Energy Modeling and Verification (IEC)

Track Performance and Fine-Tune Savings Programs by Modeling Energy Use and Verifying Savings

EcoStruxure Power Digital Application

ESXP2GE024EN-05
11/2023

EcoStruxure™ Power

Schneider Electric

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Overview

Context of Application

In order to detect abnormal equipment behavior, which is detrimental for energy consumption, or to gain a true understanding of the return on investment of an energy management program, it is important to understand the relationship of how your facility should be performing compared to the actual energy performance. Energy modeling is one way of tracking energy efficient operation and assessing the effectiveness of energy saving investments.

Problem to Solve

The facility/energy manager needs to:

- Develop strategies and action plans to reduce energy consumption or improve energy usage.
- Maximize energy efficiency of equipment and processes, and reduce operating costs of the facility.
- Determine the relative difference between pre-retrofit and post-retrofit energy consumption.

Purpose of the Application

Define modeled data of energy consumption related to energy drivers

Provide feedback loop between energy managers and operations

By analyzing the energy performance of the facility or building against a modeled baseline which takes into account all relevant energy drivers such as outside temperature, occupancy, or productivity

Use modeled data to detect abnormal consumption values

Track the improved performance, verify and report savings

By determining the difference between pre-retrofit and post-retrofit energy consumption

Application Outcomes

Trends

Comparison trends:
- Energy Usage Trends
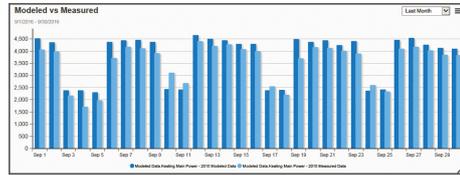- Calendar Trends

Modeled data can be displayed as trends and compared to actual data.

Dashboards

Energy Usage:
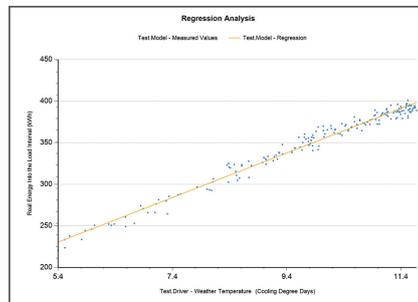
- Modeled values vs measured values

    NOTE: Modeled data can be displayed in most standard dashboards.
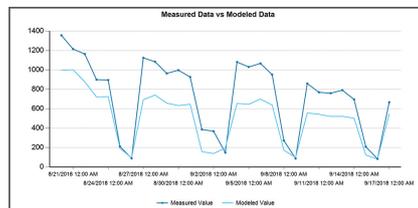

Modeled Values vs Measured Values Gadget
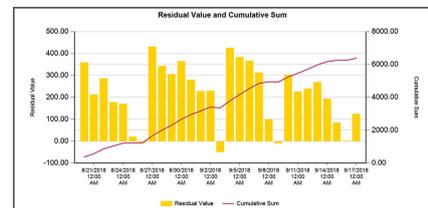
Reports

- Create Model Report
- Use Model Report

Energy Regression Analysis (Create Model Report)

Modeled Values vs Measured Values (Use Model Report)

Cumulative Savings (Use Model Report)

Cloud-Based Analytics and Services

As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.

