# Review of Wind Generation Impact on Ancillary Services

TAC Update – April 08, 2010

John Dumas

# 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**

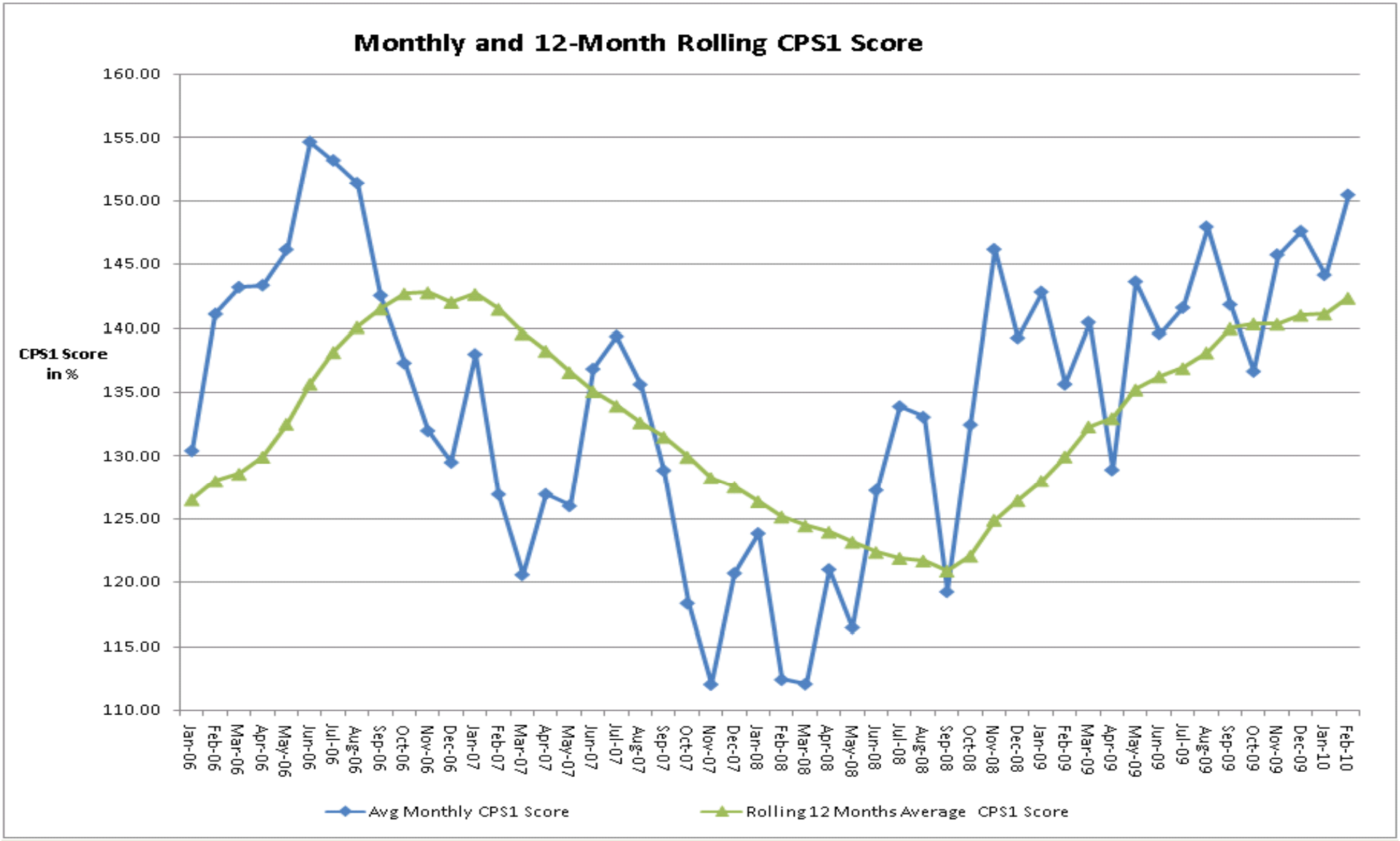
