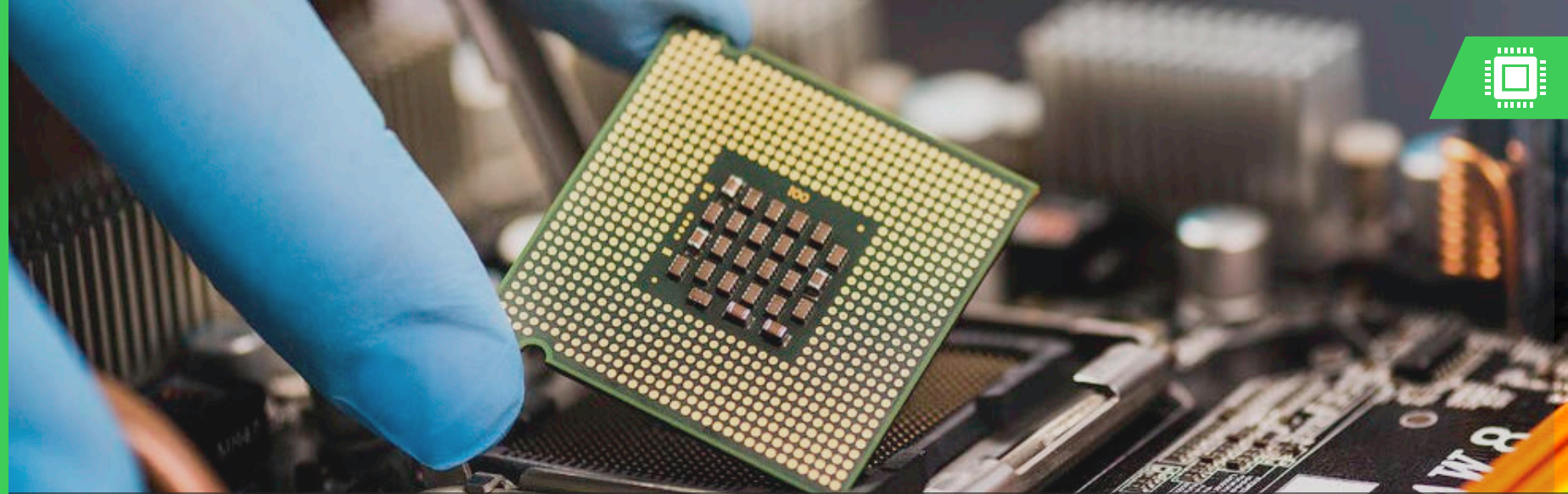
REFERENCE GUIDE



EcoStruxure™ Power for Semiconductor Fabs

Utilizing a Digital Twin for Electrical Distribution to Drive Efficient Facilities

05/2024

EcoStruxure Innovation At Every Level Power

Life Is On Schneider Electric

SECTION 1 – Introduction to the Semiconductor Fab Industry

SECTION 2 – How EcoStruxure Power Can Support the Semiconductor Fab

SECTION 3 – Digital Solutions and Services

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Life Is On Schneider Electric

Purpose of the Document

Target Audience

This document is intended to address End User Engineering, Operations and Maintenance, Consultants, EPCs (Engineering, Procurement, and Construction) and Service teams and other qualified personnel.

Objective

To understand the challenges of designing and operating a Semiconductor Fab with an efficient and sustainable electrical distribution strategy.

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SECTION 2 – How EcoStruxure Power Can Support the Semiconductor Fab

SECTION 3 – Digital Solutions and Services

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SECTION 1: Introduction to the Semiconductor Fab

Introduces the context and the challenges of a Semiconductor Fab.

SECTION 2: How Schneider Electric Can Support the Semiconductor Fab Industry with EcoStruxure Power

Describes the solutions that EcoStruxure Power provides for Semiconductor Fabs, with typical electrical and digital architectures.

SECTION 3: Digital Solutions and Services

Gives information about EcoStruxure Power capabilities for Semiconductor Fabs, sorted by value proposition:

- Transverse Lifecycle Capabilities
- Capabilities to Improve Time To Market
- Capabilities to Increase Efficiency
- Capabilities to Improve Resiliency
- Capabilities to Grow Sustainability

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Contains useful documents to find out more about capabilities.
Provides details about Green Premium.

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Semiconductor Fab Industry

Semiconductor Fab Industry Challenges

SECTION 2 – How EcoStruxure Power Can Support the Semiconductor Fab

SECTION 3 – Digital Solutions and Services

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SECTION 1

Introduction to the Semiconductor Fab Industry

WHY READ THIS SECTION?

The objective of this section is to:

- Introduce the growth, trends and challenges of the Semiconductor Fab industry
- Present the 4 pillars to meet the Semiconductor Fab challenges.

SECTION 1 – Introduction to the Semiconductor Fab Industry

Semiconductor Fab Industry

Semiconductor Fab Industry Challenges

SECTION 2 – How EcoStruxure Power Can Support the Semiconductor Fab

SECTION 3 – Digital Solutions and Services

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Semiconductor Fab Market

An industry driven by the growth of new technology

Strong Robust Growth

+7% Robust growth till 2030.

