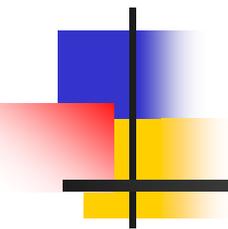


Thomas Jefferson University & Hospital Energy Program

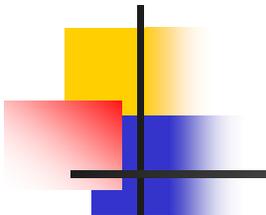
presented to

2004 National Workshop on State Building Energy Codes



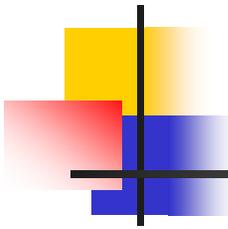
**Randolph L. Haines,
CEM, CLEP, CPE
Energy Manager
Jefferson Health
System**

**Coni Stavropoulos
President
Steamgard, LLC**



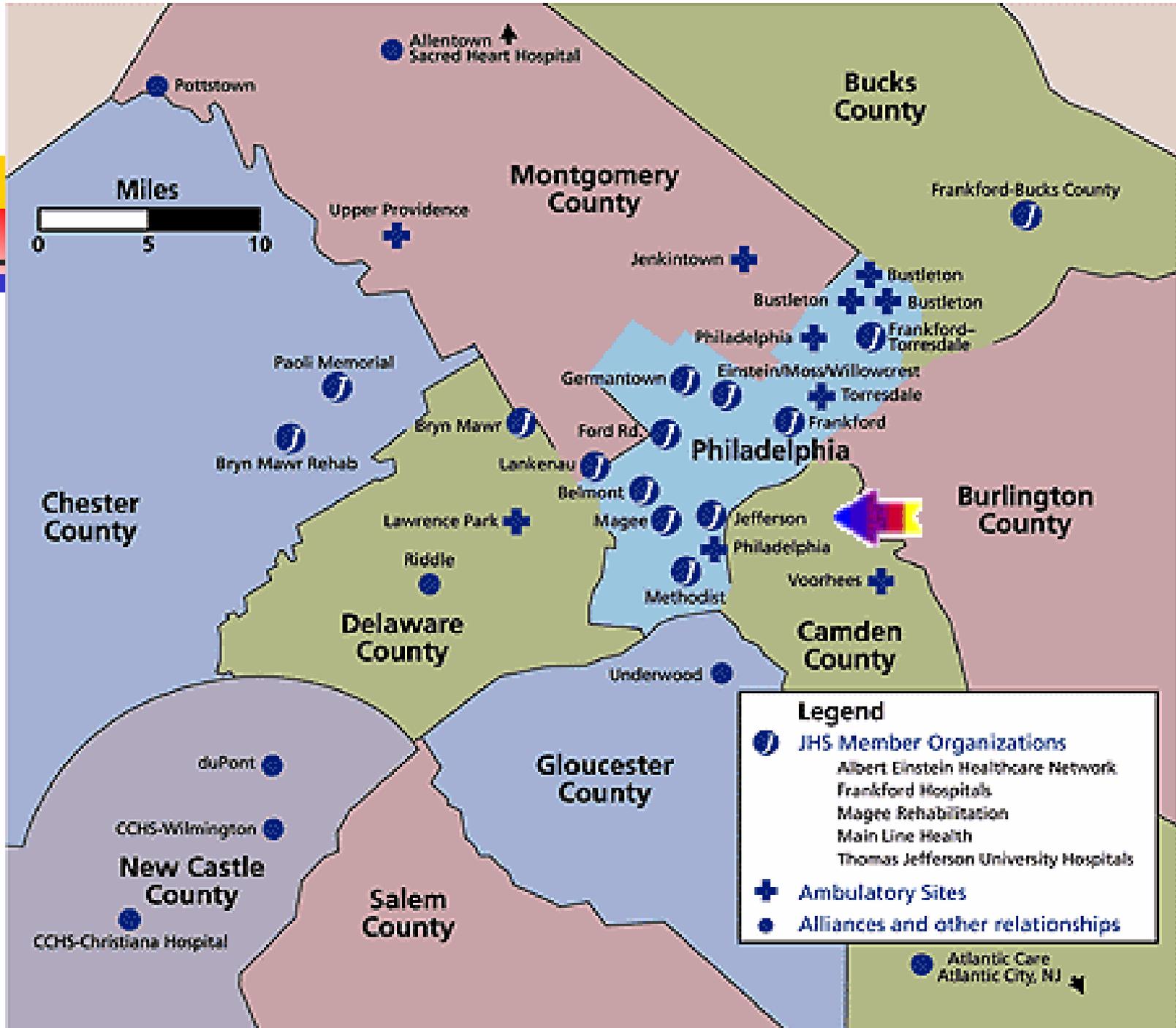
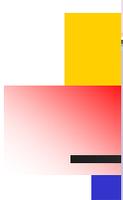
Welcome to Philadelphia!

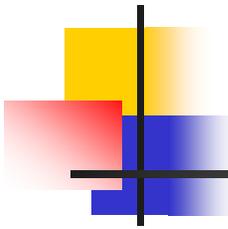




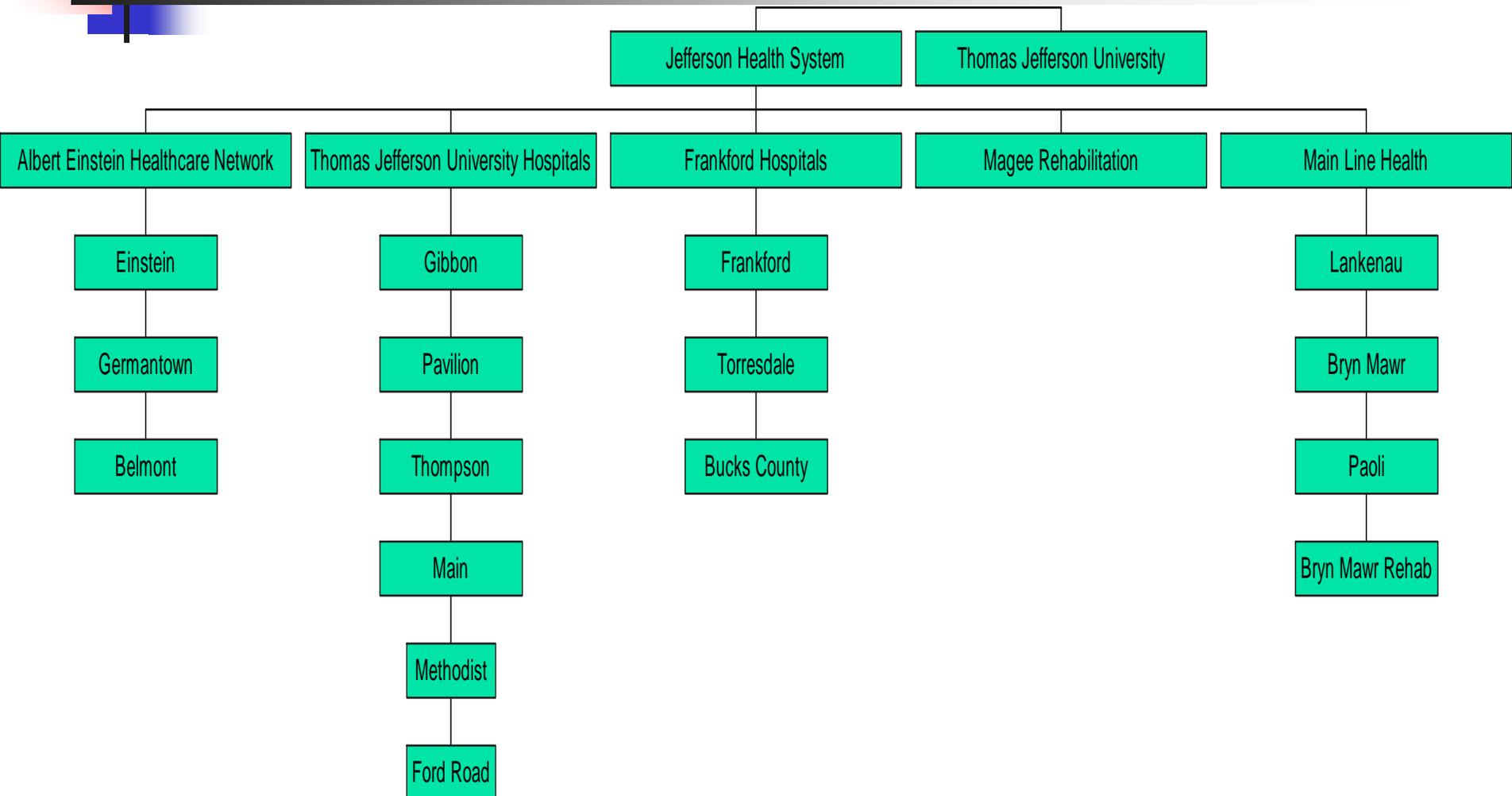
Who is Jefferson?

