OSIsoft® UC2010

Real Time Information — Currency of the New Decade

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Integrating Building Automation Systems with PI

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Agenda

- Building automation market drivers
- Energy Management in facilities
- Interface to Building Automation System (BAS)
- What can we do with the data
- Energy information system examples

Changes in building automation market

- Shift in thinking at the end-user level
- IT systems and software for :
  - Embedded intelligence at the controller level
  - Connect devices via an IP network
  - Smart meters and systems
- Shifts in government policies (ARRA, California title 24, Energy independence and security act 0f 2007, Energy Star for Building,)

Market research on BAS

(building automation system)

- Market for BAS from 36 to 42 billion/yr by 2020
- The Energy Management System (EMS) market is still fairly nascent.
- Key market players include majors supplier, start-up and IT
  - Cisco, Johnson Control/IBM, Enernoc etc..
- Demand response a key driver

If you can't measure it, you can't improve it." - Lord Kelvin

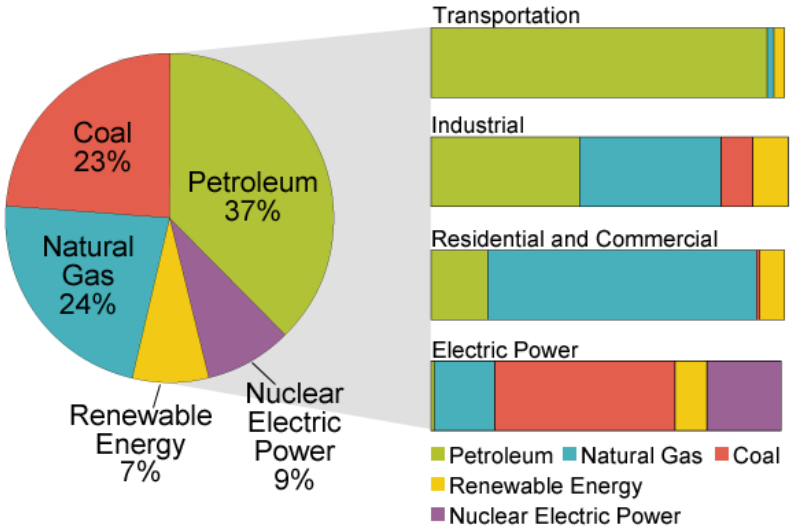
Favorable context for energy management

- Energy cost ($76/ barrel)
- Sustainability issue (triple bottom line, GHG, etc)
- Corporate and Collective will to act
  - ARRA, executive presidential order
  - Utilities incentive for energy efficiency program
  - LEED certification / IPMVP (International performance measurement and verification protocol)
  - Net zero energy building objective (micro grid / renewable)
- New and lower cost of technologies solution (metering, wireless communication, control systems)

Energy statistics for commercial building

US energy consumption overview

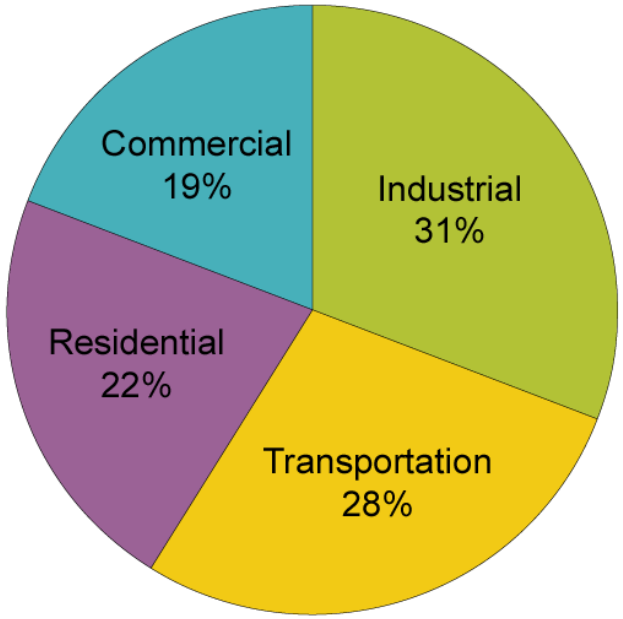
U.S. Primary Energy Consumption by Source and Sector, 2008



Total U.S. Energy = 99.3 Quadrillion Btu

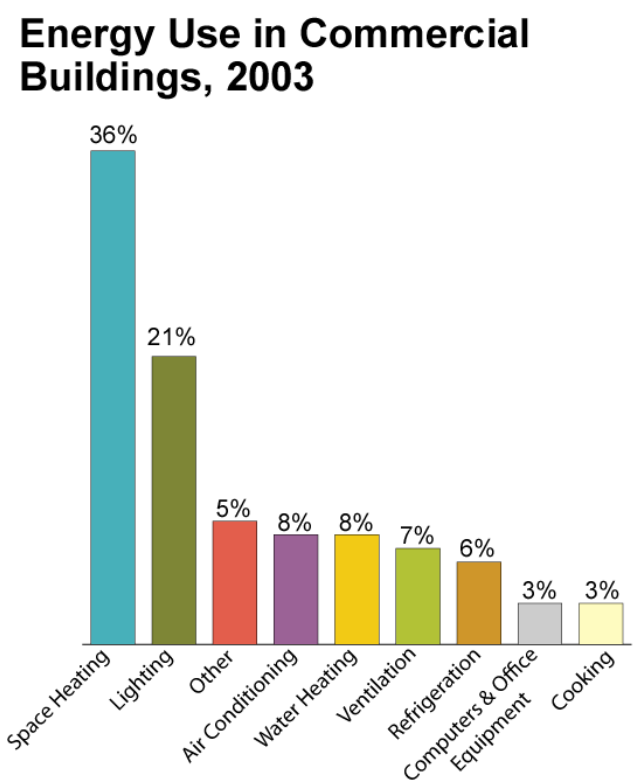
Source: Energy Information Administration, *Annual Energy Review 2008*, Tables 1.3, 2.1b-2.1f.

