
Introduction to Commercial Building Audits

Course No. ENRG 50

Introduction to Commercial Building Audits

Outline

A. Introduction to concept of commercial building energy auditing

1. Why energy efficiency (EE) is important
2. Energy use and waste in commercial building operations
3. Prioritizing energy efficiency over renewable energy generation

B. Ordinances, policies and standards governing commercial building audits

1. San Francisco Existing Commercial Buildings Performance Ordinance
2. State of California energy goals
3. ASHRAE standards, including Building Energy Assessment Professional (BEAP)
4. Other audit standards

C. Three ASHRAE audit levels

1. Preliminary energy use analysis
2. Level 1, Walk-through analysis
3. Level 2, Intermediate, energy survey and energy analysis
4. Level 3, Detailed analysis of capital-intensive modifications

D. Developing the scope of work in a commercial building audit

1. Objectives of the audit, including needed data and

resources

2. Assessment management
3. Responsibilities of audit team members

E. Elements in preliminary analysis of building performance data

1. Engineering and architectural document review
2. Geographical and climatic review
3. Review and analysis of current energy use and costs
4. Benchmarking procedures

F. Factors in on-site building assessment

1. Common safety hazards and field safety techniques
2. Occupant interviews and assessment of building operations
3. Building envelope
4. Electrical systems
5. HVAC&R systems
6. Lighting systems and use
7. Miscellaneous other energy use systems
8. Domestic water systems and use
9. Indoor environmental quality

G. Analysis of data collected

1. Identify opportunities for efficiency improvement
2. Calculate value of efficiency improvements and return on investment
3. Prioritize options based on client criteria

H. Audit completion activities

1. Prepare and present written report
2. Assist with development of implementation plan

E. Elements in preliminary analysis of building performance data

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Building Documentation

Types of documentation:

- As built drawings
- Equipment inventory
- Submittals/test and balance reports
- Controls schedule
- Maintenance logs/service requests

What are you looking for:

- The major building loads
- Control strategies
- Efficiencies of equipment

Engineering and architectural document review

Typical design work products

- A_._ (e.g. A1.0) : Architectural
- S_._ : Structural
- M_._ : Mechanical (HVAC)
- E_._ : Electrical (including lighting)
- P_._ : Plumbing (domestic water, hot water, waste water)
- C_._ : Civil (site work, stormwater)
- L_._ : Landscape

SHEET INDEX	
COVER SHEET	A-0.0
ARCHITECTURAL	
SITE PLAN	A0.1
REFERENCE SITE DETAILS	A0.2
FIRST FLOOR DEMOLITION PLAN	A1.0
FIRST FLOOR SURRENDER PLAN	A1.1
FIRST FLOOR CEILING DEMOLITION PLAN	A2.0
FIRST FLOOR EXISTING CEILING PLAN	A2.1
FIRST FLOOR SURRENDER CEILING PLAN	A2.2
SECOND FLOOR DEMOLITION PLAN	A3.0
SECOND FLOOR SURRENDER PLAN	A3.1
SECOND FLOOR CEILING SURRENDER DEMOLITION PLAN	A4.0
SECOND FLOOR EXISTING CEILING PLAN	A4.1
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ARCHITECTURAL DETAILS	A5.0
STRUCTURAL	
FIRST FLOOR STRUCTURAL PLAN & DETAILS	S-1
MECHANICAL	
MECHANICAL GENERAL NOTES	M0.0
MECHANICAL FIRST FLOOR DEMOLITION PLAN	M1.0
MECHANICAL FIRST FLOOR EXISTING PLAN	M1.1

