Tapping the Power of Facility Information

The Future of Building Management

Visibility

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Dave Mosby

Johnson Controls 125 Years

Our Journey Today

- The BAS Promise
- Where are we now?
- Where do we need to go?
- Keys to making it happen
- Focus on Visibility
- Integration to the Enterprise
- Dashboards
- Real world examples
- Summary

What is the Automation Promise

- Buildings that are:
  - Comfortable
  - Safe
    - Occupants
    - Assets
  - Efficient (Productive)
    - Energy
    - Equipment
    - Enterprise
  - Sustainable

Building Management
Where do we stand ?

- For the most part our building control systems are standalone and not integrated
- Our systems are under-instrumented
- Our control systems are over-distributed
- We are wasteful ($14 billion powering and cooling data centers in N.A. and only 30% of the energy ever touches a computer)
- We do not follow the process:

  Plan, instrument, measure, manage, improve

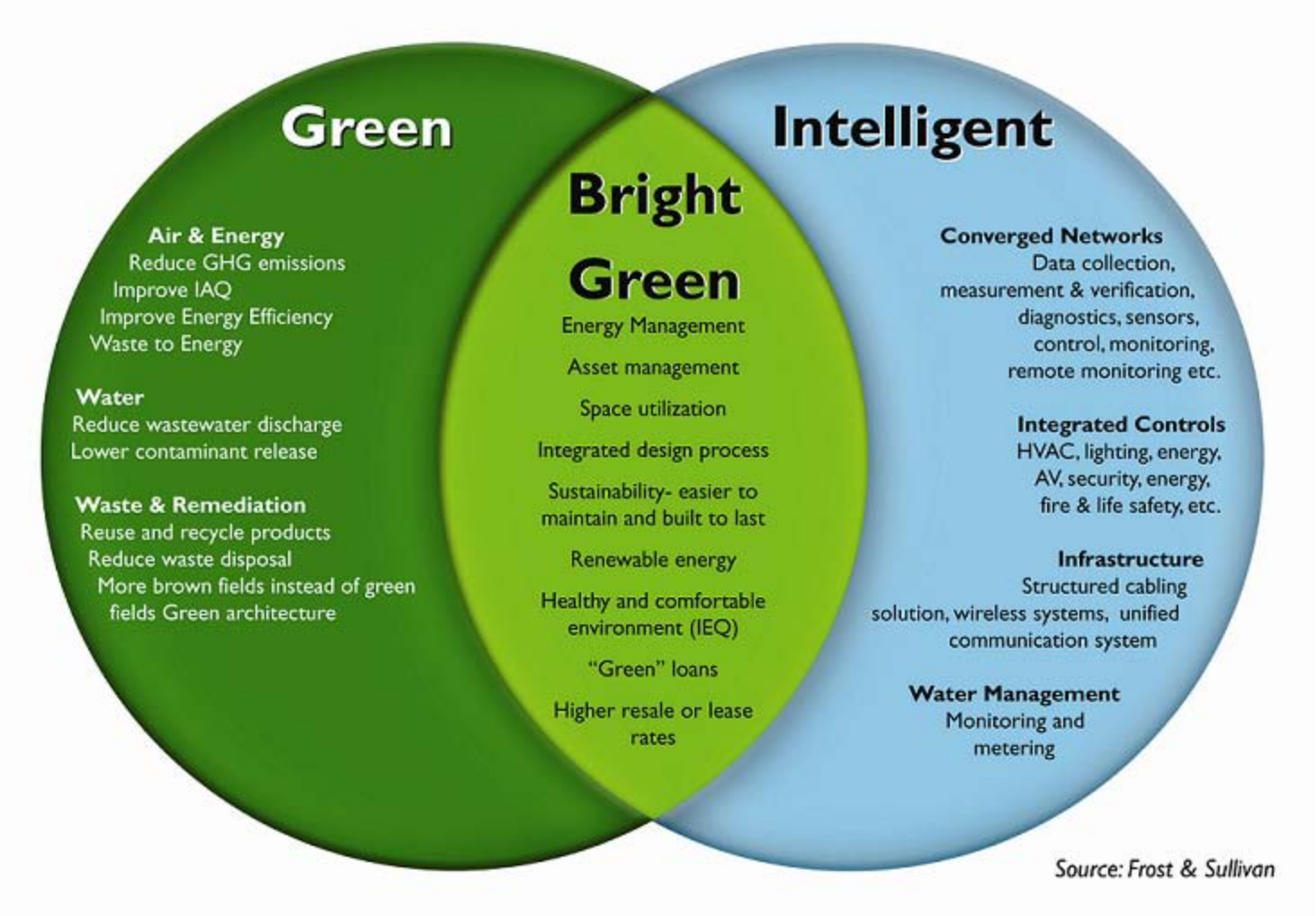
  You can’t manage what you don’t measure

THE most cost effective solution …

- **Resource efficient buildings that:**
  - Reduce energy use
  - Reduce use of Water and creation of Wastewater
  - Reduce CO_2 production
  - Increase use of renewable energy
  - Reduce consumption of other natural resources
  - Reduce generation of pollution
  - Create healthy environments and occupants

a.k.a. = A Healthy, Technology Driven, High Performance Green Building

Convergence of Intelligent and Green Buildings



Proprietary & Confidential

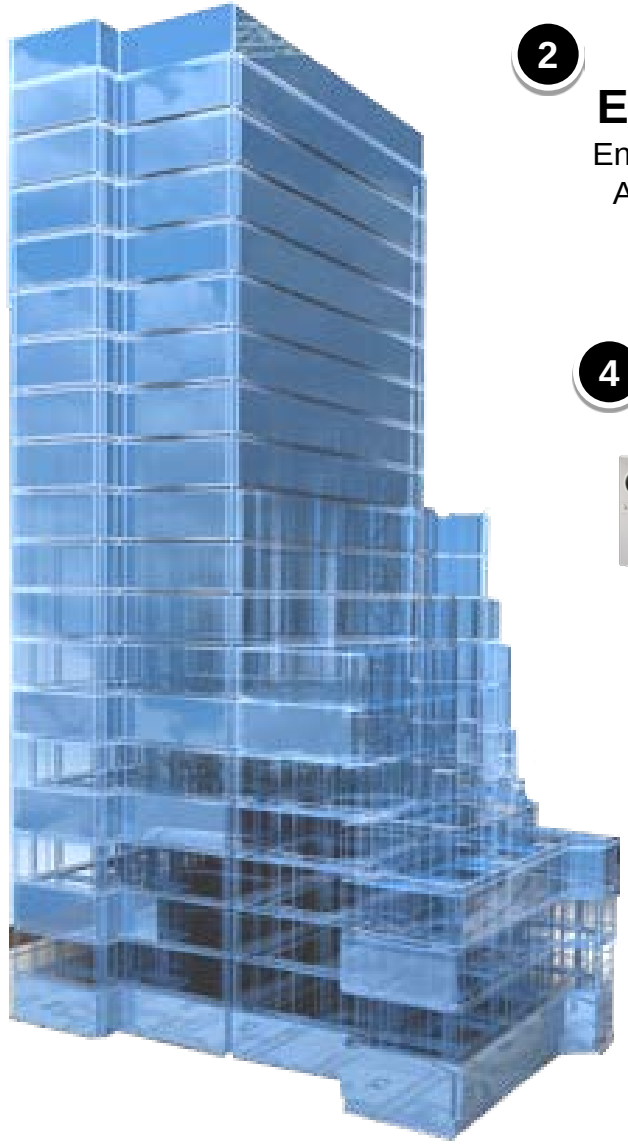
Technology applied to deliver…..

- Compatibility
- Mobility
- Connectivity
- Scalability
- Security
- Interoperability
- Efficiency
- Longevity
- Flexibility
- Reliability

Technology

Key Concepts – Applied Technology
Building Management

1 VISIBILITY
Enhanced User Experience



2 EFFICIENCY
Energy & Plant Applications

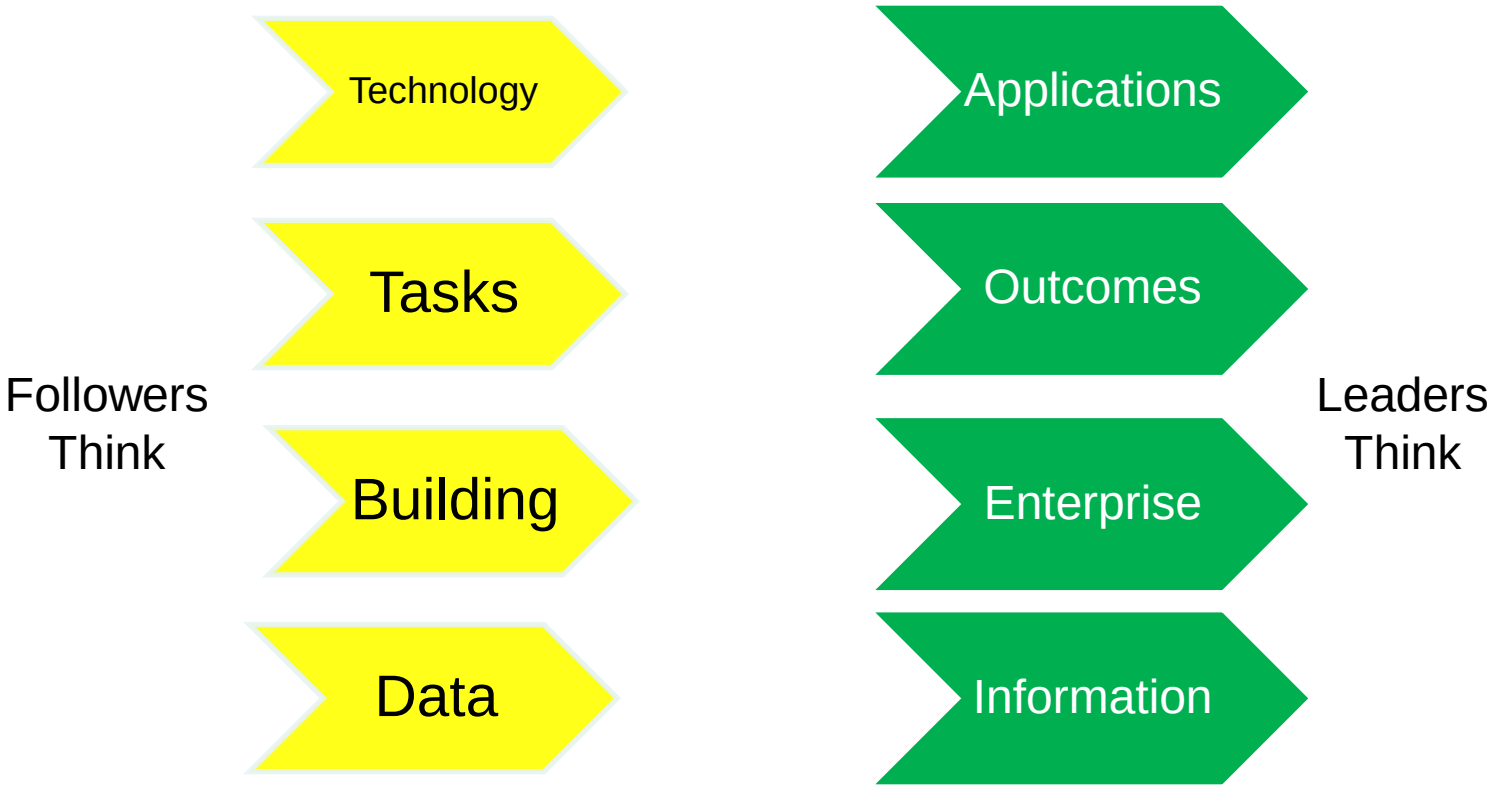
3 FLEXIBILITY
Hardware & Software Platforms

4 CONNECTIVITY
Including Enhanced Wireless Capabilities

5 SECURITY
Security & Fire Safety

6 SUSTAINABILITY
Programs

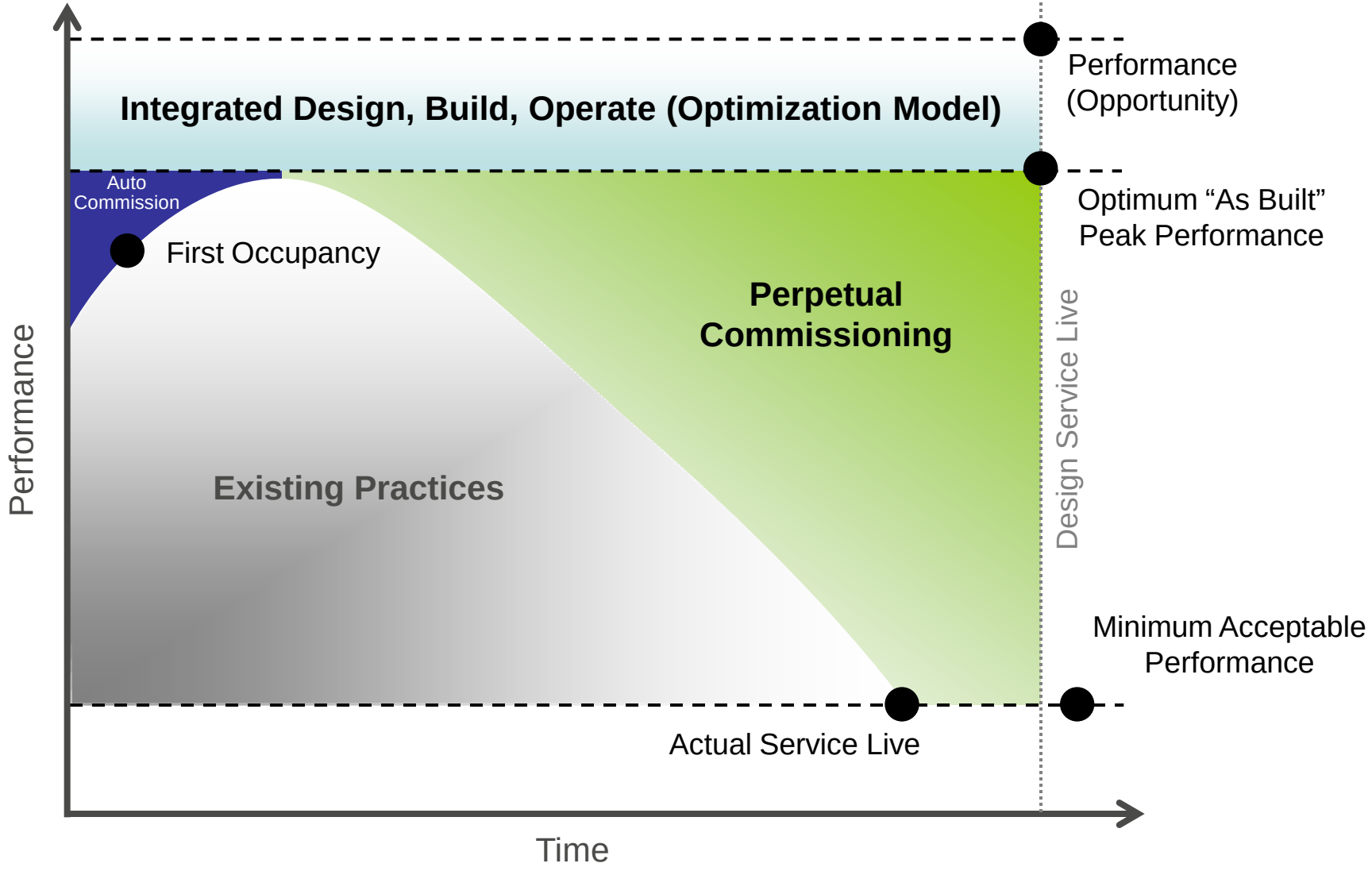
Where We are Headed
Thinking with the End in Mind – Left to Right Transformation



The Difference

Automation ----- Optimization

The Enterprise Real Lifecycle Cost Model



Proprietary & Confidential

But you can't manage what you can't see

Data transformed = Information

Information needs to be:

