Review of Wind Generation Impact on Ancillary Services

ERCOT Board of Directors Meeting
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Agenda

- **Current ERCOT Ancillary Service Requirements**
- **ERCOT NERC CPS1 Historical Scores**
- **Wind Generation impact on ERCOT Regulation**
- **Other Analysis of wind impact on Regulation**
  - GE Study of ERCOT
  - CAISO & Pacific Northwest National Laboratory
  - SPP Charles River Associates
- **How will Ancillary Service be affected by Nodal?**
- **Potential Allocation methods for Non-Spinning Reserve and Regulation Reserve**
- **Summary**

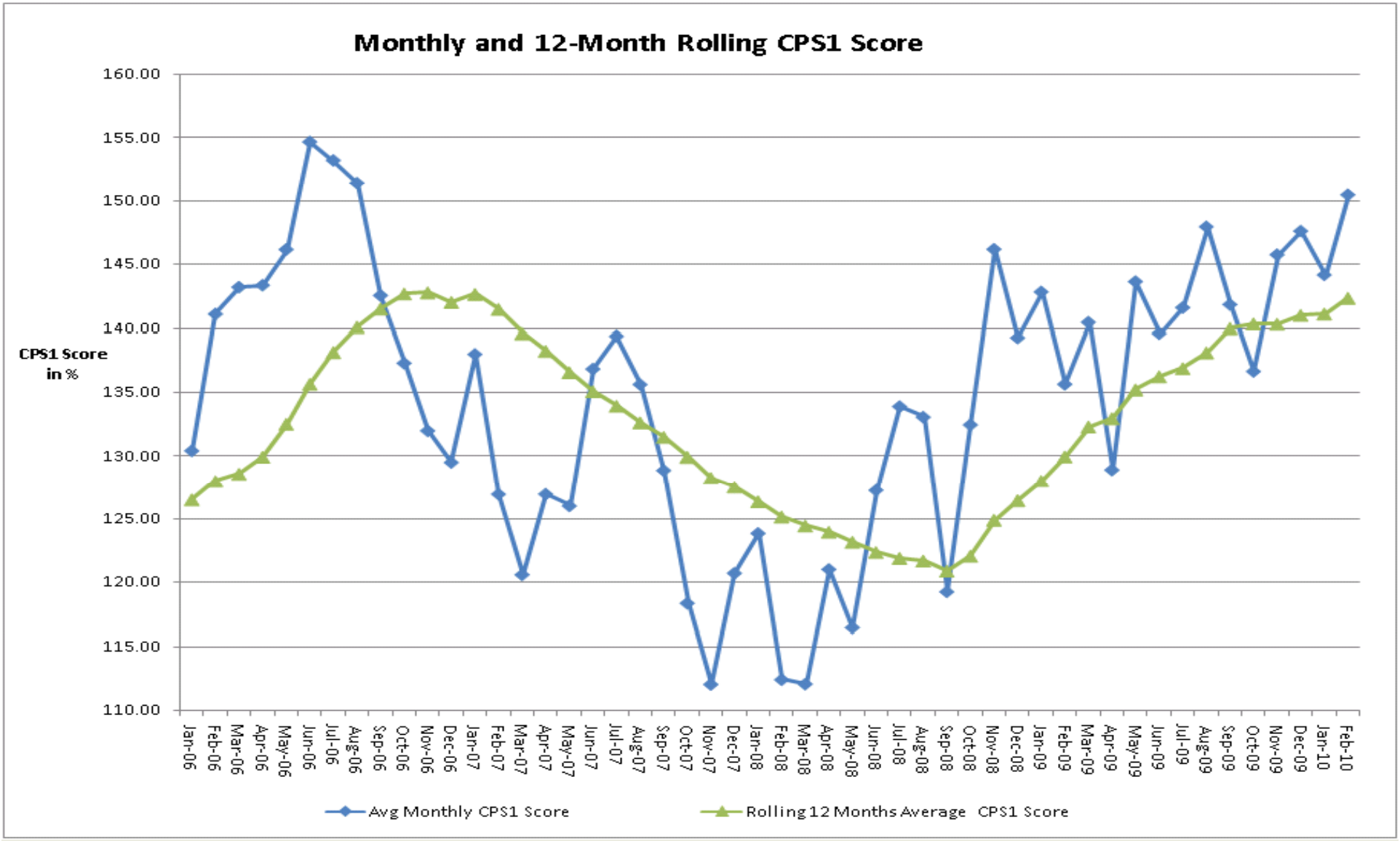
ERCOT Ancillary Services

- **Responsive Reserve 2300 MW**
  - Capacity is purchased in the day ahead market for all hours
  - Used to restore frequency within first few minutes of an event that causes a significant frequency deviation
  - Sometimes deployed when Regulation Up depleted
  - Methodology for Responsive Reserve is currently not adjusted by increased wind generation levels
- **Non-Spinning Reserve**
