Microgrid (IEC)

Optimize Your Microgrid Operations to Improve Energy Usage

EcoStruxure Power Digital Application

EcoStruxure™ Power

Schneider Electric

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Overview

Context of Application

As electrical grid ages in many parts of the world, and environmental factors such as natural disasters and storms threaten grid reliability, distributed energy resources are growing in popularity. Managing multiple sources of energy production can be complex, especially when it comes to making optimal decisions to produce locally generated energy compared to consuming grid energy in the event that grid stability is at risk. Distributed energy resources also offer an opportunity to reduce energy costs and improve the sustainability of an organization.

Problem to Solve

Microgrid facility operators need to:

- Enhance electrical system reliability in the face of grid instability and constraints, partially due to an increasing occurrence of powerful storms.

- Enable optimal energy usage and cost efficiency, leveraging distributed energy resources to reduce, reuse, and optimize energy consumption.

- Enable the optimized use of renewable resources including solar photovoltaics, fuel cells, natural gas generators, and combined heat and power systems.

Purpose of the Application

Improve resilience

Helps protect against extreme weather, cyberattacks, and grid instability to avoid costly downtime.

Help reduce risk

Enables control of financial and operational risks thanks to best-in-class strategic partners which provide Energy-as-a-Service (EaaS) with flexible governance models.

Optimize energy

Seamlessly integrate your Distributed Energy Resources (DERs) and be empowered with actionable insights on when to consume, store, and sell energy for the greatest financial advantage.

Increase sustainability

Easily quantify your carbon reduction efforts, meet your sustainability goals, and become a leader in the new energy landscape.
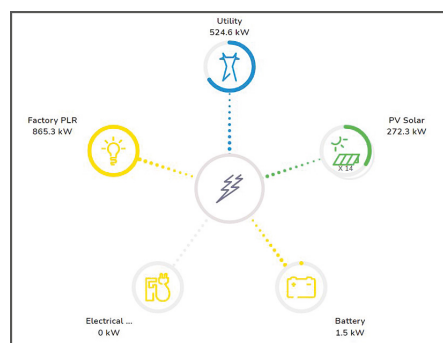

Microgrid System

Application Outcomes

Live Data Display

High-performance, real-time visualization of animated single-line diagrams provides situational awareness of the state of the power system from anywhere, and allows operators - with the proper credentials - to control it remotely. It displays information coming from the EcoStruxure Microgrid Operation controller including machine status, notifications, power flows, switch status, etc.
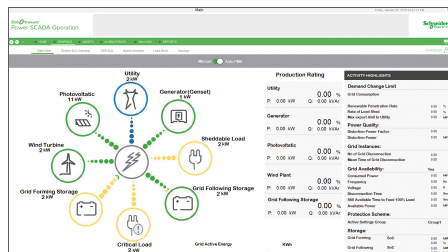
EcoStruxure Microgrid Operation Distributed Energy Resources Overview
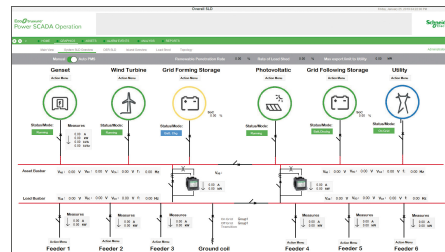
EcoStruxure Microgrid Operation Live Data Display

Events and Alarms

Alarms and sequences of events related to management of distributed energy resources and the microgrid's electrical distribution can be displayed in EcoStruxure Microgrid Operation Human Machine Interface (HMI).

Trends

Historical and live electrical data can be displayed as trends in EcoStruxure Microgrid Operation and Microgrid Advisor. With Microgrid Advisor, trended data can also be forecasted to support decision making on when to use or produce energy.

Reports

Comprehensive microgrid power system reporting is available with EcoStruxure Power Monitoring Expert integrated with EcoStruxure Microgrid Operation HMI.

Notifications

Notifications of power system events can be automatically sent by SMS or email to appropriate personnel.