Share of Energy Consumed by Major Sectors of the Economy, 2008

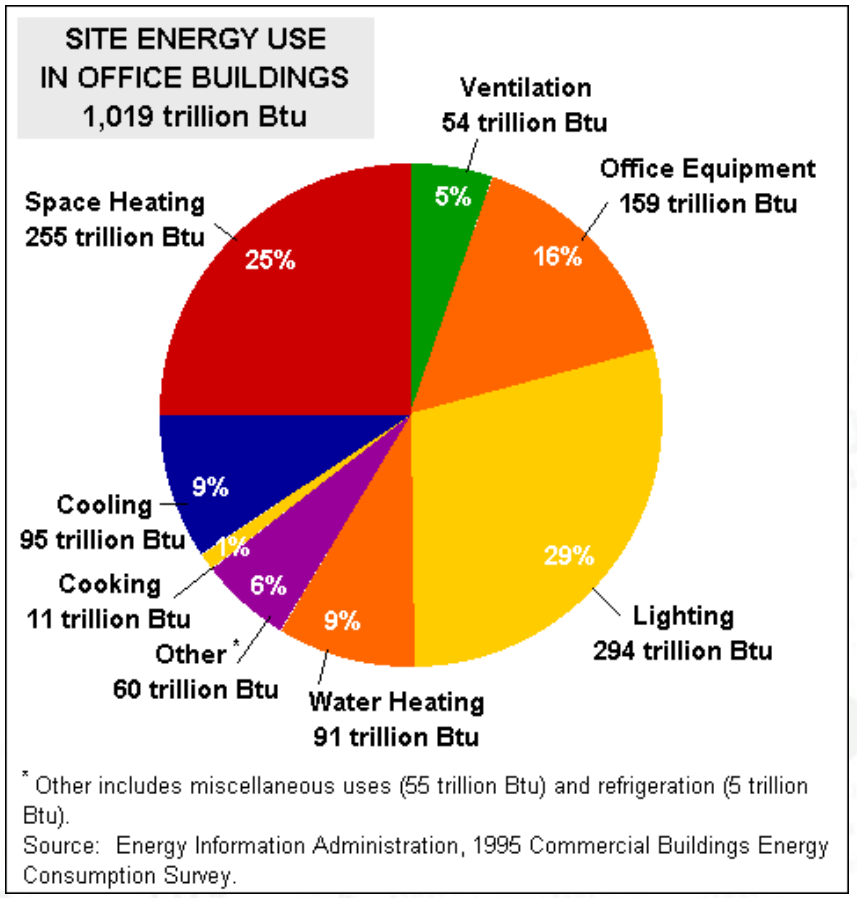


Source: Energy Information Administration, *Annual Energy Review 2008*.

Energy distribution in commercial buildings



Source: Energy Information Administration, *2003 Commercial Building Energy Consumption Survey,* Table E1A (September 2008).



The challenges of energy management

- Energy is a small % of operating cost (3% to 7%)
- Increasing energy efficiency is difficult
  - Need management commitment
  - Do you have a plan ?
  - Are technical and financial resources available?
  - Human factor, Comfort issues
  - Demand side management
  - Component in Smart Grid
- Getting data, Need to report

Building Automation System shortcoming

- Archiving capabilities limited (time, granularity, flexibility)
- Limited user friendliness in serving the data
- Legacy system need upgrading
- Limited capability to see other BAS systems
  - Get data from power meter, HVAC equipment, lighting

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Reliable controls

DISTECH CONTROLS

Schneider Electric

SQUARE D Schneider Electric

TAC

Honeywell

AMERICAN AUTO-MATRIX SMART BUILDING SOLUTIONS

VYKON

AUTOMATEDLOGIC CORPORATION

Johnson Controls

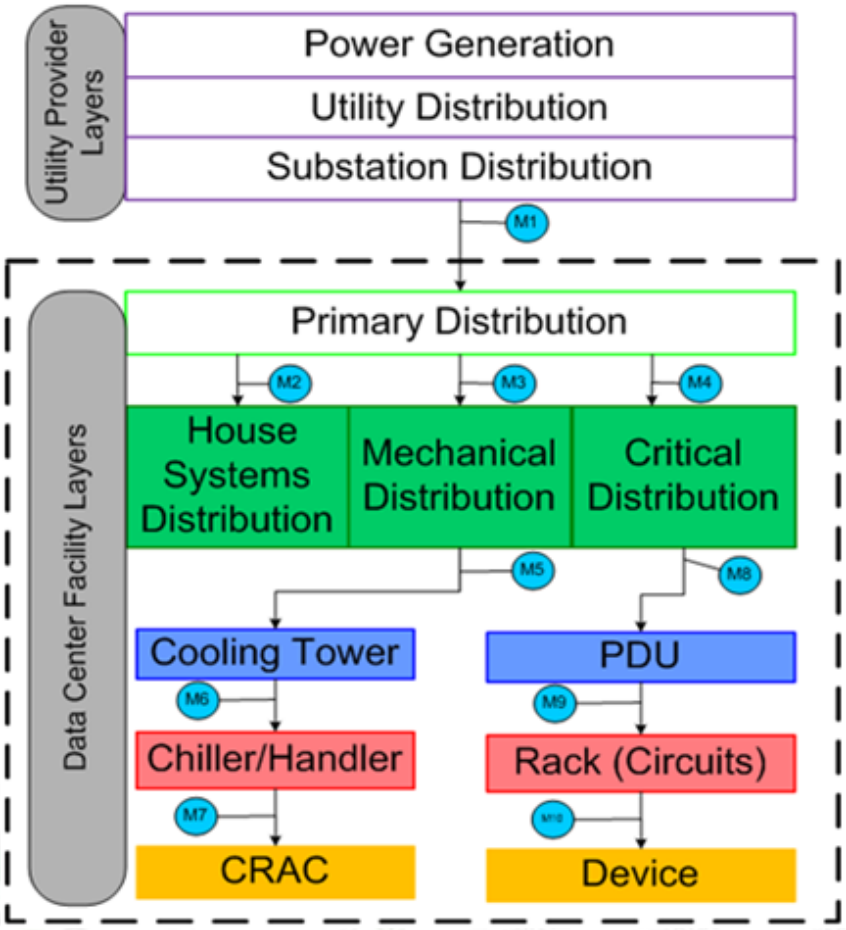
Delta CONTROLS

Infrastructure for an energy information system (EIS)

- Aggregate data from
  - Various Building automation System (BAS)
  - HVAC equipments (HVAC chiller, boiler, lighting etc)
  - Energy metering device (including sub metering)
  - Different building location and expose Data
- PI system differentiator (scalability, reliability, availability, interoperability, security)
- How do we access the data from BAS ?