  - Capacity is purchased in the day ahead market for all hours
  - Supplemental reserve consisting of off-line resources capable of ramping to a specific output level in 30 minutes or less
  - Used to replace loss of generation or to compensate for net load forecast uncertainty
  - Methodology tied to net load forecast uncertainty
  - Wind forecast uncertainty can be carved out of net load forecast
  - Establishes a floor equal to the largest unit for peak hours 700 – 2200

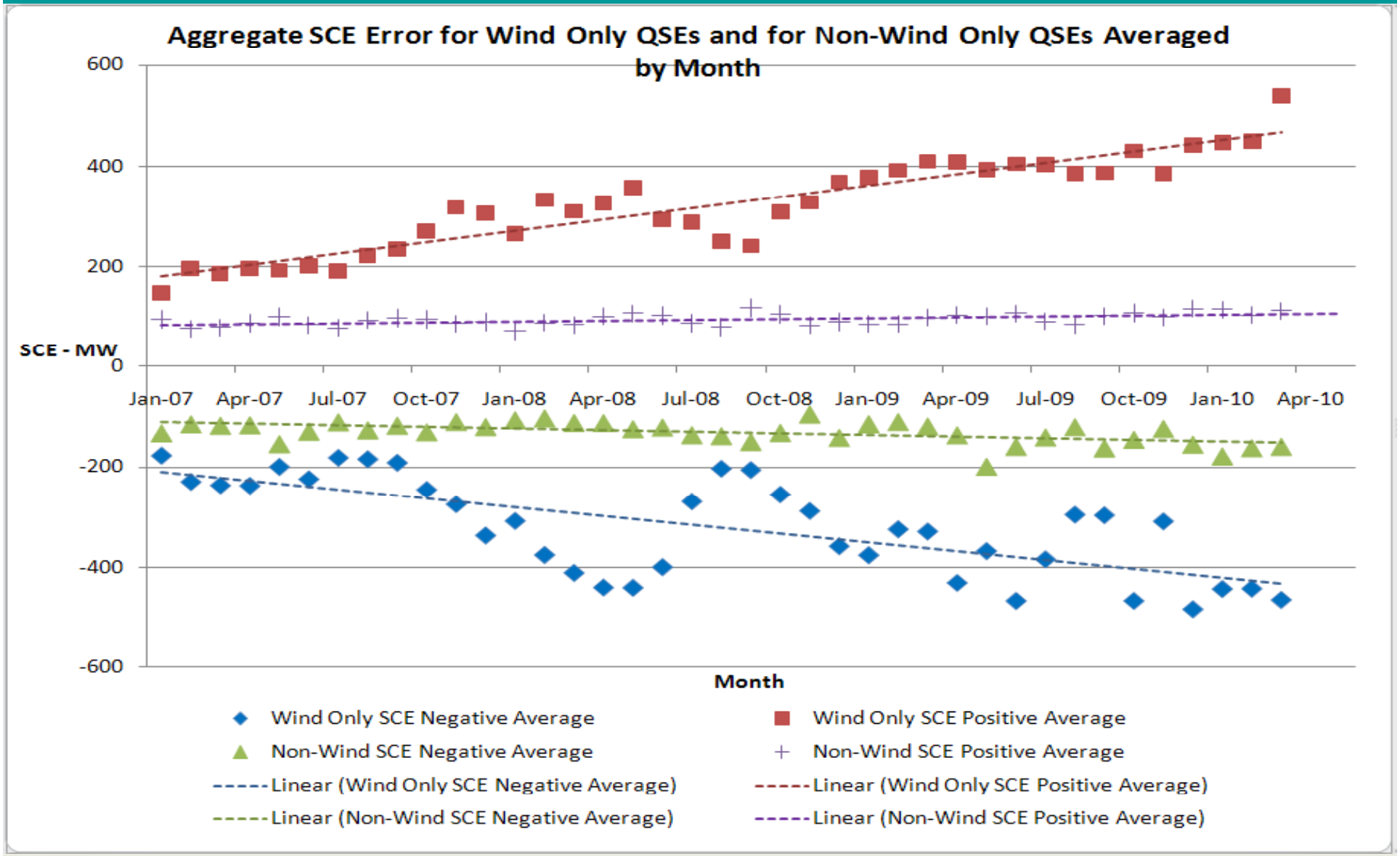
ERCOT Ancillary Services

- **Balancing Energy Services**
  - Not purchased in the day ahead market
  - Used to balance load and generation on a 15 minute based upon a forecast of load and system conditions 30 minutes in advance of the interval
- **Regulation**
  - Capacity is purchased in the day ahead market for all hours
  - Procurement capacity is based on recent historical deployments
  - Energy deployed every 4 seconds to maintain frequency
  - Works in conjunction with Balancing Energy deployments to balance load and generation

