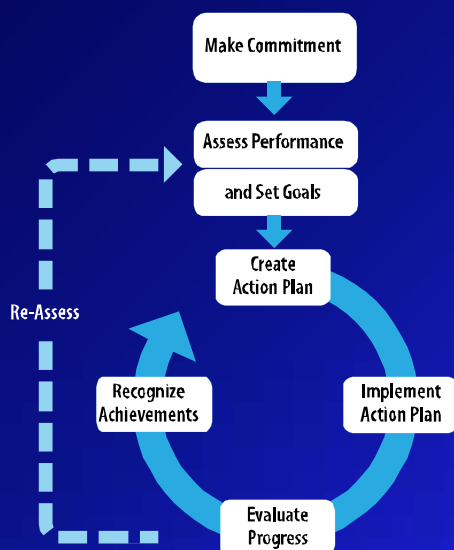


Energy Management in New and Existing Buildings A Sustainable Activity

ASHRAE TC 7.6

Richard J. Pearson, P.E., ASHRAE Fellow
February 17, 2010

Map for Today's Presentation



www.energystar.gov

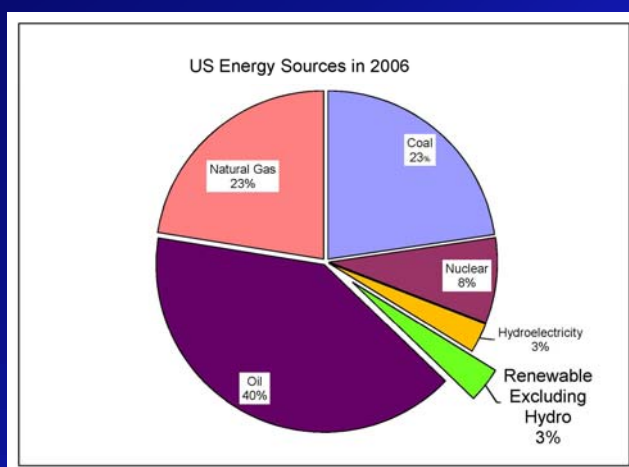
ENERGY STAR
Guidelines
describe a
management cycle
that helps you with
Execution—getting
things done!

Today's Agenda

- Impact of Energy Management
 - Environmental Impact
 - Economic Impact
- Sample Action Plans
- Prioritizing Multiple Buildings
- A Novel Pilot Project
- Successful Projects
- Making Accountability Work

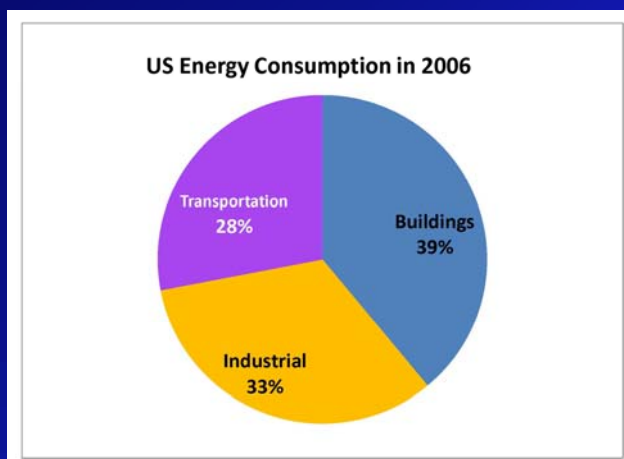
3

Renewables as an Environmental Solution?



4

Where do we use energy?



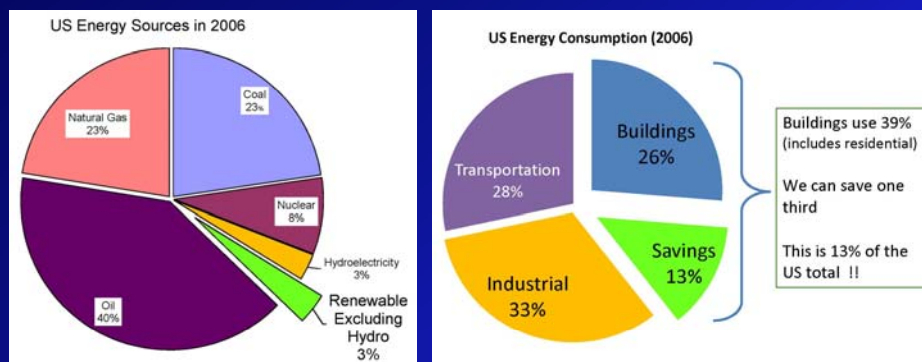
5

Energy Management Potential

- Buildings consume 39% of US energy
- 33% reduction of building energy is possible
- This will save 13% of US energy

6

Energy management is the quickest, cheapest, cleanest way to extend world energy supplies

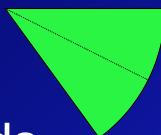


Energy management can provide four times the environmental impact of renewable energy

7

Energy Management Potential

Building Reduction
33%



National Reduction
13%

In Other Words.....

- Green
- Sustainable
- Lowers Carbon Footprint
- Lowers CO₂ Emissions
- Reduces Global Warming
- Reduces Cost
- Improves Return on Investment

Emissions Factors and Energy Prices for the Cleaner and Greener Environmental Program
<http://www.cleanerandgreener.org/download/efactors.pdf>

8

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).

9

Greener Pastures with Energy Savings

Emissions Reduction at Madison Area Technical College

Energy	Usage FY 01/02	Usage FY 06/07	Reduction!
Electricity	23,000,000 kWh	18,000,000 kWh	5,000,000 kWh
Natural Gas	900,000 therms	645,000 therms	255,000 therms
Emissions	Emissions FY 01/02	Emissions FY 06/07	Reduction!
Carbon Dioxide	30,500 tons	23,000 tons	7,500 tons
Sulfur Oxides	138 tons	106 tons	32 tons
Nitrogen Oxides	72 tons	55 tons	17 tons

Source: MATC Engineering Manager – Wesley Marquardt –
wmarquardt@matcmadison.edu

For 50 state emissions data, refer to “Emission Factors and Energy Prices”:
<http://www.cleanerandgreener.org/download/efactors.pdf>

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Energy Management 101



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

11

Energy Management 101 The Building

20-Story Office Building

- 200,000 S.F.
- 5 years old, no energy conservation
- Complex, energy intensive HVAC systems
- High utility bills
- No building automation system

12

Energy Management 101

How it worked

Actions by Facility Manager

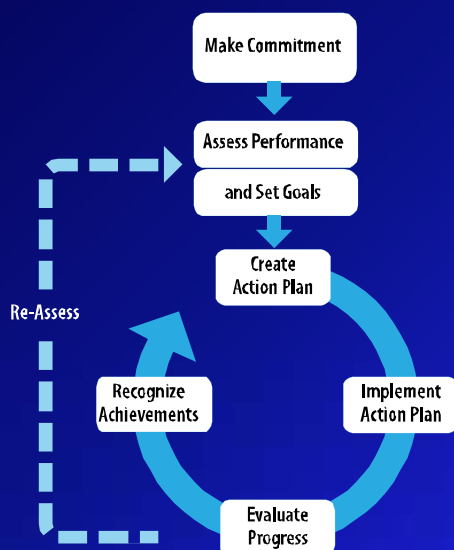
- Reviewed possible operational improvements with building engineer and design engineer
- Read meters daily
- Obtained previous day's weather data
- Harassed/complimented Building Engineer daily

Savings in one year: 33%!

13

The *Management* Content of Energy Management

www.energystar.gov

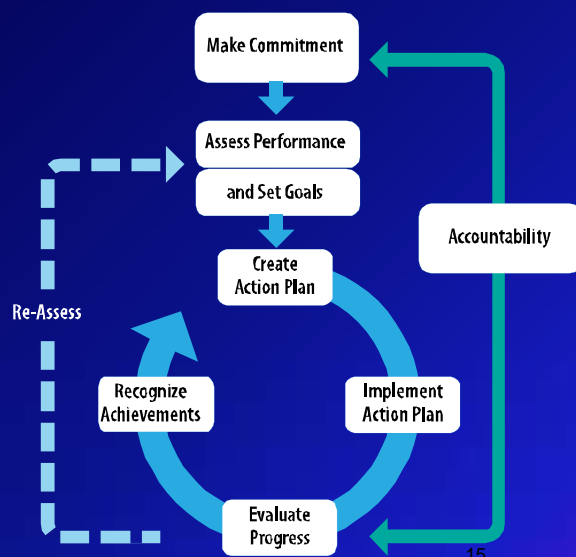


ENERGY STAR
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Execution—getting
things done!

