GovEnergy
www.govenergy.gov

· August 15-18, 2010 · Dallas, Texas ·
· Dallas Convention Center ·

Human Behavior: Session 8, DATA, SMARTGRID AND FEEDBACK.

Human Behavior:
Data, Smart Grid and Feedback

Jim Lee, President & CEO Cimetrics Inc

infometrics™
building accountability

Cimetrics Office:
38 Chauncy Street, 5th Floor,
Boston MA 02111
Tel. (617) 350-7550, Fax (617) 350-7552
Internet: www.cimetrics.com

cimetrics™

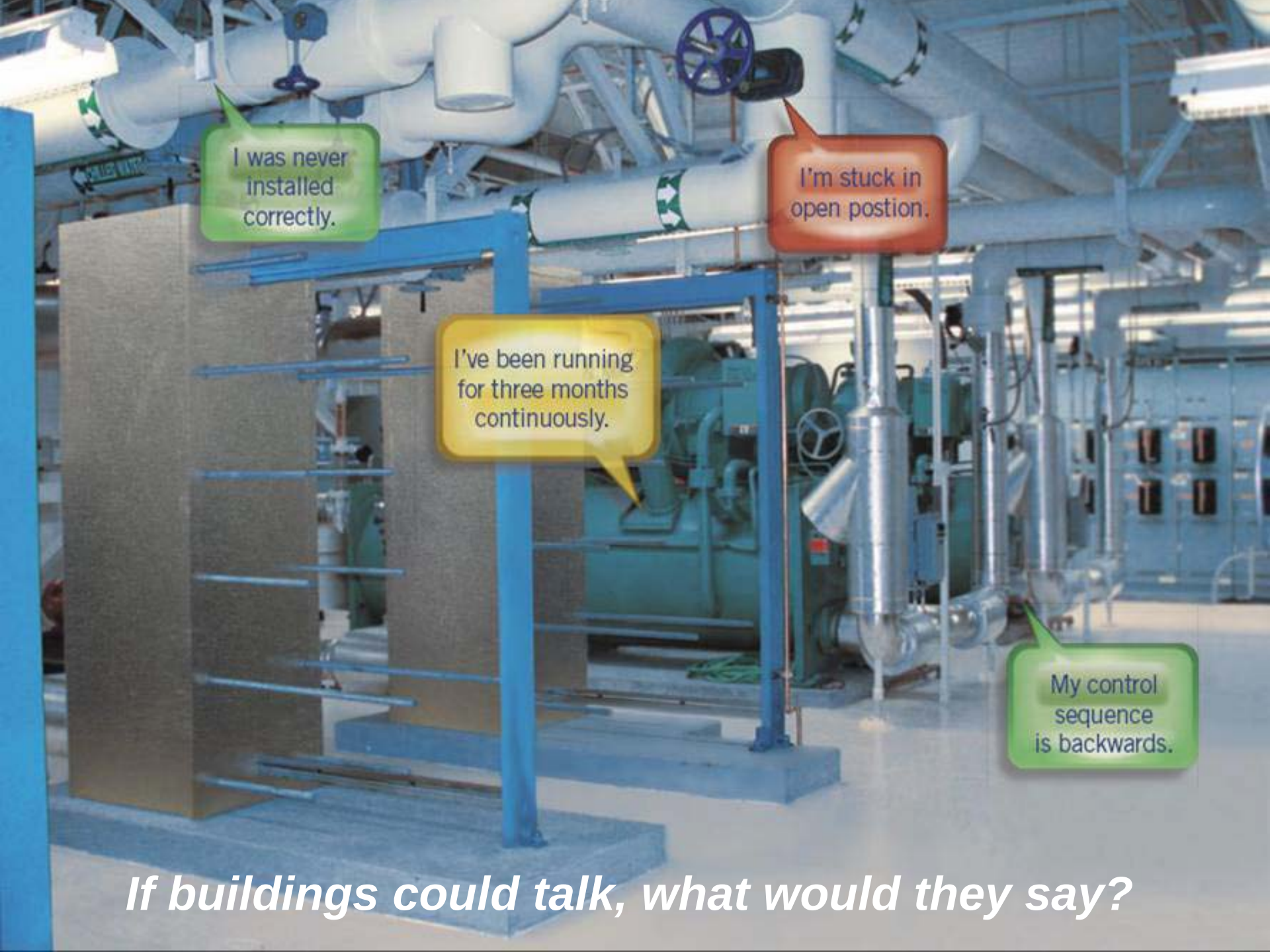
I've been running in manual operation for three years.
I'm undersized for my zone.
We're on all day long.
It's 50 degrees out here, but the system doesn't know that.
I haven't run for five weeks.

Most energy waste in buildings is due to human behavior

- Maintenance departments are frequently understaffed
- Operating personnel lack the training and/or skills to operate today's complex systems
- No one looks at the data
- 80% of buildings are never commissioned
- Building operations are frequently outsourced
- Buildings are “value engineered” for low first cost, not ongoing operating cost
- Facility managers are often measured on comfort, not energy or operating costs

GovEnergy
www.govenergy.gov

GovEnergy 2010



If buildings could talk, what would they say?

