BOC Level I

Project Workbook

Name: _____ **ID#:** _____

Company: _____

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BOC Level I Project

Purpose. The purpose of the BOC Level I project is to enable you to demonstrate your ability to apply skills developed in the BOC classes. The assignments require you to gather information about your facility, provide documentation, and make recommendations for particular building systems. Taken as a whole, the project should provide you with a useful overview of the facility's operational characteristics, energy consumption, and maintenance status.

Requirements. Completion of the Level I Project Workbook is REQUIRED for BOC Level I certification.

Organization and Instructions. The project consists of five assignments given during the class and should be completed and returned to your training coordinator for review at the start of the following class. If you have any questions, ask your training coordinator or call the NEEC office at (206) 292-4793.

Score Card. This page is completed by BOC Training Coordinator following review of each assignment. Be sure to complete your name and company name and include it when you hand in each assignment. The training coordinator will assign you a participant ID #, review your assignments, and note the score as you progress through the course series. At the end of the series, the training coordinator will submit this assignment record to NEEC.

Project Assignment Description

By Class	Due
BOC 1001: Draw a simple floor plan of the facility. Identify primary heating and cooling plants, distribution lines and control points.	the following class
BOC 1002: Create an energy benchmark for your building using Energy Star® Portfolio Manager.	the following class
BOC 1003: Perform a simplified lighting survey including lighting power density and lighting levels. Research utility contacts, incentives and calculate lighting retrofit incentive.	the following class
BOC 1004: Identify controls for the HVAC system and assess the operation of the controlled HVAC equipment. List the maintenance requirements for these systems.	the following class
BOC 1005: Develop an Occupancy Schedule. Profile the occupancy of the facility by week, month, and year.	the following class

Project Score Card

Name: _____ Company: _____ Participant ID #: _____

********** OFFICE USE ONLY **********

Date	Assignment	Score	Comments (and Reviewer's Initials)
	Assignment 1: Building Floor Plan		
	Assignment 2: Benchmark a Building		
	Assignment 3: Lighting Survey		
	Assignment 4: HVAC Control System Review		
	Assignment 5: Occupancy Schedule		

Assignment 1: Building Floor Plan

Introduction

In this project, you are asked to draw or reproduce a simple floor plan of one building and locate the major components and sub-components of the building ventilation, heating, and cooling systems. This assignment provides you hands-on practice in drawing field sketches. Floor plans and building system flowcharts serve several useful purposes. They can be used to:

- identify changes in system performance due to process changes.
- reference systems prior to on-site work.
- revise as-built plans, as necessary.
- communicate effectively with other personnel.
- proactively avoid potential health and safety hazards.

The finished floor plan should provide a well-organized, general sense of system design and essential system design details, yet concise enough to provide space for noting present system operating conditions, health and safety risks, and performance problems. Plans should be small enough to be carried easily while walking around the facility and should not require a lot of time to prepare or to revise.

Objectives

1. Using the project rubric as a guide, you will draw or reproduce a simple floor plan of a building to scale that includes major features within the space. (knowledge)
2. Using the symbol library provided, sketch one HVAC system and its major components on the floor plan using a color coded scheme to differentiate distribution pathways, supply and returns, terminal points, and sub-components. (knowledge)

Instructions

Select a single building or floor of a large building between 2,000 and 10,000 square feet. You will refer to this building or floor for the entire project so the size should be manageable for you and representative of the rest of the facility, but not too complex.

Get Started

1. Review the Assignment Rubric and the sample floor plans provided in the handbook.
2. Select one of the building systems below to include in your floor plan, then walk the space to identify space features and system components.

- Ventilation
- Heating
- Cooling

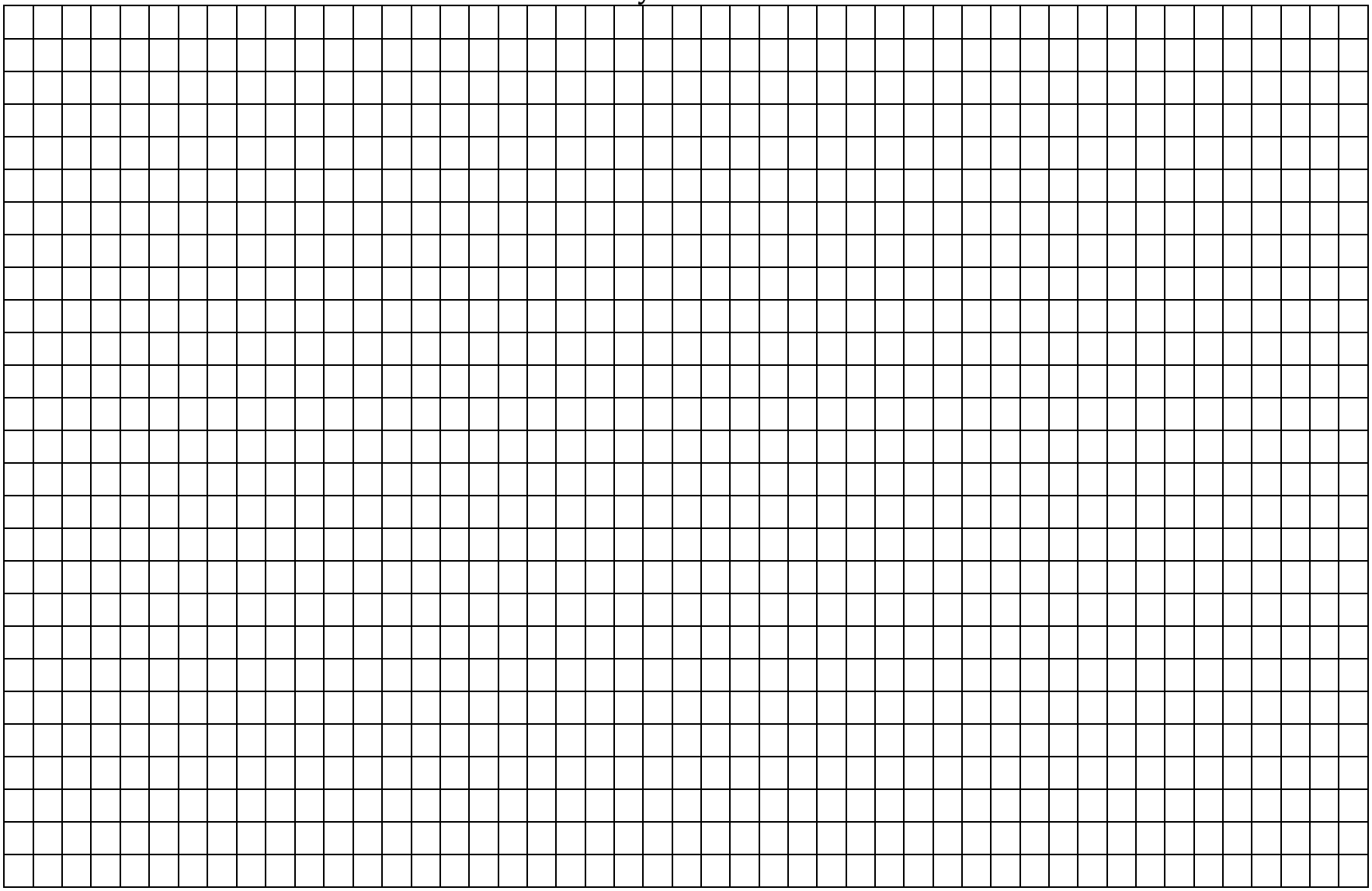
3. **Draw or reproduce a simple floor plan of the building/floor**. This should be a simple line drawing. The floor plan should show the perimeter of the building and identify the major features within the space (i.e. rooms, stairs, and elevators). Use the graph paper provided to establish scale. Alternatively, you can use an existing CAD drawing or existing floor plans.
4. **Sketch at least one HVAC system and essential system details.**
    a) Refer to the symbol library provided in the appendix of this workbook.
    b) On the floor plan, draw the HVAC system serving the building or floor using colored pencils or markers to represent the different systems. Major components can include but are not limited to a boiler, chiller, cooling tower, and rooftop unit. *Note: If using a CAD drawing or building print, trace the systems in color.*
    c) Draw relevant components of the HVAC system using color symbols, including:
        - Distribution pathways (i.e., ducts and piping).
        - Identify supply and returns for central air, water, or steam systems.
        - Identify terminal points and sub-components (i.e., supply and return registers, VAV boxes, radiators)
    d) Reference the HVAC system and components in a legend.
5. **Submit your floor plan for review.** To receive full credit for the assignment, complete and turn in the floor plan to your course coordinator at the start of the next class.

Assignment 1: Building Floor Plan Rubric

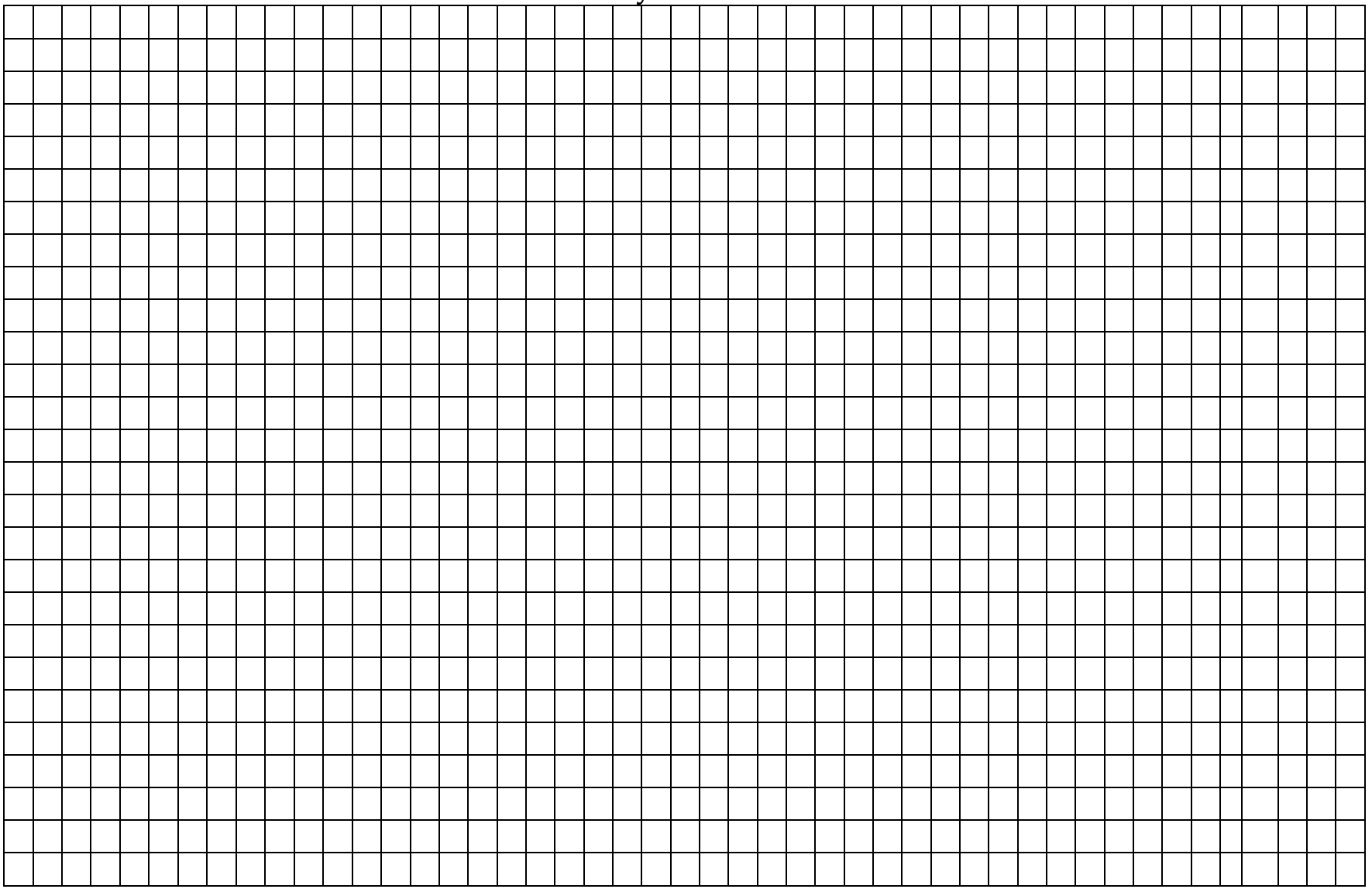
PRESENTATION	Check if Complete
Cover Page Includes All of the Following: 1. Name of facility 2. Location of floor plan in facility (e.g. building, level, etc.) 3. Square footage of floor plan area.	 1. _____ 2. _____ 3. _____
Layout 1. Plan is hand-drawn on graph paper or is a CAD drawing 2. Plan shows approximate scale.	 4. _____ 5. _____
Level of Detail 1. A legend is drawn or rendered with CAD and shows all major equipment and sub-components referenced in the floor plan. 2. Each system type and its components is uniquely color coded.	 6. _____ 7. _____
CONTENT	Check if Complete
Building Envelope and Major Structural Features 1. The perimeter of the building shows exterior walls, doors, and windows. 2. Identified major features within the structure e.g. interior walls, doors, rooms, stairs, and elevators, if applicable.	 8. _____ 9. _____
Building Systems 1. Drew at least one major HVAC system and referenced equipment type in the legend, for example boiler, chiller, window unit, heat pump, furnace, ventilation system, etc. 2. For the HVAC system above, drew relevant system subcomponents and referenced equipment type in the legend: • Heating systems (air, water, or steam): outside, supply, and return pathways, ducts, registers, radiators, piping, controls, sensors, thermostats, switches, flow control, terminal points, condensate returns, traps, variable speed pump, zone valves • Ventilation system: air handling unit, blower, fan, ducting, damper, coils, turning vanes, terminal units, air outlets/ inlets • Cooling systems (air and water): condenser, evaporator, bypass, controls, piping, fans, ducts, cooling elements, educator, pump, VAV unit, constant volume.	 10. _____ 11. _____
Office - Use	PARTICIPANT NAME_____ Reviewer Initials _____ Date _____ Score_____	**TOTAL _____/11**

