Peak Shifting Discussion and Forecast Sensitivities

SODRSTF – February 2, 2018

Andrew Gledhill
Resource Adequacy Planning

Objectives

- Peak shaving forecast sensitivities
  - Using 5/10 CP method as was previously done for the SCRSTF
  - Using an alternate method wherein peak shaving is done according to Temperature Humidity Index (THI)
- Peak shifting implications related to peak shaving
  - What is and what isn't covered by sensitivity analysis
- Information gathering and discussion

Peak Shifting Discussion

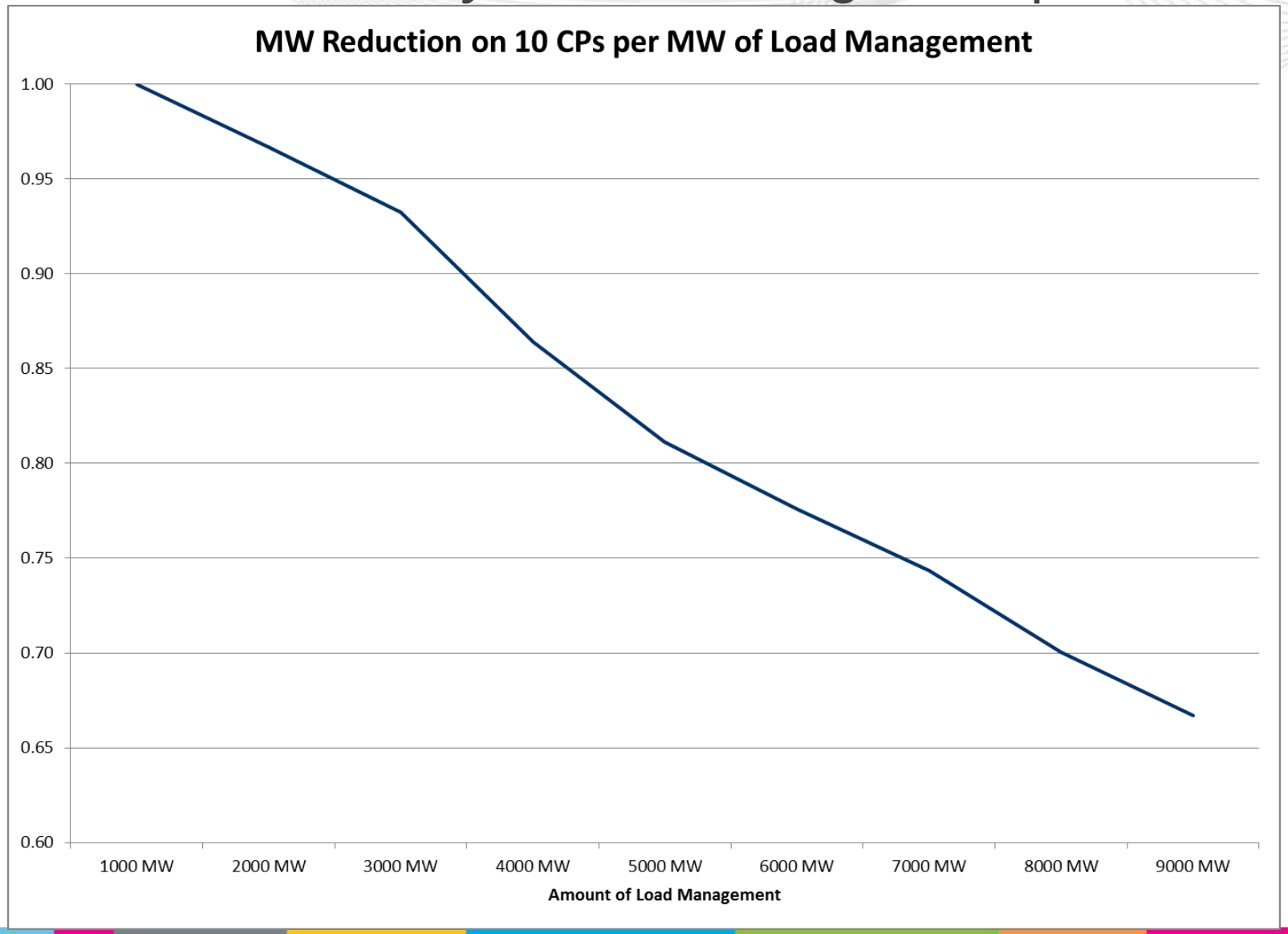
Peak Shifting

- Peak shifting is the concept that cutting load in one day or hour will make it more likely that the peak will occur on another day or hour.
  - Inter-day peak shifting is moving the peak to another day.
  - Intra-day peak shifting is moving the peak to another hour within the same day.
- This concept has been previously used when caps were evaluated for limited demand resource products (i.e. the 10 interruptions by 6 hours DR)

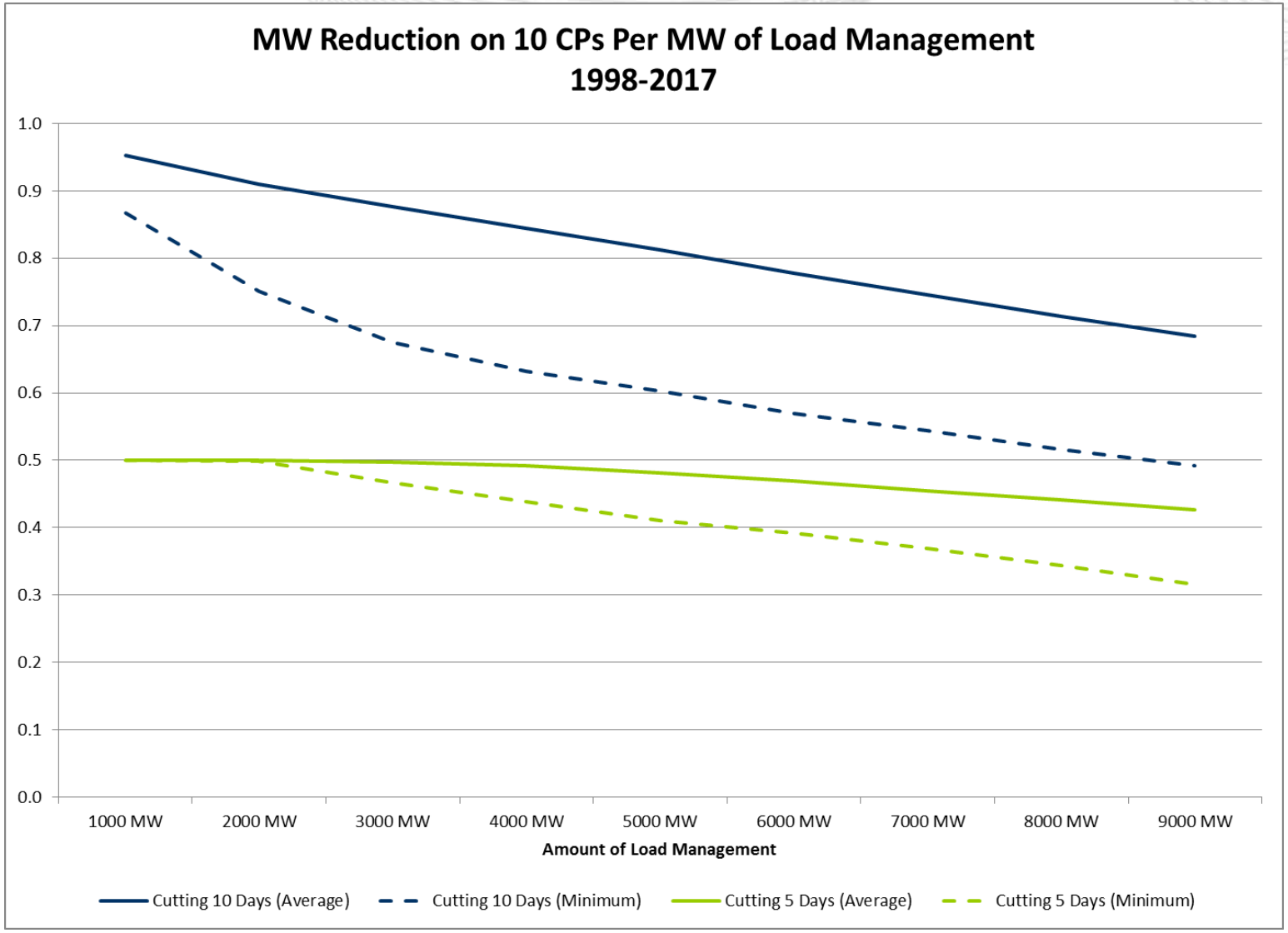
Discussion – Inter-day Shifting

- Inter-day peak shifting is tied to both the number of MWs being cut as well as the “peakiness” of the year being examined. This forecast analysis allows for inter-day peak shifting.
  - The more MWs being cut the greater the likelihood that the peak shifts, thus reducing the effectiveness of the reduction
  - The “peakier” the year the more effective the reduction (e.g. years such as 2006, 2011, 2012, and 2013)

