Memorandum

To: ISO Board of Governors

From: Karen Edson, Vice President Policy & Client Services

Date: September 7, 2012

Re: **Briefing on Distributed Energy Resources**

This memorandum does not require Board action.

EXECUTIVE SUMMARY

Distribution-connected resources – including distributed generation, demand-side resources, storage, electric vehicles and other emerging technologies – are changing the landscape of California's electric grid. Many of these changes are driven by consumers themselves, who want more control over where their energy comes from and how they use it. Management is actively supporting these changes, both by enhancing the ISO market to optimize the use of these resources, and by engaging with state policy makers to address the critical linkages needed between the retail and wholesale sides of the industry. Ultimately these emerging new resource types will create a more environmentally sustainable electricity grid that benefits all its users. To get there, several regulatory and technology barriers must be addressed. This memorandum highlights critical barriers and the steps the ISO is taking to address them.

DISCUSSION AND ANALYSIS

Distributed Generation

Various programs and targets are driving the development of distributed generation in California. These include, among others, the California solar initiative,[1] the self-generation incentive program,[2] California zero net energy action plan,[3] and the

[1] State of California, California Energy Commission & California Public Utilities Commission, *Go Solar California*; ONLINE: http://www.gosolarcalifornia.ca.gov/csi/index.php

[2] State of California, California Public Utilities Commissions, Self-Generation Incentive Program; ONLINE: http://www.cpuc.ca.gov/PUC/energy/DistGen/sgip/

[3] State of California, California Public Utilities Commission, Engage 360, *CA Energy Efficiency Strategic Plan, Zero Net Energy Action Plan: Commercial Building Sector 2010 - 2012*: http://www.cpuc.ca.gov/NR/rdonlyres/6C2310FE-AFE0-48E4-AF03-530A99D28FCE/0/ZNEActionPlanFINAL83110.pdf

Governor's call for 12,000 MW of distributed energy by 2020.[4] In contrast to large resources interconnected to the ISO grid, these resources may operate behind a customer meter and typically do not provide real-time operating data to the ISO or participate in the ISO market.

To effectively forecast demand, procure sufficient reserves and balance electricity supply and demand, the ISO needs visibility to assess at any given time the amount and type of generation connected to the distribution system and its production profile. The ISO has established metering and telemetry requirements to provide visibility to those distributed generation resources participating in the ISO market. For those resources not participating in the market, the ISO has defined requirements for visibility that include aggregated by distributed generation type and zip code, the installed nameplate capacity and the hourly aggregated production data to train the forecasting engine. To implement these requirements, the ISO, in concert with load-serving entities, is developing a process to obtain periodic updates on generation interconnections on the distribution system and is identifying options for collecting the hourly aggregated production data. We are also participating in proceedings before the California Public Utilities Commission examining interconnection procedures under the utilities' state tariffs, to develop effective metering requirements to monitor the real-time operational performance of these resources.

The Board has recently authorized the ISO to implement a process to streamline deliverability assessments for the large number of distributed generation projects requesting deliverability status. This process will assess how much local generation can receive resource adequacy status at various locations on the grid without the need for delivery network upgrades or further deliverability studies, and in a manner that does not degrade the deliverability of existing resources or projects in the ISO interconnection queue.[5] The ISO plans to implement this process starting in the fourth quarter of 2012, with the results available to support resource adequacy procurement for the 2014 compliance year. In addition, to support the integration of a larger amount of distributed resource adequacy capacity, the ISO is reviewing its must offer obligations and measurement requirements for these resources and expects to start a stakeholder process later this year. This process will consider any modification to the visibility requirements defined above for resources seeking eligibility to provide resource adequacy capacity.

[4] University of California, Berkeley Law, *California's Transition to Local Renewable Energy: 12,000 Megawatts by 2020*, June 2012: http://www.law.berkeley.edu/files/ccelp/CA_Transition_to_Local_Renewable_Energy.pdf
[5] California ISO Board of Governors, Decision on Resource Adequacy Deliverability for Distributed Generation, May 2012: http://www.caiso.com/Documents/DecisionResourceAdequacyDeliverabilityDistributedGeneration-Memo-May2012.pdf

Demand Response

Greater participation by demand-side resources in the ISO market could assist the integration of variable energy resources and serve as a cost-effective capacity resource. Currently, less than 3 MW is registered to participate in the ISO market out of the over 2,300 MW of capacity available through investor owned utility reliability and price-responsive programs.[6] While the California Department of Water Resources and others bid their pumping facilities into the ISO market, there is no market participation by non-utility demand response providers. Several unresolved regulatory issues contribute to this situation. One crucial open question is whether the ISO's programs comply with rules adopted by the Federal Energy Regulatory Commission for compensating demand response in organized electric markets, which the ISO is challenging in the U.S. Court of Appeals.[7] The same uncertainty has also stalled proceedings at the California Public Utilities Commission that are examining how to allow customers enrolled in retail demand response programs to participate in the ISO market.[8] The ISO is participating in the CPUC proceedings and is engaging in discussions with investor owned utilities and demand response aggregators to address these regulatory barriers.