Data Collection with PI

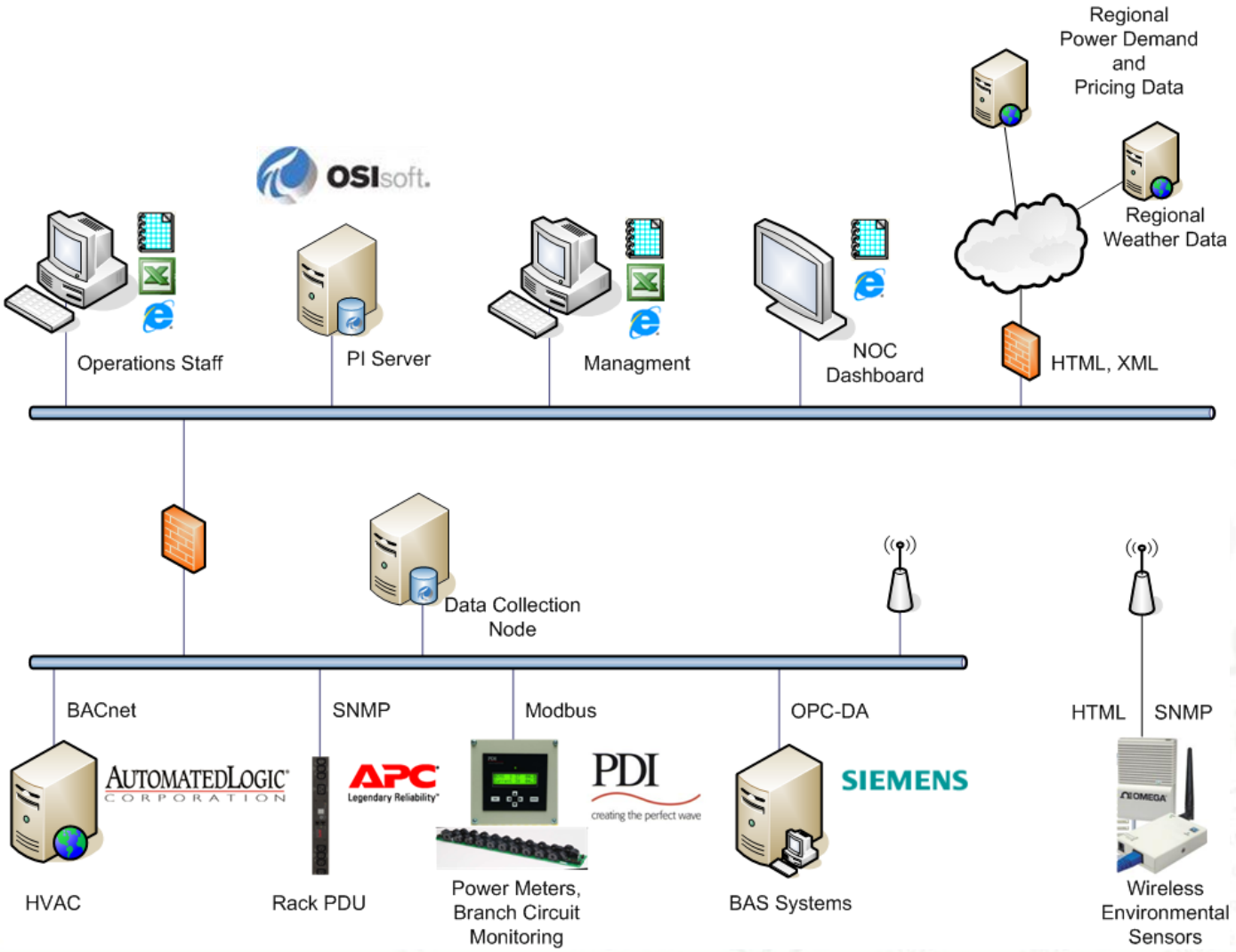
- Example: Energy Information System
  - You need Data!
  - Sub-Metering at key points
  - Visibility, “Where am I consuming the most power?”
- Where is the data?
- How do I collect the data?
- Which Interface do I use?



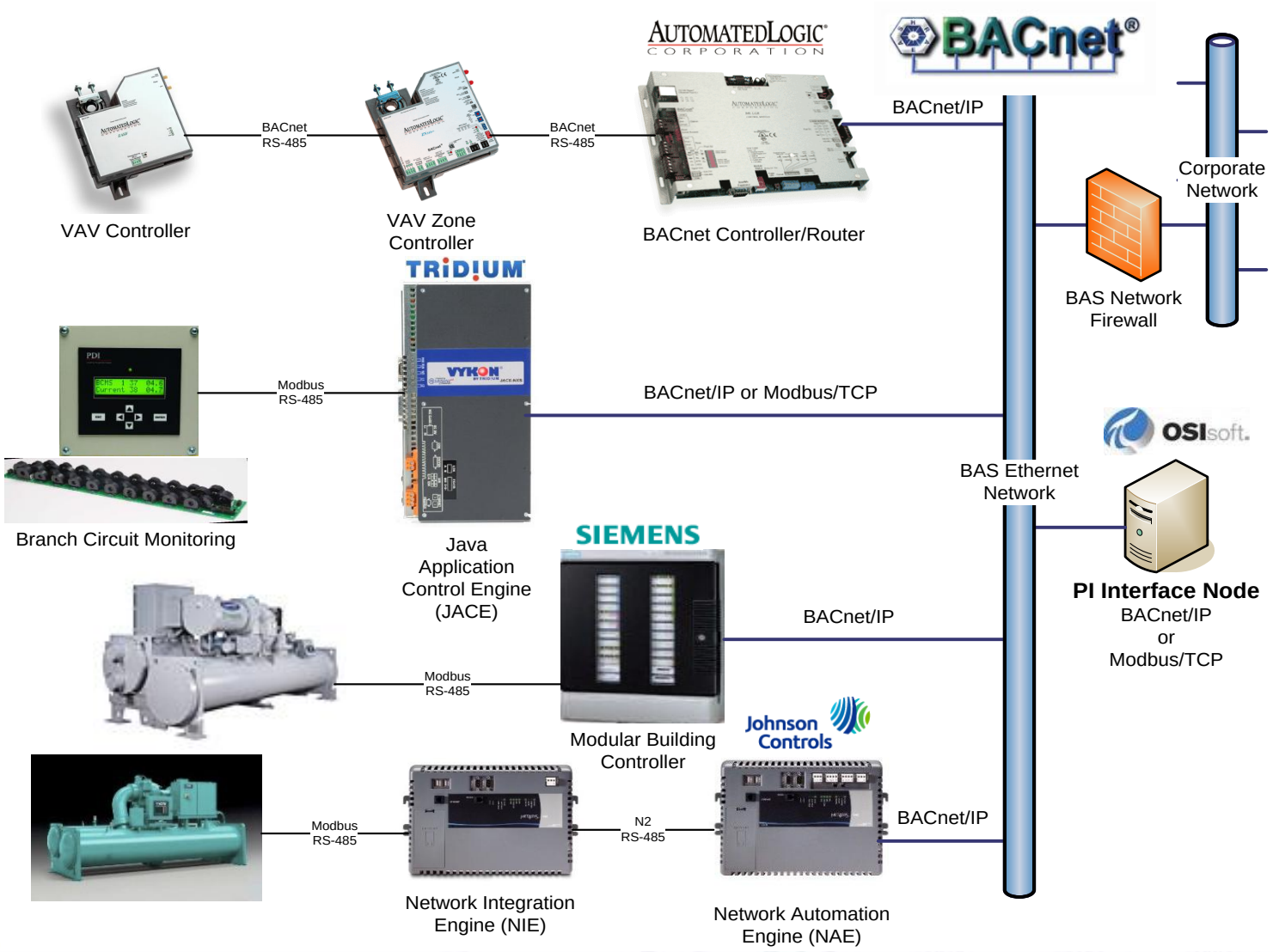
Where is the data?