Inter-day Peak Shifting Example - Summer 2017



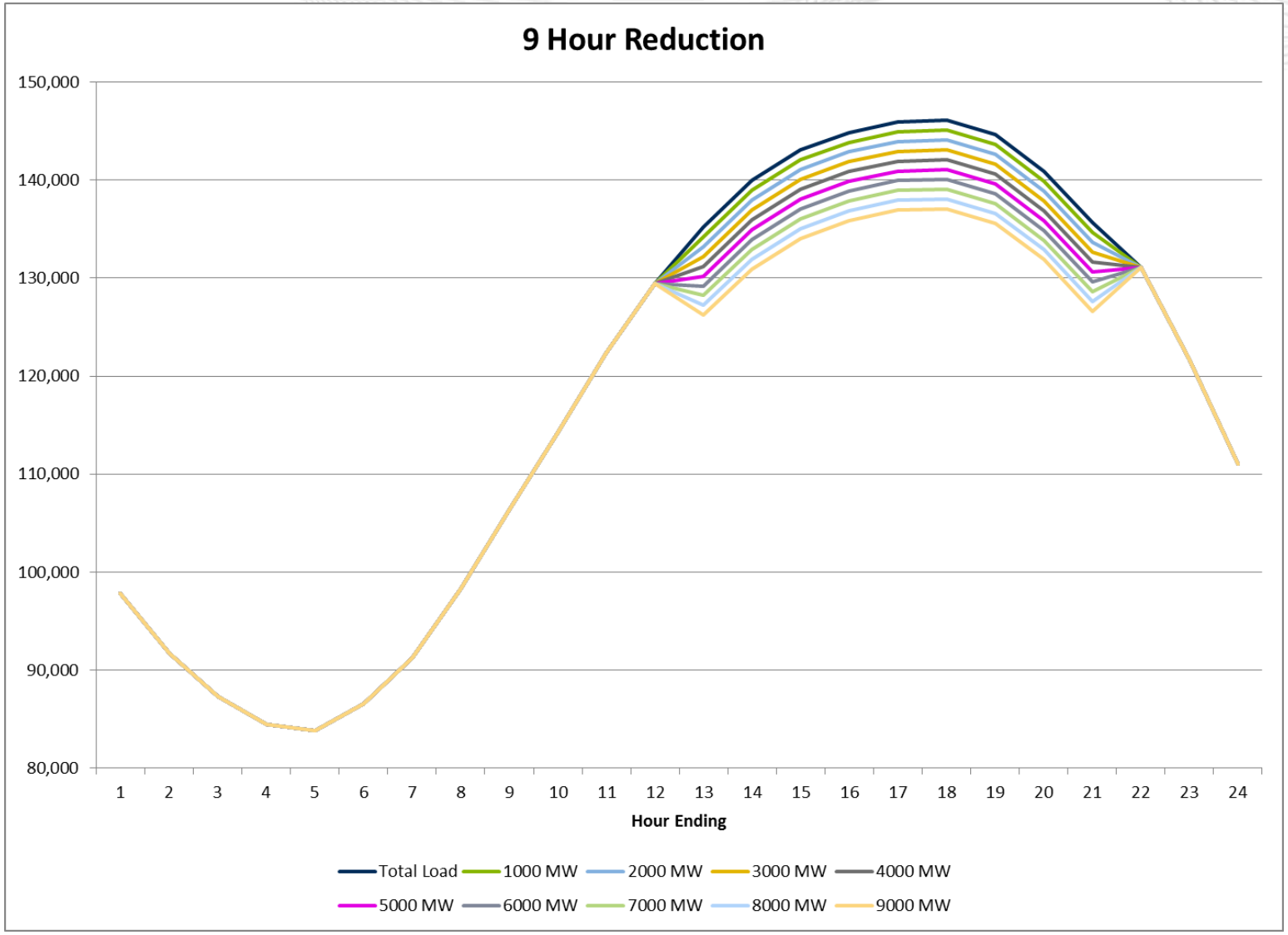
Inter-day Peak Shifting Example



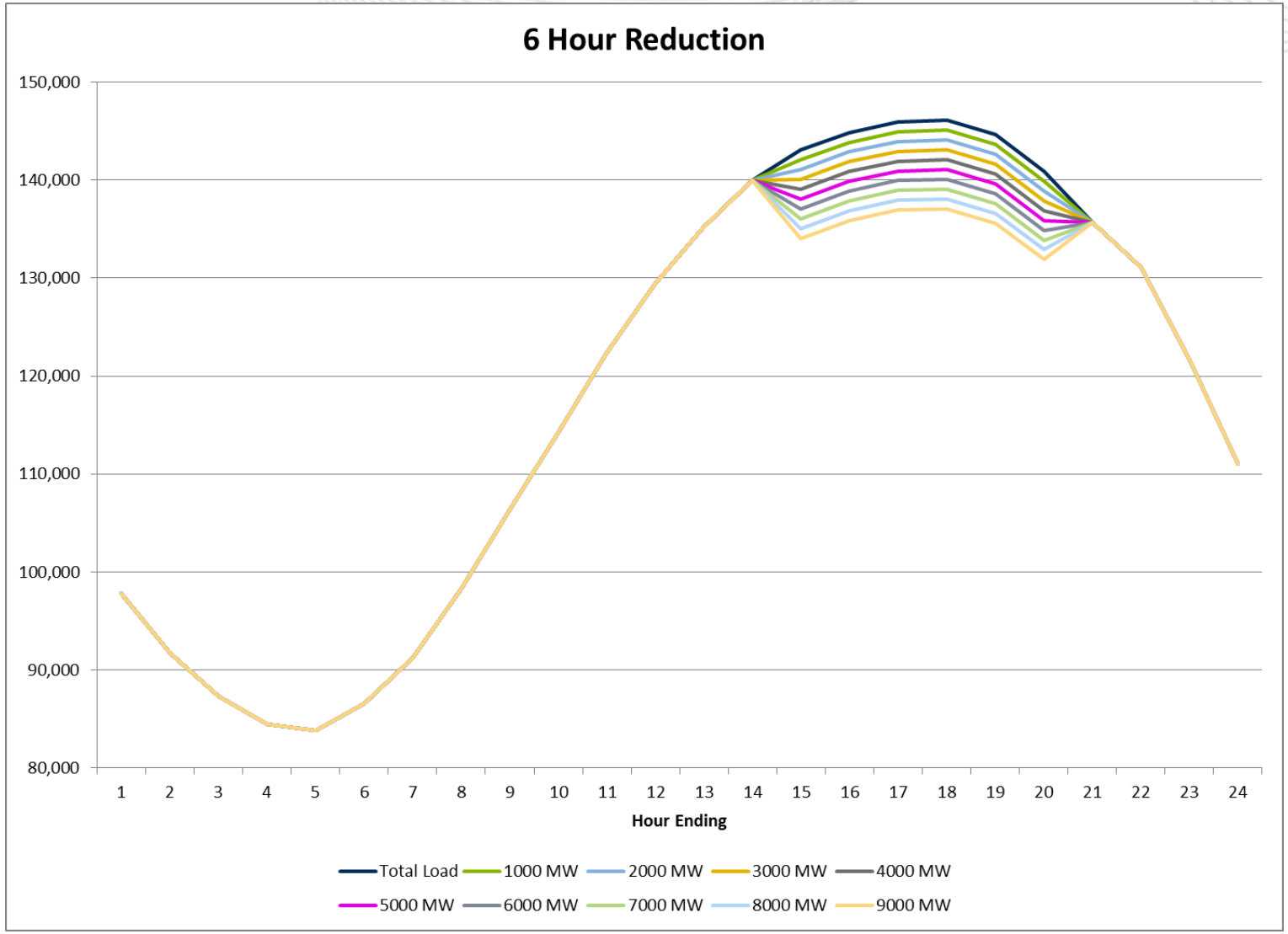
Discussion – Intra-day Shifting

- Intra-day peak shifting is tied to both the number of MWs being cut as well as the number of hours being cut.
  - The more MWs being cut the greater the likelihood that the peak shifts, thus reducing the effectiveness of the reduction
  - The more hours cut the more effective the reduction