EcoStruxure Power Advisor Data Quality Report

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Energy Modeling and Verification application:
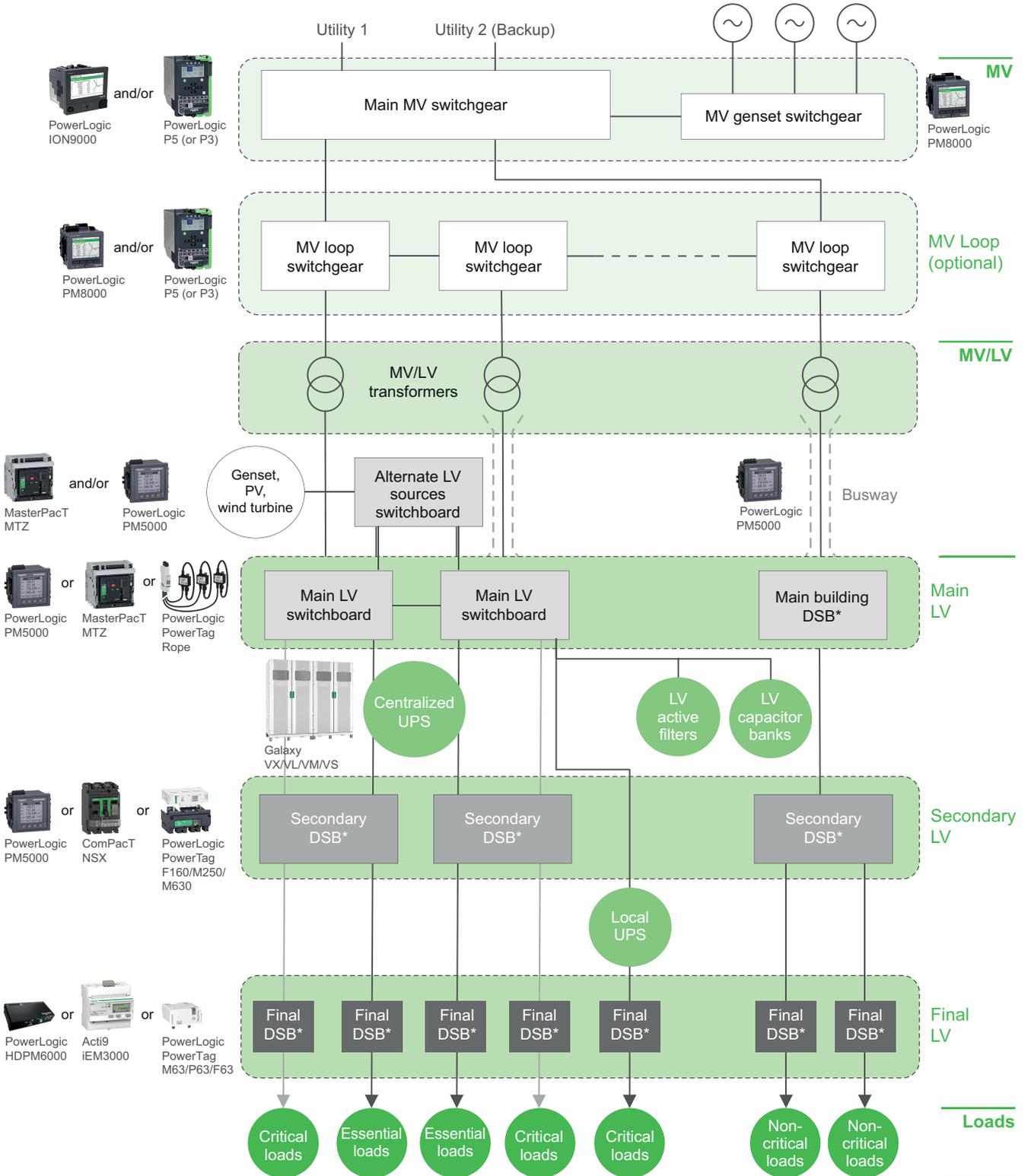
* DSB = Distribution Switchboard

Digital Architecture

In this architecture, the data is collected from connected products either directly over Ethernet or via gateways (such as the EcoStruxure Panel Server). This data is then recorded and processed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premise visualization, analysis, and reporting.

Other utility consumption inputs (WAGES) can also be directly acquired via Ethernet, via serial communication, or through hardwired signals from basic meters and sensors.

To include other process or equipment related data in the analyses, OPC or ETL can be used to acquire data from external process or building management software.

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and analyzed by experts as part of the EcoStruxure Service Plan.

