



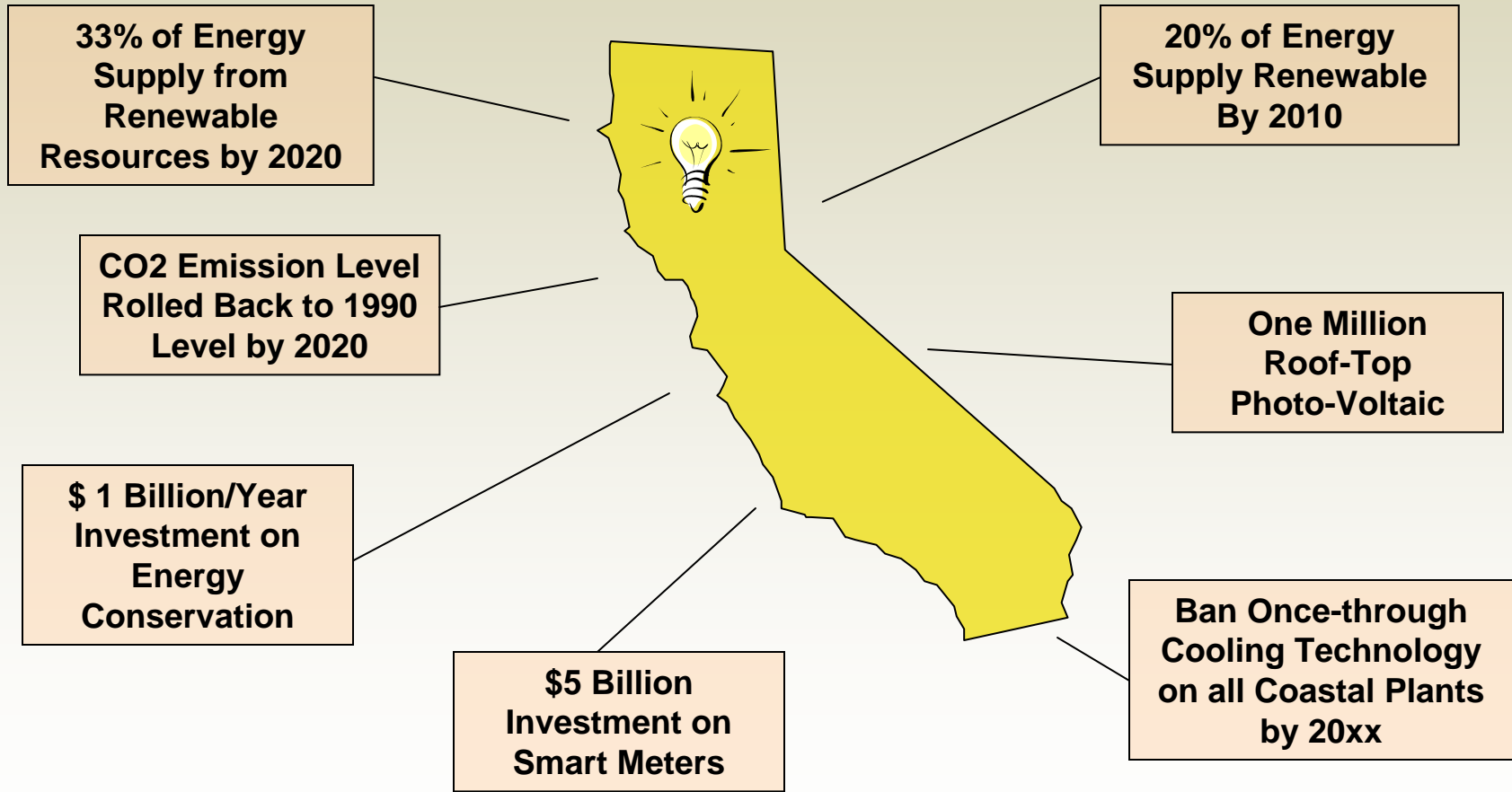
Integration of Renewables

2009 Aspen Institute Energy Policy Forum
Aspen, CO

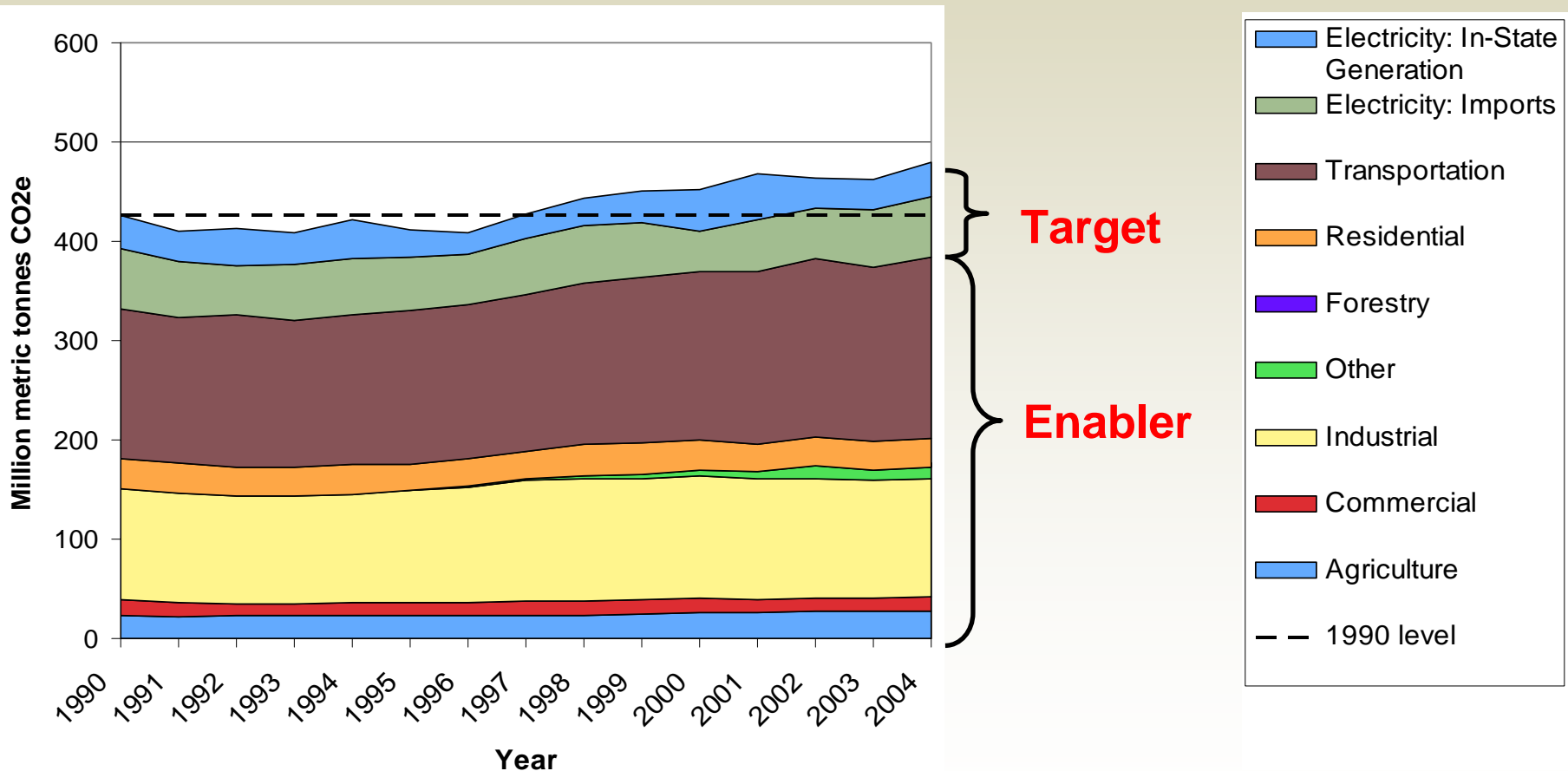
Yakout Mansour, President & CEO

July 10, 2009

Into the Future: Accommodating the Climate Change Initiatives....if it was only RPS!

