Using Six Sigma to Reduce Energy with Limited Data

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Rockwell Collins

Rockwell Collins

Is this how your company manages energy?

Photo courtesy of University of Iowa Energy Control Center

Agenda

- About Rockwell Collins
- Utility Bills
- Utility metering
- Employee Input
- Sneaker Net
- Regression
- Sub-metering
- Summary

Objective: To give you ideas for gathering energy data that you can personally implement, or share with your Facilities and ES&H personnel

Why are you here?

Rockwell Collins

- A global company operating from more than 60 locations in 27 countries
- 19,000 employees on our team
- Provides navigation, communications and display products and systems for military and commercial customers

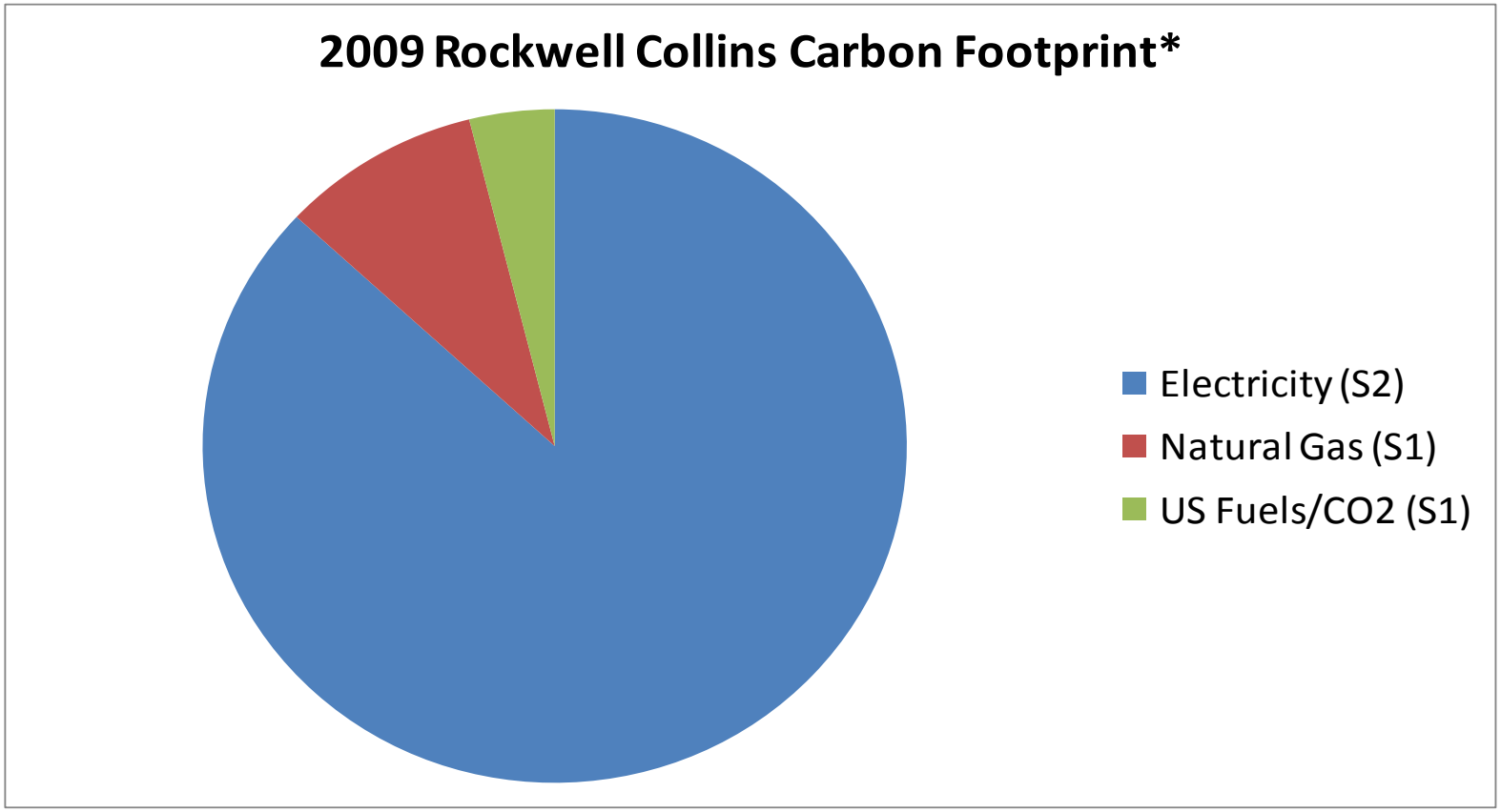
Lean Electronics℠

- Started in 1998
- Heavy on Lean tools initially
- Incorporated Six Sigma tools in 2007
- Lean Electronics℠ is an umbrella over all continuous improvement
  - Theory of Constraints (TOC), Six Sigma, Lean, Total Quality Management (TQM), Change Management, etc

