Weather Dependent Load Modeling

Sharpening the Pencil

Erik Lee - Dec 2024 DPAG Meeting

The Problem

To Properly Analyze Non-Wires Alternatives, DER and Electrification Scenarios We Need to Characterize Loads as Annual Curves

Traditional Focus on Summer & Winter Peak Only

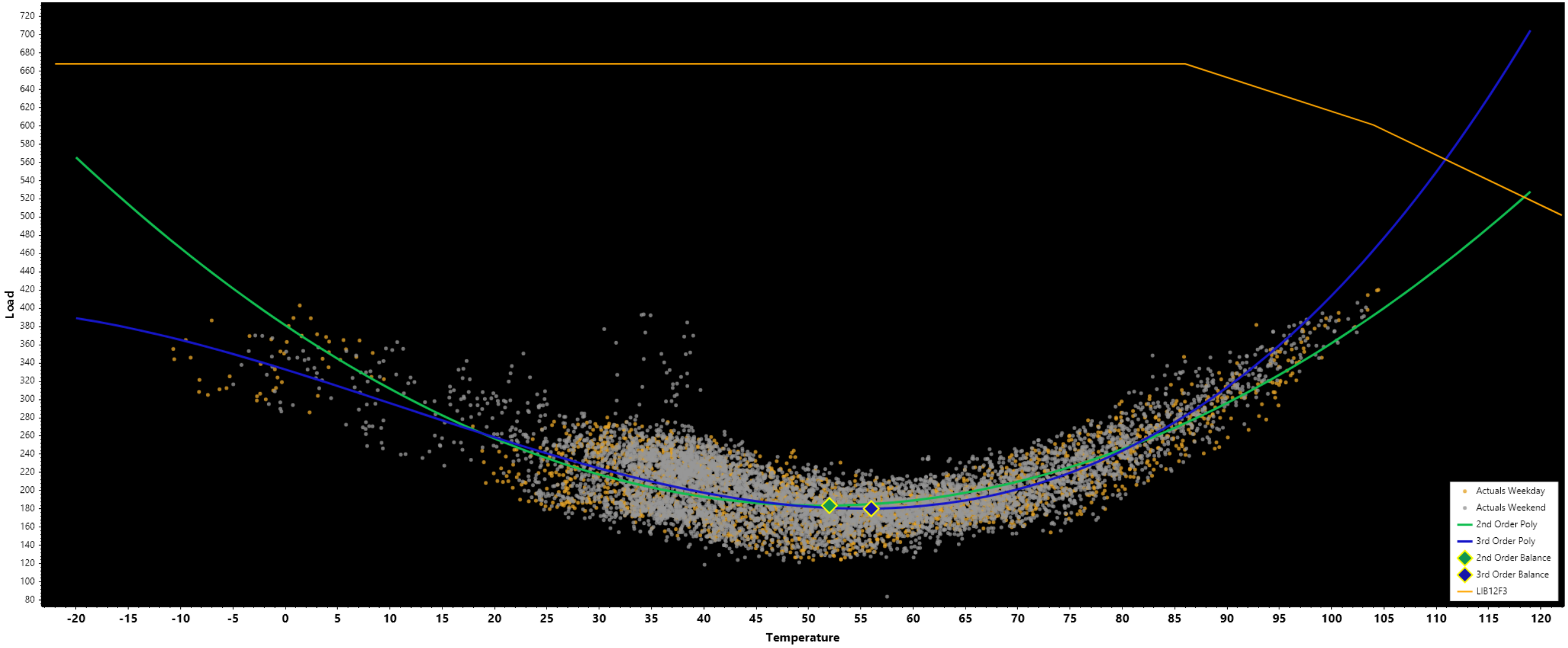
EV, PV, Electrification, ToU, Energy Efficiency, etc. (any load altering source)

Load Is Heavily Influenced by Ambient Temperature, Hour of the Day, Day of the Week, Weekday/Weekend, Month, Season

