Energy Charting and Metrics Tools

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Acknowledgements

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- New Buildings Institute
- California Commissioning Collaborative

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Tool premise

- Facilitate the examination of energy information from buildings
- Tool uses:
  - Screening/scoping
  - Energy use indicators
  - Detailed investigation
  - Correlations
  - Calculations
  - M&V
  - Persistence

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Agenda

- We'll be highlighting two tools
  - Utility Consumption Analysis Tool
    - Monthly data
  - Energy Charting and Metrics Tool
    - Interval and point data
- Tool overviews
- ECAM demo

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Utility Consumption Analysis Tool

Monthly Utility Consumption Analysis, version 1.0 **January 2008**

This workbook calculates the Average Daily Use for each calendar month. The process and benefit is documented in the paper titled *Using Utility Bills and Average Daily Energy Consumption to Target Commissioning Efforts and Track Building Performance*, by David Sellers. The paper is available at the PECI website Resource Library, http://www.peci.org/library.htm

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Tool normalizes monthly utility bills to daily use and aligns the use to the appropriate calendar month.

Calculation of Average Daily Utility Use

Utility Usage Data

Project Information

Date:	April 21, 2008
Project Name:	ABC Tower
Utility Type	Electricity
Utility Units	kWh
Utility Company	Pacific Gas and Electric
Account Number:	XXX-XXX-XXX

Date & Time	Billed Usage, kWh	Calculated Duration in Days	Input Duration in Days	Average Daily Use in Billing Period
11/27/06 12:00 PM	203,768	33.0	0.0	6,175
10/25/06 12:00 PM	197,242	30.0	0.0	6,575
9/25/06 12:00 PM	228,469	32.0	0.0	7,140
8/24/06 12:00 PM	216,998	29.0	0.0	7,483
7/26/06 12:00 PM	237,040	30.0	0.0	**7,901**
6/26/06 12:00 PM	214,849	32.0	0.0	6,714
5/25/06 12:00 PM	177,836	29.0	0.0	6,132
4/26/06 12:00 PM	170,836	29.0	0.0	5,891
3/28/06 12:00 PM	167,743	29.0	0.0	5,784
2/27/06 12:00 PM	183,040	32.0	0.0	5,720
1/26/06 12:00 PM	167,500	30.0	0.0	5,583
12/27/05 12:00 PM	156,990	30.0	0.0	5,233

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Calculations

Calculation of Average Daily Utility Use

Average Daily Use	Year			
Calendar Month	2006	2005	2004	2003
January	5,608	4,160	3,145	618
February	5,723	4,473	3,508	948
March	5,796	4,517	3,732	2,727
April	5,927	5,184	3,871	2,354
May	6,254	5,755	4,254	2,051
June	6,892	5,898	4,315	2,308
July	7,827	6,340	4,792	2,857
August	7,400	6,864	4,959	3,347
September	7,036	6,553	5,011	3,165
October	6,491	5,965	4,471	2,976
November	6,175	5,485	4,190	
December		5,284	3,957	
Complete Year Total kWh		2,024,268	1,528,473	

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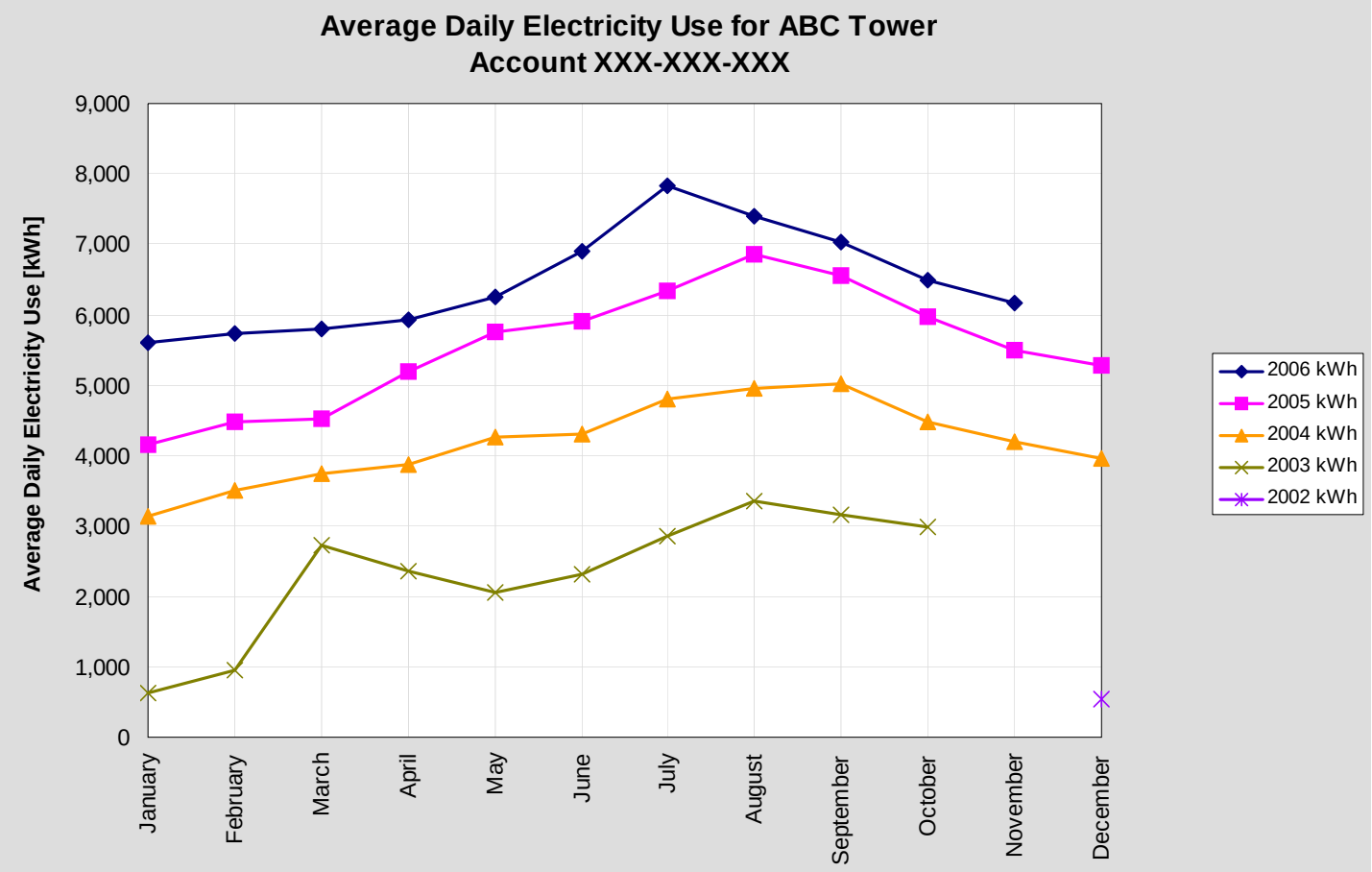
Output



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Energy Charting and Metrics Tool (ECAM)

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What is ECAM?