- Six Sigma tools are deployed when addressing more complex problems, or after the "low-hanging fruit" has been picked

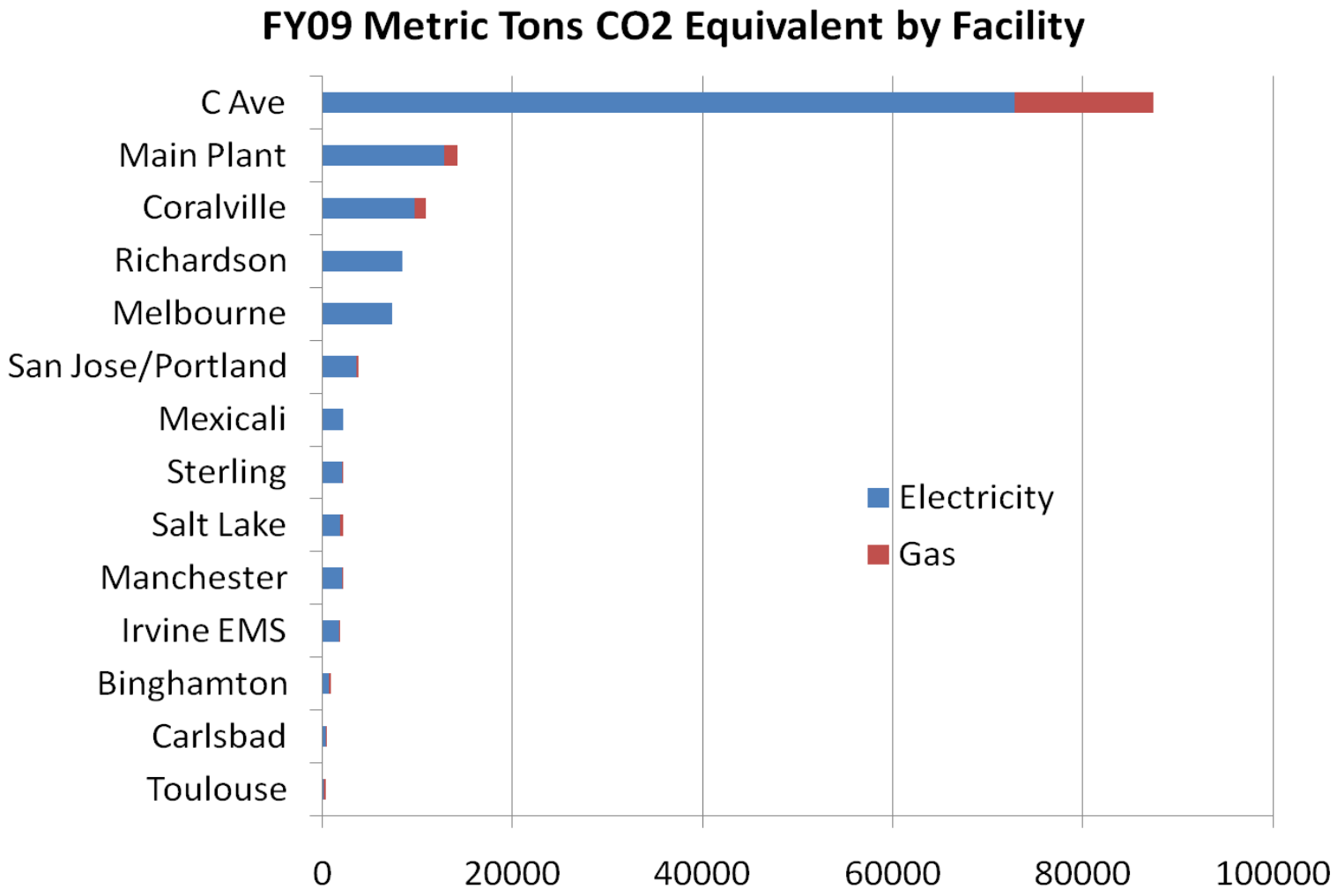
Be tenacious about gathering data!

