

Energy Management in New and Existing Buildings A Sustainable Activity

ASHRAE TC 7.6

Richard J. Pearson, P.E., ASHRAE Fellow
November 9, 2011

Map for Today's Presentation

www.energystar.gov

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

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Today's Agenda

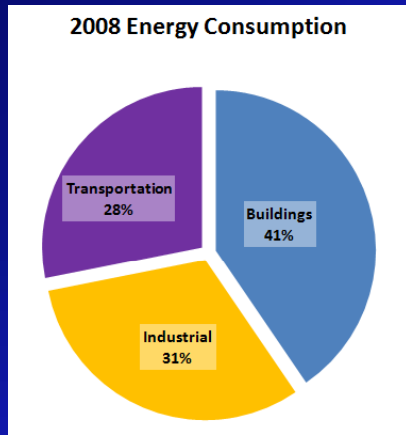
- Impact of Energy Management
 - Environmental Impact
 - Economic Impact
- Sample Action Plans
- Prioritizing Multiple Buildings
- A Novel Pilot Project
- Successful Projects
- Making Accountability Work

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Renewables as an Environmental Solution?

| Energy Source | Percentage |
|---------------------------|------------|
| Oil | 37% |
| Natural Gas | 24% |
| Coal | 23% |
| Nuclear | 9% |
| Renewable excluding Hydro | 5% |
| Hydroelectric | 2% |

Where do we use energy?

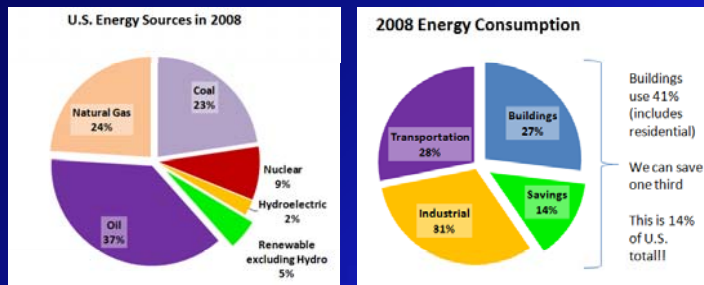


Energy Management Potential

- Buildings consume 41% of US energy
- 33% reduction of building energy is possible
- This will save 14% of US energy

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



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

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Energy Management Potential

Building Reduction
33%

National Reduction
14%



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>

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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).

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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

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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

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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%!

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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!

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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 | |

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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

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The *Management* Content of Energy Management

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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

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

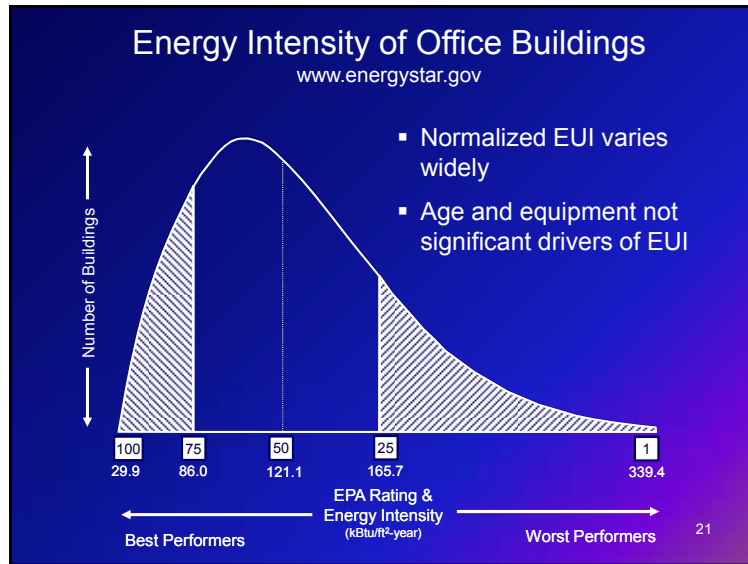
$EUI = \text{Total Annual Energy} \div \text{SF} = \text{kBTU/SF/yr}$

Example: Lowell Hall @ UW, 1996

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

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

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Energy Star Benchmarking

www.energystar.gov/benchmark

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ENERGY STAR

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
- Estimate Your Carbon Footprint
- 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. EPA has developed a [Benchmarking Starter Kit](#) to help you get started quickly.

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 multiple energy and water meters for each facility
- Customize meter names and key information
- Benchmark your facilities relative to their past performance