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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 Management Roles

ENERGY STAR Task	Owner	Manager	Staff
Make Commitment	X		
Assess Performance & Set Goals		X	
Create Action Plan		X	X
Implement Action Plan			X
Evaluate Progress		X	
Recognize Achievements	X	X	

16

Make Commitment

Top Management Commits to Continuous Improvement

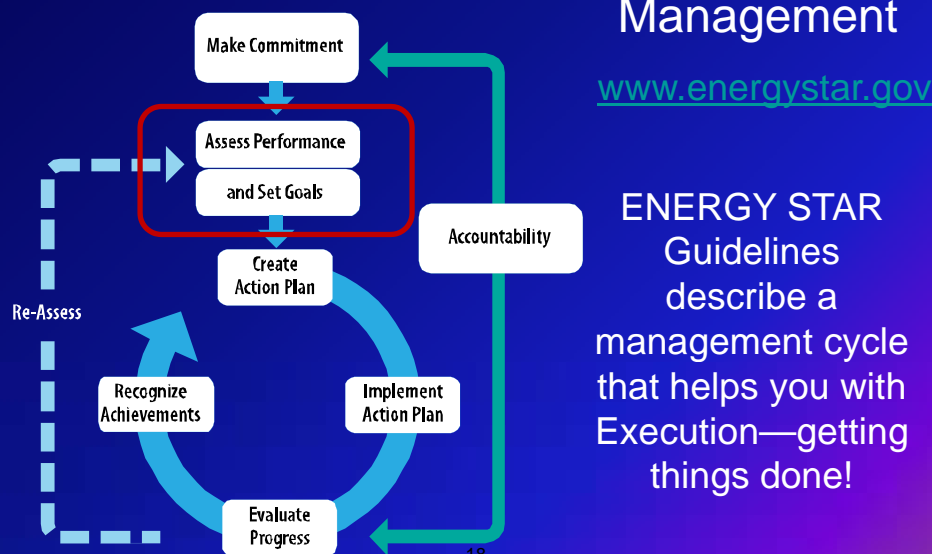
The common element of successful energy management is commitment.

- Form a Dedicated Team
- Institute an Energy Policy

17

The *Management* Content of Energy Management

www.energystar.gov



ENERGY STAR Guidelines describe a management cycle that helps you with Execution—getting things done!

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

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Indices

ECI: Energy Cost Index = \$/SF/yr

EUI: Energy Utilization Index = kBTU/SF/yr

$$\begin{aligned}
 &(\text{Annual kWh} \times 3.413) = \text{____ kBTU} \\
 + &(\text{Annual Therms} \times 100) = \text{____ kBTU} \\
 \hline
 &\text{Total Annual Energy} = \text{____ kBTU}
 \end{aligned}$$

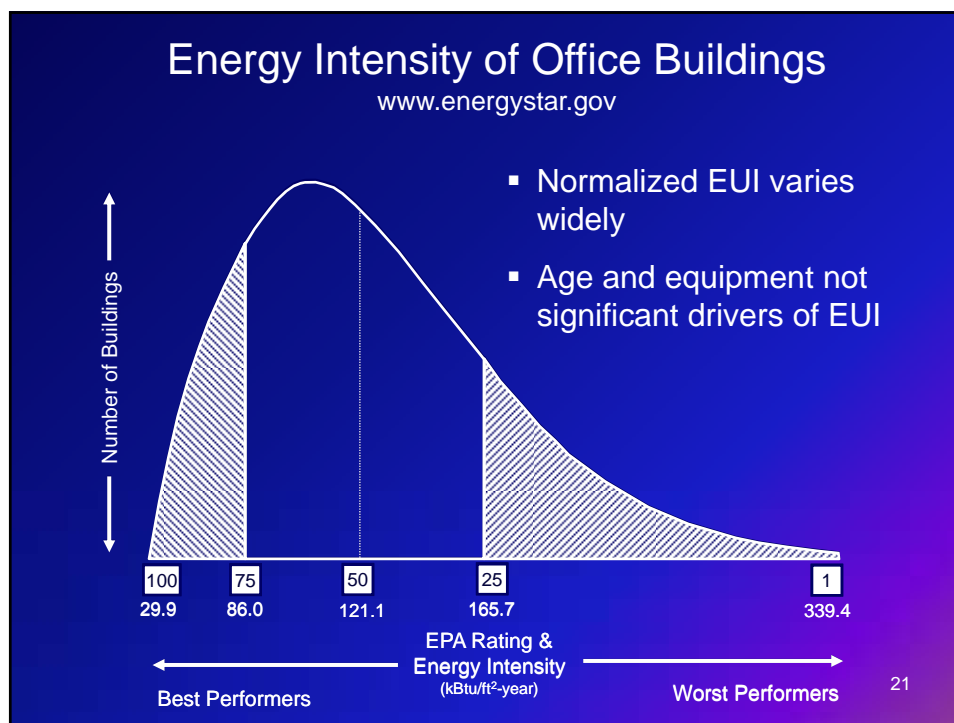
$$\text{EUI} = \text{Total Annual Energy} \div \text{SF} = \text{kBTU/SF/yr}$$

Example: Lowell Hall @ UW, 1996

$$\begin{aligned}
 &(1,209,319 \text{ kWh} \times 3.413) = 4,127,000 \text{ kBTU} \\
 + &(83,642 \text{ Therms} \times 100) = 8,364,200 \text{ kBTU} \\
 \hline
 &\text{Total Annual Energy} = 12,491,200 \text{ kBTU}
 \end{aligned}$$

$$\text{EUI} = 12,491,200 \text{ kBTU} \div 117,600 \text{ S.F.} = 106.2 \text{ kBTU/SF/yr}$$

20



Energy Star Benchmarking

www.energystar.gov/benchmark

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Portfolio Manager Overview : ENERGY STAR : Mozilla Firefox

http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfolio.manager

ENERGY STAR Superior Energy Management Creates Environmental Leaders
U.S. Environmental Protection Agency

About ENERGY STAR | News Room | FAQs | **VIDEO** | Search

Products | Home Improvement | New Homes | Buildings & Plants | Partner Resources

Home » Buildings & Plants » Portfolio Manager Overview

Portfolio Manager Overview

Portfolio Manager is an interactive energy management tool that allows you to track and assess energy and water consumption across your entire portfolio of buildings in a secure online environment. Whether you own, manage, or hold properties for investment, Portfolio Manager can help you set investment priorities, identify under-performing buildings, verify efficiency improvements, and receive EPA recognition for superior energy performance.

How can Portfolio Manager help me?

- Manage Energy and Water Consumption for all Buildings
- Rate Building Energy Performance
- Set Investment Priorities
- Verify and Track Progress of Improvement Projects
- Gain EPA Recognition
- Related Tools

Manage Energy and Water Consumption for All Buildings

Portfolio Manager helps you track and assess energy and water consumption within individual buildings as well as across your entire building portfolio. Enter energy consumption and cost data into your Portfolio Manager account to benchmark building energy performance, assess energy management goals over time, and identify strategic opportunities for savings and recognition opportunities.

Any building can efficiently track and manage resources through the use of Portfolio Manager. The tool allows you to streamline your portfolio's energy and water data, and track key consumption, performance, and cost information portfolio-wide. For example, you can:

- Track individual building energy and water consumption
- Compare building performance to similar buildings
- Identify energy and water savings opportunities
- Set energy and water goals
- Track progress over time
- Receive EPA recognition for superior energy performance

Getting Started for...

- Government
- Healthcare
- Higher Education
- Hospitality
- Industrial
- K-12
- Real Estate
- Retail
- Small Business
- Congregations
- Service & Products Providers
- Utilities & Energy
- Efficiency Program Sponsors
- Water/Wastewater Utilities

Join ENERGY STAR

Portfolio Manager Login

Username:

Forgot your username?

Password:

Forgot Your Password?

New User? Register

Login

Selected Resources

- Learn How The Rating System Works
- Take the Portfolio Manager Tour

Done

Start | Portfolio Manager Overview | Energy management... | Microsoft PowerPoint...

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Portfolio Manager Overview : ENERGY STAR : Mozilla Firefox

http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfolio.manager

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Join ENERGY STAR

Portfolio Manager Login

Username:

Forgot your username?

Password:

Forgot Your Password?

New User? Register

Login

Selected Resources

- Learn How The Rating System Works
- Take the Portfolio Manager Tour

Done

Start | Portfolio Manager Overview | Energy management... | Microsoft PowerPoint...

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ENERGY STAR

Home > Buildings & Plants > Real Estate

ENERGY STAR for Real Estate

Energy represents the single largest operating expense for commercial buildings, with about 30% of building energy used inefficiently or unnecessarily. Through partnering with ENERGY STAR, organizations with commercial real estate, corporate real estate, and multifamily housing units have experienced significant energy consumption reductions while increasing asset value. EPA supports the efforts of real estate owners and managers with a proven energy management strategy and no-cost tools to save energy and money and demonstrate environmental leadership.

What You Can Do

Owners and managers of real estate portfolios that partner with EPA and take the ENERGY STAR Challenge, demonstrate a commitment to smart energy management as well as environmental stewardship.