Reduce Carbon Footprint by 15%

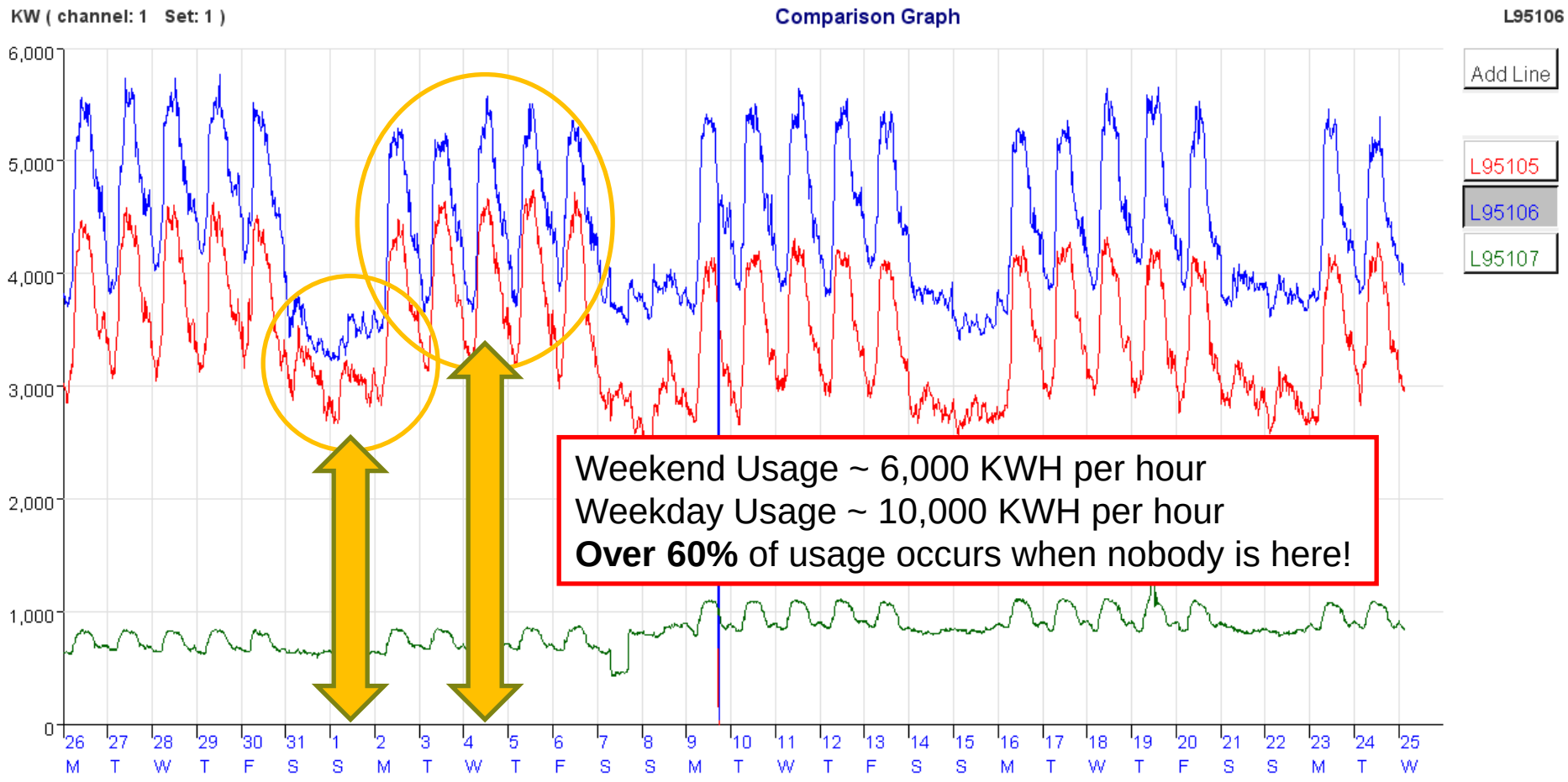


Facilities Needed Top Down Approach

Utility Bills



Utility metering



Data from 10/26/09 to 11/25/09

Breakdown of data within facility

- Complex is 1.4 Million square feet (circled in red)
- No breakdown available at lower level
- Energy "hogs" were known, but only an educated guess, and hard to show improvement
- Many ideas to pursue, but wanted clear success on first project

