Welcome
Energy Accounting & Benchmarking

Energy Accounting – Why?

➢ Compare energy consumption and cost
  ➢ Over time and among other facilities
➢ Identify energy spikes and billing errors
➢ Prioritize energy capital investments
➢ Evaluate progress and communicate results
➢ Create incentives for energy management
➢ Improve energy budget forecast
➢ Keep track of changes
Getting Started

➢ Setup a team and assign roles
  ➢ Allocate time and resources

➢ Establish contacts
  ➢ Utility account representative
  ➢ Accounting/Finance department

➢ Gather all utility accounts and facility information
  ➢ Electric, natural gas, propane, water, etc.
  ➢ Work to optimize procedure
  ➢ Setup data recording frequency
  ➢ Reduce double entry and help streamline the procedure
Poll Question:

Do you or does your organization conduct meter mapping?
Identify Utility Meters

- Identify all meter locations and determine which facilities they serve
- Create a utility meter list and utility meter map
- Determine if meters serve multiple facilities
- Group facilities in a logical manner according to the utility meters served
- Grouping facilities by the utility meters served will help in accurately benchmarking the facilities
Identify Utility Meters Mapping
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Identify Utility Meters Mapping (cont.)
Gather Facility Data

- Record building square footage (sf)
  - Where can I get the square footage data?
- Keep track of building additions and renovations
- Identify operations and schedule changes
  - Temperature setpoints
    - Heating & cooling
  - Occupancy type / usage
  - Operating hours
Gather Facility Data (cont.)

➢ Not required but good to have

➢ General description of HVAC and other energy using equipment
  ➢ Number of occupants
  ➢ HVAC (Electric heat or Gas heat)
  ➢ Number of computers
  ➢ Kitchen appliances (Gas or Electric)

➢ Record major equipment replacement
Gather Utility Data

➢ Establish baseline
  ➢ At Least One Calendar Year (12 Consecutive Months)

➢ Review Monthly Invoices
  ➢ Scanned Invoices, Tracking Spreadsheets, Software, Contact the Utility Provider

➢ Electric
  ➢ Consumption (kWh), Peak Demand (kW), etc.

➢ Natural Gas

➢ Water

➢ Chilled Water & Heating Hot Water/Steam
Why Btu’s?

➢ Energy consumption is expressed in Btu’s to allow for consumption comparisons among fuel types that are measured in different units.

➢ kWh to BTUs
  ➢ 1 KWh = 3,412 Btu
  ➢ Convert 2,000 kWh to Btu’s
    ➢ 2,000 kWh * 3,412 Btu/kWh = 6,824,000 Btu’s

➢ Natural Gas Consumption to BTUs
  ➢ 1 Cubic Foot of N. Gas = 1,030 Btu’s
  ➢ 1 CCF = 100 Cubic Ft = 103,700 Btu’s
  ➢ 1 MCF = 1,000 Cubic Ft = 1,037,000 Btu’s

➢ Propane to BTUs
  ➢ 1 Gal Propane = 91,600 Btu’s
  ➢ 1 Cubic Ft Propane = 2,500 Btu’s
Establish Energy Performance Indices (Buildings)

- **Energy Use Index (EUI)**
  - Total annual electric and natural gas usage
  - Btu/SF/Year
  - kBtu/SF/Year, Why “k”?  
    - 68,000 Btu/SF/ Yr is the same as 68 kBtu/SF/Yr

- **Energy Cost Index (ECI)**
  - Total annual electric and natural gas cost (all fuels)
  - $/SF/Year
Establish Energy Performance Indices (WWTP)

- Energy Use Index (EUI)
  - Annual energy usage divided by average effluent flow
  - kBtu/GPD/Year

- Energy Cost Index (ECI)
  - Annual energy cost divided by average effluent flow
  - $/MGD/Year

- Normalization
  - Other factors influence EUI & ECI for WWTP
    - such as influent biological oxygen demand (BOD) levels, nutrient removal, etc.
## Baseline & Performance Tracking