Cloud-based Analytics and Services

Cloud-based EcoStruxure Microgrid Advisor aggregates data from EcoStruxure Microgrid Operation as well as other inputs, including energy pricing and weather data, to define the optimal time to consume or produce energy from DERs. Control commands can be relayed back to the on-site controller to initiate actions automatically.
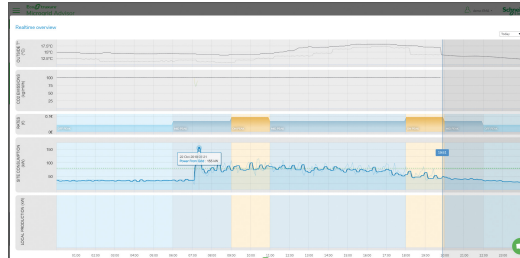
EcoStruxure Microgrid Advisor Real-time and Forecast Data
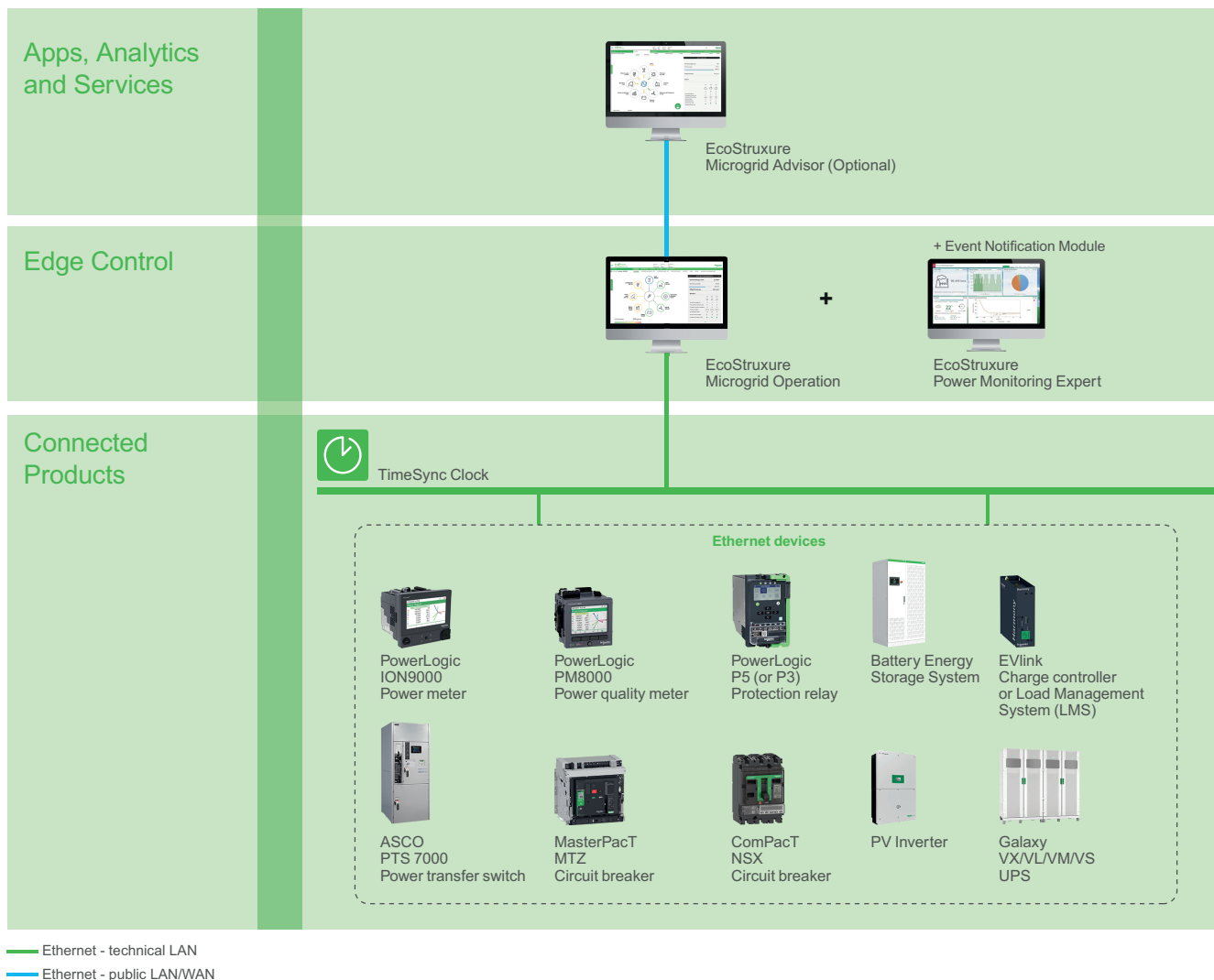
Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Microgrid application:

