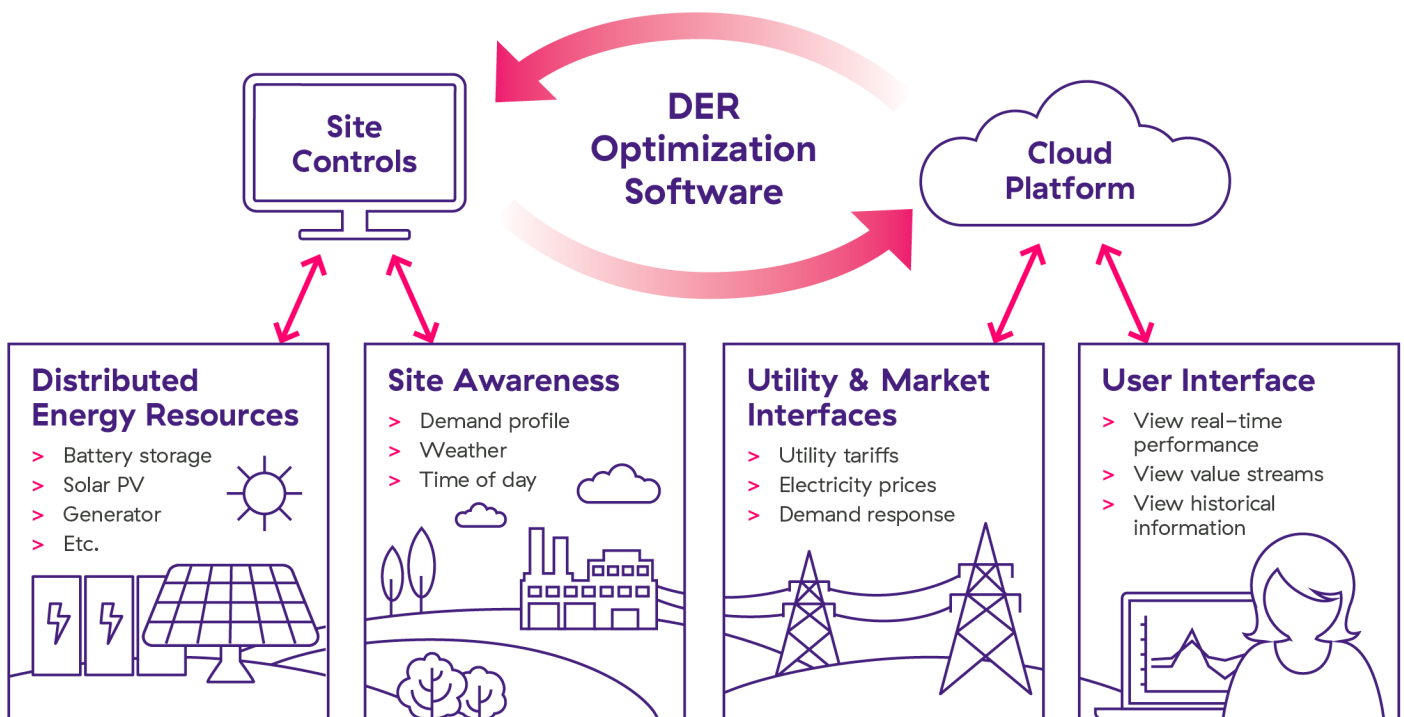


# DER Optimization Software

## Solar + Storage Fact Sheet

Enel X's DER Optimization Software (DER.OS) is a scalable management software system delivered to maximize the economic value of an energy storage system. DER.OS enables users to monitor, communicate with, and control their energy network. The system interfaces with battery energy storage and other distributed energy resources to monitor energy usage and production in real time. It is comprised of two components, one cloud-based and one site-based, that interface with other software systems and hardware devices in a holistic energy management ecosphere.





Enel X’s DER.OS user interface displays customer savings by recreating bills before and after solar-plus-storage. DER.OS provides customers and solar partners with value stacking, operations enablement, and flexible hardware integration.

### Value Stacking

DER.OS determines the optimal battery dispatch strategy using sophisticated machine learning forecasts while factoring in various revenue streams, tariffs, and incentives.

- > Bill Savings & Tariff Management
- > Solar self-consumption
- > Grid Revenue Generation
- > Incentive Capture

### Operations Enablement

Through detailed, data-based monitoring of assets, the DER.OS platform contains comprehensive customer-facing financial reporting and real-time alerting of operational issues.

