Modeling Utilities Consumption at Cornell

History of Energy Modeling
Presented by Steve Mandl

Utilities Budgets

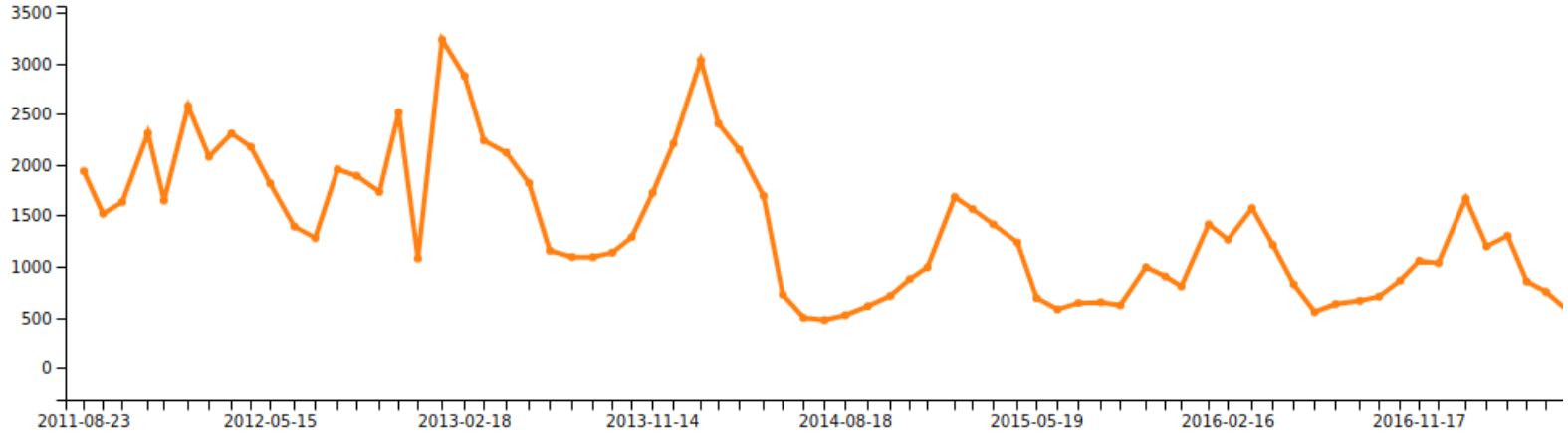
- Chilled Water
- Steam
- Electricity
- Natural Gas
- Propane
- Fuel Oil
- Potable Water
- Sewer