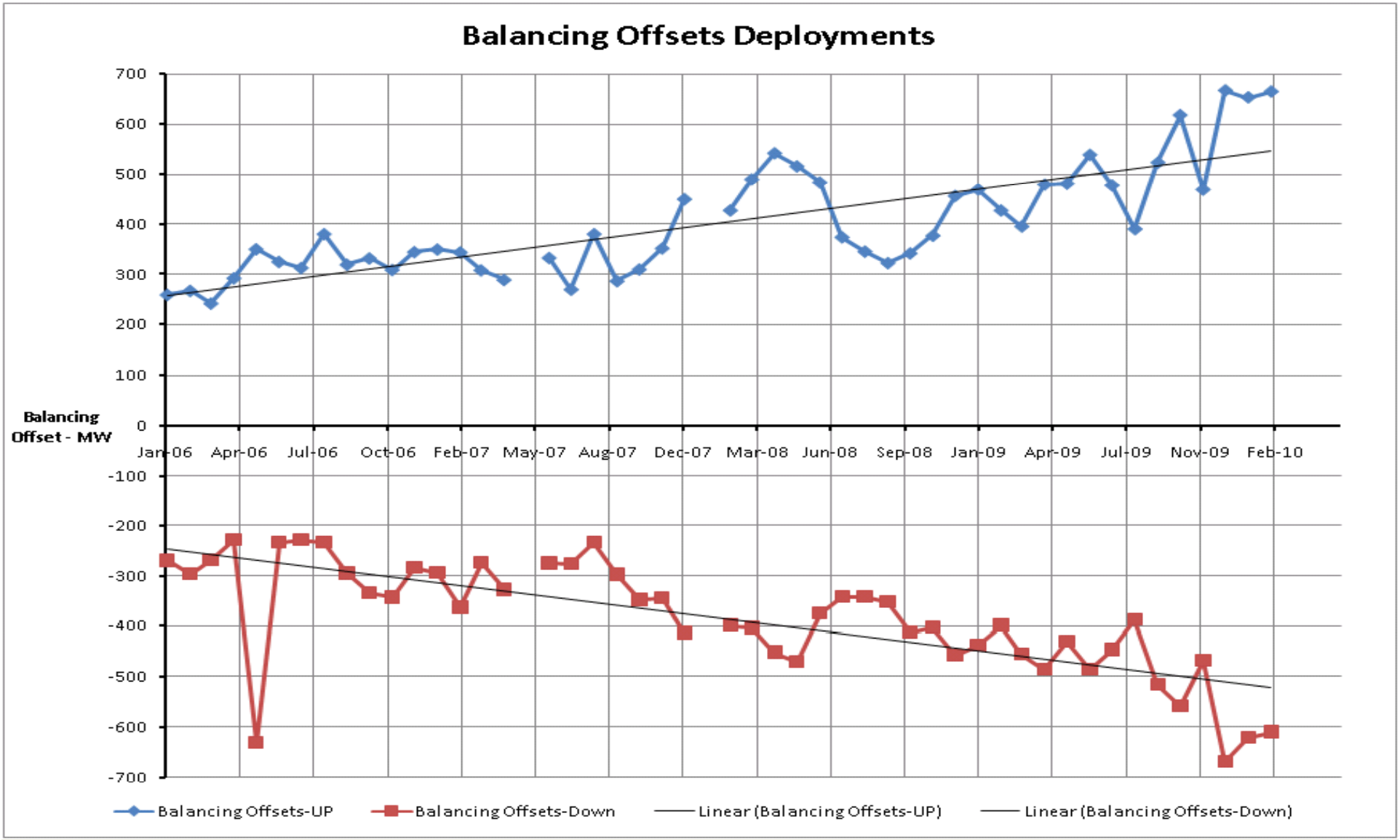
CPS1 Scores Improving Due to Governor Tuning and Reduction in Non-Conforming Load