- Tailored
- Focused
- Actionable

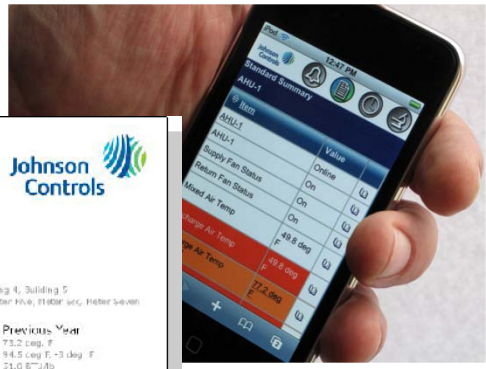
Visibility

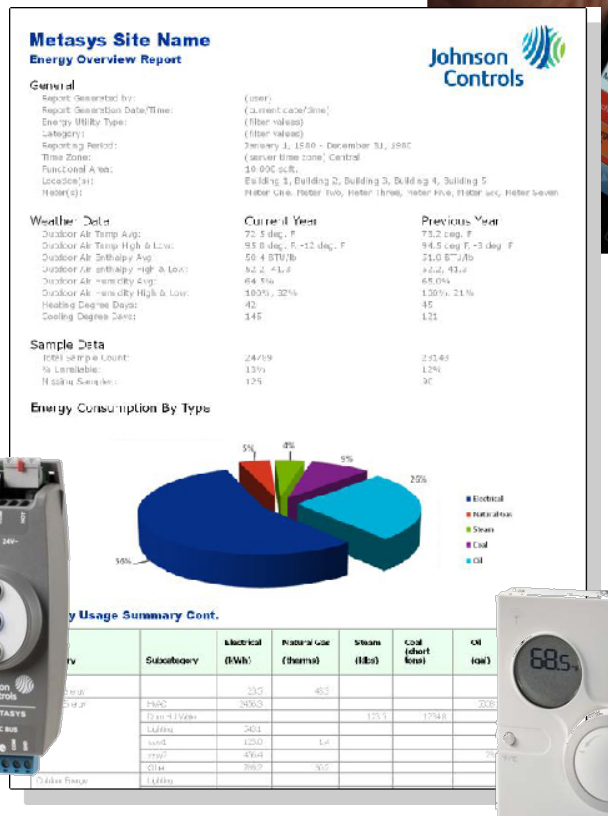
is the key

Because even the best Information is useless if it's invisible

Information Visibility Elements

- Device Level Interfaces
- Tailored Summaries
- Advanced Reporting
- Graphical displays
- Mashups
- Dashboards
- Mobile Access

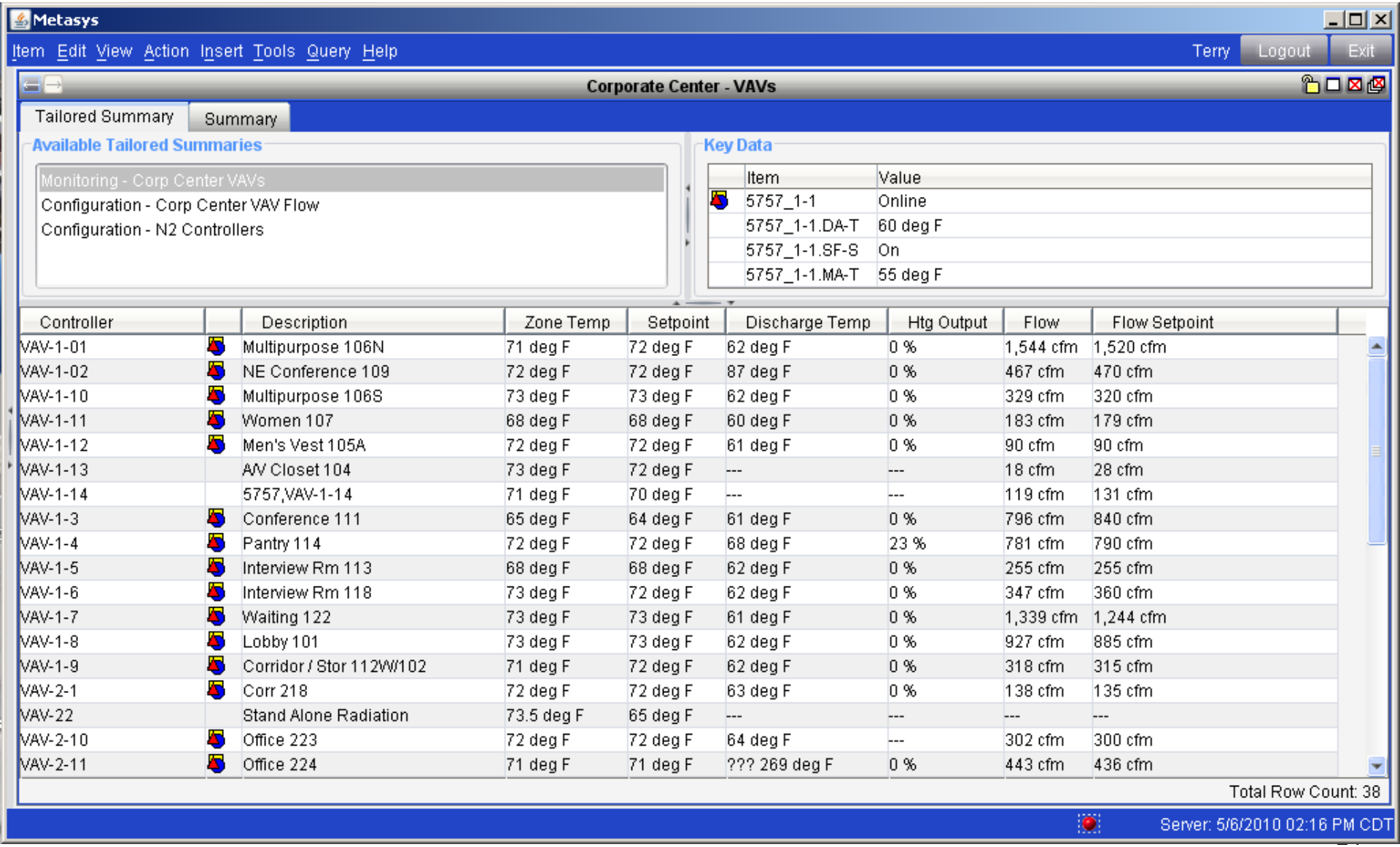




Device Level Interfaces

- Configurable
- Usable
- Secure
- Intuitive
- Efficient

Tailored Summaries



Advanced Reporting

My Site

Last Month's Energy Usage

Johnson Controls

General

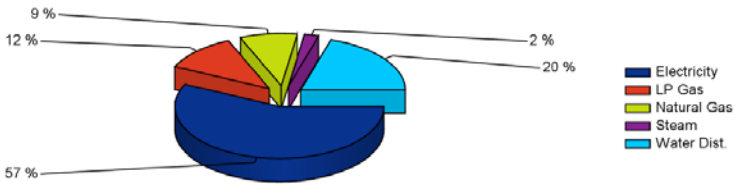
Report Generated By:	Ed, Energy Manager
Report Generation Date/Time:	Thursday, December 03, 2009 11:50 AM
Time Zone:	Central Standard Time
Report Path:	Standard Reports\Energy Essentials Reports\Big Picture Energy\
Energy Types:	Electricity, LP Gas, Natural Gas, Steam, Water Dist.
Categories:	Building Energy Use, Other, Outdoor Energy Use, Process Energy Use
Subcategories:	Domestic Hot Water, Lighting, Multiple, Other, Plug Loads, Snow Melt
Duration:	11/1/2009 12:00:00 AM - 11/30/2009 12:59:59 PM
Functional Area (no units):	N/A
Locations:	College of Engineering, Jefferson Dorm, Toner Hall
Items:	Electricity, Natural Gas, Steam, Water Dist., LP Gas
By Billing Period:	Not Included

Weather Data	Current Period	Previous Year
Outdoor Air Temp Avg (deg F):	70.13	70.31
Outdoor Air Temp High | Low (deg F):	79.99 | 60.00	89.96 | 50.02
Outdoor Air Enthalpy Avg (Btu/lb dry air):	39.91	41.26
Outdoor Air Enthalpy High | Low (Btu/lb dry air):	69.98 | 2.94	70.00 | 5.64
Outdoor Air Humidity Avg (%RH):	57.42	65.26
Outdoor Air Humidity High | Low (%RH):	59.34 | 52.77	98.00 | 45.47
Heating Degree Days (75.00deg F):	150	151
Cooling Degree Days (55.00deg F):	450	450

Sample Data Quality

Total Sample Count:	61,068	63,908
% Unreliable:	4.65	0.00
Missing Samples:	2,840	0

Overview

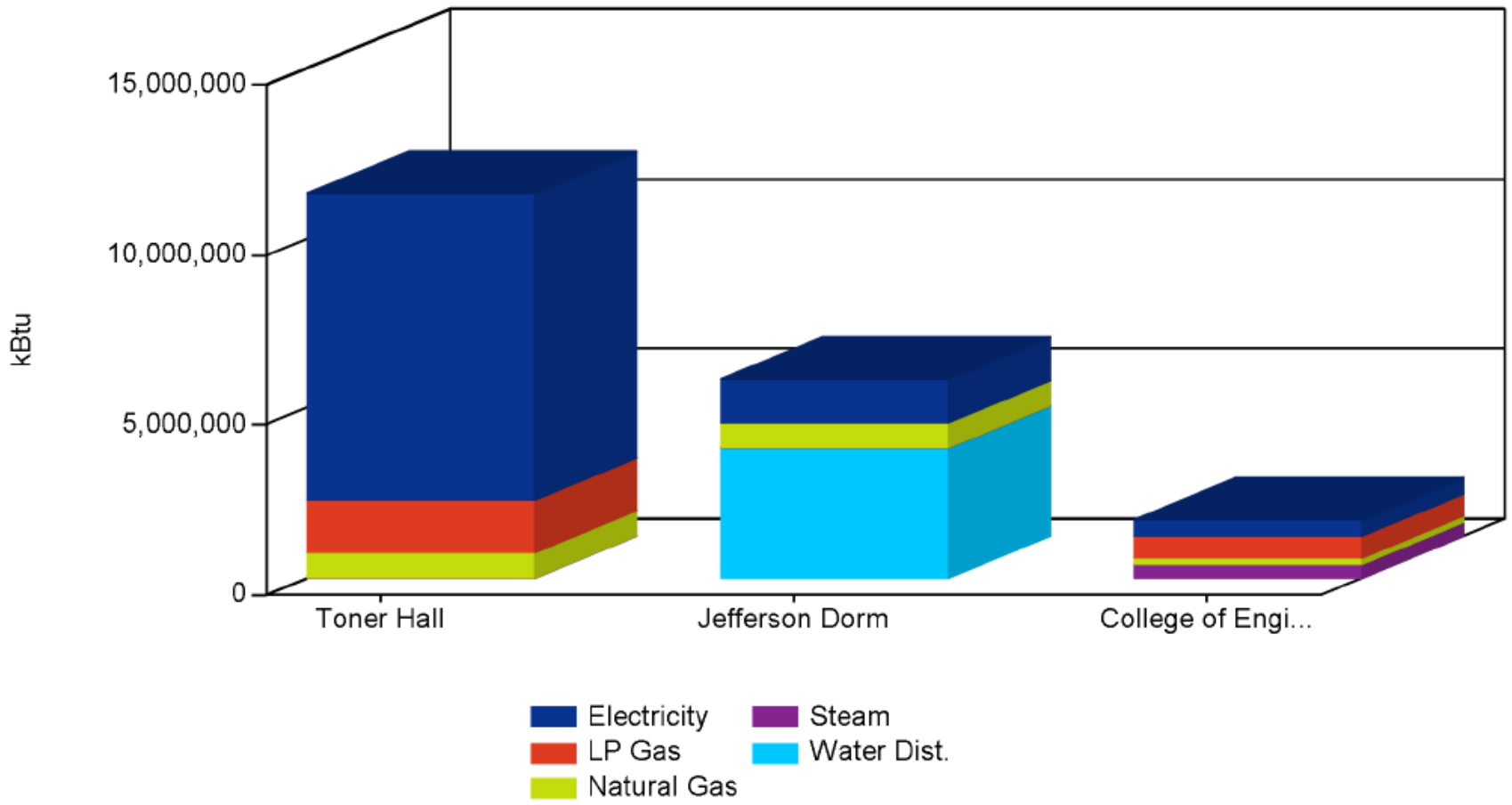


Energy Usage

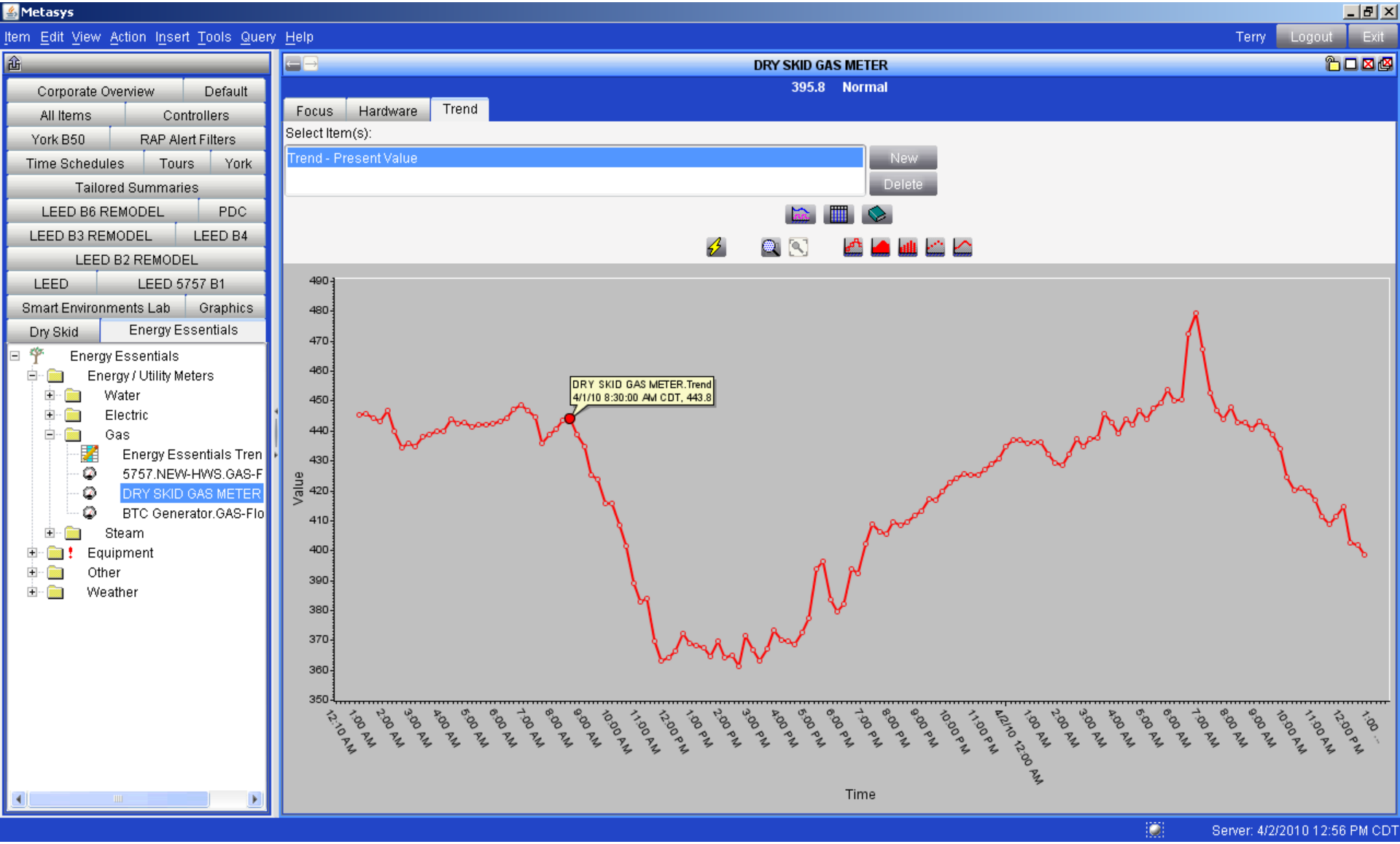
Category	Subcategory	Energy Type								Source Energy (kBtu)
		Electric (kWh)	Nat. Gas (thrm)	Steam (lbm)	Oil	Water Dist. (MBtu)	LP Gas (Gal)	Coal	Water Cons.	
Total Building Energy Use		**188,958**	**15,954**			**2,846**				**7,665,397.06**
Building Energy Use	Domestic Hot Water		15,954			2,846				5,511,924.41
	Lighting	106,450								1,213,167.62
	Multiple	10,486								119,507.27
	Plug Loads	72,022								820,797.76
Total Outdoor Energy Use		**754,527**								**8,599,006.91**
Outdoor Energy Use	Lighting	754,527								8,599,006.91
Total Process Energy Use				**267,303**			**24,142**			**2,612,888.15**
Process Energy Use	Multiple			267,303						418,208.71
	Snow Melt						24,142			2,194,679.44
Net Facility Energy Use		**943,485**	**15,954**	**267,303**		**2,846**	**24,142**			**18,877,292.12**
Source Energy Equivalent (kBtu)		**10,752,479.56**	**1,670,383.16**	**418,208.71**		**3,841,541.25**	**2,194,679.44**			**18,877,292.12**