Building Name: _____
Square Footage: _____
Location (e.g. building, level, etc.):_____

Facility Floor Plan



Facility Floor Plan



Assignment 2: Benchmark a Building

Assignment 2: Benchmark a Building

Introduction

In this assignment you will benchmark the building from Assignment 1 using the ENERGY STAR® Portfolio Manager tool. You will learn to utilize standard methods for analyzing energy used in buildings and demonstrate your skills entering facility information and energy use data into monthly, yearly, and cyclical formats. You will demonstrate your ability to separate utility billing into monthly formats, create seasonal benchmarks, and compare energy performance over time. By successfully completing this workbook assignment you will be able to convert differing energy units into a common format and calculate an Energy Use Intensity (EUI) for a building. In addition, this exercise will document your ability to evaluate and compare energy use in your building to comparable national averages for similar facilities, and document your skill in preparing information used in creating a Statement of Energy Performance (SEP).

Objectives

You will:

- Locate the current rate schedule, meter numbers, and 12 consecutive months of all electric and natural gas utility data for a commercial facility. (knowledge)
- Enter the square footage of metered space, the space usage, meter numbers, and monthly energy usage for a 12 consecutive-month period for all fuels, and the duration of the billing period and monthly utility consumption data into Portfolio Manager.
- Print the Portfolio Manager Statement of Energy Performance (SEP) and locate the site energy use intensity and Energy Star Score.
- Complete energy accounting forms and calculate energy use intensities for total energy, cost and electricity as indicated. (application, comprehension)
- Graph monthly utility consumption by fuel in MMBTU. (knowledge, application, comprehension)
- Create a Seasonal Benchmark for a building. (knowledge, application, comprehension)
- Compare Energy Performance of a building to a national benchmark. (knowledge, analysis)
- Explain the difference between site and source energy intensity. (knowledge, comprehension)
- Explain the difference between seasonal benchmarking and annual EUI Benchmarking. (knowledge, comprehension)
- Effectively organize, schedule, manage, and report project assignment. (analysis)
- Identify building characteristics that effect energy use. (analysis)

Instructions

For this assignment, refer to the building used to draw the floor plan in BOC 1001 and the utility energy use data specific to that building. If for some reason you are unable to complete the Portfolio Manager Assignment, the steps below provide instructions for Assignment A as well as an *alternative assignment:* Energy Accounting Report.

Get Started

1. **Review the Assignment-A Rubric for Portfolio Manager. NOTE:** If completing the alternative assignment using the *Energy Accounting Report*, refer to rubric B found in the Appendix B-2 of this Project Workbook.
2. **Gather Data.** Go to: https://portfoliomanager.energystar.gov/pm/dataCollectionWorksheet and select your Country and Property Type and look up the required data before logging in to Portfolio Manager.
   A Data Collection Worksheet for an office building is included in the Appendix. For other property types, go to the above referenced site and generate/print worksheets by selecting the appropriate property type. Make sure to print your data collection worksheet and bring it as part of your assignment (see rubric). Fill out as much of the data collection worksheet as you can, as some information may be difficult to obtain.
   Do you need Sample Building Data? If you don't have access to your facility's energy use, you can use the sample building data in Appendix B-4.
3. **Enter Data and Generate a Report. Complete either step 3A or 3B.**
   A. Refer to the Portfolio Manager Quick Start Guide found in the appendix of your Class 1002 Handbook for step by step instructions for entering the data you collected into Portfolio Manager. The PM Quick-Tip Guide can be found in the appendix of this Project Workbook.
      (1) When you complete data entry, generate and print the Statement of Energy Performance (SEP). See sample Statement of Energy Performance (SEP) in the workbook appendix.
   B. If completing the alternative assignment using the Energy Accounting Report, complete the three-part form found in Appendix B-3.
4. **Analyze Data and Benchmark**. Using the *SEP* or your *Energy Accounting Report*, complete the *Benchmark Analysis Worksheet* on page 19.
5. **Submit your work for review.** To receive full credit for the assignment, complete, print, and turn in the three documents enumerated below to your course coordinator at the start of the next class:
   (1) Portfolio Manager Data Collection Worksheet
   (2) Statement of Energy Performance (SEP) or the Energy Accounting Report (Part 1-3).
   (3) Benchmark Analysis Worksheet

Assignment 2-A: Portfolio Manager Rubric

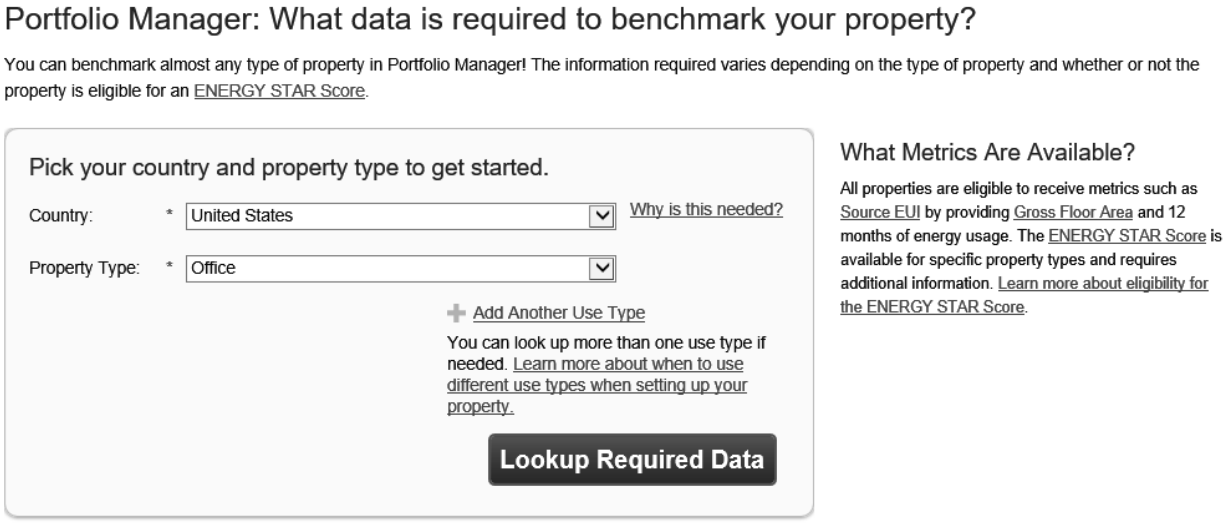
Presentation	Check if Complete
Portfolio Manager Data Collection Worksheet Includes:	
1. Building name, address and zip code	1. _____
2. Year built	2. _____
3. Building type (e.g., school, office bldg., hospital, etc.)	3. _____
4. Gross square footage	4. _____
5. All data fields specific to the building type	5. _____
6. Source of 12-month utility bills: A) Actual _____ B) Sample_____	6. _____

Reporting	Check if Complete
Report Generation and Analysis	
1. Entered utility data	7. _____
2. Generated and printed the SEP.	8. _____
Analysis: Benchmark Analysis Worksheet	
1-2. Accurately stated the EUI & Compared EUI to national average.	9. _____
3. Accurately calculated EUI difference.	10. _____
4. Identified at least two reasons that may cause the building to be higher or lower than the national average for the same building type.	11. _____

Office Use	
	PARTICIPANT NAME: _____ TOTAL _____/11 Reviewer Initials: _____Date:_____ Score: _____

ENERGY STAR® Portfolio Manager Data Collection Tool

You can benchmark almost any type of property in Portfolio Manager. The information required varies depending on the type of property and whether or not the property is eligible for an ENERGY STAR Score. Go to: https://portfoliomanager.energystar.gov/pm/dataCollectionWorksheet and select your Country and Property Type and lookup the required data.



This tool will present you with the Basic Data required for all properties as well as Additional Data required for your specific property type (see screen shots below). You can use this tool to create a "worksheet" (in Word or PDF) to send to others electronically or in hard copy. It will be especially helpful to users who need to gather this data from multiple sources.

Once you've filled in your Data Collection Worksheet, you will need to manually enter this data into Portfolio Manager. Continue to the next step of creating a Portfolio Manager account to enter your building data at www.energystar.gov/portfoliomanager.

Data Collected for All Properties

- Property Name
- Property Address
- Total Gross Floor Area
- Total Gross Floor Area of Property
- Irrigated Area
- Year Built/Planned for Construction Completion
- Occupancy
- Number of Buildings
- 12 consecutive months of energy data

Additional Data Collected for Office

The following information is **required** to get an ENERGY STAR score (if eligible):

- Gross Floor Area
- Weekly Operating Hours
- Number of Workers on Main Shift
- Number of Computers
- Percent That Can Be Heated
- Percent That Can Be Cooled

Start Collecting Data

Create a document with the information above. Create Word Create PDF

Portfolio Manager - What data is required?

In order for Portfolio Manager to calculate metrics about your property, you must provide several key pieces of information about your property's operation, in addition to your energy, water or waste data. The information required varies by the type of property and whether or not your property is eligible for an **ENERGY STAR Score**.

Data Required for All Properties	
Property Name	
Property Address	
Total **Gross Floor Area** of Property	Sq. Ft./Sq. M.
Irrigated Area	Sq. Ft./Sq. M./Acres
Year Built/Planned for Construction Completion	
Occupancy	%
Number of Buildings	

Helpful Hints for All Properties

- Definitions for Property Use Details are available in the **Portfolio Manager Glossary** (in the Help section, or https://portfoliomanager.energystar.gov/pm/glossary).
- Some properties may contain multiple Property Uses within a single building (e.g. office, data center, and parking; OR K-12 School and Swimming Pool). In most cases, EPA recommends you enter as few Property Uses as possible. More information about when to enter a separate Property Use is in this FAQ.
- For properties with multiple tenants within the same property use (e.g. Office), these tenants should be entered separately only when the number of Weekly Operating Hours differs by more than 10 hours. For example, say an Office Building has a Gross Floor Area of 100,000 square foot (SF) where 75,000 SF operates 60 hours a week and 25,000 SF operates 80 hours a week. Enter these as two separate Property Uses (one 75,000 SF property and one 25,000 SF property).

Office Uses

Data Collected for Office Uses	
The following information is required to get an ENERGY STAR Score (**if eligible**):	
Gross Floor Area	
Weekly Operating Hours	
Number of Workers on Main Shift	
Number of Computers	
Percent That Can Be Heated	
Percent That Can Be Cooled	

Definition for Office

Office refers to buildings used for the conduct of commercial or governmental business activities. This includes administrative and professional offices.

Gross Floor Area (GFA) should include all space within the building(s) including offices, conference rooms and auditoriums, break rooms, kitchens, lobbies, fitness areas, basements, storage areas, stairways, and elevator shafts.