# ERCOT Ancillary Services

- **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

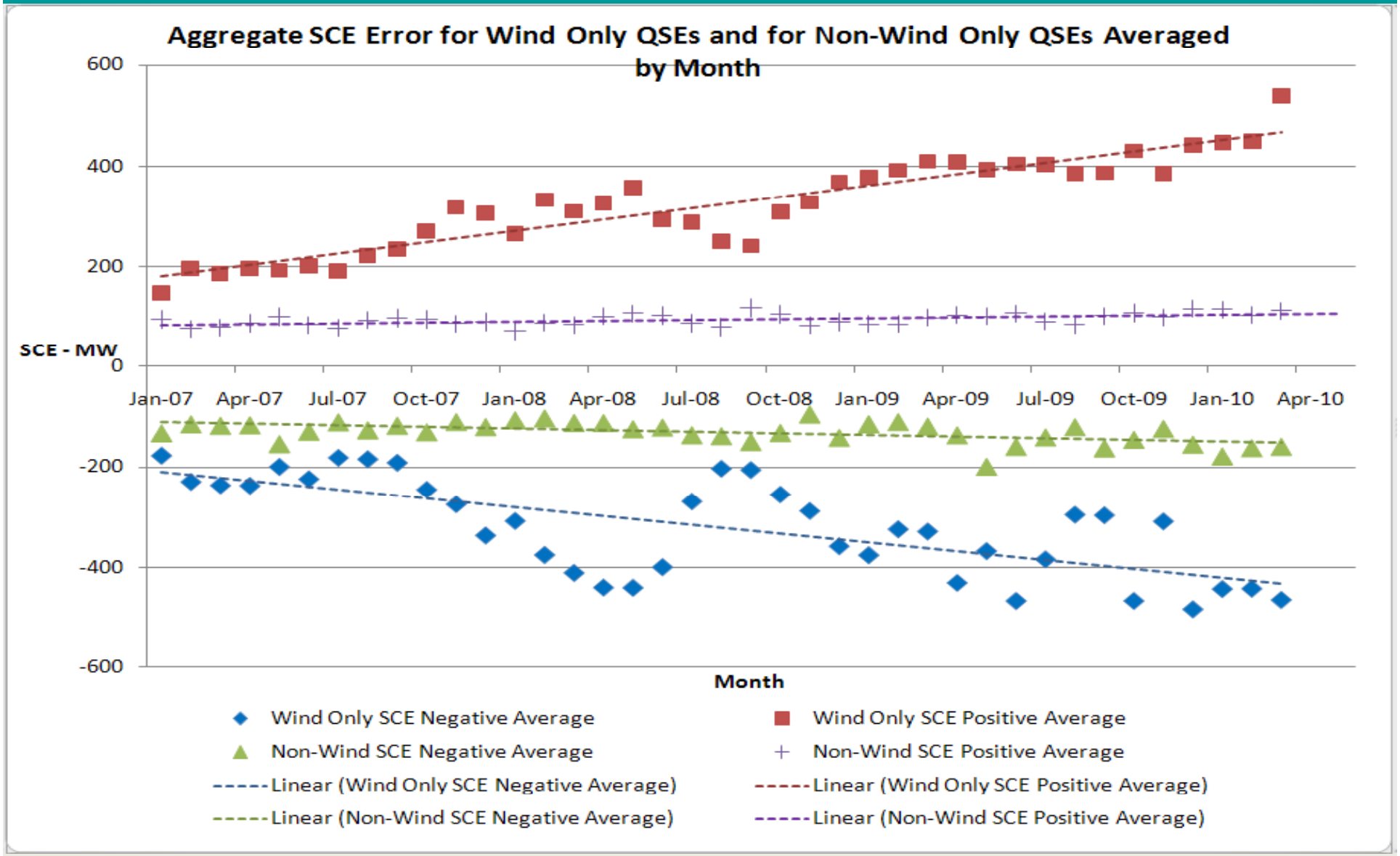
# ERCOT Ancillary Services

