GLOBAL TRAINING CENTER
DUBAI

Effective Energy Management in New and Existing Buildings (MENA)

Hassan Younes, Member ASHRAE, BEAP, BEMP, HBDP, CPMP, HFDP, OPMP

Based on the *Effective Energy Management in New and Existing Buildings* course by Richard J. Pearson, P.E., ASHRAE Fellow

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Effective Energy Management in New and Existing Buildings (MENA)

By ASHRAE

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Course ID: 920018783

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6

General CE hours

0

LEED-specific hours

LEED GREEN ASSOCIATE

LEED AP BD+C

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LEED AP O+M

Presenter Biography

Hassan Younes has over 15 years of extensive experience in the fields of Energy Efficiency, Design, Sustainability, and Project Execution and Management. Prior to co-founding grfn, he was the Mechanical Manager at Meraas Holding, one of the leading developers in the region and was involved in the design of multiple large-scale developments.

He is a trainer for the ASHRAE Global Training Centre. He is an appointed Consultant for ASHRAE 62.1 Standard. He is a Certified trainer for CEM (Certified Energy Manager) course, Certified Measurement Verification Professional (CMVP) course and the trainer for the Emirates Green Building Council Building Retrofit Program. He is also the current ASHRAE Falcon Chapter president and on the technical committee and was the Vice Chair of CIBSE Regional Chapter. He holds all the ASHRAE certifications. He has been involved in many high-end projects in the MENA region.

Today's Audience

- People responsible for facility management inside their organization
- Consulting engineers who provide energy management services to facilities
- Engineers who provide advice on energy management to facility managers and staff
- Vendors selling products to facilities

Course Objectives

- Describe the ENERGY STAR® management cycle
- Analyze basic billing and load profile information
- Interpret weather-adjusted energy data
- Distinguish the levels I, II and III of a commercial building energy audit
- Identify opportunities for energy savings in your buildings based on course suggestions
- Develop an action plan to get started, targeting:
  - Preliminary energy analysis **<u>or</u>**
  - A test of discretionary facility operation.

Guides for Today's Seminar

ENERGY STAR Guidelines for Energy Management

Connections:

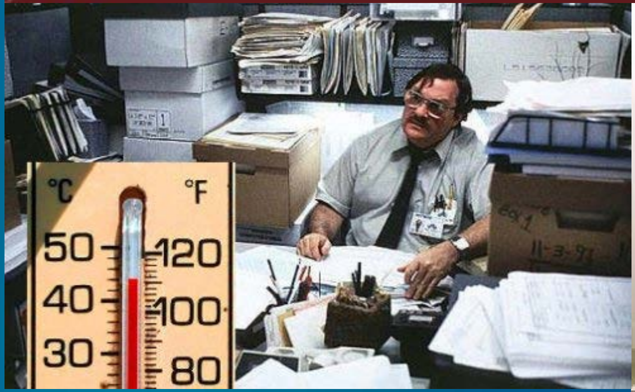
- ASHRAE Standard 100-2018, *Energy Efficiency in Existing Buildings*
- ASHRAE Standard 211-2018, *Standard for Commercial Building Energy Audits*
- *2015 ASHRAE Handbook—HVAC Applications*, Chapter 36
- Practical experience
- Opportunities in your buildings

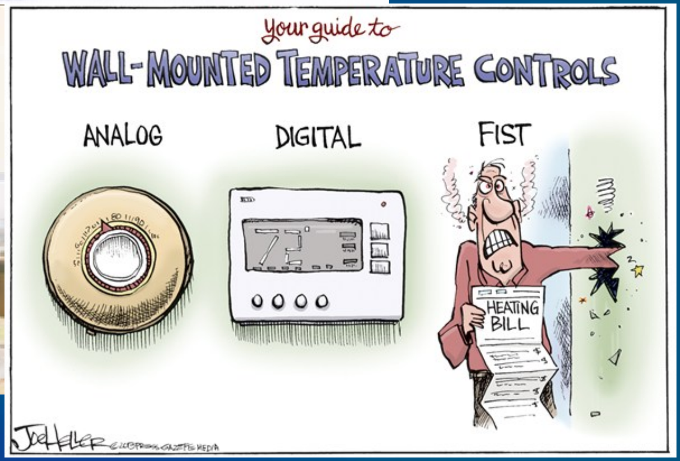
Today’s Topics

1. Introduction to energy management
2. Why commit to energy management?
3. Assessing performance and setting goals
4. Action plans: ideas and a test method
5. Evaluating results, including adjusting for weather
6. Energy management summary
7. What can you do, starting next week?

“Discomfort is Expensive”





For Example…

If typical office building includes one person for every 28 m^2

And the annual utility cost is $21.5 per m^2

Then each person is "responsible" for $600 per year

If dramatic energy conservation reduces energy usage by 50%, or $10.76 per m^2

Then savings per person = $300 per year

If average worker salary is $50,000/yr

Then savings per person = $300/$50,000 = 0.6%

Therefore any level of discomfort that distracts a person will clearly cost more in lost productivity than the $300 savings in energy

Introduction to Energy Management

Energy Management 101—Example

- Management commitment
- Manual daily meter reading
- Operational changes only
- 33% energy savings in 12 months

Energy Management 101
The Building

20-story office building:

- 200,000 ft^2 (18,580 m^2)
- Five years old, no energy conservation
- Complex, energy intensive HVAC systems
- High utility bills
- No building automation system

Energy Management 101
How It Worked

Actions by facility manager:

- Reviewed operations ideas with building engineer and design engineer
- Reviewed daily meter data for impact, intuitively adjusting for weather
- Harassed/complimented building engineer daily on performance

Energy Management 101
How It Worked

Actions by building engineer:

- Aligned building schedules with occupancy times
- Raised cold deck temperature
- Lowered hot deck temperature
- Outdoor air was introduced only during occupied hours
- Reduced duct pressures

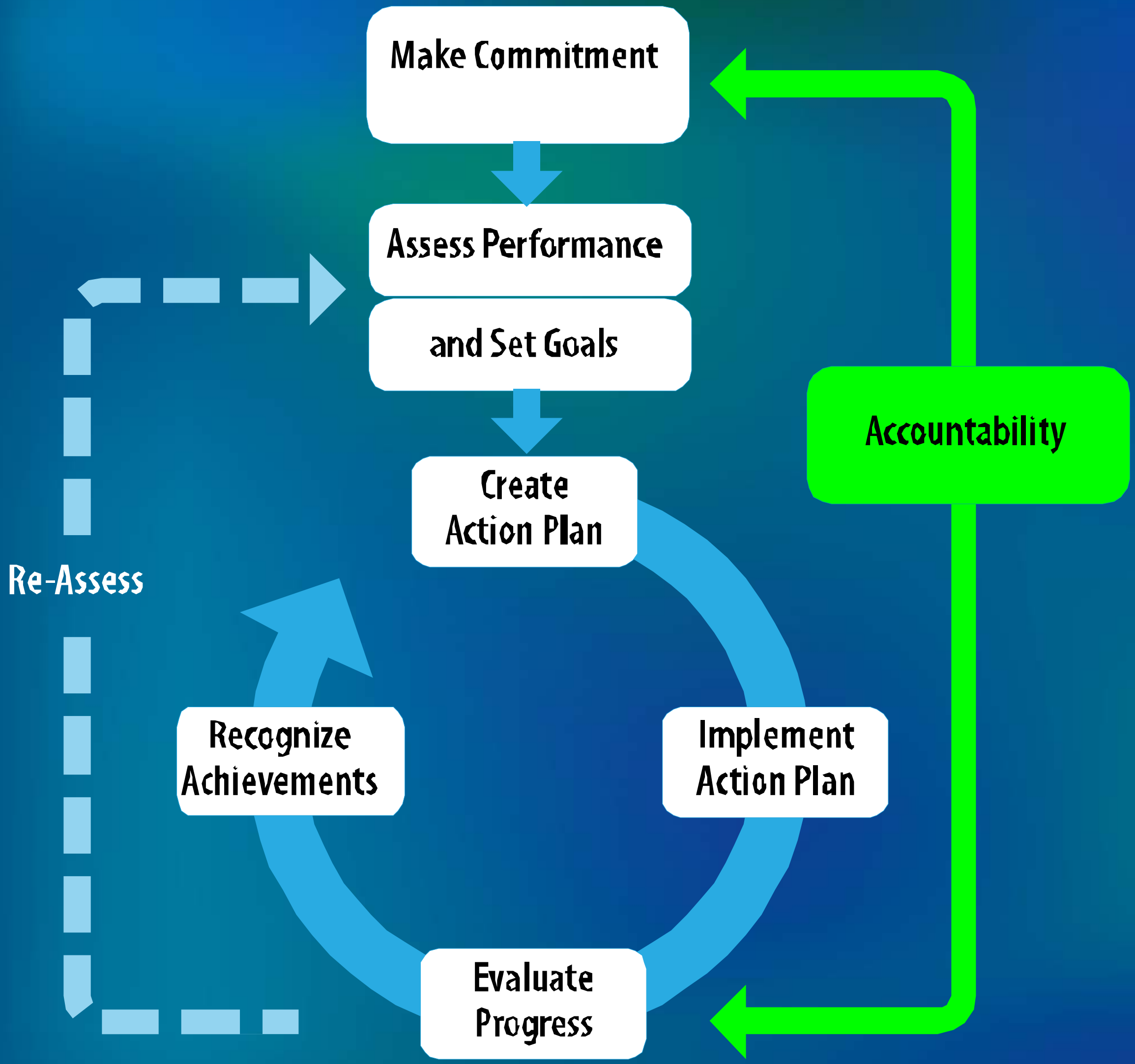
Savings in one year: 33%!

Here's a Word About Capital Projects

Energy management is the foundation for *effective* capital upgrades:

- Measure performance
- Monitor performance over time
- Deploy operations changes along with new equipment to get greatest bang for buck

The *Management* Content of Energy Management



www.energystar.gov

ENERGY STAR guidelines describe a management cycle that helps you with execution—getting things done!

Energy Manager Job Description

Chapter 36, 2015 *ASHRAE Handbook—HVAC Applications*

- Functions
  - Technical
  - Policy related
  - Planning and purchasing
- Qualifications
  - General
  - Educational/professional

Job Description—Purchasing

- Lower-cost energy
- Other non-building utilities
  - Vehicle fuel
  - Water

Jerry Eaton's Story

- Headquarters in Fond du Lac, Wisconsin
- Manufacturing and sales organization
- Multiple facilities across the U.S.
- Multimillion dollar utility bill
- Jerry Eaton—energy manager
- >$1 million annual savings (>5% of bills)

Jerry Eaton's Discoveries

- Utility cost was an overhead item—not a manageable expense
- Stickers on light switches—no impact on expense or consumption

Jerry Eaton's Parallel Activities

Developed a corporate-wide chain of accountability:

- ✓ Began with buildings (each with a meter)
- ✓ Then departments within buildings (each with a meter)
- ✓ Appointed a person in each location to be responsible for proven results

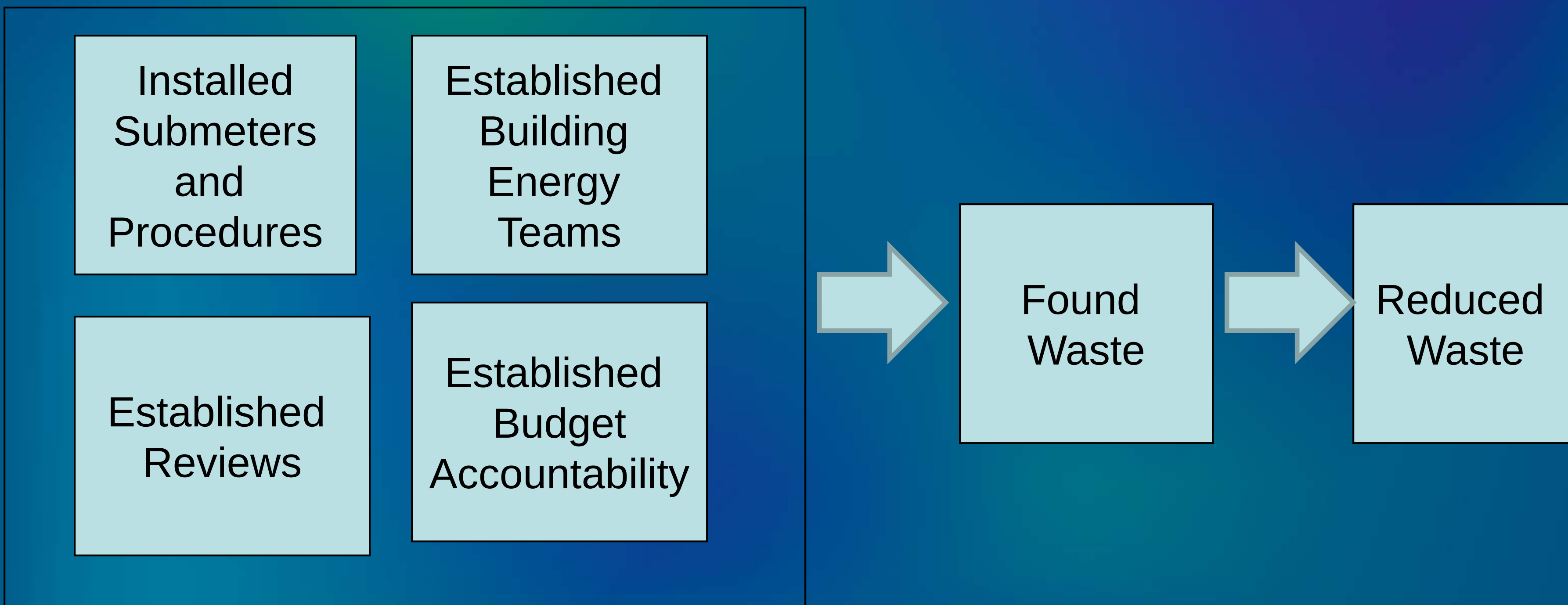
Jerry Eaton's Parallel Activities

Developed an accountability process to review results regularly

Typical *monthly* agenda:

1. A look back
   - Submeter data review, check impact of last month's action ideas
2. A look forward
   - Brainstorm ideas to decrease energy
   - Commit to try ideas (who, when)

Jerry Eaton's Parallel Activities: Summary



Jerry Eaton's Success Story

- The cost of energy became real for each unit
- Energy teams, by building or department
- The "buck" stopped at one person in each department

→ Annual savings: over $1 million (>5%)

Meters and Submeters

- Meters by themselves do not save anything
- No direct payback on the purchase of a meter
- That is not the basis for their justification as an energy conservation investment
- Question: How can you manage it if you can't measure it?

Measurement Technology

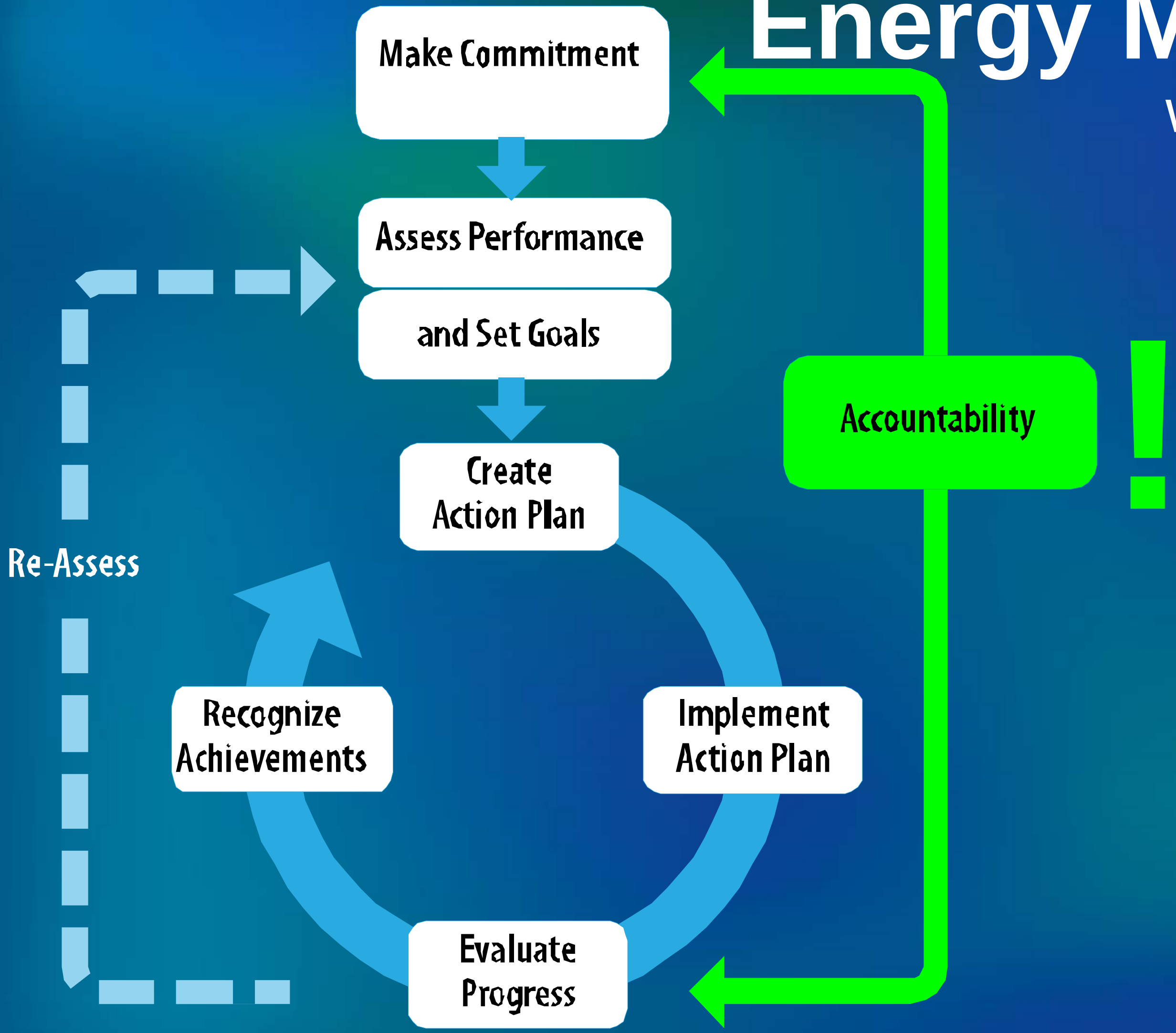
- Measurement technology is continuously improving and becoming more affordable
- More than one way to develop measurements that are useful in an energy management program
- Creative thinking and competitive bidding can produce surprising results

Was Jerry Eaton Really an Energy Manager?

- Authority to manage energy?
- Responsibility?
- Accountability?

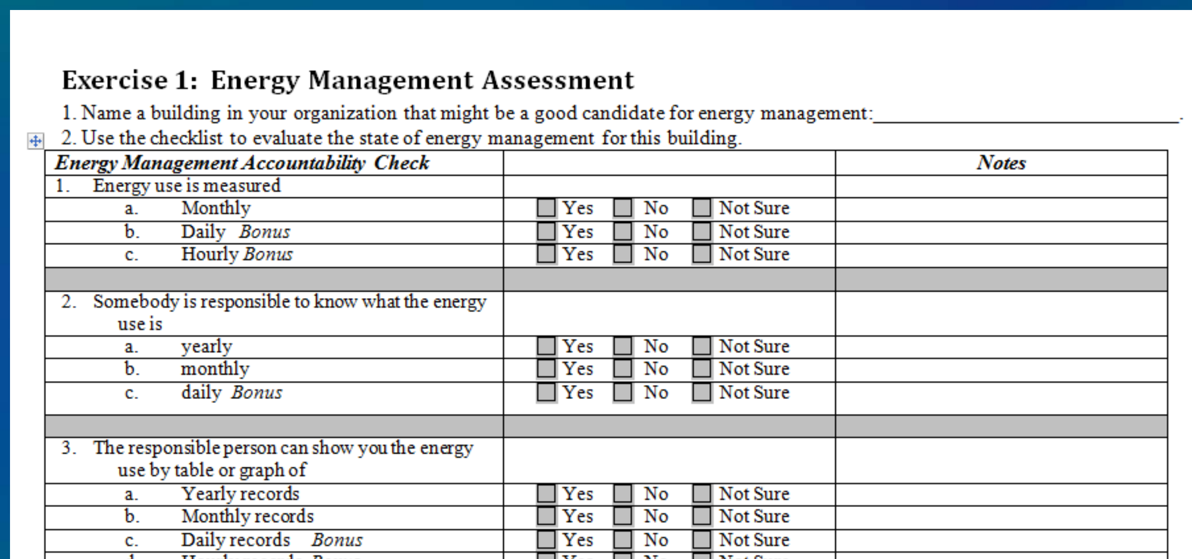
ENERGY STAR Guidelines for Energy Management

www.energystar.gov



Exercise 1: Energy Management Assessment

Page 3
in the
exercises



Exercise 1: Energy Management Assessment

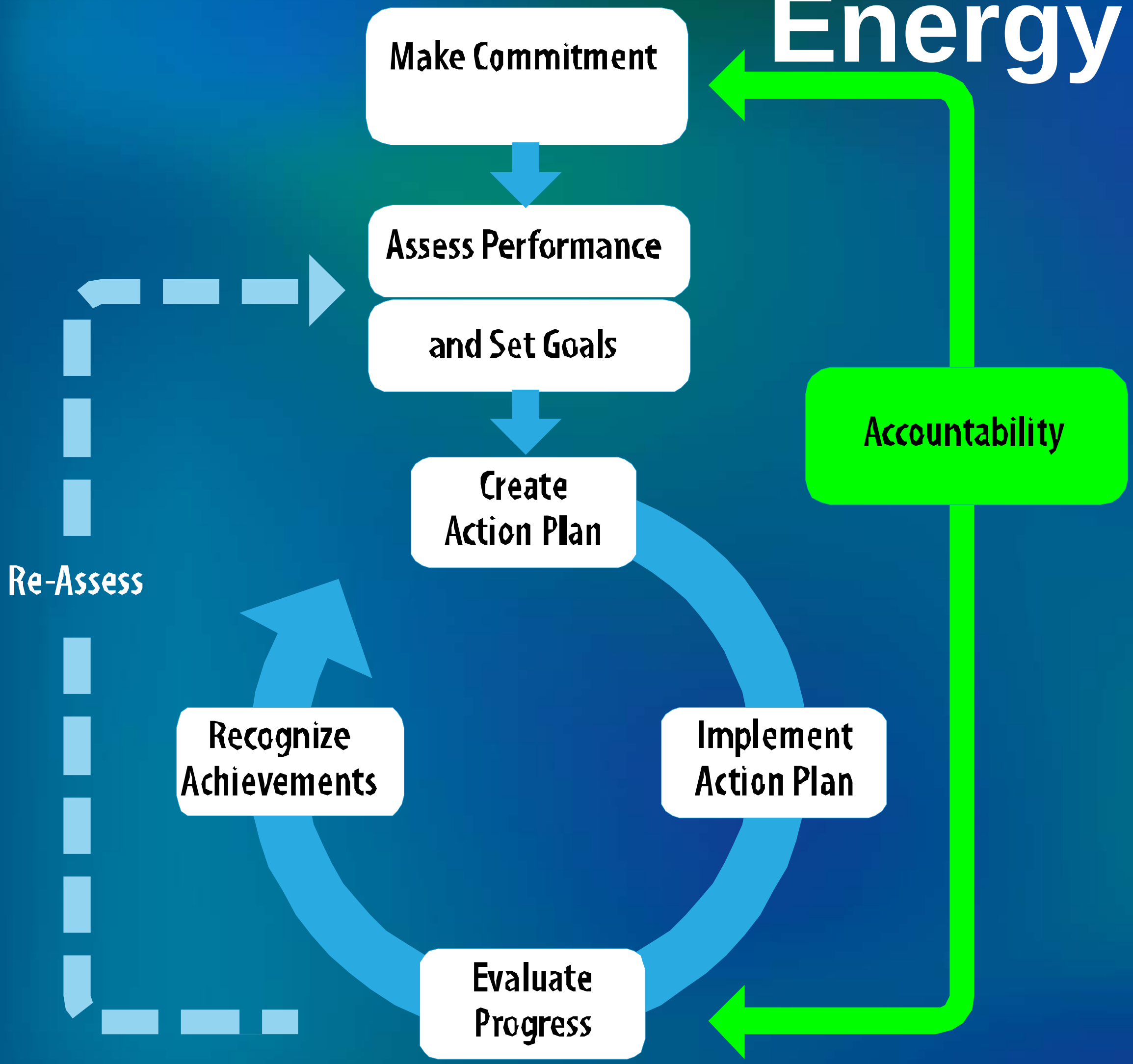
1. Name a building in your organization that might be a good candidate for energy management:__________________________.
2. Use the checklist to evaluate the state of energy management for this building.

Energy Management Accountability Check		*Notes*
1. Energy use is measured		
a. Monthly	☐ Yes ☐ No ☐ Not Sure	
b. Daily *Bonus*	☐ Yes ☐ No ☐ Not Sure	
c. Hourly *Bonus*	☐ Yes ☐ No ☐ Not Sure	
2. Somebody is responsible to know what the energy use is		
a. yearly	☐ Yes ☐ No ☐ Not Sure	
b. monthly	☐ Yes ☐ No ☐ Not Sure	
c. daily *Bonus*	☐ Yes ☐ No ☐ Not Sure	
3. The responsible person can show you the energy use by table or graph of		
a. Yearly records	☐ Yes ☐ No ☐ Not Sure	
b. Monthly records	☐ Yes ☐ No ☐ Not Sure	
c. Daily records *Bonus*	☐ Yes ☐ No ☐ Not Sure	
d. Hourly records *Bonus*	☐ Yes ☐ No ☐ Not Sure	

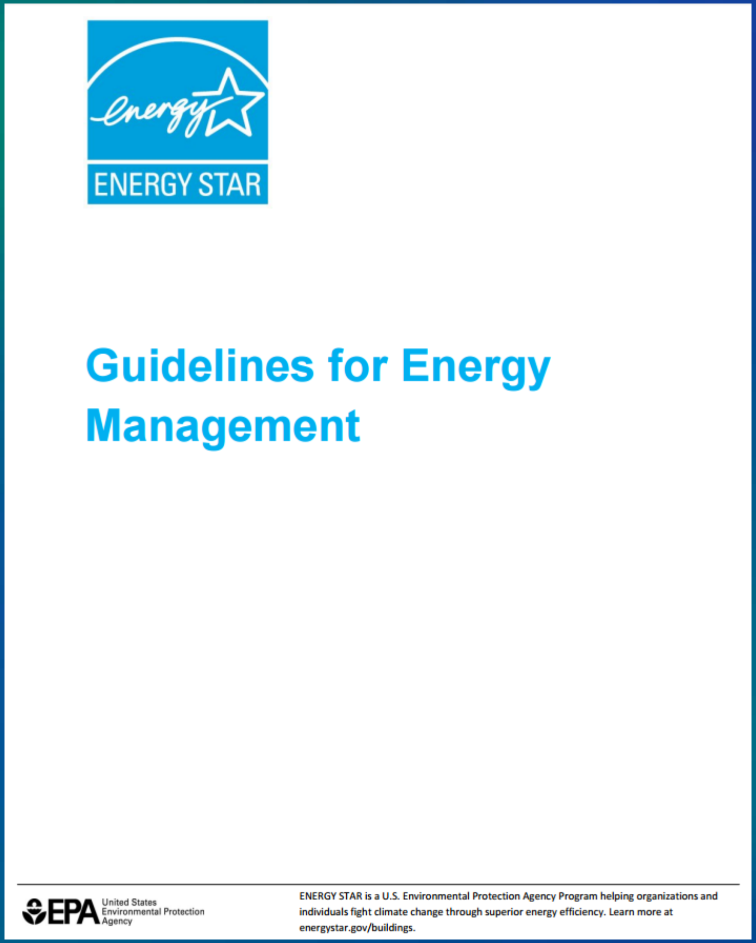
Why Commit to Energy Management?

ENERGY STAR Guidelines for Energy Management

www.energystar.gov



ENERGY STAR Guidelines for Energy Management


ENERGY STAR

Guidelines for Energy Management

EPA United States Environmental Protection Agency

ENERGY STAR is a U.S. Environmental Protection Agency Program helping organizations and individuals fight climate change through superior energy efficiency. Learn more at energystar.gov/buildings.

https://www.energystar.gov/sites/default/files/buildings/tools/Guidelines%20for%20Energy%20Management%206_2013.pdf.

Dollar Savings and Margin

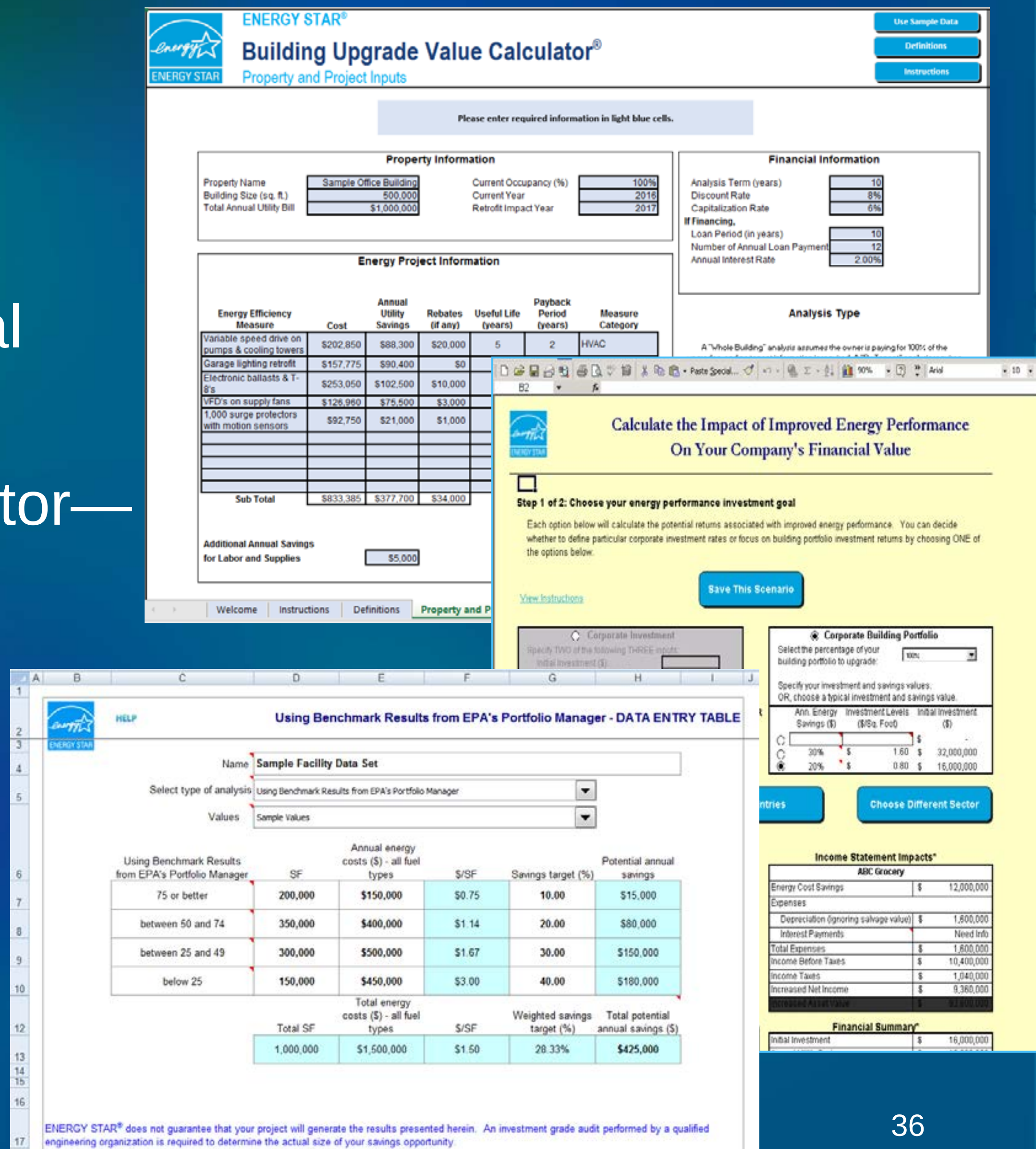
$ 1,000,000	Revenue	
$ 950,000	Expenses	
$ 50,000	Margin	(5% of revenue)

A cost savings of $1000 @ 5% margin

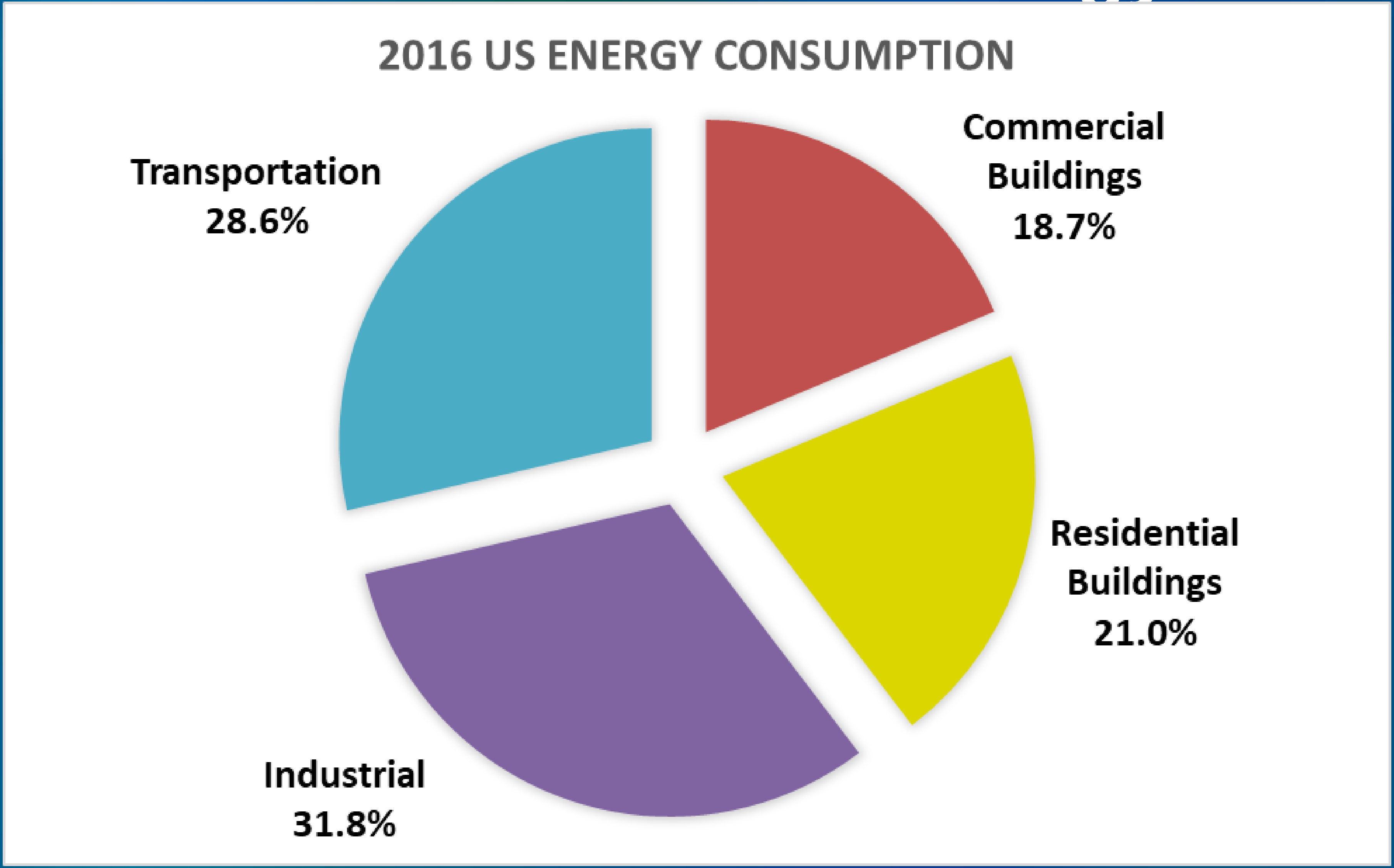
Equivalent to $20,000 in increased revenue

Financial Value Tools from ENERGY STAR

- Building Upgrade Value Calculator—Commercial Real Estate
- Financial Value Calculator—Corporate Real Estate
- Cash Flow Opportunity Calculator

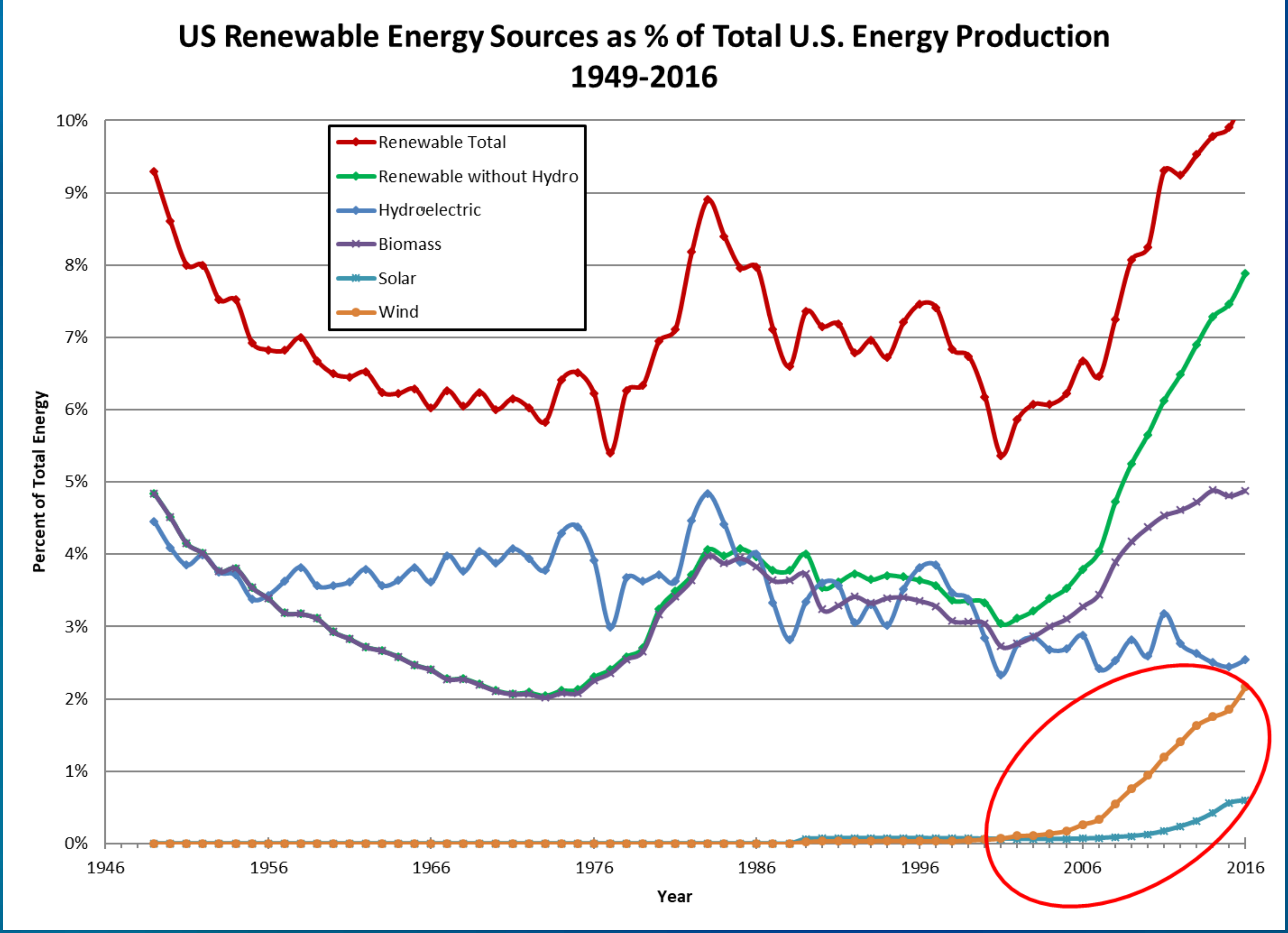


Where Do We Use Energy?



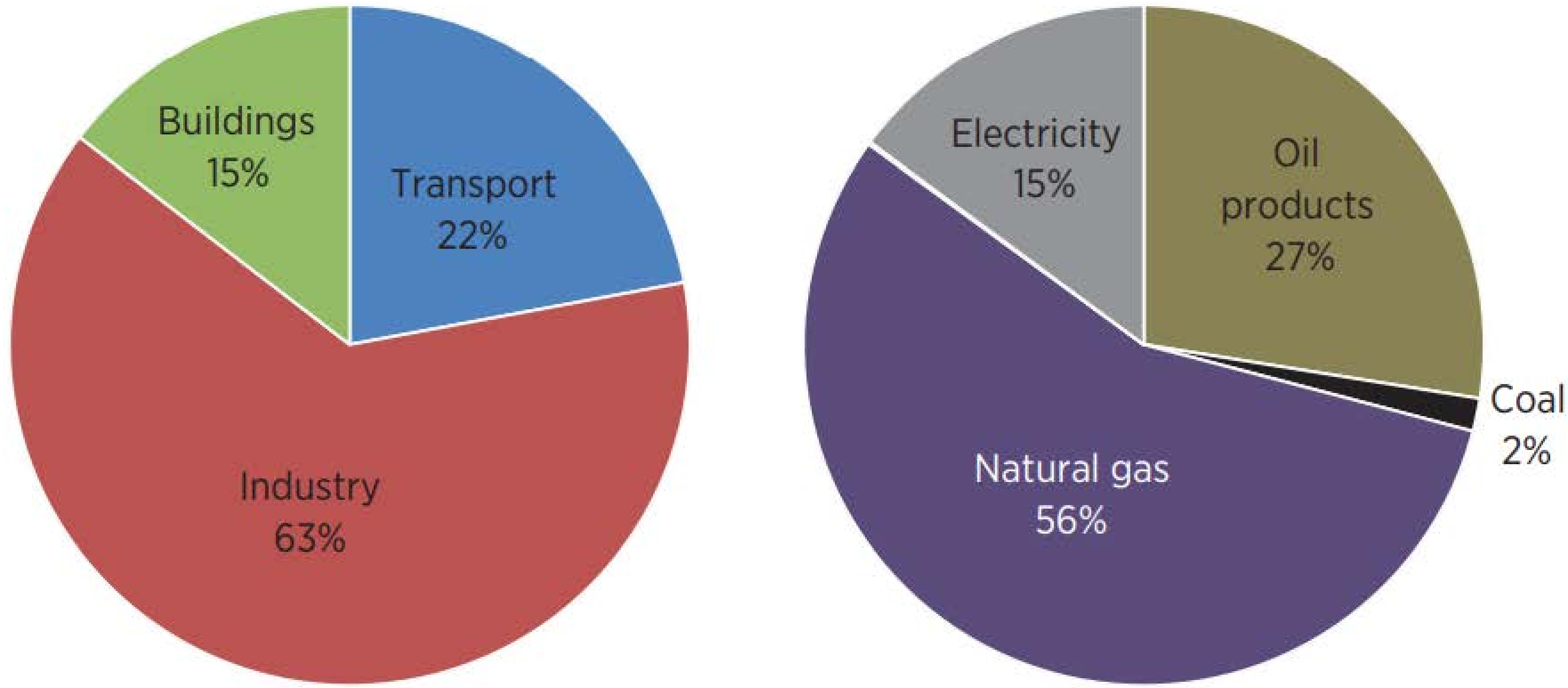
Source: U.S. EIA.

Renewable Energy Sources



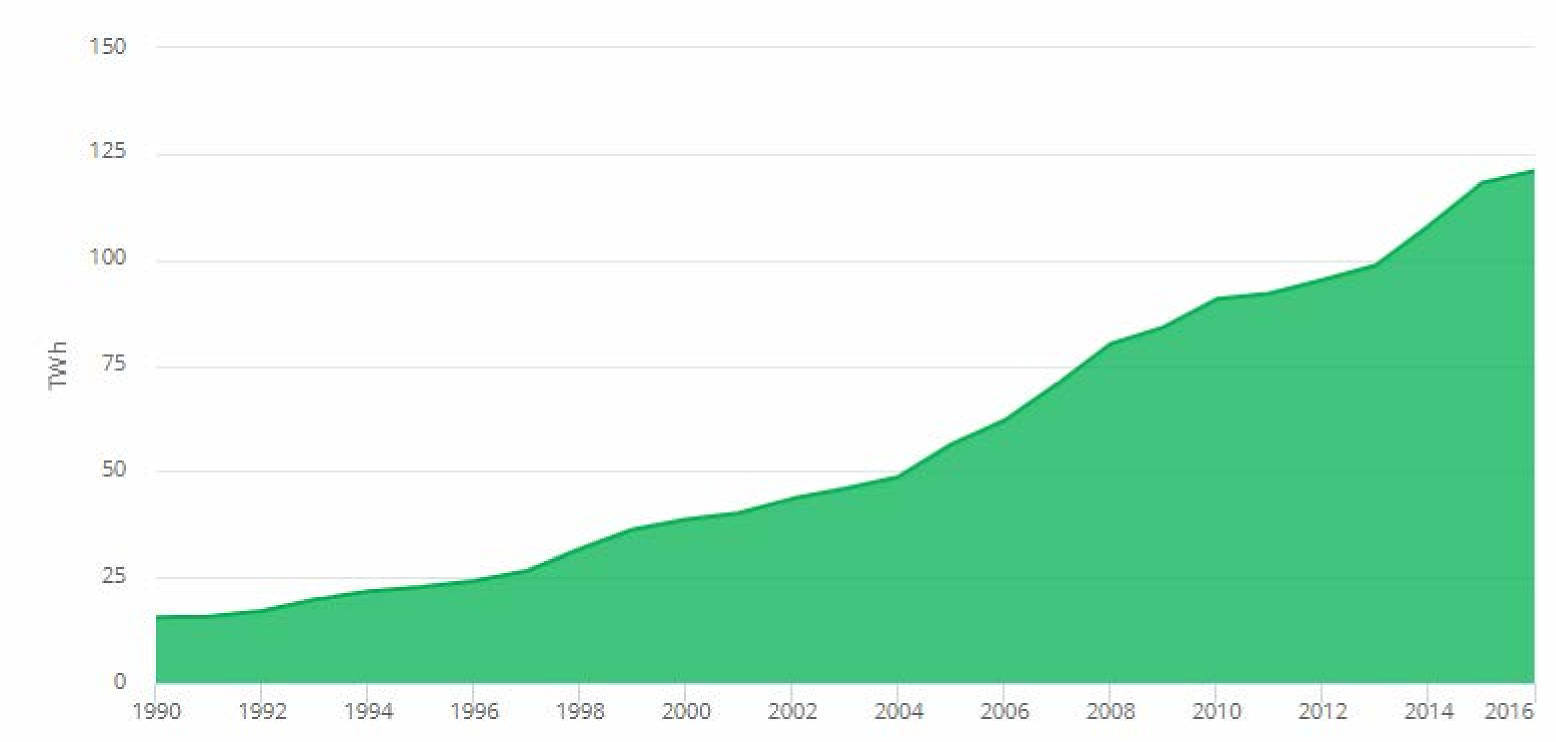
Source: U.S. EIA.

Total Energy Consumption – UAE



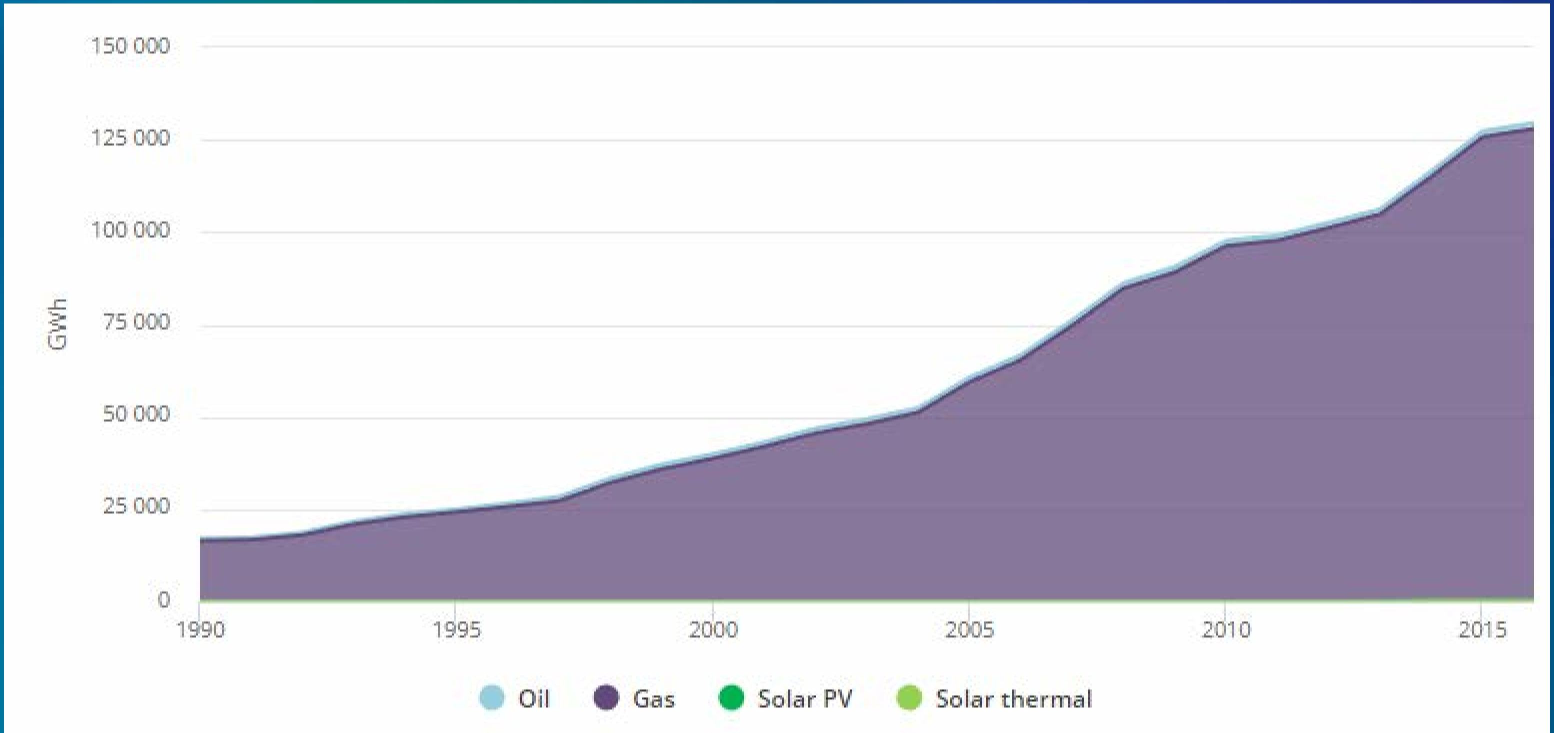
Source: REmap 2030, published April 2015.
https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA_REmap_UAE_report_2015.pdf.

Total Energy Consumption – UAE



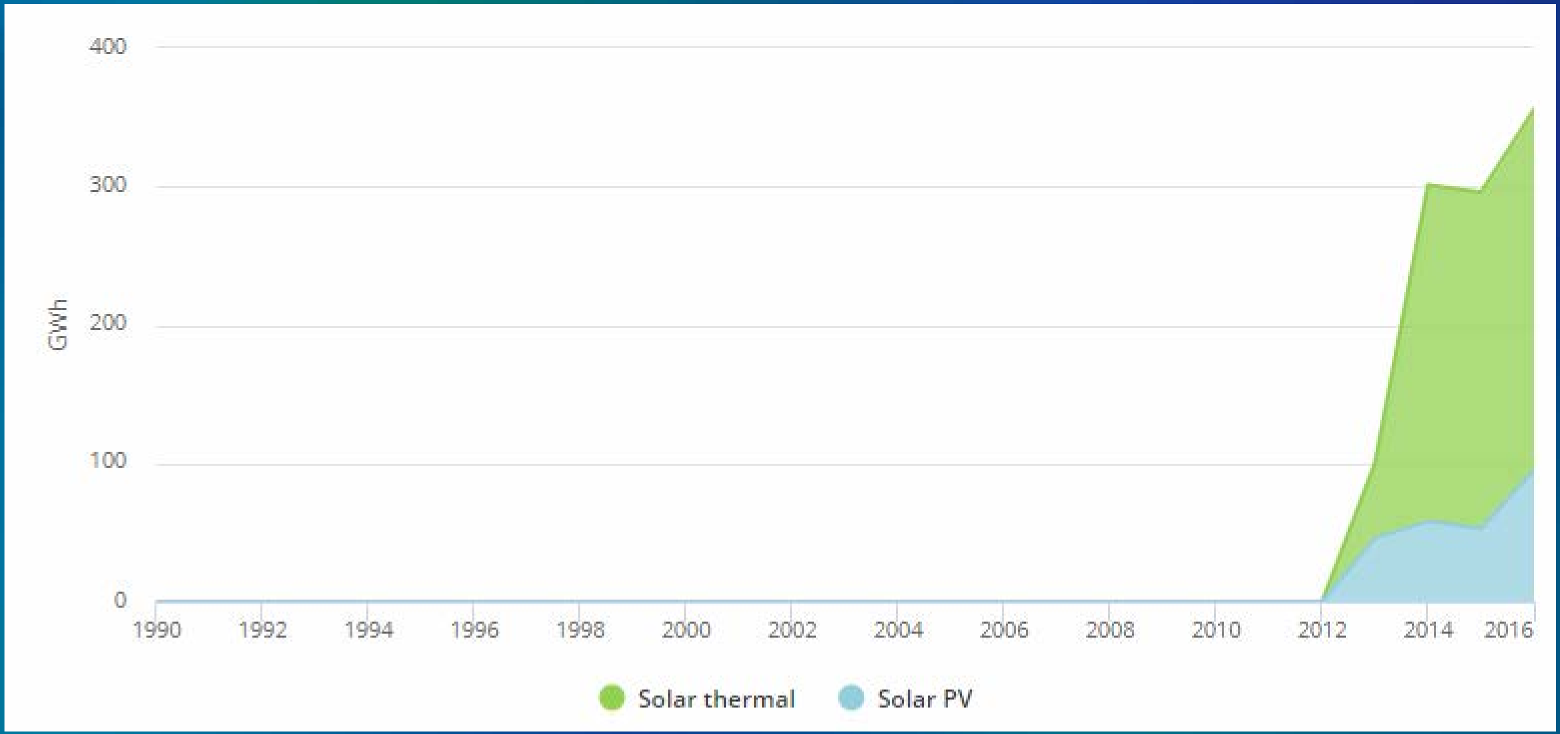
Source: IEA Electricity Information 2018.
https://webstore.iea.org/statistics/.

Energy Generation by Fuel – UAE



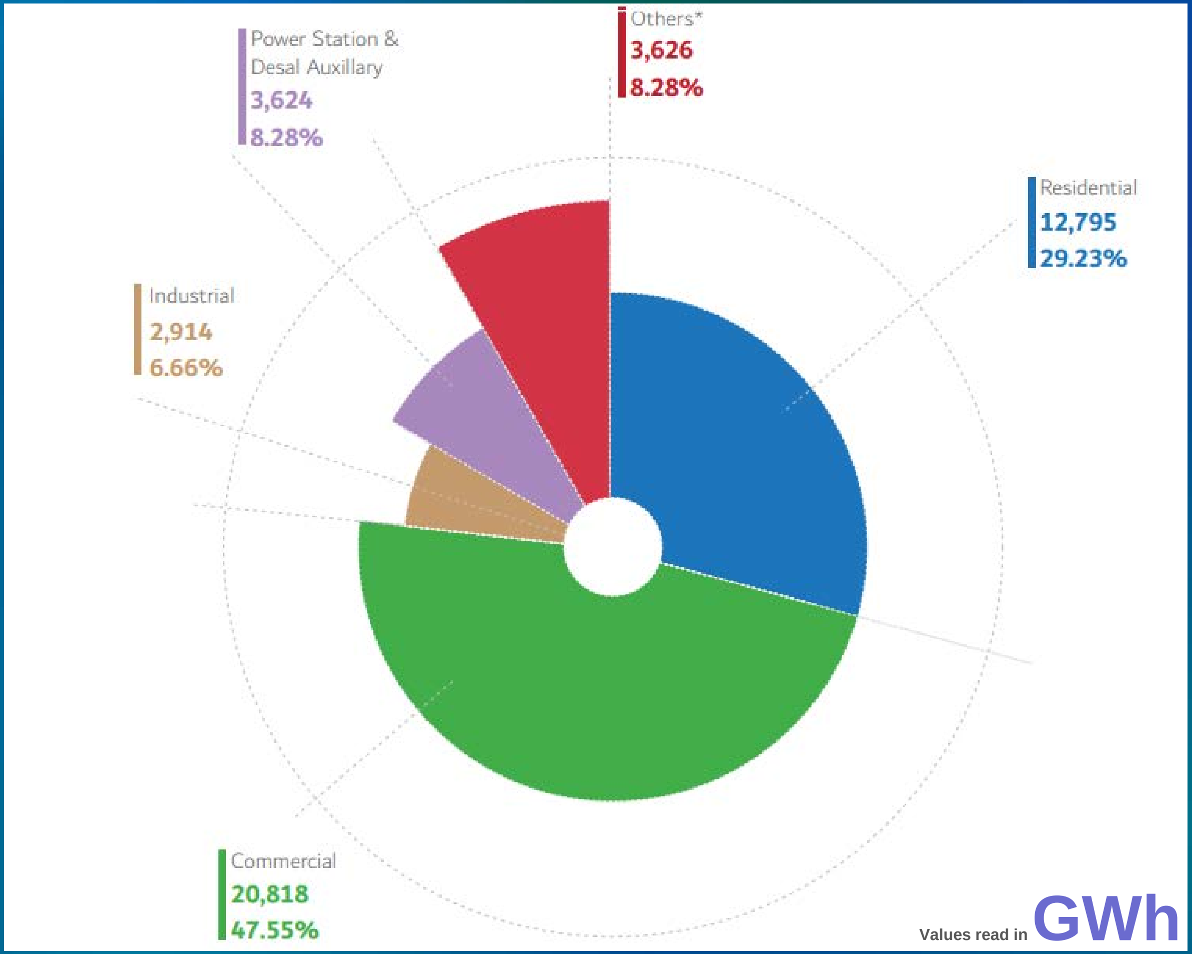
Source: IEA Electricity Information 2018.
https://webstore.iea.org/statistics/.

RE Generation by Source – UAE



Source: IEA Electricity Information 2018.
https://webstore.iea.org/statistics/.

