ENERGY EFFICIENCY & ASSESSMENT PROCESSES

Council of Industrial Boiler Owners
Environmental, Energy, and Technical Committee
Focus Group
September 10, 2013

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Agenda

- Assessments Summary
- Planning
- Establish Goals and Metrics
- Data Collection
- Assessment Methodology and Standards
- Project Development

Assessments: Summary

- Objective
  - Develop an actionable plan to reduce energy usage and energy costs

  " …to identify and develop modifications that will reduce the energy use and/or cost of operating a building"

  -ASHRAE
- Don't just get a stack of paper

  Even if you just want the stack of paper make sure it has in it what you need.
- Treat like a real project

Assessments: Types

- Commercial
  - HVAC, lighting, general envelope
- Industrial
  - Compressed air, steam distribution and use, pumping systems, process cooling water, process heating
- On site utility generation
  - Steam Plant, CW Plant, Air Plant

Assessments: Execution

- Engineering firms
- System and Process specialists
- ESCO
- Equipment Vendors
- Internal Team(s)

Whatever the manner you must involve operations personnel

Reasons for Energy Assessments

- Cost savings
- Corporate sustainability directive
- Regulatory requirements
  - Boiler MACT
- Recognition Programs
  - ISO 50001, ENERGY STAR, LEED O+M
- Incentives, Rebates, Grant Programs
- Capital improvement program

Recognition Programs

- ENERGY STAR
  - Commercial and Manufacturing
- ISO 50001
  - Boiler MACT
  - Compatible with 14001 systems
- Superior Energy Performance

ENERGY STAR Plant Certification

- Auto Assembly
- Cement
- Container Glass
- Cookie & Cracker
- Flat Glass
- Frozen Fried Potato Processing
- Integrated Paper Mill
- Juice Processing
- Petroleum Refining (private system)
- Pharmaceutical
- Pulp Mill
- Wet Corn Milling

Superior Energy Performance

- Industrial Facilities specific recognition
- Beyond ISO 50001
- ANSI/MSE 50021-2012
- ASME assessment standards
- Specific measurement and verification procedures

Utility Incentive Programs / Rider Relief

- Gas and Electric utility programs
- Programs available for small and large projects
- Can help make a project feasible
- DSE2 rider (Ohio)
  - Rebate vs. Relief

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Energy Efficiency Rider Relief

- Mercantile Customers
  - >700,000kWh annually, can be aggregate
- Rebate vs. Relief
- Periodic re-submittal
- Substantial savings opportunity

Project Planning

- Develop project / program planning document
- Establish assessment project / program goals
- Identify (and inform) project team
  - Project manager(s)
  - Subject matter / process area experts
  - **Operations personnel**

Project Planning

- Identify assessment boundaries
  - System
  - Building
  - Campus
- Begin discussion of reality of energy only projects vs. capital replacements
- Develop list of existing energy improvement needs / ideas
- Plan execution methodology(ies)
  - Internal, external firms, vendors
  - Piece by piece or entire site

Planning Goals and Metrics

- What are program goals
- Energy savings
- Cost savings
- Reduced maintenance
- GHG targets
- Water projects
- Improved comfort / process reliability

Metrics and Reporting

- Determine how paybacks and savings metrics will be calculated and used in reporting
  - SPB, ROI,SIR, financing cash flow
  - What all to include in payback calculations
    - Maintenance savings
    - Future capital avoidance
    - GHG reduction values
  - Utility rate escalation scenarios

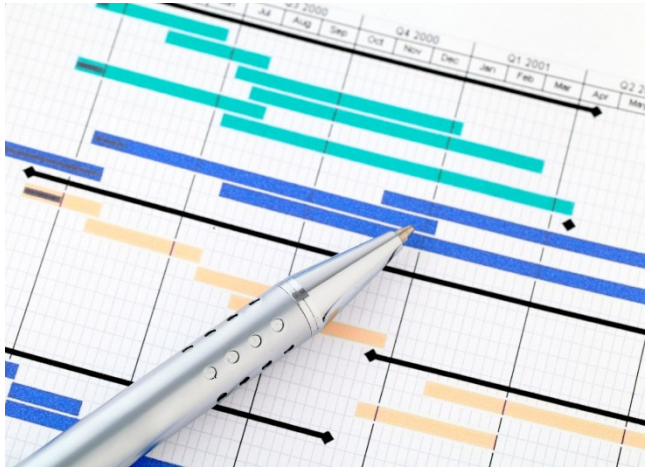
- Depth of financial analysis to include
- What are min-max thresholds for paybacks and savings for project inclusion