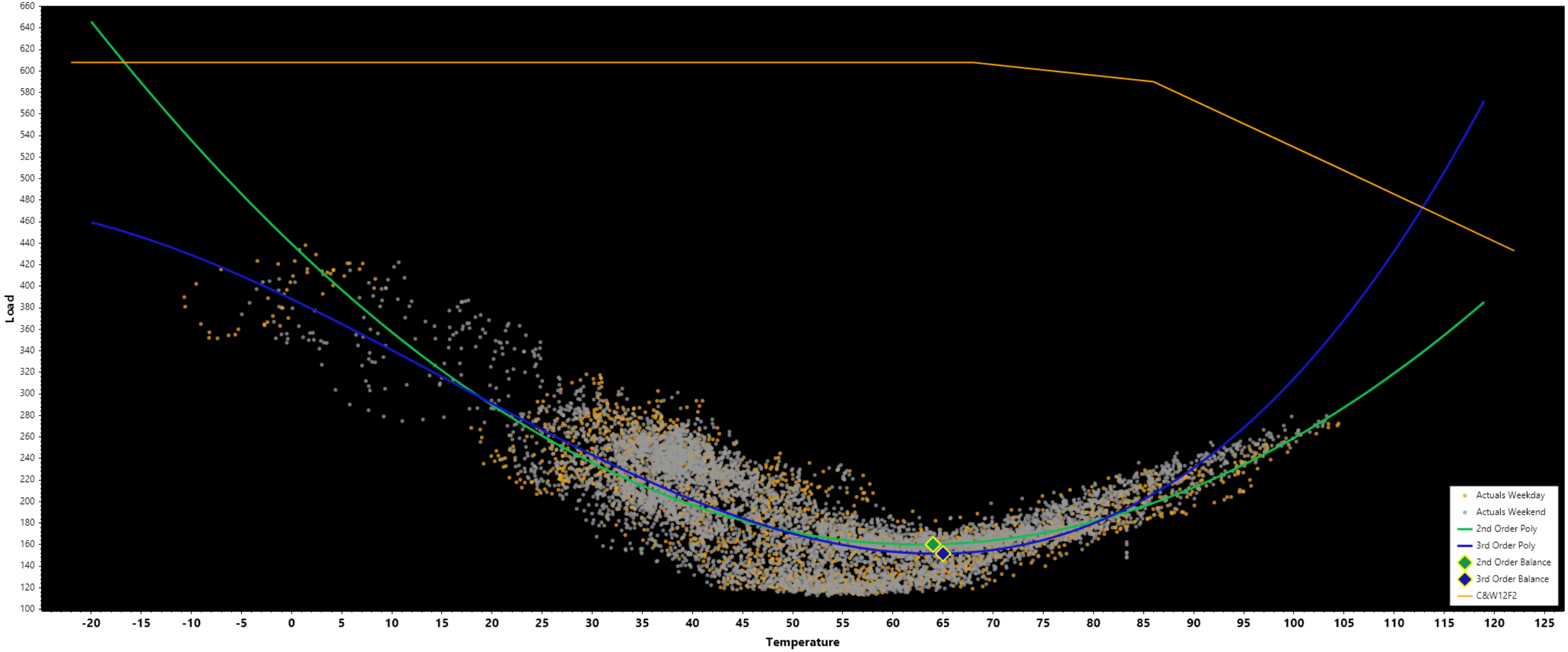
Avista's Planning Criteria Specifies a 1 in 10 Frequency of Occurrence of Extreme Weather (For Both Summer & Winter)

Avista's Facility Ratings Are Defined as a Function of Ambient Temperature

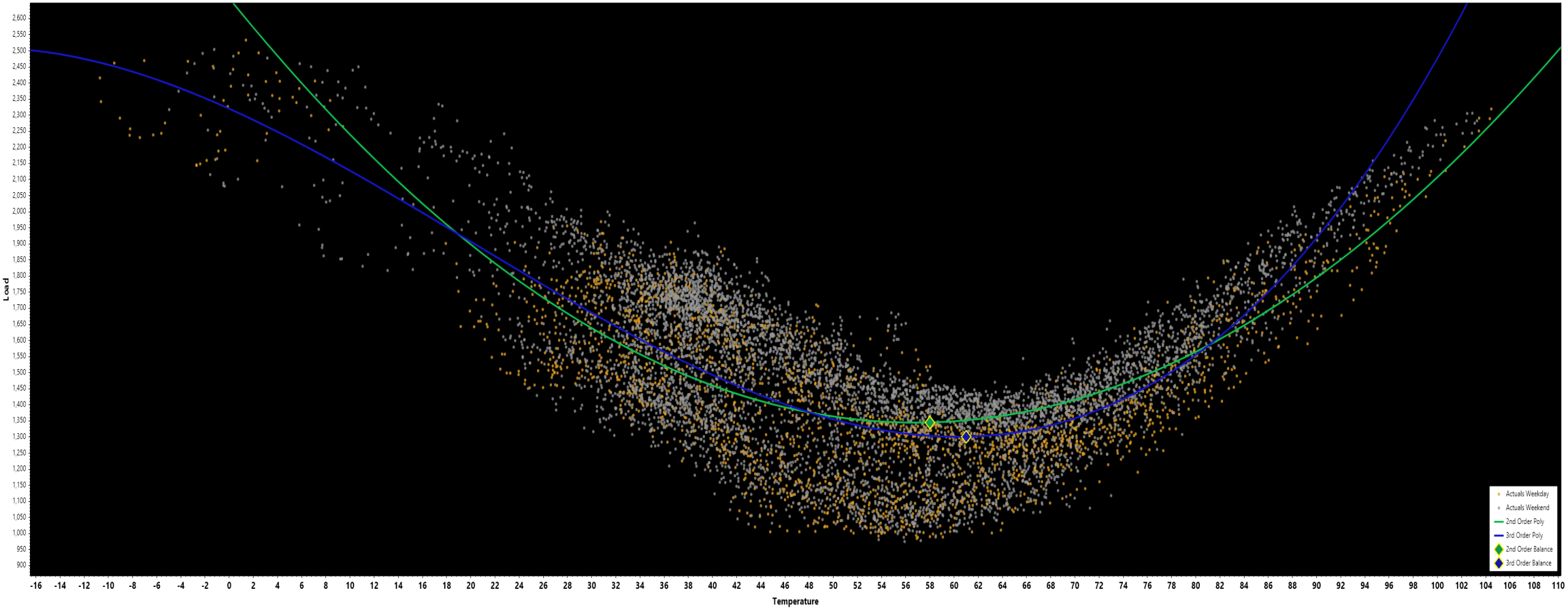
Example: Load vs. Temperature (Avg Urban Feeder)



