



# IRRP Stakeholder Meeting

October 24, 2008

# IRRP Stakeholder Meeting Agenda

Welcome	10:00AM – 10:05AM
Program Overview	10:05AM – 10:30AM
20% RPS	10:30AM – 11:45AM
Lunch Break	11:45PM – 12:15PM
Beyond 20%	12:15PM – 1:45PM
Closing	1:45PM – 2:00PM

# Today's Objectives

- Break the Silence
- Let you know what we are doing
- Lay foundation for Stakeholder Input
  - Is the scope correct?
  - Have we missed issues?
  - Priorities
  - Schedule
  - Communication structure – working groups?
- Updated Program Plan



# IRRP Stakeholder Meeting

Grant Rosenblum  
Manager, Renewables Integration

IRRP Stakeholder Meeting  
October 24, 2008

# CAISO Renewables Integration Program

**Maximize Renewable  
Resource Participation**

## **CAISO Corporate Goal:**

*Support the integration of renewable resources into the California power grid to fulfill State policy objectives*

**Grid Operations  
Infrastructure  
Markets  
Regulatory Activities**

**Reliability**

**Cost  
Efficiency**

# Vision and Program Structure

## Past Activities

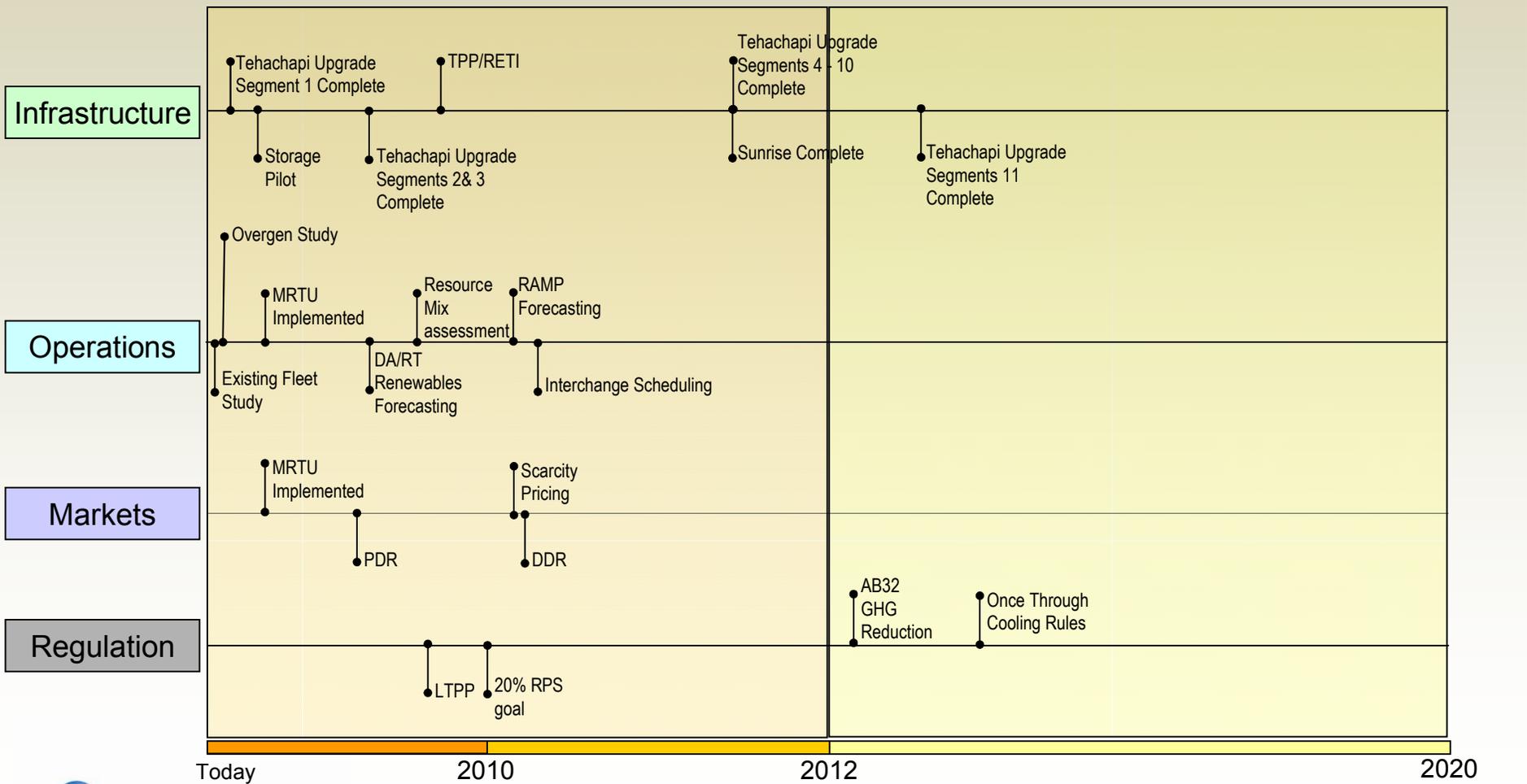
- 2007 Report
- April 2008 Stakeholder Meetings
  - Stakeholder Feedback



# Vision and Program Structure

- Two Inter-related/Overlapping Phases
  - 20% RPS
  - Beyond 20% RPS: 33-50%?
- For each phase
  - Identify impacts of renewable resources on the grid
  - Implement or facilitate solutions
- Coordinate with other electric power sector market and policy developments (e.g., once through cooling, long-term RA, greenhouse gas regulations, DR policy)
- Program seeks to be technology neutral and market driven
- Leverage expertise/resources of other agencies and market participants
  - CEC, IRC, etc.
  - Working Groups?

# Renewables Roadmap





# Operational Needs Assessment Operational Tools

Clyde Loutan  
Senior Advisor, Regional Transmission Engineer

IRRP Stakeholder Meeting  
October 24, 2008

# Results of the November 2008 Integration of Renewable Resources Study

- **Load Following is necessary to maintain stable operations**

- Load following Capacity requirements will increase



700 - 800 MW



500 - 900 MW

- **Regulation is required to maintain frequency and maintain interchange schedules**

- Regulation capacity requirements can double certain hours



170 - 250 MW



100 - 500 MW

# Existing Fleet

- Can the existing generation fleet meet the energy deliverability characteristics to integrate 20% RPS?
  - Load Following capacity, speed of ramp and ramp duration
  - Regulation capacity, speed of ramp and ramp duration
  - Frequency Responsiveness
- Sensitivities
  - High Hydro
  - Low Hydro
  - Once Through Cooling

# Existing Fleet

## ■ Methodology

- The methodology is currently under development (Working with Plexos)
- The study will utilize the Monte Carlo production cost simulation model to determine:
  - The number of hours A/S cannot be met
  - The number of hours and magnitude of unserved energy
- Unit commitment consistent with MRTU timelines
- Load and wind forecasting errors would be used for different timeframes
- *Evaluating the ability to model frequency responsive needs into the unit commitment process*

# Existing Fleet

- Deliverables
  - Identify and quantify A/S deficiencies, unserved energy
  - Evaluate potential options to improve overall coordination of existing resources
  - Recommend potential improvements to existing scheduling, reserve procurement, supplemental energy dispatch and regulation algorithms
  - Foundation for 33% RPS operational assessment; depending on the level of limitations identified and in the model and analytical approach

