Background for Monitoring-Based Commissioning

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LBNL

Research Sponsors

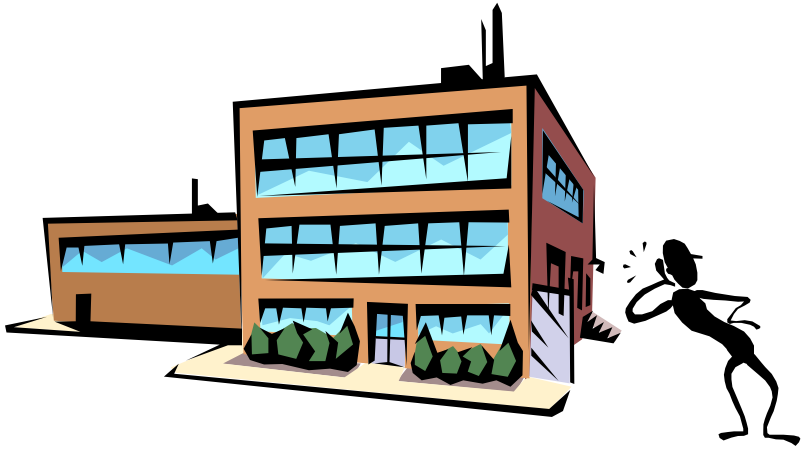
US Dept. of Energy
Calif. Energy Commission
Sacramento Muni. Utility District
Calif. Institute for Energy and the Environment
General Services Administration

Brief History of Monitoring-Based Commissioning (MBCx)

1993	**SMUD/PECI**	**1st National Conference on Building Cx**
1994-1999	**California Utilities/CIEE**	**"Diagnostics for Cx & Operations"**
		IMDS 160 Sansome Street
	CEC/CIEE	**IMDS 925 L Street**
	Texas A&M	**~ 100 Buildings**
	California Cx Collaborative	
2000-03	**SMUD/CIEE**	**IMDS 925 L Street**
		Persistence of Retro-Cx
	PIER	
	UC Santa Barbara	
	CSU Long Beach	
	Central Florida State University	
	UC Merced	**Planning and Design**
2004-05	UC/CSU/IOU Partnership	UC/CSU Campuses
	PIER	

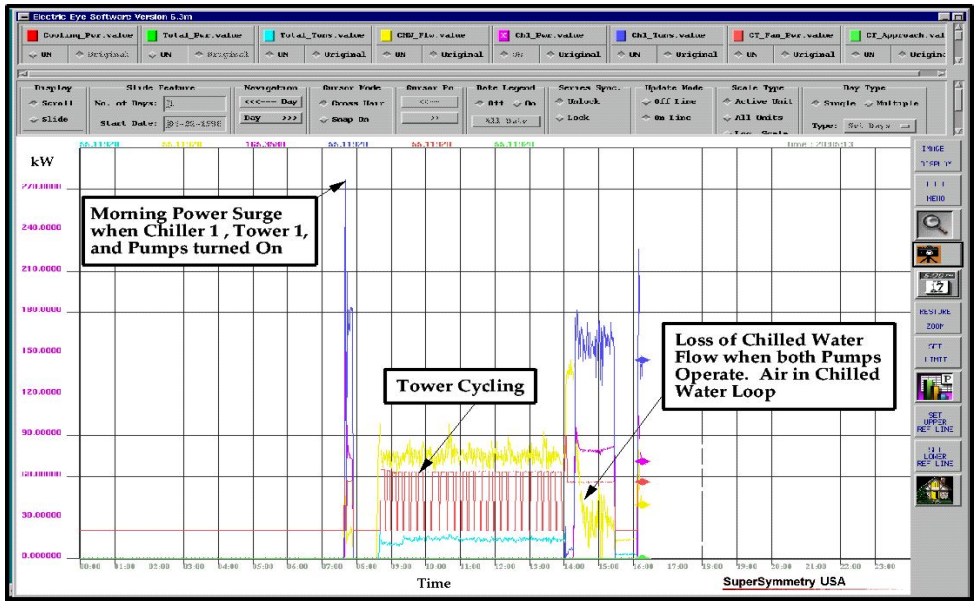
Performance Issues & Problems

- Lack of commissioning, especially of controls
- Retro-Commissioning demonstrates savings from "fixing" buildings
- Operators lack knowledge of "Design-Intent"
- Operators run buildings with minimal feedback
- Operators have few tools for performance analysis



Commissioning

- **Multiple Definitions… A set of procedures & methods to advance a system from static installation to full working order in accordance with design intent**
- **Types of Commissioning**
  - **New or Initial Commissioning**
  - **Re-commissioning**
  - **Retro-commissioning**
  - **Tune up**
  - **Continuous or On-Going**
- **Tools for Operators**
- **Tools for Engineers**