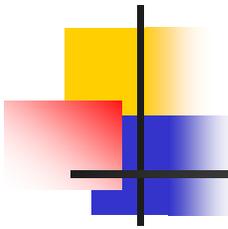
- A group of Hospitals and a teaching University in the Delaware Valley (Philadelphia)
- Largest Healthcare system in the Philadelphia Area
- Consists of more than 10 million square feet of property with more than 22,000 employees in five counties





The Jefferson Health System



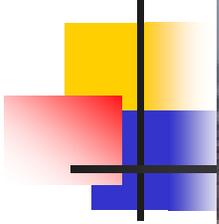


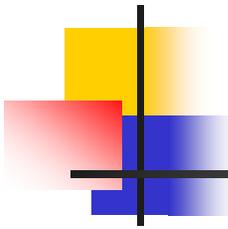
How much energy does JHS use?

- JHS has an electrical peak of 60 megawatts
- Consume more than 350,000,000 kWh per year
- Consume about 700,000 MM BTU of natural gas
- Purchase 400,000,000 lbs. of steam
- Spend about \$40 million a year on all utilities



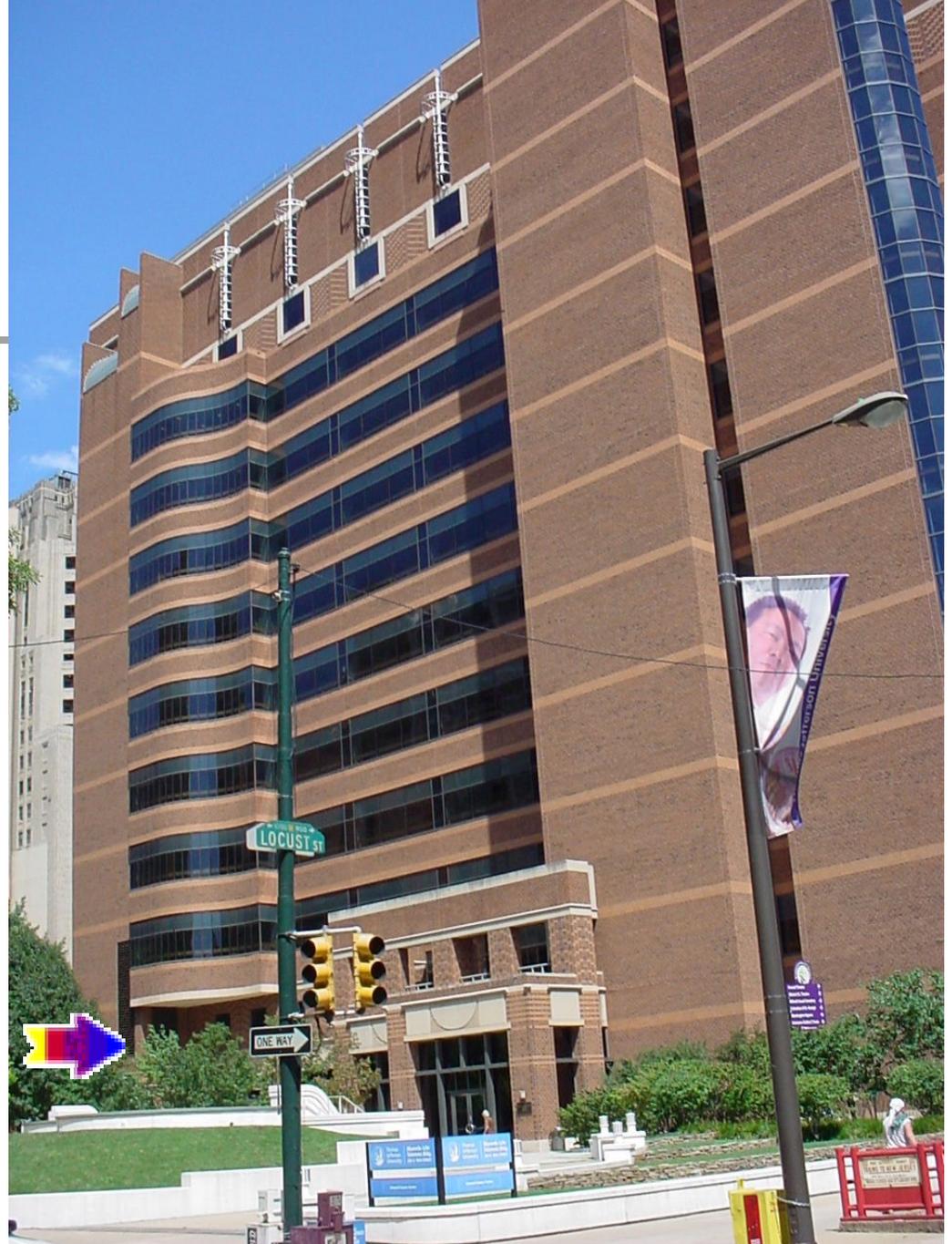
Thomas Jefferson University

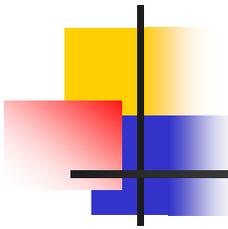




Bluemle Life Science Building

Welcome!



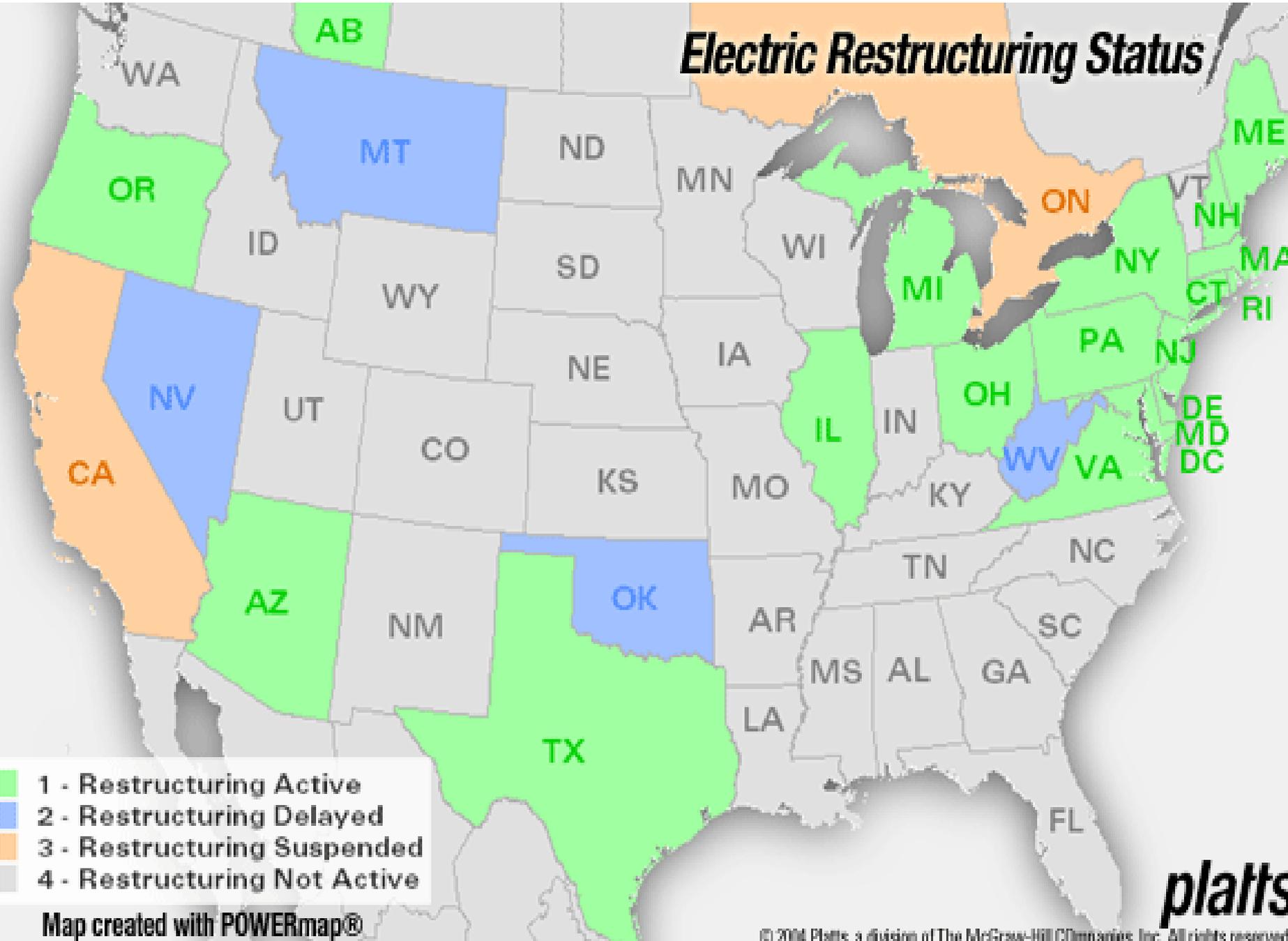


Energy Strategy

- Purchase electric generation for JHS (deregulated in PA in 1999)
- Purchase natural gas for the JHS
- Hire an ESCO to audit all buildings and install energy saving equipment
- Improve operation of existing equipment
- Communicate: reports, newsletters, updates
- Design energy efficiency into building renovations and new construction
- Recommision buildings every 3 years



