technology

Perform an economic analysis on those alternatives and determine which are cost-effective for your business or industry.

ANALYSIS OF BILLS

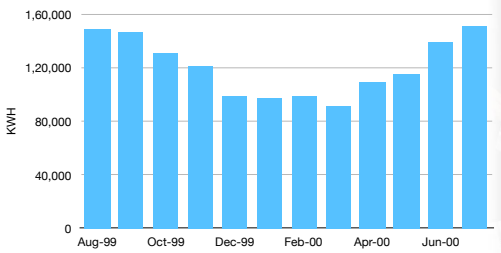
The audit must begin with a detailed analysis of the energy bills for the previous twelve months. This is important because:

The bills show the proportionate use of each different energy source when compared to the total energy bill.

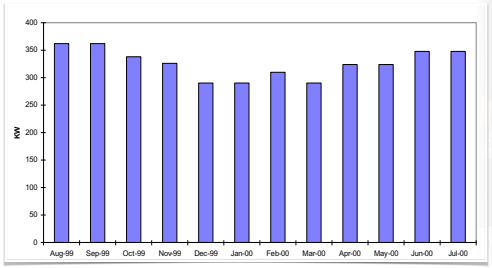
An examination of where energy is used can point out previously unknown energy wastes.

The total amount spent on energy puts an upper limit on the amount of money that can be saved.

EXAMPLE OF MONTHLY ELECTRIC CONSUMPTION – KWH



MONTHLY ELECTRIC PEAK DEMAND - KW

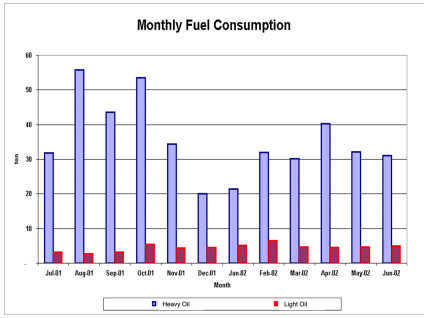


ENERGY BILL ANALYSIS

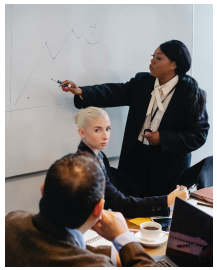
A complete analysis of a facility's energy bills requires a detailed knowledge of the rate structures in effect for the facility.

To determine accurate costs of operating individual pieces of equipment, separate energy bills into their components. E.g.demand charge and energy charges for the electric bill.

This breakdown also allows more accurate savings calculations for Energy Management Opportunities (EMOs) such as high-efficiency equipment, rescheduling of some on-peak electrical uses, etc.



STEPS IN THE ON-SITE ENERGY AUDIT



1. Identify layout and operating schedule for facility.
2. Compile an equipment inventory.
3. Determine the pattern of building use to show annual needs for heating, cooling and lighting
4. Conduct a room-by-room lighting inventory
   - ☑ light fixtures
   - ☑ lamp types, sizes and numbers
   - ☑ levels of illumination
   - ☑ uses of task lighting

GEOGRAPHIC LOCATION/DEGREE DAYS/ WEATHER DATA

- ☑ Geographic location of facility and weather data for that location are important.
- ☑ Obtain average degree days for heating and cooling for that location for the past twelve months from:
  - local weather station,
  - local utility, or
  - state energy office
- ☑ Degree-day data is very useful in analyzing energy needed to heat or cool facility.

EQUIPMENT LIST

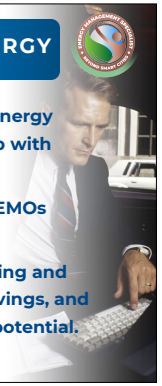
- ☑ Get equipment list for facility and review it before conducting audit.
- ☑ Identify all large pieces of energy-consuming equipment such as: heaters, A/C units, water heaters, and specific process-related equipment.
- ☑ List all major energy consuming equipment, with annual hours of use and energy ratings or efficiencies.
- ☑ The equipment list and data on operational uses of equipment provide an understanding of major energy-consuming tasks or equipment at facility.