Advanced Reporting

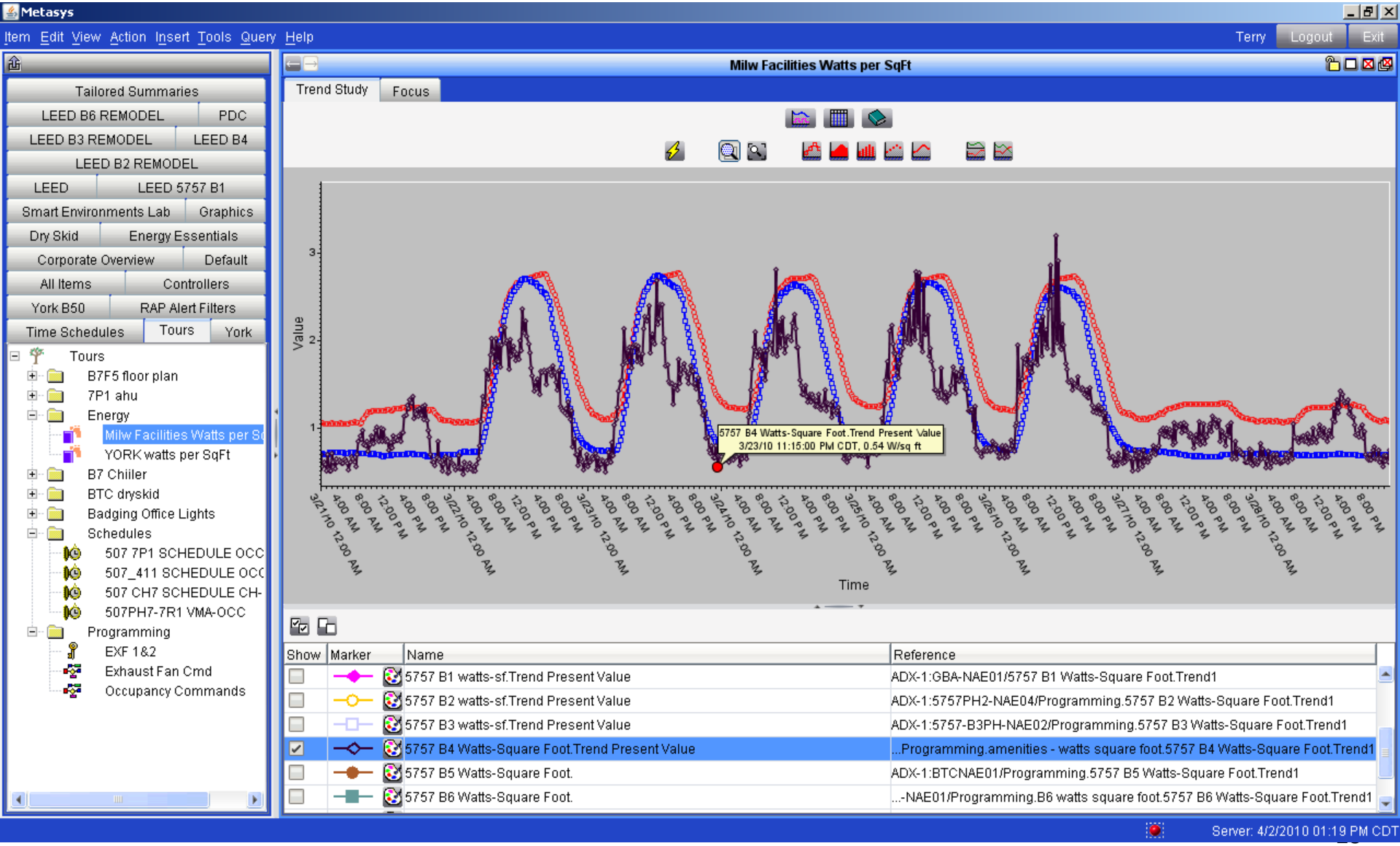
Usage by Location with Energy Type



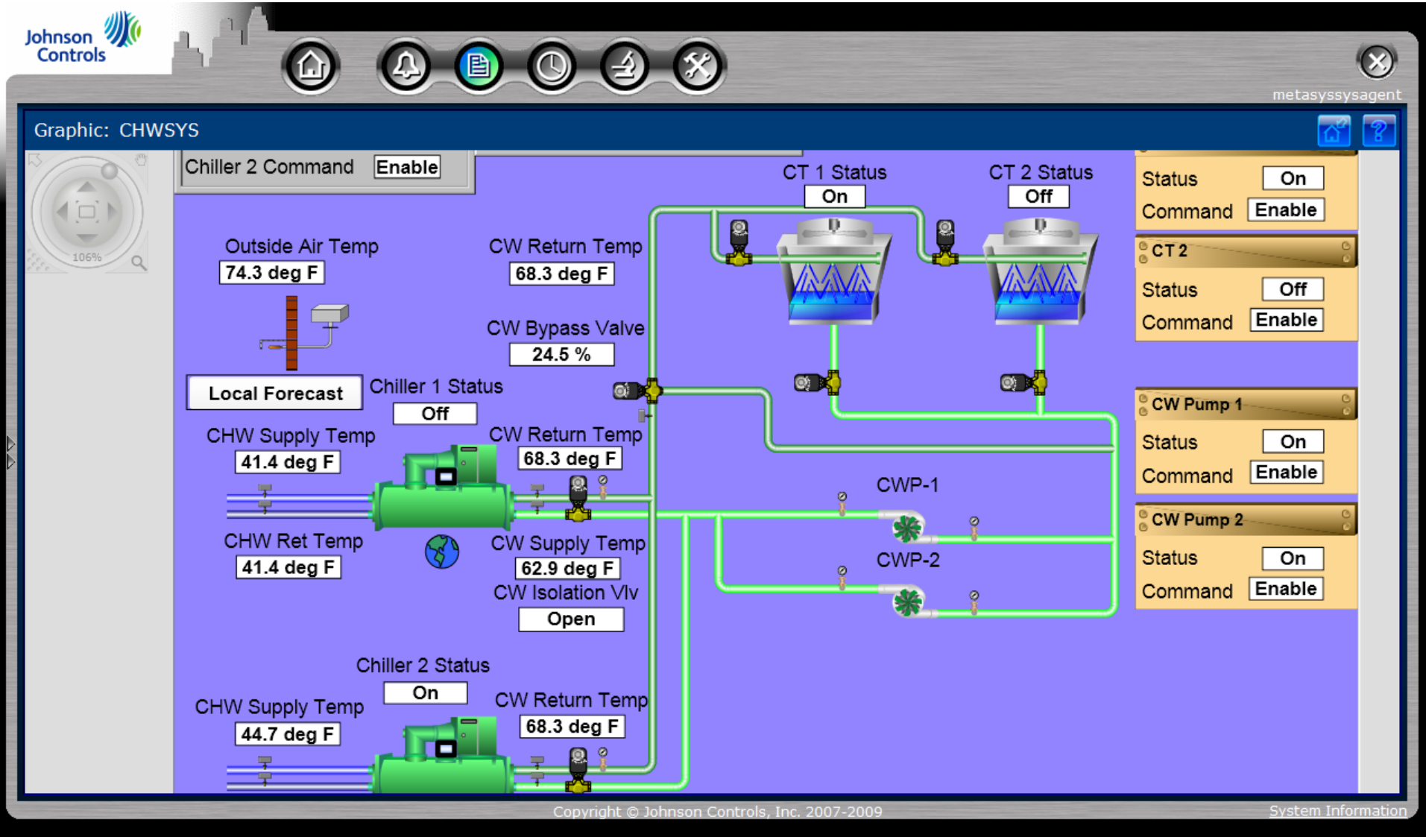
Graphical Displays



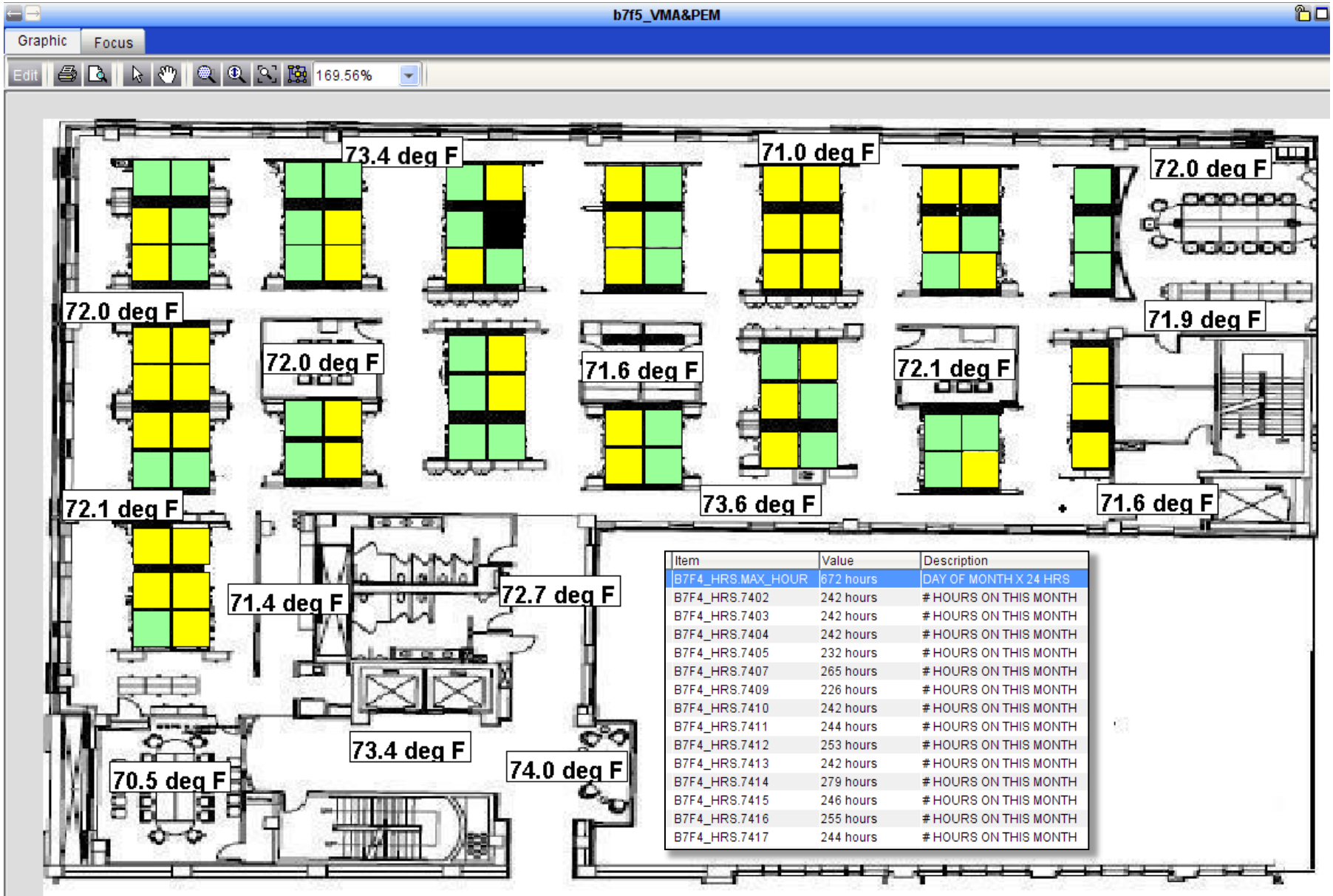
Graphical Displays/KPIs



Graphical Displays/Mashups

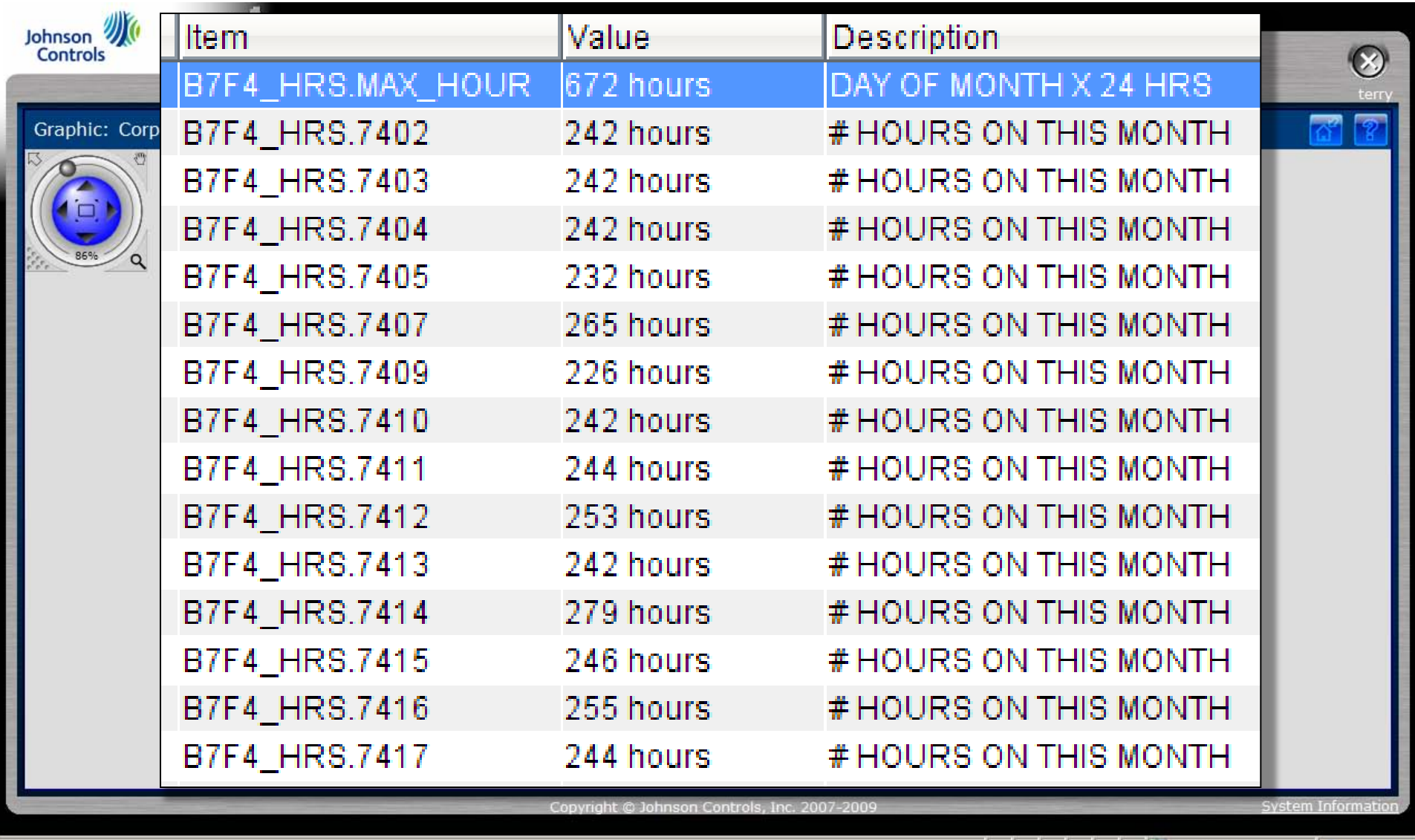


Graphical Displays/Mashups



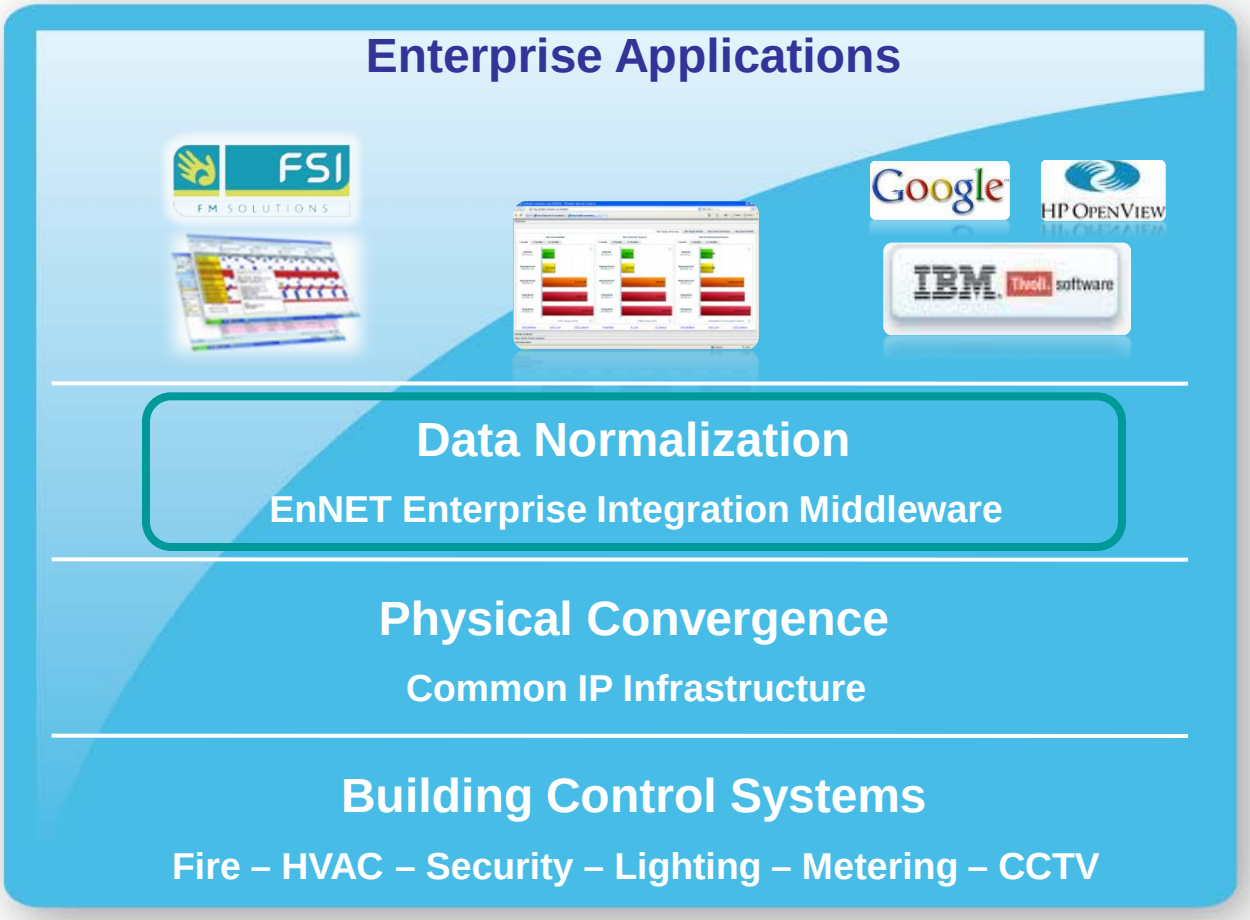
Item	Value	Description
B7F4_HRS.MAX_HOUR	672 hours	DAY OF MONTH X 24 HRS
B7F4_HRS.7402	242 hours	# HOURS ON THIS MONTH
B7F4_HRS.7403	242 hours	# HOURS ON THIS MONTH
B7F4_HRS.7404	242 hours	# HOURS ON THIS MONTH
B7F4_HRS.7405	232 hours	# HOURS ON THIS MONTH
B7F4_HRS.7407	265 hours	# HOURS ON THIS MONTH
B7F4_HRS.7409	226 hours	# HOURS ON THIS MONTH
B7F4_HRS.7410	242 hours	# HOURS ON THIS MONTH
B7F4_HRS.7411	244 hours	# HOURS ON THIS MONTH
B7F4_HRS.7412	253 hours	# HOURS ON THIS MONTH
B7F4_HRS.7413	242 hours	# HOURS ON THIS MONTH
B7F4_HRS.7414	279 hours	# HOURS ON THIS MONTH
B7F4_HRS.7415	246 hours	# HOURS ON THIS MONTH
B7F4_HRS.7416	255 hours	# HOURS ON THIS MONTH
B7F4_HRS.7417	244 hours	# HOURS ON THIS MONTH

Graphical Displays/Mashups/KPIs



Item	Value	Description
B7F4_HRS.MAX_HOUR	672 hours	DAY OF MONTH X 24 HRS
B7F4_HRS.7402	242 hours	# HOURS ON THIS MONTH
B7F4_HRS.7403	242 hours	# HOURS ON THIS MONTH
B7F4_HRS.7404	242 hours	# HOURS ON THIS MONTH
B7F4_HRS.7405	232 hours	# HOURS ON THIS MONTH
B7F4_HRS.7407	265 hours	# HOURS ON THIS MONTH
B7F4_HRS.7409	226 hours	# HOURS ON THIS MONTH
B7F4_HRS.7410	242 hours	# HOURS ON THIS MONTH