Metrics and Reporting Parameters

- What are standard energy units?
  - CCF, MCF, Therms, MMBTU, kW, kBTU, MJ
  - What will GHG assignment be?
- External project funding source(s) or incentive programs may have special reporting requirements that must be considered
  - Specific Units
  - Job Hours
  - Certifications

Data Collection (Preliminary Energy Use Analysis)

- Most important step!
  - ***Early and continued access to relevant energy data is critical***
- Establish routines for continued access to data
- Utility meters
- Maintenance records
- Capital replacement records



Data Collection: Meters

- Gather data for all available meters
- May discover meters you didn't know you had
  (…and maybe no longer own)
- Review actual bills, not just accounting summaries
- Money may be saved just from actually looking at your utility bills

Data Collection: Benchmark

- Develop benchmarks and preliminary facility assessments
- Calculate Energy Use Intensity (EUI) benchmarks
  - Energy/ft^2, cost/ft^2
  - Metrics per unit of production
- Establish baseline dataset(s)
  - Representative year, production cycle

Data Collection: Standards

- ASTM E2797: Standard Practice for Building Energy Performance Assessment for a Building Involved in a Real Estate Transaction

- ASHRAE 105: Standard Measures of Measuring, Expressing, and Comparing Building Energy Performance

Assessment Methodology

- ***Maximize project resource by executing appropriate level of assessment***
- Perform thorough utility data analysis first!
  - This helps drive and direct all subsequent work
- Walk through all facilities to focus EA dollars on buildings of highest returns and in greatest need
- Greater detail will take longer and cost more – use wisely
  - But required for large / expensive projects (and bigger savings)

Assessment Methodology

- Do not rely solely on standards descriptions
- Scope what you actually want / need to know
- Become comfortable with what vendor is going to provide
- Develop internal reporting standards

Assessment Methodology: ASHRAE

- Procedures for Commercial Building Energy Audits - 2011
- Level 1 – Walkthrough Analysis
  - High level summary
  - No Cost ECM's
  - Recommendations for more detailed work
- Level 2 – Energy Survey and Engineering Analysis
  - More savings and cost detail for longer payback ECM's
  - Recommendations for Level 3
- Level 3 – Detailed Analysis of Capital Intensive Modifications
  - 'Investment grade'
  - High detail for major capital projects

Assessment Methodology: ASME EA

- Energy Assessment Standards and Guidance documents for industrial systems
- EA-1 2009 – Process Heating Systems
- EA-2 2009 – Pumping Systems
- EA-3 2009 – Steam Systems
- EA-4 2010 – Compressed Air Systems

Assessment Methodology: Dept of Energy

- Software Tools and Qualified Specialists
- Steam Systems Tool Suite
  - Steam System Modeler Tool (SSMT)
  - Steam System Assessment Tool (SSAT)
  - 3E Plus
- Process Heating Assessment and Survey Tool (PHAST)
- Pumping Systems Assessment Tool (PSAT)
- Fan Systems Assessment Tool (FSAT)
- Compressed Air Systems (AIRMaster+)

