



California Energy Commission

Hourly Load Modeling: Methodological Issues

DAWG Meeting

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Hourly Load Model Estimation

Estimate ratio of hourly load to annual average load for each hour (24 regressions for each TAC) as a function of weather, day of the week, weekend/holiday, month, using hourly data by TAC for 2006-2016

$$L_{i,d} / L_y = f(g(t), \text{dow}_d, \text{wkhold}_d, \text{month}_d, \text{constant}_i)$$

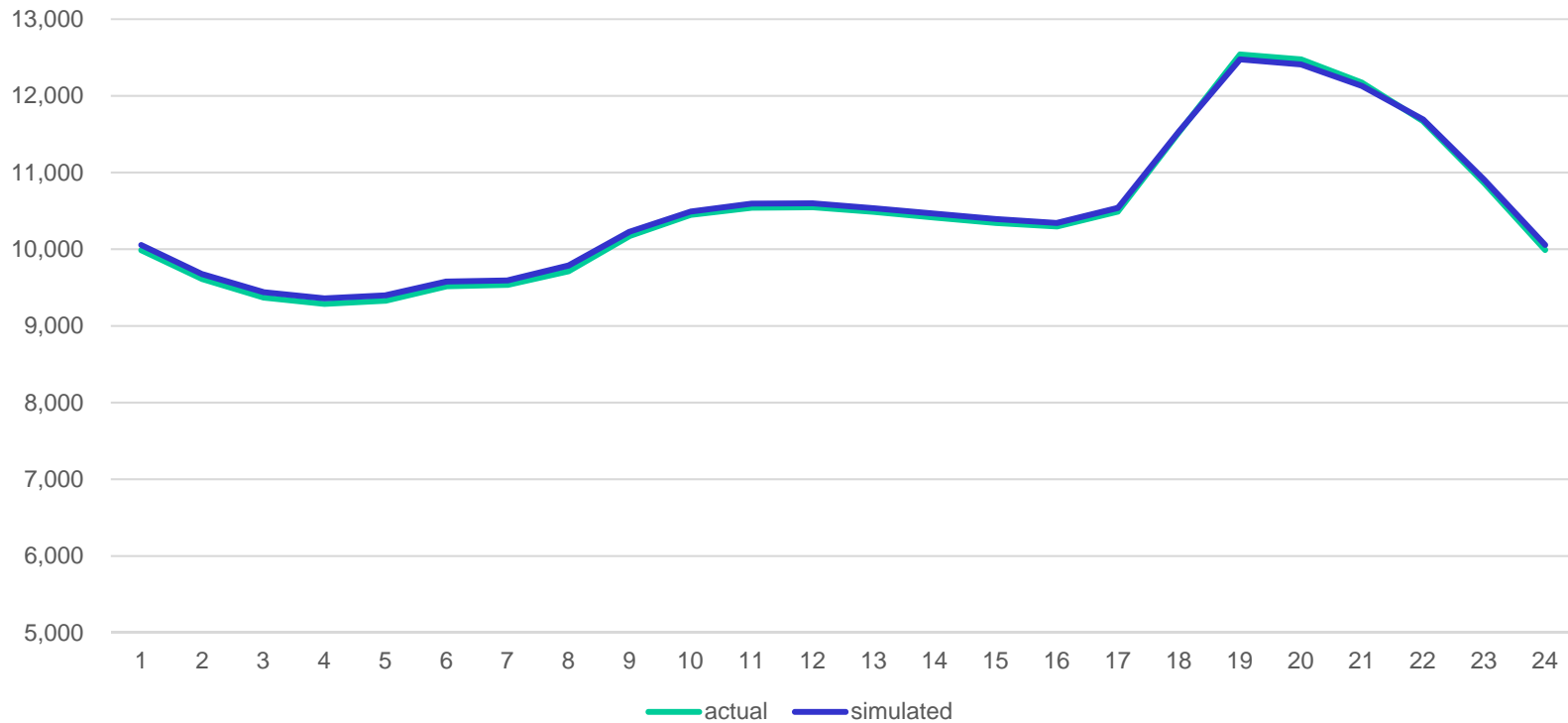
$i=1,24$ $d=1,365$, $y=1,11$, $g(t)=\text{weather}$
(temperatures, dew point and cloud cover)



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Provides Excellent Fit: Not Surprising at System Level

SCE, February 15, 2009





Implementing Hourly Load Model

- Apply estimated ratios to annual forecast “consumption” load (load served by utilities plus PV energy minus EV load)
 - Annual load forecast accounts for economic/demographic growth and other changes
- Adjust consumption load using EV charging profiles, PV generation profiles, residential TOU hourly impacts, and hourly AAEE.



Hourly Profiles

- EV charging profiles may be updated
- PV generation profiles from CSI data
- Residential TOU developed in-house
- AAEE profiles developed with Navigant



Weather-Normalized Loads

- Simulate 18 years using hourly weather and calendar effects assuming 7 different calendars (18 x 7 = 126 simulations of 8760 hourly load ratios)
- Take highest hourly ratio for each simulation, rank, and select median—this becomes weather-normalized peak ratio
 - Similarly for 2nd highest hourly load, etc., through 8760 hours
- Assign ratios to actual day and hour using “average” weather year in terms of CDD and HDD
 - 2009 for SCE and SDG&E, 2012 for PG&E



Assignment of Ratios Creates Two Issues

1. Any peculiarities of the chosen “average” weather year get carried through to forecast
Example: SCE and SDG&E had unusually low monthly peaks in May and June, 2009, leading to lower than expected CAISO peaks for these months
2. Using two different years (2009 and 2012) for assignment creates misalignment for CAISO coincident peaks