If you have restaurants, retail, or services (dry cleaners) within the Office, you should most likely include this square footage and energy in the Office Property Use. There are 4 exceptions to this rule when you should create a separate Property Use:

- If it is a **Property Use Type that can get an ENERGY STAR Score** (note: Retail can only get a score if it is greater than 5,000 square feet)
- If it accounts for more than 25% of the property's GFA
- If it is a vacant/unoccupied Office
- If the Hours of Operation differ by more than 10 hours from the main Property Use

More on this rule.

Helpful Hints for Office

- If more than 10 percent of the office's gross floor area on average was vacant through the last 12 months, enter the vacant space as a separate Property Use with zero for Weekly Operating Hours, Number of Workers on Main Shift and Number of Computers.
- The Weekly Operating Hours value is the number of hours per week that the office is occupied by the majority of its occupants. It should not include hours when the building is occupied solely by maintenance/security personnel or HVAC run times when the building is not occupied by the majority of occupants.
- The Number of Workers on Main Shift should be entered as the number of workers present on a site at the same time, not the total number of workers added up across all shifts during a day.
- When determining the Number of Computers, do not count extra monitors or tablets. For example, a desktop computer with 3 monitors would count as 1. Similarly, a laptop computer with an external monitor would count as 1.

Meter Information

What's required to see metrics:

- 12 consecutive, complete months of bills if your energy or water is metered continuously.
- At least one delivery if your energy is delivered in bulk quantities (e.g. filling a propane tank.)

Basic Meter Information	
Meter Name or ID	
Meter Type (e.g. Electricity)	
Units (e.g. kWh)	
Date Meter Became Active	
Date Meter Became Inactive	

You can use the form on the next page to get ready to enter your data so you can see metrics, however you can create your property and set up your meters without entering your meter data. You can add bills later.

Meter Bills			
Start Date/Delivery Date	**End Date (leave blank for deliveries)**	**Usage/Quantity**	**Cost (optional)**

Benchmark Analysis Worksheet

1. What was the site energy use intensity (EUI) of your building? _____

2. Find your building type in the chart below and CIRCLE it. If the building type is not listed, CIRCLE the "Other" line.

Table 1. U.S. National Averages for Site Energy Use Intensity (EUI) *Source: ENERGY STAR 2016*

Building Type	Average Site Energy Use Intensity (EUI) - kBtu/sf/year		Building Type	Average Site Energy Use Intensity (EUI) - kBtu/sf/year
Education			Public Assembly	
College	130.7		*Entertainment/Culture*	45.3
K-12	58.2		*Library*	91.6
Dormitory	73.9		*Recreation*	41.2
Fast food service	384		*Social/Meeting*	45.3
Restaurant	223.8		Public Order	
Health Care			*Fire/Police Station*	88.3
Hospital	196.9		Service (repair, personal)	49.6
Senior Living	125.7		Storage/Warehouse	28.5
Medical Office	44.4		*Refrigerated warehouse*	126.3
Lodging	73.4		Religious Worship	36.8
Office	67.3		Laboratory/Technology	78.8
Retail (non-mall)	47.1		Multifamily	78.8
Retail (mall)	93.7		Other (mixed use)	78.8

3. Compare your building's site EUI to the average for your building type. My building is (check one, and fill in the numeric difference between your building and the average):

___ Above the national average by _____ Btu/sf/year.
___ Below the national average by _____ Btu/sf/year.
___ Same as the national average

4. List the reasons your building may use more or less energy than the average building of the same type? (e.g. inefficient lighting fixtures; no energy management control system; inefficient HVAC, etc.)

A. _____

B. _____

Assignment 3: Lighting Survey

Assignment 3: Lighting Survey and Lighting Retrofit Cost Estimate

Introduction

This is a three-part project assignment. In Part I, you'll conduct a lighting survey on the areas of a building used in Assignments 1 & 2. In Part II, you'll research local lighting incentives. In Part III, you'll estimate the cost of a lighting retrofit using a typical utility incentive. By successfully completing this workbook assignment you will be able to demonstrate your knowledge of lighting levels and retrofit techniques to reduce energy use associated with lighting while maintaining recommended lighting levels needed for productivity and safety.

Objectives

You will:

1. Recall the definitions of lamp, ballast, lumen, footcandle, and fixture.
2. Demonstrate and apply an understanding of terms used in lighting and energy accounting. (knowledge, comprehension)
3. Perform a simplified lighting survey including the calculation of lighting power density (watts/SF), energy used (kWh), and lighting levels in footcandles. (knowledge, application, comprehension)
4. Identify existing lighting levels and compare findings to recommended light levels for various applications. (knowledge, analysis, application)
5. Calculate the total input power for each lighting fixture, including lamp and ballast. (application, comprehension)
6. Calculate the cost and savings for a retrofit project using manual energy accounting methods. (application, comprehension)
7. Effectively organize, schedule, manage, and report projects. (analysis)
8. Explore local utility contacts and identify incentive programs that can be used to offset the cost of making lighting system improvements. (analysis, application)
9. Calculate Simple Payback (SPB) and R.O.I. calculations for energy efficiency measures. (knowledge, analysis, comprehension) Instructions

Instructions

Review the assignment rubric.

Lighting Survey Project Rubric

Part I: Lighting Surveys (10 points)	Check if Complete
Includes the following:	
1 Name of surveyed facility	1. _____
Lighting Power Survey	
2 Identify one space type within facility per worksheet	2. _____
3 Each designated space lists: Space Square Footage, fixture type; number of fixtures per type; wattage per fixture; total wattage; watts per square feet; recommended LPD; control type;	3. _____
4 Calculations are accurate for Total Wattage (columns D xE)	4. _____
5 Calculations are accurate for Watts/ft2 (columns F / B)	5. _____
Lighting Energy Use Survey	
6 Space type, square footage, and total wattage (per fixture type) was carried over from the Lighting Power survey.	6. _____
7 Calculations are accurate for Watt Hrs per Month (columns CxD)	7. _____
8 Conversion to kWh is accurate (column E/1000)	8. _____
9 Cost Per Month is accurate (columns F x G)	9. _____
10 Cost Per Month per NET ft2 is accurate (columns H / B)	10. _____
Part II: Research (5 points)	**Check if Complete**
Utility Incentive Research:	
11 Local incentive resources are identified	11. _____
12 Steps taken to apply for incentives	12. _____
Part III: Lighting Retrofit Case Study (25 points)	**Check if Complete**
Current information, Proposed Retrofit and Calculations:	
13 Total points earned from the worksheet	13. _____

Office Use	PARTICIPANT NAME_____ Reviewer Initials _____ Date _____ Score_____	TOTAL _____/40

Get organized. You will need to collect data and enter it into the worksheets provided. A list of required information is provided below.

1. **Collect Data**
   1.1. Occupant Usage
   - ❑ More than one activity may be in use within the building or tenant space under consideration. In addition, different hours of operation may occur. You'll need to document each activity on a separate worksheet.
   - ❑ Determine the space type(s), monthly hours of operation for fixture type, and electric utility rate per kWh.
   - ❑ Net square footage of each area that has the same monthly hours of operation.

   1.2. Building Information
   - ❑ Net Square footage of the portion of the building you are observing.
   - ❑ Perform a survey of the space in order to complete the Lighting Power Survey and Lighting Energy Use surveys. Ask the BOC coordinator for information on accessing the electronic version of the worksheets (MS Excel).
   - ❑ Survey the controls within each space noting the type of controls and setting as appropriate (wall switches, timers & operating time, occupancy sensors, vacancy sensors, motion detectors, etc.).
2. **Complete the Surveys (***Tip: Also, see survey examples in the appendix C-3*)
   2.1. Lighting Power Survey - enter **building name and net square footage of all space types included in this survey.**
   - ❑ **Space Type**
     Identify the space type (e.g., classroom, office, corridor or restroom). Use a separate worksheet for each space type.
   - ❑ **Space Square Footage** (square footage for space type identified above).
   - ❑ **Fixture Type**
     Group similar fixtures together (ex: All 2-L T8 2x4 recessed together; all 2-L T8 2x2 U-tubes together, etc.).
   - ❑ **Input Watts per Fixture Type**
     - Calculate the input watts per fixture. For 4-ft fluorescent magnetic ballasted systems, use the tube watts X number of tubes + 4 watts (ballast loss). (Ex: 34 w/tube X 2 tubes = 68-w + 4-w = 72-w)
     - For 4-ft electronic ballasted fluorescent systems, use the tube watts X number of tubes X BF (ballast factor – use 0.88 for generic electronic ballasts (GEB) (Ex: 32 w/tube X 2 tubes X 0.88 = 56-w)
   - ❑ **Number of Fixtures by Type**
     Record the number of fixtures by type.
   - ❑ **Total Calculated Watts**
     Multiplying columns D and E will yield the Total Watts per Fixture Type.

- ❑ **Calculate Lighting Power Density (LPD)**
  Divide column F by D to derive the LPD for the building in watts/ SF for the space.
- ❑ **Recommended LPD**
  Look up the recommended Lighting Power Density for the space type. These are provided in appendix C-3 of this workbook. Enter the recommended value in the subtotal field.
- ❑ **Control Type**
  Enter lighting controls for space type, (e.g. time clocks, ultra-sonic, infra-red, etc.).

2.2. Lighting Energy Use Survey: Enter building name.

A. Space Type
Identify the space type (e.g., classroom, office, corridor or restroom). Use a separate worksheet for each space type.

B. Space Square Footage (square footage for space type identified above)

C. **Total Calculated Watts**
Carry over the total calculated wattage from Column F in the Lighting Power Survey for each Fixture Type surveyed.

D. Calculate the total monthly hours of operations
Monthly hours of operation for each fixture type.

E. Watt-hrs per Month
Multiply Total Calculated Wattage (C) by hours of operation (D) per month.

F. Calculate Monthly Lighting Energy
Divide column E by 1000 to calculate lighting kilowatt hours (kWh).

G. Look up average electric rate per kWh
Use the average electric utility rate per kWh from the benchmarking project in Assignment 2.

H. Calculate Cost Per Month
Multiply column F by column G to get the energy cost by fixture type.

I. Cost Per NET ft²
Divide column H by column B to get the Cost per Square Foot by fixture type and by space.

3. **Submit your work for review.** Complete, print, and turn in the four documents listed below to your course coordinator at the start of the next class:
   - ❑ Lighting Power Survey Worksheet
   - ❑ Lighting Energy Use Survey Worksheet
   - ❑ Utility Incentive Research
   - ❑ Lighting Retrofit Worksheet

Lighting Power Survey

Surveyed Building: _____

A **Space Type** (e.g., office, kitchen, classroom, etc.)	B **Space Square Footage (NET ft²)**	C **Fixture Type**	D **Number of Fixtures Per Type**	E **Input Watts Per Fixture**	F **Total Watts** (Columns D x E)	G **LPD** (Column F divided by Column B)	I **Control Type** (e.g., manual, timeclock, infra-red, etc.)	H **Illuminance Recommended (LPD)** [1] Table 3 Appendix C-2
NET ft²:	0			**TOTAL**			**LPD:**	

[1] If you have access to a light meter, compare actual room readings to the recommended lighting levels for the type of occupancy.

Lighting Energy Use Survey

Surveyed Building: _____

A	B	C	D	E	F	G	H	I
Space Type (from Lighting Power Survey)	**Space Square Footage (NET ft2)**	**Total Watts** (from Lighting Power Survey)	**Monthly Operating Hours**	**Watt-hrs per Month** (CxD)	**kWh** (E/1000)	**Average Electric Rate per kWh**	**Cost per Month** (F X G)	**Cost per NET ft2** (H/B)
1)								
2)								
3)								
4)								
5)								
6)								
TOTAL								

Utility Incentive Research

In Part II, you will research resources in your city that provide rebate incentive information including utility companies, websites, government agencies and other organizations. Then, read the case study (Part III) below and complete the worksheet.

Tip! Access www.dsireusa.org database of Energy Efficiency incentives for your state. HINT: when accessing the database, un-check the Renewable Energy box to narrow your search results.

List the local incentive resources you identified.

