SAND2008-3793C

In-house Retro-Commissioning

Optimizing Existing Buildings Energy for Efficiency

June 17, 2008

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

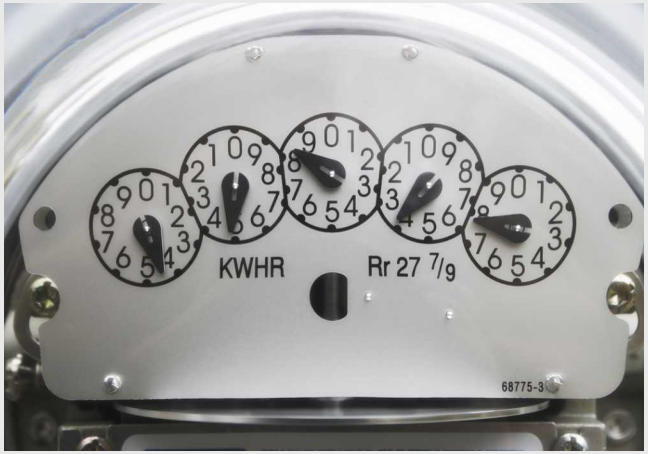
Sandia National Laboratories

Introduction

- Overview of Retro-Commissioning (Retro-Cx)
- History
- Criteria
- Process
- Building Specific Opportunities and Implementation

Types of Retro-Cx

- **Energy Reduction**
  - **Find and fix energy inefficiencies**
- **Customer Needs**
  - **Adapt the building to the need of the customer**
- **Reliability**
  - **Ensure equipment is maintained properly**
    - **High Downtime Costs**

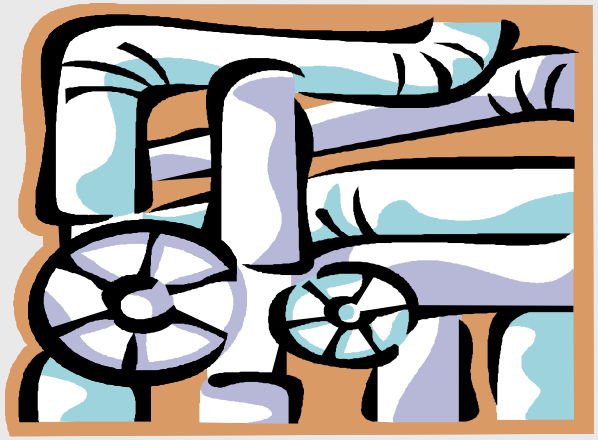


Retro-Cx Goal is to Save Energy

- Identify and resolve operating problems
- Improve comfort
- Optimize energy to meet “current” building requirements
- Reduce energy to meet DOE mandated energy reduction goals
- Future costs of electricity will double at Sandia National Laboratories New Mexico (SNL/NM) in 2009

Big Energy Users in Buildings

- HVAC accounts for 40-60% of the energy used in U.S. commercial and residential buildings
  - Source - U.S. Department of Energy



History

Retro-Cx at SNL/ NM

History of Retro-Cx at Sandia-NM

- **Third Party Retro-Cx (*April 2006)***
  - **In-house staff had to support third party (escort, educate them on the building automation system, union issues with maintenance)**
- **New Construction at all time high (822,781 square feet in past three years)**
  - **No time for in-house Retro-Cx**

History of Retro-Cx at SNL/ NM

- **During the construction boom, in-house Retro-Cx pilots of existing buildings were conducted**
  - **6585 (*Technology Support Center Office and Light Laboratory)***
    - **Operational problems, change in functionality of the building (lab to office)**
  - **PETL (*Processing and Environmental Technology Lab)***
    - **Tribal knowledge – high airflows in labs per design – airflows could be reduced and meet standard ratings for labs to save energy, the exhaust system was running at full capacity (detected on Facilities Control System (FCS))**