- **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

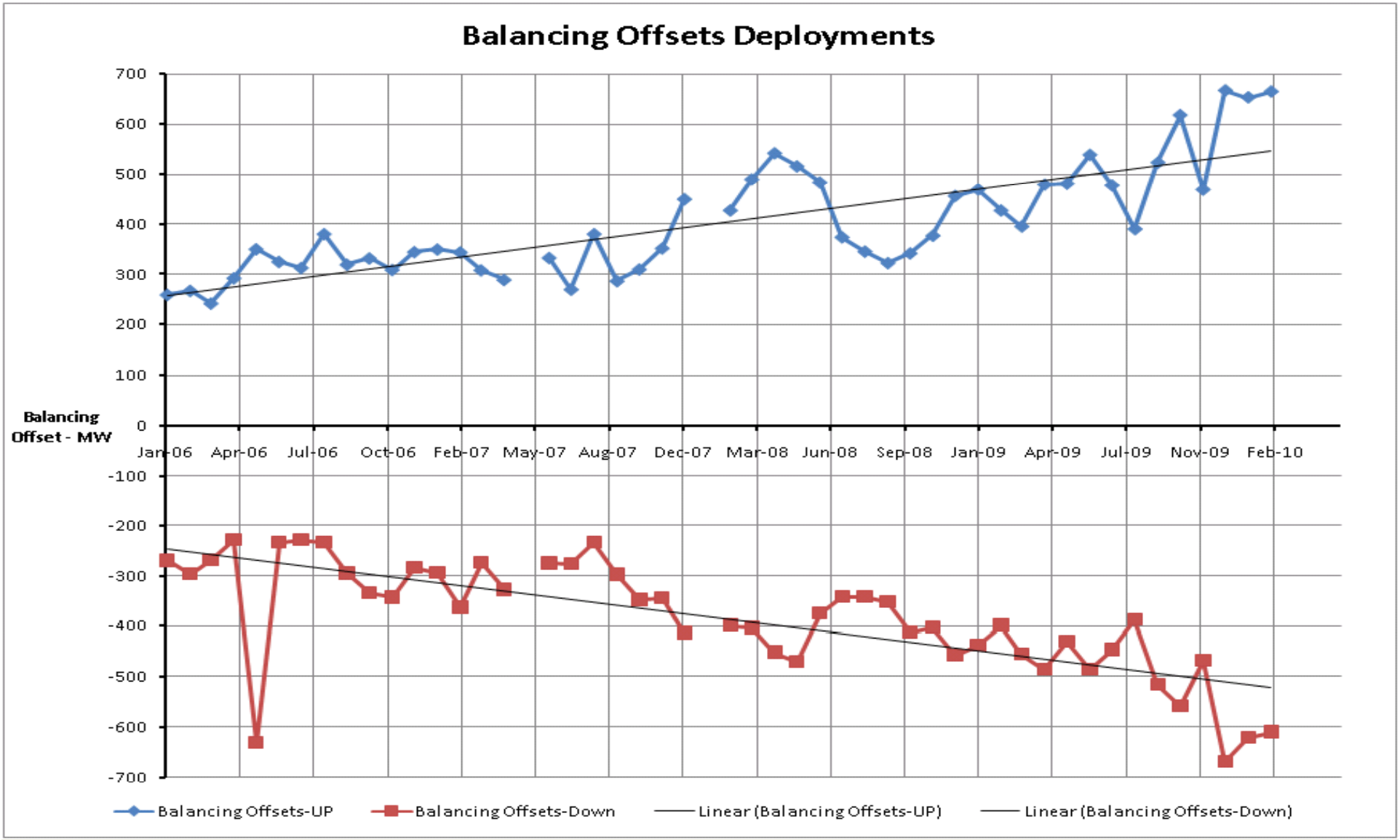
# CPS1 Scores Improving Due to Governor Tuning and Reduction in Non-Conforming Load