Internal EA Standards

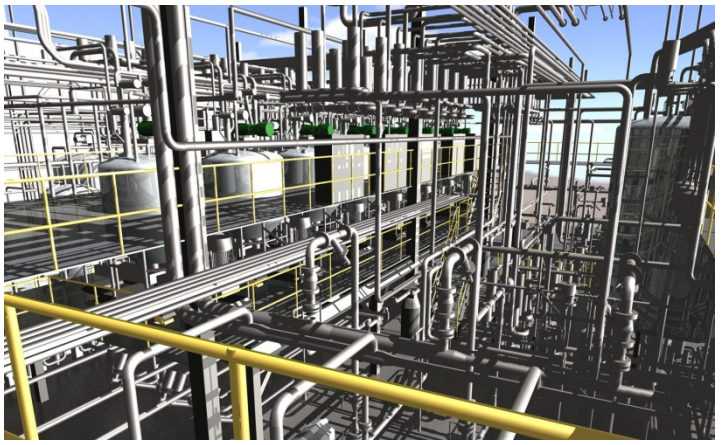
- Standardize assessment reporting (think CAD standard)
- Allows for multiple contractors to be employed but yield comparative and combinable results,
  - Saves time and money and yields better results
- Allows a assessment program to occur over long period of time (phasing)
- Determine what you really need to know and how you will use the information
- Get tables in Excel or similar standardized for importing.
  - If all reports are PDF expect to retype (a lot)

Cost Estimates

- Detailed (accurate) cost estimates essential for large projects
- Requires preliminary designs
- Need to be specific in assessment scope (and willing to pay for)
- Spend engineering dollars (reduce payback) or bid and find out

Cost Estimates

- Are project engineering costs included
  - PM Costs
  - Procurement Costs
- Are local plant requirements included
  - Safety
  - Minimum equipment standards
- Does it include everything that will need to be done in association with this project



Project Development

- Analyze assessment report(s) and review early planning discussions to decide on executable projects
- Identify synergies (good and bad)
- Review original goals and metrics
  - Adjustments may be needed
- Establish project decision metrics
  - $/kBTU saved, $/GHG saved, facility necessity
- Get input from Operations and Maintenance staff
- Will additional engineering be required?

Energy Projects and Deferred Maintenance

- Don't view energy improvements as one capital project after another
- Money likely better spent on <u>good</u> O&M and retro C_x rather than new equipment
- Annual spend on proper ***PREVENTATIVE*** maintenance could be more effective than large capital projects every 10 years
- Behavioral changes sometime most effective ECM

Capital Creep

- Equipment / systems in need or replacement will move into the project, intentioned or not
- Large energy projects should be partnered with, or designed in concert with, planned capital spends
- Many of the projects are also capital projects. Sometimes the payback is not good enough on energy alone but you will need to spend the capital soon enough when it fails

Measurement & Verification

- Critical to actual energy savings
- Must continue to monitor utility data beyond initial assessment
- Some sub-metering will be installed with projects, but may not have been there prior to ECM
- IPMVP and SEP Standards
- Account for in initial project plan

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Measurement & Verification

- Always add sub-metering whenever you can
- Develop meter and communication standards
- Use Enterprise level energy reporting and analysis tools

Summary

- Treat like a real project and PLAN!
- Operations and operations personnel
- Data collection
- Sensible assessment methodology
- Deferred maintenance
- Measurement and verification

QUESTIONS?

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Example: Funding required reporting

Required	
Unique Project ID (UPID)	BBNWO-000002
Location Zipcode	43604
Building Floorspace (ft2)	10,548
Electric Utility Name	Toledo Edison
Natural Gas Utility Name	Columbia Gas
Other Primary Energy Utility	N/A
Date of Audit Completion	4/29/2011
Audit Level (or Software)	ASHARAE Level II
Total Job Hours	37
Total Invoiced Cost	$5,000
Estimated Electricity Saved per year (kWh)	20,548
Estimated % Electricity saved	12.6%
Estimated Natural Gas saved (CCF)	1,815
Estimated % Natural Gas Saved	17.5%
Estimated Other Primary Fuel [units]	N/A
Estimated % Fuel Saved	N/A
Voluntary	
Year Constructed	1957
Percent Space conditioned	100%
Number of floors	2
Number of workers	15+
Principal Building Activity	Fire Station
Weekly operating Hours	168
Property Manager	N/A
Auditor Company Name	SSOE Group
Auditor Certification	CEM