SCE Error for Wind Only and Non-Wind Only QSEs



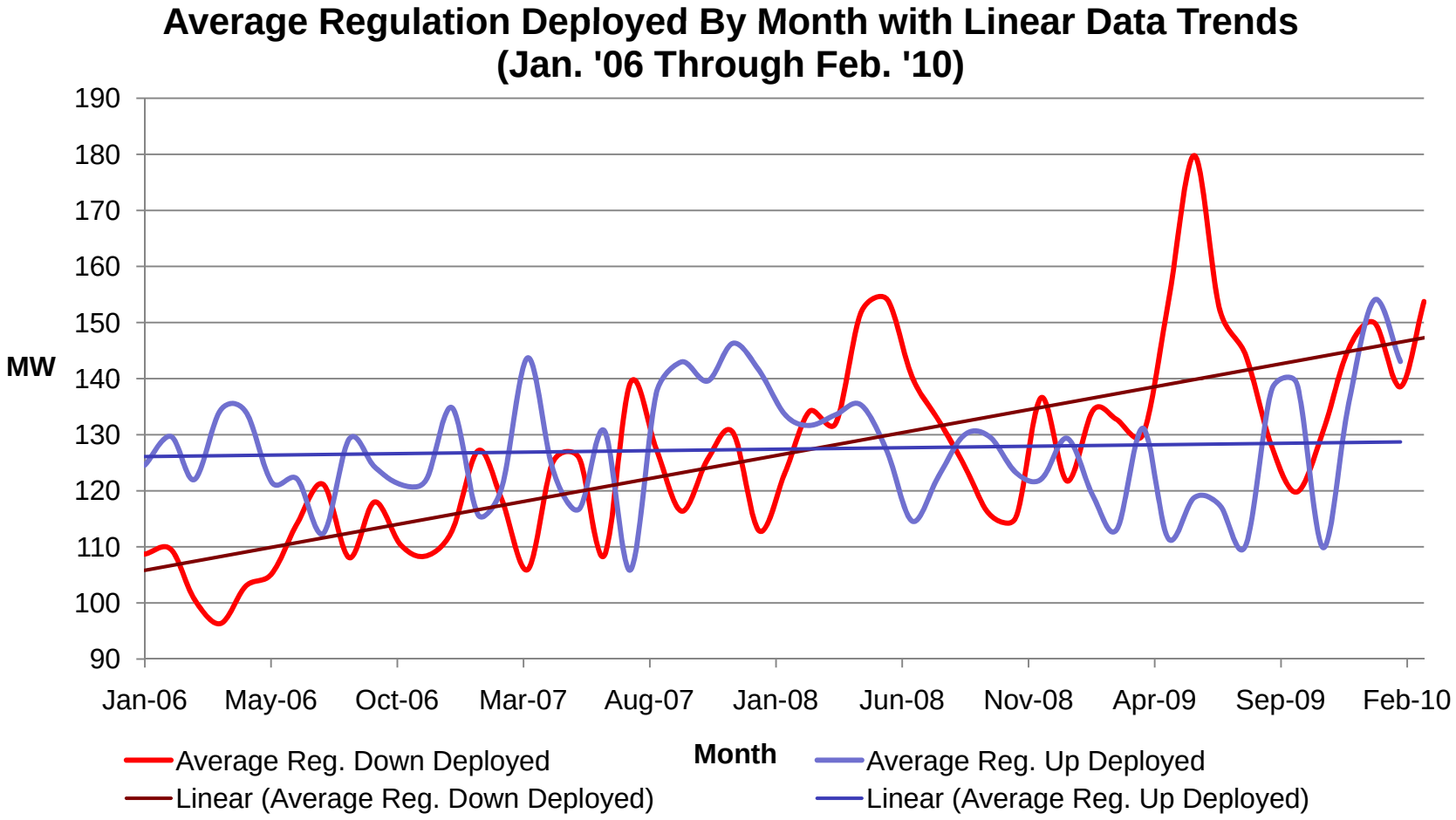
Balancing Offsets Deployments since 2006