NINE MAJOR SYSTEMS TO CONSIDER

- Building Envelope
- HVAC System – people comfort
- Electrical Supply System
- Lighting
- Boiler and Steam System
- Hot Water System - domestic
- Compressed Air System
- Motors – that I can see
- Special Purpose Process Equipment

PRELIMINARY IDENTIFICATION OF ENERGY MANAGEMENT OPPORTUNITIES

- ☑ Identifying EMOs requires a good knowledge of energy efficiency technologies available to do the same job with less energy and cost.
- ☑ During the on-site audit, take notes on potential EMOs that are evident.
- ☑ General rule: Devote the greatest effort to analyzing and implementing the EMOs that show the greatest savings, and the least effort to those with the smallest savings potential.



THE ENERGY AUDIT REPORT

The energy audit report details the final results of the energy analyses and provides energy cost saving recommendations.

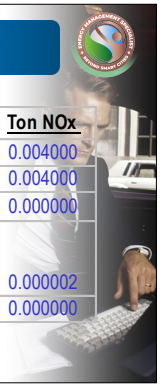
The length and detail of this report will vary depending on the type of facility audited.

A residential audit may result in a computer printout from the utility.

An industrial audit should have a detailed explanation of the EMOs and benefit-cost analyses.

EMISSION FACTORS
IN METRIC TONS

Emissions by Fuel Type	Ton CO_2	Ton SO_2	Ton NOx
1 ton No 6 Oil	3.229600	0.080000	0.004000
1 ton No 2 Oil	3.229600	0.040000	0.004000
1 m^3 of Natural Gas	0.001950	0.000000	0.000000
1 kWh of Electricity (assumes emissions are from a central utility-owned power station)	0.000775	0.000019	0.000002
1 ton of LPG	3.027000	0.000000	0.000000



DEGREE-DAYS

Heating degree-days (HDD) and cooling degree-days (CDD) are separate values and are specific to a particular geographic location.
The degree-day concept assumes:

- ☑ The average building has a desired indoor temperature of 21.1o C.
- ☑ 2.8o C of this is supplied by internal heat sources such as lights, appliances, equipment, and people.
- ☑ The base for computing degree-days is 18.3o C.

EXAMPLE

Assume a period of three days when the outside temperature averaged 10°C each day

The number of HDD for this three day period would be:

HDD = (18.33°– 10°) X 3 days
= 25 degree C days.

The units of degree days are : degrees C x days/year

THE ENERGY AUDIT REPORT FORMAT

1. Executive Summary
Provides a brief summary of recommendations and cost savings.
2. Table of Contents
3. Introduction
Describes the purpose of an energy audit. Emphasizes the need for a continuing energy cost control program.
4. Facility Description
Product or service, and materials flow. Size, construction facility layout, and hours of operation. Equipment list, with specifications.
5. Energy bill analysis
Utility rate structures.Tables/graphs of energy consumptions. Discussion of energy costs and energy bills.

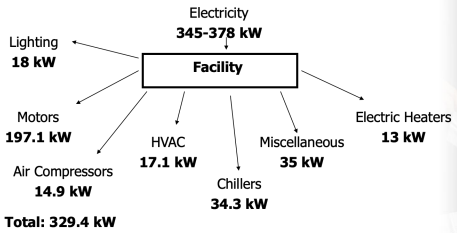
THE ENERGY AUDIT REPORT FORMAT +

6. Energy Management Opportunities Listing of potential EMOs Cost and savings analysis.

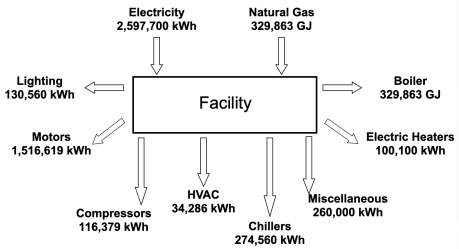
7.Energy Action Plan
Recommended EMOs and an implementation schedule
Designation of an energy monitor and ongoing program

8. Conclusion
Additional comments not otherwise and determine which are cost-effective for your business or industry.

DEMAND BALANCE FOR A FACILITY



ENERGY BALANCE FOR FACILITY



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