Analyzing Interval Data Using the Energy Charting and Metrics (ECAM) Tool

Adapted from a presentation by:

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Presentation Outline

- ECAM Capabilities
- Analysis of Interval Meter Data with ECAM
What is ECAM?

• A tool to assist with analysis of building performance data
• Facilitate the types of analyses that energy engineers, commissioning providers, and building operators might need to make
• “Semi-automation,” not complete automation of the analyses
• Because analyses is not completely automated, the tool is flexible, supporting additional analysis without limiting any normal spreadsheet functions
ECAM Version 2.0 New Features

- Excel 2007/2010 compatibility
- Full time history chart, filterable to selected months or days
- Load profile as box plots
- Load duration chart (histograms/frequency distributions)
- Chart to check input schedule
- Matrix charts
- Metrics by daytype, occupancy, and month
- Data summaries
- Additional scheduling periods for startup and shutdown
- Integrated user guide/help
- PNNL re-tuning charts (See http://buildingefficiency.labworks.org/large.stm for more details)
ECAM Detection/Diagnostic Features

• Detection
  – Tool does not provide detection directly
  – Assists with performance tracking
  – Provides the ability to investigate the relationships between variables

• Diagnostics
  – Tool does not provide diagnostics
  – Future versions may provide some limited diagnostic capabilities, but this is not the focus of the tool
  – General intent is to maximize the user’s ability to benefit from whatever data is available
Five Easy Steps

1. Select data from existing spreadsheet
2. Map points
3. Create schedules (optional)
4. Input energy project dates (optional)
5. Create metrics and charts
## User’s Data — Example

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Outside Dry Bulb</th>
<th>325 COMMON CHWS</th>
<th>326 COMMON CHWR</th>
<th>328 CHILLER 1 AMPS</th>
<th>342 COM CDW SUPPLY</th>
<th>343 COM CDW RETURN</th>
<th>345 A CHILLER ON</th>
<th>414 SCHWP-5 KW</th>
<th>415 SCHWP-6 KW</th>
<th>416 SCHWP-7 KW</th>
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<td>67.4</td>
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<td>69.2</td>
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<tr>
<td>8/23/04 3:15 AM</td>
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<tr>
<td>8/23/04 3:30 AM</td>
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<td>4.8</td>
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</tr>
</tbody>
</table>
Step 1: Select data

1a. Time Stamp Definition

Are the Time Stamps in 1 column or 2 columns?
(If 2 columns, it is assumed that the Date is in the first column and the time is in the second column)

- One Column
- Two Columns

OK

1b. Input the Data Range

Select the range of cells with your data.
You should select the full range, including the headers (Point Names), and all the records (time stamps) you want to include.

The Point Names will be assumed to be in the first row of the selected range.

Group1!A$1:$Y$8195

OK

1c. Ambient Temperature

Is Ambient Temperature data included?

- Yes
- No

1d. Ambient Temperature

Is Ambient Temperature data included?

- Yes
- No

Which column has the Ambient Temperatures?

Data!$A$1:$AQ

OK
Step 2: Map points

User’s points are mapped to common point names as per A Specifications Guide for Performance Monitoring Systems
Step 3: Create Schedule (optional)

Forms are similar to eQuest
Step 4: Input Energy Project Dates (optional)
Step 5: Create Metrics or Charts
Preprocessing of Data

- Time stamp disaggregation
- Daytyping
- Occupancy
- Pre/Post Energy Project
- Normalizations
- Calculations
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)
  - cfm (e.g. Watts/CFM)
  - gpm (e.g. gpm/ton)

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

All filters and many normalizations are automatically set up by ECAM.
Automatic Creation Of Additional Fields For Metrics

- Equipment Status
- Demand (kW)
- Chilled water tons
- Watts per square foot
- CFM per square foot
- kW per ton
- gpm per ton

- from demand (kW) or current (amps)
- from current (amps) approximate calculation
- whenever flows and temperatures are available
- for all electrical demand points (kW)
- for all air flow points
- for all related points
- for all related points
Interval Data Visualization

- Load profiles
  - Raw data
  - Averages
  - Pre/post
  - By daytype
  - Calendars

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

Filtering capabilities are provided for all types of charts
Load Profile by Daytype

- Filtering Options:
  - Year: (All)
  - Month: (All)
  - MonthYr: Sep 2006
  - Weekday: (All)
  - Day: (All)
  - Holiday: (All)
  - 5degBin: (All)
  - 1degBin: (All)
  - TempRing: (All)

Graph showing average electrical meter watts per square foot (Avg ElecMtr_Watts_perSF) over time from 12:00 AM to 10:00 PM.
Calendar Load Profile

October

Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31

PNWD-SA-9511
3-D Load Profile

Surface Chart
Box Plot Load Profile
Scatter Chart by Date Range

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

ECAM includes Scatter Charts based on PivotTables.
Scatter Chart by Occupancy with Binned Weather
INTERVAL METER DATA ANALYSIS EXAMPLES
Example: Load Profile by Daytype

24 Hour Occupied Schedule
Example: Load Profile by Daytype

- Building occupied (6 AM)
- Morning startup
- Unoccupied/shutdown
Example: Typical Office Building

- 50% load reduction between peak and nighttime
- Long shutdown period
- 5 day occupied schedule and unoccupied on weekends
Example: Good Office Building

- **80% Peak Reduction**
- **Good startup/shutdown (6 AM/6 PM)**
- **Building not occupied on weekend**
Example: Comparing data before and after improvements

- 50% reduction
- 15% Peak load reduction
- Additional 30% reduction at night
Comparing Consumption from Two Identical Buildings
Comparing Regression Analysis from Two Identical Buildings