Hunt for Talent Intensifies

+77% Rise in chip-related job vacancies from 2020.

Chip Shortages Continue

17% Annual growth in chip demand from 2020-2022, while supply grew at only 6% per year.

Focus on Sustainability

+36% Semiconductor companies reinforced ESG* practices (2021 reporting).

Acceleration of Digital Transformation

+52% Increased use of cloud / automation in 2021.

Geopolitical Impacts

65% Global share of value chain activities based in Asia, creating high supply chain risk.

* ESG = Environmental, Social, and Governance

Sources

Sources

Strong Robust Growth:
https://www.mckinsey.com/industries/semiconductors/our-insights/the-semiconductor-decade-a-trillion-dollar-industry

Hunt for Talent Intensifies:
https://asia.nikkei.com/Business/Business-Spotlight/Chip-talent-war-Taiwan-faces-critical-staffing-shortage

Focus on Sustainability:
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Geopolitical Impacts:
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Acceleration of Digital Transformation:
https://quixy.com/blog/top-digital-transformation-statistics-trends-forecasts/#:~:text=According%20to%20Markets%20and%20Markets,by%205.1%25%20according%20to%20Gartner.

Chip Shortages Continue:
https://www.mynewsdesk.com/rolandberger/pressreleases/global-semiconductor-shortage-to-persist-for-several-years-beyond-2022-3151267

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Semiconductor Fab Industry

Semiconductor Fab Industry Challenges

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Semiconductor Fab Market

The market trends: a changing landscape

- Significant **investment** for expansions and modernization
- A growing focus on **efficiency** and **sustainability**
- High demand for **power** and **water** to meet semiconductor production capacity
- Cybersecurity

SECTION 1 – Introduction to the Semiconductor Fab Industry

Semiconductor Fab Industry

Semiconductor Fab Industry Challenges ▶

SECTION 2 – How EcoStruxure Power Can Support the Semiconductor Fab

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Semiconductor Fab Industry Challenges

Four pillars to drive efficiency, resiliency and sustainability KPIs

The strong growth of the semiconductor industry leads to an increase in fabrication capacity.
Creating or expanding this capacity is not without its challenges.
Four pillars must be addressed:

Improve Time to Market

How can we accelerate the design & build of new semiconductor fabs?

Increase Efficiency

How can we reduce our operational costs?

Improve Resiliency

How can we improve power quality and minimize downtime?

Grow Sustainability

How can we reduce our carbon footprint and integrate more renewable, sustainable energy sources?

SECTION 1 – Introduction to the Semiconductor Fab Industry

SECTION 2 – How EcoStruxure Power Can Support the Semiconductor Fab

- Solutions to Address the Four Pillars
- EcoStruxure Power Value Proposition
- Example of Electrical & Digital Architectures

SECTION 3 – Digital Solutions and Services

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SECTION 2

How EcoStruxure Power Can Support the Semiconductor Fab Industry

WHY READ THIS SECTION?

The objective of this section is to:

- Present the solutions to address the four pillars to meet the Semiconductor Fab industry challenges
- Explain how Schneider Electric EcoStruxure Power can support this industry
- Give an example of electrical and digital architectures.

SECTION 1 – Introduction to the Semiconductor Fab Industry

SECTION 2 – How EcoStruxure Power Can Support the Semiconductor Fab

Solutions to Address the Four Pillars

EcoStruxure Power Value Proposition

Example of Electrical & Digital Architectures

SECTION 3 – Digital Solutions and Services

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Solutions to Address the Four Pillars of Semiconductor Fabs

The four pillars can be addressed by the following solutions:

Improve Time to Market

Use Standardized Architectures

Use standardized electrical distribution and digital tools to speed up the design, build and commissioning of new fabs.

Increase Efficiency

Improve Facility Performance

Turn data into business intelligence and leverage a digital twin to provide actionable insights to drive efficiency.

Improve Resiliency

Minimize Downtime

Help assure optimum power quality and reliability while improving safety for your staff and guarding against cyber attacks

Grow Sustainability

Meet Sustainability KPIs

Engage consultancy services to strategize, digitize and decarbonize.

This guide describes the solutions developed by EcoStruxure Power to address these four pillars.

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Solutions to Address the Four Pillars