- [Become an ENERGY STAR Partner](#)
- [Benchmark your properties in Portfolio Manager](#)
- [Join the ENERGY STAR Challenge](#)
- [Bring Your Green to Work with ENERGY STAR](#)

Learn more about ENERGY STAR for:

- [Commercial Real Estate](#)
- [Corporate Real Estate](#)
- [Multifamily Housing](#)

Quick Finder

- Portfolio Manager Login
- Target Finder
- ENERGY STAR Challenge
- ENERGY STAR Leaders
- Earn the ENERGY STAR
- Purchasing & Procurement
- Service Providers Directory
- Find Labeled Buildings and Plants
- Communications Materials
- Training

News

[New!](#) EPA Unveils Top 25 Cities with Most ENERGY STAR Buildings in 2008

See all Real Estate News:

25

Commercial Real Estate : ENERGY STAR - Mozilla Firefox

Home > Buildings & Plants > Real Estate > Commercial Real Estate

ENERGY STAR For Commercial Real Estate

Energy represents 30 percent of the typical office building's costs and is a property's single largest operating expense. ENERGY STAR partners have demonstrated:

- Energy consumption reductions of 35 percent or more through building operation and management strategy changes alone
- Increased asset value from energy performance improvements
- Increased tenant satisfaction and retention

What You Can Do

- [Join ENERGY STAR](#)
- [Prepare an Energy Strategy for the Future](#)
- [Establish a comprehensive energy management program using the Guidelines for Energy Management](#)
- [Read the Commercial Real Estate Benchmarking Starter Kit](#)
- [Assess building performance with the Building Benchmarking Starter Kit](#)
- [Participate in Online Training Services](#)
- [Purchase ENERGY STAR qualified products to save energy throughout the building](#)
- [Learn how service providers can offer energy management solutions for commercial real estate](#)
- [Learn about energy information services and find companies that offer automated benchmarking](#)
- [Communicate your energy management efforts to your tenants, employees, investors, and industry peers](#)
- [Pursue the Designed to Earn the ENERGY STAR for new construction](#)
- [Increase tenant satisfaction and retention with a Tenant Guide to Protecting the Environment & Saving Money in Leasing Practices](#)

Quick Finder

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News

[New!](#) EPA Unveils Top 25 Cities with Most ENERGY STAR Buildings in 2008

Winter 2009 Business &

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Commercial and Corporate Real Estate Benchmarking Starter Kit - ENERGY STAR - Mozilla Firefox

http://www.energystar.gov/index.cfm?c=comm_real_estate.bus_comm_real_estate_bm_starter_kit

ENERGY STAR

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Guidelines for Energy Management

Tools & Resources Library

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Commercial Building Design

Green Buildings

Getting Started for...

Government

Healthcare

Higher Education

Hospitality/Entertainment

Industrial

K-12

Real Estate

Small Business

Congregations

Service & Products Providers

Utilities & Energy

Efficiency Program

Sponsors

Water/Wastewater

Utilities

Join ENERGY STAR

Commercial and Corporate Real Estate Benchmarking Starter Kit

Office buildings, Bank Branches, Financial Centers, and Courthouses can assess their energy performance using Portfolio Manager. The following documents are intended to help you get started benchmarking, take the next steps, and assist building owners and tenants in data collection.

• [Get Started](#)

• [Collected Data](#)

• [Take the Next Steps](#)

Get Started

[Eligibility Requirements for Use of the National Energy Performance Rating System](#)

Review the criteria to determine if your property is eligible.

Quick Reference Guide (673KB)

This document provides "how-to" steps and helpful tips for users of the energy performance rating system. At a glance, it provides the eligibility criteria, property data needed, and guidance on rating interpretation for rating office buildings.

Training on Rating Energy Performance of Commercial Office Buildings with EPA's Portfolio Manager

Learn to benchmark the energy performance of your office buildings in Portfolio Manager by attending a Commercial Real Estate Benchmarking training session.

• [Live training](#)

• [Recorded training](#)

Done

start Commercial and Corp... Energy management ... EM Chapter press 60 ... EM Chapter press 60 ...

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PORTFOLIO MANAGER • QUICK REFERENCE GUIDE OFFICE BUILDINGS

Rate Your Energy Performance

Use the US EPA's energy performance rating system within Portfolio Manager to rate the energy performance of your office facilities on a scale of 1–100. Rate all of your facilities and update the data regularly to take control of your energy consumption. See top of page two for eligibility and data needed.

USE PORTFOLIO MANAGER STEP-BY-STEP

STEP	ACTIVITY	ACTION
1	Access Portfolio Manager	www.energystar.gov/benchmark
2	Access your account	<ul style="list-style-type: none"> Click REGISTER next to "New User?" Enter user name and password and click LOGIN. From the "Welcome" page, click ACCESS MY PORTFOLIO.
3	Add a new property	Click ADD A PROPERTY on the "My Portfolio" page.
4	Specify property type	Select the appropriate option and click CONTINUE.
5	Enter general building data	Enter all required information and click SAVE.
6	Enter space use data	<ul style="list-style-type: none"> Go to "Space Use" section and click ADD SPACE. Enter a space name, select the space type, and do not change the effective date. Click CONTINUE. Enter all required data. Click SAVE. Repeat until all square footages have been accounted for. For more information, see "Helpful Hints" section on the next page.
7	Enter energy use data	<ul style="list-style-type: none"> Go to "Energy Meters" section and click ADD METER. Enter meter name, energy type, and units. Answer remaining questions (typically accept all defaults). Click SAVE. Select desired number of meter entries and a start date. Click CONTINUE. Enter energy use. Click SAVE. Repeat for all fuel types used in the building.
8	Review and interpret results	At the top of the "Facility Summary" page, review your results in the "Facility Performance" section.
8a	Manage account and apply for recognition	<ul style="list-style-type: none"> View your baseline and current ratings, generate a Statement of Energy Performance, set performance targets. Share data, apply for the ENERGY STAR, create a building profile, and perform other administrative tasks.
8b		

www.energystar.gov/benchmark

E-mail: buildings@energystar.gov

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ELIGIBILITY CRITERIA

- Fifty percent or more of total building square footage (SF) must be designated as office space. No more than 10 percent of total building SF can be designated as "Computer Data Center" or "Other."
- Office buildings, courthouses, medical office buildings—minimum of 5,000 SF
- Bank/financial institutions—minimum of 1,000 SF
- Operated a minimum of 20 hours per week
- Occupied for the last 11 months by at least 1 worker, with at least 1 PC

RATING INTERPRETATION

Use your rating to set improvement goals and create an action plan. If your building's energy performance rating was:

1-49 After reducing the load on your building with aggressive low-cost operational changes, you may need to invest in capital equipment to further enhance performance and increase the bottom line.

50-74 Significant opportunities to reap savings. Simple, low-cost operations and maintenance practices, combined with equipment upgrades, could yield significant savings.

75-100 Gain recognition for your achievements and continue implementing best practices.

HELPFUL HINTS

- Computer Data Center: Input one entry for the sum of all SF used as computer data center.
- Office space: Input one entry for total gross SF including all supporting functions and common areas such as atria, elevator, stairwells, restrooms, break rooms, storage areas, and administrative areas. Only input more than one office space if operating hours for some office spaces differ by 10 or more hours from the rest of the building. For example, it is 100,000 gross SF office building where a 20,000 SF tenant works 20 hours longer each week than the rest of the building's tenants, enter two office space entries: Standard Hours (for 80,000 SF) and Extended Hours (for 20,000 SF).
- Parking: Input total parking SF based on energy usage. For example, input Enclosed parking SF where energy is used for lighting and mechanical ventilation; Non-Enclosed parking SF where energy is used for lighting and Dehumidifying SF where energy is used for lighting only at night. Do not leave any cell blank—input zero "0" if necessary.
- Enter at least 12 consecutive months of complete energy data, with no gaps or overlaps between meter entries.
- Change your password or user profile.
- Maintain contact information for your energy team.
- View online answers to Frequently Asked Questions.
- Email the system for technical assistance.
- Access online user-support information.


DATA NEEDED

- Building address
- Year built
- Gross floor area
- Operating hours per week
- Number workers on main shift
- Number of personal computers
- Percent of building heated and cooled
- At least twelve consecutive months of energy use and cost data for all fuel types

Cost data is optional and is not used in the calculation of an energy performance rating.

FEATURES

- Control account access and editing rights. On the right side of the "Facility Summary" page, go to "Sharing Data" (see [Screenshot](#) on page one). Click **ADD** to delegate access to your property to other users while retaining your access as well. Click **TRANSFER** to assign another user the role of "Building Data Administrator" for your property.
- Group facilities within an account. Organize properties into groups (e.g., by region, by facility type). From the "My Portfolio" page, click **CREATE GROUP**.
- Generate a Statement of Energy Performance. Use this resource as a management report and transactional document. Above the "Facility Performance" section of the "Facility Summary" page (see [Screenshot](#) on page one), click **GENERATE A STATEMENT OF ENERGY PERFORMANCE**.
- Track ratings and eligibility for the ENERGY STAR. From the "Facility Summary" page, under the "General Information" section (see [Screenshot](#) on page one), click "Eligibility for the ENERGY STAR" and click **APPLY** if applicable.
- Track Water Meters. At the bottom of the "Facility Summary" page, click **ADD METER** next to "Water Meters."



www.energystar.gov/
benchmark
E-mail: buildings@energystar.gov

August 2009
432-F-09-019

DRAFT

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Energy Star Portfolio Facility Summary

Facility Summary: Lowell Hall

[How do we use this data?](#)

Building ID: 1031312
Level of Access: Building Data Administrator

General Information

Address: 610 Langdon Street
Madison, WI 53705

Year Built: 1959

Facility Performance

Set Energy Performance Baseline and Targets

Select View: **Energy** [Download Data](#) [Full View](#)