Building Criteria

The Selection Process

Criteria Spreadsheet

Retro Rank	Bldg	FCS Control	Btu/GSF per year FY07	Building GSF	Building Type	Mission Critical Concerns
1	**802**	Hybrid	66,972.82	161,246	OFFICE	Not Mission Dependent
2	**890**	Hybrid	111,888.51	147,438	OFFICE/L.LAB	Mission Dependent
3	**962**	Hybrid	104,631.25	151,472	OFFCIE/L.LAB	Mission Dependent
4	**897**	Total Control	104,713.09	144,125	OFFICE/L.LAB	Mission Dependent
5	**701**	Total Control	139,860.76	151,026	OFFICE/H.LAB	Mission Dependent
6	**880**	Hybrid	187,803,589.37	206,729	OFFICE/DATA CENTER	Mission Dependent
7	**821**	Total Control	96,413.98	85,594	OFFICE/L.LAB	Mission Dependent
8	**823**	Hybrid	84,710.21	145,321	OFFICE/L.LAB	Mission Dependent

Criteria Spreadsheet

Retro Rank	Bldg	Availability Gas, Elec.	Special Considerations	Maximo Tickets (Hot/Cold)	Customer Support	Building Age (Since last major Renovation)	Grand Total
1	**802**	E, NoGas	UPGRADED DIGITAL VAV	104		57	185
2	**890**	E, NoGas	24-7 OPERATION/HUMIDITY CONSIDERATIONS	40		19	173
3	**962**	E, G		15		19	168
4	**897**	E, NoGas	UPGRADED FROM STEAM TO BOILER	36		13	168
5	**701**	E, G	24-7	27	YES	7	168
6	**880**	E, NoGas	24-7 OFFICE FAN, 24-7 DATA CENTER	49	YES	55	166
7	**821**	E, NoGas	UPGRADED FROM STEAM TO BOILER	57		27	165

Most Important in Retro-Cx Criteria

- **Building energy intensity – British Thermal Units/ Gross Square Foot (BTU/GSF)**
- **Building GSF**
- **Customer Support**

In-House Retro-Cx Process

Important Steps

Process

- **Assemble Team – Appropriate for Facility**
- **Kick-off meeting (customer, building manager, building rep., bldg. system engineer…**
  - ❖ **Lessons Learned**
- **Compile Mechanical Equipment List (MAXIMO)**
- **Walk-down Facility with Building Operator**
  - **Determine special operational needs for building**

