



California ISO
Shaping a Renewed Future

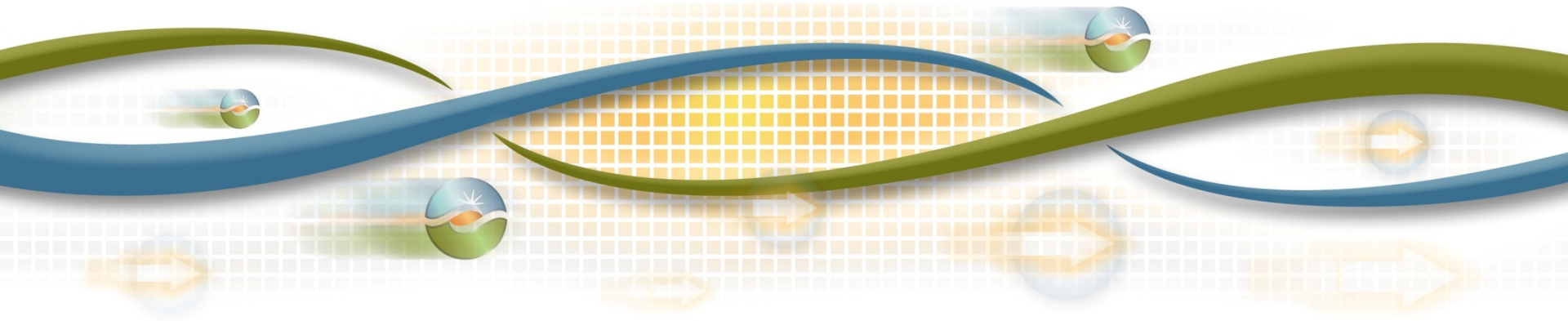
Renewables Integration Study Next Steps

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Prioritization

Study	Priority Assessment	Effort
Stochastic simulations using CAISO-developed model	High	Large
Revisit load and EE/DR assumptions	Med	Medium
Revisit supply side assumptions	Med	Small
Range of hydro conditions	Med	Medium
Review outage rates impacts	Med	Small
Step 1 sensitivity analysis (separate load, wind, solar)	High	Small
Step 1 sensitivity analysis (forecast error)	Med	Small
Step 1 Solar-Thermal Forecast Errors	Med	Medium
5 minute sensitivity	Med	Large
Create a 15-17% PRM Basecase and perform sensitivities	Med	Large
Ramp-rate sensitivities	Med	Medium
Simulate impact of different westwide market timeline	Med	Largest
Evaluate transmission upgrades	Low	Large
Evaluate storage in phase 2	Med	Medium
Evaluate Demand response in phase 2 (Break up the characteristic)	Med	Medium
Evaluate distributions used of regulation and load following requirements	High	Medium
Step 1 30 minute analysis	Med	Large
Remove CO2 price adder for out of state resources	Med	Small
Study impact of sharing and coordination of reserves with other BAAs	High	Medium/Large
Study Helms transmission constraint	Med	Medium

Note: Step 1 sensitivity analysis (separate load, wind, solar) and Evaluate distributions used of regulation and load following requirements can be combined