Dubai Electricity Consumption, 2017

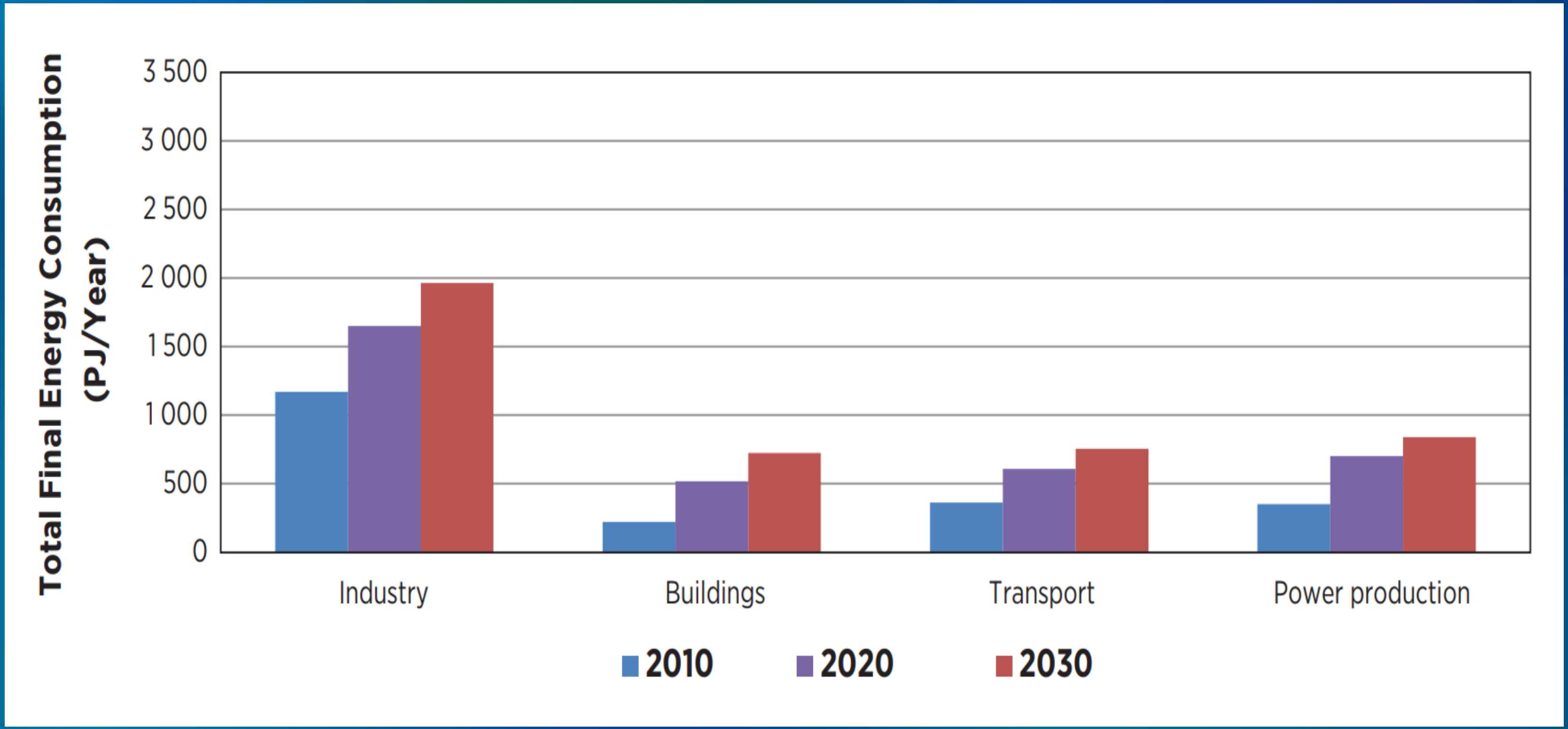


*** Others include:**

Non-commercial buildings such as mosques, police stations, government hospitals, government schools, DEWA offices, etc.

Source: DEWA annual statistics 2017.
https://www.dewa.gov.ae/~/media/Annual statistics 2017 with new cover Eng.ashx.

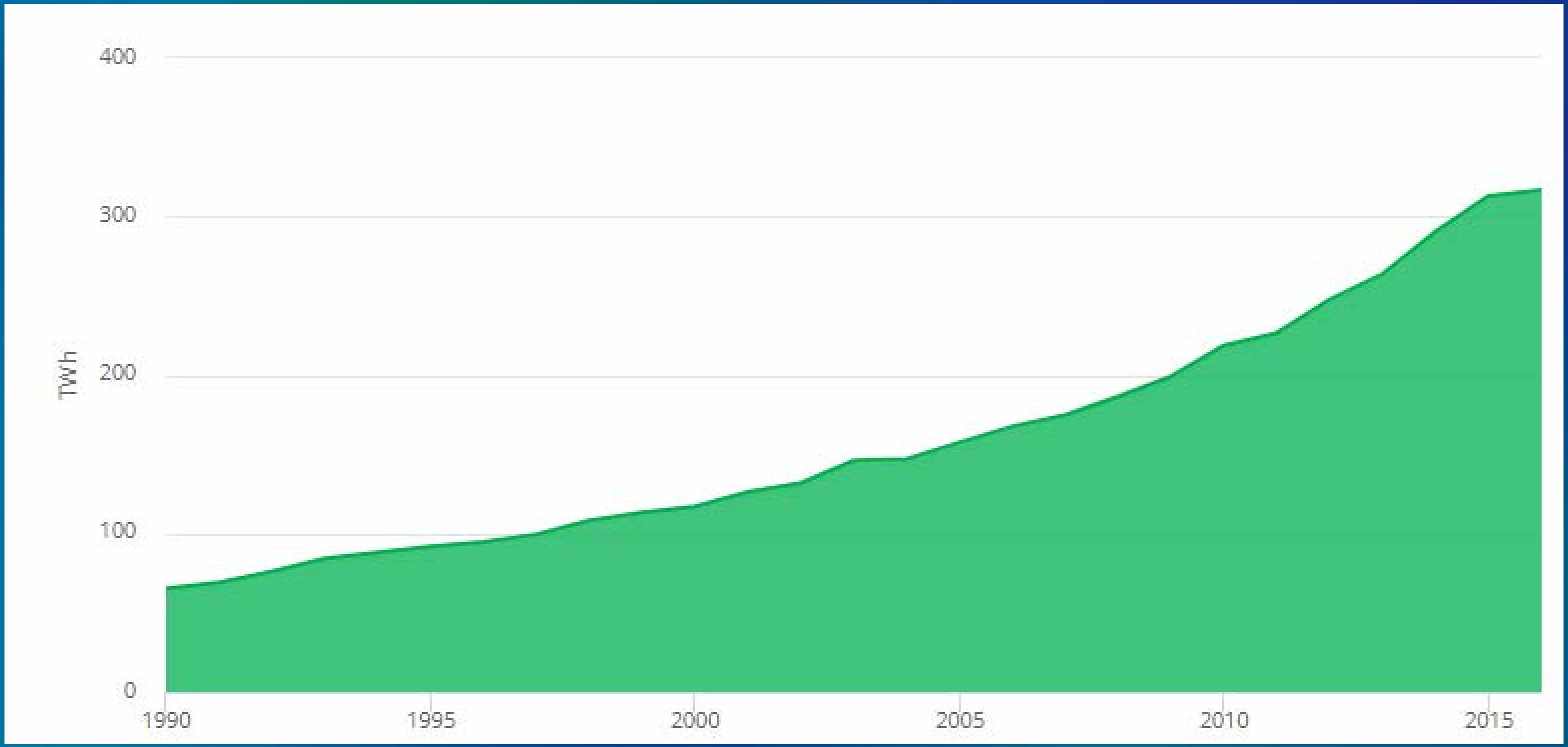
UAE Reference Case, 2010-2030



Peta Joules (PJ) = 10^{15} Joules = 278 gigawatt hours

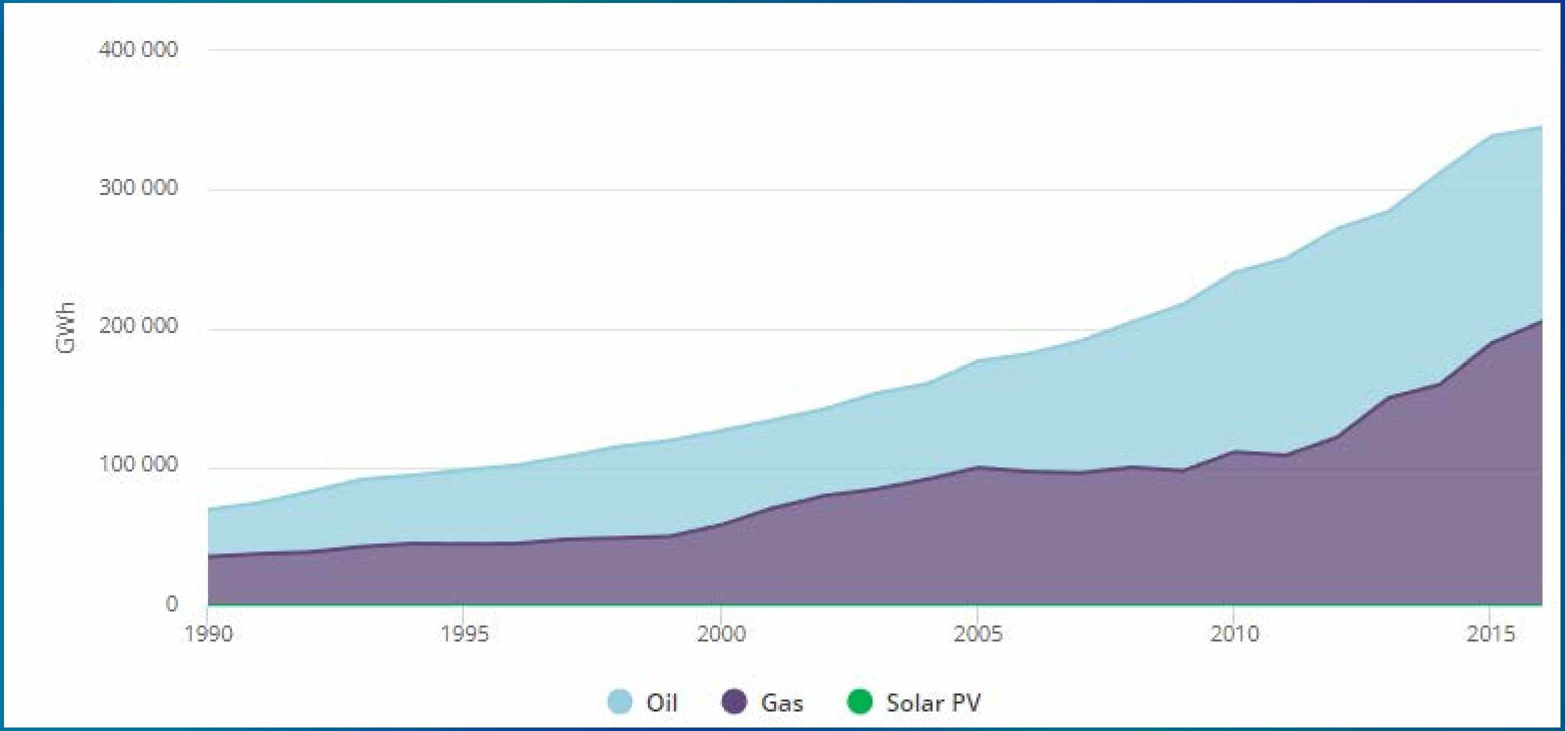
Source: REmap 2030, published April 2015.
https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA_REmap_UAE_report_2015.pdf.

Total Energy Consumption – KSA



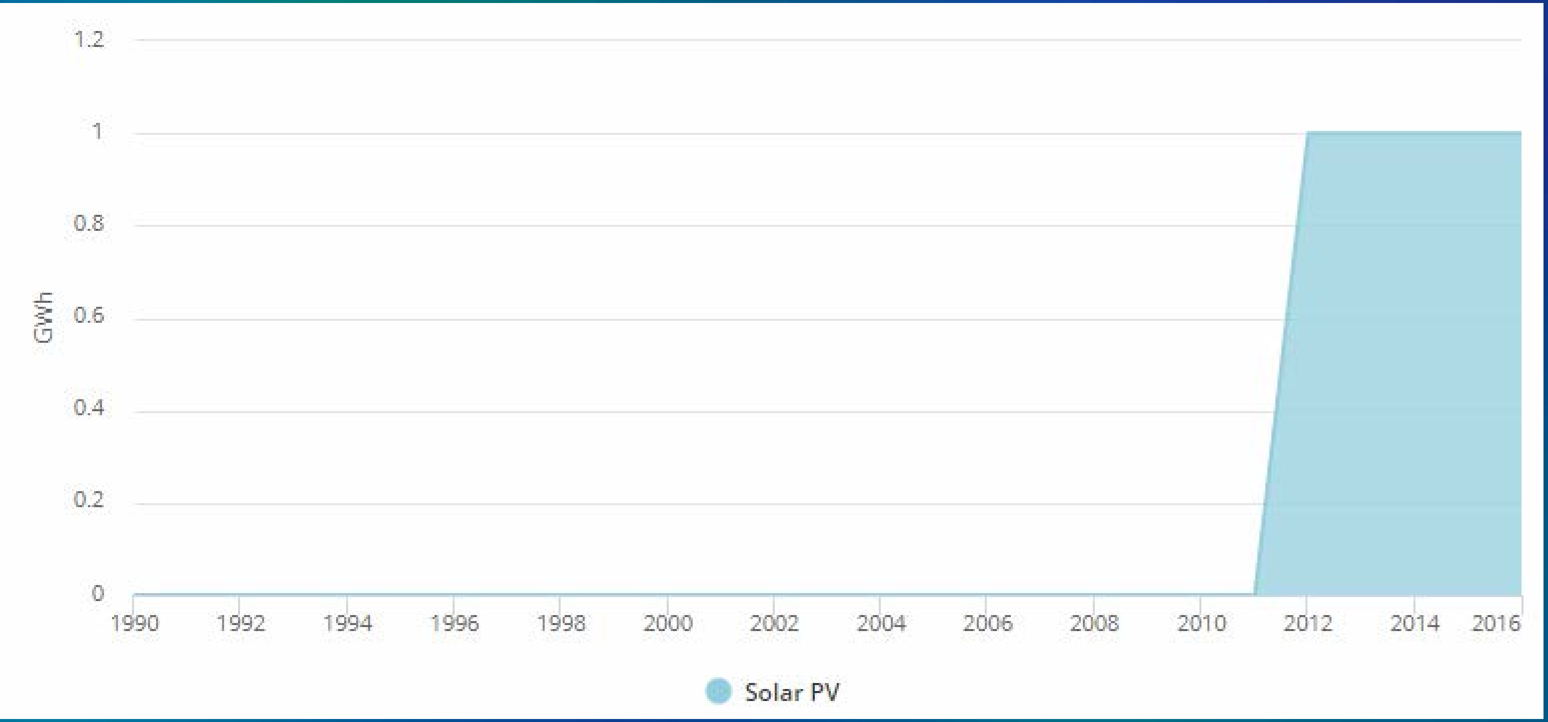
Source: IEA Electricity Information 2018.
https://webstore.iea.org/statistics/.

Energy Generation by Fuel – KSA



Source: IEA Electricity Information 2018.
https://webstore.iea.org/statistics/.

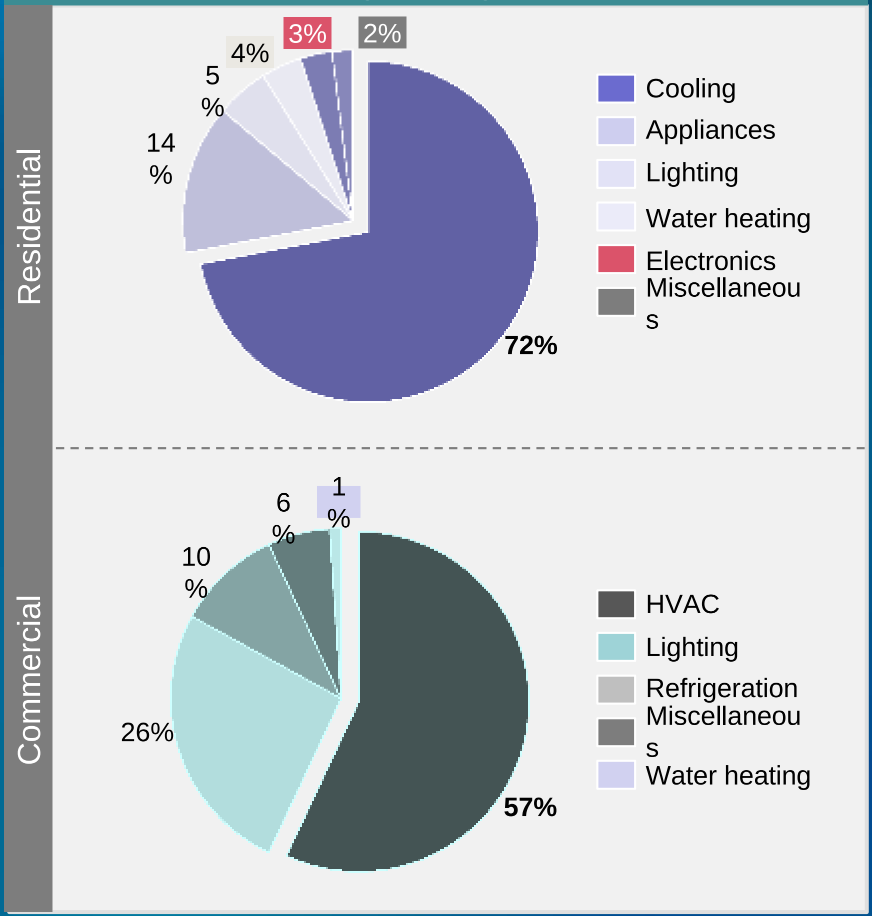
RE Generation by Source – KSA



Source: IEA Electricity Information 2018.
https://webstore.iea.org/statistics/.

Residential Energy Consumption – KSA

1. KSA Final Buildings Energy Consumption, 2011



Key Takeaways

- KSA's residential **cooling sector** is one of the leading electric energy consumers in the nation and can be responsible for up to **60% of the power demand in the summer season**.
- Cooling **energy consumption** is responsible for **72%** and **57%** of the total **residential** and **commercial energy** use in KSA, respectively.
- Energy management in KSA should focus on air conditioning and air-conditioning controls.

KSA's residential air conditioning sector consumes up to 60% of power demand in summer

Energy Management Potential

- Buildings consume almost 40% of U.S. energy
  - Residential (21.0%) + Commercial (18.7%) = 39.7% (U.S.)
- Buildings consume almost 77 % of Dubai's Electricity
- Air conditioning consume almost 60% of total electrical buildings' consumption in the GCC
- 33% reduction of building energy is possible
- Great savings potential on global energy use by reducing buildings' energy consumption

International Goals – COP21/ 23

- Agreement to limit temperature rise to 2°C with target of 1.5°C

- INDC's issued by each country forming strategy for climate change mitigation and adaptation

INDCs: http://unfccc.int/focus/indc_portal/items/8766.php

Government Strategies

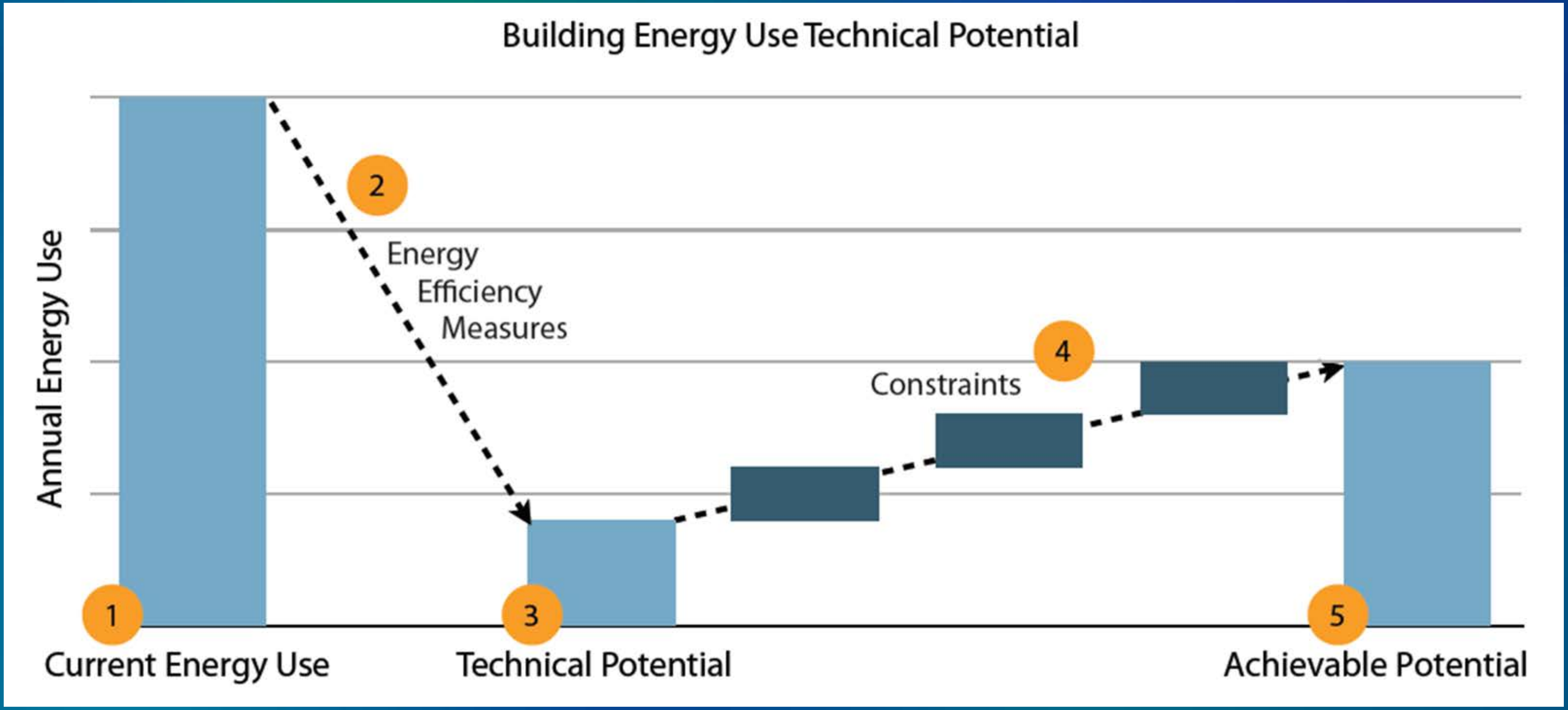
- UAE Clean Energy Strategy
  - To diversify the energy mix by 2050: 44% clean energy, 38% gas, 12% clean coal, and 6% nuclear.
- Dubai Integrated Energy Strategy
  - 30% reduction of the water and energy use by 2030
- Retrofit Strategies
  - Tarsheed Program in Saudi Arabia
  - Dubai Etihad ESCO to retrofit government buildings
  - Abu Dhabi Tarsheed Program for government buildings
  - Barjeel program in Ras Al Khaimah for government buildings

Retrofit Potential – Financial

- Energy Efficiency Investment
  - $385 billion/year
  - $5.8 trillion by 2030
- Intergovernmental panel for Climate Change (2014)
  - Energy efficiency investments and behavioral changes most cost-effective strategy to reduce carbon emissions
- UNEP Finance Investor Briefing (2014)
  - Investment in retrofits bring “better than expected” returns
  - Most effective means to reduce GHG emission while increasing asset value
- UAE
  - 30% energy reduction target in Dubai and Abu Dhabi

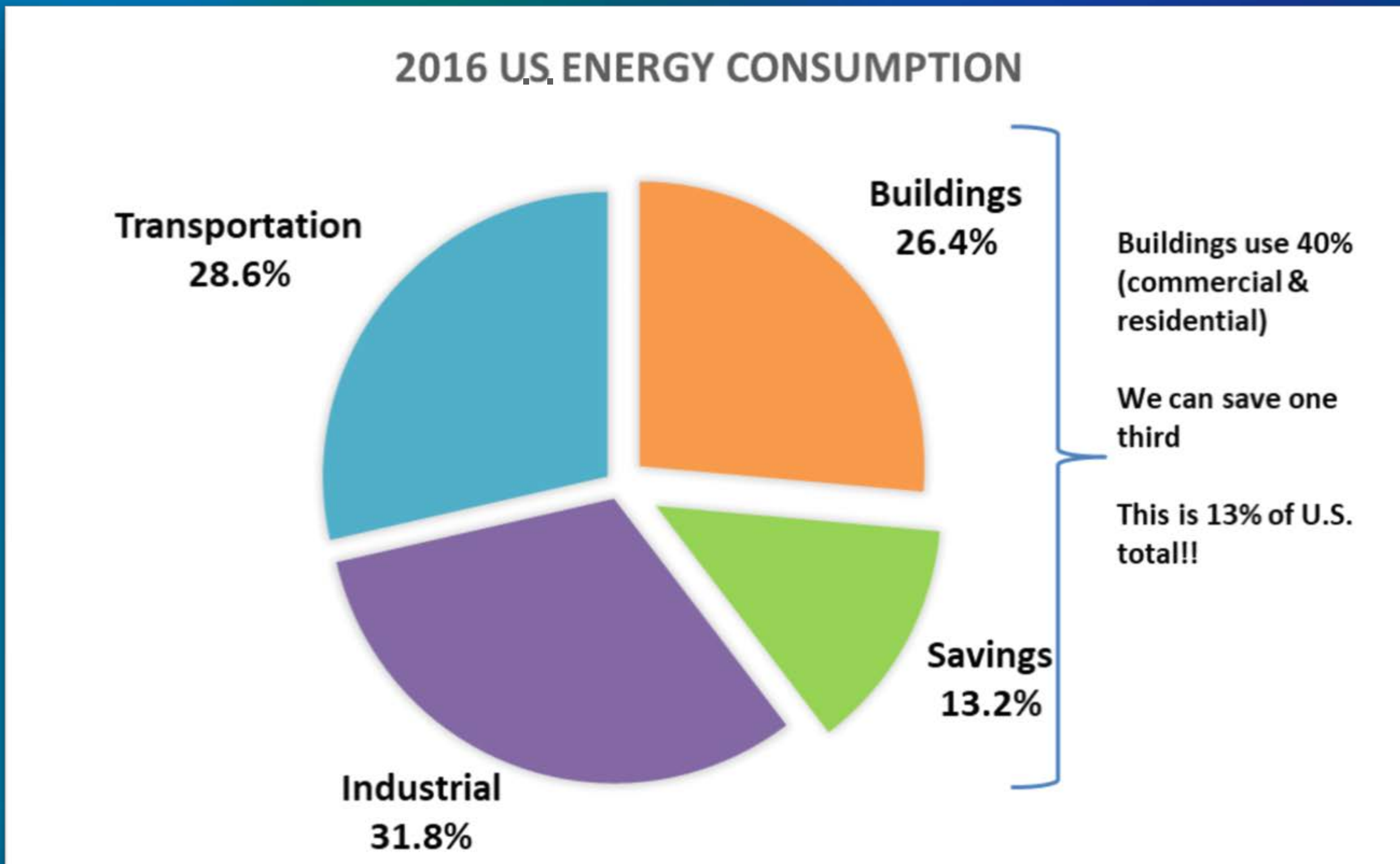
Source: Emirates Green Building Council.

Retrofit Technical Potential



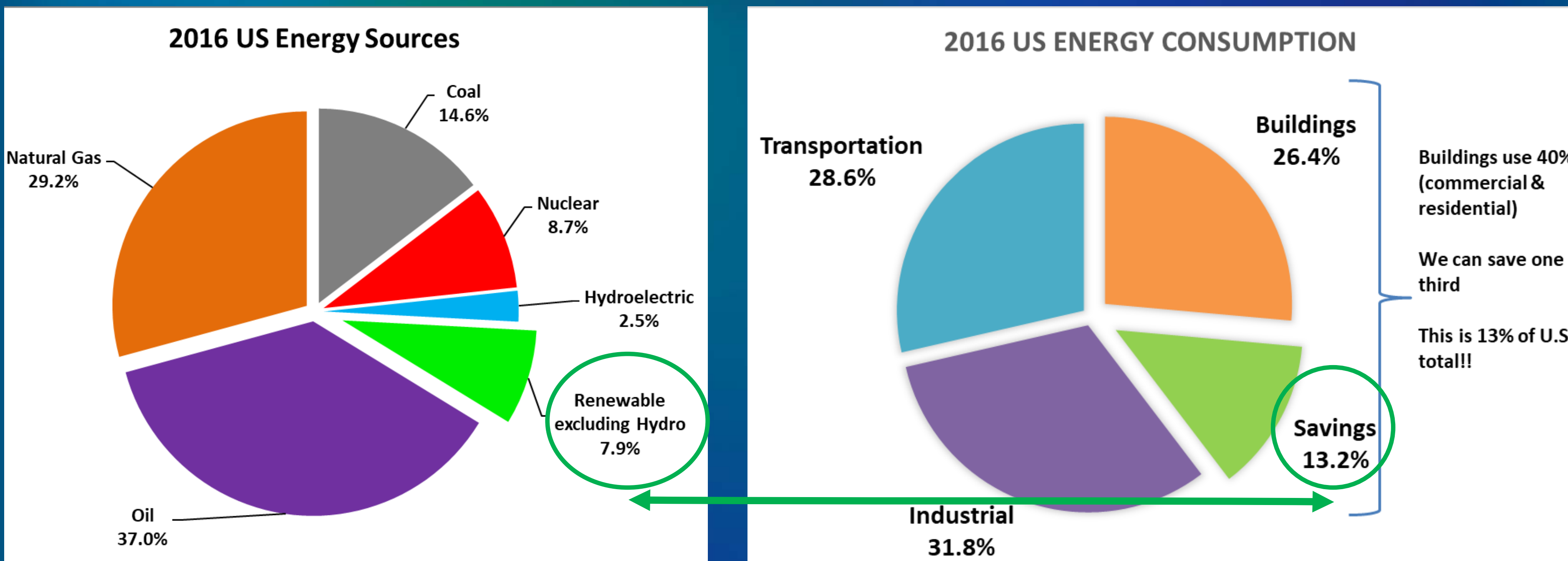
Source: RMI Retrofit Guide; Emirates Green Building Council.

Renewables as an Environmental Solution?



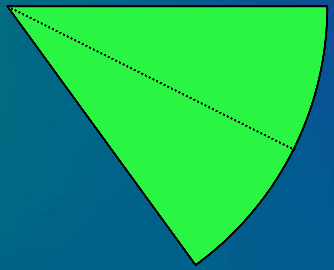
Source: U.S. EIA.

Energy Management is the Quickest, Cheapest, Cleanest Way to Extend World Energy Supplies



Energy management can provide nearly two times the environmental impact of renewable energy!

Where Can You Get the 33%?



- Some from smarter use of what you have right now
- Some from capital upgrades

Greener Pastures with Energy Savings

Emissions Reduction at Madison College

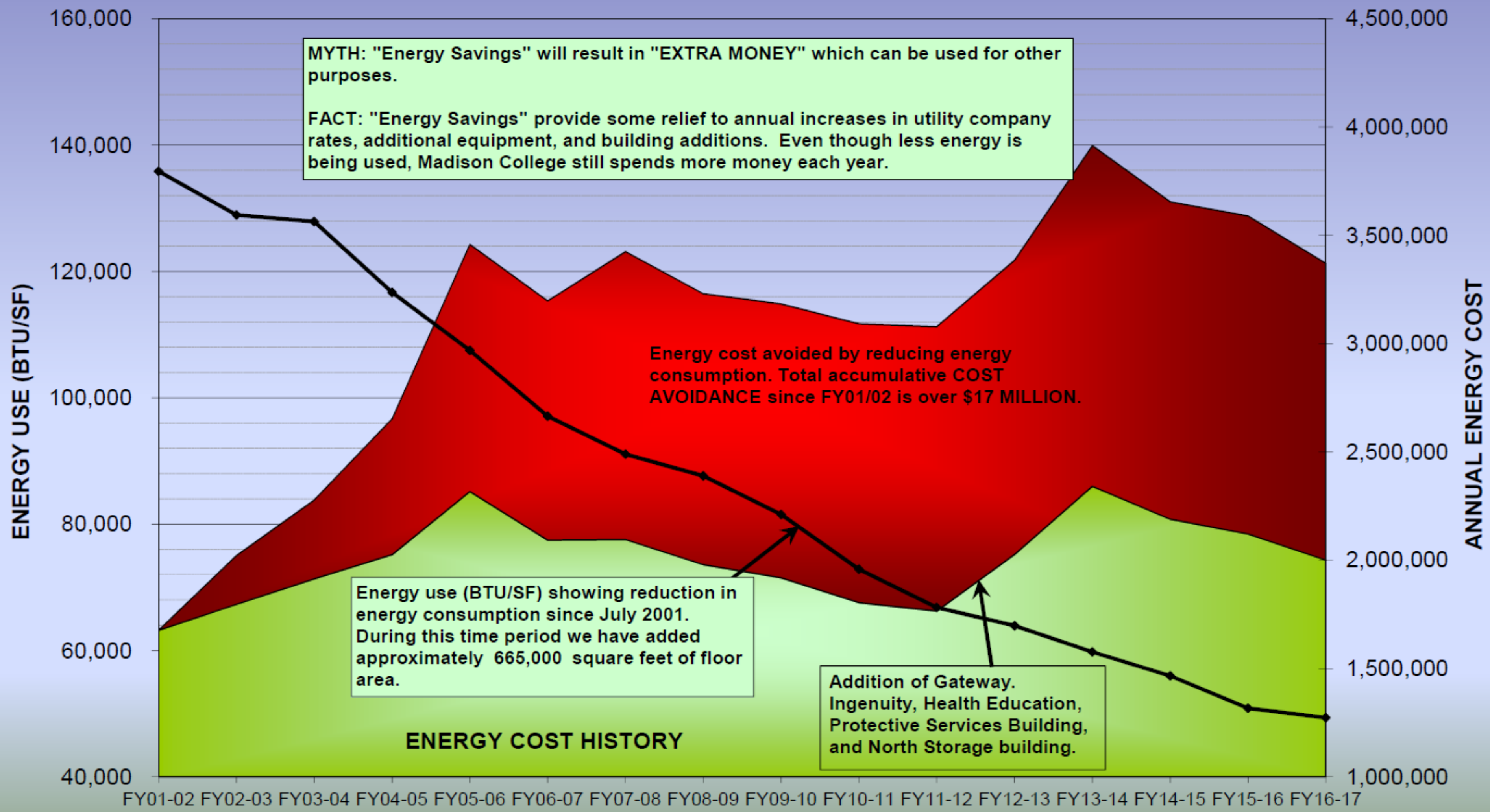
Energy	Usage FY 01/02 111,484 m²	Usage FY16/17 176,515 m²	Annual Reduction!
Electricity	23,000,000 kWh	16,000,000 kWh	7,000,000 kWh
Natural Gas	94,950 GJ	42,200 GJ	52,750 GJ
Emissions	**Emissions FY 01/02**	**Emissions FY 16/17**	**Annual Reduction!**
CO_2	25,000 tons	15,000 tons	10,000 tons

The above energy savings were achieved with an <u>additional 65,030 m²</u> conditioned space!

Source: Madison College Engineering Manager. Wesley Marquardt.
wmarquardt@madisoncollege.edu.

Greener Pastures with Energy Savings

Energy Cost Avoidance at Madison College



New Buildings Are a Target Too!

New buildings are often inefficient at start-up (even LEED-certified buildings).

New building performance significantly deteriorates in the first three years of operation, by as much as 30% (even those designed as energy-efficient green buildings).

General Services Administration Energy Management Program

U.S. Courthouse

Jacksonville, Florida

- Constructed in early 2000s
- Disappointing energy use

DOE-ORNL Report

2000s New Building Performance

Far less efficient than design intent

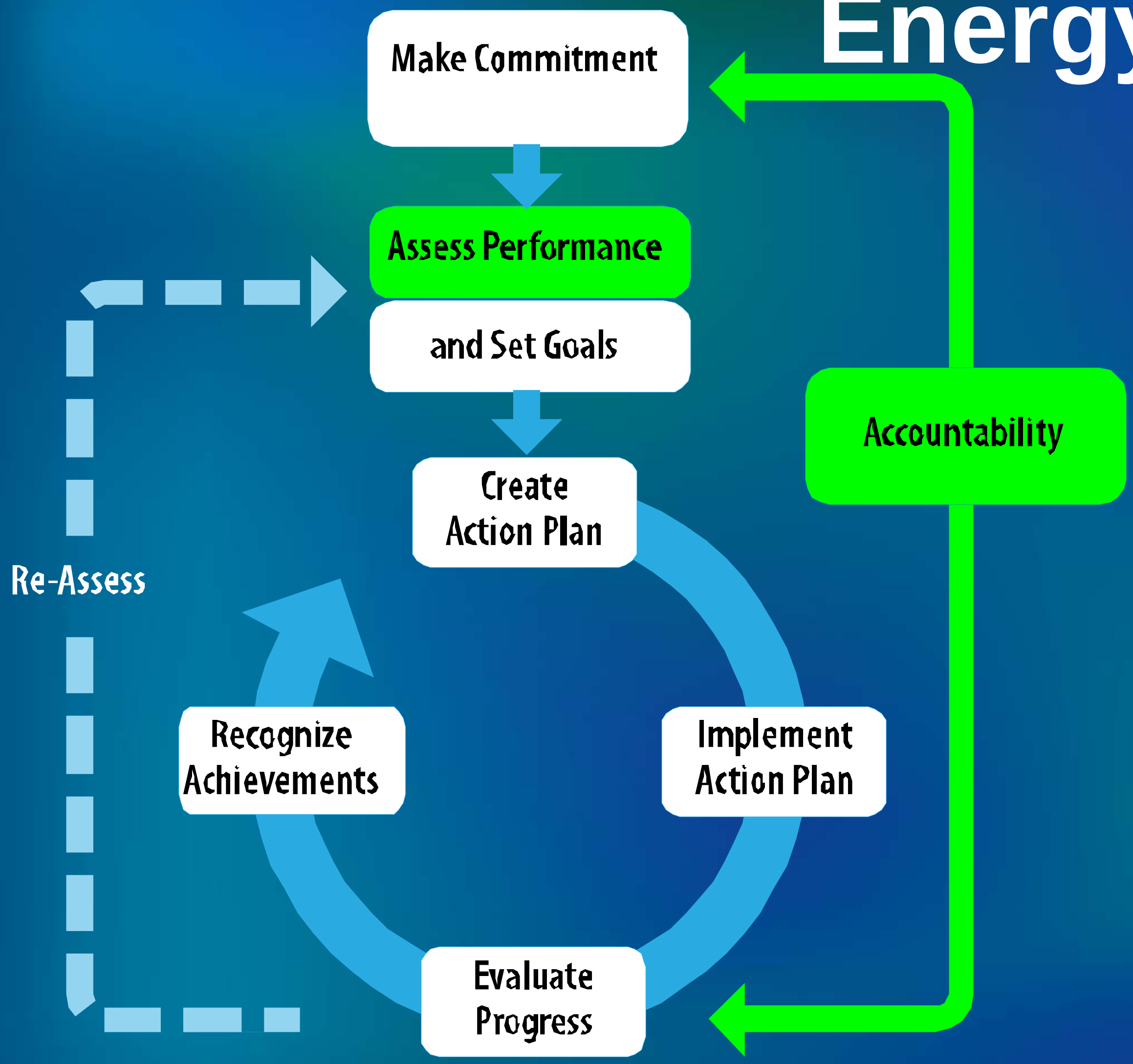
	Actual	Target
Floor Area ft² (m²)	492,000 (45,710)	492,000 (45,710)
EUI (kBtu/ft²/year)	81	52
Energy Star Rating	41	75
Cost ($k/year)	632	407
EUI (kWh/m²/year)	255	164

We'll come back to this example after we've defined a few terms…

Assessing Performance

ENERGY STAR Guidelines for Energy Management

www.energystar.gov



ENERGY STAR Advice: Assess Performance

Assessing performance is the periodic process of evaluating energy use and establishing a baseline.

- **Data collection and management**
- **Baselining and benchmarking**
- **Analysis and evaluation**

What About Energy Audits?

- ENERGY STAR: audits in the analysis *and*
- We recommend other work FIRST!
- Stay tuned: audits defined and discussed later…

ANSI/ASHRAE/IESNA Standard 100-2018

NEW!

STANDARD

ANSI/ASHRAE/IES Standard 100-2018
(Supersedes ANSI/ASHRAE/IES Standard 100-2015)
Includes ANSI/ASHRAE/IES addenda listed in Annex N

Energy Efficiency in Existing Buildings

See Annex N for approval dates.

This Standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the Standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE website (www.ashrae.org) or in paper form from the Senior Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

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ANSI/ASHRAE/IESNA Standard 100-2018
Energy Efficiency in Existing Buildings

- Excerpts from Table of Contents:

ASHRAE Standard 100-2018, *Energy Efficiency in Existing Buildings*

- Energy Targets

Table 7-2a Building Activity Site Energy Targets (EUI_{t1}) (I-P Units)

		EUIs by Building Type by Climate Zone (kBtu/ft^2·yr)																
		ASHRAE Climate Zone																
No.	Commercial Building Type	1A	2A	2B	3A	3B Coast	3B Other	3C	4A	4B	4C	5A	5B	5C[a]	6A	6B	7	8
1	Admin/professional office	39	40	39	42	33	39	33	46	40	40	48	42	39	54	47	58	81
33	Hospital/inpatient health	142	143	140	141	134	138	130	143	129	135	139	126	135	142	130	144	166
34	Nursing home/assisted living	84	83	81	83	69	78	75	91	82	84	99	88	85	109	100	118	156
35	Dormitory/fraternity/sorority	40	43	42	47	31	43	40	58	48	54	65	55	52	75	66	85	119

Excerpts from Table 7-2a

- Target values derived from CBECS 2003 and represent the 25th lowest percentile of energy use by each building category.

ASHRAE Standard 100-2018, *Energy Efficiency in Existing Buildings*

- Energy Targets

TABLE 7-2 Building Activity Energy Targets (EUI_{t1}) (SI Units)[1]

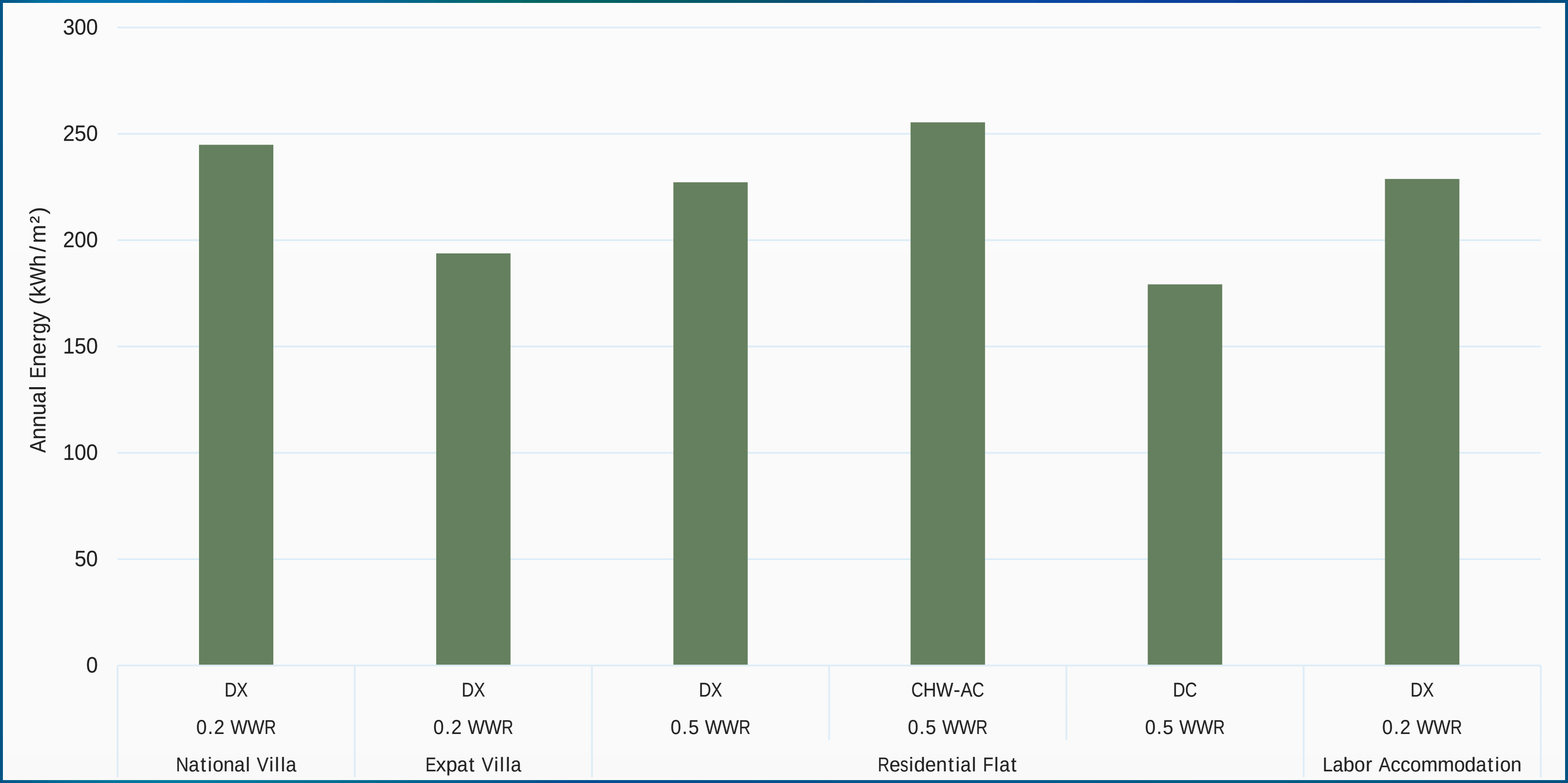
No.	Commercial Building Type	EUIs by Building Type by Climate Zone ($MJ/m^2 \cdot yr$)																
		ASHRAE Climate Zone																
		1A	2A	2B	3A	3B Coast	3B Other	3C	4A	4B	4C	5A	5B	5C[2]	6A	6B	7	8
1	Admin/professional office	443	456	446	472	372	440	379	518	449	458	547	475	446	608	536	657	921
33	Hospital/inpatient health	1610	1624	1591	1602	1518	1570	1481	1628	1462	1533	1578	1435	1529	1615	1482	1631	1882
34	Nursing home/assisted living	955	944	915	938	787	884	852	1038	929	958	1120	1002	970	1243	1132	1335	1774
35	Dormitory/fraternity/sorority	457	483	480	538	357	493	456	656	549	613	744	626	586	852	753	968	1352

Excerpts from Table 7-2

- Target values derived from CBECS 2003 and represent the 25th lowest percentile of energy use by each building category.

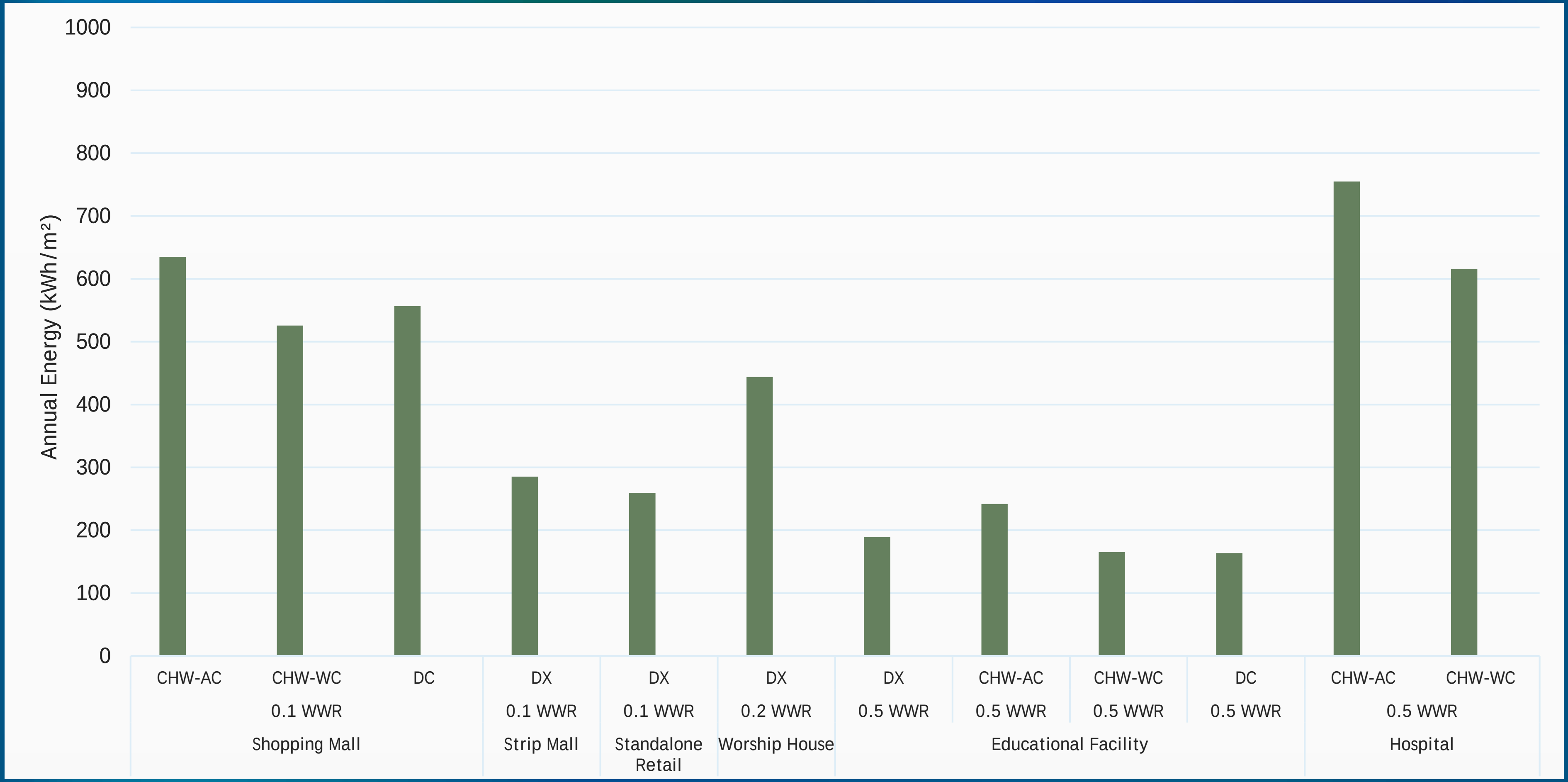
Summary of EUIs – UAE

(Residence type building typologies)



Source: Griffin Consultants.

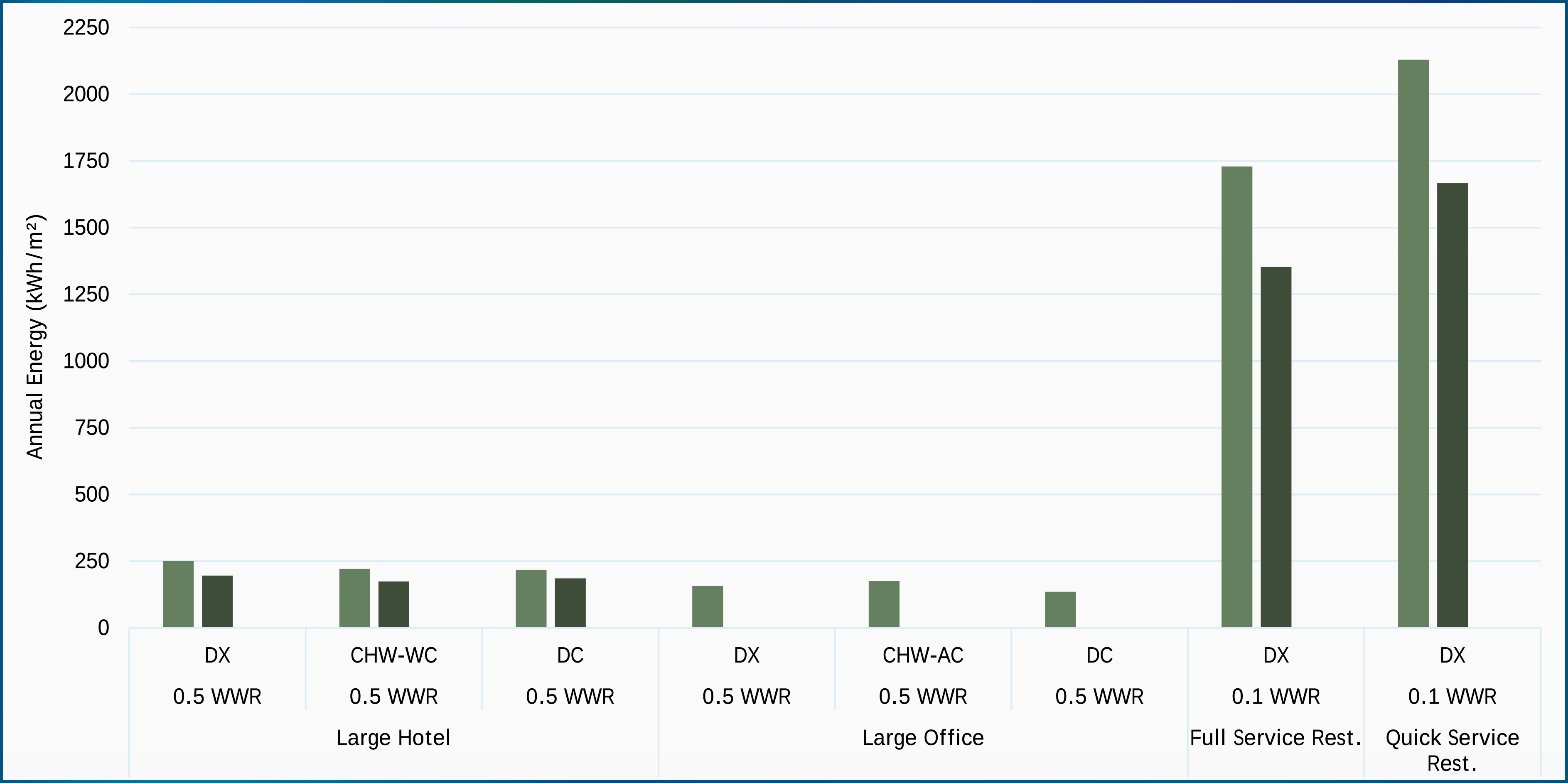
Summary of EUIs – UAE
(DM public building typologies)



Source: Griffin Consultants.

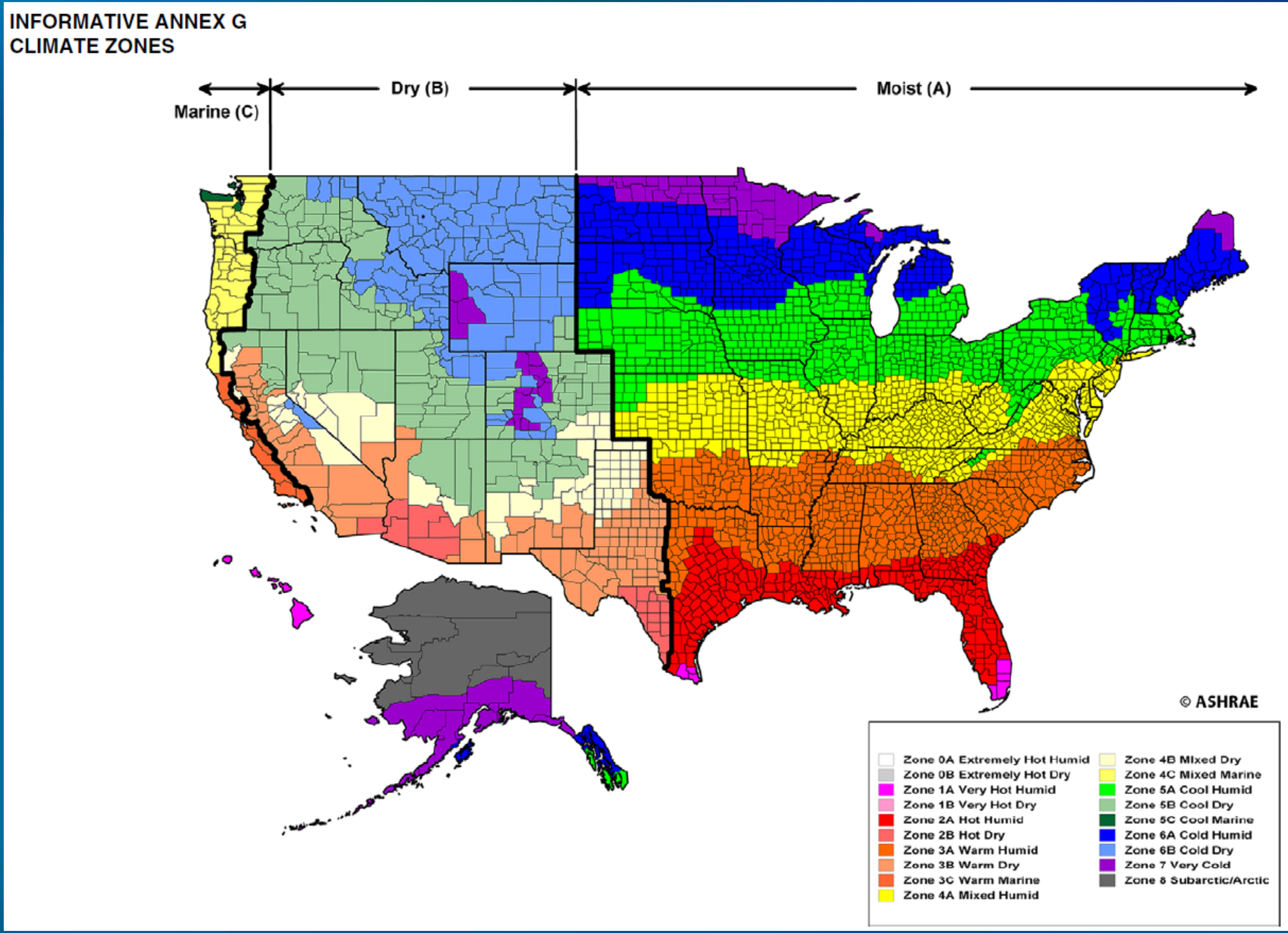
Summary of EUIs – UAE

(DM commercial building typologies)



Source: Griffin Consultants.