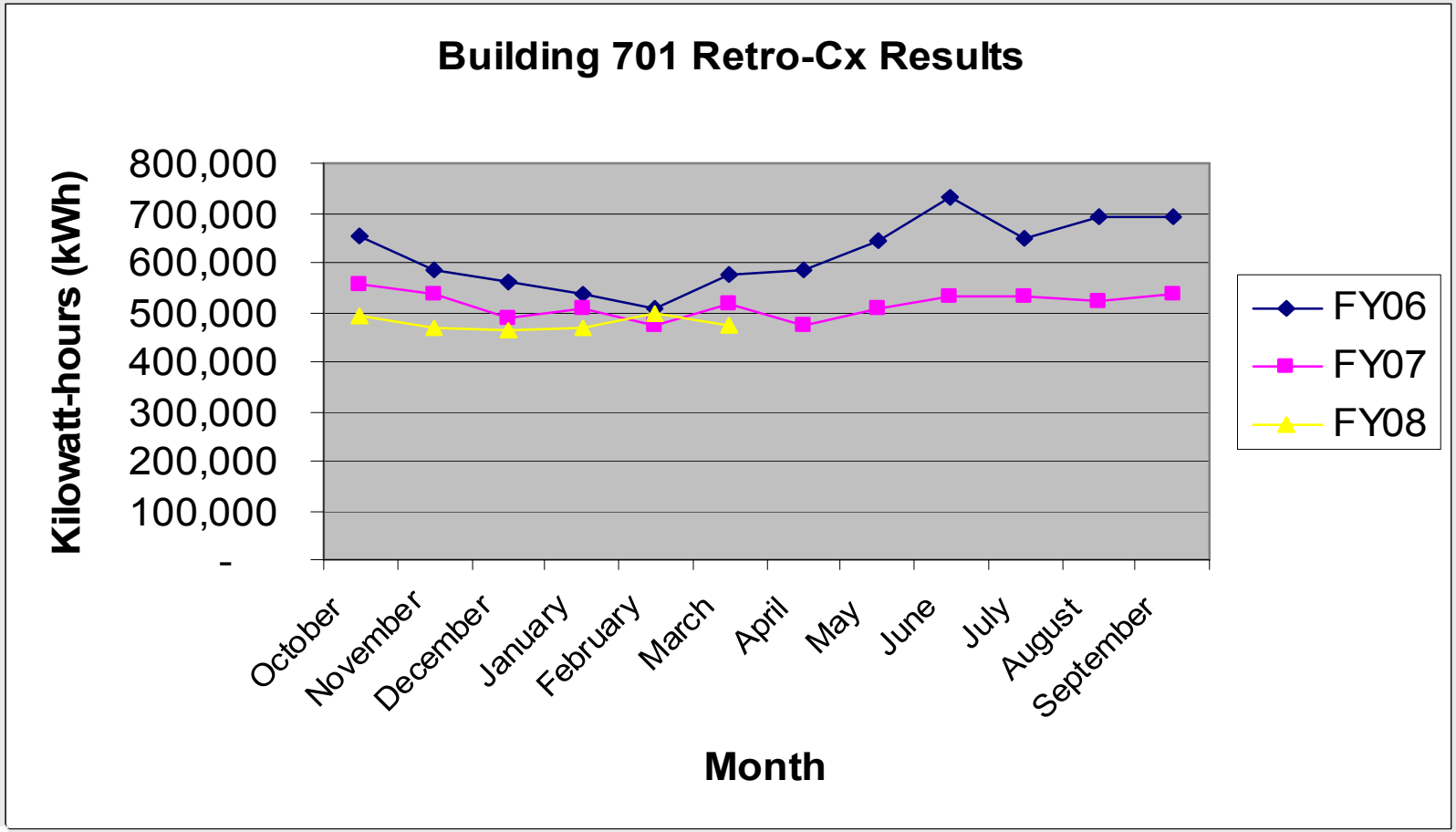
Process (continued)

- Building Survey
- Compile Deficiencies List
  - Verification of proper operation of components
- Trend/Monitor Energy Consumption Data and Customer Satisfaction
- Repair or replace any non-operational components (Maintenance)
- Verify Facilities Control System (FCS) Programming of Heating Ventilation and Air Conditioning (HVAC) System
  - Meets “current” building requirements