Building floor plan

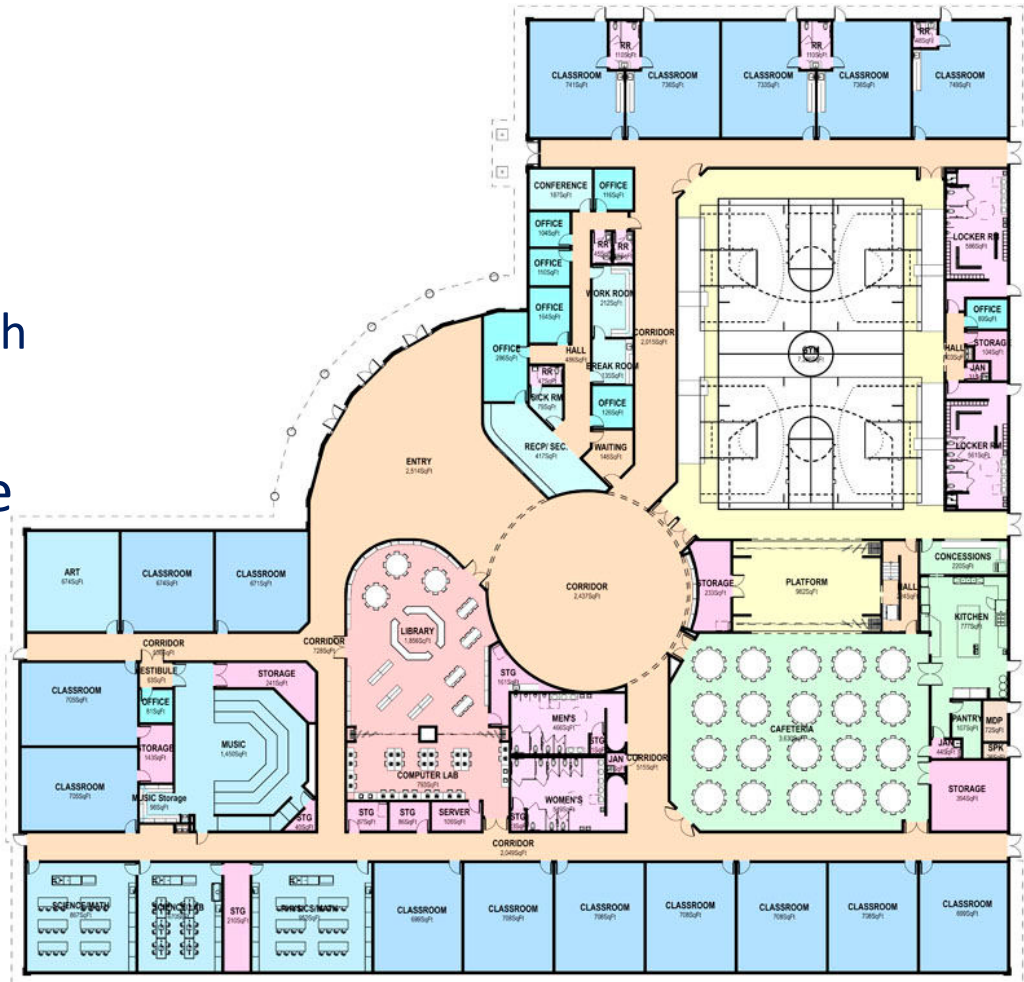
- Info:

- Name and location
- Year of construction
- Size: floors, sf
- North arrow
- Locations of mechanical, electrical and other rooms with specialized equipment

- If drawings not available

- photograph egress plans
- Building outline from Google maps

<http://www.veritasschool.net/plans.html>



Equipment inventory demo

FY2010 Building Equipment Inventory

	A	B	C	D	E	F
1		Technical Exhibit 5				
2		FY2010				
3		ECC Facilities Operations & Maintenance				
4		Building Equipment Inventory Listing				
5		not all inclusive				
6	Equipment Type	Description	Frequency	ECC (main building)	Annex	
7	A-01	air dryer, refrigerated	S	2	1	
8	A-02	Unitary, Heating and Cooling Unit air barrier	A	5	4	
9	A-03	humidification system	S	2	7	
10	A-04	air compressor - any size or type	S	7	5	
11	A-05	AC Unit Special (ComputerRoomAC Unit)	M	79	30	x
12	A-06	AC Machine Packaged Unit	Q	0	4	
13	A-10	heat pump	A	9	0	
14	A-11	air handling Unit (AHU)	A	21	7	
15	A-13	AC Unit - Ceiling Mounted	M	0	2	
16	B-01	battery charger (stand alone)	Q	12	7	
17	B-02	boiler	A	3	2	
18	B-04	burner	A	3	2	
19	B-07	boiler - internal inspection/hydrostatic test	A	3	2	
20	B-08	boiler - external inspection	A	3	2	
21	C-01	Central Clock System	S	1	1	
22	C-04	Central Mini-Computer HVAC System(BAS)	Q	1	3	
23	C-08	Central Control Panel (BAS)	A	1	3	
24	C-09	cooling tower - maintenance	A	6	3	
25	C-10	cooling tower - cleaning	Q	6	3	
26	D-01	Overhead Power Operated Doors/Gates	S	11	10	