Brainstorming - Items left on during off-hours

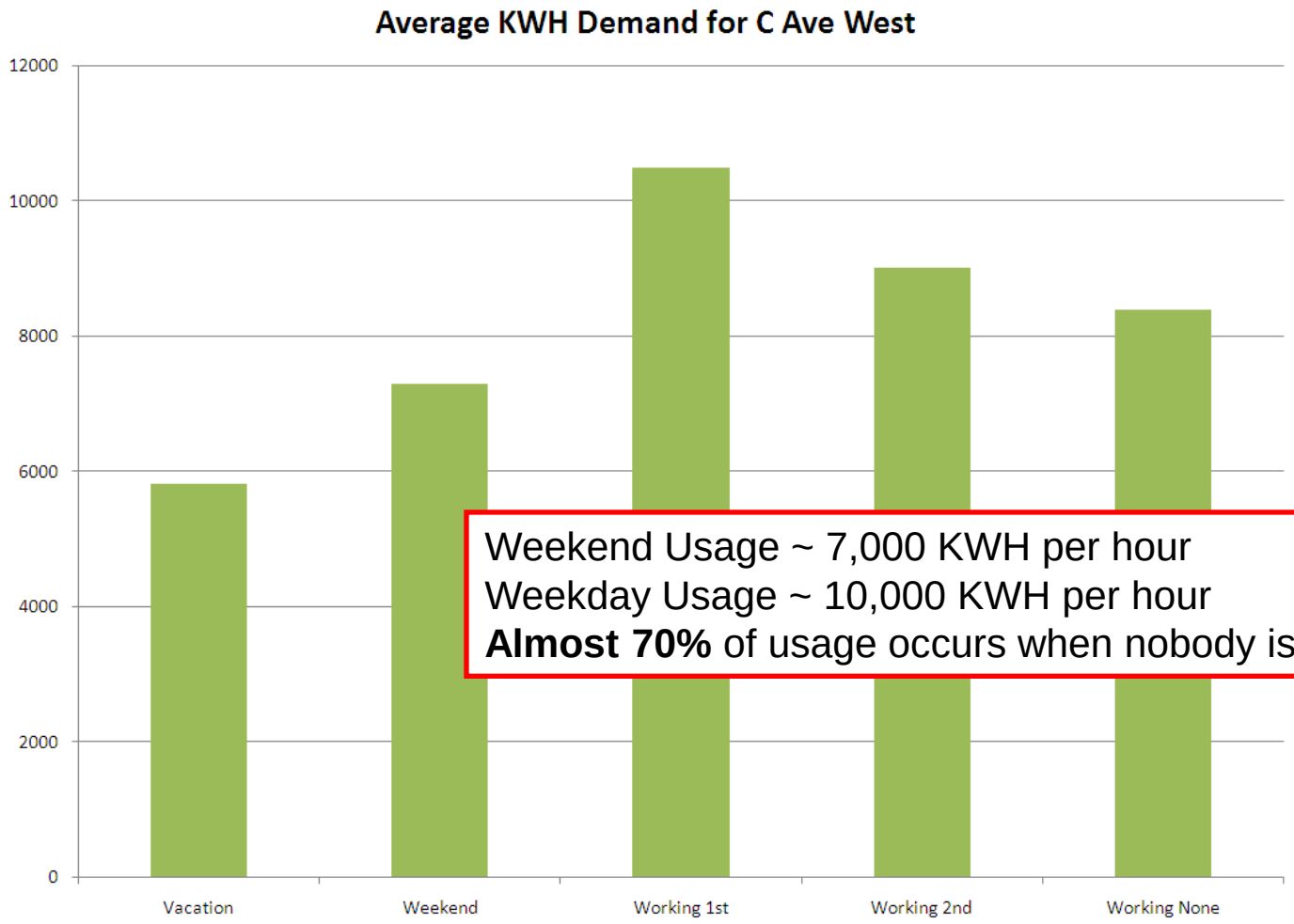
- Burn in Chambers
- Test Stations
- Personal Computers
- HVAC System/Exhaust Fans
- Lighting (Emergency/Left On)
- Servers (Data Center)
- Environmental Labs
- Plug Load Items
- Parking Lot Lights
- Alarm Systems (Security)

Sneaker Net

- Pencil and paper still effective method of data collection!