Building Performance

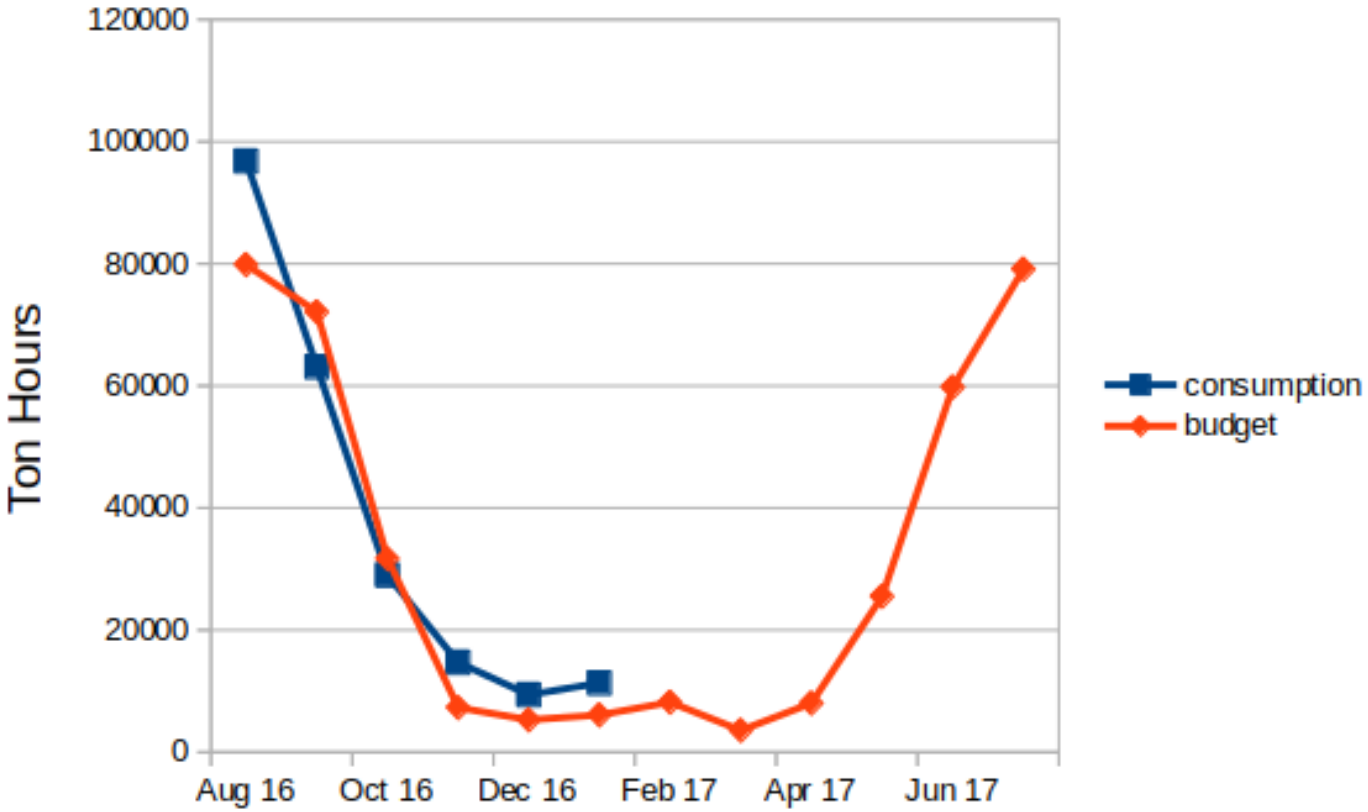
- How to compare performance between buildings, or in the same space from year to year?
- After an ECI, the consumption went down; how much of that is due to weather, and how much is due to the ECI?
- We want to profile the budget throughout the year, and adjust for weather changes

Mann Library May 2014 ECI

Monthly Steam Consumption (kLbs)