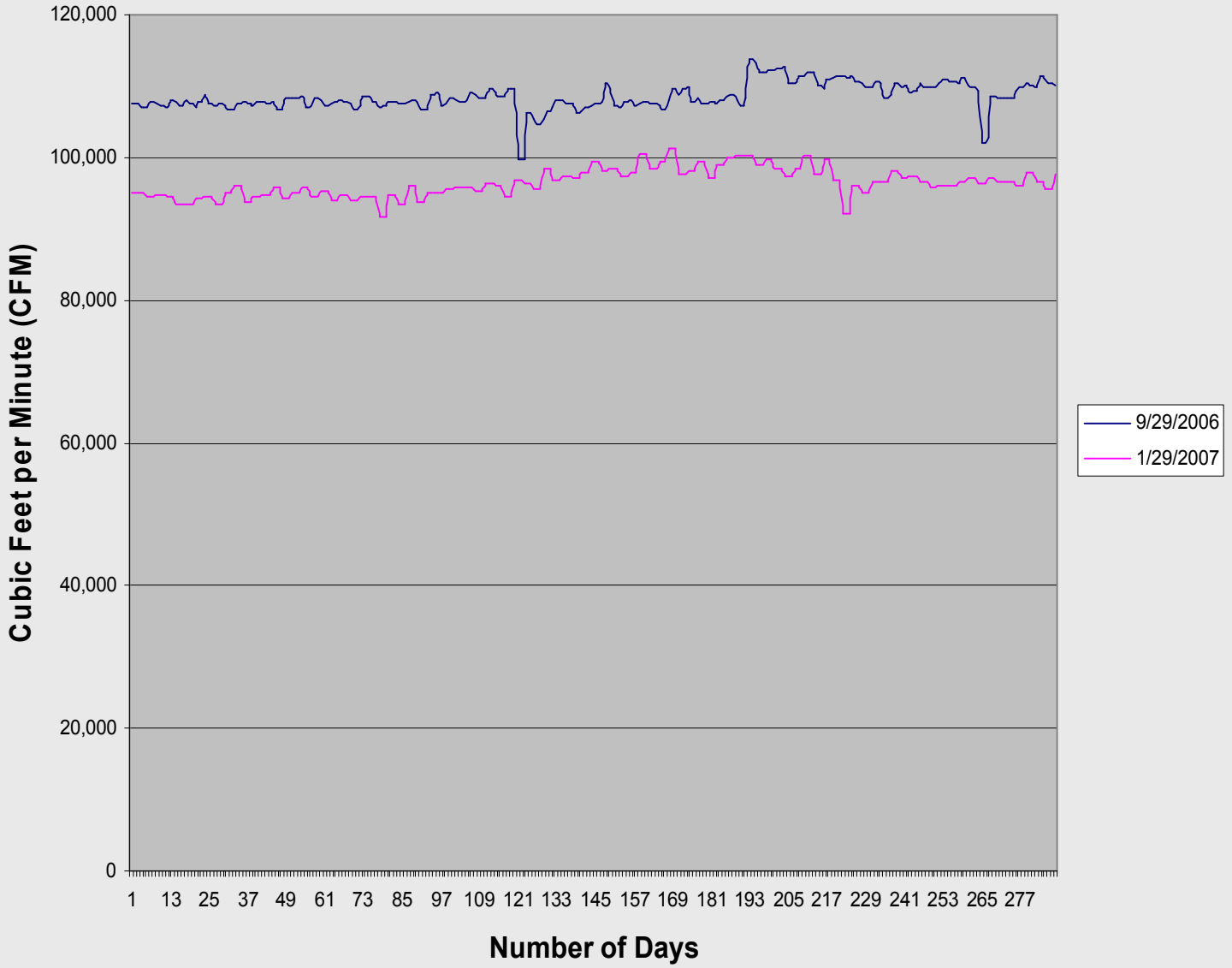
Pilot Retro-Cx Projects

701 & 6585

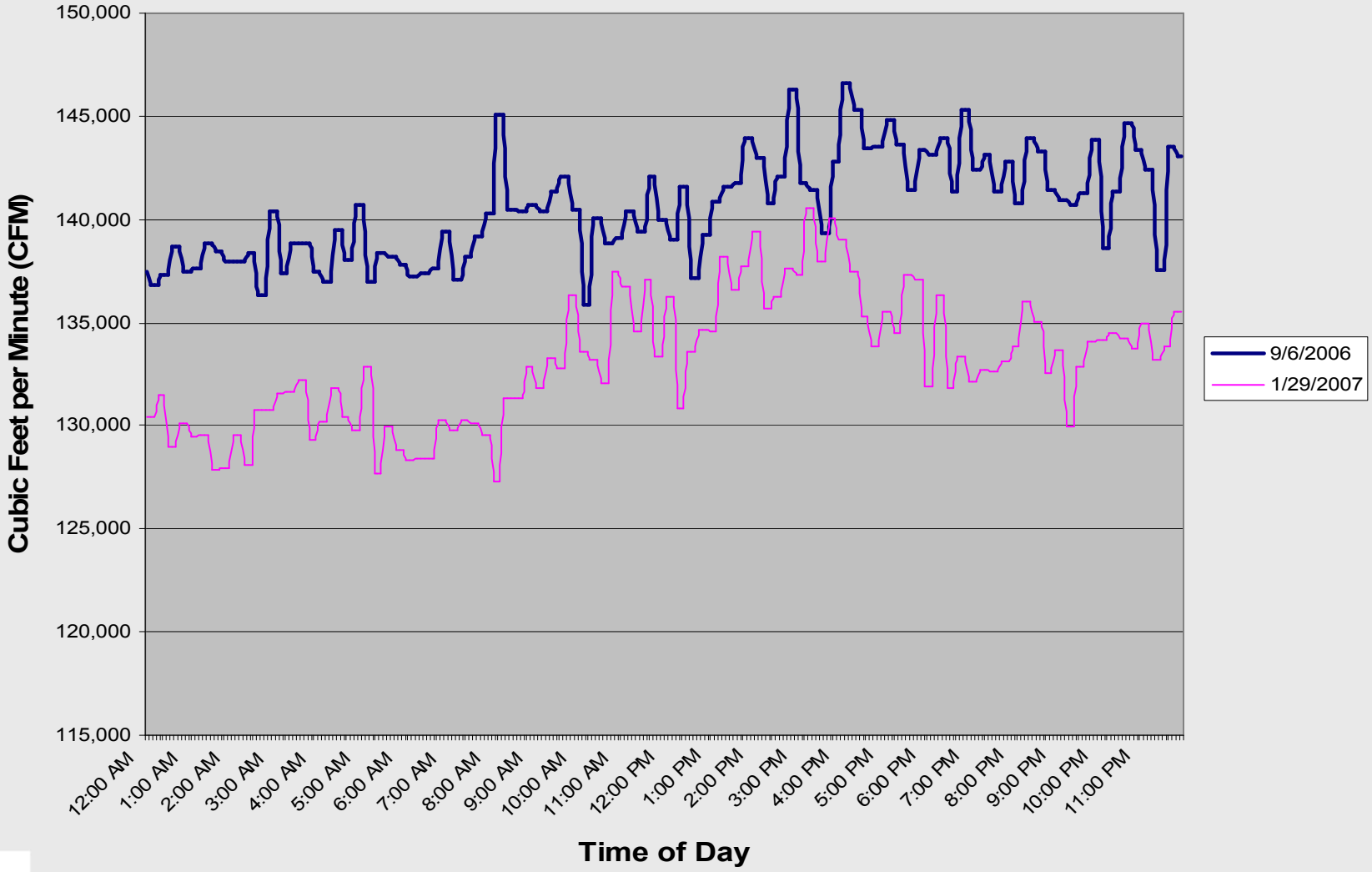
Load Profiles of PETL