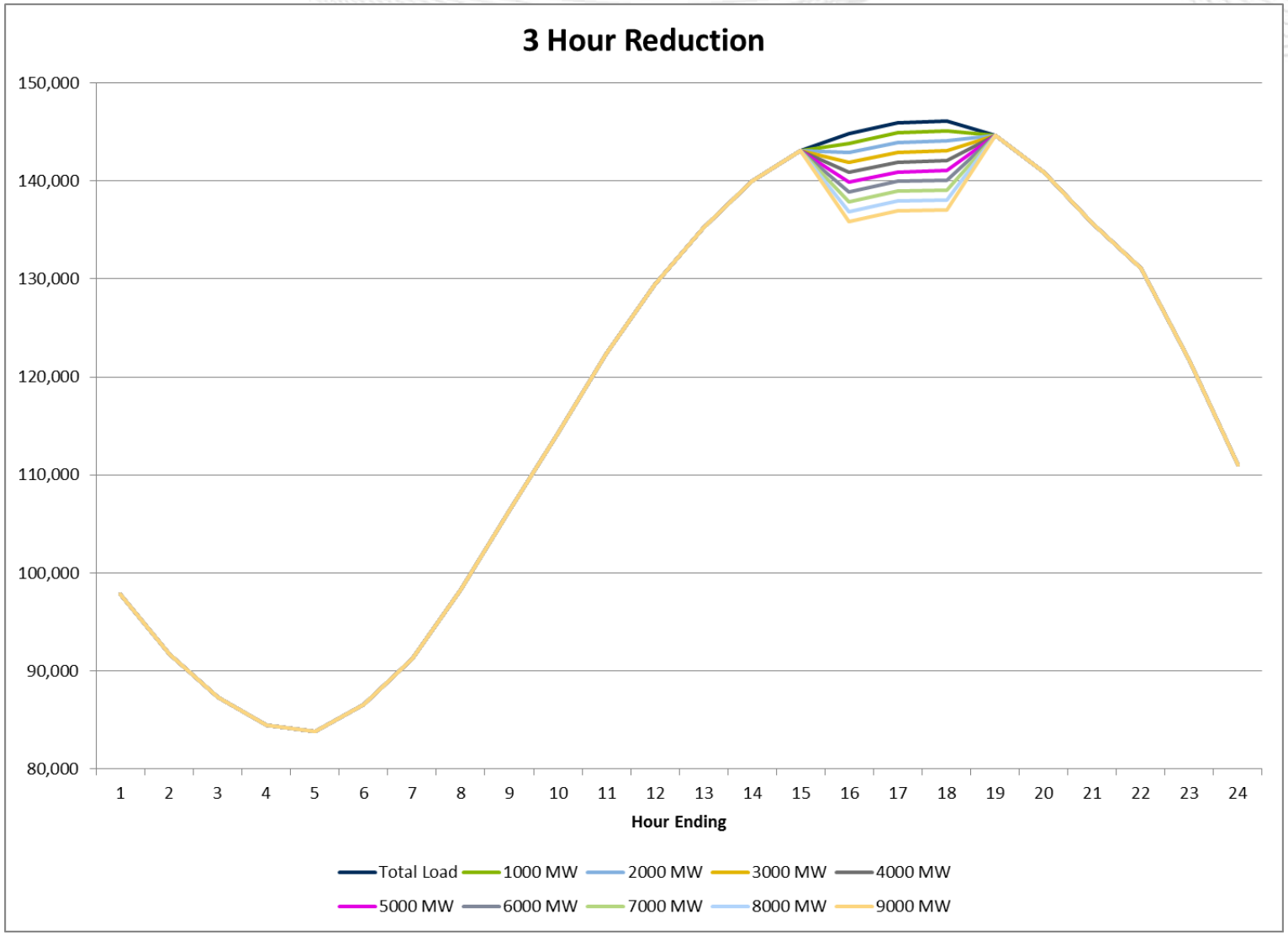
Intra-day Peak Shifting Example – July 19, 2017



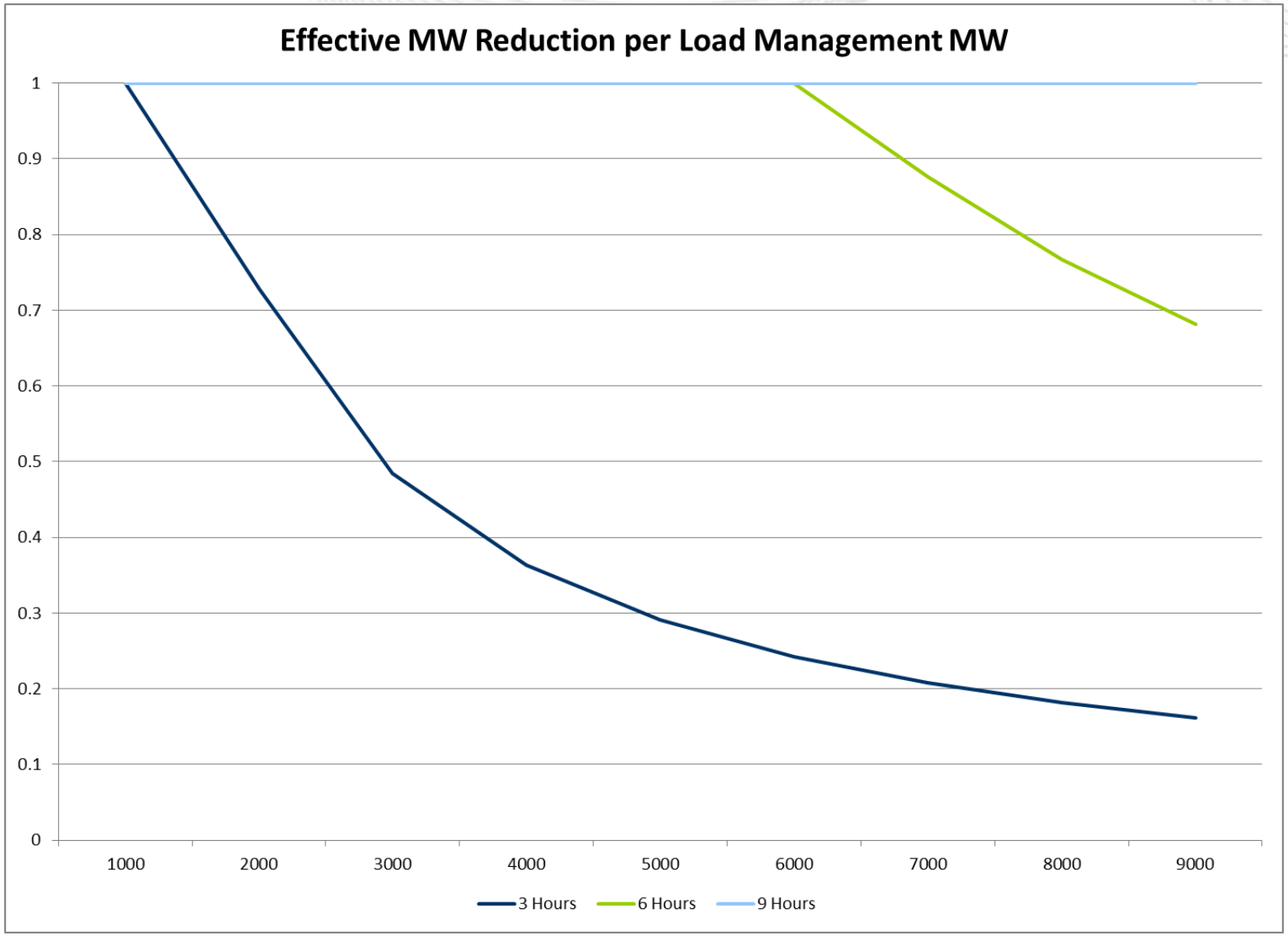
Intra-day Peak Shifting Example – July 19, 2017