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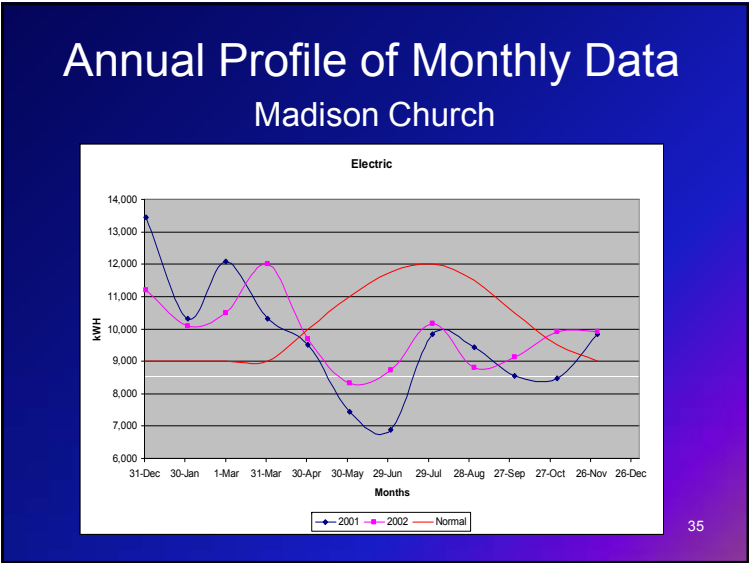
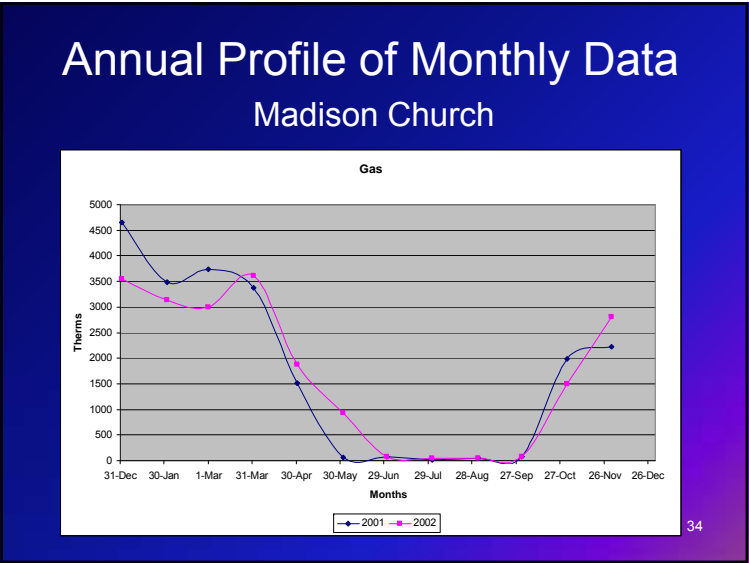
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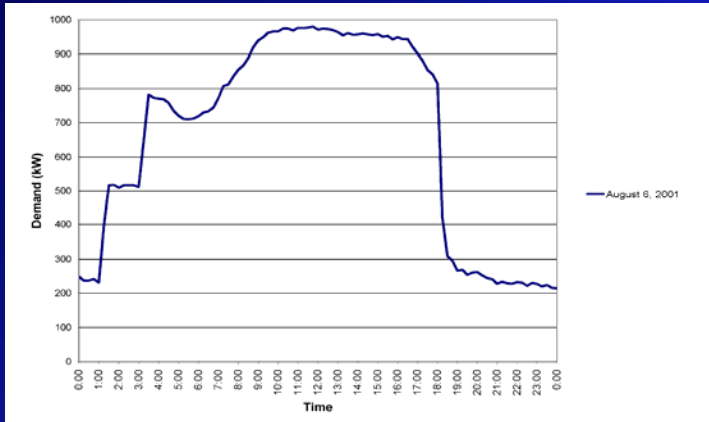
Assess Performance & Set Goals

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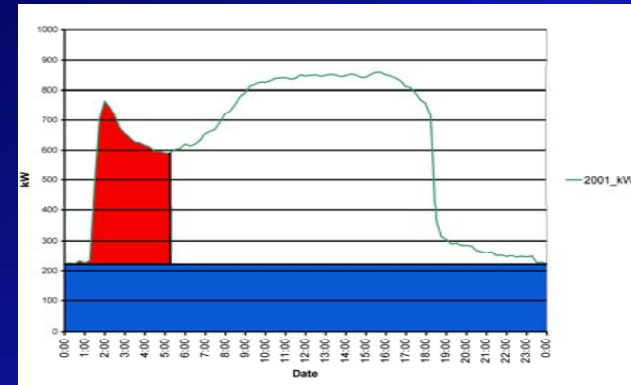


Daily Profile of 15 Minute Data



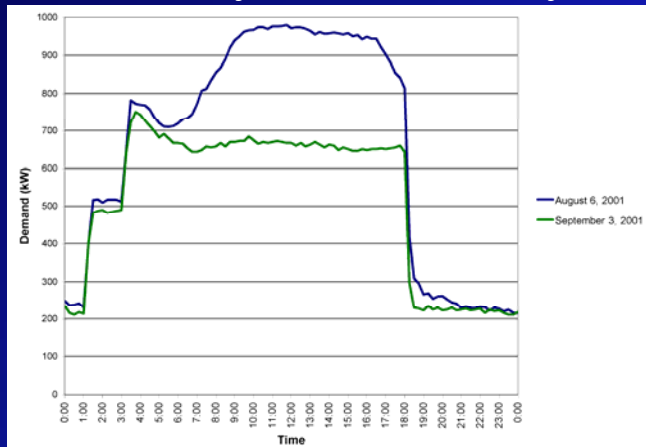
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Daily Profile of 15 Minute Data Honolulu Office Building



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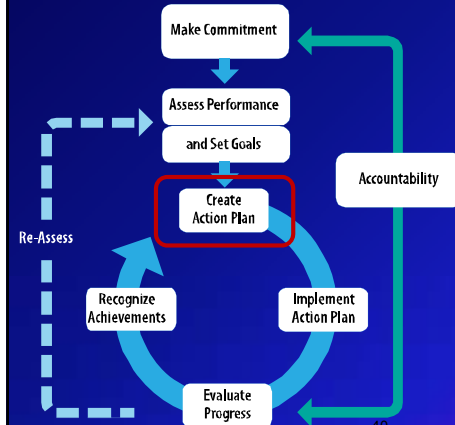
Monday versus Holiday