### Energy Utilization Index

<table>
<thead>
<tr>
<th>Facility</th>
<th>EUI (kBtu/ft²/Yr)</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility A</td>
<td>64.9</td>
<td>58.5</td>
<td>38.7</td>
</tr>
<tr>
<td>Facility B</td>
<td>58.5</td>
<td>53.7</td>
<td>43.7</td>
</tr>
<tr>
<td>Facility C</td>
<td>43.7</td>
<td>39.2</td>
<td>31.2</td>
</tr>
<tr>
<td>Facility D</td>
<td>39.2</td>
<td>33.1</td>
<td>31.2</td>
</tr>
</tbody>
</table>

### Energy Cost Index

<table>
<thead>
<tr>
<th>Facility</th>
<th>ECI ($/ft²/Yr)</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility A</td>
<td>$1.85</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Facility B</td>
<td>$1.23</td>
<td>0.96</td>
<td>$0.91</td>
</tr>
<tr>
<td>Facility C</td>
<td>$1.21</td>
<td>$1.14</td>
<td>$0.91</td>
</tr>
<tr>
<td>Facility D</td>
<td>$1.23</td>
<td>$1.14</td>
<td>$0.91</td>
</tr>
</tbody>
</table>

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Texas Energy Engineering Services, Inc. (www.teesi.com)
Other Energy Performance Indices

- Other indices
  - kWh/SF
  - kWh/Occupant
  - $/Occupant
  - Btu/Occupant

- Used to compare building energy performance

- Weather normalization
Poll Question:

Do you or does your organization actively track electric demand?
Energy Accounting & Benchmarking

Electric Demand

➢ Not typically tracked, but can be beneficial

➢ Larger commercial buildings may represent 30-50% of the electric cost

➢ Additional advantage to tracking demand is the ability to calculate a building’s load factor

➢ Identify Peak Demand times with interval data
Electric Demand

- Peak power draw (kW)
- Demand charges ($/kW)

Building ABC

<table>
<thead>
<tr>
<th>Month</th>
<th>Electrical Demand (kW)</th>
<th>Demand Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec</td>
<td>400</td>
<td>$1,500</td>
</tr>
<tr>
<td>Jan</td>
<td>400</td>
<td>$1,500</td>
</tr>
<tr>
<td>Feb</td>
<td>400</td>
<td>$1,500</td>
</tr>
<tr>
<td>Mar</td>
<td>600</td>
<td>$3,000</td>
</tr>
<tr>
<td>Apr</td>
<td>600</td>
<td>$3,000</td>
</tr>
<tr>
<td>May</td>
<td>600</td>
<td>$3,000</td>
</tr>
<tr>
<td>Jun</td>
<td>600</td>
<td>$3,000</td>
</tr>
<tr>
<td>Jul</td>
<td>600</td>
<td>$3,000</td>
</tr>
<tr>
<td>Aug</td>
<td>600</td>
<td>$3,000</td>
</tr>
<tr>
<td>Sep</td>
<td>600</td>
<td>$3,000</td>
</tr>
<tr>
<td>Oct</td>
<td>600</td>
<td>$3,000</td>
</tr>
<tr>
<td>Nov</td>
<td>600</td>
<td>$3,000</td>
</tr>
</tbody>
</table>
Load Factor Analysis

➢ The ratio of average kW to peak kW in billing period
➢ Represents consistency of facility usage
Example Interval Demand Data

Peak Day Profile Examples

- June 2017
- August 2017
- November 2017

Electrical Demand (kW)

Time of Peak Day

0
200
400
600
800
1000
1200
1400
1600
1800

12:00:00 AM
3:00:00 AM
6:00:00 AM
9:00:00 AM
12:00:00 PM
3:00:00 PM
6:00:00 PM
9:00:00 PM
12:00:00 AM
Poll Question:

Do you or does your organization actively track water usage?
Water Consumption and Performance

➢ Develop water baseline

➢ Performance indices
  ➢ Total annual water consumption per square foot
    ➢ Gallons/ft\(^2\)/Year
  ➢ Total annual water consumption per occupant
    ➢ Gallons/occupant/day
Budgeting

➢ One of the important functions of an Energy Manager

➢ Energy accounting tools
  ➢ Historical consumption and costs
  ➢ Forecast consumption and costs

➢ Energy management activities
  ➢ Staffing and manpower
  ➢ Equipment
  ➢ Energy retrofits
Estimating future utility budget:

Assume you have a 100,000 ft² (SF) facility and your total annual energy costs are $100,000 per year. There will soon be a 20,000 ft² addition to the facility next year.

