DCentrIQ™

Distributed Energy Resource Management Systems

Pulling it all together

Distributed energy resources stand ready to realize their full technical and economic potential with an Internet of Energy (IoE) cloud-based platform that monitors market conditions, aggregates data and automates operating decisions. The technology can benefit off-takers, asset owners and utilities by ensuring the most reliable and least expensive electricity is prioritized from all available energy sources, maximizing financial and operational performance while working in concert with utilities to strengthen and stabilize the grid.

It's a hot, sunny morning at the ACME Office Park. The complex's large solar photovoltaic array is carrying the buildings' electrical load; the battery-based energy storage system is charging; a natural-gas fueled engine generator set waits on standby. As the day progresses, a control system electronically monitors local weather information and tracks the real-time price of energy in the regional independent system operator (ISO) market. At late afternoon, the ISO market price begins to rise sharply, soon surpassing a programmed threshold. Immediately the battery storage system begins discharging, feeding power to the grid. The generator starts, synchronizes with the grid and begins exporting power.

By late evening, the market price has fallen back to normal levels, the generator shuts down and the battery system goes into recharge mode. Meanwhile, the office park ownership group has earned a meaningful profit from sales of kilowatt-hours, enhancing return on investment from the park's hybrid distributed energy resource (DER) system, seamlessly and automatically without operator intervention.

This office park and energy exchange scenario are imaginary, but the technologies that can enable it are real. In fact, this is just one illustration of how DERs can meet their full technical and economic potential through innovative software that integrates on-site power sources, relevant operating data and electric utility grid connections. Besides helping owners operate distributed resources optimally, software-driven technology can facilitate a variety of other benefits that include:

- Support for utility grid stability
- Aggregation of multiple DERs for dispatch as a unit
- Forecasting capability based on weather and market trends

Software and control technology can help infuse the classical centralized utility power system architecture with agile distributed resources that are able to be deployed quickly and economically in response to grid conditions and market pricing signals. It enables an intelligent power distribution ecosystem with mutual benefits for utilities and behind-the-meter customers.

A GROWING ROLE FOR DISTRIBUTED ENERGY

Consideration for distributed energy started to come into conversation in the early '90s as demand for electricity grew and utilities faced constraints on their ability to expand supply. Most notably, competition in power markets made utilities hesitant to invest billions of dollars in new power plants, while public opposition to new transmission and distribution lines delayed their permitting and drove up their costs.

Early distributed energy tended to be diesel or natural-gas fueled combustion engine generators or gas turbines, placed at strategic points within the utility network. Sometimes utility-owned and sometimes hosted by large commercial or industrial customers, these units were dispatched at times of high demand on the grid, helping to forestall construction of central power infrastructure. Utilities have also dealt with high-demand periods through demand response programs in which large customers receive rate incentives to interrupt or curtail loads when directed. More recently, as utilities face Renewable Portfolio Standards and as the costs of wind and solar generation have fallen dramatically, many DERs take the form of renewable energy installations.

Meanwhile, innovations in battery technology, like lithium-ion and flow batteries, have made energy storage more feasible, in turn helping make renewable energy systems more self-sufficient. Today, hybrid DERs – with renewables, energy storage, fuel cells, and engines or turbines – are increasingly common.

In this environment, DER sites are challenged to improve the financial return on investments. On the other hand, utilities are challenged to maintain stable supply, frequency and voltage despite a growing share of intermittent renewable energy sources feeding the grid. Automated control by way of a secure and integrated software platform can provide the link that enables stakeholders on both sides of the meter to meet their key objectives.

SUPERVISORY SOLUTIONS

A critical step in managing DERs is properly integrating the different energy sources and facilitating their connection to the utility grid. To that end, DCentrIQ utilizes DCentrIQ Power Control Hardware that enables different energy sources to work in a synchronized manner, continuously prioritized and optimized.

This modular, scalable energy control platform is designed for commercial, industrial and multi-tenant buildings, especially those located where utility power is unavailable or unreliable, or where there is a high penetration of renewable generation. The system integrates all AC and DC inputs and automatically routes the generated electricity to make use of the most reliable, most cost effective and cleanest power source available at any given time, either into the buildings or out to the grid. Once deployed, the system can be scaled up, scaled down or reconfigured with plug-and-play simplicity to meet changing requirements. The next critical step is a software platform that exerts supervisory control over the DERs and integrates them seamlessly with the utility grid (in grid-tied projects). To serve that objective, DCentrIQ utilizes the DCentrIQ Internet of Energy (IoE) platform. At its most basic level of function, DCentrIQ IoE connects to a distributed energy resource by way of a communication interface and in turn securely connects to a utility or microgrid, to energy markets and to a cloud-based repository of data for analysis. These connections combine to create a smart platform that helps optimize the value of distributed resources.

The DCentrIQ IoE platform can integrate with DCentrIQ's Power Control Hardware, but DCentrIQ IoE is hardware agnostic, able to work with essentially any power management and distribution equipment. It communicates with important data sources, pulling in ISO spot-market pricing, utility rate structures, real-time data on utility energy demand, current weather data and forecasts and other information that can help the distributed resource operate effectively and optimize return. The software also performs advanced analytics on the data to help fine-tune operating strategies going forward.

DCentrIQ IoE moves DERs beyond the traditional role of simply lowering energy bills through demand response, as it creates a portal to energy markets, enabling supply response on demand – the ability to generate revenue by delivering and selling electricity on the spot market when prices are advantageous. To that end, it provides physical and cyber-secure connections to local utilities and regional ISOs, in compliance with NERC Critical Infrastructure Protection (CIP) rules.

Priority 1: Fulfill the internal load without exceeding a preset maximum kW level (demand charge mitigation).