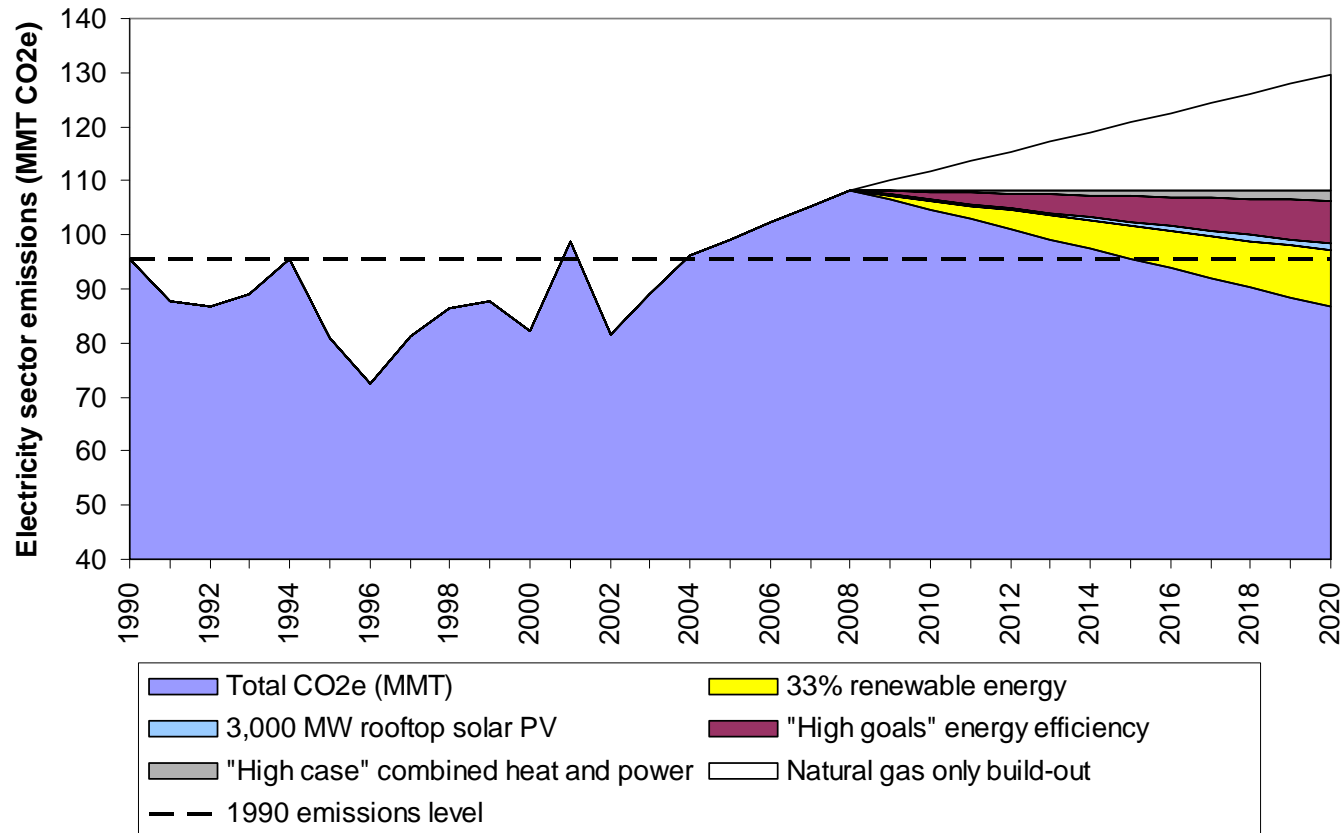


Into the Future: Achieving Statewide 1990 Level Emissions by 2020 (California Assembly Bill 32)



Source: CARB Emissions Inventory, updated Nov. 2007

Into the Future: Electricity Sector Emission Reductions Potential Compared to Historic Electricity Sector Emissions



● Gas Build-out ● Reference Case ● Accelerated Policy Case

What is necessary to integrate 20% renewable generation?

- We have published engineering studies on how to integrate renewable generation to meet the 20% RPS.
- Intermittency and timing of renewable resources create operational challenges.
 - Morning and evening ramp will increase 20-30%.
 - Potential wind forecast errors will drive the need for increased regulation capacity (as much as 500 MW) and a much deeper supplemental energy stack.
 - Over-generation will occur during certain hours but can be mitigated by minimal curtailment.
- Needed integration services can be provided by:
 - Hydro, IF there is enough water.
 - New thermal, IF it has the right characteristics.
 - Existing thermal, IF it is kept operating at certain levels (but could defeat the purpose).

What is necessary to integrate 20% renewable generation? (Con't)

- Other mitigation measures are also necessary:
 - Advanced Demand Response
 - Curtailment mechanisms
 - Improved technology
 - Better forecasting tools
 - Storage
- Maintaining existing generation is essential (although replacement or re-powering can work).