* DSB = Distribution Switchboard
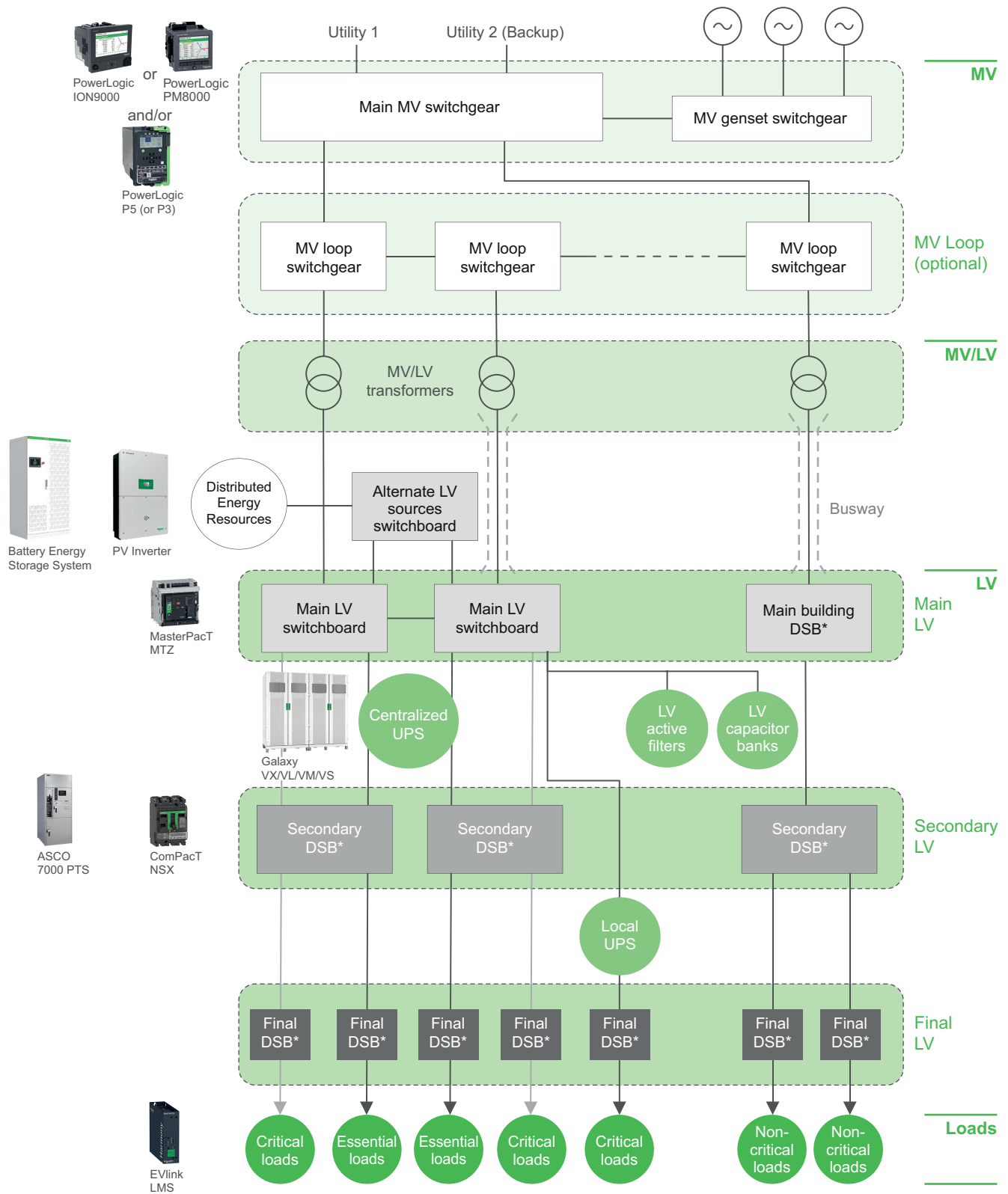
Digital Architecture