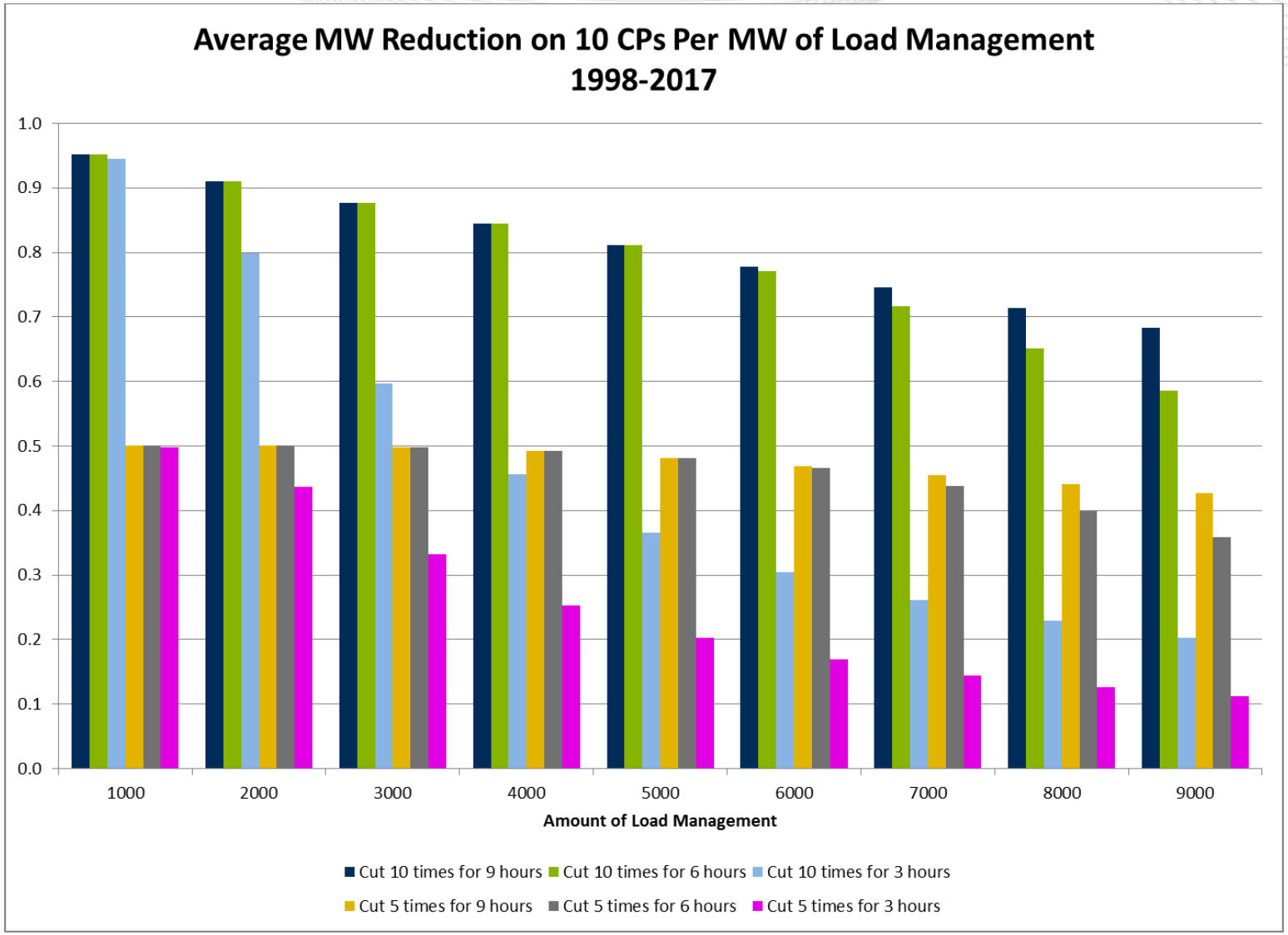
Intra-day Peak Shifting Example – July 19, 2017



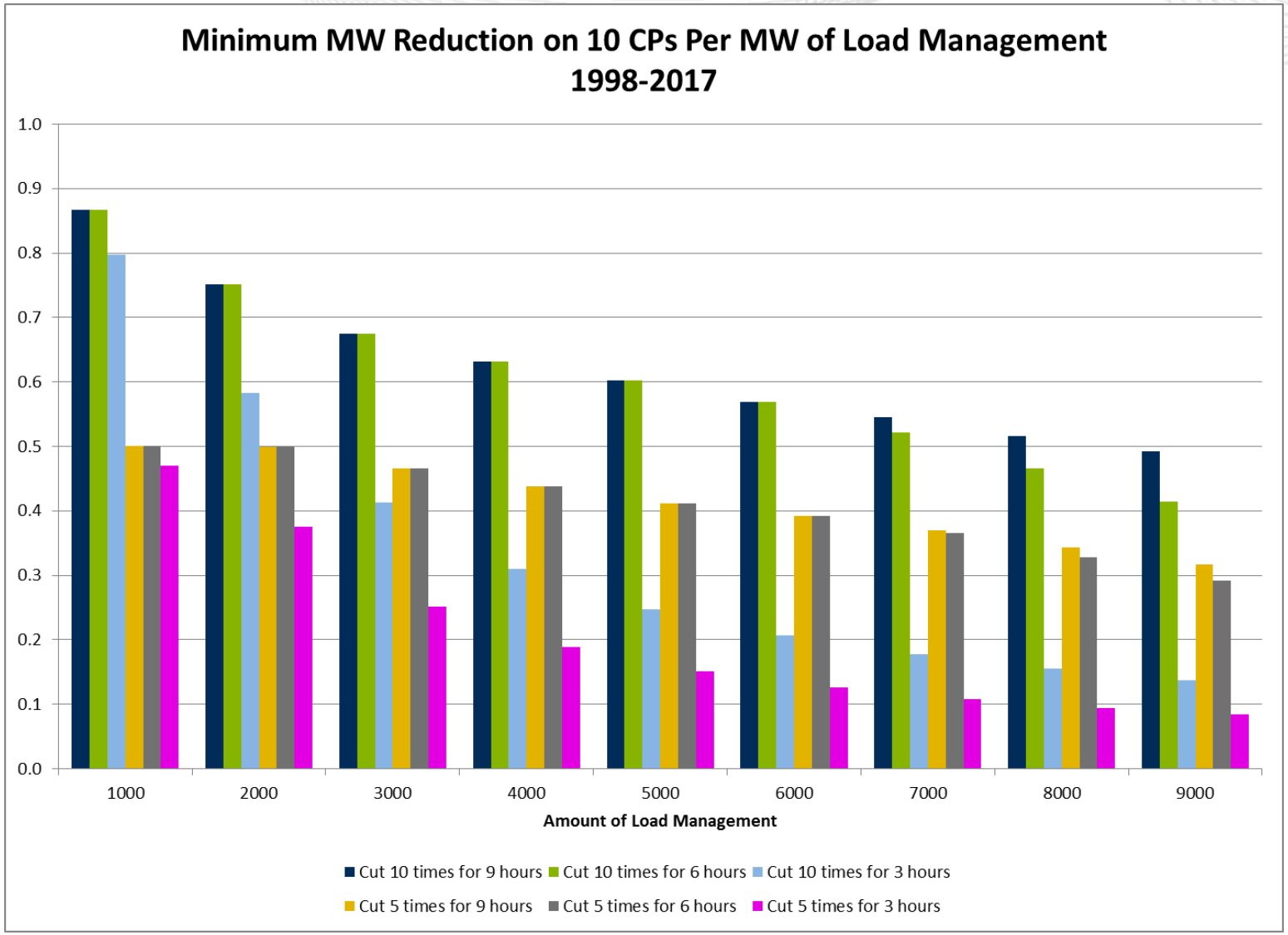
Intra-day Peak Shifting Example – July 19, 2017



Combination of Inter-day and Intra-day



Combination of Inter-day and Intra-day



Forecast Sensitivities: CP Based Runs

Forecast Analysis

- Reduce load on top 5 or top 10 days per year over an increasing number of years and evaluate the impact on the forecast versus baseline.
  - No adjustment is made to guard against inter-day peak shifting at the zonal level (i.e. do not prevent if peak shaving causes what was originally the rank 6 day to become the rank 5 day)
  - Assumption is made that there is no intra-day shifting (i.e. load management is 100% effectual at reducing daily peak). In other words, peak shaving is assumed to be enacted for the entire day.