- > Financial Reporting
- > Asset Management
- > Monitoring
- > Alerting

### Hardware Platform

Enel X provides both the battery energy storage system (BESS) hardware and the Enel X Site Controller. The evolving Approved Vendor List (AVL) includes industry-leading BESS models, revenue grade metering, multiple PV inverter models, and flexible communications network compatibility.

- > BESS Hardware and site controller
- > Metering
- > PV Inverter Compatibility
- > Network Requirements

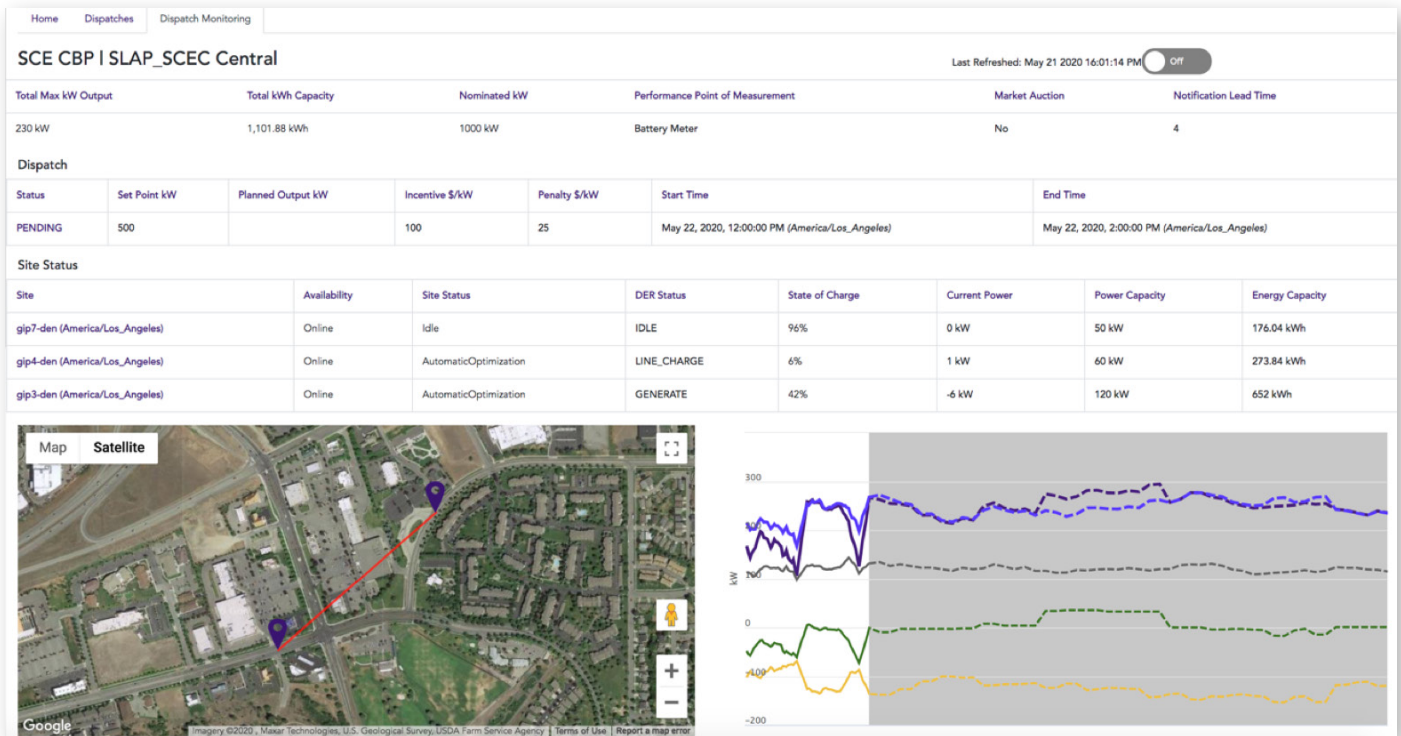
# Value Stacking

## Bill Savings/Tariff Management

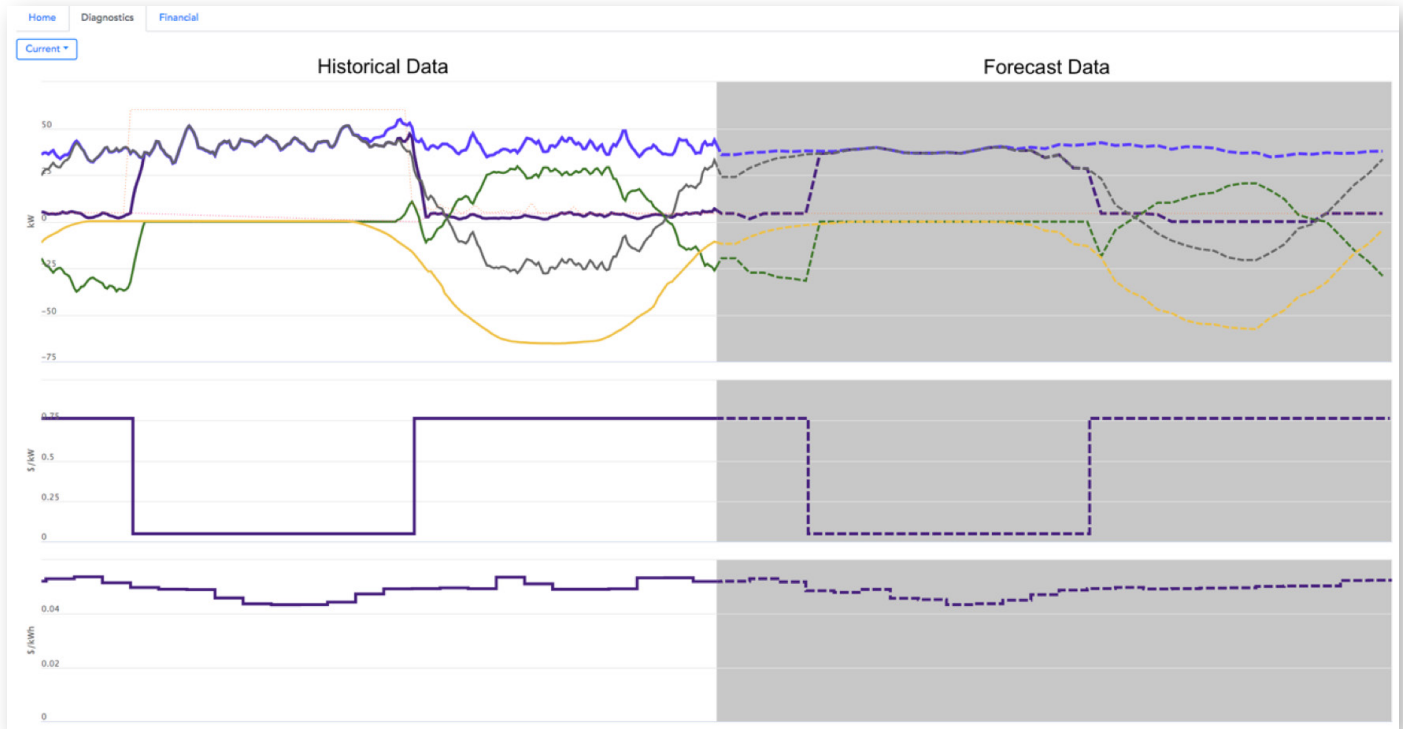
DER.OS operates continuously to minimize the overall system cost and maximize the system’s economic value. The software accomplishes this objective using highly accurate machine-learning forecasting algorithms that incorporate both recent historical demand data and weather forecast inputs to predict the future building load and solar generation. With this data, DER.OS can create an optimal BESS discharge and charge strategy. The software primarily aims to decrease demand charges and capitalize on energy arbitrage opportunities, while also accounting for solar self-consumption, battery degradation, and other operational constraints.

## Grid Revenue Generation

DER.OS enables storage systems to capture revenue from many different grid services programs, such as demand response, operating reserves, and other market opportunities. DER.OS typically operates using fully automated dispatches, but can also be controlled through manual dispatches if necessary. Enel X’s experienced operations team monitors battery performance 24/7 in its Network Operations Center (NOC) in the event that a manual dispatch is required. When dispatched, DER.OS co-optimizes grid service opportunities with the other value streams such as bill savings and incentive compliance.