Persistence of Savings from CX

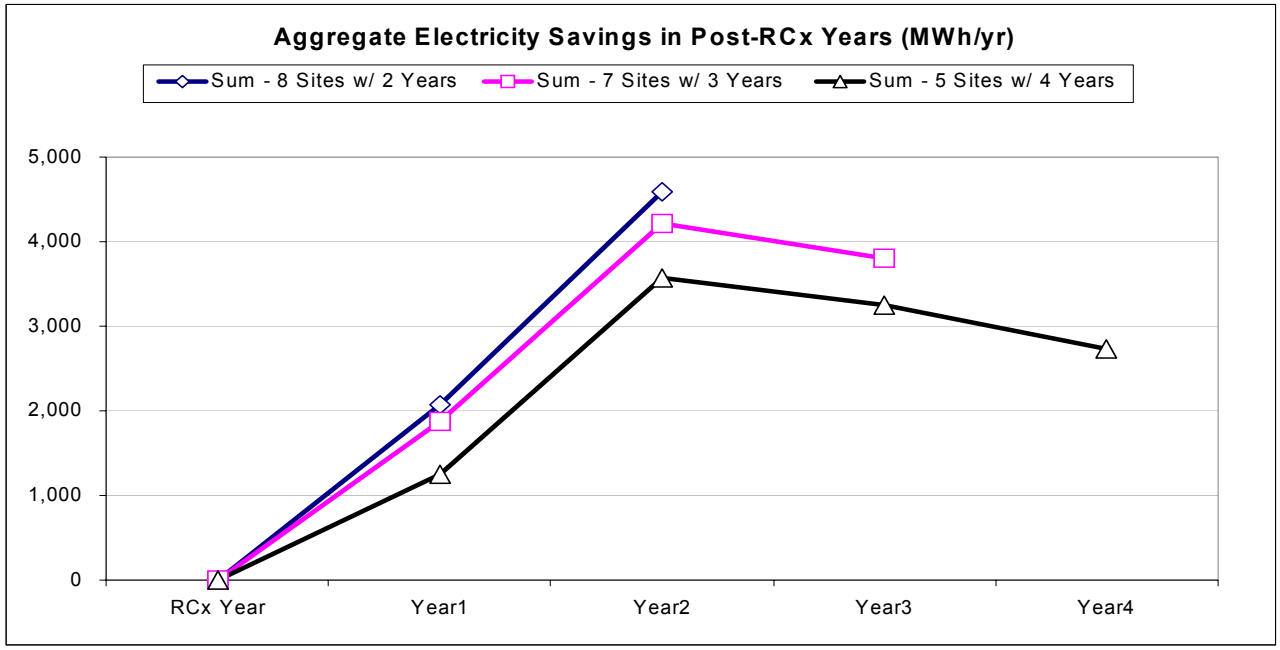
Retrocommissioning Participants in Year 1999

- Office1 (352,000 ft2)
- Hospital1 (267,000 ft2)
- Office5 (150,000 ft2)
- Lab1 (94,000 ft2)

•Recommissioning Participants in Year 2000

- Office6 (308,400 ft2)
- Office2 (383,200 ft2)
- Office3 (400,000 ft2)
- Office 4 (324,000 ft2)

Whole-Building energy data needed to help show
If energy use is increasing of decreasing!



Information Monitoring & Diagnostic System Prototype (early 1990s)

- Data acquisition system
- High quality sensors (power, flows, temps)
- Data visualization tools
- High frequency data
- Automated diagnostic prototype research

