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Hourly Load Modeling and Other Methodological Issues

IEPR Workshop

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Presentation Components

- Hourly Load Modeling
 - Background
 - Forecast Issues from CED 2017
 - How these issues will be addressed
- Other Methodological Issues
 - Weather normalization
 - Residential TOU



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

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

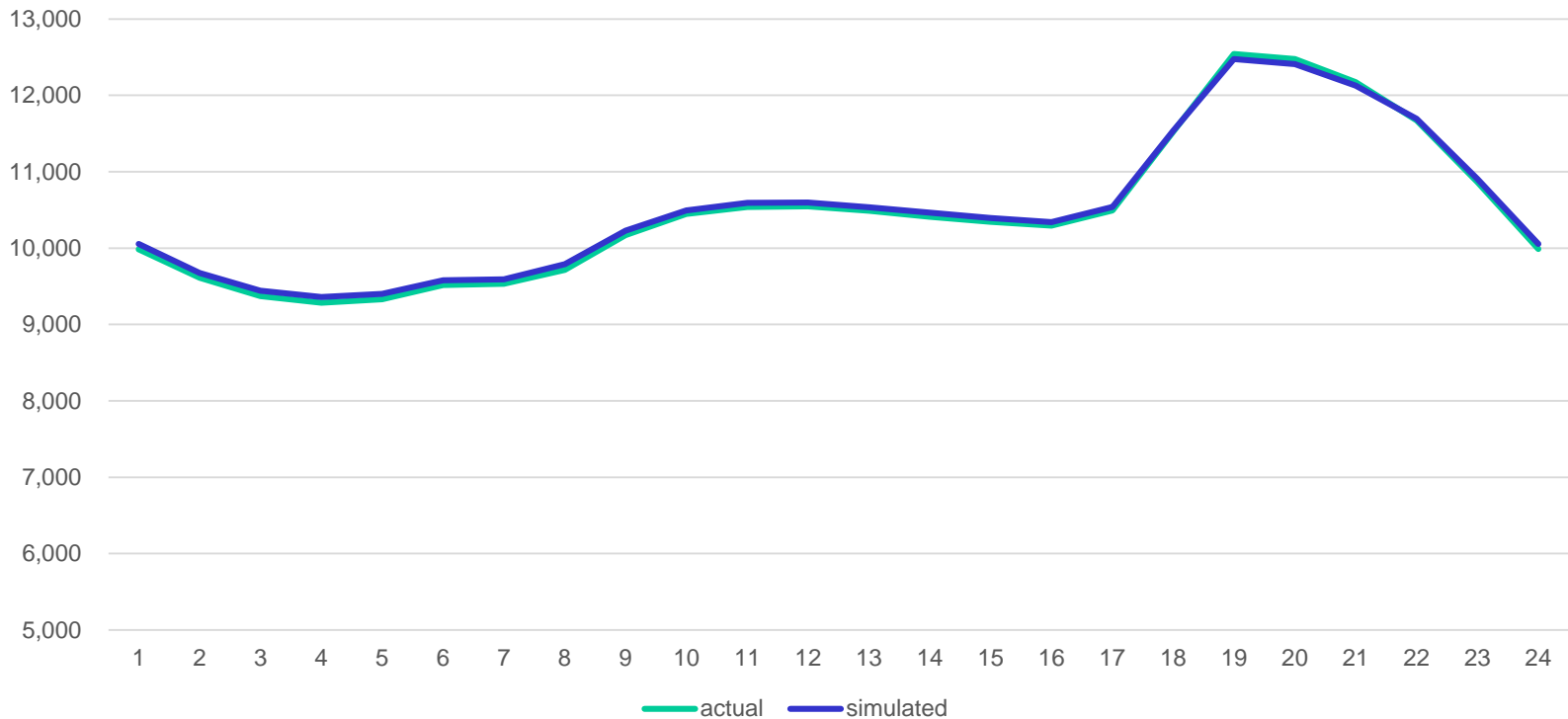
$i=1,24$ $d=1,365$, $y=1,11$, $g(t)=\text{weather}$
(temperatures, dew point and cloud cover)



