



Energy Accounting & Benchmarking

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Welcome



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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?**

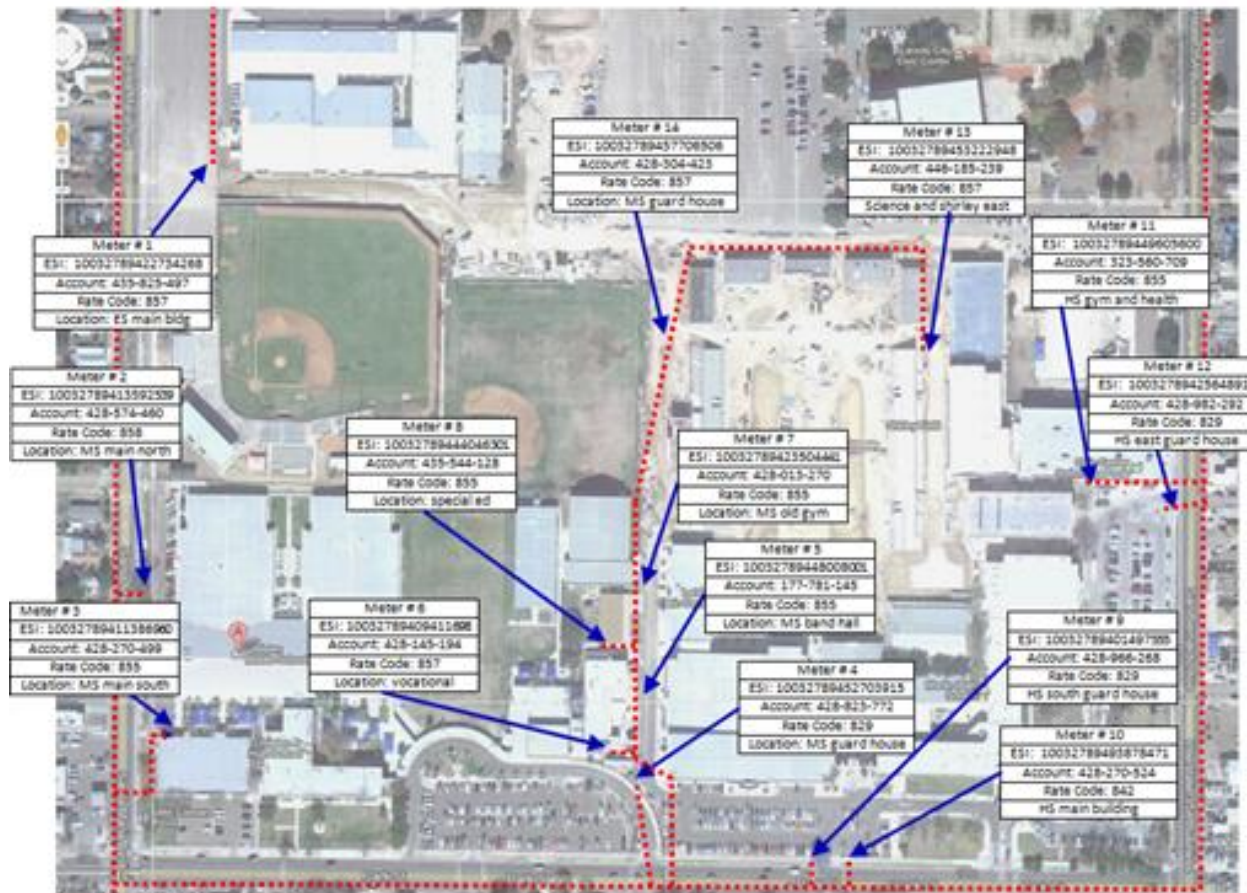


Identify Utility Meters

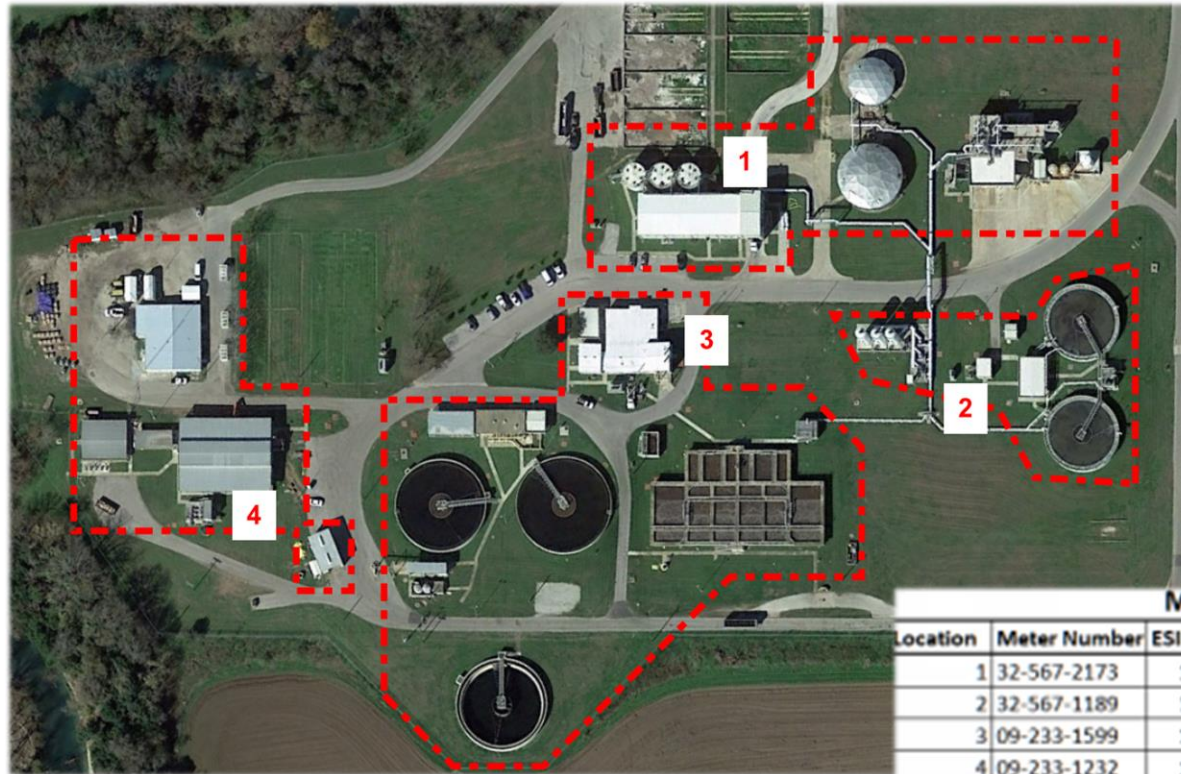
- Identify all meter locations and determine which facilities they serve
- Create a utility meter list and utility meter map
- Determine if meters serve multiple facilities
- Group facilities in a logical manner according to the utility meters served
- Grouping facilities by the utility meters served will help in accurately benchmarking the facilities



Identify Utility Meters Mapping



Identify Utility Meters Mapping (cont.)



Meter Key

| Location | Meter Number | ESID # | Serving |
|----------|--------------|------------|---------------------------|
| 1 | 32-567-2173 | 1003987124 | Pumps, Tanks, Shed |
| 2 | 32-567-1189 | 1003986282 | Aerators, Tanks, Pumps |
| 3 | 09-233-1599 | 1003988580 | Aerators, Basins, Pumps |
| 4 | 09-233-1232 | 1003989116 | Offices, Maintenance Shed |



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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
 - $2,000 \text{ kWh} * 3,412 \text{ Btu/kWh} = 6,824,000 \text{ Btu's}$
- 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)