EcoStruxure Power Value Proposition ▶

Example of Electrical & Digital Architectures

SECTION 3 – Digital Solutions and Services

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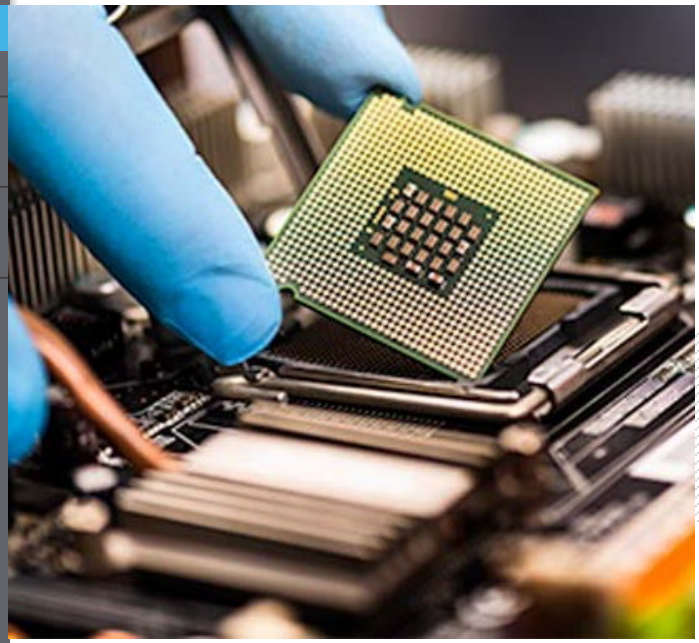
EcoStruxure Power Value Proposition

EcoStruxure Power for Semiconductor Fabs



From **electrical design** to **operations** and **maintenance**

We are your **end-to-end digital partner** to design, build, operate and maintain semiconductor fabs with the utmost **efficiency** and **resiliency** towards a **sustainable** future.

Our **collaborative environments,** enhanced by the Electrical Distribution **Digital Twin** of your fab, enable **high productivity operations.**

SECTION 1 – Introduction to the Semiconductor Fab Industry

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Solutions to Address the Four Pillars

EcoStruxure Power Value Proposition

Example of Electrical & Digital Architectures

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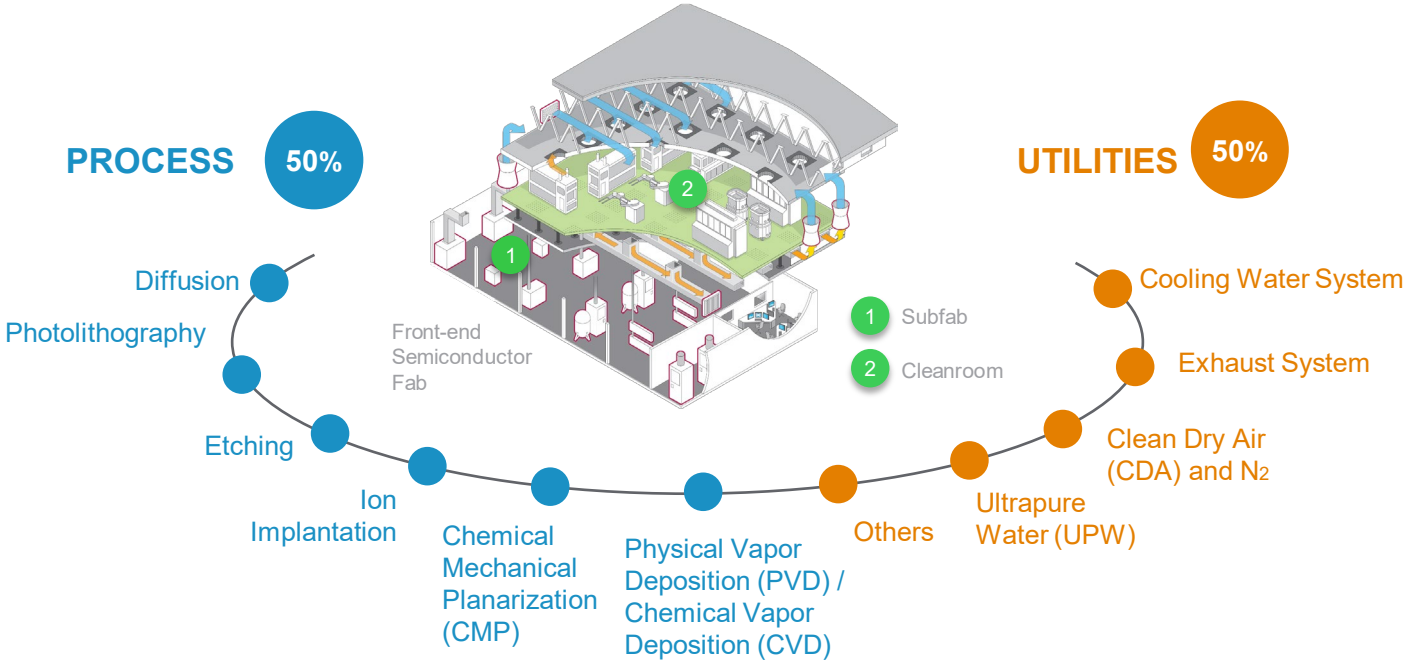
Example of Electrical and Digital Architectures

Typical front-end Semiconductor Fab

Energy is key, whether for processes or for utilities: specific attention must be given to the design of the electrical architecture and associated digital architecture which will enable digital solutions and services.