# SCE Error for Wind Only and Non-Wind Only QSEs



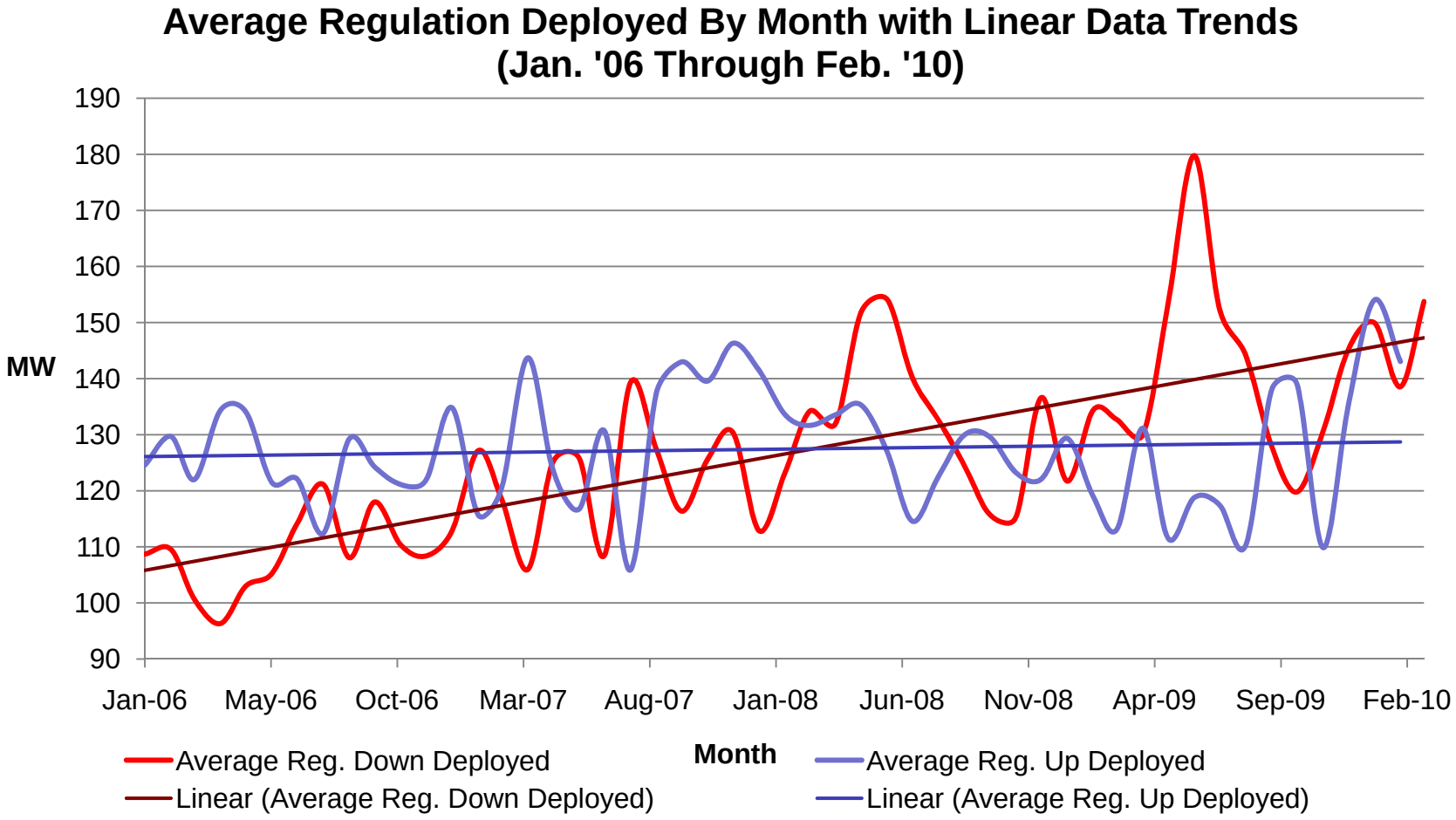
# Balancing Offsets Deployments since 2006