Electric Restructuring Status

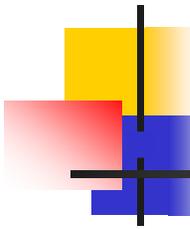


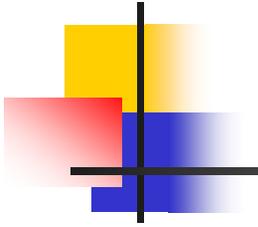
- 1 - Restructuring Active
- 2 - Restructuring Delayed
- 3 - Restructuring Suspended
- 4 - Restructuring Not Active

Map created with POWERmap®

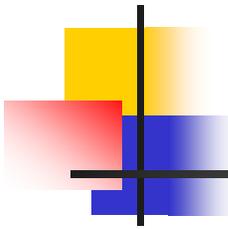
platts

Energy Saving Projects Center City Campus

- 
- Installed near-real-time advanced metering system throughout the health system
 - Retrofitted lighting from T-12 to T-8 lamps and replaced with electronic ballasts & controls
 - Installed modified venturi steam traps and removable steam blankets on valves, strainers and PRV's
 - Installed Variable Frequency Drives (VFD's) on air handlers
 - Added Building Automation Points to optimize Start/Stop
 - Installed heat recovery on steam condensate to heat incoming domestic water

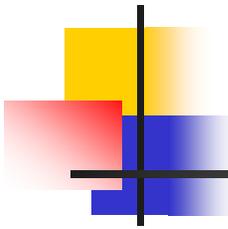


We live in a sea of facts,
but drown in the lack of
knowledge.



Metering System

- Now have 50 data loggers throughout the Jefferson Health System
- More than 250 real meters; electric, steam, gas, water, chilled water, hot water
- More than 50 virtual meters; sub meters groups, buildings, entire JHS



Why Advanced Metering?

- Save Money:
- Purchase of commodity
- Catch equipment running out of tolerance
- Bill tenants and audit bills
- A lot of other good reasons (raise awareness, see results of changes)

Hardware

Where it all begins - \$

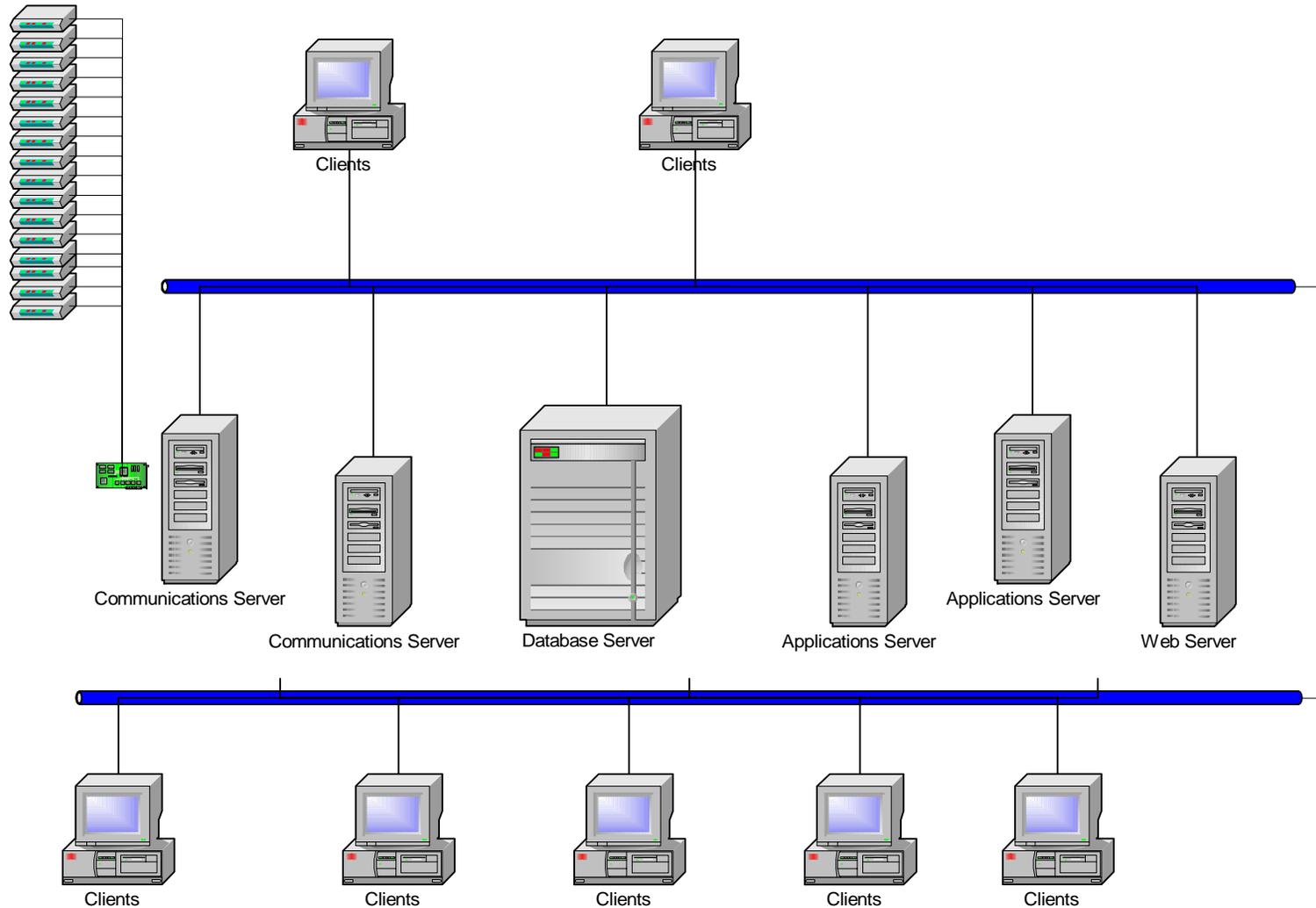




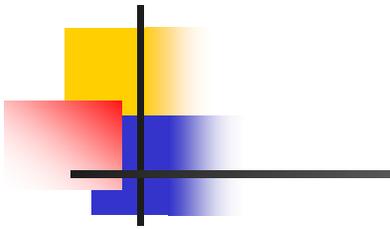
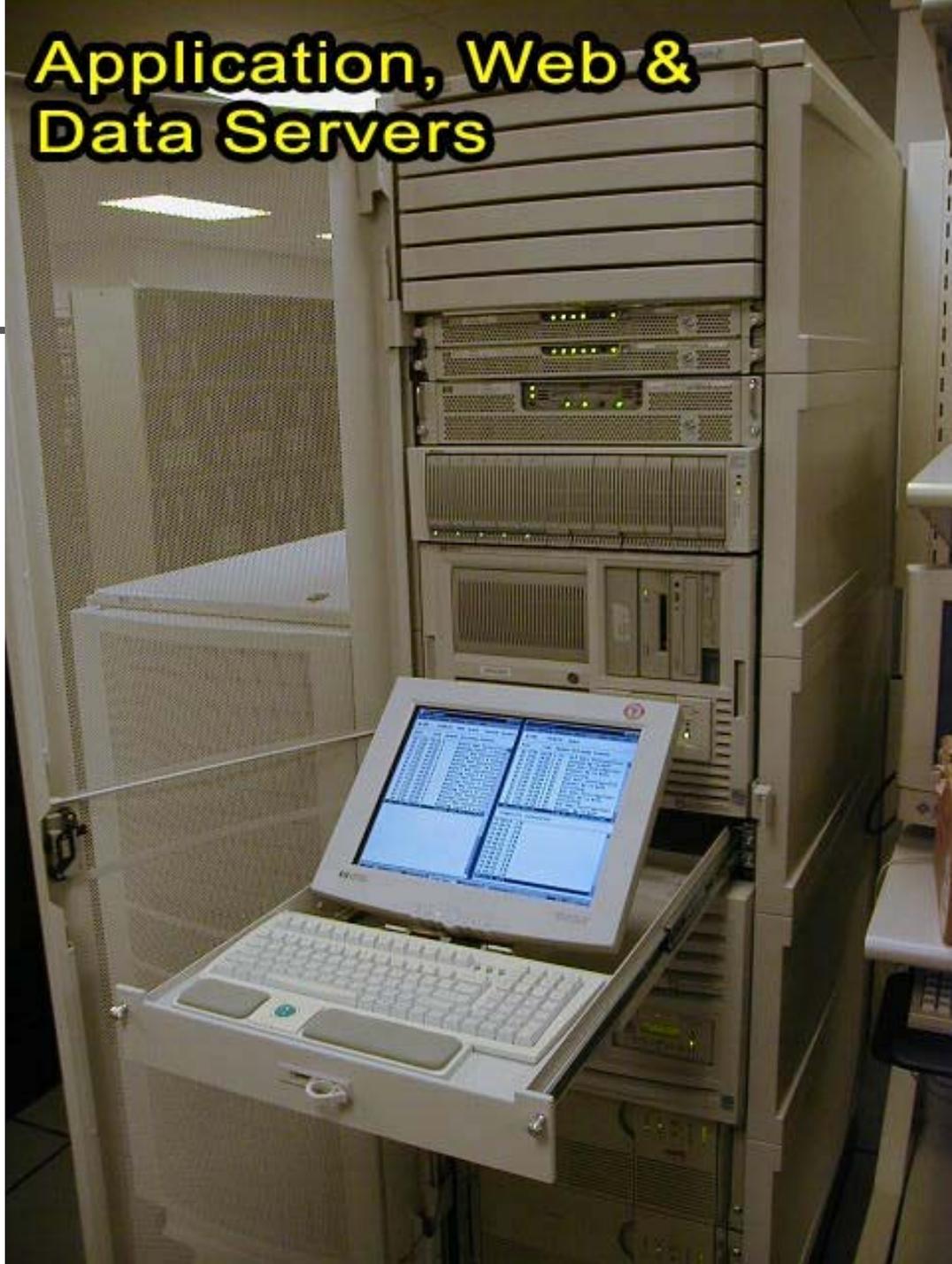
Recorder & Terminal Server