Renewable Integration Study: Next Steps

Study	Description/Goal	Schedule	Team
Study 1 Stochastic Study	Evaluate a probabilistic analysis approach that will quantify the range and distribution of resource need considering load and resource uncertainties to meet a 1 day in 10 expected outage frequency. (Work would use existing models/tools, such as: RiskSolver, Matlab and GE-MARS, or Plexos)	<ul style="list-style-type: none"> • Nov 17 - Propose work to all parties • Dec 7 - Complete and present initial results for first case • Dec 16 - Complete first case; present results • March 30 - Complete and present results for other cases 	<ul style="list-style-type: none"> • Shucheng Liu – ISO • Kevin Woodruff - TURN • Angela Tanghetti - CEC • Chris Ungson - DRA • Udi Helman - BrightSource • Jack Ellis • Eric Leuze - GenOn • Dariush Shirmohammadi - CalWEA • Brian Theaker - NRG • Robb Anderson - SDG&E • Arne Olson - E3 • Mark Minick - SCE • Michelle Lew, Antonio Alvarez - PG&E • David Miller - CEERT
Study 2 Step 1 Sensitivity	<ol style="list-style-type: none"> 1) Develop range of possible forecast errors and corresponding Step 1 results. (Bookends: CAISO's actual 2010 experience vs. reasonable forecast improvements) 2) Develop representations of Step 1 results for the stochastic or LOLP analysis. (Probability distribution and correlations vs. hourly regulation and LF values for different weather scenarios.) 3) Develop forecast error and step 1 results for multi-hour unit commitment to cover units with start times longer than 1 hour. 	<ul style="list-style-type: none"> • Nov 17 - Propose work to all parties • Dec 7 - Document methodology to develop items 1)-3) • Dec 16 - Complete items 1) - 3) 	<ul style="list-style-type: none"> • Clyde Loutan - ISO • June Xie - ISO • Kevin Woodruff - TURN • Udi Helman - BrightSource • Matt Barmack - Calpine • Daidipya Patwa, Antonio Alvarez - PG&E • Eric Leuze - GenOn • Chris Ungson, Bob Fagan - DRA • Mark Minick, Megan Mao, Aaron Fisherman - SCE
Study 3 15-17% PRM	Understand the drivers of capacity need above the current 15%-17% PRM requirement for the All-Gas Scenario (~20% RPS) under the current methodology.) Drivers identified so far for study are: <ol style="list-style-type: none"> 1) Full contingency reserve requirement, 2) Full regulation and load following requirement, and 3) Resources not available to their full RA or NQC level in high need hours. 	<ul style="list-style-type: none"> • Nov 17 - Propose work to all parties • Dec 7 - Complete deep dive of past All-Gas simulation to understand #3 of work scope by Nov 22 • Dec 16 - Complete the analysis, findings and recommendations 	<ul style="list-style-type: none"> • Shucheng Liu - ISO • Kevin Woodruff - TURN • Matt Barmack - Calpine • Antonio Alvarez - PG&E • Eric Leuze - GenOn • Dariush Shirmohammadi - CalWEA • Chris Ungson, Bob Fagan - DRA • Brian Theaker - NRG • Robb Anderson - SDG&E • Arne Olson - E3 • Mark Minick, Aaron Fisherman - SCE • Keith White - CPUC • Angela Tanghetti - CEC

Renewable Integration Study: Next Steps

Study	Description/Goal	Schedule	Team
<p>Study 4 5-min sensitivity</p>	<p>Validate the findings from hourly simulation using 5-minute simulations in Plexos. Methodology:</p> <ol style="list-style-type: none"> 1) Select a few days with upward ramping deficiency from hourly simulation 2) Load 5-minute inputs, except for load following 3) Add a 5-minute forecast error to load for load, wind and solar forecast uncertainty 	<ul style="list-style-type: none"> • Nov 17 - Propose work to all parties • Dec 7 - Document methodology for validation and gather and enter inputs • Dec 16 - Complete the analysis, findings and recommendations 	<ul style="list-style-type: none"> • Shucheng Liu - ISO • June Xie - ISO • Kevin Woodruff - TURN • Udi Helman - BrightSource • Antonio Alvarez - PG&E • Eric Leuze - GenOn • Dariush Shirmohammadi - CalWEA • Bob Fagan, Rachel Wilson - DRA • Mark Minick, Martin Blagaich - SCE
<p>Study 5 Reserves with other BAAs</p>	<p>Determine to what extent we can count of reserves from neighboring BAs for integration. Proposed work: Run sensitivities to test the impact of the following changes in assumptions:</p> <ul style="list-style-type: none"> • Enforce contingency and flexibility (regulation and load following) reserves for the rest of the west • Honor coal dispatch requirements • Limit exports outside of California to what the advisory group believes is possible • Use the dump power function for converging the simulation (rather than relaxing model constraints) • Run scenarios with increased intra-hour and dynamic scheduling assuming west-wide intra-hourly or dynamic scheduling, making sure to quantify the amount of transmission needed to be set aside for integration 	<ul style="list-style-type: none"> • Nov 17 - Propose work to all parties. Identify all sensitivities of interest • Dec 7 - Document methodology to achieve sensitivities • Dec 16 - Complete the analysis, findings and recommendations 	<ul style="list-style-type: none"> • Mark Rothleder - ISO • Kevin Woodruff - TURN • Jack Ellis • Tom Miller, Antonio Alvarez - PG&E • Eric Leuze - GenOn • Bob Fagan, Rachel Wilson - DRA • Brian Theaker - NRG • Mark Minick, Megan Mao – SCE • Angela Tanghetti - CEC