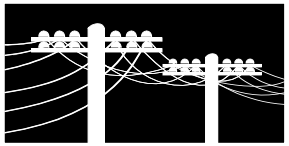
Ongoing Commissioning

Connectivity **Analysis** **Reporting** **Savings**

infometrics™
building accountability

Value Proposition

Energy
10-20%



Maintenance
5-10%

Labor Resources
5-20%

Comfort
3-15%

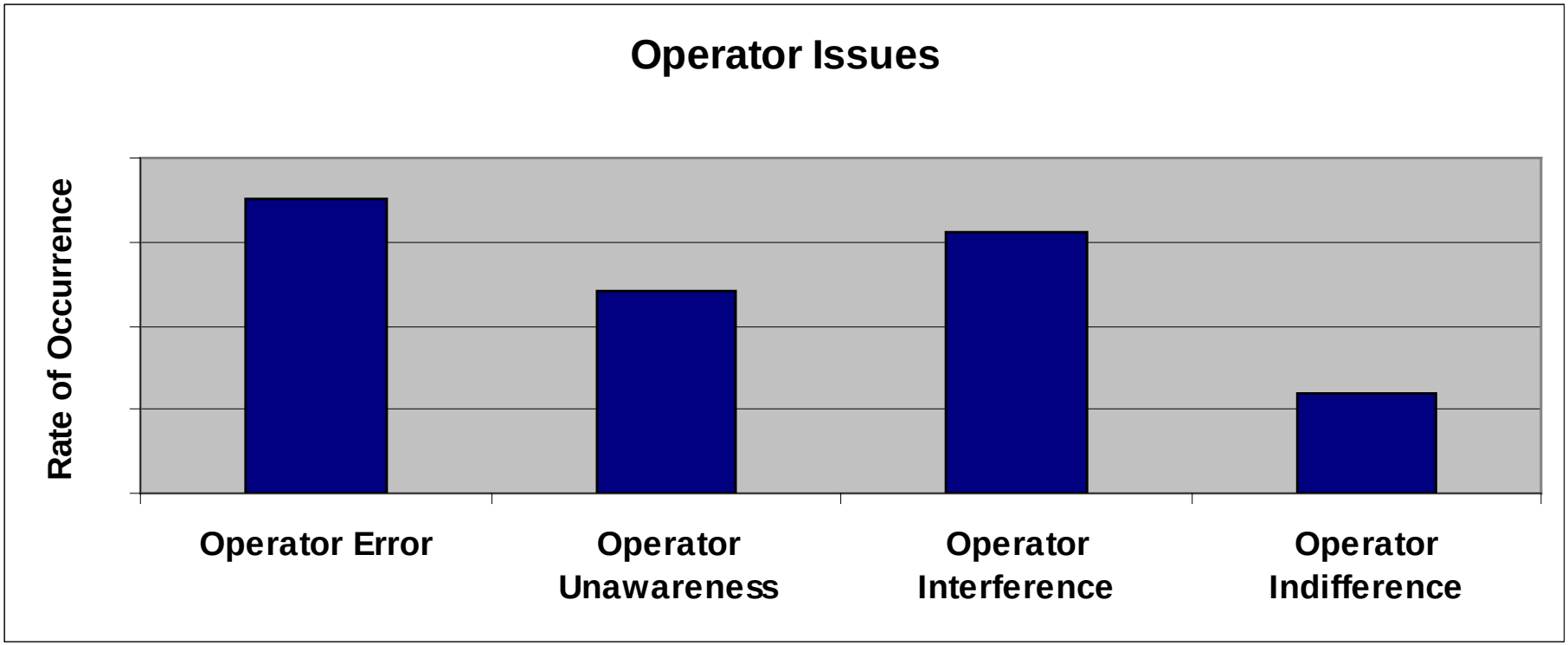
Commissioning

GHG Emissions

Regulatory

Industry Facts - Operations

An Iowa energy center study showed that 33% of problems found in building operation can be attributed to operators capabilities and training.



infometrics™ building accountability

Enterprise Management

1- Issue Tracking and Resolution – Track the status of issues/recommendations and their impact on operation

Issue Name	Issue #	Date Opened	Date Closed	Cimetrics Comments
Central chilled water plant is not optimized. Low Δ T in primary loop with multiple chillers running.	ABC-WC-001	8/2004	8/11/2004	As of August 11, only a single chiller was operating.
Several points are questionable or appear to be duplicates.	ABC-WC-003	8/2004		Investigate removing or replacing points not used.
Some of the air handling units are over-ventilating based on building plan design values.	ABC-WC-004	8/2004		This issue will be re-addressed when outdoor air conditions dictate.

2 - Impact Assessment and Prioritization – Tailored to business needs and goals.

Issue #	Safety	Code	Comfort	O&M	Savings
ABC-WC-001				■	■
ABC-WC-003				■	■
ABC-WC-004			■	■	■

3-Decision Support

Outline proposed solutions and proposed cost savings, giving clients all necessary financial decision support information.

Issue Name	Issue #	Report Month/ Year	Calculated Annual Savings	FY08 Savings
Central chilled water plant is not optimized. Low Δ T in primary loop with multiple chillers running.	ABC-WC-001	8/2009	$27,122	$27,122
Excess hours of operation for AHUs.	ABC-WC-007	8/2009	$7,614	$7,614
Exhaust Fans are commanded "ON" during excessive hours.	ABC-WC-018	9/2009	$1,313	$1,313
Economizer cycle not optimized in WC AHUs.	ABC-WC-019	10/2009	$2,105	90% $1,895

infometrics™ building accountability

Carbon Dioxide Emissions Reductions Reporting

Issue Name	Issue #	Report Month/Year	Estimated Annual CO_2 Savings (Metric Tons)	Implemented CO_2 Savings (Metric Tons)
AHU-02 heating coil valve appears to be leaking.	HUB-CRB-011	11/2006	65.4	65.4
AHU-01 heat recovery increasing DAT when not needed.	HUB-CRB-012	11/2006	48.2	48.2
AHU-03 heat recovery increasing DAT when not needed.	HUB-CRB-013	11/2006	46.1	46.1
AHU-02 heat recovery increasing DAT when not needed.	HUB-CRB-014	11/2006	31.7	31.7
Heat recovery appears in bypass mode below 38F OAT.	HUB-CRB-017	1/2007	1,624.0	50% 812.0

Sample Customer CO_2 Emissions Reductions in the past year:

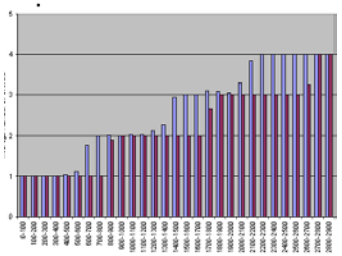
Customer 1	**3,288.2 metric tons**
Customer 2	**946.2 metric tons**
Customer 3	**3,605.9 metric tons**

Infometrics Reports- 5 Key Components (continued)

4-Detailed situation analysis with informative descriptions-

Includes zone, AHU and plant level performance analysis combined with industry benchmarks, regulations and customer-specific needs

To the right is an illustration of the AVERAGE number of chillers online and the OPTIMUM number of chillers online for different plant (cooling) loads during July. It appears that extra chillers are running when the chilled water plant sees between 600 and 800 tons (running 2 chillers when only 1 is necessary), between 1,400 and 1,800 tons (running 3 chillers when only 2 are necessary) and when the chilled water plant sees between 2,000 tons and 2,700 tons (running 4 chillers when only 3 are necessary).