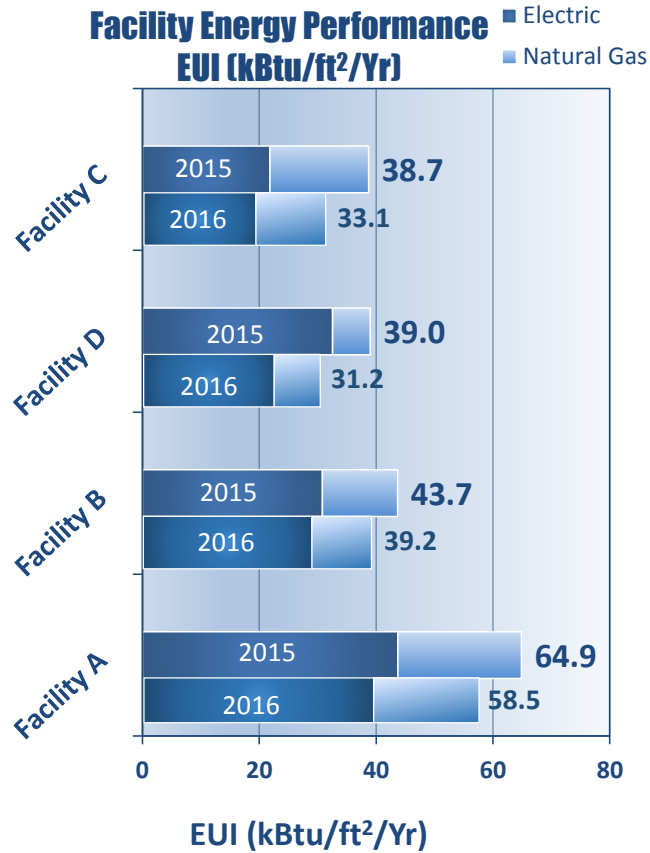
- Energy Use Index (EUI)
 - Annual energy usage divided by average effluent flow
 - kBtu/GPD/Year

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

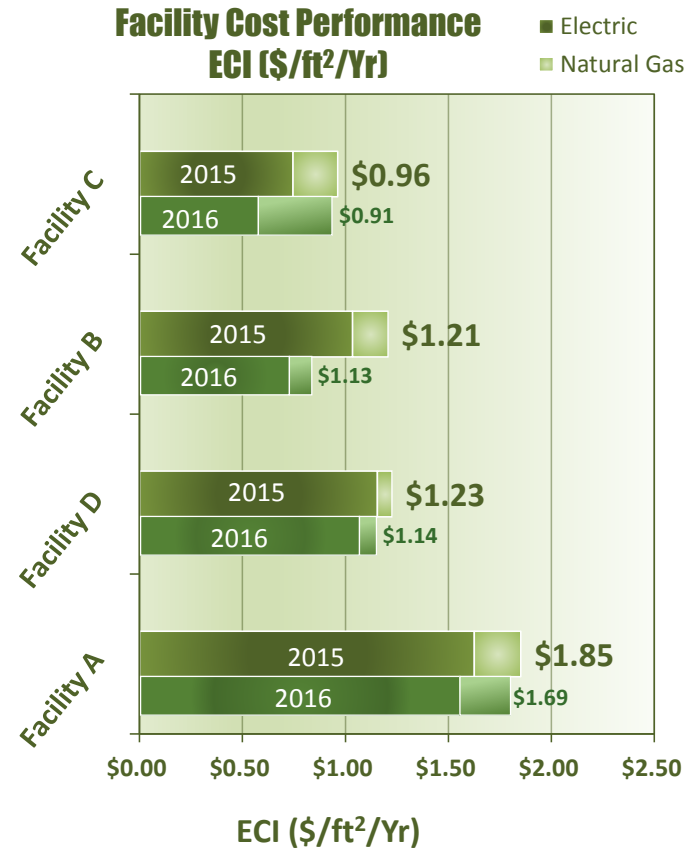
- Normalization
 - Other factors influence EUI & ECI for WWTP
 - such as influent biological oxygen demand (BOD) levels, nutrient removal, etc.

Baseline & Performance Tracking

Energy Utilization Index



Energy Cost Index



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?



