

Residential Critical Peak Pricing Model

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Conference

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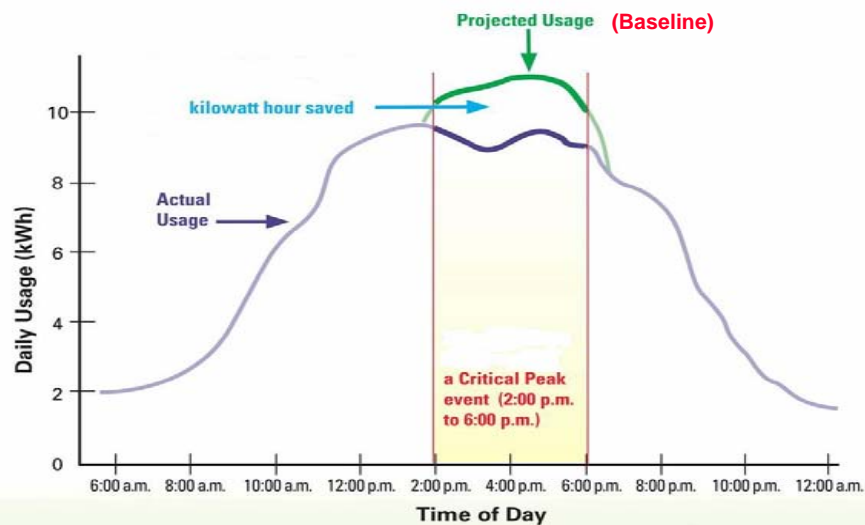


Outline

- What is Critical Peak Pricing Program?
- How does it work?
- Baseline Algorithm
- Issues
- Potential Solutions

What is Critical Peak Pricing Program?

- Is a demand response program for residential customers
- Reduce demand for electricity during high demand periods
- Is a reward program
- Is a pilot program with about 1,100 customers in 2008



How does it work?

-Enrollment period

- Send out E-mail/letter to customers with AMI meters
- Develop algorithm for customer baseline construction
- Monitor customers hourly load data

How does it work?

-Event call process

- Determine the event call date and time (weekends and holidays are excluded)
- Create potential call list
- Inform customers of upcoming event call
- Analyze customers data and build baseline
- Calculate customers rebates based on the analysis results
- Updates customer's data on web site

Baseline Algorithm

-Test models

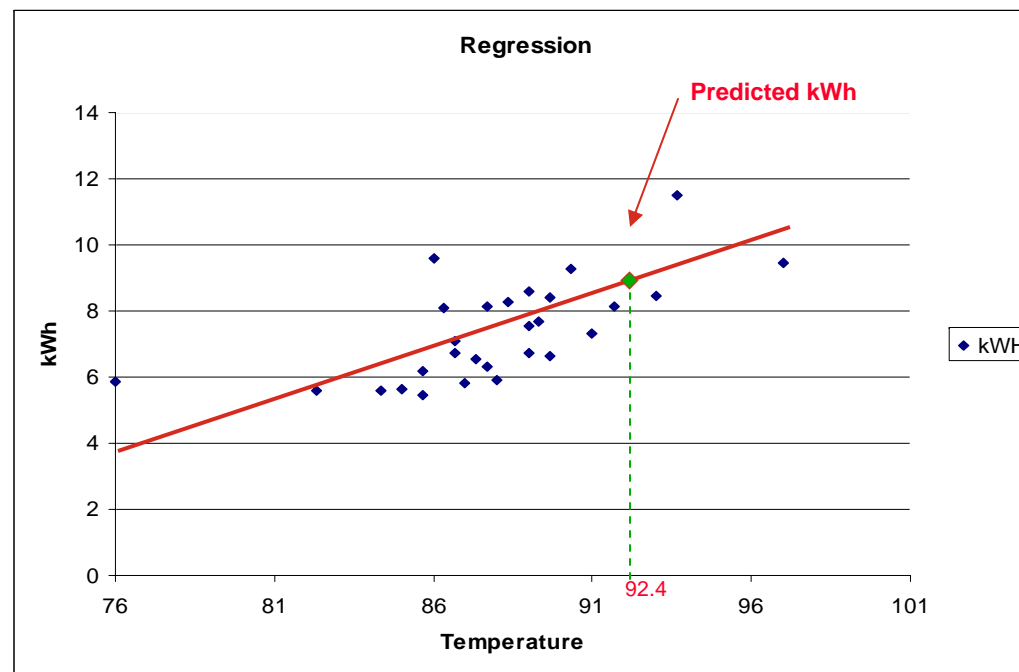
- Simple average of high usage days
- Adjusted average
- Weighted sum of average and maximum method
- Event period regression model
- Hourly regression model
- Time series

