

Interval Meter Analysis Tool Guide

The Interval Meter Analysis Tool provides the user with an easy way to analyze metered data and quantify energy savings after implementation of energy conservation measures (ECM). All tabs that the user should interact with are colored a shade of green. The user can ignore all other tabs (shaded grey) as they are responsible for background calculations.

NOTE: This is a macro-enabled workbook. If you cannot use macro-enabled workbooks on your computer, you will not be able to use this tool.

Setup

Initial Setup

Start by inputting the initial setup parameters into the tool. Every parameter is required but the **bolded** sections are most important for analysis:

- **Cell F7: Baseline vs. Post Analysis**
 - Select Baseline or Post Analysis based on which stage of analysis you are performing.
- **Cell F8: Meter Type**
 - Specify if the data is Electric, Natural Gas, Chilled water etc.
 - Note: Separate Interval Meter Analysis Tools must be created for each meter type (applicable only if you have interval data for meter types other than electric)
- Cell F9: Append to Existing Data
 - This is applicable in instances where baseline or post analysis already exists, and more recent data becomes available. 'Append' will append data to the existing baseline data or the existing post data, whichever is selected.
 - Note: Additional data should only be appended in increments of 12-months so that months are not over-represented. If the existing data was not a 12-month period and you are appending data to correct this, a shorter interval is acceptable.
- **Cells F10 & F11: Input and Output units**
 - Select the appropriate input units.
 - Output can be converted to different units if desired.
- **Cell F12: Interval**
 - Specify if the existing data is in 15-minute or 1-hour intervals; note that your metered data file must be in one of those two formats.
- Cells F13 & F14: Re-scaling & Missing Hours
 - Typical selection for re-scaling is "If Deviation is Excessive". Data will be re-scaled by the factor given in Cell I13 after data is uploaded.
 - Calculations for this re-scaling factor can be found in the Calibration tab and are meant to scale the metered data to the utility billing data.
 - The deviation threshold can be adjusted in the Setup-Advanced section of this instruction document.
 - Typical selection for filling in missing hours is "No", but this can be used when there are gaps in the interval data.
- Cell F15: How to Fill in Outdoor Air Temperature (used to estimate consumption)?
 - Typical selection is "Use Substitute Weather Data".
 - Outdoor air temperature (OAT) for each interval should already be recorded in the interval data.

- **Cells F16 & F17: Start and End Dates**

- Input the dates of interest here (likely most recent 1-2 years of data); the tool will filter out all other dates.
- Preferred method is to define an interval in sets of 12-months (12, 24, etc.) so months aren't overrepresented in the analysis.

Interval metered data input files

Now the interval metered data file information needs to be provided:

- **Interval data file formatting**

- File type: ".csv"
- Ensure the dates in the metered data file are in column A; re-format the file first if they're not.
- Headers should go in row 1 with data starting from row 2.
- Data should be sorted with oldest dates at the top.
- Typical format for interval data:
 - Column A contains date in intervals (example format: 10/1/2015 0:15)
 - Column B contains meter value per interval.
 - The data should be interval data (usage per interval), not cumulative sum data.
 - Column C contains OAT per interval in Fahrenheit.

- **Cells B20-22**

- Column with Date should always be A
- Specify the columns with meter total (kWh, cf, kBtu, etc.) and OAT
- Substitute OAT data can be input later if interval data doesn't have it.

- **Cell B24: File search**

- Use the file search function to navigate to the correct file containing the interval data.
- In Cell A24, the file name should have automatically populated in the following format:
 - Example: *Example Interval Data_Baseline.csv*
- The path to the file will be automatically populated in cell C24.

- **Cell B25-31: File search**

- Instead of consolidating your interval data, you can select multiple files to be concatenated. Make sure each file has a unique data range (the timestamp isn't repeated across multiple files).
- Follow the same instructions as Cell B24: File search to add additional data files.

- **Ensure the interval metered data file is closed** on your computer before running the macro.

Calibrate to Utility Data

Metered data can be calibrated to monthly utility billing data by inserting your file information here.