- Data Sources
  - Meters, Air Handlers, Chillers, Pumps, Cooling Towers, Switchgear, Temp/Humidity Sensors
- Types of data
  - Temperatures, Power Measurements, HVAC Equipment Status, Power Panel Details, Alarms

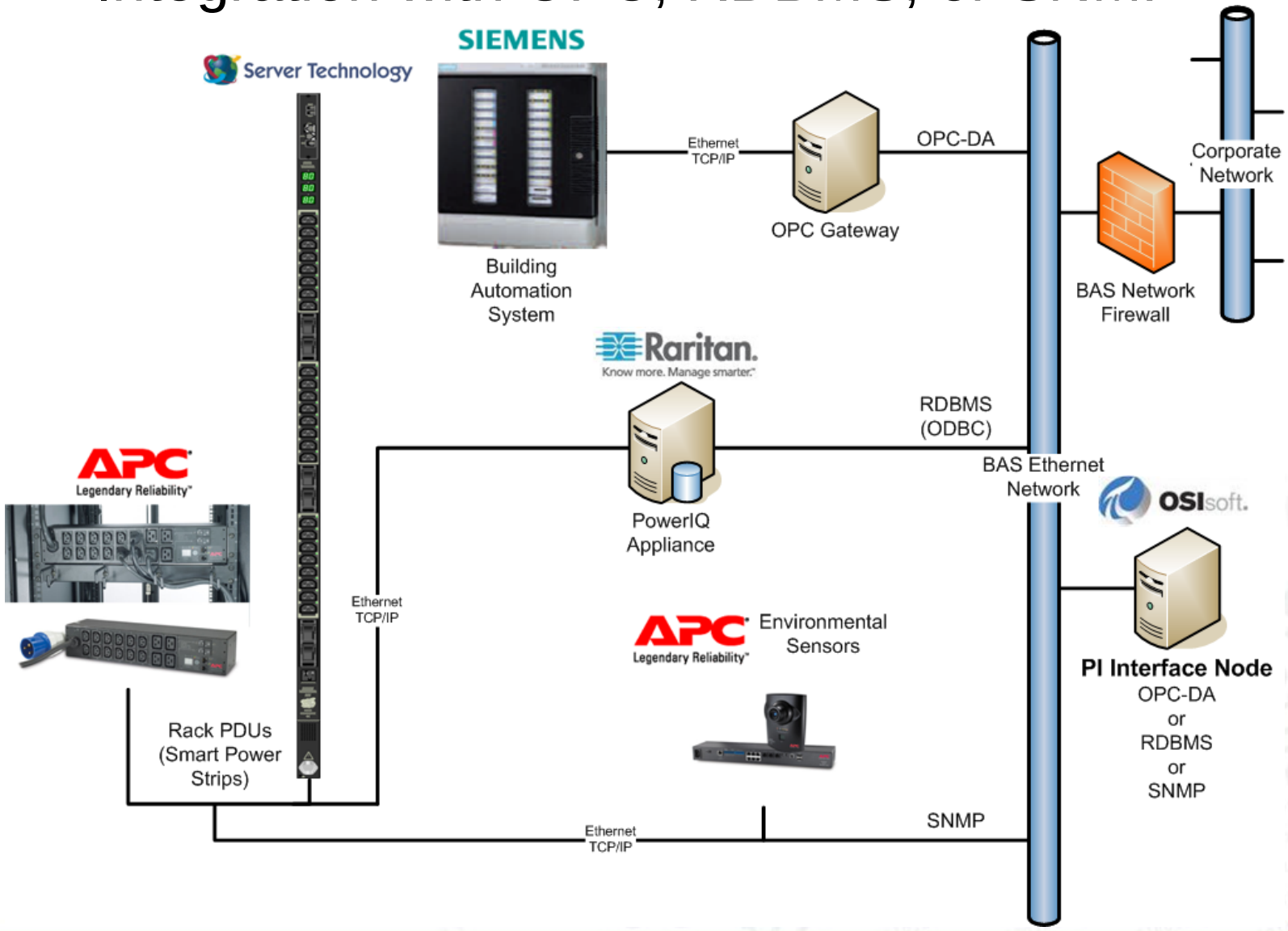
Example System Deployment



Integration with BACnet/IP or Modbus/TCP



Integration with OPC, RDBMS, or SNMP



How do I collect the data?

- Poll Building Automation System (BAS)
  - SCADA for building mechanical systems
  - ALC, Honeywell, Johnson Controls, Siemens, Tridium
- Poll Devices/Equipment Directly

Data Collection Examples

- Eaton Power Xpert Meters
  - Modbus interface can poll meters directly
- ALC (Automated Logic Corporation)
  - BACnet interface can poll controllers or devices directly
- Siemens Apogee BAS
  - OPC-DA interface can poll data points via OPC gateway server
  - BACnet gateway is also available