Responsive Reserve Service Deployments summary

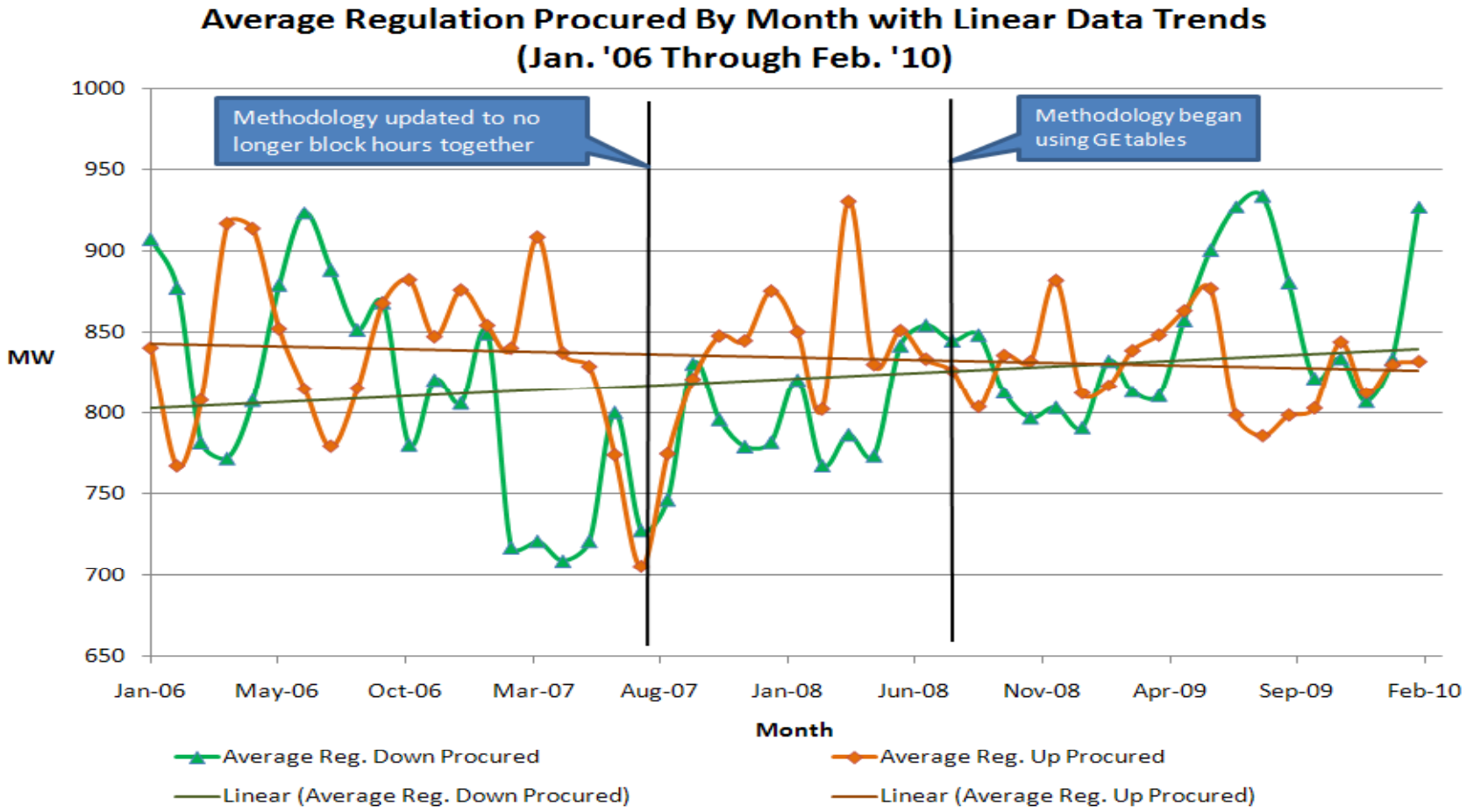
Year	RRS Deployments	Wind Related RRS Deployments (based on operator log)	Wind Related RRS Deployments when Out of Up-Regulation	Wind Gen Installed Capacity (End of Year) MW
2006	184	18	4	2892
2008	281	54	23	8024
2009	174	30	18	8954
2010(Feb)	37	9	6	~9100