- **Utility billing data file formatting**
 - The tool assumes the export format for EnergyStar Portfolio Manager for utility billing data.
 - The header for data should be on row 6 with data starting from row 7.
 - Format for utility billing data (bolded columns are required):
 - **Column A** contains the Meter Consumption ID
 - If you do not have a meter consumption ID, just say “N/A” for each month entry.
 - **You must have a value in each row for every data entry.**
 - **Column B** contains the start date for the billing period (example format: 10/1/2020)
 - **Column C** contains the end date for the billing period (example format: 10/31/2020)
 - **Column D** contains the usage amount for the billing period.
 - **Column E** contains the cost for the billing period in US dollars.
 - Column F denotes if the value is an estimated value or not.
 - Column G contains demand data for the billing period.
 - Column H contains demand cost for the billing period in US dollars.
 - Column I denotes when the data was last modified.
 - Column J denotes the user that made the modification.
- **Cell J20: File search**
 - Use the file search function to navigate to the correct file containing the utility billing data.
 - In Cell I20, the file name should have populated in the following format:
 - Example: *Example Utility Billing Data-Electric.xlsx*
 - The path to the file will be automatically populated in cell K20.
- **Cells J21-24**
 - Specify the columns that contain necessary information (refer to screenshot below)
- **Ensure the utility data file is closed** on your computer before running the macro.

Substitute Outdoor Air Data

If your metered data doesn't include outdoor air data, you can supplement that with another file; otherwise leave this section blank.

- **OAT data formatting**
 - Ensure that column A is the date and it's sorted by oldest dates at the top.
- **Cells I26, J26, K26: File search**
 - Use the file search function to navigate to the correct file containing the OAT data.
 - The file name should populate in Cell I26
 - Example: *Example OAT.csv*
 - The path to the file will be automatically populated in cell K20.
- **Cell J28**
 - Specify the column that contains the OAT.

Finalize Data Inputs

You have now entered all required information. Verify input fields. If you want to review advanced setup options, find instructions in the [Setup-Advanced](#) section.

Upload and Filter Data

Make sure you are in the Setup tab.

- **Upload and Filter Data**
 - Ensure all files you're utilizing are closed; if they are open when you try to upload, the tool won't work correctly.
 - Select "Upload and Filter Data" at the top of the Setup tab, and the tool will analyze the metered data.

Setup-Advanced

Optionally you can specify more advanced parameters in the "Setup-Advanced" tab. After adjusting this tab, return to the Setup tab and follow the upload data instructions in the [Upload and Filter Data](#) section.

- Cell F1: Maximum Missing Hours for OA Interpolation
 - If the OAT data is missing for up to this many hours, the OAT will be interpolated. If the OAT is missing for more hours than defined here, the data will be dropped.
- Cell F2: Maximum Peak to Median Ratio
 - Specifies a threshold where data is dropped if the meter reading is X times greater than the median.
- Cell F3: Minimum Fraction of Median Allowable
 - Specifies a threshold where data is dropped if the meter reading is less than X% of the median.
- Cell F4: Occupied Consumption defined as X% above minimum consumption.
 - Specifies the percentage threshold to define the occupancy schedule.
 - If the meter reading is greater than X% above the minimum consumption, it is defined as occupied.
- Cell F5: Fraction of Missing Hours allowed in Calibration.
 - If re-calibrating interval data to match utility bills, months with more than the fraction of missing data specified will be dropped from calibration. Otherwise, interval data will be scaled up to account for missing data.
- Cell F6: Allowable Deviation from Utility Bill Totals
 - Specifies the threshold for calibration if in the The Interval Meter Analysis Tool provides the user with an easy way to analyze metered data and quantify energy savings after implementation of energy conservation measures (ECM). All tabs that the user should interact with are colored a shade of green. The user can ignore all other tabs (shaded grey) as they are responsible for background calculations.

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- **Setup** tab you selected in cells F13 & F14: Re-scaling & Missing Hours "If Deviation is Excessive".