What does it take to integrate a higher RPS in California? “Out of the Box” on all fronts!

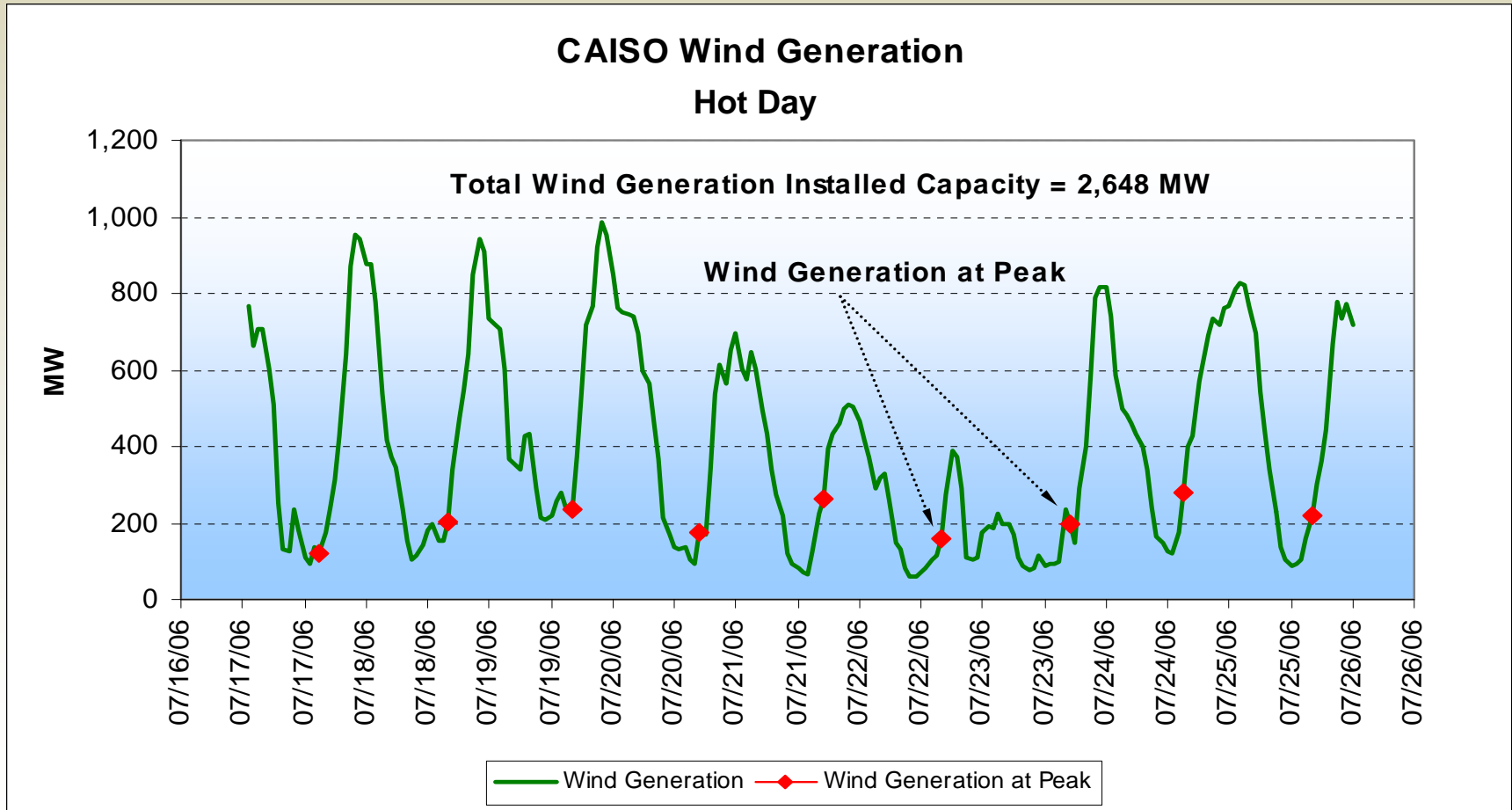
Case	GWh	Avg. Mw	Nameplate Mw
20% RPS (2010)	55,657	6,353	13,614
33% RPS (2020)	102,000	11,600	29,000

- Achieving 33% requires us to meet two times load growth with renewables between now and 2020.
- The increase in need for capacity, ramping, and regulation to achieve 33% RPS is not linear – it is much greater.
- 5-7 major transmission projects.
- Regional diversification is important technically and economically.
- Key questions are:
 - How much “in the box” thinking is still viable?
 - Can we retain and invest in more non base-load facilities?
 - Does retirement or replacement make sense?