http://www.irs.gov/pub/irs-procure/techexhibit_5_equipment_pm_inventory.pdf

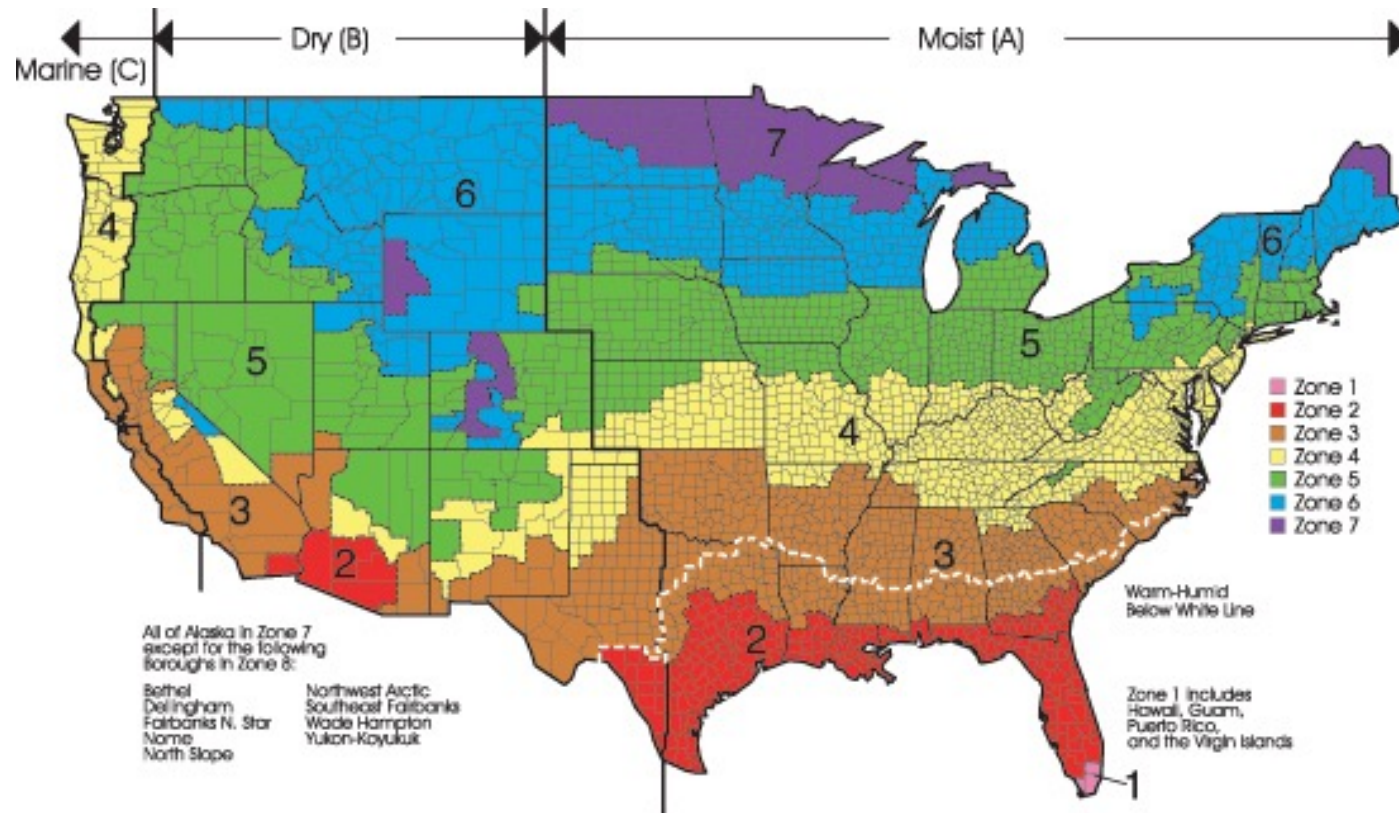
Catalog existing equipment

- System configuration
 - Equipment:
 - Type
 - Quantity
 - Efficiency
- Controls
 - Identify schedules (Building automation system)
 - Locate other sensors and controls
 - Locate zone controls

E. Elements in preliminary analysis of building performance data

1. Engineering and architectural document review
2. Geographical and climatic review
3. Review and analysis of current energy use and costs
4. Benchmarking procedures