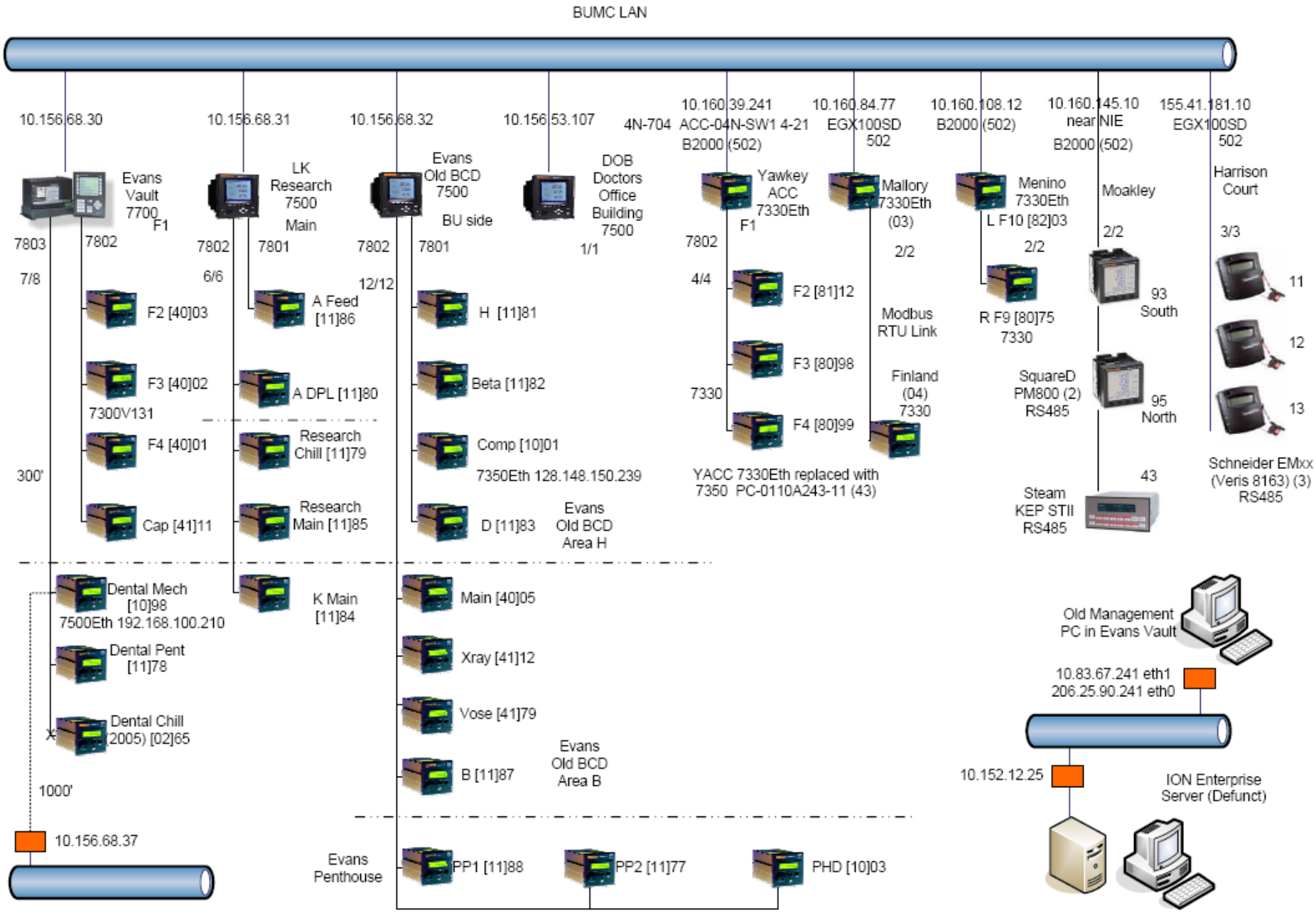


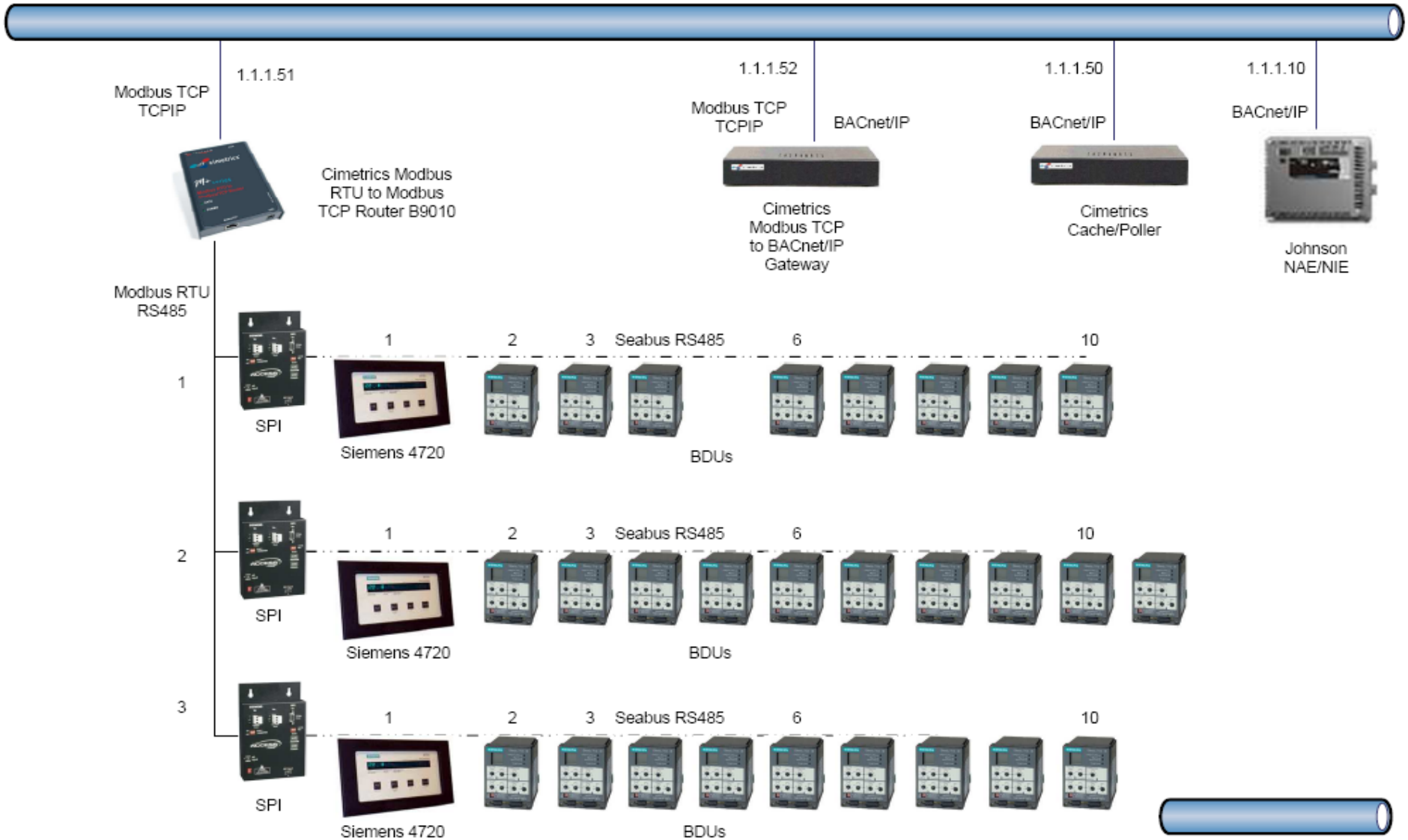
5-Actionable Improvement recommendations-Recommended control strategies, optimization and additional hardware needs are identified