B7F4_HRS.7411	244 hours	# HOURS ON THIS MONTH
B7F4_HRS.7412	253 hours	# HOURS ON THIS MONTH
B7F4_HRS.7413	242 hours	# HOURS ON THIS MONTH
B7F4_HRS.7414	279 hours	# HOURS ON THIS MONTH
B7F4_HRS.7415	246 hours	# HOURS ON THIS MONTH
B7F4_HRS.7416	255 hours	# HOURS ON THIS MONTH
B7F4_HRS.7417	244 hours	# HOURS ON THIS MONTH

Enterprise Integration, Information Dashboards



Benefit/ Value

Reduced CAPEX and OPEX

Operation
Maintenance
Compliance
Efficiency

Summary

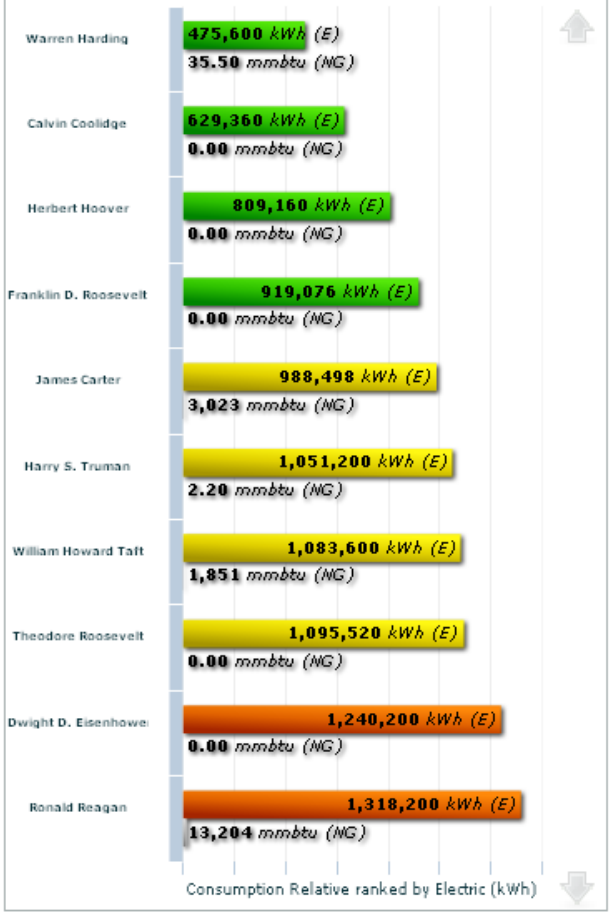
Site Rankings

Cost and Usage Summary | Cost and Usage Detail | BAS Events Summary | BAS Events Detail

Site Set: 1900s Presidents (17 Sites)

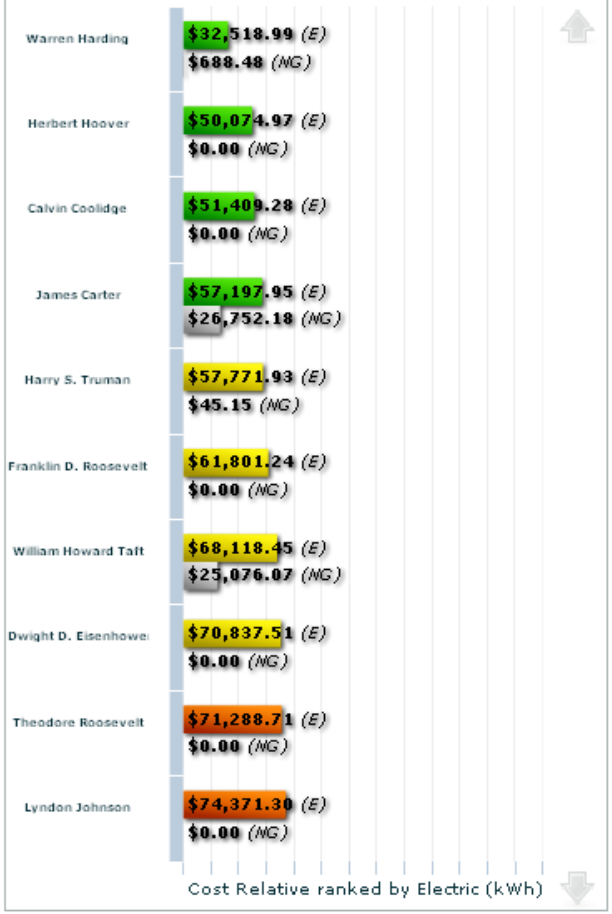
Site Consumption

Mar 2009 | Jan 2009 to Mar 2009 | Apr 2008 to Mar 2009



Site Economic Impact

Mar 2009 | Jan 2009 to Mar 2009 | Apr 2008 to Mar 2009



Site Environmental Impact (Estimated)

Mar 2009 | Jan 2009 to Mar 2009 | Apr 2008 to Mar 2009

Rank By: Electric (kWh) | Natural Gas (mmbtu) | Normalization: Relative (No Normalization) | per sf | per Person | per Degree Day Heating | per Degree Day Cooling

Energy Analyzer

Time Series/Event Analysis

Help

Administration

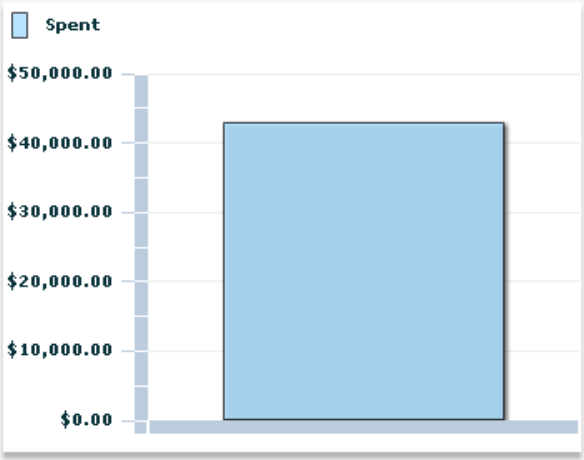
Done | Local intranet | 100%

Summary

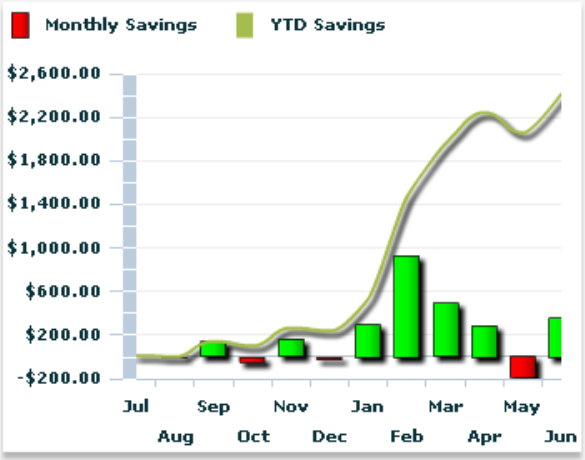
Cost and Usage Summary | Cost and Usage Detail | BAS Events Summary | BAS Events Detail

Site: Warren Harding

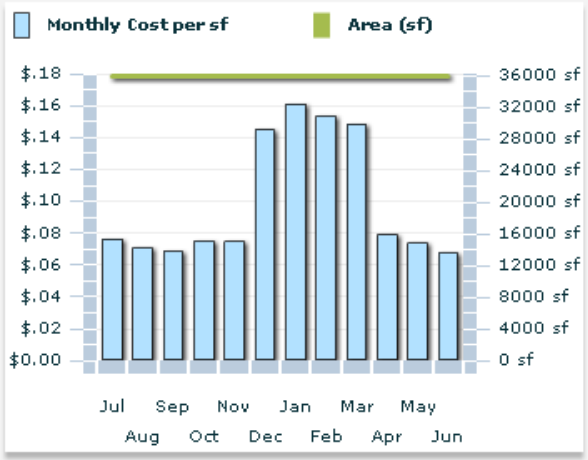
FYTD Expenses (Electric)