Baseline Algorithm

-Final model: 2 step estimation

- Step 1: Event period energy prediction using regression

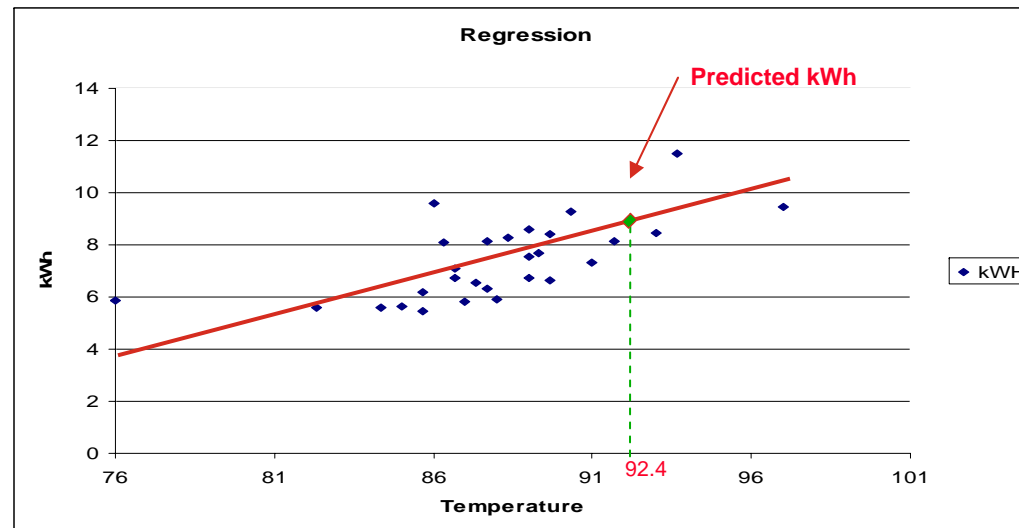
$$\text{kWh}_{\text{event_period}} = \beta_0 + \beta * \text{temperature}$$



Baseline Algorithm

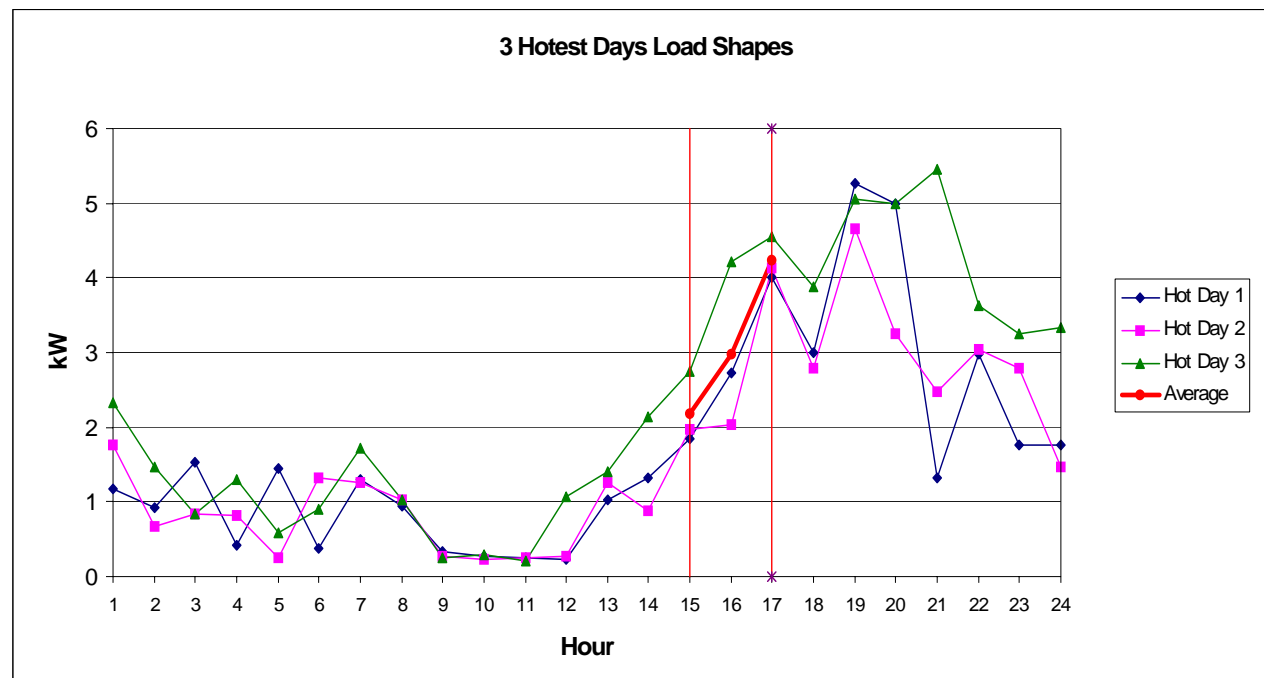
(Step 1 continued)