Study Group 1: Stochastic Simulation

- Purpose
 - To incorporate uncertainties in key input assumptions in determining need for capacity
- Scope
 - May apply to all cases
 - May be used together with Plexos simulation
- Study Approach
 - Loss of Load Probability (LOLP)
 - Others
- Schedule
 - Complete evaluation of methodology and possibility to perform stochastic simulation by the end of the year

Study Group 2: Step 1 Sensitivity

- Purpose:
 - Review and improve representation of variability and forecast error parameters for load/wind/solar being used in the study
- Scope:
 - To estimate Step 1 requirements for use in Plexos simulations or stochastic simulations
- Study Approach:
 - Bracket range of forecast errors for wind and solar (PV and CST) based on past forecast experience and reasonable achievable forecast improvements
 - Where there is little or no forecast experience (PV and CST) use a range based on other studies or industry knowledge of forecast errors
 - Develop a range of forecast errors and corresponding Step 1 inputs to use in Plexos and in stochastic simulations

Study Group 3: 15-17% Planning Reserve Margin (PRM) Case Analysis

- Purpose
 - To understand gaps between resource output and NQC and other key drivers of capacity need from prior studies
- Study Approach
 - Deep-dive analysis of 2020 All-Gas case results
 - Plexos sensitivity cases based on the 2020 All-Gas case
 - 15-17% PRM without AS and load following requirement
 - 15-17% PRM case plus AS requirements
 - 15-17% PRM case plus AS and load following requirements
- Schedule
 - Complete deep-dive analysis in November, 2011
 - Complete sensitivity cases by the end of the year

Study Group 4: 5-minute Production Simulation

- **Purpose**
 - To validate findings from hourly production simulations
- **Scope**
 - Based on 2020 High-Load case
 - Selected days with upward ramping capacity shortage
- **Basic assumptions**
 - Same unit commitment as in hourly simulation
 - No explicit hourly load following requirement
 - 5-min load profiles and 5-min ramping capacity requirement to account for forecast errors of load, wind and solar generation
- **Schedule**
 - Complete simulation in November, 2011

Study Group 5: Reserves with BAA Coordination

- Purpose

The renewable integrations studies to date have assumed existing inter balancing authority area operations:

- Intertie scheduling is predominantly hourly schedules
 - 40% of renewable imports
- Dynamic transfer will accommodate some transfers:
 - Existing dynamic scheduled resources
 - 15% of renewable imports
- Intra-hour schedule (15 minute scheduling)
 - 15% of renewable imports
- Ancillary services provided by existing resources specific system imports.

The renewable integrations studies to date have also assumed:

- Outside of CA, BAAs have no contingency, regulation, or load following requirements

Study Group 5: Reserves with BAA Coordination

- **Proposed Sensitivities:**
 - What if contingency and flexibility requirements are enforced outside of CA
 - What if coal dispatch requirements are also enforced
 - What if increased intra-hour and dynamic scheduling is available west-wide
 - What if dump power function is used for converging the simulation (rather than relaxing model constraints)
 - What if reserves could be shared between CA-BAAs
 - What if reserves could be shared more west-wide
 - Assess export limits
- **Schedule**
 - Complete simulation in November, 2011

Group 6: Develop method for studying alternative to meeting needs

- Purpose:
 - Identify alternatives for potential study (i.e. modifications to existing system to increase flexibility and new capacity)
 - Identify methods of studying alternatives
 - Describe what might be achievable in this case
- Schedule
 - Complete in December, 2011