Metering System Architecture

- Unified
- Oracle 8.1.5
- SQL Server 7.0
- AMR
- Scalable
- Flexible
- Configurable
- Interoperable
- API
- Audit Trail
- Security
- Permissions
- Ownership Rights
- Multi-vendor
- Communications
- PDK
- Connectivity
- Client Server
- ODBC
- 32-bit
- Web
- Push
- Pull



Application, Web & Data Servers





Address http://10.160.3.3/runreport.asp Go Links

Select Report



Utility:

Period:

Report:

- Day Power Report
- Day on Day Profile
- Sample hours
- Week Power Report
- Week on Week Profile

Select Site:

- Delivery Aggr. of JHS
- Delivery Aggr. of TJU & TJUH
- Delivery Aggr. of TJU
- Delivery Aggregate of TJUH
- Delivery Aggregate of Main Line Health
- Delivery Aggregate of Einstein Health System
- Delivery Aggregate of Frankford Health System
- Delivery Aggregate of Magee Rehab

Length:

Format:

End Date:

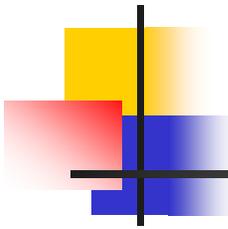
◀ **October 2001** ▶

S	M	T	W	T	F	S
30	1	2	3	4	5	6
7	8	9	10	11	12	13

Destination:

Screen Email

Resolution:



Lighting

- Retrofitted 72,900 T-12 lamps with T-8 lamps
- Replaced 5,000 incandescent lamps with compact fluorescent
- Replaced 33,570 magnetic ballasts with electronic type
- Replaced 1360 Exit signs with LED type
- Tandem wired many fixtures saving ballasts and heat load



Lighting-before retrofit, (2) F40 lamps per fixture



Lighting-after retrofit-(2) F17 T-8 lamps per fixture



Installed 5000 Compact Fluorescent Lamps

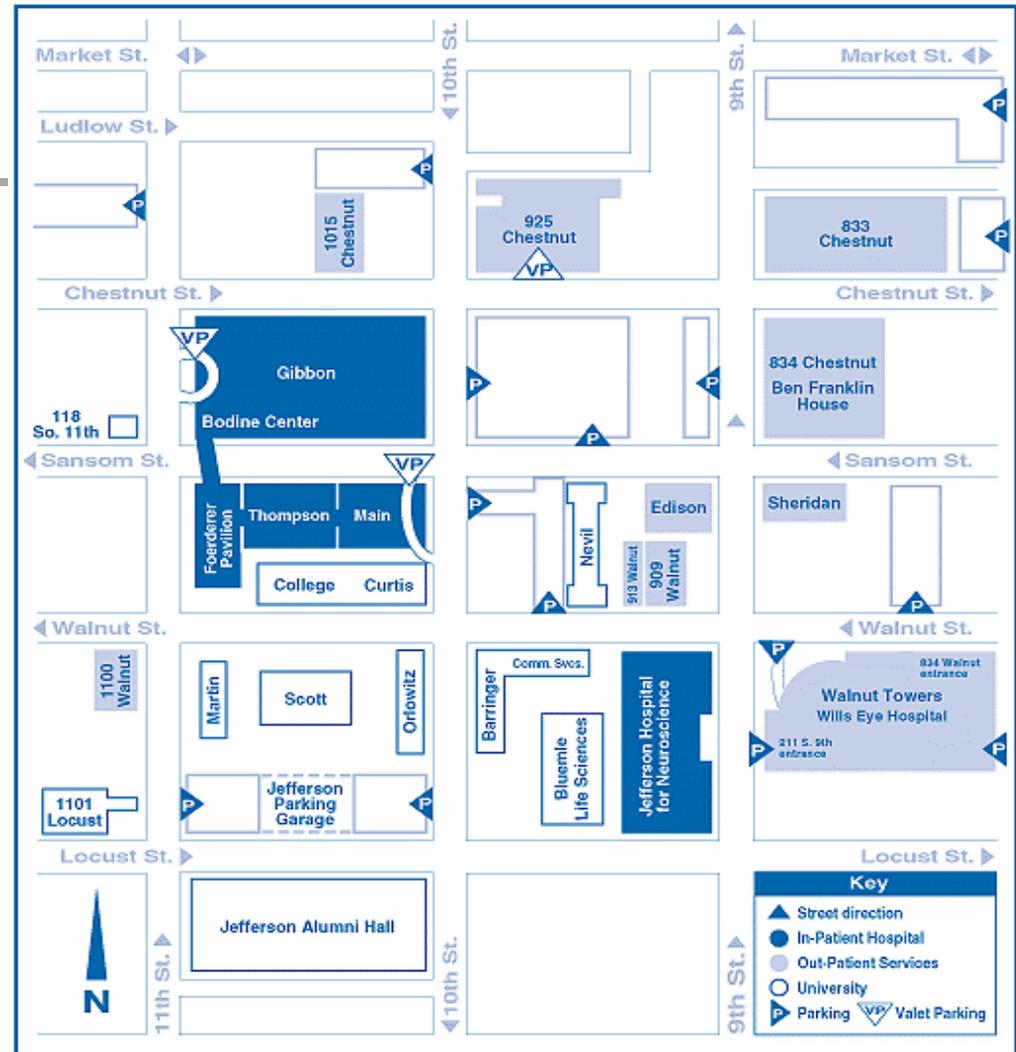


Installed 500 lighting controls

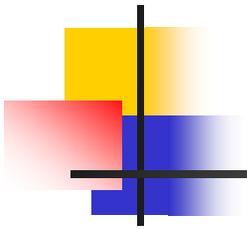


Background on the Steam Trap Measure

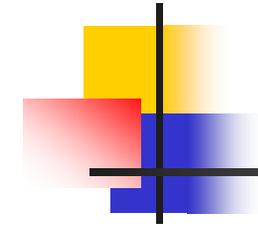
- 17 buildings on campus
- Totaling 4,200,000 sqft.
- 1100 total steam traps in various applications.
- Full System Audit with specific M&V criteria



How STEAMGARD® Works

- 
-
- **Physics of Two-Phase Flow**
 - **Effect of Pressure**
 - **Effect of Variable Flow**
 - **Steam Loss Through Venturi Nozzles**

Two-Phase Flow Basics



The **STEAMGARD®** unit utilizes the following:

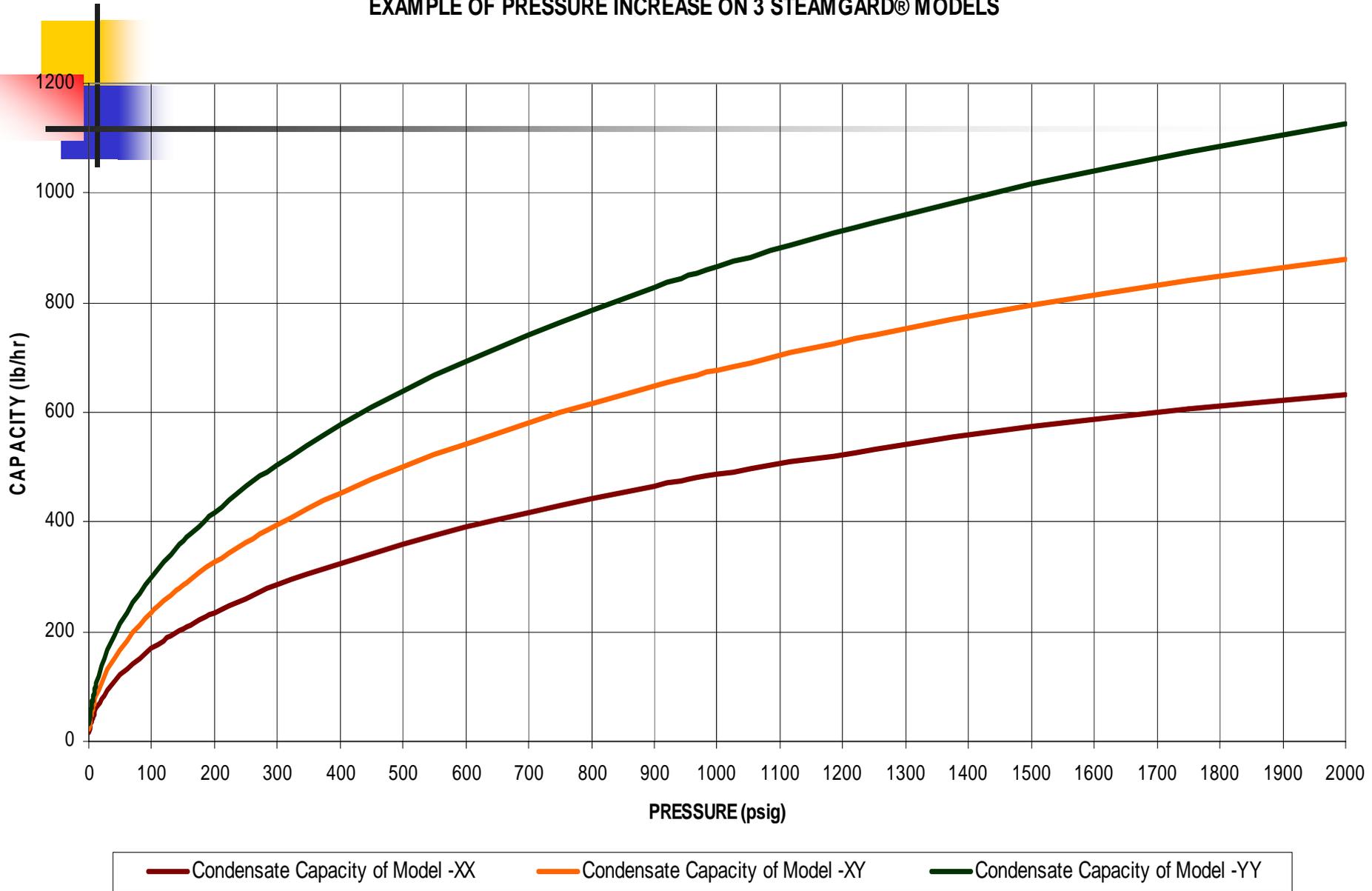
- A modified venturi nozzle to provide a restriction in flow.
- The pressure differential upstream and downstream of the unit.
- The density / volumetric difference between two equal units of a vapor and a liquid.
 - As an example, at 15 psig, condensate is over 817 times more dense than steam (58.82 lb/cuft for condensate versus 0.072 lb/cuft for steam).

Effect of Pressure on STEAMGARD®

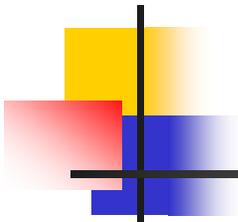
- As pressure increases, the condensate capacity of the STEAMGARD® unit increases.
- Negative back pressure (vacuum) increases the condensate capacity of the STEAMGARD® unit.
- Positive back pressure decreases the condensate capacity of the STEAMGARD® unit.
- Applying the STEAMGARD® unit IS PRESSURE DEPENDENT.

Pressure Vs. Capacity of STEAMGARD®

EXAMPLE OF PRESSURE INCREASE ON 3 STEAMGARD® MODELS

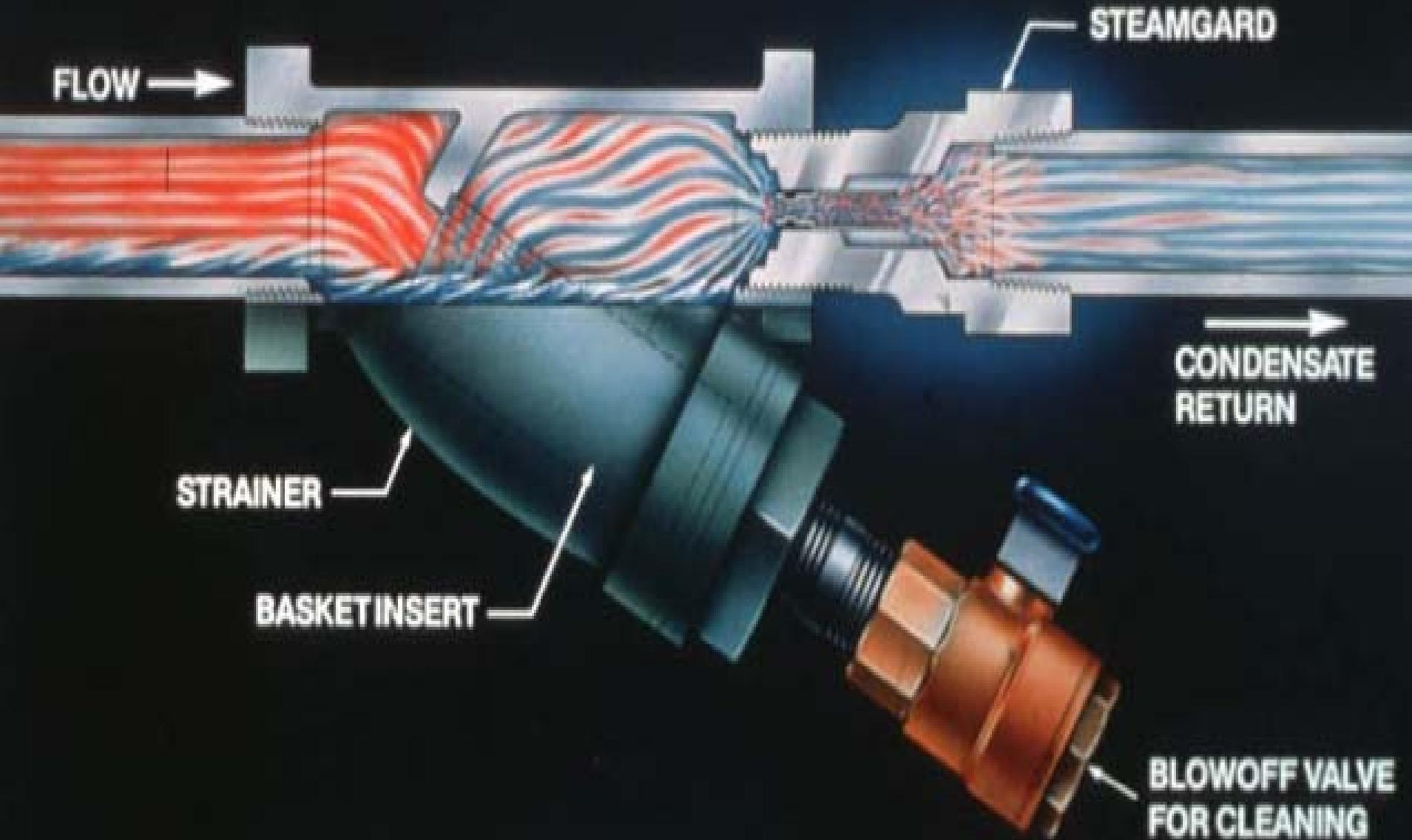


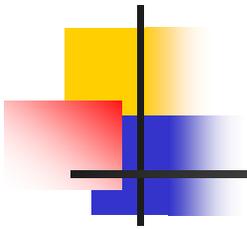
Variable Flow Through STEAMGARD®



- **Common variable flow applications are:**
 - **Air Handling Units**
 - **Heat Exchangers**
 - **Condensers**
 - **Absorption Chillers**
- **Large steam consuming applications with large varying load utilize control valves to modulate their steam consumption.**

Cutaway of the installed product





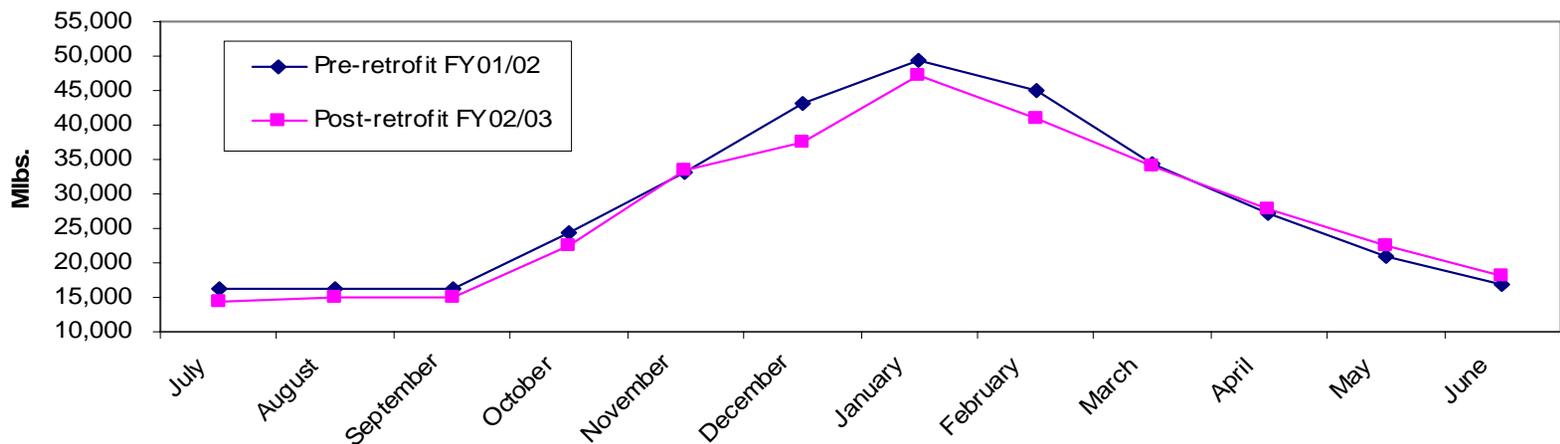
Economic Profile

- Steamgard, LLC engineered and installed the project turnkey in two phases
- Total savings in 2003 was \$ 262,000 versus the projected savings \$170,000
- Total steam consumption reduced by 5.5% post retrofit- details in next slide