# Responsive Reserve Service Deployments summary

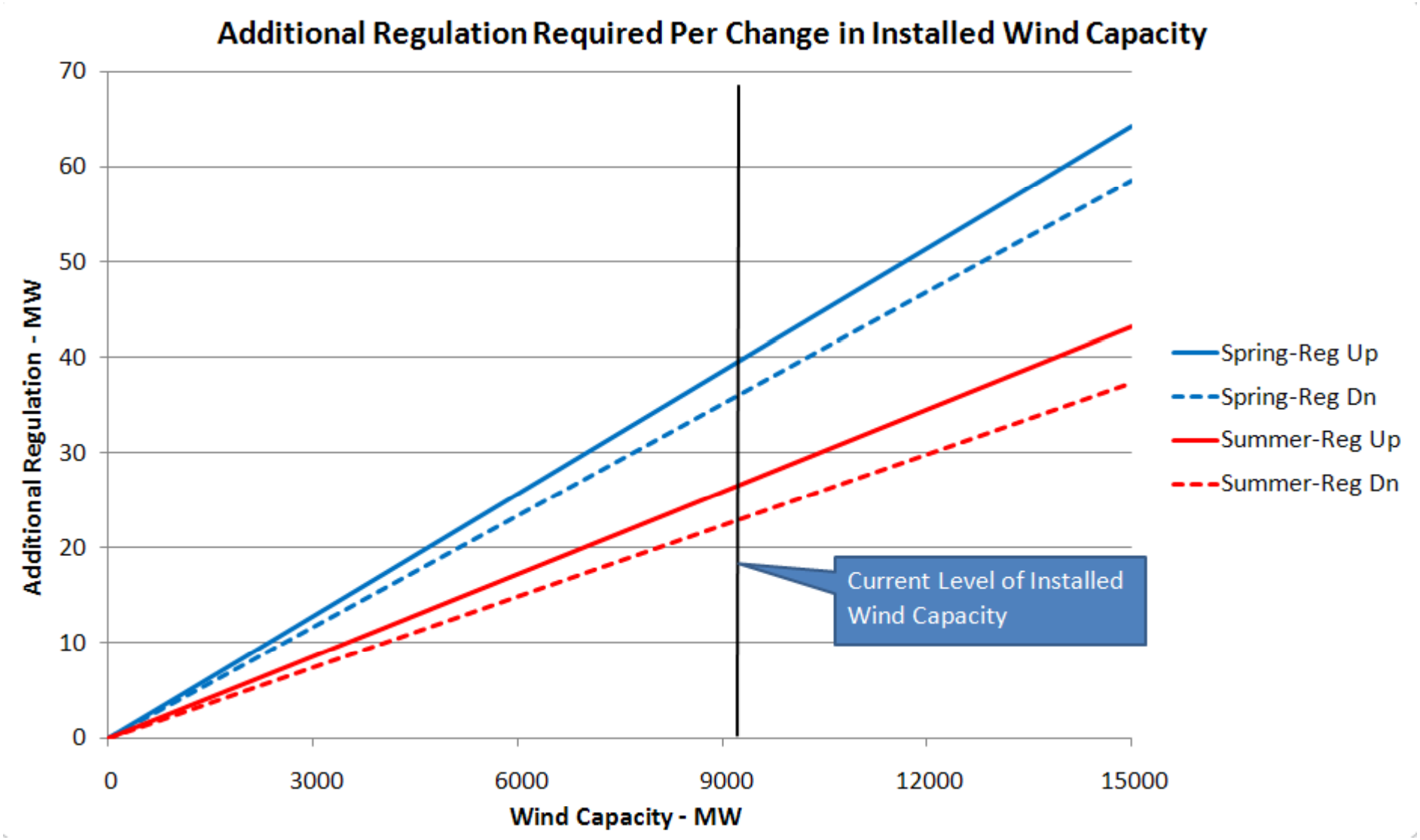
| Year | RRS Deployments | Wind Related RRS Deployments (based on operator log) | Wind Related RRS Deployments when Out of Up-Regulation | Wind Gen Installed Capacity (End of Year) MW |
|---|---|---|---|---|
| 2006 | 184 | 18 | 4 | 2892 |
| 2008 | 281 | 54 | 23 | 8024 |
| 2009 | 174 | 30 | 18 | 8954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