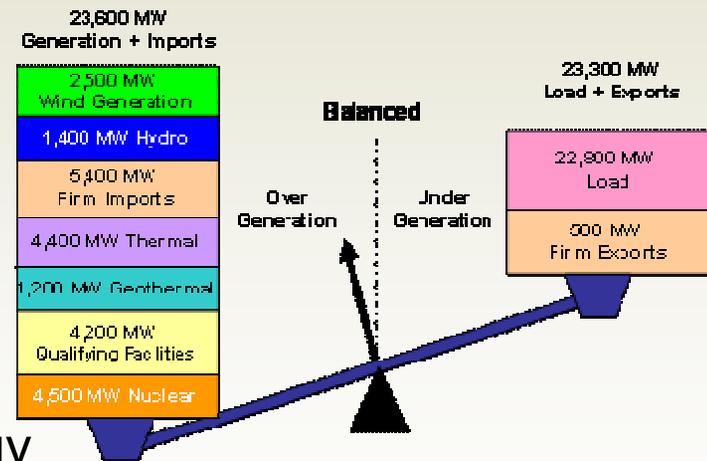
# Existing Fleet

- Timeline

- Draft Report – Early December 2008
- Stakeholder Meeting – December 2008
- Revised Draft Posted for comments - January 2009
- Final Report - February 2009

# Over-Generation Analysis

- Identify and quantify over-generation occurrences
  - Quantify the frequency, duration and magnitude of over-generation
  - Identify issues associated with over-generation
- Sensitivities
  - High Hydro
  - Low Hydro
- Methodology
  - Statistical Analysis
  - Historical generation by technology
  - Assumptions (Thermal, Hydro, Imports)



# Over-Generation

- Deliverables

- Not who, but how much
- Expected curtailment hours by season
- Expected curtailment MWH by season
- Recommendations/conclusions

- Timeline

- Draft report posted for comments – Third week of October 2008
- Stakeholder Meeting – November 2008
- Revised draft posted for comments – early December 2008
- Final Report – December 2008

# Operational Tools

## ■ Objectives

- Develop visualization tools to help operators deal with renewable integration. The team includes BPA, CAISO, WAPA, MISO, New England ISO, and PJM
- Integration with Market Systems

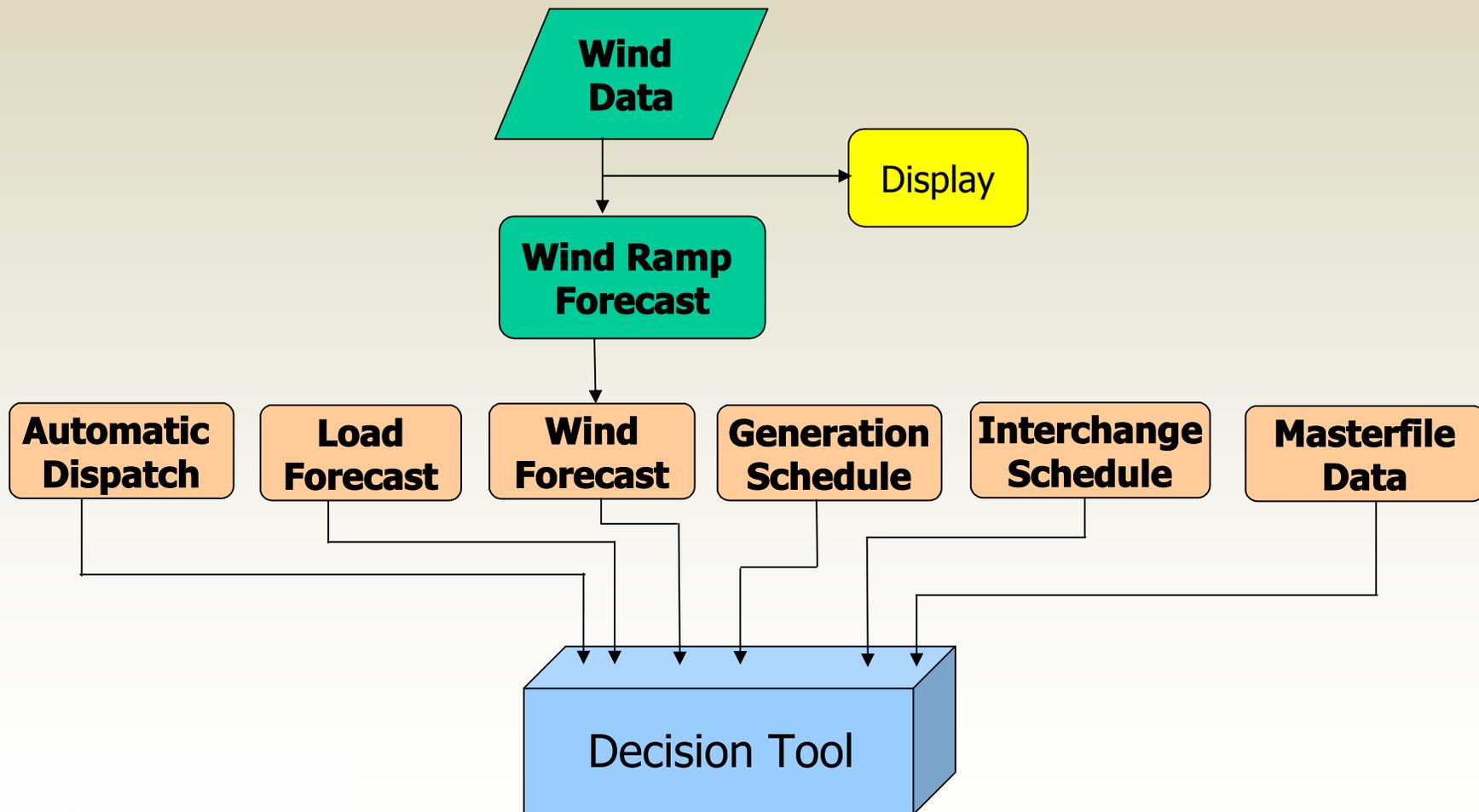
## ■ Ramp

- 24-hours look ahead – peak & off-peak
- 2-3 hours look ahead with 5-minute resolution
- Provide probabilities of expected ramps
- Forecast the impacts of unpredicted wind ramps