_____

_____

_____

List the steps that need to be taken to apply for incentive sponsored energy efficiency projects before and after they are completed.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Lighting Retrofit Case Study and Worksheet

The commercial building in our case example operates 3,000 hours annually and has 250 fixtures with 4 fluorescent lamps each and electronic ballasts and are rated at 112 watts each. The lamps are at the end of their life and as the Building Operator you are preparing for a group re-lamping and are asked to research cost and incentive programs for a tubular LED retrofit of the existing fixtures. You purchased and tested several LED lamps and have determined that a 17-watt tubular UL Type A lamp is the best option using 4 lamps per fixture which will reduce the wattage of the fixture to 75 watts each (including ballast losses). The project cost is $40/fixture which includes labor and lamp disposal cost. The Electric Utility company offers a rebate of $1/lamp and the electricity rate for your building is $0.12/kWh.

Given the facility and incentive information provided, complete the lighting retrofit worksheet on the next page.

National average electricity rate (2018)

Lighting Retrofit Worksheet

First complete the top section by filling in each line with current lighting system information and proposed retrofit data provided, and then perform the calculations.

	Current	Proposed
Watts per fixture (A)	watts	watts
Operating hours (B)	hours	hours
Number of fixtures C)		
Annual consumption	kWh/yr	kWh/yr

(A)x(B)X(C) Note: Divided by 1000 to get kilowatt hours

Calculations

Energy Savings	kWh Current annual comsumption	minus	kWh Proposed annual comsumption	equals	kWh Annual energy savings
Cost savings	kWh Annual energy savings	X	$/kWh Energy rate $/kWh	equals	$ Annual cost savings
Fixture Cost	 # of fixtures	X	$ Cost per fixture	equals	$ Total fixture cost
Utility Incentive	 # of fixtures	X	$/fixture Rebate per fixture	equals	$ Total utility incentive
Net project cost	$ Fixtures plus labor cost	minus	$ Utility Incentive	equals	$ Net project cost
Payback period	$ Net project cost	divided by	$ annual $ savings	equals	years Payback in years
Return on Investment (ROI) Note: ROI is 1 divided by the payback period	1	divided by	 Payback in years	equals	% ROI

Assignment 4: HVAC Controls Review

Assignment 4: HVAC Controls Review

Introduction

In this assignment you will refer to the building you used in Assignment 1 to 1) identify HVAC control systems, 2) assess the operation of the controlled HVAC equipment, and 3) list the maintenance requirements for these systems. By successfully completing this workbook assignment, you will check your understanding of various controls for heating, cooling and refrigeration systems, identify control components, and provide recommended system improvements. This assignment will involve using your building automation system (BAS) to document operation of the control system. If you do not routinely use the BAS, you may need to request assistance from the building operator responsible for the BAS operation.

Objectives

You will:

1. Recall controls terminology used for Heating, Ventilation Air Conditioning and Refrigeration (HVACR) Control systems. (knowledge, comprehension)
2. Document operation and maintenance schedules and sequence of operation for HVAC Control Systems. (apply)
3. Document and evaluate maintenance records for your HVAC Control Systems. (analysis)
4. Determine if typical system problems exist including inoperable dampers, sensors out-of-calibration/inaccurate, and defective gauges. (analysis)
5. Use the building automation system (BAS) to review operation of the control system for heating, cooling, and ventilation. (apply, analysis)

Instructions: Review the assignment rubric.

HVAC Control Systems Review Project Rubric	
	Check if Complete
Building HVAC Control Zone(s) information includes all of the following:	
1. Name of HVAC zone, and type of control system associated with the zone (electric, pneumatic, DDC).	1. _____ /2 pt
	Check if Complete
Heating and Cooling Systems Review	
2. Type of system (heating, cooling and ventilation), sq ft, fuel type, and zones served are listed.	2. _____ / 3 pt
3. Control point types and operational measurements are listed. <u>Heating system:</u> "No boiler or furnace" box is checked: allow 2.5 points. *Otherwise complete the following for full points:* Stack/flue temps, Water/steam temp, OSA, Water treatment, Blowdown frequency, Water use, Firing temp and rate, Boiler room temp, % oxygen in stack. <u>Cooling System:</u> "No cooling system" box is checked: allow 2.5 points. *Otherwise complete the following for full points:* Temperatures for zones, supply air, return air, outside air, RAT & SAT difference, Temp across coils, Frost, Compressor temp and cycle rate, type of refrigerant.	3. _____ / 5 pt
Ventilation Systems Review	
4. Ventilation system measurements and/or comments are listed for the following items: Actual % Outside air (OSA); filter change and coil cleaning frequency	4. _____ / 2 pt
Control Systems Review	
5. Operating schedule for occupied mode is provided	5. _____ /2 pt
6. Sequence of operation is described	6. _____ /2 pt
7. Comparison of programmed sequence to actual operation is described	7. _____ /2 pt
8. Steps for testing the system operation are described, including the measurement instruments used	8. _____ /2 pt
Office Use	PARTICIPANT NAME_____ Reviewer Initials _____ Date _____ Score_____
	TOTAL ____/20

Get organized. You will need to obtain data in order to enter information into the worksheets provided. A list of required information is provided below.

1. **Collect Data**
   - 1.1 Occupant Usage
     - ❑ More than one activity (use) may be in use within the building or tenant space under consideration. In addition differing hours of operation may occur.
   - 2.1 Building/ Mechanical/HVAC Controls Information:
     - ❑ Identify each mechanical zone, occupant density, net square footage, space type/use, and hours of operation.
     - ❑ Survey the HVAC controls within each space (runtime, thermostats, pneumatics, DDC) noting the type of controls and current setting.
   - 3.1 Operation Manual
     - ❑ Review operation manuals and recommended settings, calibrations.
     - ❑ Review automated or manual settings, override settings, emergency shutdown, smoke evacuation, typical control schemes, etc.
     - ❑ Research training needed, types of programs to interface into the HVAC Controls, etc.
   - 4.1 Maintenance Schedules
     - ❑ Review Control manufacturers' specifications or instructions.
     - ❑ Research training needed, and recommended calibration procedures. etc.

2. **Complete Applicable HVAC Control Systems Worksheets**
   - 1.1 Heating System (Controls) Operation Review Worksheet
   - 2.1 Ventilation Control Systems Worksheet
   - 3.1 Cooling System Control and/or Heat Pump Controls Worksheet
   - 4.1 Building Control Systems Review

3. **Submit your work for review.** Turn in the documents listed above.

Building and Mechanical HVAC Zone Information
Complete the information below. Copy and use additional forms, if needed.

Building name: _____ Gross square footage (ft^2) _____

Zone 1 name: _____ Occupant density (people/1000 ft^2) _____

Type of Control for Zone 1 (electrical, pneumatic, DDC) _____

Space Type (Use) 1: _____ Net Ft^2 _____ Hrs of Mechanical Operation _____

Space Type (Use) 2: _____ Net Ft^2 _____ Hrs of Mechanical Operation _____

Space Type (Use) 3: _____ Net Ft^2 _____ Hrs of Mechanical Operation _____

Zone 2 name: _____ Occupant density (people/1000 ft^2) _____

Type of Control for Zone 2 (electrical, pneumatic, DDC) _____

Space Type (Use) 1: _____ Net Ft^2 _____ Hrs of Mechanical Operation _____

Space Type (Use) 2: _____ Net Ft^2 _____ Hrs of Mechanical Operation _____

Space Type (Use) 3: _____ Net Ft^2 _____ Hrs of Mechanical Operation _____

Zone 3 name: _____ Occupant density (people/1000 ft^2) _____

Type of Control for Zone 3 (electrical, pneumatic, DDC) _____

Space Type (Use) 1: _____ Net Ft^2 _____ Hrs of Mechanical Operation _____

Space Type (Use) 2: _____ Net Ft^2 _____ Hrs of Mechanical Operation _____

Space Type (Use) 3: _____ Net Ft^2 _____ Hrs of Mechanical Operation _____

Heating Systems Controls Operation Review

Heating System Type (e.g., boiler, furnace, packaged unit, gas pack): _____

Zones Served _____ Ft² Served by System _____ Fuel Type: _____

Complete this section for a boiler or gas furnace. If you do not have a boiler or gas furnace, check the box below and proceed to the next system review worksheet.

☐ **No Boiler or Furnace**

Date of Review	**Item**	**List the measurement for each item, or provide a comment**
	Stack or flue temperatures	
	Water Temperature or Steam Pressure	
	Outside Air Temperature	
	Water Treatment Amounts	
	Frequency and Length of Blowdowns	
	Water Usage (if metered)	
	Firing Temperature or Pressures for On/Off Cycles	
	Firing rate (e.g., On-Off, Staged, or Modulating)	
	Boiler Room Temperature and OSA Control	
	Percentage of oxygen in the stack	

Ventilation Control Systems Review

Ventilation System (e.g., mechanical, natural, dedicated outdoor air system): _____

Review Date	Item	List the measurement for each item
	% Outside Air (OSA)	
	Frequency of Filter Change	
	Coil Cleaning Frequency	

Cooling Systems Controls and/or Heat Pump Controls Review

☐ If you do not have a cooling system or heat pump, check the box and proceed to the control systems review worksheet.

Cooling System Type: _____ Ft^2 Served by System _____ Fuel Type: _____

Zones Served:_____

Date of Review	Item	List the measurement for each item
	Zone Temperature: Return air temperature (RAT): Supply air temperature (SAT): Outside Air Temp (OAT): Difference between RAT and SAT:	
	Temperatures Across Condenser Coils	
	Frost on Suction Line During Cooling? (uncommon)	
	Compressor Temperature (warm @ bottom and cool @ top but no frost)	
	Identify Refrigerant	
	Compressor Cycle Rate	

Control Systems Review

In this section, you will compare the programmed control setting to the actual operation of the system. The question we want to answer is "When the control sequence of operation indicates an action, does the system respond as the controller indicates?" Select one system (e.g., heating, or cooling) for review.

System Type reviewed: _____ Building Name: _____

Date of review: _____ Type of Control (electrical, pneumatic, DDC): _____

	Reviewed Item
	1. Describe the HVAC operating schedule and setpoints for the occupied mode. Occupied mode (days of week & hours of day):_____ _____ Occupied mode heating/cooling setpoint: _____ 2. Write the sequence of operation for the occupied mode. _____ _____ _____ Is there an economizer? ___Yes ___ No Economizer control type: _____ Changeover temp: _____ 3. Describe how the programmed sequence of operation above compares to actual operation. *(For example, is the heating/cooling temp setpoint occurring when it should?).* _____ _____ _____ 4. Describe the steps you took to test the system to verify the actual operation? _____ _____ List measurement instruments you used: _____

Assignment 5: Occupancy Schedule

Assignment 5: Occupancy Schedule

Introduction

In this assignment you will again refer to the building you used throughout the project workbook to apply standard methods for documenting and analyzing the effects of occupant density, hours of use, and other occupant factors occurring within buildings. You will demonstrate your understanding of occupant-based energy use and occupant indoor air quality issues. By successfully gathering data and completing charts you will gain an understanding of peak use and periods of low density which affect energy use data on daily, weekly, monthly, yearly, and cyclical time periods. By successfully completing this workbook assignment you will be able to gain an understanding of how building controls could increase occupant comfort, improve air quality, and reduce energy. The occupancy profiles you develop will also provide valuable information to be used in the future for comparisons over time.

Objectives

You will:

1. Apply standard methods for documenting hours of operation and occupant use and density using recognized protocols. (application, comprehension)
2. Create charts for various time periods, comparing varying occupant densities over time. (knowledge, application, comprehension)
3. Analyze energy consumption based on density, the impact and effects of space use, hours of operation, and occupant density related to energy use. (comprehension, analysis, knowledge,)
4. Access the need for occupant-based controls such as occupancy sensors, timers, vacancy sensors, and thermostats and then determine whether implementation of controls can reduce energy consumption while maintaining or improving occupant comfort. (comprehension, analysis, knowledge)

Instructions

Review the assignment rubric.

Building Occupancy Profile Rubric

Presentation	Check if Complete
Cover page includes all of the following:	
1. Name of surveyed facility	1. _____
2. Square Footage	2. _____
Content	**Check if Complete**
Building Occupancy Schedule	
3. At least one building zone is profiled	3. _____
4. Each building zone lists the square footage; weekday hours and number of people; weekend hours and number of people	4. _____
Building Occupancy Profile	
5. Daily profile represents use of one zone within the building according to time of day	5. _____
6. Weekly profile represents of one zone within the building according to the day of the week	6. _____
7. Annual profile represents use of of one zone within the building according to the time of year	7. _____
Level of Detail	
8. Daily, weekly and annual profiles indicate occupancy percentages and trends	8. _____
9. Building occupancy schedule provides clear indication of type of building zone (e.g. Office; Retail; Gym, etc)	9. _____
10. Overall profile provides a clear graphical representation of the use of the building and each accessible zone	10. _____
Analysis	
11. Answer the six Occupancy Profile Analysis questions.	11. _____/6__
12. Answers to the 6 questions reflect a comparitive anlaysis of the profiles to the operating characteristics of mechanical systems serving each area.	12. _____

Office Use	PARTICIPANT NAME_____ Reviewer Initials _____ Date _____ Score_____	**TOTAL** _____/17

Get organized. You will need to obtain data in order to produce occupancy density charts over time. A list of some of the required information is provided below.