How to Address These Issues

1. Construct a Typical Meteorological Year (TMY) for each TAC and forecast hourly load ratios directly using model coefficients.
 - Most recent version (TMY3) covers only through 2005
 - Does not cover all of the weather stations we use
 - Discontinuity from one month to the next
 - May not be appropriate for forecasting extremes (i.e. peaks)



How to Address These Issues

2. Develop “average” months for each TAC based on criteria such as CDD, HDD, and monthly peaks. Assign ranked hourly ratios to days/hours based on this constructed year.
 - Also has discontinuity issue from month to month
 - Hourly load ratios for constructed year need to be rescaled



How to Address These Issues

3. Use method 2 but “smooth” the transition from month to month.
 - Overlapping monthly periods?
4. Rather than run the simulations to get set of ranked hourly load ratios for each hour, develop distributions by day/month. For example, first Monday in January, second Tuesday in March, July 4, etc.

The accuracy of peaks is unclear



TAC Hourly Loads Estimated Independently

- This may contribute to CAISO misalignment
 - Correlations among TACs not explicitly accounted for
- Model can be re-estimated as a combination cross-section time series model, where correlations among the cross-sections are incorporated during coefficient estimation



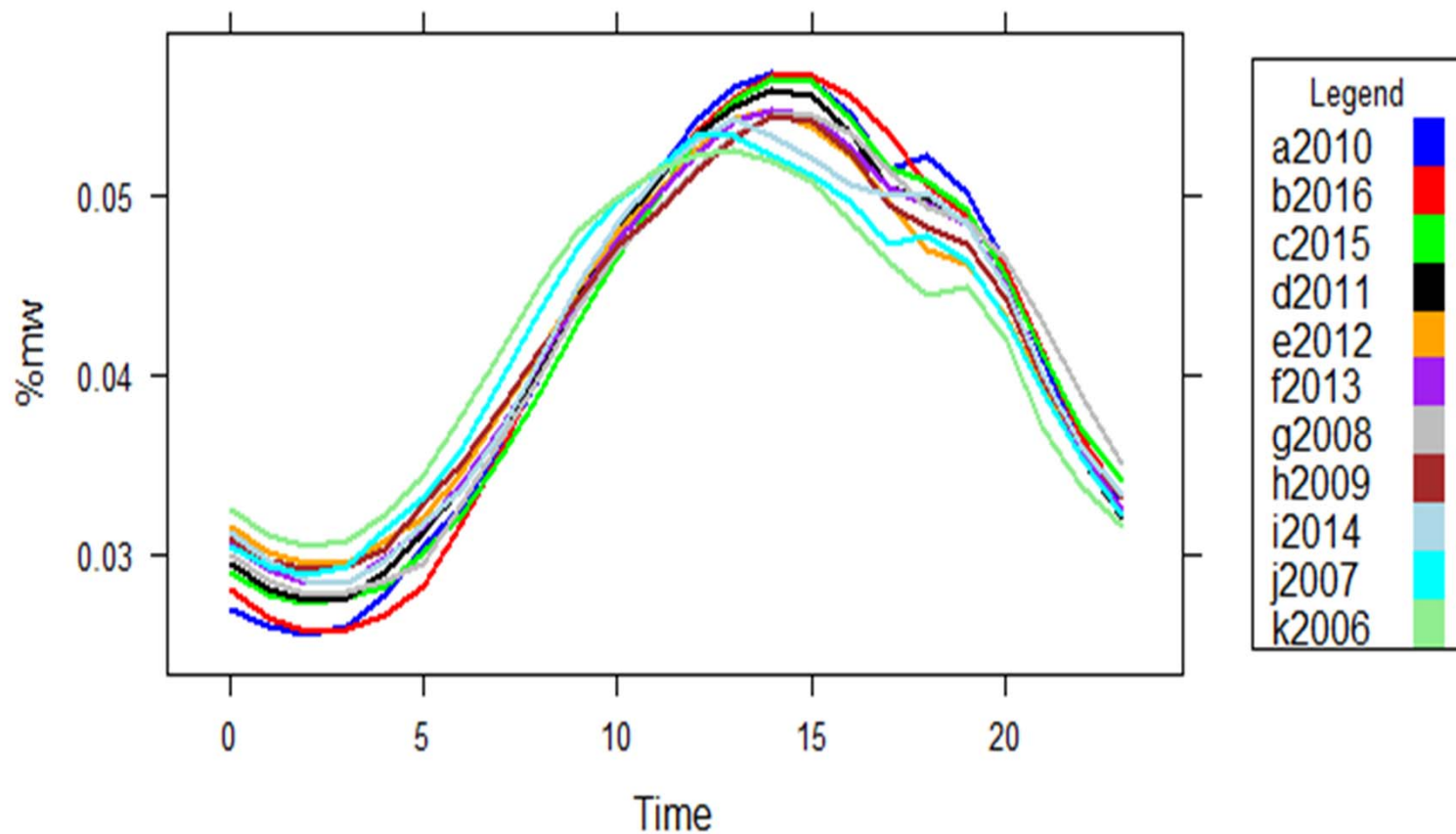
Other Issue: SCE Peak Shift

- During 2017 IEPR process, SCE voiced concerns about the magnitude of their peak shifts compared to PG&E
 - CEC staff pointed to SCE loads falling more quickly in late afternoon/evening vs. PG&E
 - SCE responded that overall this may be true, but more recent years show loads pushing out later into the afternoon/evening
- Some evidence for SCE assertion—staff considering using more recent years



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Total Hourly Demand for SCE Historical Peak Day By Year





Questions/Comments?