ASHRAE Standard 100-2018: Climate Zones Map



ASHRAE Standard 100-2018, *Energy Efficiency in Existing Buildings*

- Operating Shifts

TABLE 7-3 Building Operating Shifts Normalization Factor

No.	Building Activity/Type	Weekly Hours		
		50 or less	51 to 167	168
1	Admin/professional office	1.0	1.0	1.4
2	Bank/other financial	1.0	1.0	1.4
3	Government office	1.0	1.0	1.4
4	Medical office (nondiagnostic)	1.0	1.0	1.4
5	Mixed-use office	1.0	1.0	1.4

Excerpts from Table 7-3

Assess Performance:
Year, Month, and Daily Data

- Annual usage
  – Energy cost index (ECI)
  – Energy utilization index (EUI)
- Annual profile of monthly data
- Daily profile of 15-minute data

Indices

ECI: Energy Cost Index = $/m²/yr

EUI: Energy Utilization Index = kWh/m²/yr

(Annual kWh) = _____kWh

+ (Annual Therms × 29.3) = _____kWh

Total Annual Energy = _____kWh

EUI = Total Annual Energy ÷ m² = kWh/m²/yr

Example: Lowell Hall @ UW

(1,209,319 kWh) = 1,209,319 kWh

+ (83,642 Therms × 29.3) = 2,451,175 kWh

Total Annual Energy = 3,660,494 kWh

EUI = 3,660,494 kWh ÷ 10,925 m² = 335 kWh/m²/yr

Indices

ECI: Energy Cost Index = $/SF/yr

EUI: Energy Utilization Index = kBtu/SF/yr

(Annual kWh × 3.413) =_____kBtu

\+ (Annual Therms × 100) =_____kBtu

Total Annual Energy =_____kBtu

EUI = Total Annual Energy ÷ SF = kBtu/SF/yr

Example: Lowell Hall @ UW

(1,209,319 kWh × 3.413) = 4,127,000 kBtu

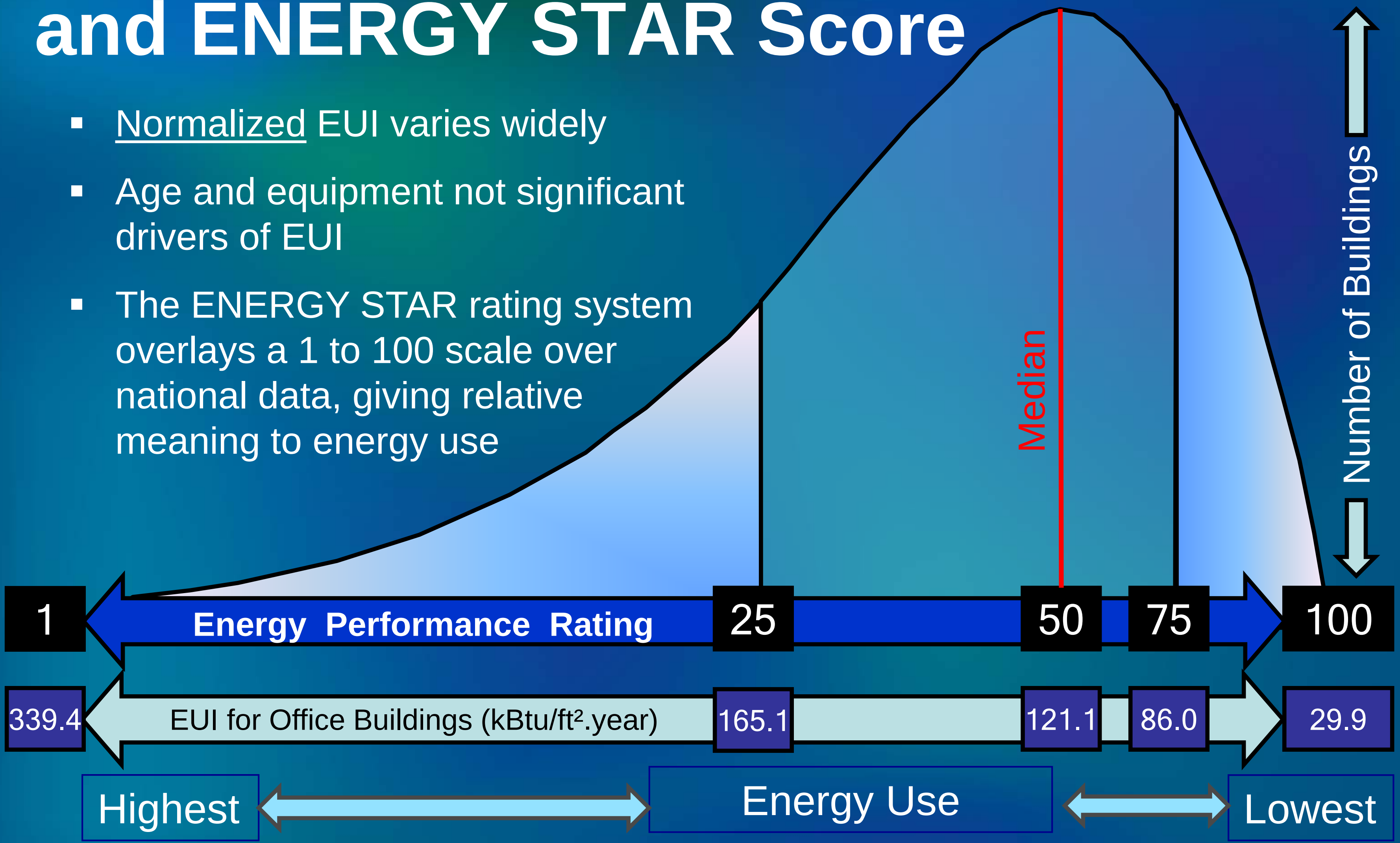
\+ (83,642 Therms × 100) = 8,364,200 kBtu *(2,451,305 kWh)*

Total Annual Energy = 12,491,200 kBtu *(3,660,810 kWh)*

EUI = 12,491,200 kBtu ÷ 117,600 SF = 106.2 kBtu/SF/yr *(334.9 kWh/m²/yr)*

Energy Intensity of Office Buildings and ENERGY STAR Score

- Normalized EUI varies widely
- Age and equipment not significant drivers of EUI
- The ENERGY STAR rating system overlays a 1 to 100 scale over national data, giving relative meaning to energy use



Energy Intensity of Office Buildings and ENERGY STAR Score

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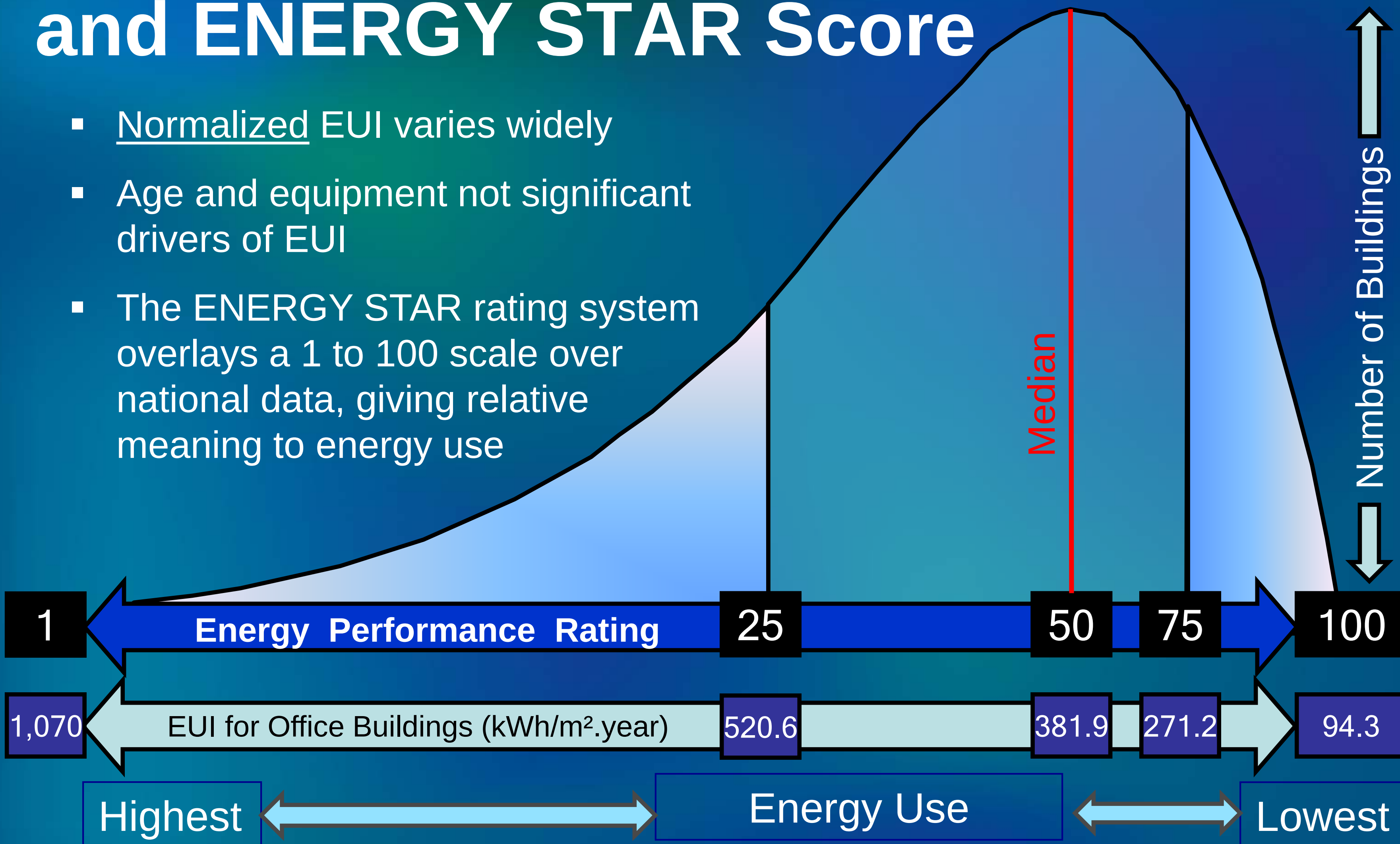


Exercise 2:
EUI and ECI Questions

Page 6
in the
exercises

BREAK!

Benchmarking Using ENERGY STAR's Portfolio Manager

www.energystar.gov/benchmark

https://www.energystar.gov/buildings/training/slide_library

ENERGY STAR Score Eligible Building Types


Bank Branches


Barracks


Courthouses


Data Centers


Distribution Center


Financial Offices


Hospitals


Hotels


K-12 Schools


Medical Offices


Multifamily Housing


Non-refrigerated Warehouses


Office Buildings


Refrigerated Warehouses


Residence Hall


Retail Stores


Senior Care Community


Supermarkets


Wastewater Treatment Plants


Wholesale Club/ Supercenter


Worship Facilities

Obtaining an Energy Performance Rating

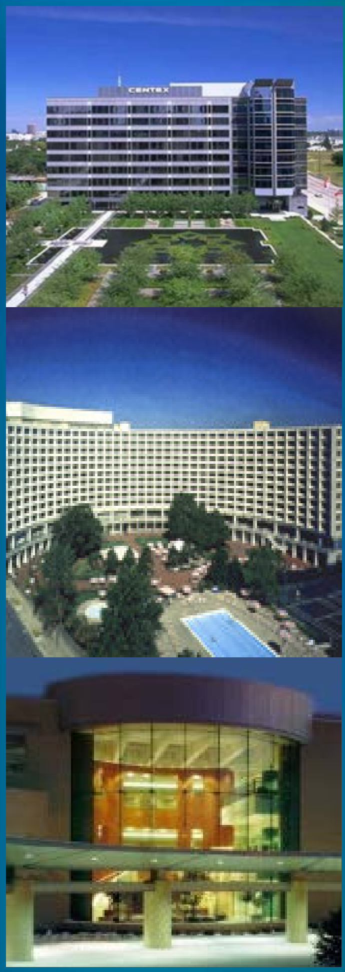
- ENERGY STAR **Portfolio Manager**—Existing Commercial Buildings

  www.energystar.gov/benchmark.

- ENERGY STAR **Target Finder**—Commercial New Construction Projects

  www.energystar.gov/targetfinder.

Why Benchmark? ENERGY STAR Says:



- Heighten awareness of energy use
- Assess effectiveness of current operations, policies, practices
- Set priorities for upgrade efforts and retrofits
- Track, verify, and recognize achievements
- Document role in environmental stewardship and demonstrate success

Benchmarking with Portfolio Manager

- Compare buildings against similar buildings nationwide and against other buildings in your portfolio
- Receive an ENERGY STAR score normalized for weather
- Identify opportunities and set priorities for upgrade investments
- Track and manage:
  - Energy consumption and costs over time
  - Direct, indirect, and total greenhouse gas emissions
- Gain recognition from EPA for success!

Getting Started with ENERGY STAR Benchmarking

www.energystar.gov/benchmark

ENERGY STAR® PortfolioManager® "How To" Series

Portfolio Manager® Quick Start Guide

EPA's ENERGY STAR Portfolio Manager tool helps you measure and track energy use, water use, 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/benchmark. 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, 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.

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 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**.

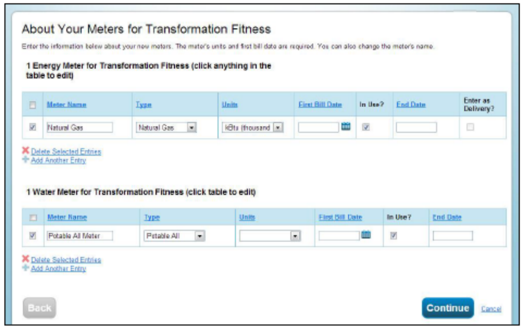
Property Types

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.

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, simply include it in the square footage of the building's primary use. You do not need to add another type of use.

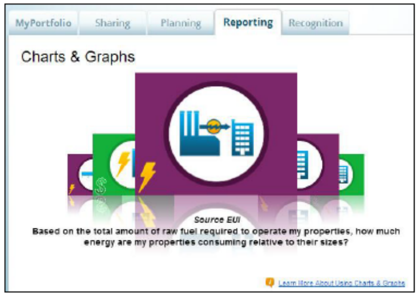
2 Enter Energy & Water Data



To receive an accurate picture of your building's performance, you need to tell Portfolio Manager how much and what kind of energy and water your building consumes. Follow these steps to enter energy and water data for your property.

1. Click on your property from the **MyPortfolio** tab and then select the **Meters** tab.
2. Click **Add Another Meter**.
3. Select the sources of your property's energy and your property's water usage, identify the number of meters, and then click **Get Started!**
4. Click on a meter to enter units and first bill date. If it is a bulk fuel purchase, select the **Enter as Delivery?** checkbox. Then click **Continue**.
5. Click the gray 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.
6. Click **Finish Meter Set Up** when you have finished entering information for each meter.
7. Select the boxes of the meters that total your property's energy and water use on the **Meters to Add to Total Consumption** 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/benchmark.
To get answers to your questions, visit www.energystar.gov/buildingshelp.

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2. Enter use details for the property and then click **Save Use**.

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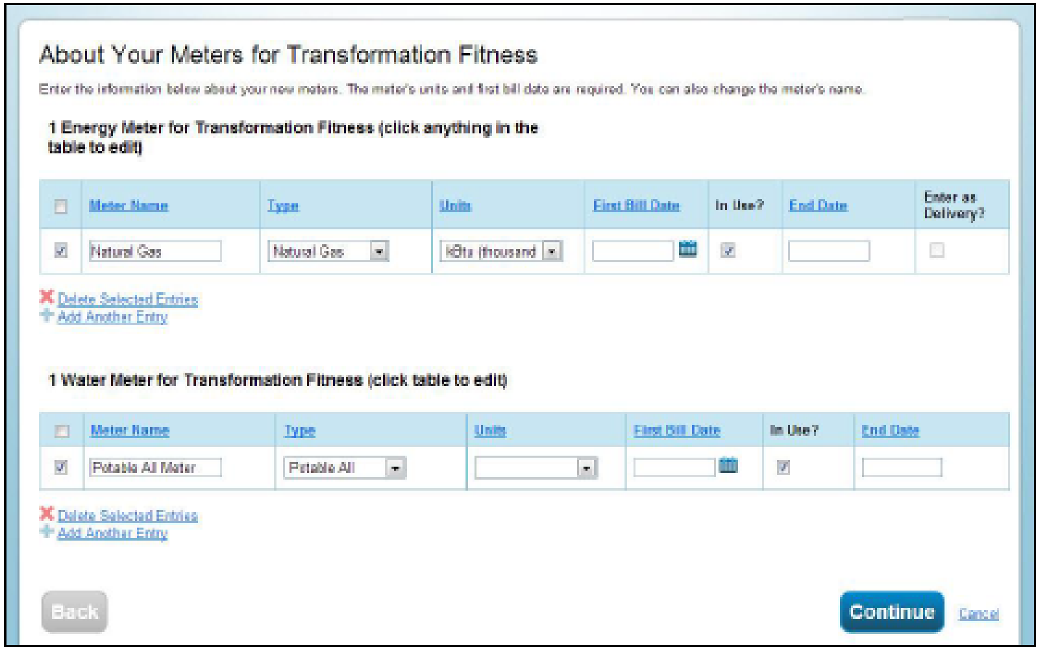
To receive an accurate picture of your building's performance, you need to tell Portfolio Manager how much and what kind of energy and water your building consumes. Follow these steps to enter energy and water data for your property.



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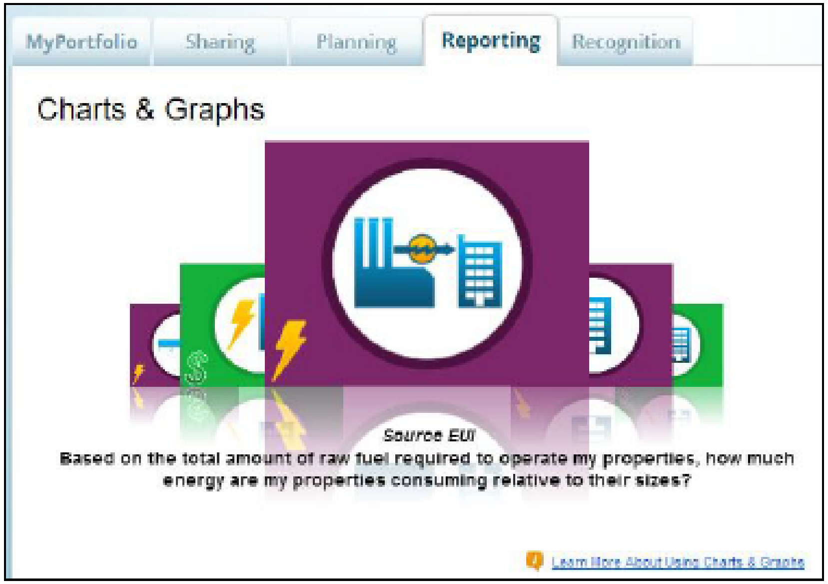
3 View Results & Progress



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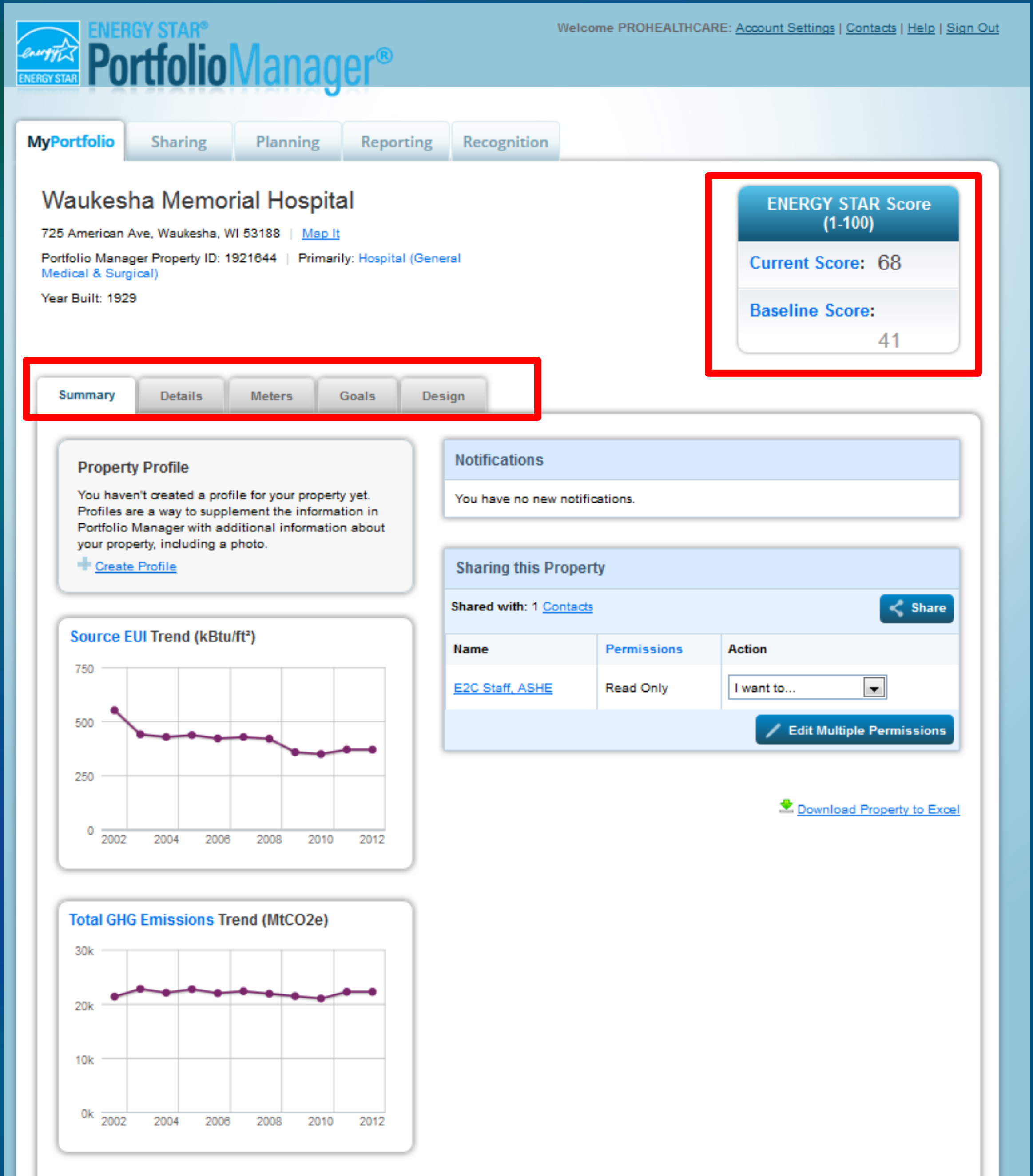
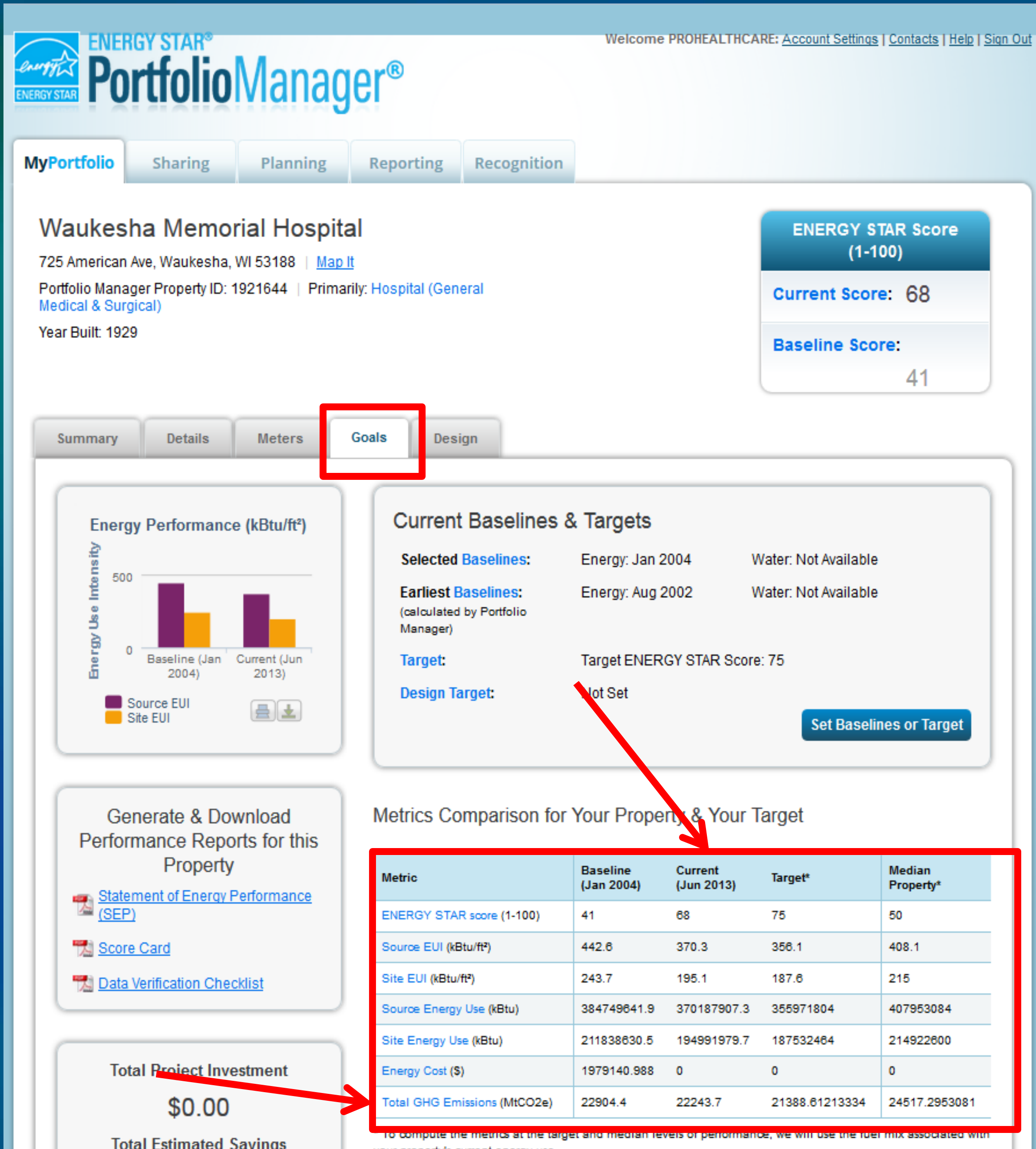
Track Facility Energy Performance



Greenhouse Gas Emissions



Metric	Baseline (Jan 2004)	Current (Jun 2013)	Target*	Median Property*
ENERGY STAR score (1-100)	41	68	75	50
Source EUI (kBtu/ft²)	442.6	370.3	356.1	408.1
Site EUI (kBtu/ft²)	243.7	195.1	187.6	215
Source Energy Use (kBtu)	384749641.9	370187907.3	355971804	407953084
Site Energy Use (kBtu)	211838630.5	194991979.7	187532464	214922600
Energy Cost ($)	1979140.988	0	0	0
Total GHG Emissions (MtCO2e)	22904.4	22243.7	21388.61213334	24517.2953081

To compute the metrics at the target and median levels of performance, we will use the fuel mix associated with your property's current energy use.

Portfolio Manager Metrics Comparison

Metrics Comparison for Your Property & Your Target

Metric	Baseline (Jan 2004)	Current (Jun 2013)	Target*	Median Property*
ENERGY STAR score (1-100)	41	68	75	50
Source EUI (kBtu/ft²)	442.6	370.3	356.1	408.1
Site EUI (kBtu/ft²)	243.7	195.1	187.6	215
Source Energy Use (kBtu)	384749641.9	370187907.3	355971804	407953084
Site Energy Use (kBtu)	211838630.5	194991979.7	187532464	214922600
Energy Cost ($)	1979140.988	0	0	0
Total GHG Emissions (MtCO2e)	22904.4	22243.7	21388.61213334	24517.2953081

* To compute the metrics at the target and median levels of performance, we will use the fuel mix associated with your property's current energy use.

Statement of Energy Performance

2013

ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

68

ENERGY STAR® Score[1]

Waukesha Memorial Hospital

Primary Property Function: Hospital (General Medical & Surgical)
Gross Floor Area (ft²): 999,640
Built: 1929

For Year Ending: June 30, 2013
Date Generated: December 16, 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
Waukesha Memorial Hospital 725 American Ave Waukesha, Wisconsin 53188		

Property ID: 1921644

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
195.1 kBtu/ft²

Annual Energy by Fuel

Natural Gas (kBtu)	115,459,202 (59%)
Fuel Oil (No. 2) (kBtu)	364,872 (0%)
Electric - Grid (kBtu)	79,167,906 (41%)

Source EUI
370.3 kBtu/ft²

National Median Comparison

National Median Site EUI (kBtu/ft²)	215
National Median Source EUI (kBtu/ft²)	408.1
% Diff from National Median Source EUI	-9%

Annual Emissions

Greenhouse Gas Emissions (MtCO2e/year)	22,244

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

Professional Engineer Stamp (if applicable)

2018

ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

80

ENERGY STAR® Score[1]

Waukesha Memorial

Primary Property Type: Hospital (General Medical & Surgical)
Gross Floor Area (ft²): 934,671
Built: 1914

For Year Ending: June 30, 2018
Date Generated: September 27, 2018

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
Waukesha Memorial 725 American Ave Waukesha, Wisconsin 53188		

Property ID: 4331251

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
188.1 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	64,742,341 (37%)
Natural Gas (kBtu)	111,114,016 (63%)

Source EUI
318.8 kBtu/ft²

National Median Comparison

National Median Site EUI (kBtu/ft²)	220.3
National Median Source EUI (kBtu/ft²)	373.3
% Diff from National Median Source EUI	-15%

Annual Emissions

Greenhouse Gas Emissions (Metric Tons CO2e/year)	16,673

Signature & Stamp of Verifying Professional

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

Signature: ____________________ Date: __________

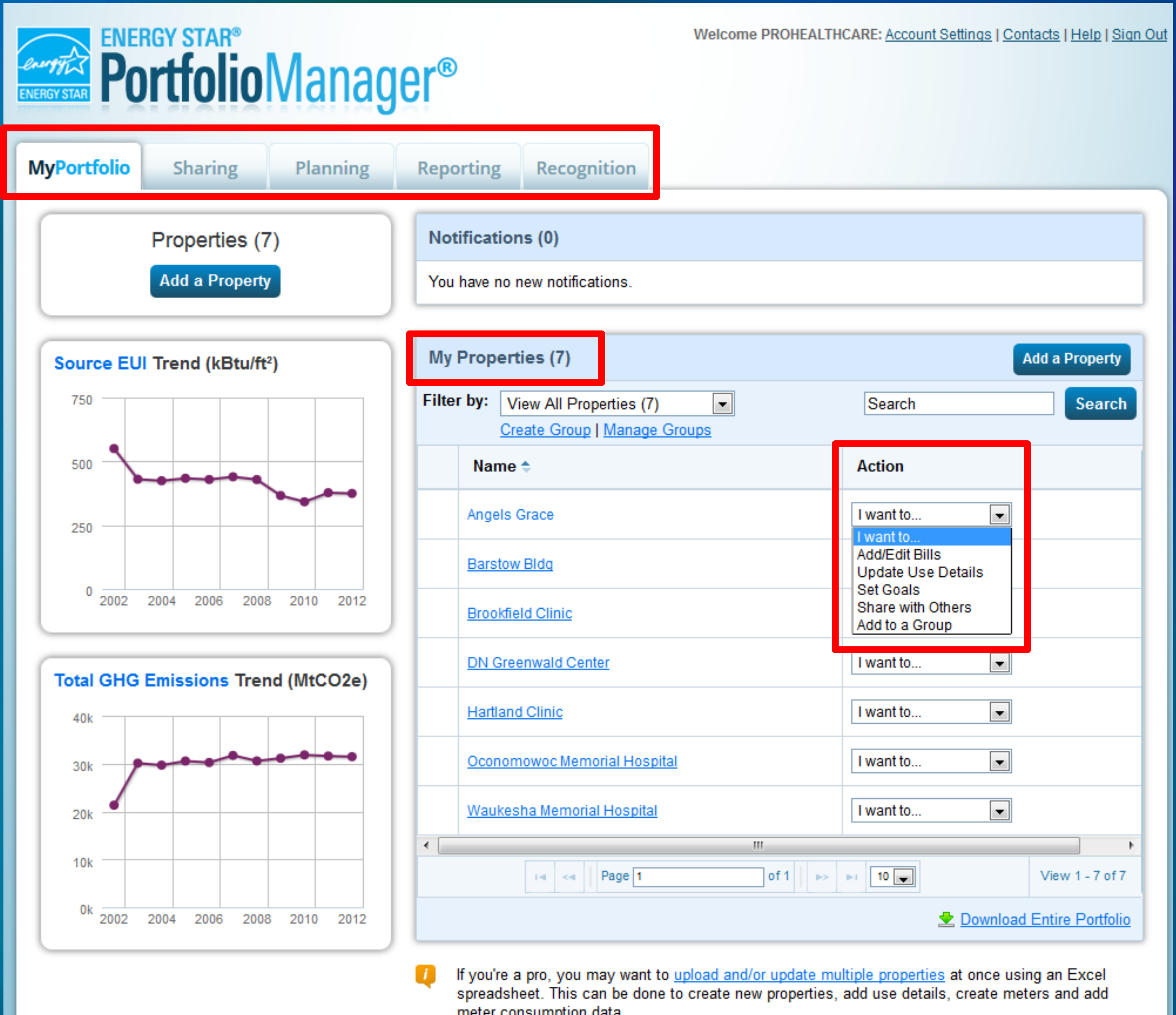
Licensed Professional

Professional Engineer Stamp (if applicable)

Changes to Waukesha Memorial Hospital Since 2013

- Upgraded controls on AHUs
  - Reset duct pressure setpoint
  - Reset supply air temperature
  - Economizer at 62°F (16.6°C)
  - Optimal start
- Replace AHUs
  - New fans with VFDs
  - Hot water instead of steam heat
  - Chilled water instead of DX cooling
- New chiller plant
  - Magnetic bearing centrifugal chillers
  - Cooling towers with VFDs and indoor sump
- Replace constant-volume reheat with VAV with reheat

Track Portfolio Energy Performance



How Do I Enter a Facility that is Not Located in the United States?

"You may create a facility that is not located in the United States in the same way that you create other facilities: select 'Add Facility' from the My Portfolio page in Portfolio Manager and enter the required information. After you select the Country, you will be asked to select the city outside of the United States that is closest to your facility from a dropdown list."

—ENERGY STAR Website

Can a Building Located Outside of the United States Earn the ENERGY STAR?

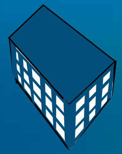
"The only buildings located outside of the U.S. that are eligible to earn the ENERGY STAR are those that are owned and occupied by the U.S. Government and that have met U.S. construction codes."

- ENERGY STAR Website

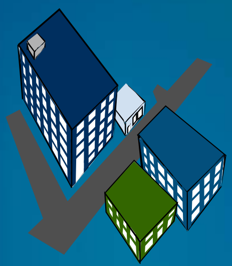
All Buildings Can Benchmark, but Some Cannot Receive a Rating

- Benchmark your facility against itself
  - Look at trends in historical data
- Compare to other buildings in your portfolio
  - Prioritize upgrade opportunities
  - Create an internal benchmark
  - “Create a Group” to compare select buildings
- Compare to national average energy use intensity (EUI) or ASHRAE Standard 100-2018 for your building type
  - Set performance targets

Ways to Obtain the Rating or EUI



- **Single Building Manual Entry**
  - Enter building and energy consumption information into Portfolio Manager



- **Excel Data Upload**
  - Upload building data in Portfolio Manager using an Excel template

- **Automated Benchmarking Services**
  - Use an ENERGY STAR service and product provider to have the rating automatically integrated into your energy information and bill handling system for all buildings

Information Required for Rating

All Space Types	K-12 School	Office	Hospitals
• Address • Year Built • At least 12 months energy data	• SM* • # Walk-in refrigerator/ freezer units • # PCs • Open weekends: Y/N • Cooking: Y/N • High school: Y/N • % heated • % AC	• SM* • # Workers • Op. hrs. • # PCs • % heated • % AC	• SM* • Licensed and staffed bed capacity • # workers • # MRI machines • Laundry • Tertiary care • Laboratory • # floors • % heated • % AC

Examples

***Gross square metre—deduct "upper floors" of atria**

Data Collection Worksheet

LEARN MORE AT energystar.gov

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.

Data collection worksheets available for download at: https://portfoliomanager.energystar.gov/pm/dataCollectionWorksheet.

ENERGY STAR Rating as a Quick Guide

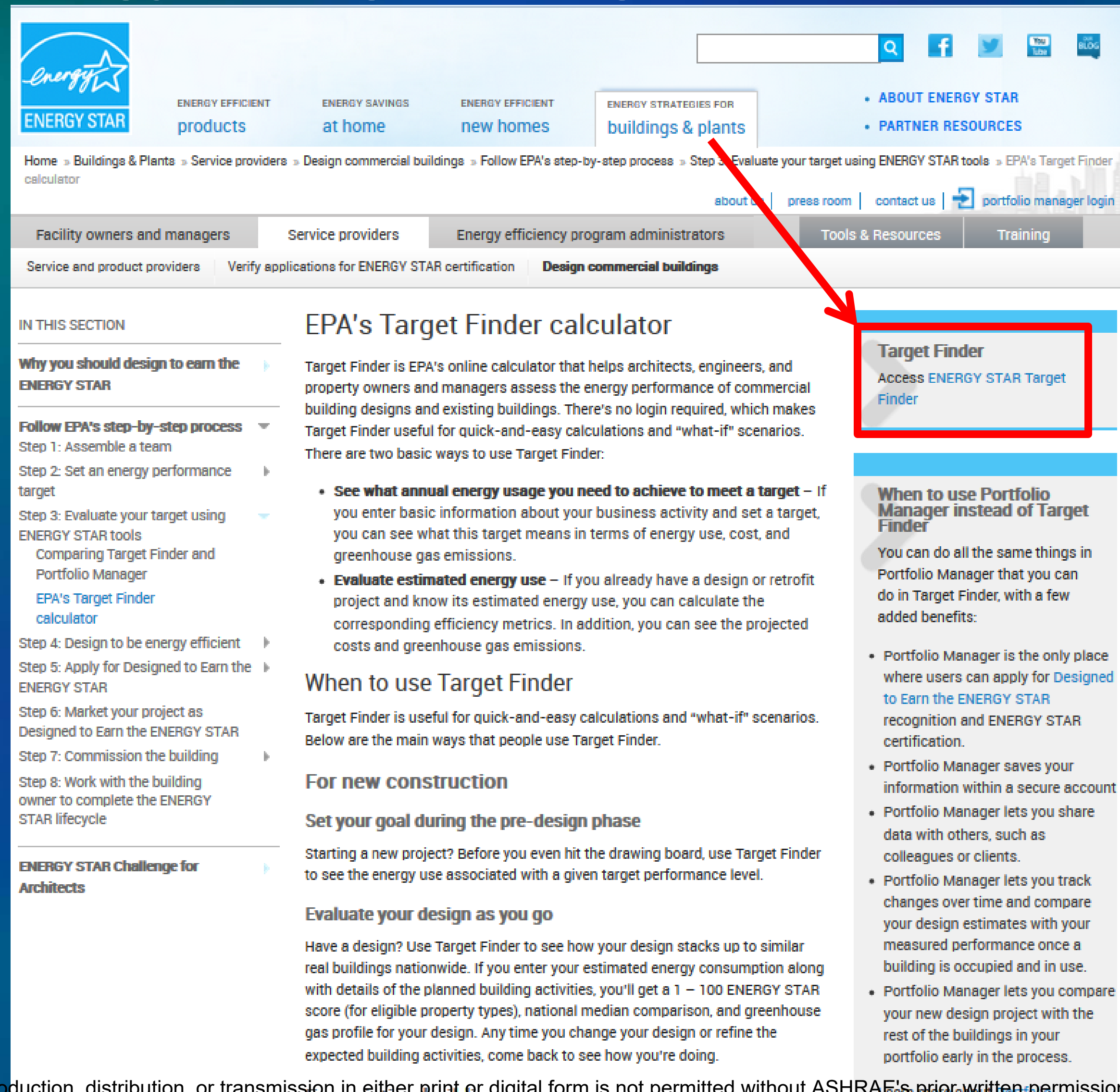
- If your building has a low score (less than 25), there are likely to be many opportunities.
- If your building has a high score (more than 75):
  - Confirm that you can monitor to keep it there
  - Go look for another building to improve

ENERGY STAR Target Finder

http://www.energystar.gov/targetfinder

Use in design phase to

- Set energy targets
- Evaluate energy use of building models to compare design options



ENERGY STAR

ENERGY EFFICIENT products | ENERGY SAVINGS at home | ENERGY EFFICIENT new homes | ENERGY STRATEGIES FOR buildings & plants

- ABOUT ENERGY STAR
- PARTNER RESOURCES

Home » Buildings & Plants » Service providers » Design commercial buildings » Follow EPA's step-by-step process » Step 3: Evaluate your target using ENERGY STAR tools » EPA's Target Finder calculator

about us | press room | contact us | portfolio manager login

Facility owners and managers | Service providers | Energy efficiency program administrators | Tools & Resources | Training

Service and product providers | Verify applications for ENERGY STAR certification | **Design commercial buildings**

IN THIS SECTION

Why you should design to earn the ENERGY STAR

Follow EPA's step-by-step process

Step 1: Assemble a team

Step 2: Set an energy performance target

Step 3: Evaluate your target using ENERGY STAR tools

Comparing Target Finder and Portfolio Manager

EPA's Target Finder calculator

Step 4: Design to be energy efficient

Step 5: Apply for Designed to Earn the ENERGY STAR

Step 6: Market your project as Designed to Earn the ENERGY STAR

Step 7: Commission the building

Step 8: Work with the building owner to complete the ENERGY STAR lifecycle

ENERGY STAR Challenge for Architects

EPA's Target Finder calculator

Target Finder is EPA's online calculator that helps architects, engineers, and property owners and managers assess the energy performance of commercial building designs and existing buildings. There's no login required, which makes Target Finder useful for quick-and-easy calculations and "what-if" scenarios. There are two basic ways to use Target Finder:

- **See what annual energy usage you need to achieve to meet a target** – If you enter basic information about your business activity and set a target, you can see what this target means in terms of energy use, cost, and greenhouse gas emissions.
- **Evaluate estimated energy use** – If you already have a design or retrofit project and know its estimated energy use, you can calculate the corresponding efficiency metrics. In addition, you can see the projected costs and greenhouse gas emissions.

When to use Target Finder

Target Finder is useful for quick-and-easy calculations and "what-if" scenarios. Below are the main ways that people use Target Finder.

For new construction

Set your goal during the pre-design phase

Starting a new project? Before you even hit the drawing board, use Target Finder to see the energy use associated with a given target performance level.

Evaluate your design as you go

Have a design? Use Target Finder to see how your design stacks up to similar real buildings nationwide. If you enter your estimated energy consumption along with details of the planned building activities, you'll get a 1 – 100 ENERGY STAR score (for eligible property types), national median comparison, and greenhouse gas profile for your design. Any time you change your design or refine the expected building activities, come back to see how you're doing.

For existing buildings

Target Finder

Access ENERGY STAR Target Finder

When to use Portfolio Manager instead of Target Finder

You can do all the same things in Portfolio Manager that you can do in Target Finder, with a few added benefits:

- Portfolio Manager is the only place where users can apply for Designed to Earn the ENERGY STAR recognition and ENERGY STAR certification.
- Portfolio Manager saves your information within a secure account
- Portfolio Manager lets you share data with others, such as colleagues or clients.
- Portfolio Manager lets you track changes over time and compare your design estimates with your measured performance once a building is occupied and in use.
- Portfolio Manager lets you compare your new design project with the rest of the buildings in your portfolio early in the process.

Learn more about Portfolio

ENERGY STAR Target Finder *(cont.)*

http://www.energystar.gov/targetfinder

ENERGY STAR® Portfolio Manager®

Help

Target Finder

You can use this tool to set energy targets and possibly receive an ENERGY STAR score for design projects. To get started, tell us more about your design property, including information about how it will be used once it's constructed, and optionally the estimated annual energy use.

About Your Design Project

Name:

Country: * --- Select ---

Street Address:

City/Municipality:

State/Province: * --- Select ---

Postal Code: *

Year Planned for Construction Completion:

Primary Function for your Design Project: * Select a primary function

Gross Floor Area: * Sq. Ft. Temporary Value

Gross Floor Area is the total floor area, expressed in square feet or square meters, measured from the principal exterior surfaces of the building(s) and not including parking area(s).

How many physical buildings will be part of your property?

- **None**: My property is part of a building
- **One**: My property is a single building
- **More than One**: My property includes multiple buildings

How many?

Property Use Details

In order to provide you with metrics about your design, we need to know how the space in this property will be used. Based on the primary function you selected, we are assuming this is how the floor area of this property will be used. If your property has multiple uses you can add them below in order to correctly classify the square footage of your design property.

Add Another Type of Use | Add

Estimated Design Energy (Optional)

If you have an estimate of how much energy your design property will use annually, enter it below to receive a score (if available) and energy metrics for your design. You can then use these metrics to compare to your target and/or property's performance (in the future). To get the most accurate metrics, provide estimates for total annual energy from each energy type.

I don't have (or don't want to) enter energy estimates.

	Energy Type	Units	Estimated Total Annual Energy Use	Energy Rate ($/unit)
	Electric - Grid	kBtu (thousand Bt		$ / kBtu (thousand Bt

Delete Selected Entries

Add Another Entry

Target

You can choose either a Target ENERGY STAR Score or a Target % Better than Median to see how much energy your property would need to be consuming annually to reach your target. If you have estimated your property's annual consumption, you can compare this against your target.

- Target ENERGY STAR Score — ENERGY STAR Scores are not available for every type of property because of availability of reliable reference information.
  75
- Target % Better than Median — This is calculated based on the median property. For example, you might like your property to be 20% better than a typical property of the same type.

View Results | Cancel

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Track Water Use Too

PORTFOLIO MANAGER

ACCOUNT INFORMATION | CONTACTS | FREQUENTLY ASKED QUESTIONS | CONTACT US | HELP | LOGOUT

Home > My Portfolio > Garvey School > Add Meter

Add Facility Water Meter: Garvey School

Use Portfolio Manager to track your facility's water use. To view this information, select the Water Use view on the Facility Summary or Portfolio View pages.

Note that entering water use information will not affect your facility's energy performance rating.

* REQUIRED

Add Water Meter

*Meter Name:

*Select the type of water use:

- [ ] Indoor
- [ ] Outdoor

Or

- [ ] Wastewater/Sewer

*Units: Select Units

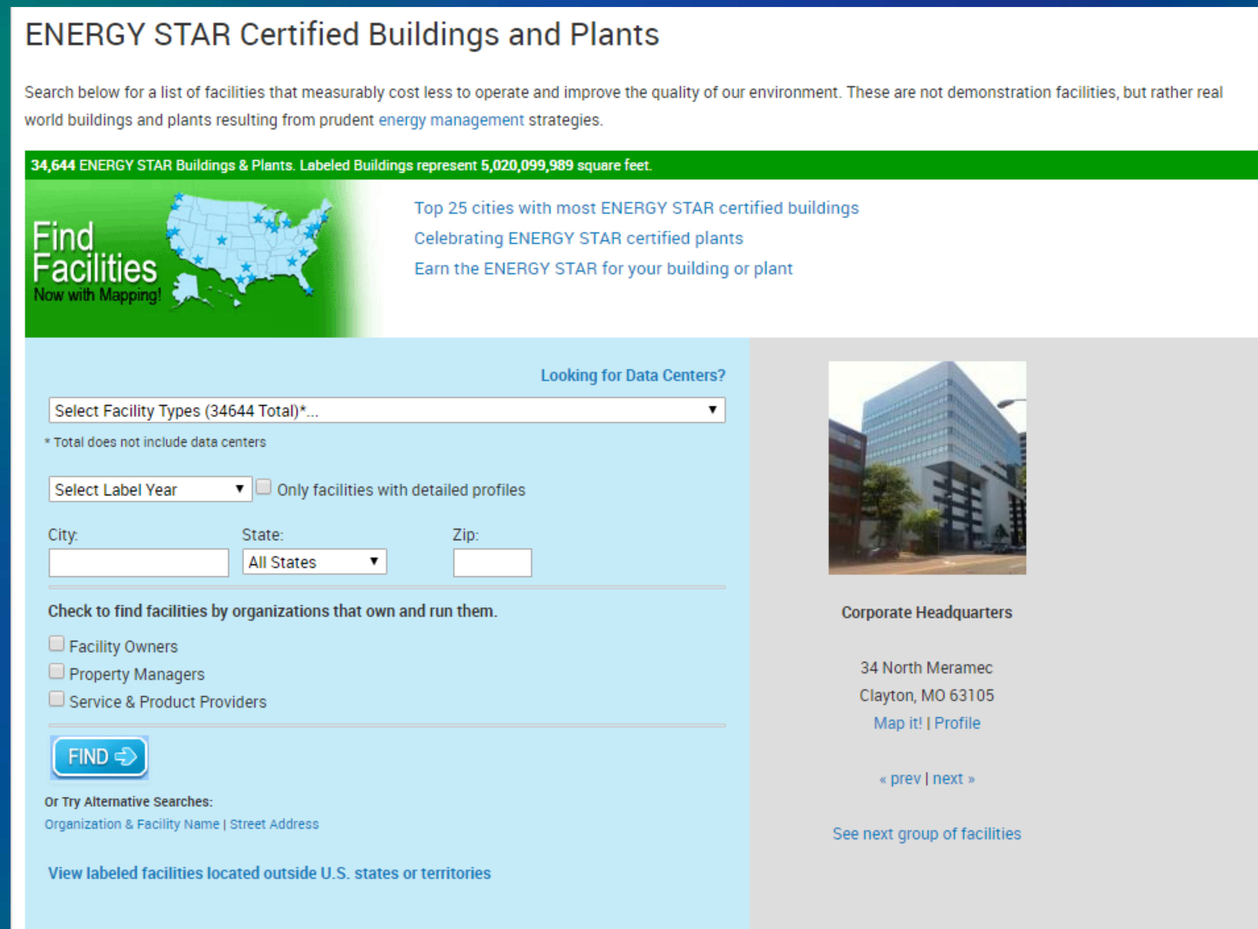
*Add this meter to Total Facility Water Use?

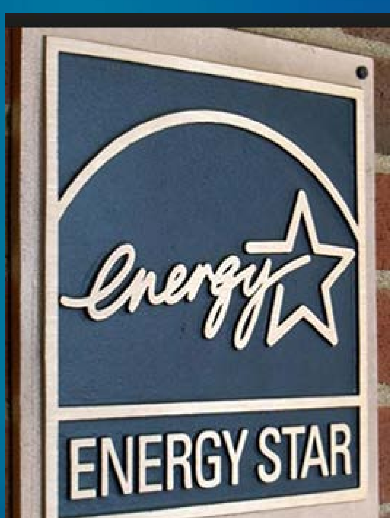
- (•) Yes, calculate this total water use by including this meter
- ( ) No, adding this meter to this total water use will inflate the actual value

CANCEL SAVE

ENERGY STAR "75+" Recognition

- Listed on the website
- Wall plaque
- Citation from EPA





For more information on ENERGY STAR Benchmarking visit:

https://www.energystar.gov/buildings/training/slide_library

Exercise 3:
Portfolio Manager Facility Report

Page 8
in the
exercises

Exercise 3: Portfolio Manager Facility Report

The next two pages show an excerpt from a Statement of Energy Performance generated by Portfolio Manager for Garvey School.

Take a look at the document and answer the following questions.

1. *Statement of Energy Performance (page 9 of this packet):*
   Which statements are correct in interpreting the Energy Performance Rating of 13?
   A. Garvey School uses more energy than 87% of schools in the EPA database after accounting for size, equipment and climate differences.
   B. Garvey School uses more energy than 13% of schools in the EPA database after accounting for size, equipment and climate differences.
   C. Garvey School's score is too low for EPA ENERGY STAR recognition.
   D. Energy data from 2005 and 2006 were used to compute the rating.

Site Versus Source Energy

OMB No. 2060-0347

ENERGY STAR

STATEMENT OF ENERGY PERFORMANCE
Garvey School

Building ID: 1427605
For 12-month Period Ending: April 30, 20
Date SEP becomes ineligible: N/A

Facility
Garvey School
10309 S Morgan St
Chicago, IL 60643

Facility Owner
N/A

Year Built: 1968
Gross Floor Area (ft^2): 57,410

Energy Performance Rating[2] (1-100) 13

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	3,808,114
Natural Gas - (kBtu)[4]	0
Total Energy (kBtu)	3,808,114

Energy Intensity[5]

Site (kBtu/ft^2/yr)	66
Source (kBtu/ft^2/yr)	222

Table 1
Source-Site Ratios for all Portfolio Manager Fuels

Fuel Type	Source-Site Ratio
Electricity (Grid Purchase)	3.340
Electricity (on-Site Solar or Wind Installation)	1.0
Natural Gas	1.047
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.01
Propane & Liquid Propane	1.01
Steam	1.45
Hot Water	1.35
Chilled Water	1.05
Wood	1.0
Coal/Coke	1.0
Other	1.0

$222 = 66 \times 3.340$

Practical Implications

- Don’t mix site and source energy values in your analysis
- Not all source energy calculations use the EPA method
- Site energy drives basic $ costs
- Source energy drives environmental costs

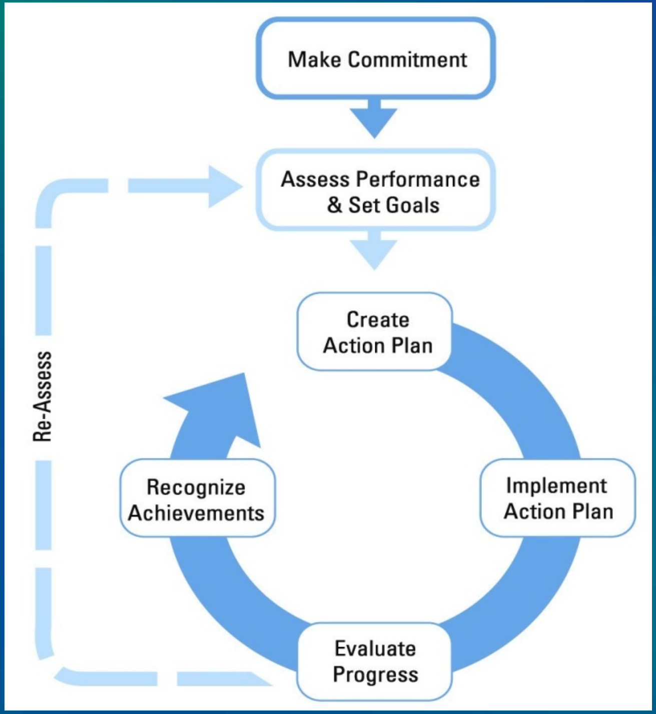
Reference Schematic of EPA Tools on ENERGY STAR Site

EPA Tools Support the Energy Management Process

6. Communicate results

5. Demonstrate results

4. Implement quality projects and evaluate



1. Commit to energy efficiency

2. Identify qualified projects

3. Understand financial value

Reference Schematic of EPA Tools on ENERGY STAR Site

EPA Tools Support the Energy Management Process

6. Communicate results

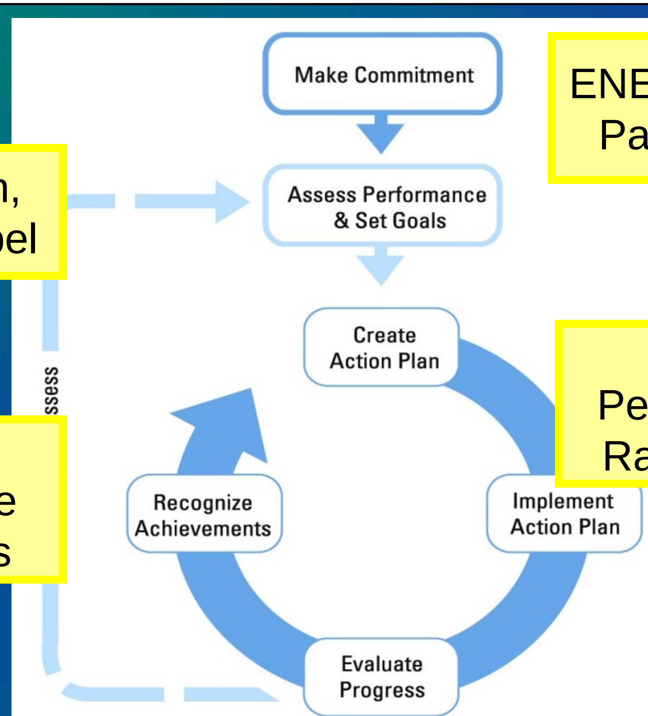
Recognition, Results, Label

5. Demonstrate results

Energy Performance Rating Tools

4. Implement quality projects and evaluate

Technical Resources



ENERGY STAR Partnership

1. Commit to energy efficiency

Energy Performance Rating Tools

2. Identify qualified projects

3. Understand financial value

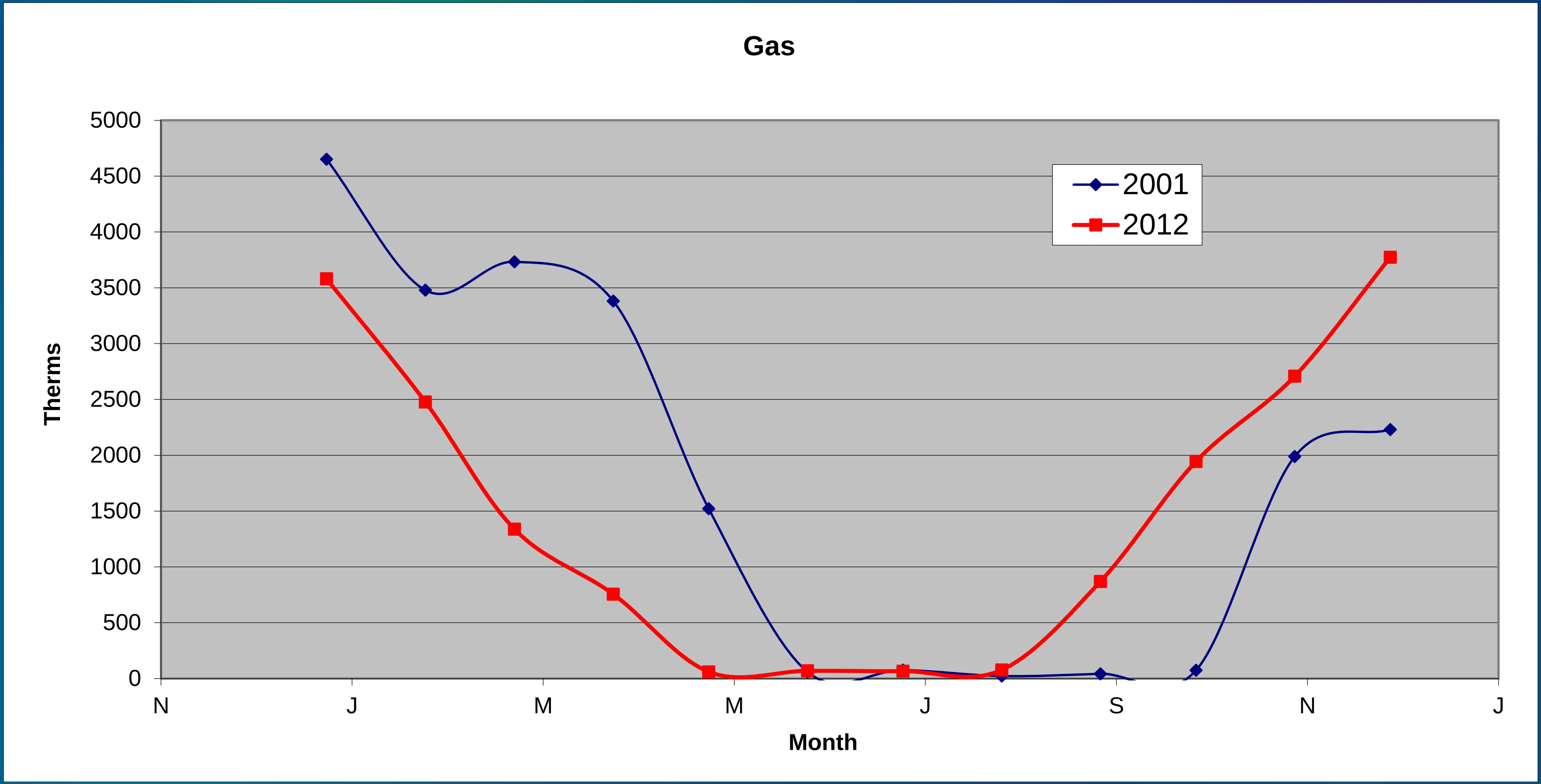
Financial Tools

Assess Performance

- Annual usage
  - Energy cost index (ECI)
  - Energy utilization index (EUI)
- Annual profile of monthly data
- Daily profile of 15-minute data