1. **Collect data**
   1.1 Occupant Usage
   - ❑ Observe each major area or zone within the building and begin to develop daily, weekly and annual occupancy profiles for each zone.
   - ❑ Interview several building occupants, operators, and custodial staff to determine actual number of occupants and working hours as well as an estimate of customers, students or other visitors using the area.
2. **Create Occupancy Graphs and Profiles**
   - ❑ Use the occupancy profile forms to create daily, weekly, and annual graphs of space use for each major zone. Make additional copies of the occupancy profile, as needed.
3. **Analyze Results to Identify Energy Savings Opportunities**
   - ❑ Using the completed profiles, analyze the graph of the profile to identify times of low occupancy and begin to identify opportunities to reduce energy consumption.
   - ❑ Compare the profiles to the operating characteristics of mechanical systems serving each area.
   - ❑ Answer the Occupancy Profile Analysis questions.

Building Name: _____ Gross Ft² _____

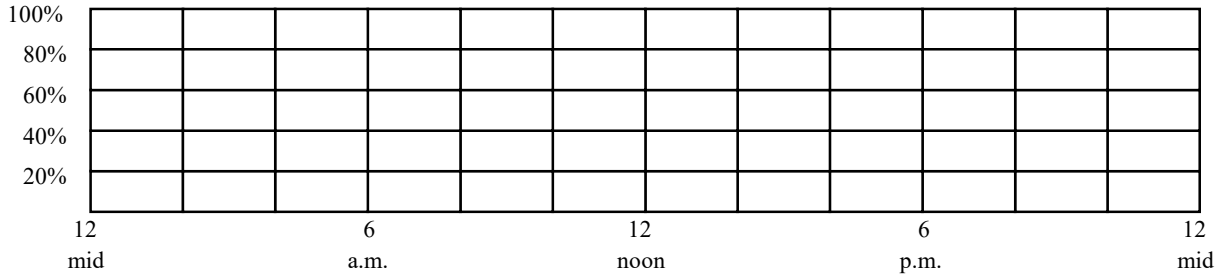
Building Occupancy Schedule

AREA/ZONE	AREA SQ. FT.	WEEKDAYS			WEEKENDS/HOLIDAYS		
		HOURS		# of People	HOURS		# of People
		From	To		From	To	

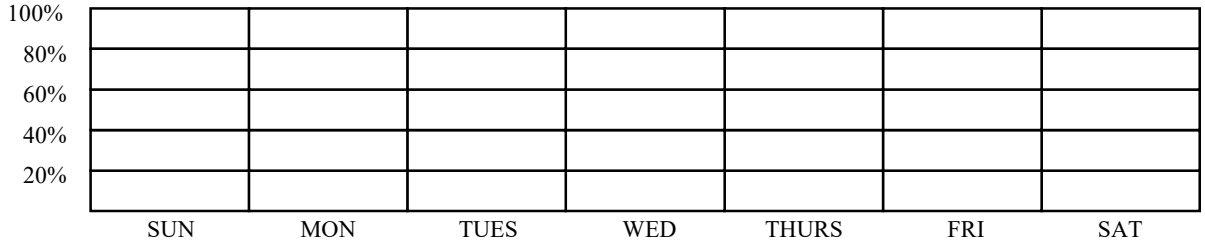
Zone: _____

Building Occupancy Profile

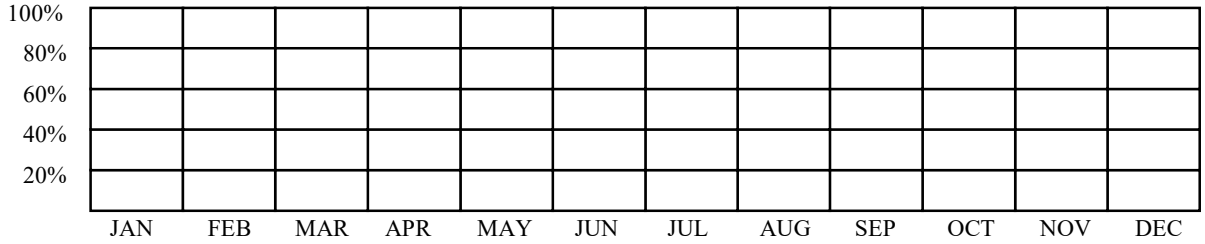
Daily Profile



Weekly Profile



Annual Profile



Occupancy Profile Analysis

Compare each profile to the operating characteristics of mechanical systems serving each area from Assignment 4 and answer the questions below. Remember, most often the easiest opportunities to reduce energy consumption occur when no one is in the building or zone.

Answer the following questions:

1. Do time clock settings match the current pattern of use?

2. Is the quantity of ventilation air appropriate for the number of occupants in the zone?

3. Are off-hour activities causing heating and cooling systems to operate as if the zone is fully occupied?

4. Can off-hour activities be rescheduled or relocated to maximize efficiency?

5. What controls could be used to reduce energy consumption?

6. What controls/sensors could be used to improve indoor air quality?

Appendix

Glossary

Assignment 1: Project Floor Plan Symbols **Appendix A-1**

Assignment 2A: PM Quick Start Guide & Helpful Tips **Appendix B-1**

Assignment 2B: Energy Accounting Rubric **Appendix B-2**

Assignment 2B: Energy Accounting Report Form **Appendix B-3**

Assignment 2: Sample Building Data **Appendix B-4**

Assignment 3: Indoor/Outdoor Light Levels **Appendix C-1**

Assignment 3: General Lighting Power Densities **Appendix C-2**

Assignment 3: Survey Worksheet Examples **Appendix C-3**

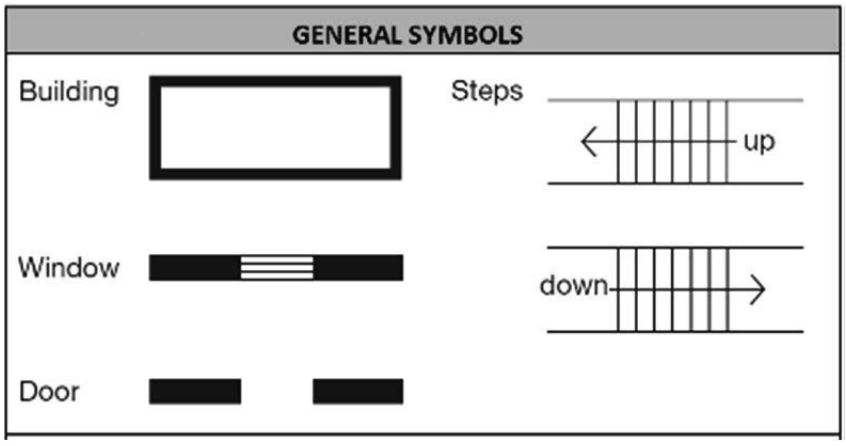
Glossary

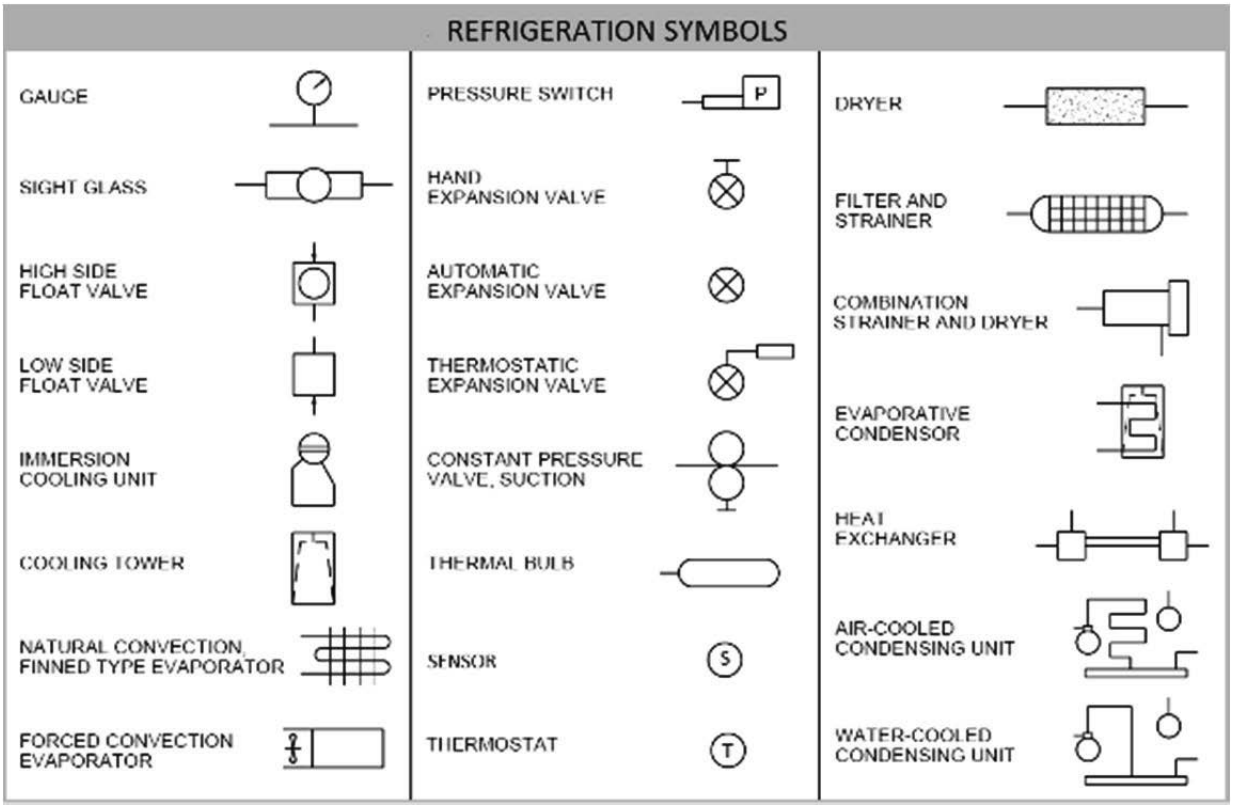
Btu	British thermal unit. The amount of energy needed to raise one pound of water one degree F.
EUI	A representation of annual energy usage per square foot of a facility. May appear in any basic or common unit (i.e. kWh/Ft^2, BTU/Ft^2, therms/Ft^2).
Goal	State the general purpose of the assignment and provide the basis for learning objectives. They should answer two questions: (1) what learning is expected, and (2) why the learning is important or why participants want to learn the relevant skill or knowledge.
HVAC Floor Plan	Sketched plan of the heating, ventilation, and air-conditioning equipment servicing a building. Can be used during a walkthrough to note and reference parameters, occupancy levels, use, and IEQ, or other problems to specific locations.
HVAC	Heating, ventilation, and air-conditioning
KW	Kilowatt. One thousand Watts. A Watt is a rate of consumption of useful electrical energy.
KWh	Kilowatt-hours. One thousand Watt-hours. A Watt-hour is the total energy consumed by using energy at a rate of one Watt for a period of one hour.
MMBtu	One million British Thermal Units.
Payback period	The amount of time it takes for an energy efficiency measure's energy cost savings to cover its purchase, installation, and operating costs. Payback (Years) = Net Installation Cost ($) ÷ Annual Energy Savings ($)
ROI	A method used to evaluate the efficiency of an energy efficiency upgrades/investment or to compare the efficiency of a number of different investments. To calculate ROI, the annual energy savings divided by the cost of the investment; the result is expressed as a

	percentage or a ratio. ROI (%) = [Annual Energy Savings ($) ÷ Installation Cost ($)] x 100
Site Energy	Site energy is the amount of heat and electricity consumed by a building as reflected in utility bills.
Source Energy	Source energy is the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, thereby enabling a complete assessment of energy efficiency in a building.
SEP	Statement of Energy Performance is a report generated in Energy Star Portfolio Manager for any building you enter into the tool. This document communicates information about a building's energy performance in a format that is both understandable and easy-to-use in business transactions. It is a required component of your building's application for the ENERGY STAR designation and would need to be validated by a Professional Engineer or Registered Architect.