Key step was to align substation to work group

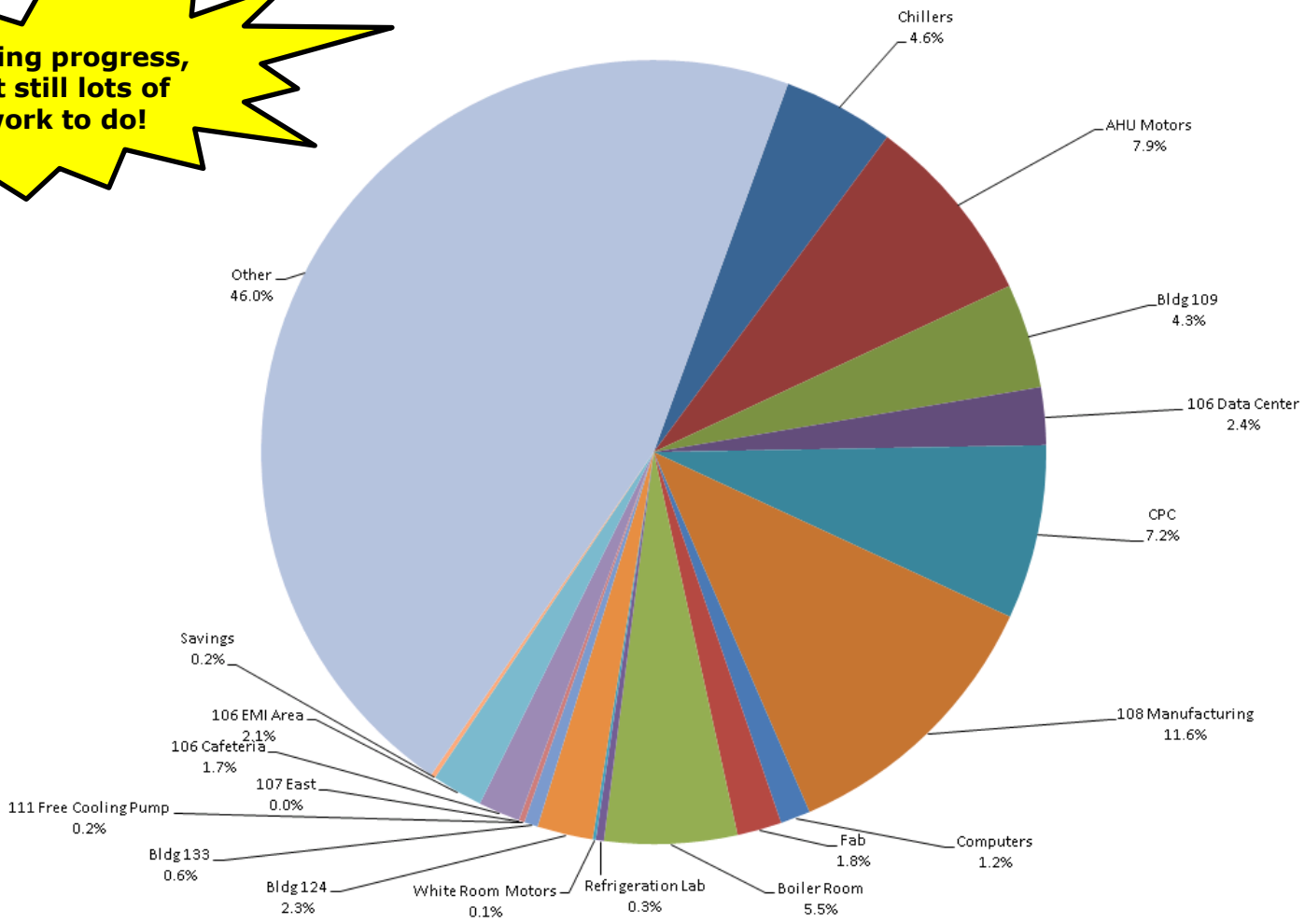
Breakout by Working Conditions



Weekend Usage ~ 7,000 KWH per hour
Weekday Usage ~ 10,000 KWH per hour
Almost 70% of usage occurs when nobody is here!

Updated Breakdown of Usage

Making progress, but still lots of work to do!



Employee Input helped finalize improvement plan

- One of the top suggestions from maintenance employees who were familiar with system
- Actual impact of HVAC will be higher than 12.5% when exhaust fans, pumps included
- HVAC easier to address than isolating manufacturing areas to specific equipment