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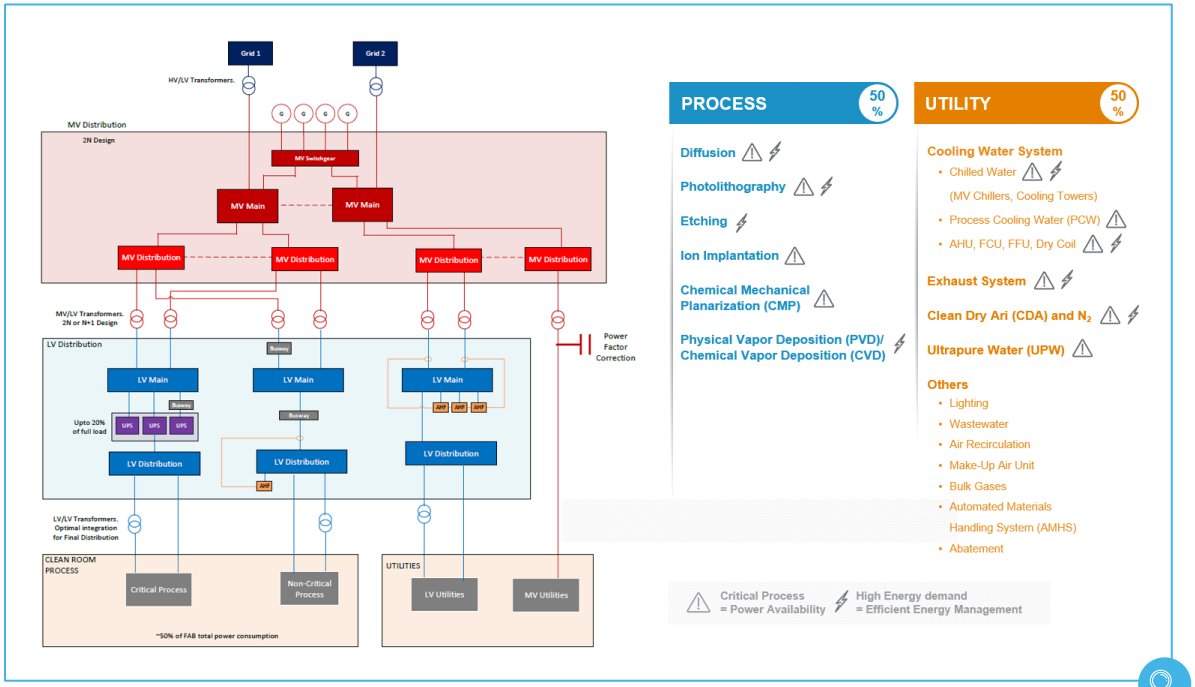
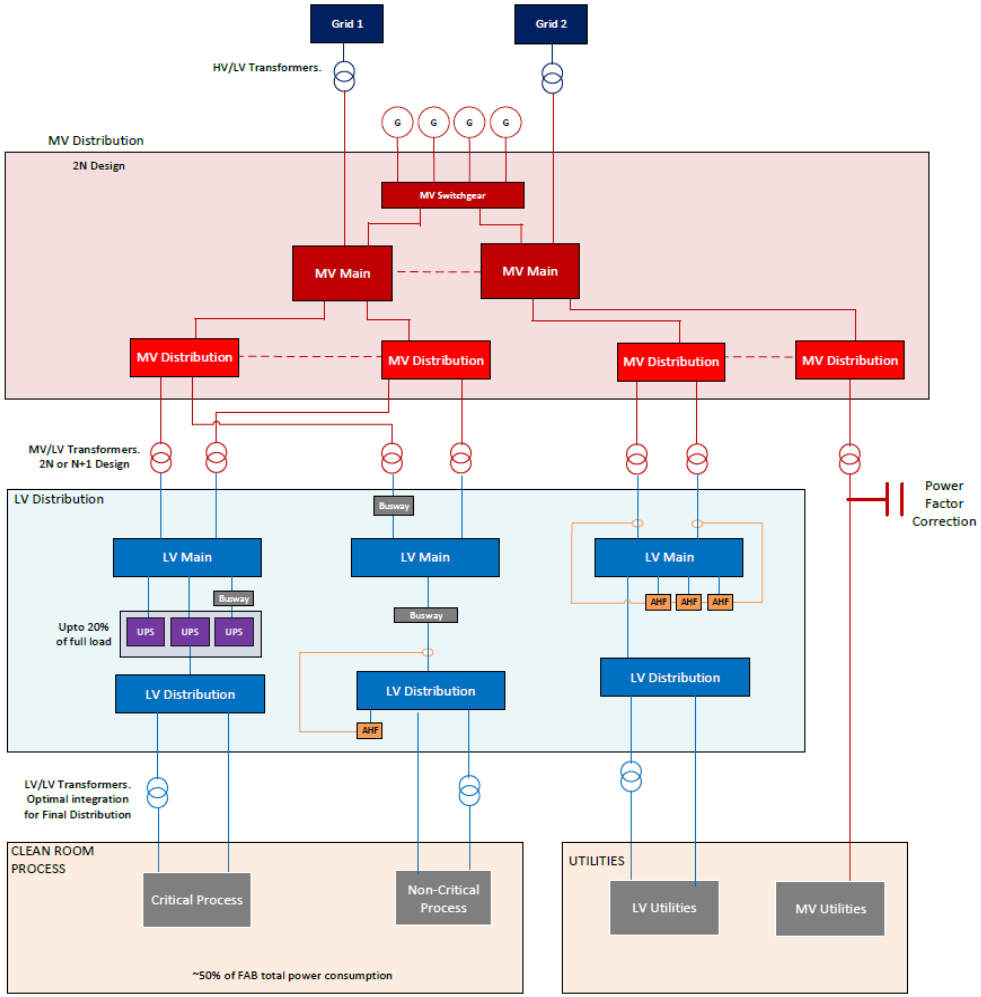
Example of Electrical and Digital Architectures