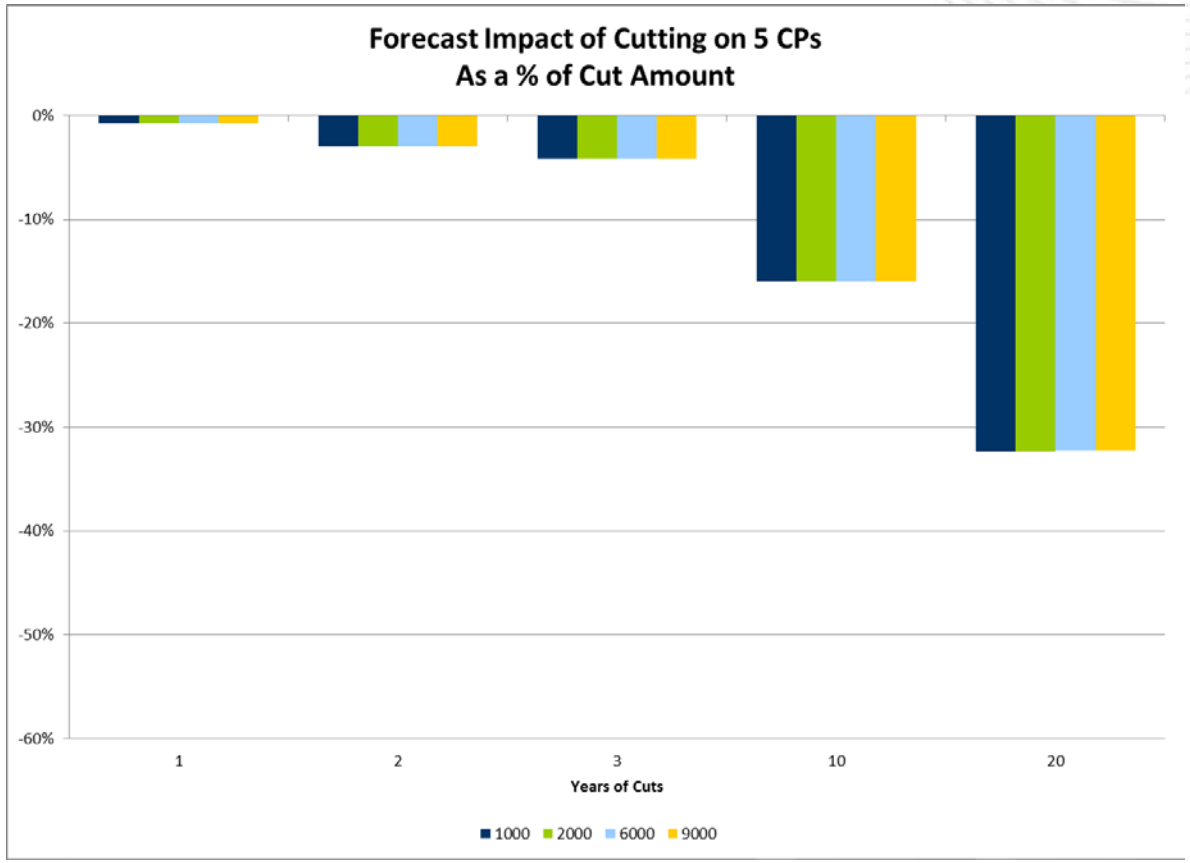
Sensitivity Description

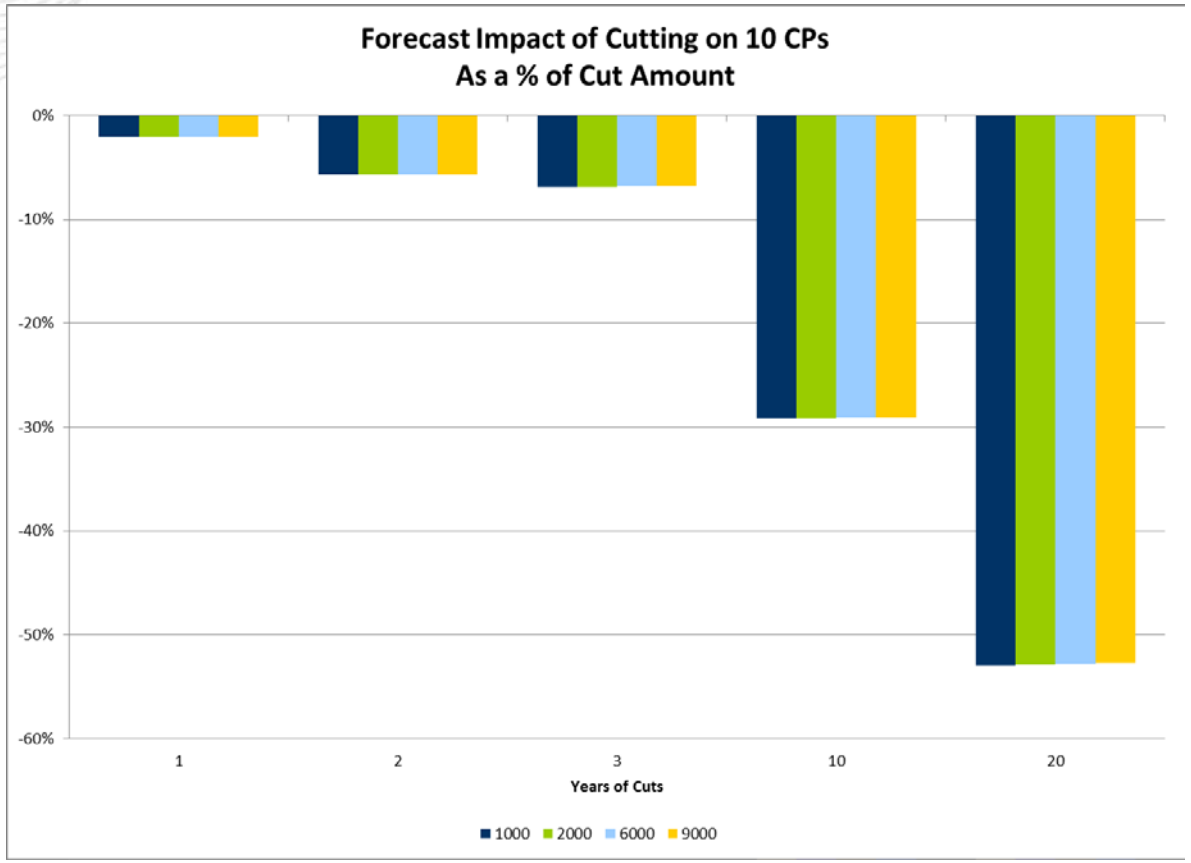
- Cut historic daily top 5 or 10 RTO peaks per year …
  - by…
    - 1000 MW
    - 2000 MW
    - 6000 MW
    - 9000 MW
  - over...
    - 1 year (2017)
    - 2 years (2016-2017)
    - 3 years (2015-2017)
    - 10 years (2008-2017)
    - 20 years (1998-2017)
  - for a total of 40 forecast sensitivity runs.

Sensitivity Description

- Peak shaving is apportioned to zones based on their share of the 2017 Weather Normalized peak.
- Forecast sensitivities are run as normal using modified history in the estimation period
- Forecast sensitivity results are compared versus the 2018 forecast (baseline). Deltas are computed as a ratio of the load management for the given sensitivity.