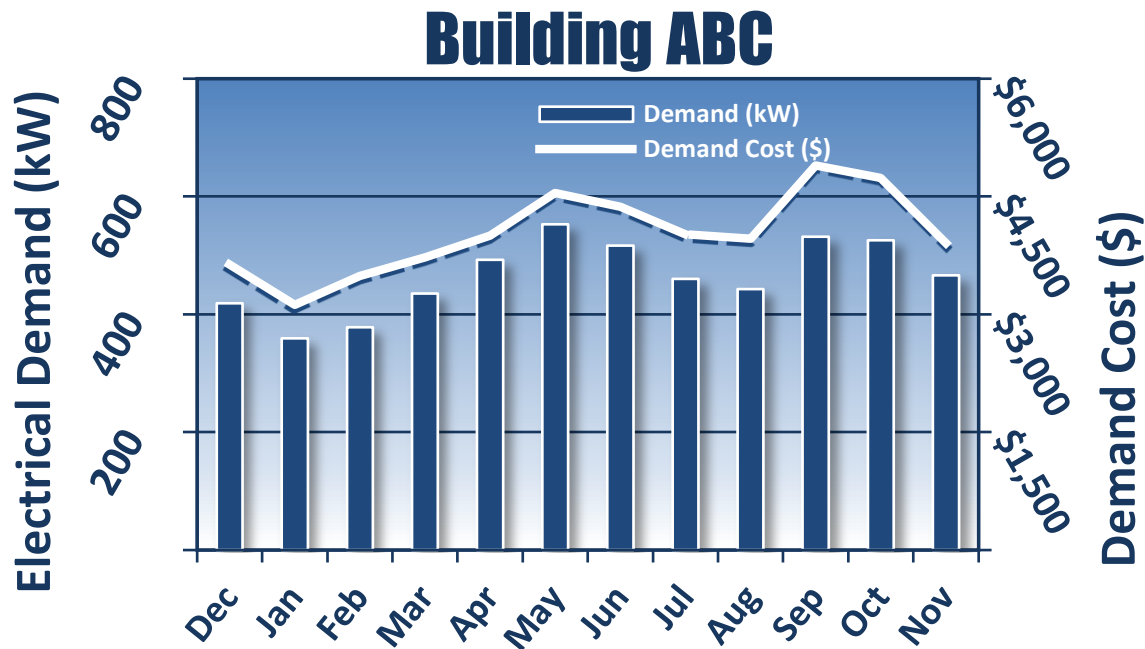
Electric Demand

- 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

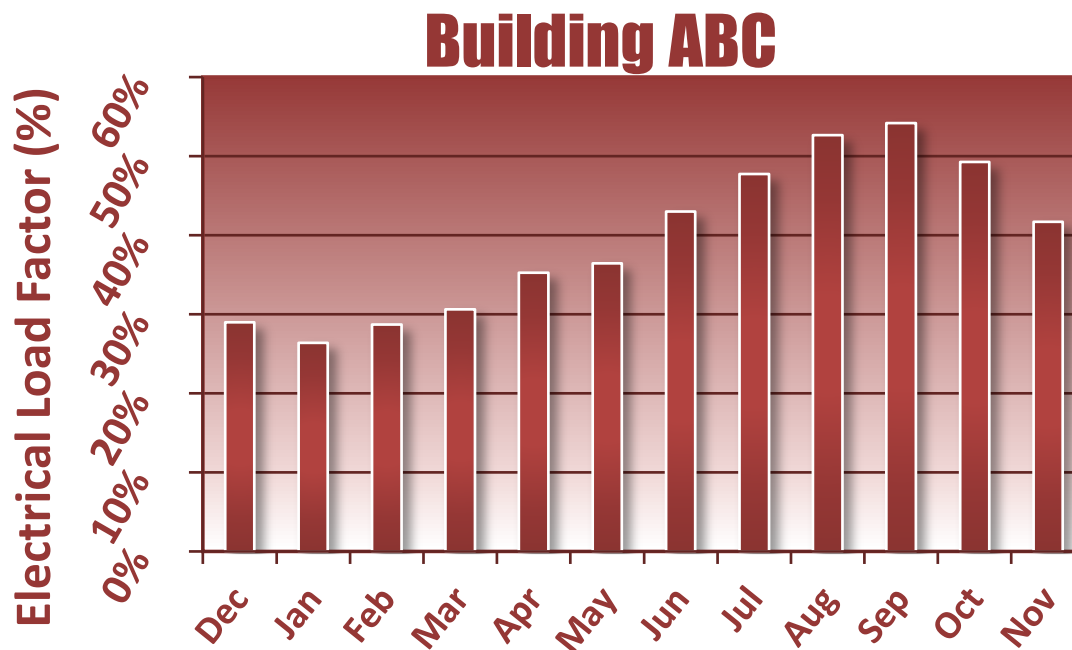
- Peak power draw (kW)
- Demand charges (\$/kW)