# Changes in the Amount of Regulation being Deployed

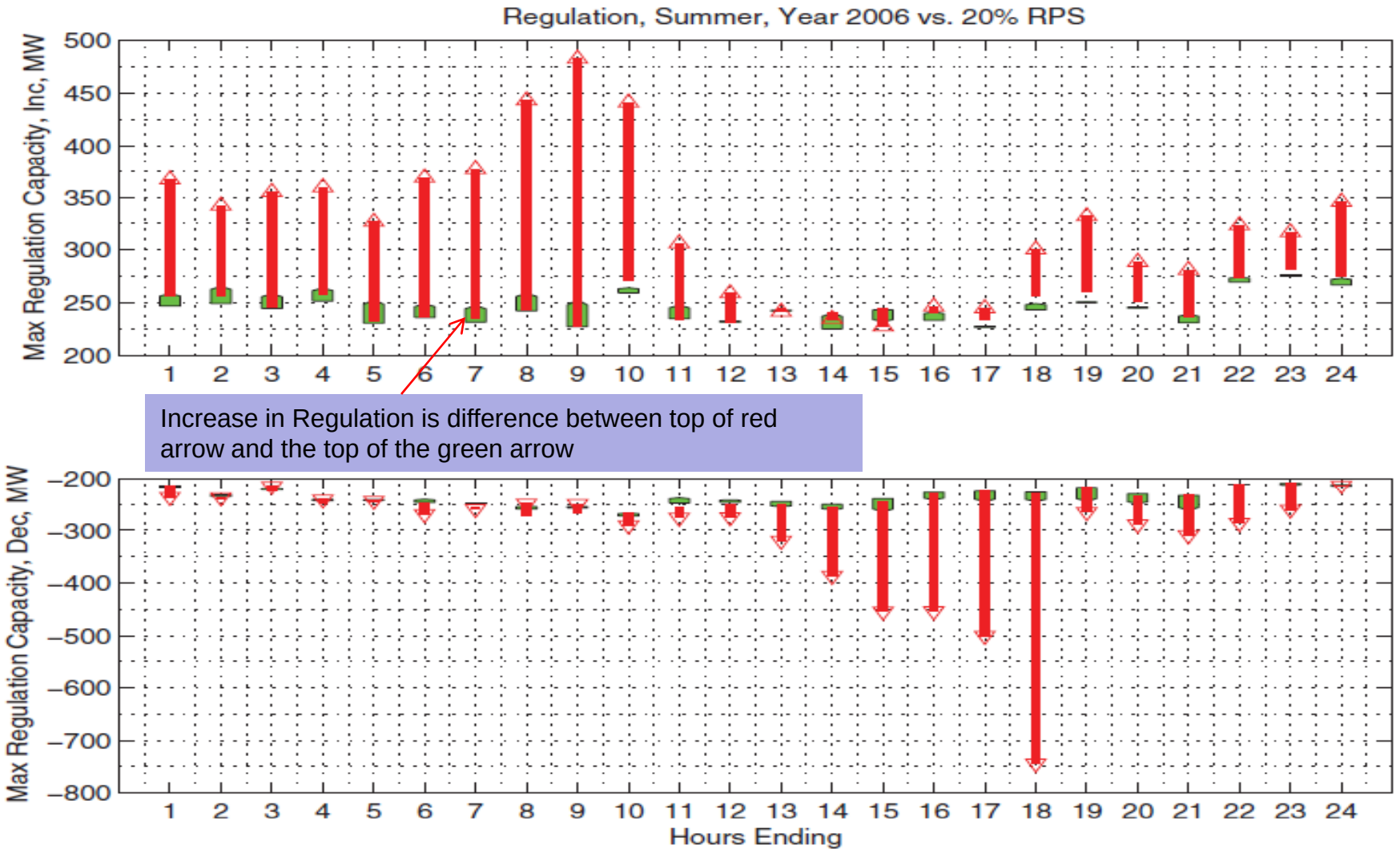



- **Trend does show an increase in the average reg. down deployments**
- **No significant change in trend of average reg. up deployments**