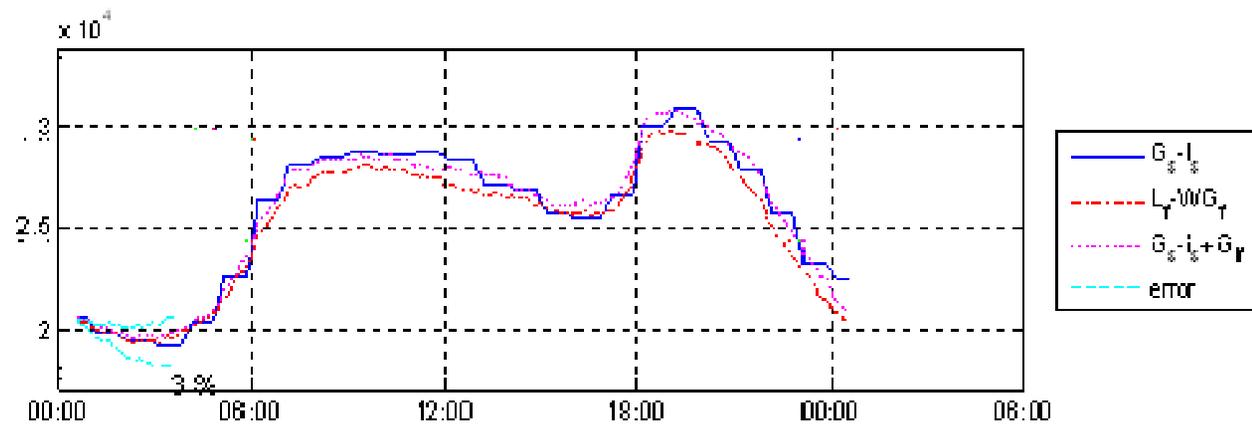
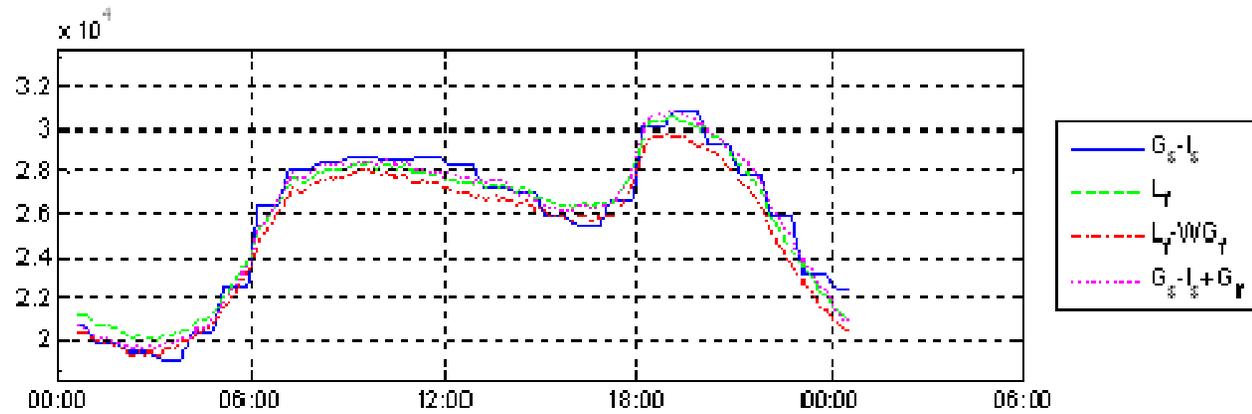
## ■ Timeline

- Prototype by December 2008

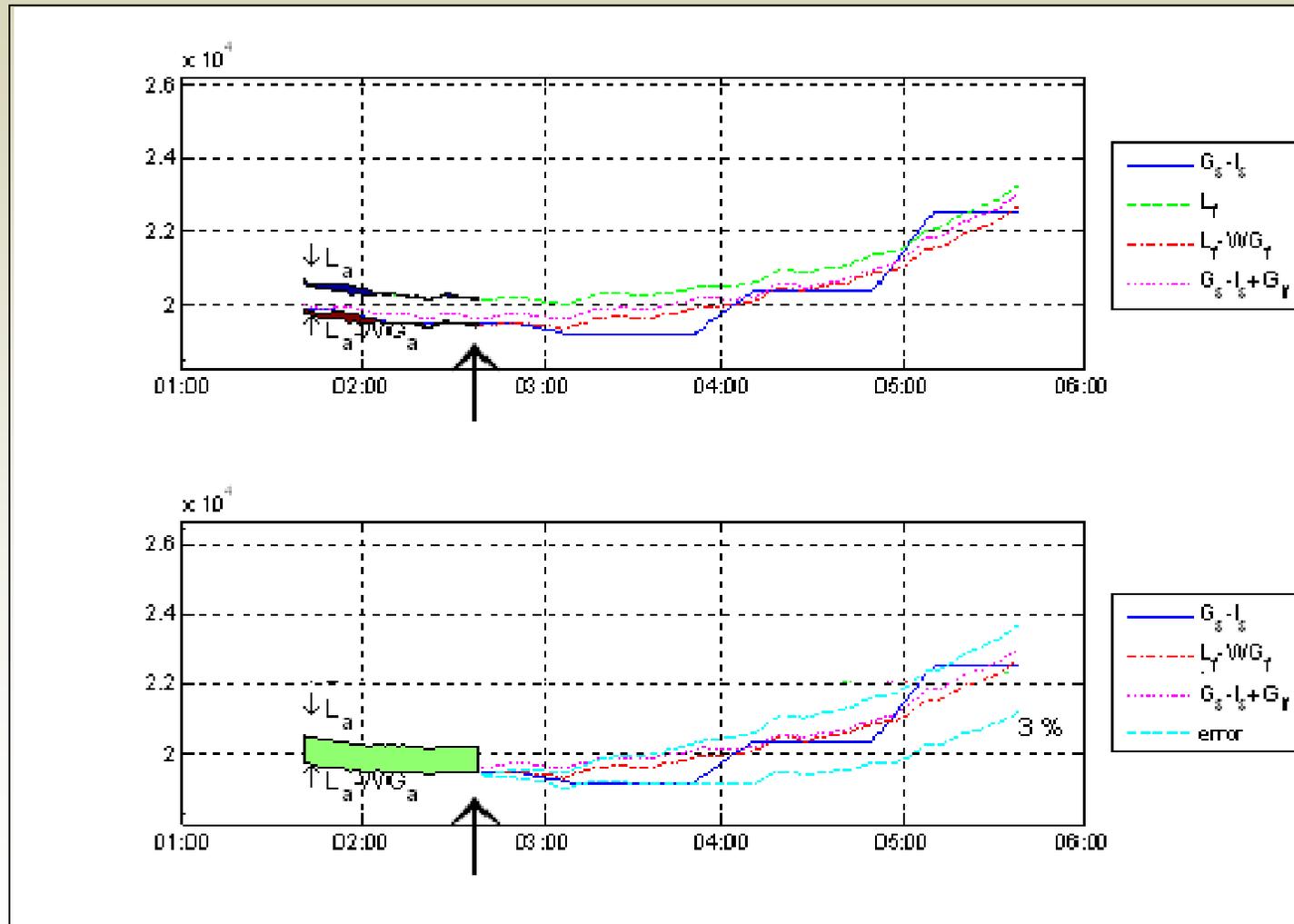
# Operational Tools



# 24-Hours Look Ahead



# 3-Hours Look Ahead





# Operational Tools & Forecasting

Jim Blatchford  
Sr. Policy Issues Representative

IRRP Stakeholder Meeting  
October 24, 2008

# Operational Tools

- PIRP
  - Solar Paper
  - Wind Paper
  - Application Enhancements
  - Meetings



# Operational Tools - PIRP

- Solar Technical Paper
  - Vetted 2007- 2008
  - Incorporated into BPM
- Wind Technical Paper
  - Start the Stakeholder Process
  - Incorporate Findings from Internal Engineering & AWS Truewind Studies
  - Incorporated into BPM
- PIRP App. Enhancements
- PIRP Monthly Meetings