Data Collection Interfaces

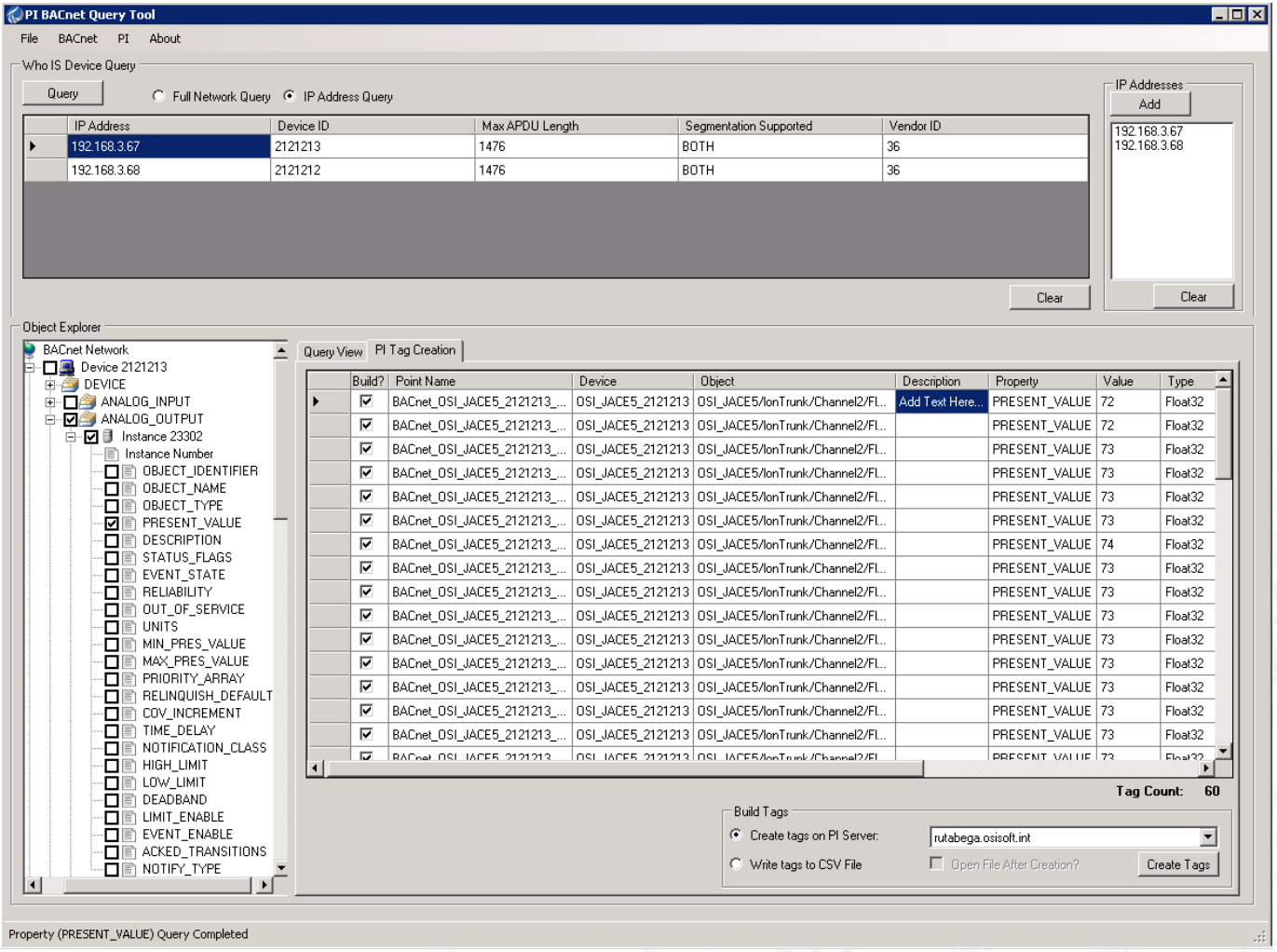
- Most Common Protocols
  - Modbus
    - TCP/IP or Serial
  - BACnet
    - TCP/IP (UDP)
  - OPC, RDBMS, SNMP

Modbus

- Modbus Serial/Modbus Plus & Modbus Ethernet
  - In Development: Re-write
    - Improved Scalability
      - Multiple Devices
      - Device Masters
    - Logging and Tracing
      - Details and Options
    - Runtime Configuration
      - Enable/Disable ports on the fly
      - Logging changes on the fly
    - Phase 2 Failover

- BACnet/IP support
  - Change of Value (COV)
    - Exception based data collection
  - Phase 2 Failover
  - BACnet Query Tool
    - Easy to use GUI tool
    - Auto-Discovery of BACnet devices
    - Automatic Point Configuration on PI Server

BACnet Query Tool



Other Interfaces

- OPC DA
  - Common gateway to BAS platforms
- RDBMS
  - SQL based queries via ODBC
- SNMP
  - Supports SNMP v1, v2, & v3
  - Point Builder/MIB Browser in SMT
- What do we do with the data

Value of PI in facilities

- Connects to BAS, equipments and metering devices
- Monitor, track and report (commissioning value)
- Guardian of equipment and building performance (optimization value)
- Protects and maximize investment in energy efficiency (insurance value)
- Efficient use of human resources (action value)

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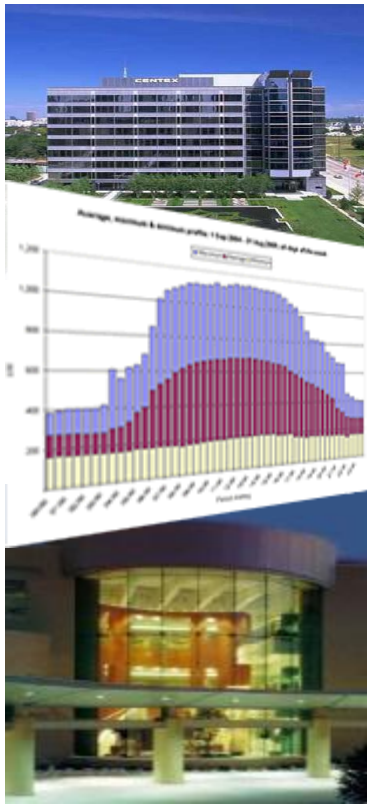
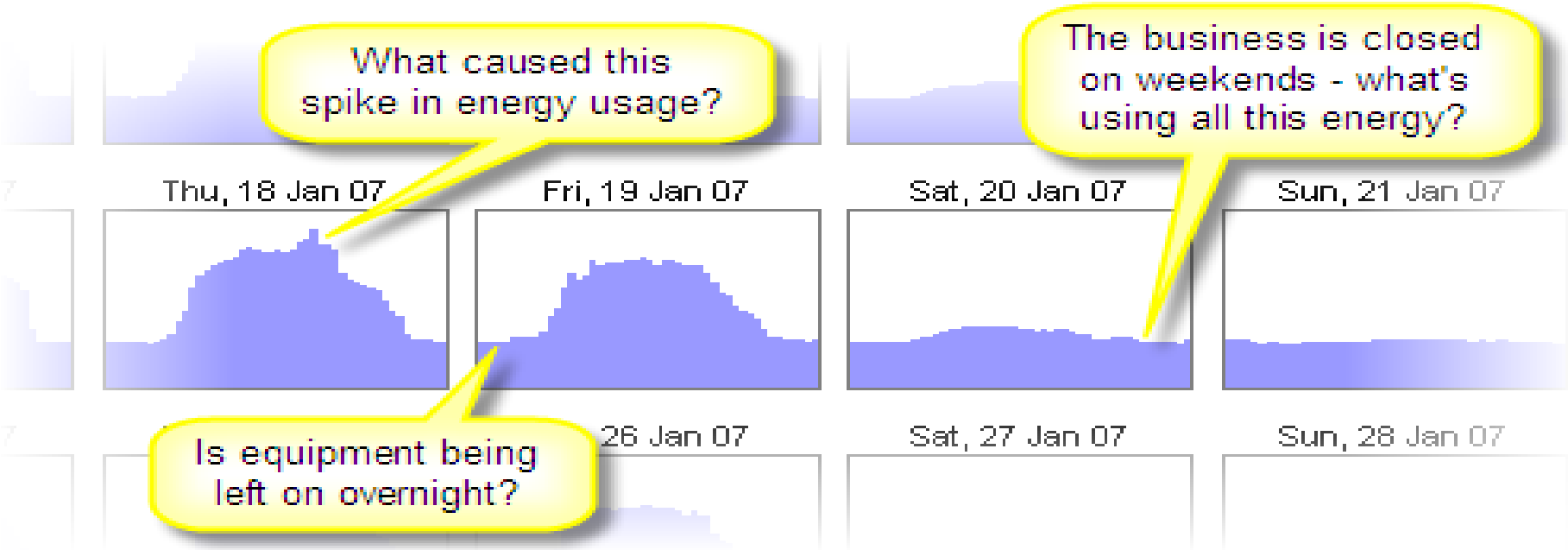
Benefits of Tracking Energy Performance