What will be the estimated electric budget for the building addition (similar occupancy, usage, rates, HVAC/lighting systems, etc.)?
Energy Budgeting Forecasting (cont.)

➢ Existing square footage (SF): 100,000 ft$^2$
  Annual energy costs last year: $100,000$
  Facility addition square footage (SF): 20,000 ft$^2$

➢ Calculate annual energy cost index (ECI):

\[
ECI = \frac{\text{Annual Energy Cost}}{\text{Square Footage}} = \frac{$100,000/yr}{100,000 \text{ ft}^2} = $1.00/\text{SF}
\]

➢ Projected additional energy costs for next year:

\[
ECI \times \text{Total Square Footage for Addition} = $1.00/\text{SF} \times (20,000 \text{ SF}) = $20,000/yr
\]
Simple Payback

➢ Example of measure of worth is to calculate the simple payback (years)

➢ Simple payback = initial cost / annual savings

➢ Determines the number of years required to recoup the cost of the initial investment

➢ The annual savings can other quantifiable savings
Simple Payback (cont.)

Example payback calculation:

It costs $10,000 to retrofit existing T8 linear fluorescent lighting to LED lighting at your building. The estimated annual energy savings are calculated to be $1,500/year. What would be the simple payback for the LED retrofit project?
Simple Payback Calculation

➢ Total Project Cost: $10,000
➢ Annual Energy Cost Savings: $1,500/yr

\[
\text{Simple Payback (years)} = \frac{\text{Project Cost} [\$]}{\text{Annual Savings} [\frac{\$}{yr}]}
\]

\[
\text{Payback} = \frac{\$10,000}{\$1,500/yr} = 6.6 \text{ years}
\]

➢ Other factors (maintenance, buydown, rebates etc.)
Cumulative Savings Simple Payback

Utilize the savings of multiple projects to improve the overall “cumulative” payback.

<table>
<thead>
<tr>
<th>Project</th>
<th>Project Cost ($)</th>
<th>Project Savings ($)</th>
<th>Simple Payback (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC Replacement</td>
<td>$100,000</td>
<td>$6,500</td>
<td>15.4</td>
</tr>
<tr>
<td>Lighting Retrofit</td>
<td>$75,000</td>
<td>$18,750</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>$175,000</strong></td>
<td><strong>$25,250</strong></td>
<td><strong>7</strong></td>
</tr>
</tbody>
</table>
Energy Accounting & Benchmarking

Life Cycle Analysis

- Initial Cost
- Maintenance Cost
- Operating Cost
- Energy Cost
- Salvage Value
Poll Question:

How do you track your energy?
Energy Accounting Software

➢ Energy Accounting is an important practice to monitor energy consumption for facilities

➢ Various software tools are available in the market & some are FREE
  ➢ ENERGY STAR Portfolio Manager, spreadsheets, commercially available software etc.
Energy Accounting Software

Energy accounting system benefits include:
- Maintain historical data and set goals
- Track changes
- Budget energy costs more accurately
- Evaluate energy program
- Identify and correct anomalies early
  - Weather, floor area, operational changes, etc.

Communicate RESULTS
What is Portfolio Manager?

- Developed by EPA and DOE as part of ENERGY STAR Program
- Online energy and water tracking tool
➢ SECO Schools and Local Government program
   ➢ Energy Technical Assistance & Preliminary Energy Assessments

➢ LoanSTAR (Funding source)

➢ Other programs
Questions?

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