The digital architecture of the Microgrid application involves collecting the input data from the different products, either directly over Ethernet or via gateways. This data is then used by the Edge Control software (EcoStruxure Microgrid Operation with optional integration of EcoStruxure Power Monitoring Expert) for on-premise visualization, analysis, reporting, and control. Data can also be utilized by EcoStruxure Microgrid Advisor for advanced optimization and control.
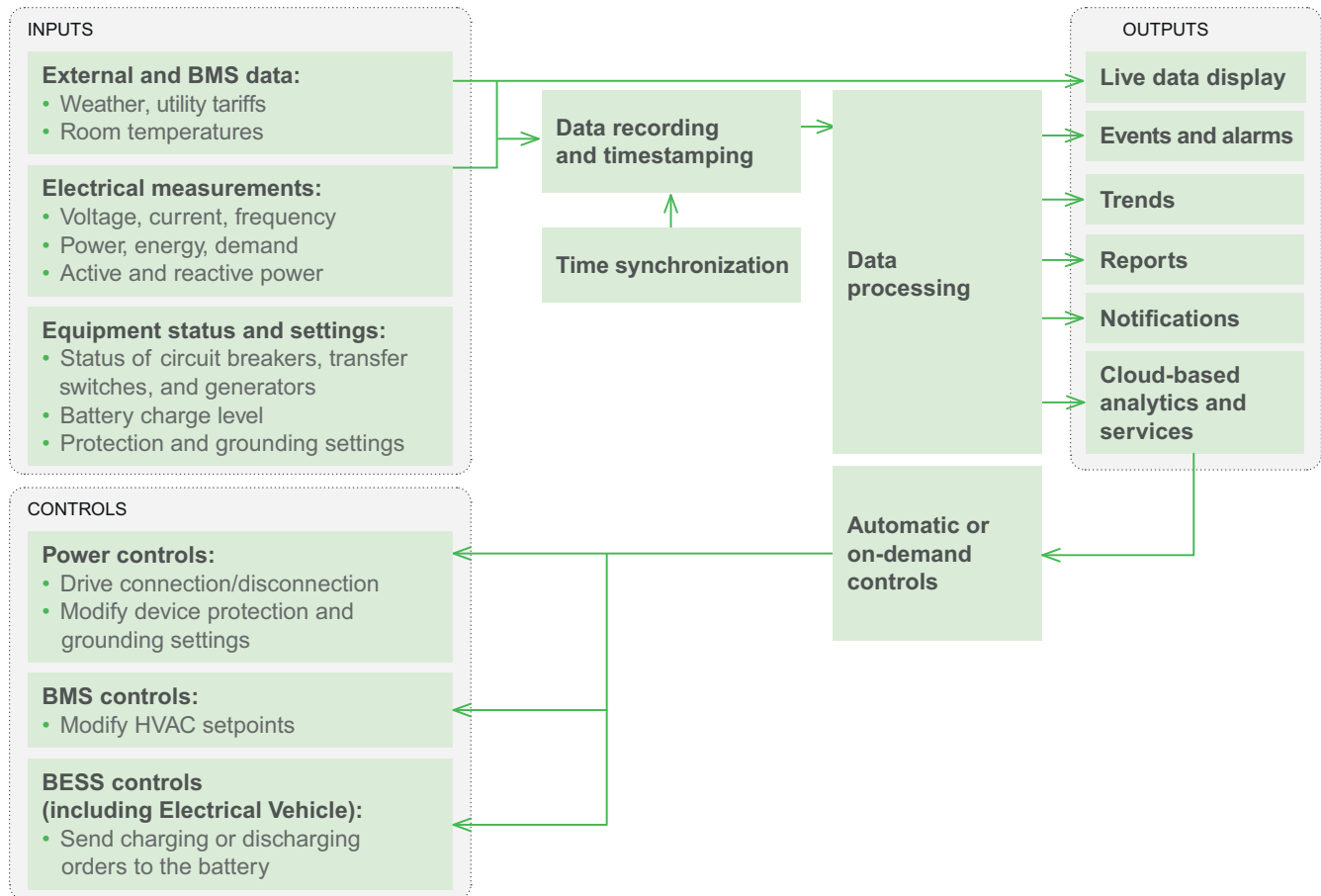
A microgrid can integrate one of those two control solutions or both depending on the customer requirements. The recommended digital architecture for the application is shown below:

Apps, Analytics and Services

EcoStruxure
Microgrid Advisor (Optional)

Edge Control

EcoStruxure
Microgrid Operation

+

+ Event Notification Module

EcoStruxure
Power Monitoring Expert

Connected Products

TimeSync Clock

Ethernet devices

PowerLogic
ION9000
Power meter

PowerLogic
PM8000
Power quality meter

PowerLogic
P5 (or P3)
Protection relay

Battery Energy
Storage System

EVlink
Charge controller
or Load Management
System (LMS)

ASCO
PTS 7000
Power transfer switch

MasterPacT
MTZ
Circuit breaker

ComPacT
NSX
Circuit breaker

PV Inverter

Galaxy
VX/VL/VM/VS
UPS

— Ethernet - technical LAN
— Ethernet - public LAN/WAN

System Description

Data Flow

The Microgrid application can be broken down as follows:

Inputs

The following data is required:

External and Building Management System (BMS) Data

External data inputs can be supplied to the system to guide energy production and the consumption strategy:

- Weather forecasts
- Utility pricing rules

BMS-related data can also influence the microgrid management strategy:

- HVAC status
- Acceptable room temperature

Electrical Measurements

Connected products required to implement a microgrid solution can vary based on the project site, size, and types of Distributed Energy Resources (DERs) utilized to achieve the application goals.

Typical connected products include:

- **Energy/power meters**, such as PowerLogic ION9000

PowerLogic
ION9000

- **Protection relays**, such as PowerLogic P5/P3

PowerLogic
P5

PowerLogic
P3

- **Circuit breakers**, such as MasterPacT MTZ, ComPacT NSX

MasterPacT
MTZ

ComPacT
NSX

The following electrical measurements can be collected:

- Voltage, current, frequency
- Power, energy, demand
- Active and reactive power

Equipment Status and Settings

- Open/closed position of circuit breakers
- Operating mode of transfer switches such as ASCO 7000 Series PTS
- Battery charge level
- Generator status
- Active protection and grounding settings

ASCO
7000 Series
PTS

Battery Energy
Storage System

PV Inverter

Data Recording and Timestamping

For a microgrid operator to make informed decisions and take corrective action, accurate timestamped data is needed to determine when, where, and in what order events have occurred for root cause analysis.

To enable diagnosis of complex microgrid power and energy events in EcoStruxure Microgrid Operation, it is recommended to utilize connected products (meters, protection relays, etc.) with onboard data logging capability and with a time precision of +/- 10 milliseconds.

EcoStruxure
Microgrid Operation

For a comprehensive overview of device recording and timestamping capabilities, refer to Time Synchronization Capabilities of EcoStruxure Power Connected Products.

Time Synchronization

For a consistent chronological view of all microgrid events, the date and time should be accurately distributed to connected products and other management systems.

Time synchronization can be performed using various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be associated with a GPS antenna to achieve the required time accuracy.

TimeSync Clock

Data Processing

In a microgrid application, there are several embedded functions enabled by the processed input data in the controller of EcoStruxure Microgrid Operation to manage the operating conditions of Distributed Energy Resources (DERs).

EcoStruxure Microgrid
Operation Controller

These are described as follows:

Topological engine:

Computes and analyzes the electrical network topology in real time.

Load sharing:

Provides voltage and frequency stability by balancing production and consumption in real time, aiming to maximize renewable power production within the microgrid.

DER management:

Function in charge of driving and interacting with each of the DERs in the microgrid, taking into account the type of DER, the type of DER inverter, and the different operating conditions.