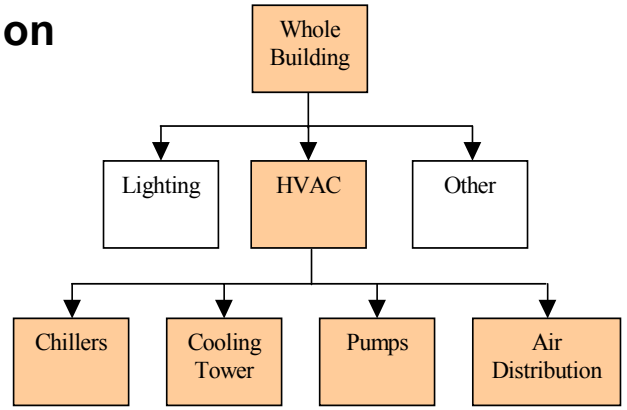
IMDS On-Site Archive

Internet
ISDN Connection

IMDS Remote Archive

- On-Site Electric Eye Software
- Real-time Remote Web Browser
- Public Access

Supersymmetry LBNL



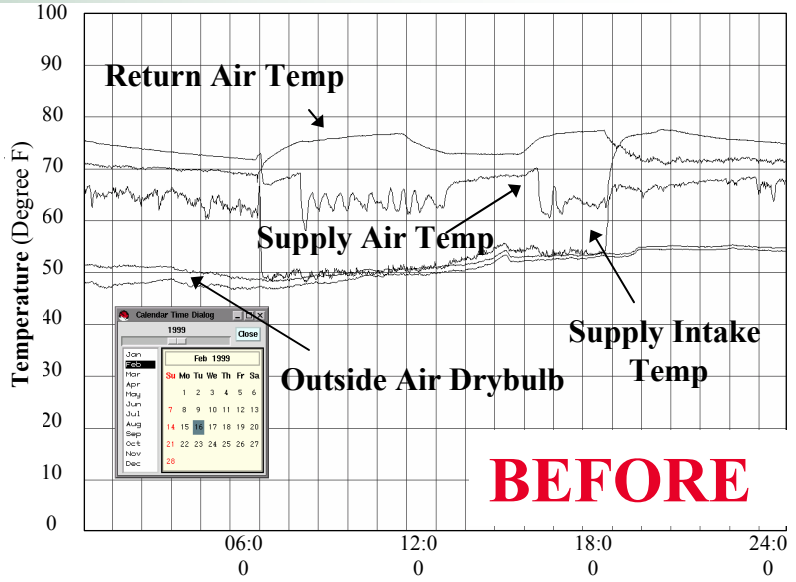
IMDS Evaluation Results

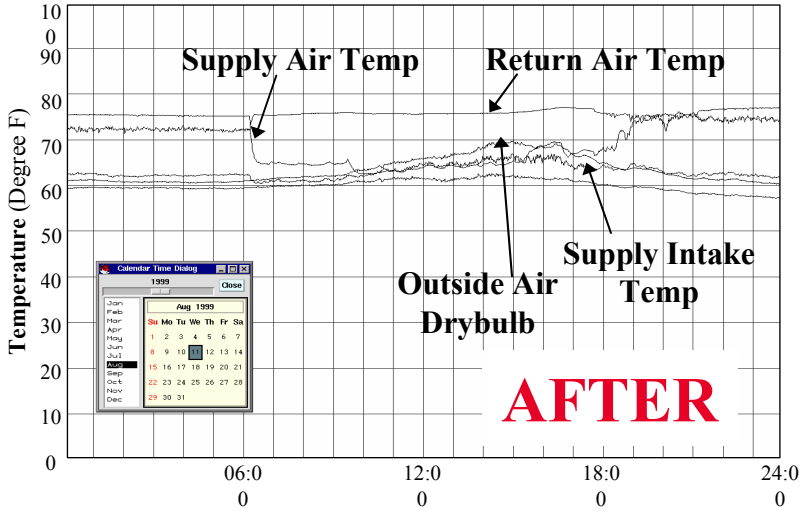
Key Benefits of IMDS

- Dramatic improvement in control & automation
- Better comfort & reduced complaints
- Extended equipment life