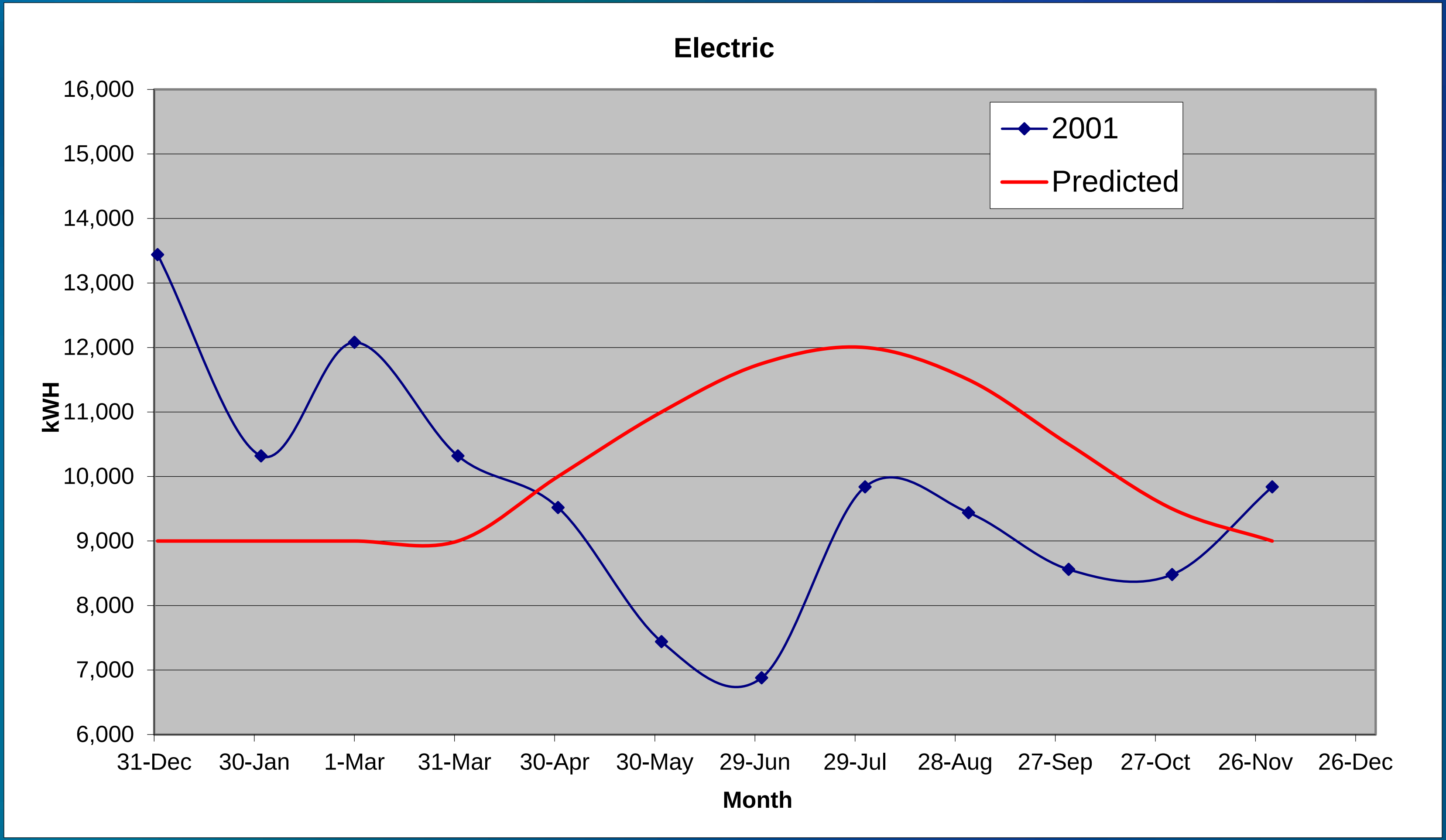
Annual Profile of Monthly Data

Madison Worship House



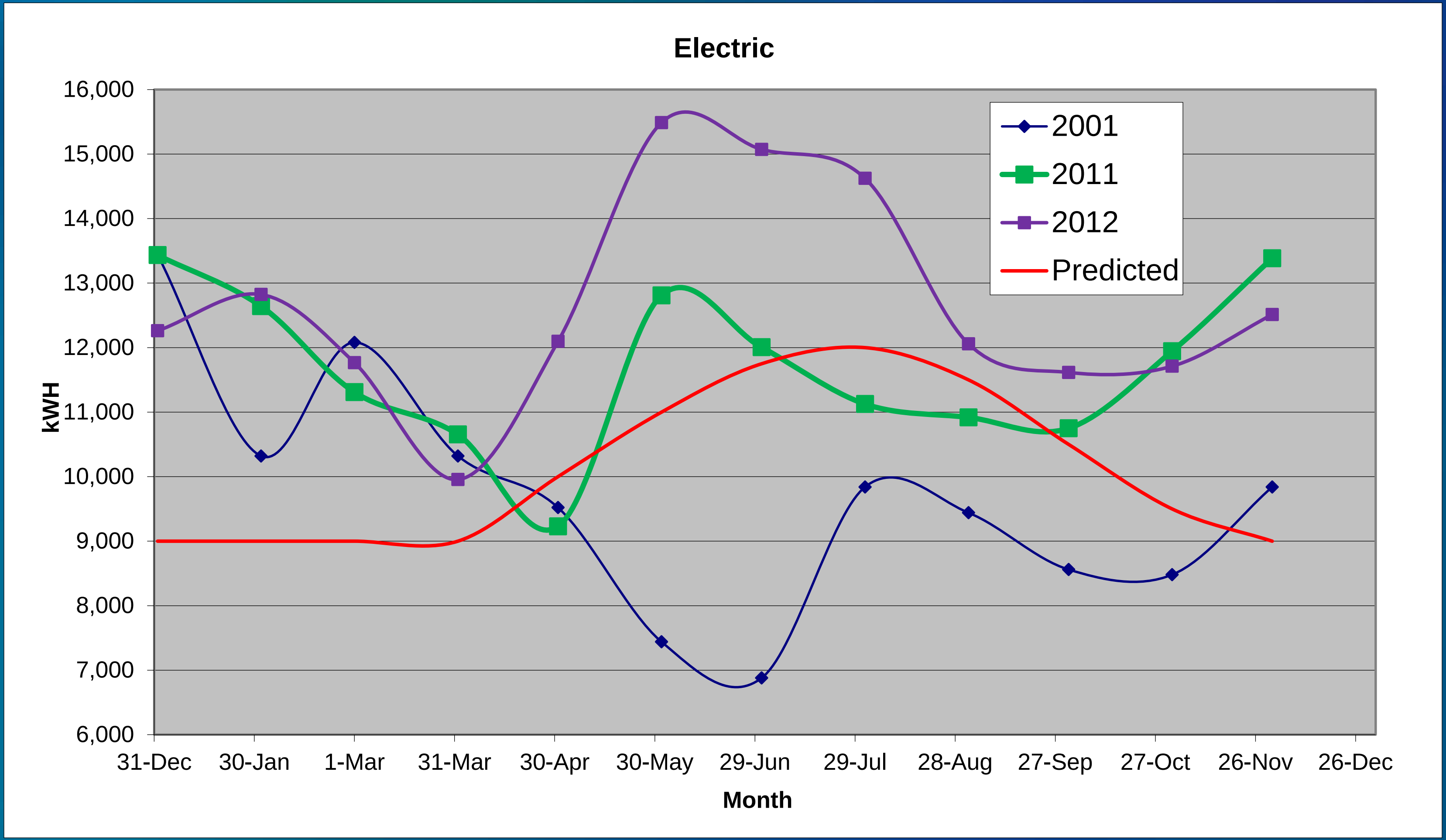
Annual Profile of Monthly Data

Madison Worship House



Annual Profile of Monthly Data

Madison Worship House



Exercises 4A and 4B: Monthly Electric and Gas Profiles

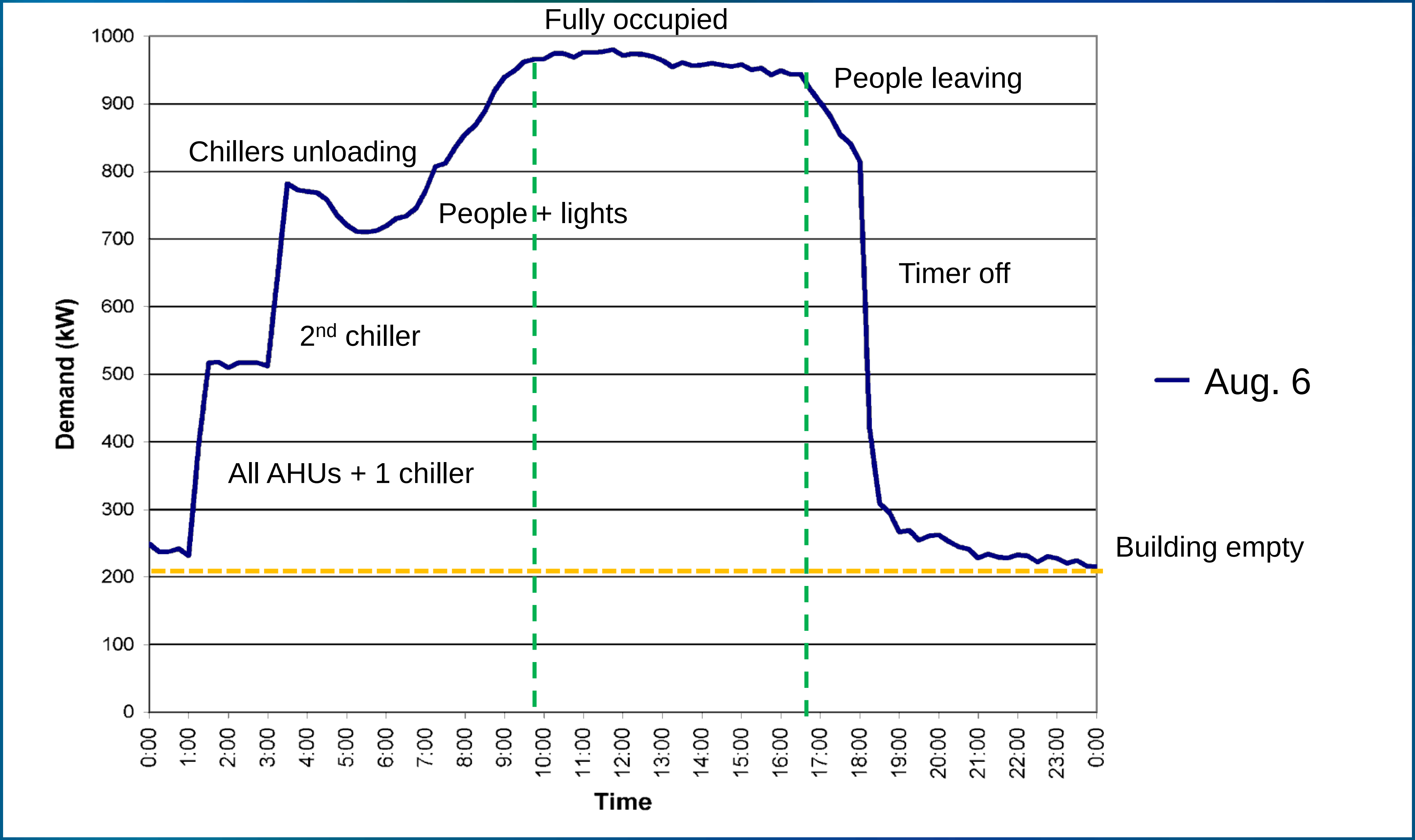
Page 11
in the
exercises

Assess Performance

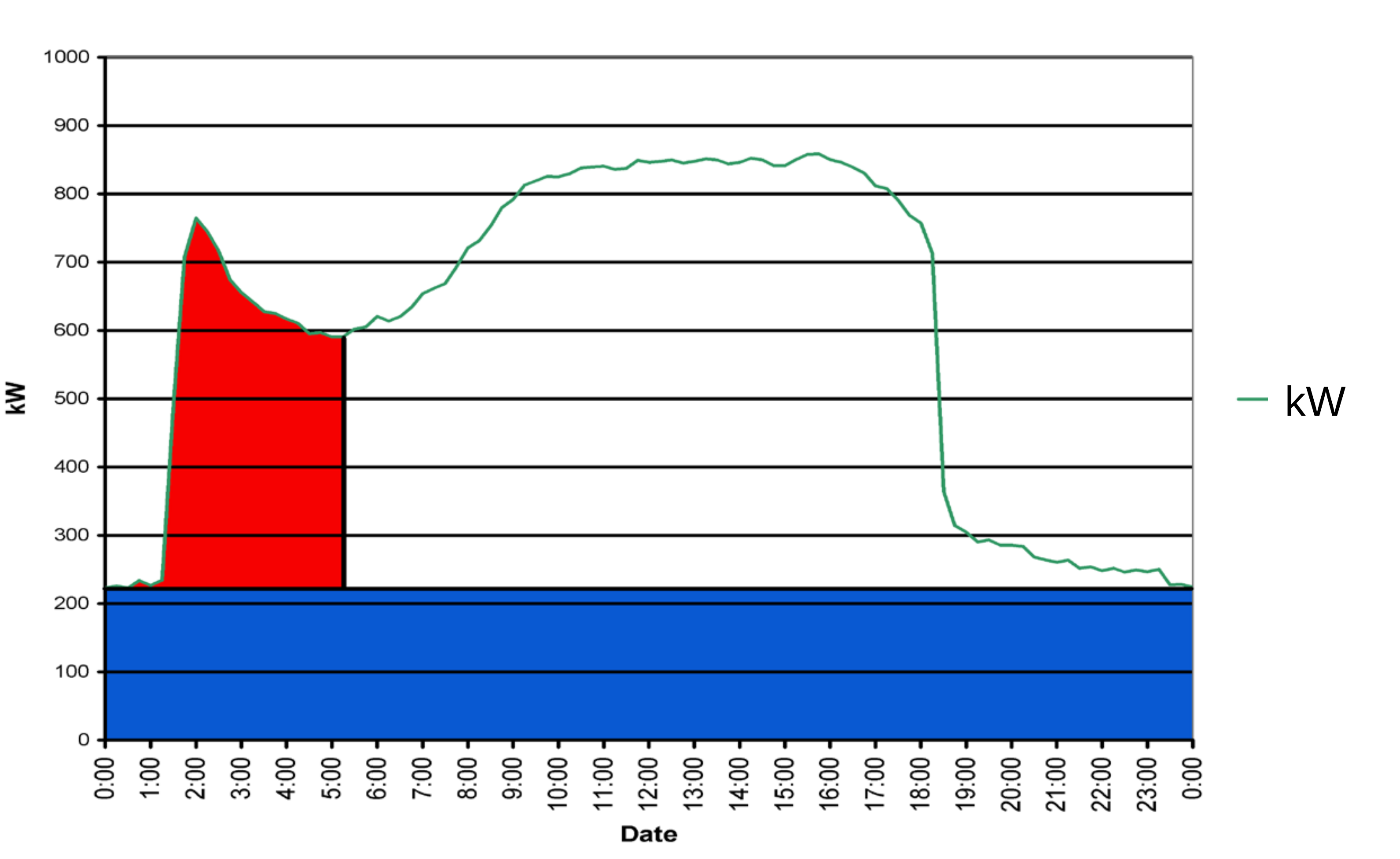
- Annual usage
  - Energy cost index (ECI)
  - Energy utilization index (EUI)
- Annual profile of monthly data
- Daily profile of 15-minute data

Honolulu Office Building: Using 15-Minute Data to Identify Opportunities

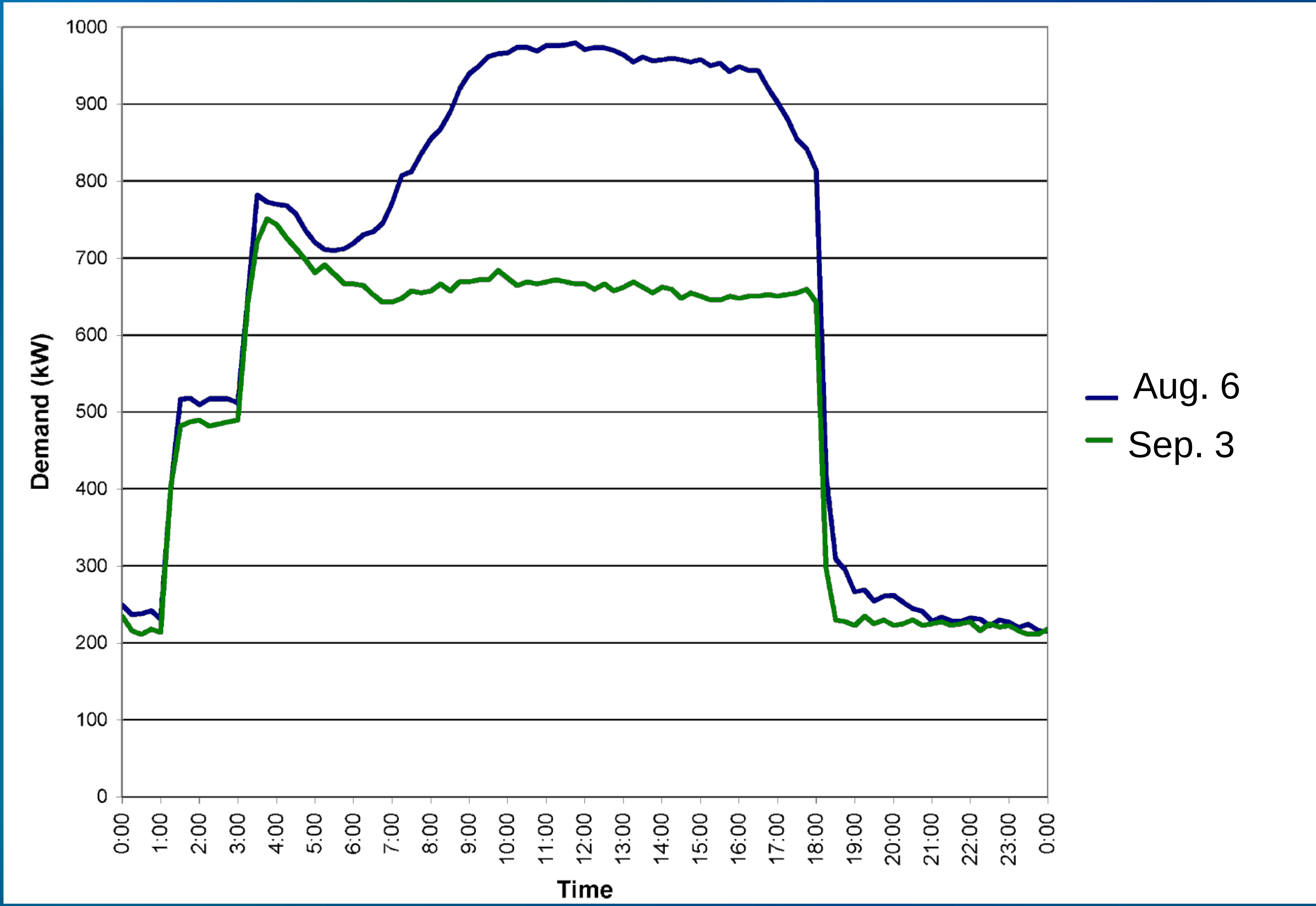
Daily Profile of 15-Minute Data



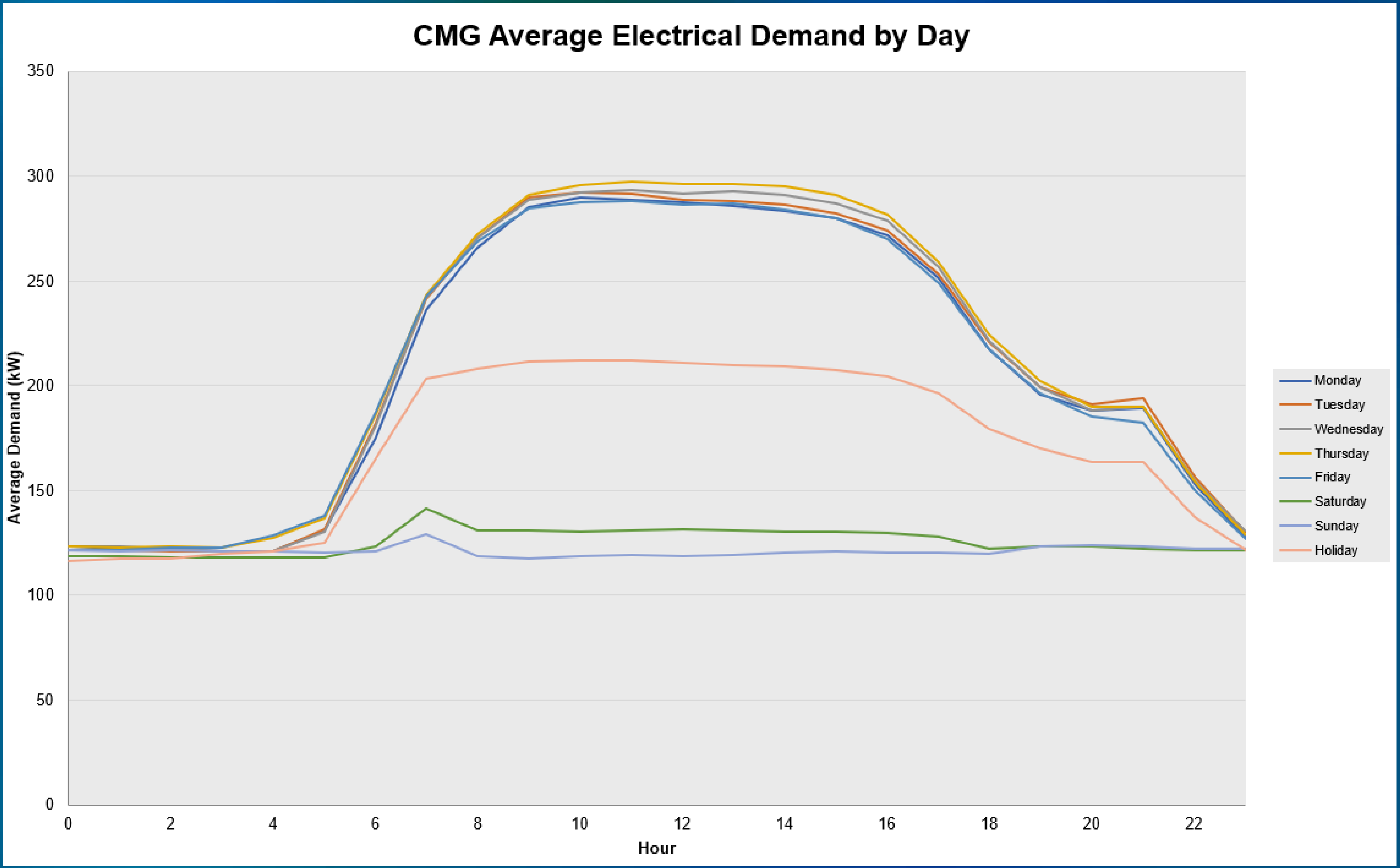
Simplified Profile



Monday Versus Holiday



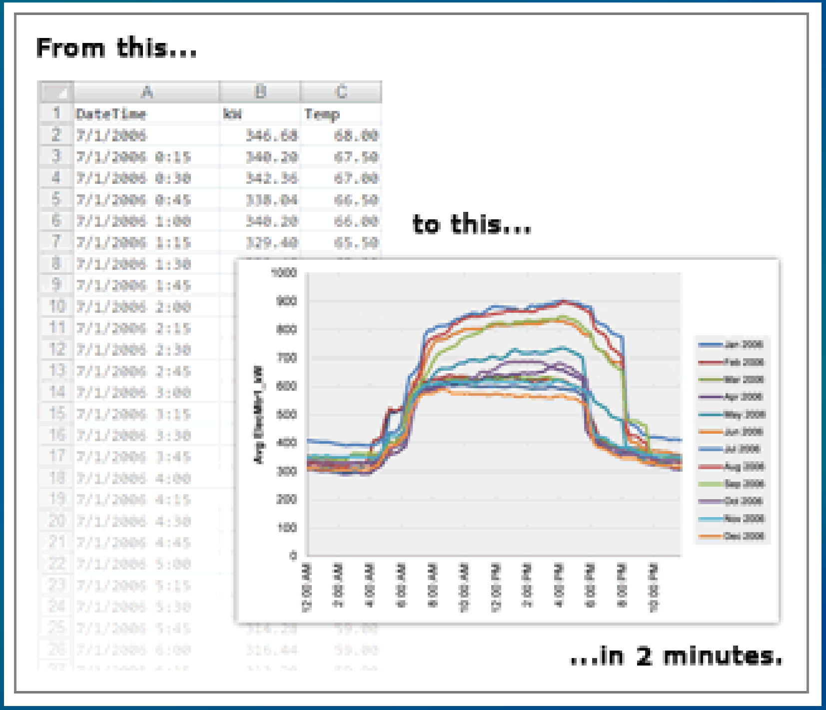
New Software to Evaluate Interval Data



New Software to Evaluate Interval Data

- ECAM for Excel from California Commissioning Collaborative

https://www.cacx.org/PIER/ecam/



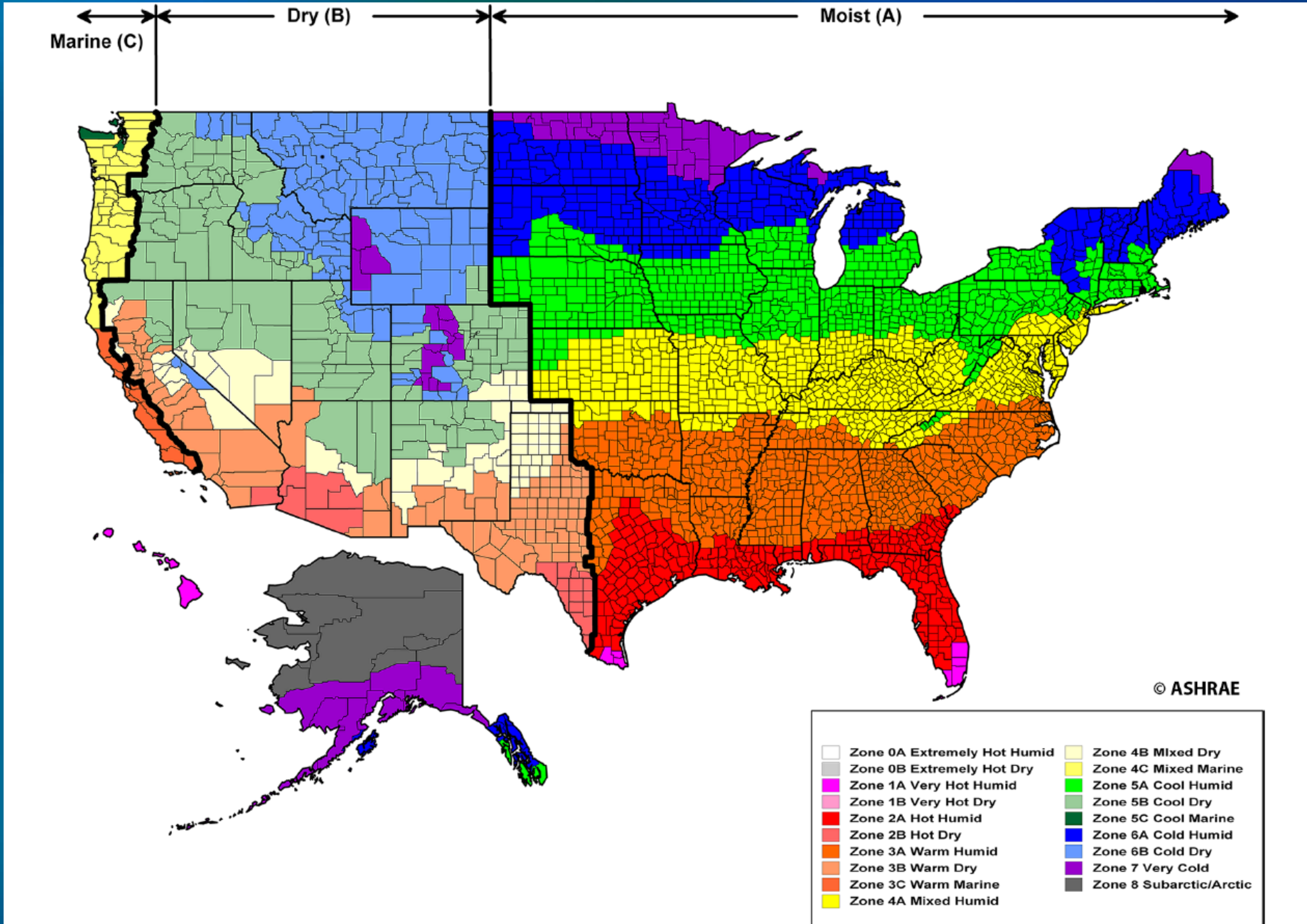
Meters and Submeters

- Meters by themselves do not save anything
- No direct payback on the purchase of a meter
- But… how can you manage it if you can't measure it?

Measurement Technology

- Costs decline, features improve
- More options than ever
- Creative thinking and competitive bidding can get you useful metering

Prioritizing Multiple Buildings



Prioritizing Multiple Buildings

Site	SF	Zone	Type	ECI	EUI	Current $	
601-Tysons Corner	39,463	4	Homestore	$3.01	193	$118,823	
510-Mission Viejo	12,895	4	Housewares	$6.10	177	$78,685	
503-Fashion Valley	14,510	4	Housewares	$6.66	177	$96,579	
412-Roseville	34,372	4	Homestore	$4.13	176	$142,059	
851-Lenox	36,919	4	Homestore	$3.21	175	$118,325	
855-Alpharetta	29,282	4	Homestore	$2.52	156	$73,674	EMS
511-South Coast II	36,417	4	Homestore	$6.02	154	$219,158	
402-Corte Madera	11,632	4	Housewares	$6.29	142	$73,119	
404 a - Santana Row	38,017	4	Homestore	$5.96	140	$226,467	EMS
507-University Town Centre	12,678	4	Housewares	$5.33	137	$67,561	
406-Walnut Creek	37,552	4	Homestore	$6.16	129	$231,358	
505-Pasadena	38,566	4	Homestore	$4.26	128	$164,175	
506-Topanga Plaza	14,262	4	Housewares	$3.11	121	$44,383	
860-Crabtree Valley	13,305	4	Housewares	$1.86	115	$24,761	
411-Union Square Furniture	43,167	4	Homestore	$4.91	114	$211,820	
502-Century City(Closed)	14,200	4	Housewares	$2.10	79	$29,763	
407-Hillsdale	15,238	4	Housewares	$3.24	71	$49,341	
403-Palo Alto	38,920	4	Homestore	$0.86	40	$33,588	

Prioritizing Multiple Buildings (SI)

Site	m²	Zone	Type	ECI	EUI	Current $	
601-Tysons Corner	3,668	4	Homestore	$32.40	609	$118,823	
510-Mission Viejo	1,198	4	Houseware	$65.66	558	$78,685	
503-Fashion Valley	1,349	4	Houseware	$71.62	558	$96,579	
412-Roseville	3,194	4	Homestore	$44.47	555	$142,059	
851-Lenox	3,431	4	Homestore	$34.49	552	$118,325	
855-Alpharetta	2,721	4	Homestore	$27.07	492	$73,674	EMS
511-South Coast II	3,384	4	Homestore	$64.75	486	$219,158	
402-Corte Madera	1,081	4	Houseware	$67.64	448	$73,119	
404 a - Santana Row	3,533	4	Homestore	$64.10	441	$226,467	EMS
507-University Town Centre	1,178	4	Houseware	$57.34	432	$67,561	
406-Walnut Creek	3,490	4	Homestore	$66.29	407	$231,358	
505-Pasadena	3,584	4	Homestore	$45.81	404	$164,175	
506-Topanga Plaza	1,325	4	Houseware	$33.48	382	$44,383	
860-Crabtree Valley	1,237	4	Houseware	$20.02	363	$24,761	
411-Union Square Furniture	4,012	4	Homestore	$52.80	359	$211,820	
502-Century City(Closed)	1,320	4	Houseware	$22.55	249	$29,763	
407-Hillsdale	1,416	4	Houseware	$34.84	224	$49,341	
403-Palo Alto	3,617	4	Homestore	$9.29	126	$33,588	

Prioritizing Multiple Buildings

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507-University Town Centre	12,678	4	Housewares	$5.33	137	$67,561	
406-Walnut Creek	37552	4	Homestore	6.161	129	231357.872	
505-Pasadena	38566	4	Homestore	4.257	128	164175.462	
506-Topanga Plaza	14262	4	Housewares	3.112	121	44383.344	
860-Crabtree Valley	13,305	4	Housewares	$1.86	**115**	$24,761	**Target**
411-Union Square Furniture	43,167	4	Homestore	$4.91	114	$211,820	
502-Century City(Closed)	14,200	4	Housewares	$2.10	79	$29,763	
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Prioritizing Multiple Buildings

Site	SF	Zone	Type	ECI	EUI	Current $	New $	Savings	
601-Tysons Corner	39,463	4	Homestore	$3.01	193	$118,823	$70,678	$48,146	
510-Mission Viejo	12,895	4	Housewares	$6.10	177	$78,685	$51,093	$27,592	
503-Fashion Valley	14,510	4	Housewares	$6.66	177	$96,579	$62,924	$33,655	
412-Roseville	34,372	4	Homestore	$4.13	176	$142,059	$92,740	$49,320	
851-Lenox	36,919	4	Homestore	$3.21	175	$118,325	$77,619	$40,707	
855-Alpharetta	29,282	4	Homestore	$2.52	156	$73,674	$54,176	$19,498	**EMS**
511-South Coast II	36,417	4	Homestore	$6.02	154	$219,158	$164,146	$55,012	
402-Corte Madera	11,632	4	Housewares	$6.29	142	$73,119	$59,252	$13,867	
404 a - Santana Row	38,017	4	Homestore	$5.96	140	$226,467	$185,686	$40,781	**EMS**
507-University Town Centre	12,678	4	Housewares	$5.33	137	$67,561	$56,700	$10,861	
406-Walnut Creek	37,552	4	Homestore	$6.16	129	$231,358		**$339,438**	
505-Pasadena	38,566	4	Homestore	$4.26	128	$164,175			
506-Topanga Plaza	14,262	4	Housewares	$3.11	121	$44,383			
860-Crabtree Valley	13,305	4	Housewares	$1.86	**115**	$24,761	**Target**		
411-Union Square Furniture	43,167	4	Homestore	$4.91	114	$211,820			
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403-Palo Alto	38,920	4	Homestore	$0.86	40	$33,588			
						$2,003,639			

Prioritizing Multiple Buildings (SI)

Site	m²	Zone	Type	ECI	EUI	Current $	New $	Savings	
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412-Roseville	3,194	4	Homestore	$44.47	555	$142,059	$92,740	$49,320	
851-Lenox	3,431	4	Homestore	$34.49	552	$118,325	$77,619	$40,707	
855-Alpharetta	2,721	4	Homestore	$27.07	492	$73,674	$54,176	$19,498	**EMS**
511-South Coast II	3,384	4	Homestore	$64.75	486	$219,158	$164,146	$55,012	
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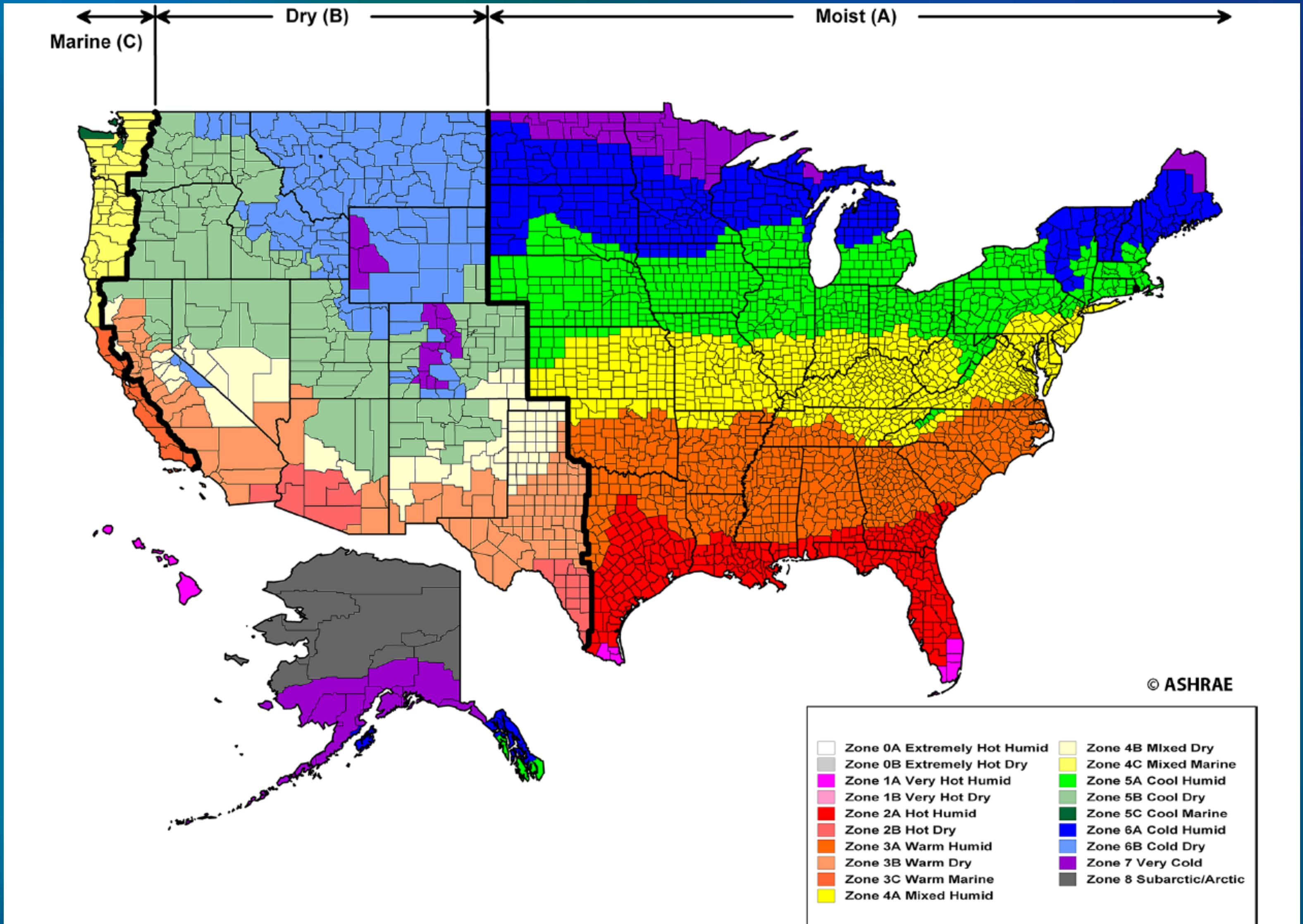
406-Walnut Creek	3,490	4	Homestore	$66.29	407	$231,358		**$339,438**	
505-Pasadena	3,584	4	Homestore	$45.81	404	$164,175			
506-Topanga Plaza	1,325	4	Houseware	$33.48	382	$44,383			
860-Crabtree Valley	1,237	4	Houseware	$20.02	**363**	$24,761	**TARGET**		
411-Union Square Furniture	4,012	4	Homestore	$52.80	359	$211,820			
502-Century City(Closed)	1,320	4	Houseware	$22.55	249	$29,763			
407-Hillsdale	1,416	4	Houseware	$34.84	224	$49,341			
403-Palo Alto	3,617	4	Homestore	$9.29	126	$33,588			
						$2,003,639			

Climate Zone Map (2018)

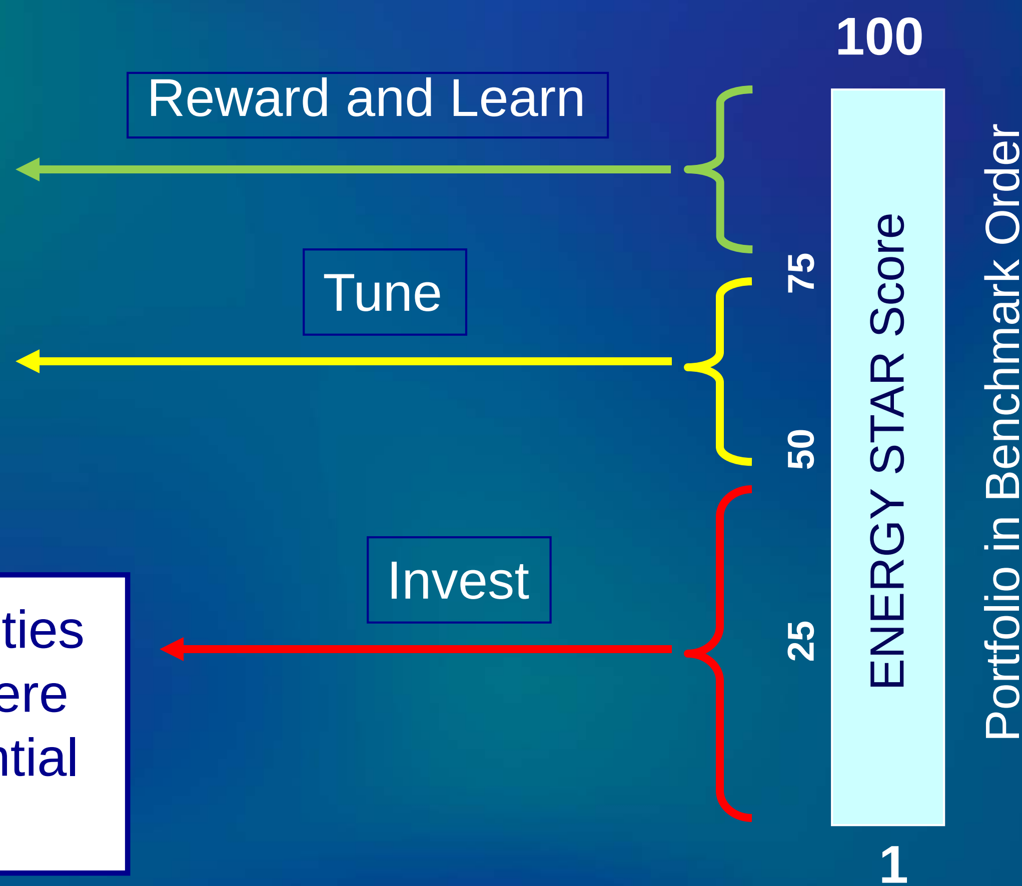


Identify Priorities Across Portfolios

High scoring buildings provide lessons learned and may be ENERGY STAR candidates

O&M improvements will yield savings and may be ENERGY STAR candidates

Best investment opportunities are in lower quartiles, where there is the greatest potential for improvement



Exercise 5: Site Targeting Case

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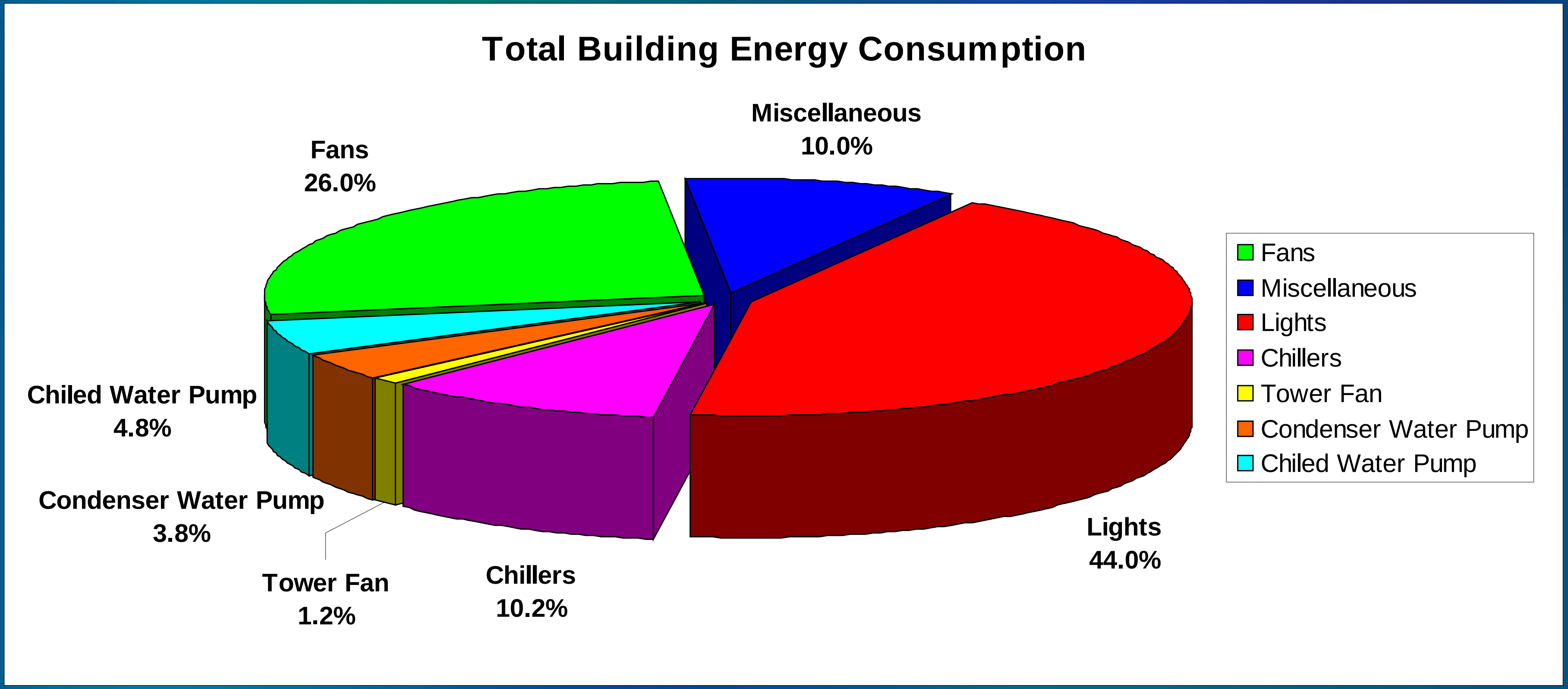
in the
exercises

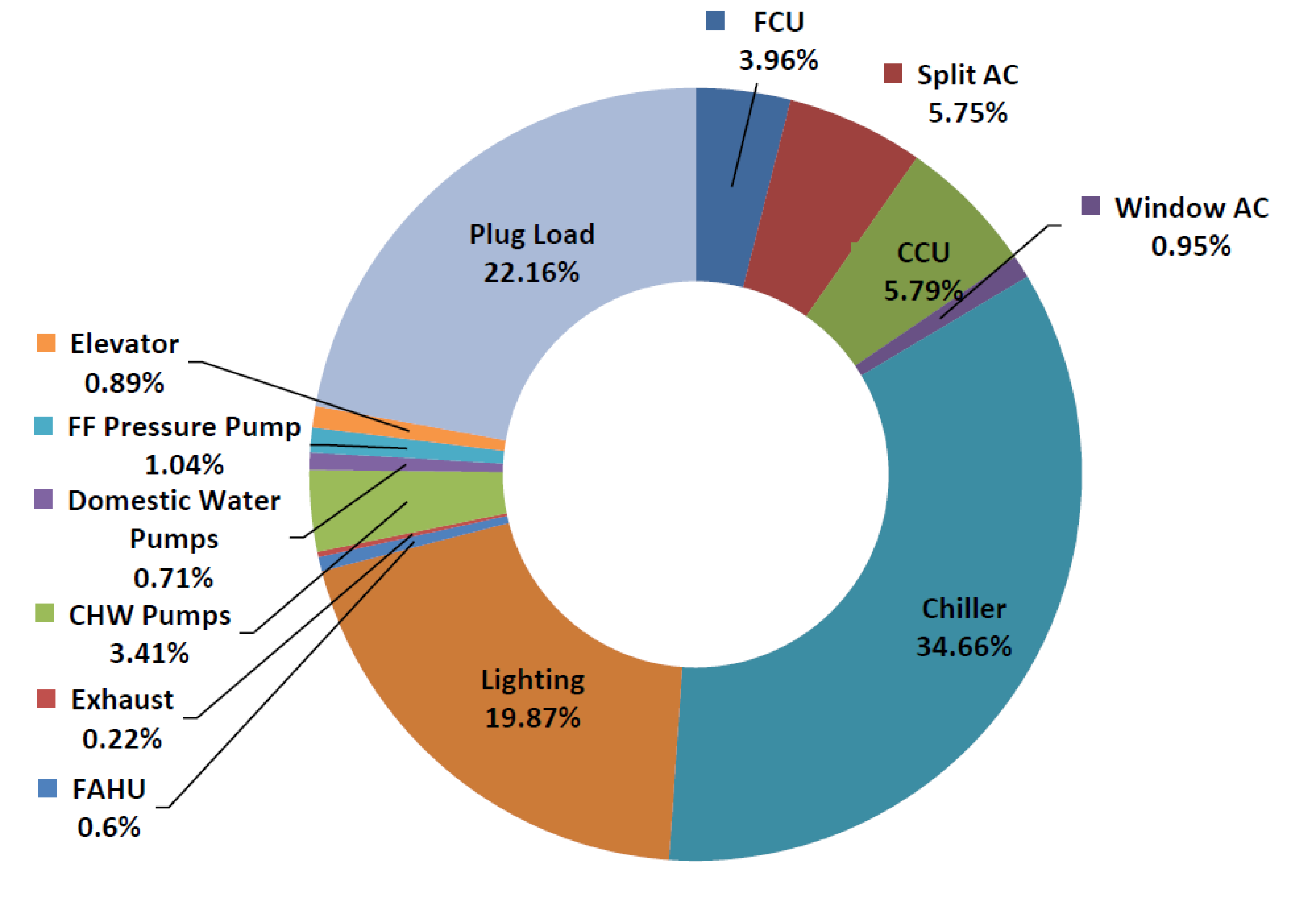
BREAK!

Why Look at a Breakdown of Energy Use?

What System Should I Tackle?

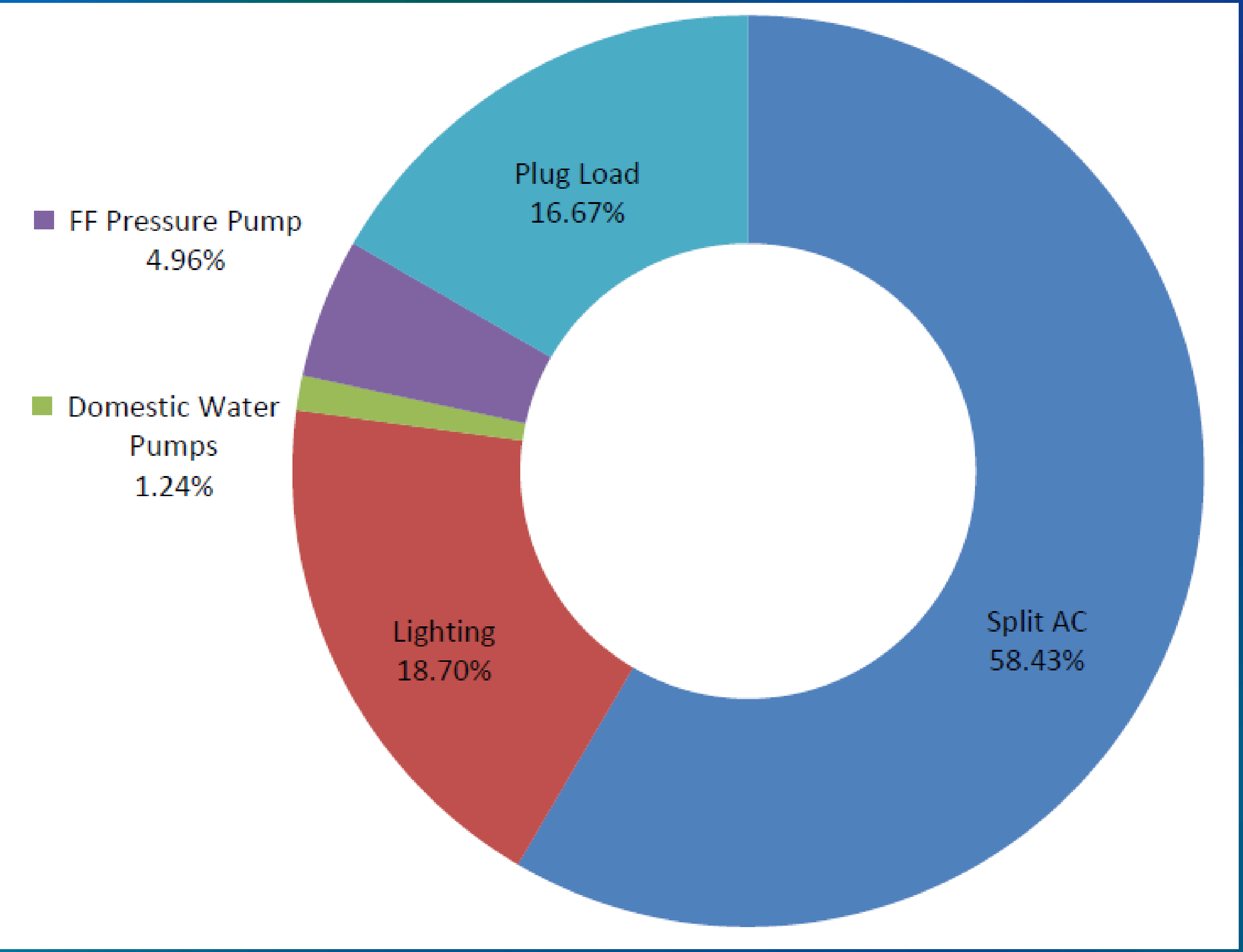


Dubai Fire Station1 Example – Actual End Use



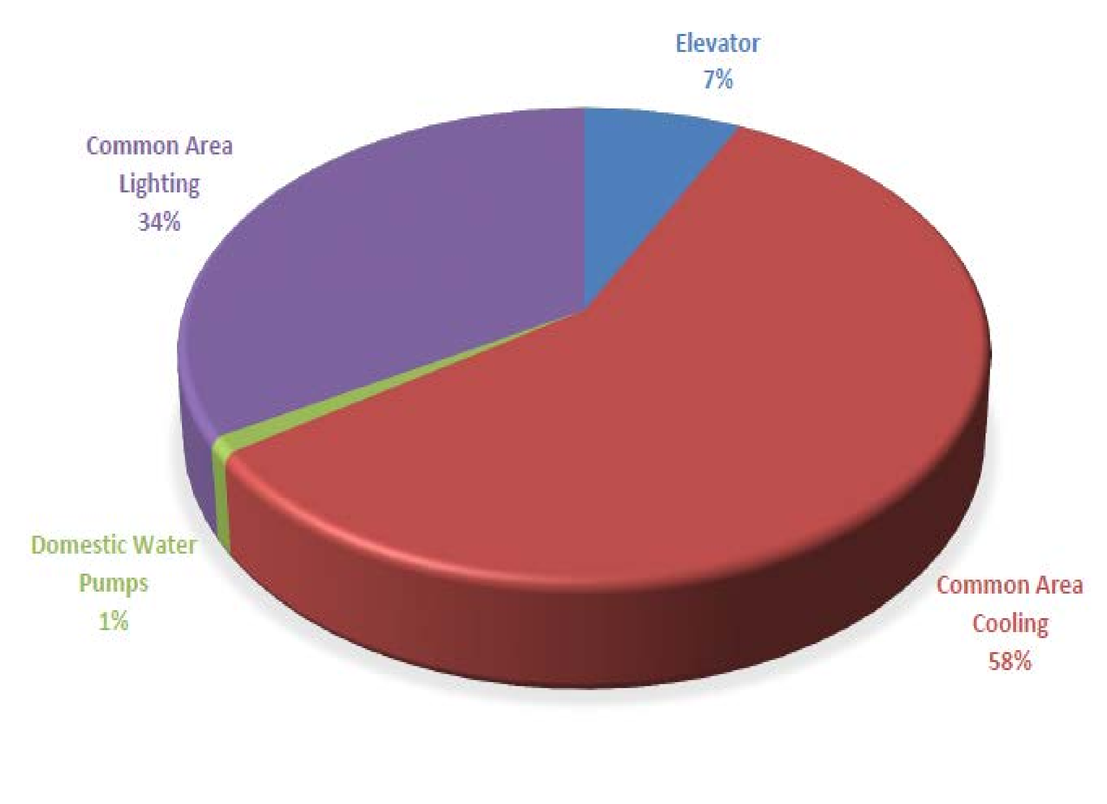
Source: Griffin Consultants.

Dubai Fire Station2 Example – Actual End Use



Source: Griffin Consultants.

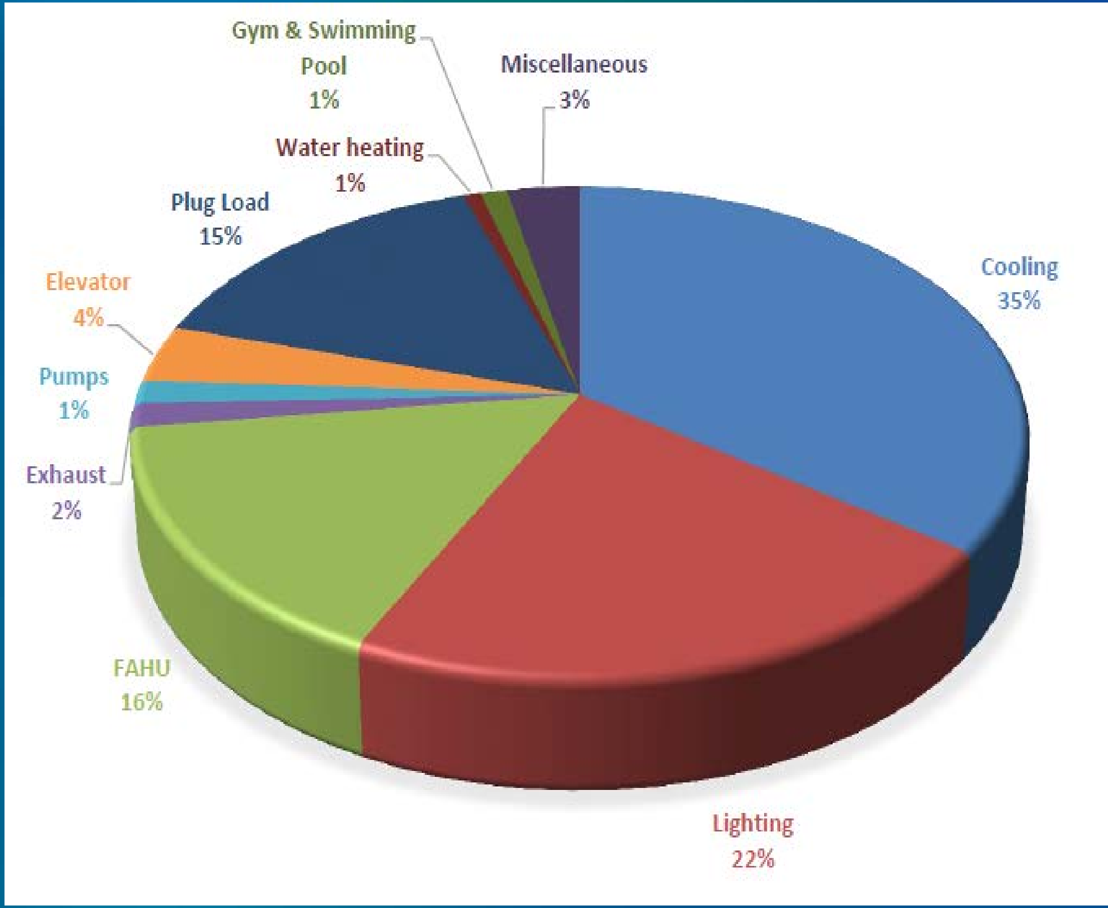
Dubai Residential Building Example – Actual End Use



- Residential building
- Common areas in five residential floors
  - 3,020 m²
- One basement floor
  - 4,355 m²

Source: Griffin Consultants.