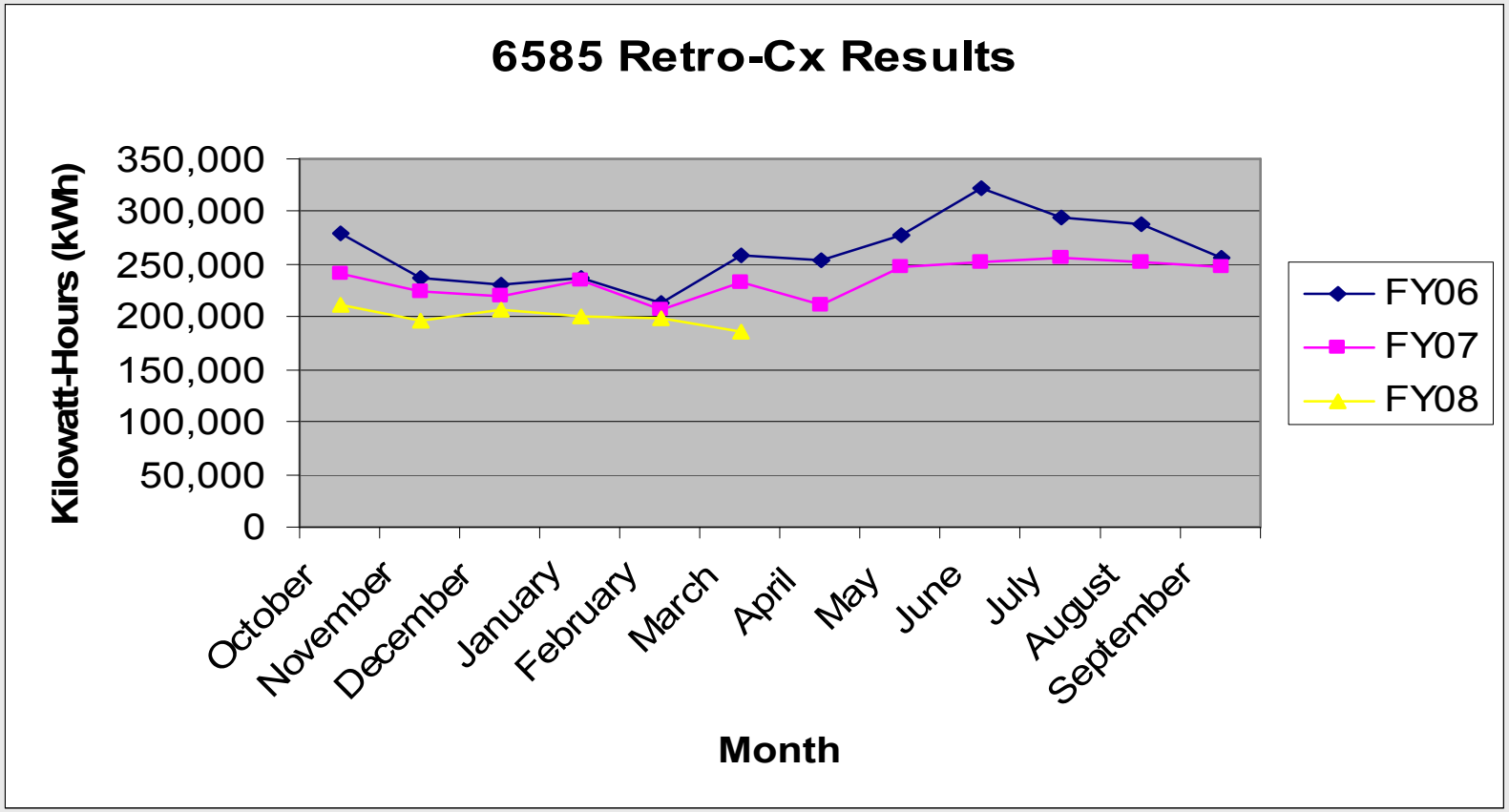
BLDG 701 Lab Makeup Airflow



BLDG 701 Exhaust CFM



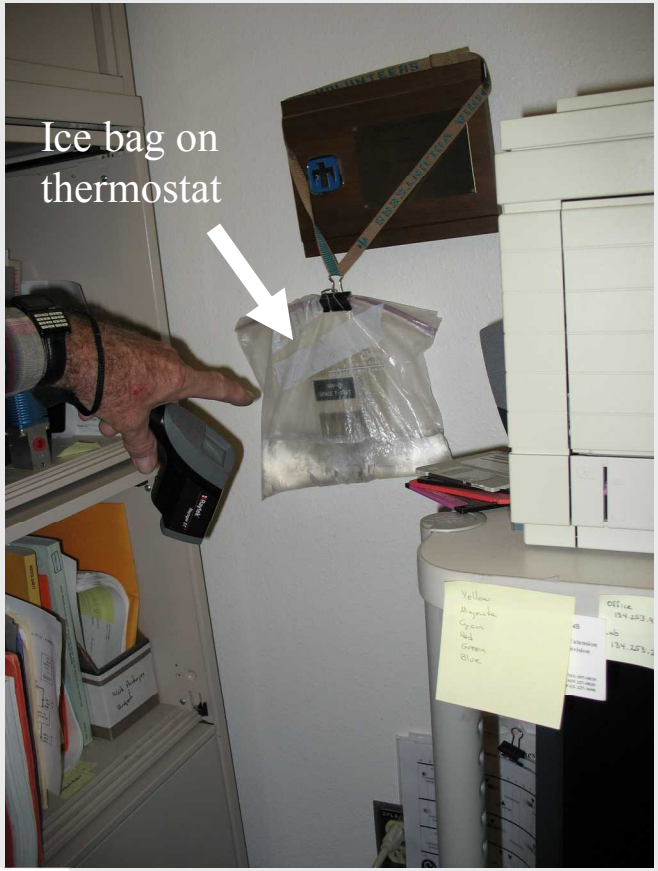
6585 Load Profile