- A tool for excel based energy charting and metrics intended to facilitate the examination of energy information from buildings.

- The full capabilities of Microsoft Excel® remain accessible to the user, so other summaries, charts, and analyses can be easily added as needed.

“poor person’s energy information system”

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Universal Translator Capabilities

- ✓ Combining datasets
- ✓ Synchronizing time steps
- ✓ Assign point attributes (robust capabilities)
- ✓ Set up filters (time, equip. operation, temps) (manual)
- ✓ Data Summaries
- ❑ Metrics
- ✓ Data Visualization
- ✓ Automated analyses (some)

UT has robust capabilities for combining and synchronizing data from a variety of sources.

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ECAM Capabilities

- ❑ Combining datasets
- ❑ Synchronizing time steps
- ✓ Assign point attributes / define points (partial)
- ✓ Set up filters (time, equip. operation, temps) (automated)
- ✓ Data Summaries
- ✓ Metrics
- ✓ Data Visualization
- ❑ Automated analyses

In present version, many features require consistent interval data (not COV)

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ECAM Metrics Creation Capabilities

In ECAM, metrics are typically data averaged over a particular time period

- Can be normalized:
  - Building area (e.g. W/sqft)
  - Cooling tons (e.g. kW/ton, gpm/ton)
  - CFM (e.g. Watts/CFM)
  - gpm (e.g. Watts/gpm)

Many normalizations are setup automatically by ECAM.

- Can be filtered by:
  - Year
  - Month
  - Pre/Post time periods
  - Daytype
  - Time of day
  - Occupancy
  - Weather conditions
  - Equipment Status
  - Combinations

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Data Visualization

- Load profiles
  - Raw data
  - Averages
  - Pre/post
  - By daytype
  - Calendars
- Scatter charts
  - Raw data
  - Averages
  - Pre/post
  - By daytype
  - Multiple points
  - By occupancy
  - By time of day
  - Choice of independent variable

Filtering capabilities are provided for all types of charts

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Preprocessing

- Time stamp disaggregation
- Daytyping
- Occupancy
- Pre/Post Energy Project
- Normalizations
  - W/sf
  - CFM/sf
  - kW/ton
  - gpm/ton
- Calculations

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4 EASY STEPS

1) Select data
2) Define points
3) Define schedules
4) Input project dates

READY TO CREATE METRICS & CHARTS

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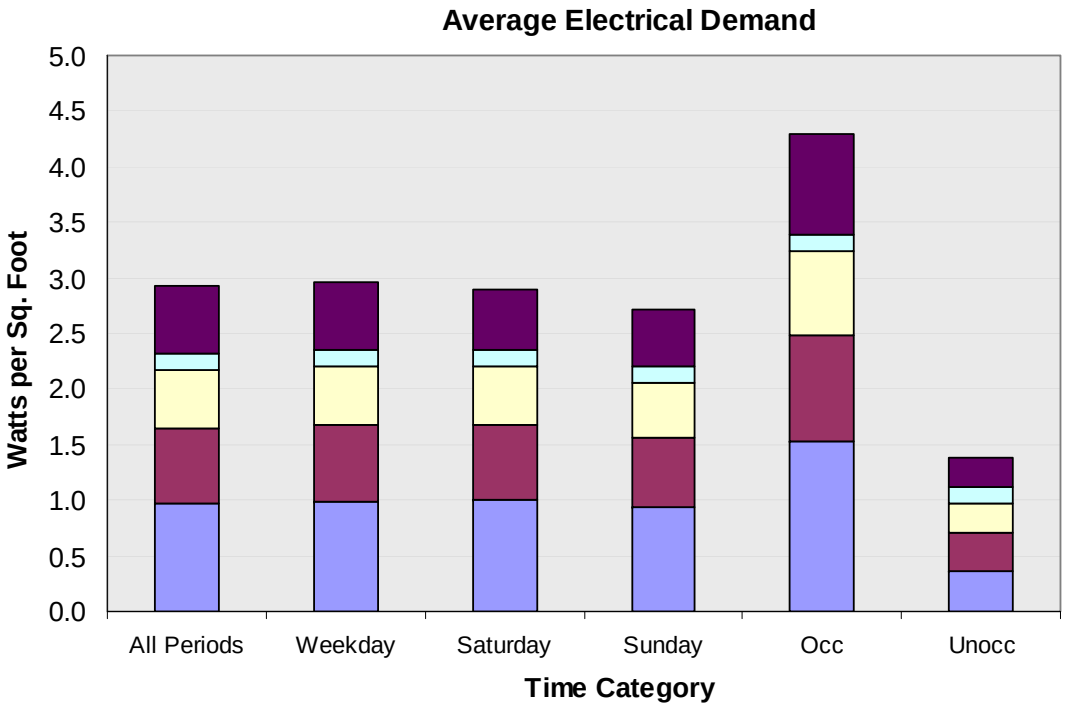
Energy Performance Metrics, Filterable

Year	(All)
Month	(All)
MonthYr	May 2006
Day	(All)
Hour	(All)
Daytype	(All)
Weekday	(All)
Occupancy	(All)
Holiday	(All)
5degBin	(All)
1degBin	(All)



Points	All Periods	Weekday	Saturday	Sunday	Occ	Unocc
Avg ElecMtr1_Watts_perSF	0.98	0.99	1.00	0.93	1.53	0.36
Avg ElecMtr2_Watts_perSF	0.68	0.68	0.68	0.63	0.96	0.36
Avg ElecMtr3_Watts_perSF	0.53	0.53	0.52	0.49	0.76	0.26
Avg ElecMtr4_Watts_perSF	0.15	0.15	0.15	0.15	0.15	0.15
Avg ElecMtr5_Watts_perSF	0.60	0.61	0.54	0.51	0.90	0.26