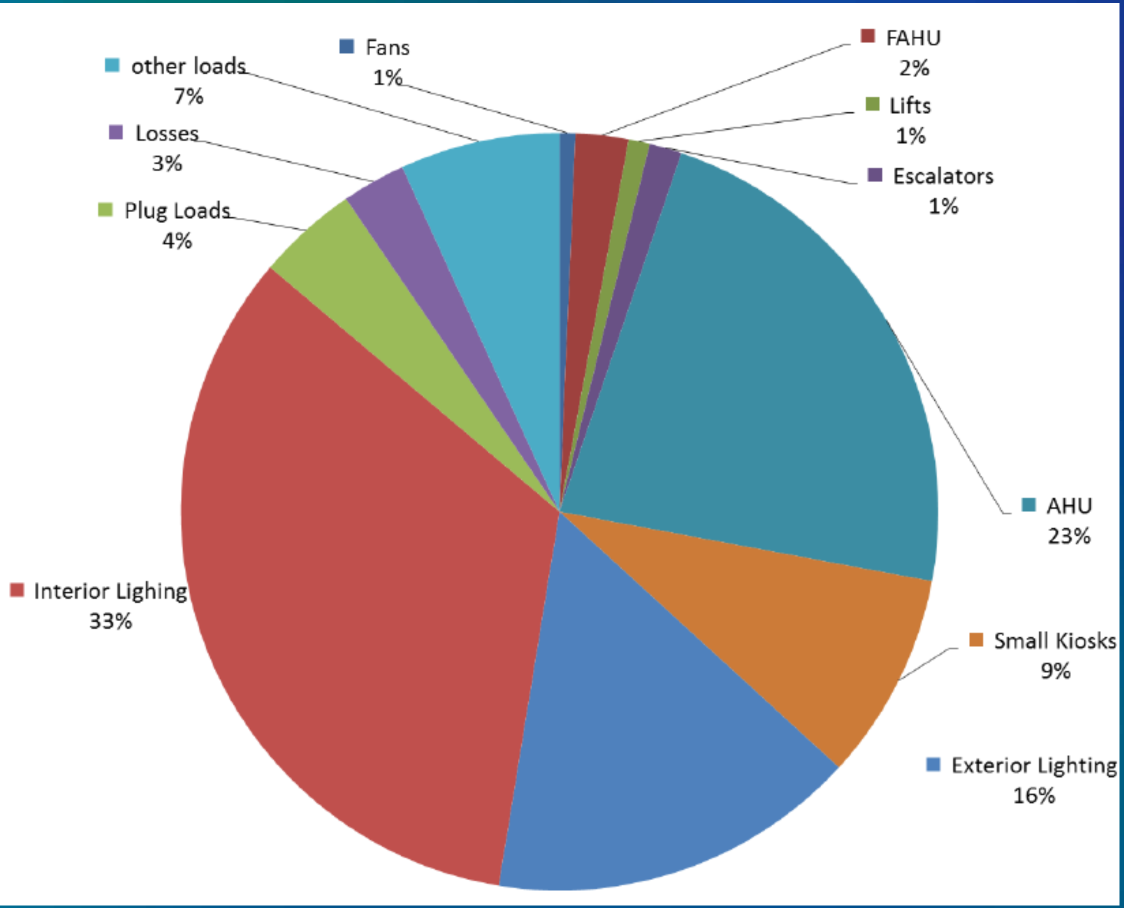
Dubai Res/Comm. Building Example – Actual End Use



- Multi-use building
- Two office floors
  - 4,000 m²
- Common areas in thirteen residential floors
  - 2,330 m²
- Two basement floors
  - 4,980 m²

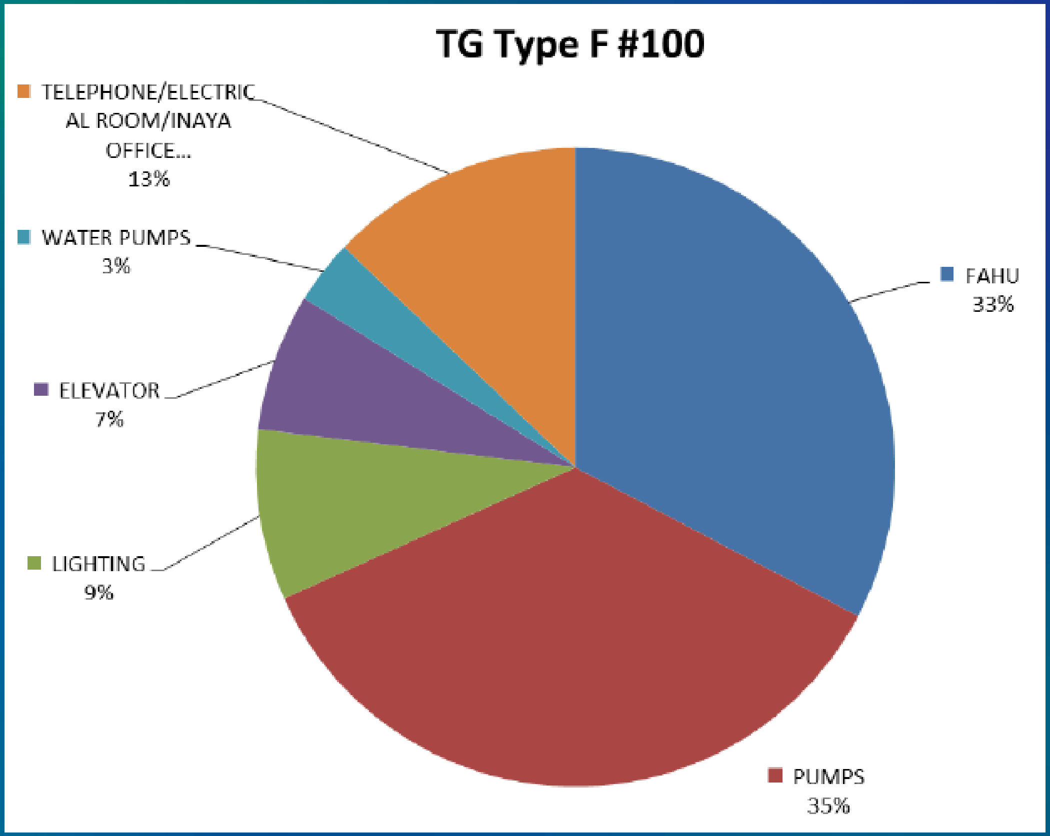
Source: Griffin Consultants.

District Cooling Fed Mall in the UAE – Electrical Actual End Use



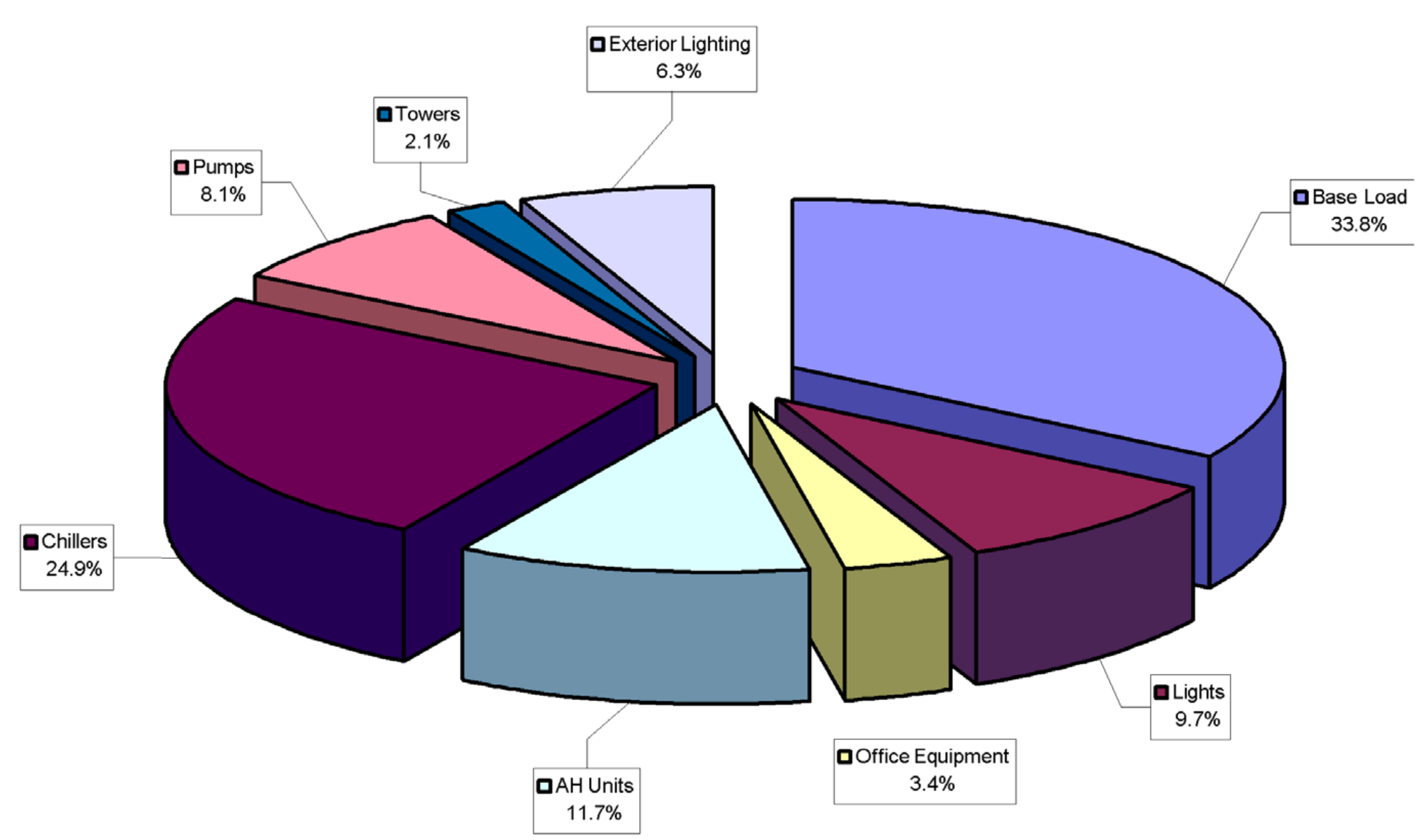
Source: Griffin Consultants.

Res. Community Example (DC Fed) – Electrical Actual End Use

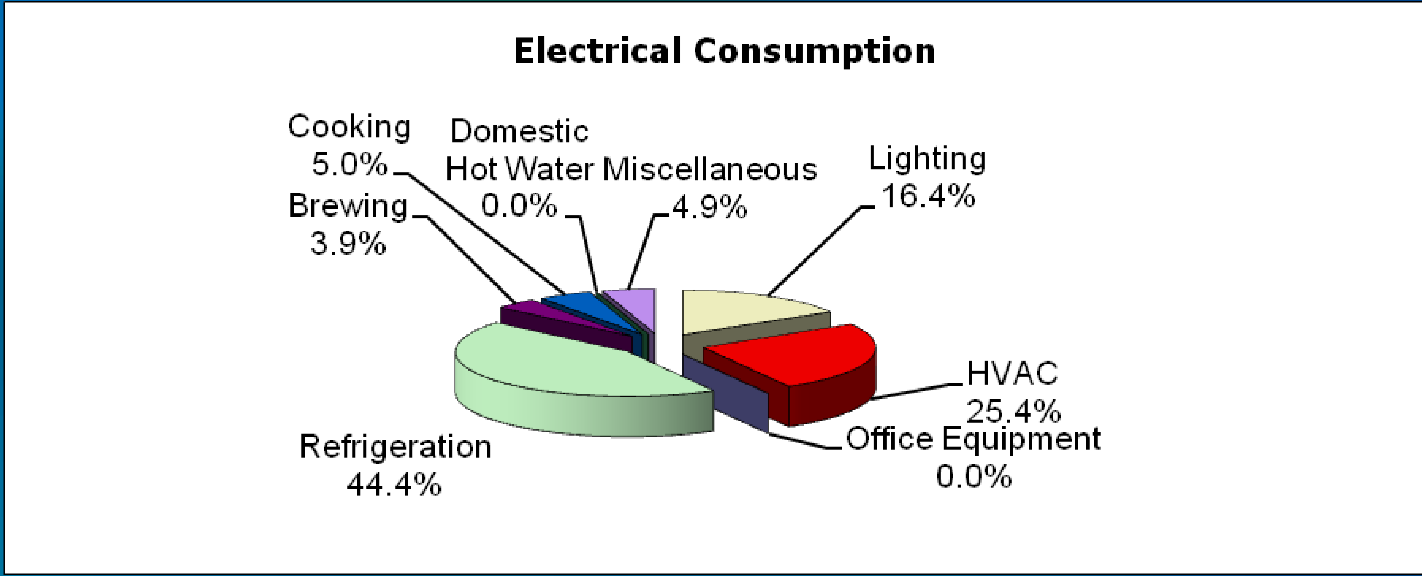


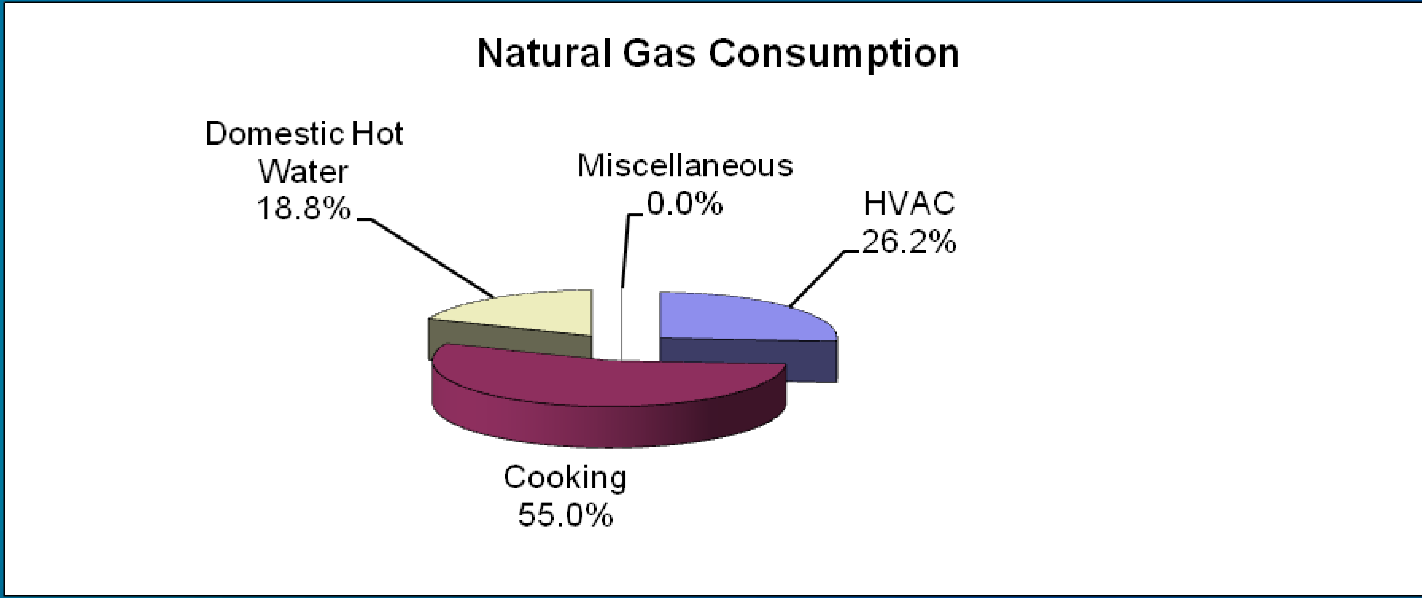
Source: Griffin Consultants.

Honolulu Office Building Actual End Use



Doty Street Pub—Inventory





Examples of End-Use Energy Calculations

Lighting example:

46 lamps × 52 watts/lamp × 0.95 load factor × 6516 h/yr × 0.001 kW/watt

→ 14,807 kWh/yr

Fan example: 1.3 hp × 0.746 kWh/hp × 90% efficiency × 65% full load for fixed-speed motor × 1200 h/yr → 840 kWh/yr

Exercise 6: System Target Case

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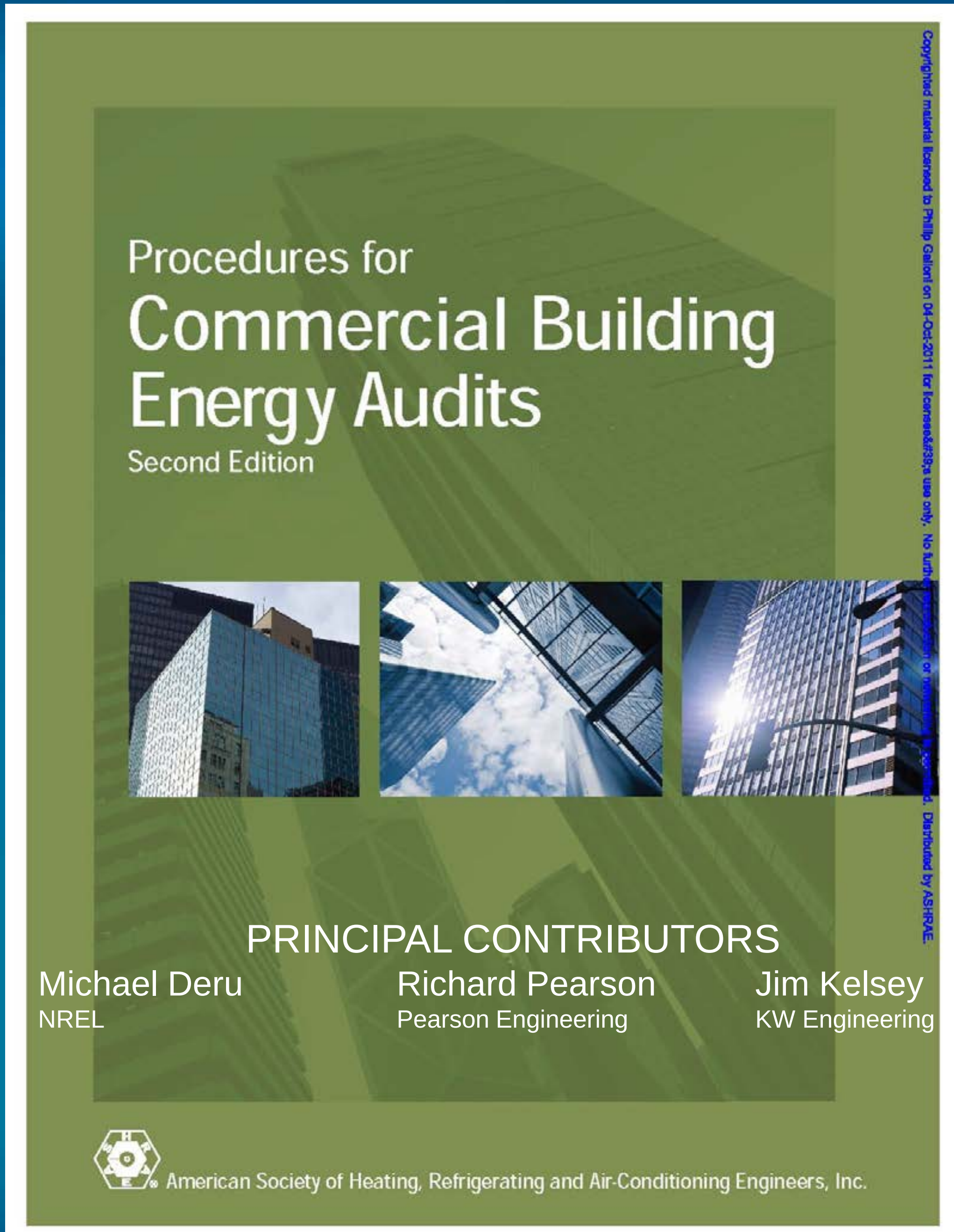
in the
exercises

An Introduction to Energy Audits:

The foundation for
smart capital investment
and
a source of O&M ideas



A LEED Existing Buildings Reference

What is an Energy Audit?

- An energy audit "…identifies and develops modifications that will reduce the energy use and/or cost of operating a building."*
- ASHRAE defines three levels of energy audit.
- There are tasks and deliverables at each level.

**Procedures for Commercial Building Energy Audits* (2011)

*ASHRAE Standard 211

Objectives of an Energy Audit

- Collect and analyze historical energy usage/cost
- Study the building and its operation
- Identify potential modifications
- Perform an engineering and economic analysis
- Prepare a rank-ordered list of modifications
- Prepare a report/provide recommendations

What You Can Get…

- Level I
  - New ideas for low cost/no cost changes
  - Ideas for capital changes
- Level II
  - All practical changes to procedures and settings
  - List of capital projects; estimated costs and benefits
- Level III
  - Detailed economic and engineering basis for capital projects

Table 1 — Energy Audit Required Tasks

Process	Level 1	Level 2	Level 3
Conduct PEA	•	•	•
Conduct walk-through survey	•	•	•
Identify low-cost/no-cost recommendations	•	•	•
Identify capital improvements	•	•	•
Review mechanical and electrical (M&E) design and condition and O&M practices		•	•
Measure key parameters		•	•
Analyze capital measures (savings and costs, including interactions)		•	•
Meet with owner/operators to review recommendations		•	•
Conduct additional testing/monitoring			•
Perform detailed system modeling			•
Provide schematic layouts for recommendations			•

Report	Level 1	Level 2	Level 3
Estimate savings from utility rate change	•	•	•
Compare EUI to EUIs of similar sites	•	•	•
Summarize utility data	•	•	•
Estimate savings if EUI were to meet target	•	•	•
Estimate low-cost/no-cost savings		•	•
Calculate detailed end-use breakdown		•	•
Estimate capital project costs and savings		•	•
Complete building description and equipment inventory		•	•
Document general description of considered measures		•	•
Recommend measurement and verification (M&V) method		•	•
Perform financial analysis of recommended EEMs		•	•
Write detailed description of recommended measures			•
Compile detailed EEM cost estimates			•

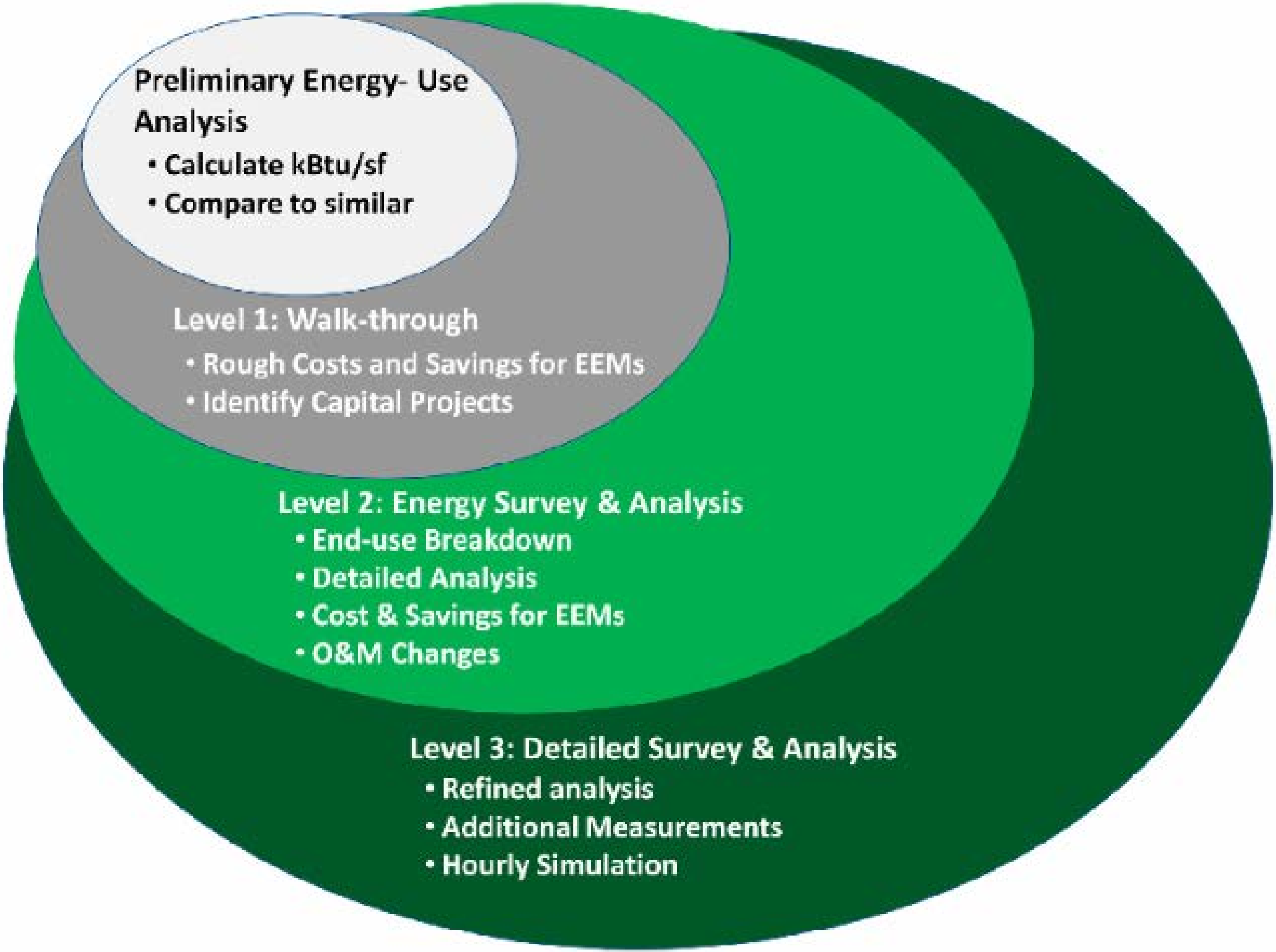


Figure 1 — Relationships of ASHRAE Energy Audit Levels 1, 2, and 3

Energy Audits and Capital Projects

Levels II and III give the economic and engineering foundation for capital projects

- In the context of proper O&M procedures
- Understanding the organization’s capacity to incorporate the changes

Energy Audits II and III reduce the risk of unexpected results in capital projects

How You Can Use the ASHRAE Definitions of Energy Audits I, II, III

As a building owner:

- Cite the definitions (cut and paste) for RFP
- Compare vendor offerings to the definitions to negotiate proposed services

As a vendor:

- Cite the definitions (cut and paste) in your responses to RFP
- Use the outlines to organize your reports

Exercise 7: Audit Level Examples

Project Information

Owner: IFA
Client: Fairmont Hotels
Contract Type: Guaranteed Savings Energy Performance Contract
Area: 90,000 m²

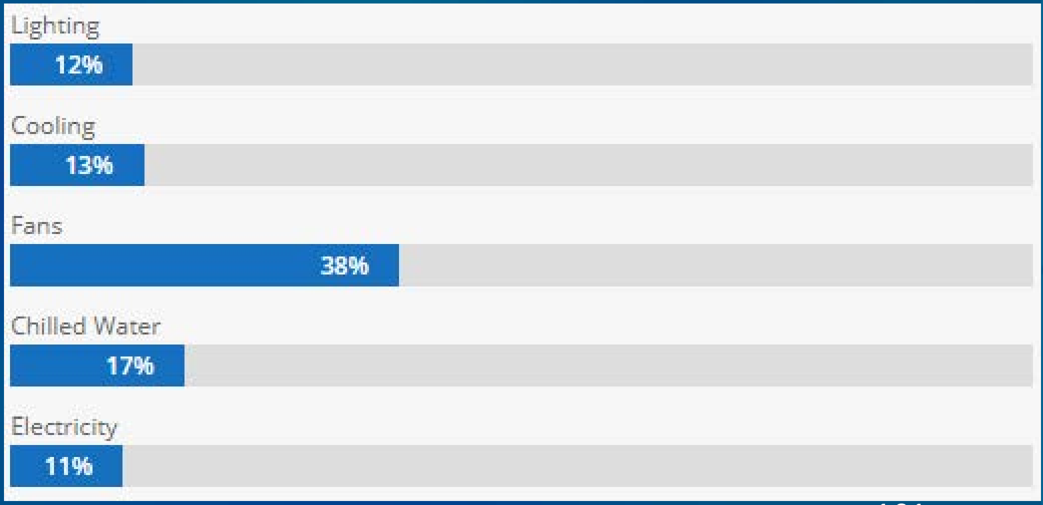
Source : takasolutions

Project Summary

The Fairmont Palm is a world class 5-star hotel located on the trunk of the Palm Jumeirah in Dubai, UAE. The 300 room beach resort includes a spa, conference center, penthouses and 7 food and beverage outlets. takasolutions supports the team via a guaranteed savings energy performance contract.

Savings

19% Savings
400,000 tons of CO_2 Saved
12,847 MWh / Year Saved



Results

takasolutions works with the hotel management team to provide energy auditing, package procurement, implementation management and energy management for energy services. Ongoing M&V and operations over the contract period will offer energy insight, reporting and a guarantee of savings.

Energy Audit Case Studies

Source: Griffin Consultants

Project Information

Contract Type: ASHRAE Level III EA Implementation (Retrofit of residential communities)

Community: Discovery Gardens residential community

Project Summary

The project involves energy audit (EA) of a representative residential building and community-wide EA implementation in three phases.

Phase 1 – 4 buildings; Phase 2 – 28 buildings; Phase 3 – 27 buildings

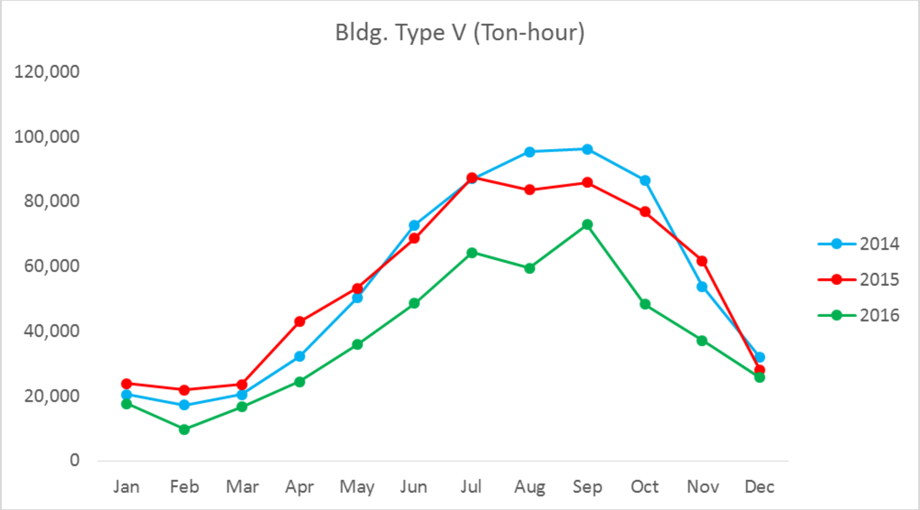
Results

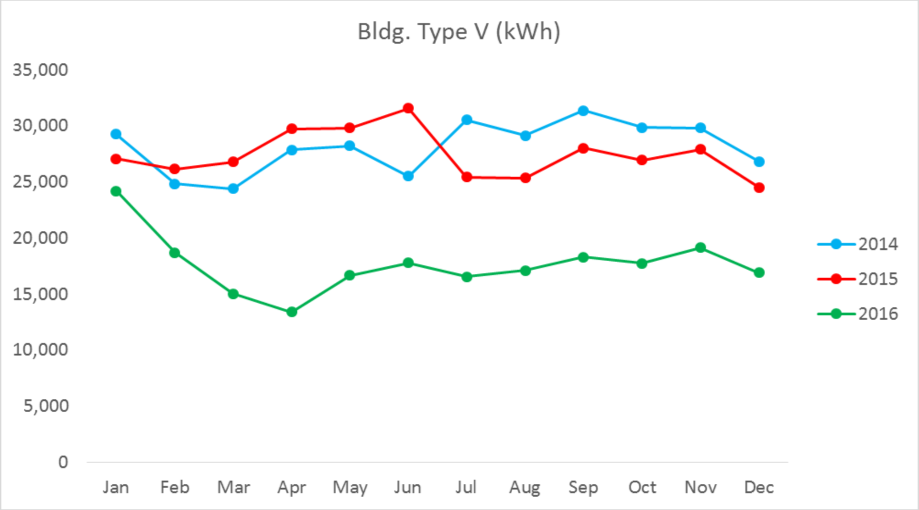
- No/ low cost ECMs:
  - Reduction in exhaust airflows to ASHRAE minimum requirements
  - Replacement of FAHU pulley to reduce fan motor power
  - Resetting of DPT points for chilled water pumps
- Total cost savings equivalent to **AED 3 million/ annum**
- Simple pay-back of **5 months**

Energy Audit Case Studies

Source :Griffin Consultants

Phase 1 Implementation – Total consumption





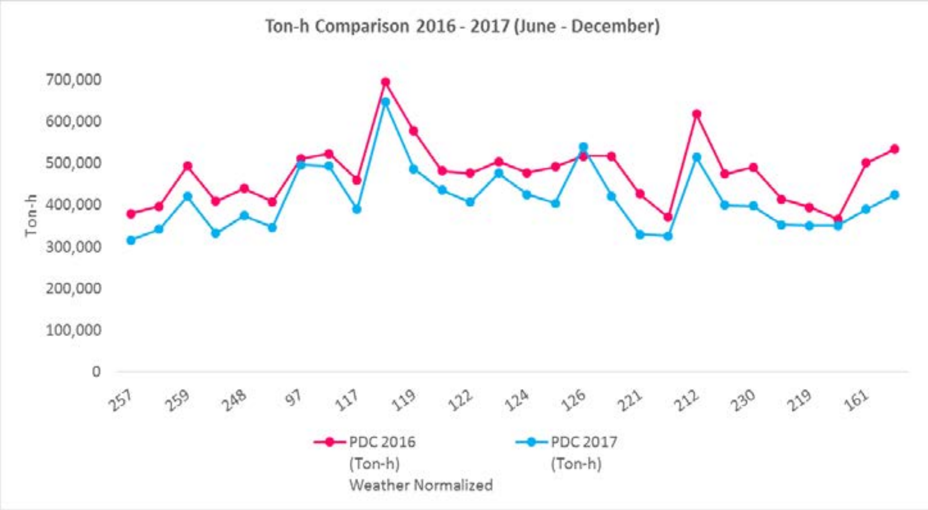
Implementation period for ECMs – January to March 2016

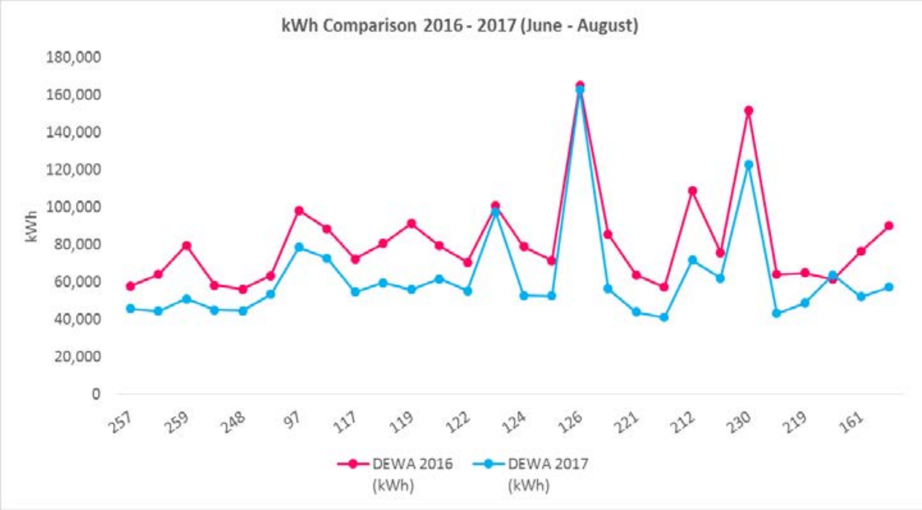
Savings comparison – April to December 2014, 15, 16

Energy Audit Case Studies

Source: Griffin Consultants

Phase 2 Implementation – Total consumption





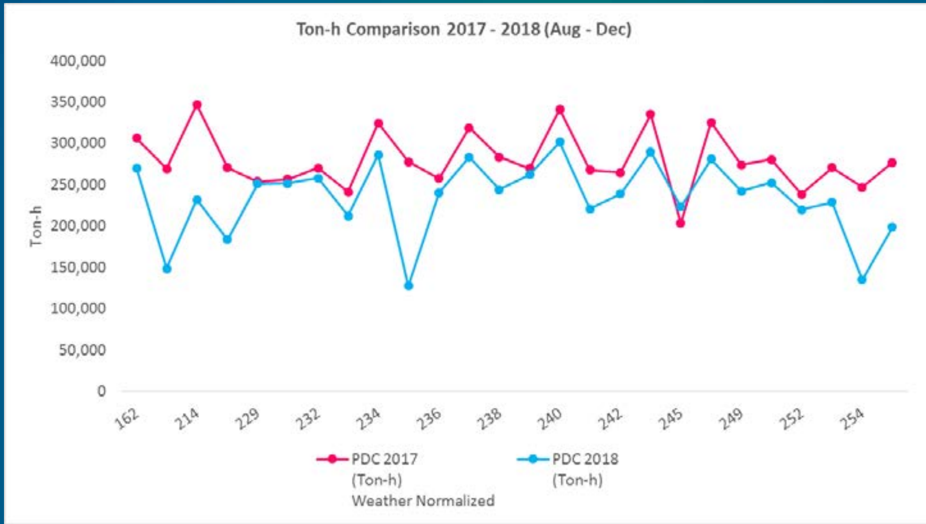
DC savings comparison period – June to December

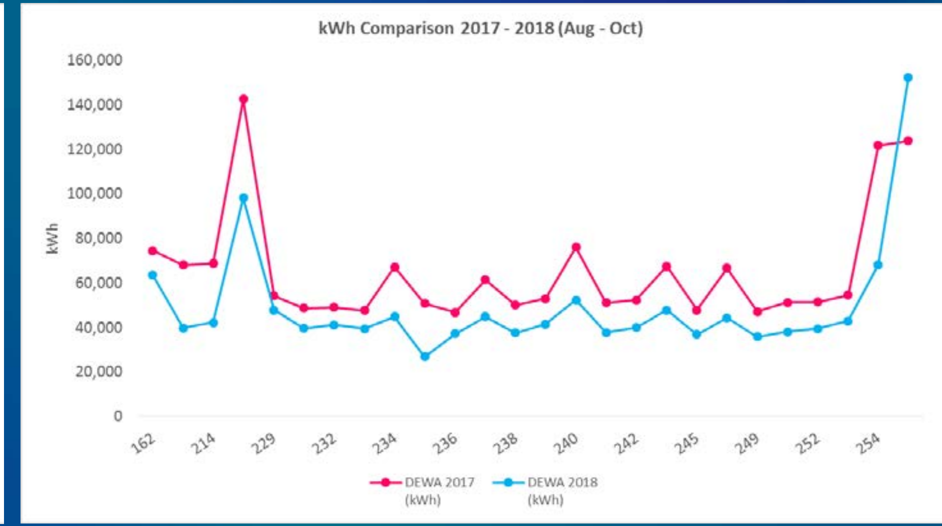
Electricity savings comparison period – June to August

Energy Audit Case Studies

Source: Griffin Consultants

Phase 3 Implementation – Total consumption





DC savings comparison period – August to December

Electricity savings comparison period – August to October

Exercise 7: Audit Level Examples

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in the
exercises

Exercise 7: Audit Level Examples

Audit of a Military Base Building, Okinawa, Japan

Read the audit report's Executive Summary to answer the questions. Pay particular attention to the paragraph preceding Table 1. (The Table of Contents is included for reference.)

1. Here are five statements that include major elements of ASHRAE Audits II and III
   - A. The audit has an analysis of current energy use
   - B. The audit outlines the costs and savings of major energy efficiency measures (EEMs)
   - C. Specific operations and maintenance recommendations are listed in the Table of Contents
   - D. Capital project recommendations are given (with costs and savings).
   - E. The report offers detailed analysis of capital projects, including energy simulations to justify recommendations.

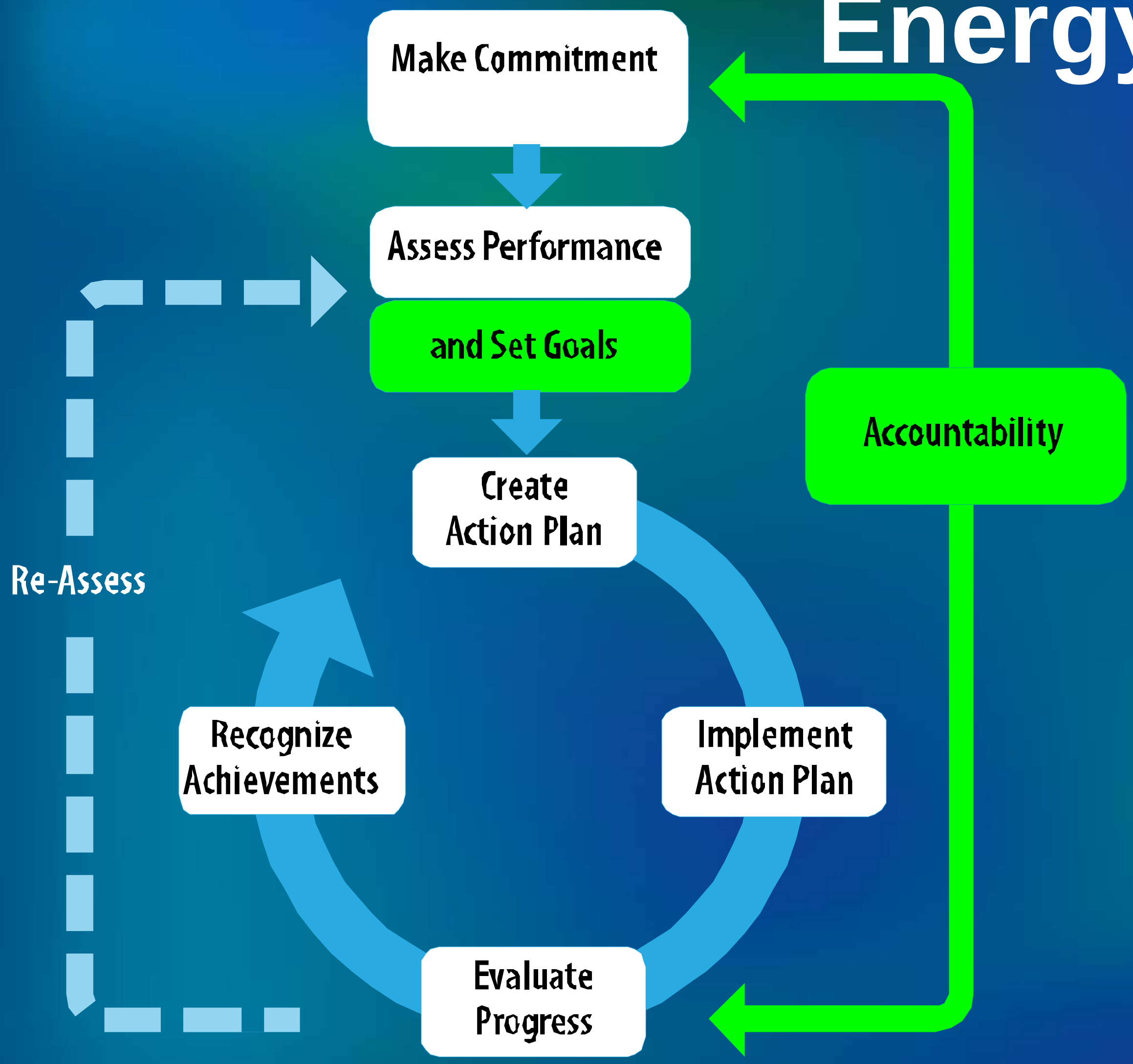
What About Commissioning?

- Commissioning
- Recommissioning
- Retrocommissioning

2015 *ASHRAE Handbook—*
HVAC Applications, Chapter 43

ENERGY STAR Guidelines for Energy Management

www.energystar.gov



Benefits of Goal Setting

- Sets the tone for improvement
- Basis to measure success
- Helps the energy team to identify progress and setbacks
- Fosters ownership, creates purpose, and motivates
- Demonstrates commitment
- Creates schedules and milestones

Goals: Corporate Example

ENERGY STAR Partner: 3M

Energy Efficiency Goal: Improve global energy efficiency by 20% between 2006 and 2010, with 2005 as the baseline year. Efficiency will be calculated by dividing 3M net sales by 3M total energy use.

Progress: Through 2008, energy efficiency has been improved by 19.2%.

Level II and III Audits: Ingredients for Goals for a Building

Energy Efficiency Measure (EEM): AHU Variable Frequency Drives	**Estimated Impact Calculation**
Existing System Simulation	843,961 kWh/year
EEM Simulation	705,903 kWh/year
EEM Energy Savings	138,058 kWh/year
EEM $ Savings	$22,918/year
EEM construction cost (Engineering not included)	$63,100
EEM Simple Payback	2.75 years

SMART Goals—Reminder

- Specific
- Measurable
- Attainable
- Relevant
- Time framed

Setting the Goal—Example

We will document 5% electrical energy savings over eight weeks at the Hilldale facility.

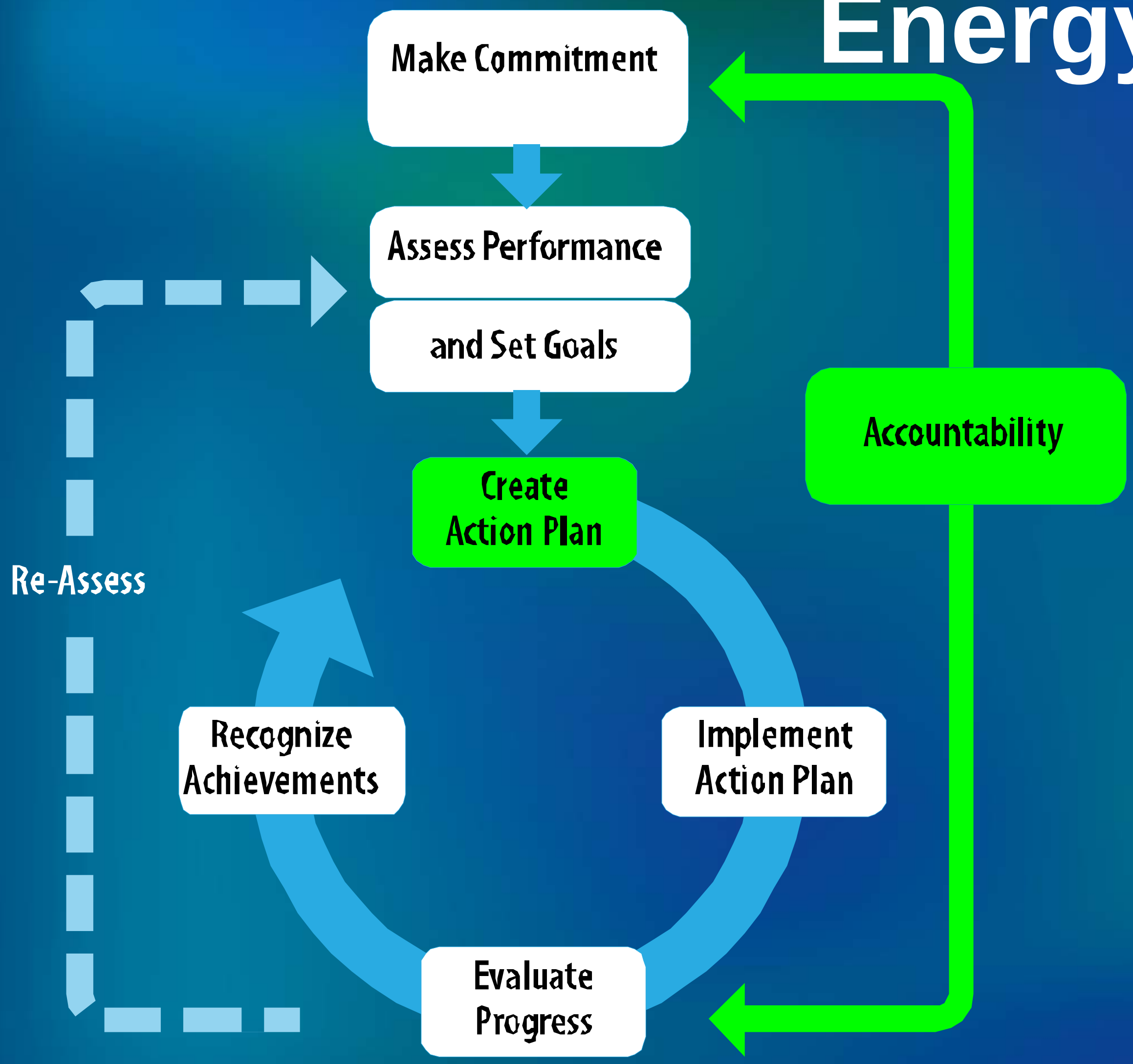
Table discussion: How SMART is the Great Dane goal?

Action Plans: Ideas and a Test Method

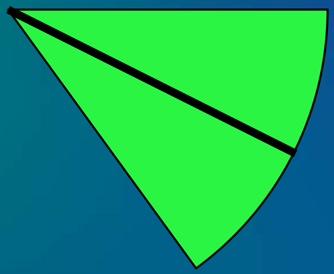
Now that I have a target building, how do I start saving energy?

ENERGY STAR Guidelines for Energy Management

www.energystar.gov



Two Types of Action



- Discretionary facility operation
- Capital improvements

Learning by Doing: "Reverse" Energy Audit Process

- Low-cost actions decrease utility costs first
- Knowledge and skill built by facility staff
- In-depth audit and capital improvements follow, on firm foundation

"The most thorough energy conservation program begins at the end of each distribution system and works back to the Central Plant."

- John Freund, John Deere Corp.

HPAC, September 1980, p.58

….So, start with end uses !

A General Sequence of Systems to Tackle

- Lighting
- Fan systems
- Pumping systems
- Boilers and chillers

Easier to harder

Sample Discretionary Actions—Lighting

Easier to harder

- Match operating hours to activities
  - Unoccupied lighting
  - Existing custodial lighting
- Take advantage of daylight
- Check delays on occupancy sensors
- Assure appropriate foot-candles for tasks (lumens)
- Install high-Kelvin lamps

Sample Discretionary Actions—Fan Systems

- Match running time to activities
- Lower hot-air temperatures
- Raise cold-air temperatures
- Lower fan pressure in ducts
- Adjust static pressure set points
  - Manual reset
  - Dynamic reset using damper positions
- Minimize outdoor air quantities
- Minimize exhaust quantities
- Match ventilation to number of occupants
- De-energize exhaust fans and close OA dampers when unoccupied

Easier to harder

Major Tip

To warm or cool the building ahead of occupancy, be sure that outdoor air dampers are closed until occupancy.

Sample Discretionary Actions—Fan Systems (*cont.*)

- Make best use of economizer operation
- Eliminate simultaneous heating and cooling
- Reduce airflow in constant volume (CV) systems
- De-energize non-essential loads
- Seal leaky ducts
- Convert CV systems to VAV

Easier to harder

Sample Discretionary Actions—Pumping Systems

- Match running time to activities
- De-energize non-essential loads
- Verify proper flow
  - Throttle balance valves
  - Trim pump impellers
- Lower pressure set point to optimize variable flow
  - Manual reset
  - Dynamic reset
- Convert CV system to variable flow

Easier to harder

Sample Discretionary Actions—Boilers

Easier to harder

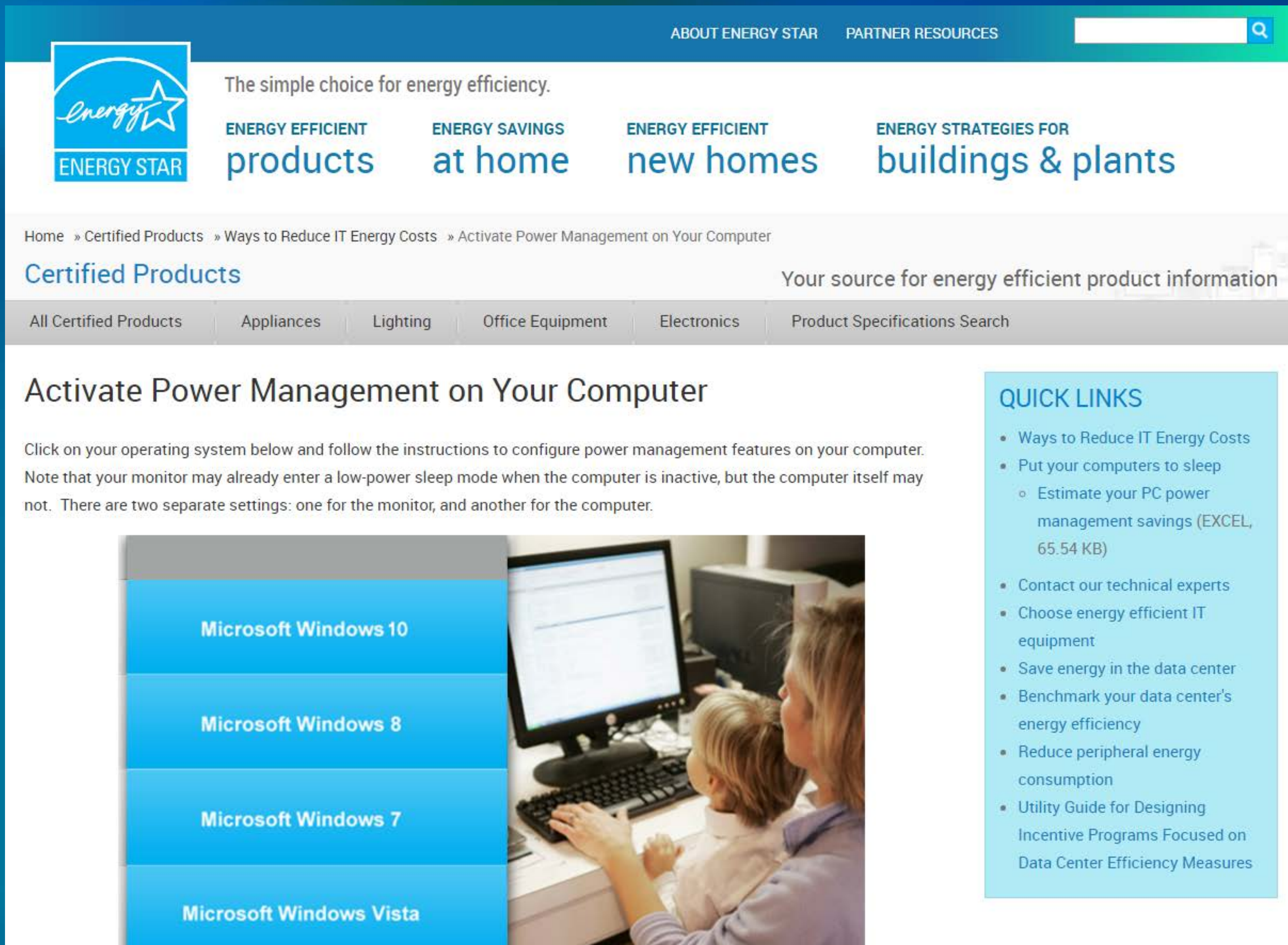
- Lower hot-water temperatures
- If steam, lower steam pressure
- Install modulating burners (linkage-less)
- Optimize boiler sequencing
- Minimize losses in de-energized boilers

Sample Discretionary Actions—Chillers

Easier to harder

- Match running time to activities
- Raise chilled-water set points
- Reduce condenser water temperature
- Optimize cooling tower fan speed
- Optimize chiller staging
- Minimize chiller cycling
- Reduce chilled-water flow

ENERGY STAR IT Tools


ABOUT ENERGY STAR PARTNER RESOURCES

energy ENERGY STAR

The simple choice for energy efficiency.

ENERGY EFFICIENT products | ENERGY SAVINGS at home | ENERGY EFFICIENT new homes | ENERGY STRATEGIES FOR buildings & plants

Home » Certified Products » Ways to Reduce IT Energy Costs » Activate Power Management on Your Computer

Certified Products

Your source for energy efficient product information

All Certified Products | Appliances | Lighting | Office Equipment | Electronics | Product Specifications Search

Activate Power Management on Your Computer

Click on your operating system below and follow the instructions to configure power management features on your computer. Note that your monitor may already enter a low-power sleep mode when the computer is inactive, but the computer itself may not. There are two separate settings: one for the monitor, and another for the computer.

Microsoft Windows 10

Microsoft Windows 8

Microsoft Windows 7

Microsoft Windows Vista

QUICK LINKS

- Ways to Reduce IT Energy Costs
- Put your computers to sleep
  - Estimate your PC power management savings (EXCEL, 65.54 KB)
- Contact our technical experts
- Choose energy efficient IT equipment
- Save energy in the data center
- Benchmark your data center's energy efficiency
- Reduce peripheral energy consumption
- Utility Guide for Designing Incentive Programs Focused on Data Center Efficiency Measures

https://www.energystar.gov/products/low_carbon_it_campaign/power_management_computer

Other Lists of Discretionary Opportunities

Chapter 36, “Energy Use and Management,” 2015 *ASHRAE Handbook—HVAC Applications*

ASHRAE Standard 100-2018, *Energy Conservation in Existing Buildings*

Exercise 8: Ranking Discretionary Actions for Discussion and Application

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in the
exercises

Exercise 8: Discretionary Facilities Operations Checklist

Directions: Check off actions you would like the instructor to discuss further (***More?*** column). We'll take a quick poll of participants as our guide. Use the ***Notes*** column to flag actions you want to investigate when you return to work. (See **slides 152-161** and refer to ASHRAE Standard 100 Informative Annex E for more energy efficiency measures)

More?	Discretionary Facilities Operation Actions	Notes for your buildings
	Lighting	
	• Match operating hours to activities	
	• Replace lamps with LED or low-wattage fluorescent	
	• Take advantage of daylight	
	• Check delays on Occupancy Sensors	
	• Assure appropriate Foot-candles (lumens)	

BREAK!

Handouts

1. Course exercises
2. Energy Management Session Supplement
3. “Focus on Energy” best practices spreadsheets
4. WA Energy Audit checklists
5. References
6. Advocate Healthcare EM operational checklists
7. Aurora walk-thru audit notes
8. Excerpts from ASHRAE Standard 100-2018
9. ENERGY STAR Guidelines for Energy Management

Wisconsin's Focus on Energy

Best Practices Spreadsheets

focus on energy℠

The power is within you.

Wisconsin's Focus on Energy

Best Practices Spreadsheets

- **Air handlers**
- **Boilers**
- **Chillers**
- **Cooking**
- **Domestic hot water**
- **HVAC**
- **Lighting**
- **Miscellaneous equipment**
- **Refrigeration**

focus on energy™
The power is within you.

Air-Handlers Best Practices

- **Install variable-speed controls on air handler supply fan**
- **Convert air handling system from constant volume to variable air flow**
- **Convert dual duct or multizone air handling system to variable air flow**
- **Install premium efficiency motors**
- **Install high efficiency AC units or RTUs**
- **Reduce outdoor air intake**
- **Install night setback controls (heating season)**
- **Install night setup controls (cooling season)**

Air-Handlers Best Practices

Variable Speed Drive on an Air Handler

Converting an air handler from one type of control (constant volume to variable air volume) can save heating, cooling and fan energy. Fan energy savings only are calculated by this spreadsheet.

The heating and cooling energy savings are very dependent on type of air handling system, and how the system is operated. Therefore, those savings are not reflected in this spreadsheet.

Air Handlers Best Practices

EXISTING

	Example	System 1
Motor Horsepower	7.5	7.5
Motor Efficiency	85.3%	85.3%
% Full Load	65.0%	65.0%
Annual Operation Hours	2,500	2,500
Conversion Factor	0.746	0.746
kW	4.3	4.3
kWh/yr	10,658	10,658
Average kWh Rate	$0.080	$0.080
Annual Energy Cost	$853	$853

:
Annual operating hours is generally assumed as the open hours.

Sample hours per year defaults:
2000 hrs/yr - Educational (10 hr/day x 200 day/yr)
5760 hrs/yr - Food Sales (16 hr/day x 360 day/yr)
3744 hrs/yr - Food Service (12 hr/day x 6 day/wk x 52 wk/yr)
8760 hrs/yr - Health Care (24 hours per day)
2500 hrs/yr - Office (10 hr/day x 5 day/wk x 50 wk/yr)
3640 hrs/yr - Retail (10 hr/day x 7 days/week x 52 weeks/year)
-
Modify as need to match your use patterns.

PROPOSED

	Example	System 1
Motor Horsepower	7.5	7.5
Motor Efficiency	85.3%	85.3%
VFD Efficiency	98.0%	98.0%
Conversion Factor	0.746	0.746
Savings Factor	0.59	0.59
kW	4.4	4.4
kWh/yr	4,459	4,459
Annual Energy Cost	$357	$357

SAVINGS

	Example	System 1
kW	-0.1	-0.1
kWh/yr	6,199	6,199
Annual Cost Savings	$496	$496
Project cost Estimate	$1,688	$1,688
Incentive	$0	$147
Simple Payback	3.4	3.1

INDEX

Red triangles in the upper right corner means there is a comment explaining the cell.

Index Page | Savings Summary | VFD on AHU Supply Fan | Constant Volume to VAV | Dual Duct or Multi Zor

Ready

Install variable-speed controls on supply fan

Air Handlers Best Practices

Outside Air Reduction

Air handling units serve several functions including space heating, cooling and ventilation. Facility ventilation is generally accomplished by bringing in outside air, mixing it with "return air" at the air handler, and distributing the resulting "mixed air" throughout the facility. Bringing in outside air increases energy consumption during most times of year because the outside air needs to be conditioned. Therefore, it is important to make sure the correct amount of outside air is being supplied to the facility only when needed. Outside air is needed when the facility is occupied, or when large exhaust systems are being operated. The calculations below estimate gas savings associated with an outside air reduction. If the facility is cooled, and/or the ahu fans are shut down during times of reduced ventilation, then there will also be electrical savings.