12 Months Ending	Total Energy Use (kBtu (thousand Btu))	Actual Annual Energy Intensity (kBtu/Sq. Ft.)	Energy Savings (kBtu (thousand Btu))	Energy Savings per Sq. Ft. (kBtu/Sq. Ft.)	Rating (1-100)	Energy Use Alerts	Full Year
December 1991	12,769,894.26	109.9	N/A	N/A	N/A	Data > 120 days old Must Have Monthly Electrical Data	Yes
December 2003	13,165,935.00	112.0	N/A	N/A	36	Data > 120 days old	Yes

[REFRESH VIEW](#)

Space Use

Add Space

Space Name	Space Type	Floor Area (Sq. Ft.)	% Floor Area	Alerts
Lodging	Hotel (Upscale)	63,134	54	Delete Space
Staff Offices	Office (General)	54,458	46	Delete Space
Total		117,592	100 %	

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

General Facility Administration

Take 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

Statement of Energy Performance

Generate a Statement of Energy Performance
View Statement of Energy Performance

Applying for the ENERGY STAR Label

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

Labeled Building Profiles

Create New/Update Existing Published Building Profile
Edit Draft Building Profile
View status of Building Profiles
Compare Building Profile Accounts

Energy Meters

Add Meter | Download all Meter Data (Excel)

Meter Name	Energy Type	Space(s)	Last Meter Entry (End Date)	Alerts
Electricity	Electricity (kWh (thousand Watt-hours))	Entire Facility	12/31/2003	Data > 120 days old Delete Meter
Gas	Natural Gas (therms)	Entire Facility	12/31/2003	Data > 120 days old Delete Meter

Target Page in Portfolio Manager <http://www.energystar.gov/benchmark>

Set Energy Performance Baseline and Targets

You may establish an energy performance baseline and targets by either defining a target rating or a target reduction. The energy use and costs displayed reflect required levels to meet either the target rating and percent reduction goal. Select "Save" to store the entered targets in Portfolio Manager.

Set Baseline (12 Months Ending) December 2003

Target (1-100 Rating)	Baseline Rating (1-100)	Baseline Energy Use (kBtu/year)	Target Energy Use (kBtu/year)	Energy Cost Savings (\$/year)	Target Reduction (%)
75	36	13,165,035	9,177,257	\$46,564	31 %

CANCEL RECALCULATE SAVE

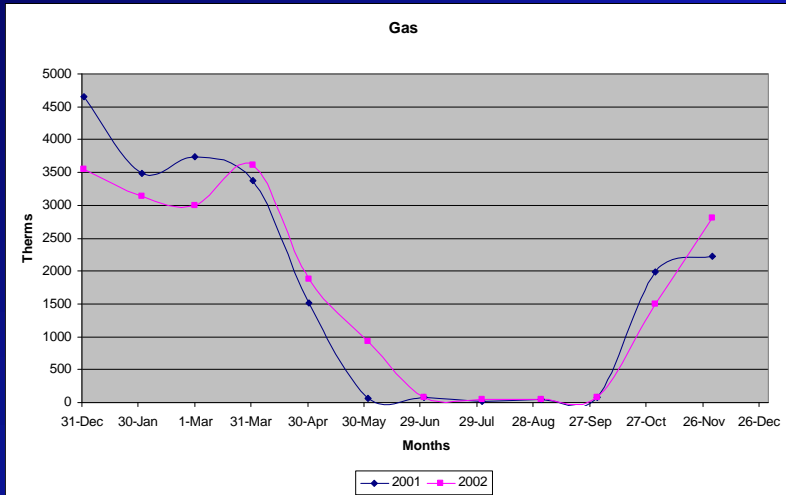
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Assess Performance & Set Goals

- Annual Usage
 - Energy Cost Index (ECI)
 - Energy Utilization Index (EUI)
- **Annual Profile of Monthly Data**
- **Daily Profile of 15 minute Data**

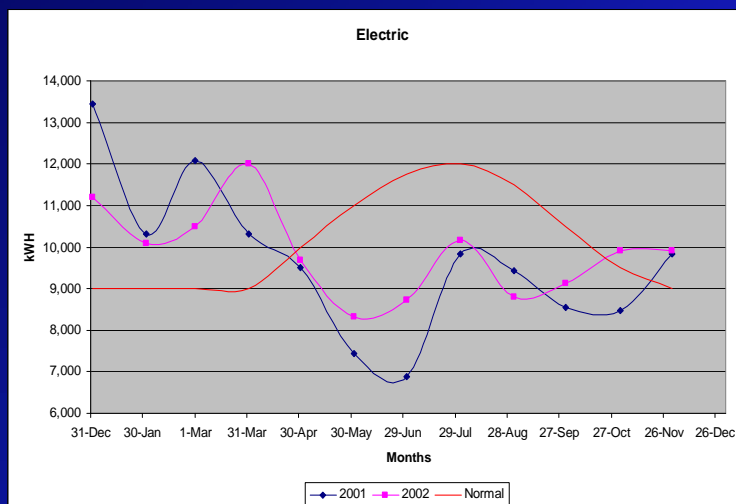
32

Annual Profile of Monthly Data Madison Church



33

Annual Profile of Monthly Data Madison Church



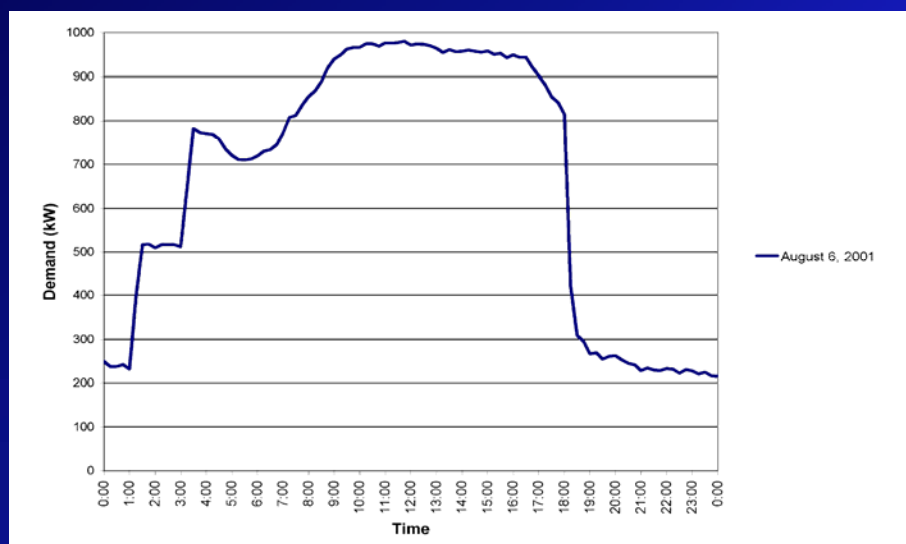
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Honolulu Office Building



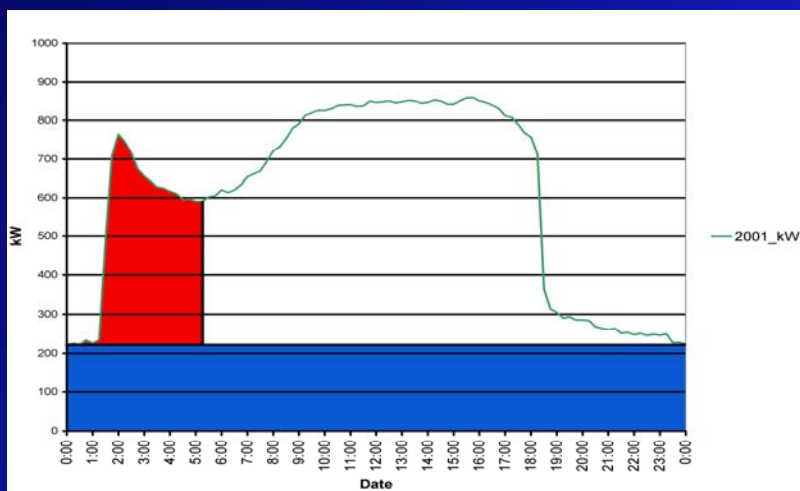
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Daily Profile of 15 Minute Data



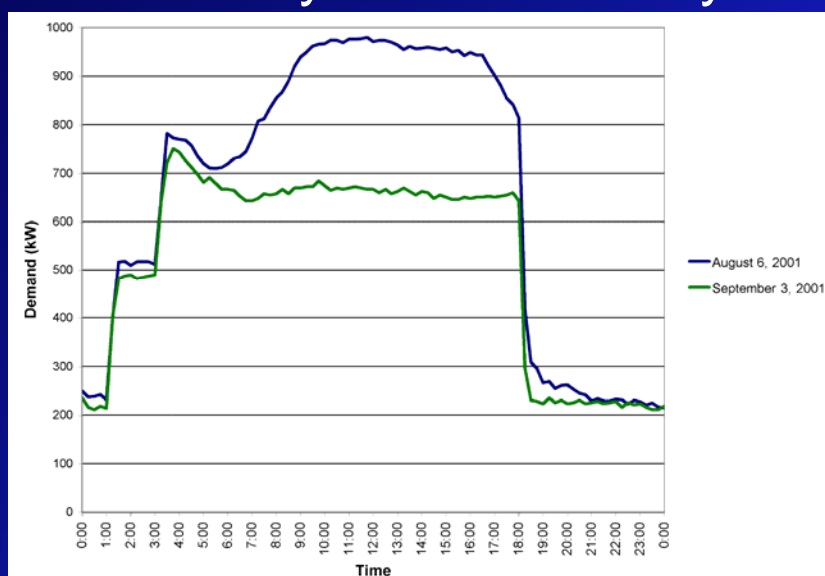
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Daily Profile of 15 Minute Data Honolulu Office Building