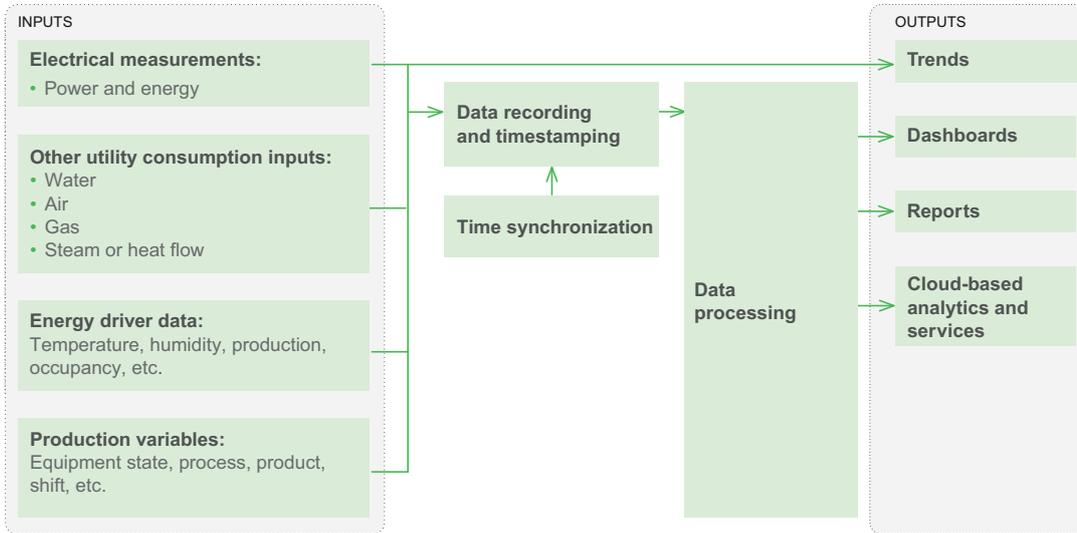The recommended digital architecture for the application is shown below:
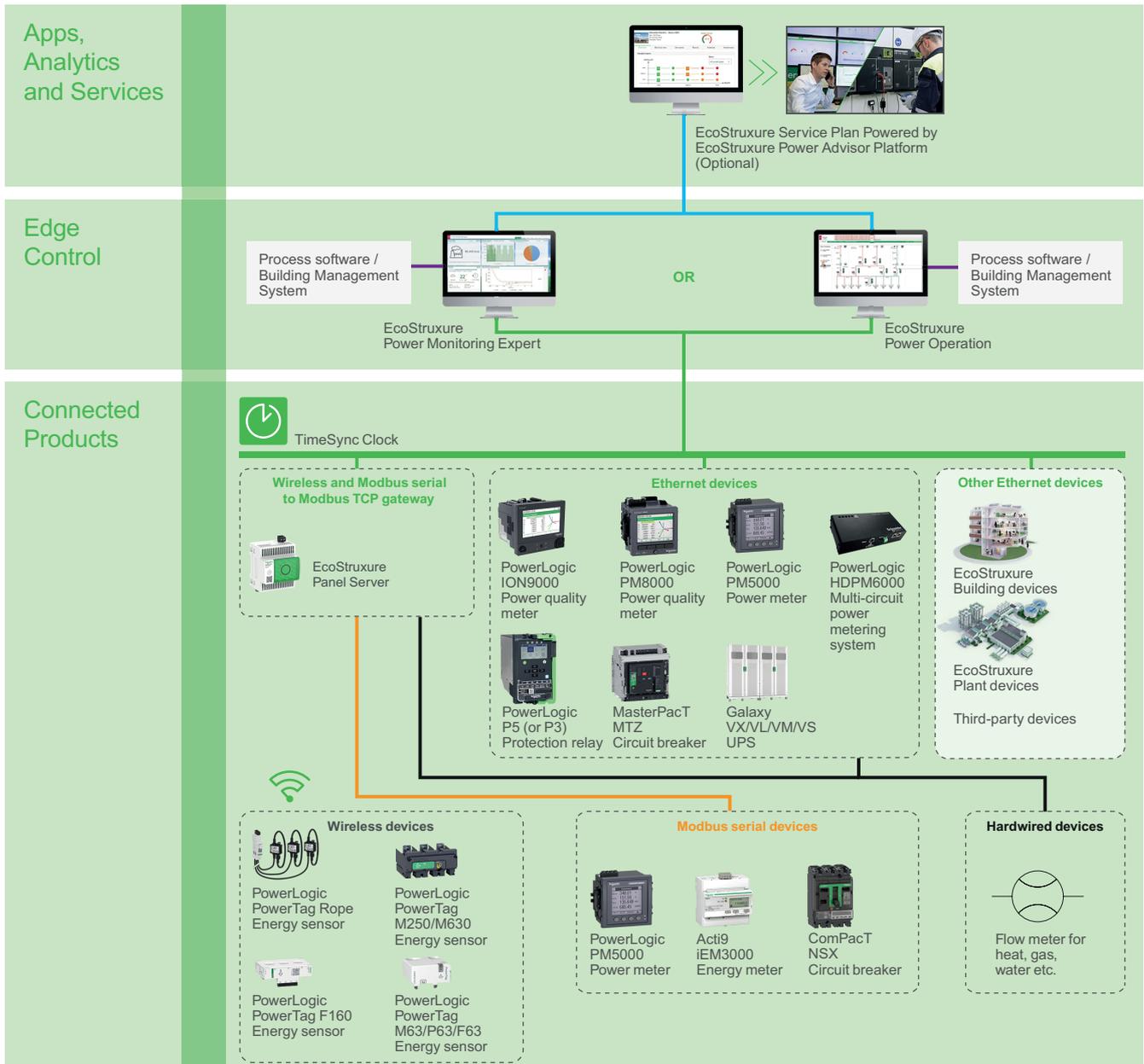
System Description