  - Especially without more detailed data
  - Will require less behavior change from employees
- Waiting for complete data will delay project, data is only estimates and small samples (lots of assumptions)

Opportunity to achieve goal was discovered!

What determines the price of your home?

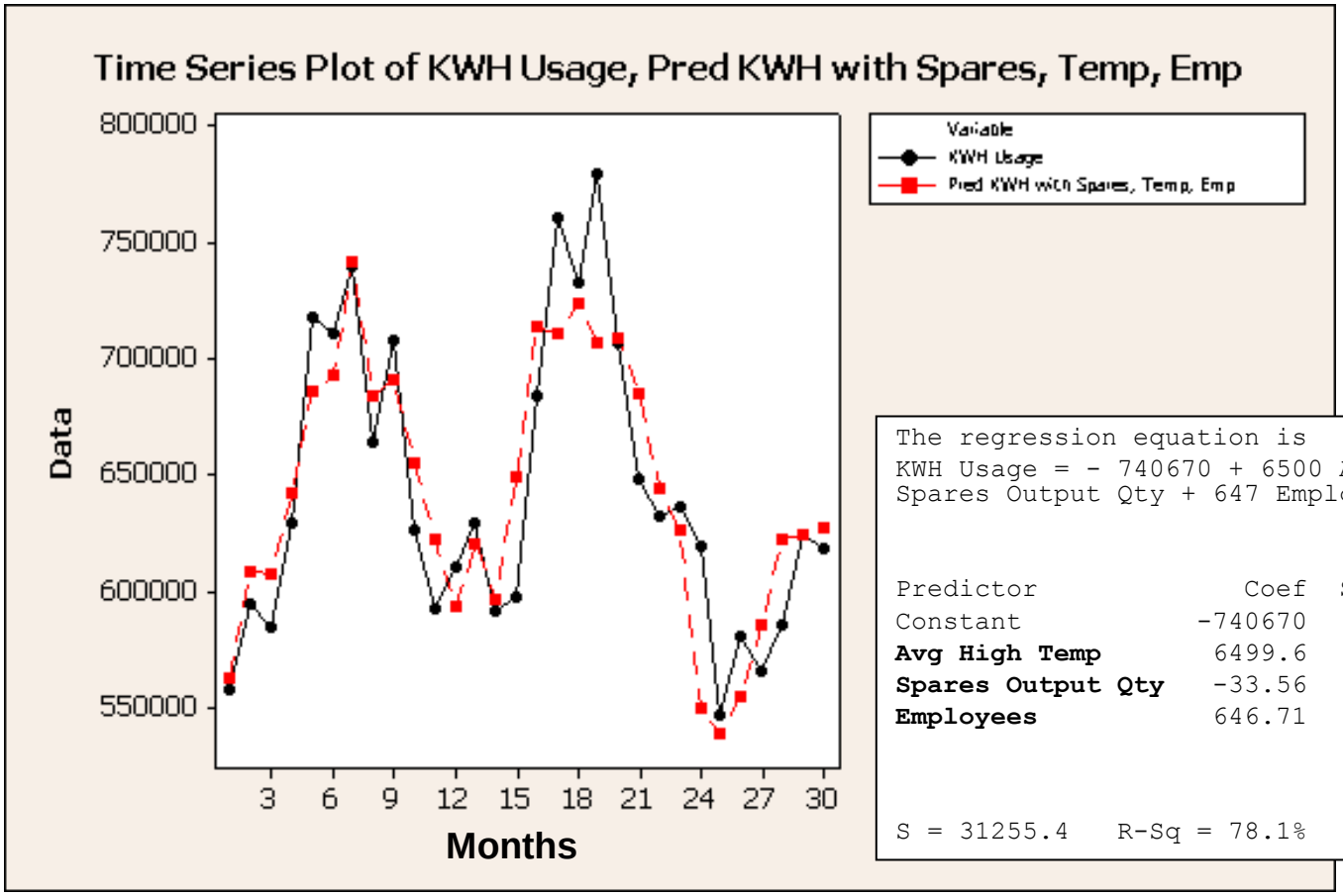
- The median price of a home in a nice community is $300,000
- If we only used that number as a predictor of the price of another home in that community, how far off would we be?
  - Assume that houses are not identical, vary from $150K to $500K
  - What other information should we know about the house?