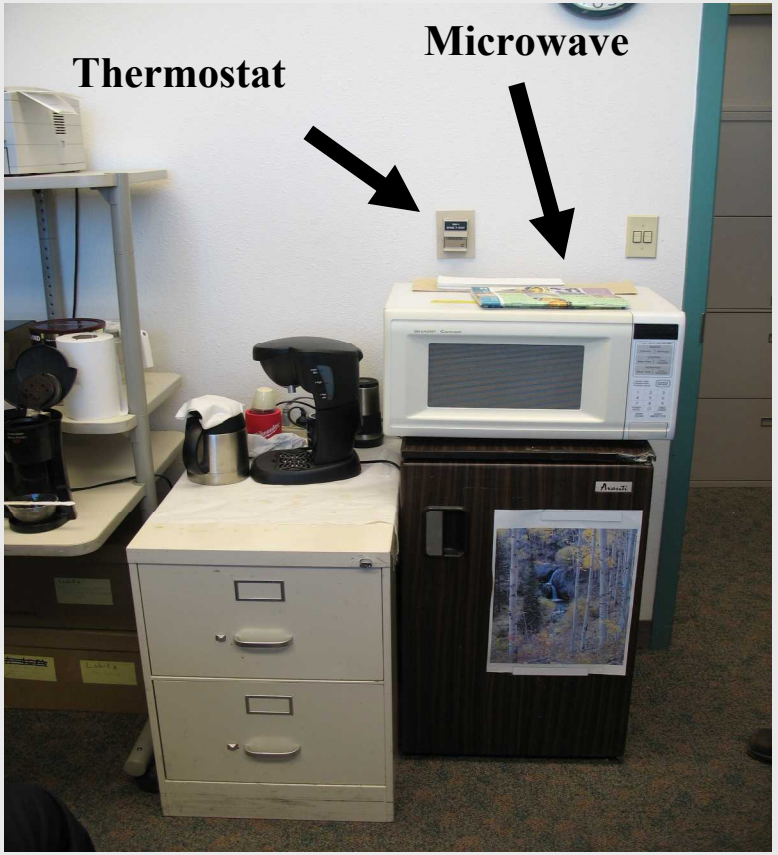


Annual Energy and Cost Savings

- **Building 701:**
  - 1,341,920 kWh
  - FY08: $53,500
  - FY09: $107,000
  - 1342 tons of carbon dioxide emissions avoided
- **Building 6585**
  - 452,888 kWh
  - $ 18,115
  - FY09: $36,230
  - 453 tons of carbon dioxide emissions avoided