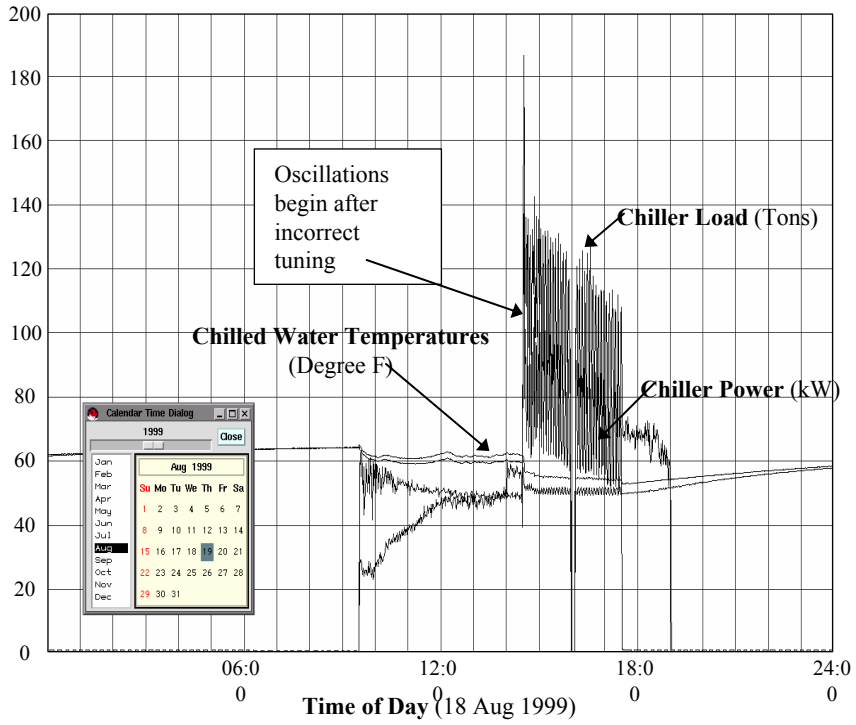
Desire for New Technology

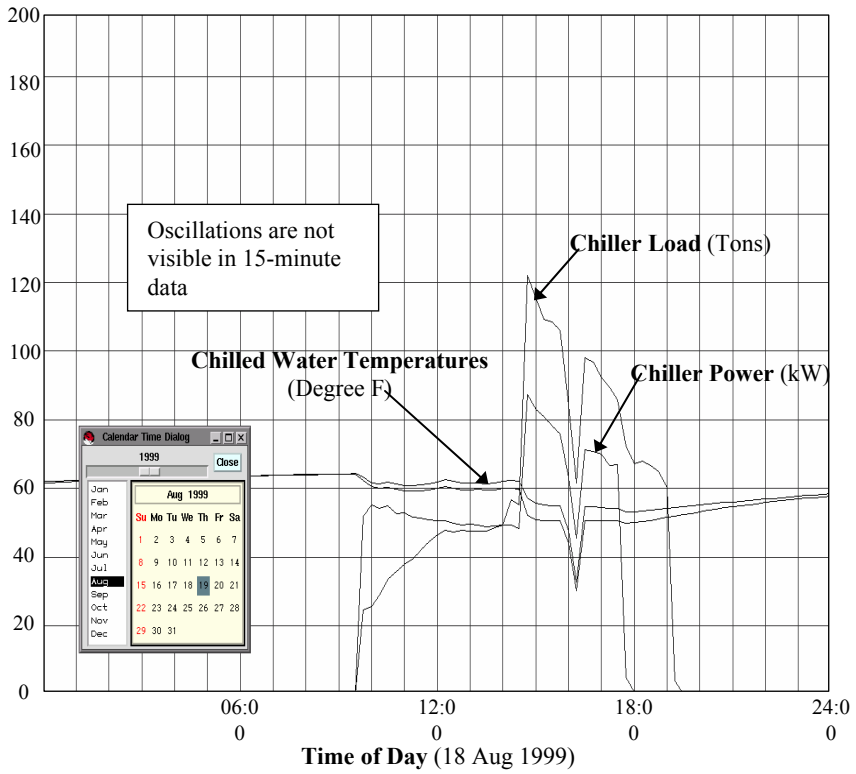
- Continuous archive
- Real-time graphical analysis
- Web-based remote access





Inlet Vane Control Problem





IMDS Sites and Results

San Francisco (1998)

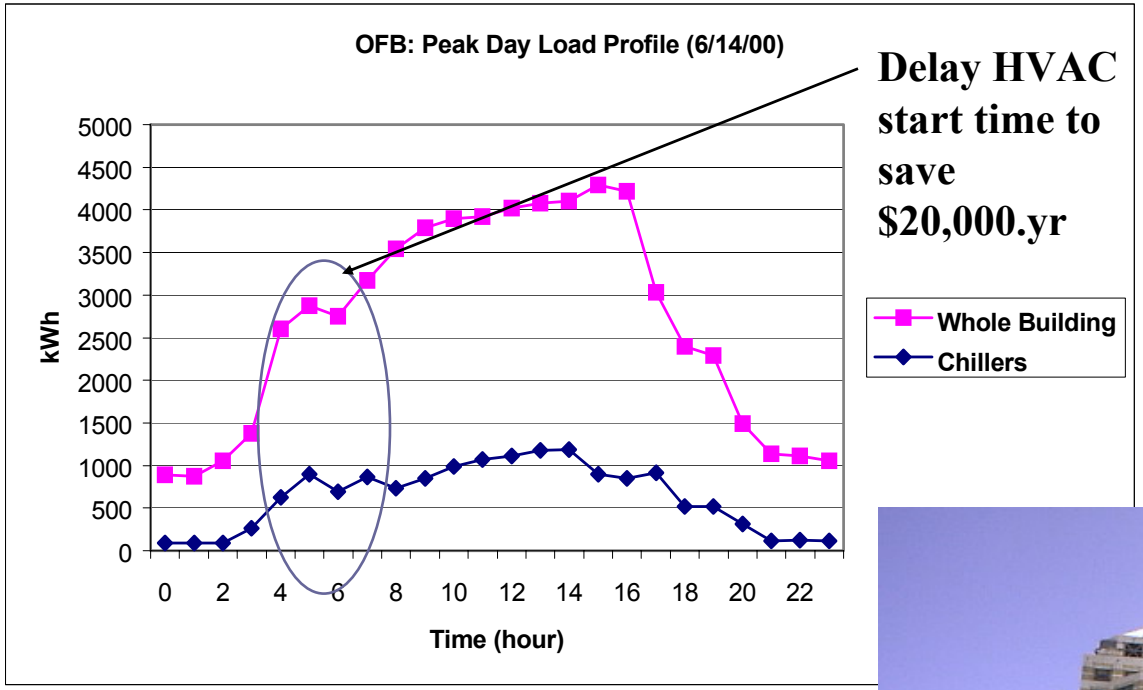
- Dramatic improvement in controls & automation
- Better comfort & reduced complaints
- Extended equipment life
- Energy down 16% after IMDS-based retrofit