Another critical barrier to demand response participation in the ISO market is the lack of sufficient revenue opportunities for demand-side resources. Demand response providers have expressed the need for a long-term (3-5 year) forward market for resource adequacy that can support demand-side resources. The PJM Interconnection currently administers a 3-year forward centralized capacity market. Current participation by demand response in the PJM market is over 12,000 MW.[9] In the most recent PJM capacity auction, 14,800 MW was awarded to demand response resources for the 2015-2016 timeframe.[10]

A concern that demand response providers have voiced directly related to the ISO is the cost, complexity, limited number of options and an inability to aggregate data for meeting the ISO's telemetry and metering requirements. The ISO is reviewing its current requirements and additional options that leverage technology advancement to address this concern. We have held small group workshops and expect to launch a larger stakeholder effort later this year.

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[6] As of July 2012, there are four proxy demand resources registered for a total of 2.728 MW. Three resources are pending registration that total 1.051 MW. Proxy demand resources were awarded two trade dates in June with total day-ahead award = 0.62 MW for 5 hours, and total reliability unit commitment award = 0.29 MW for 2 hours.

[7] *Demand Response Compensation in Organized Wholesale Energy Markets* Order No. 745, FERC Stats. & Regs ¶ 31,322 (2011). This matter is now pending before the United States Court of Appeal for the District of Columbia Circuit.

[8] State of California, California Public Utilities Commission Rulemaking 0701041: http://docs.cpuc.ca.gov/PublishedDocs/EFILE/RULINGS/65125.PDF

[9] PJM, 2012 demand response activity report: http://www.pjm.com/markets-and-operations/demand-response/~/media/markets-ops/dsr/2012-dsr-activity-report-20120712.ashx

[10] PJM, 2015/2016 RPM base residual auction results: http://www.pjm.com/markets-and-operations/rpm/~/media/markets-ops/rpm/rpm-auction-info/20120518-2015-16-base-residual-auction-report.ashx

Another important aspect to enabling demand response is the need for coordination between the distribution and transmission system operations. Currently, distribution system operations can dispatch demand response to manage distribution system reliability. If dispatch of these resources is not coordinated, there could be unintended consequences for operations. The ISO is learning about this need through demand response coordination put in place as one of the mitigation measures for the San Onofre Nuclear Generating Station outage.

The ISO does not need the ability to dispatch all demand-side resources for these resources to provide value to the electric grid. Demand can also respond to signals reflecting grid conditions. End-use consumer devices can incorporate the capability to respond in real-time to such signals. In July 2011, the CPUC directed the state's large investor-owned utilities to work with the ISO to develop "a methodology to make wholesale prices available to customers" and to develop a pilot project to "provide price information to customers in real time or near-real time." [11] The ISO has issued a whitepaper proposing a wholesale grid state indicator as a first step to support pilots that will examine the effectiveness of grid status signals to trigger price-responsive real-time demand response.[12]

Energy Storage

Energy storage resources, similar to demand-side resources, have the potential to help the ISO balance supply and demand and integrate renewable resources. The use of pumped storage hydro to balance the electric grid is well established. Recently other forms of energy storage, including compressed air energy storage, battery energy storage, flywheels, and other technologies are gaining traction to participate as grid resources. Energy storage resources will typically be located at a customer's site behind the utility meter and, in most cases, they will interconnect to the distribution grid, which presents challenges comparable to those of distributed generation and demand response.

The ISO plans to implement a "non-generating resource" model this fall to enable energy storage resources to participate in the ISO market. Under this model, the demand mode of the resource will be treated as negative generation when it is charging or consuming power. The ISO is actively engaged in the CPUC proceedings to understand how to facilitate participation by behind-the meter energy storage resources in the ISO market. Two battery projects primarily funded through Department of Energy grants are expected to come on-line and participate in the ISO market this year.[13] Once these batteries are on-line, the ISO will perform extensive simulations to understand

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[11] State of California, California Public Utilities Commission, Decision 11-07-056: http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/140369.pdf

[12] California ISO, June 2012, *White paper proposal, Wholesale Grid State Indicator to Enable Price Responsive Demand*: http://www.caiso.com/Documents/WhitePaperProposal-WholesaleGridStateIndicator-EnablePriceResponsiveDemand.pdf

[13] The two projects including PG&E 2 MW, 7 hour (14 MWh) sodium sulfur (NaS) battery located in Vaca-Dixon and SCE 8 MW, 4 hour (32 MWh) lithium-ion battery located at the Monolith substation in the Tehachapi area.

their operational capabilities and to develop appropriate applications to support business cases for future energy storage investments.