Grid management:

Monitors and analyzes the grid status in real time to detect when it is not available or when the electrical conditions require the microgrid to be disconnected from the grid. During grid-connected mode, the Microgrid Controller manages the import/export of energy to/from the grid.

Load shedding:

Turns off non-critical loads when consumption exceeds local production capacity.

Black start sequence feature:

In the absence of grid connection or self-generation, this feature provides the possibility for the microgrid to start its own electricity production and to reactivate itself sequentially as an island.

Protection relays and grounding/earthing system management:

Manages the protection relays and the grounding/earthing system during transition and operation in islanded mode.

Controls

To constantly optimize the power supply strategy, EcoStruxure Microgrid Operation Controller will control field devices dynamically.

EcoStruxure Microgrid Operation Controller

Power Controls

The following power controls can be sent:
- Open/close circuit breakers and transfer switches
- Adjust/curtail photovoltaic output
- Charge/discharge batteries
- Start/stop generator(s)
- Modify device protection and grounding settings

Building Management System (BMS) controls

EcoStruxure Microgrid Operation Controller can also interact with the BMS to optimize the overall site energy consumption strategy:
- Modify HVAC setpoints

Battery Energy Storage System (BESS) controls (including electrical vehicle)

EcoStruxure Microgrid Operation Controller can send commands to the storage system to optimize its control strategy:

- When to charge
- When to discharge
- Stop charging according to maximum State of Charge

EVlink LMS

Outputs

Live Data Display

High-performance real-time visualization of animated one-line diagrams in EcoStruxure Microgrid Operation's SCADA HMI allows you to gain situational awareness of the state of your power system from anywhere, and it allows operators, with the proper credentials, to perform remote control. It displays information coming from the EcoStruxure Microgrid Operation Controller: machine status, power flows, switch status, etc.

A Harmony Magelis Compact iPC can be used for local HMI/SCADA. It communicates with the controller as the monitoring and control access point.

It embeds the following features:

- Monitors and controls the microgrid electrical distribution topology
- Monitors and controls the EcoStruxure Microgrid Operation Controller functions
- Monitors the system architecture and its communication network
- Acts as the maintenance access point of the solution (access to technical documents and configuration software)

EcoStruxure
Microgrid Operation

Harmony Magelis Compact
iPC

Events and Alarms

Event log viewers:

Events and alarms are uploaded from devices and visualized in native event and alarm viewers of the Edge Control software (EcoStruxure Microgrid Operation). Chronological views include all events and alarms, acknowledged or unacknowledged alarms, and summary alarms or incidents related to microgrid events. High speed and high precision sequence of events analysis helps locate

the source of any switching sequence issues or other related faults. In addition, user remote control actions are traced with operator name and timestamp.
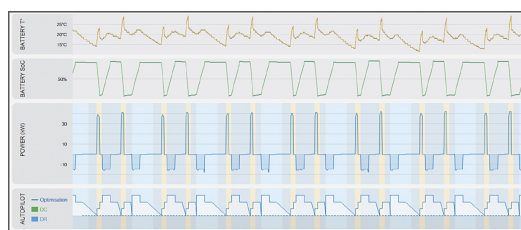

EcoStruxure
Microgrid Operation

Smart alarming:

With the optional integration of EcoStruxure Power Monitoring Expert, microgrid events or alarms are intelligently grouped to be displayed as comprehensive microgrid incidents and reduce the overall number of alarms in the viewer. Further analysis can be performed through drill-down (refer to the Power Event Analysis application).

EcoStruxure
Power Monitoring Expert

Trends

Historical energy data from the microgrid power system can be displayed as trends in EcoStruxure Microgrid Operation for on-site facility teams to monitor and manage the electrical system and DERs. Trending in EcoStruxure Microgrid Advisor can additionally show near-real-time and forecasted energy production and consumption data within the context of other parameters such as energy rate schedules, temperature, and other factors that drive decision-making for optimal microgrid energy usage and production modes.

Battery Charge/Discharge Trend in EcoStruxure Microgrid Advisor

Reports

When EcoStruxure Power Monitoring Expert is installed and integrated with EcoStruxure Microgrid Operation, comprehensive reporting on the microgrid electrical network is enabled. Refer to applications such as Electrical Distribution Monitoring and Alarming, Power Quality Monitoring and Compliance, Capacity Management, among other applications for details on reporting that can be embedded in a microgrid solution.