California Energy Commission

Provides Excellent Fit: Not Surprising at System Level

SCE, February 15, 2009

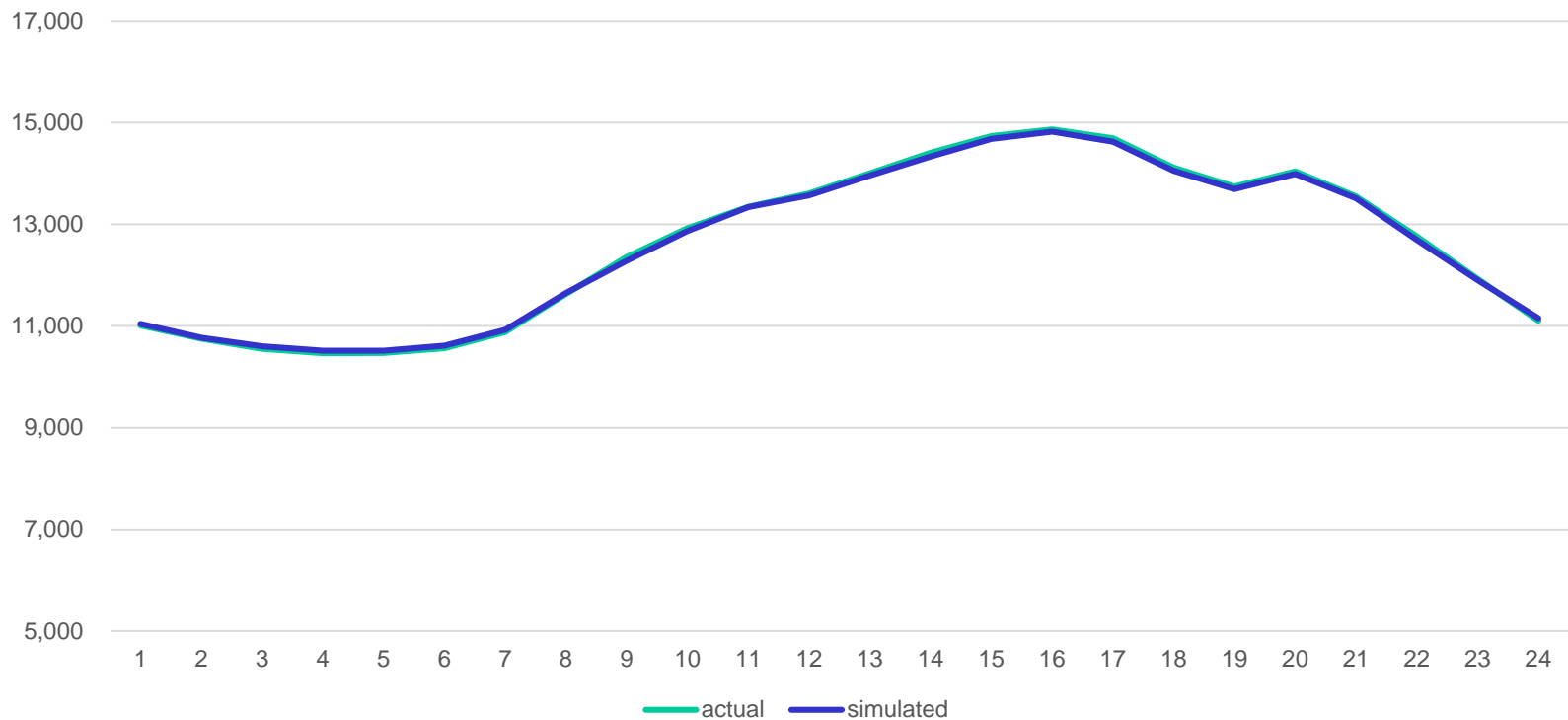




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SCE, August 15, 2009

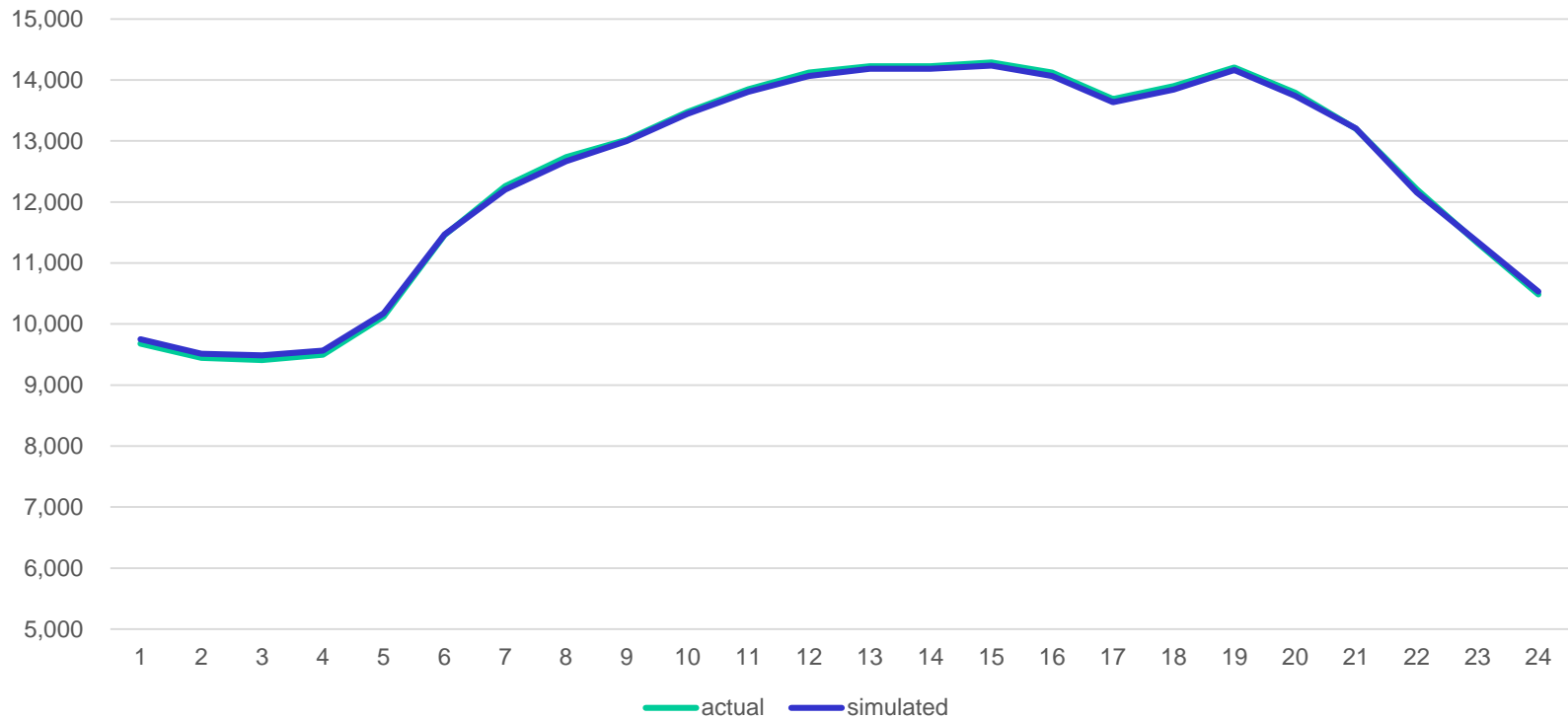




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Provides Excellent Fit: Not Surprising at System Level

SCE, October 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 17 years using hourly weather and calendar effects assuming 7 different calendars ($17 \times 7 = 119$ simulations for each hour)
- 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