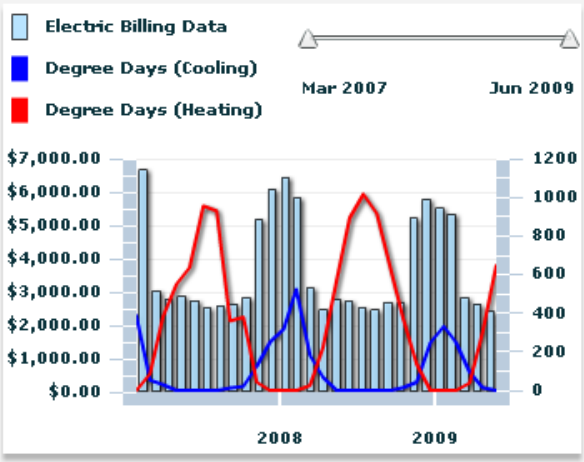
FYTD and Monthly Savings



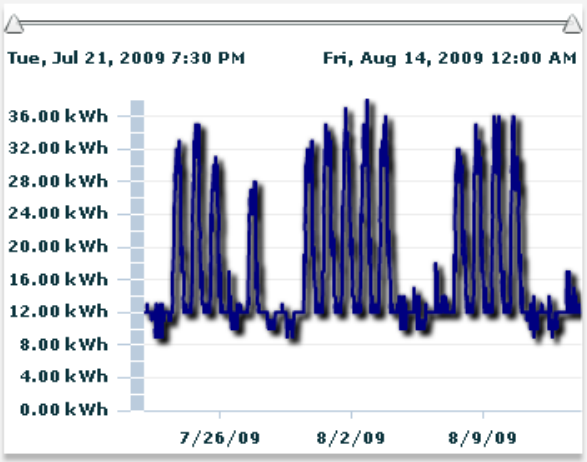
Dollars per sf Savings



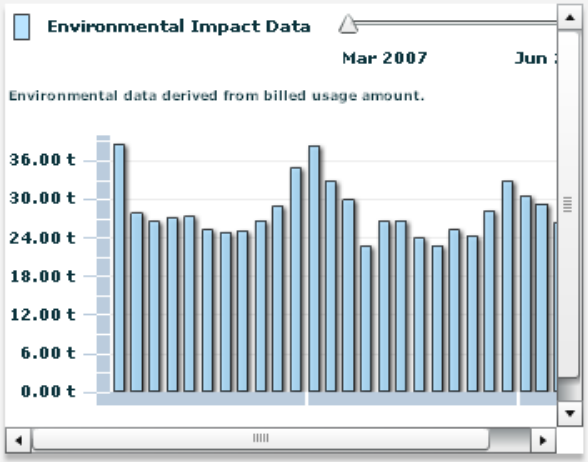
Site Billing Data



Site Metering Data for Electric



Environmental Data for Elec



Energy Analyzer

Time Series/Event Analysis

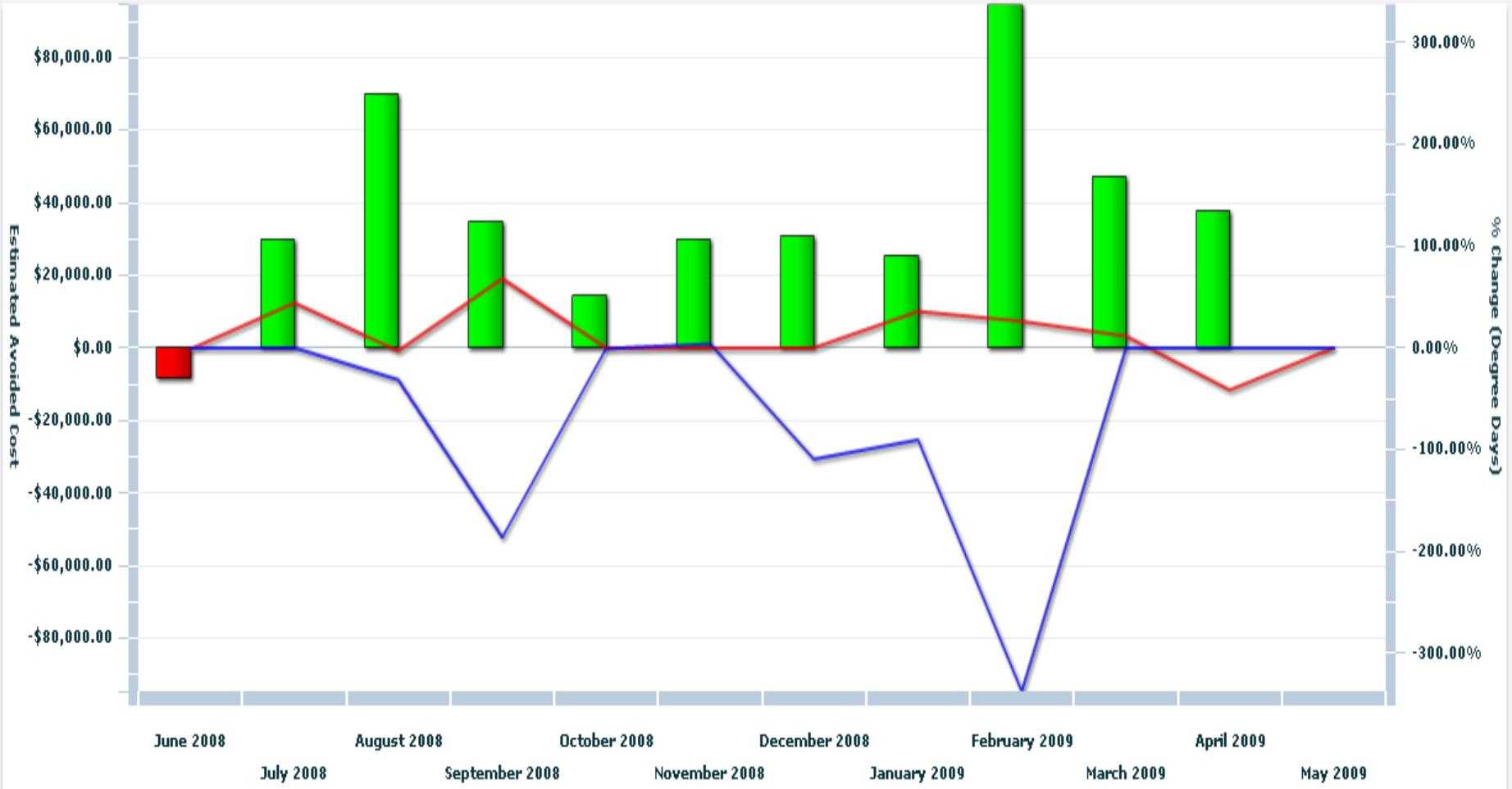
Help

Administration

Done
Internet
100%

Data Controls

Enterprise Usage - All (44 Sites) Showing actual usage, calculated baseline



Baseline Chart | Deviation Chart | Cost Avoidance Chart | Data Grid

Total cost avoided: $406,673.31. Positive numbers represent an avoidance, negative numbers extra expense.

Tree Navigator

Details

Stats | Event Details | Event Detection | Date Range | Messages

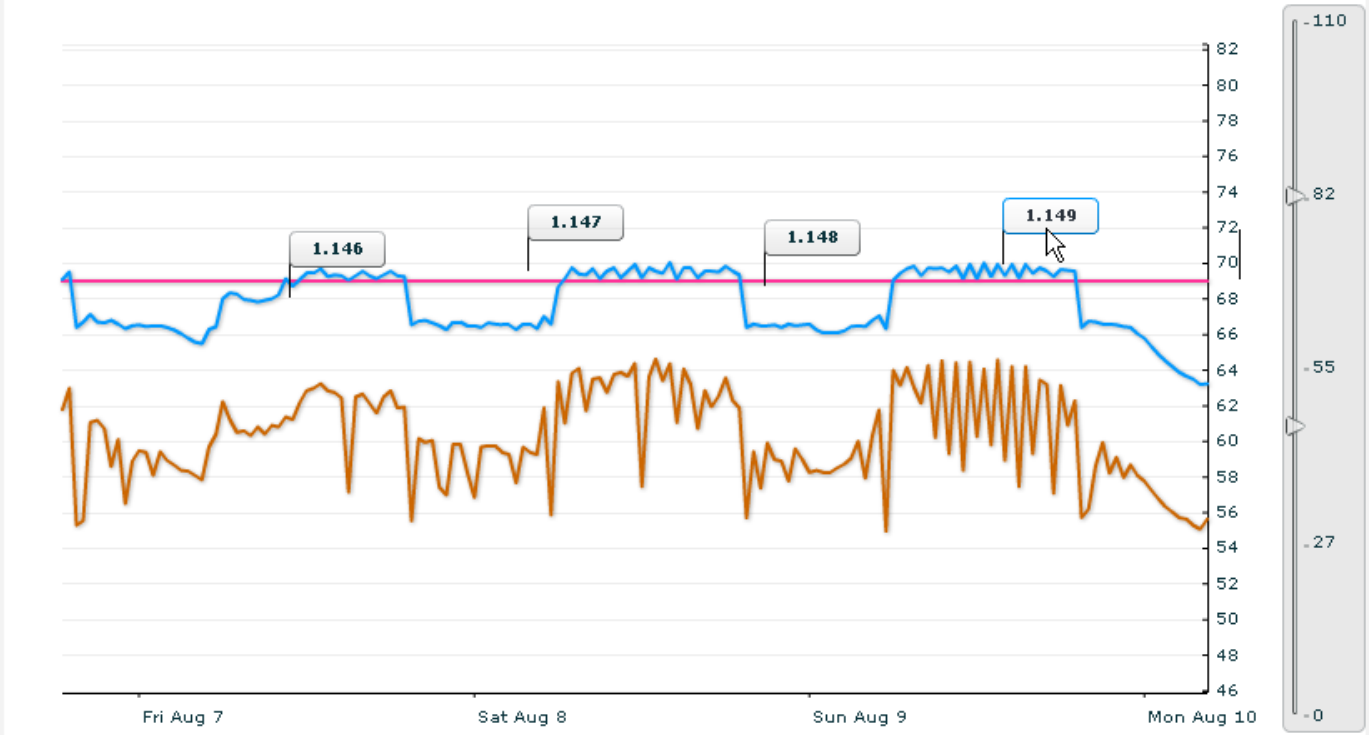
- ( ) Current Week
- (•) Current Month
- ( ) Current 3 Months
- ( ) Custom Range
- [ ] Show Forecasted Data

Custom Range to Retrieve

From 07/22/2009

To 08/21/2009

Zoom 1d 5d 1m 3m Max + - Data Axis Scaling Restore Default Scale to Data



<

>

Click the graph icon to see the graph, the table icon to see tabluar data, or the [a] button to export to CSV.

Related Events

HVAC_Events

1.137: Sun Aug 2 2009 10:00:00 PM
George Washington RTU-4
EnNET - Warning
The Space Temperature was below the Unoccupied Heating Setpoint plus the default allowed deviation. The default allowed

1.145: Thu Aug 6 2009 10:30:00 AM
George Washington RTU-4
EnNET - Warning
The Space Temperature was above the Unoccupied Cooling Setpoint plus the default allowed deviation. The default allowed

1.146: Fri Aug 7 2009 06:00:00 AM
George Washington RTU-4
EnNET - Warning
The Space Temperature was above the Unoccupied Cooling Setpoint plus the default allowed deviation. The default allowed

1.147: Fri Aug 7 2009 06:00:00 PM
George Washington RTU-4
EnNET - Warning
The Space Temperature was above the Unoccupied Cooling Setpoint plus the default allowed deviation. The default allowed

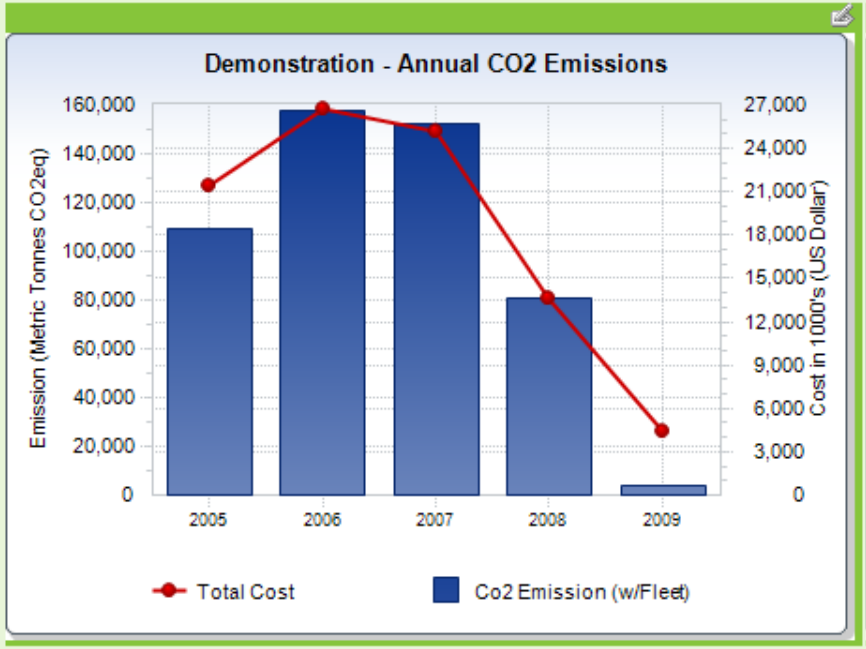
1.148: Sat Aug 8 2009 06:00:00 AM
George Washington RTU-4
EnNET - Warning
The Space Temperature was above the Unoccupied Cooling Setpoint plus the default allowed deviation. The default allowed

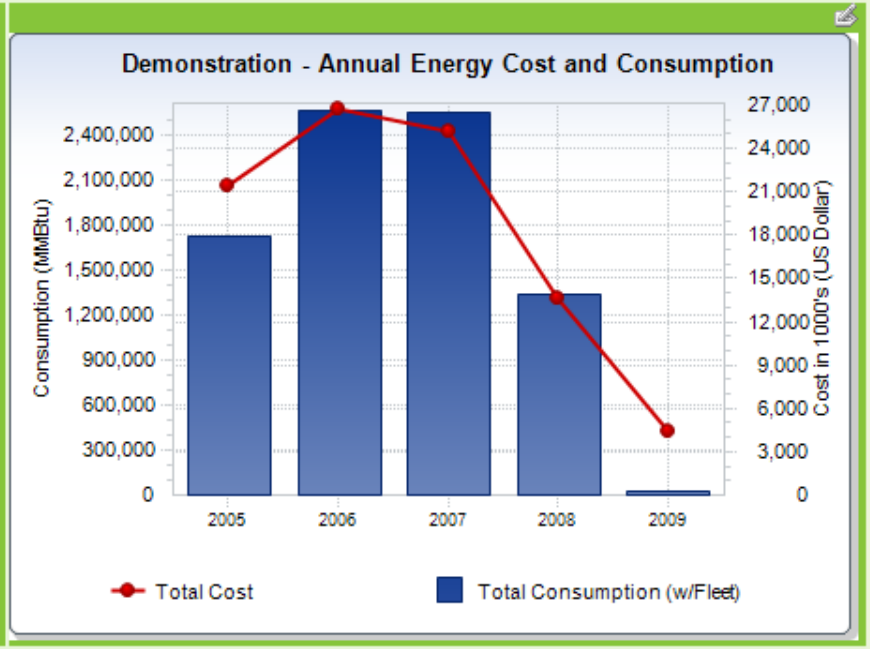
1.149: Sat Aug 8 2009 06:00:00 PM
George Washington RTU-4
EnNET - Warning
The Space Temperature was above the Unoccupied Cooling Setpoint plus the default allowed deviation. The default allowed

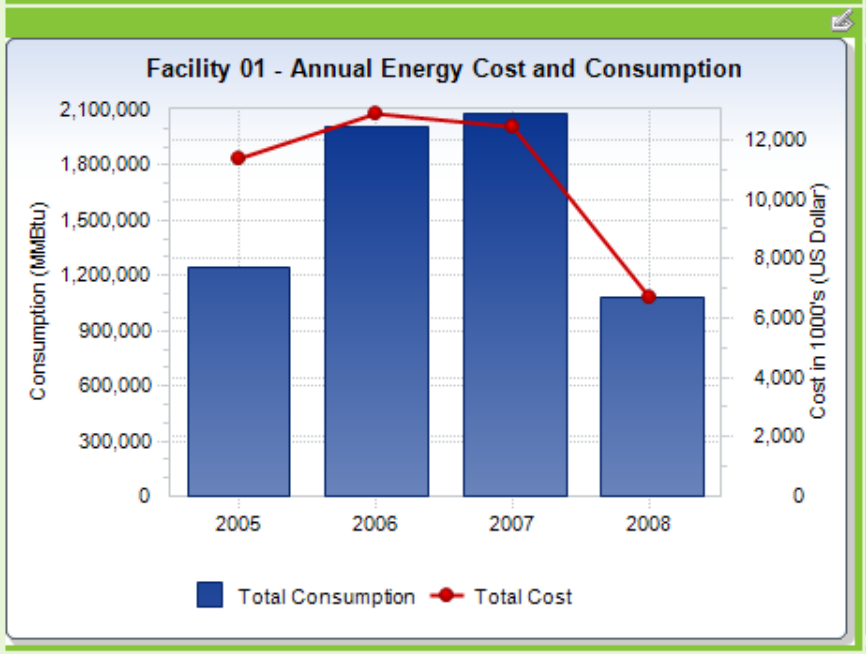
1.150: Sun Aug 9 2009 06:00:00 AM

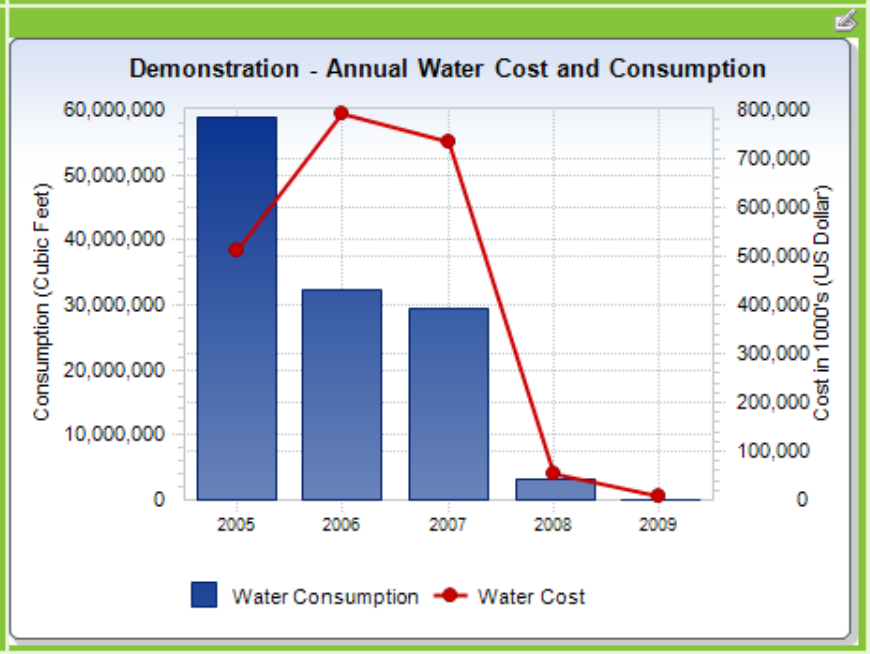
Refresh Events | Load More Events

Done
Internet
100%


Demonstration - Annual CO2 Emissions
Emission (Metric Tonnes CO2eq)
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Cost in 1000's (US Dollar)
27,000
24,000
21,000
18,000
15,000
12,000
9,000
6,000
3,000
0
2005
2006
2007
2008
2009
Total Cost
Co2 Emission (w/Fleet)


