CAISO Perspective on 33% Renewables and impact on Greenhouse Gas

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Market, Operations and Infrastructure Objectives for 2020

- Reliably and efficiently integrate 33% renewables and have tools and strategies in place for higher levels of renewables in subsequent years.
- Prepare for robust power system, market and operations with increased penetration of distributed resources.
- Increased penetration of renewables coupled with GHG restrictions by 2020 could lead to early retirements of thermal generation.
- Evaluate implications for Resource Adequacy pricing and requirements.

33% Energy from Renewables is a game changer

The 33% RPS goal and other initiatives will require fundamental changes to the power system.

- A significant amount (3000+ MWs) of the new renewable generation will no longer be installed in discrete clusters but could be Distributed Generation and Photovoltaic panels on a million rooftops, backyards and over parking lots.
- The Renewable Electric Transmission Initiative (RETI) has identified 29 Competitive Renewable Energy Zones (CREZ) but there is a significant amount of new generation planned that is not in the CREZ areas.
- It seems clear that substantial amounts of future generation will not be located in clusters but will be spread throughout both the transmission and distribution systems.

33% Energy from Renewables is a game changer

- The elimination of OTC power plants will further disperse generation and potentially reduce the amount of large generation resources close to large load centers.
- New Energy Storage facilities with 5 to 6 hours of energy absorption or delivery and located in strategic areas will be useful.
- Demand Response will provide flexibility in matching loads to available generation resources.
- GHG reduction requirements will put major pressure on elimination of many thermal power plants.

Expected Roles for Gas-Fired Generation in a High-Renewables, Low-GHG-Emissions Electric System

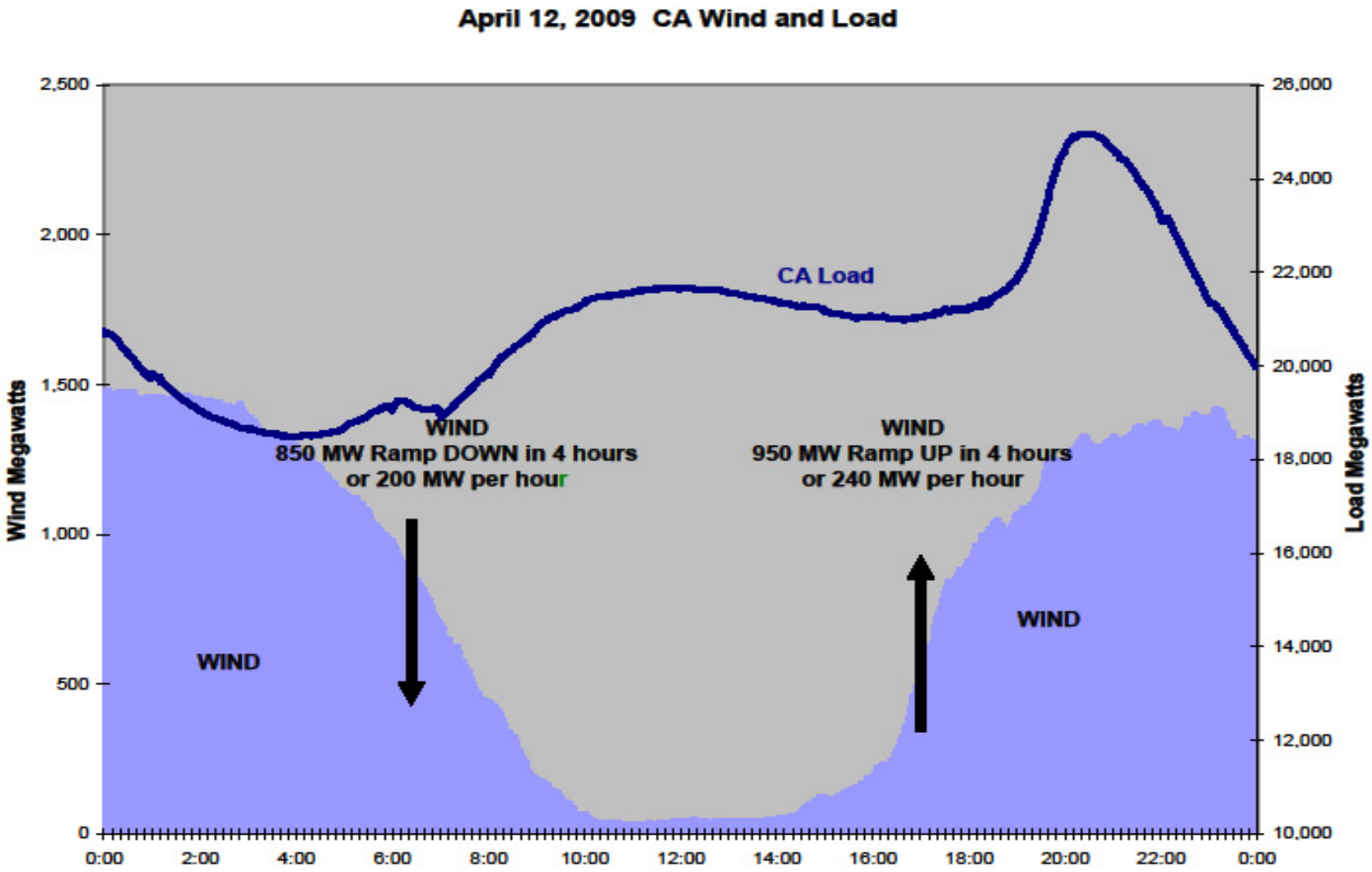
GHG Framework Report identifies 5 roles for new gas-fired power plants