Changes in the Amount of Regulation being Deployed



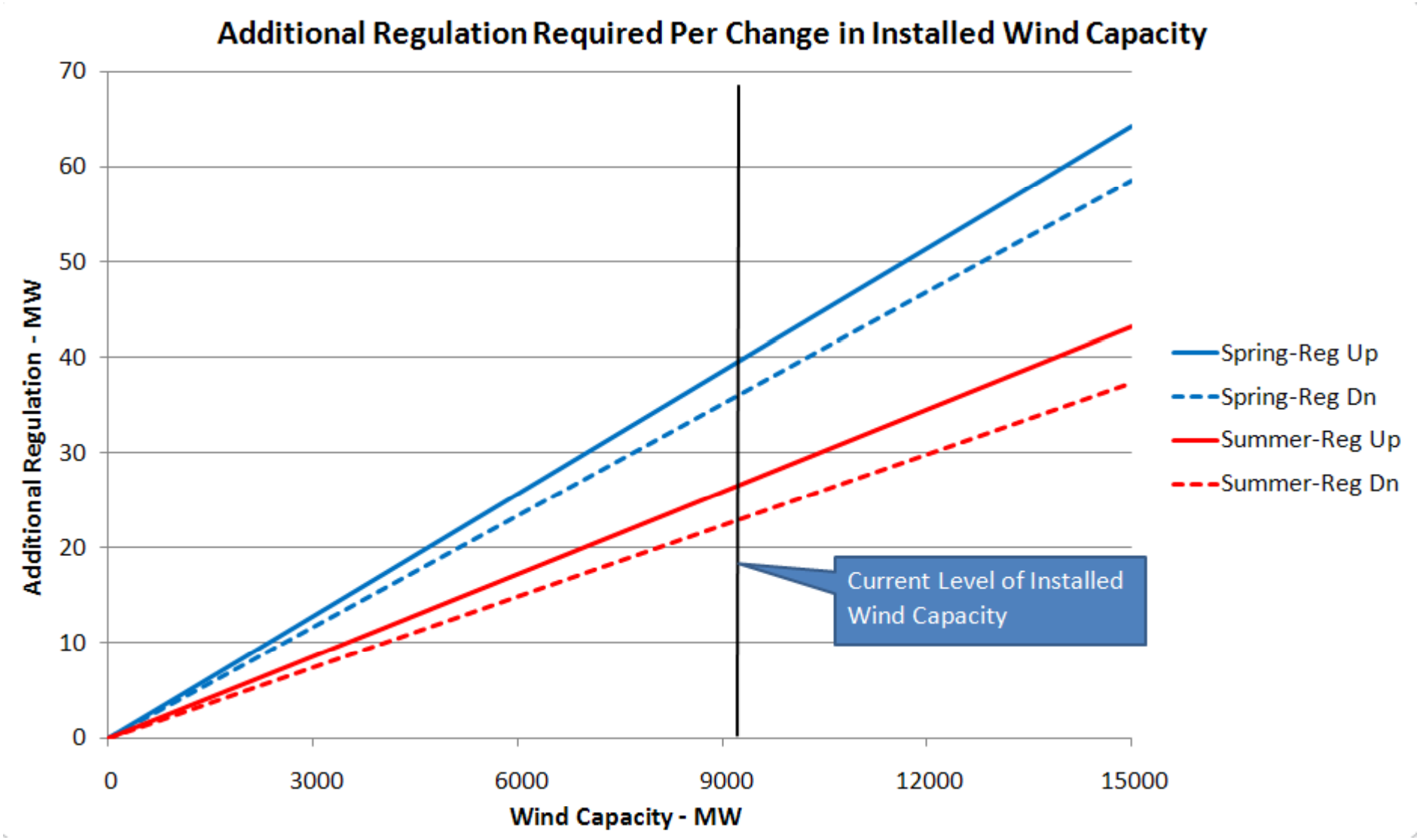
- **Trend does show an increase in the average reg. down deployments**
- **No significant change in trend of average reg. up deployments**