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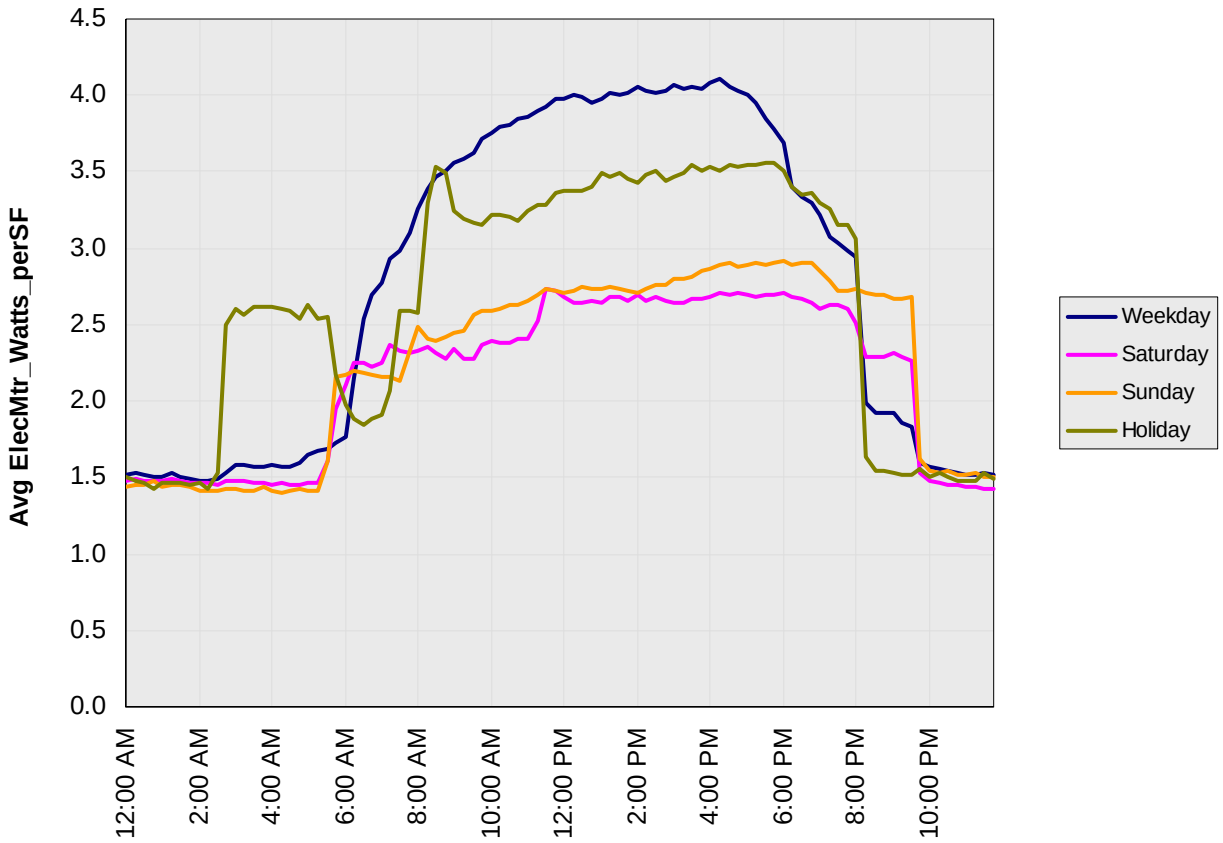
Load Profile by Daytype

Year	(All)
Month	(All)
MonthYr	**Sep 2006**
Weekday	(All)
Day	(All)
Holiday	(All)
5degBin	(All)
1degBin	(All)
TempRng	(All)



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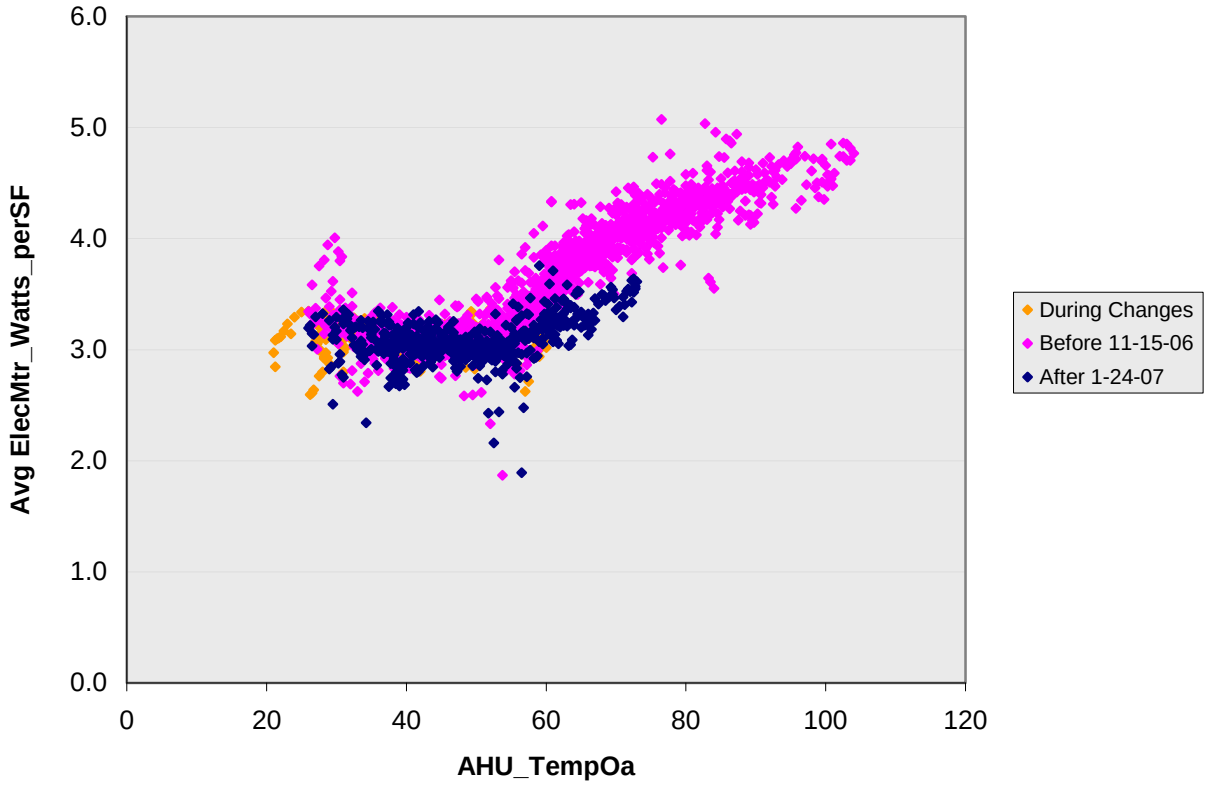
Scatter Chart by Date Range



Excel won't create Scatter Charts based on PivotTables (PivotCharts).