Demonstration - Annual Energy Cost and Consumption
Consumption (MMBtu)
2,400,000
2,100,000
1,800,000
1,500,000
1,200,000
900,000
600,000
300,000
0
Cost in 1000's (US Dollar)
27,000
24,000
21,000
18,000
15,000
12,000
9,000
6,000
3,000
0
2005
2006
2007
2008
2009
Total Cost
Total Consumption (w/Fleet)


Facility 01 - Annual Energy Cost and Consumption
Consumption (MMBtu)
2,100,000
1,800,000
1,500,000
1,200,000
900,000
600,000
300,000
0
Cost in 1000's (US Dollar)
12,000
10,000
8,000
6,000
4,000
2,000
0
2005
2006
2007
2008
Total Consumption
Total Cost


Demonstration - Annual Water Cost and Consumption
Consumption (Cubic Feet)
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
Cost in 1000's (US Dollar)
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
2005
2006
2007
2008
2009
Water Consumption
Water Cost

Reports

- Project Summary Report
- Quarterly Savings Report
- Change Report

Toolbox

- ROI Calculator
- Unit of Measure Converter
- Currency Converter
- CO_2 Calculator

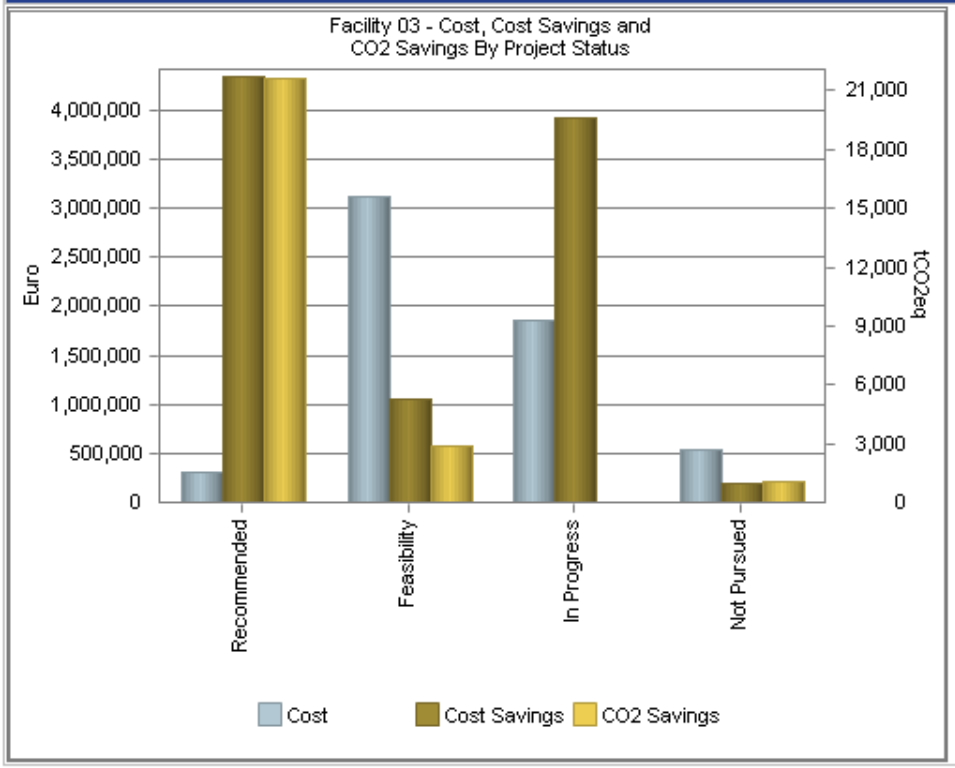
Admin

- Project Categories
- User Preferences
- Category Grouping

My Reports

Report Name	Run	Delete
1		

Facility Project Summaries — Facility 03



Completed Projects
All Others

Facility Project List

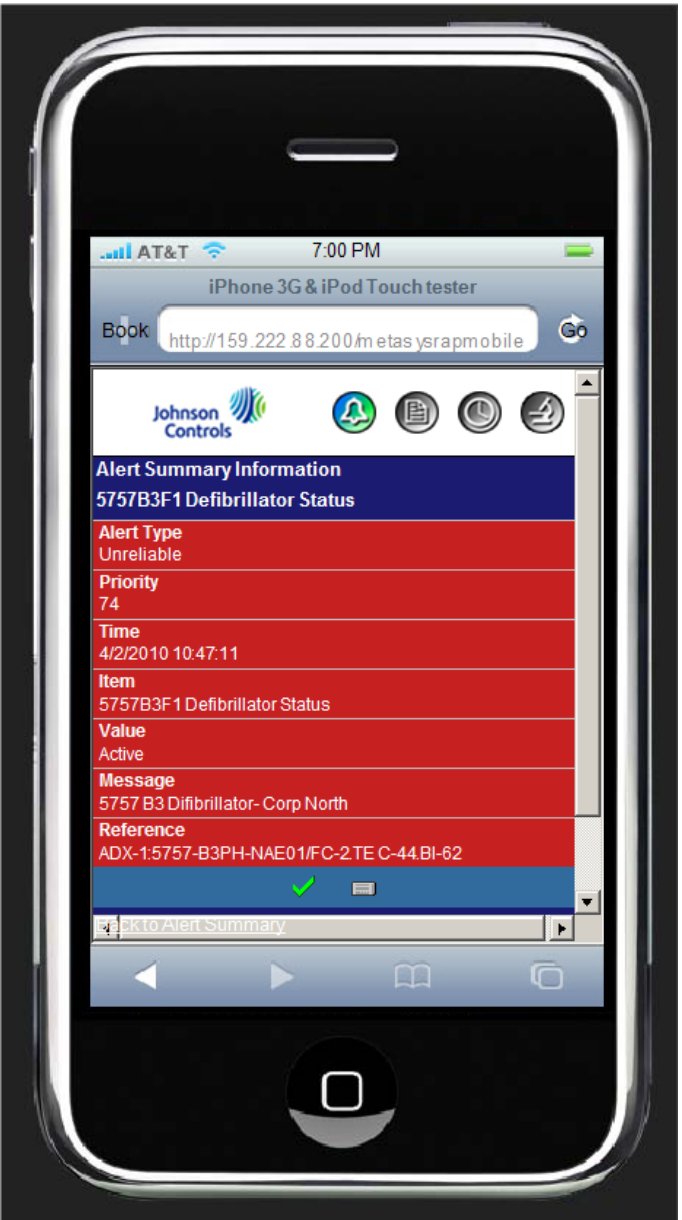
Add New Project

Export to Excel

Click on column headers to sort.

Project Number	Project Name	Status	Project Manager	Budgeted Year	Building	Documentation			
7716	902 Filter System Modifications	Recommended	S.Mitchell	N/A	Building A	View	View	Edit	Delete
7715	500 LTHW FCU and RHB pumps seasonal shutdown	Feasibility	Steve Mitchell	N/A	Building A	View	View	Edit	Delete
7714	Science Building Vac Pump Turn Off	Recommended	Steve Mitchell	N/A		View	View	Edit	Delete

Mobile Access/UI convergence



Mobility

Visibility: Summary & Direction

- “We are headed, inexorably, toward an image based culture dominated by the visual language…”

  Futurists, 1970

- We will not type, but rather touch, pinch, swoosh, tilt, shake and caress.

  (Wired Magazine 05/2010)

Vision

A more comfortable, safe and sustainable world.

Johnson Controls

Case Study: State of Missouri
Enterprise Solution

Dave Mosby, National Solutions Business Development Director

Johnson Controls

OVERVIEW

- Vision
- Solution
- Results
- Lessons Learned
- Questions

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Budget Boxes

Communications Infrastructure

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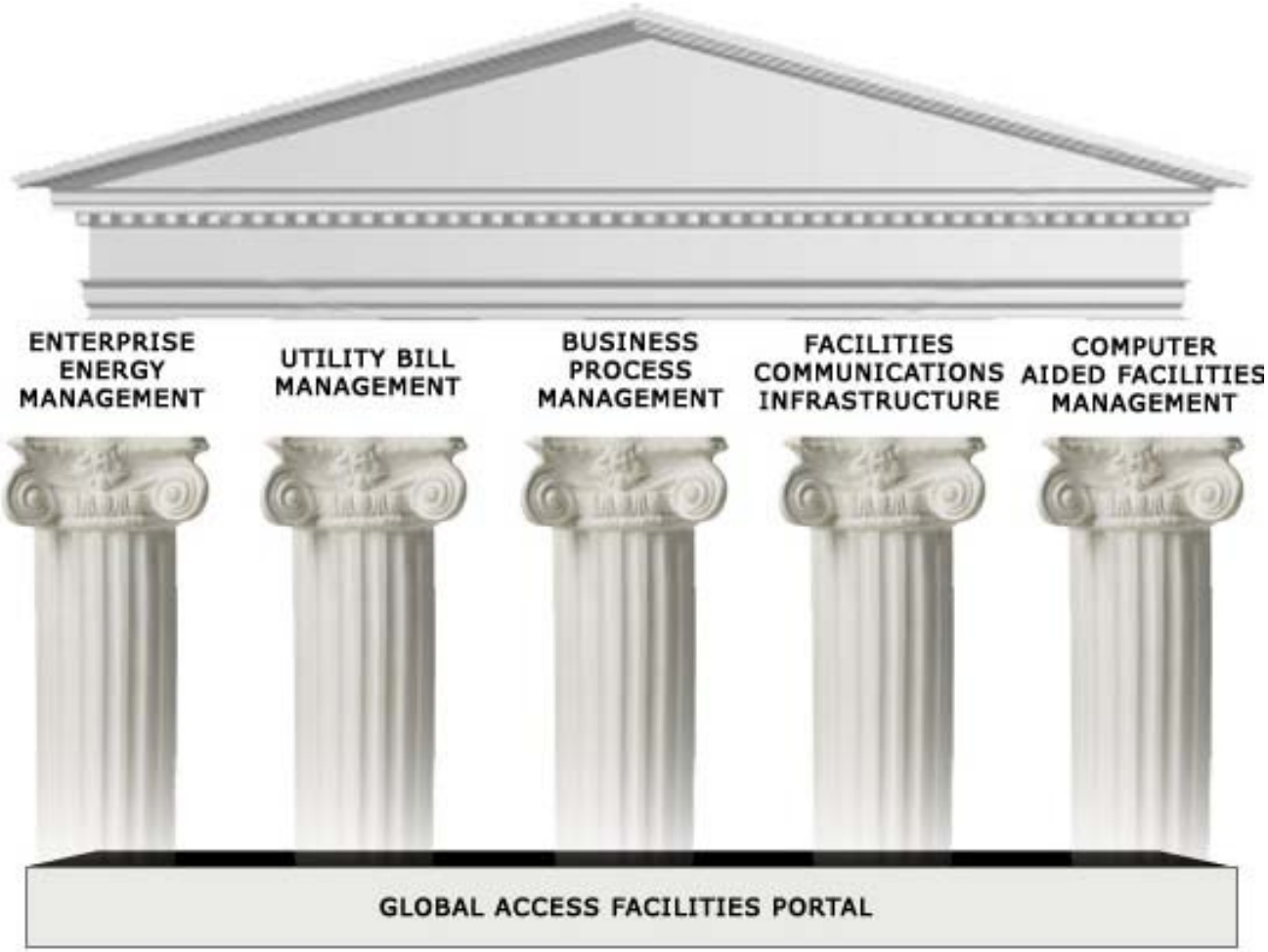
RADIO CALL
PULL

Enterprise Solution



Building Blocks of the Enterprise Solution

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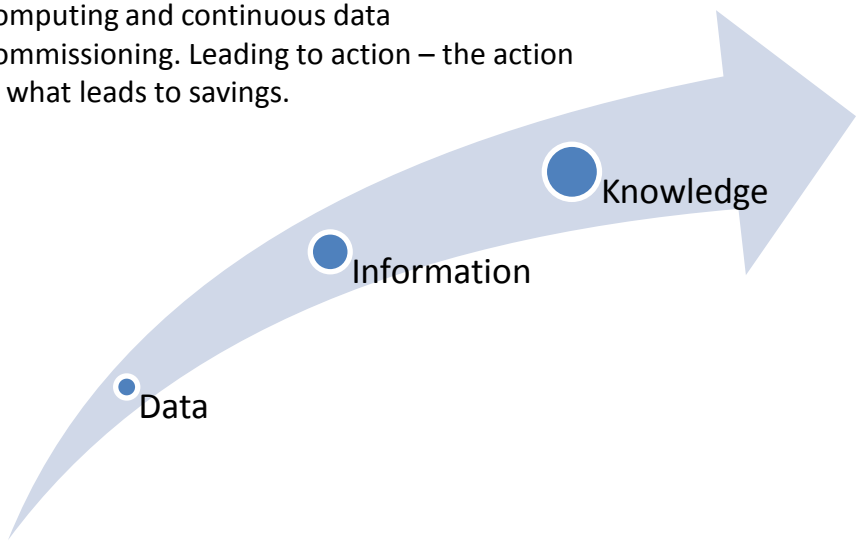
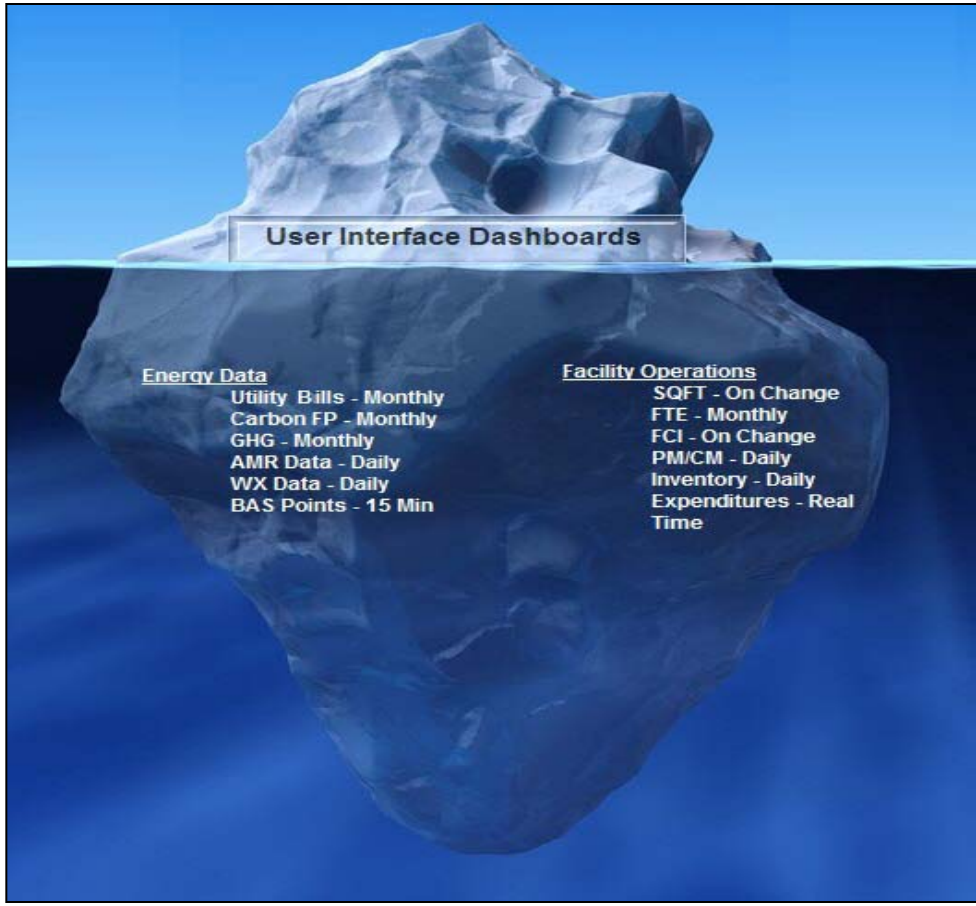
Enterprise Solution – Driving Value

Multiple Data sources are leveraged in a distributed data environment – This is the fuel to drive the data through into cloud computing and continuous data commissioning. Leading to action – the action is what leads to savings.