- Visibility and analysis
- 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

Analyze and Investigate

- Chart your energy consumption
- Key performance indicator (daily / monthly / annual consumption)
- Calculate your cost per equipment



Commissioning

- Monitoring and tracking energy use leads to reductions of 10 to 15%.
  - Check and tune up building systems
  - resetting existing controls to reduce HVAC
  - Identify waste while maintaining or even increasing comfort levels for occupants.
  - Energy star rating
- Commissioning usually costs between 5 and 40 cents per square foot.

PI and energy management applications

- System Optimization Analysis
- Energy Forecasting Model
- Energy Benchmarking Model
- Equipment Performance Ranking
- Reference Model Analysis
- Tariff Analysis
- Peak Demand Control Model
- Return on Investment (ROI) Analysis
- Greenhouse Gas (GHG) carbon reporting

Remote performance monitoring

Typical office building in Chicago
250,000 sq/feet
Centrifugal chiller, Gas-fired hot water boiler, Mon-Fri 7:00am – 6:00pm
Energy cost base line $480 586/yr
Energy saving 23% or $113,000/yr

More potential because less managed overall

Complex heterogeneous data stream

- 499 900 square feet
- Energy cost (est. $1 000 0000)
- LEED Gold certified 2007
- **1 MW (two 500-kW)** natural gas-fired V-12 engine systems 71 % of electricity, 100% of steam demand)
- **Chiller: York 320-ton water absorption**
- **Estimated 50%** overall efficiency (heating, cooling, electricity)
- **Expected Payback Time: 4 to 5 years**
- **Better return because better managed??**

About Harvard Medical School

Facilities Department

- 2.8 Million Square Feet
- Full Time Contracted Staff of 60
- Facilities Management
  - 18,000 Maintainable Assets, 24/7 Call Center, 200 Node BMS
- Energy Usage
  - 15 Mw Electric, 70K lbs/hr Steam, 10k+ Tons Chilled Water, $25 Million Annual Utilities

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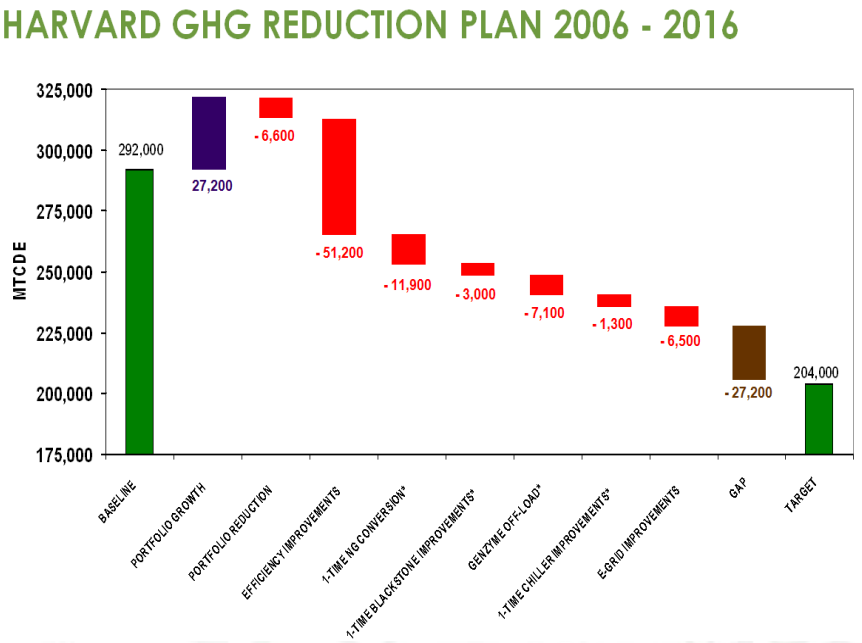
Sustainability and GHG

- 2006 57,266 MTCDE
- 2008 57,592 MTCDE

Goal

- 2016 40,086 MTCDE

30 % GHG Reduction



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Sustainability and GHG

- Approx. 60 Primary Meters
- Approx. 112 Tenant and Sub-meters
- 172 Total CHW / Steam / Electric / Air