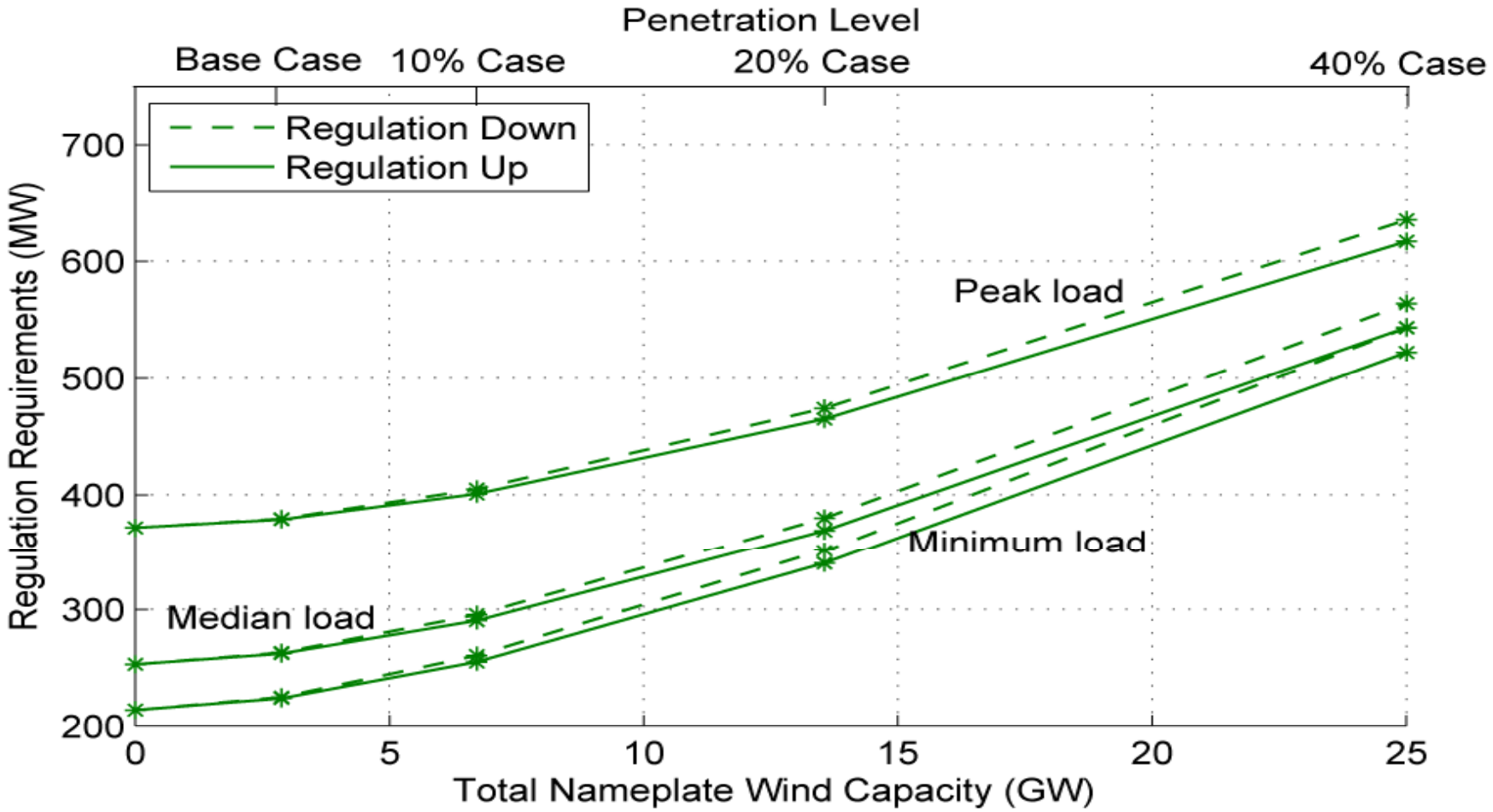
# GE Study for Regulation Service Assuming 5-minute Nodal Dispatch



# 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**