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At an Executive Level an Enterprise Solution provides:

Visibility - a window into real estate, energy, operating, capital programs

Transparency – data availability to all with the click of a mouse

Accountability – independent measurement & verification 'managed' by internal staff

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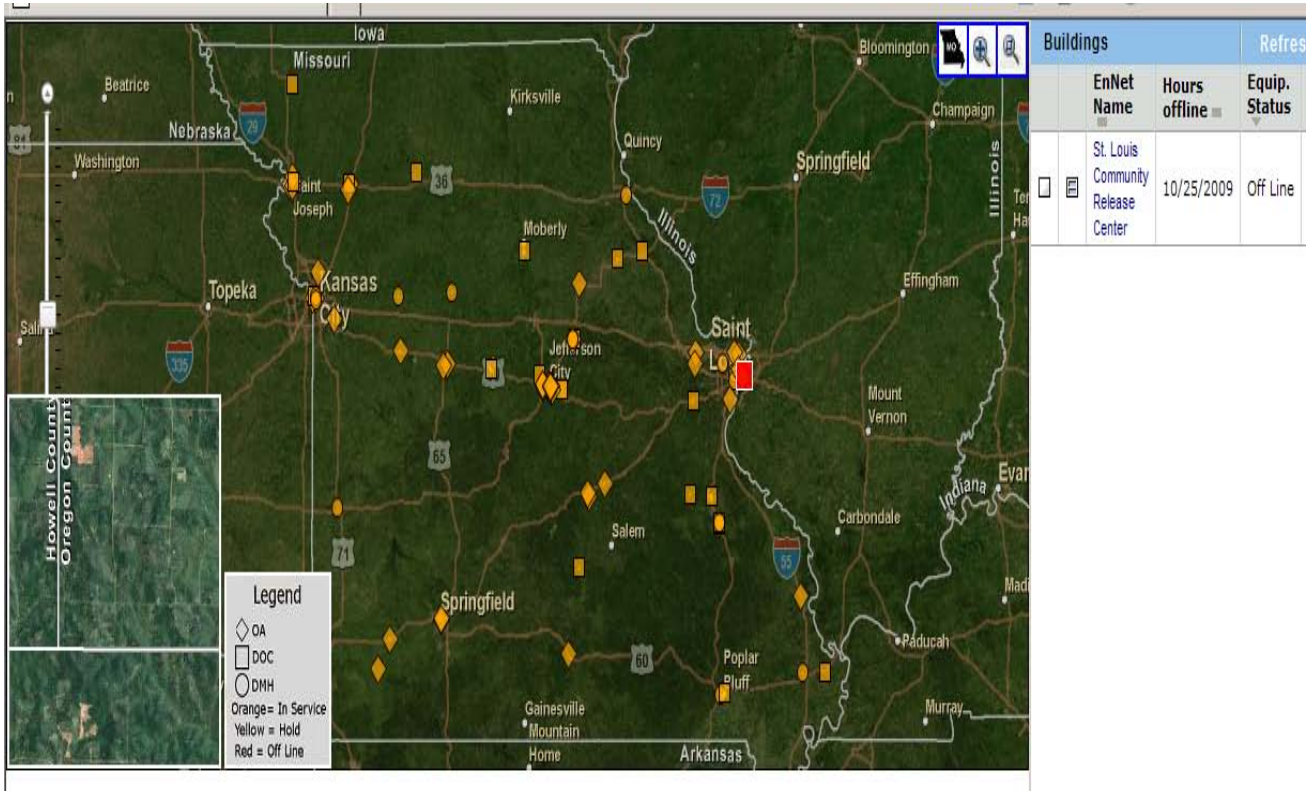
Enterprise System Monitoring

The State Network is monitored from Network 24 hours a day / 7 days a week with full visibility of platform status and any issues state-wide.

162 Sites, 1000 + buildings



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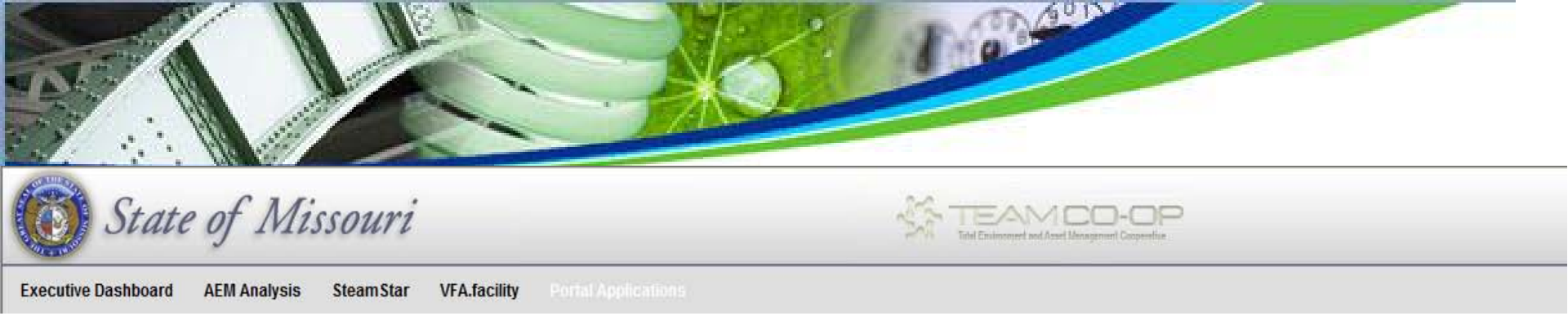
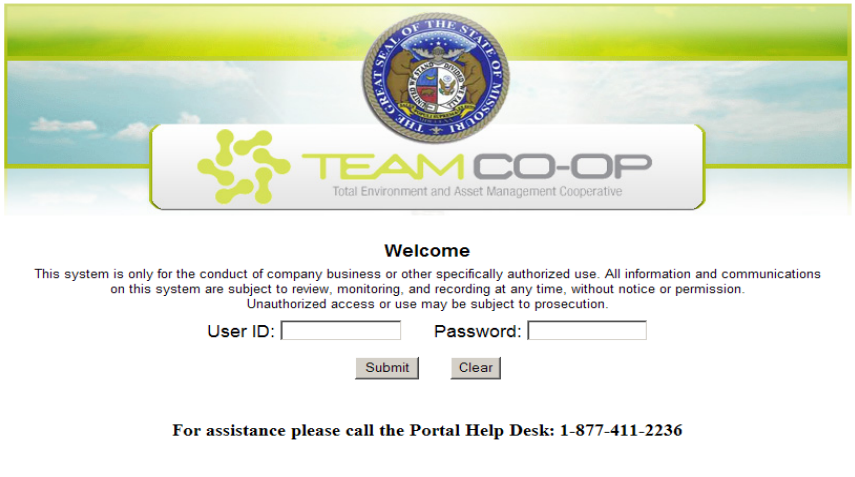
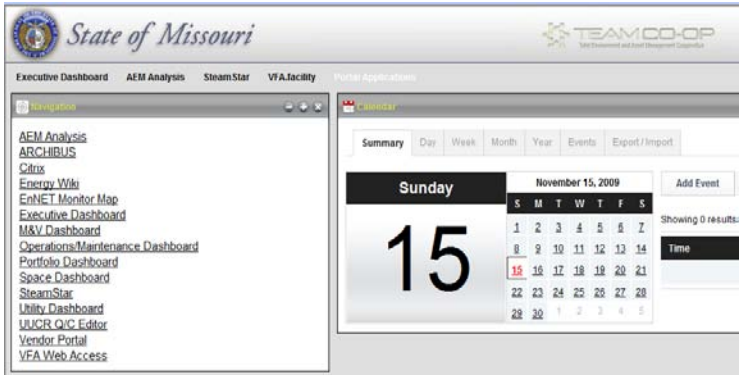


The Global Access Portal gives **controlled access and security** to a full system of applications for the total management of the State's portfolio of facilities.

Single Sign-On limits the confusion of multiple passwords.





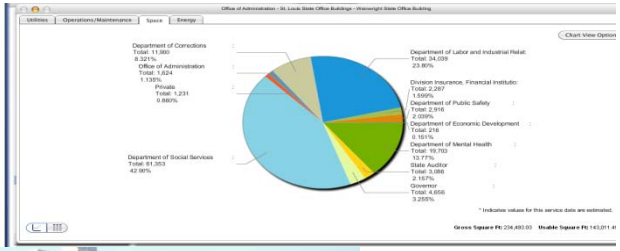
- Utility Bill Management
- Enterprise Energy Management
- Computer Aided Facilities Management
- Business Process Management
- Energy WIKI
- Vendor Portal
- Steam Star
- VFA

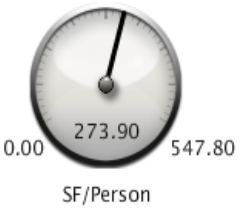
Johnson Controls

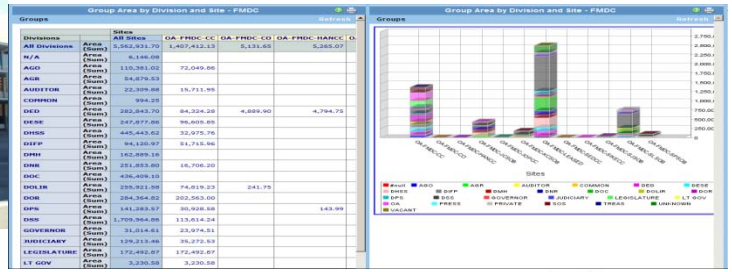
Real Estate

Leasing Expenditures: FY06 $55.3 M; FY09 $41.7

$20.9 Million Sold in Excess Real Estate





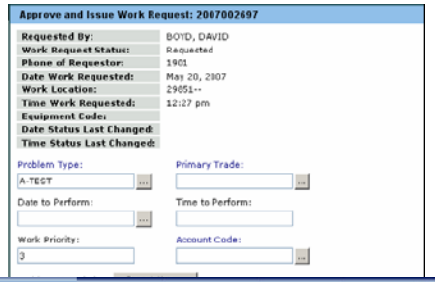


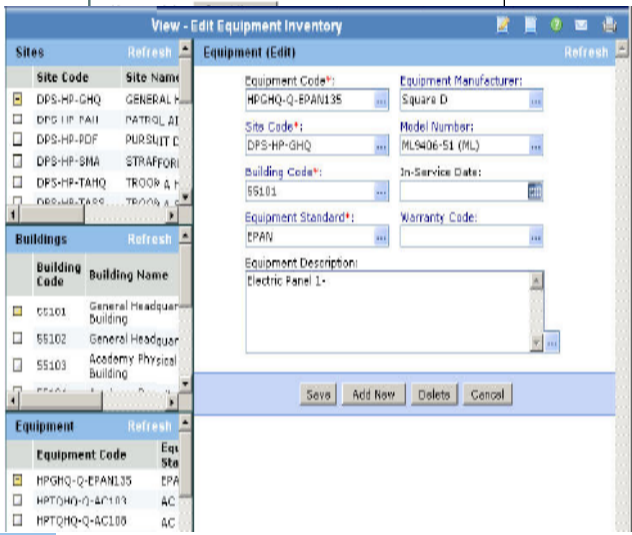
Johnson Controls

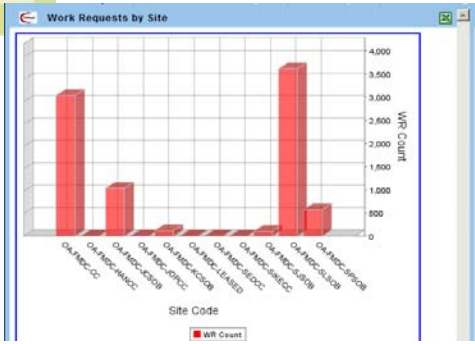
Operations

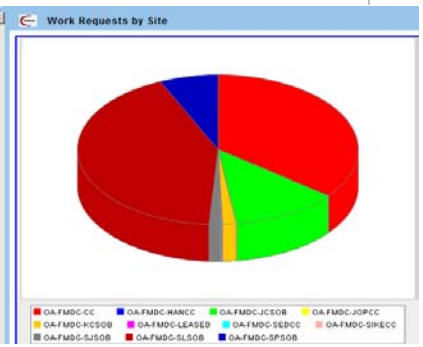
The State of Missouri created a state of the art facilities management unit. With Blackberry interfaces, touch style kiosks, & 'one touch' supplier (Grainger) integration the maintenance staff and supervisors have the tools necessary to effectively manage:

- Purchase Orders
- Work Orders
- Preventative Maintenance
- Inventory **($500K reduction**)
- Resource Loads









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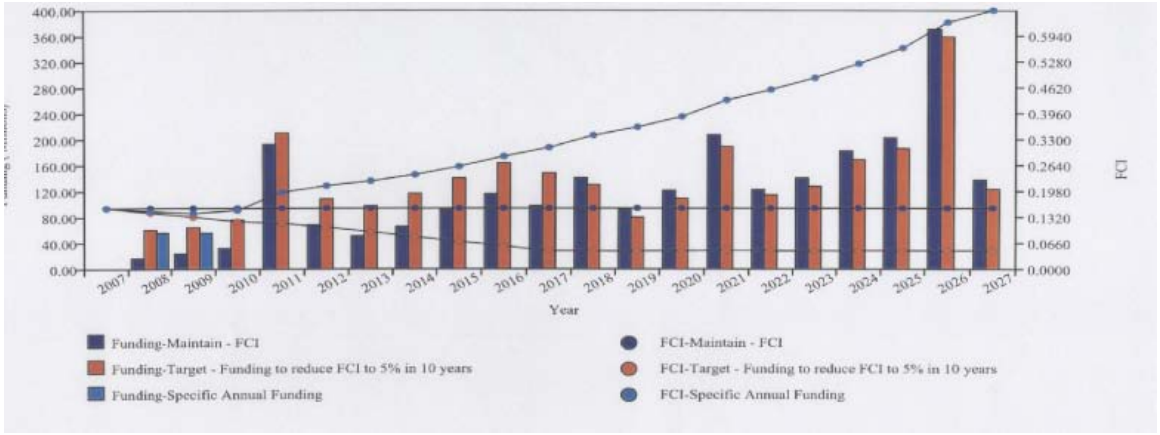
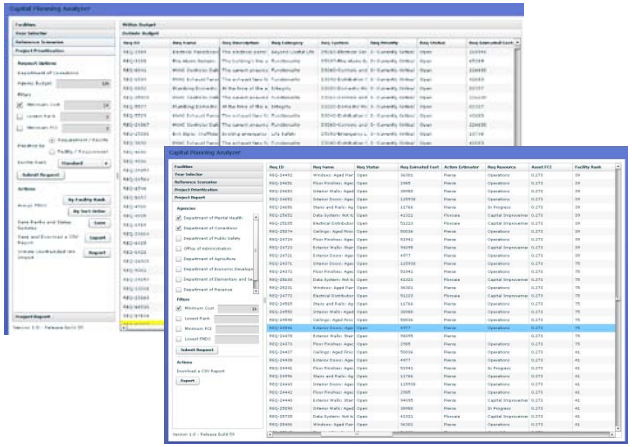
Capital