Typical electrical architecture for a Semiconductor Fab



Example of Electrical Architecture



PROCESS 50 %

- Diffusion ⚠ ⚡
- Photolithography ⚠ ⚡
- Etching ⚡
- Ion Implantation ⚠
- Chemical Mechanical Planarization (CMP) ⚠
- Physical Vapor Deposition (PVD)/ Chemical Vapor Deposition (CVD) ⚡

UTILITY 50 %

Cooling Water System

- Chilled Water ⚠ ⚡
  (MV Chillers, Cooling Towers)
- Process Cooling Water (PCW) ⚠
- AHU, FCU, FFU, Dry Coil ⚠ ⚡

Exhaust System ⚠ ⚡

Clean Dry Ari (CDA) and N_2 ⚠ ⚡

Ultrapure Water (UPW) ⚠

Others

- Lighting
- Wastewater
- Air Recirculation
- Make-Up Air Unit
- Bulk Gases
- Automated Materials Handling System (AMHS)
- Abatement

⚠ Critical Process = Power Availability

⚡ High Energy demand = Efficient Energy Management

Example of Electrical Architecture

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Example of Electrical & Digital Architectures ▶

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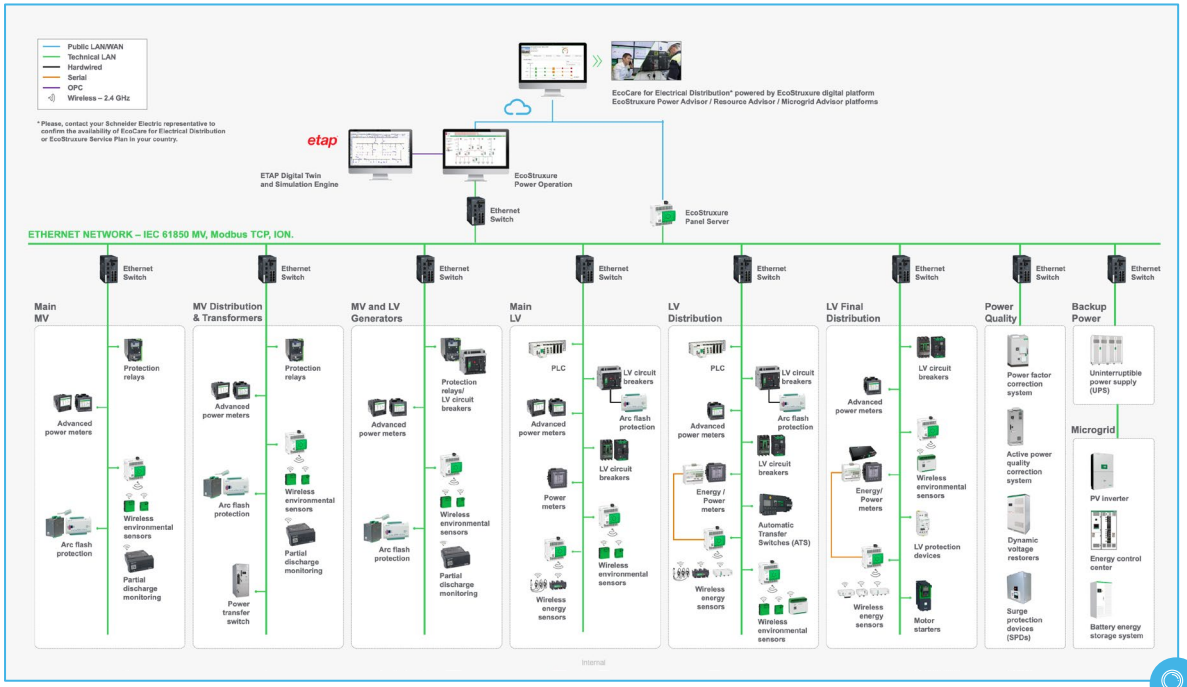
Example of Electrical and Digital Architectures

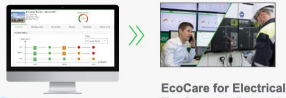
Suggested digital architecture (high-level view) for a Semiconductor Fab



Example of Digital Architecture (High-Level View)

Public LAN/WAN
Technical LAN
Hardwired
Serial
OPC
Wireless – 2.4 GHz

* Please, contact your Schneider Electric representative to confirm the availability of EcoCare for Electrical Distribution or EcoStruxure Service Plan in your country.