“Out of the Box RPS” requires “Out of the Box Thinking”

- Regulatory
 - Transmission: 50% done, 250% to go
 - Federal vs. State (not just siting) must converge
 - Cost recovery, not just transmission
- Infrastructure Planning/Siting
 - Not just transmission
 - One project at a time is good for Y3K
- Operation
 - 50% of nameplate is largely intermittent
 - Forecasting generation plus forecasting load
 - Dispatch is redefined
 - Intra-hour schedule and NERC reliability standards
- Market
 - More of existing products, unbundling some, and creating new ones
 - Can we trust the market to provide what is needed? The risk factor.

Wind Production on Peak Heat Days



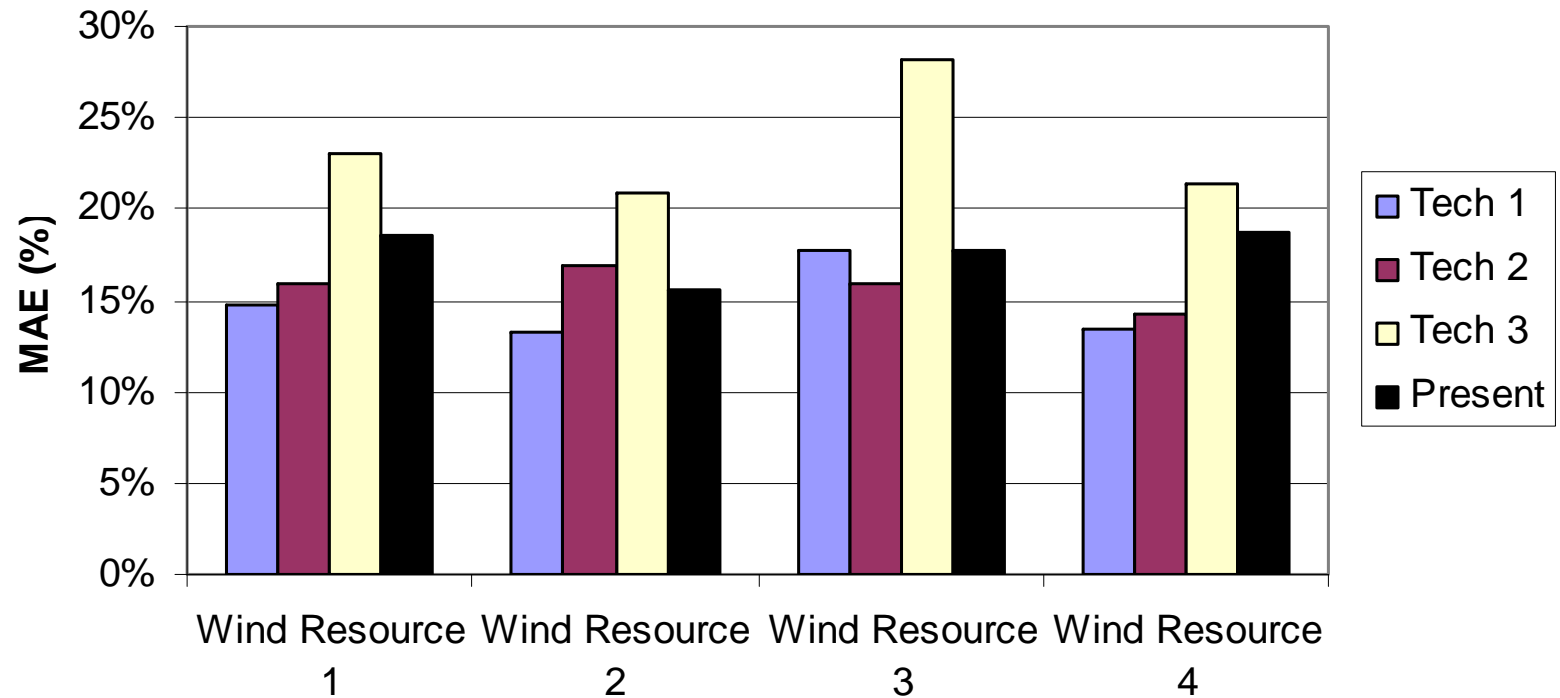
Towards RPS – Green Energy

The Capacity Element

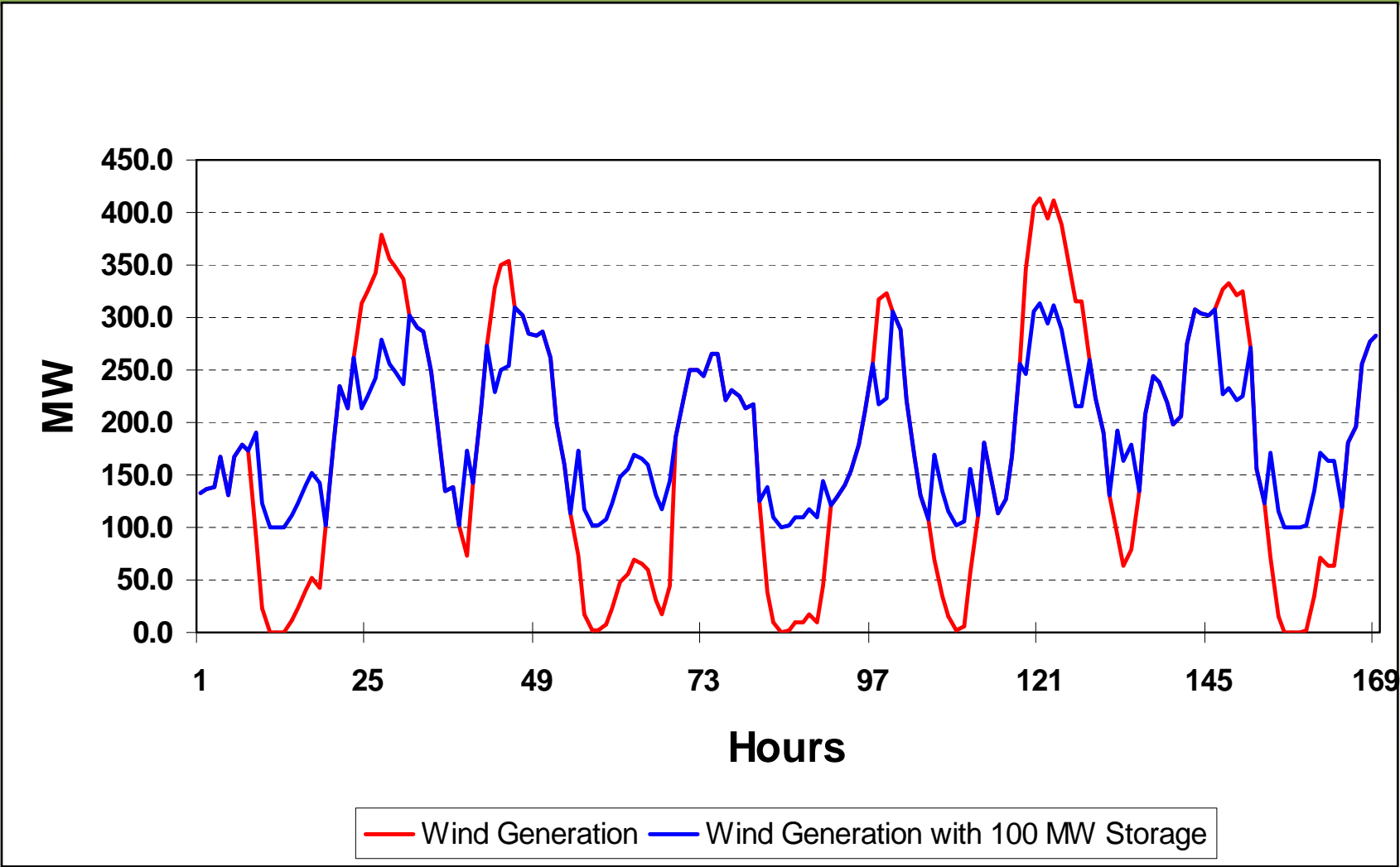
	Wind	Solar PV (non-DG)	Solar Thermal	Geothermal
Capacity Value	15-30% prior CPUC Approx. 3-8% new CPUC	65%	71-80%	80-90%
Capacity Factors	18-20% historical <30% new turbines	18-24%	20-28%	80-90%