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Energy Star Guidelines for Energy Management

www.energystar.gov



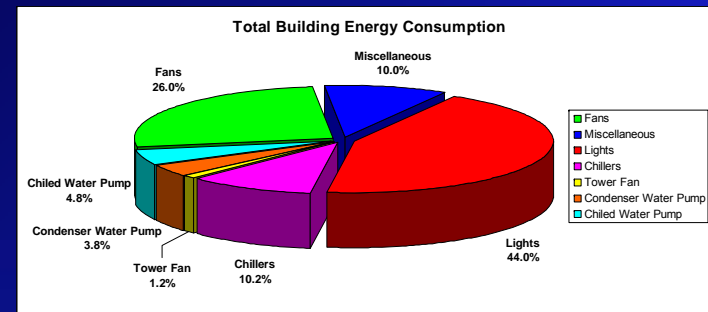
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Action Plan: Evaluating Multiple Buildings

| Site | SF | Zone | Type | ECl | EU | Current \$ |
|----------------------------|--------|------|------------|--------|-----|------------|
| 601-Tyson's Comer | 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 |
| 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 |
| 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 |
| 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 |

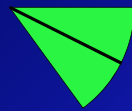
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Action Plan: Evaluating End Use Within a Building



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Two Types of Action



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

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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)

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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 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

Easier to harder

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Action Plans: Ideas and a Test Method

Sample Discretionary Actions – Fan Systems (continued)

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

Easier to harder

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Action Plans: Ideas and a Test Method

Sample Discretionary Actions – Pumping Systems

- 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

Easier to harder

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Action Plans: Ideas and a Test Method

Sample Discretionary Actions – Boilers

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

Easier to harder

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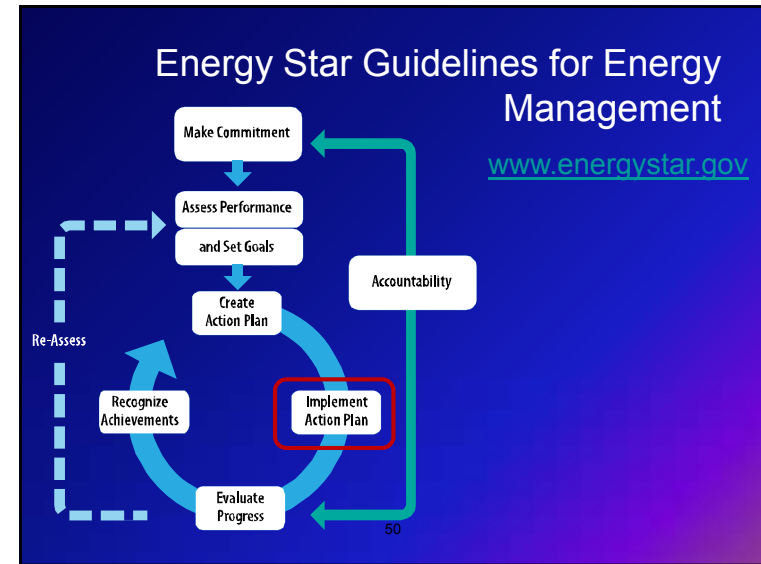
Action Plans: Ideas and a Test Method

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

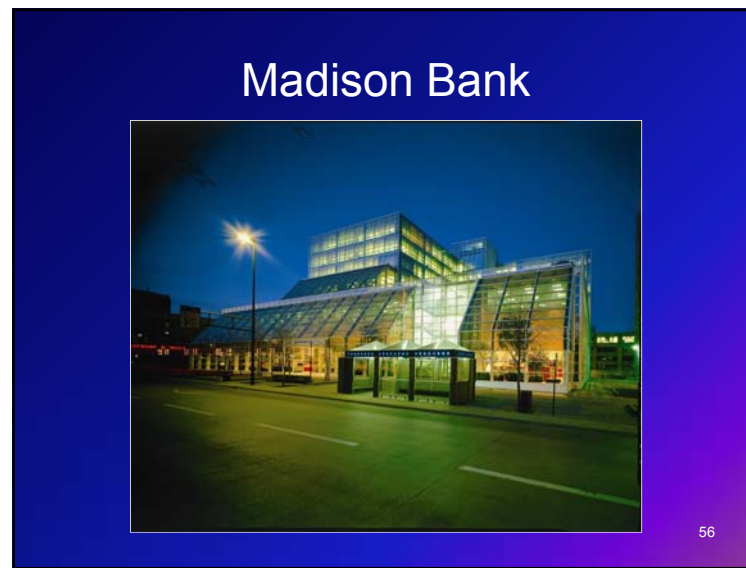
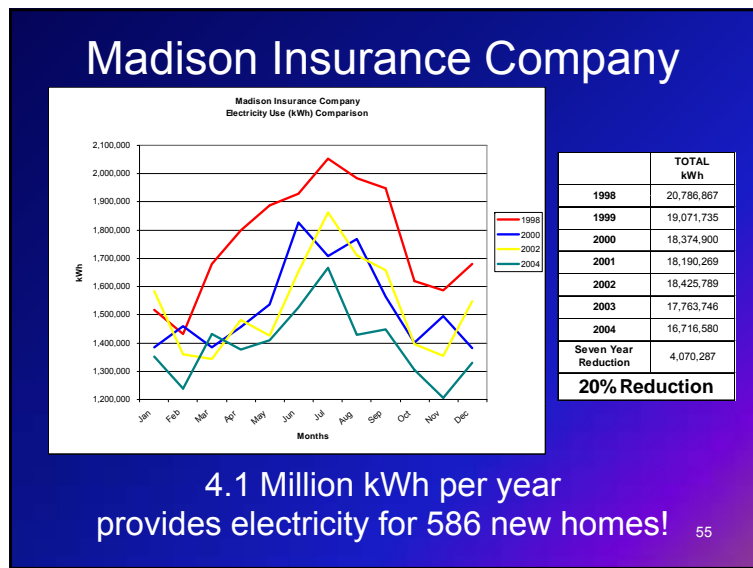
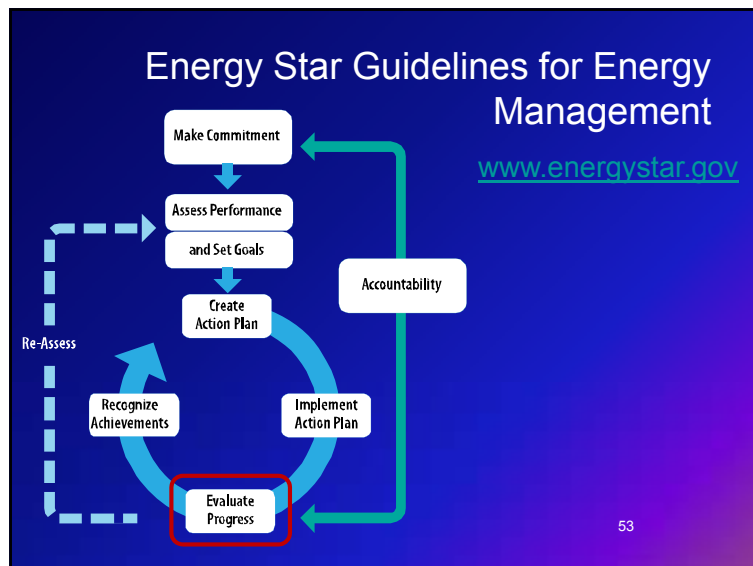
- Risk of occupant discomfort
- Risk of equipment failure
- Experimentation can be terrifying