EcoCare for Electrical Distribution* powered by EcoStruxure digital platform
EcoStruxure Power Advisor / Resource Advisor / Microgrid Advisor platforms

etap

ETAP Digital Twin and Simulation Engine

EcoStruxure Power Operation

Ethernet Switch

EcoStruxure Panel Server

ETHERNET NETWORK – IEC 61850 MV, Modbus TCP, ION.

Main MV

Ethernet Switch
Protection relays
Advanced power meters
Wireless environmental sensors
Arc flash protection
Partial discharge monitoring

MV Distribution & Transformers

Ethernet Switch
Protection relays
Advanced power meters
Wireless environmental sensors
Arc flash protection
Partial discharge monitoring
Power transfer switch

MV and LV Generators

Ethernet Switch
Protection relays/ LV circuit breakers
Advanced power meters
Wireless environmental sensors
Arc flash protection
Partial discharge monitoring

Main LV

Ethernet Switch
PLC
LV circuit breakers
Arc flash protection
Advanced power meters
LV circuit breakers
Power meters
Wireless environmental sensors
Wireless energy sensors

LV Distribution

Ethernet Switch
PLC
LV circuit breakers
Arc flash protection
Advanced power meters
LV circuit breakers
Energy / Power meters
Automatic Transfer Switches (ATS)
Wireless energy sensors
Wireless environmental sensors

LV Final Distribution

Ethernet Switch
Advanced power meters
LV circuit breakers
Energy/ Power meters
Wireless environmental sensors
LV protection devices
Wireless energy sensors
Motor starters

Power Quality

Ethernet Switch
Power factor correction system
Active power quality correction system
Dynamic voltage restorers
Surge protection devices (SPDs)

Backup Power

Ethernet Switch
Uninterruptible power supply (UPS)

Microgrid

PV inverter
Energy control center
Battery energy storage system

Internal

Example of Digital Architecture (High-Level View)

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Example of Electrical & Digital Architectures ▶

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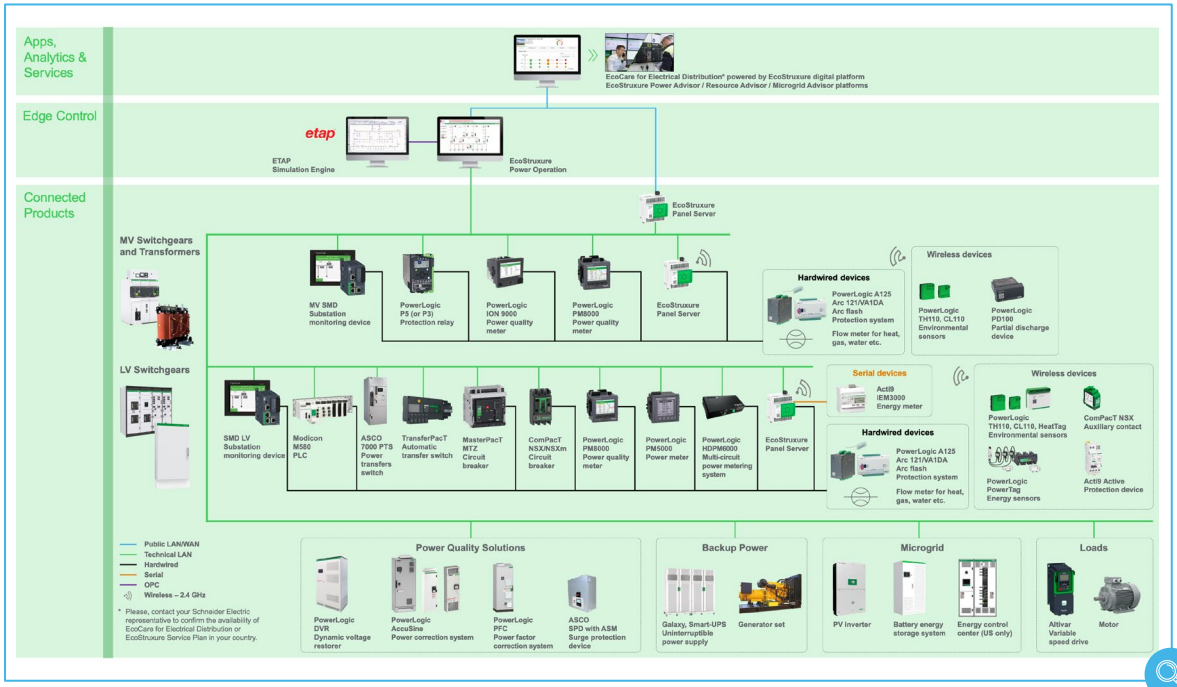
Example of Electrical and Digital Architectures

Corresponding detailed digital architecture for a Semiconductor Fab



Example of Digital Architecture (Detailed View)

Apps, Analytics & Services

EcoCare for Electrical Distribution* powered by EcoStruxure digital platform
EcoStruxure Power Advisor / Resource Advisor / Microgrid Advisor platforms

Edge Control

etap

ETAP
Simulation Engine

EcoStruxure
Power Operation

Connected Products

EcoStruxure
Panel Server

MV Switchgears and Transformers

MV SMD
Substation
monitoring device

PowerLogic
P5 (or P3)
Protection relay

PowerLogic
ION 9000
Power quality
meter

PowerLogic
PM8000
Power quality
meter

EcoStruxure
Panel Server

Hardwired devices

PowerLogic A125
Arc 121/VA1DA
Arc flash
Protection system

Flow meter for heat, gas, water etc.