Tips

1. Turn off unneeded exhaust fans
2. Do not open OA dampers until occupancy

Air Handlers Best Practices

EXISTING	Example	System 1
CFM of Outside Air	3,000	3,000
AHU Motor Size (hp)	5	5
AHU Motor Efficiency	87.5%	87.5%
AHU Motor Load Factor	65%	65%
Hrs/Wk OA is Supplied:	45.0	45.0
Wks/Yr OA is Supplied:	50	50
Heating Balance Point (F):	60	60
Heating Degree Hours:	148,283	148,283
Heating System Efficiency:	80.0%	80.0%
Is the facility cooled?	Yes	Yes
Cooling Balance Point:	65	65
Cooling Degree Hours:	18,690	18,690
EER of Cooling System:	10.2	10.2
Conversion Factor	100,000	100,000
Avg Gas Use (th/yr)	1,485	1,485
Average therm Rate	$0.710	$0.950
kWh/yr	8,332	8,332
Average kWh Rate	$0.080	$0.080
Annual Energy Cost	$1,721	$2,077
PROPOSED		
CFM of Outside Air	600	600
Hrs/Wk OA is Supplied:	37.5	37.5
Wks/Yr OA is Supplied:	50	50
Avg Gas Use (th/yr)	248	248
kWh/yr	5,573	5,573
Annual Energy Cost	$622	$681
SAVINGS		
th/yr	1,237	1,237
kWh/yr	2,759	2,759
Annual Cost Savings	$1,099	$1,396
Project cost Estimate	$0	$500
Incentive	$0	$19
Simple Payback	Immediate	0.3

Reduce outdoor air intake

Chillers Best Practices

- **High efficiency chillers**
- **Chilled-water reset**
- **Chilled-water pump VFD**

Chillers Best Practices

Chilled Water Reset

Chilled water temperature is often kept at a fixed set point. However, chillers tend to operate more efficiently, and have more cooling capacity if they are operated at higher chilled water temperatures. To increase chiller efficiency, chilled water temperature can be adjusted automatically based on the outside air temperature.

Tips

1. Increase chilled-water temperature: save 1.5% power per 0.55°C
2. Decrease condenser water temperature: save 1.5% power per 0.55°C

Extreme Example

Increase chilled-water temperature from 5.5°C to 8.9°C **and** decrease condenser water temperature from 25°C to 23.9°C:

Save 13.5% power

Chillers Best Practices

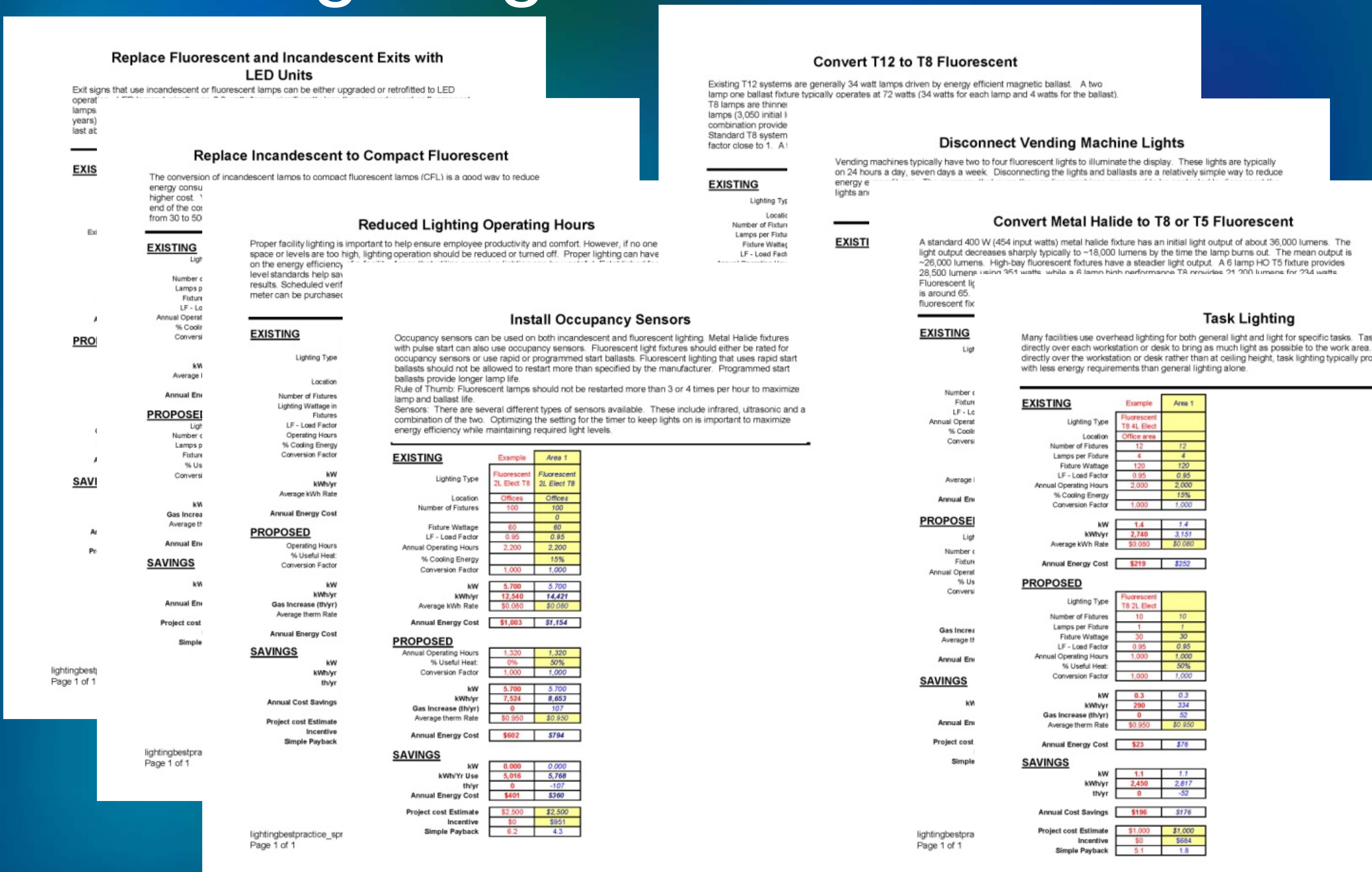
	Example	System 1
EXISTING		
Existing Air Conditioner Size	20	20
Chilled Water Temperature	45	45
Existing Air Conditioner Efficiency (EER/SEER)	10.2	10.2
EqFlHrs	900	900
Unit Conversion (btu/tons)	12,000	12,000
Unit Conversion (watts/kW)	1,000	1,000
kW	23.5	23.5
kWh/yr	21,176	21,176
Average kWh Rate	$0.080	$0.080
Annual Energy Cost	$1,694	$1,694
PROPOSED		
Ave. Chilled Water Temp.:	50	50
Proposed Air Conditioner Efficiency (EER/SEER)	10.7	10.7
Unit Conversion (btu/tons)	12,000	12,000
Unit Conversion (watts/kW)	1,000	1,000
kW	22.4	22.4
kWh/yr	20,187	20,187
Annual Energy Cost	$1,615	$1,615
SAVINGS		
kW	1.1	1.1
kWh/yr	989	989
Annual Cost Savings	$79	$79
Project cost Estimate	$1,000	$1,000
Incentive	$0	$124
Simple Payback	12.6	11.1

Chilled-water reset

Lighting Best Practices

- ~~Compact Fluorescents~~ ***LEDs***
- LED exit lights
- Reduced hours of operation
- Occupancy sensors
- Vending machines
- T12 to high-performance T8s
- Metal halide to high-performance T8s or T5s
- Task lighting

Lighting Best Practices



Replace Fluorescent and Incandescent Exits with LED Units

Exit signs that use incandescent or fluorescent lamps can be either upgraded or retrofitted to LED

Replace Incandescent to Compact Fluorescent

The conversion of incandescent lamps to compact fluorescent lamps (CFL) is a good way to reduce

Reduced Lighting Operating Hours

Proper facility lighting is important to help ensure employee productivity and comfort. However, if no one space or levels are too high, lighting operation should be reduced or turned off. Proper lighting can have

Convert T12 to T8 Fluorescent

Existing T12 systems are generally 34 watt lamps driven by energy efficient magnetic ballast. A two lamp one ballast fixture typically operates at 72 watts (34 watts for each lamp and 4 watts for the ballast).

Disconnect Vending Machine Lights

Vending machines typically have two to four fluorescent lights to illuminate the display. These lights are typically on 24 hours a day, seven days a week. Disconnecting the lights and ballasts are a relatively simple way to reduce

Convert Metal Halide to T8 or T5 Fluorescent

A standard 400 W (454 input watts) metal halide fixture has an initial light output of about 36,000 lumens. The light output decreases sharply typically to ~18,000 lumens by the time the lamp burns out. The mean output is ~26,000 lumens. High-bay fluorescent fixtures have a steadier light output. A 6 lamp HO T5 fixture provides

Install Occupancy Sensors

Occupancy sensors can be used on both incandescent and fluorescent lighting. Metal Halide fixtures with pulse start can also use occupancy sensors. Fluorescent light fixtures should either be rated for occupancy sensors or use rapid or programmed start ballasts. Fluorescent lighting that uses rapid start ballasts should not be allowed to restart more than specified by the manufacturer. Programmed start ballasts provide longer lamp life.
Rule of Thumb: Fluorescent lamps should not be restarted more than 3 or 4 times per hour to maximize lamp and ballast life.
Sensors: There are several different types of sensors available. These include infrared, ultrasonic and a combination of the two. Optimizing the setting for the timer to keep lights on is important to maximize energy efficiency while maintaining required light levels.

EXISTING	Example	Area 1
Lighting Type	Fluorescent 2L Elect T8	Fluorescent 2L Elect T8
Location	Offices	Offices
Number of Fixtures	100	100
		0
Fixture Wattage	60	60
LF - Load Factor	0.95	0.95
Annual Operating Hours	2,200	2,200
% Cooling Energy		15%
Conversion Factor	1,000	1,000
kW	5.700	5.700
kWh/yr	12,540	14,421
Average kWh Rate	$0.080	$0.080
Annual Energy Cost	$1,003	$1,154
PROPOSED		
Annual Operating Hours	1,320	1,320
% Useful Heat:	0%	50%
Conversion Factor	1,000	1,000
kW	5.700	5.700
kWh/yr	7,524	8,653
Gas Increase (th/yr)	0	107
Average therm Rate	$0.950	$0.950
Annual Energy Cost	$602	$794
SAVINGS		
kW	0.000	0.000
kWh/Yr Use	5,016	5,768
th/yr	0	-107
Annual Energy Cost	$401	$360
Project cost Estimate	$2,500	$2,500
Incentive	$0	$951
Simple Payback	6.2	4.3

Task Lighting

Many facilities use overhead lighting for both general light and light for specific tasks. Task li directly over each workstation or desk to bring as much light as possible to the work area. Be directly over the workstation or desk rather than at ceiling height, task lighting typically provid with less energy requirements than general lighting alone.

EXISTING	Example	Area 1
Lighting Type	Fluorescent T8 4L Elect	
Location	Office area	
Number of Fixtures	12	12
Lamps per Fixture	4	4
Fixture Wattage	120	120
LF - Load Factor	0.95	0.95
Annual Operating Hours	2,000	2,000
% Cooling Energy		15%
Conversion Factor	1,000	1,000
kW	1.4	1.4
kWh/yr	2,740	3,151
Average kWh Rate	$0.080	$0.080
Annual Energy Cost	$219	$252
PROPOSED		
Lighting Type	Fluorescent T8 2L Elect	
Number of Fixtures	10	10
Lamps per Fixture	1	1
Fixture Wattage	30	30
LF - Load Factor	0.95	0.95
Annual Operating Hours	1,000	1,000
% Useful Heat:		50%
Conversion Factor	1,000	1,000
kW	0.3	0.3
kWh/yr	290	334
Gas Increase (th/yr)	0	52
Average therm Rate	$0.950	$0.950
Annual Energy Cost	$23	$76
SAVINGS		
kW	1.1	1.1
kWh/yr	2,450	2,817
th/yr	0	-52
Annual Cost Savings	$196	$176
Project cost Estimate	$1,000	$1,000
Incentive	$0	$684
Simple Payback	5.1	1.8

Miscellaneous Best Practices

- ENERGY STAR Computers and Monitors
- Replace windows
- Vending machine occupancy sensors
- Add roof insulation
- Reduce infiltration

Miscellaneous Best Practices *(cont.)*

Install Occupancy Sensors on Vending Machines

Vending machines typically operate 24 hours a day, seven days a week. There are a number of products available that turn off the vending machine using an occupancy sensor. When no one is near the machine for a preset amount of time, the unit turns off. When someone walks by, the unit turns on. These devices are also set up to make sure the that the machine maintains beverages at a low temperature. Occupancy sensor units for vending machines typically cost ~$180 per unit.
Rule of Thumb: Installing a occupancy sensor device on a vending machine can typically save $50-$120/machine/year depending on the type of unit and amount of people traffic by the unit. Simple payback range, 1.5 - 4 years.

Miscellaneous Best Practices *(cont.)*

EXISTING	Example	Area 1
Number of Vending Machines	6	6
% Useful Heat:	50%	50%
% AC Savings:	15%	15%
kWh/yr saved per machine	1,800	1,800
kW	None	None
kWh/yr	12,420	12,420
Average kWh Rate	$0.080	$0.080
Gas Increase (th/yr)	230	230
Average therm Rate	$0.950	$0.950
Annual Energy Cost	$775	$775
PROPOSED		
kW	None	None
kWh/yr	0	0
Gas Use (th/yr)	0	0
Annual Energy Cost	$0	$0
SAVINGS		
kW	None	None
kWh/yr	12,420	12,420
Gas Use (th/yr)	-230	-230
Annual Cost Savings	$775	$775
Project cost Estimate	$1,080	$1,080
Incentive	$0	$215
Simple Payback	1.4	1.1

Vending machine occupancy sensors

Wisconsin's Focus on Energy

Best Practices Spreadsheets

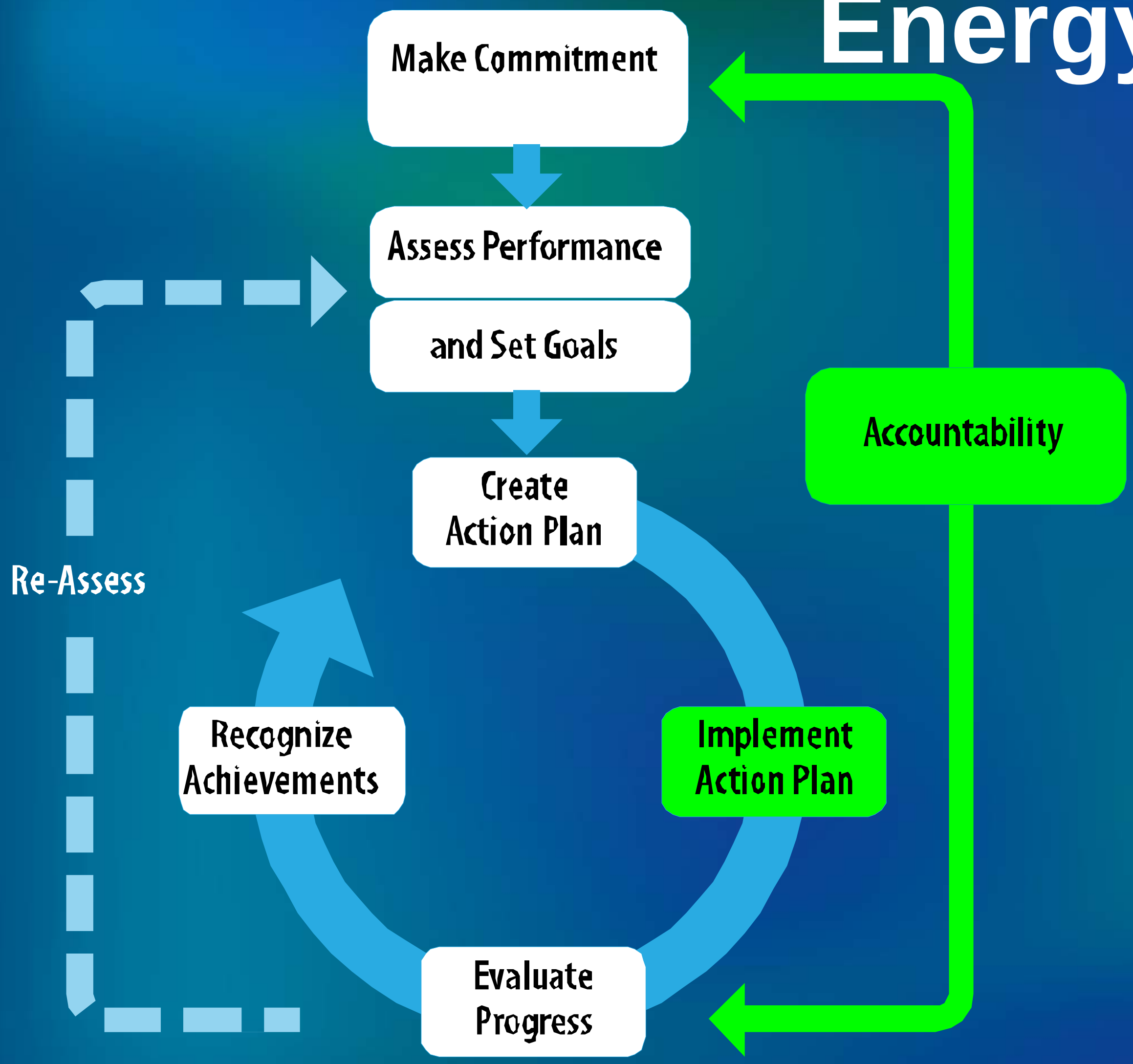
Available in virtual handouts

focus on energy[sm]

The power is within you.

ENERGY STAR Guidelines for Energy Management

www.energystar.gov

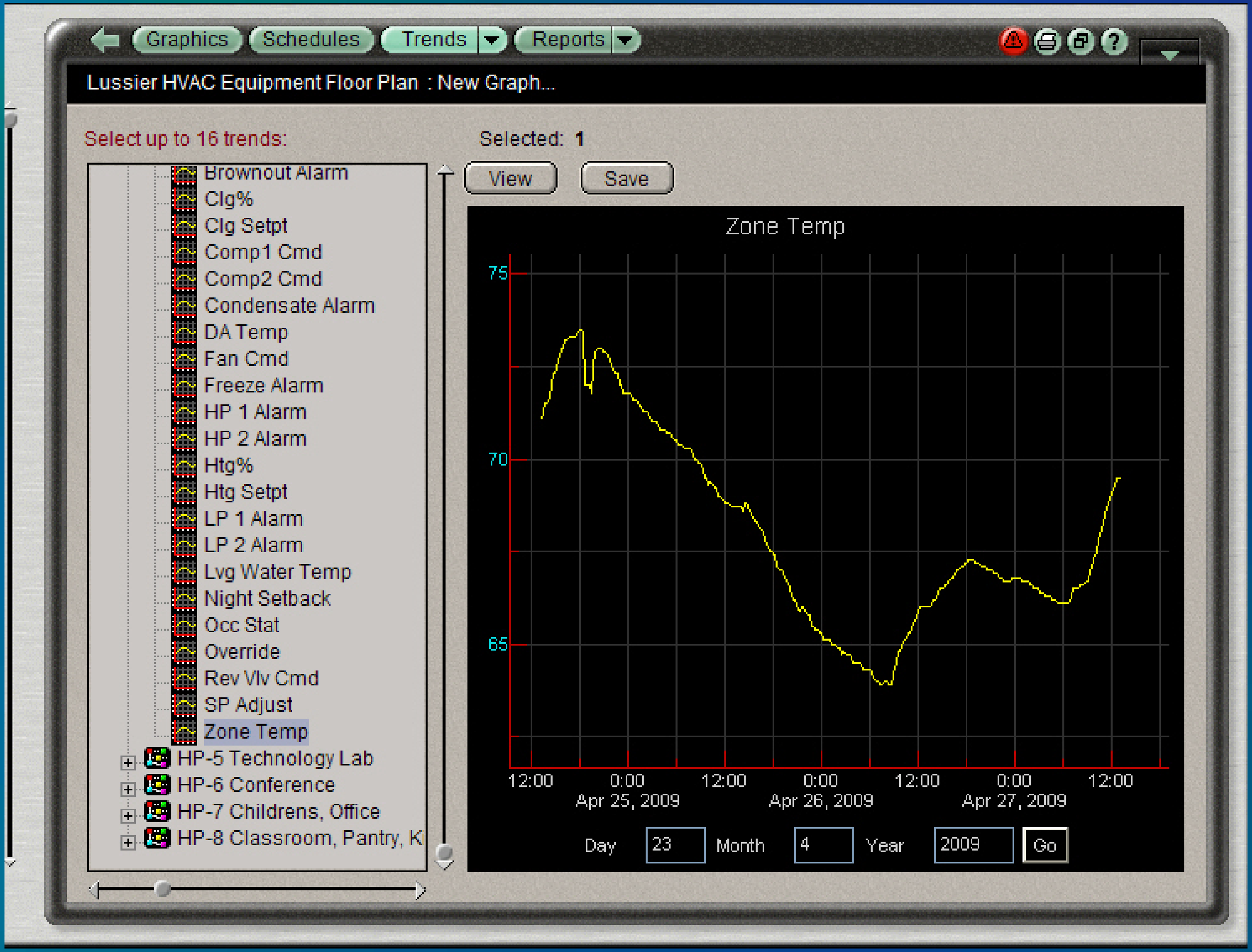


Introducing End-Use Evaluation

Use trend logs or portable data loggers:

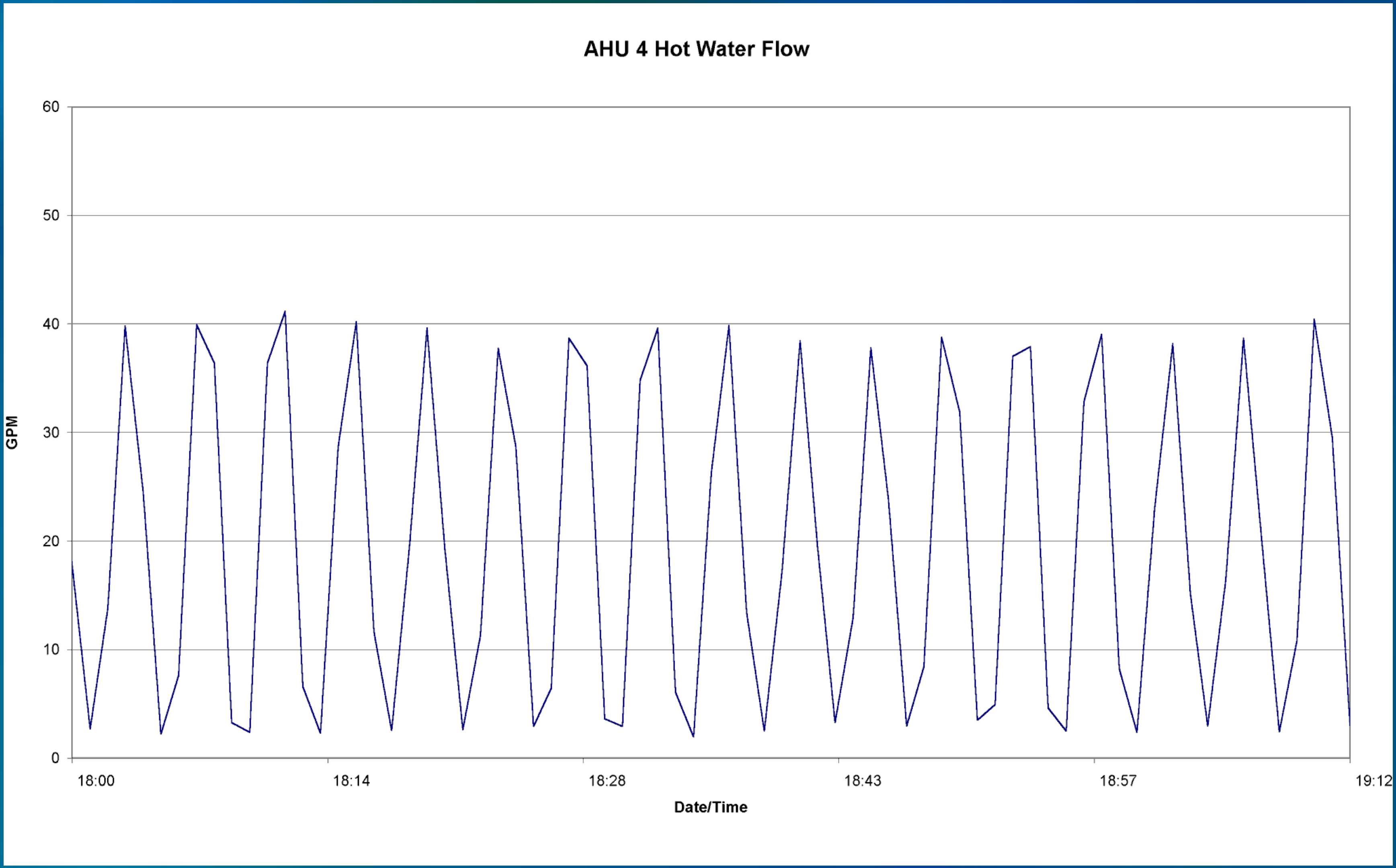
- Runtime
- Temperature and humidity fluctuations
- Electrical use
  - Amps
  - Watts
  - kWh

Trend Logs from Control Systems

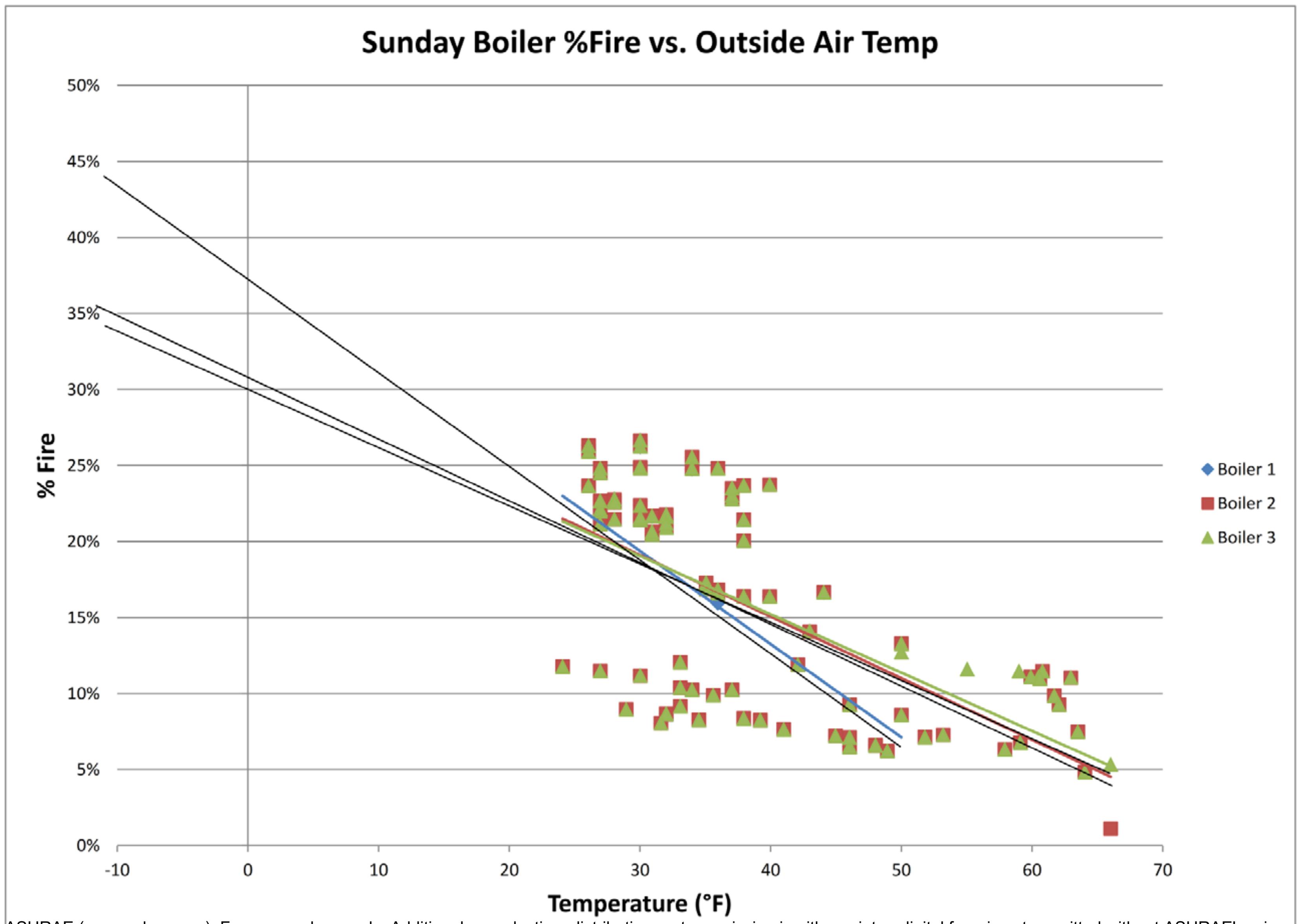


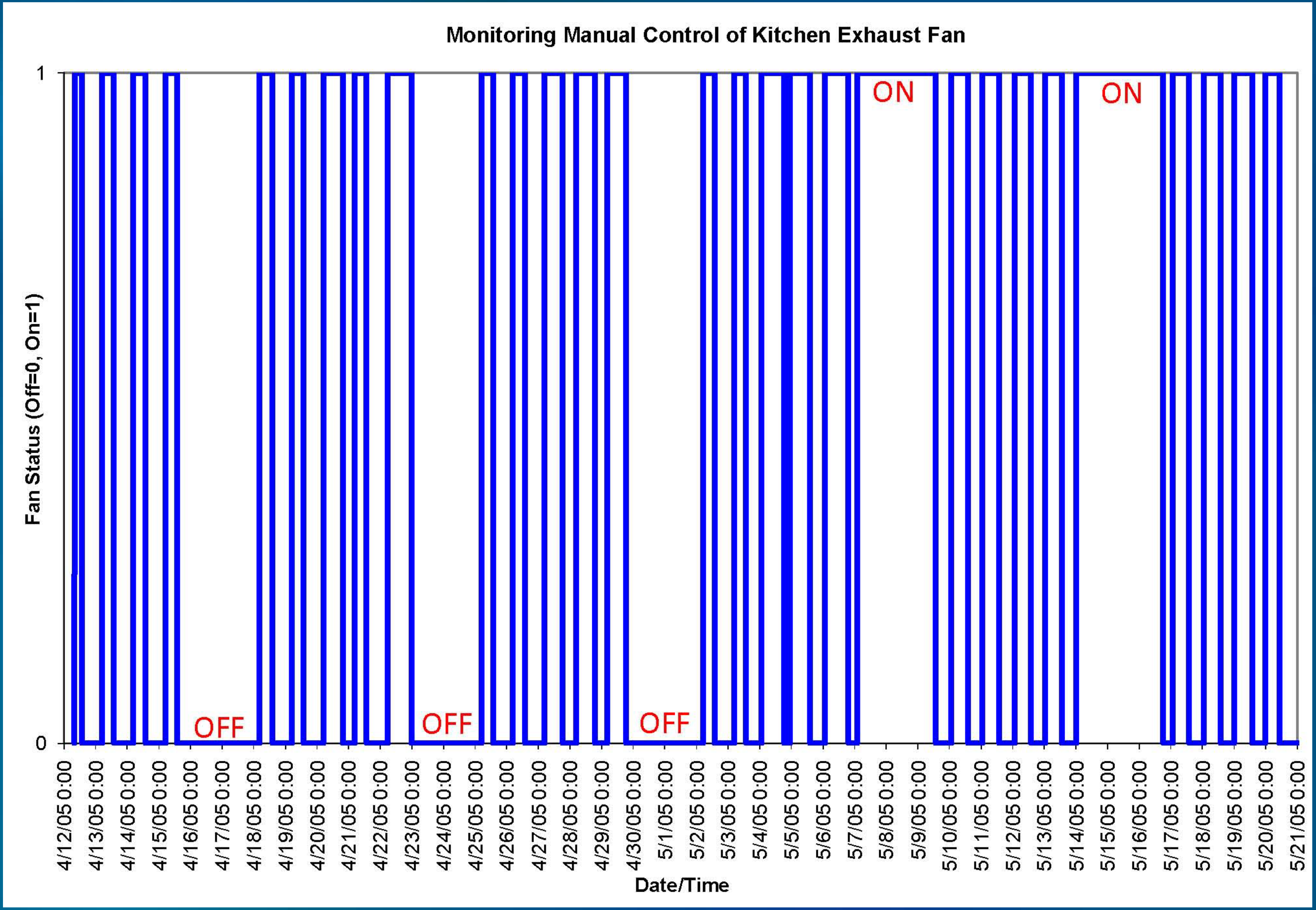
Stand-alone Loggers (Download Data to Analyze)

Motor On-Off Logger (R)
Temp/RH/Light Level (L)

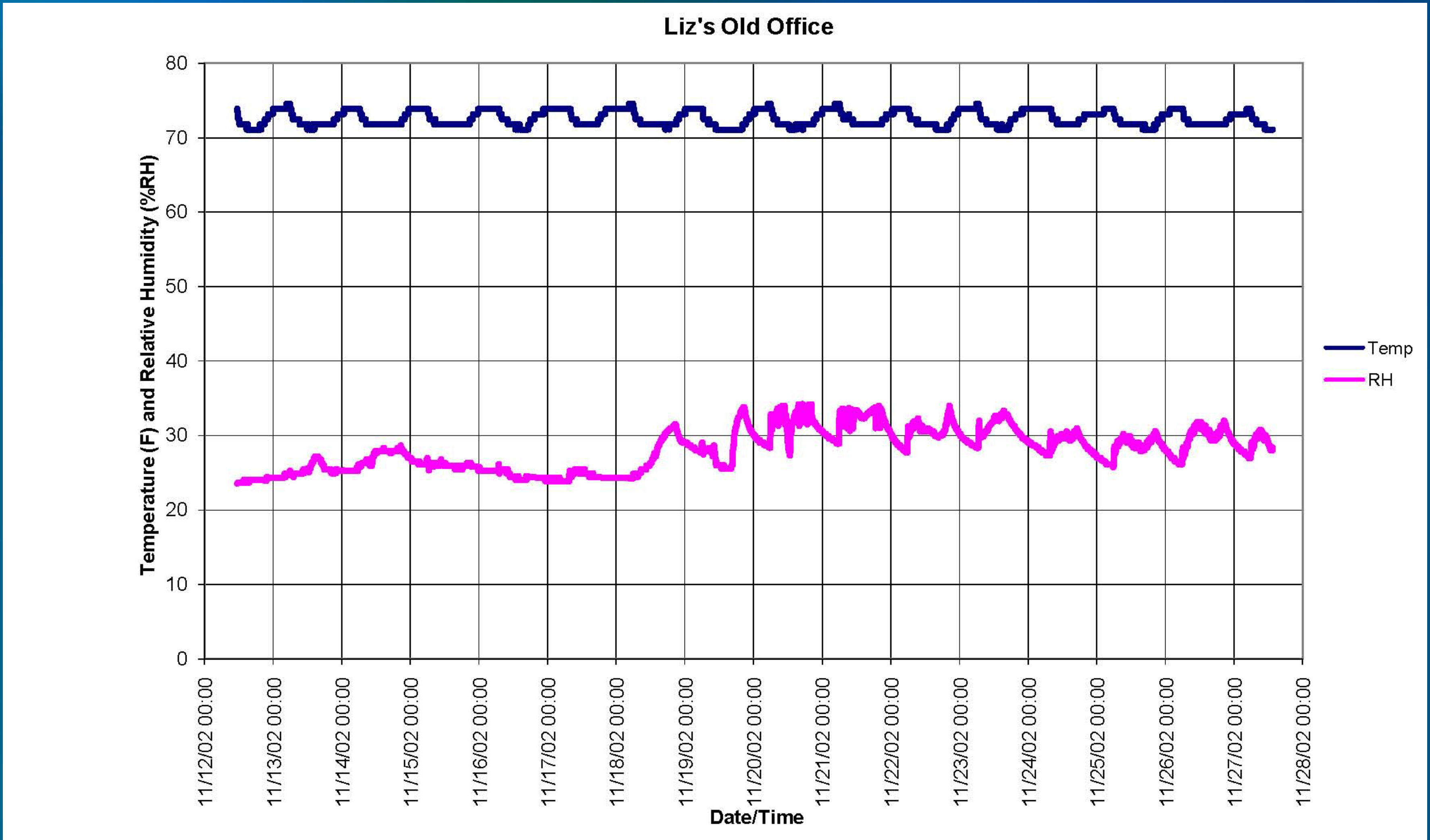

AHU 4 Hot Water Flow
GPM
60
50
40
30
20
10
0
18:00
18:14
18:28
18:43
18:57
19:12
Date/Time

Boiler Fire Rate Versus OA Temperature

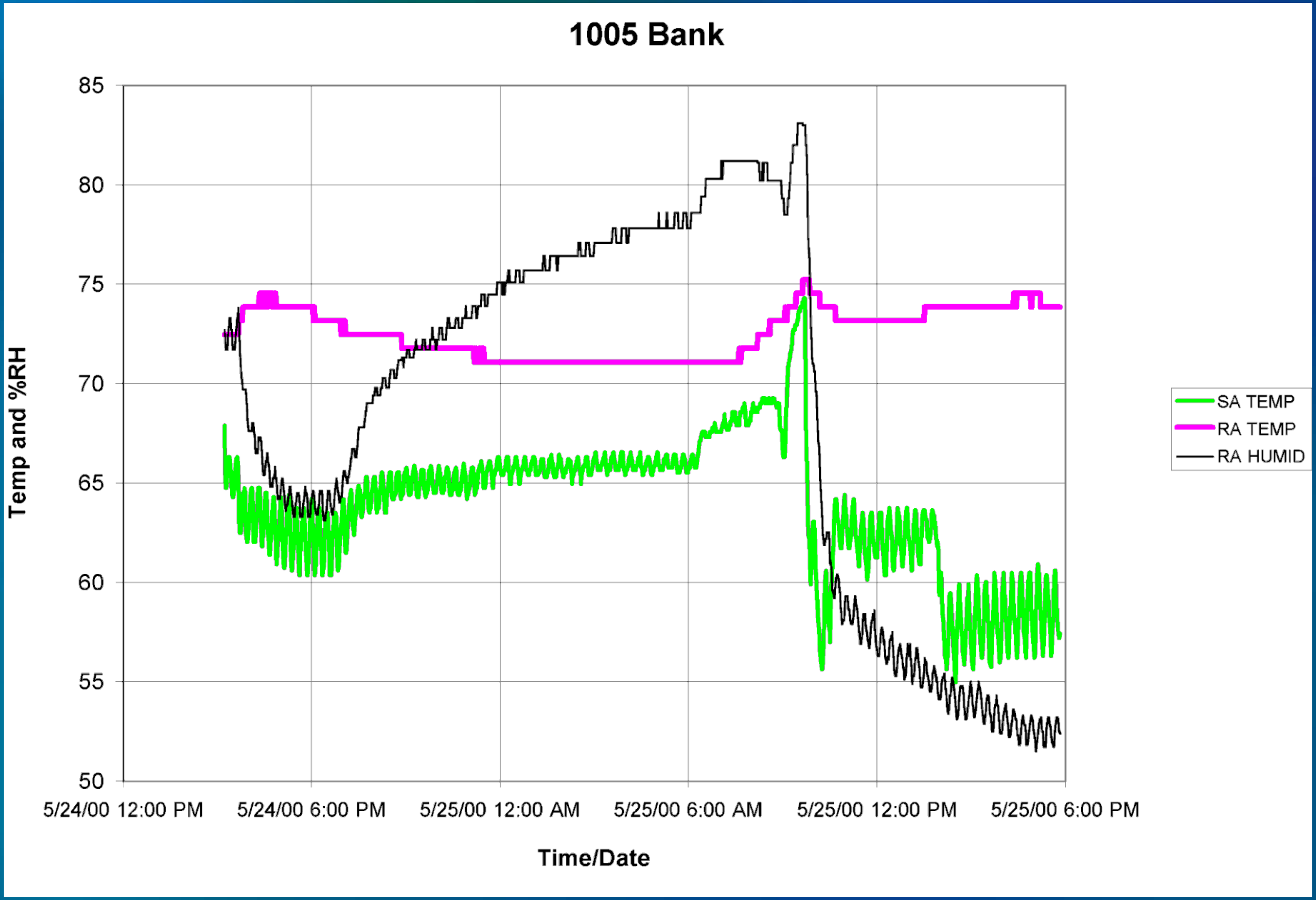



Monitoring Manual Control of Kitchen Exhaust Fan
Fan Status (Off=0, On=1)
1
0
OFF
OFF
OFF
ON
ON
4/12/05 0:00
4/13/05 0:00
4/14/05 0:00
4/15/05 0:00
4/16/05 0:00
4/17/05 0:00
4/18/05 0:00
4/19/05 0:00
4/20/05 0:00
4/21/05 0:00
4/22/05 0:00
4/23/05 0:00
4/24/05 0:00
4/25/05 0:00
4/26/05 0:00
4/27/05 0:00
4/28/05 0:00
4/29/05 0:00
4/30/05 0:00
5/1/05 0:00
5/2/05 0:00
5/3/05 0:00
5/4/05 0:00
5/5/05 0:00
5/6/05 0:00
5/7/05 0:00
5/8/05 0:00
5/9/05 0:00
5/10/05 0:00
5/11/05 0:00
5/12/05 0:00
5/13/05 0:00
5/14/05 0:00
5/15/05 0:00
5/16/05 0:00
5/17/05 0:00
5/18/05 0:00
5/19/05 0:00
5/20/05 0:00
5/21/05 0:00
Date/Time

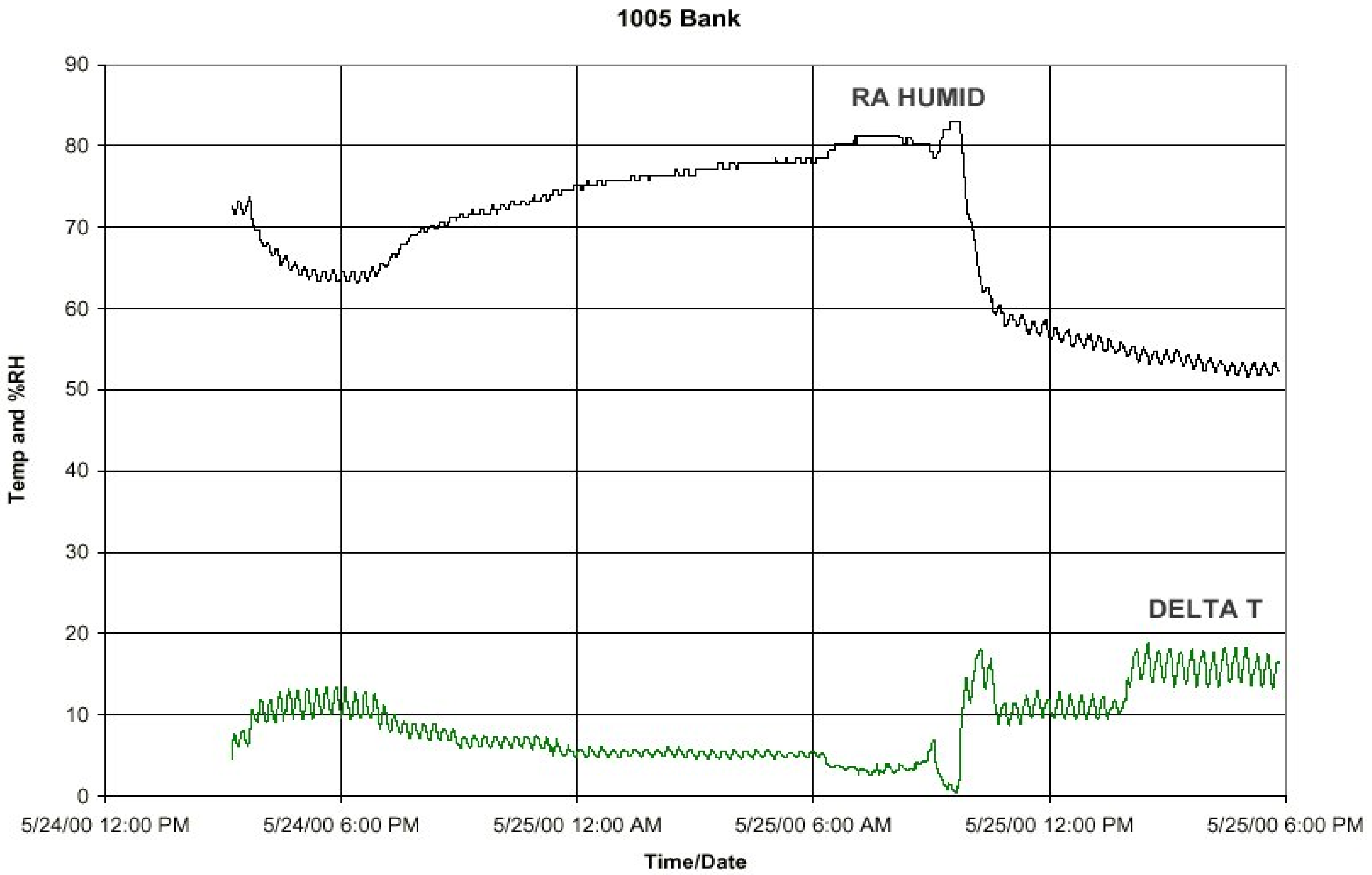
Office Temperature/RH—Verex



Bank Temperature/RH



Bank ΔT Versus %RH



Cooling Coil Rules of Thumb

ΔT of Air	Moisture Removal
2.8° to 4.4°C	zero
4.4° to 6.7°C	barely measurable
6.7° to 8.9°C	good
8.9° to 11.1°C	excellent

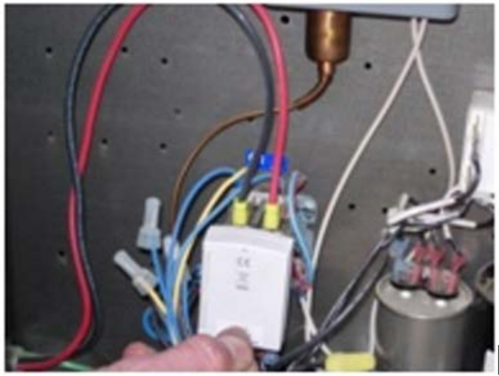
Case Exercise 9: Using Motor Logger Data

Page 30
in the
exercises

Exercise 9: Using Motor Logger Data

A stand-alone "Motor On/Off" logger was placed on the compressor motor controls to track when the Doty Street walk-in freezer compressor turned on and shut off.

← Compressor motor; controls and logger (below)



Disincentives for the Building Engineer

- Risk of occupant discomfort
- Risk of equipment failure
- Experimentation can be terrifying

Incentives for the Building Engineer

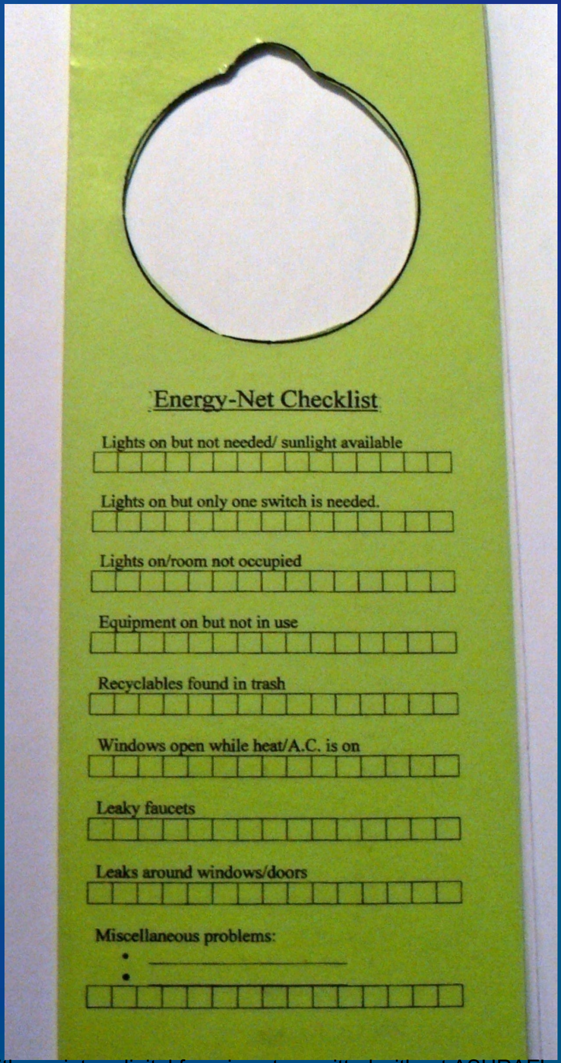
- Regular monitoring by the manager
- Managerial encouragement to experiment
    - Occasional, brief discomfort is OK
- Teamwork
- Accomplishment—getting results
- Perks paid for by savings

So, if the Risk of Change is Worrisome…

- Take **small** steps that are reversible.
- Study your results, communicate, and adjust as needed.
- Engage your boss and occupants in the tests.

Testing School Lighting Changes

Hitch Elementary School, Chicago, IL


Energy-Net Checklist

Lights on but not needed/ sunlight available

Lights on but only one switch is needed.

Lights on/room not occupied

Equipment on but not in use

Recyclables found in trash

Windows open while heat/A.C. is on

Leaky faucets

Leaks around windows/doors

Miscellaneous problems:

-
-

Ingredients for the Test

1. Aim: reduce wasted energy use
2. Measures: 30-minute electric meter use; patrol compliance
3. Change idea: Use daylight when possible in classrooms

Test Plan: Try different levels, just the week before spring vacation.

Tuesday: All lights on

Wednesday: One bank only

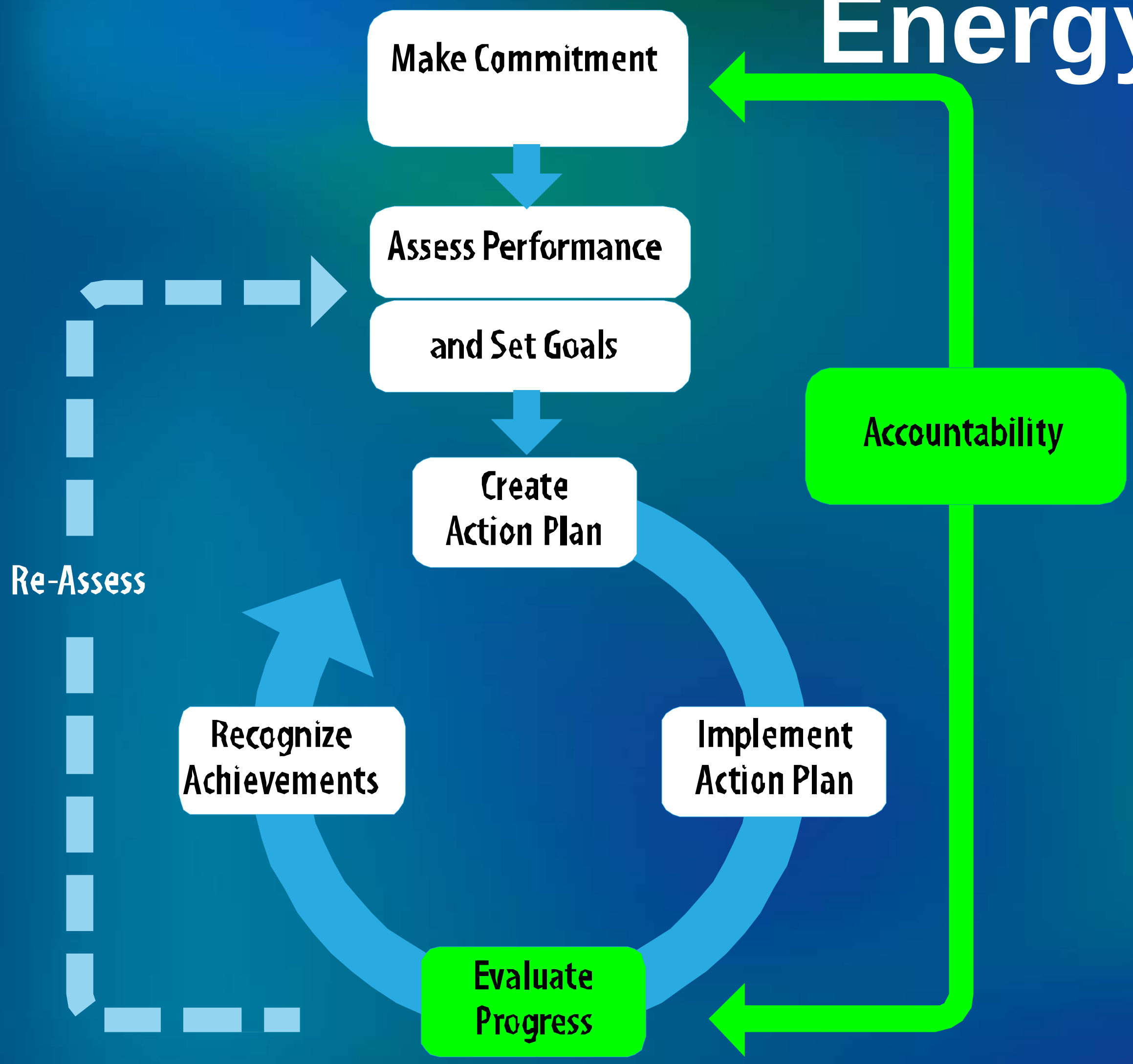
Friday: Daylight only…. Then, vacation!

BREAK!

Evaluating Progress

ENERGY STAR Guidelines for Energy Management

www.energystar.gov



Greener Pastures with Energy Savings

Emissions Reduction at Madison College

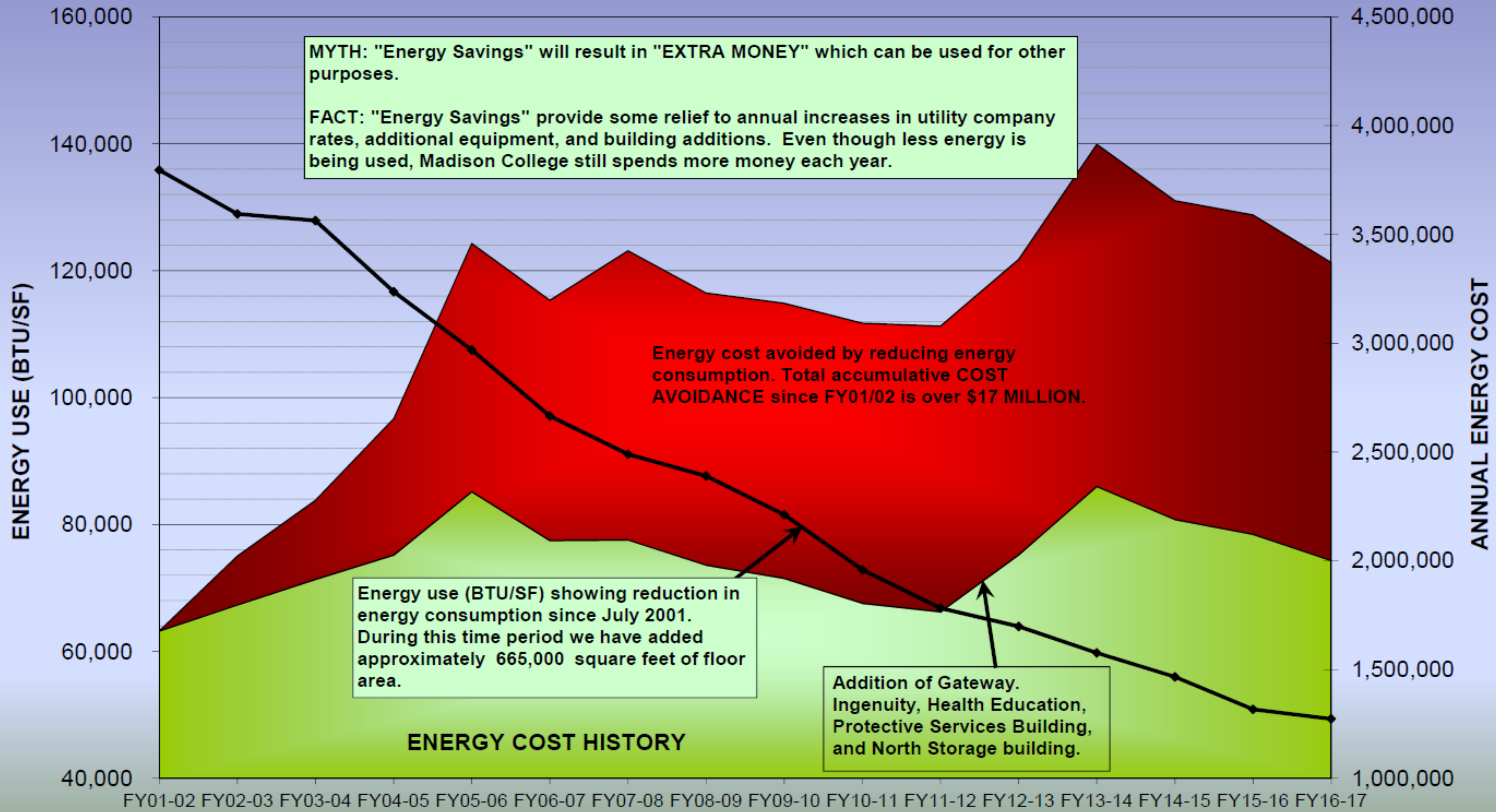
Energy	Usage FY 01/02 111,484 m²	Usage FY16/17 176,515 m²	Annual Reduction!
Electricity	23,000,000 kWh	16,000,000 kWh	7,000,000 kWh
Natural Gas	94,950 GJ	42,200 GJ	52,750 GJ
Emissions	**Emissions FY 01/02**	**Emissions FY 16/17**	**Annual Reduction!**
CO_2	25,000 tons	15,000 tons	10,000 tons

The above energy savings were achieved with an additional 65,030 m² conditioned space!

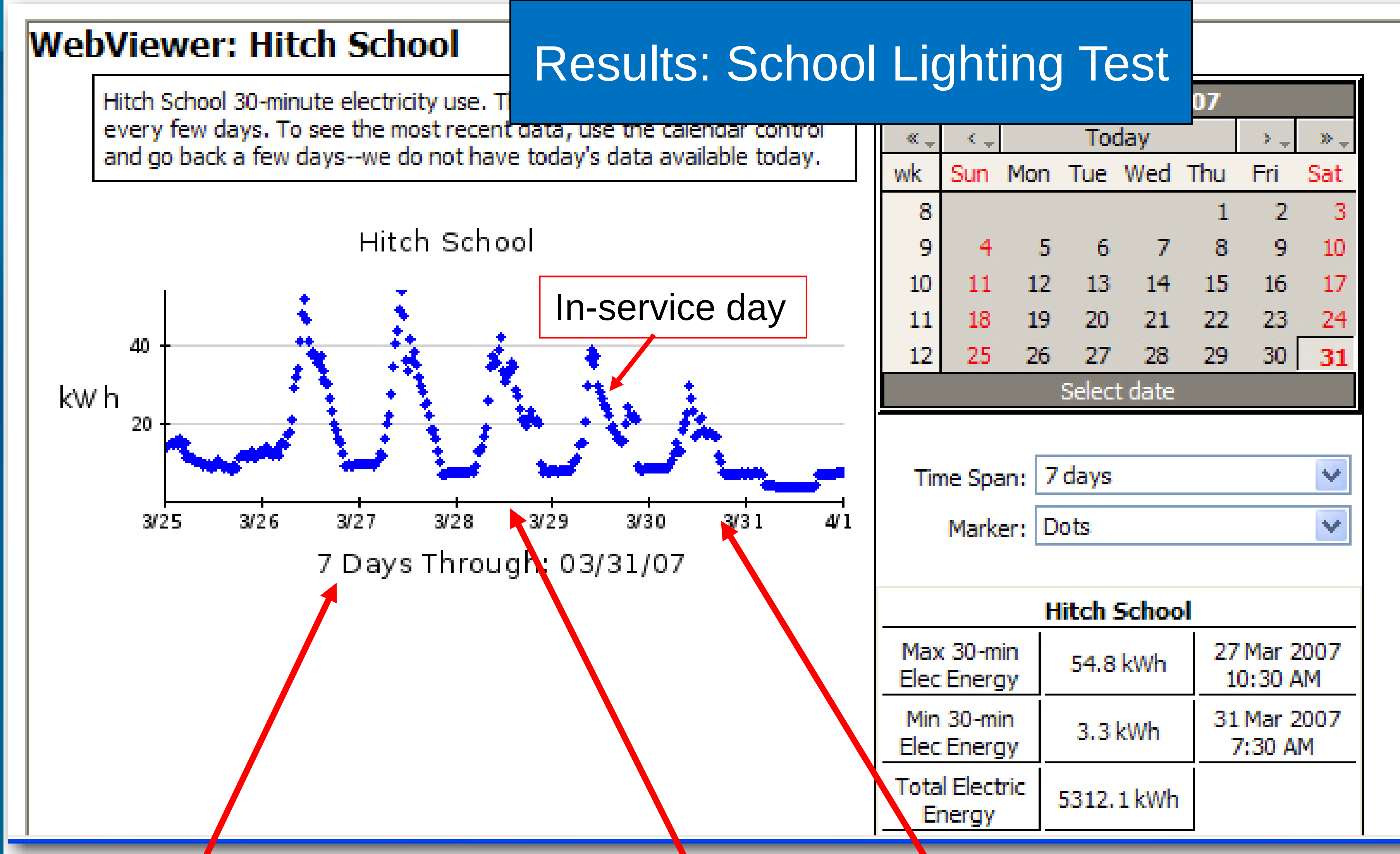
Source: Madison College Engineering Manager. Wesley Marquardt.
wmarquardt@madisoncollege.edu.