Assignment 1: Floor Plan Symbols

The symbols shown here are those common and generally used on HVAC drawings. This list can and should be expanded to include items that are not covered here. If a symbol is needed to represent an item that is not covered, the symbol should be included in the legend and labeled for clarity to facilitate communication with those who will be read the drawings. The symbol does not need to be an exact layout of the actual system or drawn to scale.





Heating, Ventilation, and Air Conditioning Symbols

Equipment

EXPOSED RADIATOR

RECESSED RADIATOR

FLUSH ENCLOSED RADIATOR

PROJECTING ENCLOSED RADIATOR

UNIT HEATER (PROPELLER) – PLAN

UNIT HEATER (CENTRIFUGAL) – PLAN

UNIT VENTILATOR – PLAN

STEAM

DUPLEX STRAINER

PRESSURE-REDUCING VALVE

AIR LINE VALVE

STRAINER

THERMOMETER

PRESSURE GAUGE AND COCK

RELIEF VALVE

AUTOMATIC 3-WAY VALVE

AUTOMATIC 2-WAY VALVE

SOLENOID VALVE

Ductwork

DUCT (1ST FIGURE, WIDTH; 2ND FIGURE, DEPTH) — 12 X 20

DIRECTION OF FLOW

FLEXIBLE CONNECTION

DUCTWORK WITH ACOUSTICAL LINING

FIRE DAMPER WITH ACCESS DOOR — FD | AD

MANUAL VOLUME DAMPER — VD

AUTOMATIC VOLUME DAMPER

EXHAUST, RETURN OR OUTSIDE AIR DUCT – SECTION — 20 X 12

SUPPLY DUCT – SECTION — 20 X 12

CEILING DIFFUSER SUPPLY OUTLET — 20" DIA CD 1000 CFM

CEILING DIFFUSER SUPPLY OUTLET — 20 X 12 CD 700 CFM

LINEAR DIFFUSER — 96 X 6-LD 400 CFM

FLOOR REGISTER — 20 X 12 FR 700 CFM

TURNING VANES

FAN AND MOTOR WITH BELT GUARD

LOUVER OPENING — 20 X 12-L 700 CFM

Heating -Piping

HIGH-PRESSURE STEAM — HPS

MEDIUM-PRESSURE STEAM — MPS

LOW-PRESSURE STEAM — LPS

HIGH-PRESSURE RETURN — HPR

MEDIUM-PRESSURE RETURN — MPR

LOW-PRESSURE RETURN — LPR

BOILER BLOW OFF — BD

CONDENSATE OR VACUUM PUMP DISCHARGE — VPD

FEEDWATER PUMP DISCHARGE — PPD

MAKEUP WATER — MU

AIR RELIEF LINE — V

FUEL OIL SUCTION — FOS

FUEL OIL RETURN — FOR

FUEL OIL VENT — FOV

COMPRESSED AIR — A

HOT WATER HEATING SUPPLY — HW

HOT WATER HEATING RETURN — HWR

A/C Piping

REFRIGERANT LIQUID — RL

REFRIGERANT DISCHARGE — RD

REFRIGERANT SUCTION — RS

CONDENSER WATER SUPPLY — CWS

CONDENSER WATER RETURN — CWR

CHILLED WATER SUPPLY — CHWS

CHILLED WATER RETURN — CHWR

MAKEUP WATER — MU

HUMIDIFICATION LINE — H

DRAIN — D

ENERGY STAR® PortfolioManager®

"How To" Series

Portfolio Manager® Quick Start Guide

EPA's ENERGY STAR Portfolio Manager tool helps you measure and track the energy and water use, waste and materials, and greenhouse gas emissions of your buildings, all in a secure online environment. You can use the results to identify under-performing buildings, set investment priorities, verify efficiency improvements, and receive EPA recognition for superior energy performance. Follow the steps in this guide to get started using the new Portfolio Manager to benchmark your properties, assess performance, and view results.

Getting Started

Step 1: *Add a Property*

Step 2: *Enter Energy & Water Data*

Step 3: *View Results & Progress*

1 Add a Property

To get started, log in to Portfolio Manager at www.energystar.gov/portfoliomanager. Then, follow these instructions to create a property and to enter property information.

1. Click **Add a Property** on the **MyPortfolio** tab.
2. Answer questions about your property and click **Get Started!**
3. Enter basic property information and select the boxes next to the statements that apply to your property. Then click **Continue**.
4. Enter Use Details such as Gross Floor Area (GFA), operating hours, and number of workers for each type of use. You can use default or temporary values at this time and enter more accurate data later. **NOTE:** Mouse over the Use Detail to see a definition.
5. Click **Add Property**. When you have successfully added your property, you will see the property's **Summary** tab.

Property Types

All property types can be benchmarked. For properties with multiple buildings only hospitals, hotels, K-12 schools, multifamily, and senior care communities are eligible to receive the 1 – 100 ENERGY STAR score.

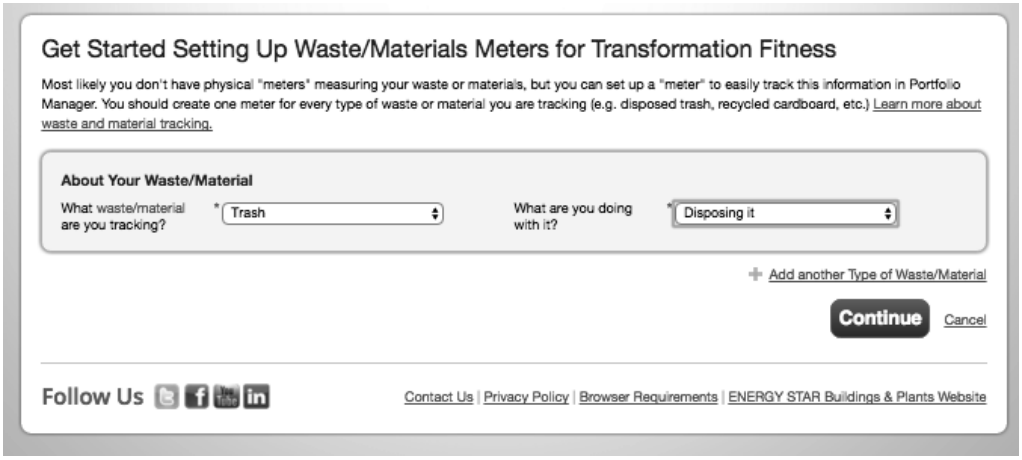
If you have additional types of uses on the property, you can add them at any time.

1. Click the property's **Details** tab, and then select a Property Use Type from the **Add Another Type of Use** drop-down menu. Click **Add**.
2. Enter Use Details for the property and then click **Save Use**.

Properties with Multiple Use Types

Some properties include multiple use types, such as restaurants in hotels, salons in senior care communities, and cafeterias in hospitals. As a general rule, if a certain use commonly occurs in the type of property being benchmarked, do not break it out as a separate Property Use Type. Simply include it's square footage with the building's primary use.

2 Enter Energy, Water, and Waste & Materials Data



To receive the most accurate picture of your building's performance, tell Portfolio Manager how much energy and water your building consumes, and the volume of waste and materials that you generate. Follow these steps to enter energy, water, and waste data for your property.

1. Click on your property from the **MyPortfolio** tab, then select either the **Energy, Water,** or **Waste & Materials** tab.
2. Click **Add A Meter**.
3. If you create an energy or water meter:
    i. Select the type of energy or water used and the number of meters to create, and click **Get Started!**
    ii. Click on a meter to enter units and first bill date. If this meter reflects a bulk fuel purchase for an energy meter, select the **Enter as Delivery?** checkbox.
    iii. Click the blue arrow next to each meter to expand the section on the **Your Meter Entries** page. Click **Add Another Entry** under the meter and enter data. Check **Estimation** if you are not including measured data for the entry. You may also choose to record cost here, too. Once you're finished adding entries, click **Continue**.
    iv. Select the boxes of the meters that total your property's energy or water use on the **Select Meters to Include in Metrics** page. Click **Apply Selections**.
4. If you create a waste meter:
    i. Select the waste you are tracking and indicate what you do with it. Click **Continue.**
    ii. Indicate how often the material is being collected (regular or intermittent), the units used for tracking, and if prompted, the date you first started tracking. Click **Create Meter(s).**
    iii. Click the blue arrow next to each meter to expand the section on the **Your Meter Entries** page. Click **Add Another Entry** under the meter and enter data. Check **Estimation** if you are not including measured data for the entry. You may also choose to record cost and disposal destination here, too. Once you're finished adding entries, click **Continue**.
    iv. Select the boxes of the meters that total your property's waste and materials on the **Select Meters to Include in Metrics** page. Click **Apply Selections**.

3 View Results & Progress

It is easy for you to see trends and to track improvement for your entire portfolio of buildings with a variety of standard graphs and reports in Portfolio Manager. Follow these steps to view reports about your properties and to assess progress.

- ✓ Click the **Reporting** tab to view graphs and reports for a property or portfolio.
- ✓ Click on the **Charts & Graphs** options to instantly see colorful graphs of how your portfolio or group of properties is performing. You can print graphs or download the images to incorporate into a presentation or document.
- ✓ View the **Templates & Reports** section to see a list of available standard reports, including Performance Highlights, Energy Performance, and Water Performance. Select **Generate New Report** from the **Action** drop-down menu to create a spreadsheet.

Learn More!

To learn more about Portfolio Manager, visit www.energystar.gov/portfoliomanager.
To get answers to your questions, visit www.energystar.gov/buildingshelp.

PM Helpful Hints

- Enter **12 or more consecutive months** of energy data for all fuels covering the same time period.
- Be sure to **review energy data** you have entered for lapses in time. Where gaps occur, the tool may not be able to generate a rating. If no energy was used for a particular time period, enter a zero for that period.
- When entering quantitative data, **do not include commas or other punctuation** in either energy consumption or cost. The tool will do this for you.
- When **updating** a facility's energy use, enter the appropriate meter name and energy use data, while selecting the correct units of measurement.
- Be sure to **include the correct zip code**, as the tool normalizes for both climate and weather variations.
- **Coordinate with your energy service provider or utility** to help assess the performance of your building and implement improvements.

For **further assistance**, select "Help" on the Portfolio Manager top navigation bar or contact the Help Desk by submitting the Online Help Form:
https://portfoliomanager.zendesk.com/hc/en-us/requests/new

Statement of Energy Performance (SEP): What does it tell you?

ES (Energy Star) Score
The SEP generates an Energy Performance Rating Score of 1-100. A rating of 50 indicates that the building, from an energy consumption standpoint, performs better than 50% of all similar buildings nationwide (average energy performance), while a rating of 75 indicates that the building performs better than 75% of all similar buildings nationwide (top performance).

If you received an "N/A," it means your building is not ratable in the Energy Star tool. *Note: Review your input for errors. Some common mistakes that might result in an N/A are double entering a day, etc.*

Energy Use Index (EUI)
The SEP also generates an Energy Use Index (EUI) for energy intensity. Site energy intensity and source energy intensity are each reported in kBtu/sf/year (expressing how much energy is used each year per square foot of building). **Site Energy** is the amount of heat and electricity consumed by a building as reflected in utility bills. **Source Energy** is the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, thereby enabling a complete assessment of energy efficiency in a building.