Sensitivity Results for Delivery Year 2021

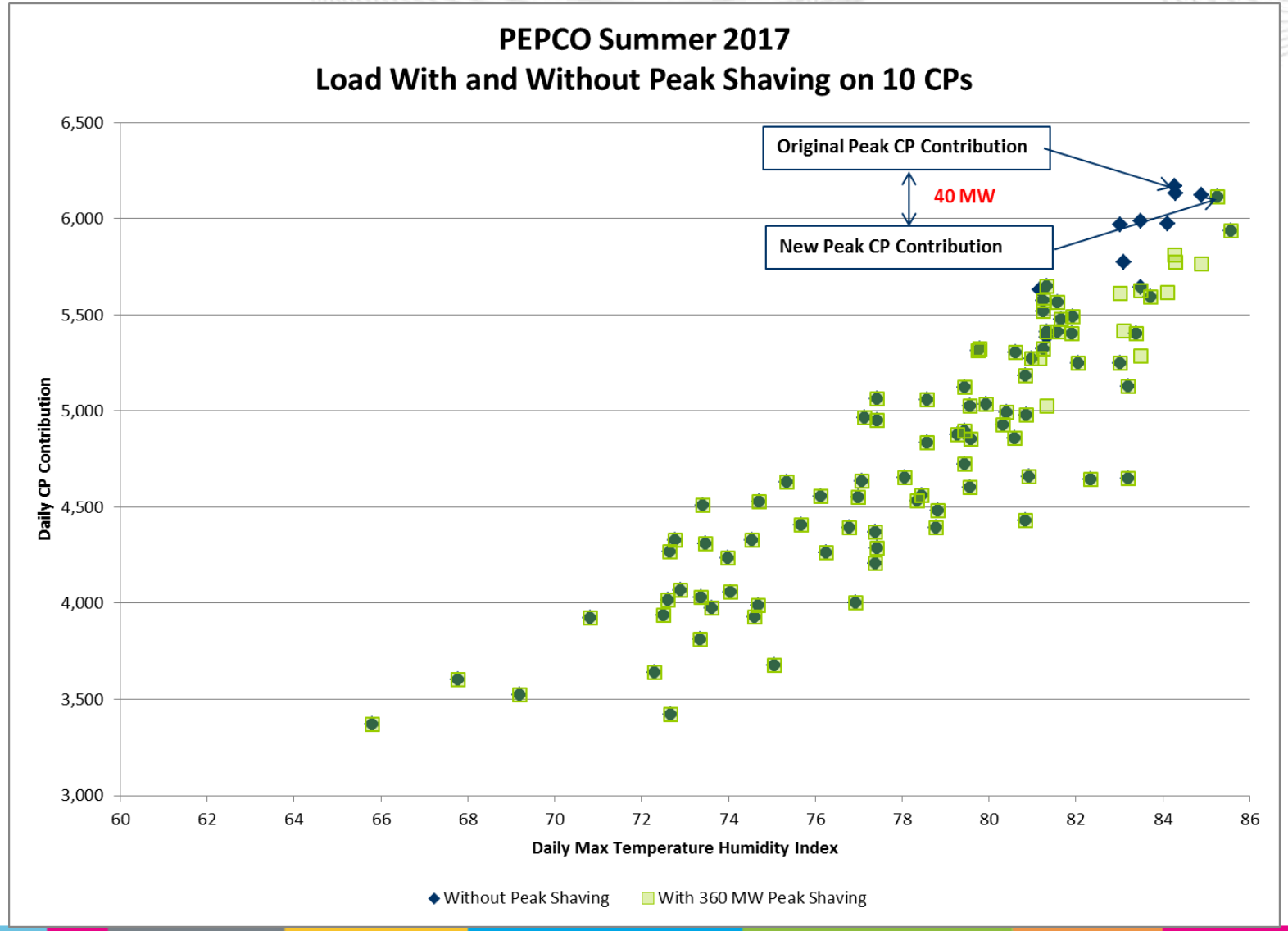




Sensitivity Discussion

- Recall that PJM uses a bottom-up forecast methodology (forecast zones to sum up to the RTO) rather than a top-down methodology (forecast RTO and divide up to the zones)
  - Cutting on the 5 or 10 RTO CP days will not necessarily fully reduce peak zonal contributions to the RTO