ECAM includes Scatter Charts based on PivotTables.

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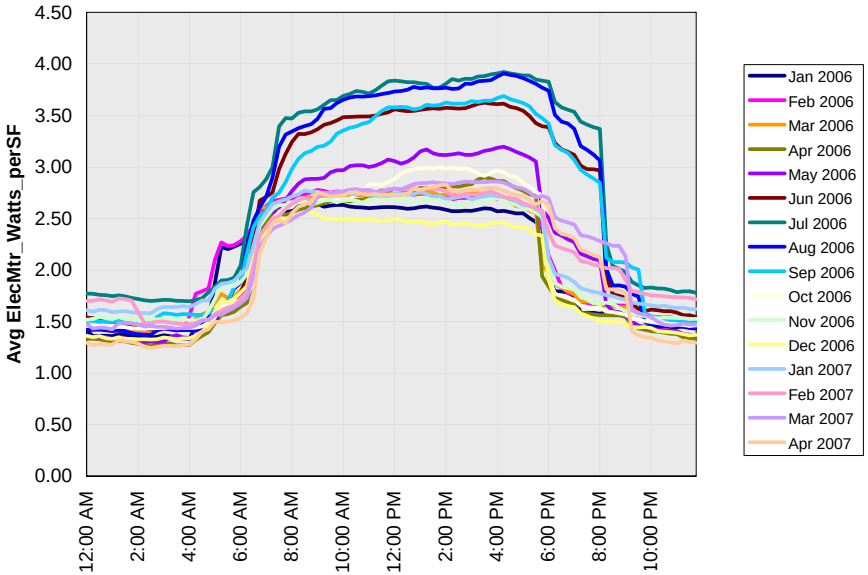
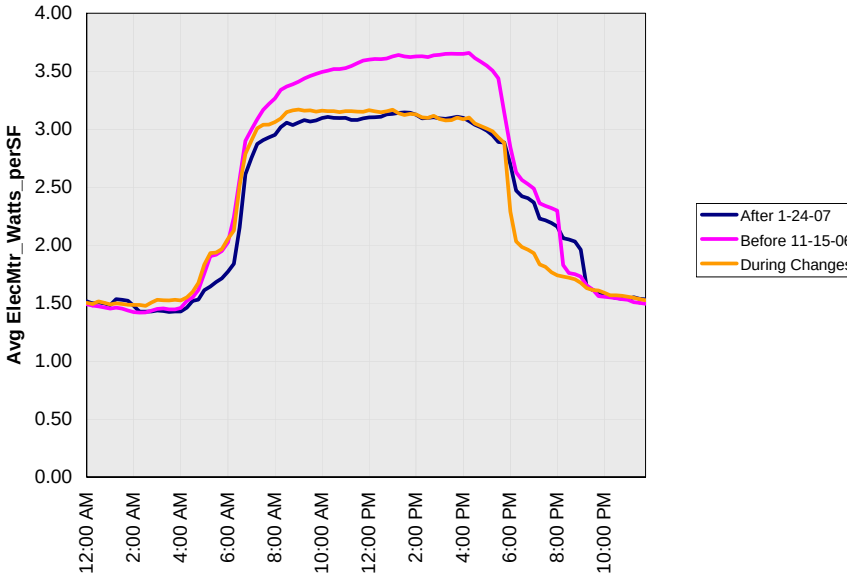
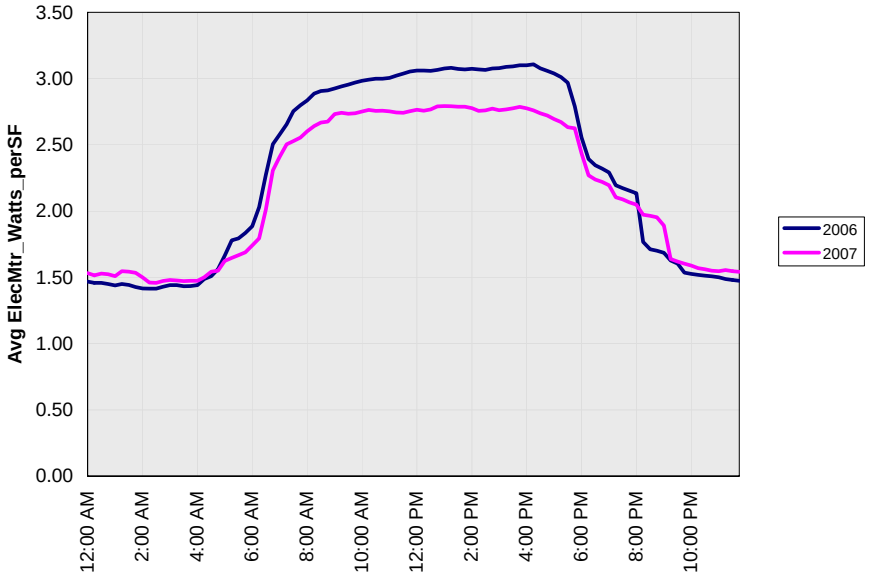
Sample Charts, continued