Data Flow

The Energy Modeling and Verification application can be broken down as follows:

INPUTS

Electrical measurements:
• Power and energy

Other utility consumption inputs:
• Water
• Air
• Gas
• Steam or heat flow

Energy driver data:
Temperature, humidity, production, occupancy, etc.

Production variables:
Equipment state, process, product, shift, etc.

Data recording and timestamping

Time synchronization

Data processing

OUTPUTS

Trends

Dashboards

Reports

Cloud-based analytics and services

Inputs

The following data are required to implement the Energy Modeling and Verification application:

Electrical Measurements

The following electrical measurements are collected at each point of interest in the electrical distribution, from Medium Voltage, to Low Voltage, down to Final Distribution.

- Power values (kW, kVAR, kVA)
- Energy values (kWh, kVARh, kVAh)

These data may be acquired from:

- **Power/energy meters** such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000

PowerLogic ION9000

PowerLogic PM8000

PowerLogic PM5000

PowerLogic HDPM6000

Acti9 iEM3000

PowerLogic PowerTag

- **Devices with embedded metering** such as PowerLogic P5/P3, MasterPacT MTZ, and ComPacT NSX protection devices, or Galaxy VX/VL/VM/VS UPS

PowerLogic P5	PowerLogic P3	MasterPacT MTZ	ComPacT NSX	Galaxy VX/VL/VM/VS

- **Third-party devices (via Modbus)**

Other Utility Consumption Inputs

The following utilities can be monitored:

- Water
- Air
- Gas
- Steam or heat flow

They can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Energy Driver Data

Any data which might have an impact on energy consumption should be leveraged.

For example:

- Weather information (outside temperature, humidity, etc.)
- Production volumes (number of units, tons, etc.)
- Hours of operation and operation schedules (work hours, weekdays vs weekends, seasons, shifts, etc.)
- Base loads
- Building occupancy

These can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices. They can also be imported in EcoStruxure Power Monitoring Expert from customer systems through OPC [1] or ETL[2].

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Production Variables

To correlate energy consumption with the different production variables such as equipment states, processes, production lines, products produced, shifts, etc.,

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1. OPC: Open Platform Communications
2. The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert or Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

these production variables must be monitored, recorded, and used to normalize the respective energy consumption.

Examples:

- Process batch A/B/C/
- Product X/Y/Z produced on which machine during which shift
- Equipment in normal/maintenance mode
- Motor low/medium/high speed

These can be imported in EcoStruxure Power Monitoring Expert or Power Operation from customer production systems through OPC[3] or ETL[4]

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Alternatively, these can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Data Recording and Timestamping

For the Energy Modeling and Verification application, a timestamp accuracy of ±1 second is sufficient.

Advanced power meters such as the PowerLogic ION9000, PM8000, HDPM6000, and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states. EcoStruxure Power Monitoring Expert or Power Operation can then retrieve the records with their original timestamp.

PowerLogic
ION9000

PowerLogic
PM8000

PowerLogic
HDPM6000

PowerLogic
PM5000

For other devices (PowerLogic P5/P3, MasterPacT MTZ, Galaxy VX/VL/VM/VS, entry-level PowerLogic PM5000 models, Acti9 iEM3000, PowerLogic PowerTag, etc.) energy measurements and equipment states are acquired by the connected products and then recorded and timestamped by EcoStruxure Power Monitoring Expert or Power Operation.

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3.   OPC: Open Platform Communications
4.   The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert or Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

PowerLogic
P5

PowerLogic
P3

MasterPacT
MTZ

Galaxy
VX/VL/VM/VS

PowerLogic
PM5000

Acti9
iEM3000

PowerLogic
PowerTag

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

When acquiring data from other customer systems, timestamps can also be imported through OPC[5] or ETL[6].

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

Time Synchronization

For consistent timestamping of all the data, the date and time should be accurately distributed to connected products and data loggers.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.