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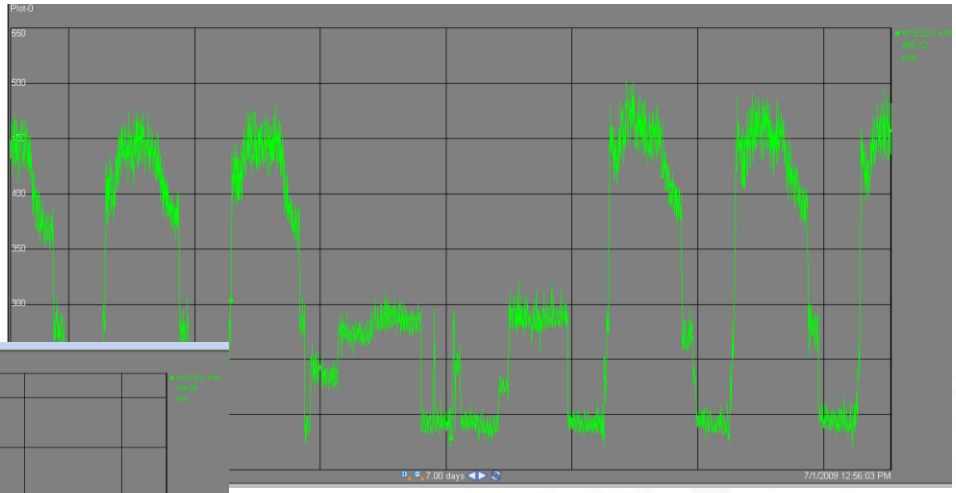
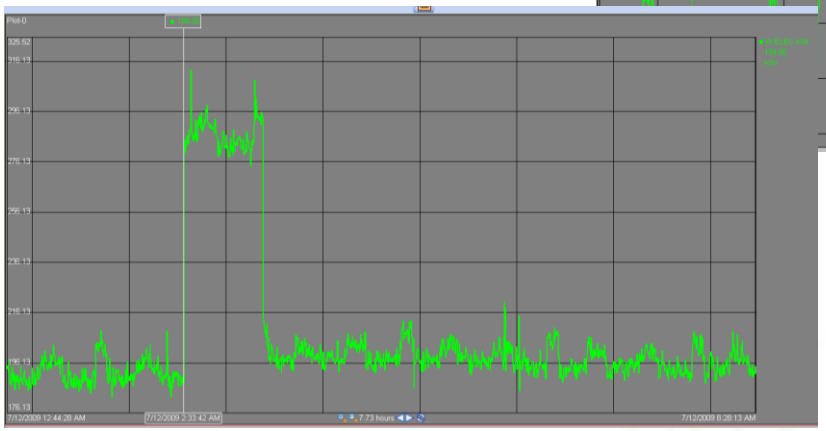
Facilities Management

- Event Analysis





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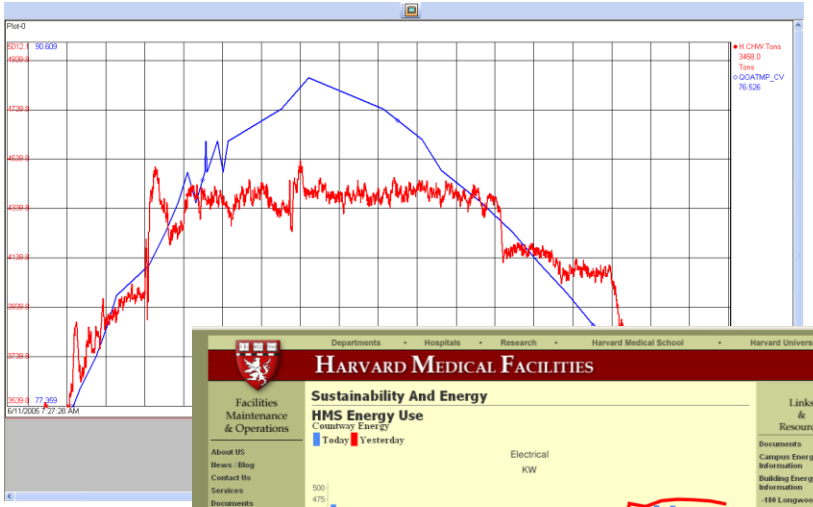
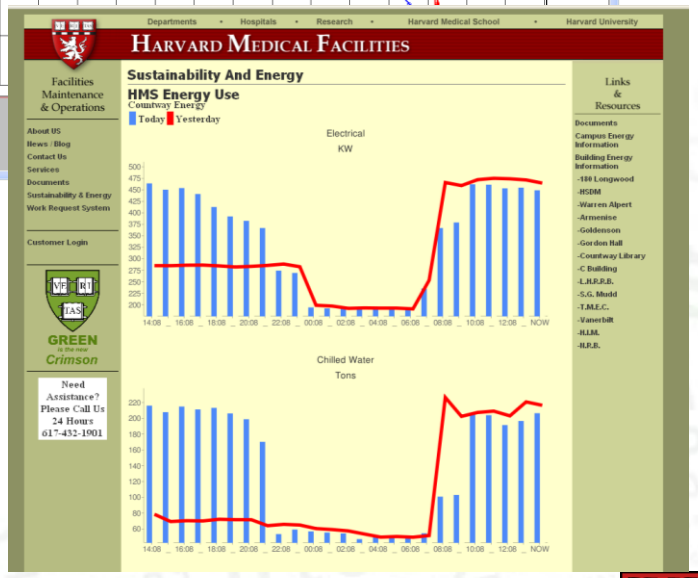
Sustainability and GHG

- Automated Load Shedding



- Real Time Energy Use on Web for Public



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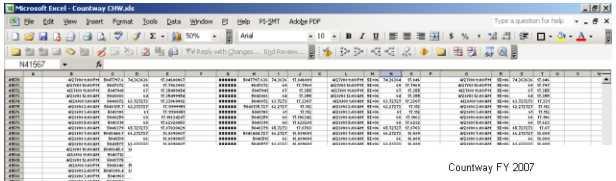
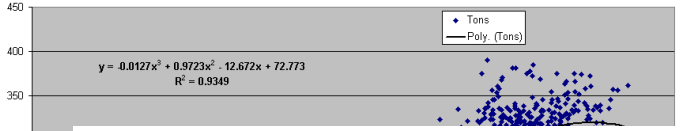
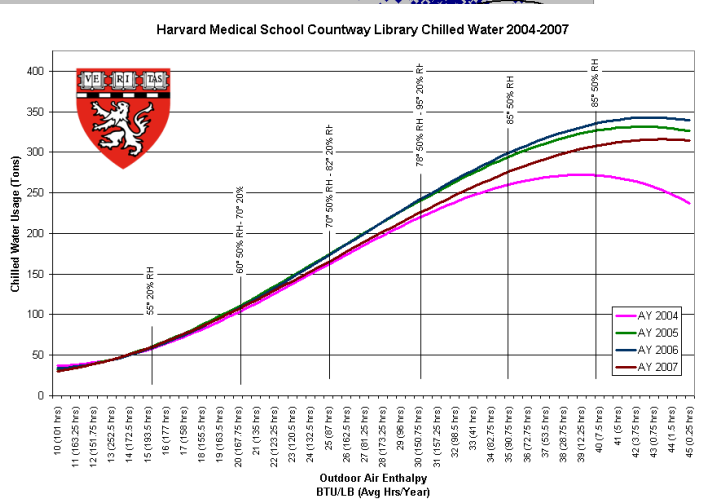
Sustainability and GHG

- Analyze Energy Usage
- Model Building Performance
- Trend ‘Creep’