Changes in the Amount of Regulation being Procured

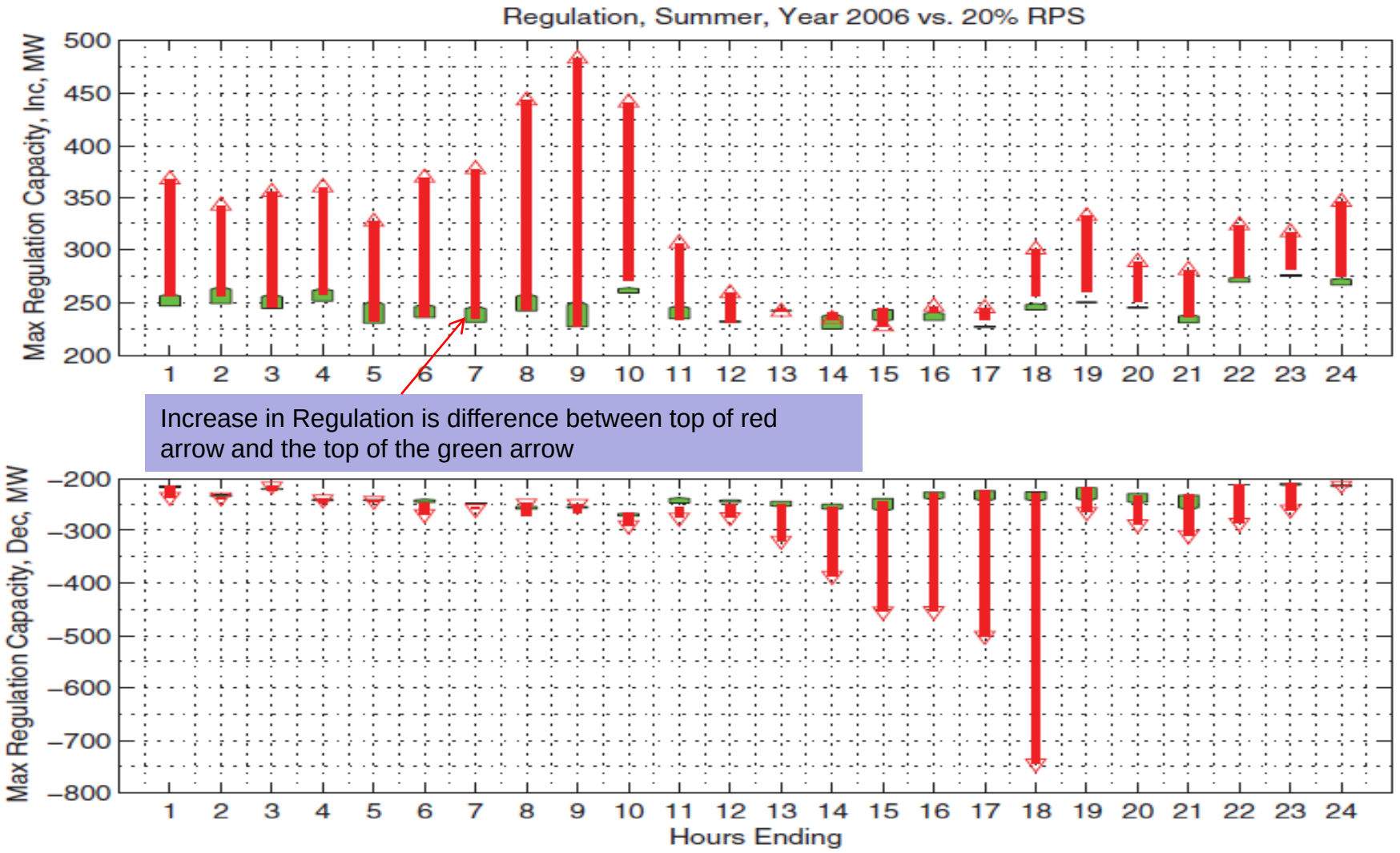


- **No significant change in trend of reg. down or up procurements over last several years**
- **Regulation methodology was changing during this window of time**

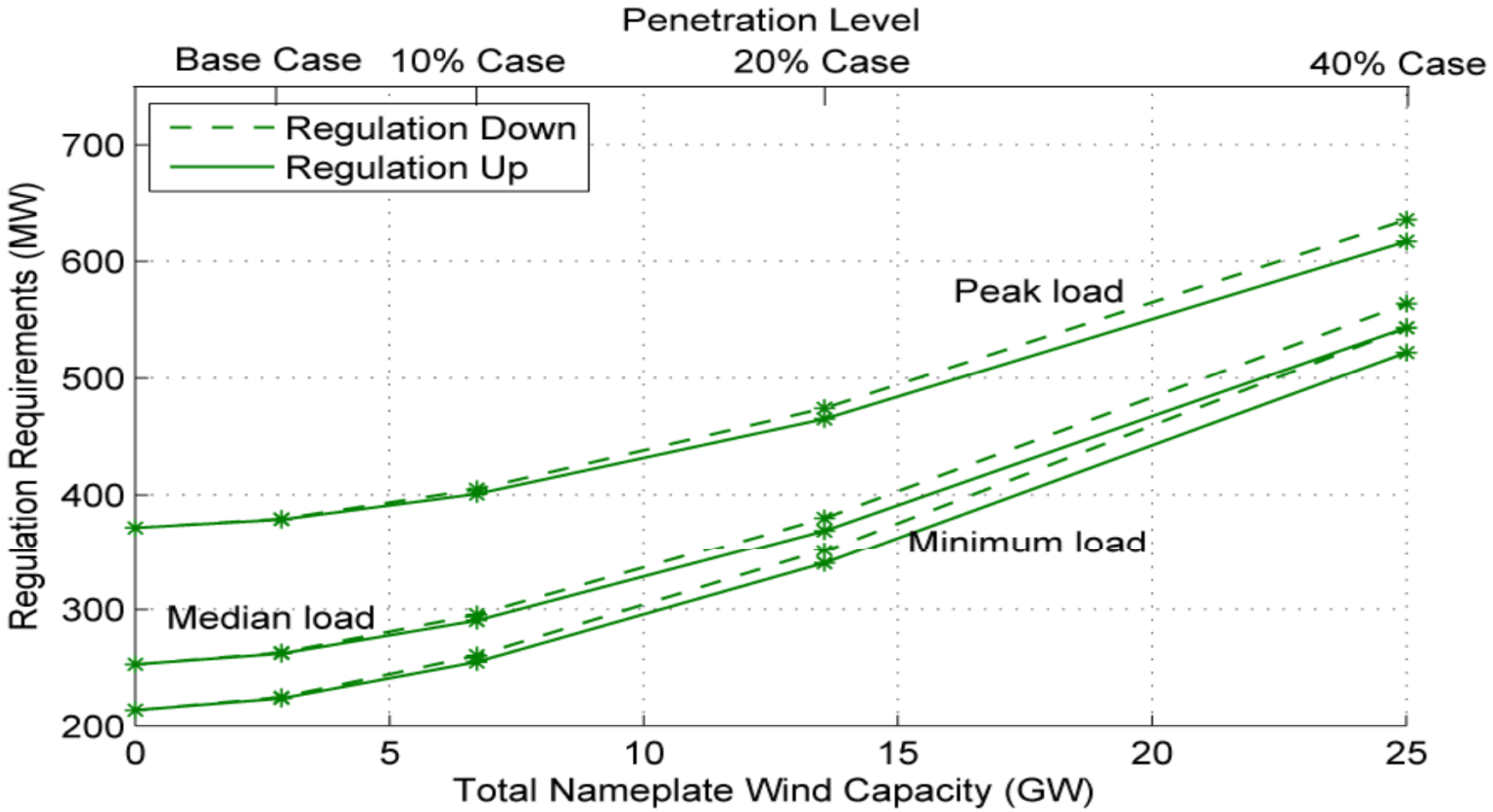
GE Study for Regulation Service Assuming 5-minute Nodal Dispatch