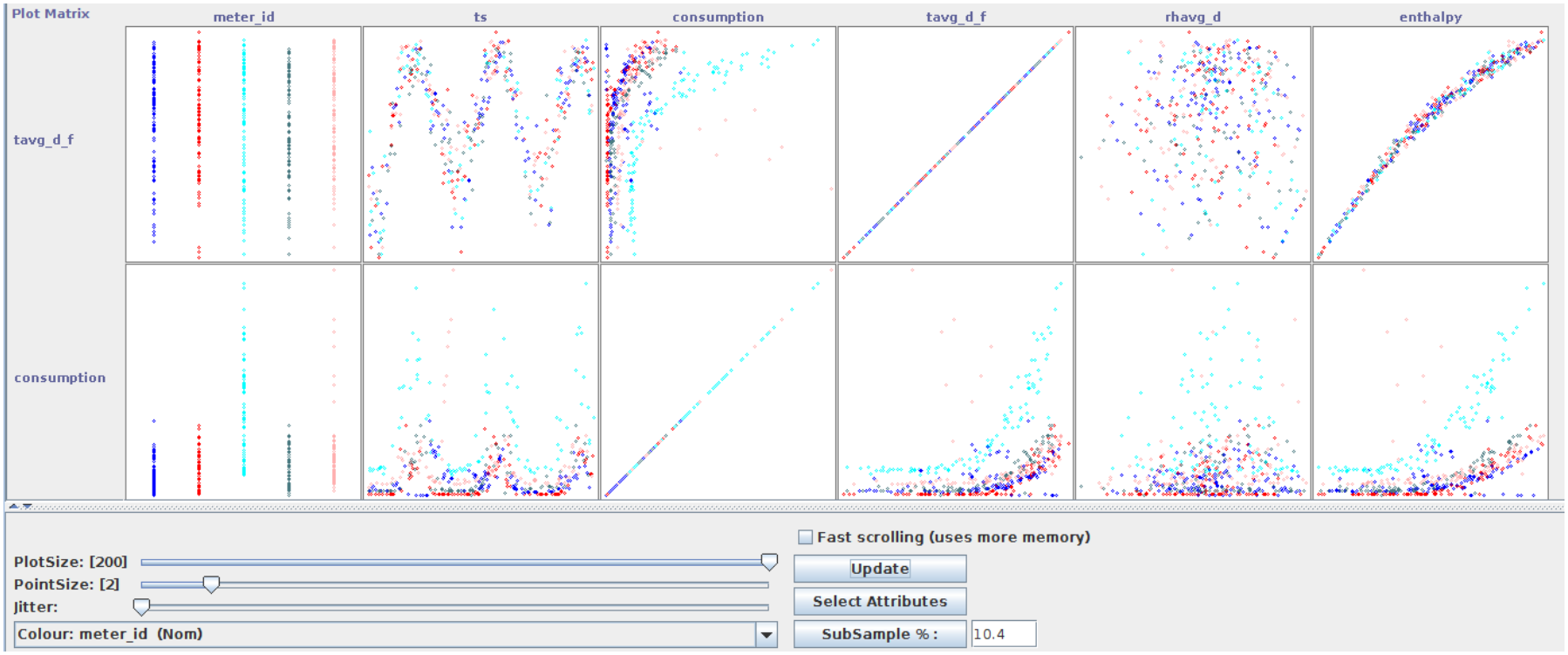


Weather Adjusted Consumption



Initial Solution

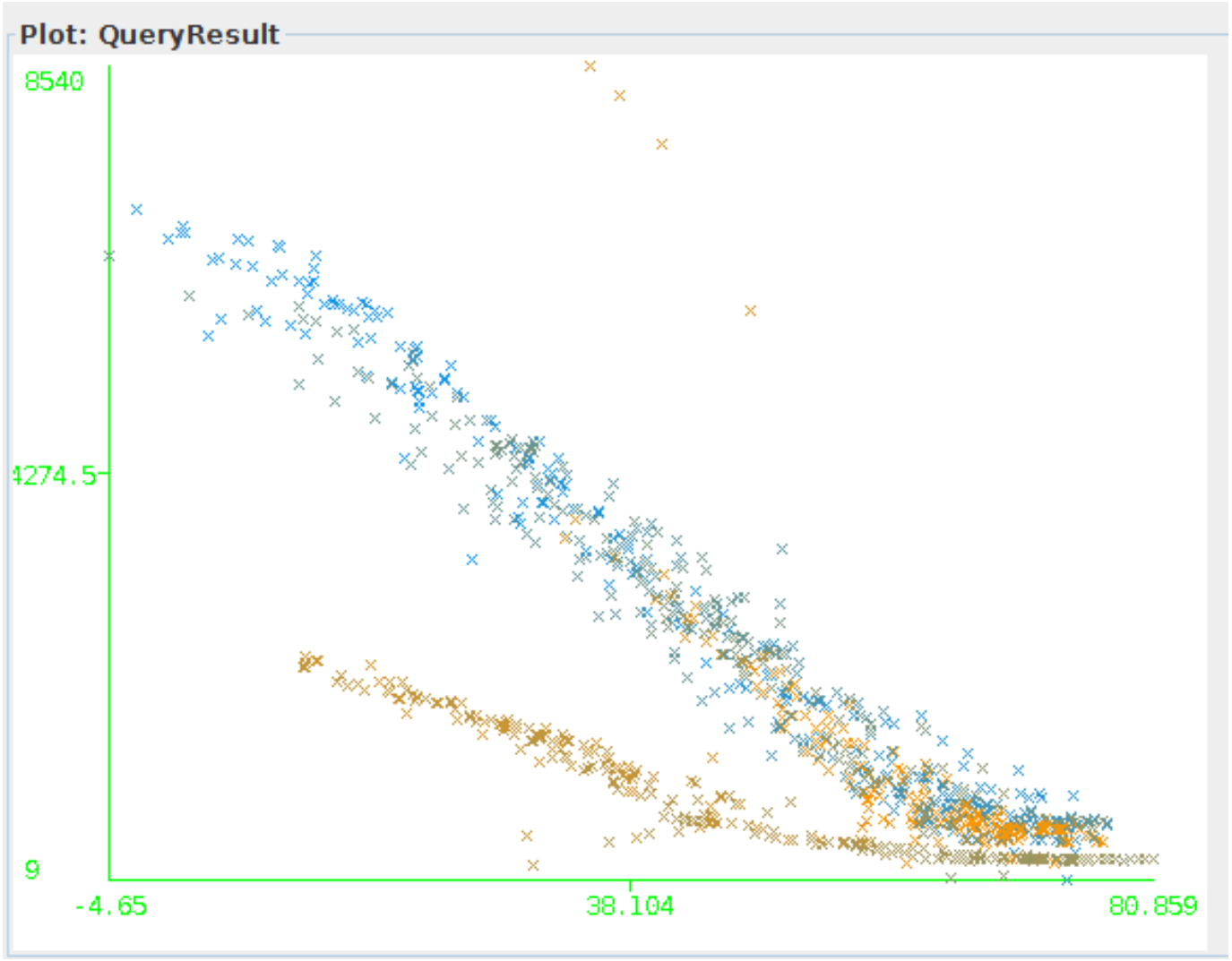
Physics-Based Model



Physics model limitations

- Occupancy affects consumption, and is independent of weather
- Solar insolation affects consumption
- Each meter required manually adjusted model parameters
- Some commodities' relationship with weather is not clear or easy to model