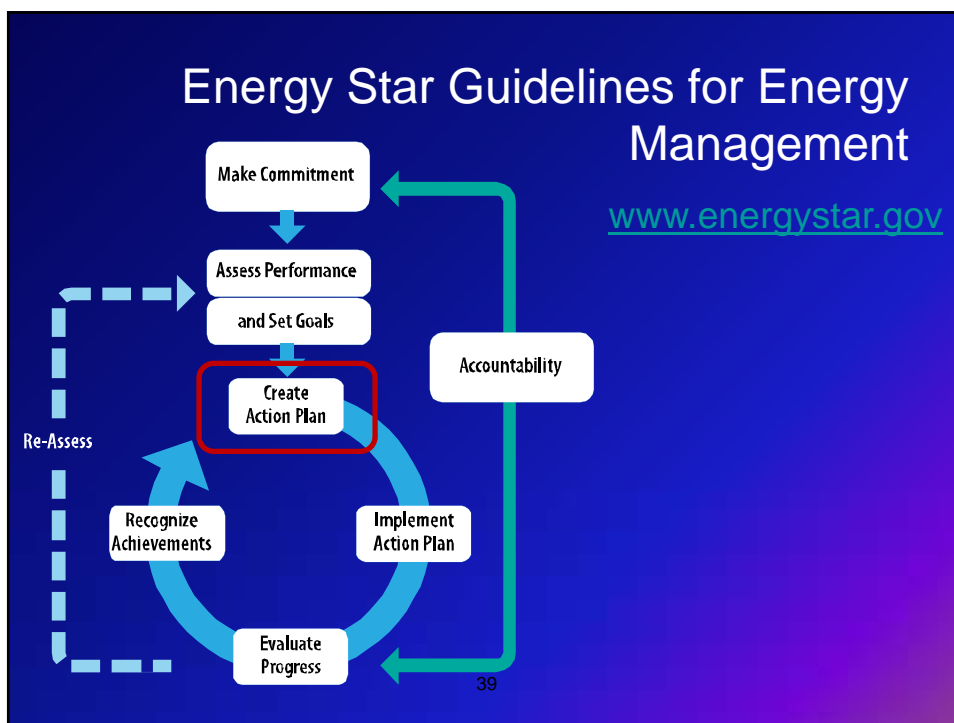


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Monday versus Holiday



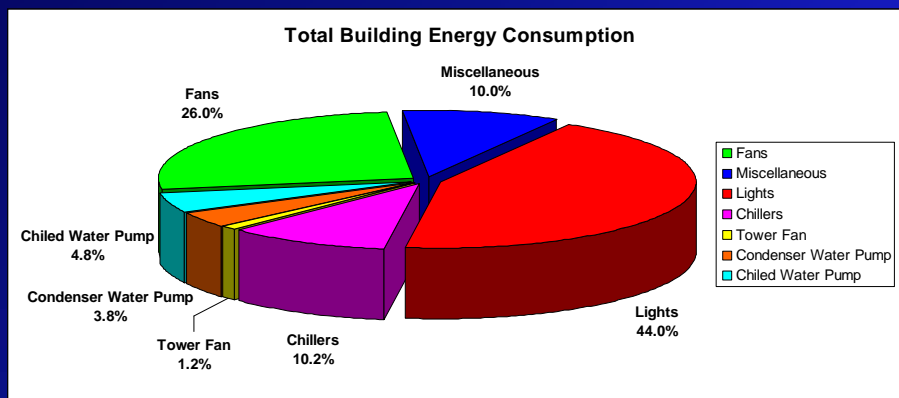
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Action Plan: Evaluating Multiple Buildings

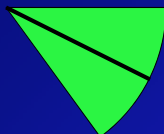
Site	SF	Zone	Type	ECI	EUI	Current \$	
601-Tyson's Corner	39,463	4	Homestore	\$3.01	193	\$118,823	
510-Mission Viejo	12,895	4	Housewares	\$6.10	177	\$78,685	
503-Fashion Valley	14,510	4	Housewares	\$6.66	177	\$96,579	
412-Roseville	34,372	4	Homestore	\$4.13	176	\$142,059	
851-Lenox	36,919	4	Homestore	\$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	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	
407-Hillsdale	15,238	4	Housewares	\$3.24	71	\$49,341	
403-Palo Alto	38,920	4	Homestore	\$0.86	40	\$33,588	

Action Plan: Evaluating End Use Within a Building



41

Two Types of Action



- Smarter use of what you have right now (Discretionary Operation)
- Energy Audits and Capital Improvements

42

Sample Discretionary Actions

- Lighting

Easier to harder

- Match operating hours to activities
- Take advantage of daylight
- Check delays on Occupancy Sensors
- Assure appropriate Foot-candles (lumens)

43

Sample Discretionary Actions

– Fan Systems

Easier to harder

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

44

Sample Discretionary Actions – Fan Systems (continued)

Easier to harder

- Make best use of economizer operation
- Eliminate simultaneous heating and cooling
- Reduce airflow in constant volume (CV) systems
- De-energize nonessential loads

45

Sample Discretionary Actions— Pumping Systems

Easier to harder

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

46

Sample Discretionary Actions – Boilers

Easier to harder

- Lower hot water temperatures
- If steam, lower steam pressure
- Optimize boiler sequencing
- Minimize losses in de-energized boilers

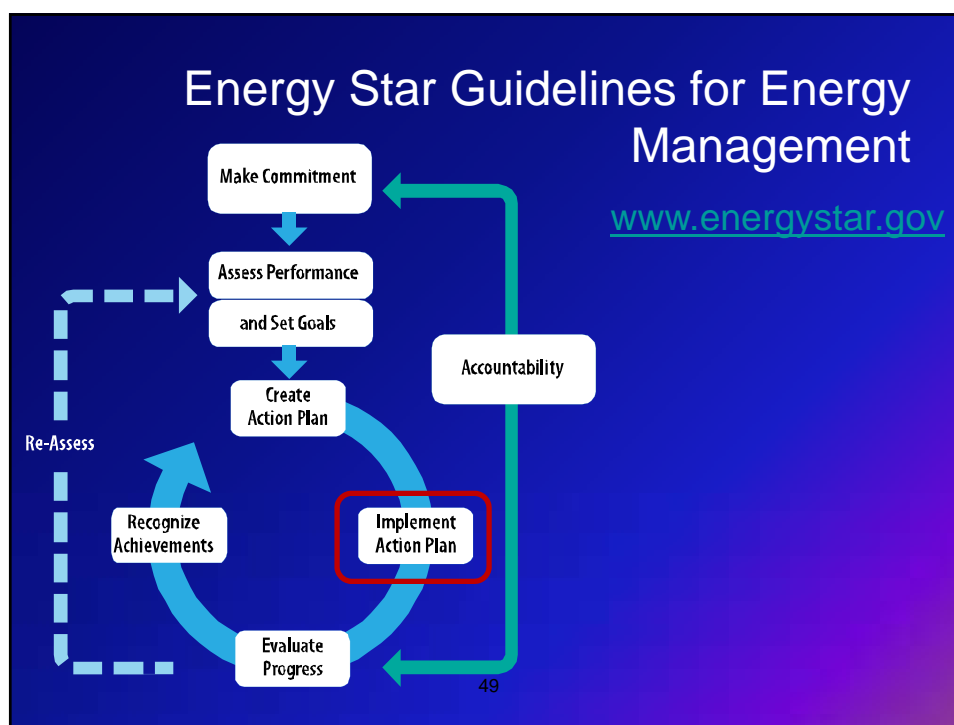
47

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

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Disincentives for the Building Engineer

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

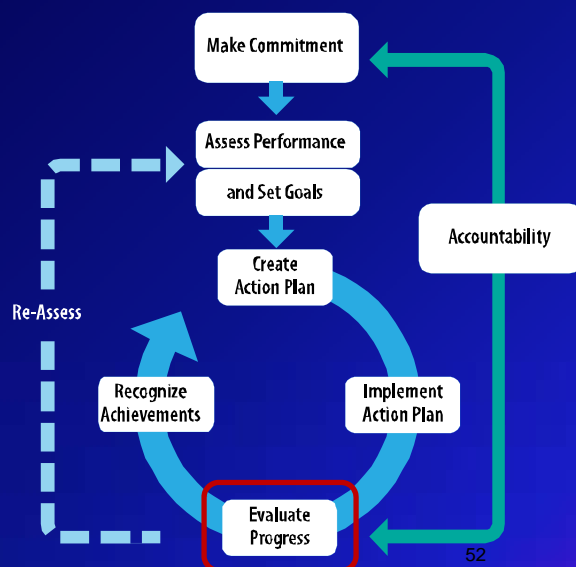
Incentives for the Building Engineer

- Regular monitoring by the manager
- Managerial encouragement to experiment
 - Occasional, brief discomfort is OK
- Teamwork
- Accomplishment – Getting results

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Energy Star Guidelines for Energy Management

www.energystar.gov

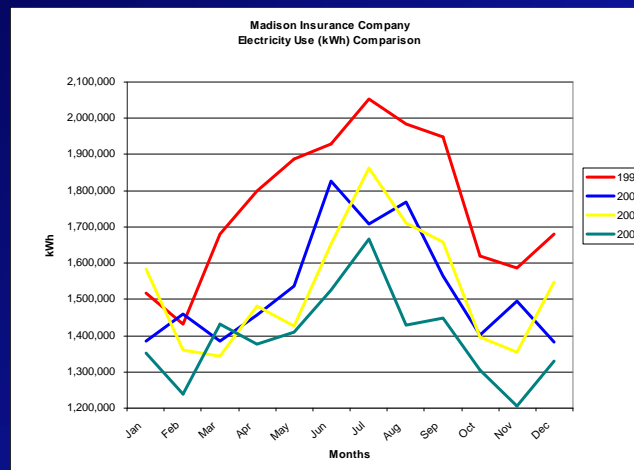


Madison Insurance Company



53

Madison Insurance Company



	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!