It is recommended that a **common chilled water supply temperature sensor be installed** so that total chilled water plant load can be more accurately determined. **The optimum number of chillers** is based on the central plant switch over values shown:

0-850 tons	Use (1) chiller
850-1,750 tons	Use (2) chillers
1,750-2,650 tons	Use (3) chillers
2,650-3,550 tons	Use (4) chillers
3,550 tons & up	Use (5) chillers

infometrics™ building accountability


BUMC LAN
10.156.68.30
Evans Vault 7700
F1
7803
7802
7/8
F2 [40]03
F3 [40]02
7300V131
F4 [40]01
300'
Cap [41]11
Dental Mech [10]98
7500Eth 192.168.100.210
Dental Pent [11]78
Dental Chill (2005) [02]65
1000'
10.156.68.37
10.156.68.31
LK Research 7500
Main
7802
7801
6/6
A Feed [11]86
A DPL [11]80
Research Chill [11]79
Research Main [11]85
K Main [11]84
10.156.68.32
Evans Old BCD 7500
BU side
7802
7801
12/12
H [11]81
Beta [11]82
Comp [10]01
7350Eth 128.148.150.239
D [11]83
Evans Old BCD Area H
Main [40]05
Xray [41]12
Vose [41]79
B [11]87
Evans Old BCD Area B
Evans Penthouse
PP1 [11]88
PP2 [11]77
PHD [10]03
10.156.53.107
DOB Doctors Office Building 7500
1/1
4N-704
10.160.39.241
ACC-04N-SW1 4-21
B2000 (502)
Yawkey ACC 7330Eth
F1
7802
4/4
F2 [81]12
F3 [80]98
7330
F4 [80]99
YACC 7330Eth replaced with 7350 PC-0110A243-11 (43)
10.160.84.77
EGX100SD 502
Mallory 7330Eth (03)
2/2
Modbus RTU Link
Finland (04) 7330
10.160.108.12
B2000 (502)
Menino 7330Eth
L F10 [82]03
2/2
R F9 [80]75
7330
10.160.145.10
near NIE
B2000 (502)
Moakley
2/2
93 South
SquareD PM800 (2) RS485
95 North
43
Steam KEP STII RS485
155.41.181.10
EGX100SD 502
Harrison Court
3/3
11
12
13
Schneider EMxx (Veris 8163) (3) RS485
Old Management PC in Evans Vault
10.83.67.241 eth1
206.25.90.241 eth0
10.152.12.25
ION Enterprise Server (Defunct)


1.1.1.51
Modbus TCP
TCPIP
Cimetrics Modbus
RTU to Modbus
TCP Router B9010
1.1.1.52
Modbus TCP
TCPIP
BACnet/IP
Cimetrics
Modbus TCP
to BACnet/IP
Gateway
1.1.1.50
BACnet/IP
Cimetrics
Cache/Poller
1.1.1.10
BACnet/IP
Johnson
NAE/NIE
Modbus RTU
RS485
1
SPI
1
2
3
Seabus RS485
6
10
Siemens 4720
BDUs
2
SPI
1
2
3
Seabus RS485
6
10
Siemens 4720
BDUs
3
SPI
1
2
3
Seabus RS485
6
10
Siemens 4720
BDUs

Webimetrics Analysis Navigator - Windows Internet Explorer

http://davis/Webimetrics/InfometricsAnalysis.aspx?STRCID=51

File Edit View Favorites Tools Help

Webimetrics A... | Yahoo! Mail: The ... | Welcome to Wind... | Report Manager | Home | Feeds (J) | Print | Page | Tools