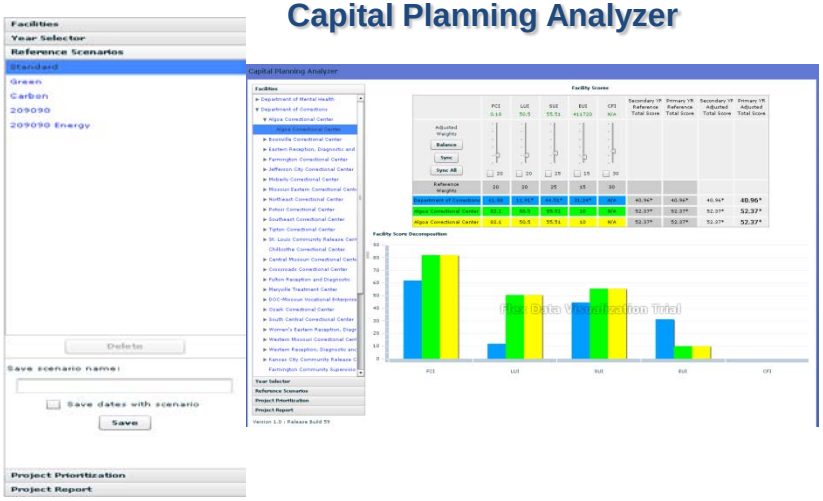
Funding/FCI Report



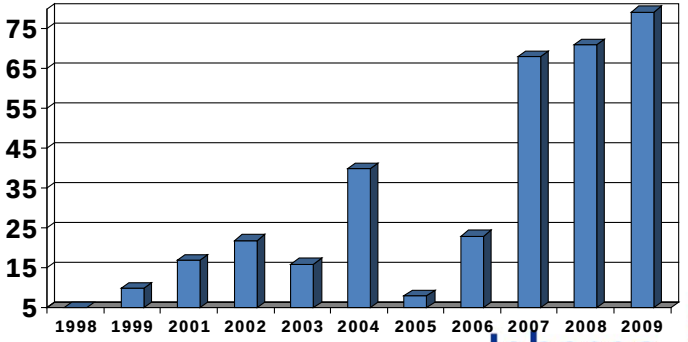
Project Prioritization



Capital Planning Analyzer



Facilities Maintenance & Repair Fund



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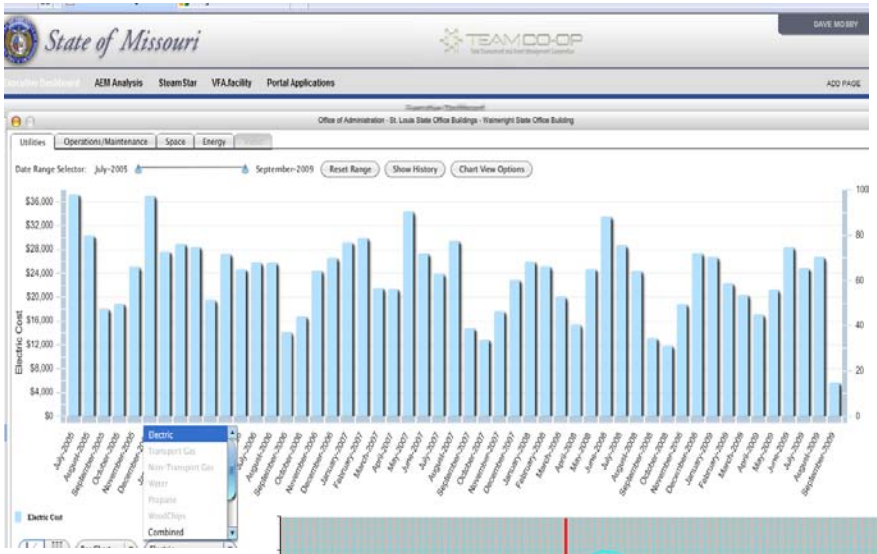
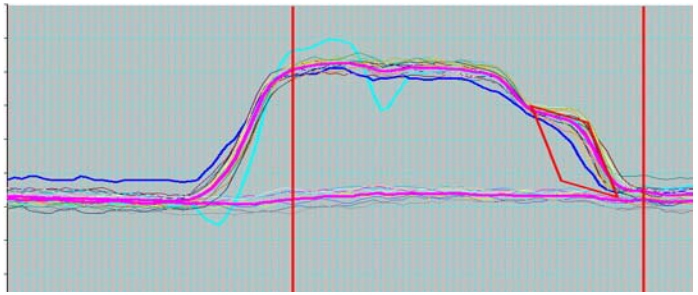
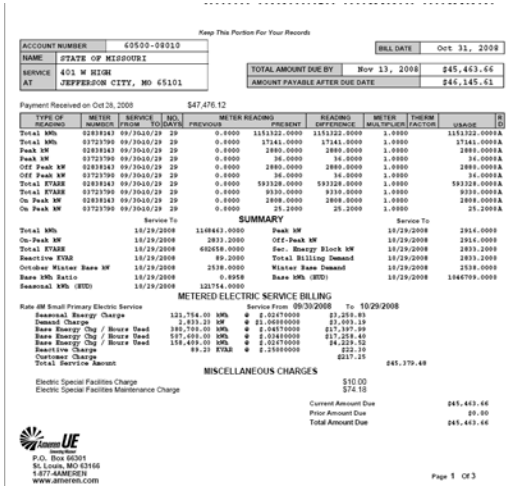
Energy Management – Accounting & Analysis







The energy management solution gives executives and building managers access to the necessary data, **at all levels of detail**, to properly manage and maintain their buildings in the most energy efficient manner possible.

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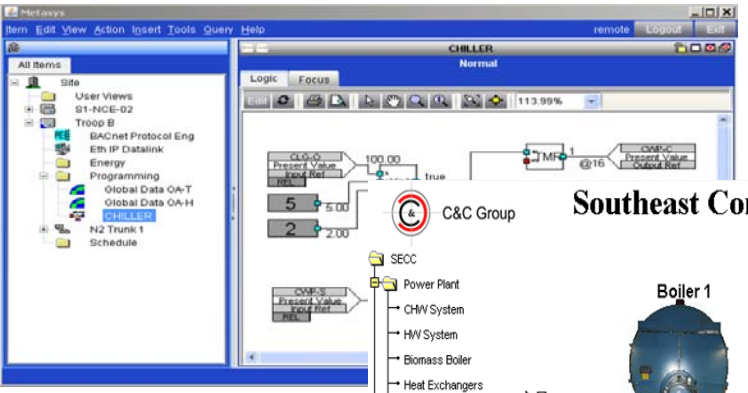
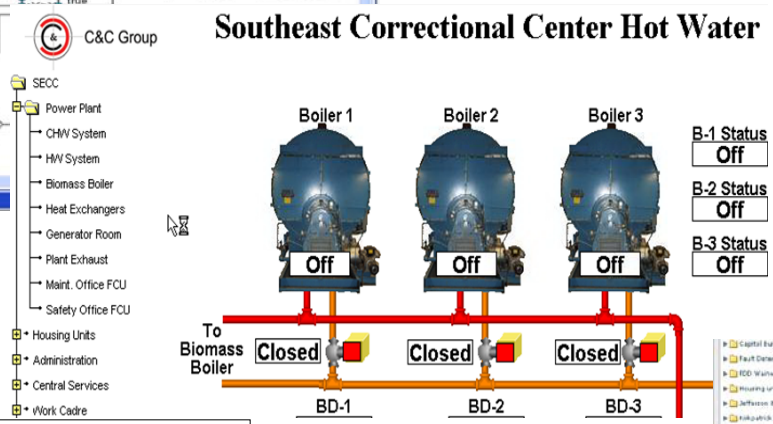
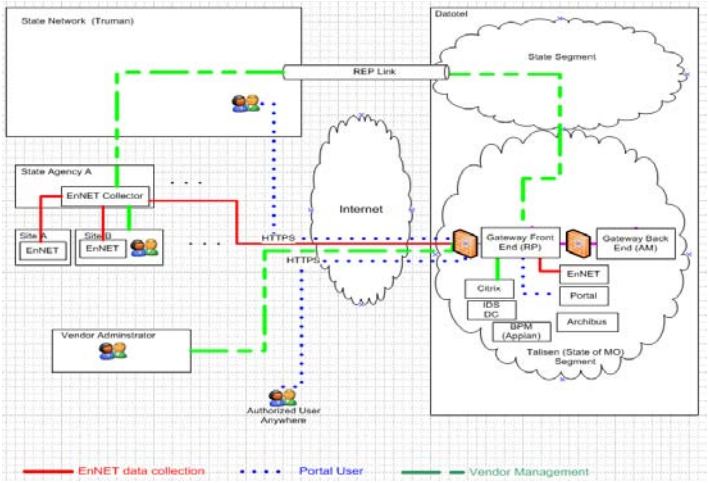
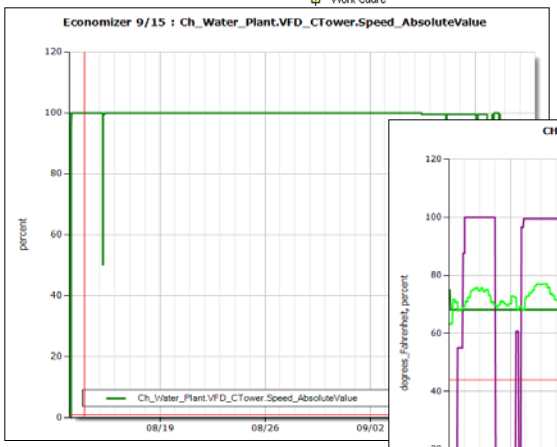
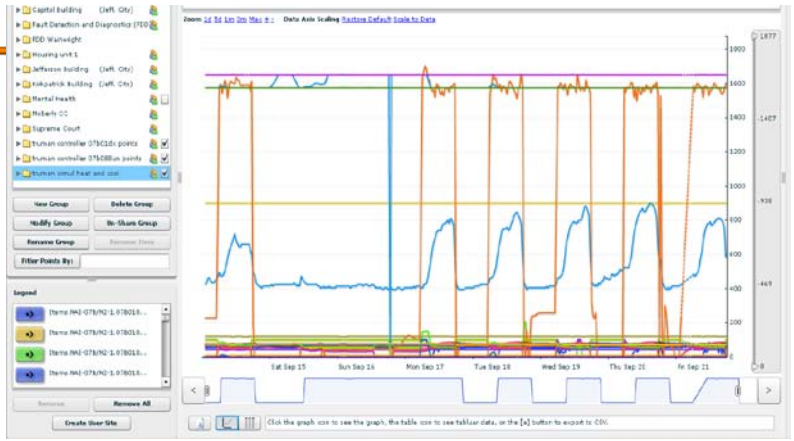
Energy Management – Equipment Operations











Johnson Controls

Inventory of Utility Accounts Finds Savings

- **Boonville Correctional Center**

Single Six Inch Water Meter

A water account was found to be billing $425 every month even though no water was being used for last 13 years!!

= $425 * 12 = $5,100 in annual savings for this one account

= $5,100 * 13 = $66,300 spent over 13 years without this visibility

Account # 18960100 was closed immediately!!

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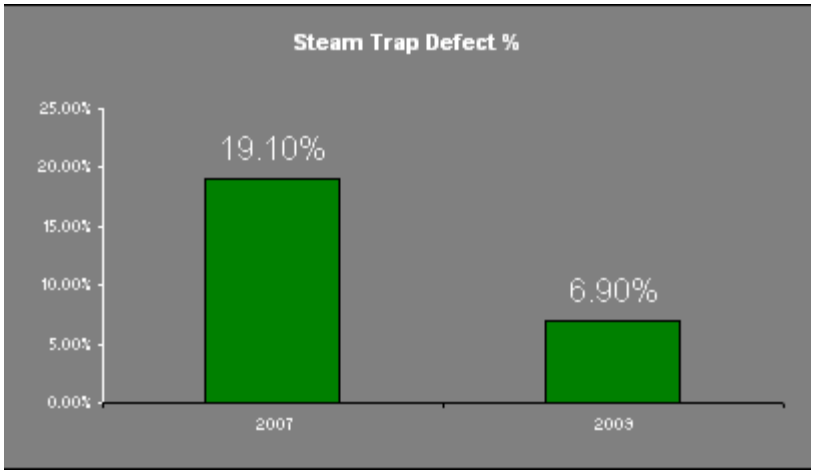
SteamStar Savings



"This was the most aggressive and productive trap testing project I have been involved in. The overall payback taking into account trap survey costs, replacement costs and energy losses (not including labor) was about a **26 day payback**." -- Dir. Of Institutional Markets Armstrong National, Inc.

2007 Steam Trap Statistics

- 3,302 Installed Steam Traps Tested
- 2,981 Steam Traps In Service
- 568 Found Defective

While the State of Missouri has saved ~ $1M annually by replacing the defective traps, there is ~ $800K left in potential annual savings in the remaining defective steam traps.

Johnson Controls

Lewis and Clark

- Occupied in FY05, 122,000 sqft, 400 Employees, Cost $17.5 M
- Green Design Elements – Daylighting, HE-HVAC, Recycling, Water Conservation, Native Materials
- Moving from Excellent to Outstanding Performance FY07 ESP Deployed

- FY06 12.1 KWhs/SF
- FY08 11.6 KWhs/SF
- CY10 10.9 KWhs/SF
- **9.0 % Reduction**

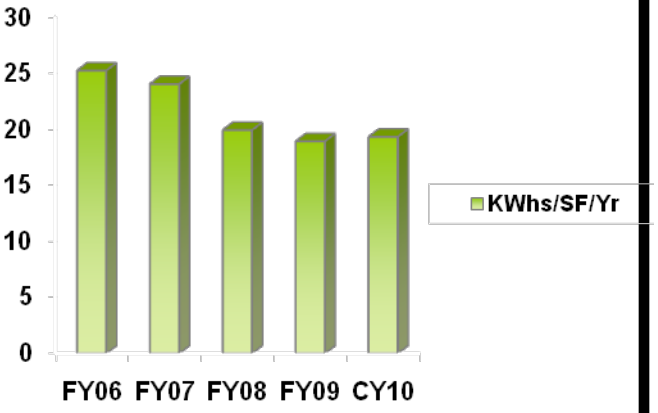
Harry S. Truman

- Sq. Ft. – 753,138
- 2800 FTE
- Built in 1983
PC 2005

- FY06 26.7 KWhs/SF
- FY08 21.7 KWhs/SF
- CY10 19.2 KWhs/SF
- **28.0 % Reduction**

Wainwright

Size:	234,599 sq. ft.
Building Population:	693
Year Built:	1891
Year Commissioned:	1981



- FY06 25.2 KWhs/SF
- FY08 24.0 KWhs/SF
- CY10 19.3 KWhs/SF
- **23.4 % Reduction**

Johnson Controls

“Gov. Nixon announces 5.6 percent reduction in state energy bill over past year - saving taxpayers more than $3 million.”

“In the first year of implementation of EO 09-18, Gov. Nixon's administration achieved the following reductions:

Electricity: **Decrease of 25 million kWh (kilowatt-hours), or 5.5 percent**. That's enough to power more than 2,500 Missouri households for an entire year, and it corresponds to 16,250 tons of carbon dioxide not being emitted into the atmosphere.

Gas (propane and natural gas): **Decrease of 180,000 MMBtu (1 million Btu), or 9.1 percent**. That's enough to run more than 7,000 residential water heaters in Missouri for an entire year, and it corresponds to almost 11,000 tons of carbon dioxide not being emitted into the atmosphere.”

Governors Office Press release, April 26, 2010.

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Lesson Learned

- Vision, Vision, Vision
- Politics, Power and People
- Leverage the law
- Make Money
- Public, Private Partnerships

Johnson Controls

- Contact
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  - david.mosby@jci.com
  - 573-979-3052 (c)

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