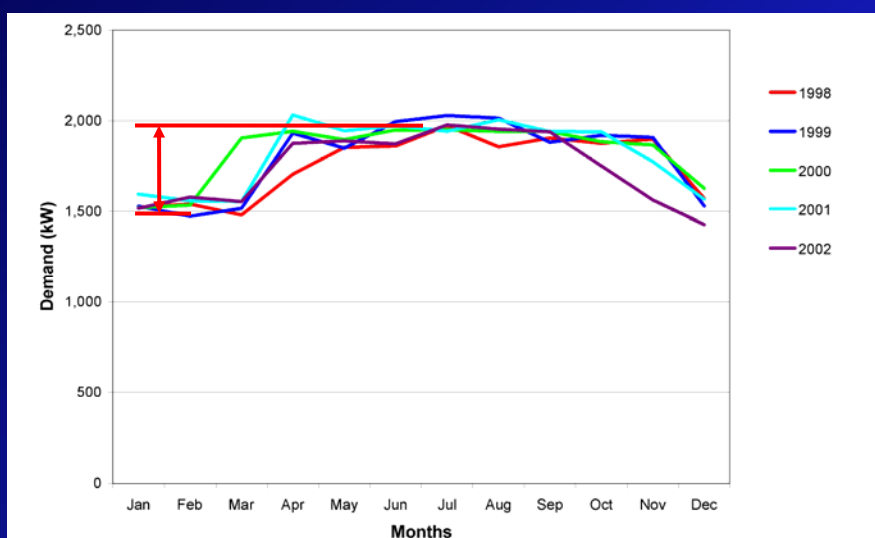
54

Madison Bank



55

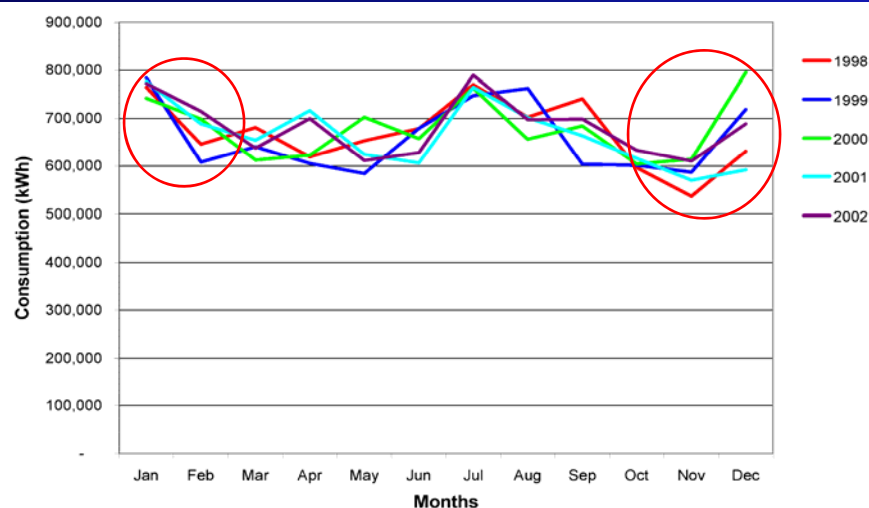
Annual Profile of Monthly Peaks (kW)



Chillers add 500 kW in summer

56

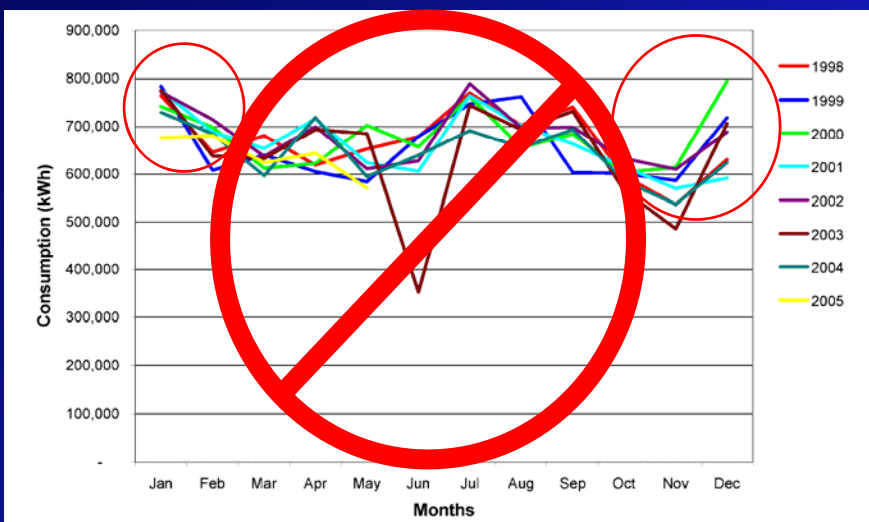
Annual Profile of Monthly kWh



Fans waste energy in winter!

57

Evaluate Progress 3 Years Later



Energy Management Did Not Work!

58

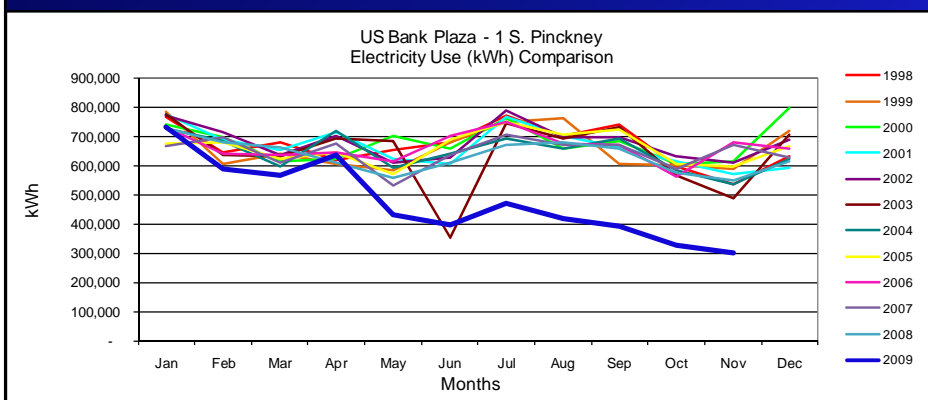
Explanation of the failure to see progress at Madison Bank

- 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

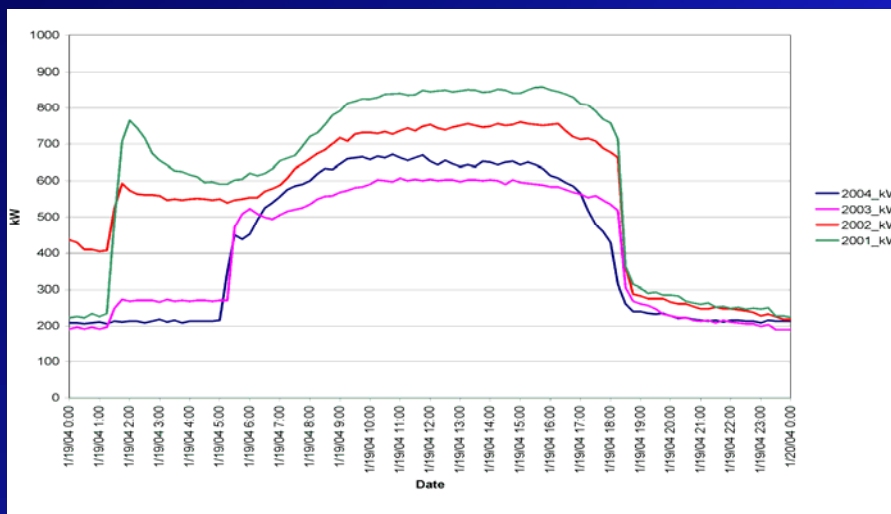
Therefore, NO CHANGE.

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Late Breaking News!