DER.OS Dispatch Management Tool



DER.OS Forecasting and ITC Compliance

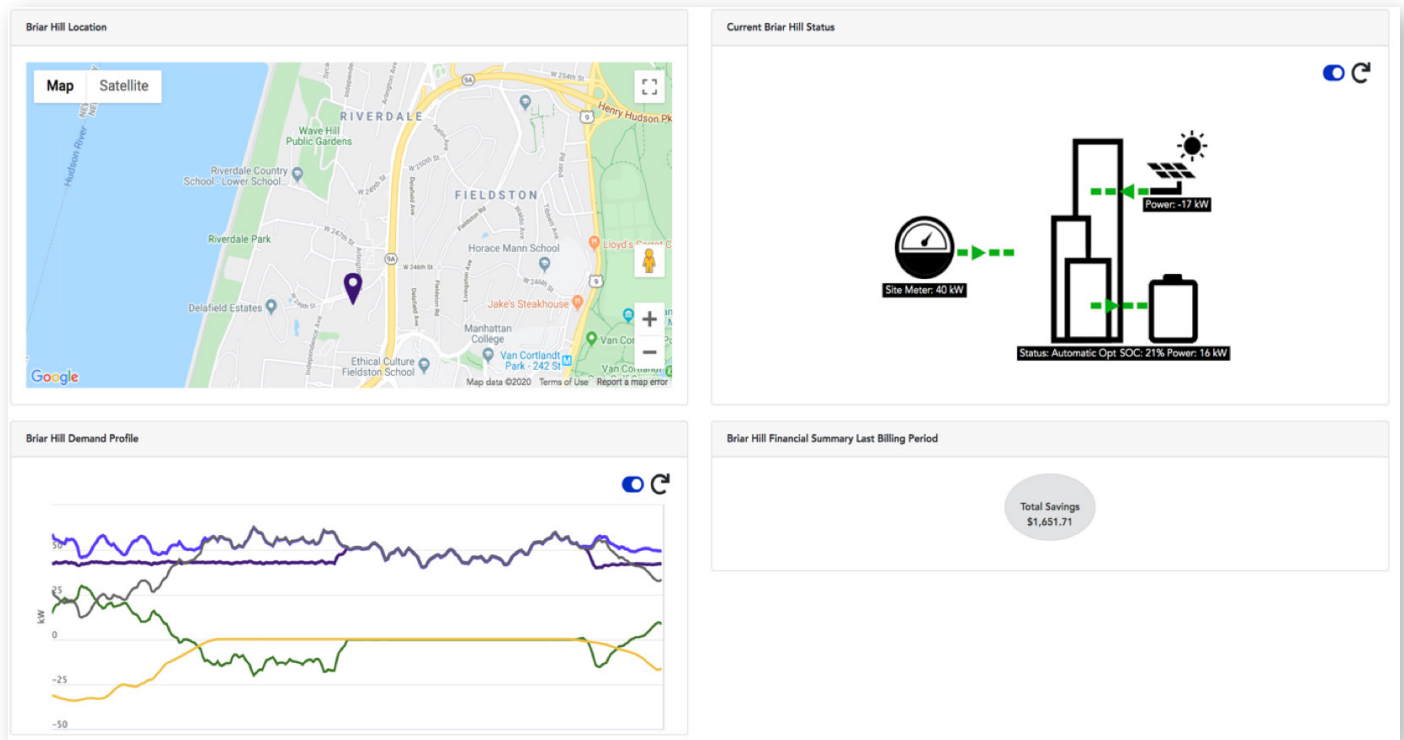
## Federal Incentives

Projects that receive federal incentives, such as the Investment Tax Credit (ITC), are required to be charged 100% from solar generation to receive the maximum possible ITC incentive. DER.OS can be configured to charge 100% from solar and has redundant systems to ensure compliance. Through load, weather and solar forecasts, as shown below, DER.OS continuously optimizes the control of the DERs to maximize delivery of the ITC incentive.

## State Incentives

DER.OS also has the ability to layer state incentive programs into the value stack, where applicable. For example, DER.OS ensures that systems in Massachusetts enrolled in the Solar Massachusetts Renewable Target (SMART) program or systems in California enrolled in the Self Generation Incentive Program (SGIP) properly comply with yearly cycling requirements. In addition, DER.OS is flexibly designed to ensure any incremental program benefits and requirements will be captured, such as the SGIP greenhouse gas (GHG) emission reduction and performance-based incentive.

# Operations Enablement



DER.OS Site Dashboard

## Financial Reporting

DER.OS uses tariff information and 5-minute interval data collected from Site, BESS, and PV meters to calculate the bill savings in a "before" and "after" bill comparison, including showing any savings realized by having a lower energy charge via a cheaper solar Power Purchase Agreement (PPA). DER.OS disaggregates the savings by source, including Rate Switch Savings, Solar Savings, and Storage Savings. Additional customized reports can be discussed with Enel X's Asset Management team to meet customer needs.

## Monitoring & Asset Management

DER.OS includes a suite of tools that Enel X's operations teams use internally to efficiently monitor and manage the system, including detailed tariff and configuration management interfaces and data visualization of load data.

