

## CAISO's Response to Questions for Participants in the 33% Renewables Workshop

The CAISO's study efforts on integration of renewable resources has primarily focused on 20% RPS and what is required to ensure successful operation at this level. Our 33% renewables study commenced in May 2009 and involves a stakeholder advisor group composed of a cross-section of industry representatives (33% Study). The 33% Study will likely have multiple phases and subcomponents. Only phase 1 is ongoing. The CAISO has also engaged several consultants to work with us on the project and we expect to have Phase 1 results published by 4<sup>th</sup> quarter 2009.

### 1. What is/was the purpose and principle research questions of the study?

The CAISO's 33% Study focuses on three areas:

- What transmission facilities are required to both interconnect the new renewable resources and to upgrade the transmission network to handle the additional resources and loads projected for the year 2020? (Phase 1) Are there issues of reactive resources, voltage stability and control, dynamic stability, and short circuit duty,
- What will be the operational characteristics of the new set of renewable resources and the impact on regulation, load following, ramping, and over and under generation? (Phase 1) Based on the operational characteristics of the new set of renewable resources, will there be system control issues? What are the characteristics of the nuclear, thermal and hydro generation fleet that will be required to accommodate the variability of the renewables resources? Phase 2 will look at how large a role will be required for energy storage and demand response resources to complement the generation resources? We expect to have preliminary results from the KEMA study will be available for inclusion in the Phase 1 report and final results available in the Phase 2 report. The detailed models for demand response and storage will be looked at in Phase 2.
- What changes, if any, will be required in the CAISO market system to facilitate the integration of 33% RPS?

### 2. Brief description of methodology/links to documentation

The Phase 2 of the RETI process should produce a proposed transmission plan for 33% RPS that the CAISO will use as an input for creating a more detailed 33% transmission plan.

The CAISO has engaged NEXANT to help with the detailed production costing studies on the various renewable scenarios for Phase 1 of the 33% Study. A detail work flow chart is contained in our presentation material.

### 3. Key drivers

The key drivers are:

- The scenarios that describe the types and amounts of renewable resources that will be added to the system and the years that they will be interconnected.
- Capacity factors for the various types of renewable resources in order to achieve the 75,000 GW-Hrs from renewable resources. Inaccurate capacity factors will either over or under estimate the capacity needed to achieve the amount of energy expected from renewable resources under various portfolio scenarios.
- The types of thermal generation that will be added or retired between the years 2013 and 2020.
- Potential additions of energy storage resources including large pump hydro generation and compressed air energy storage that can shift large amounts of off-peak energy production for delivery of energy during peak load periods and large energy ramp periods.
- Potential load growth of greater than expected due to PHEV or other types of new load.

### 4. Findings and conclusions

We do not have any findings or conclusions to report at this time.

### 5. Uncertainties

There are many uncertainties, including some of those listed under drivers above. The uncertainties and risks will be generally handled by using scenarios analysis.

### 6. Lessons for implementing a higher level of renewable in California by 2020.

To be determined

### 7. Recommendations for further analysis

We anticipate that the examination of requirements to integrate large amounts of renewable resources will be a continuing process over the next several years. The nature of future analyses will likely evolve over time in response to additional information regarding changes in technology and renewable and conventional resource portfolios. One issue for further analysis, for instance, is the interconnection standards for inverter based technology. Solar PV and some wind generation will all use inverters to produce AC power at the interconnection point. Today's standards for inverter performance appear to be very weak on Low Voltage Ride Through requirements, simulated governor response for frequency recovery, and the ability to provide reactive power/voltage control. More research and analysis of inverter technology is required, including the ability to incorporate communication technology into the inverter design for "smart grid" implementation.



8. Input assumptions: matrix for comparing studies
  - a. Load forecast used
  - b. How was the “additional renewables” (amount required for 33 percent renewable energy by 2020) calculated for your study?
  - c. What did you assume for Renewable Portfolio Standard developments in the rest of Western Electricity Coordinating Council (WECC)?, how much fossil generation was added to replace once-through cooling retirements and how much was added to “back-up” intermittent renewable energy in California and the rest of the WECC?
  - d. What major transmission upgrades were included and in what year in California and the rest of WECC?

The CAISO typically coordinates our load forecasts with the CEC load forecasts. The details on the data assumptions for our study will be included in our report that will be produced later this year.