Countway FY 2007





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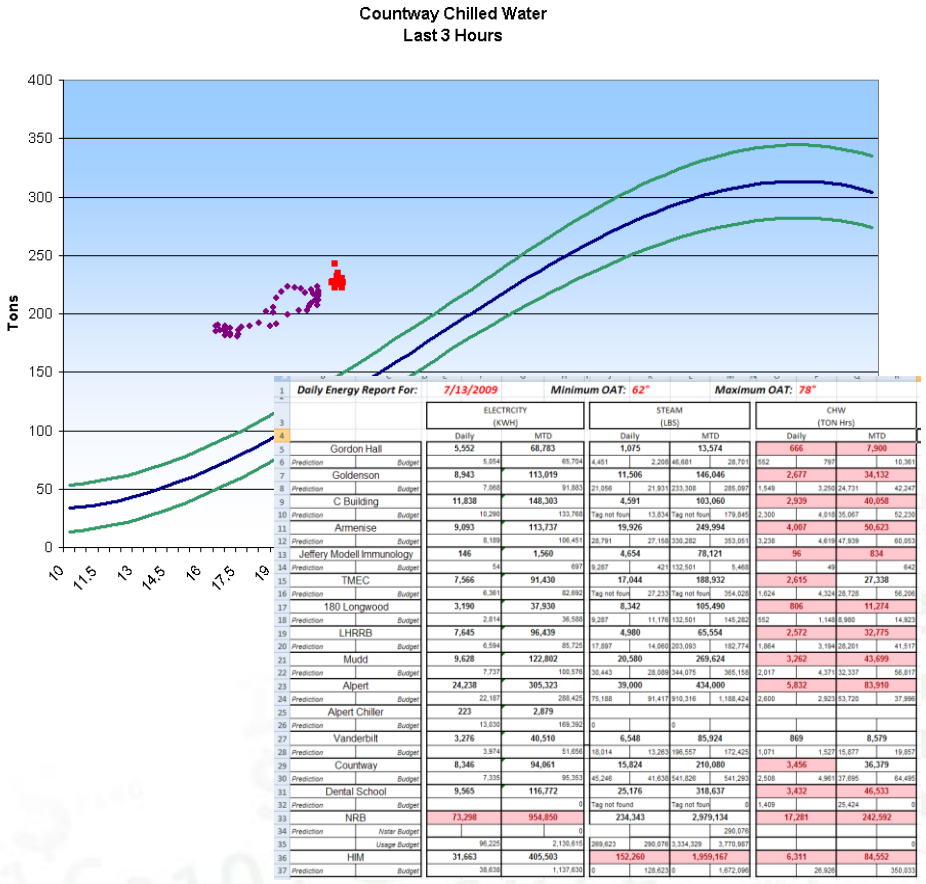
Sustainability and GHG

- View Impact of Sequence / Strategy Change
- Daily Energy Report



Daily Energy Report For:	7/13/2009	Minimum OAT: 62°	Maximum OAT: 78°						
		ELECTRICITY (KWH)		STEAM (LBS)		CHW (TON Hrs)			
		Daily	MTD	Daily	MTD	Daily	MTD		
Gordon Hall		5,552	68,783	1,075	13,574	666	7,900		
	Prediction	5,054	65,704	4,451	2,208 46,681	28,701	552	797	10,361
	Budget								
Goldenson		8,943	113,019	11,506	146,046	2,677	34,132		
	Prediction	7,060	91,883	21,056	21,931 233,308	285,097	1,549	3,250	24,731 42,247
	Budget								
C Building		11,838	148,303	4,591	103,060	2,939	40,058		
	Prediction	10,290	133,768	Tag not found	13,834 Tag not found	179,845	2,300	4,018	35,067 52,236
	Budget								
Armenise		9,093	113,737	19,926	249,994	4,087	50,623		
	Prediction	8,189	106,451	28,791	27,158 330,282	353,051	3,238	4,619	47,939 60,053
	Budget								
Jeffery Modell Immunology		146	1,560	4,654	78,121	96	834		
	Prediction	54	697	9,287	421 132,501	5,468	49		642
	Budget								
TMEC		7,566	91,430	17,044	188,932	2,615	27,338		
	Prediction	6,361	82,692	Tag not found	27,233 Tag not found	354,028	1,624	4,324	28,728 56,296
	Budget								
180 Longwood		3,190	37,930	8,342	105,490	806	11,274		
	Prediction	2,814	36,586	9,287	11,176 132,501	145,282	552	1,148	8,980 14,923
	Budget								
LHRRB		7,645	96,439	4,980	65,554	2,572	32,775		
	Prediction	6,594	85,725	17,897	14,060 203,093	182,774	1,864	3,194	28,201 41,517
	Budget								
Mudd		9,628	122,802	20,580	269,624	3,262	43,699		
	Prediction	7,737	100,578	30,443	28,089 344,075	365,158	2,017	4,371	32,337 56,817
	Budget								
Alpert		24,238	305,323	39,000	434,000	5,832	83,910		
	Prediction	22,187	288,425	75,188	91,417 910,316	1,188,424	2,600	2,923	53,720 37,996
	Budget								
Alpert Chiller		223	2,879	0	0				
	Prediction	13,030	169,392						
	Budget								
Vanderbilt		3,276	40,510	6,548	85,924	869	8,579		
	Prediction	3,974	51,656	18,014	13,263 196,557	172,425	1,071	1,527	15,877 19,857
	Budget								
Countway		8,346	94,061	15,824	210,080	3,456	36,379		
	Prediction	7,335	95,353	45,246	41,638 541,826	541,293	2,508	4,961	37,895 64,495
	Budget								
Dental School		9,565	116,772	25,176	318,637	3,432	46,533		
	Prediction		0	Tag not found	Tag not found	0	1,409		25,424 0
	Budget								
NRB		73,298	954,850	234,343	2,979,134	17,281	242,592		
	Prediction		0		290,076				
	Natar Budget								
	Usage Budget	96,225	2,130,619	269,623	290,076 3,334,329	3,779,987			0
HIM		31,663	405,503	152,260	1,959,167	6,311	84,552		
	Prediction	38,638	1,137,630	0	128,623 0	1,672,096		26,928	350,033
	Budget								

Live PI links- See PI In action

https://facilities.med.harvard.edu/energy/

UC Davis

http://facilities.ucdavis.edu/Dashboard/

Queen's University

http://livebuilding.queensu.ca/

Rochester University

http://meters.energy.rochester.edu/rc%20sharepoint%20files/hutch%20hall%20electric.aspx

University of Connecticut

http://www.fo.uconn.edu/cogen.htm I

http://www.uaf.edu/fs/services/utilities/

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