Greener Pastures with Energy Savings

Energy Cost Avoidance at Madison College



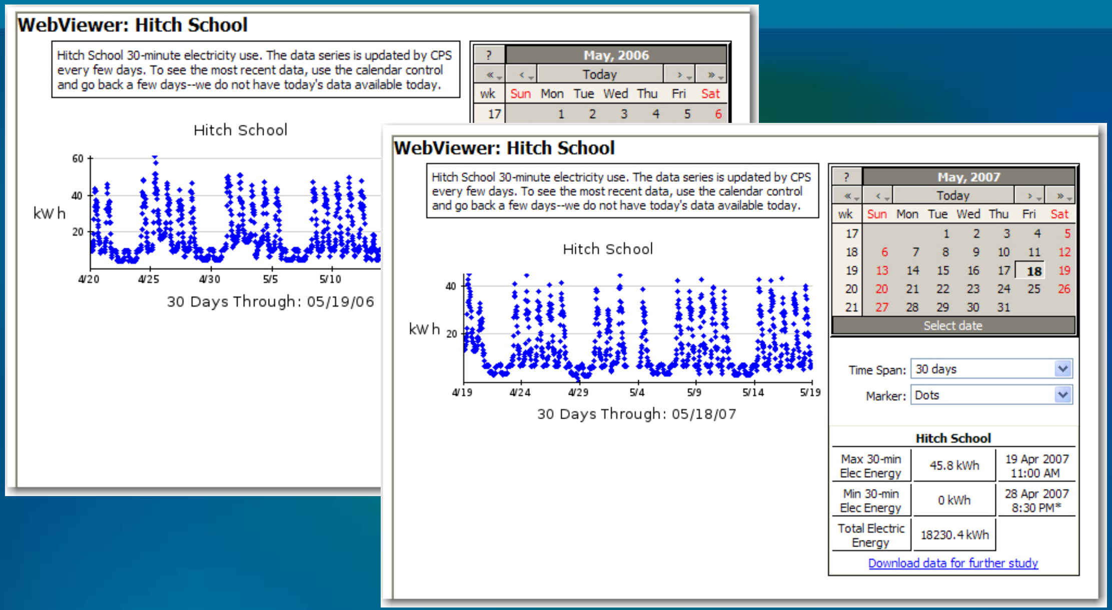
Results: School Lighting Test



Tuesday Test: Please use both light banks

Wednesday Test: Please use only one light bank

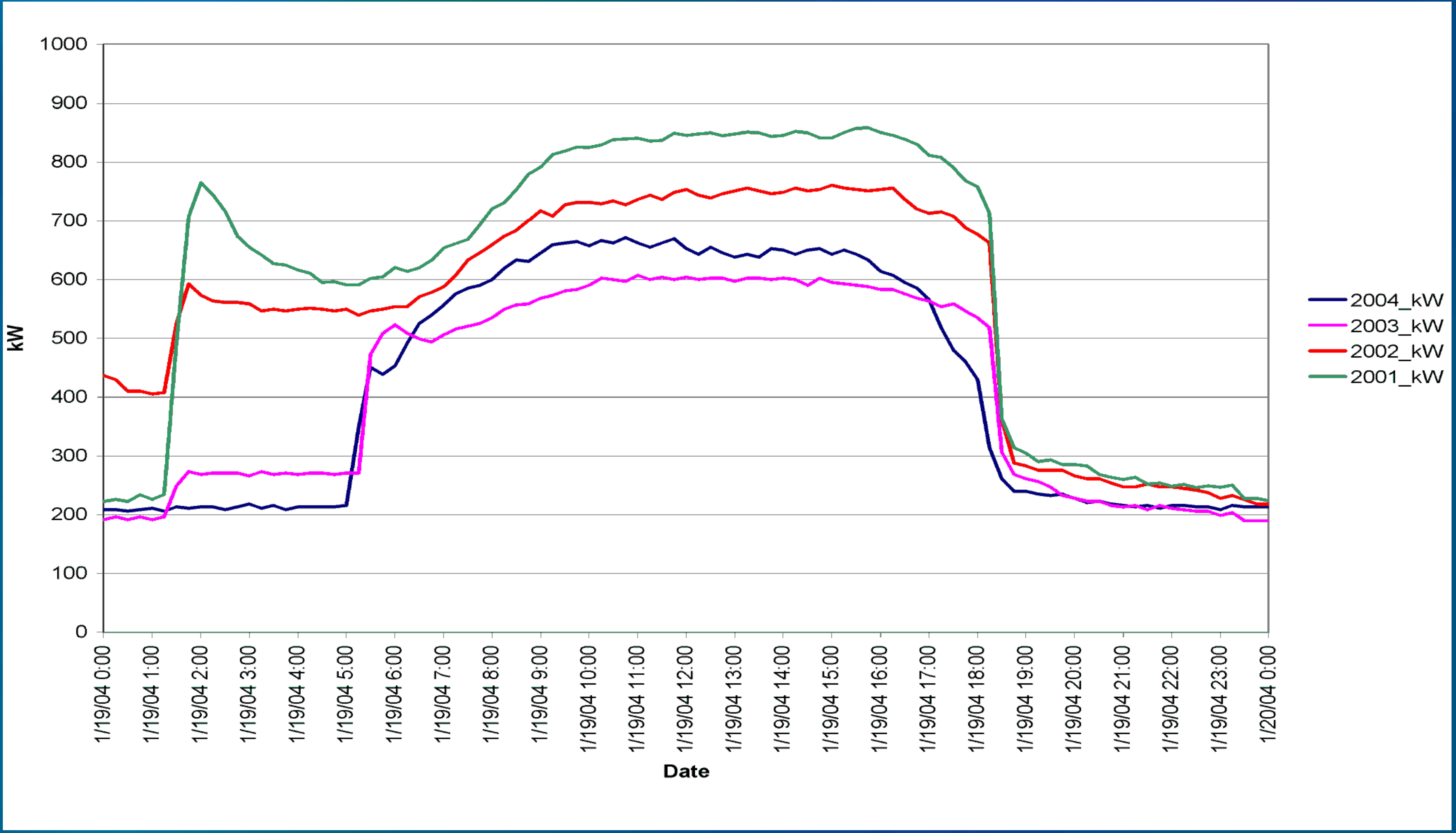
Friday Test: Please use daylight only



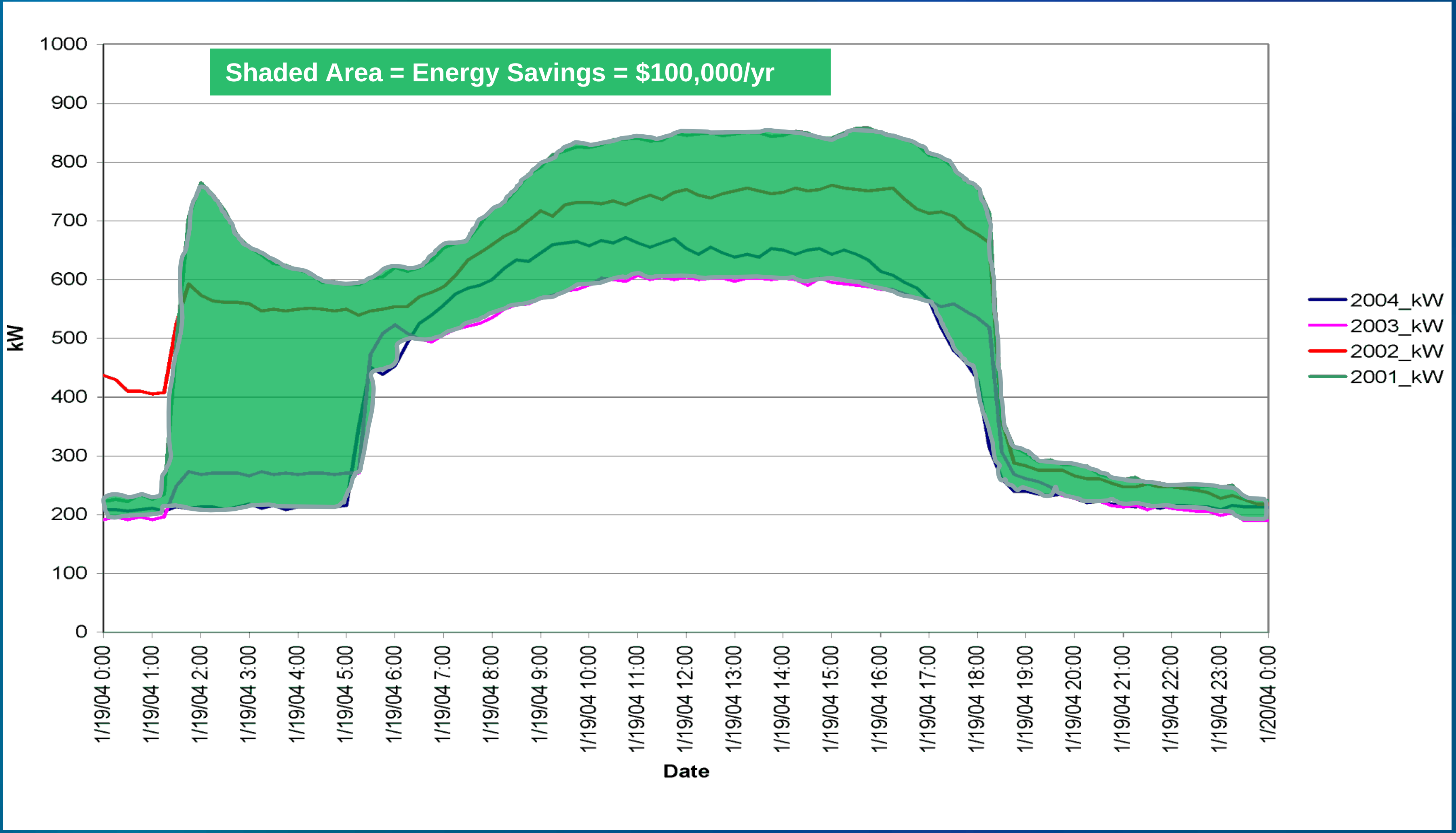
30-day period 2007 versus 2006, more than 20% energy savings!

30 Days Time Period	Total Energy, kWh	Total energy M–F 8:30 to 3:30, kWh	Median Daily Maximum 30-Min Demand, kW
4/20/2006–5/19/2006	24,690	11,130	93.5
4/19/2007–5/18/2007	19,000	9300	81.5

Honolulu Office Building: Before and After



Honolulu Office Building: Before and After



What We Did

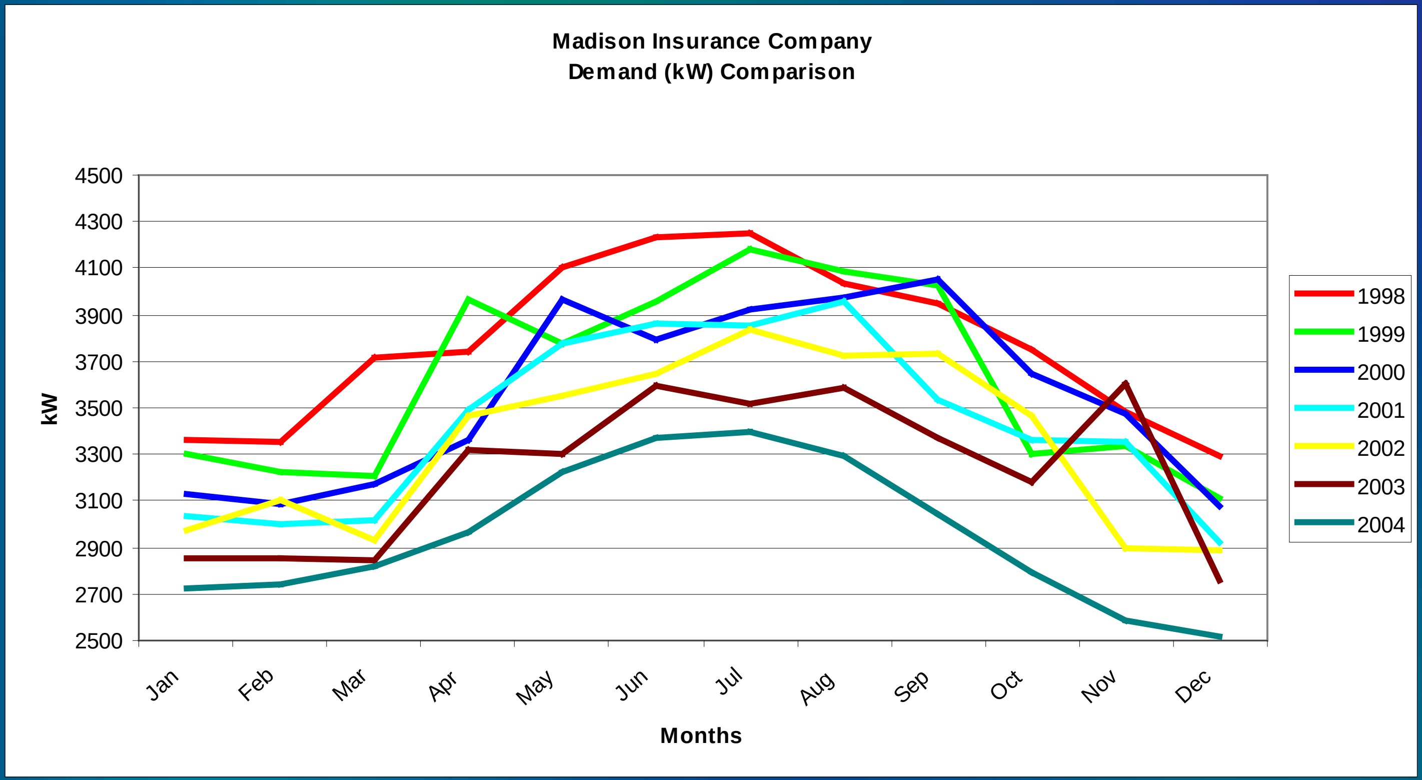
- Operational changes—matched schedules to occupancy
- Capital—more efficient chillers, pumps, towers; new building automation system to integrate equipment operation
- Cost of changes paid back in five years from savings

Honolulu Office Building: Energy Management Results

- 20% energy savings
- Savings per year:
  - \$100K
  - 750 tons carbon dioxide (CO_2)
  - 2.3 tons nitrogen oxide (No_x)
  - 2.0 tons sulfur dioxide (SO_2)

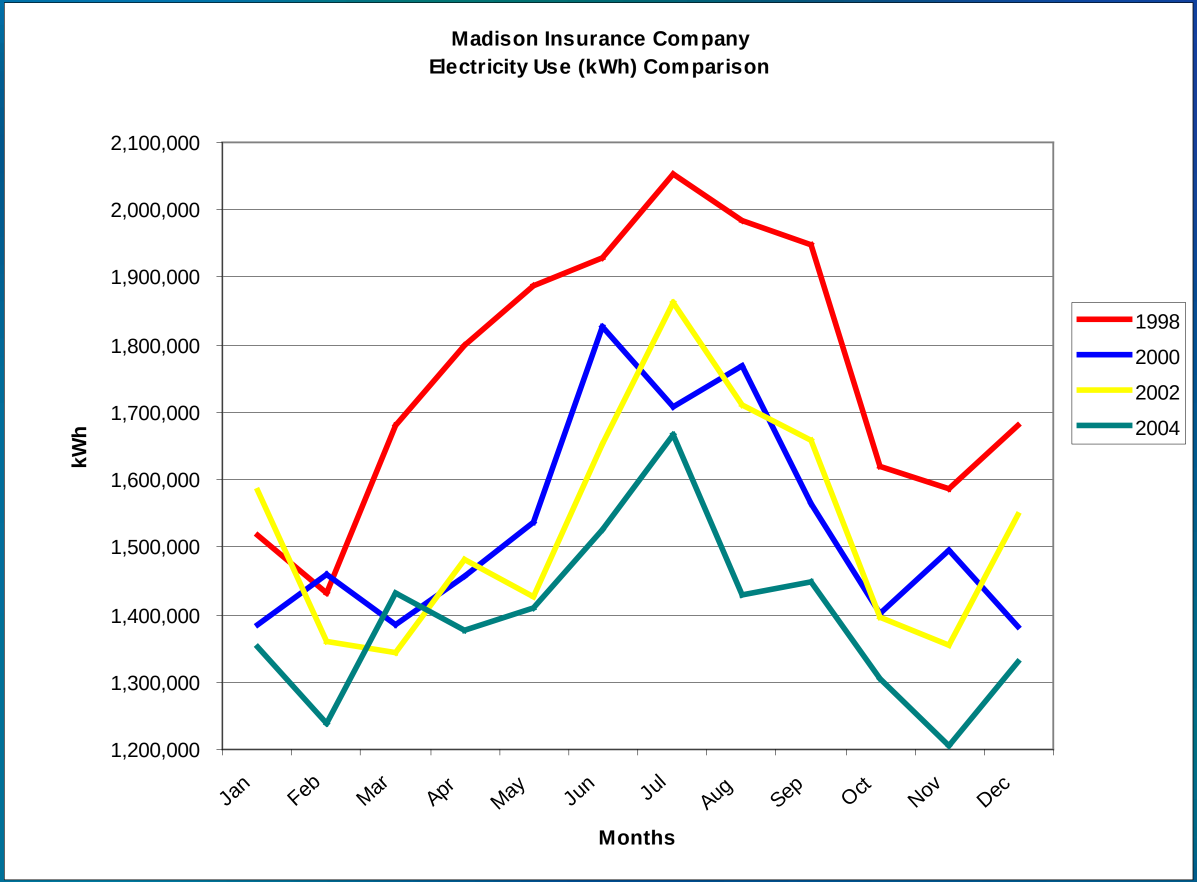
Madison Insurance Company

Madison Insurance Company: Evaluate Progress



	Peak kW
1998	4,250
1999	4,184
2000	4,054
2001	3,956
2002	3,833
2003	3,597
2004	3,394
Seven Year Reduction	**856**

Madison Insurance Company: Evaluate Progress



	TOTAL kWh
1998	20,786,867
1999	19,071,735
2000	18,374,900
2001	18,190,269
2002	18,425,789
2003	17,763,746
2004	16,716,580
Seven Year Reduction	4,070,287
20% Reduction	

4.1 million kWh per year
provides electricity for 586 new homes!

Madison Insurance Company

- Operations changes: matched energy use to occupancy and needs
  - Reduced fan energy
  - Reduced pump energy
  - Reduced lighting energy
- Capital upgrade: lighting retrofit

GSA Energy Management Program: The Rest of the Story

U.S. courthouse

Jacksonville, Florida

Energy improvements

DOE-ORNL Report

2000s New Building Performance

	Actual	Target
Floor Area ft² (m²)	492,000 (45,710)	492,000 (45,710)
EUI (kBTU/ft²/year)	83 😪	52
Energy Star Rating	41 😪	75
Cost ($k/year)	632 😪	407
EUI (kWh/m²/year)	262	164

Far less efficient than design intent

EEMs Implemented

- VAV minimum settings reduced to 10%
- Boilers turned off in summer
- AHU duct static pressure set points reduced from 375 Pa to 175 Pa

Results of Control Modifications

	Original	Target	New
Floor Area ft² (m²)	492,000	492,000	492,000 (45,710)
EUI (kBtu/ft²/year)	83	52	45
Energy Star Rating	41	75	79
Cost ($k/year)	632	407	377
EUI (kWh/m²/year)	262	164	142

- Energy Savings: 18.7 trillion Btu/year
- Energy Savings: 5,480.4 GWh
- Cost savings: Over $200,000/year

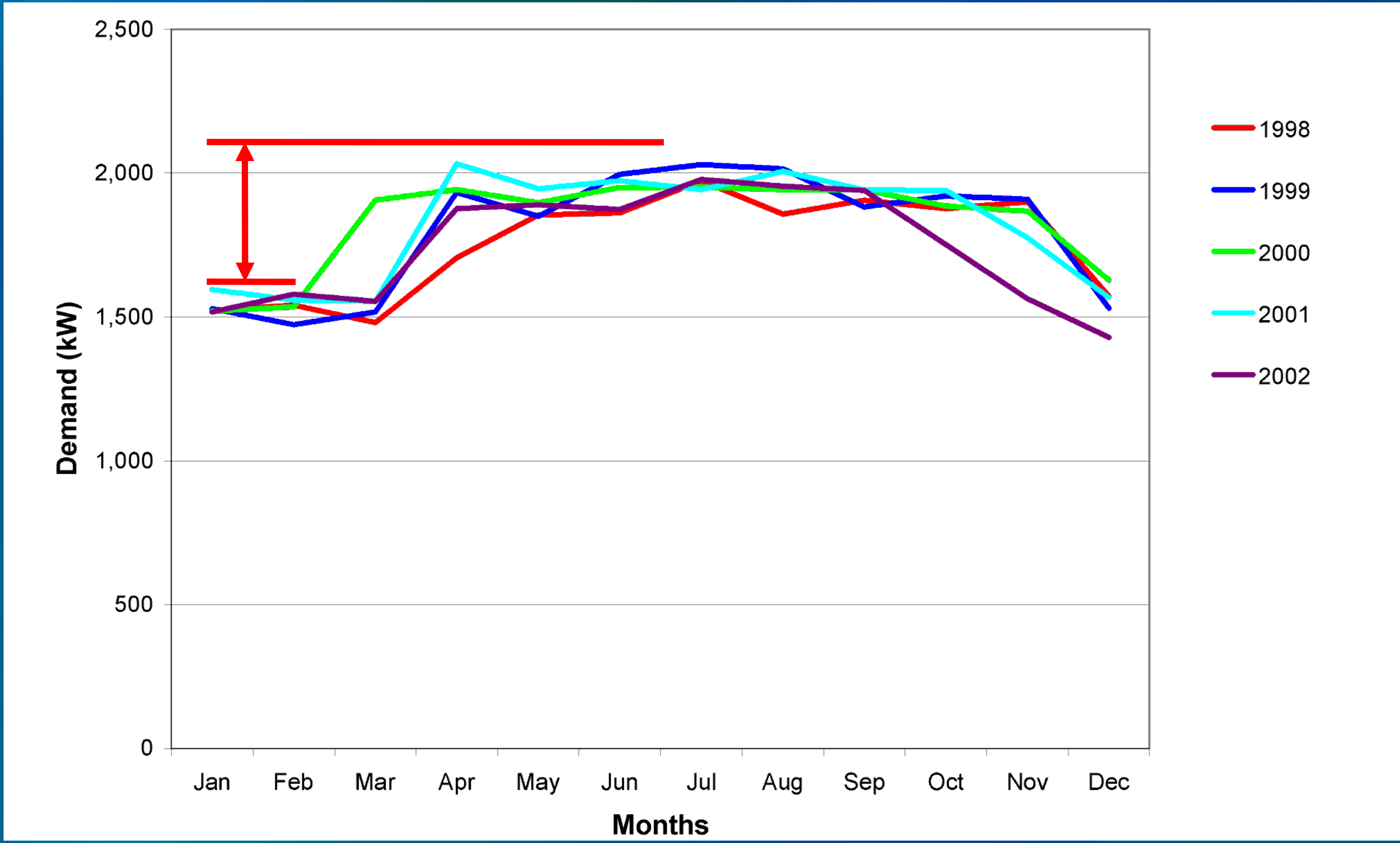
ENERGY STAR plaque is now in the lobby!

Downtown Chicago ENERGY STAR Building

Uninsulated concrete, single-pane glass

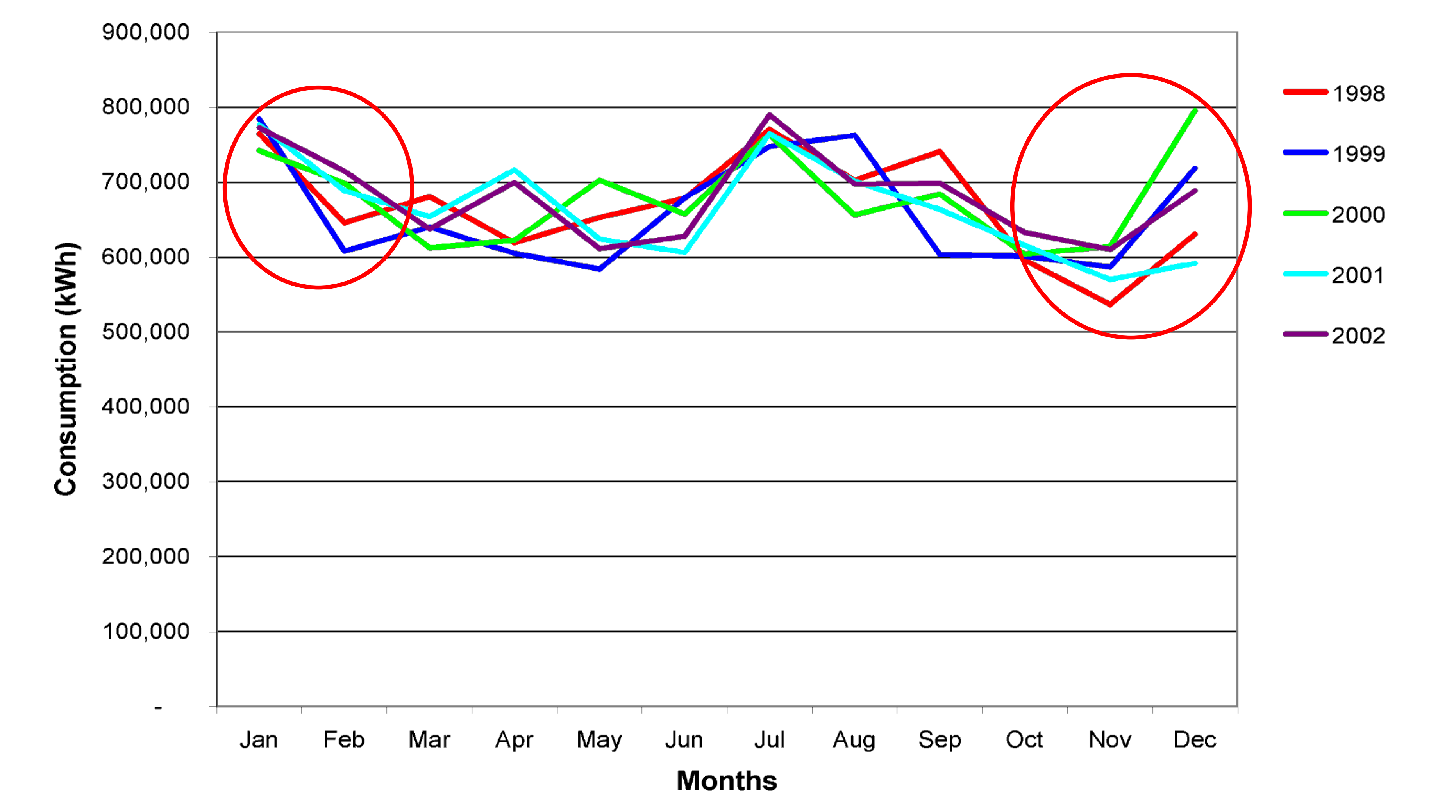
Madison Bank

Annual Profile of Monthly Peaks, kW



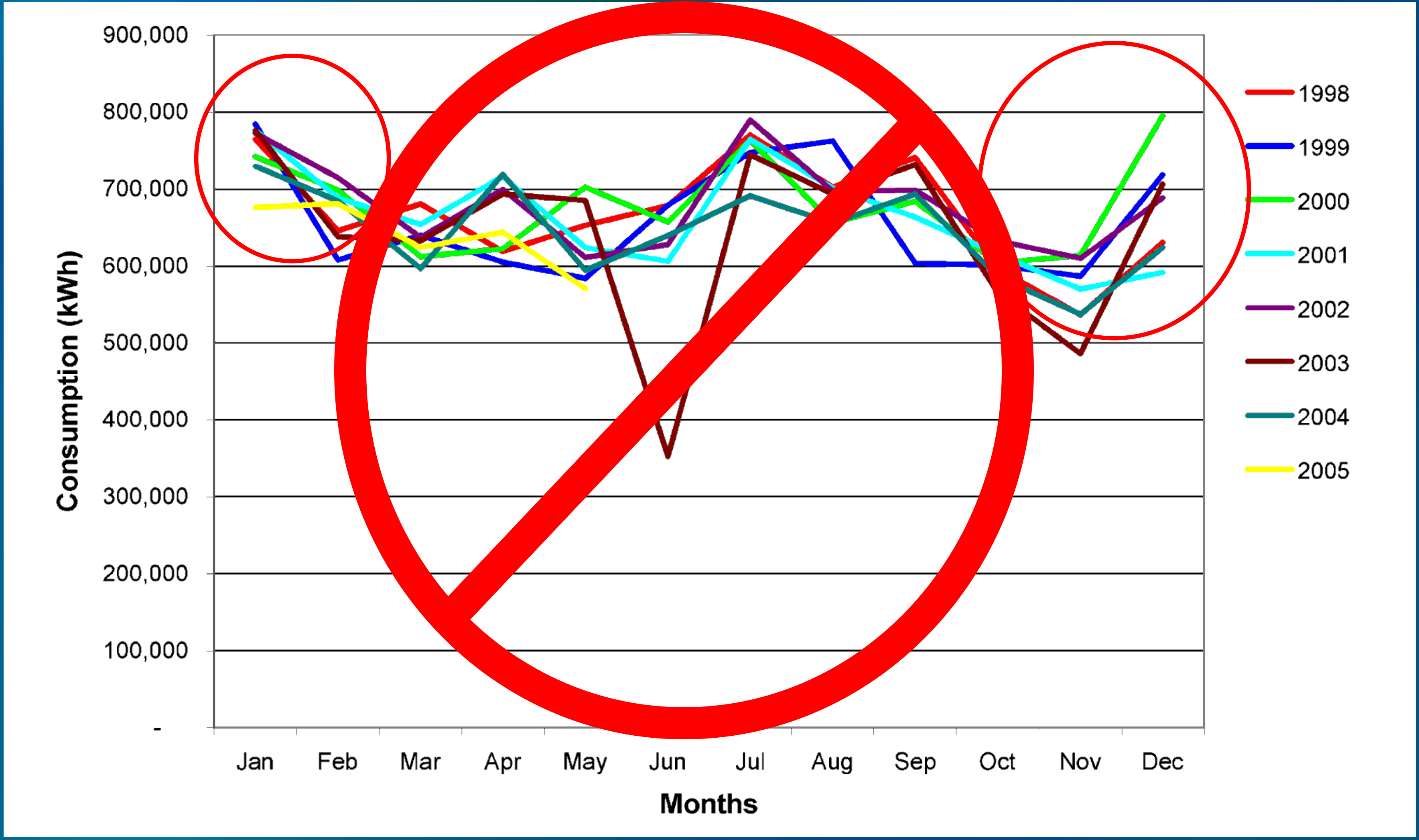
Chillers add 500 kW in summer

Annual Profile of Monthly kWh



Fans waste energy in winter!

Evaluate Progress Three Years Later



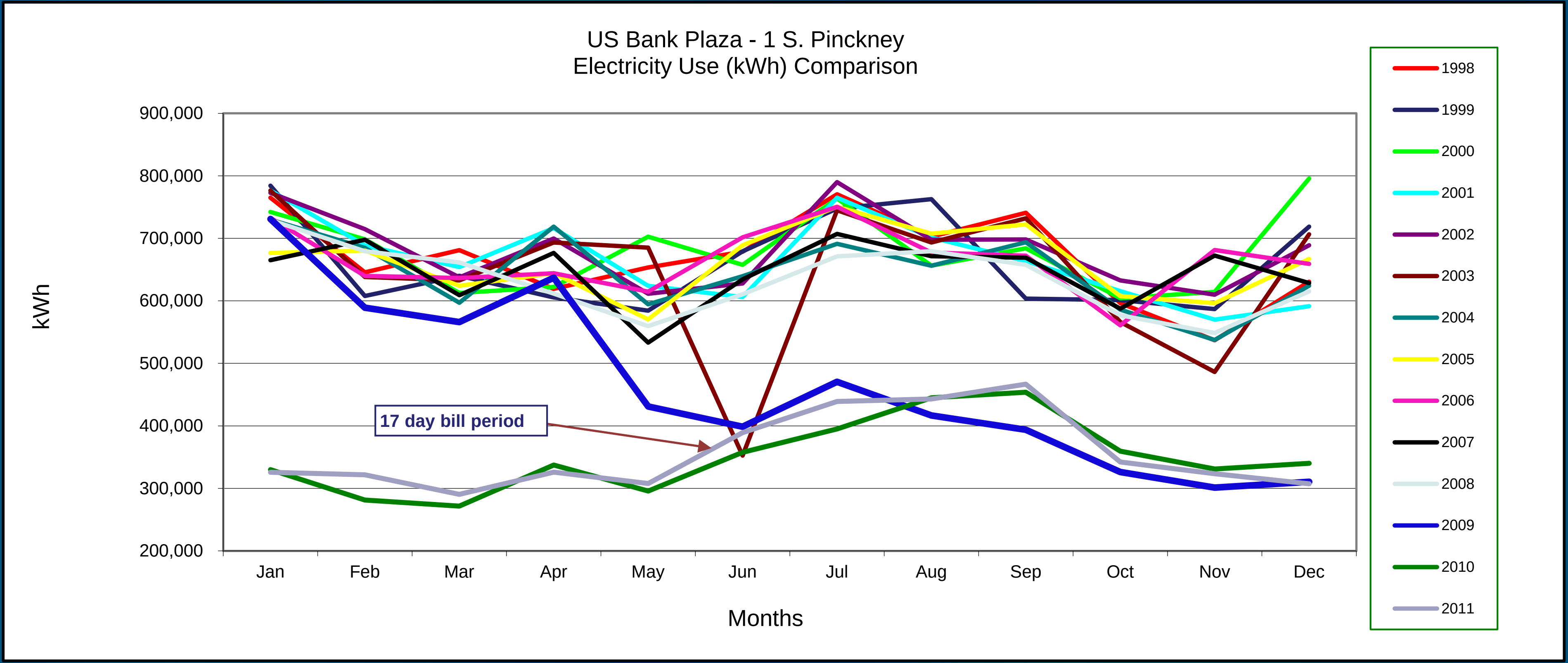
Energy management did not work !

Explanation of No Progress at Madison Bank

- The high electrical energy use in colder months results from decision to maintain fans on 24/7:
  - No commitment to improve energy use
  - No accountability

Therefore, **no change**

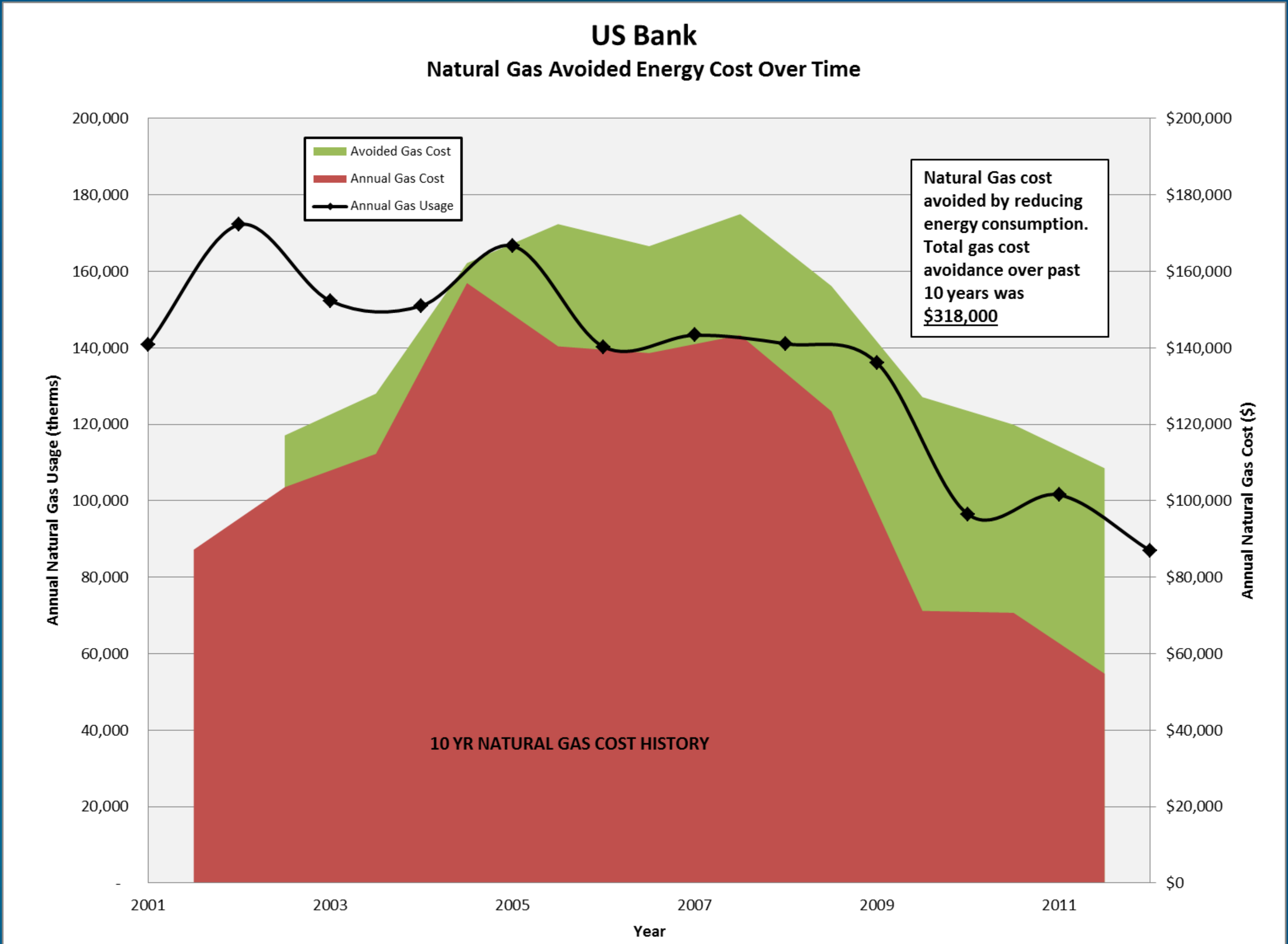
But Things Have Changed!



August 2010: New tenants include 1,020 m^2 restaurant

U.S. Bank Gas Utility Analysis

Year	Gas Usage, therms	Gas Cost, $	Gas Rate, $/therm
2002	172,220 (18,169210 MJ)	$87,236	$0.51 ($0.005)
2011	101,556 (10,714,158 MJ)	$70,713	$0.70 ($0.0065)
Reduction	70,664 (41%) (7,455,052 MJ)	$16,523 (19%)	+$0.19

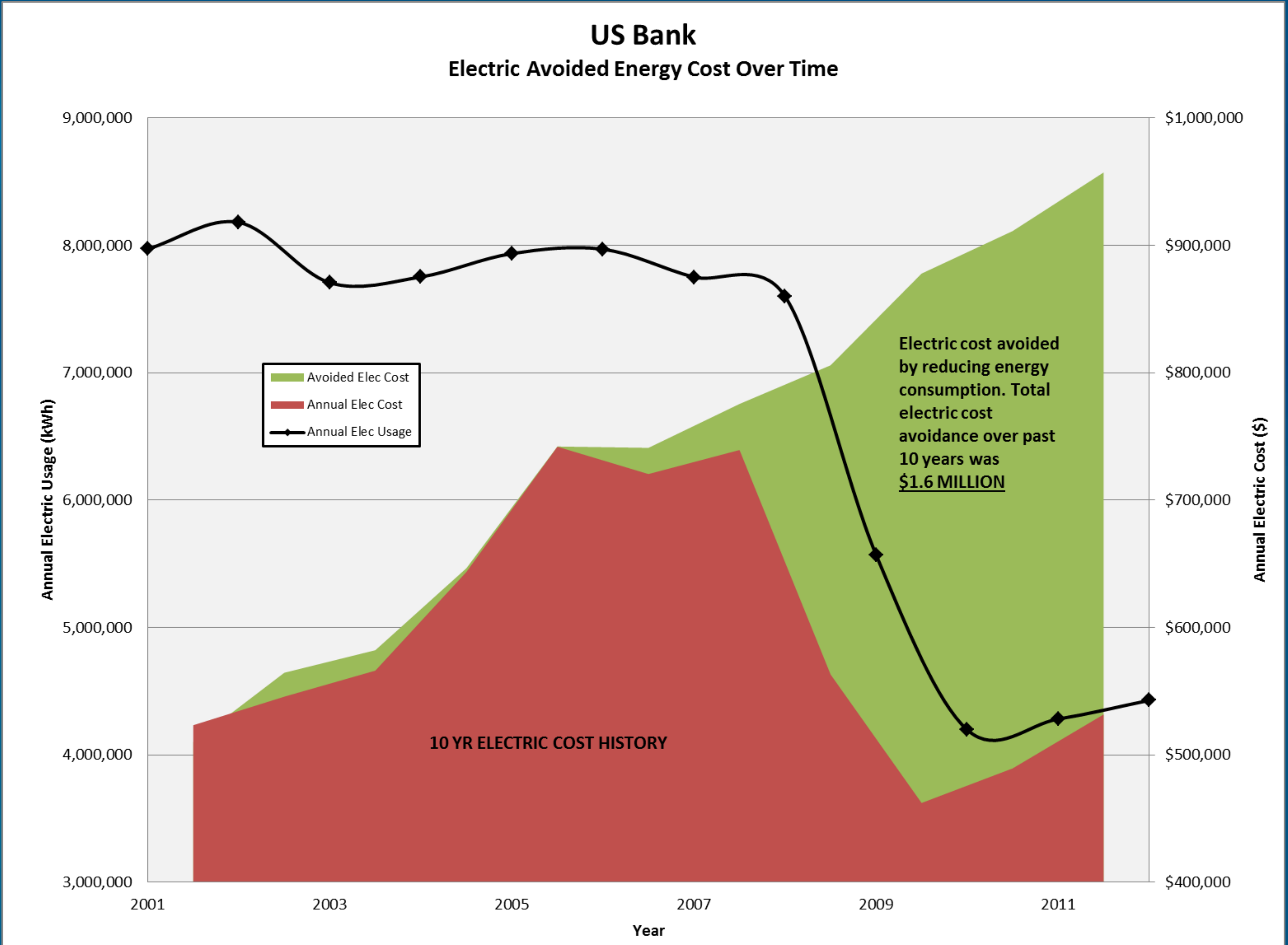

US Bank
Natural Gas Avoided Energy Cost Over Time
Avoided Gas Cost
Annual Gas Cost
Annual Gas Usage
Natural Gas cost avoided by reducing energy consumption. Total gas cost avoidance over past 10 years was $318,000
10 YR NATURAL GAS COST HISTORY
Annual Natural Gas Usage (therms)
Annual Natural Gas Cost ($)
Year
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
$200,000
$180,000
$160,000
$140,000
$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$0
2001
2003
2005
2007
2009
2011

US Bank Electric Utility Analysis

Year	Electric Usage, kWh	Electric Cost, $	Electric Rate, $/kWh
2002	8,181,296	$523,405	$0.064
2011	4,282,613	$489,521	$0.114
Reduction	3,898,683 (48%)	$33,884 (6.5%)	+$0.05

US Bank Electric Demand Analysis

Year	Max Electric Demand, kW	Min Electric Demand, kW
2002	1979	1430
2011	1433	724
Reduction	546	706


US Bank
Electric Avoided Energy Cost Over Time
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
Annual Electric Usage (kWh)
$1,000,000
$900,000
$800,000
$700,000
$600,000
$500,000
$400,000
Annual Electric Cost ($)
Avoided Elec Cost
Annual Elec Cost
Annual Elec Usage
Electric cost avoided by reducing energy consumption. Total electric cost avoidance over past 10 years was $1.6 MILLION
10 YR ELECTRIC COST HISTORY
2001
2003
2005
2007
2009
2011
Year

US Bank Asset Value Example

Using a 7.6% cap rate

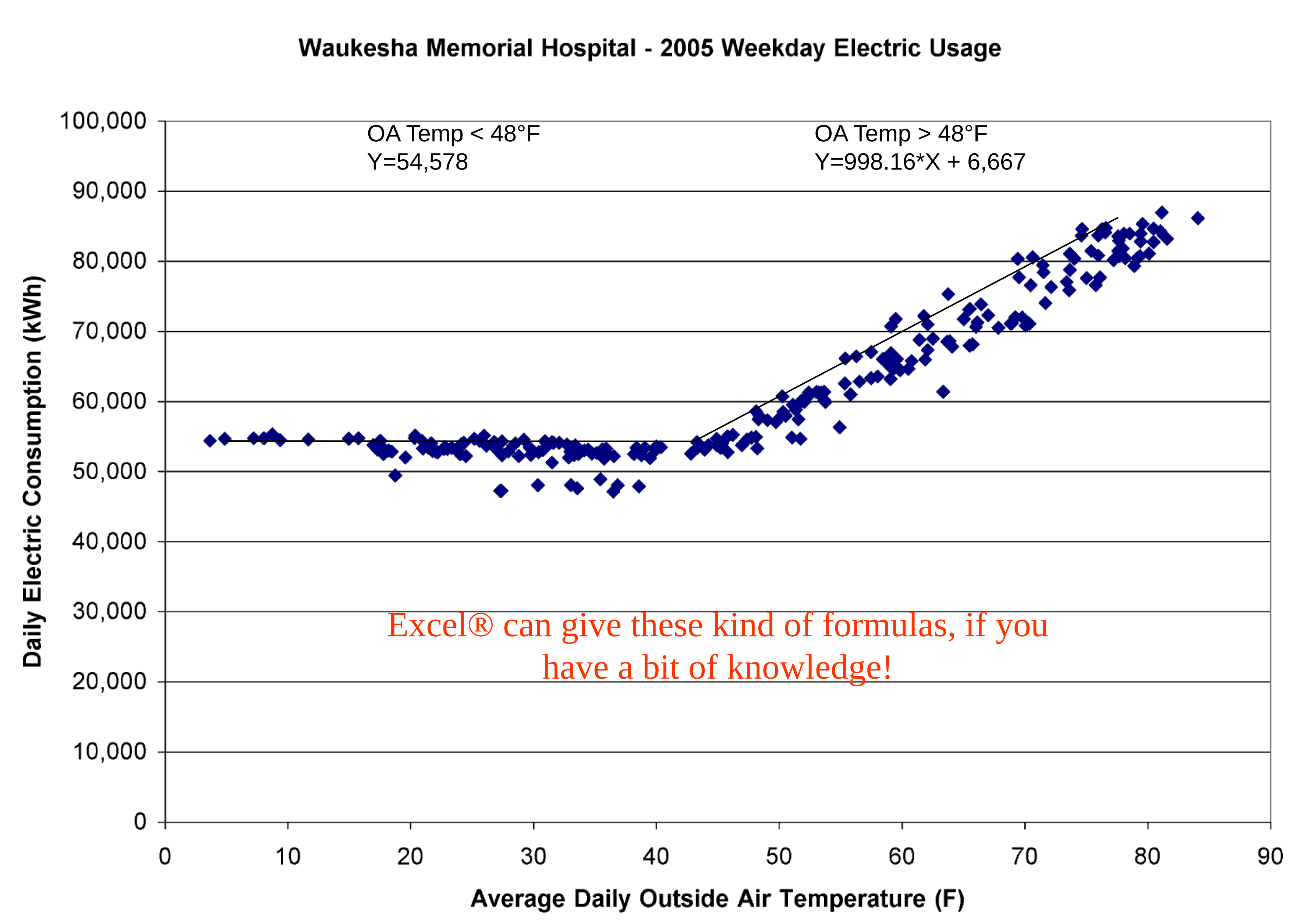
- 2002 costs minus 2011 costs
  Total Savings = $50,407
- $50,407 ÷ 0.076 (cap rate) =
  $663,250 increased asset value
- **Rates have increased in 9 years**
- Using 2011 rates for both 2002 and 2011 consumption
  Total Savings = $493,915
- $493,915 ÷ 0.076 (cap rate) =
  $6,498,882 increased asset value

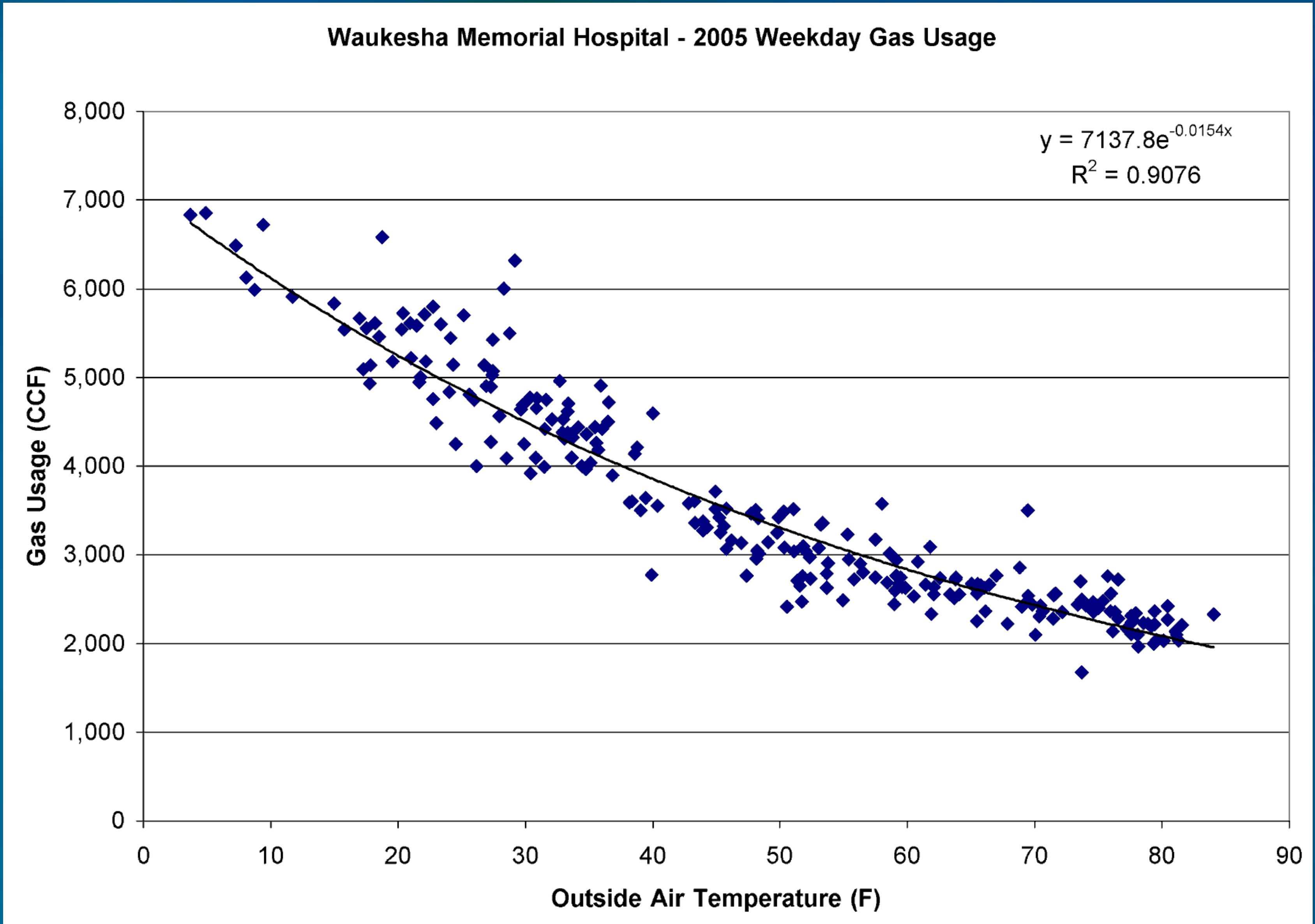
Results of Pilot Project at Waukesha Memorial Hospital

- Collected 2005 utility information
  - 30-minute electric
  - Daily natural gas consumption
- Plotted daily consumption versus outdoor air temperature
  - Established a model of building with weather normalized
  - Weekend usage slightly different than weekday usage

Daily Data: Results of Pilot Project at Waukesha Memorial Hospital

- $90,000 annual savings in natural gas use
- Adjustments to steam pressure and fine-tuning of burners on boilers—no capital!
- Data provided clues to changes in operations


Waukesha Memorial Hospital - 2005 Weekday Electric Usage
OA Temp < 48°F
Y=54,578
OA Temp > 48°F
Y=998.16*X + 6,667
Daily Electric Consumption (kWh)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0
10
20
30
40
50
60
70
80
90
Average Daily Outside Air Temperature (F)
Excel® can give these kind of formulas, if you have a bit of knowledge!