Geographical and climate review



http://www.commercialwindows.org/codes/standards_ashrae90_1_more.php#2010

Geographical and climate review

http://www.commercialwindows.org/code_standards_ashrae90_1_more.php#2010

ASHRAE 90.1-2010 Prescriptive Fenestration Requirements								
Climate Zone	1	2	3	4	5	6	7	8
Vertical Fenestration								
Maximum U-factor								
Framing materials other than metal with or without metal reinforcement or cladding								
Non-metal frame	1.20	0.75	0.65	0.40	0.35	0.35	0.35	0.35
Metal framing with or without thermal break								
Curtain wall/storefront	1.20	0.70	0.60	0.50	0.45	0.45	0.40	0.40
Entrance door	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All other metal fram	1.20	0.75	0.65	0.55	0.55	0.55	0.45	0.45
Maximum SHGC								
All vertical fenestration	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
Skylights with Glass								
Maximum U-factor								
with curb	1.98	1.98	1.17	1.17	1.17	1.17	1.17	0.98
without curb	1.36	1.36	0.69	0.69	0.69	0.69	0.69	0.58
Maximum SHGC								
0%-2% of roof area	0.36	0.36	0.39	0.49	0.49	0.49	0.68	Any
2.1%-5% of roof area	0.19	0.19	0.19	0.39	0.39	0.49	0.64	Any

SHGC requirements for vertical fenestration are adjusted where shading from permanent projections is provided. For skylights with plastic and curb, different requirements apply.

Mandatory air leakage limits depend on the fenestration type. For windows, sliding doors, swinging doors and most skylights, the maximum air leakage rate is 0.2 cfm/ft², or 0.3 cfm/ft² if tested at 6.24 psf.

Climate data for simulation

http://apps1.eere.energy.gov/buildings/energyplus/weatherdata_simulation.cfm

[Weather Bank](#) - maintains hourly and daily historical data records from every National Weather Service reporting station in US, as well as other locations around the world. They archive weather data on a real-time basis and certain updates are made hourly. This hourly archiving began in late Nov., 1994.

[National Climatic Data Center](#) - NCDC is the world's largest active archive of weather data. NCDC produces numerous climate publications and responds to data requests from all over the world. NCDC operates the World Data Center for Meteorology which is co-located at NCDC in Asheville, North Carolina, and the World Data Center for Paleoclimatology which is located in Boulder, Colorado.

[Weather Source](#) - Weather Source provides historical and real-time digital weather information for more than 10,000 locations across the United States and around the world.

[Weather Analytics](#) - Site specific weather files in EnergyPlus format based on the latest 30 years of hourly data are now available from the private sector company Weather Analytics for any official weather station on more than 600,000 35-km grid tiles across the globe. These files are built by integrating hourly weather station observations and the new NOAA reanalysis data sets. Both Typical Meteorological Year (TMY) files and individual, Actual Meteorological Year (AMY) files are available, as are files constructed from the previous 12 months.

[Meteonorm](#) - Meteonorm extrapolates hourly data from statistical data for a location. Where statistical data aren't available, Meteonorm interpolates from other nearby sites. Generally, a statistical approach is a last resort - weather files generated from statistics will not demonstrate the normal hour-to-hour and day-to-day variability seen in measured data.

E. Elements in preliminary analysis of building performance data

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Utility analysis

- Utility rate schedules
 - used to calculate the savings and paybacks

Utility Rate Schedule – FY 11 (July 2010 through June 2011)		
Utility	Unit	Rate
Steam	MMBtu	\$21.00
Chilled Water	Ton-Days	\$10.39
Electricity	kWh	\$0.11
Natural Gas	therms	\$1.47
Fuel Oil #2	gallons	\$2.73
Water	CGCF	\$11.25