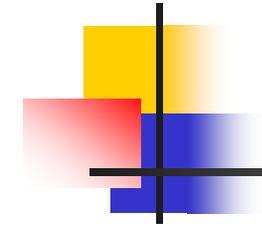
Campus savings using regression analysis to weather adjust

Month	Steamgard Post Retrofit in Actual Mlbs.	Heating Degree Days	Pre-retrofit Calculated Use-Mlbs.	Actual Fuel in \$/Mlb.	Steam Savings in Mlbs	Savings \$
July	14,426	0	16,217	\$9.472	1,791	\$16,961
August	14,860	1	16,246	\$11.178	1,386	\$15,495
September	15,090	4	16,335	\$12.853	1,245	\$16,004
October	22,376	277	24,425	\$14.291	2,049	\$29,276
November	33,368	567	33,018	\$13.391	(350)	(\$4,690)
December	37,408	910	43,181	\$14.696	5,773	\$84,847
January	47,300	1,123	49,493	\$15.107	2,193	\$33,130
February	41,015	975	45,108	\$15.388	4,093	\$62,976
March	34,043	618	34,529	\$17.254	486	\$8,385
April	27,724	373	27,269	\$16.521	0	\$0
May	22,497	157	20,869	\$16.514	0	\$0
June	18,036	25	16,957	\$17.915	0	\$0
Average	27,345	419	28,637	\$14.548		
Total	328,143	5,030	343,647		18,665	
Annual Savings						\$262,383

TJU & TJUH Campus Steam Use FY01/02 vs.02/03



Benefits



- Reduction in total steam consumption purchased by 5.5%
- Increased equipment efficiency
- Extended equipment useful life of 15 years-
no moving parts
- Reduced Maintenance Costs
- Predictable, consistent, constant performance and System Standardization.

Installed 444 removable steam insulation blankets on valve bonnets, strainers & PRV's



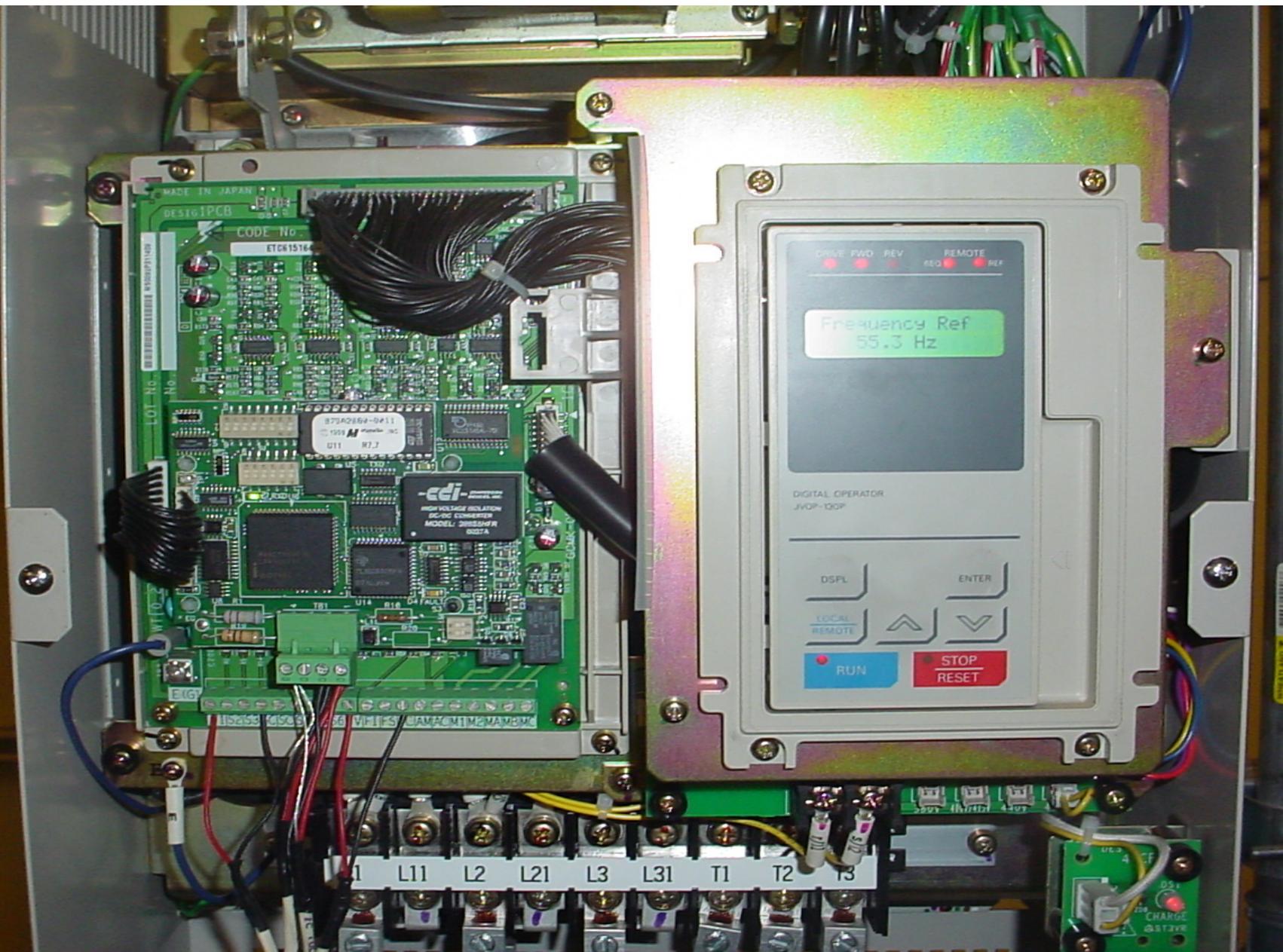
Installed (23) VFD's on motors totaling 1085 HP