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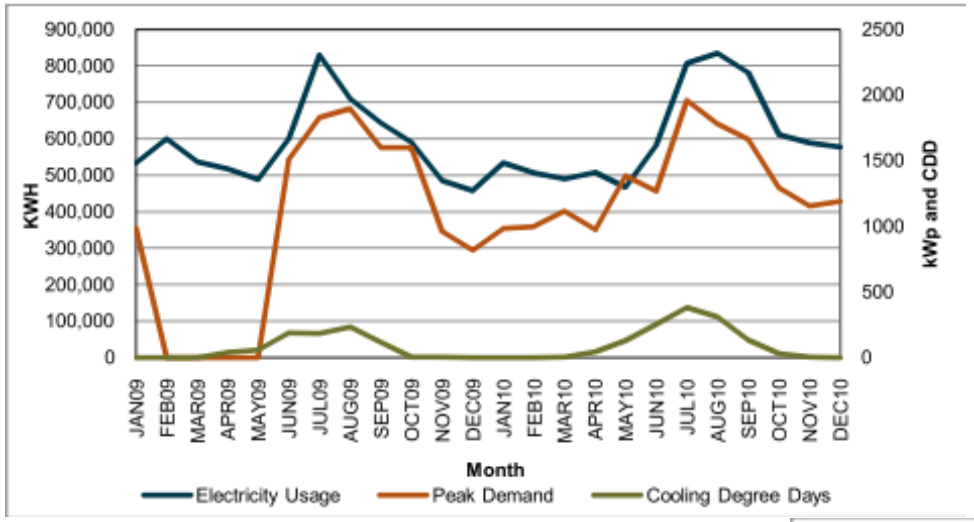
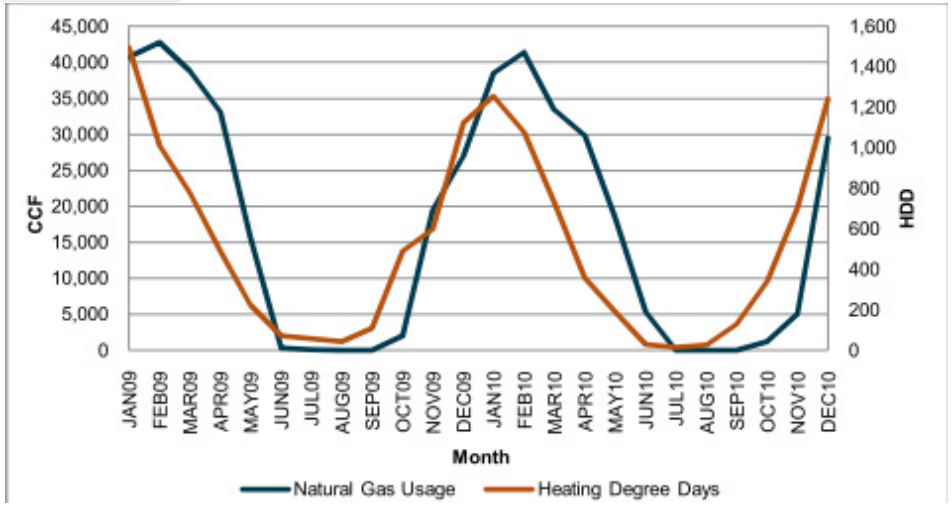
Example: Early Analysis

Building	
Facility Type	Labs and Offices
Location	Toledo, OH
Gross Building Floorspace (ft^2)	17,750
Year Constructed	1996
Annual Consumption	
Electric (KWH)	693,400
Electric (KWH/ft^2)	39.1
Benchmark (KWH/ft^2)	N/A
Average Peak (kWp)	116.9
Load Factor	67.7%
Natural Gas (CCF)	49,802
Natural Gas (ft^3/ft^2)	280.6
Benchmark Gas (ft^3/ft^2)	N/A
Other Primary Fuel (CCF)	N/A
Other Primary Fuel (CCF/ft^2)	N/A
Total Energy (kBTU)	7,346,031
Total Energy (kBTU/ft^2)	413.9
Benchmark EUI (kBTU/ft^2)	N/A
Annual Costs	
Electric	$67,112
Electric ($/KWH)	$0.097
Electric ($/$ft^2$)	$3.78
Natural Gas	$49,774
Natural Gas ($/CCF)	$0.999
Natural Gas ($/$ft^2$)	$2.80
Other Primary Fuel	N/A
Other Primary Fuel ($/unit)	N/A
Other Primary Fuel ($/$ft^2$)	N/A
Total Energy	$116,886
Total Energy ($/$ft^2$)	$6.59