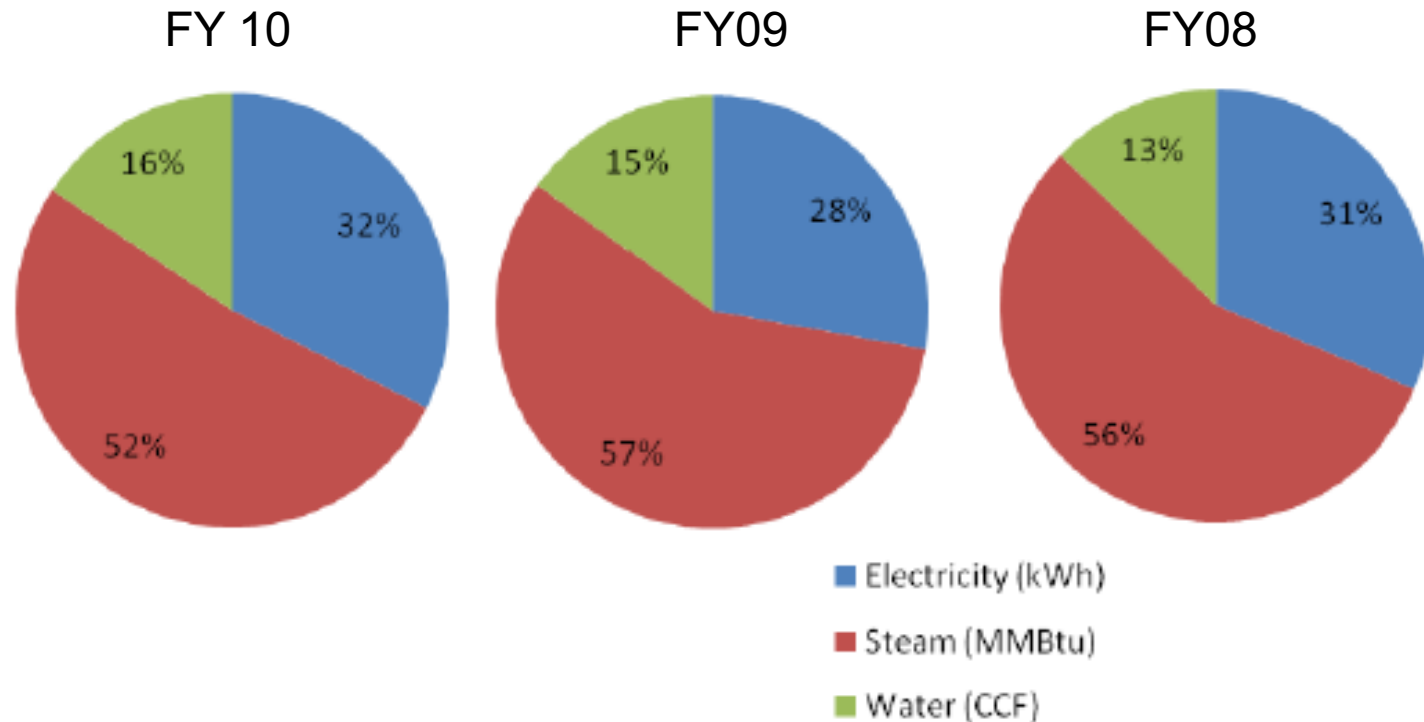
http://www.uos.harvard.edu/fmo/building_maintenance/quincy_house_energy_audit.pdf

Energy performance summary by fiscal year

Energy Performance Summary by Fiscal Year						
Year	Energy Type	Metric Tons of CO2 Equivalent	Total Annual Use	Conversion Multiplier	Thousand BTU (kBtu)	Total Annual Cost
FY10	Electricity (kWh)	341	907,793	3.412	3,097,390	\$102,944
	Steam (MMBtu)	646	7,875	1000	7,874,580	\$165,366
	Natural Gas (therms)	0.2	38	100	3,800	\$56
	Totals	987	-	-	10,975,770	\$318,102
FY09	Electricity (kWh)	338	900,063	3.412	3,071,015	\$114,668
	Steam (MMBtu)	729	8,883	1000	8,883,350	\$235,764
	Natural Gas (therms)	0.2	31	100	3,100	\$46
	Totals	1,067	-	-	11,957,465	\$412,336
FY08	Electricity (kWh)	359	936,456	3.412	3,195,188	\$121,798
	Steam (MMBtu)	760	8,858	1000	8,857,830	\$217,606
	Natural Gas (therms)	0.1	23	100	2,300	\$210
	Totals	1,119	-	-	12,055,318	\$389,371
*MTCDE for FY10 is not yet available. These numbers are based on equivalents from FY08.						

http://www.uos.harvard.edu/fmo/building_maintenance/quincy_house_energy_audit.pdf

Utility spending breakdown



Steam was the most expensive utility followed by electricity.

http://www.uos.harvard.edu/fmo/building_maintenance/quincy_house_energy_audit.pdf

End use component energy usage breakdown

Annual Energy Consumption by End Use Components FY 2010									
End Use	Electricity		Chilled Water	Steam	Natural Gas	Total	% of Total Use	Total Cost (\$)	% of Total Cost
	kWh	kBtu	kBtu	kBtu		kBtu			
Space Heating	-	-	-	7,163,580	-	7,163,580	65%	150,435	56%
Space Cooling	34,662	118,300	-	-	-	118,300	1%	3,931	1%
Domestic Hot Water	-	-	-	711,000	-	711,000	6%	14,931	6%
Lights	757,238	2,584,454	-	-	-	2,584,454	24%	85,871	32%
Other Equipment*	115,893	394,635	-	-	3,800	398,435	4%	13,198	5%
Total	907,793	3,097,390	0	7,874,580	0	10,971,970	100%	268,366	100%
*Includes: SAF, RAF, exhaust fans, exterior lights, chiller, motors, pumps, plug loads, and miscellaneous equipment									

http://www.uos.harvard.edu/fmo/building_maintenance/quincy_house_energy_audit.pdf

