



Title of Proposed Initiative:

New Market Structure to Facilitate High-Penetration DR-DER Integration

Investment Areas:

- Technology Demonstration and Deployment
- Market Facilitation

Electricity System Value Chain:

- Grid operations/market design

Issues and Barriers:

The current energy market structure in California under the CAISO Market Redesign and Technology Update (MRTU) has certain limitations for supporting high-penetrations of distributed solar PV, distributed storage and demand-side capabilities. More specifically, the market structure was built around centralized generation and transmission serving load on distribution grid through supply substations. The model has deficiencies dealing with high levels of generation on distribution grid, especially renewable intermittent resources, as well as dealing with distributed storage and demand response. These deficiencies limit economic and grid reliability benefits that can be realized through operational and market integration of distributed clean energy technologies. Significant revenue streams can be created for the owners of distributed clean energy resources if the energy market structure is adjusted to accommodate the high penetrations of such resources.

Initiative Description and Purpose:

This initiative will analyze, develop, and evaluate, in a demonstration project, the concept of Distribution System Operator (DSO) within the context of the CAISO energy market and grid operation. The concept provides for many DSOs, each responsible for a portion of the distribution grid, each connected to the bulk power system (CAISO) at one or more supply substations (CAISO interface points). Each DSO will be responsible for managing, forecasting, and dispatching intra-DSO resources. Each DSO will interact with the ISO similar to a neighboring Balancing Area or a metered subsystem (MSS); reliably and economically serve its native load while maximizing economic benefits to its customers by leveraging its distributed and clean energy resources. By aggregating and netting its supply and demand, the DSO concept can lower many of the existing CAISO and IOU barriers for support of distributed generation (PV) and storage at high-level penetration levels. It also gives the DSO and resource owners greater opportunity to participate in the CAISO energy, ancillary service and balancing markets, and provides new opportunities for creation of localized energy and balancing markets for distributed energy resources.

The estimated funding requirements for this initiative, concept demonstration, and evaluation will be \$1,000,000 to \$3,000,000 USD, with the pilot demonstration project involving a distribution utility, a number of existing distributed clean energy resources, CAISO support, as well as subject matter expertise, resources, and vendor DSO management technology.

Stakeholders:

- A California distribution utility with distribution circuit having existing clean energy resources, e.g., solar PV, at commercial, industrial and/or residential customer sites, and potentially battery or other storage capabilities
- End-use utility customers with clean energy resources
- California ISO - market design, operations, and Demand Response (DR)
- California Public Utilities Commission (CPUC)
- Vendor for data communication and control of Distributed Energy Resources (DER)
- Vendor for DSO management software, distribution grid operation, and required functionality for resource scheduling, optimization, and market operation

Background and the State-of-the-Art:

The initiative requires analysis, development, and evaluation of market structure, as well as operating and business practices for the proposed DSO. The initiative also requires bringing together a diverse set of existing technologies and adopting them for the demonstration and evaluation of the proposed DSO concept. The

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individual base technologies needed for support of the initiative are currently available; however they need to be assembled and integrated, creating a platform for end-to-end demonstration and evaluation of the DSO concepts. Some of the existing research, development, and demonstration capabilities that are relevant and can be used in this project include:

- CAISO DR and DER Integration Roadmap and existing programs
- Energy Imbalance Market initiatives by CAISO/PacifiCorp as well as other entities within Western Electricity Coordinating Council (WECC)
- DOE ARRA Smart Grid demonstration and grant projects at Burbank Water and Power (BWP), Kansas City Power & Light (KCP&L) and at Electric Power Board of Chattanooga (EPB)
- OATI webSmartEnergy suite applications for management of DR and DER, including load forecasting, rooftop and distributed PV generation forecasting, DR-DER availability forecasting, resource aggregation and Virtual Power Plant (VPP) creation, creation of Dispatchable resources including ancillary services and balancing energy from DR-DER. Optimal scheduling and dispatch of demand-side resources, measurement, verification and settlement, among others
- NERC CIP and NIST NISTR Cyber Security requirements
- PJM and ERCOT market experience for DR
- Smart Invertors for residential and commercial solar PV deployments
- Grid integrated energy storage capabilities
- CA CEC and CA utilities' initiatives for integration of demand-side resources

Various elements of the proposed technology have been successfully deployed and tested at different utilities across the North America. This project is focused on development, demonstration, and evaluation of a new energy market structure using these software and hardware technologies. The technology elements are mostly at a commercial scale deployment level; however, the combination of technologies used, their configuration, integration, business, operational, and market rules for their operation, as well as evaluation process, is the subject of this EPIC project.

Justification:

This initiative will lower the technical and operational barriers for higher deployment levels of distributed clean energy resources including solar PV, storage and DR, and will enhance the economics of such resources by facilitating participation of said resources in energy markets for the supply of energy, ancillary services, and balancing services. The beneficiaries are consumers, utilities, and the CAISO. Consumers will receive higher return on clean energy investments via new revenue streams (ISO and DSO and bilateral energy markets, as well as potentially lower rates) and utility incentives (DR programs). Through management of local distributed and DR resources, utilities can manage their load shape and improve system balancing, thus reducing the need for centralized generation and the ISO to provide ancillary services and balancing energy, as well as creating additional flexibility against market price dynamics. For the CAISO, it will reduce operational and technology costs for support of high penetrations of DER and allow for more efficient market operation.

Ratepayer Benefits:

- Promote greater reliability
- Potential energy and cost savings
- Societal benefits
- Environmental benefits - specify
- GHG emissions mitigation/adaptation in the electricity sector at the lowest possible cost

Studies show that proper integration of distributed demand-side resources in California can yield approximately \$800,000 USD Net Present Value (NPV) benefit per each MW of capability (the value is NPV over ten years). This figure represents energy market and grid level benefits and does not include the economic benefits associated with deferred capital investment in distribution and transmission infrastructure, nor does it include the environmental benefits of clean energy resources. The proposed DSO will enable greater levels of distributed resource deployments across the CAISO member utilities as well as other utilities in the state.

Public Utilities Code Sections 740.1 and 8360:

This proposed initiative will address the following elements of the Public Utilities code:

- It increases the value of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid

- It provides for dynamic optimization of grid operations and resources, including appropriate utilization of grid operations and resources with cost-effective full cyber security
- Deployment and integration of cost-effective distributed resources and generation, including renewable resources
- Development and incorporation of cost-effective DR, demand-side resources, and energy-efficient resources
- Deployment of cost-effective smart technologies, including real time, automated, interactive technologies that optimize the physical operation of appliances and consumer devices for metering, communications concerning grid operations and status
- Integration of cost-effective smart appliances and consumer devices
- Provide consumers with timely information and control options
- Identification and lowering of unreasonable or unnecessary barriers to adoption of Smart Grid technologies, practices, and services