cimetrics

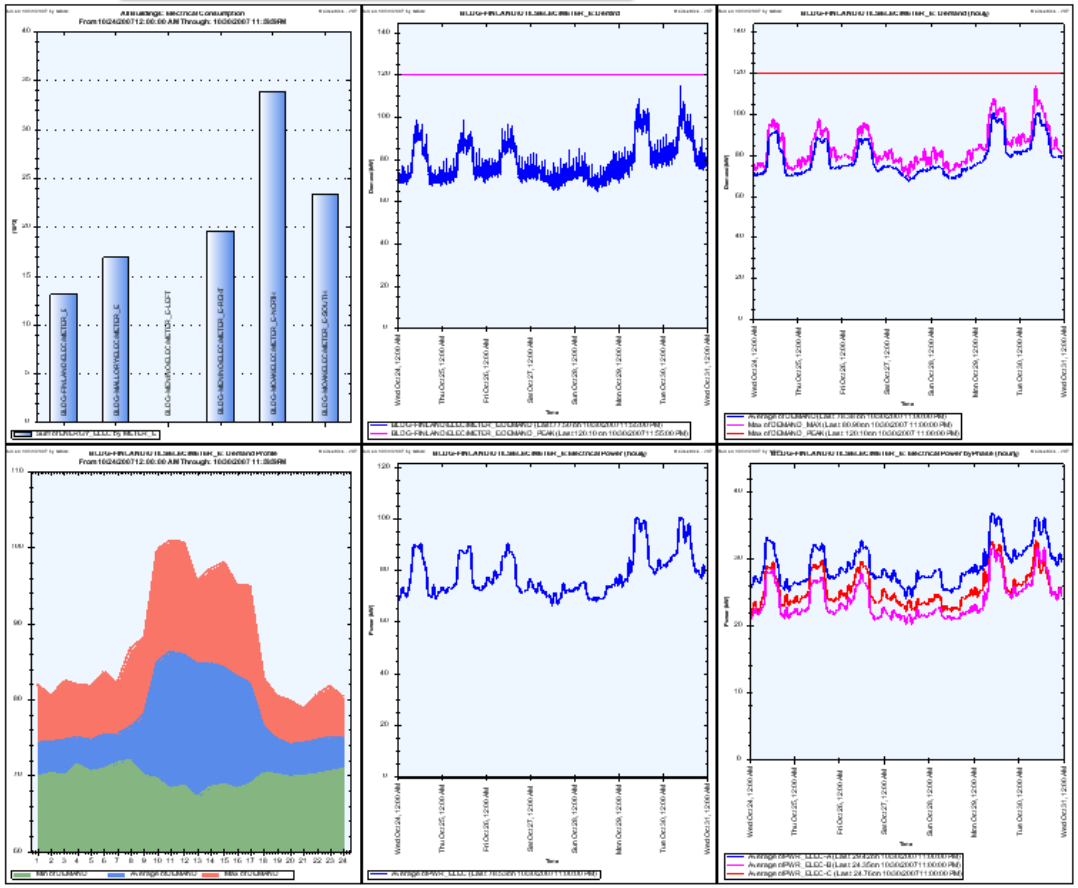
Webimetrics 3.1

Zoom All | Save Checked | Clear Checked | Home | Logout

Open new page with a list of last generated graphs' 900 by 700 pngs...

6 Graphs for Boston Uni

- Analysis Navigator
  - Boston University Medical Campus - MC
    - All Buildings
      - ☑ Electrical Consumption
    - BLDG-FINLAND
      - ☐ Electrical Consumption
      - UTILS
        - ELEC
          - METER_E
            - ☑ Demand
            - ☑ Demand (hourly)
            - ☑ Demand Profile
            - ☑ Electrical Power (hourly)
            - ☑ Electrical Power by Phase (hourly)
            - ☐ Power Factor (hourly)
            - ☐ Power Factor by Phase (hourly)
    - BLDG-MALLORY
    - BLDG-MENINO
    - BLDG-MOAK



Build Graph(s) From: 10/24/2007 12:00:00 ... Through: 10/30/2007 11:59:59 ...

Time Group By: Graph Default ☐ Hide TreeView ☐ Show Data

infometrics building accountability

http://davis/Webimetrics/NavGraph.aspx | Local intranet | 100%

Nagios - Windows Internet Explorer

https://support.cimetrics.com:8051/nagios/

Nagios

Nagios

General
- Home
- Documentation

Monitoring
- Tactical Overview
- Service Detail
- Host Detail
- Hostgroup Overview
- Hostgroup Summary
- Hostgroup Grid
- Servicegroup Overvie
- Servicegroup Summa
- Servicegroup Grid
- Status Map
- Google Map
- Service Problems
  - Unhandled
- Host Problems
  - Unhandled
- Network Outages

Show Host:

- Comments
- Downtime
- Process Info
- Performance Info
- Scheduling Queue

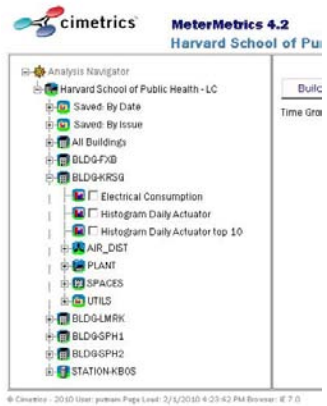
Reporting

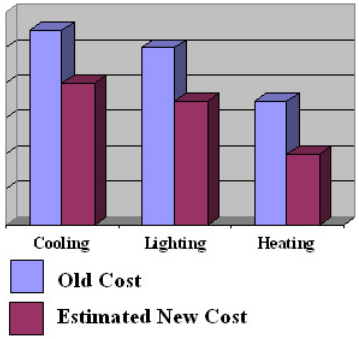
Internet 100%

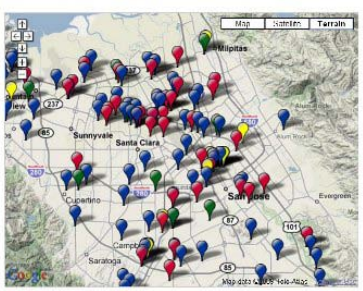
Dashboards:

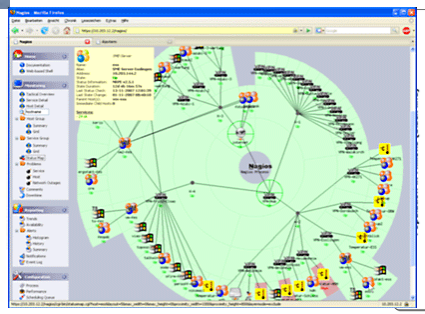
-Provide real time feedback to managers and occupants