Interesting Findings





Building 880

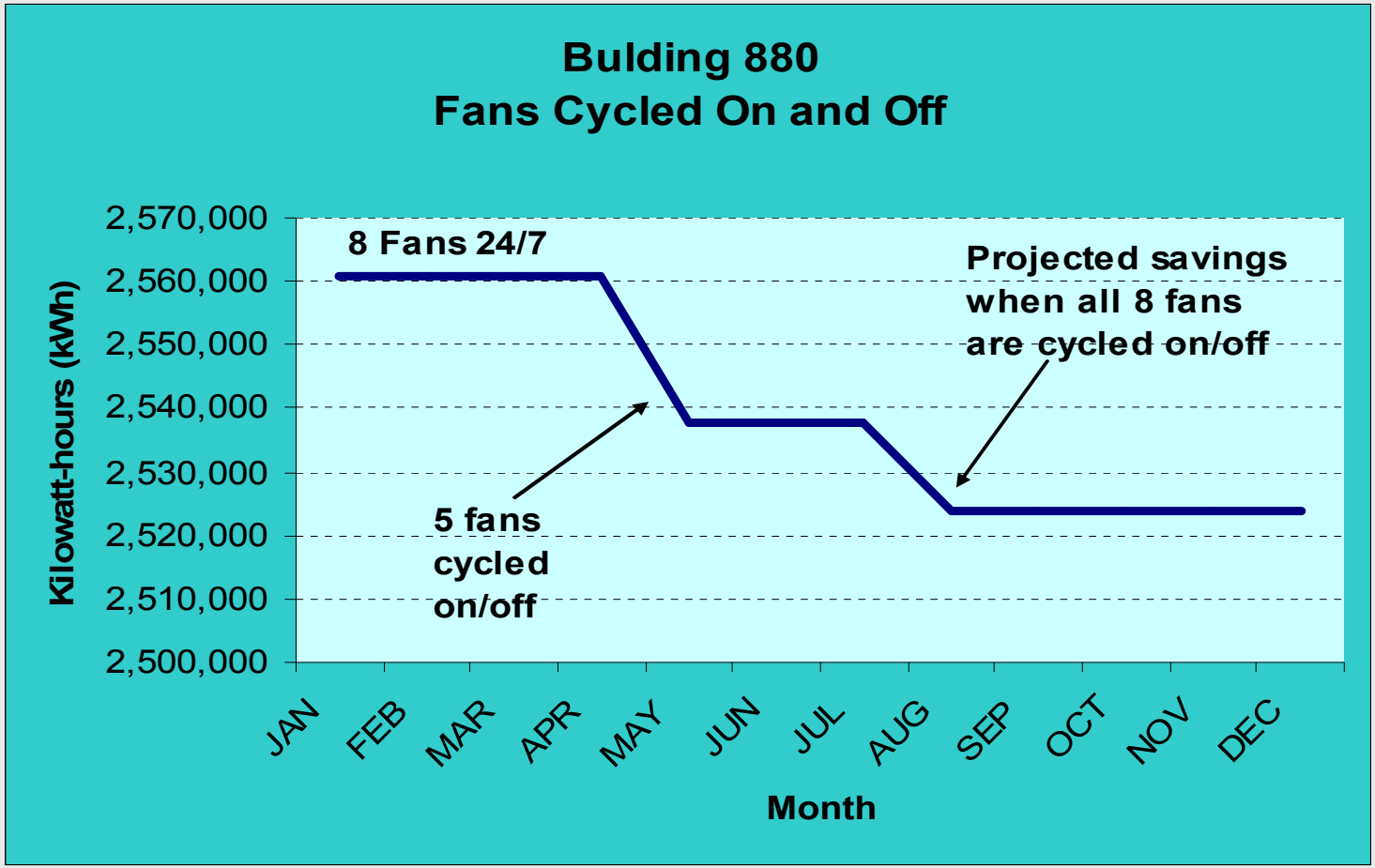
Current Retro-Cx Project

880 Retro-Cx Process

- Building Description – Started off as a warehouse (1953)
  - 153, 530 Gross Square Feet
- Obvious Fixes
  - Office Fans operating 24 hours/ 7 days a week
  - Economizer Fans 1-8 non-operation (building static problems)
  - 880 Annex - ∆T issues – Cold side Control of CRAC Units
- Tribal Knowledge
- FCS - Findings

Building 880

Initial Retro-Cx Results



Conclusion

- In-house Retro - Cx is a good Return on Investment (ROI)
- Previous projects had a payback of less than one year
- Improved Occupant Comfort
- Reduced energy consumption
- ROI will be shorter as the cost of energy increases