Honolulu Office Building After

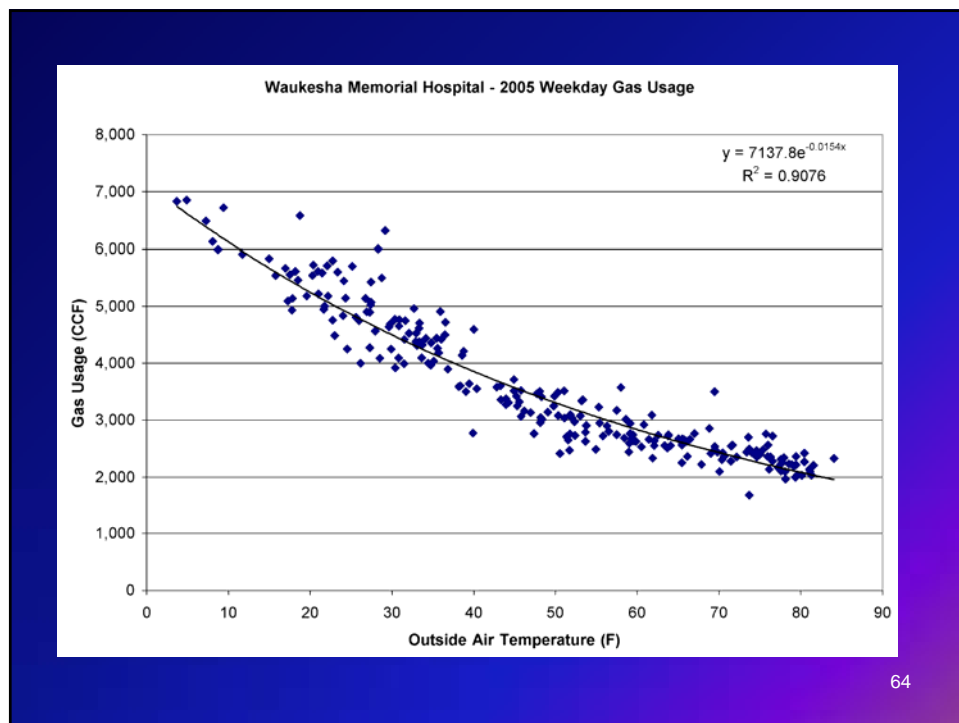
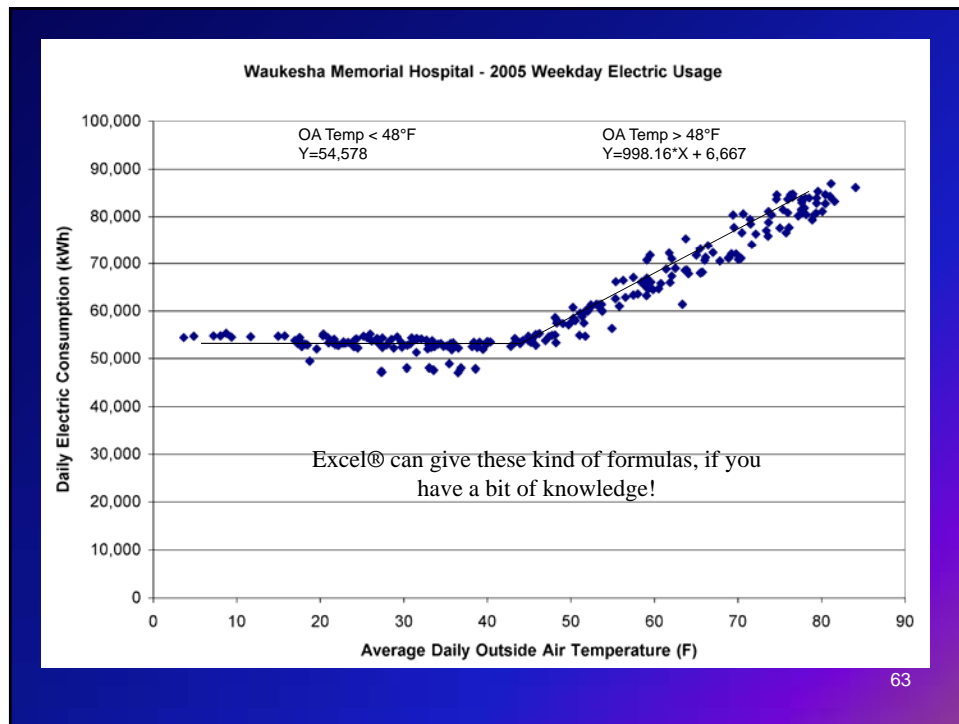


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Unique Process using daily energy data

- Collect one year's utility data
 - Electric interval data (15 min or 30 min)
 - Daily natural gas (or steam) consumption
- Plot daily consumption versus Outside Air Temperature
 - Establish a model of each building normalized for weather
 - Weekend usage slightly different than weekday usage

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7% savings in 12 months: \$89K and 530 Tons CO₂

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	1,258,157	92.9%	89,214	21,525,821	21,602,617	101.5%	-323,204

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Extra Benefit: An Energy Management Breakthrough

Day	Outside Air Temp Deg F	Gas			Electric			Comment
		Calculated Usage CCF	Actual Usage CCF	Difference %	Calculated Usage kWh	Actual Usage kWh	Difference %	
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	80.5	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	61,692	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	60,676	102.9	Sun
9/25/2006	58.1	2,917	2,357	80.8	64,659	62,718	97.0	

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Applying the Process

Aurora Health Care – 2009

- 17 facilities
- 7 million sq. ft.
- Each facility joined the Portfolio Manager® system
- President of Aurora Healthcare signed an EnergyStar® commitment to reduce energy 12% in 3 years
- Each facility utilizes the spreadsheet and records energy consumption daily
- Monthly summaries distributed to all
- Monthly energy initiative meeting to share successful ideas

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Aurora Sinai Medical Center Daily Utility Tracking Spreadsheet

Day	Outside Air		Steam			Generators		Electric				Comment
	Temp Deg F	Humidity % RH	Calc. Usage 1000 lbs.	Actual Usage 1000 lbs.	Difference %	Oil Usage Gals	Load Shedding KWH	Calc. Usage KWh	Actual Usage KWh	Total Usage KWh	Difference %	
11/1/2009	47.0	82.0	295	347	83.8			51,493	53,403	53,403	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	263	254	88.8			56,068	57,068	57,068	101.8	
11/4/2009	44.0	68.0	294	250	87.9			59,385	56,943	56,943	95.5	
11/5/2009	45.0	56.0	282	237	84.0			60,063	57,236	57,236	96.2	
11/6/2009	49.0	70.0	273	220	80.5			63,315	58,303	58,303	92.1	
11/7/2009	52.0	58.0	246	202	82.1			68,566	58,106	58,106	84.5	
11/8/2009	52.0	72.0	269	161	70.9			60,474	55,779	55,779	92.2	
11/9/2009	57.0	61.0	255	221	86.6			69,756	61,526	61,526	88.2	
11/10/2009	47.0	75.0	278	224	80.7			61,704	57,227	57,227	92.8	
11/11/2009	43.0	65.0	297	244	85.1			58,482	57,833	57,833	98.5	
11/12/2009	42.0	70.0	289	230	79.6			57,877	56,900	56,900	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	297	230	86.1			61,293	54,238	54,238	88.5	
11/15/2009	42.0	63.0	293	248	84.0			52,381	51,183	51,183	97.9	
11/16/2009	44.0	64.0	284	257	90.4			59,288	56,803	56,803	96.8	
11/17/2009	45.0	67.0	282	248	87.9			60,393	57,421	57,421	96.6	
11/18/2009	49.0	88.0	280	239	85.4			60,868	56,945	56,945	93.3	
11/19/2009	45.0	83.0	282	239	84.7			60,063	56,649	56,649	94.3	
11/20/2009	50.0	73.0	271	243	89.7			64,120	56,762	56,762	88.8	
11/21/2009	49.0	84.0	294	235	82.9			55,558	51,160	51,160	92.1	
11/22/2009	49.0	90.0	284	232	81.8			55,558	51,396	51,396	92.5	
11/23/2009	49.0	90.0	280	231	82.5			60,868	56,656	56,656	93.0	
11/24/2009	48.0	88.0	280	235	84.0			60,396	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	38.0	56.0	326	286	88.7			56,859	52,524	52,524	93.0	
11/28/2009	40.0	70.0	298	249	83.7			50,842	50,391	50,391	99.5	
11/29/2009	39.0	60.0	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	1,670,267	1,670,267	93.8	

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Aurora Sinai Medical Center 2009 Utility Summary

Day	Outside Air		Steam			Generators Load Shedding kWh	Electric			
	Temp	Humidity	Calc. Usage	Actual Usage	Difference		Calc. Usage	Actual Usage	Total Usage	Difference
	Deg F	% RH	1000 lbs	1000 lbs	%		kWh	kWh	kWh	%
January-09	16.5	63.3	14,447	14,436	99.9	0.0	1,849,828	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	7,888	7,248	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	2,226,347	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	89.6	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

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Aurora Health Care 2009 Utility Summary