Example: Early Analysis





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Example: Summary table

ECM	Description	Electrical Savings (KWH/yr)	Electrical Savings (%) (1)	Electrical Savings ($/yr)	Natural Gas Savings (CCF/yr)	Natural Gas Savings (%) (2)	Natural Gas Savings ($/yr)	Total Energy Savings (kBTU/yr)	Total Energy Savings (%) (3)	Total Cost Savings ($/yr)	Project Cost ($)	Simple Pay Back (yrs)
1	Insulate Steam Valves	0	0.0%	$0	2,000	1.0%	$1,053	200,000	0.9%	$1,053	$8,000	7.6
2	Insulate Steam Lines	0	0.0%	$0	1,000	0.5%	$527	100,000	0.4%	$527	$3,500	6.6
3	Replace Air Handling Units	8,000	0.8%	$1,216	1,000	0.5%	$527	127,296	0.5%	$1,742	$75,000	43.0
4	Boiler Economizers	0	0.0%	$0	10,000	5.0%	$5,266	1,000,000	4.3%	$5,266	$65,000	12.3
5	Lighting Retrofits	900,000	90.0%	$136,770	0	0.0%	$0	3,070,800	13.1%	$136,770	$400,000	2.9
6	VFD Pump Replacement	110,376	11.0%	$16,774	0	0.0%	$0	376,603	1.6%	$16,774	$100,000	6.0
	TOTAL	**908,000**	**90.8%**	**$137,986**	**14,000**	**7.0%**	**$7,373**	**4,498,096**	**19.2%**	**$145,359**	**$551,500**	**3.8**

Example: BBWNO standard

I. **Summary**
   - A. Brief Building description and summary of operation
   - B. TABLE – ECM Summary
   - C. TABLE – ARM Summary

II. **Bldg Benchmark**
   - A. Simple description of benchmarking comparison and annual facility usage
   - B. TABLE – Benchmarking and Energy Summary

III. **Facility Operation**
   - A. Description of Mechanical system operations and general facility conditions, etc.
   - B. Hours of operation, usage and occupancy
   - C. Approximate people count
   - D. % of space heated and cooled
   - E. O&M issues

IV. **Energy Conservation Measures**
   - A. ECM #X
     1. Description
     2. Savings Calculations
        a. Assumptions
   - B. TABLE – ECM Detailed (if necessary)
   - C. To ASHRAE Level 2 standards calculations to state assumptions basis for savings and cost numbers and state degree of accuracy assumed (+/- X%)

V. **Additional Recommended Measures**
   - A. ARM # and Description
     1. Categorization (Poor, Fair, Good)
   - B. TABLE – ARM Detailed (if necessary)

I. **Renewable Energy (if requested)**
   - A. Standard RE feasibility discussion (PV, WIND, Solar Thermal)
   - B. TABLE – PV area available
   - C. TABLE – Solar Thermal area available

II. **Water Savings Opportunities (if relevant / requested)**
   - A. Bathroom Faucet, Shower, Toilet counts (table only)
   - B. General description of site Irrigation (if applicable)
   - C. Savings opportunities possible.

III. **Appendices**
   - A. Utility Analysis and mention rate structure for facility
     1. TABLE – Energy Usage Detailed
     2. PLOT(S) - Energy Usage
     3. Demand Costs vs. kWh (if relevant)
     4. Include HDD and CDD on Plots
   - B. Department of Energy Project Reporting Requirements

IV. **Miscellaneous / Optional Appendices**
   - A. Lighting counts for rebates
   - B. Count and record all meters entering building (include meter numbers)
   - C. Equipment inventory and expected life (recommended)
   - D. Significant maintenance history
   - E. Native Excel files of tables and Word file of report(s) should be provided to TLPCA for future use.