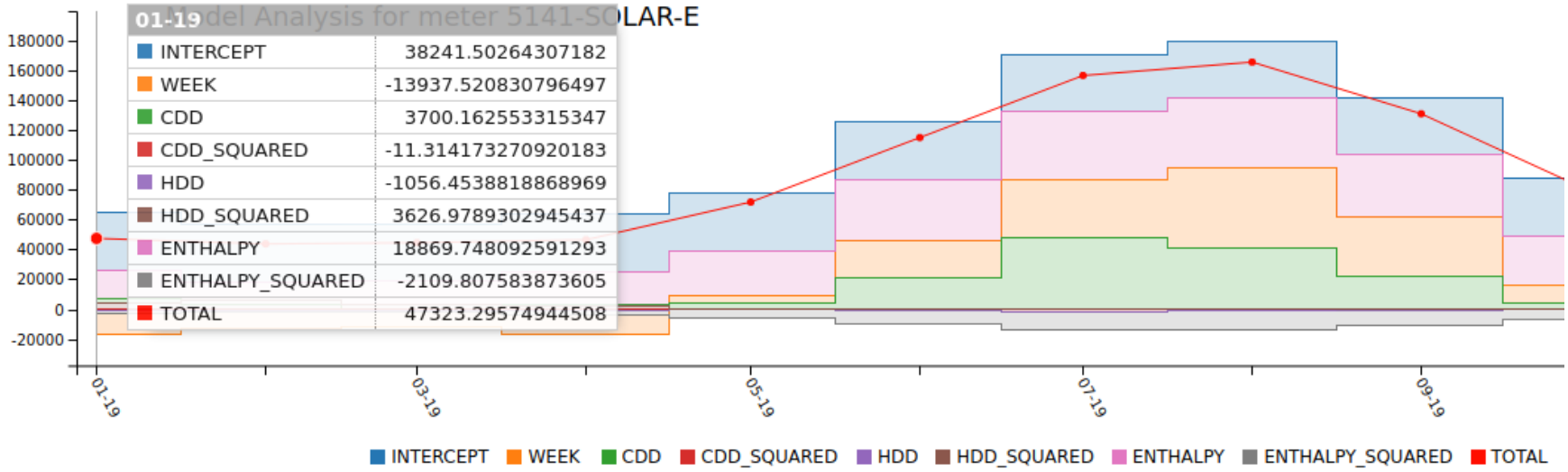
Steam vs. Temp - Colored by Age



Machine Learning Models

- Automated batch model creation
- RMSE is minimized
- Training sample is a set of periods between meter reads
- Features are manually predetermined from analysis of the historic consumption
- Cross-validation helps minimize overfitting

ML Model Analysis



A Model Analyzing Actual Consumption