Sacramento (2001)

- Largest US Property Management Company
- Reduced cost and new features
- More conventional operations staff
- Similar results – daily use by staff for control

LBNL Activities in Federal Buildings:

Utility and EMCS Data Analysis



Case Study – UC Santa Barbara

- 4.5 million ft^2 (conditioned space)
- Energy Information System
  - EEM Suite™
  - Installed in Summer 2001

- Case Study
  - EIS Costs
  - EIS Operations
  - Findings from the EIS
  - Energy Savings
  - Costs and Benefits

EIS Operation

- **Daily routine**
  - Eyeball time-series graphics, etc.
  - Spend at least 30 minutes a day.
- **Occasional uses**
  - Check equipment performance when it was retrofit.
  - Check system operation when the energy manager tests new operational strategies.
  - Spend more time on EIS than usual.

24 Hour Line Chart report - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media

Address http://128.111.142.104/siliconenergy/data_analyst/asp/report_line_frame.asp

EEM·Suite

powered by Silicon Energy

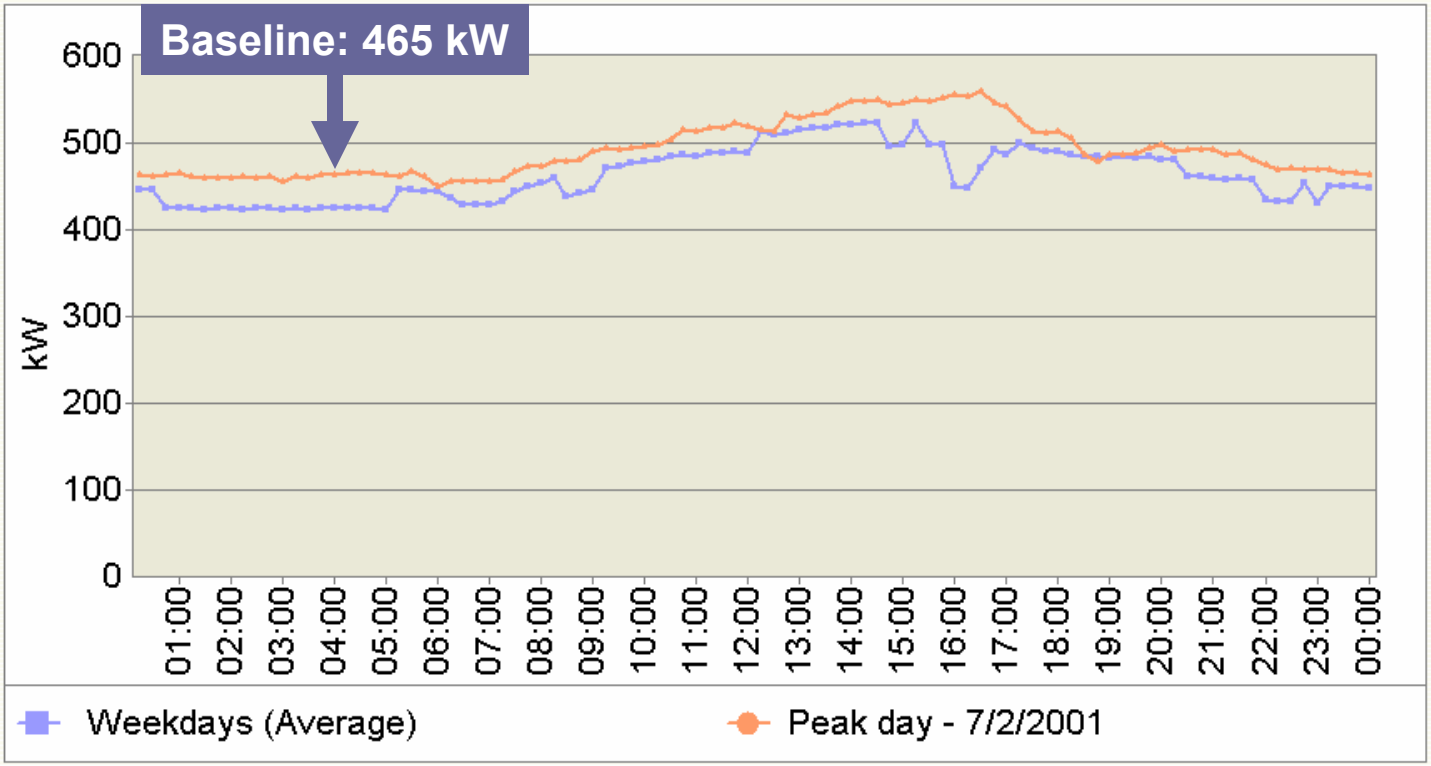
24 Hour Line Chart report

- Home
- Enterprise Navigator
- Alarm Manager
- Forecasting
- Data Analyst
  - Single Point Trend
  - Multi-Point Trend
  - 3D Surface Chart
  - 24 Hour Line Chart
  - Scatter Plot
  - Statistical Summary
  - Histogram
  - Single Point Digital
  - Multi-Point Digital
  - Data View and Export
- Energy Analyst
- Cost Analyst
- System Manager
- My Favorite Reports
- Point group editor
- User preferences
- Help
- About
- Logout