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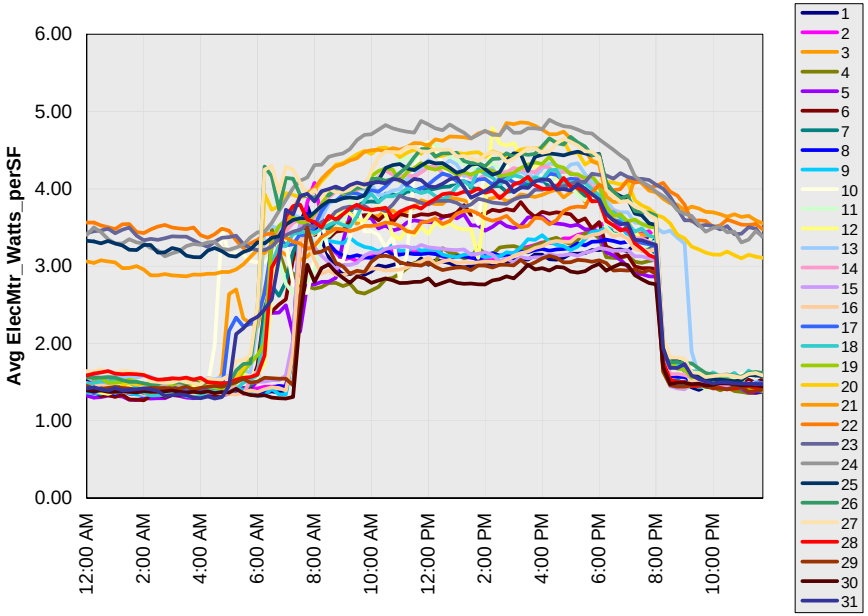
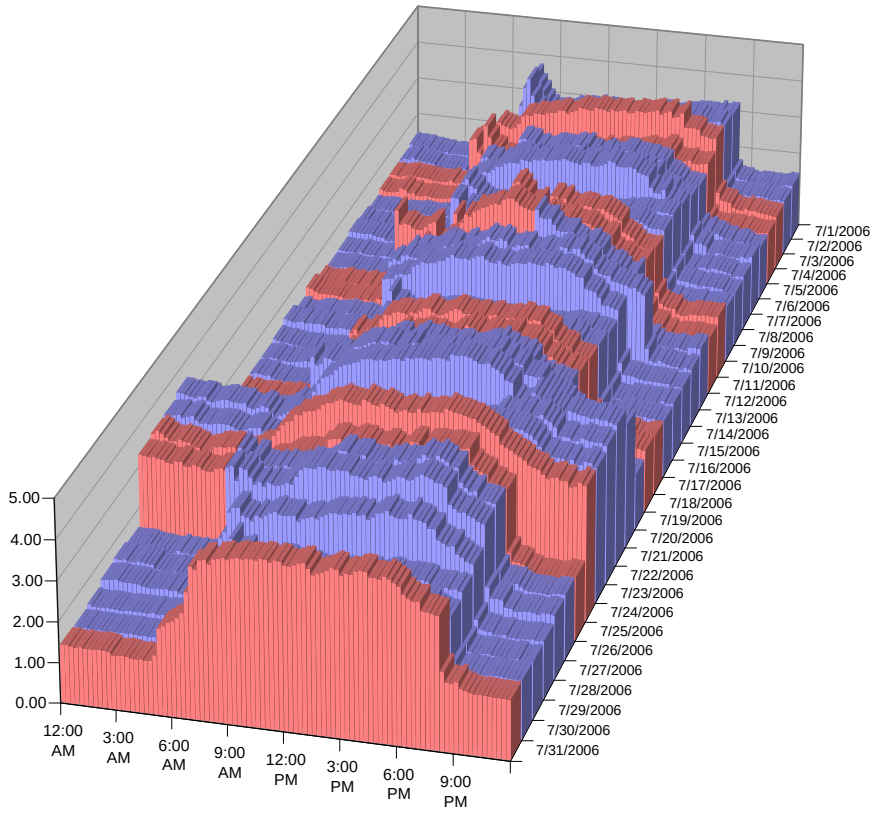
Generating a 3-d Load Profile



Start with a load profile by day for a selected monthyear



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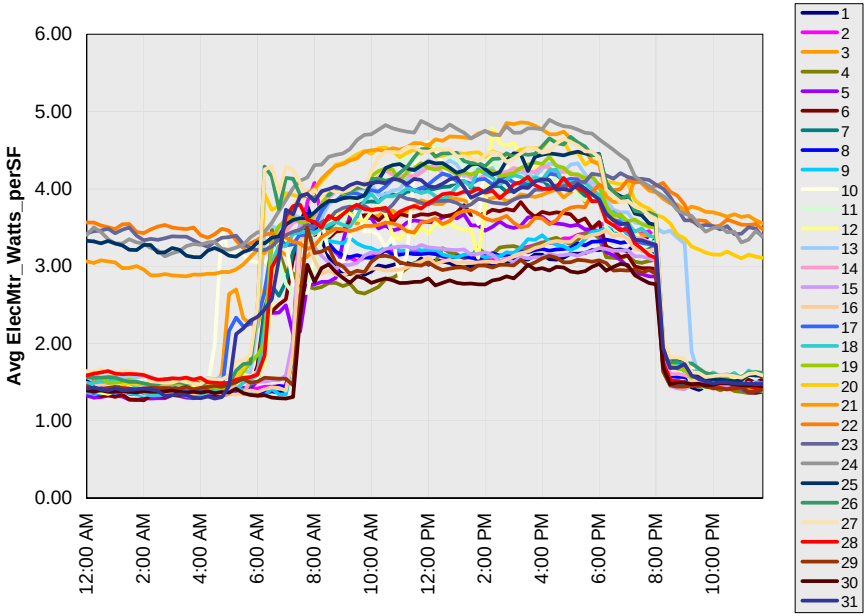
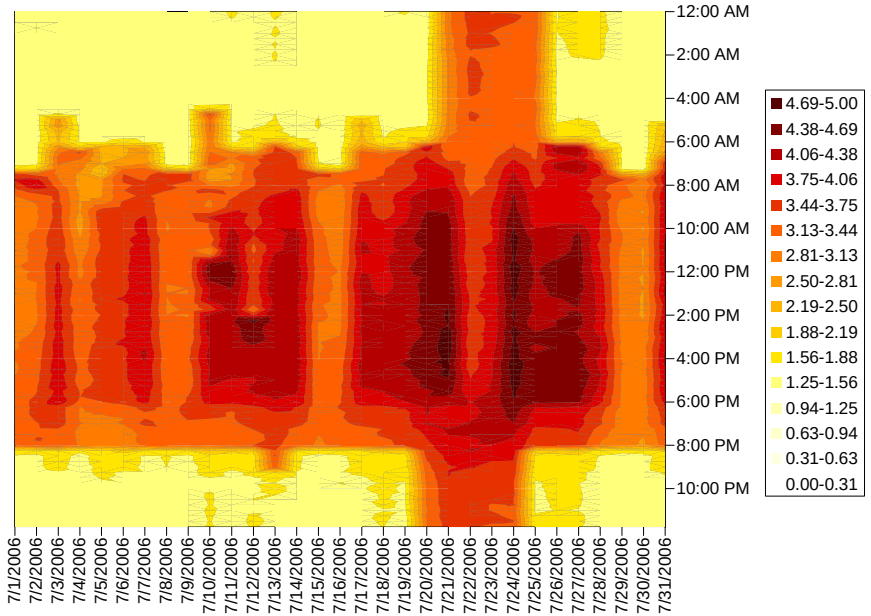
Generating a Surface Chart