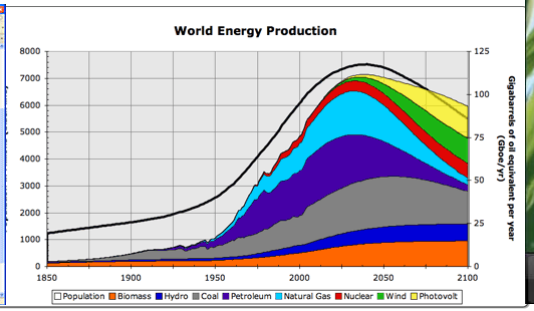
-Used to modify behavior of occupants









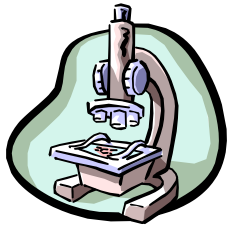


infometrics™
building accountability

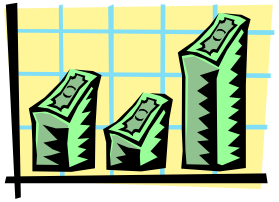
Fault Detection and Diagnosis

- Detect

- Evaluate



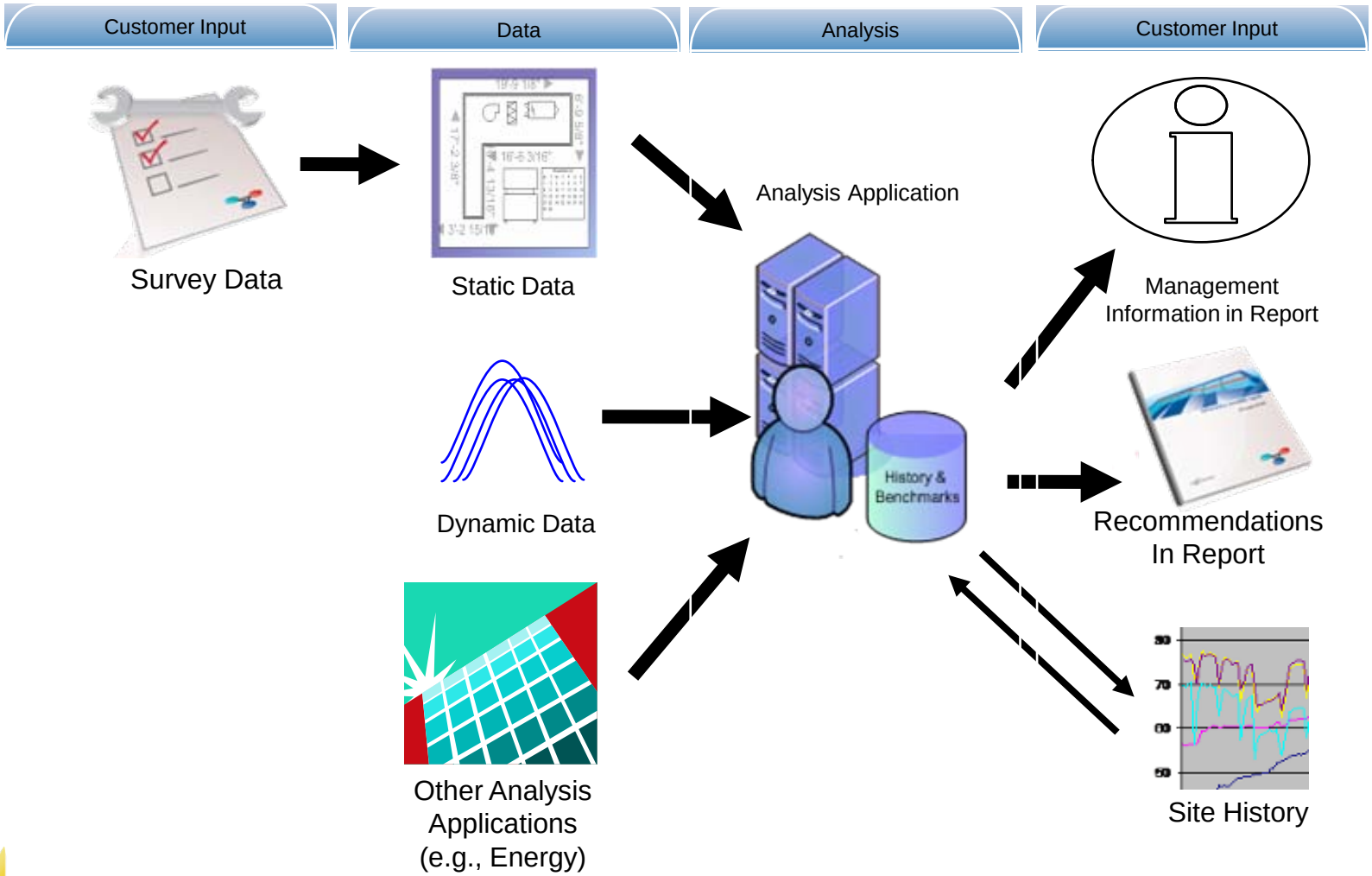
- Prioritize



- Recommend

- Communicate

Analysis Approach



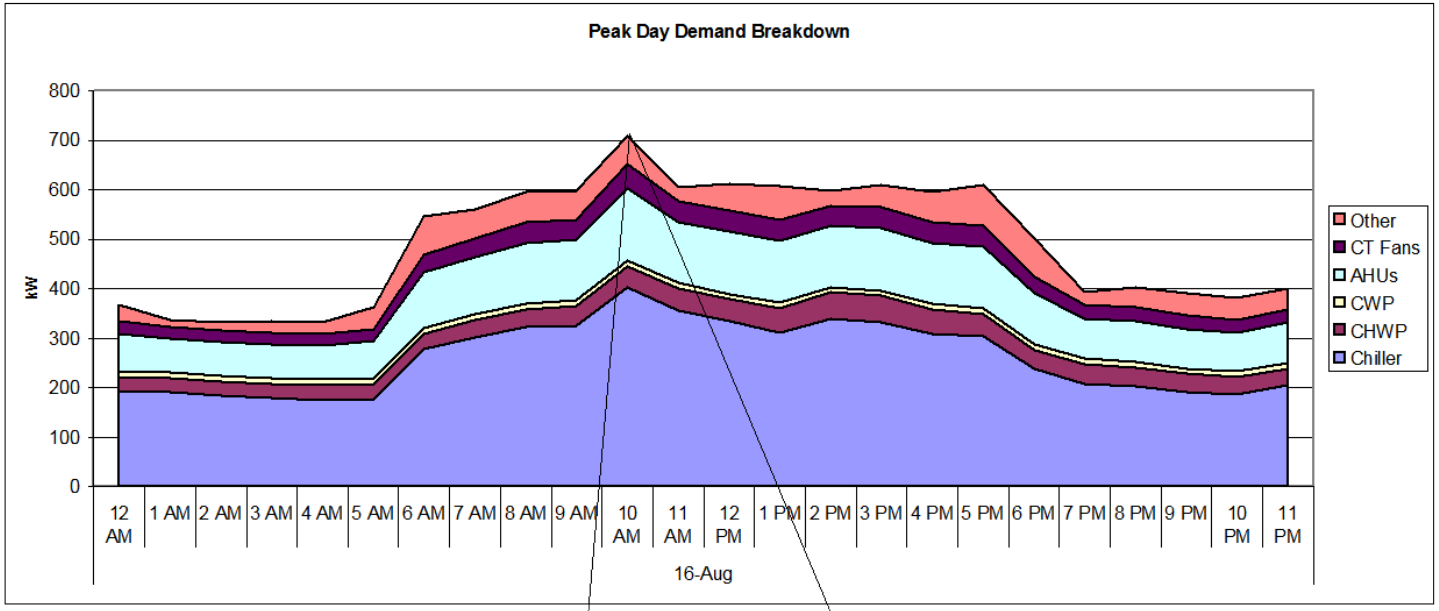
GovEnergy 2010

Sample Analysis Application Modules

- Utility Interface
- Chiller
- Cooling Tower
- Pump
- Control Loop
- Plant Operation
- Heating Plant