A regulatory issue involving regional reliability standards may also create a constraint on the ability of energy storage resources to participate in the ISO market. Management believes that energy storage resources should have the flexibility to participate in all aspects of the ISO market so long as they meet applicable technical requirements. However, a regional reliability standard adopted by the Western Electric Coordinating Council does not clearly state that energy storage resources may provide both spinning and non-spinning reserve. WECC must obtain FERC approval of its standard, so the ISO will ask FERC in its review of the WECC standard to clarify that all technically qualified resources, including energy storage, may provide both spinning and non-spinning reserves. It is expected that FERC will review this standard by the end of this year.

Similar to demand response providers, energy storage developers have shared concerns about the cost, complexity and limited number of options for meeting the ISO's telemetry and metering requirements. Energy storage is also seeking operating flexibility to support multiple simultaneous uses of their resources. For example, in concept a storage resource could provide both local voltage support and regulation services to the ISO. The ISO is examining technology options to address these concerns, including sub-metering solutions that will allow greater flexibility for energy storage resources to meet requirements necessary to participate in the ISO market.

Electric Vehicles

In March 2012, Governor Brown issued an executive order[14] setting targets for electric vehicle infrastructure readiness to support 1 million zero emission vehicles by 2020, 1.5 million by 2025 and, by 2050, a target reduction of greenhouse gas emissions from the transportation sector to a level 80 percent below 1990 levels. In addition, an April CPUC settlement agreement[15] with NRG will contribute over $100 million to enable a network of electric vehicle charging stations throughout the state. This development requires thoughtful planning in order to link charging practices with grid conditions. For instance, coordinated charging times will help avoid steep ramp conditions on the grid. One way to facilitate managed charging is through price signals. The CPUC alternative-fueled vehicle proceeding[16] in a July 2011 decision[17] affirmed existing electric vehicle rates as sufficient for early electric vehicle market development, and set the stage for review of these rates in 2013. Based on renewable integration studies conducted by

[14] Governor Brown, Executive Order for zero-emission vehicles: http://gov.ca.gov/news.php?id=17463
[15] State of California, California Public Utilities Commission, CPUC Settlement bringing electric vehicle charging infrastructure to California's diverse communities: http://www.cpuc.ca.gov/PUC/hottopics/1Energy/120427_NRG_FERC.htm
[16] State of California, California Public Utilities Commission, alternative-fueled vehicle information: http://www.cpuc.ca.gov/PUC/hottopics/1Energy/090814_ev.htm
[17] State of California, California Public Utilities Commission, rulemaking 09-08-009: http://docs.cpuc.ca.gov/word_pdf/AGENDA_DECISION/139101.pdf

the ISO, the load shape will change significantly and will increase operational needs for flexibility in ramping and load following. It will be important for the CPUC to design electric vehicle rate structures that are consistent with these conditions. Vehicle charging could also be linked to the condition of the grid through a grid state indicator referenced above or a real-time market price signal.

Once a significant number of vehicles with two-way charging capability are available, there will be an opportunity to leverage these vehicles through aggregation as a grid resource. When aggregated, these vehicles will appear to the ISO as an energy storage resource. In addition to the same barriers faced by energy storage resources, the aggregation of electric vehicles is further complicated by the control systems and location management of the vehicles. The ISO is working with the United States Air Force on a vehicle-to-grid pilot that should result in a demonstration that will occur next year. We also are conducting outreach to state policy makers to discuss how to separate vehicle-to-grid capability from the utility retail electric service as a whole to facilitate the participation of electric vehicles in wholesale electric markets.

Microgrid / Virtual Power Plant Configurations

An emerging configuration expected to become more prevalent is a microgrid or virtual power plant configuration. This configuration is a collection of resources including generation, demand response, and energy storage, as well as end-use load that is aggregated and optimized to lower costs, provide energy security, or create additional revenue opportunities. In a microgrid, all resources are co-located to allow the microgrid to separate electrically from the larger grid, if necessary. A virtual power plant on the other hand aggregates resources across a wider region with no ability to separate from the system and typically relies on different sets of resources to participate in an ISO market. The ISO is working with the University of California San Diego Microgrid to better understand how to integrate these configurations into the ISO market.

SUMMARY

There is no question that the future electricity system, which is approaching rapidly, will feature much higher amounts and greater diversity of distributed energy resources, as well as more active participation by energy consumers in managing their sources and uses of energy. The ISO is working to facilitate this future while maintaining the integrity of its core functions, by advancing development of new market products and services, participation rules, technical specifications, and other processes to enable increased interconnection and participation from distributed generation, demand-side resources and emerging technologies on the electric grid. This effort is part of our five-year strategic plan. We believe this effort will benefit users of the electric grid and ensure we maintain grid reliability, efficient wholesale markets and open access as resources and technologies evolve.