Example: Load vs. Temperature (Low Income Feeder)

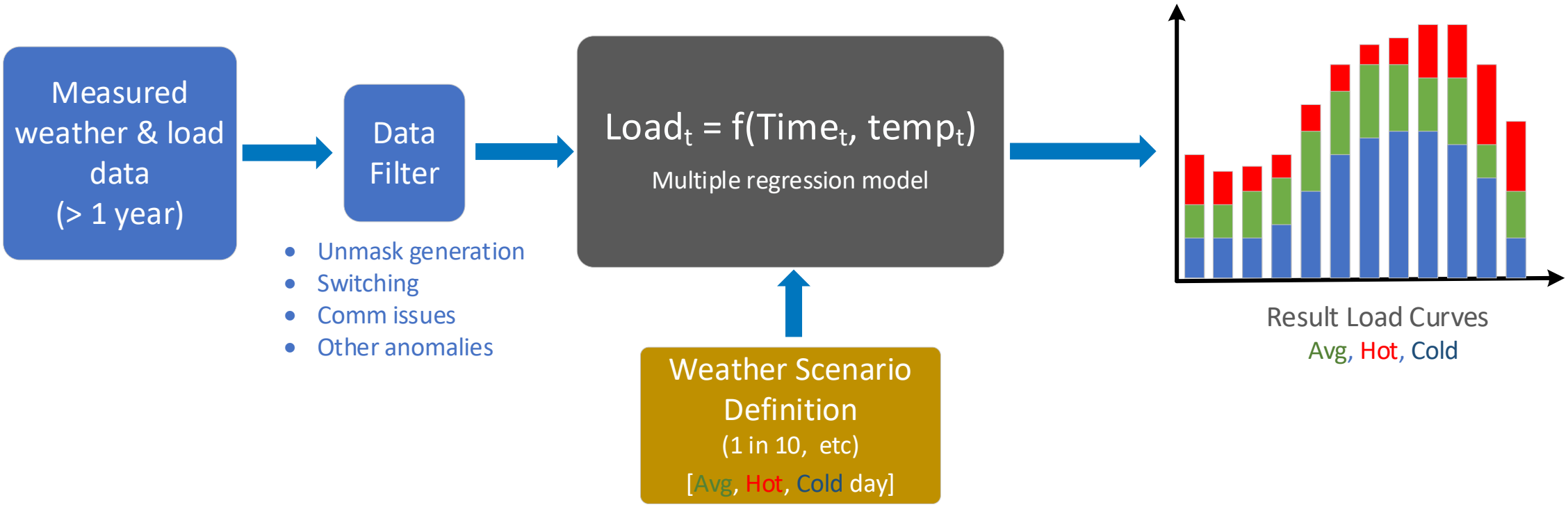


Example: Balancing Area (BA) Load vs. Temperature

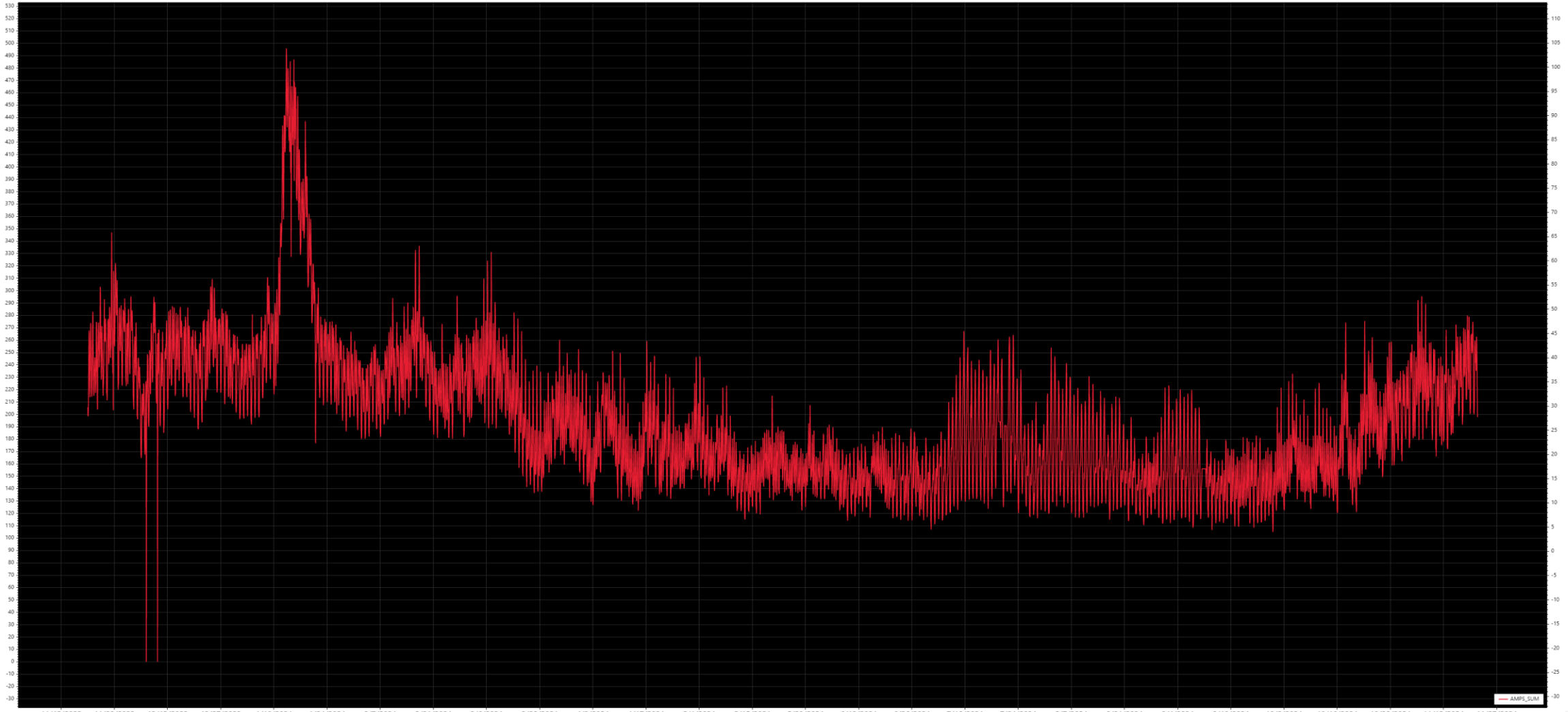


The Solution: Weather Normalized Load Curves Using Frequency of Occurrence (FoC) Data

- Use measured weather, time & load data to create a regression model that can then be fed a normalized temperature curve to produce weather normalized load curves