Day Ahead Wind Forecast Performance

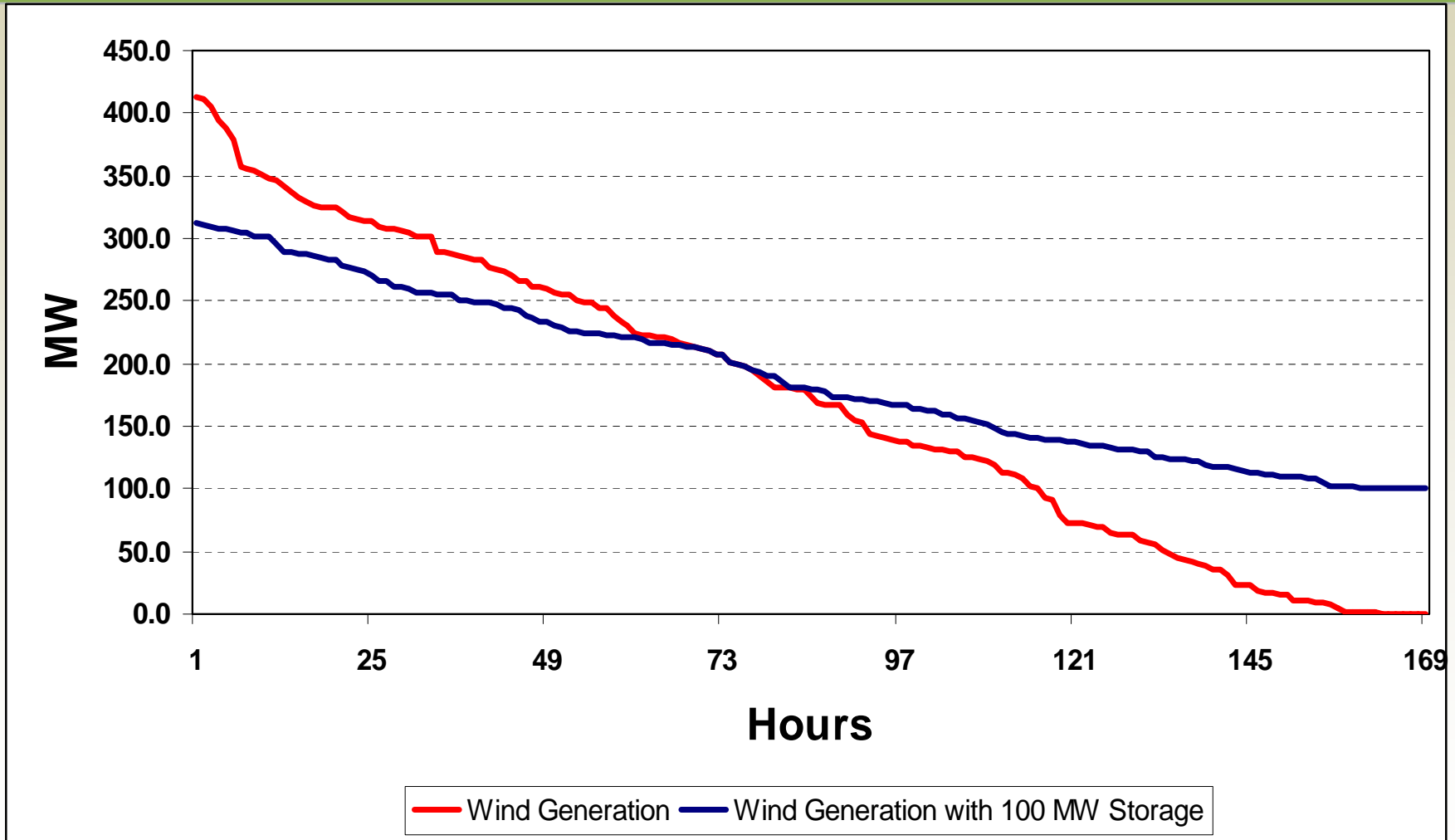
It is what it is!



Tehachapi Wind Generation with 100 MW Storage



Duration Curve for Tehachapi Wind Generation (pre and post storage conditions)



Conclusions

1. California is on its way to meet the 20% RPS.
2. Flexibility in meeting higher RPS is crucial. Ohm's Law cannot change by legislation.
3. Regulatory policies and certainty are important early in the process.
4. Innovative "Out of the Box" approaches are crucial on every front.