Square Footage	Lot Size	# of Bedrooms
Distance from downtown	Style	Age of home
Garage size	# of Bathrooms	Basement size

Features: Pool, Central Air, fireplace, Landscaping, curb appeal, exterior condition, crime data, school district

We can use Regression Analysis to create a model

Regression Examples with Electricity Usage

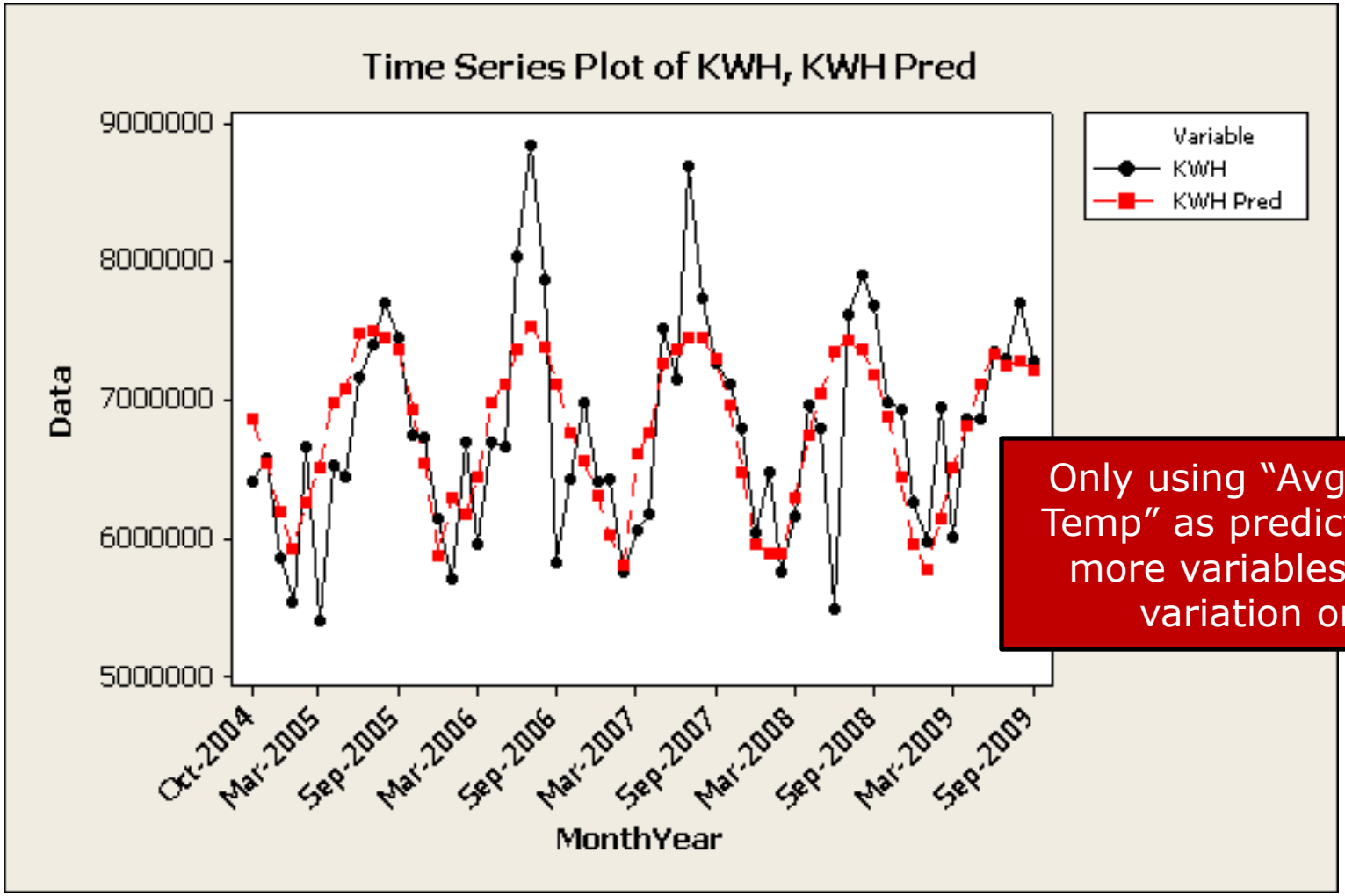


The regression equation is
KWH Usage = - 740670 + 6500 Avg High Temp - 33.6 Spares Output Qty + 647 Employees

Predictor	Coef	SE Coef	T	P
Constant	-740670	145555	-5.09	0.000
Avg High Temp	6499.6	944.8	6.88	0.000
Spares Output Qty	-33.56	11.17	-3.00	0.006
Employees	646.71	91.93	7.03	0.000