Data Cleansing: A Manual Effort



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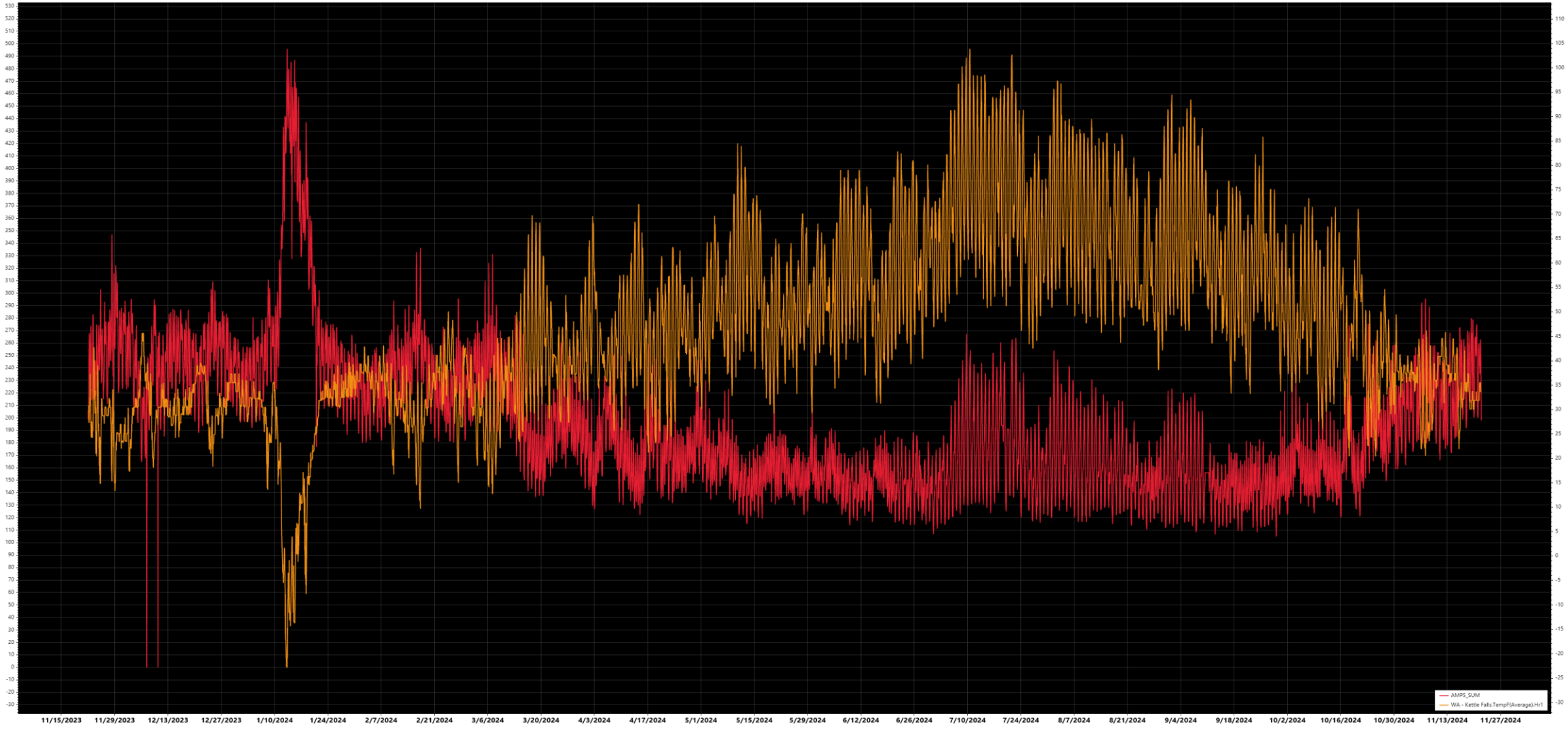