Energy use and cost indices by fiscal year

Energy Use and Cost Indices by Fiscal Year		
Year	Metric	Utility Data
FY 10	Energy Utilization Index (kBtu/ft ² /year)	75.49
	Cost Index (\$/ft ² /year)	1.85
	Water Used (CCF)	4,421
	Total Water Cost (\$/year)	49,736
	Cost Index, Including Water (\$/ft ² /year)	2.19
FY 09	Energy Utilization Index (kBtu/ft ² /year)	82.24
	Cost Index (\$/ft ² /year)	2.41
	Water Used (CCF)	5,379
	Total Water Cost (\$/year)	61,859
	Cost Index, Including Water (\$/ft ² /year)	2.84
FY 08	Energy Utilization Index (kBtu/ft ² /year)	82.91
	Cost Index (\$/ft ² /year)	2.33
	Water Used (CCF)	4,519
	Total Water Cost (\$/year)	49,758
	Cost Index, Including Water (\$/ft ² /year)	3.02

Electrical demand by fiscal year

Because the demand has been stable for the past three fiscal years, the audit team recognizes equipment and operations have been consistent and will look for opportunities to reduce the building's peak load.

Electrical Demand FY08 through FY10		
Years	Metric	Electrical Data
FY10	Maximum Demand (kW)	365
	Maximum Demand (watts/ft2)	2.51
FY09	Maximum Demand (kW)	365
	Maximum Demand (watts/ft2)	2.51
FY08	Maximum Demand (kW)	360
	Maximum Demand (watts/ft2)	2.48

E. Elements in preliminary analysis of building performance data

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Benchmarking



Required data for benchmarking?

- Portfolio Manager username and password.
- The building street address, year built, and contact information.
- The building gross floor area and key operating characteristics for each major space type.
- 12 consecutive months of utility bills for all fuel types used in the building.

Data Collection Worksheet:

http://www.energystar.gov/ia/business/downloads/PM_Data_Collection_Worksheet.doc

Portfolio Manager Quick Reference Guide:

http://www.energystar.gov/ia/business/downloads/PM_QuickRefGuide.pdf?cff0-e2dd

Partial Data Collection Worksheet

<p><u>Hospital (General Medical and Surgical):</u></p> <p>Required:</p> <p>_____ Gross floor area (>20,000 SF)</p> <p>_____ # of staffed beds</p> <p>_____ # of MRI machines</p> <p>_____ # FTE workers</p> <p>Optional:</p> <p>_____ Laboratory on-site – yes or no</p> <p>_____ Laundry facilities on site – yes or no</p> <p>_____ Number of Buildings</p> <p>_____ Maximum # of floors</p> <p>_____ Tertiary care facility – yes or no</p> <p>_____ Ownership Status (drop down of options)</p>	<p><u>House of Worship:</u></p> <p>Required:</p> <p>_____ Gross floor area (SF)</p> <p>_____ Maximum seating capacity</p> <p>_____ Weekdays of operation</p> <p>_____ Hours of operation per week</p> <p>_____ # of personal computers</p> <p>_____ Presence of cooking facilities - yes or no</p> <p>_____ # of commercial refrigeration/freezer units</p>	<p><u>Medical Office:</u></p> <p>Required:</p> <p>_____ Gross floor area (SF)</p> <p>_____ # of workers on main shift</p> <p>_____ Weekly operating hours</p> <p>_____ Percent of floor area that is cooled in 10% increments (10%, 20%, 30%, etc.)</p> <p>_____ Percent of floor area that is heated in 10% increments (10%, 20%, 30%, etc.)</p>
<p><u>Hotel:</u></p> <p>Required:</p> <p>_____ Gross floor area (SF)</p> <p>_____ # of rooms</p> <p>_____ # of workers on main shift</p> <p>_____ # of commercial refrigeration/freezer units</p> <p>_____ On-site cooking – yes or no</p> <p>_____ Percent of floor area that is cooled in 10% increments (10%, 20%, 30%, etc.)</p> <p>_____ Percent of floor area that is heated in 10% increments (10%, 20%, 30%, etc.)</p> <p>Optional:</p> <p>_____ Hours per day the guests are on-site</p> <p>_____ Number of guest meals served</p> <p>_____ Square footage of full-service spas</p> <p>_____ Square footage of gym/fitness center</p> <p>_____ Laundry processed at site (drop down of options)</p> <p>_____ Annual quantity of laundry processed on-site</p> <p>_____ Average Occupancy (%)</p>	<p><u>K-12 School:</u></p> <p>Required:</p> <p>_____ Gross floor area (SF)</p> <p>_____ # of personal computers</p> <p>_____ # of walk-in refrigeration/freezer units</p> <p>_____ High school - yes or no</p> <p>_____ Open weekends – yes or no</p> <p>_____ On-site cooking – yes or no</p> <p>_____ Percent of floor area that is cooled in 10% increments (10%, 20%, 30%, etc.)</p> <p>_____ Percent of floor area that is heated in 10% increments (10%, 20%, 30%, etc.)</p> <p>Optional:</p> <p>_____ Months of use</p> <p>_____ School District</p>	<p><u>Multifamily Housing:</u></p> <p>Required:</p> <p>_____ Gross floor area (SF)</p> <p>Optional:</p> <p>_____ Total number of units</p> <p>_____ Total number of bedrooms</p> <p>_____ Maximum number of floors in the tallest building/tower</p> <p>_____ Percent of square footage devoted to common area</p> <p>_____ Number of laundry hookups in individual apartment units</p> <p>_____ Number of laundry hookups in common areas</p> <p>_____ Total number of dishwashers in all units</p> <p>_____ Percent of floor area that is cooled in 10% increments (10%, 20%, 30%, etc.)</p> <p>_____ Percent of floor area that is heated in 10% increments (10%, 20%, 30%, etc.)</p> <p>_____ Primary hot water fuel type</p> <p>_____ Resident population type (No specific type, Dedicated Student, Dedicated Military, Dedicated Senior/Independent Living, Dedicated Special Accessibility Needs, Other Dedicated Housing)</p> <p>_____ Government subsidized housing (Yes or No)</p>