Notifications

Alarm notifications available with the optional Event Notification Module for EcoStruxure Power Monitoring Expert can be automatically sent via SMS or email to configured recipients on user defined schedules.

Alarm notifications can be configured to delay sending notifications during a user-defined amount of time and to send a single notification for multiple events. This prevents flooding of notifications.

Cloud-Based Analytics and Services

EcoStruxure Microgrid Advisor cloud-based analytics help optimize the energy production and consumption of on-site Distributed Energy Resources (DERs).

EcoStruxure Microgrid Advisor
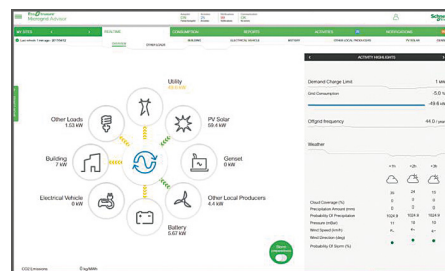
EcoStruxure Microgrid Advisor HMI

They forecast and optimize when to produce, consume, and store energy on a customer site, based on electricity tariff rate, site constraints, weather forecast information, and demand response requests.

> **NOTE:** EcoStruxure Microgrid Advisor does not replace existing control solutions which may already be installed at a site such as a Building Management System (BMS) for HVAC[1] systems, cluster for Electrical Vehicle (EV) charging stations, etc.

EcoStruxure Microgrid Advisor manages and optimizes the following four DER control orders:

- Accumulation
- Normal
- Low
- Sleep

These orders are sent to the DER itself (energy storage system) or to the existing DER management solutions, such as:

- EcoStruxure Microgrid Operation
- Building Management System for HVAC[1] systems
- Cluster for Electrical Vehicle (EV) charging stations

Thanks to the web interface, the site facility manager can monitor near-real-time energy data as well as the potential savings and earnings achieved. Such data can also be exported in an Excel file for deeper analysis.

Some optimization use cases include:

Tariff management:

- Controlling DERs according to the variable electricity tariff rate. EcoStruxure Microgrid Advisor can modify the energy consumption / energy production ratio of the site to adapt it to the tariff periods (peak/off-peak periods) while maintaining the same level of comfort for occupants.

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1.   HVAC: Heating, Ventilation, Air Conditioning

Demand control:

- Reducing the demand charge of a site by leveraging the DER's flexibility to reduce the consumption peak of the facility (peak shaving) and thereby reducing the demand charge for the customer

Self-consumption:

- Maximizing energy consumption of local energy sources including energy storage systems

Demand response:

- Performing demand response orders by connecting to a utility or a commercial aggregator platform which can monetize demand response orders

Off-grid mode preparation:

- Preparing a customer site to enter island mode using the forecasting capabilities of EcoStruxure Microgrid Advisor in association with the EcoStruxure Microgrid Operation Controller. EcoStruxure Microgrid Operation, by collecting weather forecast information, is able to calculate the probability of a storm arriving in the next three hours. If the probability of a storm is high, the facility manager can activate the off-grid preparation mode.

  EcoStruxure Microgrid Operation will switch the priority from energy saving / cost optimization to reliability, in order to store and accumulate as much energy as possible, before the EcoStruxure Microgrid Operation Controller goes into off-grid (island) mode.
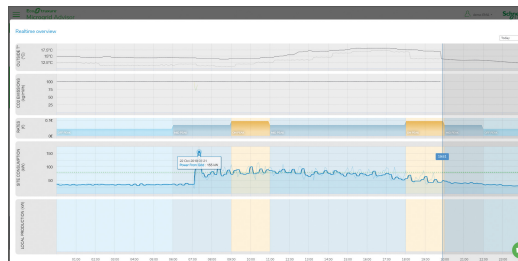
EcoStruxure Microgrid Advisor Remote Monitoring and Forecasting

As standards, specifications, and design change from time to time,
please ask for confirmation of the information given in this publication.

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