# Forecasting

## ■ RFB Goals

- Ensure HA PIRP Forecast is the Most Accurate.
- Develop Accurate Day Ahead Forecast (RUC Input)
- Use Latest Technology Available
- Reduce Operating Costs
- Develop 5-min forecast in-house (Real Time input)



## ■ RFB Criteria

- DA Forecast
  - <15 % RMS
- HA Forecast
  - <7% RMS
- 5-min Forecast in-house

$$RMS = \sqrt{\frac{\sum \epsilon^2}{n}}$$

# Forecasting Issues

- AWS Truewind Study

Facility	Next Operating Hour			Next Day
	Annual MAE	% mons < 12%	% mons < 14%	Annual MAE
Plant E	13.83%	22.2%	55.6%	19.83%
Plant H	13.65%	16.7%	58.3%	18.60%
Plant F	15.30%	0.0%	16.7%	19.43%
Plant I	6.80%	100.0%	100.0%	15.38%
Plant A	11.30%	66.7%	83.3%	15.63%
Plant O	14.18%	33.3%	50.0%	18.44%
Plant J	12.94%	25.0%	66.7%	21.17%
Plant K	14.57%	16.7%	50.0%	20.57%
Plant L	14.76%	16.7%	50.0%	21.41%
Plant G	15.29%	8.3%	16.7%	17.80%
Plant D	8.13%	100.0%	100.0%	41.41%
Plant B	14.59%	0.0%	50.0%	20.64%
Plant C	12.43%	25.0%	50.0%	17.44%
Plant M	14.91%	16.7%	58.3%	18.77%
Plant N	14.86%	16.7%	37.5%	24.49%
<b>Overall</b>	<b>13.32%</b>	<b>28.7%</b>	<b>54.4%</b>	<b>18.85%</b>