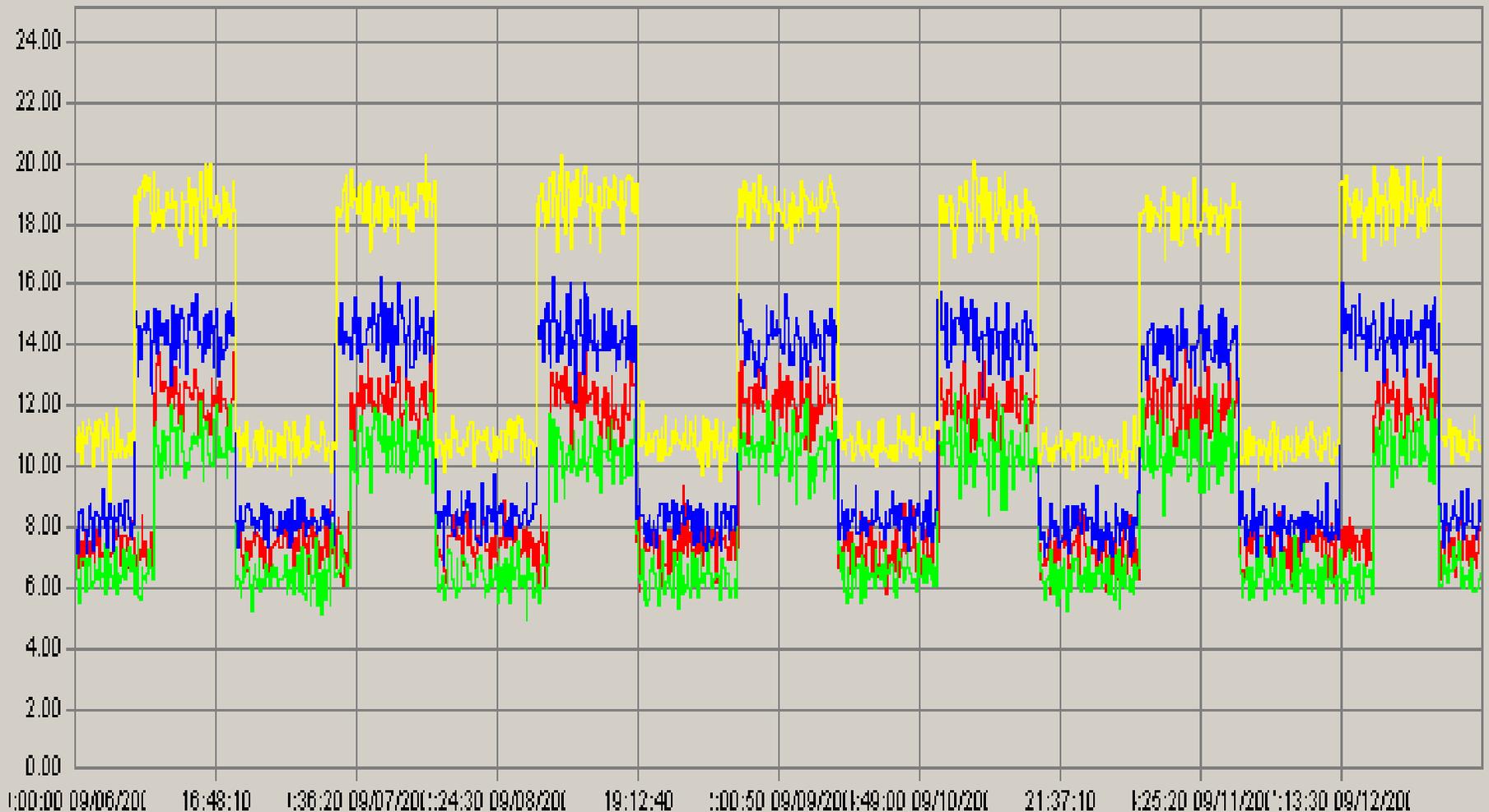
Return VFD and motor



VFD with L.A.N. Communications Card

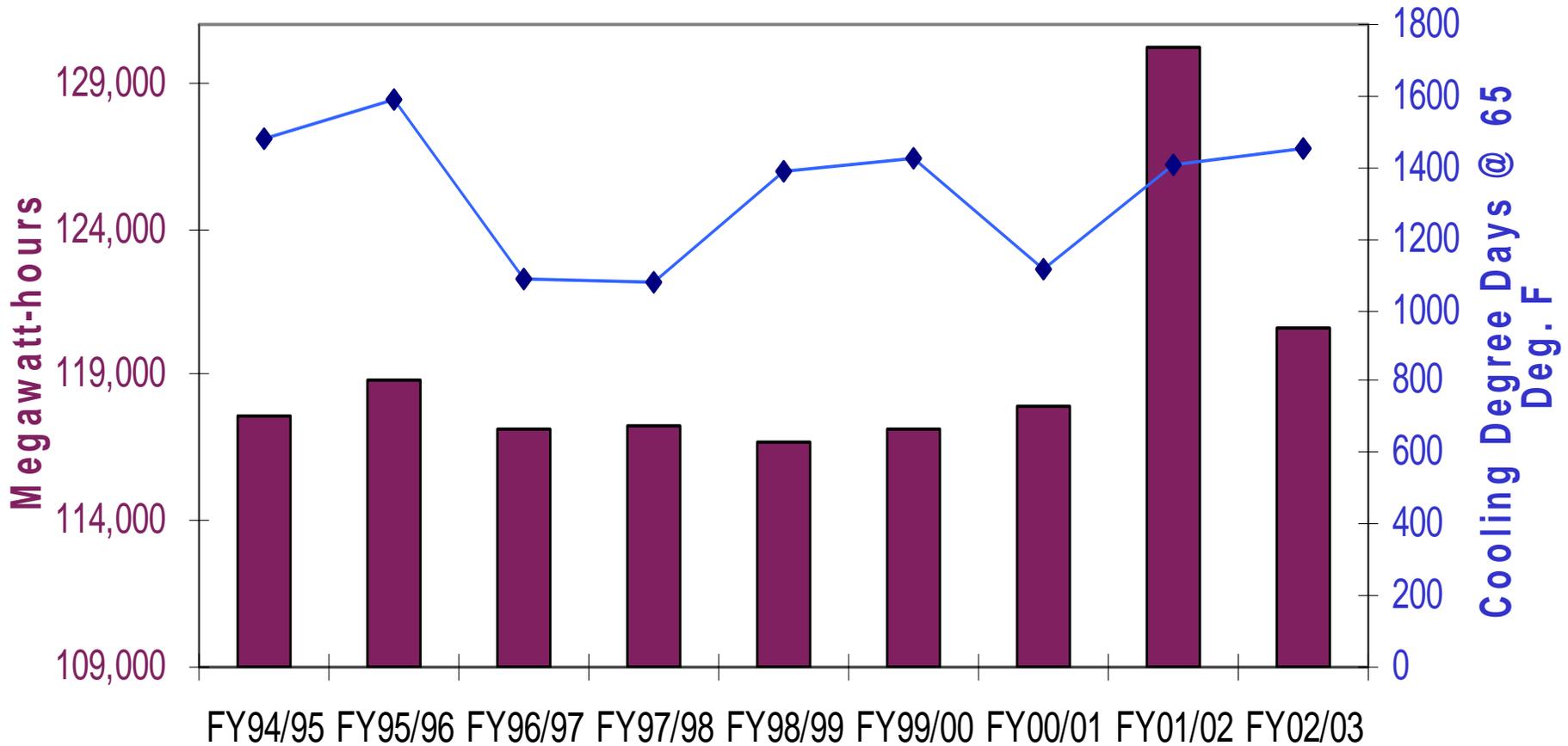


Installed 40 additional points on our Building Automation System for Start/Stop control