1. "Intermittent Generation Support".

   Provide quick start capability, ramping, Ancillary Services and replacement energy

The number one key role for gas fired thermal plants and for hydro generation resources (when available) will be the ability to quickly start up and ramp up to provide energy to serve load when the intermittent generation resources are ramping down. Thermal plants must also have the ability to be shut down when they are not needed due to excess generation on the system and have the ability to quickly restart without having to wait for 5 to 6 hours. Ramp rates of 10 to 30 MW/Minute will be important.

Today's experience with 3000 MW of wind. For 33% RPS, expect these numbers to increase by 4X for 12,000 MW of wind



GHG Framework Report identifies 5 roles for new gas-fired power plants

2. "Local Capacity Requirements".

   Provide voltage support, transmission loading relief, and potentially black start services in constrained areas

We agree that this will continue to be a key role for both thermal generating plants and potentially for energy storage facilities. For reliability requirements, it is critical to have dispatchable energy resources in transmission constrained areas that can provide dynamic reactive power for voltage support and transmission loading relief. For areas with HVDC lines to the area, local AC generation will be critical for black-start recovery of that area as the AC plant provides the synchronizing signal required for the HVDC terminal.

GHG Framework Report identifies 5 roles for new gas-fired power plants

3. "Grid Operations Support".

   Provide fast start capability, rapid ramping, load following and supplemental energy, Ancillary Services, and Black Start.

33% energy from renewables means that 67% of the energy must be supplied from other resources such as nuclear plants, gas-fired thermal generation, large hydro generation and energy imports. A second key factor is the amount of Dependable Energy that is available to serve peak loads. Historically wind generation can only produce 5% to 8% of its nameplate rating on hot summer peak load days. So 12,000 MW of wind generation will probably provide less than 1,000 MW of energy at the time of the summer peak load hours. Solar generation may have a much higher value for summer peak loads but it is not available for winter peak loads in the 7PM to 9PM periods. So gas-fired thermal generation essential for grid reliability.

GHG Framework Report identifies 5 roles for new gas-fired power plants

4. "Extreme Load / System Emergencies Support".

   Provide fast start capability, rapid ramping, load following, Low Pmin loading levels, Ancillary Services, and Black Start.

Gas-fired peaking power plants that can start-up and synchronize to the system within 10 minutes and provide emergency power have proven to be extremely valuable for ensuring the reliability of the power grid. These simple cycle power plants have great value when they must be called upon but hopefully they do not have to be started very often. They are a critical part of the generation portfolio.

GHG Framework Report identifies 5 roles for new gas-fired power plants

5. "General Energy Support".

   Provide cost competitive energy, meet RA requirements, and limited amount of regulation and spinning reserves.

Combined cycle gas fired thermal power plants that are based loaded units with low heat rates are an essential resource for serving customer loads.