- Air Handling Unit
- VAV System
- Air Side Economizer
- Water Side Economizer
- Reset Schedule
- Comfort
- Humidification

Building Systems <=> Smart Grid



NBS - System Peak Summary (Chilled Water Plant)

Outdoor Air Temperature = 92.5°F
Outdoor Air Relative Humidity = 65.40%

Chiller Summary	Load at Peak	Design Load*	Average Load
Chiller #1	97%	85%	74.30%
Chiller#2	89%	85%	68.50%
	Temp	Design T	Avg. T
Common Chilled Water Temp	41.7°F	45°F	43.6°F

Pump Summary	VFD Output	Status
CHWP#1	98.55%	ON
CHWP#2	89.30%	ON
CWP#1	n/a	ON
CWP#2	n/a	ON
Common Backup Pump	n/a	OFF

AHU Summary	SF VFD Output	RF VFD Output
AHU#1	95.0%	92.4%
AHU#2	87.0%	85.0%
AHU#3	95.0%	94.0%
AHU#4	50.0%	48.7%
AHU#5	98.0%	95.6%
AHU#6	94.0%	91.0%
AHU#7	94.0%	91.0%

CF Fan Summary	VFD Output
CT#1	93.70%
CT#2	93.20%

*Design Day = 98°F/78°WB

GovEnergy
www.govenergy.gov

GovEnergy 2010

Account review: The Harvey W. Wiley Building

What did we analyze?

- **388,000 Square feet**
- **5,800 Johnson Controls Metasys BAS points**
- **750+ pieces of equipment (multiple types)**

All of these are monitored 24 hours a day, 7 days a week.

What did we find?

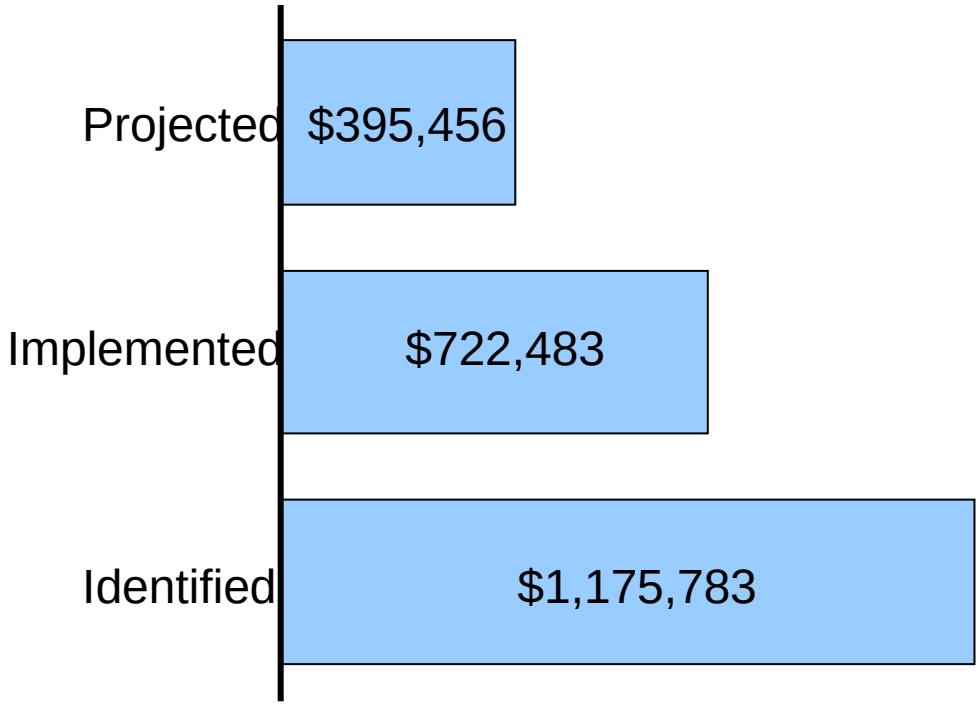
- 49 issues
- $1,175,783 in potential savings per year
- 5,954 Metric tons of potential CO_2 savings per year

Source: GSA Wiley site data and June 2010 Infometrics report.

infometrics building accountability

Energy cost savings

Energy savings ($ per year)



What does it mean?

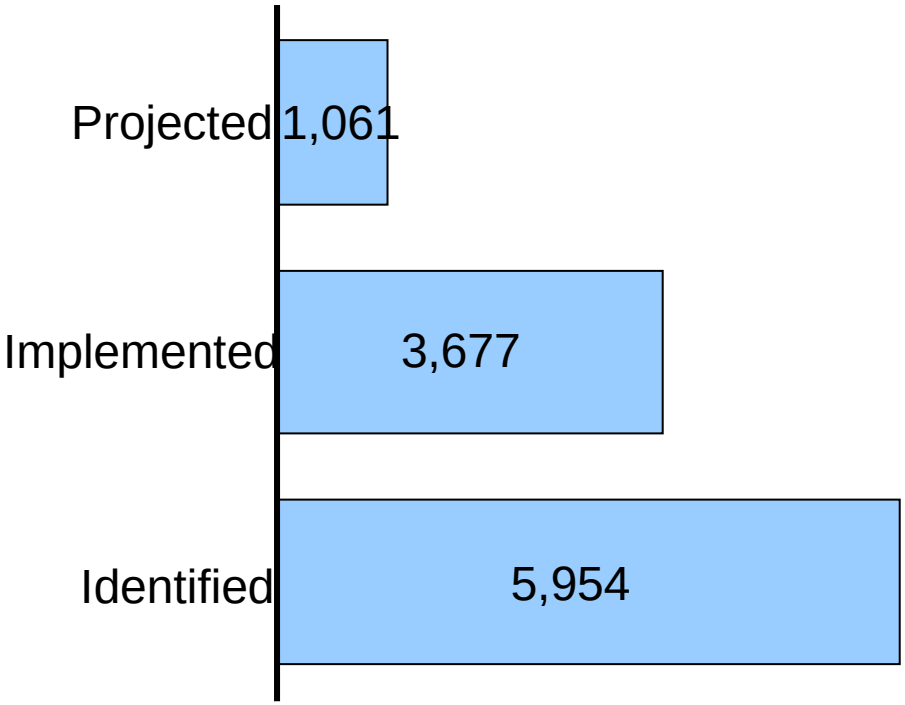
- Exceeded the projected goal. Implemented savings are greater than projected.
- Payback of 4 months.
- Potential to further improve implemented savings number exists.