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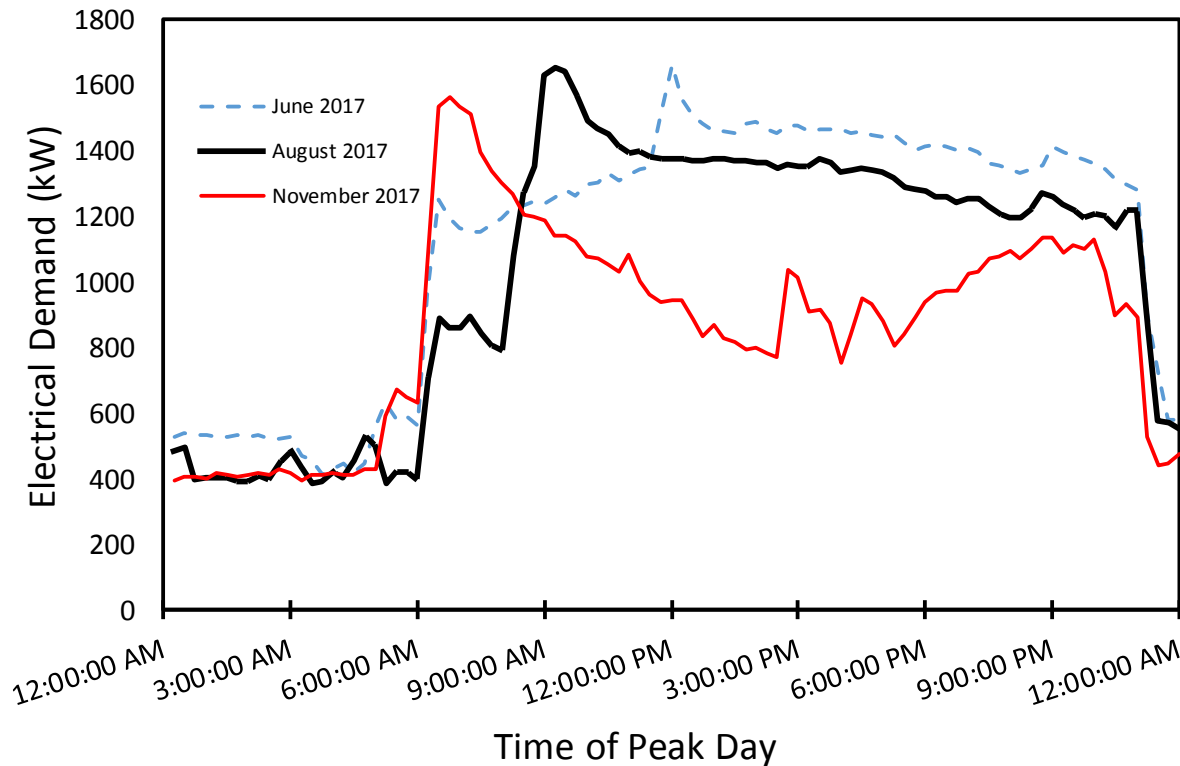
Load Factor Analysis

- The ratio of average kW to peak kW in billing period
- Represents consistency of facility usage



Example Interval Demand Data

Peak Day Profile Examples



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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/ft²/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



Energy Budgeting Forecasting

➤ 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 ft²**
Annual energy costs last year: **\$100,000**
Facility addition square footage (SF): **20,000 ft²**
- Calculate annual energy cost index (ECI):
 - $ECI = \frac{\text{Annual Energy Cost}}{\text{Square Footage}} = \frac{\$100,000/\text{yr}}{100,000 \text{ ft}^2} = \mathbf{\$1.00/\text{SF}}$
- Projected *additional* energy costs for next year:
 - $ECI * \text{Total Square Footage for Addition}$
 $= \$1.00/\text{SF} * (20,000 \text{ SF}) = \mathbf{\$20,000/\text{yr}}$



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**

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

➤ *Payback* =
$$\frac{\$10,000}{\$1,500/\text{yr}} = \mathbf{6.6 \text{ years}}$$

➤ Other factors (maintenance, buydown, rebates etc.)