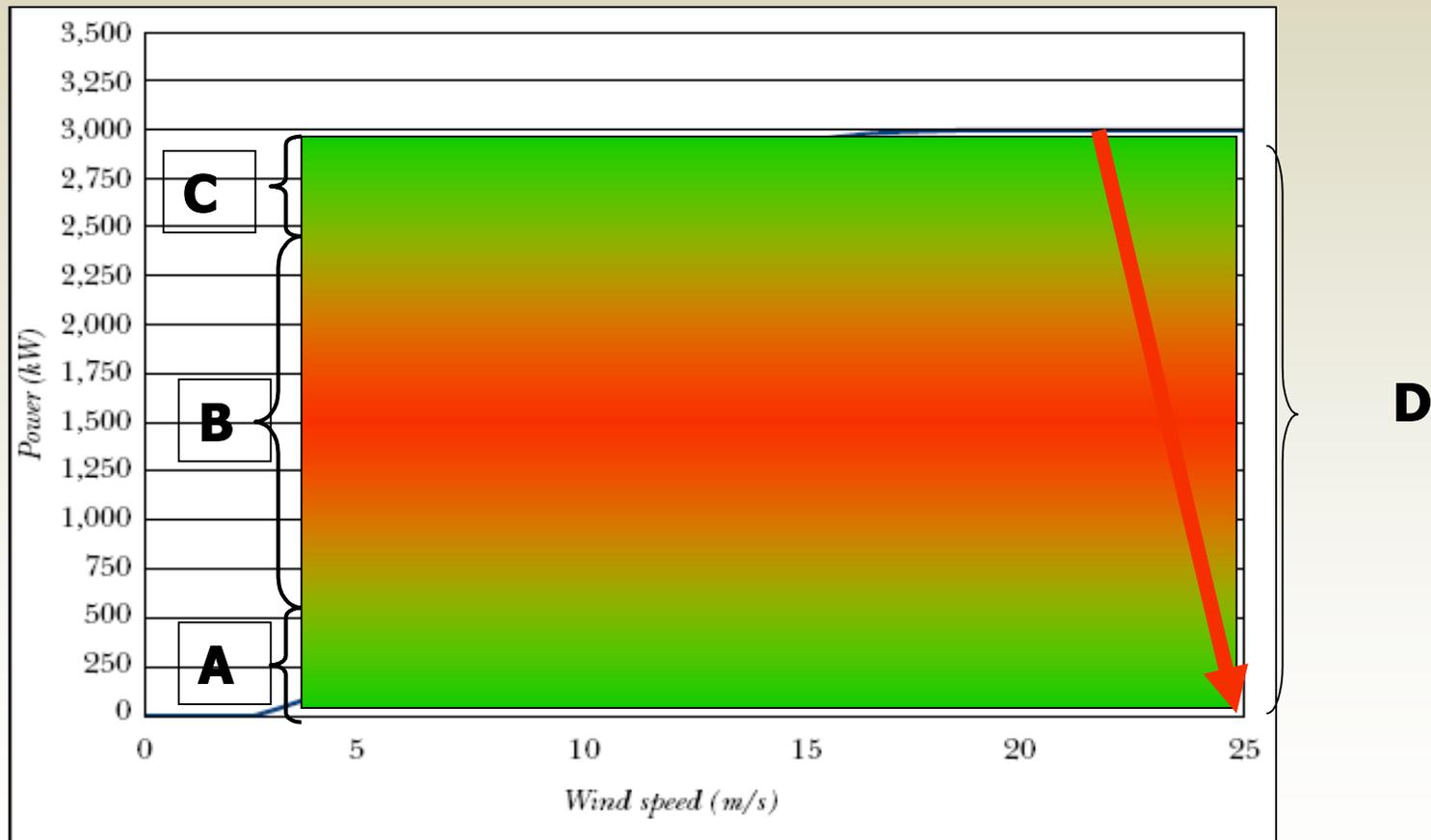
- Internal Root Cause Analysis

- Outage Reporting
- Data Redundancy
- Independent Power Sources
- Compliance



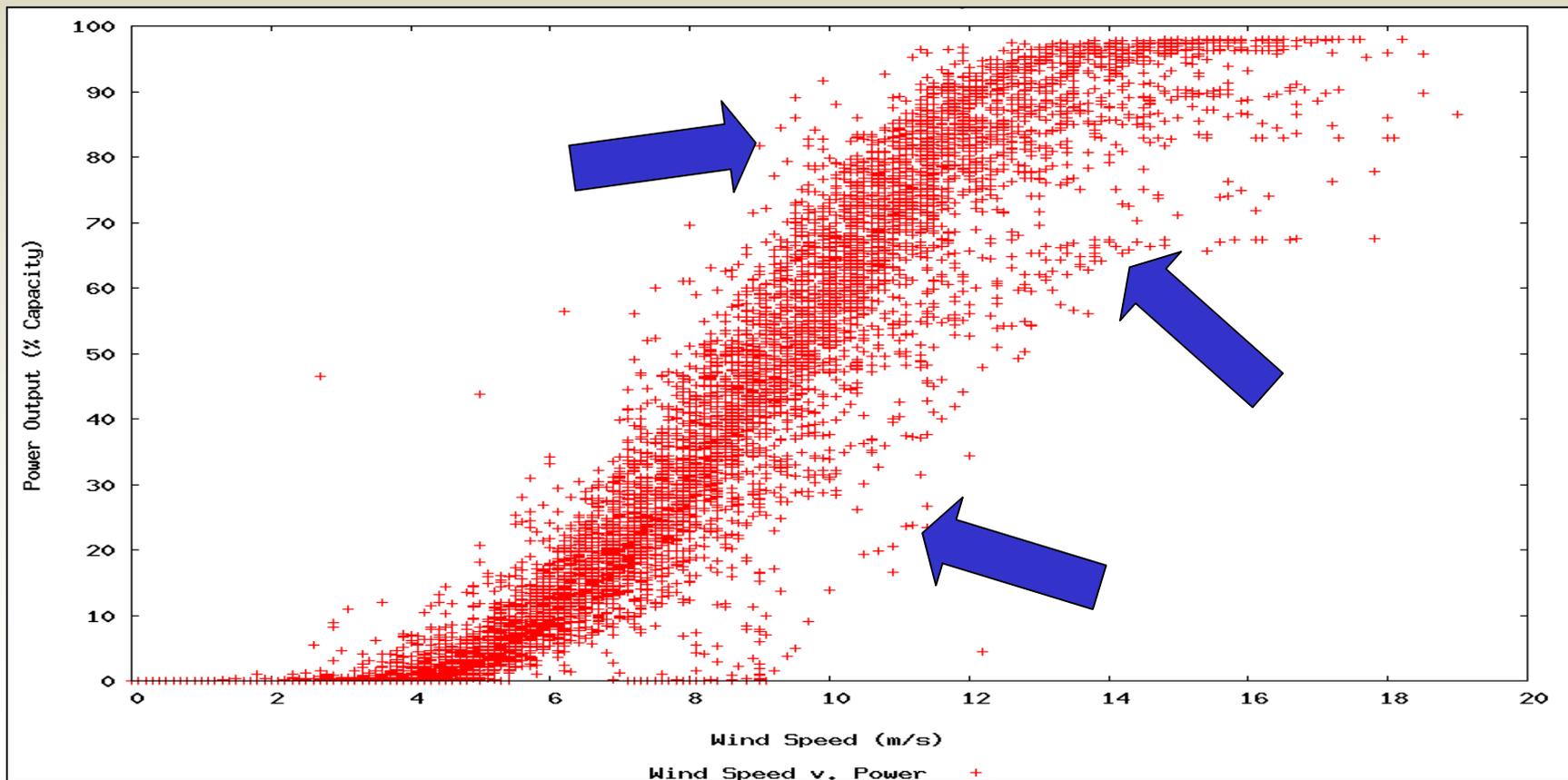
# Going Forward

## Dissecting the Power Production Curves



# Going Forward

Continue to Improve the Curves w/ Data Quality



# Going Forward

## ■ Studies

- Ramp/Spike Events
- High Speed Cutout Consequences
  - How Often Over Speed
  - % Change of Power
  - Return Ramps after Over Speed
  - Ramp Down Curve
- Ramps
  - Correlation with Diurnal Patterns

## ■ Metrics as a Function of:

- Season
- Time of day
- Look out period
- Wind Production/Load
- Cross correlation between forecast time periods
- Auto Correlation
- Persistency Forecast
- Inter-agency Coop

# Going Forward

- PIRP Meetings
  - Tentative Schedule

Nov 21, 2008	Dec 19, 2008
Jan 23, 2009	Feb 20, 2009
Mar 20, 2009	Apr 17, 2009
May 22, 2009	Jun 19, 2009



- Topics
  - Wind White paper
  - BPM Schedule
  - And More





# Market Products

Udi Helman  
Principal, Market and Product Development

IRRP Stakeholder Meeting  
October 24, 2008

# Market Development For Renewable Integration

- Effect of MRTU market design and planned enhancements (MAP) on renewable integration
- Evaluate further modifications to existing products and pricing rules (Market Initiatives Roadmap, etc.)
- Evaluate whether new market products are needed to stimulate needed capabilities (Roadmap, etc.)
- Possible pilot projects for alternative technologies to demonstrate capability and market value in ancillary services
- Evaluate market aspects of interdependencies with other electric power sector market and policy developments (e.g., once through cooling, long-term RA, greenhouse gas regulations)
- Coordination with other ISOs/RTOs to facilitate market development

# Some Principles for CAISO Market Design

- Market design should be “technology neutral”
- Market design should be more “complete” over time
  - In this context, we mean that products and pricing should be available to represent binding constraints and elicit needed capabilities to relieve those constraints
- New market products must not be duplicative with existing products
- New market products should reflect stakeholder interest as well as CAISO evaluation of operational/market needs

# Are Market Design Changes Needed for 20% RPS?

- Operational assessments suggest that the existing fleet is sufficient to support 20% RPS, but that additional capabilities would enhance integration (and are needed beyond 20%)
- CAISO 2007 Study identified needs for:
  - Additional ramp capability for load following and regulation
  - Quick start capability
  - Wider operating ranges from existing resources
  - Load shifting from peak to off-peak hours
- And addressed markets for
  - Additional Regulation Up and Regulation Down
  - Resource Adequacy

# MRTU and Planned Enhancements will support meeting the 20% RPS (and beyond)

- MRTU will improve scheduling and dispatch of existing resources
  - Integrated Forward Market (IFM) and Residual Unit Commitment (RUC)
  - Improved Real-time unit commitment and economic dispatch
- Planned MRTU enhancements could stimulate market response in support of renewable integration
  - Scarcity Pricing during Regulation and Operating Reserve Shortages
  - Increased Demand Response -- Proxy Demand Resource (PDR) and Dispatchable Demand Response (DDR)

## Other Near-Term Market Development Options

- Roadmap includes many items that could improve efficiency of scheduling and dispatch
- Thirty Minute Operating Reserves
  - Issue paper available November 2008
- Revisit DEC Bid Cap after MRTU implementation?
  - Stakeholder interest associated with wind integration
- *Additional market issues discussed in afternoon session*

# End of Morning

- Lunch



# Operational Needs Assessment

## Beyond 20%

Clyde Loutan  
Senior Advisor, Regional Transmission Engineer

IRRP Stakeholder Meeting  
October 24, 2008

# Future Resource Mix

- Determine the best mix of resources that would be required to provide regulation, load following and ramping needs to meet the higher RPS goals.
  - Speed of delivery of energy
    - Fast ramp
    - Ramp duration
    - Fast Regulation
    - Frequency Responsive Reserve
  - Quick Start Units
  - Multiple start/stop units
  - Resources with Low  $P_{\min}$
  - Resources with regulating capability

# Future Resource Mix

- Methodology
  - The methodology is currently under development (Working with Plexos and PNNL)
  - Build on existing fleet 20% RPS results
  - Coordinate and build upon Nexant study
- Feed into CPUC LTPP

# Future Resource Mix

- Deliverables
  - Recommend potential improvements to existing scheduling timelines
  - Recommend potential improvements to existing reserve procurement, supplemental energy dispatch and regulation algorithms
  - Identify future system requirements which may result in new market products
  - Recommend possibly changes to unit commitment and dispatch strategies
- Timeline
  - Final Report – Q3 2009