24 Hour Line Chart report

Day of week: Weekdays

Report date: 9/30/2003 6:26:41 PM
Report span: 7/1/2001 - 7/31/2001
Total days: 22



Data summary

Point: 45 / pnorth.pw6572.PSB North Electrical Demand					
Minimum	Minimum time stamp	Maximum	Maximum time stamp	Average	Units

Internet

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24 Hour Line Chart report - Microsoft Internet Explorer

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Address

EEM·Suite

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24 Hour Line Chart report

Day of week: Weekdays

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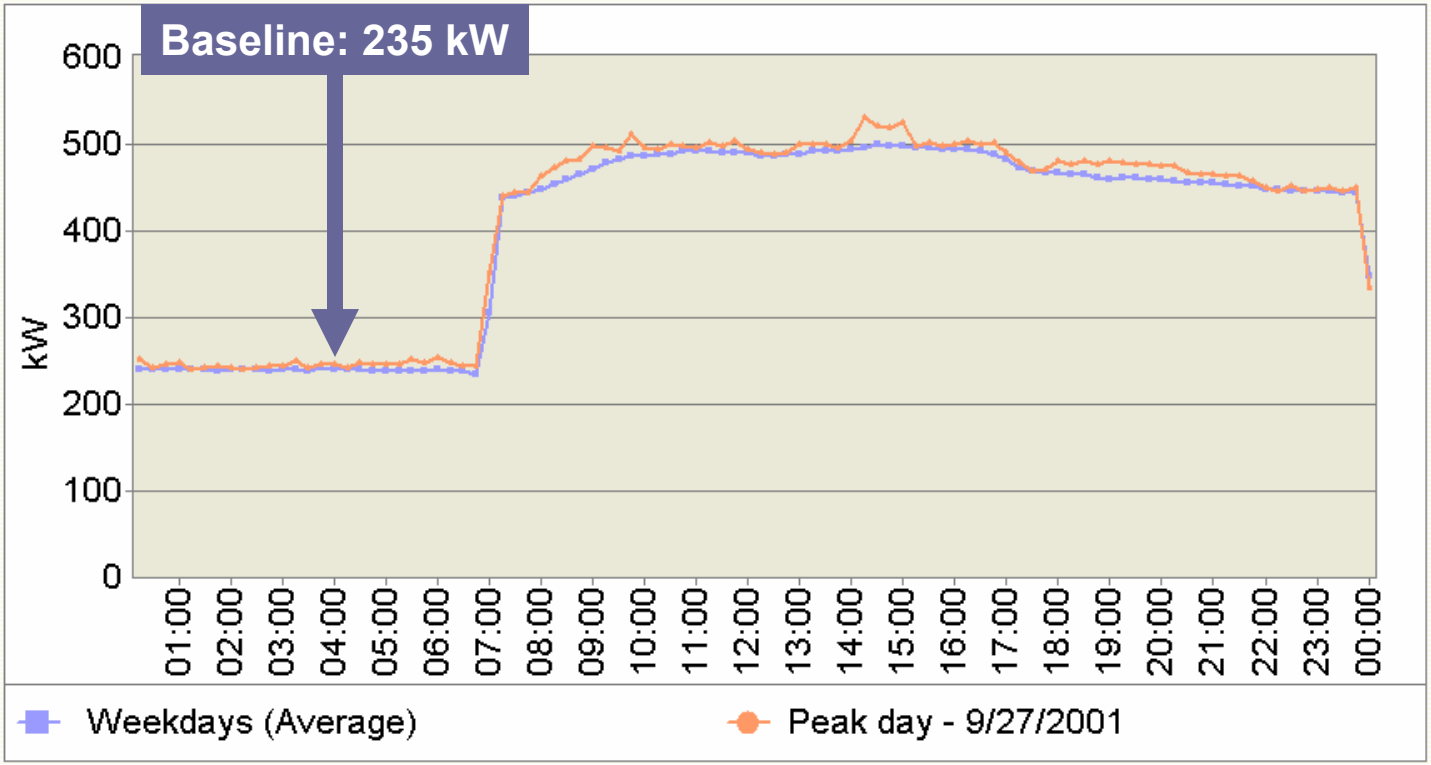
Report span: 9/1/2001 - 9/30/2001
Total days: 20