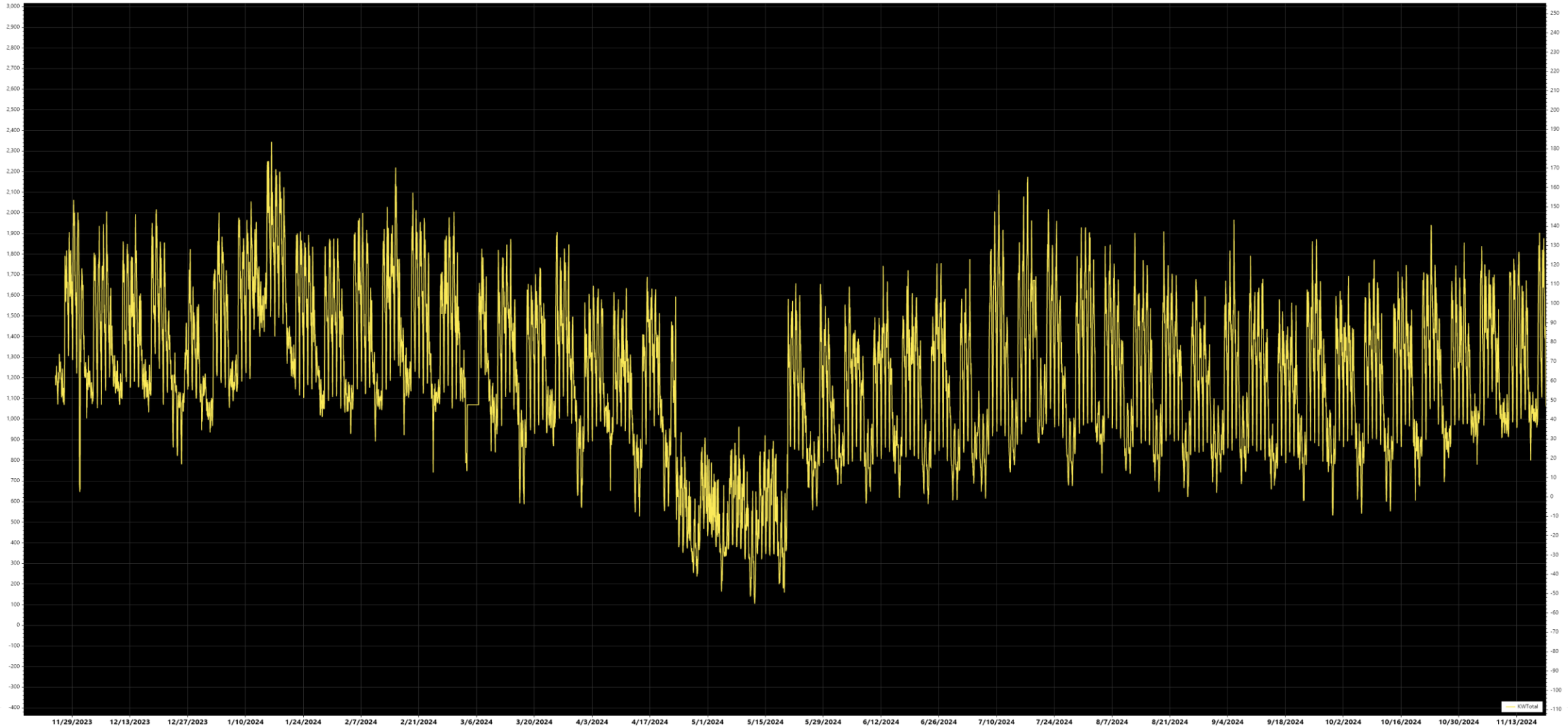


Data Cleansing: Switching



Why Hot, Cold and Avg Curves?