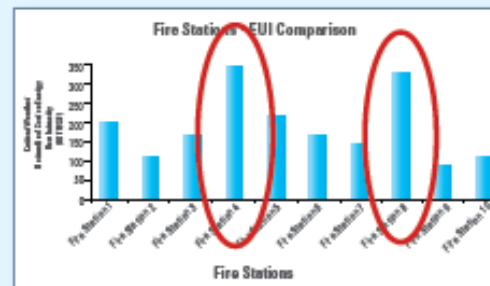
Benchmarking – Identify Energy Efficiency Projects

STEP	ACTIVITY	ACTION
1	Access Portfolio Manager. (step not shown)	Visit www.energystar.gov/benchmark . Scroll down to the Login section on the right-hand side in the middle of the page.
2	Access your account. (step not shown) • Create a new account. • Login to an existing account.	• Click REGISTER , and follow instructions. • Enter user name and password, and click LOGIN .
3	Review system updates and enter account. (step not shown)	Click ACCESS MY PORTFOLIO , located below Welcome to Portfolio Manager .
4	Add a new facility. (step not shown)	Click ADD a Property , located in the upper right portion of the screen.
5	Select property type and enter general facility information. (step not shown)	Select the option that most closely resembles your facility and click CONTINUE . Enter general data and click SAVE . For more information on facility space types, see: www.energystar.gov/index.cfm?c=eligibility.bus_portfoliomanager_space_types .
6	Enter space use data.	From the Facility Summary page, shown above, go to the Space Use section, located half way down the page, and click ADD SPACE . • Enter a facility name. In the Select a Space Type menu, select the appropriate space type(s) for your building. If your space is not listed, select Other . Click CONTINUE . • Enter building characteristics. Click SAVE . Information required for each space type is listed here: www.energystar.gov/index.cfm?c=eligibility.bus_portfoliomanager_space_types . • Repeat steps above to add all major spaces in your facility. Use bulk import service to minimize manual data entry of large sets of facility data (10 or more facilities or campuses are required). • Go back to My Portfolio by clicking on the link in the upper left portion of the page. • Click IMPORT Facility Data Using Templates , located below Add a Property .
7	Enter energy use data.	From the Facility Summary page, go to the Energy Meters section, located below the Space Use section, and click ADD METER . • Enter meter name, type, and units. Click SAVE . • Enter number of months and start date. Click CONTINUE . • Enter energy use and cost for each month. Click SAVE . • Repeat for all energy meters and fuel types.