The system is also capable of performing basic solar monitoring and reporting of photovoltaic (PV) meter data. DER.OS collects this meter data for control, optimization, and performance reporting and is available for visualization on the DER.OS User Interface (UI). The required DER.OS metering is typically installed in addition to a dedicated PV monitoring system, for example where additional monitoring is required for Tax Equity purposes or for investor reporting.

## Alerting

DER.OS has an evolving list of alerting capabilities to notify the Enel X operations teams of issues. Example alerts include any abnormal changes in savings, BESS malfunction alarms, data gaps, and solar ITC violations. Enel X Network Operations Center is remotely capable of diagnosing and troubleshooting any warnings and alarms, and if necessary can send a technician to the site.

## Data Accessibility

Data collected by the Enel X Site Controller are stored locally for control and redundancy, as well as sent to the cloud for continued accessibility and lifetime data storage. DER.OS stores 5 minute data for all configured parameters for each device. Stored data points can be exported to .csv files for use outside of the DER.OS platform.



*Enel X Network Operations Center Headquarters, Boston, MA, USA*

Data Point Name	Description	Device Availability	Displayed on DER.OS UI device tab	Displayed on DER.OS UI dashboards
<b>5-minute demand</b>	Average power of the 5 minute interval	Meters, BESS, PV	Yes	No
<b>30-minute demand</b>	Average power of the previous rolling 30 minute interval	Meters, BESS, PV	Yes	Yes
<b>power</b>	Instantaneous power sampled every 5 minutes	Meters, BESS, PV	Yes	Yes
<b>energyImported</b>	Accumulated energy imported	Meters, BESS, PV	Site Meter only	No
<b>energyExported</b>	Accumulated energy exported	Meters, BESS, PV	Site Meter only	No
<b>voltage</b>	Three-phase average line-line voltage	Meters, BESS, PV	Yes	No
<b>current</b>	Average three-phase current	Meters, BESS, PV	Yes	No
<b>power factor</b>	Power factor	Meters, BESS, PV	Yes	No
<b>SOC</b>	BESS state of charge	BESS	Yes	Yes



# Hardware Platform

## Metering

For DER.OS to function properly, a revenue grade meter must be installed to monitor the power flow of each energy asset. As a result, all DER.OS solar-plus-storage projects require an Enel X approved meter on both the PV and BESS systems. Enel X has a current approved vendor list (AVL) and continues to work with partners on expanding this list.

## PV Inverter Compatibility

DER.OS must be used with compatible devices when communication or control of the devices is required. For a solar-plus-storage project, DER.OS requires the site meter, BESS and PV meter to be sourced from the Enel X AVL. In addition, if PV curtailment is required, then the PV inverter also must be from the Enel X AVL.

## Network Requirements

DER.OS requires an internet connection to connect the site devices to the DER.OS cloud. Internet communication requirements are flexible to meet project needs, including options for Enel X supplied internet or customer supplied internet. The standard option is for Enel X to supply an internet modem. If a customer prefers to supply their own internet, Enel X's project engineers can work with the customer to create a custom solution.

## Interconnection Approach

Interconnection requirements vary by project and by region. The Enel X field engineering team has extensive experience in interconnection and can recommend the most effective approach to achieving interconnection success. Enel X will review partners' BESS interconnection applications and provide feedback for the most efficient and effective process.

## Ongoing O&M

Enel X operations and maintenance services include: 24/7 monitoring from the network operations center (NOC), DER.OS SaaS Optimization Software, network

support and operations services, communication services, warranty services, and preventative and corrective maintenance plans in accordance with original equipment manufacturer (OEM) requirements. Enel X consistently syncs operational data locally and through the cloud platform so that customers can view real-time operational data in the web-based DER.OS platform. Various O&M reports and communications are available to customers tracking uptime, performance, and maintenance activity.

## Sites with Existing (non-Enel X Owned) Solar on Site

Enel X supports a wide variety of configurations, including compatibility with existing solar and other assets (fuel cells, generators, etc.). Metering and/or direct connection to the solar controls will allow the DER.OS system to monitor and, if needed, control or curtail solar operation. The ease of integration depends on whether the existing system's components are currently included in Enel X's AVL or compatible with other relevant specifications. Even in cases where the ITC does not pose a constraint on system operations, Enel X prefers to monitor the site's existing solar production so that DER.OS can better optimize system performance and take into account the solar impact on site load. In addition, visibility into the PV performance improves the ability of DER.OS to accurately forecast site load, which is a critical input in the underlying algorithm.

	Site has Enel X approved meter	Site has Enel X approved meter & PV inverter
PV monitoring	✓	✓
PV control (curtailment)		✓
PV microgrid		✓