TimeSync Clock

Data Processing

Energy Modeling

Based on acquired input data, a regression analysis is performed to define a model of energy/power in relation to different energy drivers. The application uses this model to forecast consumption, highlight unexpected changes in consumption, or verify savings resulting from energy conservation measures.

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5.   OPC = Open Platform Communications
6.   ETL = The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert and Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

> **NOTE:** Typically a minimum of 6 months of historical data is required to create accurate energy models (especially when seasonal temperature data is used in the model).

Energy modeling is embedded in the optional Energy Analysis Reports module of EcoStruxure Power Monitoring Expert and Power Operation.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Outputs

Outputs are displayed via EcoStruxure Power Monitoring Expert or Power Operation. The Energy Analysis Reports module of EcoStruxure Power Monitoring Expert or Power Operation must be deployed to benefit from these features.

Trends

Modeled data can be saved in the database and displayed as a trend for comparison with actual field data.

Dashboards

Modeled data can be saved in the database and displayed as a dashboard.
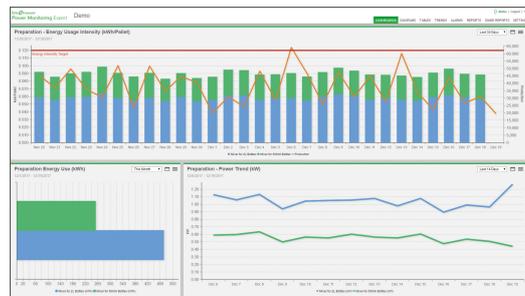
Dashboard

Reports

The first step in the use of the Energy Modeling and Verification application is to build an energy model (performed in the Create Model Report). This energy model is then used for the various analyses and verifications (with the Use Model Report).

Create Model Report

This report is used to create a model of a facility or process compared to various energy drivers such as outside temperature, production volumes, etc. After the model has been created, this report will not need to be run unless a new model needs to be created.

Create Model Report

> **NOTE:** To use this report, the data for the independent variables (driver data) and for the dependent variable (power/energy) must be available in the EcoStruxure Power Monitoring Expert database for the reporting period.

Use Model Report

The Use Model Report shows the expected consumption of a facility or process, based on a model created with the Create Model Report. The report shows a graphical representation of the modeled data, the measured data, and the delta between the two. It also includes tables with numeric data.

The objective is to compare expected consumption to actual consumption in order to:

- Identify unexpected changes in consumption related to abnormal load use or load dysfunction
- Identify actual savings as a result of energy conservation measures

This report can be displayed or automatically sent by email.

> **NOTE:** The report is not limited to energy consumption modeling. It can be used to model any quantity that is dependent on drivers, for example power factor based on power demand.

> **NOTE:** To use this report, at least one model must have been defined for the facility or process. For forecasted energy/power consumption, the forecast of the independent variables (driver data) must be available in the Power Monitoring Expert database for the reporting period.
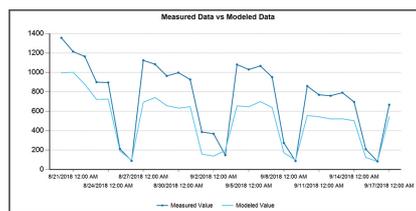
Use Model Report: comparison between expected and actual energy consumption
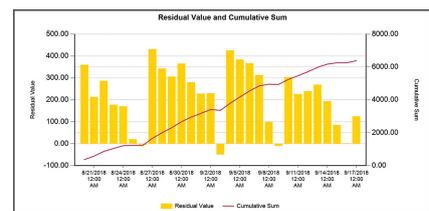
Use Model Report: residual value and cumulative sum of difference between expected and actual energy consumption
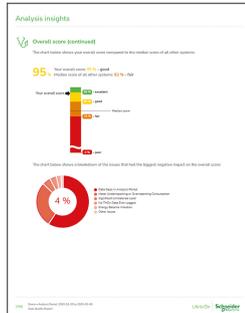
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Cloud-Based Analytics and Services

As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.
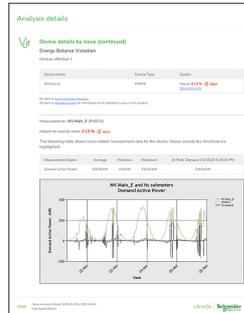
For further information, refer to Data Quality Management.

EcoStruxure Service Plan Powered by EcoStruxure Power Advisor Platform

EcoStruxure Power Advisor
Electrical Health Report -
Overall Score

EcoStruxure Power Advisor
Electrical Health Report -
Device Details by Issue

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