



**Title of Proposed Initiative:**

Integration of High-Penetration Clean-Energy Resources in Distribution and Transmission Operations

**Investment Areas:**

- Technology Demonstration and Deployment

**Electricity System Value Chain:**

- Distribution

**Issues and Barriers:**

With high penetration of clean energy resources, operating the power system of today is presenting many new challenges to the system operator. This is true both at the wholesale/bulk power as well as at the Retail/Distribution levels. At the distribution grid level, the increasing numbers of distribution and customer-side solar generation assets, which for the most part are rolled out without any coordinated planning, are impacting the safety and the reliability of the distribution system. In addition, at the retail level and in certain areas, the increasing numbers of plug-in electric vehicles offer additional challenges, as well as opportunities, to the distribution grid operator. At the bulk power level, the increasing proliferation of renewable energy resources such as wind and solar, coupled with their inherent variability and unpredictability, is presenting challenges in provision of balancing energy and ancillary services. The problem is exacerbated by the lack of energy storage capability in the system.

To address the challenges at the bulk power level, regulatory agencies have stepped in by encouraging or mandating the use of customer-side resources, such as Demand Response (DR) and Distributed Energy Resources (DER) for the provision of much needed balancing energy and flexible reserves. At the retail level, distribution grid operators are requiring better visibility to customer side load and generation assets. As such, the use of customer side resources in support of the system operations, both at the transmission and distribution levels, is being seen as the key in addressing many operational challenges. As a result, there are increasing requirements for capabilities to provide visibility and control in the distribution grid, not only at the distribution substation and primary circuit levels, but also at the secondary circuit and at the customer side.

Conventional Distribution Management Systems (DMS) installed today employ tools such as State Estimators and Power Flow Calculators originally developed for the bulk power Energy Management Systems using sophisticated mathematical-based algorithms. These algorithms combine detailed mathematical models of the grid equipment with the limited available real-time telemetry to provide observability into the system. However, at the distribution levels, especially for last mile secondary circuits connecting to the customers, models of the distribution grid may not be readily available. As such, the coverage of most DMS installations is limited to the boundaries of substations and primary feeders and circuits.

Advanced Metering Infrastructures (AMI), on the other hand, provide a wealth of information from the customer side of the equation. The abundance of data combined with topological connectivity information can provide an accurate picture of the distribution grid. This is achieved without a need for employing complex mathematical algorithms or relying on accurate three-phase network models and parameters. In addition, the ubiquitous Internet and Internet based communication technologies, coupled with proliferation of inexpensive gateways and sensors and remote controllable devices, present another opportunity of remote sensing and control. As a part of the proposed project, OATI will demonstrate the capabilities of harvesting AMI data, coupled with telemetry from remote sensing equipment, to present an accurate and consistent picture of the distribution grid all the way from distribution substation to the DER as well as DR resources on the customer side of the meter. Through the control capabilities at the end-customer side, OATI will demonstrate the capability to manage and control such devices. Overall, the improved Supervisory and Control capabilities will facilitate:

- Management and administration of distributed generation resources at the customer level
- Coordinated planning for the installation and roll out of such devices
- The ability for the distribution system operator to employ customer side assets to address distribution grid reliability issues

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- The provision of much needed balancing energy, flexible ramping and other ancillary services in support of overall system operation and to allow integration of renewable/variable energy resources both at the retail and the bulk power/wholesale levels.

#### **Initiative Description and Purpose:**

As a part of the proposed project we will demonstrate how through the incorporation of inexpensive measuring and control devices and employing the public Internet as the primary communication technology, as well as incorporating available data from AMI we can provide the complete visibility to the system operator of the locations and capabilities of these DR and Distributed resources and to provide the capability to manage and to control such devices to address various operational and supply economy issues.

The required level of funding for the proposed demonstration project will be between \$2,000,000 to \$3,000,000 USD.

#### **Stakeholders:**

The proposed project will promote the implementation of DER and allows their incorporation and participation in support of distribution grid, wholesale transmission and generation system, as well as market operations. As such, the stakeholders will primarily include:

- End-use Customer - The project will allow better management and roll out of DER and opens doors for participation of these resources in various operational and economic scenarios thus providing better services to all customers and additional sources of revenues for owners of such assets
- Distribution System Operators - The project will allow complete visibility and control to all distributed assets in the distribution network. Through the improved visibility and control the distribution system operator can better manage the roll out of these assets and will be able to use these assets to deal with distribution grid operations issues such as phase balancing, reduction in losses, system overload and voltage conditions as well as outage management and restoration
- Transmission Grid/Bulk Power generation operations - The Bulk Power system operations will benefit through improved capabilities to forecast and to control distributed assets in the provision of energy, fast ramping, and other ancillary services in support of operations
- Market Operators - The market operator will have more flexible resources that are predictable and viable for the provision of various market products

Overall, the proposed project will help reduce the cost of energy in state of California and will provide better liquidity in energy and Ancillary Service markets.