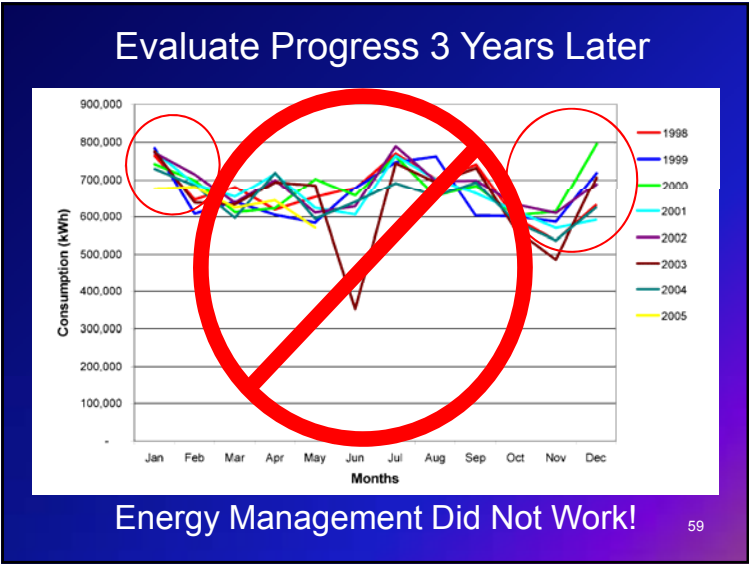
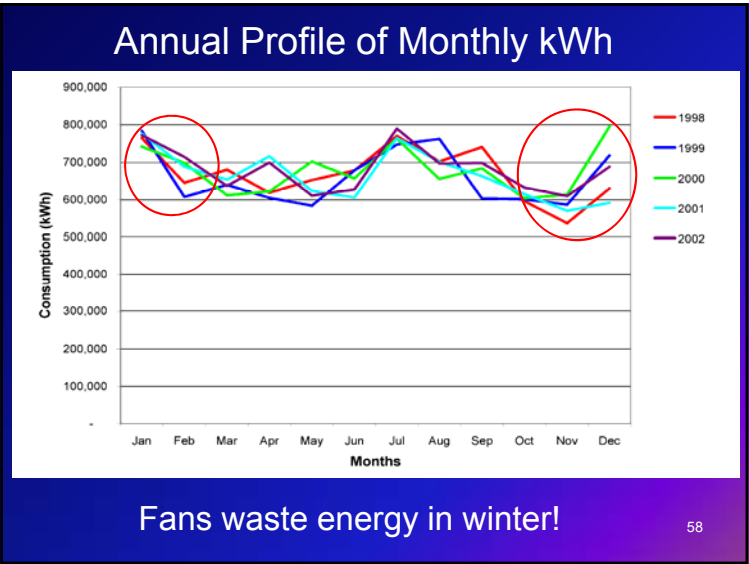
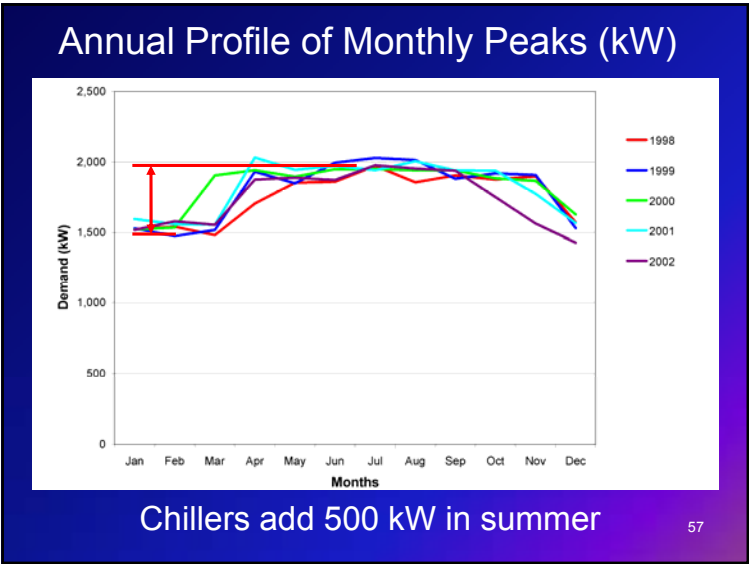
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Incentives for the Building Engineer

