

## **QUESTIONS FOR CAISO AND PNM**

### **SYSTEM STATISTICS**

How much wind is on your system relative to annual peak and annual minimum load?

Where are your wind resources primarily located?

What types and vintages of turbines are deployed in your control area?

### **SYSTEM IMPACTS**

Broadly, how have system operations changed as more wind plants have come on line? How has the demand for regulation, load following and other reserves changed with the introduction of increasing amounts of wind? Have you developed any rules of thumb for the relationship between increased wind penetration and demand for these services?

How are regulation and load following services provided in your control area? What types of generating resources are providing these services? Has this changed over time? Has the rise in natural gas prices affected the sources of ancillary services available, i.e. has wind displaced natural gas-fired generation and created both savings in energy but challenges for integration?

What is the role of hydro in providing balancing capacity in your system? Do fish constraints limit the ability of hydro units to provide these services? Does the CAISO do anything different with respect to balancing capacity during dry years? Are other capacity resources being added in any amount to complement the new wind resources? For PNM, have you purchased or self-supplied your additional (if any) balancing capacity needs?

What has been your experience with the market for regulation and load following services? Can you provide any sense of the costs of such balancing capacity and how it changes over the course of the day/season/year?

How has the uncertainty of wind forecasting errors affected your day-ahead dispatch? Are there times of the day/year when the operating impacts are more severe than at other times? How are wind forecasts used in the day-ahead forecast? What about days where the system is forecast to be especially tight?

How have you integrated wind forecasting into your day-ahead/hour-ahead dispatch and other operational models?

What operational strategies have you adopted to help minimize opportunity costs of uncertainty?

How have costs of wind integration across the different time horizons (day-ahead, regulation and load following) increased or decreased over time on a per-MWh of wind (or other) basis?

## **WIND TURBINE TECHNOLOGY**

Do the newer and larger turbines have fewer/more issues since they appear to have a better power curve and more advanced electronics?

## **FORECASTING**

How have wind forecasting services improved over time and how important are they to system operators?

Are wind forecasts that are used sufficiently accurate to commit sales from wind generation?

To what extent has wind forecasting reduced your balancing capacity requirements?

What have been the strengths and weaknesses of California's PIRP program, including issues regarding wind generation serving loads outside of the ISO control area?

## **CAPACITY VALUE OF WIND**

What is your perspective on the methods being used to assign capacity value to wind projects?

How are wind plants being treated on a planning basis (i.e., are they being included in the capacity tabulation and for planning margin)?

## **GEOGRAPHIC DIVERSITY**

To what extent are the projects in your control area geographically diversified, and how has this geographical diversity impacted the demand for balancing capacity?

## **TRANSMISSION**

Has the uncertainty of wind forecasting resulted in inefficient usage of transmission?

## **MARKET STRUCTURE**

What is your perspective on having a more granular (e.g., 10-minute) marketplace to assist utilities in balancing their systems?

Is the marketplace showing any signs of becoming more volatile (energy and reserves markets) based on the penetration and performance of wind?

If approved, what impact will Frequency Responsive Reserves, which will replace spinning reserves and result in a net decrease in on-line spinning reserves WECC wide, have on wind integration - both operations and costs?

## **ADMINISTRATIVE/PERSONNEL/CULTURE**

How do operators now feel about wind relative to when wind was very new to the system? How have operators changed the way they work in order to better manage the wind on the system?

Have staffing levels risen much to deal with wind integration? In which areas have staffing levels risen to deal with wind integration?

**INFORMATION RESOURCES**

What industry or user groups have you joined, if any, that you find useful?