# Transmission Planning

Beyond 20%

David Le

Lead Regional Transmission Engineer

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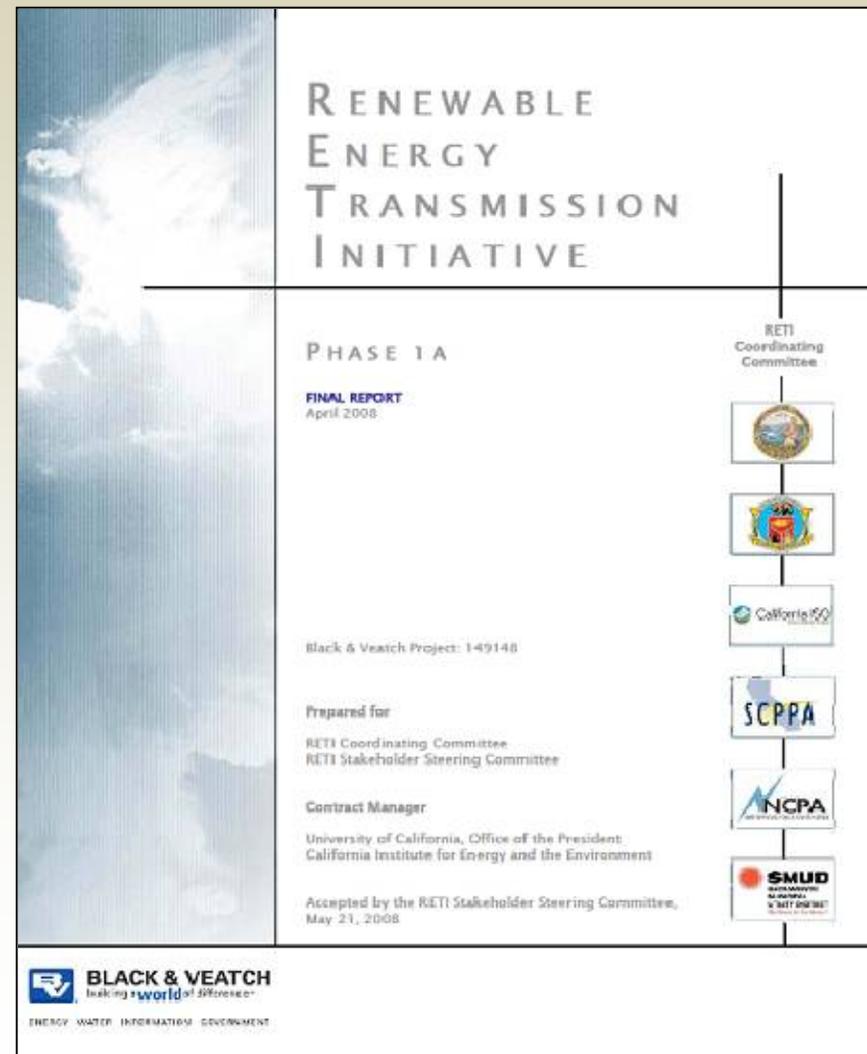
# Transmission Expansion - Coordination Efforts

- RETI
- Western Governors Association
- CPUC - LTPP

# CAISO Coordination with RETI

Utilize RETI forum to:

- Obtain information on priority CREZs
  - Produce conceptual plans for accessing CREZ
  - Coordination with POUs
  - Inputs into CAISO transmission planning process
- ✓ Phase II schedule and work plans currently in development by RETI





# Market Products

Beyond 20%

Udi Helman

Principal, Market and Product Development

IRRP Stakeholder Meeting

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# Market Products beyond 20%

- Over next 2-3 years, more detail on key policy and regulatory drivers of resource mix will be available:
  - Regional renewable development
  - Greenhouse gas policy
    - Cap and trade system? California-only, WCI or national? Electricity-only or multi-sectoral?
  - Once-through cooling
  - Possible changes in Resource Adequacy program and Long-term Procurement Plan
- We will also have more information on
  - MRTU performance
  - Integration of Demand Response and Storage
- Operational assessments of renewable integration will need to be updated on an ongoing basis to inform market needs

# Key Market Design Topics

- Next Generation of Ancillary Services
  - Modifications to existing Ancillary Service Products and Specifications
    - e.g., to support demand response and storage participation
  - Additional Types of Operating Reserve
  - Frequency Responsive Reserves
    - A function of NERC/WECC decisions
  - Fast Regulation
- Future design of Resource Adequacy program
  - Bilateral or Auction Market? Multi-year Forward?
  - Consideration of specific resource capabilities?



# Vision Beyond 20%

David Hawkins  
Lead Renewables Power Engineer

IRRP Stakeholder Meeting  
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# “To 20 Per Cent and Beyond”!!!