- Hot
  - Summer: Peak Load
  - Winter: Minimum Load (for Hosting Capacity)
- Cold
  - Summer: Minimum Load (for Hosting Capacity)
  - Winter: Peak Load
- Avg:
  - General Purpose & Operations Use

Remember, It's a Model

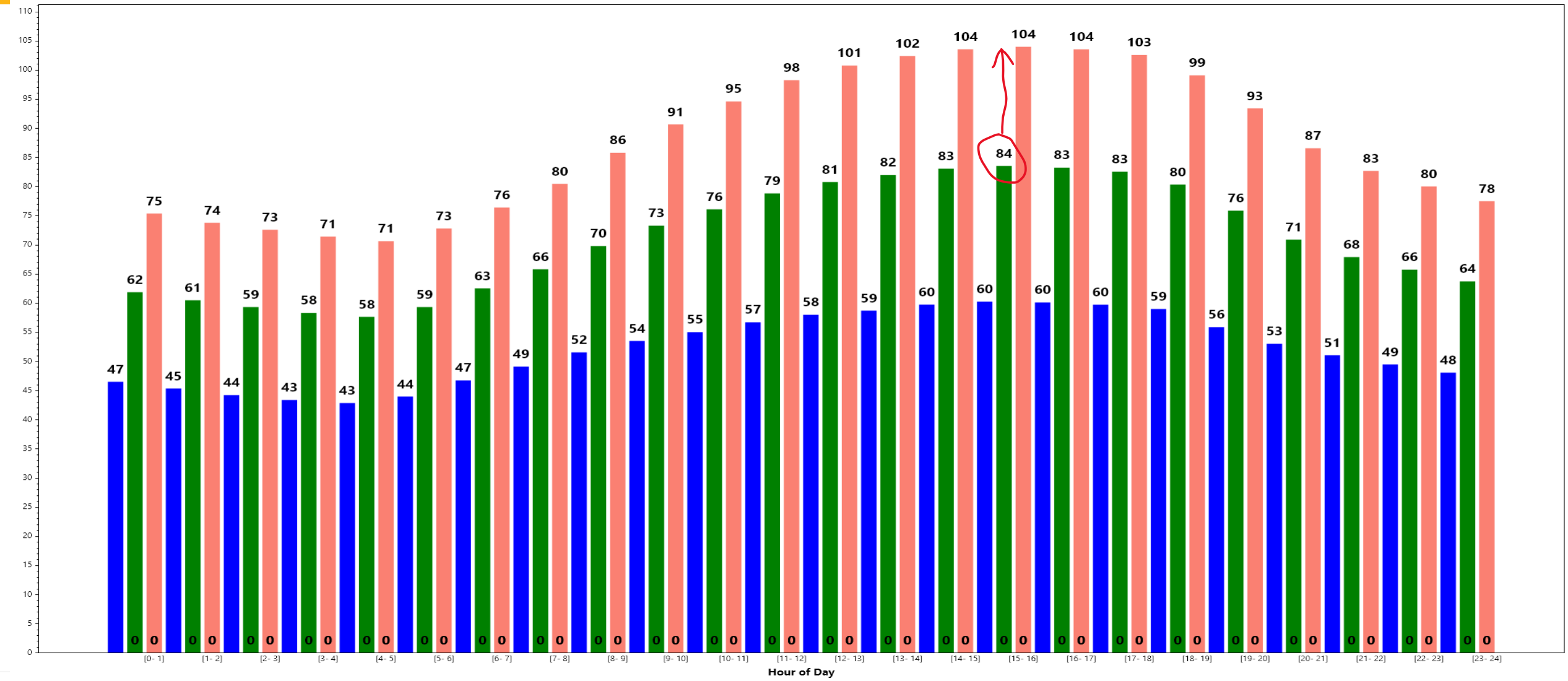
All models are approximations. Essentially, all models are wrong, but some are useful. However, the approximate nature of the model must always be borne in mind.