Electric Used vs Cooling Degree Days @ 65 Deg. F

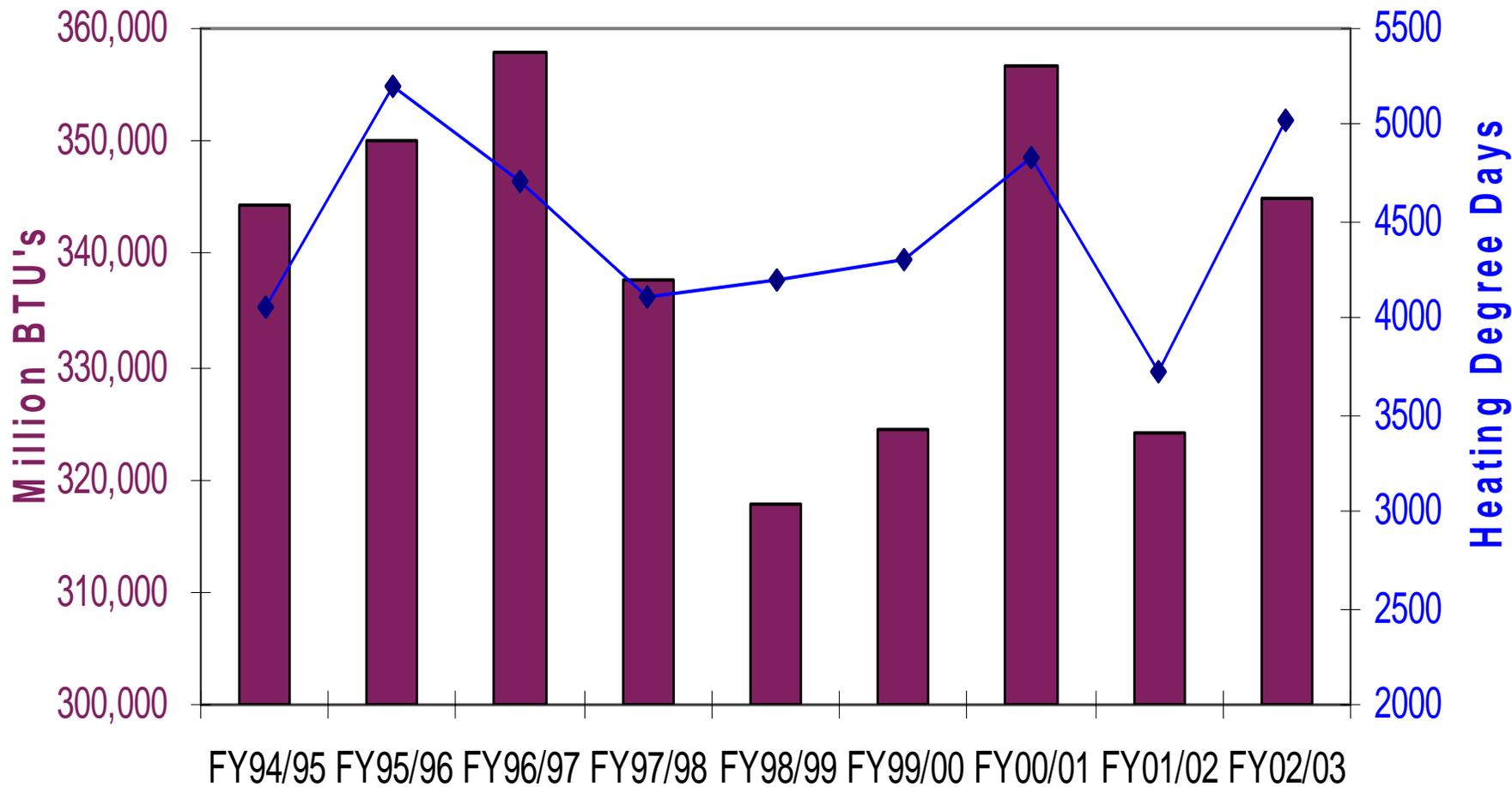
*Added 925 Chestnut & JHN



*

Steam Used versus Heating Degree Days @ 65 Deg. F

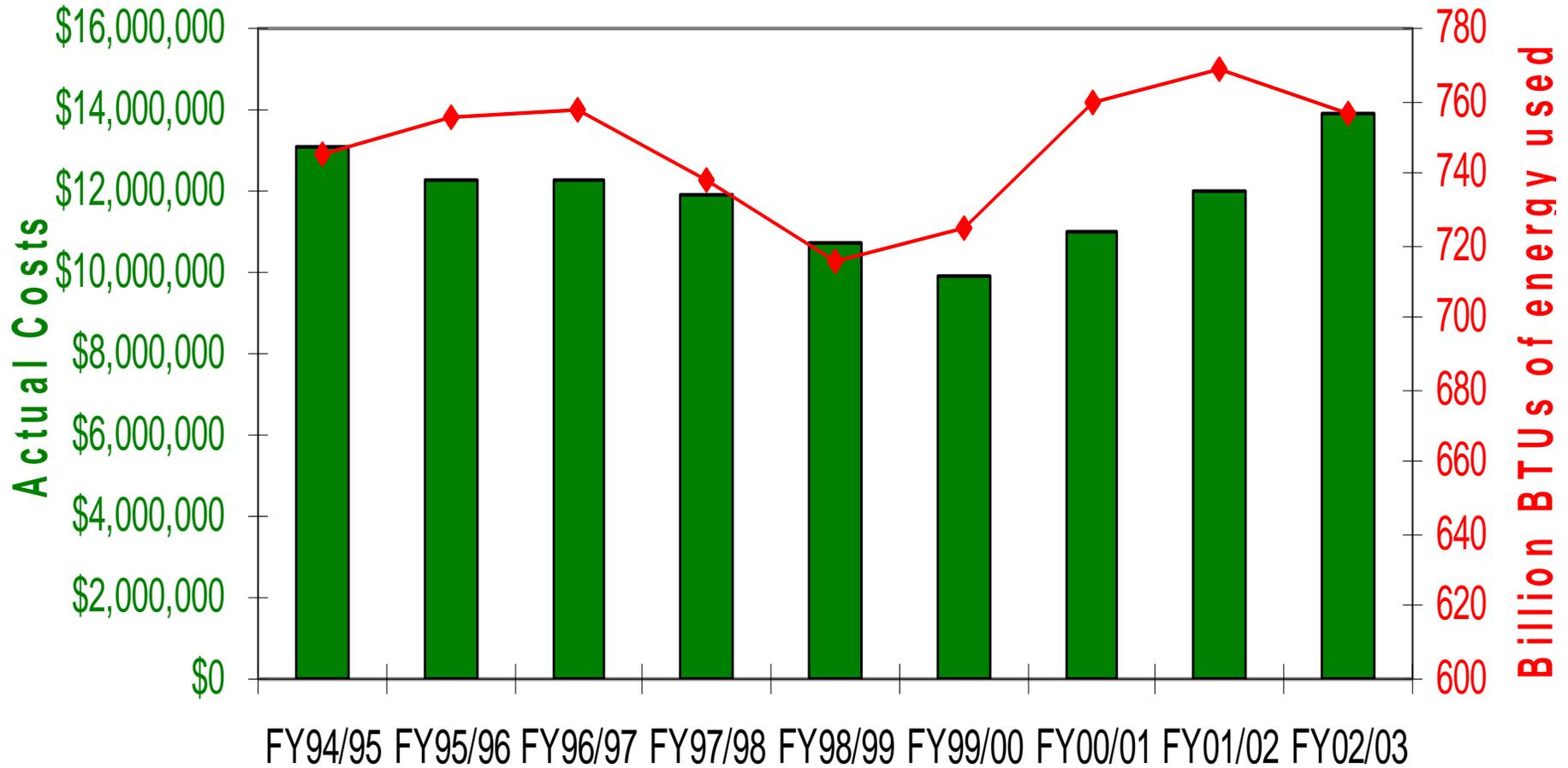
*Added 925 Chestnut & JHN



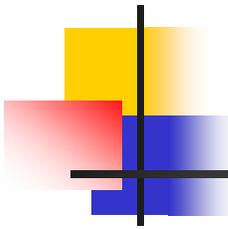
*

Historical Utility Cost & Use-Center City

* Added 925 Chestnut and JHN



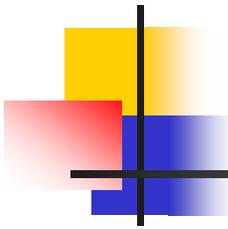
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How much are we saving?

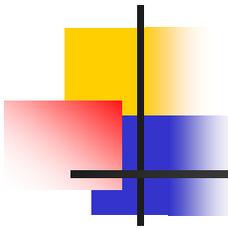
- We are now saving \$1,408,000 per year compared to January 2001
- We are saving 15,985,000 kwh and 46,174,000 lbs. of steam per year.
- We have a positive cash flow of \$238,000/year
- We've installed more than \$7,000,000 worth of new equipment in our buildings





To Maintain Savings

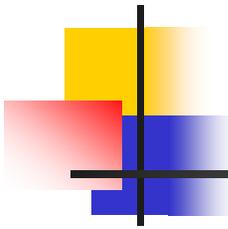
- Communication to all employees using “Currents” quarterly energy newsletter and management update presentations
- Using metering, continuously monitor use and send reports to operational supervisors
- Incorporate energy efficient design into new and retrofit spaces-ASHRAE 90.1 code for PA helps a lot!
- Re-commission buildings every 3 years



Challenges

- Space use continues to change from office to lab space (100% outside air)
- Energy intensity still going up (more computers, MRI's, etc.)
- Capital and Operational funding keeps getting tighter





Future Projects

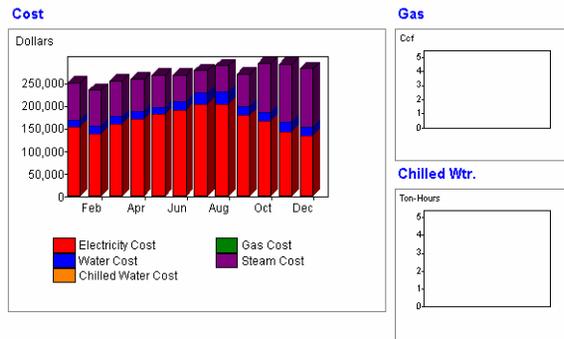
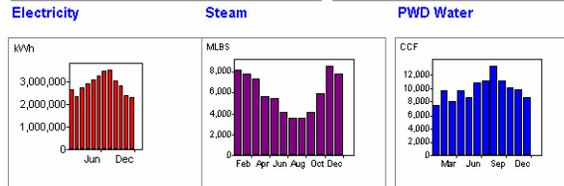
- Central Chilled Water Plant for 6 buildings-6600 tons
- Package Boilers in 3 buildings
- Lighting controls in TJU buildings



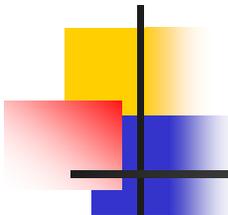
Live Demo of Metering System and Tour of Mechanical Room

Monthly Use and Cost - All Utilities

Name: **Gibbon Building** Period Ending: **12/02**



Month	Consumption					Cost					Total Dollars
	Electricity kWh	Gas Ccf	PWD Water CCF	Steam MLBS	Chilled Wtr. Ton-Hours	Electricity Dollars	Gas Dollars	PWD Water Dollars	Steam Dollars	Chilled Wtr. Dollars	
Jan	2,641,458	-	7,500	8,162.5	-	155,547.60	-	14,372.03	83,584.00	-	253,503.63
Feb	2,351,010	-	9,690	7,711.8	-	139,712.95	-	18,010.90	78,968.83	-	236,692.69
Mar	2,735,016	-	8,092	7,217.5	-	181,476.96	-	15,316.60	79,536.85	-	266,330.41
Apr	2,896,308	-	9,699	5,646.5	-	172,434.56	-	18,002.07	69,903.67	-	260,340.30
May	3,079,224	-	8,726	5,345.4	-	182,368.40	-	16,379.84	69,971.29	-	268,719.53
Jun	3,247,538	-	10,081	4,093.8	-	191,557.90	-	19,904.59	57,722.58	-	269,205.07
Jul	3,477,336	-	11,139	3,562.0	-	205,145.80	-	24,014.08	50,259.82	-	279,419.70
Aug	3,502,470	-	13,275	3,643.3	-	205,307.75	-	26,826.74	57,126.94	-	289,261.43
Sep	3,033,678	-	11,047	4,162.9	-	179,081.61	-	21,143.32	71,976.54	-	272,201.47
Oct	2,809,566	-	10,194	5,922.0	-	166,648.10	-	21,201.76	107,425.08	-	295,274.94
Nov	2,420,346	-	9,864	8,446.9	-	144,124.67	-	20,612.83	130,082.26	-	294,819.76
Dec	2,294,526	-	8,747	7,754.1	-	136,949.78	-	18,557.02	127,787.57	-	283,294.37
Period	34,488,474	0	118,854	71,669	0	2,040,356	0.00	234,421.78	984,345.43	0.00	3,259,123



Handout, Questions & Answers

- Presentation handout
- I want to thank Ron Bowlan, Associate Vice President at Thomas Jefferson University
- Bruce Henderson, System Administrator at Thomas Jefferson University
- Louie Nazirides, Steamgard
- Greater Philadelphia Association of Energy Engineers
- Questions, call me at 215-503-6099 or e-mail, Randoph.Haines@jefferson.edu