- If the metered data differs from the utility billing data by greater X%, then the interval data is calibrated to match the utility billing data. If the threshold is exceeded, the calibration factor will be visible in the Setup tab Cell I13.
- If baseline data is calibrated using utility billing data (if in the The Interval Meter Analysis Tool provides the user with an easy way to analyze metered data and quantify energy savings after implementation of energy conservation measures (ECM). All tabs that the user should interact with are colored a shade of green. The user can ignore all other tabs (shaded grey) as they are responsible for background calculations.

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- **Setup** tab you selected in cells F13 & F14: Re-scaling & Missing Hours “If Deviation is Excessive” or “Yes”), then the same calibration factor calculated for the baseline data will be used for the post-implementation data for consistency.
- Cells F10-21: Holiday Selection
 - Select which holidays are applicable for the analysis. Holidays are treated as Sundays in analysis.

Return to the Setup tab and follow the upload data instructions in the [Upload and Filter Data](#) section.

Baseline Hourly & Post-Analysis Hourly

The Baseline Hourly tab is where the baseline data you uploaded resides. The tool will analyze the data and display information such as occupancy schedule and average hourly consumption. The Post-Analysis Hourly tab provides similar information using the post-analysis data.

- Baseline Hourly Tab layout
 - Columns A through K pull in the baseline interval data that you input in the Setup tab.
 - The “Raw, Hourly Averages” table in Columns N through V calculates the average hourly consumption for each day of the week.
 - The “Occupancy Status” table in Columns X through AE shows the estimated occupancy schedule of the building.
 - If you would like to define your own occupancy schedule, you can denote occupied with and unoccupied with 0 manually in the table.
 - This schedule will be used for both the baseline analysis and the post-implementation analysis.
- Baseline Hourly graph
 - The graph in this tab provides a visual representation of the energy usage during building operating hours. The graph also depicts the average peak and average base load consumption.
- Post-Analysis Hourly
 - This tab contains similar information to the Baseline Hourly tab using the post-visit data. No graph is provided in this tab, but a visual comparison of Baseline vs. Post energy usage can be found in the Hourly Summary tab.

Temperature Bin Analysis

The Temperature Bin Analysis tab shows the consumption broken into bins of data that occur during associated outdoor air temperature ranges. The tool separates the data into both occupied and unoccupied periods based on consumption and splits the data based on OAT (warm vs. cold).

- Within the “Temperature and Occupancy-Based Model” table, you can note where the occupied and unoccupied changepoints are analyzed for the data in rows cells Z5 and Z6.
- The graph in this tab can be manually adjusted by changing the “Resolution” or the change points.
 - “Resolution” will adjust the granularity of the data represented in the graph (the size of the temperature bin). A resolution of 1.5°F will show data points for every 1.5°F, a resolution of 5°F will show data points for every 5 °F, etc.
 - Change Point Adjustment allows you to tune the graph so that it better represents where energy usage patterns begin to transition from cold weather operations to warm weather operations (and vice versa).

Hourly Summary & Monthly Summary

These two tabs compare the energy usage of the baseline and post data and calculate the savings percentages after implementing energy conservation measures.

- Hourly Summary
 - In Cell E31, you will find the percent savings in energy consumption from comparing the baseline and post data's average hourly energy consumption.
 - Cells H28 and H29 show the breakdown in savings between occupied and unoccupied hours.
 - This tab also contains a graph showing the visual representation of the average daily load profiles for the baseline and post-implementation energy consumption.
- Monthly Summary
 - This tab contains the weather-corrected energy savings, which provide savings percentages that are normalized by the average temperature for each month.
 - It is important to weather correct energy consumption when quantifying energy savings because OAT strongly impacts energy consumption. If the post-implementation year was warmer than the baseline year, raw energy data may show an increase in electricity consumption even though the building is operating more efficiently.

You can continue to track the energy consumption of your building by using the Append tool in the Setup tab and add new data as it becomes available. Repeat this process for each building and for each energy utility in your portfolio. Please contact fempre-tuning@hq.doe.gov for questions or technical assistance.