- George Box

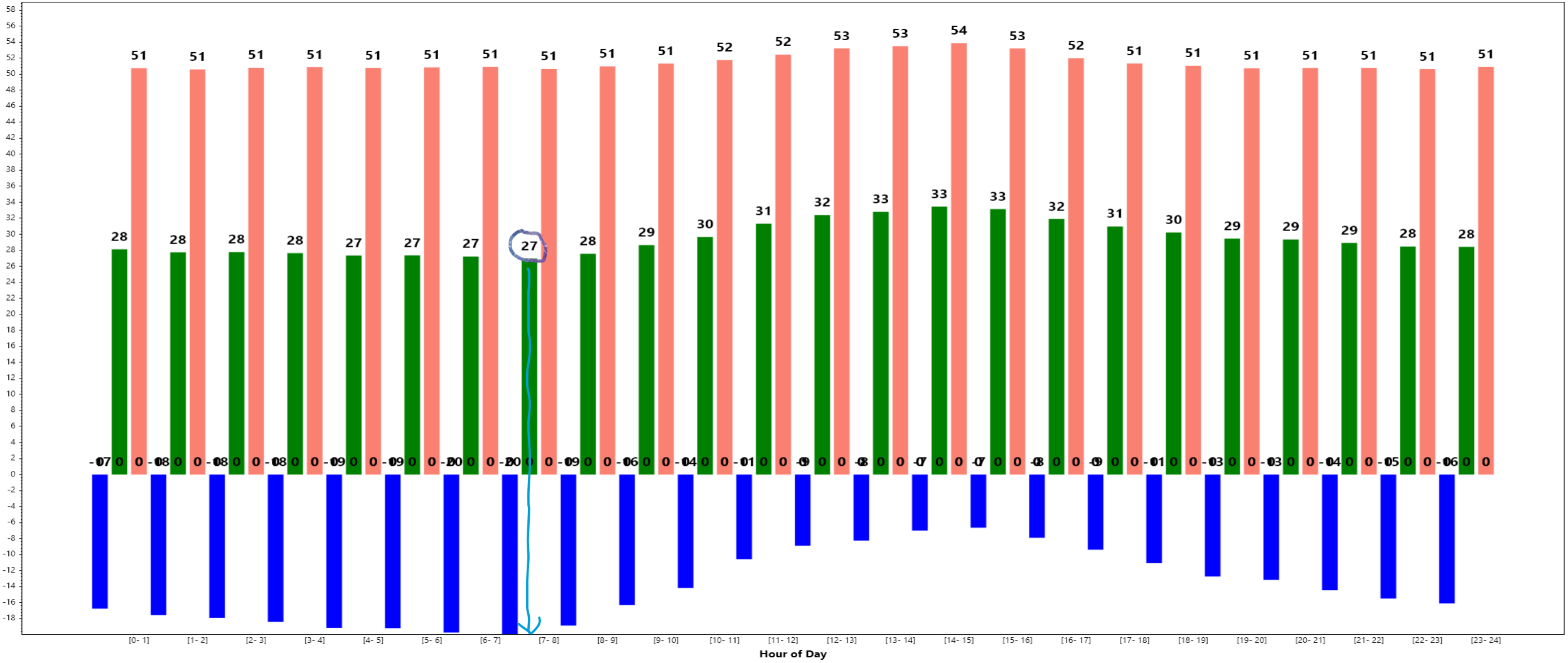
Deriving Weather Curves

- Using Regional Historical NOAA Hourly Temperature Data
  - We Currently Define 7 Microclimate Regions (Electrical Distribution Service Area)
- 12 Months x 24 Hours/Day = 288 Data Point Yearly Temperature Curve
- Bin the Historical Data into 288 Buckets, Calculate Average & Standard Deviation for each
- Use Frequency of Occurrence (FoC) Data to Define Desired Peak and Minimum Annual Temperature
  - Spokane 1 in 10 = 104F Summer, -20F Winter
- Find Peak & Minimum Values of the ‘Average’ Curve
- Find the Hot Day & Cold Day ‘Offset Factors’ That Scales the Average Curve Peak & Min to the Desired FoC Temperature Values
- Apply the ‘Offset Factors’ to the other 287 Buckets Using Each Bucket’s Average and Standard Deviation

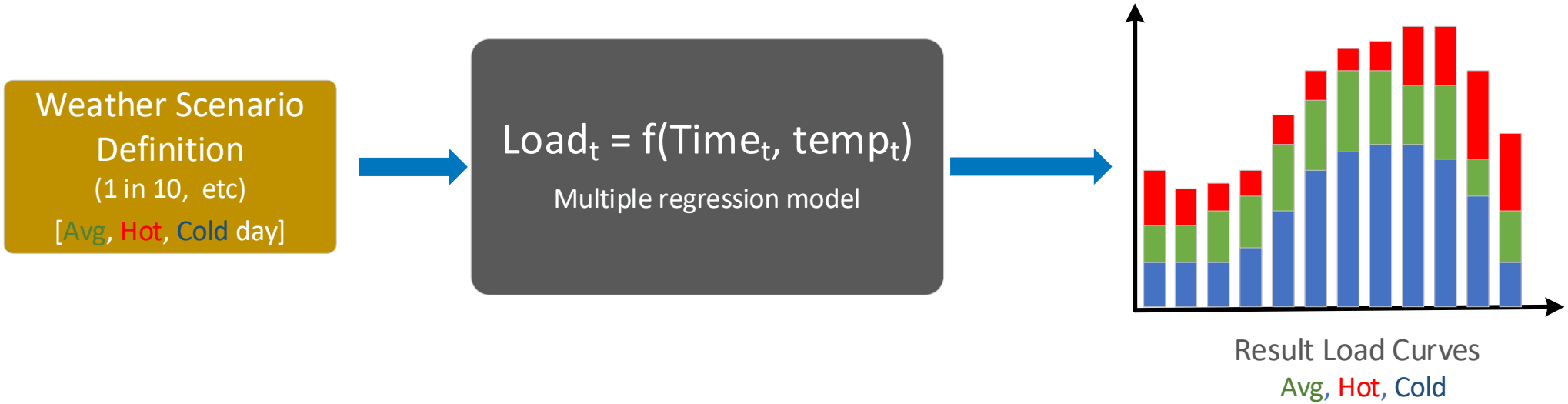
1 in 10 Scenario Temperature: Summer Peak Temperature - July