Waukesha Memorial Hospital - 2005 Weekday Gas Usage
$y = 7137.8e^{-0.0154x}$
$R^2 = 0.9076$
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Gas Usage (CCF)
0
10
20
30
40
50
60
70
80
90
Outside Air Temperature (F)

Discretionary Operations Changes to Improve Gas Use

- Lowered steam pressure, in steps
  - – Starting pressure was ~827 kPa
  - – Tested reductions in steps of 69 kPa
  - – Settled on new level: ~621 kPa
- Fine-tuned burners

7% Savings in 12 Months: $89K and 530 Tons CO_2

Date	OA Temp	OA Dew Point	Actual Boiler CCF	Predicted CCF	Percent	Savings CCF	Actual Electric kWh	Predicted kWh	Percent	Savings kWh
1/1/2006	33.6	33.6	3,958	4,141	95.6%	183	47,958	49,045	97.8%	1,087
1/2/2006	38.6	38.6	3,891	3,939	98.8%	48	49,774	54,578	91.2%	4,804
1/3/2006	38.3	38.3	3,699	3,957	93.5%	258	53,456	54,578	97.9%	1,122
1/4/2006	38.9	38.9	4,189	3,921	106.8%	-268	53,936	54,578	98.8%	642
1/5/2006	34.5	33.3	4,943	4,196	117.8%	-747	54,140	54,578	99.2%	438
1/6/2006	28.3	24.6	4,768	4,616	103.3%	-152	52,441	54,578	96.1%	2,137
1/7/2006	31.5	30.7	4,545	4,273	106.4%	-272	48,884	49,045	99.7%	161
1/8/2006	34.2	33	4,492	4,104	109.4%	-388	48,255	49,045	98.4%	790
1/9/2006	34.1	33.1	4,832	4,222	114.5%	-610	53,642	54,578	98.3%	936
1/10/2006	24.6	23.3	4,303	4,887	88.1%	584	54,025	54,578	99.0%	553
12/21/2006	37.6	35.7	4,323	4,000	108.1%	-323	54,332	54,578	99.5%	246
12/22/2006	42.7	42.3	3,379	3,698	91.4%	319	53,468	54,578	98.0%	1,110
12/23/2006	37.3	35	3,970	3,919	101.3%	-51	48,960	49,045	99.8%	85
12/24/2006	33.6	25.5	3,799	4,141	91.7%	342	48,222	49,045	98.3%	823
12/25/2006	33.8	30.1	3,998	4,241	94.3%	243	47,188	54,578	86.5%	7,390
12/26/2006	29.6	23.5	4,234	4,525	93.6%	291	52,071	54,578	95.4%	2,507
12/27/2006	31.4	24.7	3,741	4,401	85.0%	660	52,698	54,578	96.6%	1,880
12/28/2006	37.6	32.8	3,357	4,000	83.9%	643	53,081	54,578	97.3%	1,497
12/29/2006	38.7	37.1	3,503	3,933	89.1%	430	52,887	54,578	96.9%	1,691
12/30/2006	34.7	33.9	3,236	4,074	79.4%	838	49,211	49,045	100.3%	-166
12/31/2006	43	41	3,243	3,600	90.1%	357	49,071	49,045	100.1%	-26
Totals			**1,168,973**	**1,258,187**	**92.9%**	**89,214**	**21,925,821**	**21,602,617**	**101.5%**	**-323,204**

Extra Benefit: An Energy Management Breakthrough

		Gas			Electric			Comment
	Outside Air Temp	Calculated Usage	Actual Usage	Difference	Calculated Usage	Actual Usage	Difference	
Day	Deg F	CCF	CCF	%	kWh	kWh	%	
9/9/2006	61.1	2,749	2,301	83.7	62,238	63,894	102.7	Sat
9/10/2006	61.0	2,753	2,360	85.7	62,137	64,325	103.5	Sun
9/11/2006	60.8	2,799	2,328	83.2	67,354	70,286	104.4	
9/12/2006	64.5	2,644	2,129	[illegible]	71,048	74,922	105.5	Rained all Day
9/13/2006	60.7	2,803	2,348	83.8	67,255	69,804	103.8	
9/14/2006	62.7	2,718	2,374	87.3	69,251	70,119	101.3	
9/15/2006	65.3	2,610	2,846	109.1	71,886	73,333	102.0	
9/16/2006	69.9	2,410	2,823	117.1	71,141	71,129	100.0	Sat
9/17/2006	72.3	2,325	2,734	117.6	73,558	73,354	99.7	Sun
9/18/2006	59.8	2,842	3,134	110.3	66,346	66,540	100.3	Correct chiller problem
9/19/2006	52.0	3,205	2,345	73.2	58,571	55,413	94.6	Chillers off most of the day
9/20/2006	51.6	3,224	2,394	74.3	58,181	57,429	98.7	
9/21/2006	55.5	3,035	2,393	78.9	62,104	61,892	99.7	
9/22/2006	62.0	2,747	2,273	82.7	68,562	69,437	101.3	
9/23/2006	62.1	2,710	2,405	88.8	63,215	65,916	104.3	Sat
9/24/2006	58.1	2,876	2,470	85.9	59,176	60,878	102.9	Sun
9/25/2006	58.1	2,917	2,357	80.8	64,659	62,718	97.0	

Applying the Process

Aurora Health Care—2009

- 17 facilities
- 650,320 m^2
- Each facility joined the Portfolio Manager® system
- President of Aurora Healthcare signed an ENERGY STAR commitment to reduce energy 12% in three years
- Each facility utilizes the spreadsheet and records energy consumption daily
- Monthly summaries distributed to all
- Monthly energy initiative meeting to share successful ideas

Aurora Sinai Medical Center
Daily Utility Tracking Spreadsheet

Day	Outside Air		Steam			Generators		Electric				Comment
	Temp	Humidity	Calc. Usage	Actual Usage	Difference	Oil Usage	Load Shedding	Calc. Usage	Actual Usage	Total Usage	Difference	
	Deg F	% RH	1000 lbs.	1000 lbs.	%	Gals	kWh	kWh	kWh	kWh	%	
11/1/2009	41.0	62.0	295	247	83.6			51,462	53,402	53,402	103.8	
11/2/2009	49.0	58.0	273	229	83.8			63,315	57,429	57,429	90.7	
11/3/2009	40.0	51.0	293	254	86.6			56,066	57,069	57,069	101.8	
11/4/2009	44.0	68.0	284	250	87.9			59,288	56,643	56,643	95.5	
11/5/2009	45.0	56.0	282	237	84.0			60,093	57,236	57,236	95.2	
11/6/2009	49.0	70.0	273	220	80.5			63,315	58,303	58,303	92.1	
11/7/2009	62.0	58.0	246	202	82.1			68,666	58,106	58,106	84.6	
11/8/2009	52.0	72.0	269	191	70.9			60,474	55,779	55,779	92.2	
11/9/2009	57.0	61.0	255	221	86.6			69,758	61,526	61,526	88.2	
11/10/2009	47.0	75.0	278	224	80.7			61,704	57,727	57,727	93.6	
11/11/2009	43.0	65.0	287	244	85.1			58,482	57,633	57,633	98.5	
11/12/2009	42.0	70.0	289	230	79.6			57,677	59,900	59,900	103.9	
11/13/2009	50.0	53.0	271	231	85.2			64,120	57,556	57,556	89.8	
11/14/2009	53.0	66.0	267	230	86.1			61,293	54,238	54,238	88.5	
11/15/2009	42.0	63.0	293	246	84.0			52,281	51,183	51,183	97.9	
11/16/2009	44.0	64.0	284	257	90.4			59,288	56,803	56,803	95.8	
11/17/2009	45.0	67.0	282	248	87.9			60,093	57,421	57,421	95.6	
11/18/2009	46.0	88.0	280	239	85.4			60,898	56,845	56,845	93.3	
11/19/2009	45.0	83.0	282	239	84.7			60,093	56,649	56,649	94.3	
11/20/2009	50.0	73.0	271	243	89.7			64,120	56,792	56,792	88.6	
11/21/2009	46.0	84.0	284	235	82.9			55,558	51,190	51,190	92.1	
11/22/2009	46.0	90.0	284	232	81.8			55,558	51,366	51,366	92.5	
11/23/2009	46.0	90.0	280	231	82.5			60,898	56,656	56,656	93.0	
11/24/2009	46.0	88.0	280	235	84.0			60,898	57,344	57,344	94.2	
11/25/2009	47.0	90.0	278	254	91.5			61,704	56,144	56,144	91.0	
11/26/2009	39.0	82.0	304	273	89.8			57,149	50,756	50,756	88.8	
11/27/2009	36.0	56.0	326	289	88.7			56,805	52,824	52,824	93.0	
11/28/2009	40.0	70.0	298	249	83.7			50,642	50,391	50,391	99.5	
11/29/2009	39.0	80.0	307	263	85.8			52,584	49,852	49,852	94.8	
11/30/2009	36.0	62.0	326	275	84.4			56,805	55,524	55,524	97.7	
Total	**45.6**	**70.5**	**8,521**	**7,218**	**84.7**	**0**	**0.0**	**1,781,085**	**1,670,287**	**1,670,287**	**93.8**	

Aurora Sinai Medical Center
2009 Utility Summary

Day	Outside Air		Steam			Generators	Electric			
	Temp	Humidity	Calc. Usage	Actual Usage	Difference	Load Shedding	Calc. Usage	Actual Usage	Total Usage	Difference
	Deg F	% RH	1000 lbs	1000 lbs	%	kWh	kWh	kWh	kWh	%
January-09	16.5	63.3	14,447	14,436	99.9	0.0	1,649,628	1,704,820	1,704,820	103.3
February-09	28.1	65.5	10,803	9,811	90.8	0.0	1,537,195	1,487,773	1,487,773	96.8
March-09	36.4	63.8	10,357	10,101	97.5	0.0	1,756,208	1,628,481	1,628,481	92.7
April-09	45.6	59.9	8,522	8,090	94.9	0.0	1,798,526	1,631,179	1,631,179	90.7
May-09	57.8	58.2	7,886	7,246	91.9	0.0	2,129,761	1,953,022	1,953,022	91.7
June-09	65.4	84.4	7,105	7,046	99.2	0.0	2,255,967	2,150,896	2,150,896	95.3
July-09	69.0	62.5	7,093	6,880	97.0	0.0	2,421,150	2,261,776	2,261,776	93.4
August-09	69.6	67.1	7,052	5,703	80.9	0.0	2,426,409	2,258,857	2,258,857	93.1
September-09	64.3	71.9	7,179	5,103	71.1	0.0	2,229,347	2,049,718	2,049,718	91.9
October-09	49.1	70.9	8,509	6,737	79.2	0.0	1,922,029	1,796,748	1,796,748	93.5
November-09	45.6	70.5	8,521	7,218	84.7	0.0	1,781,085	1,670,287	1,670,287	93.8
December-09	27.4	73.3	12,045	10,725	98.6	0.0	1,692,976	1,569,630	1,569,630	92.7
Total	**47.9**	**67.6**	**122,585**	**99,096**	**80.8**	**0.0**	**23,600,280**	**22,163,187**	**22,163,187**	**93.9**

Energy Savings:

- 19% reduction in steam usage
- 6% reduction in electrical usage

Aurora Health Care 2009–2012 Utility Summary

Facility	Sq Ft	2009-2012 Summary					
		%	CO2 Reduction (lbs)	2009 EUI (kBtu/ft²)	2010 EUI (kBtu/ft²)	2011 EUI (kBtu/ft²)	2012 EUI (kBtu/ft²)
Sheboygan	290,071	84.5%	7,069,354	298.6	270.5	283.7	260.5
Baycare Clinic	610,716	94.1%	5,205,605	273.6	258.1	261.7	246.3
Hartford	150,000	79.5%	4,845,765	256.5	276.4	255.8	235.2
Two Rivers	183,500	83.6%	5,565,232	267.2	265.5	249.3	221.6
West Allis Memorial	848,440	82.0%	21,241,383	277.5	259.3	246.0	231.8
Summit	789,591	88.9%	12,758,285	N/A	N/A	221.6	199.3
St. Luke's South Shore	360,555	80.9%	11,321,748	242.8	227.6	216.6	202.1
Burlington	220,000	81.7%	4,143,428	178.4	207.2	207.3	192.1
Sinai Medical Center	858,000	81.3%	30,610,684	225.6	214.4	199.6	191.6
St. Lukes ★	1,718,168	82.7%	47,767,288	213.8	203.0	193.8	183.7
Kenosha	339,020	92.3%	1,513,574	N/A	N/A	256.5	238.7
Oshkosh ★	470,000	75.1%	17,685,848	205.0	187.4	163.3	150.8
Lakeland	296,280	94.2%	(3,113,398)	129.2	146.9	154.6	153.4
Heil	218,677	95.5%	7,698,062	198.7	180.1	191.7	181.4
Hospice	31,200	77.5%	745,255	204.0	193.5	190.9	162.6
Corporate Building	21,760	60.1%	1,119,143	170.5	154.2	129.3	112.2
Psychiatric Hospital	206,074	86.8%	155,646	91.8	85.5	88.9	76.7
Forest Home ★	135,000	63.1%	8,685,962	82.0	74.0	72.8	68.0
Total	7,747,052	85.2%	185,018,863	227.8	205.6	196.8	182.4

★ **Achieved EnergyStar Award!**

Highlighted buildings are not acute care hospitals

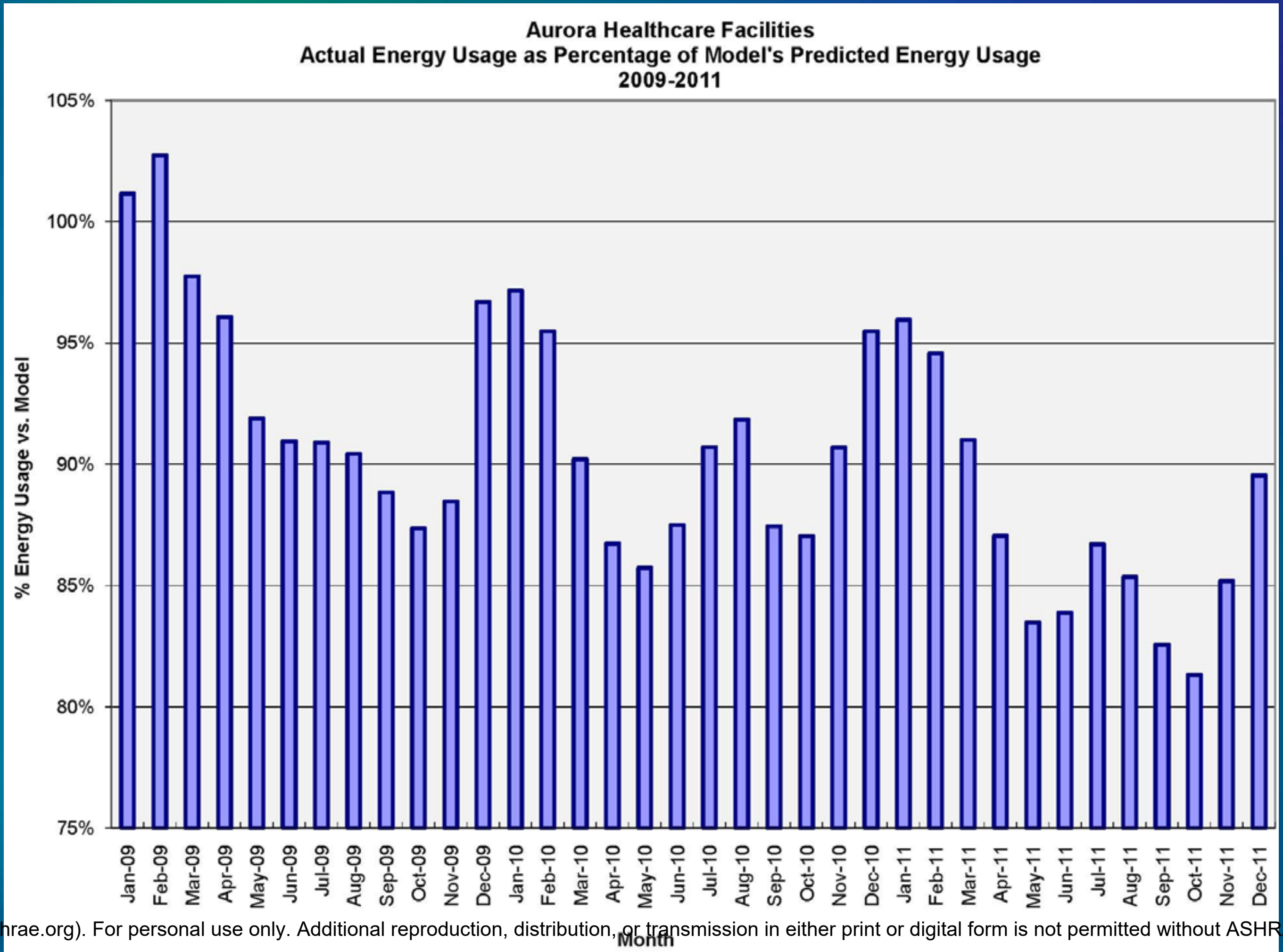
NEW

Savings:

- 14.8% reduction in energy usage
- 92,509 tons reduction in CO_2 emissions

Aurora Health Care 2009–2011

- 14.1% reduction in energy consumption
- 142.6 million pound (64,669 metric tons) reduction in CO_2
- Three facilities achieved ENERGY STAR



Additional Energy Management Breakthroughs

	Day	Temp	Humidity	Calc. Usage	Actual Usage	Difference	Oil Usage	Load Shedding	Calc. Usage	Actual Usage	Total Usage	Difference	
11	5/8/2012	60.0	65.0	189	177	93.8			62,486	61,239	61,239	98.0	CHILLER #3
12	5/9/2012	51.0	79.0	214	205	95.9			56,625	57,051	57,051	100.8	CHILLER #3
13	5/10/2012	52.0	64.0	211	201	95.5			57,276	58,815	58,815	102.7	CHILLER #3
14	5/11/2012	63.0	42.0	182	188	103.2			64,439	63,091	63,091	97.9	CHILLER #3
15	5/12/2012	63.0	64.0	179	200	111.7			59,474	58,277	58,277	98.0	CHILLERS #1 & #3
16	5/13/2012	58.0	40.0	190	191	[illegible]			56,237	57,250	57,250	101.8	CHILLERS #1 & #3
17	5/14/2012	66.0	31.0	176	189	[illegible]			66,393	64,286	64,286	96.8	CHILLERS #1 & #3
18	5/15/2012	72.0	37.0	168	185	[illegible]			70,300	65,794	65,794	93.6	CHILLERS #1 & #3
19	5/16/2012	52.0	55.0	211	194	[illegible]			57,276	59,808	59,808	104.4	CHILLER #3
20	5/17/2012	54.0	60.0	205	184	90.0			58,579	59,359	59,359	101.3	CHILLER #3
21	5/18/2012	65.0	52.0	178	183	102.6			65,741	63,080	63,080	96.0	CHILLERS #1 & #3
22	5/19/2012	69.0	55.0	169	176	103.9			63,358	63,187	63,187	99.7	CHILLERS #1 & #3
23	5/20/2012	78.0	49.0	161	178	110.6			69,185	66,113	66,113	95.6	CHILLERS #1 & #3

FOUND STEAM LEAK ON CT-SF-U04 HEATING ISOLATION VALVE.

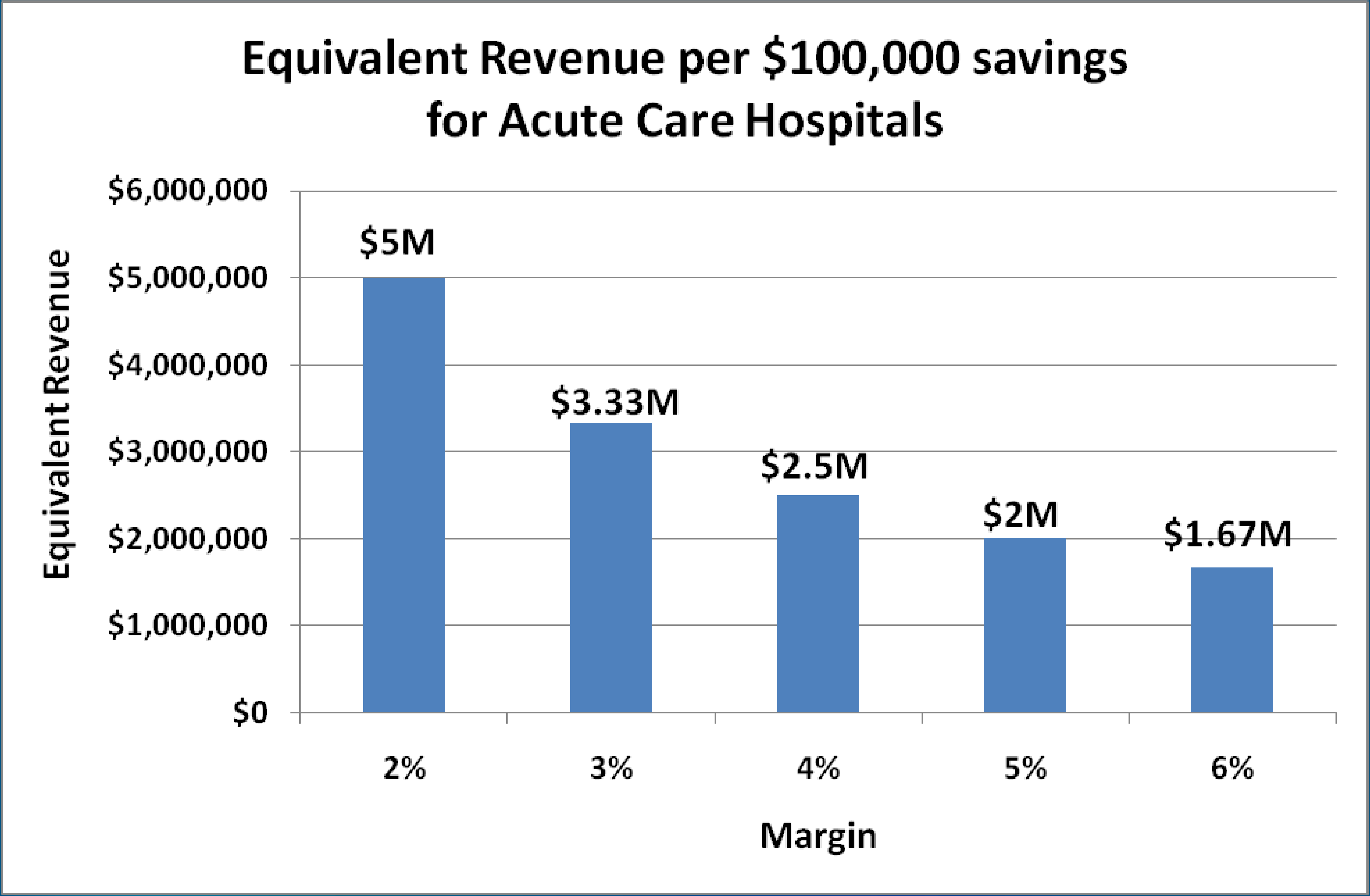
REPAIRED IN AFTERNOON.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Day	Outside Air		Steam			Generators		Electric			
2		Temp	Humidity	Calc. Usage	Actual Usage	Difference	Oil Usage	Load Shedding	Calc. Usage	Actual Usage	Total Usage	Difference
3		Deg F	% RH	1000 lbs	1000 lbs	%	Gals	kWh	kWh	kWh	kWh	%
4	2/1/2011	22.0	76.0	363	363	100.1			50,875	50,184	50,184	98.6
5	2/2/2011	21.0	71.0	368	366	99.4			50,893	46,611	46,611	91.6
6	2/3/2011	9.0	54.0	[illegible]	[illegible]	90.1			51,110	50,452	50,452	98.7
7	2/4/2011	16.0	60.0	[illegible]	[illegible]	90.8			50,984	50,147	50,147	98.4
8	2/5/2011	23.0	59.0	[illegible]	[illegible]	86.9			46,044	45,329	45,329	98.4
9	2/6/2011	28.0	83.0	[illegible]	[illegible]	88.0			45,826	44,917	44,917	98.0
10	2/7/2011	24.0	72.0	351	338	96.3			50,839	49,646	49,646	97.7
11	2/8/2011	14.0	61.0	412	428	104.0			51,020	50,604	50,604	99.2
12	2/9/2011	8.0	50.0	452	477	105.5			51,128	50,684	50,684	99.1
13	2/10/2011	[illegible]	[illegible]	[illegible]	[illegible]	93.3			51,201	50,883	50,883	99.4
14	2/11/2011	[illegible]	[illegible]	[illegible]	[illegible]	90.9			51,038	50,955	50,955	99.8
15	2/12/2011	[illegible]	[illegible]	[illegible]	[illegible]	89.8			45,783	46,469	46,469	101.5
16	2/13/2011	[illegible]	[illegible]	[illegible]	[illegible]	89.5			47,342	45,448	45,448	96.0
17	2/14/2011	38.0	58.0	282	281	99.7			52,554	50,387	50,387	95.9
18	2/15/2011	31.0	72.0	314	266	84.7			50,712	51,350	51,350	101.3

FOUND F/B DAMPER ISSUES ON CT-SF-U01 THRU CT-SF-U05

FOUND STEAM LEAKS ON CT-SF-U02 HTG COIL & ON CT-SF-U05 VACUUM BREAKER (VACUUM BREAKER WAS REPLACED 02/10/2011)

BREAK!



Source: Corporate Realty, Design & Management Institute.

Aurora Health Care Equivalent Revenue (Using a 4% Margin)

- 2009–2012 Total Energy Savings (weather-normalized)

  Total Savings = $8,665,000

- $8,665,000 ÷ 0.04 (margin) =

  $216,625,000 equivalent revenue

- **$216,625,000** ÷ 4 years =

  <u>$54,156,250 Equivalent Revenue per Year</u>

Energy Management Strategies Taken

- Chiller operations
- HW reset schedules
- Run schedules (occupied/unoccupied, day/night, summer/winter)
- DA temperature reset schedules
- Steam pressures
- Installation of variable-speed drives
- Steam trap survey
- Shutting off air handling units in unoccupied areas
- Maintaining modified space temperatures
- Promoting the energy message at department meetings

Outdoor Air Temperature Data Sources

Sources	Barriers to Use
Outdoor air sensors—BAS	Extracting data; maintenance of sensors; data quality
Stand-alone temperature sensors	Extracting data; maintenance of sensors; data quality
NOAA data (public domain) https://gis.ncdc.noaa.gov/maps/ncei#app=cdo	No cost for simple searches; cumbersome to access multiple locations
Weather data services	Fee for access to comprehensive database
Weather Underground https://www.wunderground.com/history/	No cost for searches; long time periods require multiple searches

Exercise 10: Weather Normalization

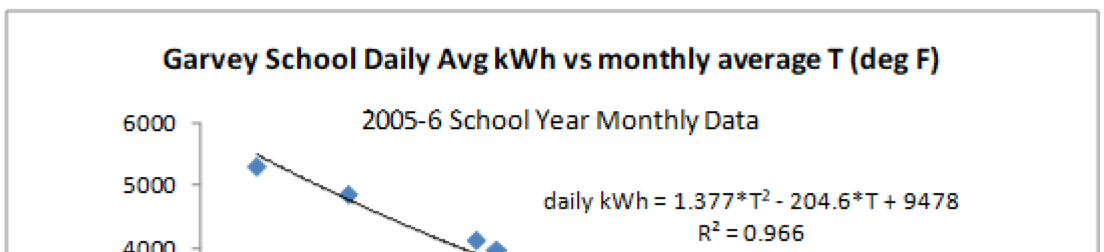
Page 31 in the exercises

Exercise 10A: Weather Normalization

Part 1: We introduced Garvey School, an elementary school in Chicago, earlier in the seminar when we discussed Portfolio Manager. It is an "all-electric" school, built in 1968.

The graph shows the relationship between average monthly temperature and average daily electricity use, based on 12 monthly utility bills for the school year 2005-6 (baseline year). Daily temperature data were obtained from the O'Hare Airport weather station.

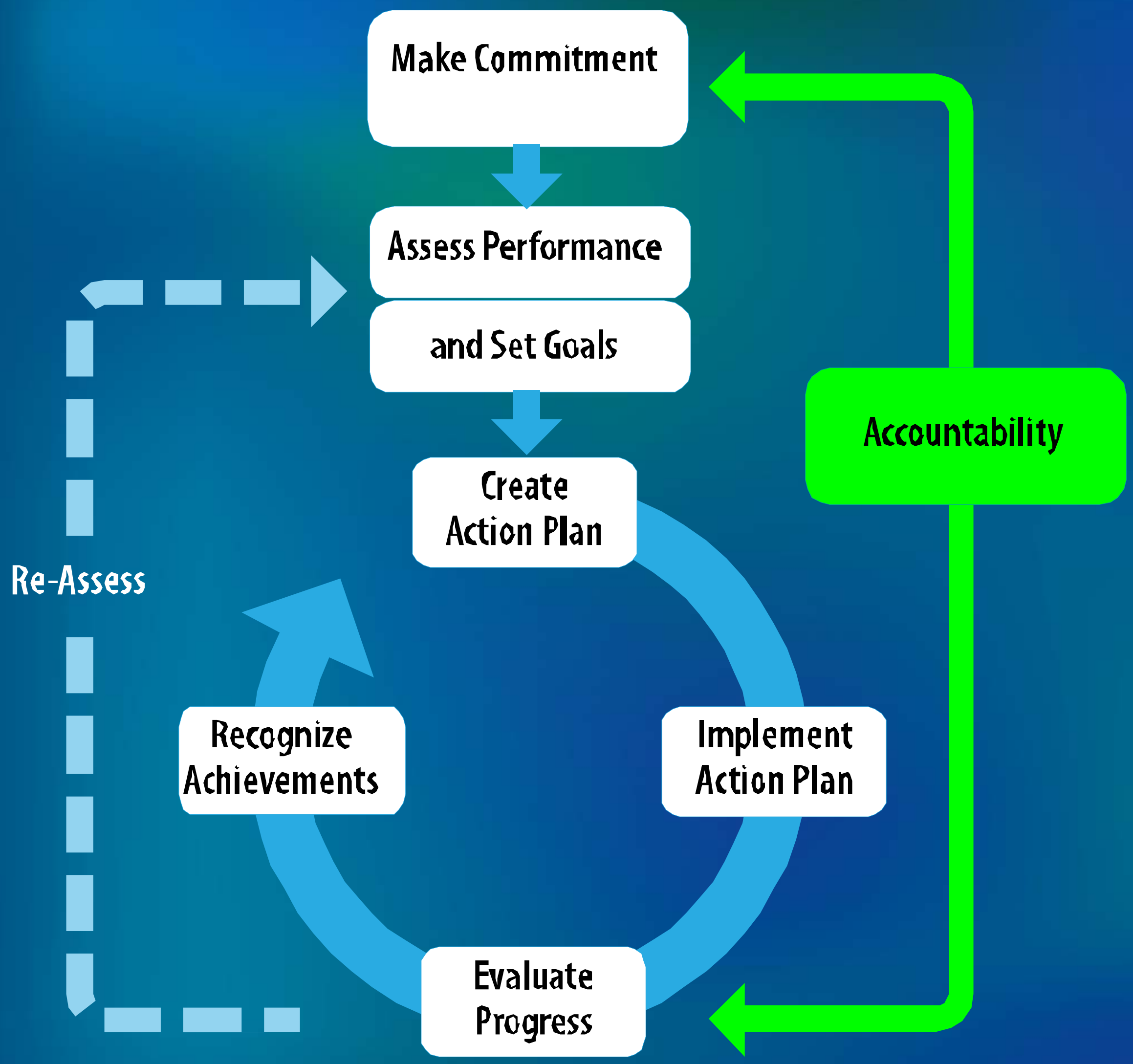
Excel® generated the equation relating daily kWh to average monthly temperature. (See notes below on the Excel command details).



Exercise includes short tutorial on generating graph and equation using Excel®

Energy Management: Accountability Revisited

Accountability



A person is accountable; a department or building can't be!

Lowell Hall Facility—What's Missing?

Space Use Add Space

Space Name	Space Type	Floor Area (Sq. Ft.)	% Floor Area	Alerts	
Lodging	Hotel	88,949	76		Delete Space
Staff Offices	Office	28,634	24		Delete Space
Total		117,583	100		

Because more than 50% of your building is Hotel, your building is designated as Hotel within Portfolio Manager. This building may be eligible for a rating (Click to learn more). If you can see a rating for this building, please note that the rating takes into account all of the space types you have listed. If you cannot see a rating for this building, you can be compared to the national average for Hotel (Click to learn more).

Due to rounding, the % Floor Area Total may not always equal 100%.

Energy Meters Add Meter | Update Multiple Meters | View All Meter Data in Excel

Meter Name	Energy Type	Space(s)	Last Meter Entry (End Date)	Alerts	Read/Write Access	
Electricity	Electricity - Grid Purchase (kWh (thousand Watt-hours))	Entire Facility	05/15/2012	Data > 120 days old. more		Delete Meter
Gas	Natural Gas (therms)	Entire Facility	05/14/2012	Data > 120 days old. more		Delete Meter

The energy meters for this facility quantify whole facility energy consumption. This consumption total includes all common and tenant spaces in the facility. (Change Metering Configuration)

General Facility Administration
Track Energy Performance Improvements
Delete this Facility from Portfolio Manager
Contact us

Sharing Data
Add user to share this Facility
Modify list of users
Transfer Facility to another user
View entire Access List for this Facility

Applying for the ENERGY STAR
Apply for the ENERGY STAR
View status of ENERGY STAR Applications

Building Profiles
A building Profile can be created when an ENERGY STAR label application is submitted

Facility Upgrades

Change	When
Efficient central water chiller	Summer 1995
Lighting upgrade (T8, elec ballasts)	Spring 1996
Cooling tower replacement	Spring 2000
Building automation controls	Spring 2000
Heating water pumps modification to AHU	Summer 2003
Remodel of lobby, HVAC upgrade	Summer 2006

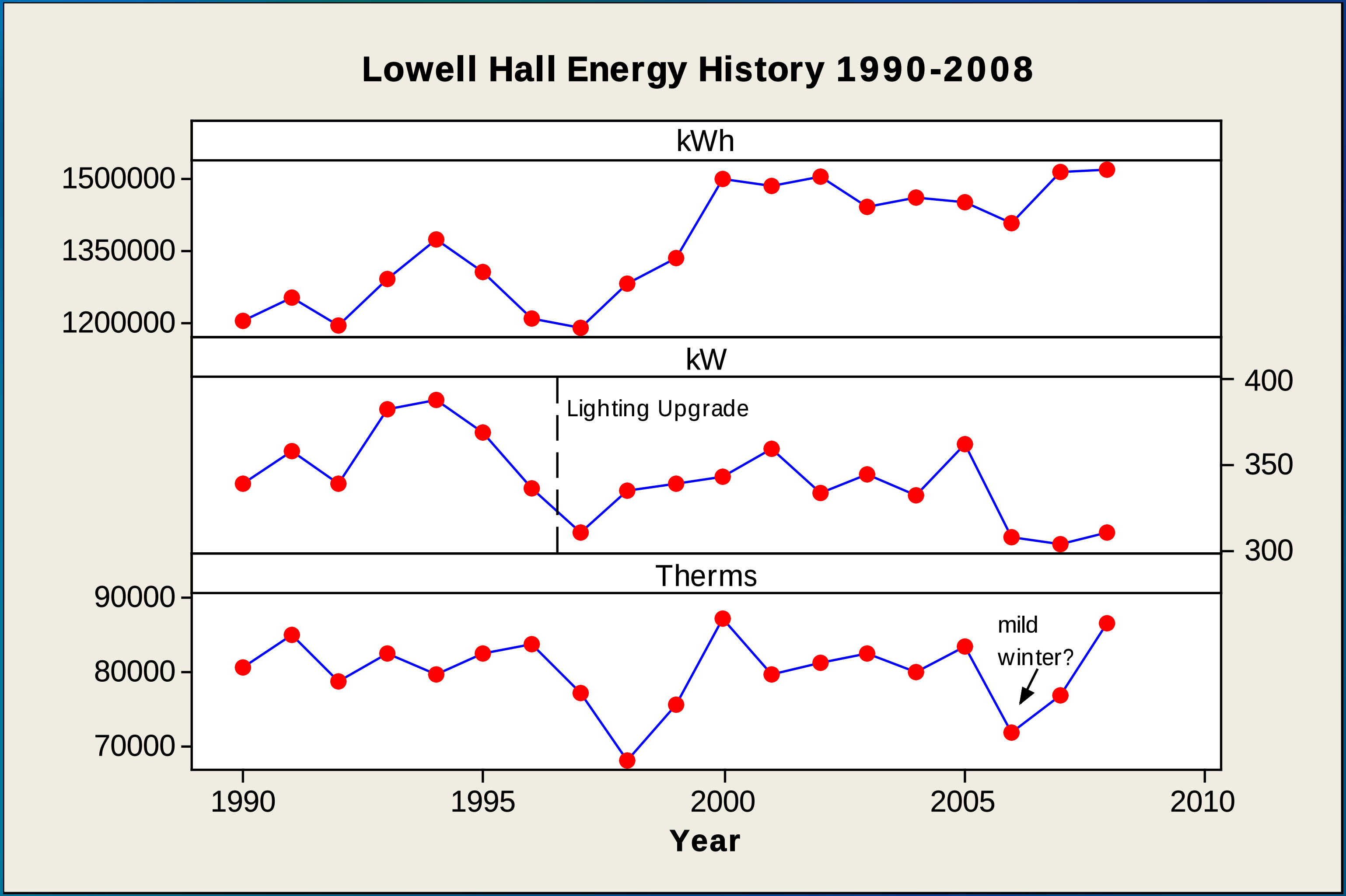
Lowell Hall Energy Performance

Facility Performance Set Baseline Periods | Set Energy Performance Target

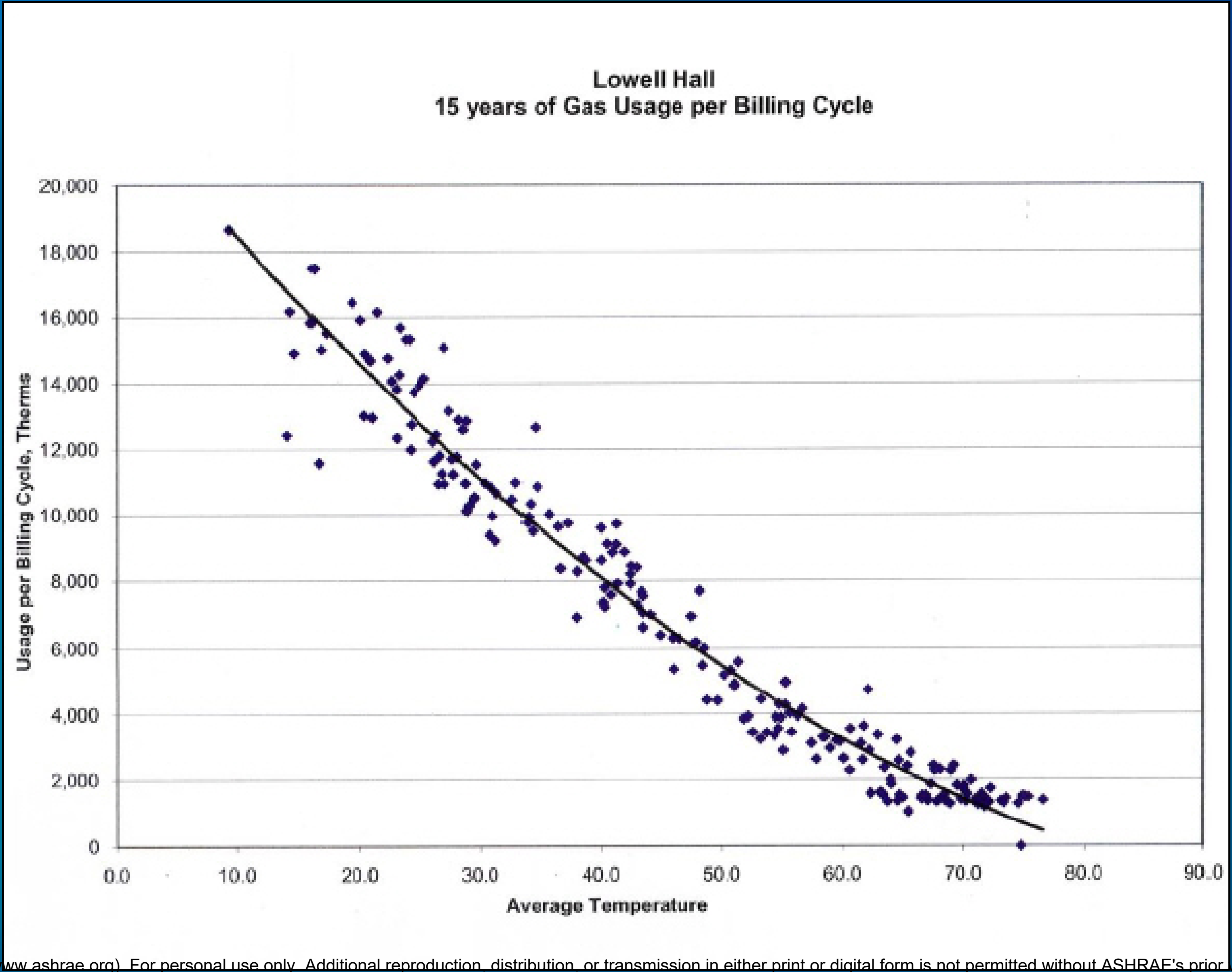
Select View: Summary: Energy Use — Create View | Edit View

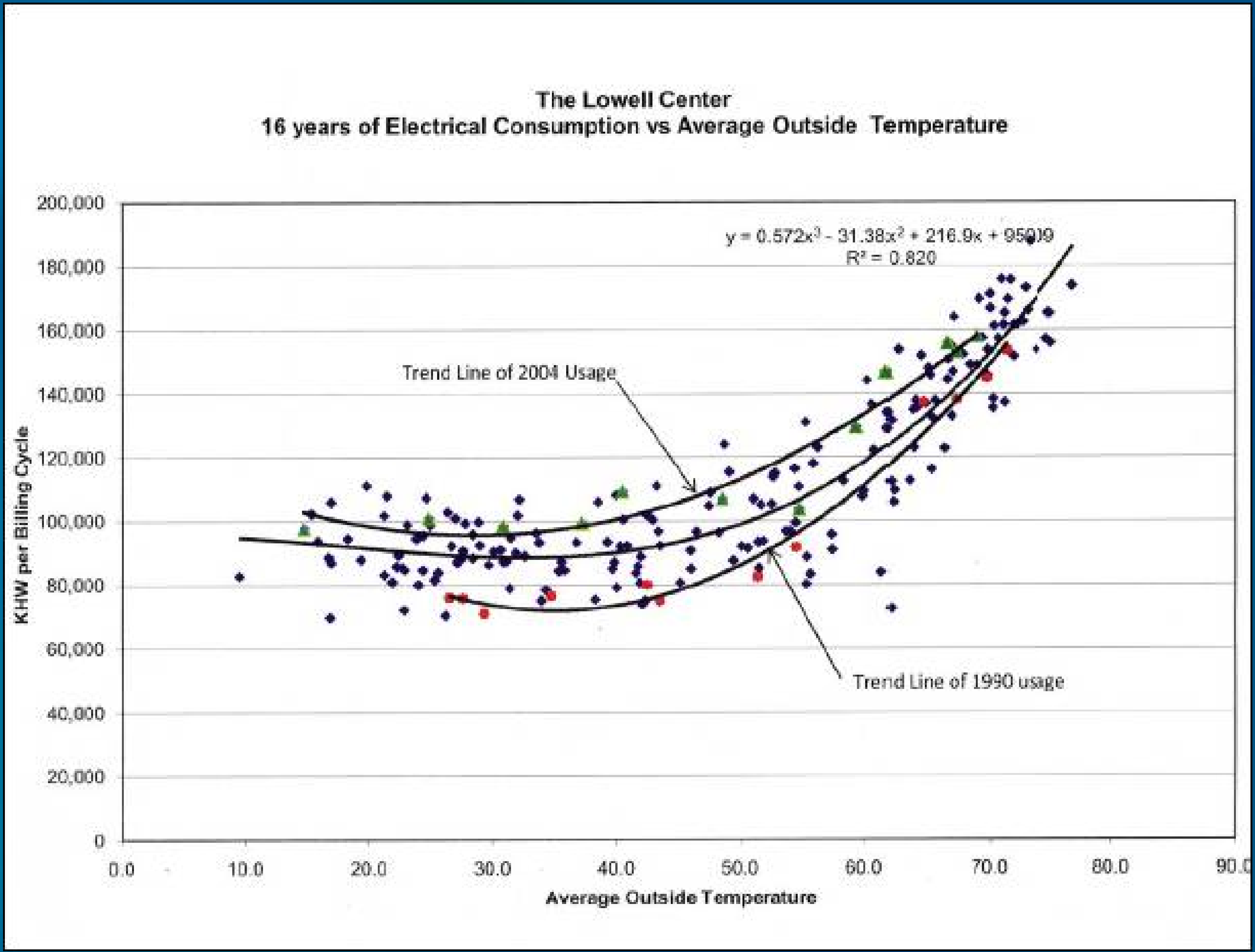
12 Months Ending	Current Rating (1-100)	Current Site Energy Intensity (kBtu/Sq. Ft.)	Current Source Energy Intensity (kBtu/Sq. Ft.)	Change from Baseline: Energy Use Intensity (kBtu/Sq. Ft.)	Change from Baseline: Adjusted Energy Use Intensity (kBtu/Sq. Ft.)
May 2000	42	109.7	208.7	-18.7	-19.5
April 2012	20	117.8	225.1	-10.6	36.8
Change	-22	8.1	16.4	N/A	N/A

History Matches Portfolio Manager



Lowell Hall—Gas Usage





The Lowell Center
16 years of Electrical Consumption vs Average Outside Temperature
y = 0.572x³ - 31.38x² + 216.9x + 95909
R² = 0.820
Trend Line of 2004 Usage
Trend Line of 1990 usage
KHW per Billing Cycle
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
Average Outside Temperature

Lowell Hall Evaluation

Score on our Energy Management checklist:

1 YES 14 NO
No Bonus Points

Energy Management Accountability Check	
1. Energy use is measured	
a. Monthly	☒ Yes ☐ No
b. Daily *Bonus*	☐ Yes ☒ No
c. Hourly *Bonus*	☐ Yes ☒ No
2. Somebody is responsible to know what the energy use is	
a. yearly	☐ Yes ☒ No
b. monthly	☐ Yes ☒ No
c. daily *Bonus*	☐ Yes ☒ No
3. The responsible person can show you the energy use by table or graph of	
a. Yearly records	☐ Yes ☒ No

Energy Management at Monona Terrace Convention Center

Jeff Griffith
Building Maintenance Supervisor

- Action plan
- Monitoring
- Benchmarking
- Accountability

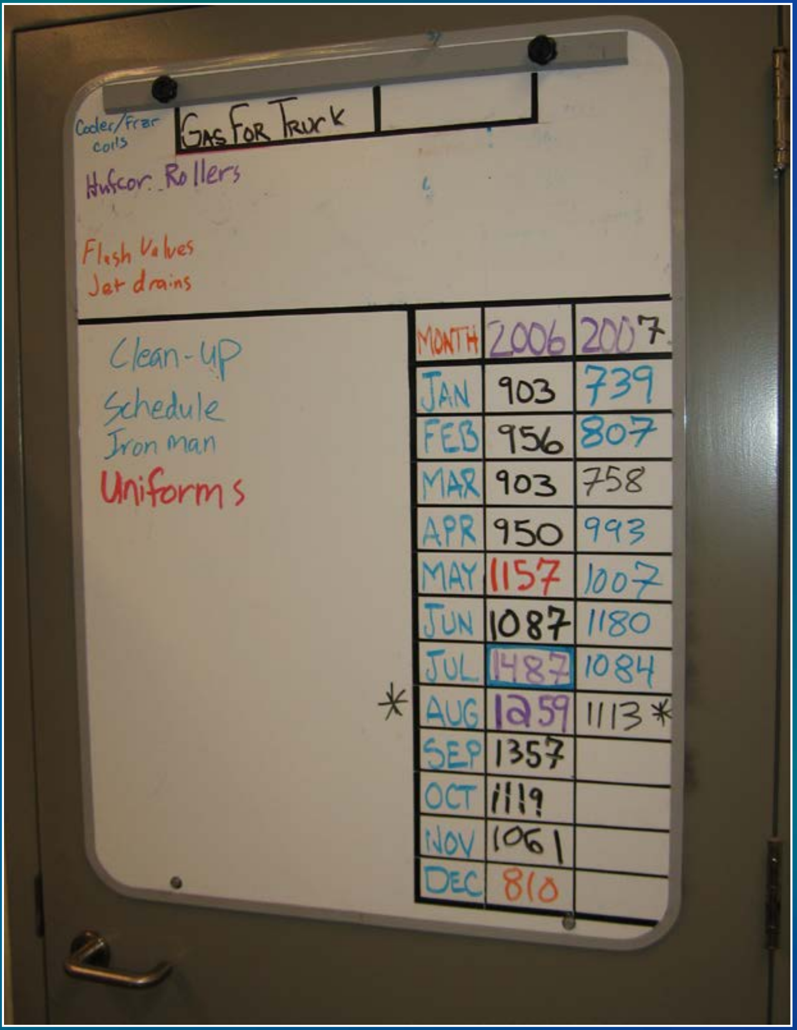
Action Plan

- Initial commissioning by staff
- No compromise in customer comfort
- Eliminate simultaneous heating and cooling
- Adapt operation to daily schedule
- Eliminate energy use in unoccupied spaces
- Regular reminders to entire staff

Regular Monitoring

- Weekly energy review by engineering staff
- BAS alarms to pagers
  - Demand exceeds 1100 kW
  - Chilled water exceeds 50°F
- Personal attention by one engineer on peak days

Monitoring—Low Tech Display!



Benchmarking

	Square Footage	Electricity (kbtu/sqft)	Nat Gas (kbtu/sqft)	Steam (kbtu/sqft)	Chilled Water (kbtu/sqft)	Total Energy (kbtu/sqft)
Rochester, NY	200,000	55.76	0.00	0.00	0.00	55.76
Pittsburg. PA	1,500,000	24.05	0.00	32.25	106.46	162.75
Collinsville, IL	72,500	102.42	69.39	0.00	0.00	171.81
Rochester, MN	191,531	79.90	4.77	89.98	0.00	174.65
Milwaukee, WI	667,475	65.23	2.16	80.06	0.00	147.46
Madison, WI	303,000	51.08	9.51	4.91	0.00	65.50
Sarasota Springs, NY	52,500	66.23	89.81	0.00	0.00	156.04
Toledo, OH	325,000	39.72	73.74	0.00	0.00	113.46
Davenport, IA	154,215	45.26	81.37	0.00	0.00	126.62
Totals	3,466,221					

Accountability

- Jeff—personally accountable to the facility manager for facility energy use
- Engineering staff—accountable to Jeff for components of energy use
- Entire staff maintains an energy-conscious culture
- Weekly staff review of energy use

Monona Terrace Evaluation

Energy Management Accountability Check		*Notes*
1. Energy use is measured		
a. Monthly	☒ Yes ☐ No ☐ Not Sure	
b. Daily *Bonus*	☒ Yes ☐ No ☐ Not Sure	
c. Hourly *Bonus*	☒ Yes ☐ No ☐ Not Sure	Real time w/trending & totalization
2. Somebody is responsible to know what the energy use is		
a. yearly	☒ Yes ☐ No ☐ Not Sure	
b. monthly	☒ Yes ☐ No ☐ Not Sure	
c. daily *Bonus*	☒ Yes ☐ No ☐ Not Sure	Maint Super
3. The responsible person can show you the energy use by table or graph of		
a. Yearly records	☒ Yes ☐ No ☐ Not Sure	
b. Monthly records	☒ Yes ☐ No ☐ Not Sure	
c. Daily records *Bonus*	☒ Yes ☐ No ☐ Not Sure	Steam & Electric
d. Hourly records *Bonus*	☒ Yes ☐ No ☐ Not Sure	Real time w/trending & totalization
4. Somebody is accountable to actually make changes to improve energy use.	☒ Yes ☐ No ☐ Not Sure	
5. Somebody has planned, tested or deployed a change in procedures or operating practices to improve energy use		lighting controls upgrade.
a. in the last 90 days	☒ Yes ☐ No ☐ Not Sure	
b. in the last 30 days	☒ Yes ☐ No ☐ Not Sure	

18 YES (including 5 Bonus items on monitoring)

2 NO

6. Somebody has checked performance of clocks, set-points, or other parameters using suitable probes and loggers		Bi-annual Inspection/Calibration of all HVAC Controllers & equipment
a. In the last 90 days	☒ Yes ☐ No ☐ Not Sure	
b. In the last 30 days	☒ Yes ☐ No ☐ Not Sure	
7. For the last major upgrade of equipment or controls, somebody did a numerical "before and after" analysis to judge actual energy impact of the change.	☒ Yes ☐ No ☐ Not Sure	lighting controls/daylight harvestors. Measured before & after but didn't have accurate way to "predict" impact.
Bonus The "before and after" analysis compared predicted energy impact to actual energy impact	☐ Yes ☒ No ☐ Not Sure	
8. The responsible person can get technical assistance when s/he is not sure of the next energy management step, test or change (assistance can be internal or external).	☒ Yes ☐ No ☐ Not Sure	Johnson Controls MG&E. Focus on Energy
9. A regular forum (meeting) is held at least monthly to review energy performance and actions taken to use energy more intelligently—the responsible person has to give explanations based on numbers, in tables and graphs, not anecdotes.	☒ Yes ☐ No ☐ Not Sure	Weekly Maintenance Staff meeting.
10. A manager of the responsible person (the "boss") attends the review meeting described in 9.	☐ Yes ☒ No ☐ Not Sure	

Total 18 Yes 2 No ___ Not Sure

Monona Terrace

LEED EB Gold Certification

- Significant energy savings
- Nontoxic cleaning products
- Use of clean energy
- High recycling rates

Dubai Chamber Example LEED EB Recertification

Project Information

Building: Dubai Chamber

Contract Type: LEED v4 recertification EBOM

Total Area: 20,000 m²

Conditioned Area: 16,457 m²

Project Summary

Dubai Chamber, 1st LEED EBOM in the region, is a leading example for CSR focusing its efforts on green building and sustainability. The Dubai Chamber reduced potable water use by 69%, energy use of HVAC by further more than 25%, the need for a cooling tower by using outdoor water fountain as a Hx to cool server room, etc.

Results

ENERGY STAR label rating of 91

Consumes less energy than 91% of similar buildings in the US (with normalization)

LEED Platinum certification

Exercise 11: Plans for Next Week

Page 37
in the
exercises

Exercise 11: Planning Exercises

Now is the time to reflect on our seminar and begin to plan how to improve Energy Management in your organization.

<u>Options to develop your intentions for ***action*** after the ASHRAE Meeting</u>
Exercise 11A helps you identify beginning actions to organize and review energy performance data.

Exercise 11B helps you begin to plan a test of a discretionary facility operations change.

Exercise 11C applies the ENERGY STAR® facility assessment matrix, using all the steps of the Energy Management Cycle (requires internet connection).

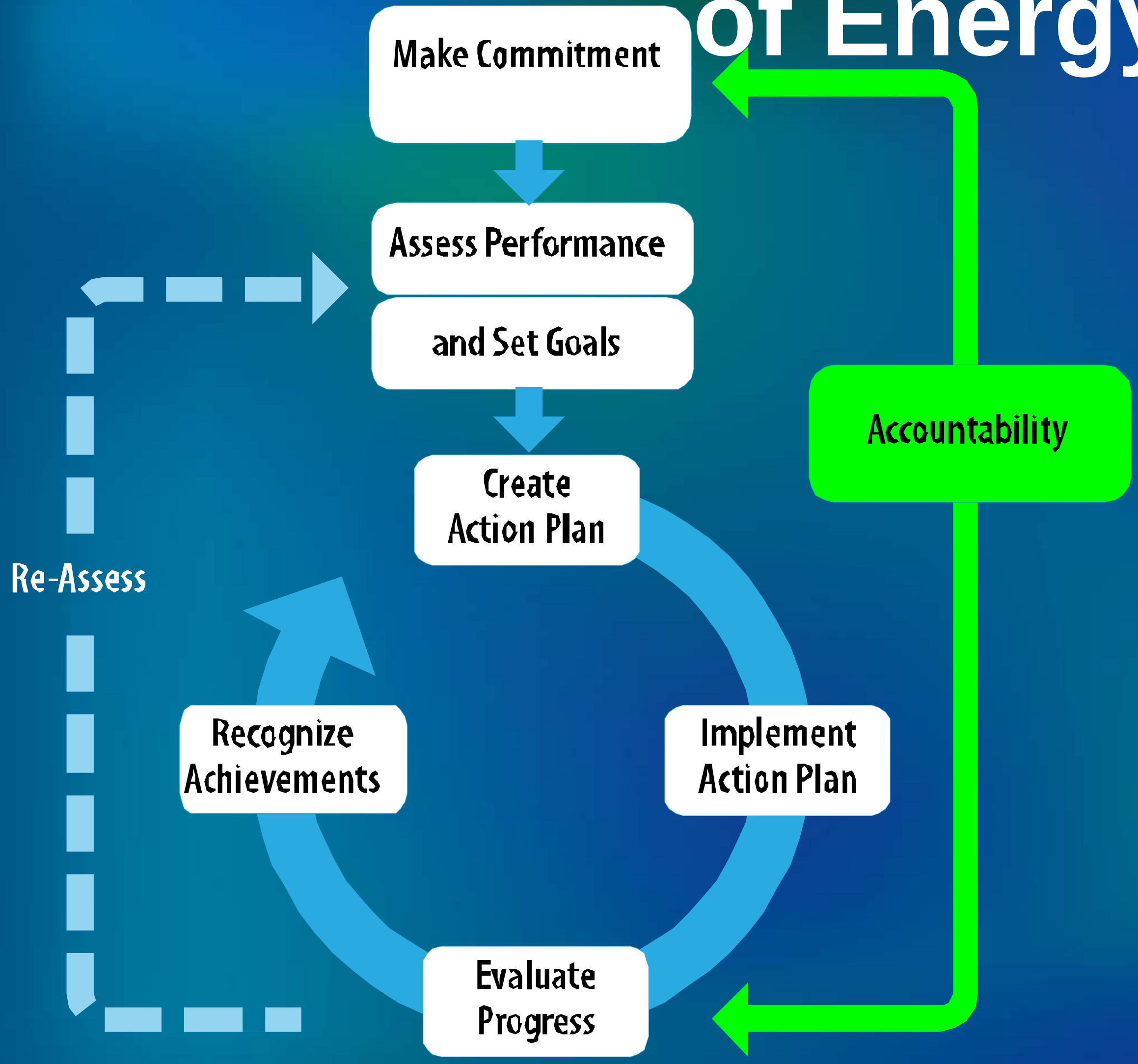
<u>Everyone needs to summarize and prepare a short report out to the session:</u>
Exercise 11D is a simple summary of your intentions when you return to work after the ASHRAE Meeting.

Poll: What Will You Do Next Week?

- Collect 24 months of utility bills?
- Use Portfolio Manager?
  - Review EUI and rating
- Test one discretionary action?
- Go through energy management checklists?
- Or something else?

Recap and Send-off

Recap: The *Management* Content of Energy Management



www.energystar.gov

This is the cycle we have used to guide our discussion. It's time to summarize.

Recap: Assess Performance

Don’t start with audits!

Recap: Assess Performance

Monitor

- Know what performance actually is
- Different time scales
  - Year
  - Month
  - Day
  - Hour or shorter

Benchmark

- Know how performance compares
- Relevant references
  - Self reference (history)
  - Similar buildings
  - Local utility examples
  - ENERGY STAR, etc.

Recap: Why Assess Performance?

To see striking patterns and big differences

- Time-based performance
  - Winter versus summer
  - Weekday versus weekend
  - Day versus night
- One building versus other buildings’ performance
- Predicted versus actual performance

Recap: Create Action Plan

Questions to guide you:

- Where are there big differences?
- What could cause the differences?
- What can you adjust?

Ingredients of your plan:

- Choose something to adjust
- Monitor performance before and after
- Identify limits and barriers
- Repeat

Recap: Evaluate Progress

How?

- Look at energy use over time
- Do adjustments sync with improved energy use?

Why?

- Prove that adjustments improve energy use
- To guide your next actions

Recap: Accountability

Who is accountable to

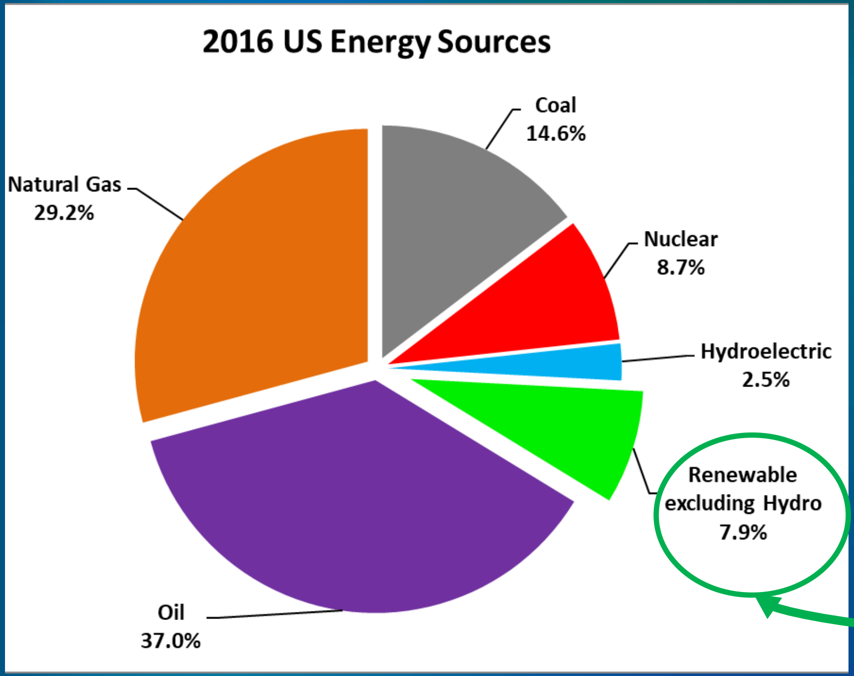
- Assess energy performance?
- Create and carry out action plans to improve performance?
- Evaluate progress?

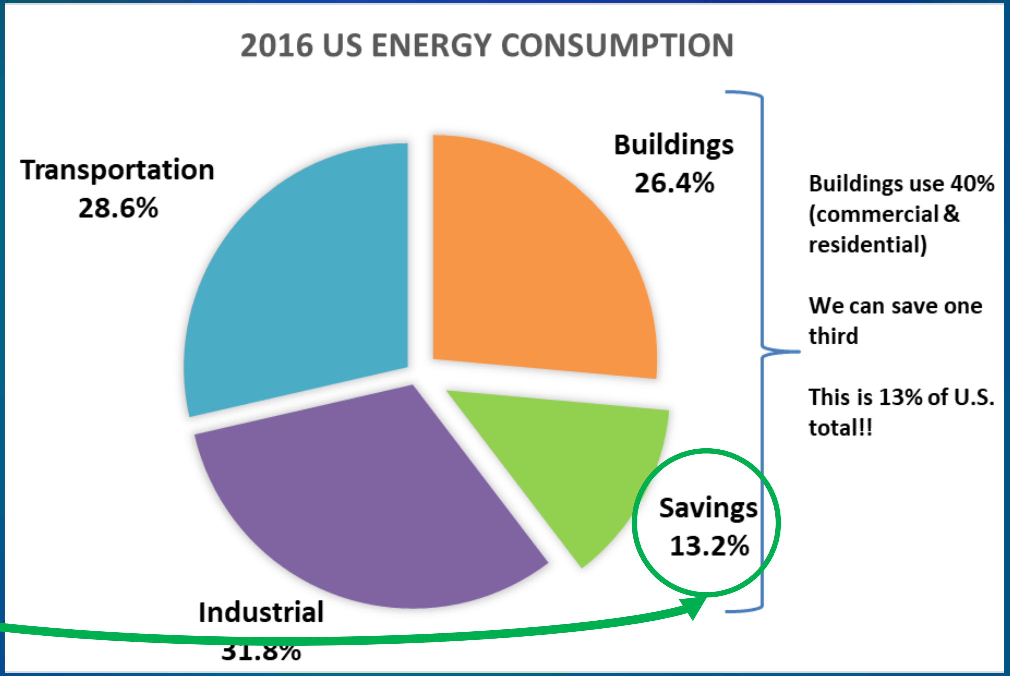
Recap: When are You Really Ready for Audits and Retrocommissioning?

- When you have a monitoring and benchmarking system in place
- When you have adjusted everything you can think of to improve energy performance

And Now the Send-Off…

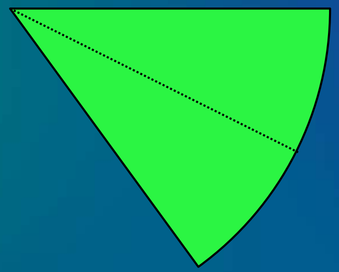
Energy Management is the Quickest, Cheapest, Cleanest Way to Extend World Energy Supplies





Energy management can provide nearly two times the environmental impact of renewable energy!

33% Energy Savings Are Possible in Existing Buildings



- Some from smarter use of what you have right now
- Some from capital upgrades

Sustained Energy Savings Require Management Actions

- An individual must be accountable
- Team-oriented atmosphere
- Use of data to guide actions

Remember to Monitor!

Resources for Your Energy Management Work

Supplementary Information

References

Text and online references are listed in the References supplement

Link to ASHRAE Bookstore

http://www.techstreet.com/ashrae

Check out the resources mentioned in this seminar and more at the online ASHRAE Bookstore!

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- ASHRAE values your comments about this course. You will receive your Certificate of Attendance when you finish the online course evaluation form at the URL below. Please use the link to also access supplemental files: **https://www.ashrae.org/14oct2020gtc**

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