Priority 2: Monitor the ISO energy price and sell excess energy to the grid when that price exceeds $X per MWh.

Priority 3: Monitor the power factor and mitigate if it falls below 0.X (avoiding utility bill power factor charges).

DOOR TO OPPORTUNITY

Supervisory software opens multiple revenue opportunities beyond pure sales of kilowatt hours, and its appeal reaches beyond commercial and industrial enterprises that operate DERs. Investor and consumer-owned utilities are increasingly interested in harnessing distributed energy as part of their grid infrastructure – to improve service, enhance resiliency and provide more value to customers while managing the grid with optimum efficiency. An effective software platform simplifies the management of these often widely scattered assets as they proliferate.

Meanwhile, working in concert with utilities and ISOs, DER owners can receive compensation for providing a variety of grid-support functions, including:

- **Spinning reserve** (an ideal application for battery-based energy storage)
- **Non-spinning reserve** (a natural role for standby engine-driven generation)
- **Frequency regulation** (a strong attribute of lithium-ion batteries)
- **Capacity market participation**
- **Voltage support**
- **Black start assistance**

SECURE MONITORING AND CONTROL

The automation of these transactions means DER operators do not need to become experts in energy markets to maximize revenue. They can simply focus on their core business, monitoring the energy system's performance if they so wish, while receiving a revenue stream and benefiting from utility bill reductions.

The software runs on desktop and laptop computers, as well as mobile devices such as tablets and smartphones. It is compatible with Windows, Linux and OSX operating systems. The user interface for a solar photovoltaic distributed energy resource shows the real-time solar power generation, the energy stored at the site, and the power importing to or exporting from the grid real-time. In addition, real-time pricing of the ISO/utility electricity markets is shown, along with notifications

of monetization opportunities, energy transactions and operational alerts. Users also see their accumulated revenue generated from electricity sales and dollars saved on utility bills.

A cloud service interface lets personnel view the system remotely, in the same way a facility manager working from home might call up a dashboard display for a building automation system. The platform also includes a remote operator interface by which qualified users can troubleshoot, operate and maintain the system from any location.

A security appliance walls the system off from any other control infrastructure the user shares with the local utility. Widely recognized third-party security applications are built into the software platform that meet mission critical cyber security requirements.

The DER dashboard is easy to read and is viewable on all mobile devices, as well as desktop

RICH IN FEATURES

Provides users a wide range of capabilities to efficiently operate systems, document performance and gather information from which to base decisions about refining the distributed resource structure and operations over time. These features include:

Data Storage

A local data store resides on site on an industrial server, while a cloud server has potential to hold system histories and other data from multiple sites.

DER Apps

A variety of applications – such as demand response, ISO energy market and power factor correction – enable users to monetize their distributed resources.

Monitoring

The software can be readily configured to auto detect specific site condition changes and automatically notify the relevant parties.

Operational Reporting

Cloud-server data can be used to generate reports, create user interface tools and perform analytics.

Smart Platform for Maximum Profit

The software platform allows DER operators or utilities to aggregate geographically scattered distributed assets and dispatch them as a unit to meet market needs – in effect several distributed assets function as one virtual power plant.

Cloud Access

Cloud-server data can be used to generate reports, create user interface tools and perform analytics.

Resource Aggregation

The software platform allows DER operators or utilities to aggregate geographically scattered distributed assets and dispatch them as a unit to meet market needs – in effect several distributed assets function as one virtual power plant.

Financial Reporting

A variety of applications – such as demand response, ISO energy market and power factor correction – enable users to monetize their distributed resources.

Hardware Flexibility

The software can be readily configured to auto-detect specific site condition changes and automatically notify the relevant parties.

TOWARD A PROFITABLE FUTURE

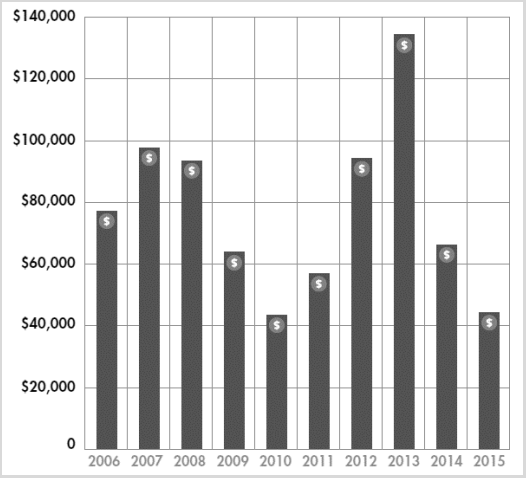
As the electric utility infrastructure changes and evolves, distributed energy resources will play an increasingly important role. Power consumers and utilities alike can benefit from integrated solutions that help maximize power stability, resiliency and affordability. Those solutions include innovative power management technologies controlled by software platforms that simplify operations and enable ongoing optimization strategies driven by distributed energy intelligence.

An Energy Sales Scenario

A scenario based on actual spot-market pricing data from the Alberta Electric System Operator (AESO) in Canada, illustrates how a distributed energy resource operating with the EMS platform could benefit from supply response to demand.

The analysis looks back on 10 years of AESO real-time pricing data and assumes the EMS monitored that pricing in real time, auto-initiating continuous export of 250 kW to the grid during all hours when the AESO energy price exceeded $0.10 per kWh.

250 kW E-Market Sales > 10 Cents / kWh



The accompanying graph shows that from 2006 through 2015, cash generated from selling electricity whenever the wholesale energy price exceeded $.10 per kWh was on average $76,000 per year.

This hypothetical but realistic scenario demonstrates the value of using a software platform to help a distributed energy installation generate revenue and maximize return on investment.