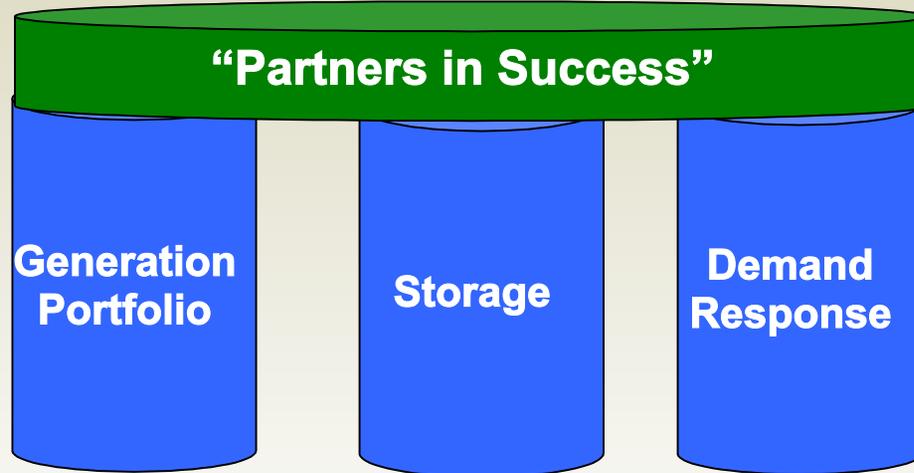


**Wind Generation**



**Solar Generation**

## Resources Required for Renewables Integration



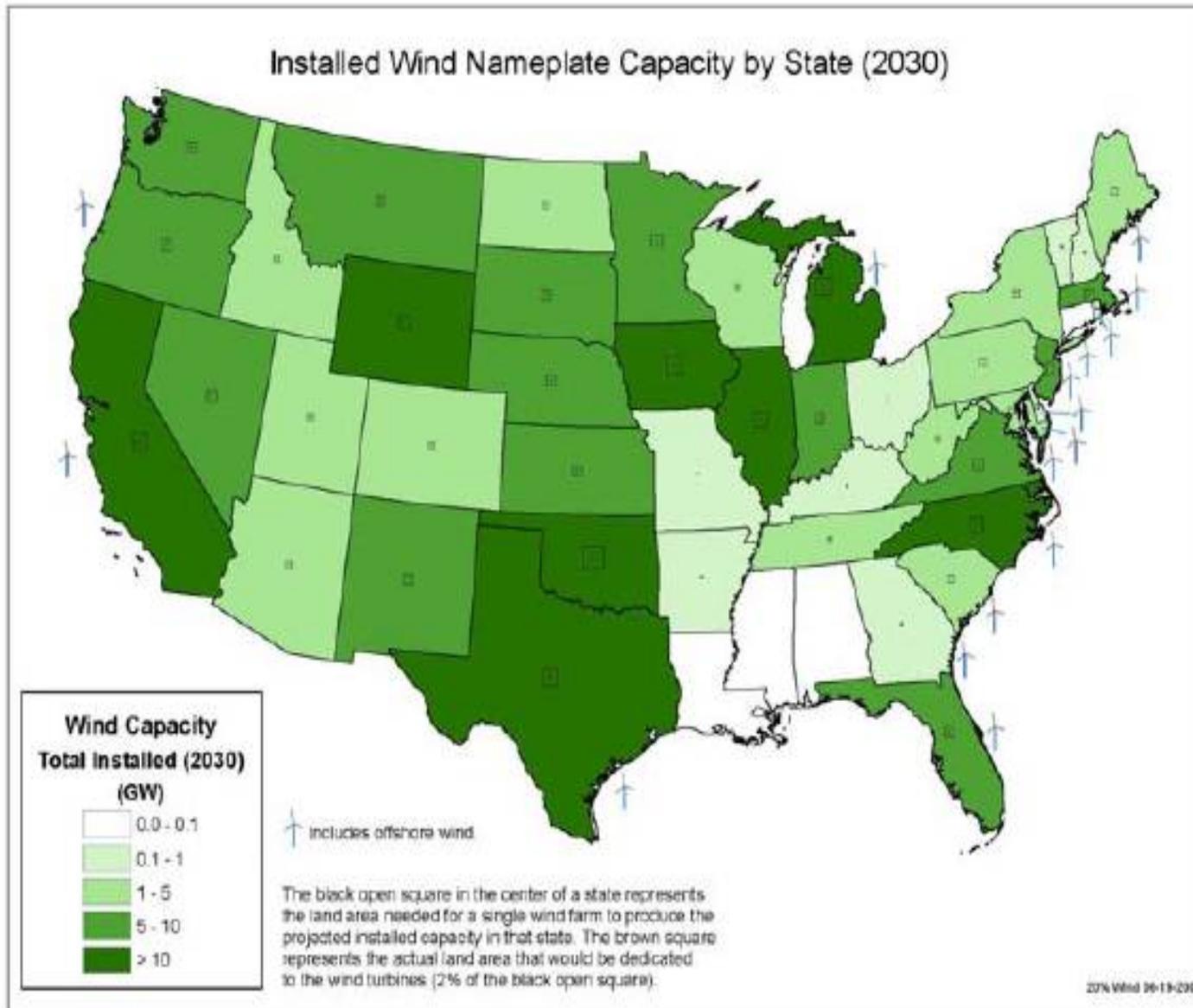
**Hydro Generation**

**Quick Start Units**  
**Fast Ramping**  
**Wider Operating Range (lower  $P_{min}$ )**  
**Regulation capability**

**Shift Energy from off-peak to on-peak**  
**Mitigate Over Generation**  
**Voltage Support**  
**Regulation capability**

**Price sensitive load**  
**Responsive to ISO dispatches**  
**Frequency Responsive**  
**Responsive to Wind Generation Production**

Figure 1-8. 46 states would have substantial wind development by 2030



### Land Requirements

Altogether, new land-based installations would require approximately 50,000 square kilometers (km<sup>2</sup>) of land, yet the actual footprint of land-based turbines and related infrastructure would require only about 1,000 to 2,500 km<sup>2</sup> of dedicated land—slightly less than the area of Rhode Island.

The 20% Wind Scenario envisions 251 GW of land-based and 54 GW of shallow offshore wind capacity to optimize delivered costs, which include both generation and transmission.

## Vision Beyond 20% - how do we integrate large amounts of renewables?

20% is only one milepost on the road for integrating large amounts of renewable resources.

- Changes to Interchange Scheduling
  - New Strategies for reducing barriers between control areas
- Changes to NERC and WECC Standards
- Integration of Storage
- ADI – Ace Diversity Interchange
- R&D

# Potential changes to interchange scheduling

- Today we are limited to block hourly schedules or dynamic interchange schedules.
- Joint project with BPA to explore the concept of scheduling the delivery of wind energy from BPA to CAISO on a 10, 15, 20, or 30 minute basis.
  - Shared regulation burden and potential reduction in regulation
  - Requires information on forecast energy production for the wind plant
  - Requires agreement with SC on how to schedule the energy
  - Needs metrics on how to evaluate results
- ACE Diversity Interchange and ACE sharing between BA's