Technical discussions on this topic to follow



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



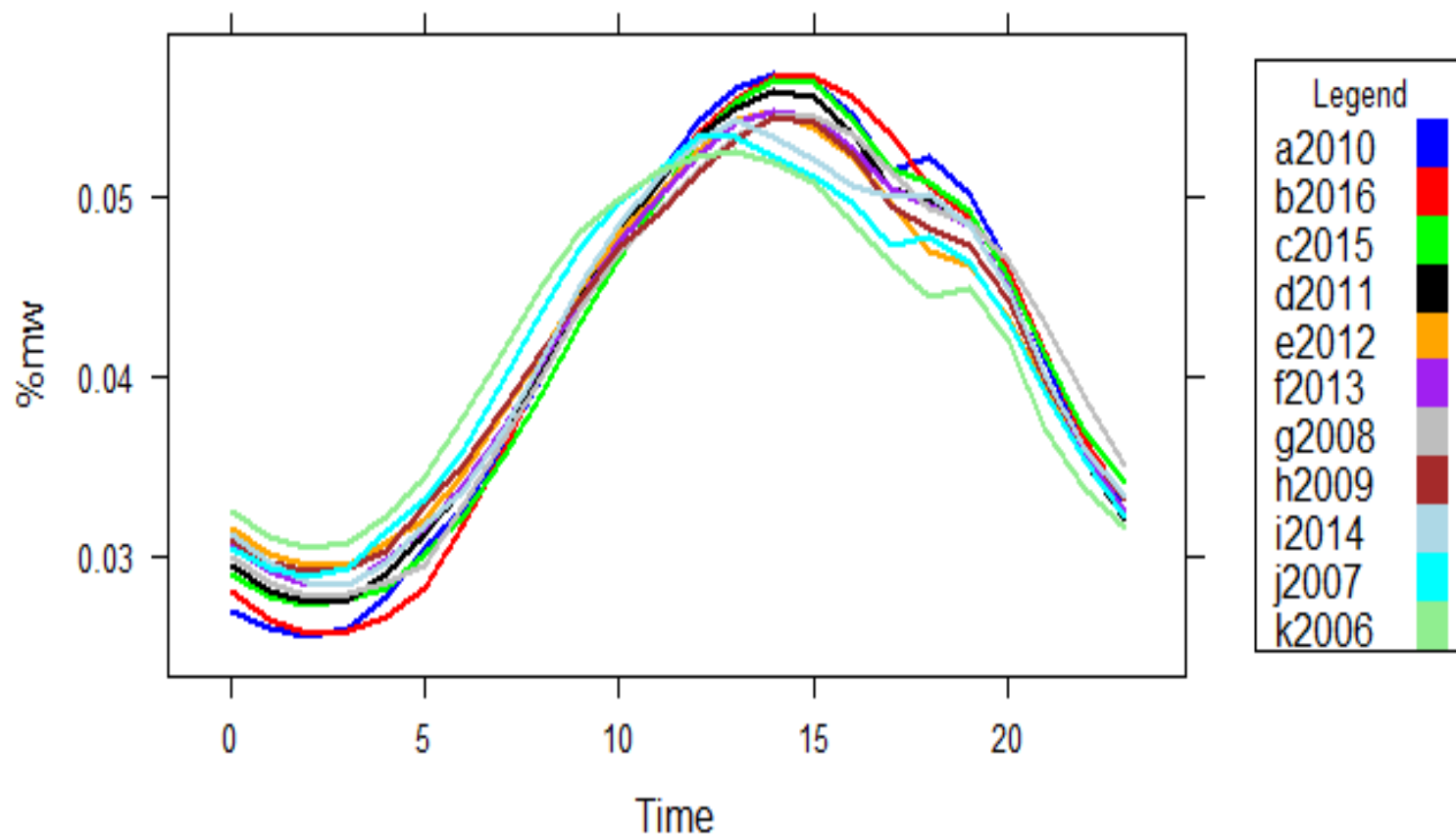
Other Issue: SCE Peak Shift

- 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





Other Issues: Weather Normalization

- Weather-normalized peaks for the last historical year serve as starting points for the peak forecasts
- Recent forecasts have shown “bouncing around” of starting points and thus peak forecasts
- Potential methods to address this variability have been developed by staff and will be discussed through DAWG



Other Issues: Residential TOU

- Developed and incorporated in hourly load forecast for the first time in CED 2017
- Since CED 2017, we have discovered a misalignment between TOU hourly shapes and overall hourly loads
- Staff will attempt to align the two properly for the forecast update so that higher hourly loads generally correspond to higher TOU impacts, etc.
- In addition, IOU TOU profiles will be updated to reflect participation rates in the current default pilots



Questions/Comments?