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

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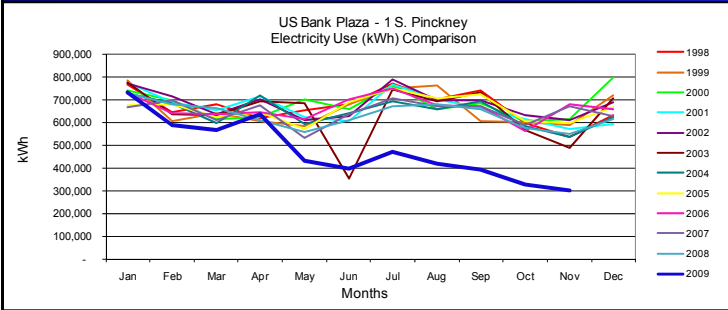
Explanation of the failure to see progress at Madison Bank

- 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.

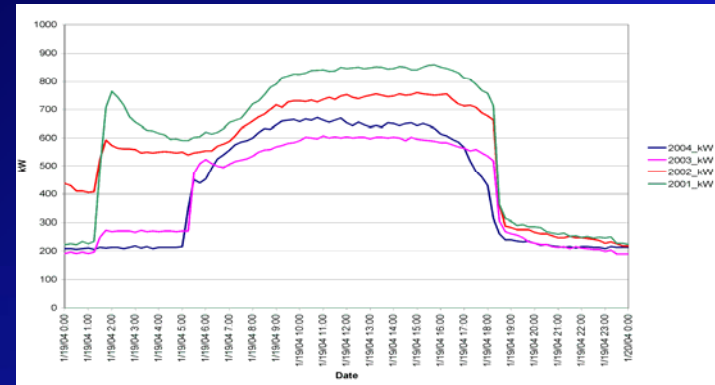
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Late Breaking News!



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Honolulu Office Building After



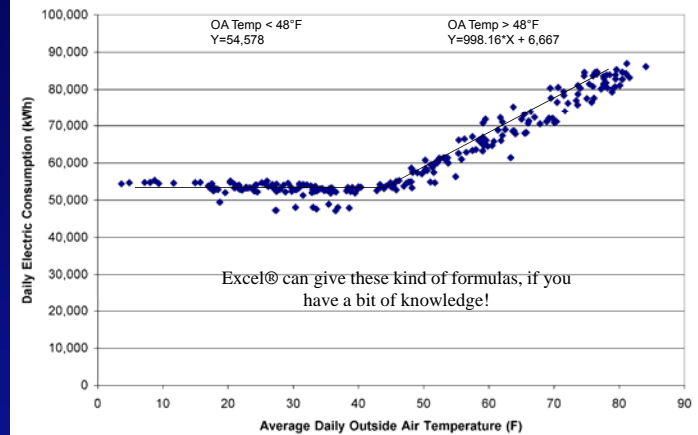
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Results of Pilot Project at Waukesha Memorial Hospital

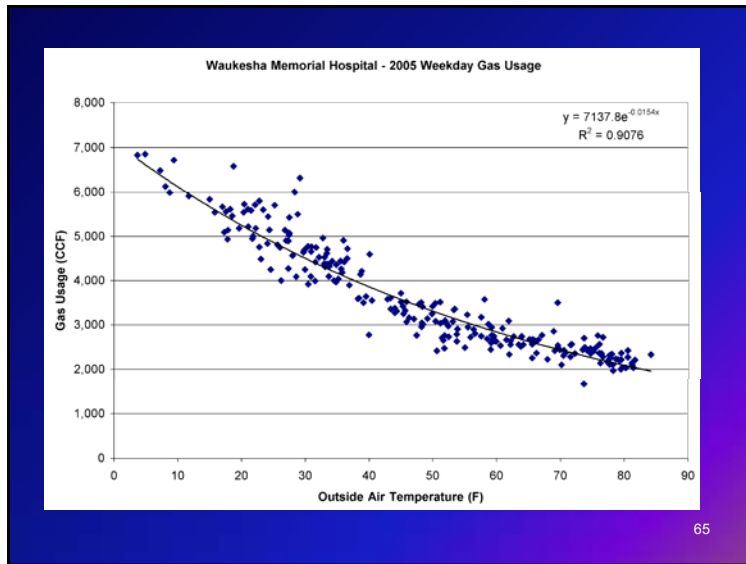
- Collected 2005 utility information
 - 30 minute electric
 - Daily natural gas consumption
- Plotted daily consumption versus Outside Air Temperature
 - Established a model of building with weather normalized
 - Weekend usage slightly different than weekday usage

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Waukesha Memorial Hospital - 2005 Weekday Electric 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 | 3,988 | 4,241 | 94.3% | 243 | 47,186 | 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 | 1,258,167 | 92.9% | 89,214 | 21,325,821 | 21,602,617 | 101.5% | -323,204 |