Wireless devices

PowerLogic
TH110, CL110
Environmental
sensors

PowerLogic
PD100
Partial discharge
device

LV Switchgears

SMD LV
Substation
monitoring device

Modicon
M580
PLC

ASCO
7000 PTS
Power
transfers
switch

TransferPacT
Automatic
transfer switch

MasterPacT
MTZ
Circuit
breaker

ComPacT
NSX/NSXm
Circuit
breaker

PowerLogic
PM8000
Power quality
meter

PowerLogic
PM5000
Power meter

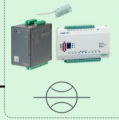
PowerLogic
HDPM6000
Multi-circuit
power metering
system

EcoStruxure
Panel Server

Serial devices

Acti9
iEM3000
Energy meter

Hardwired devices



PowerLogic A125
Arc 121/VA1DA
Arc flash
Protection system

Flow meter for heat, gas, water etc.

Wireless devices

PowerLogic
TH110, CL110, HeatTag
Environmental sensors

ComPacT NSX
Auxiliary contact

PowerLogic
PowerTag
Energy sensors

Acti9 Active
Protection device

Public LAN/WAN
Technical LAN
Hardwired
Serial
OPC
Wireless – 2.4 GHz

* Please, contact your Schneider Electric representative to confirm the availability of EcoCare for Electrical Distribution or EcoStruxure Service Plan in your country.

Power Quality Solutions

PowerLogic
DVR
Dynamic voltage
restorer

PowerLogic
AccuSine
Power correction system

PowerLogic
PFC
Power factor
correction system

ASCO
SPD with ASM
Surge protection
device

Backup Power

Galaxy, Smart-UPS
Uninterruptible
power supply

Generator set

Microgrid

PV inverter

Battery energy
storage system

Energy control
center (US only)

Loads

Altivar
Variable
speed drive

Motor

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- Capabilities to Improve Resiliency
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SECTION 3

Digital Solutions & Services

WHY READ THIS SECTION?

This section gives information about EcoStruxure Power capabilities for Semiconductor Fabs aligned to the industry challenges.

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Introduction

EcoStruxure Power provides capabilities to support the challenges of Semiconductor Fabs throughout their lifecycle

Design, Build, Commission
(Consultants & EPC)

Operate & Maintain
(Operators, maintenance team, service teams)

Improve Time to Market

These capabilities provide standardized designs and digital architectures, and enable easy simulation, to reduce cost of design and ownership.

Increase Efficiency

These capabilities use digitization to provide intelligent information to the workforce, allowing them to make smart decisions that reduce operating costs and increase efficiency.

Improve Resiliency

These capabilities use digitization to reduce unplanned downtime, increase reliability, and thus reduce production waste.

Grow Sustainability

These capabilities help track energy consumption and carbon emissions to meet sustainability requirements.

Transverse Lifecycle Capabilities

Digital Solutions that support your project from the Design, Build, Commission to Operate & Maintain phases.

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Capabilities to Grow Sustainability

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Overview of Digital Solutions and Services

Design, Build, Commission
(Consultants & EPC)

Operate & Maintain
(Operators, maintenance team, service teams)

Improve Time to Market

- AC&DC electrical network bus design and simulation
- Electrical network short circuit simulation
- Network load flow and voltage drop simulation
- Device coordination and selectivity
- Arc fault protection and coordination
- Power quality simulation and modeling
- Renewable & microgrid energy storage sizing simulation
- Power system study

Increase Efficiency

- Operator training simulation
- Energy monitoring and usage analysis
- Energy performance, modeling and verification
- Capacity management

Improve Resiliency

- Predictive simulation
- Simulate before Operate
- Electrical distribution monitoring and alarming
- Power event analysis
- Asset performance
- Power quality monitoring and compliance
- Power quality and power factor correction
- Thermal and partial discharge monitoring
- Arc flash protection

Grow Sustainability

- Carbon neutrality consulting services
- Energy efficiency compliance
- Greenhouse gas reporting

Transverse Lifecycle Capabilities

Electrical Digital Twin

Green Premium

Cybersecurity

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Transverse Lifecycle Capabilities

Electrical Digital Twin

Green Premium

Cybersecurity

Electrical Digital Twin

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- Capabilities to Increase Efficiency
- Capabilities to Improve Resiliency
- Capabilities to Grow Sustainability