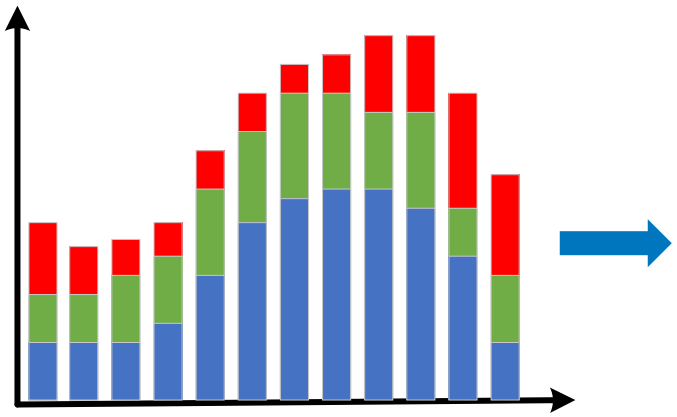
1 in 10 Scenario Temperature: Winter Min. Temperature - January



Input Weather Scenario Through The Load Function

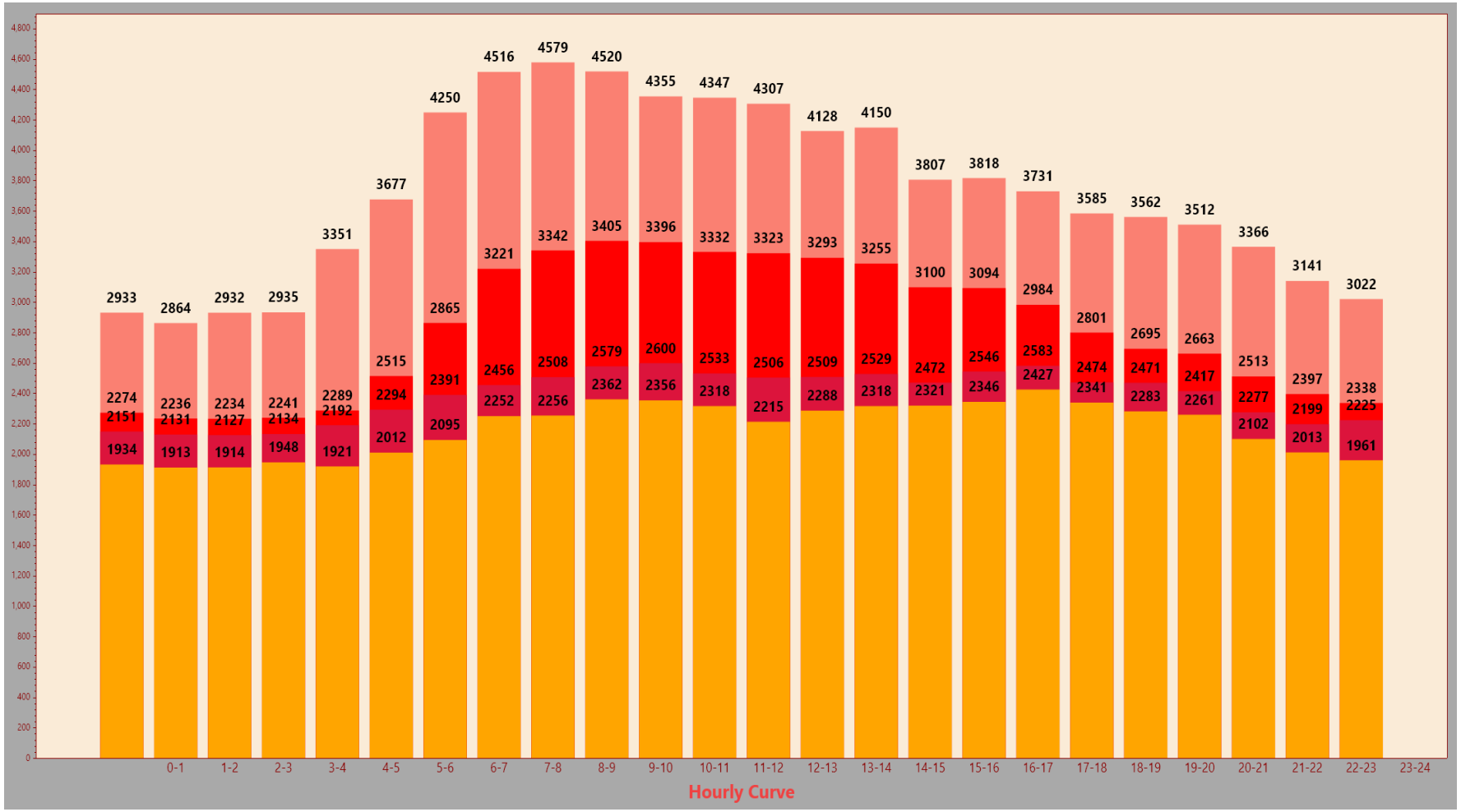


The Result: Peak day, Min day, Weekday, Weekend Load Curves



Result Load Curves

Avg, Hot, Cold



Thank You!

Questions, comments, ideas?