Start with a load profile by day for a selected monthyear



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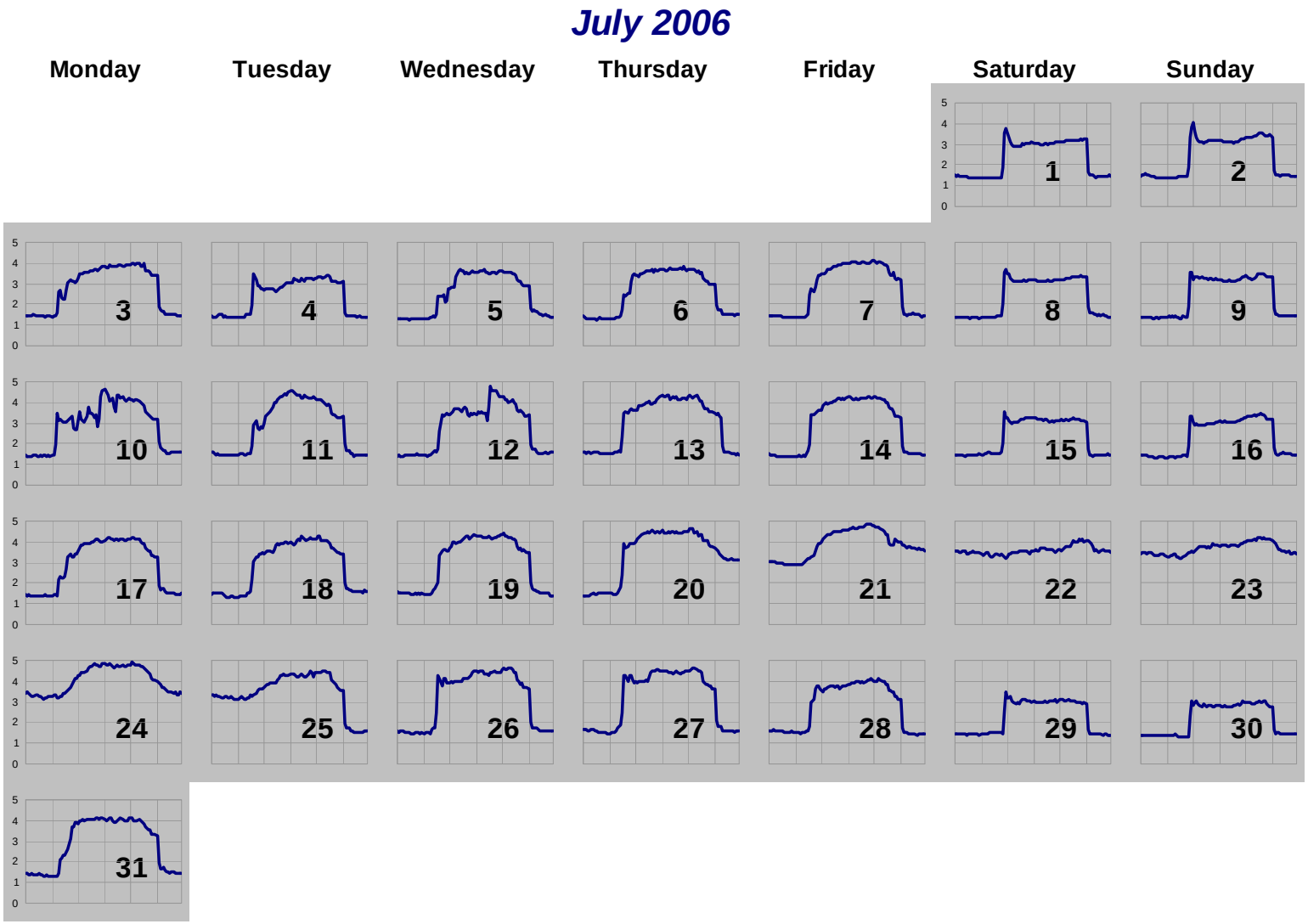
Calendar Load Profile



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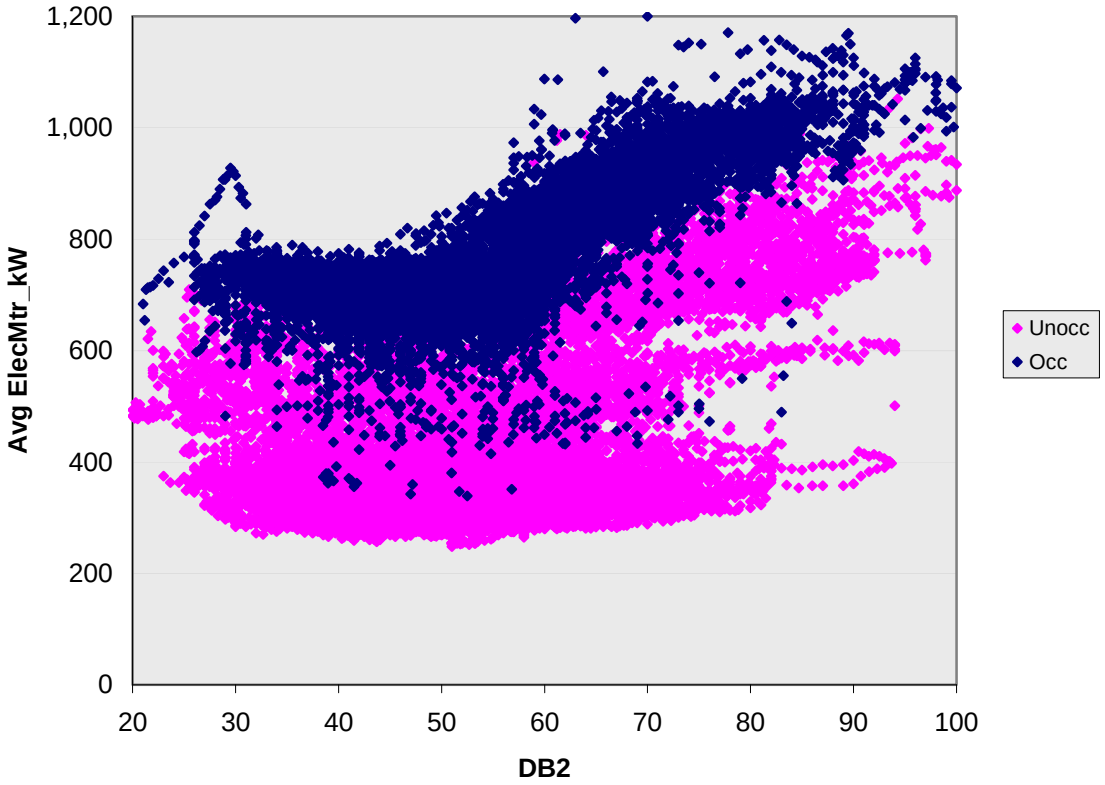
Scatter Chart by Occupancy with raw data