S = 31255.4 R-Sq = 78.1% R-Sq(adj) = **75.6%**

Regression Analysis for C Ave

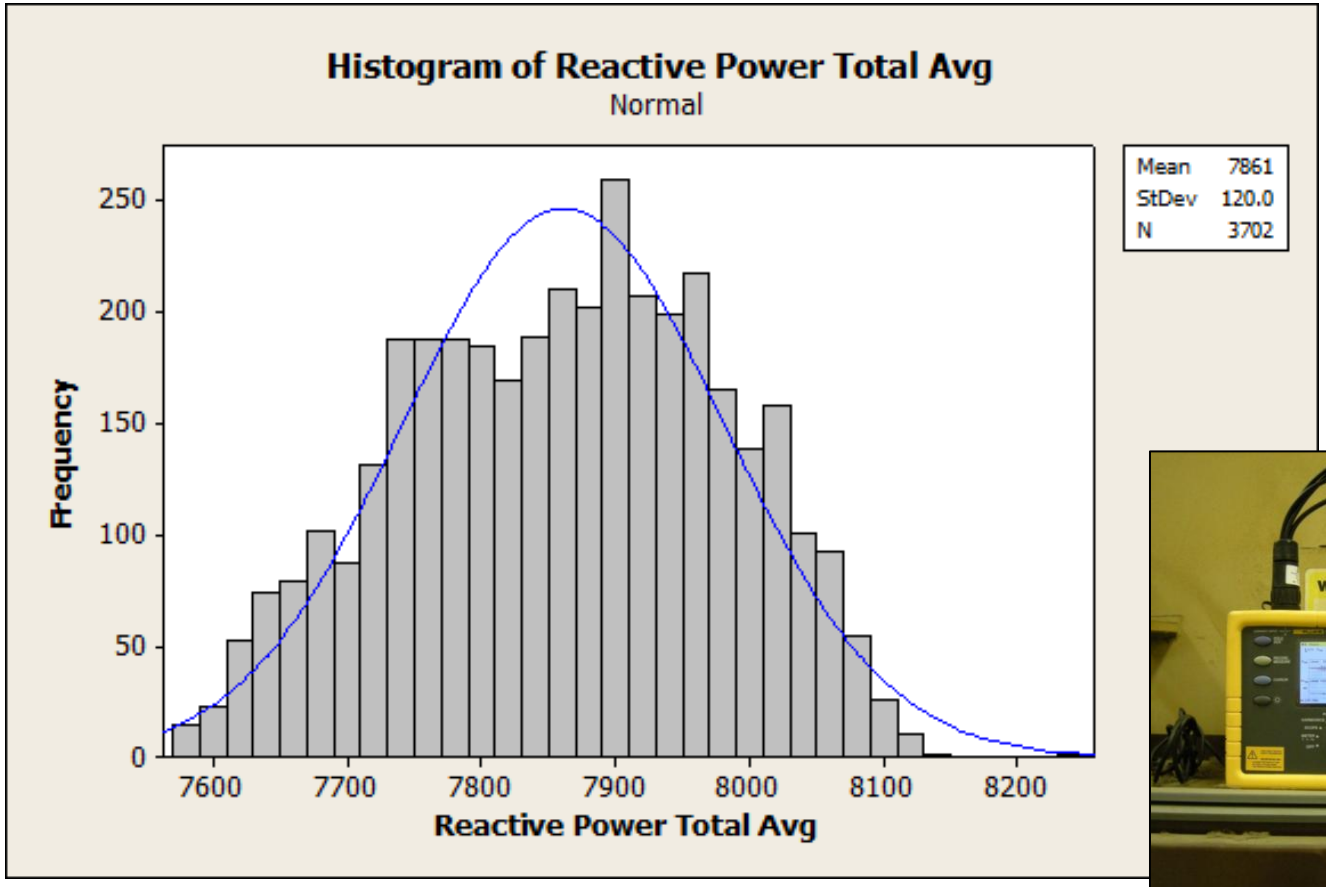


Only using "Avg Outside Temp" as predictor, need more variables…(50% variation only)

Considering: Billing Days, Employee Count, Production Volume, Production Days, Power Factor, Peak Demand, etc

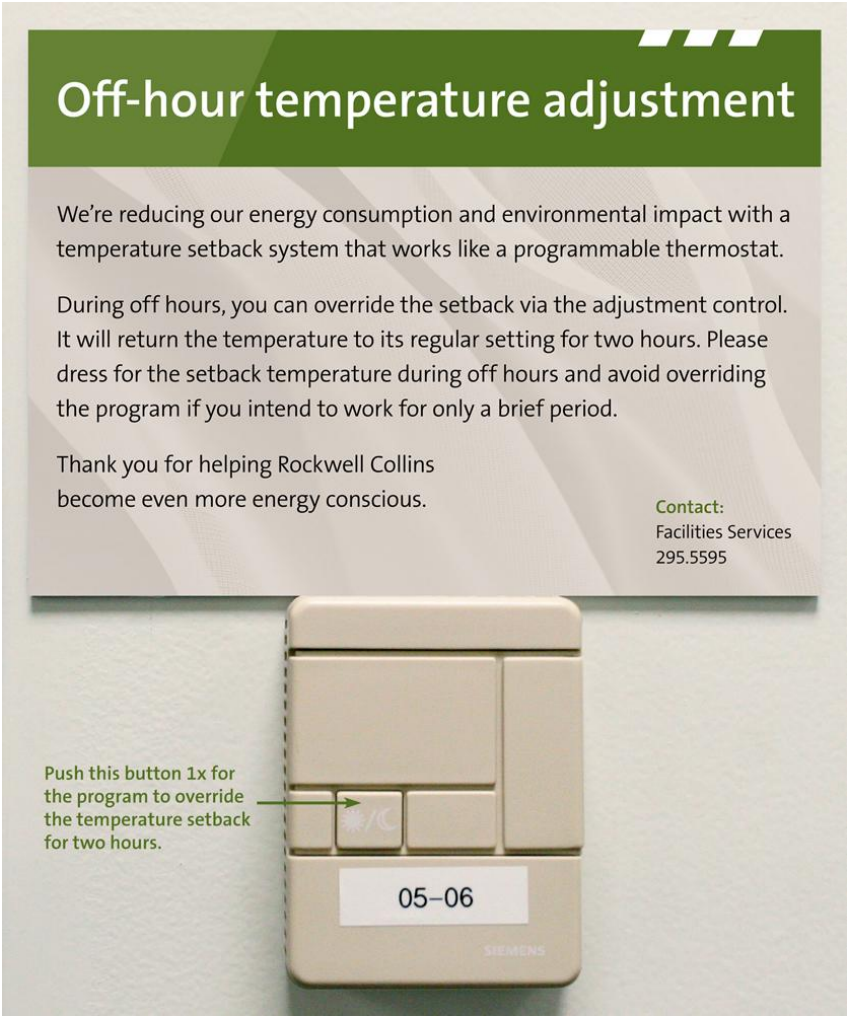
Sub-metering

- Setup meters on specific AHUs in pilot area (targeted approach)



Override Buttons = Change Management

- Once the buttons were installed, they were not used very often
- Feeling of having control over the situation seemed to alleviate concerns



Project Savings

- 122 Air Handler Units adjusted
- Estimated savings of $2585 per AHU
- Over $300K in electricity savings
- Almost 4M kWh reduction
  - which is equivalent to:
    - 1782 tons of coal avoided
    - Electricity to 400 homes per year
    - 2,000 acres of trees
    - 500 vehicles off the road

Image courtesy of http://www.ohiocitizen.org

Summary

- Don’t let any limitations get in the way of making data-driven decisions

- Use these approaches to find opportunities
  - Utility Bills
  - Utility metering
  - Employee Input
  - Sneaker Net
  - Regression
  - Sub-metering

- **Please share and discuss this presentation with your Facilities and ES&H personnel**

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