- Stepwise model selection:
 - Fixed variables: average temperature over the event period
 - Potential effects: dew point temperature, one day temperature lag, two day temperature lag
- Regression is weighted on temperature



Baseline Algorithm

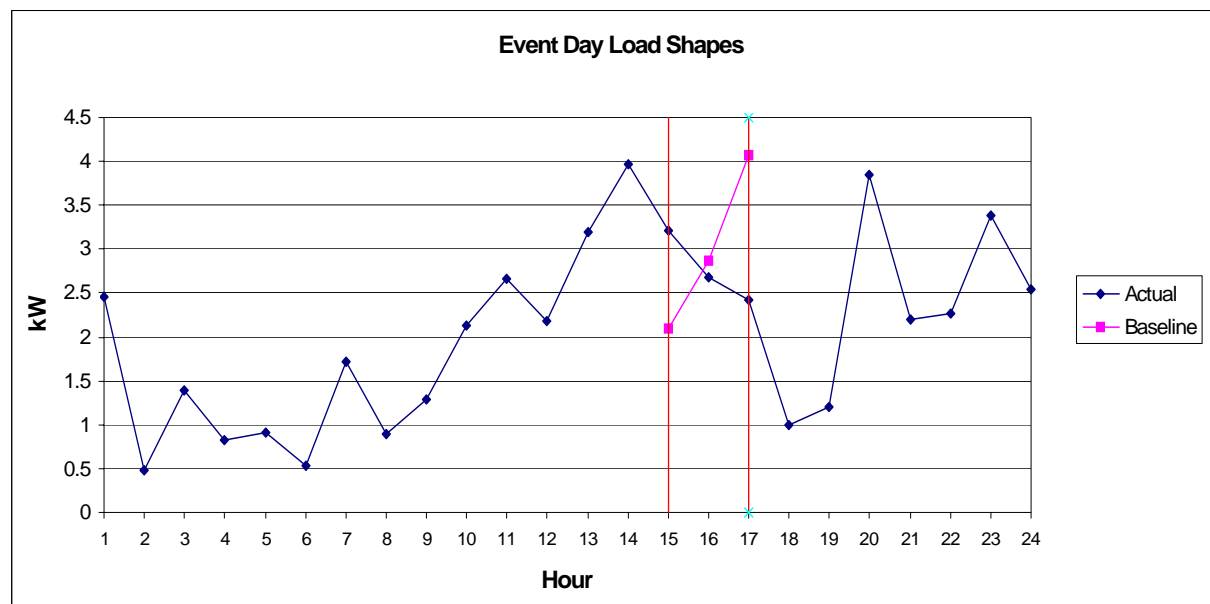
- Step 2: Baseline Loadshape creation
 - Create typical hot day loadshapes by averaging 3 hottest days in 15 weekdays prior to event date.



Baseline Algorithm

(Step 2 continued)

- Allocate estimated event period energy to average loadshape



- The energy savings is the positive difference between the estimated baseline and the actual measured demand by hour.

Baseline Algorithm

-Outlier Detection and Model Validation (regression model)

- Test R-student residual for outliers
- Test on inadequate regression model
 - Small degrees of freedom
 - Prediction lower than customer's historical minimum
 - High prediction error (Press statistic)

-In case of inadequate model, average of 3 hottest days forms the baseline

Issues

-AMI meter issues:

- Data gaps
- No decimal point readings
- Reading value decrease

-Weather issues:

- Weather station match

-Model issues:

- Hourly loadshape variation
- Large regression prediction error when solved at low temperature
- Negative slope
- Error due to customer behavior change over time

-Other issues: vacation home, customer random behavior etc.

Potential Solutions

- Continuous effort in improving AMI meter data quality
- Study pulling in more weather stations
- Additional model statistics:
 - Large model prediction error within event day temperature range
 - Negative values of sum of regression model coefficients
 - Large difference between regression prediction and hot day average
- Shadow models
 - Weights by temperature group
 - Event day adjustments
 - Time distance adjustments
 - Average models
 - Time series

Questions?

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