#### **Background and the State-of-the-Art:**

The proposed demonstration project will leverage OATI's existing webSmartEnergy suite of applications and products as well as OATI GridControl gateway and control devices.

The ARRA funded projects where the proposed technology has been implemented include: (1) Kansas City Power and Light-Green Zone demonstration project, (2) Electricity Power Board of Chattanooga Tennessee, (3) Burbank Water and Power

#### **Justification:**

The proposed project will impact the energy value chain in the state of California from end-use energy customer, to distribution grid operations, to transmission, to Bulk Power operation, ending with wholesale market operations.

Performance improvements will include:

- Management and coordinated deployment of distributed clean energy resources (DR/DER) at the customer level,
- Phase balancing and reduction in grid losses,
- Addressing distribution grid reliability and safety issues and improving quality of service through improved visibility and control of customer side assets,
- Forecasting and scheduling of distributed assets in support of Bulk Power system operations,
- Provision of various flexible market products to wholesale markets.

This research is appropriate for public funding since it has a profound impact on many sectors in the energy industry in California. There are end-use customer benefits from reduction in energy costs in addition to benefits from new opportunities to participate in grid and market operations. The distribution system operator benefits from improved visibility to the grid as well as from access to more resources which improve grid reliability and quality of service. Furthermore, the Bulk Power system operator will benefit through access to a larger pool of resources and assets to deal with imbalance issue resulting from the proliferation of

variable energy resources such as wind and solar at the wholesale level. The energy and ancillary services markets benefit through the increased numbers and availability of flexible resource that will provide better market liquidity and help reduce costs for energy and ancillary services. The project, overall, will help increase the penetration levels of clean and renewable resources both at the wholesale and at the retail levels.

**Ratepayer Benefits:**

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|---|---|
| <input checked="" type="checkbox"/> Promote greater reliability       | <input checked="" type="checkbox"/> GHG emissions mitigation/adaptation in the electricity sector at the lowest possible cost |
| <input checked="" type="checkbox"/> Potential energy and cost savings | <input checked="" type="checkbox"/> Low emission vehicles/transportation  |
| <input checked="" type="checkbox"/> Increased safety                  | <input checked="" type="checkbox"/> Economic development  |
| <input checked="" type="checkbox"/> Societal benefits                 |   |
| <input checked="" type="checkbox"/> Environmental benefits            |   |

The following provide additional detail:

- Promote greater grid reliability - Through the improved visibility and control capability, the distribution grid operator will have more resources and assets at his/her disposal to address overload, and over/under voltage issues. The improved visibility will also allow him/her to better manage the roll out and deployment of distributed assets in the distribution grid
- Potential energy and cost saving - From the point of view of the end-use customer, the capability to earn additional revenues through participation in addressing grid reliability issues or by participating in energy and A/S markets will help offset energy costs. From the overall system and market perspective the capability of customer side distributed generation and DR assets will help reduce the wholesale energy and ancillary service prices which can trickle down to retail levels. Additional benefits will include improved phase balancing and the resulting reduction in system losses
- Increased Safety - Improved visibility to the secondary distribution circuits and customer-side generation equipment directly translate to improvements in safety
- Societal Benefits - The society will benefit through increased penetration of clean and renewable assets, and resulting reduction in greenhouse gas emissions, improved quality of service, energy cost reductions, and customer satisfaction
- Environmental benefits/GHG Emissions Mitigation - The proposed system will facilitate the roll out of customer side clean/renewable/distributed energy resources and will facilitate their incorporation in various aspects of system and market operations and various levels. These clean renewable resources will help reduce reliance on environmentally unfriendly sources of energy and will directly result in reduction in GHG emissions
- Low emission vehicles/transportation - The coverage of the project will include all customer side assets including plug-in electric vehicles. The project will facilitate the scheduling of charge/discharge of charging stations and allow their incorporation, like other customer side resources, in grid and market operation. On a separate project, OATI has already demonstrated the capability to manage vehicle charging stations through OATI products and services
- Economic development - The overall reduction in energy costs resulting from the proposed project will stimulate the economy. In addition, the capability of controlling customer side assets, individually, will create many other new opportunities that will further improve the economy in the state of California.

**Public Utilities Code Sections 740.1 and 8360:**

The proposed project is in line with all the principles articulated in California Public Utilities Code Sections 740.1 and 8360.