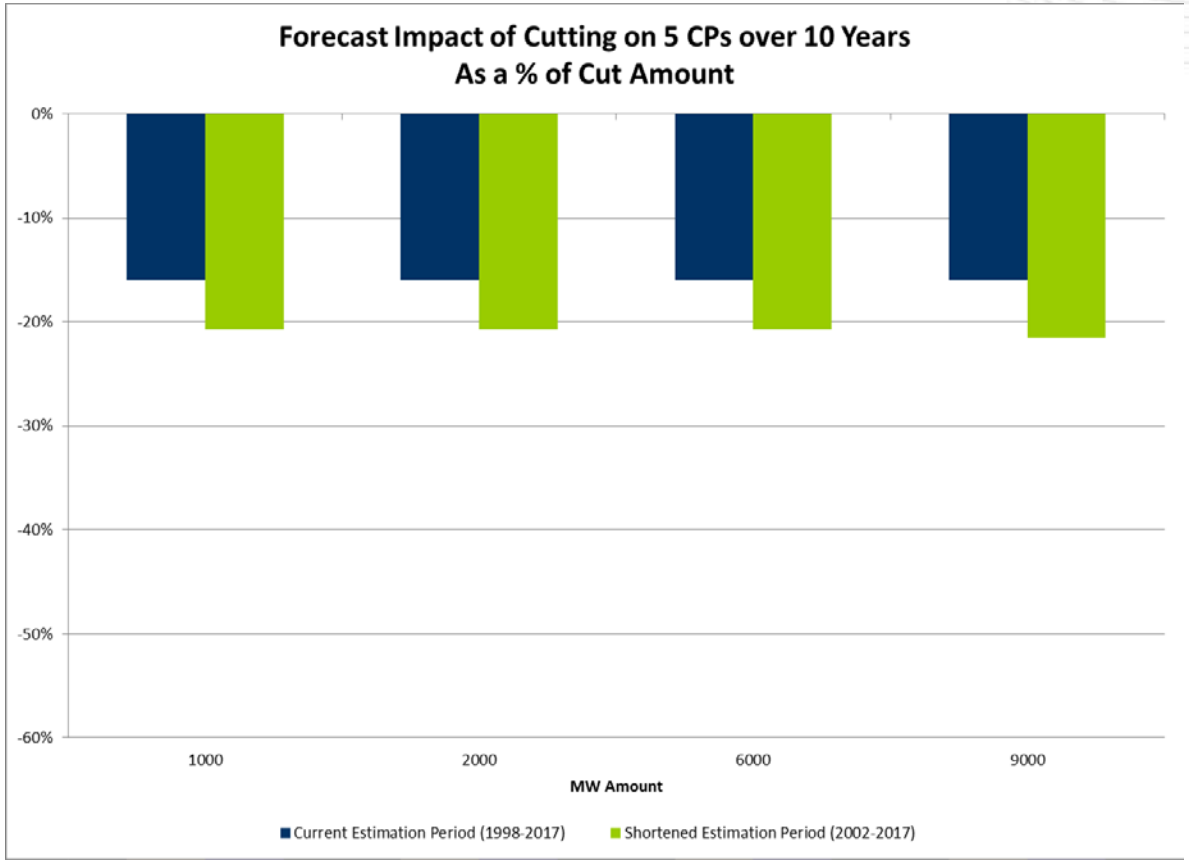
Zonal Load Example

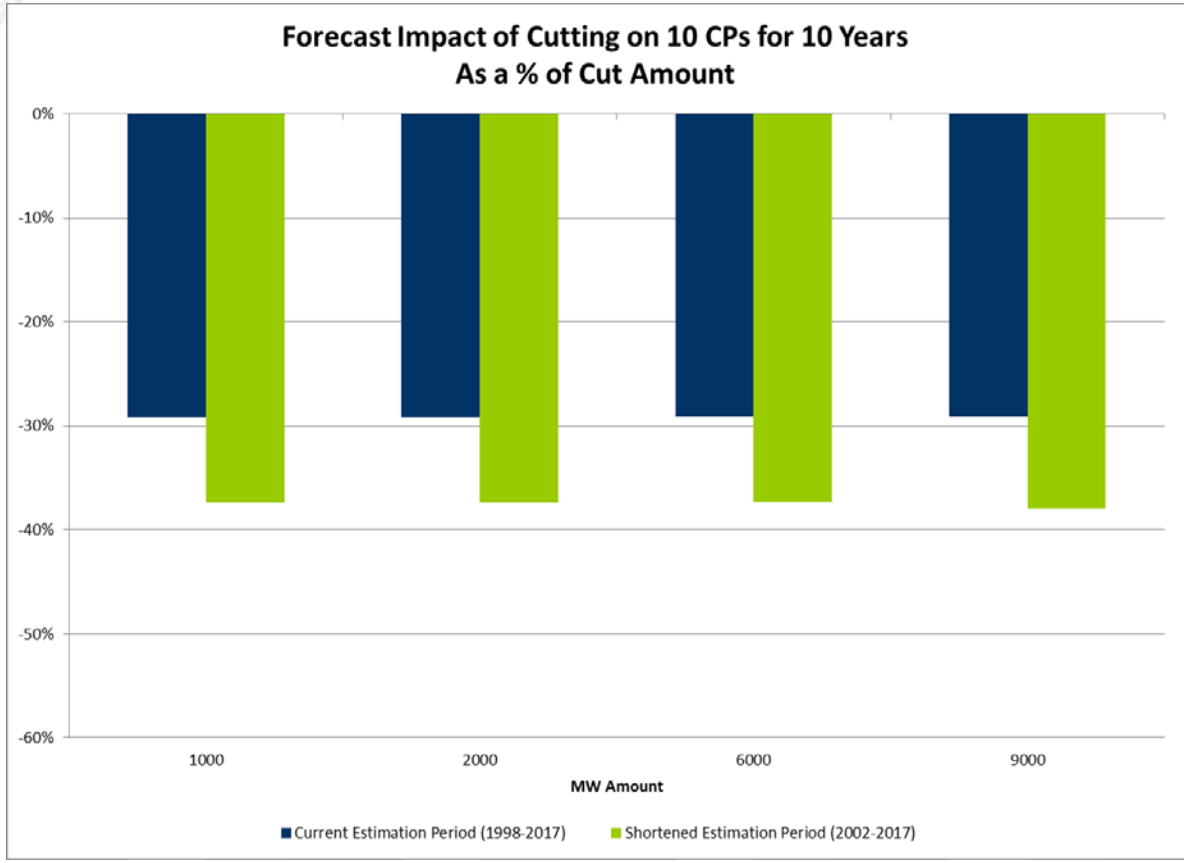


Sensitivity Discussion

- The PJM load forecast model uses historical loads back to 1998. There has been frequent discussion regarding shortening the estimation period.
  - Using the subset of sensitivities with cuts over the last 10 years on 5 and 10 RTO CPs. Additional forecast runs were performed with historical loads starting in 2002.

Estimation Period Sensitivities for Delivery Year 2021



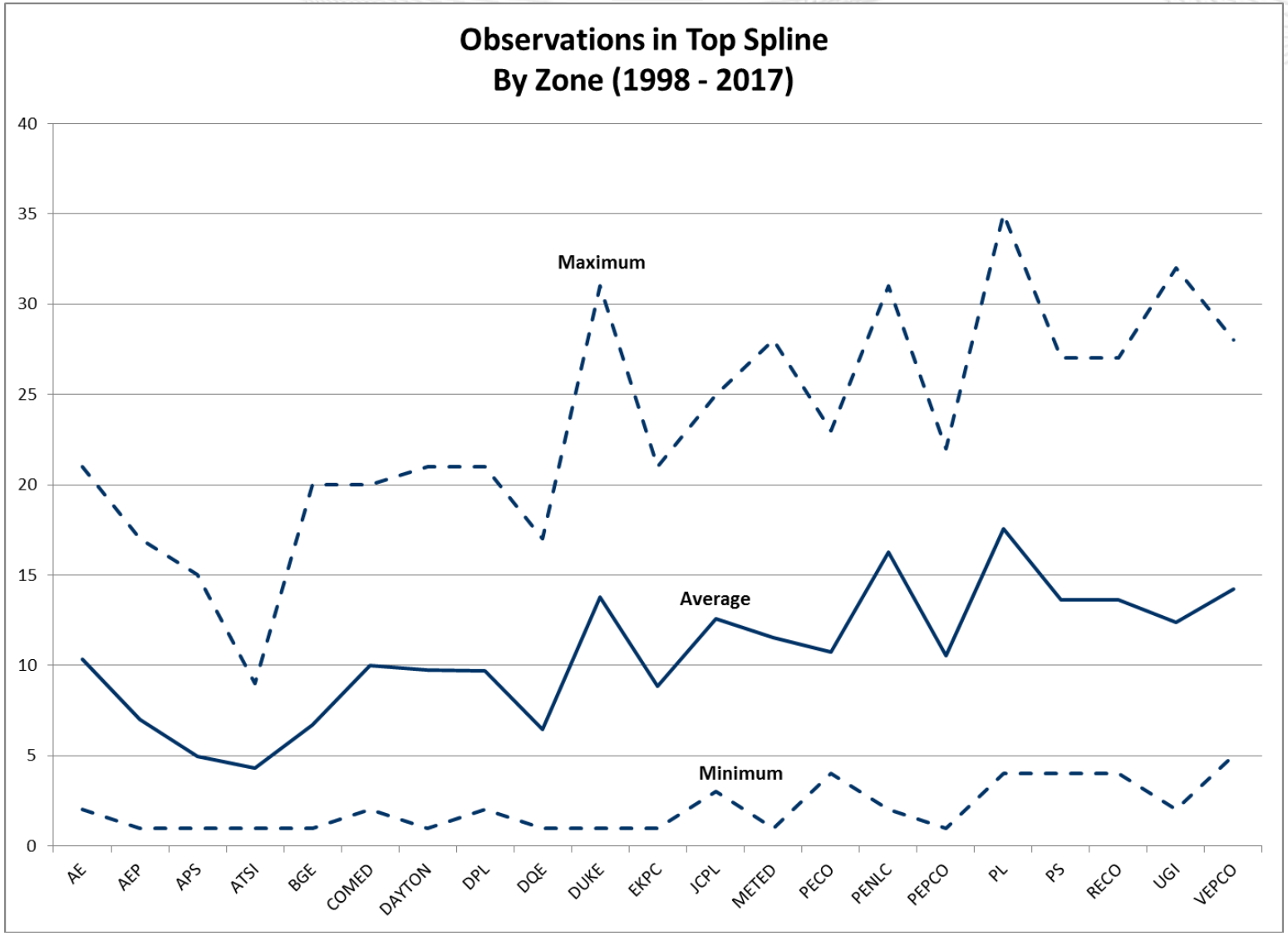


Forecast Sensitivities: THI Based Runs

Sensitivity Description

- Instead of cutting on top RTO peak days cut on zonally hot days, according to the Temperature Humidity Index (THI).
  - Several years ago PJM implemented a THI spline to recognize the different relationship of load to weather over different THI ranges
  - Targeting the top spline has the most impact on the zonal observations that impact the RTO peak
    - Zones have different cut points
    - The number of cut days will vary by year and by zone