www.energystar.gov/benchmark


Benchmarking – Identify Energy Efficiency Projects

STEP	ACTIVITY	ACTION
8	Create custom groups.	<p>Organize facilities into groups (e.g., Fire Stations, Northwest Region). Groups are completely customizable, and each facility may belong to multiple groups.</p> <ul style="list-style-type: none"> • From the My Portfolio page, click CREATE GROUP, located directly to the right of the Group drop-down menu. • Follow instructions to select buildings and name your group. • Once they have been saved, custom groups will be available in the Group drop-down menu.
9	View and interpret results.	<p>Option 1: Go to My Portfolio and view all buildings to compare performance metrics.</p> <p>Option 2: Export data to Microsoft® Excel.</p> <ul style="list-style-type: none"> • On the My Portfolio page, select the view, from the View drop-down menu that will display the data you wish to export. The My Portfolio page will update to display the selected view. (9a) • Select the DOWNLOAD IN EXCEL link. A File Download dialog window will open. Follow the steps provided by Excel. (9b) • Use Excel functionality to view building energy performance graphically. The example below shows a comparison of Energy Use Intensity for a portfolio of fire stations, identifying under-performing buildings to target for energy efficiency improvements.



www.energystar.gov/benchmark

Benchmarking – Track Progress over Time



www.energystar.gov/benchmark

STEP	ACTION
1	From the My Portfolio page or the Facility Summary page, select the Create View link, located directly to the right of the View drop-down menu.
2	Enter a name for the view. To set as the default view, select the box labeled Set this View as My Portfolio Default , located directly to the right of View Name . You may include up to 7 (seven) columns in each view.
3	Choose each metric to be included in the view by selecting an order number from the Preferred Column Order drop-down menu to the left of the Facility Data column.
4	Click SAVE at the bottom of the page. You will be returned to the My Portfolio page, and your custom view will be available in the View drop-down menu. <small>(step not shown)</small>

Benchmarking – Verify and Document Results

GENERATE A STATEMENT OF ENERGY PERFORMANCE AND AN ENERGY PERFORMANCE REPORT

STEP ACTION

1

From your selected building's **Facility Summary** page, click **GENERATE A STATEMENT OF ENERGY PERFORMANCE**.

2

On the next page, select a period ending date. (step not shown)

3

Click **GENERATE REPORT**, located in the bottom right corner of the screen. (step not shown)

4

Save the Statement of Energy Performance, accompanying Data Checklist, and Facility Summary that include information on energy use intensity and greenhouse gas emissions.

5

From the **My Portfolio** page, click **REQUEST ENERGY PERFORMANCE REPORT**, located under **Work with Facilities**, which shows reductions in key performance indicators over a user-specified time period. Specify the type of report, the facilities to be included, and the requested report columns. The report will be e-mailed to a user-specified address within one business day. (step not shown)

QWB No. 2008-0347

STATEMENT OF ENERGY PERFORMANCE

Fire Station 2

Building ID: 1542551
For 12-month Period Ending: December 31, 2009
Date SEP becomes available: N/A

Date SEP Generated: March 05, 2009

Facility	Facility Owner	Primary Contact for this Facility
Fire Station 2 600 Blank Street Arlington, VA 22209	N/A	N/A
Year Built: 1990 Gross Floor Area (sq): 300,000		
Energy Performance Rating ¹ (1-100)		
Site Energy Use Summary ⁴		
Electricity (kBtu)		
Natural Gas (kBtu)		
Total Energy (kBtu)	15,500,000	
Energy Intensity ⁴		
Site (kBtu/sq/yr)	52	
Source (kBtu/sq/yr)	173	
Emissions (based on site energy use)		
Greenhouse Gas Emissions (MtCO ₂ e/year)	2,352	
Electric Distribution Utility		
Virginia Electric & Power Co		
National Average Comparisons		
National Average Site EU	76	
National Average Source EU	157	
% Difference from National Average Source EU	15%	
Building Type	Station/Police Station	
Meets Industry Standards ⁵ for Indoor Environmental Conditions:		
Ventilation for Acceptable Indoor Air Quality	N/A	
Acceptable Thermal Environmental Conditions	N/A	
Adequate Illumination	N/A	

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Certifying Professional

N/A

www.energystar.gov

BEST Center Curricula, Resources & Recordings

Academic Programs

Georgia Piedmont Technical College - Building Automation Systems

Milwaukee Area Technical College - Sustainable Facilities Operations

Laney College - Commercial HVAC Systems

City College San Francisco - Commercial Building Energy Analysis & Audits

Professional Development Materials, Presentations & Videos

National Institutes

Building Automation Systems Instructor Workshops

Webinars (e.g., BEST Talks)

Faculty Profile Videos

Reports & Case Studies

Marketing Resources

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