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Internet

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UCSB EIS Cost/Benefit Analysis

Electricity Cost Saving

	Electricity [MWH]	Peak Demand [kW]	Total
May00-April01	83,700	12,742	
May01-April02	75,100	11,362	
Saving	8,600	1,300	
Cost saved	$430,000 (10.3%)	$160,000 (12.4%)	$590,000 (10.8%)
Due to EIS (50%)	$215,000	$80,000	$295,000

EIS first year cost: $295,000

Payback period: 1.2 year

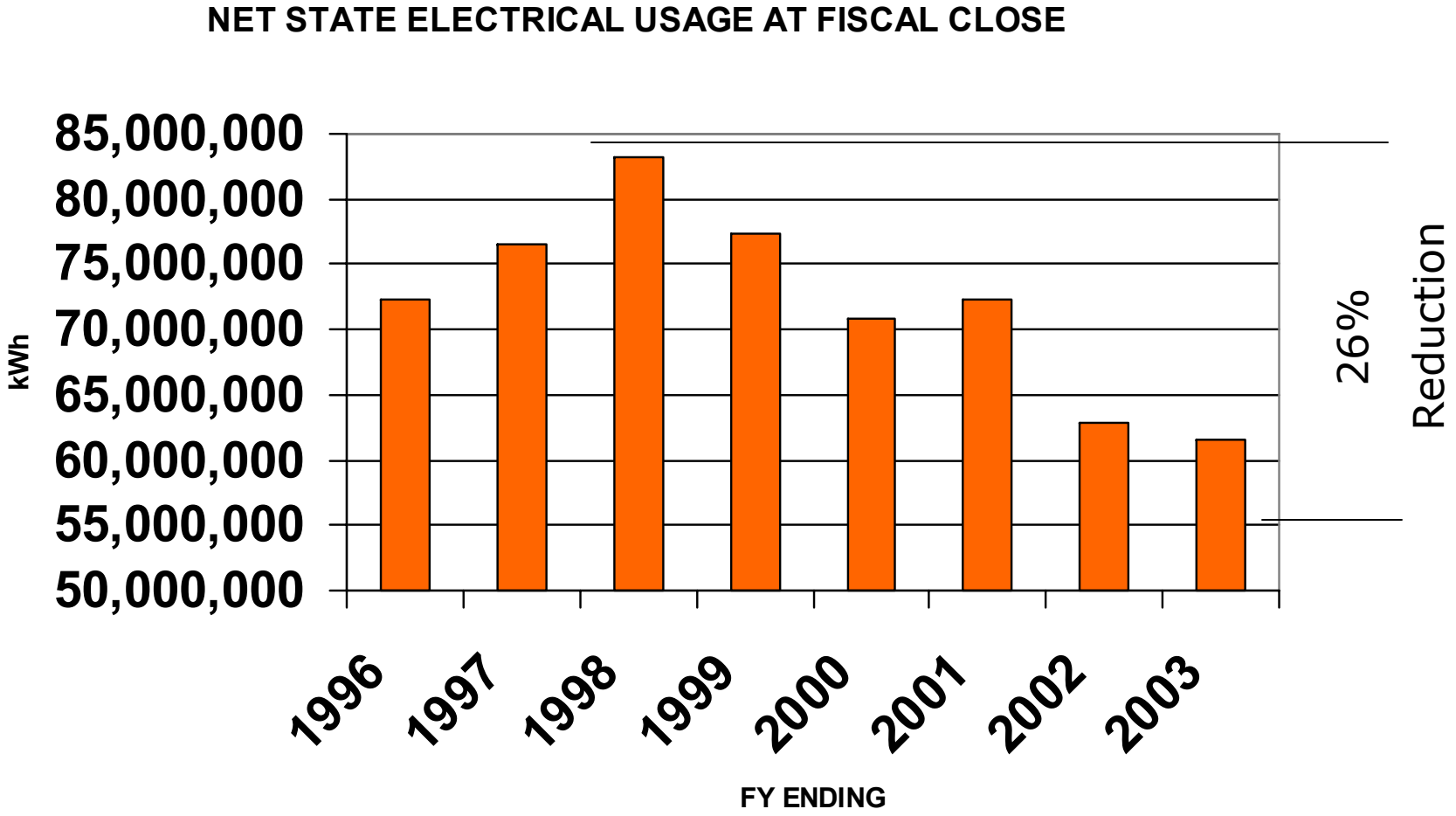
Conclusions at UCSB

- UCSB Campus achieved significant savings (25%) by combination efforts of capital investments and O&M.
- EIS helped to find O&M energy savings.
- EIS helped to quantify each saving opportunity in capital investment or O&M.
- EIS reduced time-consuming work.
- If the facility did not have someone proactive to analyze the data, the EIS would be useless.