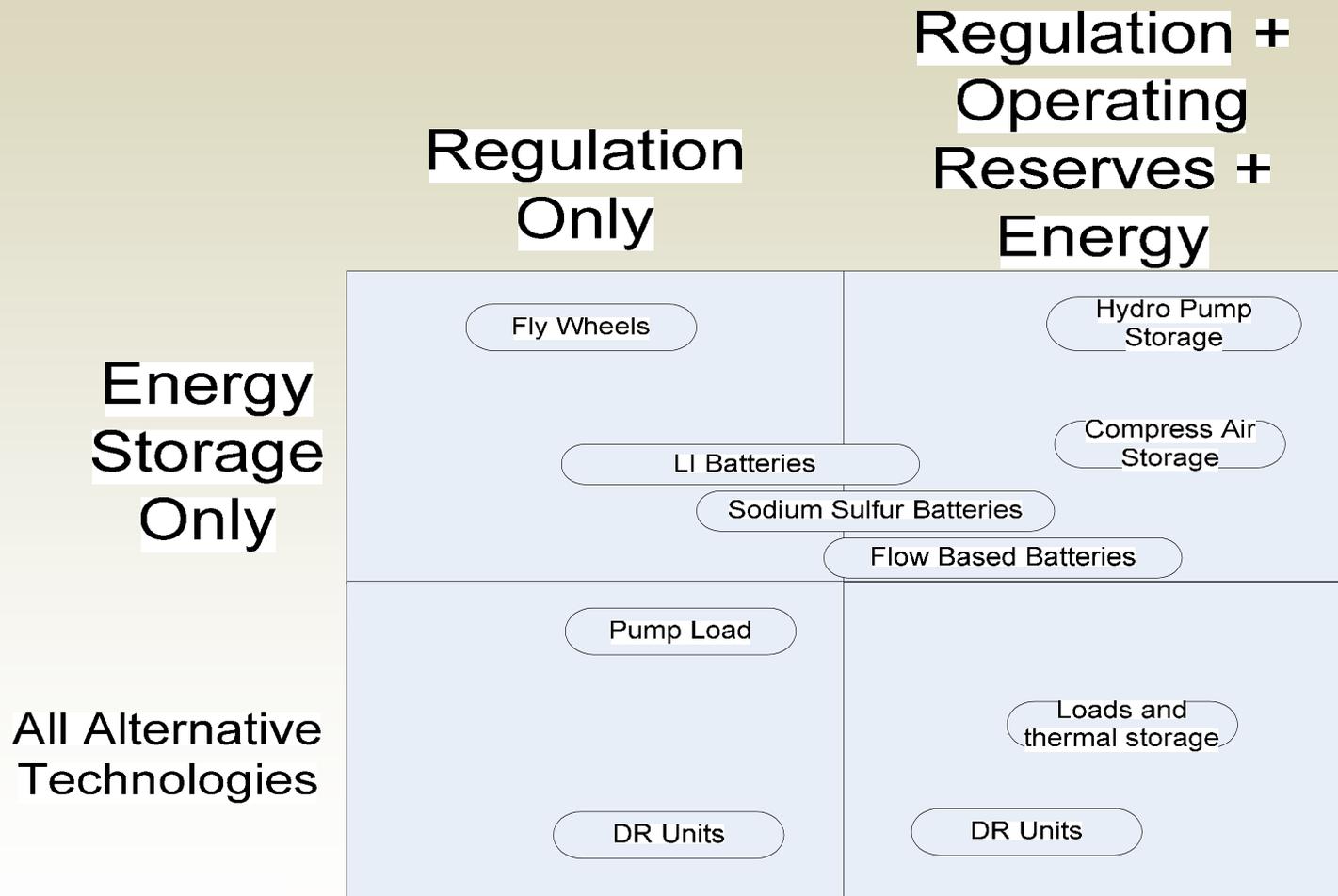
# Changes to NERC and WECC Standards

- Current NERC BAL standards (CPS-1 and CPS-2) require much tighter frequency and interchange controls than most other areas in the world (especially Europe)
- New version of BAL standards 7-11 are being developed and should be available in 2009 for comments and approval
  - These new standards will make it easier to handle the variability of intermittent resources
- Proposed Frequency Response Requirement standard (30 second response) will require new strategies and potentially new capabilities to meet this standard.

# Integration of Energy Storage

- Review of other ISO/RTO implementation of storage
  - Midwest ISO
  - NY ISO
  - ISO-NE
- CAISO discussion paper under development
  - Identification of product need
  - Technical issues
  - Market issues
  - Settlement concerns
- Potential pilot test program

# Identification of Storage Target Market



# Energy Storage

## Potential value of energy storage facilities -- a Control Area Operator's perspective

- Fast response to control signals, frequency response, and automated dispatch commands
- High ramp rates
- High reliability and stability, environmentally friendly
- Easy to start and stop
- Lower cost energy but usually limited energy supply
  - Inconsistent with tariff requirement for min. 1 hour of energy
- Increases the supply of Regulation Services
- Large storage facilities can provide critical night time loads to help balance system

# Energy Storage

- Document issues, barriers, and opportunities for energy storage facilities – rewrite discussion paper
- Internal CAISO review of project plan and timeline
- Installation of a 2 MW LI Battery facility for regulation in October-November 2008
- Develop proposed pilot test of storage facilities for regulation services – potential implementation in Q2 2009
- Discussion of the detailed pilot test plan with Stakeholders

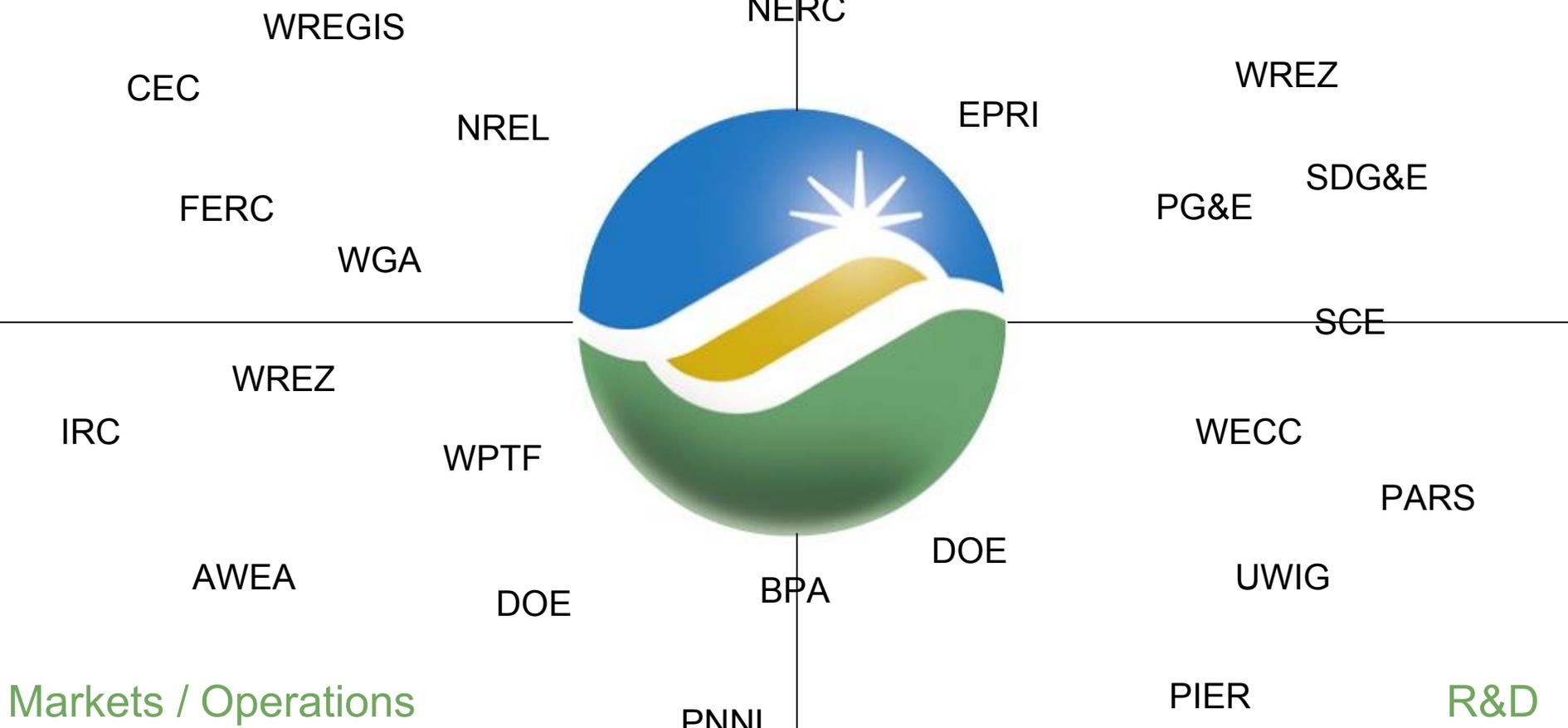
# R&D Projects

- Intelligent Agent project for matching wind generation energy production with available transmission capacity
- Deployment of new technology to predict impact of storm fronts on wind parks and detection of wind sheer
- Use of SynchroPhasor technology to
  - Improve transient stability models of wind farms
  - Measure the damping of the grid and potential increase the dynamic stability limits on key transmission paths (i.e. COI)
- 2009 EPRI Project – Enabling Transmission for Large Scale Renewable Integration
- Critical Operating Constraints Forecasting for Renewables Integration

# Industry Integration

## Policy / Regulation

## Infrastructure



# Next Steps

- Working Groups
  - Storage
  - PIRP Calls
  - Resource Mix Study
  - Market and Policy Issues
  - Other?
- Develop working group processes
- Feedback due November 7<sup>th</sup>
  - Feedback to [jblatchford@caiso.com](mailto:jblatchford@caiso.com)