LEARN MORE AT energystar.gov

ENERGY STAR® Statement of Energy Performance

86

ENERGY STAR® Score[1]

Sample Property

Primary Property Function: Office
Gross Floor Area (ft²): 200,000
Built: 1980

For Year Ending: April 30, 2013
Date Generated: June 28, 2013

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Sample Property 123 Main Street Arlington, Virginia 22030	Wellington Commercial Property Managers 1 Washington Blvd Arlington, VA 22030 (____)____-_____	Jane Smith 1 Washington Blvd Arlington, VA 22030 (____)____-_____ jsmith@wcbp.com

Property ID: 5000023

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
75 kBtu/ft²

Source EUI
217 kBtu/ft²

Annual Energy by Fuel	
Electric - Grid	13,202,160 (88%)
Natural Gas	1,853,000 (12%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	122
National Median Source EUI (kBtu/ft²)	352
% Diff from National Median Source EUI	-38%
Annual Emissions	
Greenhouse Gas Emissions (MtCO²e/year)	1,927

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Licensed Professional

Donald Brown
1 Washington Blvd
Arlington, VA 22030
202-333-4444
donaldbrown@wcpb.com

Professional Engineer Stamp
(if applicable)

Assignment 2-B: Energy Accounting Report Rubric

Complete *ONLY* if you are NOT able to complete Assignment A

Data Collection	Check if Complete
Portfolio Manager Data Collection Worksheet Includes:	
1. Building name, address and zip code	1. _____
2. Year built	2. _____
3. Building type (e.g., school, office bldg., hospital, etc.)	3. _____
4. Gross square footage	4. _____
5. All data fields specific to the building type	5. _____
6. Source of 12-month utility bills: A) Actual _____ B) Sample_____	6. _____
Reporting	**Check if Complete**
Energy Accounting: Page 1	
1. 12 months of electric and gas consumption data	7. _____
2. 12 months of electric and gas cost	8. _____
3. Accurately converted from kWh to MMBTU	9. _____
4. Accurately converted from therms to MMBTU	10. _____
Calculations: Page 2	
1. Accurate site energy use index (EUI)	11. _____
2. Accurate annual cost per square Foot	12. _____
3. Accurate annual electric benchmark	13. _____
Graph: Page 3	
1. Graph shows month by month consumption of both gas and electric fuels	14. _____
2. Each fuel type is uniquely color coded	15. _____
3. Y axis lists MMBTU coordinates (e.g., 0, 20, 40, etc)	16. _____
4. Graph correlates to MMBTU calculations in Energy Accounting section	17. _____
Analysis: Benchmark Analysis Worksheet	
1A. Accurately stated the EUI & compared EUI to national average.	18. _____
1B. Accurately calculated EUI difference in percentage.	19. _____
2. Identified at least two reasons that may cause the building to be higher or lower than the national average for the same bldg type.	20. _____
Office Use	PARTICIPANT NAME: _____ TOTAL _____/20
	Reviewer Initials: _____Date:_____ Score: _____

Energy Accounting Report - Part 1

Complete *ONLY* if you are NOT able to complete Assignment 2-A

Building Name:_____
Gross Square Footage: _____
Building Type:_____

Year	Electricity			Natural Gas		
Month	Consumed kWh	Electric MMBTU kWh x 0.003413	Electric Cost	Consumed Therms	Gas MMBTU Therms x 0.10	Gas Cost
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						
Annual Totals						

1. Enter monthly electrical kWh and cost from utility bill.
2. Convert monthly kWh to MMBTU.
3. Enter monthly natural gas therms and cost from utility bill.
4. Convert monthly therms to MMBTU.
5. Total all columns.

Energy Accounting Report - Part 2

Use the annual totals from Part 1 to complete the following calculations:

	Annual Electric MMBTU	+		Annual Gas MMBTU	=		Annual Total MMBTU	÷		Square Footage	X	1,000	Conversion Factor	=		Energy Use Index 1,000 BTU/FT^2

2. Calculate Annual Cost per Square Foot (Dollars / Square Foot)

	Annual Electric Cost	+		Annual Gas Cost	=		Annual Energy Cost	÷		Square Footage	=		Annual Cost Per Ft^2

3. Calculate Annual Electric Benchmark (kWh / Square Foot / Year)

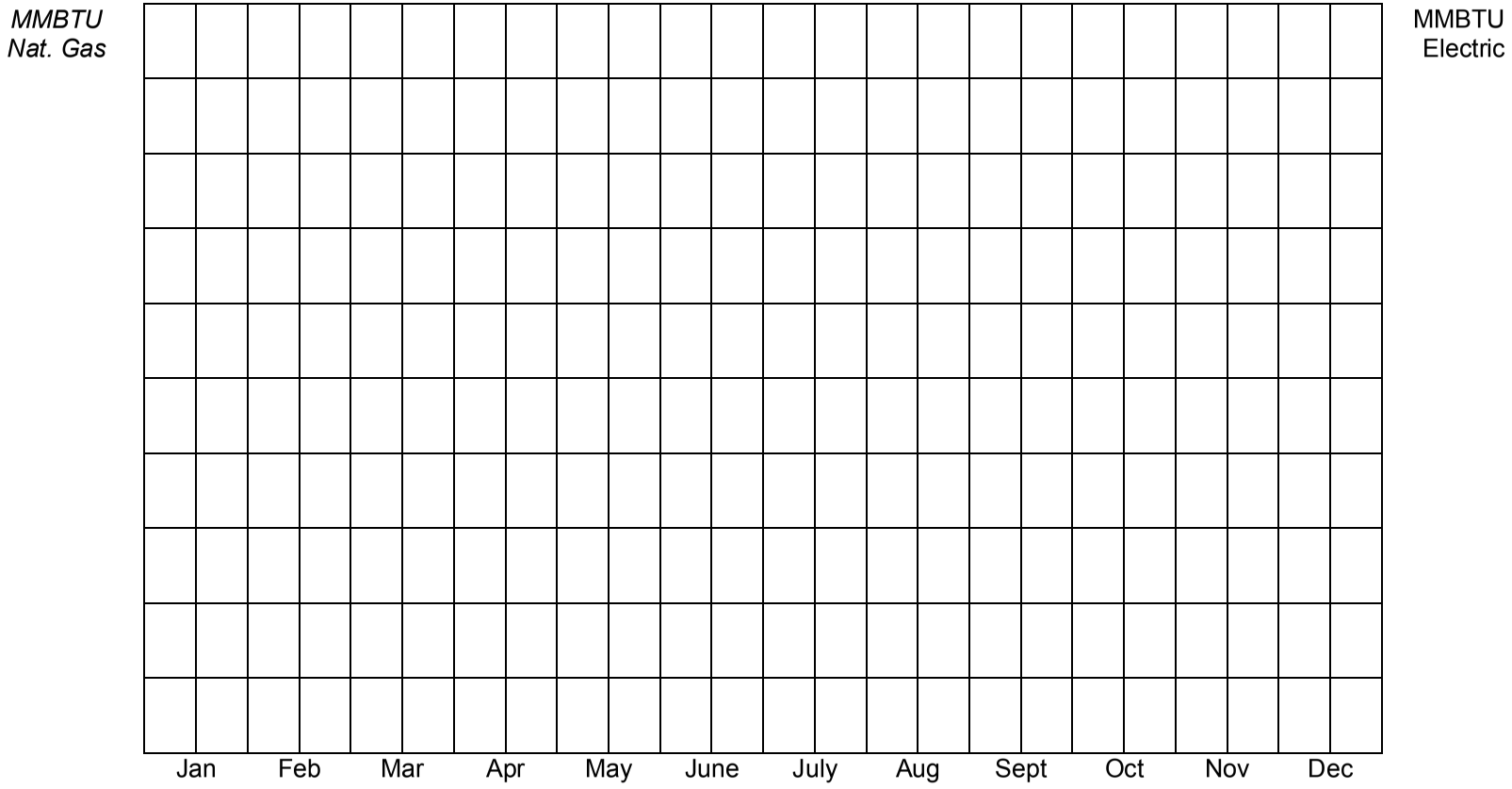
	Annual Electric kWh	÷		Square Footage	=		Annual Electric Benchmark

(For Base Year)

Energy Accounting Report - Part 3

Using MMBTU columns from Part 1, graph monthly MMBTU's for both gas and electric consumption on the graph below, and then complete the Benchmark Analysis Worksheet (**Part 4**) found on page 21 of this workbook.

Monthly Fuel Consumption by Type
Million BTU Per Month



Sample Data - Mix-Use: 2900 On First Apartments

DATA FIELD	INPUT DATA

PART 1 - Add General Information	
Facility Name/Address	2900 First Avenue
City, State, Zip	Seattle, WA 98121
Year Built	1989
Predominant Space Use	Multifamily Housing
TOTAL Square Feet	**188,715**

PART 2 - Add Facility Spaces	
6 Retail Spaces Combined	
Gross Floor Area	14,912
Operating Hours/Week	54
Number of Refrigeration Cases	9
Number of Walk-in Refrigeration	1
Workers on Main Shift	17
Number of PCs	21
Number of Cash Registers	3
% Heated	100
% Cooled	100
Exterior Entrance to Public	Yes
Denny Market (Supermarket/Grocery)	
Gross Floor Area	2,447
Operating Hours/Week	119
Workers on Main Shift	1
Number of Walk-in Refrigeration	0
Cooking Facilities	No
% Heated	100
% Cooled	100
Number of Refrigeration Cases	9
Number of Cash Registers	2
Multifamily Housing	
Gross Floor Area	150,356
Number of Units	135
Total Number of Bedrooms	142
Number of Floors	7
% Floor Area of Common Space	25
Laundry in each unit	135
Laundry in common area	0
Total dishwasher hookups	135
% Heated	90
% Cooled	0
Primary Hot Water Fuel Type	Electricity
Resident Population Type	Not specific
Government Subsidized Housing	N
Parking	
Enclosed Floor Area	21,000
Non-Enclosed Floor Area	0
Open Floor Area	0
Weekly Hours of Access	168
Swimming Pool	
Pool Size	Short Course (25 yards x 20 yards)
Indoor or Outdoor	Outdoor
Months in Use	N/A

PART 3 - Add Energy Meters	
"Add Meter"	
Select "Electricity" as Energy Type	Electricity
Select "kWh" from the Units list	kWh
Add 12 months of data	See Part 3A
"Add Meter"	
Select "Natural Gas" as Energy Type	Natural Gas
Select "therms" from the Units list	therms
Add 12 months of data	See Part 3B

PART 3A - Add Electric Meter Entries			
Start Date	**End Date**	**Energy Use**	**Cost ($)**
12/1/11	12/31/11	159,765	15,977
11/1/11	11/30/11	139,297	13,930
10/1/11	10/31/11	119,535	11,953
9/1/11	9/30/11	106,151	10,615
8/1/11	8/31/11	110,726	11,073
7/1/11	7/31/11	113,108	11,311
6/1/11	6/30/11	114,162	11,416
5/1/11	5/31/11	124,316	12,432
4/1/11	4/30/11	140,217	14,022
3/1/11	3/31/11	156,131	15,613
2/1/11	2/28/11	161,617	16,162
1/1/11	1/31/11	178,955	17,896

PART 3B - Add Gas Meter Entries			
Start Date	**End Date**	**Energy Use**	**Cost ($)**
12/1/11	12/31/11	196	196
11/1/11	11/30/11	191	191
10/1/11	10/31/11	228	228
9/1/11	9/30/11	368	368
8/1/11	8/31/11	292	292
7/1/11	7/31/11	356	356
6/1/11	6/30/11	479	479
5/1/11	5/31/11	264	264
4/1/11	4/30/11	363	363
3/1/11	3/31/11	417	417
2/1/11	2/28/11	446	446
1/1/11	1/31/11	445	445

Sample Data: Palomar Medical Center

DATA FIELD	INPUT DATA

PART 1 - Add General Information	
Facility Name/Address	555 East Valley Pkwy
City, State, Zip	Escondido, CA 92025
Year Built	1957
Predominant Space Use	Hospital (General Medical and Surgical)
TOTAL Square Feet	**572,444**

PART 2 - Add Facility Spaces	
Computer data centers	
Gross Floor Area	12,000
Annual IT Energy	50,000,000 kBtu
IT Energy Configuration	UPS Supports only IT Equipment
Hospital (General Medical and Surgical)	
Gross Floor Area	425,000
Full-time Equivalent (FTE) Workers	1,785
Number of Staffed Beds	211
Number of MRI Machines	1
Number of Buildings	1
Maximum Number of Floors	9
Ownership Status	Non Profit
Laboratory	Y
Laundry Facility	N
Tertiary Care	N
Parking Garage	
Enclosed Floor Area	135,444
Non-Enclosed Floor Area	0
Open Floor Area	0
Weekly Hours of Access	168

PART 3 - Add Energy Meters	
"Add Meter"	
Select "Electricity" as Energy Type	Electricity
Select "kWh" from the Units list	kWh
Add 12 months of data	See Part 3A
"Add Meter"	
Select "Natural Gas" as Energy Type	Natural Gas
Select "therms" from the Units list	therms
Add 12 months of data	See Part 3B

PART 3A - Add Electric Meter Entries			
Start Date	**End Date**	**Energy Use**	**Cost ($)**
2/1/12	2/29/12	1,129,648	112,965
1/1/12	1/31/12	1,200,382	120,038
12/1/11	12/31/11	1,164,066	116,407
11/1/11	11/30/11	1,169,832	116,983
10/1/11	10/31/11	1,290,330	129,033
9/1/11	9/30/11	1,315,080	131,508
8/1/11	8/31/11	1,398,754	139,875
7/1/11	7/31/11	1,369,504	136,950
6/1/11	6/30/11	1,214,870	121,487
5/1/11	5/31/11	1,201,550	120,155
4/1/11	4/30/11	1,164,890	116,489
3/1/11	3/31/11	1,165,976	116,598

PART 3B - Add Gas Meter Entries			
Start Date	**End Date**	**Energy Use**	**Cost ($)**
2/1/12	2/29/12	906	906
1/1/12	1/31/12	933	933
12/1/11	12/31/11	1,030	1,030
11/1/11	11/30/11	952	952
10/1/11	10/31/11	980	980
9/1/11	9/30/11	866	866
8/1/11	8/31/11	927	927
7/1/11	7/31/11	748	748
6/1/11	6/30/11	625	625
5/1/11	5/31/11	1,471	1,471
4/1/11	4/30/11	936	936
3/1/11	3/31/11	1,022	1,022

Sample Data - Office: 1234 Broadway St.