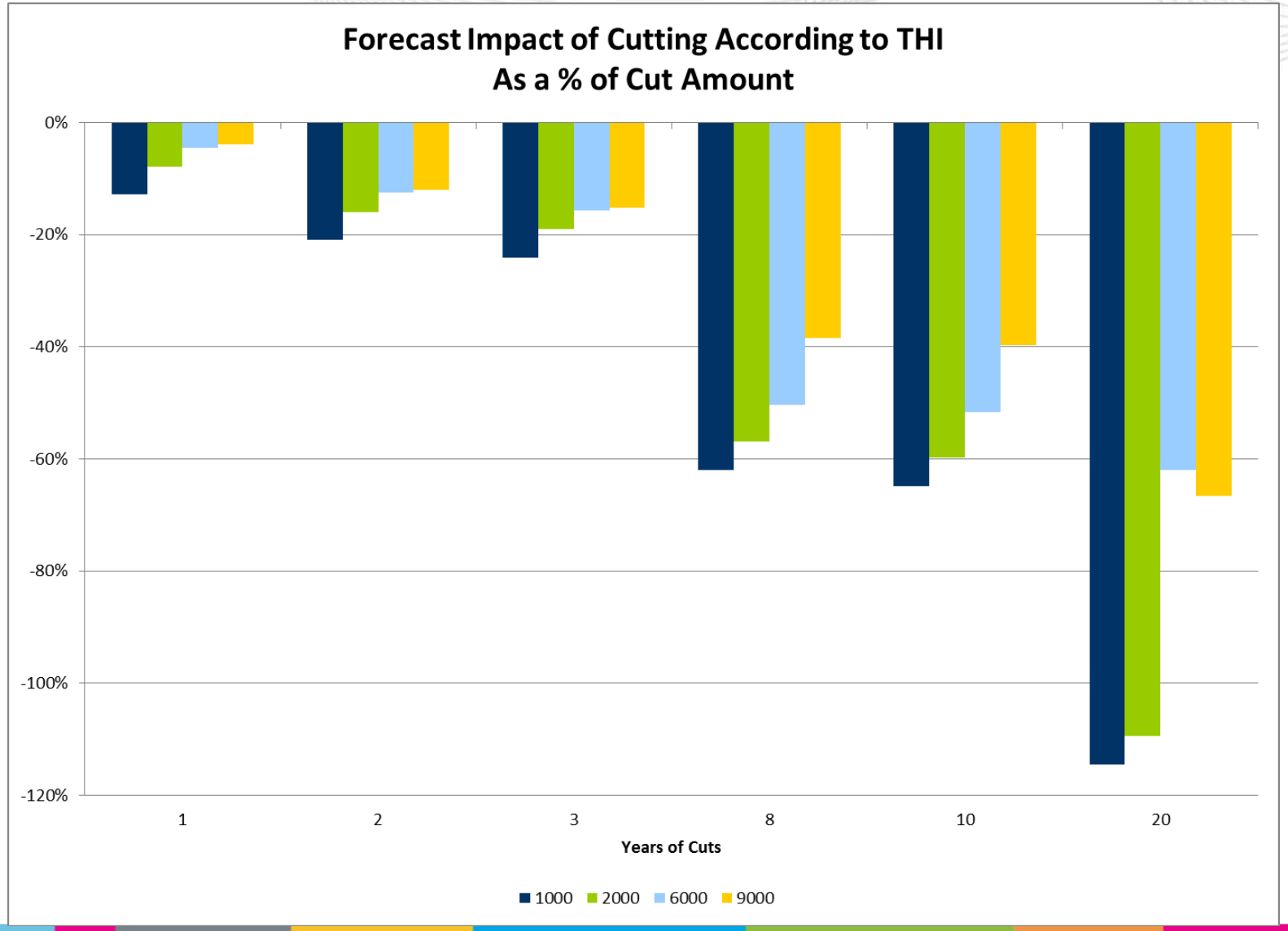
Top Spline Summary



Sensitivity Description

- Cut load on all days with THI above the final spline cut point…
  - by…
    - 1000 MW
    - 2000 MW
    - 6000 MW
    - 9000 MW
  - over...
    - 1 year (2017)
    - 2 years (2016-2017)
    - 3 years (2015-2017)
    - 8 years (2010-2017)
    - 10 years (2008-2017)
    - 20 years (1998-2017)
  - for a total of 24 forecast sensitivity runs.

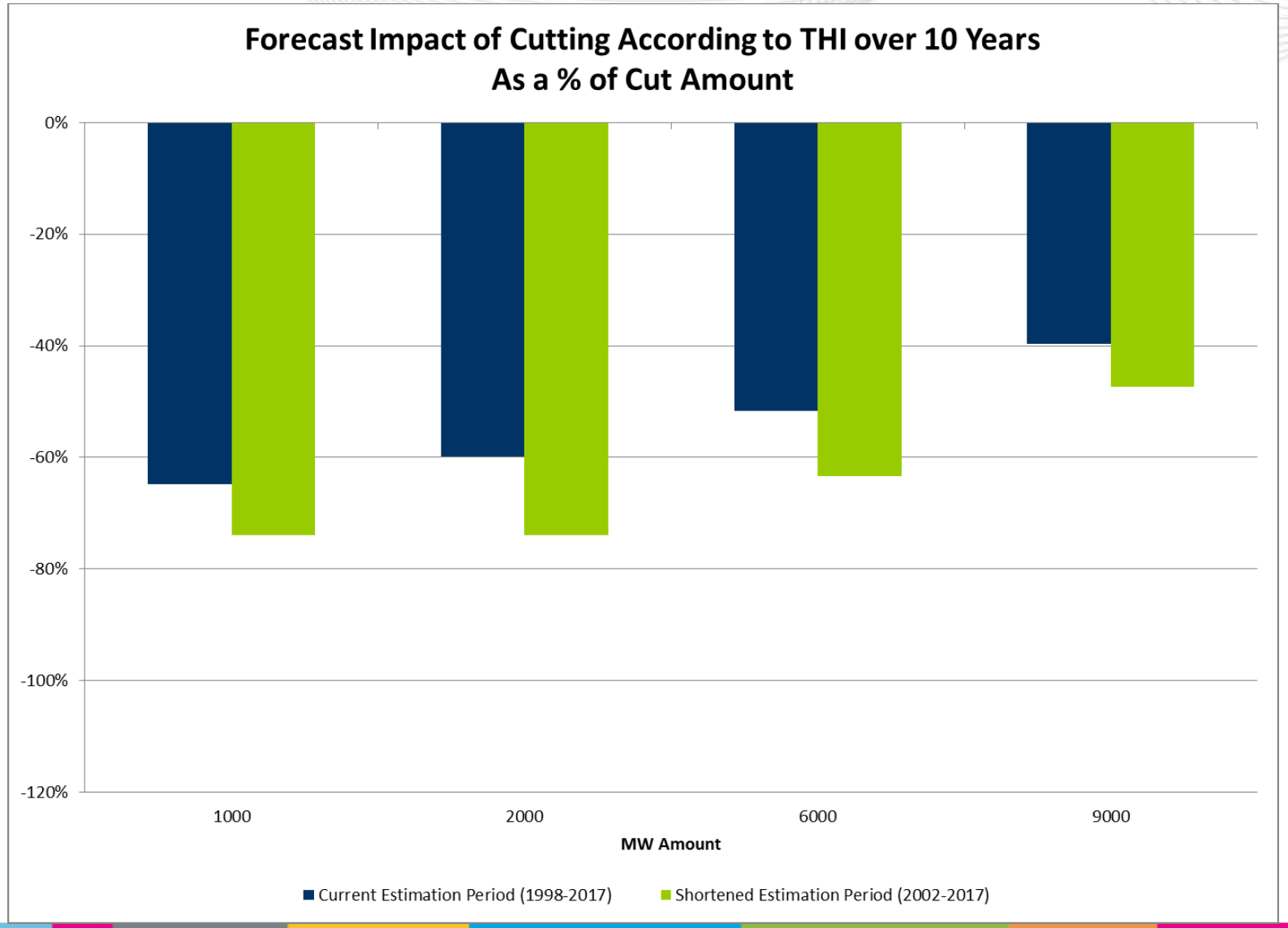
Sensitivity Results for Delivery Year 2021



Sensitivity Discussion

- The PJM load forecast model uses historical loads back to 1998. There has been frequent discussion regarding shortening the estimation period.
  - Using the subset of sensitivities with cuts over the last 10 years on days with THI above the final spline cut point. Additional forecast runs were performed with historical loads starting in 2002.

Estimation Period Sensitivities for Delivery Year 2021



Sensitivity Results

- Cutting according to THI impacts forecast results significantly more quickly than cutting according to RTO CP days.
- Forecast impacts fade the larger the cut amount.
  - Reflects the impact of peak shifting. If enough MWs are cut on high THI days, peaks will start occurring on days where THI lies just below the cut point.

Additional Comments

Additional Comments

- Need more information on how peak shaving would behave.
  - What would trigger action and over what hourly duration?
  - Limitations on number of actions?

Additional Comments

- PJM is currently in the midst of forecast model development. This analysis represents forecast impacts using the model in place for the 2018 Load Forecast. Model changes may (would likely) lead to a different outcome.