Source: Cimetrics analysis. GSA June, 2010 Infometrics report and Cimetrics proposal.

infometrics building accountability

CO_2 savings

CO_2 savings (Metric tons per year)



What does it mean?

- Positioned for two of the three LEED Energy and Atmosphere prerequisites.
- Qualifying for at least 10 LEED Energy and Atmosphere points.
- Smaller carbon footprint for your services.

…and all this is achieved with the $722,483 in <u>realized</u> cost savings!

Source: Cimetrics analysis. GSA June, 2010 Infometrics report and Cimetrics proposal.

infometrics building accountability

Case Study: Root cause analysis of frozen coils on GSA Wiley building

Date	Event	Result
January 16, 2009	▪ Site personnel discover frozen coils on AHU-02 and AHU-04.	▪ Disrupted operations. ▪ Loss of ventilation air to lab areas. ▪ Poor space temperature control. ▪ High cost to repair AHUs.

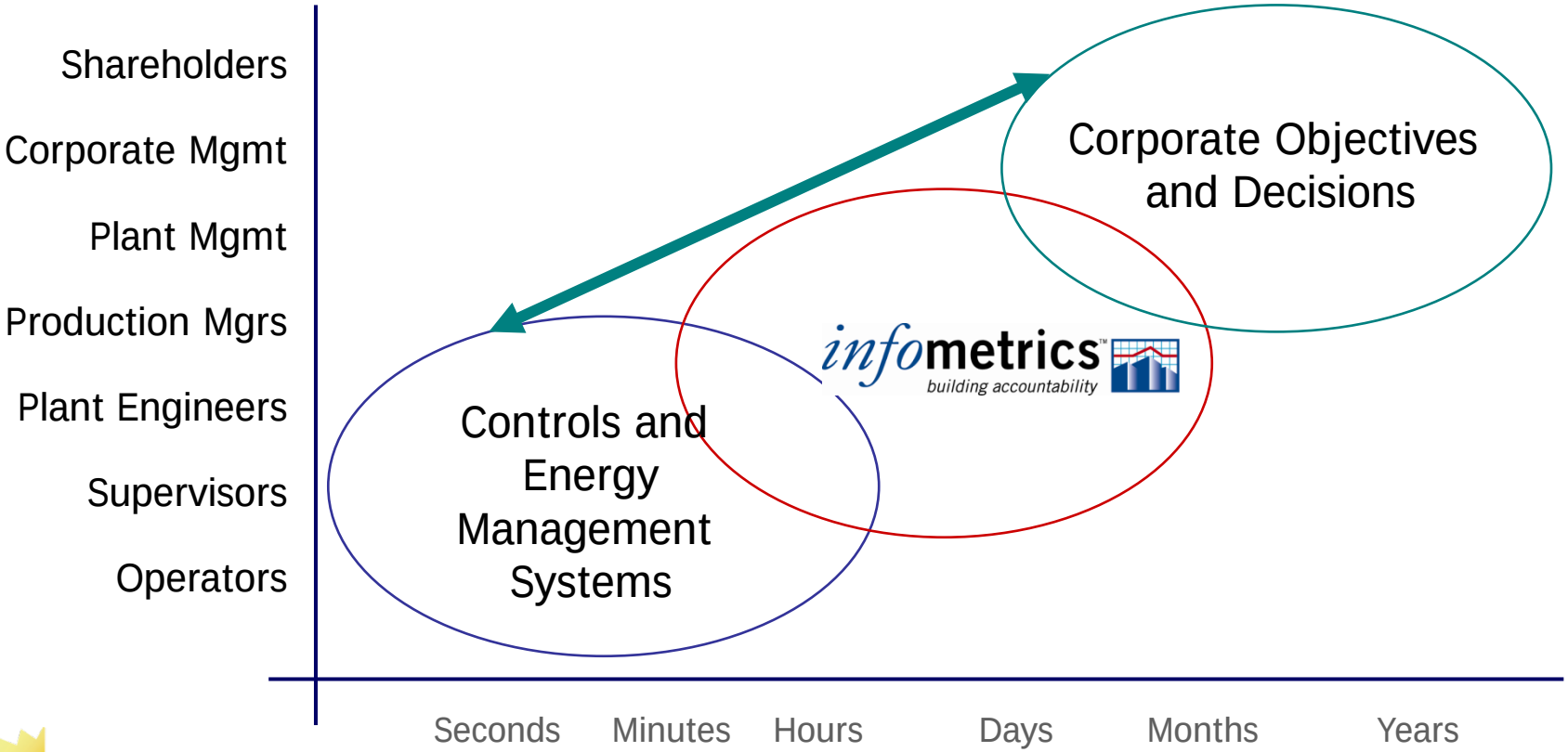
February 6, 2009	▪ GSA request Infometrics team to perform a root cause analysis.	▪ Analysis of data revealed that:
		  ▪ BAS was in override.
		  ▪ AHUs meant for 24/7 were shut down.
		  ▪ Freeze alarms were ignored.
		▪ Override prevented freeze protection logic to execute & prevent freezing.

February 9, 2009	▪ Infometrics reviewed the analysis findings with the GSA.	▪ Confirmed that the units were in override. A sign in the operator room that said "*Do not run units in override*" but the BAS was in override mode.

Source: GSA Frozen Coil report, February 2009.

Enterprise Management

Infometrics presents a bridge between real-time energy management and control systems data and corporate management objectives.



GovEnergy 2010