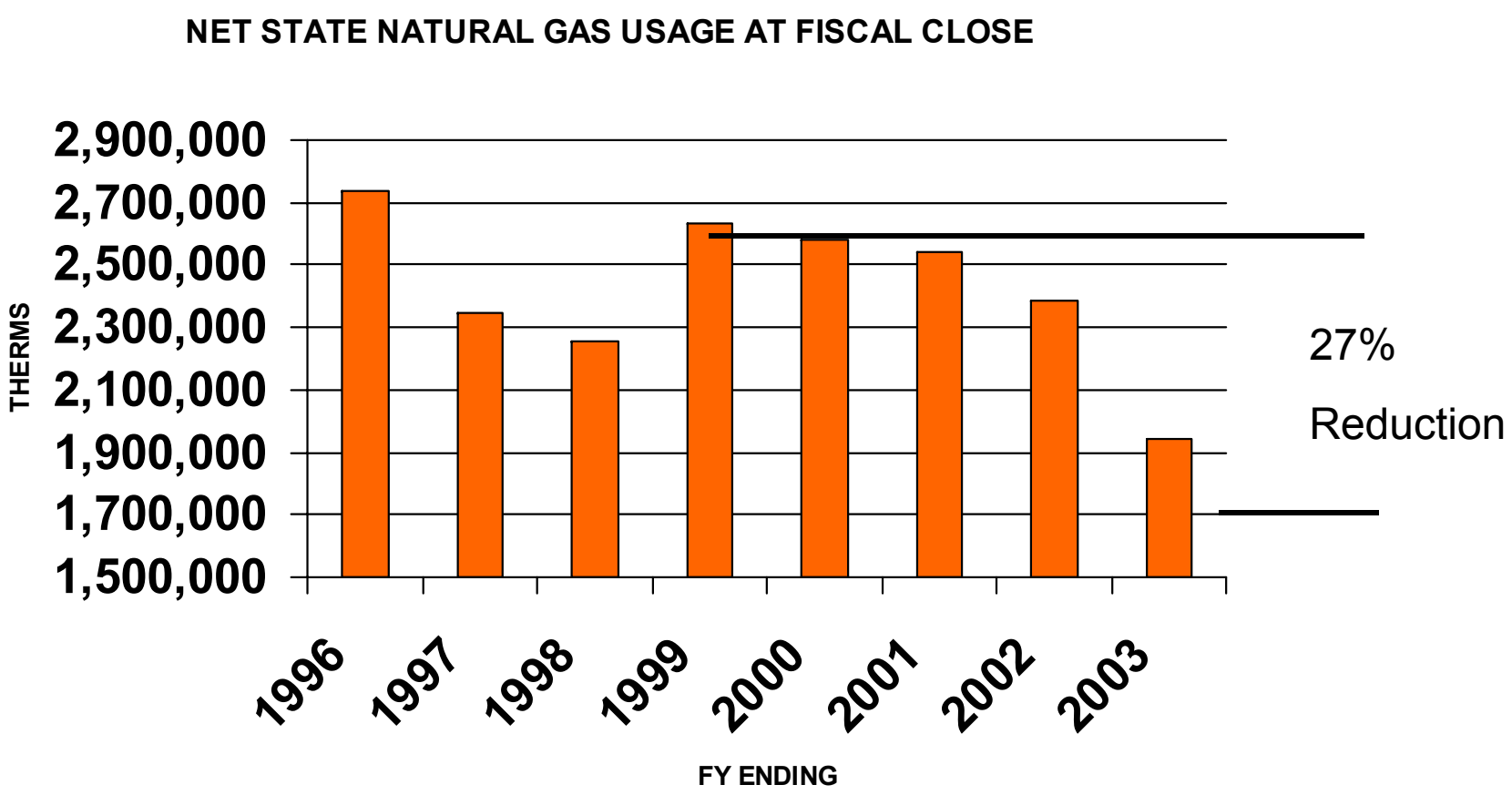
Evaluation of Current Diagnostic Tools

		Detection									Diagnosis
		Bench-mark	Raw data visual	Ref. line	Stats	Perf. Metrics	Guide	Rules	Model baseline	**Cost**	Rules
		Manual						*Automated*			
ENFORMA			✓	✓	✓-	✓	✓				
UCB Tools			✓	✓	✓	✓	✓				
UT			✓	✓	✓	✓-		✓-			✓-
WBD	**WBE**					✓			✓	✓	
	OA/E							✓		✓	✓
PACRAT		✓	✓		✓	✓+		✓+	✓	✓	✓
EEM Suite		✓	✓		✓	✓					

Electrical Savings



Natural Gas Savings



Summary & Future Directions

- Great opportunities to integrate continuous monitoring & diagnostics to ensure efficiency
- Need to improve monitoring equipment, visualization, and automated analysis techniques
- Consolidation of utility and O&M activities
- Integration of energy and peak demand management with control
- Diagnostic research underway