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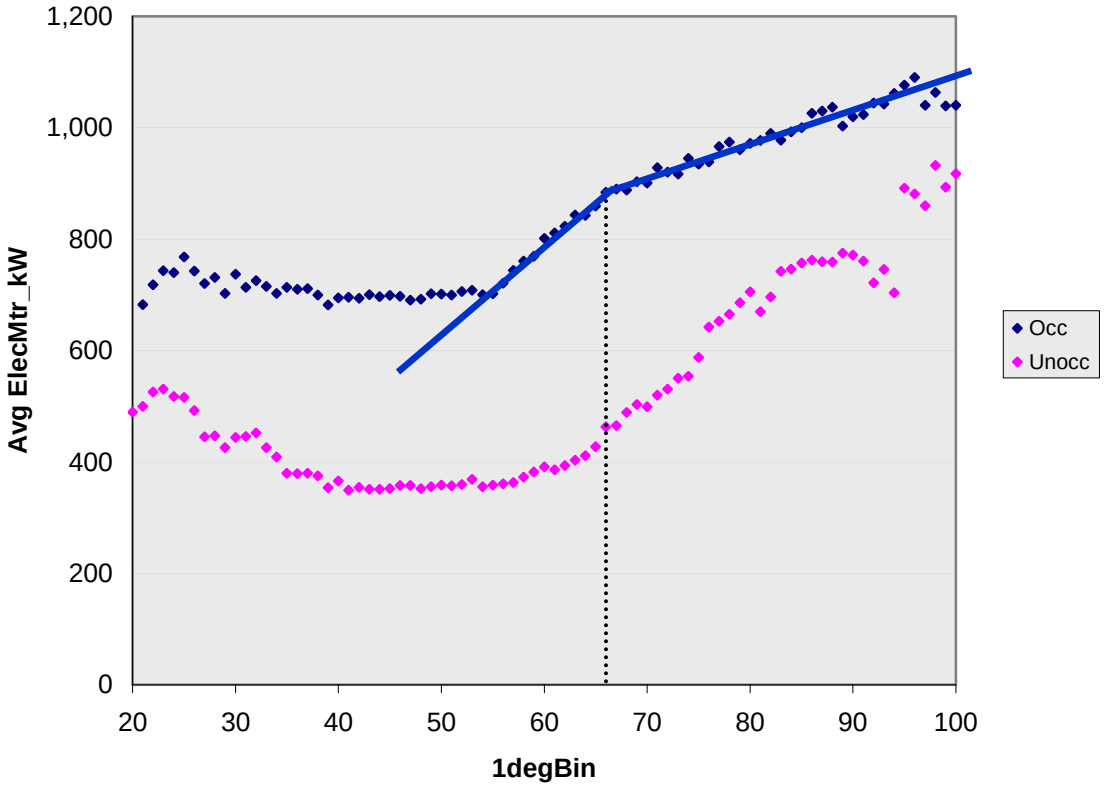
Scatter Chart by Occupancy with binned Weather



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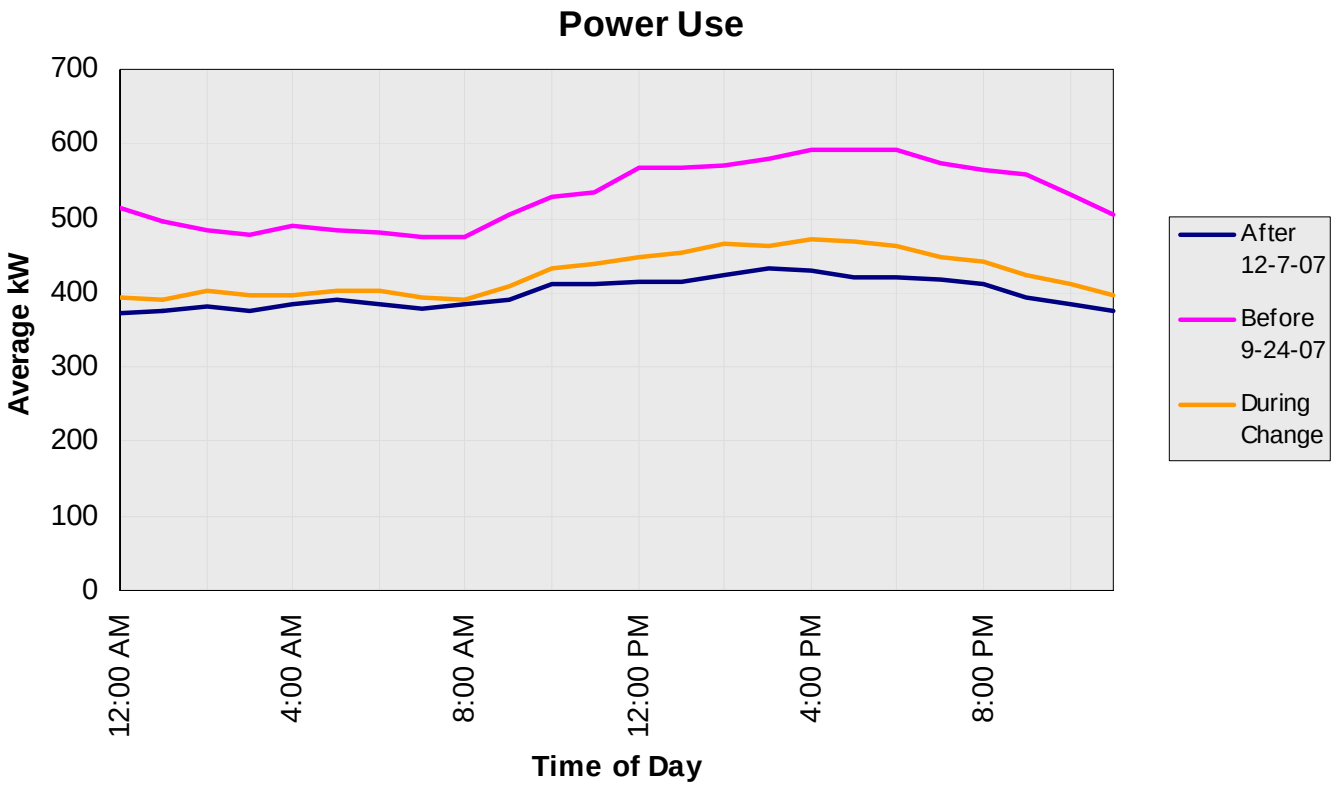
Load Profile by Date Range