CAISO Study Results approximately 6700 MW of Wind



SPP Study Results



Spring regulation requirements as a function of the total wind nameplate capacity for different daily load levels

Nodal Impact to Non-Spinning Reserve And Regulation Reserve

- **Non-Spinning Reserve procurement amounts will not be affected by the Nodal design**
  - Non-Spinning Reserve is procured based on Forecast Uncertainty and loss of Generation
- **Regulation Reserve procurement amounts will most likely be reduced by Nodal design**
  - Zonal Balancing Energy Deployments perform load following on a 15 minute basis and SCED will load follow on a 5 minute basis
  - Regulation Reserve is utilized to fine tune between the market load balancing deployment intervals. A more frequent load balancing market interval should result in less Regulation needed

Wind Allocation of Non-Spinning Reserve

- **Non-Spinning Reserve is purchased based on Net Load Forecast Uncertainty**
- **Net Load Forecast Uncertainty can be separated into wind and load forecast uncertainty**
- **The contribution of wind forecast uncertainty can be computed**
- **The on-peak floor of the largest unit could be subtracted from wind allocation for the on-peak hours**
- **For example Hour 1 of January would have resulted in 38.96 % allocation to wind generation.**
- **The percent allocation would change for each four hour block based on winds computed contribution to net load forecast error during those hours.**

Wind Allocation of Regulation Reserve

- **Regulation Reserve will work in conjunction with SCED to balance load and generation**
- **Wind Generation that does not follow SCED can cause more Regulation to be deployed**
  - The difference between actual wind output and the SCED base point for wind generation can be measured.
  - The direction of the error can be compared to the system regulation deployments.
  - If wind generation is off their schedule in a direction that contributed to more system regulation, the amount of schedule deviation that contributed to system regulation could be charged to wind
  - Example: System Regulation Up = 200MW; WGR1 is generating below its base point by 50 MW; Base point schedule = 100 MW and actual output = 50 MW. This 50 MW could be charged by multiplying 50 * MCPC of Regulation divided by 12 for each 5 minute interval.

Summary

- **ERCOT NERC CPS1 scores have improved due to Governor Tuning and reduction in non-conforming load**
  - Reduction in governor dead-bands from 0.036 Hz to 0.0167 Hz by a number of generators including lignite generators.
  - Wind Speed increases/decreases contribute to the need for more secondary frequency control in the form of regulation but doesn't change instantaneously and doesn't cause frequency spikes.
  - ERCOT will continue to monitor potential reductions in online thermal generation due to wind penetration for the potential impact on system inertia.
- **Wind Generation does increase the amount of Non-Spinning Reserve requirements. This increase can be measured and allocated**
- **Wind Generation does increase the amount of Regulation Reserve requirements. This increase can be measured and allocated.**
- **Wind Generation ramps may require a new 10 minute type Ancillary Service product in the future**