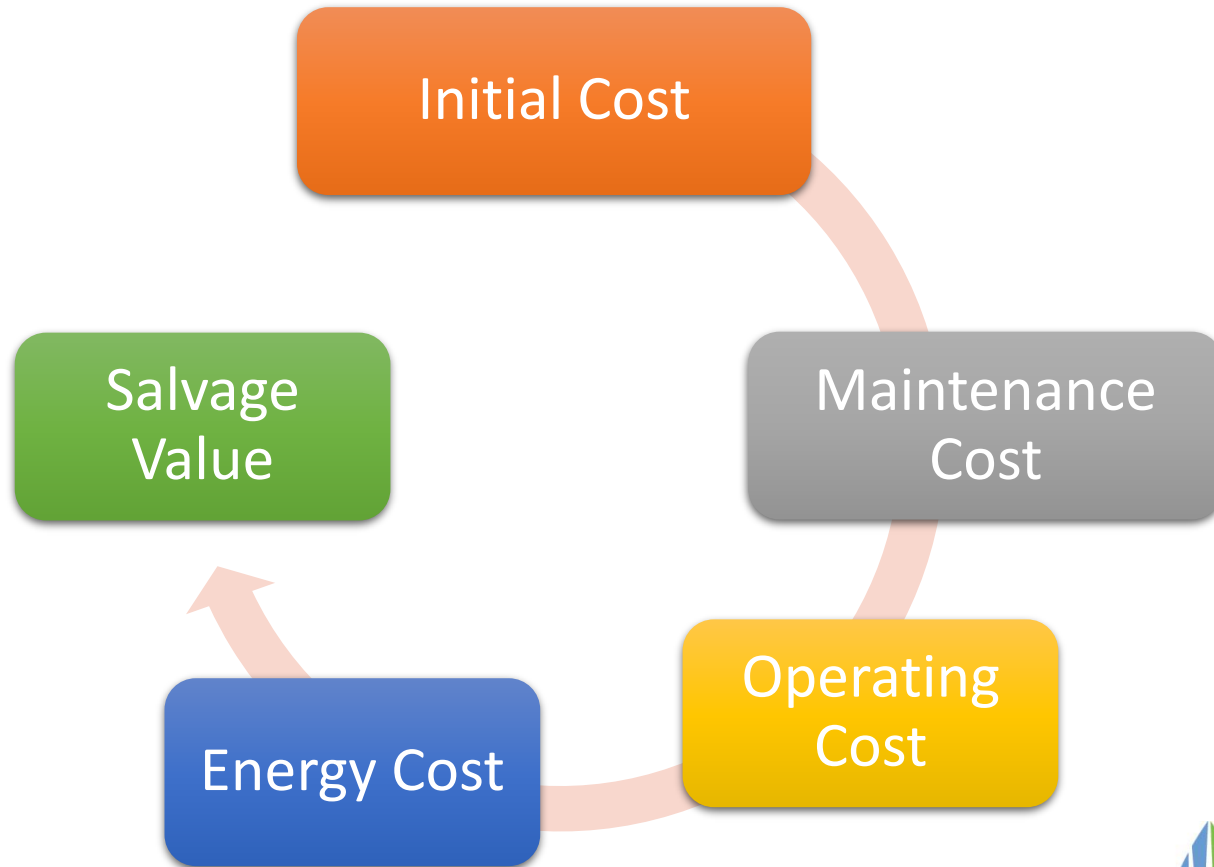
Cumulative Savings Simple Payback

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

| Project | Project Cost (\$) | Project Savings (\$) | Simple Payback (Years) |
|-------------------|-------------------|----------------------|------------------------|
| HVAC Replacement | \$100,000 | \$6,500 | 15.4 |
| Lighting Retrofit | \$75,000 | \$18,750 | 4 |
| | | | |
| Total: | \$175,000 | \$25,250 | 7 |



Life Cycle Analysis



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

▶ Basic Meter Information

▼ Monthly Entries

Display Year(s):

| | Start Date | End Date | Usage kWh (thousand Watt-hours) | Cost (\$) |
|--------------------------|------------|-----------|---------------------------------|-----------|
| <input type="checkbox"/> | 1/1/2014 | 1/31/2014 | 273,600 | 37,094.00 |
| <input type="checkbox"/> | 2/1/2014 | 2/28/2014 | 273,000 | 37,011.00 |
| <input type="checkbox"/> | 3/1/2014 | 3/31/2014 | 311,400 | 41,390.00 |
| <input type="checkbox"/> | 4/1/2014 | 4/30/2014 | 324,000 | 43,452.00 |
| <input type="checkbox"/> | 5/1/2014 | 5/31/2014 | 425,400 | 51,521.00 |



State Energy Conservation Office

- SECO Schools and Local Government program
 - Energy Technical Assistance & Preliminary Energy Assessments
- LoanSTAR (Funding source)
- Other programs



Questions?

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