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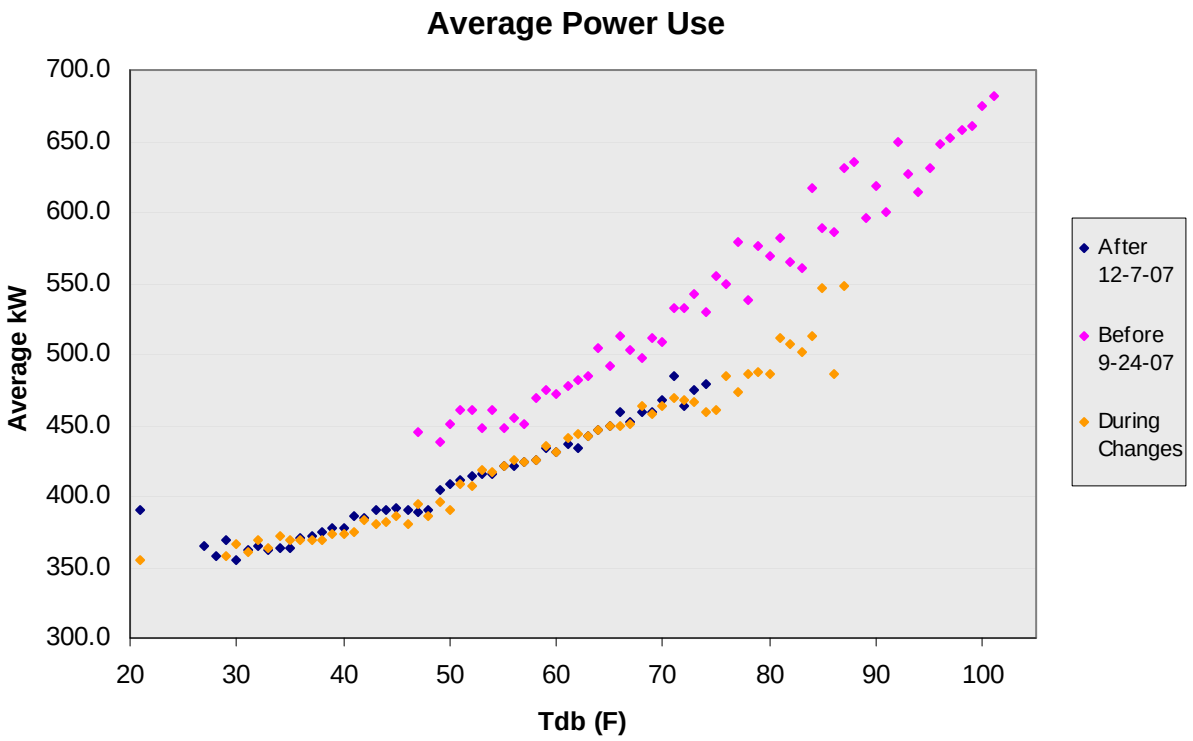
Scatter Chart by Date Range



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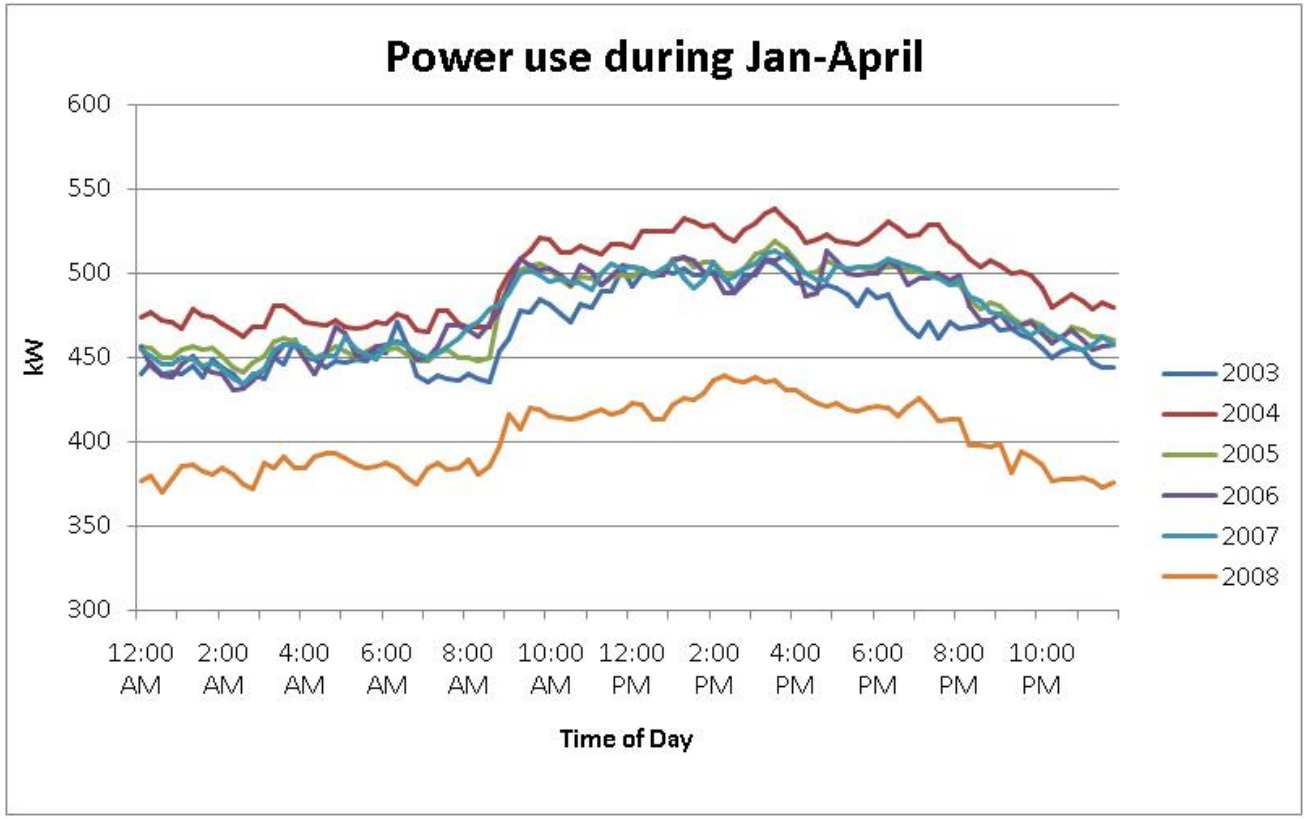
Load Profile by Year



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DEMO

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Resources and Links

http://www.cacx.org/resources/rcxtools/spreadsheet_tools.html

- ECAM
- Utility Consumption Analysis Tool
- Energy savings calculation tools for variable-flow systems
  - Pumping System Workbook
  - Fan System Workbook
- RCx Findings Workbook

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