Facility	Sq Ft	2009 Total		
		%	CO2 Diff (lbs)	kBTU/Sq Ft
Baycare Clinic	610,716	101.1%	421,175	273.6
Burlington	265,776	99.4%	(17,962)	178.4
Corporate Building	21,760	84.4%	151,902	170.5
Forest Home	135,000	73.1%	1,820,253	82.0
Hartford	150,000	87.3%	1,017,265	256.5
Heil (Removed Laundry)	173,000	88.6%	1,842,661	251.2
Hospice	31,200	91.6%	119,722	204.0
Kenosha	339,020	90.3%	943,518	201.4
Lakeland	296,280	85.2%	569,396	129.2
Oshkosh	470,000	97.2%	1,385,805	205.0
Psychiatric Hospital	206,074	92.9%	9,145	91.8
Sheboygan	276,000	92.1%	1,134,109	298.6
Sinai Medical Center	858,000	91.8%	4,486,145	225.6
St Luke's	1,600,000	93.0%	7,571,334	229.6
St Luke's South Shore	360,555	93.3%	1,480,687	242.8
Two Rivers	183,500	97.1%	925,209	267.2
West Allis Memorial	848,440	94.9%	2,315,629	277.5
Total	6,825,321	94.0%	26,155,994	227.8

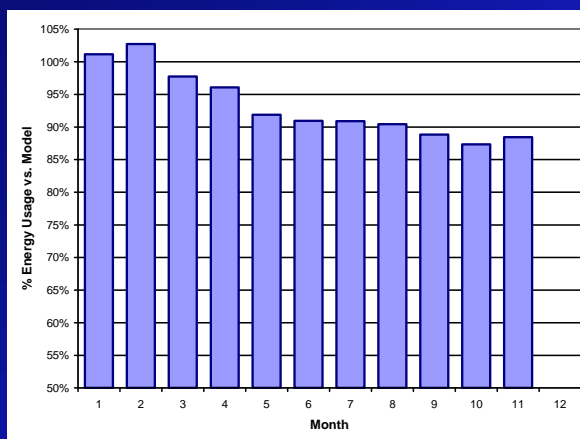
Savings:

- 6% reduction in energy usage
- 26,155,994 lbs. reduction in CO2 emissions

70

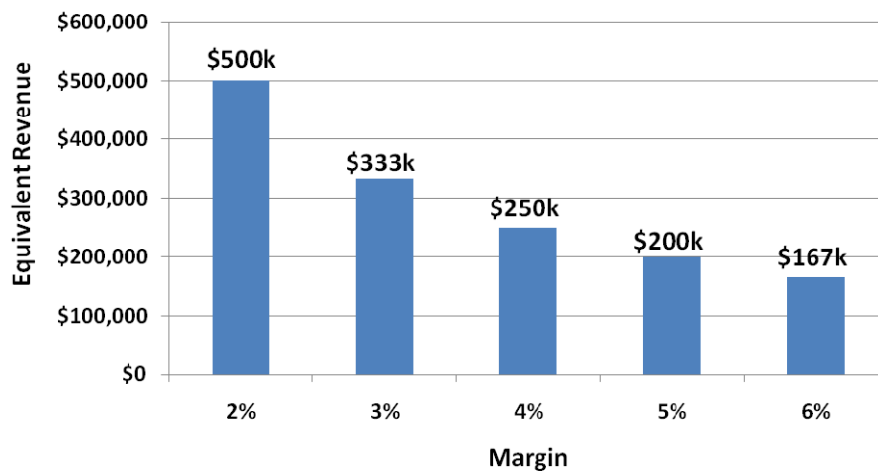
Aurora Health Care

- 6% reduction in energy consumption
- 26 million pound reduction in CO₂
- One facility qualifies for EnergyStar



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Equivalent Revenue per \$10,000 savings for Acute Care Hospitals



Source: Corporate Realty, Design, & Management Institute

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Energy Management Strategies Taken

- Chiller operations
- H.W. reset schedules
- Run schedules (occ./unocc., day/night, summer/winter)
- D.A. temperature reset schedules
- Steam pressures
- Installation of variable speed drives
- Isolation dampers for unoccupied areas
- Steam trap survey
- Shutting off air handling units in unoccupied areas.
- Maintaining modified space temperatures
- Promoting the energy message at department meetings

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Reverse Energy Audit Process

- Low cost actions decrease utility costs first
- In-depth audit and capital improvements follow

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Energy Management at Monona Terrace Convention Center

Jeff Griffith

Building Maintenance Supervisor

- Action Plan
- Monitoring
- Benchmarking
- Accountability

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Monona Terrace

LEED Silver Certification for Existing Buildings

- Significant Energy Savings
- Non-toxic cleaning products
- Use of Clean Energy
- High Recycling Rates

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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

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Regular Monitoring

- Weekly energy review by engineering staff
- BAS alarms to pagers
 - Demand exceeds 1,100 kW
 - Chilled water exceeds 50°F
- Personal attention by one engineer on peak days

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Monitoring and Benchmarking

Gas For Truck

Hiscox Rollers

Flush Valves
Jat draws

Clean-up
Schedule
Jat draws
Uniforms

MONTH	2006	2007
JAN	903	739
FEB	956	807
MAR	903	758
APR	950	993
MAY	1157	1007
JUN	1087	1180
JUL	1487	1084
AUG	1297	1113
SEP	1357	
OCT	1119	
NOV	1061	
DEC	810	

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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					

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Accountability

- Jeff is personally accountable to the Facility Manager
- Engineering Staff is accountable to Jeff and to each other
- Entire staff maintains an energy conscious culture
- Weekly staff review of energy use

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Examples of Success

82



Downtown Chicago Energy Star Building



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GSA Energy Management Program

US Courthouse
Jacksonville, Florida
Energy Improvements

DOE-ORNL Report

84

2005 New Building Performance

- Floor area: 492,000 sq.ft.
- EUI: 83 kBTU/SF
- Energy Star rating: 41
- Utility costs: \$664,000/year
- Far less efficient than design intent

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ECMs Implemented

- VAV minimum settings reduced to 10%
- Boilers turned off in summer
- Duct static pressure set points reduced from 1.5" to 0.7"

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Results of Modifications

- EUI: 45 kBTU/SF
- Energy Star rating: 79
- Energy Savings: 11,700 million Btu/year
- Cost savings: \$220,000/year

EnergyStar plaque is now in lobby!!

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Recap & Send-off

Recap: The *Management* Content of Energy Management



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Recap: Assess Performance

Don't start with audits!

Monitor

- Actual Performance
 - Year
 - Month
 - Day
 - Hour or shorter

Benchmark

- Compare performance
- Relevant references

Recap: Create Action Plan

Questions

- Where are big differences?
- What can you adjust?

Ingredients

- Adjust something
- Monitor performance
- 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

Is someone accountable?

“Are we practicing Energy Management in our facility?”

Impressive energy efficiency projects are often presented, including:

“A \$\$\$ boiler efficiency project is complete”

“A \$\$\$ lighting efficiency project is complete”

“Several buildings on campus have achieved EnergyStar ratings”

Cut to the Chase

Has the Energy Utilization Index (EUI) of the facility improved or not?

Remember: EUI = kBtu per square foot

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Sample Energy Efficiency Projects All in one building – A Real Example

- Windows replaced with more efficient
- Roof insulation improved
- All fluorescent lighting improved (T12 to T8)
- Chiller replaced with more efficient
- One system converted to VAV
- Building Automation System replaced with more efficient

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Result

The building uses **MORE ENERGY**
than before the six efficiency projects!

EUI INCREASED
from 105 to 110 kBtu/SF!

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WHY?

- No monitoring
- No oversight

**NO ENERGY
MANAGEMENT**

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DO NOT
LOSE SIGHT
OF THE
BOTTOM LINE!

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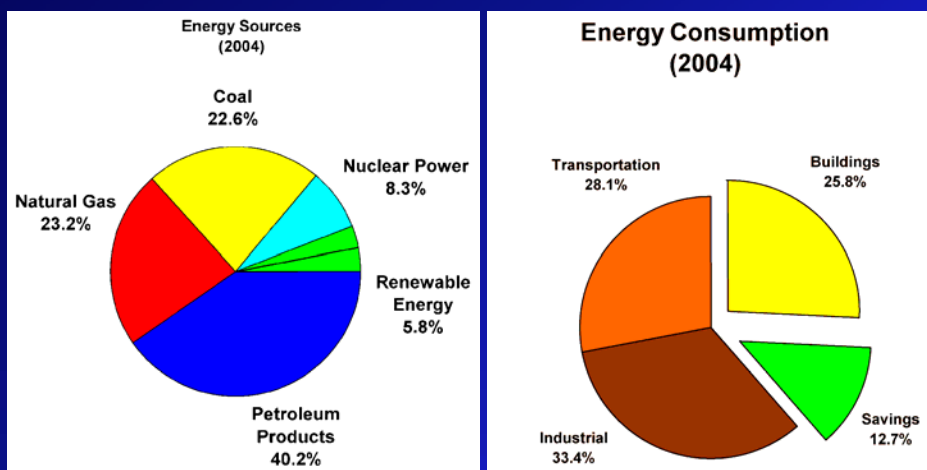
Prepare for Culture Change — What You Can Do...

- Collect 24 months of utility bills
- Enter utility information into Energy Star Portfolio Manager and get your score as a baseline
- Review the Discretionary Action Plans (slides 43-48)
- Try one change—save some energy, reduce climate impact and build your confidence to deploy on-going Energy Management

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And now the Send-off...

Energy management is the quickest, cheapest, cleanest way to extend our world's energy supplies



Energy Management provides the biggest and fastest way to reduce greenhouse gas emissions

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Sustained Energy Savings require Management Actions

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

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Remember to Monitor!!



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References

Text and on-line references are listed in the References supplement

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