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Extra Benefit: An Energy Management Breakthrough

| Day | Outside Air Temp Dry/F | Gas | | | Electric | | | Comment |
|-----------|---------------------------|-------------------------|---------------------|-----------------|-------------------------|---------------------|-----------------|------------------------------|
| | | Calculated Usage CCF | Actual Usage CCF | Difference % | Calculated Usage kWh | Actual Usage kWh | Difference % | |
| 8/9/2006 | 81.1 | 2,749 | 2,301 | 83.7 | 62,238 | 63,894 | 102.7 | Sat |
| 8/10/2006 | 81.0 | 2,753 | 2,360 | 85.7 | 62,137 | 64,325 | 103.5 | Sun |
| 8/11/2006 | 80.8 | 2,799 | 2,328 | 83.2 | 67,354 | 70,286 | 104.4 | |
| 8/12/2006 | 64.5 | 2,644 | 2,129 | 80.5 | 71,048 | 74,822 | 105.5 | Rained all Day |
| 8/13/2006 | 60.7 | 2,803 | 2,348 | 83.8 | 67,255 | 69,804 | 103.8 | |
| 8/14/2006 | 62.7 | 2,718 | 2,374 | 87.3 | 69,251 | 70,119 | 101.3 | |
| 8/15/2006 | 65.3 | 2,610 | 2,846 | 109.1 | 71,886 | 73,333 | 102.0 | |
| 8/16/2006 | 69.9 | 2,410 | 2,823 | 117.1 | 71,141 | 71,129 | 100.0 | Sat |
| 8/17/2006 | 72.3 | 2,325 | 2,734 | 117.6 | 73,558 | 73,354 | 99.7 | Sun |
| 8/18/2006 | 59.8 | 2,842 | 3,134 | 110.3 | 66,346 | 66,540 | 100.3 | Correct chiller problem |
| 8/19/2006 | 52.0 | 3,205 | 2,345 | 73.2 | 58,571 | 55,413 | 94.6 | Chillers off most of the day |
| 8/20/2006 | 51.6 | 3,224 | 2,394 | 74.3 | 58,181 | 57,429 | 98.7 | |
| 8/21/2006 | 55.6 | 3,035 | 2,595 | 85.5 | 62,104 | 61,892 | 99.7 | |
| 8/22/2006 | 62.0 | 2,747 | 2,273 | 82.7 | 68,962 | 69,437 | 101.3 | |
| 8/23/2006 | 62.1 | 2,710 | 2,405 | 88.8 | 63,215 | 65,916 | 104.3 | Sat |
| 8/24/2006 | 58.1 | 2,876 | 2,470 | 85.9 | 59,176 | 60,878 | 102.9 | Sun |
| 8/25/2006 | 58.1 | 2,917 | 2,357 | 80.8 | 64,659 | 62,718 | 97.0 | |

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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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Applying the Process

Aurora Health Care – 2009

- 17 facilities
- 7 million ft²
- 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 2009 Utility Summary

| Day | Outside Air | | Steam | | | Generators | Electric | | | |
|--------------|---------------|------------------|-------------------------|--------------------------|-----------------|----------------------|--------------------|---------------------|--------------------|-----------------|
| | Temp Deg F | Humidity % RH | Calc. Usage 1000 lbs | Actual Usage 1000 lbs | Difference % | Load Shedding kWh | Calc. Usage kWh | Actual Usage kWh | Total Usage kWh | Difference % |
| January-09 | 18.5 | 63.3 | 14,447 | 14,436 | 99.9 | 0.0 | 1,648,828 | 1,704,820 | 1,704,820 | 103.3 |
| February-09 | 28.1 | 65.5 | 10,803 | 8,811 | 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 | 1,828,481 | 1,828,481 | 104.2 |
| April-09 | 45.6 | 59.9 | 8,522 | 8,060 | 94.6 | 0.0 | 1,798,526 | 1,831,179 | 1,831,179 | 101.8 |
| May-09 | 57.5 | 56.2 | 7,868 | 7,246 | 92.1 | 0.0 | 2,129,761 | 1,963,022 | 1,963,022 | 91.7 |
| June-09 | 65.4 | 54.4 | 7,105 | 7,046 | 99.2 | 0.0 | 2,255,987 | 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 | 2,281,776 | 2,281,776 | 94.3 |
| August-09 | 66.6 | 67.1 | 7,062 | 5,703 | 80.9 | 0.0 | 2,426,406 | 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 | 2,046,718 | 2,046,718 | 91.9 |
| October-09 | 48.1 | 70.9 | 8,569 | 8,737 | 102.0 | 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 | 89.0 | 0.0 | 1,692,976 | 1,569,630 | 1,569,630 | 92.7 |
| Total | 47.9 | 67.6 | 122,565 | 95,056 | 80.8 | 0.0 | 23,606,280 | 22,163,187 | 22,163,187 | 93.5 |

Energy Savings:

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

70

Aurora Health Care 2009-2010 Utility Summary

| Facility | Sq Ft | 2009-2010 Total | | | |
|------------------------|------------------|-----------------|-------------------|----------------------------------|----------------------------------|
| | | % | CO2 Diff (lbs) | 2009 EUI (kBtu/ft ²) | 2010 EUI (kBtu/ft ²) |
| Sheboygan | 276,000 | 89.6% | 2,958,873 | 258.6 | 284.2 |
| Hartford | 150,000 | 90.7% | 1,447,970 | 256.5 | 276.1 |
| Two Rivers | 183,900 | 97.0% | 1,587,841 | 267.2 | 265.4 |
| West Allis Memorial | 845,440 | 92.8% | 8,882,695 | 277.5 | 259.2 |
| Baycare Clinic | 610,716 | 99.2% | 1,578,550 | 272.6 | 258.1 |
| St Luke's South Shore | 360,555 | 90.5% | 4,189,934 | 242.8 | 227.6 |
| Sinai Medical Center | 858,000 | 89.9% | 11,218,115 | 225.6 | 214.3 |
| Burlington | 220,000 | 97.0% | 1,188,255 | 178.4 | 203.5 |
| St Luke's ★ | 1,718,168 | 91.1% | 18,162,528 | 229.6 | 203.0 |
| Kenosha | 339,020 | 99.9% | 1,614,300 | 201.4 | 194.7 |
| Chesham | 470,000 | 94.0% | 4,580,028 | 205.0 | 187.4 |
| Sunmit | 789,591 | 98.7% | 2,273,173 | N/A | 150.8 |
| Lakeland | 298,280 | 87.3% | (432,713) | 129.2 | 146.9 |
| Heil (Removed Laundry) | 173,000 | 84.4% | 5,556,691 | 251.2 | 226.8 |
| Hospice | 31,200 | 90.5% | 279,033 | 204.0 | 193.3 |
| Corporate Building | 21,760 | 91.3% | 334,268 | 170.5 | 154.2 |
| Psychiatric Hospital | 206,074 | 90.4% | 80,285 | 91.8 | 85.4 |
| Forest Home ★ | 135,000 | 89.2% | 4,095,725 | 82.0 | 74.0 |
| Total | 7,687,304 | 92.4% | 67,567,601 | 227.8 | 207.9 |

★ Achieved EnergyStar Award!

Highlighted buildings are not acute care hospitals

Savings:

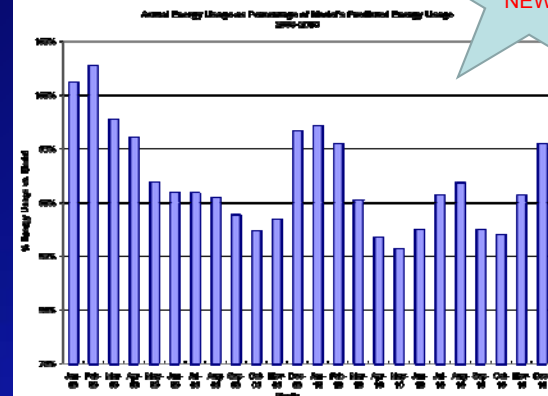
- 7.6% reduction in energy usage
- 67,567,601 lbs. reduction in CO₂ emissions

NEW

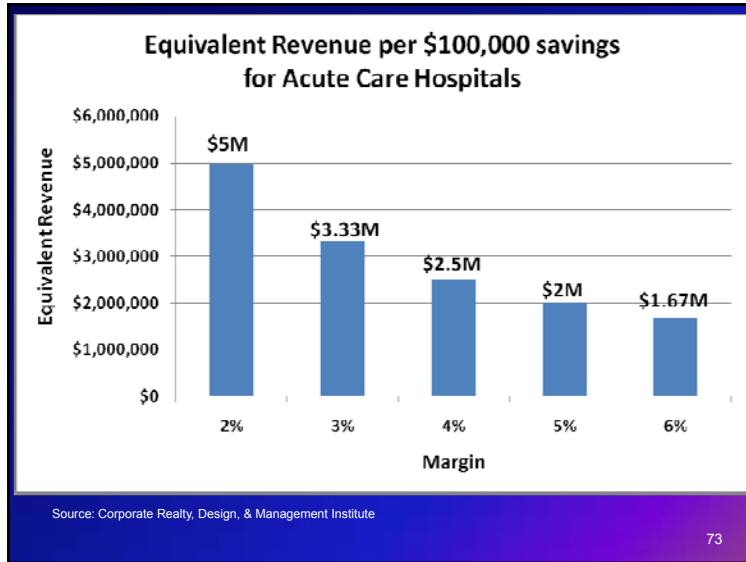
71

Aurora Health Care 2009-2010

- 7.6% reduction in energy consumption
- 67.6 million pound reduction in CO₂
- Two facilities achieved ENERGY STAR



72



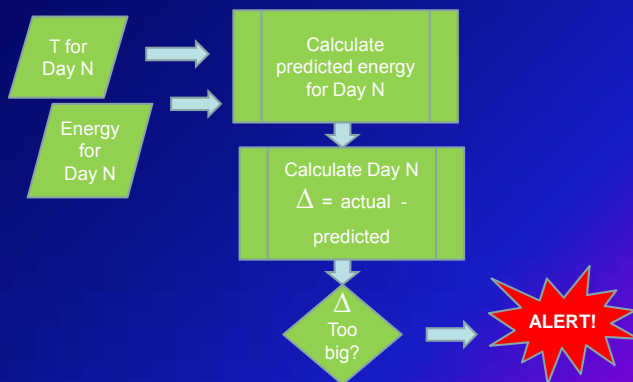
73

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

74

Automating The Daily Method



75

Example of Free NOAA Data

The screenshot shows the NOAA website interface for the Twin Cities Forecast Office. The main navigation includes Home, News, Organization, and Search. A sidebar on the left lists various services like Local forecast by city, Hazards, and Observations. The main content area features 'Observed Weather Reports' with filters for Product, Location, and Timeframe. A green box highlights the 'Observed Weather Reports' section.