DATA FIELD	INPUT DATA

PART 1 - Add General Information	
Facility Name/Address	1234 Broadway St.
City, State, Zip	Annapolis, MD 21403
Year Built	1999
Predominant Space Use	Office
TOTAL Square Feet	**432,000**

PART 2 - Add Facility Spaces	
Computer data centers	
Gross Floor Area	12,000
Annual IT Energy	50,000,000 kBtu
IT Energy Configuration	UPS Supports only IT Equipment
Financial tenants	
Gross Floor Area	100,000
Operating Hours/Week	85
Workers on Main Shift	500
Number of PCs	1,000
% of Space Air-Conditioned	50% or more
% of Space Heated	50% or more
After-hours HVAC tenants	
Gross Floor Area	50,000
Operating Hours/Week	110
Workers on Main Shift	120
Number of PCs	200
% of Space Air-Conditioned	50% or more
% of Space Heated	50% or more
All other tenants	
Gross Floor Area	220,000
Operating Hours/Week	60
Workers on Main Shift	800
Number of PCs	960
% of Space Air-Conditioned	50% or more
% of Space Heated	50% or more
Parking Garage	
Enclosed Floor Area	50,000
Non-Enclosed Floor Area	50,000
Open Floor Area	0
Weekly Hours of Access	168

PART 3 - Add Energy Meters	
"Add Meter"	
Select "Electricity" as Energy Type	Electricity
Select "kWh" from the Units list	kWh
Add 12 months of data	See Part 3A
"Add Meter"	
Select "Natural Gas" as Energy Type	Natural Gas
Select "therms" from the Units list	therms
Add 12 months of data	See Part 3B

PART 3A - Add Electric Meter Entries			
Start Date	**End Date**	**Energy Use**	**Cost ($)**
5/1/12	5/31/12	1,200,000	120,000
6/1/12	6/30/12	1,000,000	100,500
7/1/12	7/31/12	1,200,000	120,000
8/1/12	8/31/12	1,100,000	110,000
9/1/12	9/30/12	1,000,000	100,000
10/1/12	10/31/12	999,000	99,900
11/1/12	11/30/12	800,000	80,000
12/1/12	12/31/12	900,000	90,000
1/1/13	1/31/13	750,000	75,000
2/1/13	2/28/13	800,000	80,000
3/1/13	3/31/13	900,000	90,000
4/1/13	4/30/13	850,000	85,000
5/1/13	5/31/13	975,000	97,500
6/1/13	6/30/13	1,000,000	100,000

PART 3B - Add Gas Meter Entries			
Start Date	**End Date**	**Energy Use**	**Cost ($)**
5/1/12	5/31/12	1,000	1,100
6/1/12	6/30/12	850	900
7/1/12	7/31/12	900	990
8/1/12	8/31/12	950	1,050
9/1/12	9/30/12	1,500	1,700
10/1/12	10/31/12	2,000	2,200
11/1/12	11/30/12	4,800	4,800
12/1/12	12/31/12	4,000	5,000
1/1/13	1/31/13	4,000	5,000
2/1/13	2/28/13	4,600	5,600
3/1/13	3/31/13	3,200	5,200
4/1/13	4/30/13	2,000	4,000
5/1/13	5/31/13	1,700	1,800
6/1/13	6/30/13	1,200	1,400

Sample Data: Tacoma Power Elementary School

DATA FIELD	INPUT DATA

PART 1 - Add General Information	
Facility Name/Address	605 First Ave.
City, State, Zip	Tacoma, WA 98402
Year Built	2000
Predominant Space Use	K-12 School
TOTAL Square Feet	**45,000**

PART 2 - Add Facility Spaces	
K12 School	
Gross Floor Area	45,000
Building open at all on weekends?	No
Number of PCs	70
Number of walk-in refrigeration/freezer units	1
Presence of cooking facilities	Yes
% of Space Cooled	90
% of Space Heated	100
Is this building a high school?	No
How many months building in use?	12
School District	Tacoma
Parking Garage	
Enclosed Floor Area	0
Non-Enclosed Floor Area	0
Open Floor Area (w/o roof)	10,000
Weekly Hours of Access	168

PART 3 - Add Energy Meters	
"Add Meter"	
Select "Electricity" as Energy Type	Electricity
Select "kWh" from the Units list	kWh
Add 12 months of data	See Part 3A
"Add Meter"	
Select "Natural Gas" as Energy Type	Natural Gas
Select "therms" from the Units list	therms
Add 12 months of data	See Part 3B

PART 3A - Add Electric Meter Entries			
Start Date	**End Date**	**Energy Use**	**Cost ($)**
1/1/12	1/31/12	24,000	$1,200.00
2/1/12	2/29/12	20,000	$1,000.00
3/1/12	3/31/12	24,000	$1,200.00
4/1/12	4/30/12	22,000	$1,100.00
5/1/12	5/31/12	20,000	$1,000.00
6/1/12	6/30/12	18,990	$1,000.00
7/1/12	7/31/12	18,000	$900.00
8/1/12	8/31/12	16,000	$800.00
9/1/12	9/30/12	18,000	$900.00
10/1/12	10/31/12	20,000	$1,000.00
11/1/12	11/30/12	22,000	$1,100.00
12/1/12	12/31/12	22,000	$1,100.00
1/1/13	1/31/13	24,000	$1,200.00
2/1/13	2/28/13	20,000	$1,000.00

PART 3B - Add Gas Meter Entries			
Start Date	**End Date**	**Energy Use**	**Cost ($)**
1/1/12	1/31/12	3,500	$3,500.00
2/1/12	2/29/12	3,600	$3,600.00
3/1/12	3/31/12	3,600	$3,600.00
4/1/12	4/30/12	1,000	$1,000.00
5/1/12	5/31/12	1,100	$1,100.00
6/1/12	6/30/12	1,000	$1,000.00
7/1/12	7/31/12	1,000	$1,000.00
8/1/12	8/31/12	1,000	$1,000.00
9/1/12	9/30/12	1,000	$1,000.00
10/1/12	10/31/12	2,000	$2,000.00
11/1/12	11/30/12	4,000	$4,000.00
12/1/12	12/31/12	4,000	$4,000.00
1/1/13	1/31/13	4,000	$4,000.00
2/1/13	2/28/13	4,500	$4,500.00

Recommended Light Levels

Table 1: Outdoor Light Levels

Condition	Illumination	
	(ftcd)	*(lux)*
Sunlight	10,000	107,527
Full Daylight	1,000	10,752
Overcast Day	100	1,075
Very Dark Day	10	107
Twilight	1	10.8
Deep Twilight	0.1	1.08
Full Moon	0.01	0.108
Quarter Moon	0.001	0.0108
Starlight	0.0001	0.0011
Overcast Night	0.00001	0.0001

Table 2: Recommended Indoor Light Levels by Task

Activity	Illumination	
	(ftcd)	*(lux)*
Public areas with dark surroundings	2 -- 5	20 - 50
Simple orientation for short visits	5 -- 9	50 - 100
Working areas where visual tasks are only occasionally performed	9 -- 14	100 - 150
Warehouses, Homes, Theaters, Archives	14	150
Easy Office Work, Classes	23	250
Normal Office Work, PC Work, Study Library, Groceries, Show Rooms, Laboratories	47	500
Supermarkets, Mechanical Workshops, Office Landscapes	70	750
Normal Drawing Work, Detailed Mechanical Workshops, Operation Theatres	93	1,000
Detailed Drawing Work, Very Detailed Mechanical Works	140 - 186	1500 - 2000
Performance of visual tasks of low contrast and very small size for prolonged periods of time	186 - 465	2000 - 5000
Performance of very prolonged and exacting visual tasks	465 - 930	5000 - 10000
Performance of very special visual tasks of extremely low contrast and small size	930 - 1860	10000 - 20000

Table 3: General Lighting Power Densities (LPD) for Building Interiors

NOTE: These allowed limits are for example purposes only. Refer to local state energy codes for specific guidelines.

Use	LPD (watts/sq. ft.)
Automotive facility	0.85
Convention center	1.1
Court house	1.1
Cafeterias, fast food establishments, restaurants/bars	1.2
Dormitory	0.85
Dwelling units	1
Exercise center	0.95
Gymnasia, assembly spaces	0.95
Health care clinic	1
Hospital, nursing homes, and other Group I-1 and I-2 Occupancies	1.2
Hotel/motel	1
Laboratory spaces (all spaces not classified "laboratory" shall meet office and other appropriate categories)	1.62
Laundries	1.2
Libraries	1.2
Manufacturing facility	1.2
Museum	1
Office buildings, office/administrative areas in facilities of other use types (including but not limited to schools, hospitals, institutions, museums, banks, churches)	0.91
Parking garages	0.2
Penitentiary and other Group I-3 Occupancies	0.9
Police and fire stations	0.9
Post office	1
Retail, retail banking, mall concourses, wholesale stores (pallet rack shelving)	1.33
School buildings (Group E Occupancy only), school classrooms, day care centers	1
Theater, motion picture	0.97
Theater, performing arts	1.25
Transportation	0.8
Warehouses	0.5
Workshop	1.2
Plans Submitted for Common Areas Only	
Main floor building lobbies (except mall concourses)	1.1
All building common areas, corridors, toilet facilities and washrooms, elevator lobbies, including Group R-1 and R-2 Occupancies	0.8

Survey Examples

Lighting Power Survey: EXAMPLE

Surveyed Building: ACME Building Gross Square Footage: 10,000

A	B	C	D	E	F	G	I	H
Space Type (e.g., office, kitchen, classroom, etc.)	**Space Square Footage (NET ft²)**	**Luminiare Type**	**Number of Luminaires Per Type**	**Input Wattage Per Luminaire**	**Total Wattage** (Columns D x E)	**Watts per Sq. Ft.** (Column F divided by Column B)	**Control Type** (e.g., manual, timeclock, infra-red, etc.)	**Illuminance Recommended (LPD)** [1] Table 3 Appendix C-2
Office Space 1	2,000	3 Lamp F32T8 w/ electronic ballasts	6	96	576		manual	
		4 Lamp F32T8 w/ electronic ballasts	10	128	1280		manual	
		2 Lamp F32T8 w/ electronic ballasts	2	64	128		manual	
NET ft²:	**2,000**			**TOTAL**	**1984**	**0.992**	**LPD:**	**0.91**

Lighting Energy Use Survey

Surveyed Building: ACME Building Gross Square Footage: 10,000

A	B	C	D	E	F	G	H	I
Space Type (from Lighting Power Survey)	**Space Square Footage (NET ft2)**	**Total Wattage** (from Lighting Power Survey)	**Runtime Hours per Month**	**Watt hrs per Month** (CxD)	**kWhr** (E/1000)	**Average Electric Rate per kWhr**	**Cost per Month** (F X G)	**Cost per NET ft2** (H/B)
Office Space 1	2,000	576	720	414,720	415	$0.083	$34.45	$0.017
		1,280	360	460,800	461	$0.083	$38.26	$0.019
		128	360	46, 080	46	$0.083	$3.82	$0.002
TOTAL	**2,000**	**1,984**	**1,140**	**921,600**	**922**	**$0.083**	**$76.53**	**$0.04**