76

Examples of Success

77



Energy Management at Monona Terrace Convention Center

Jeff Griffith

Building Maintenance Supervisor

- Action Plan
- Monitoring
- Benchmarking
- Accountability

78



Monona Terrace

LEED Silver Certification for Existing Buildings

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

79

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

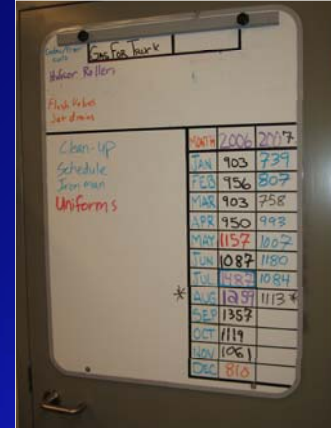
80

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

81

Monitoring and Benchmarking



82

Benchmarking

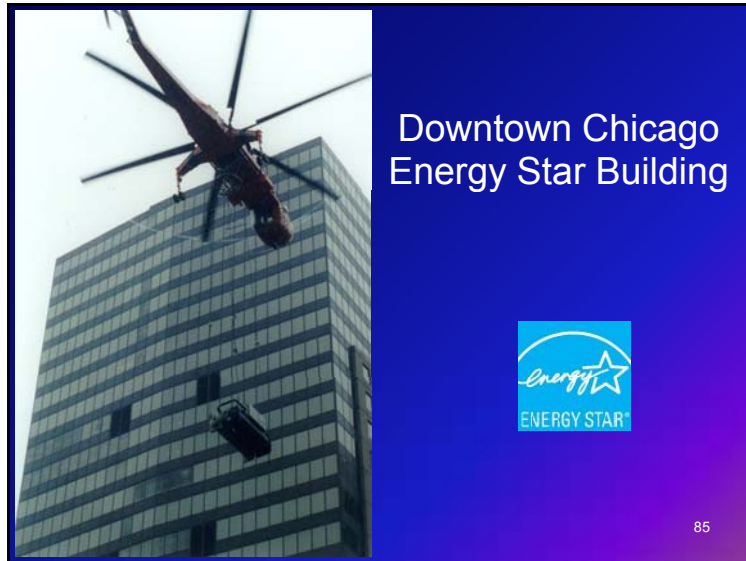
| | Square Footage | Electricity (kbtu/sqft) | Nat Gas (kbtu/sqft) | Steam (kbtu/sqft) | Chilled Water (kbtu/sqft) | Total Energy (kbtu/sqft) |
|----------------------|----------------|-------------------------|---------------------|-------------------|---------------------------|--------------------------|
| 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 | | | | | |

83

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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GSA Energy Management Program

US Courthouse
Jacksonville, Florida
Energy Improvements

DOE-ORNL Report

86

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

87

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"

88

Results of Modifications

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

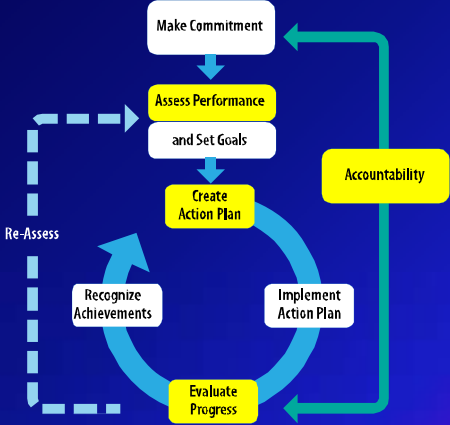
EnergyStar plaque is now in lobby!!

89

Recap & Send-off

90

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.

91

Recap: Assess Performance

Don't start with audits!

| | |
|--|---|
| <p>Monitor</p> <ul style="list-style-type: none"> • Actual Performance <ul style="list-style-type: none"> – Year – Month – Day – Hour or shorter | <p>Benchmark</p> <ul style="list-style-type: none"> • 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

97

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

98

Result

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

EUI INCREASED
from 105 to 110 kBtu/SF!

99

WHY?

- No monitoring
- No oversight

**NO ENERGY
MANAGEMENT**

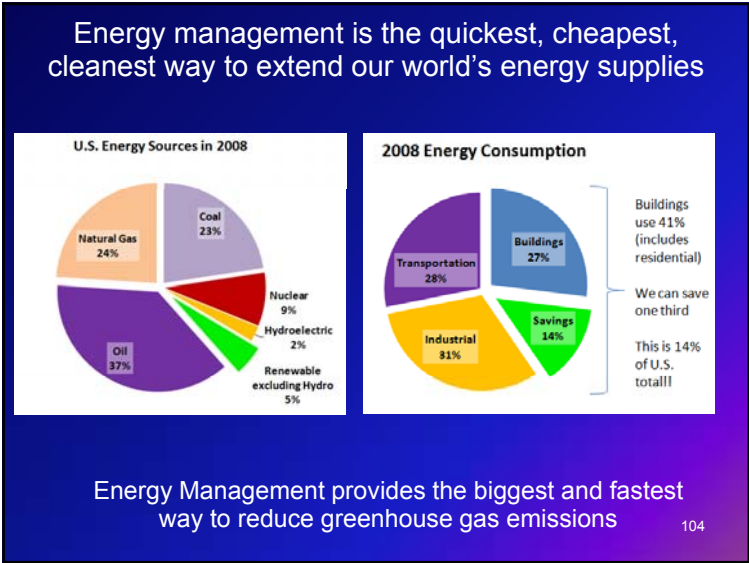
100

**DO NOT
LOSE SIGHT
OF THE
BOTTOM LINE!**

101

- 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
- 102

And now the Send-off...



Sustained Energy Savings require Management Actions

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

105

Remember to Monitor!!



106

Low Energy Buildings

SYSTEMS MUST BE SIMPLE!

Einstein: "Everything should be as simple as possible, but no simpler."

Condensing boilers – low temperature, hot water

Minimal fan energy – larger AH, larger ducts
= smaller motors

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Low Energy Buildings

Zoned by functions

Minimal operation when unoccupied

Thorough Design Intent document

- Significant input from owner
- Tailored to Owner's capabilities

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References

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

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About the Speaker

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