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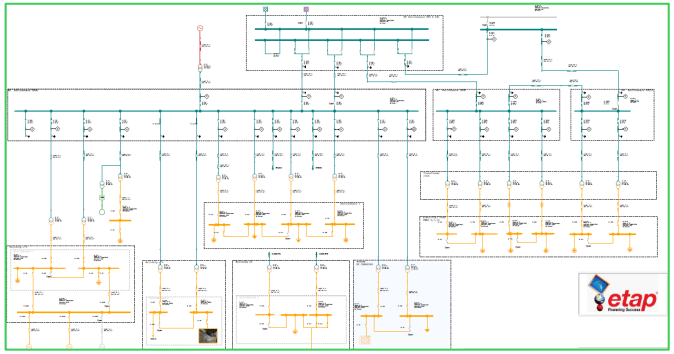
Maintain a Digital Twin of your electrical distribution

Benefits

- Intelligent user-interface for all levels of AC and DC networks
- Enables users, from the design to operate phases, to model, simulate, analyze and validate electrical power systems to predict their electrical network behavior
- Takes the day-to-day system modeling and design tasks to a new level of speed, accuracy and ease



Electrical Digital Twin

Green Premium

Manage sustainability from design to end of life

Green Premium™ Sustainable performance, by design

Benefits

- Green Premium* products provide detailed information on their regulatory compliance, material content, environmental impact, and circularity attributes.

1 Compliance and transparency
(compliance certificates, circularity profiles, environmental footprint, etc.)

2 Circular performance

Durability, upgradeability, re-manufacture, recycled content, recyclability

3 Well-being performance

E.g. free of PVC, mercury, silicone, SVHC, lead, toxic heavy metal and compliant with California Prop 65

4 Resource performance

Optimized energy performance

Lower carbon emissions

Green Premium Value Proposition

* The Green Premium label was created to provide Schneider Electric's customers with more sustainable products and to be transparent with environmental information.

Supporting your efforts for a **LEED certified building**

Helping you achieve **Living Building Challenge** certification

Learn more about:
- Green Premium

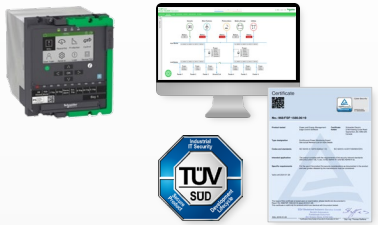
Cybersecurity

Help secure the digital power distribution system

Benefits

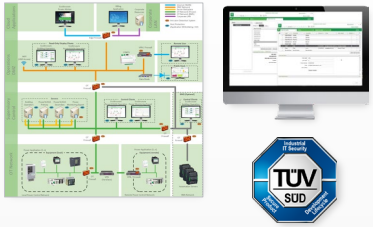
- Provides a selection of cybersecurity certified products
- Provides certified system architectures and solutions
- Delivers lifecycle services

Certified products



Certified products developed according to IEC 62443 functional requirements with Secure Development Lifecycle processes.

Certified systems & solutions



Certified secure system architecture according to IEC 62443-3-3 with documented processes and solutions for a secure system. Cybersecurity system configuration software for consistent security policy deployment.

Lifecycle services

Consulting services from design, implementation, operations and maintenance to tailor your security solutions to your strategy and budget.

Learn more about:

- Cybersecurity

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Capabilities to Improve Time to Market

Design, Build, Commission
(Consultants & EPC)

Operate & Maintain
(Operators, maintenance team, service teams)

Improve Time to Market

- AC&DC electrical network bus design and simulation
- Electrical network short circuit simulation
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- Power quality simulation and modeling
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- Operator training simulation
- Energy monitoring and usage analysis
- Energy performance, modeling and verification
- Capacity management

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- Power quality monitoring and compliance
- Power quality and power factor correction
- Thermal and partial discharge monitoring
- Arc flash protection

Grow Sustainability

- Carbon neutrality consulting services
- Energy efficiency compliance
- Greenhouse gas reporting

Transverse Lifecycle Capabilities

Electrical Digital Twin

Green Premium

Cybersecurity

AC and DC Electrical Network Bus Design and Simulation

SECTION 1 – Introduction to the Semiconductor Fab Industry

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- Capabilities to Improve Resiliency
- Capabilities to Grow Sustainability

BIBLIOGRAPHY

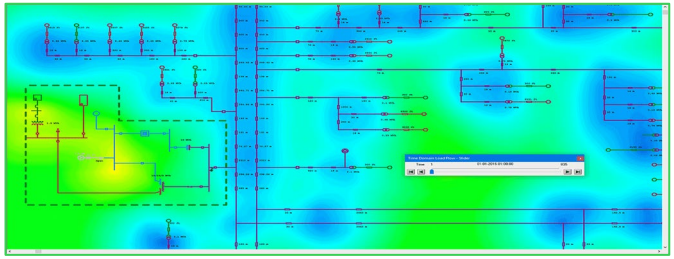
Optimize bus design allocation and simulation

Primary Department

- Design
- Construction

Benefits

- Single solution/environment
  - Unified AC & DC solution from HV to LV
  - One unique platform and one database
- Efficient profile management
  - User-defined loading and generation profiles
  - External data profile based on field measurements
- Scalability
  - Load growth study for future planning
- Event simulations within the calculation period



ETAP Electrical Network Model

Electrical Network Short Circuit Simulation

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BIBLIOGRAPHY

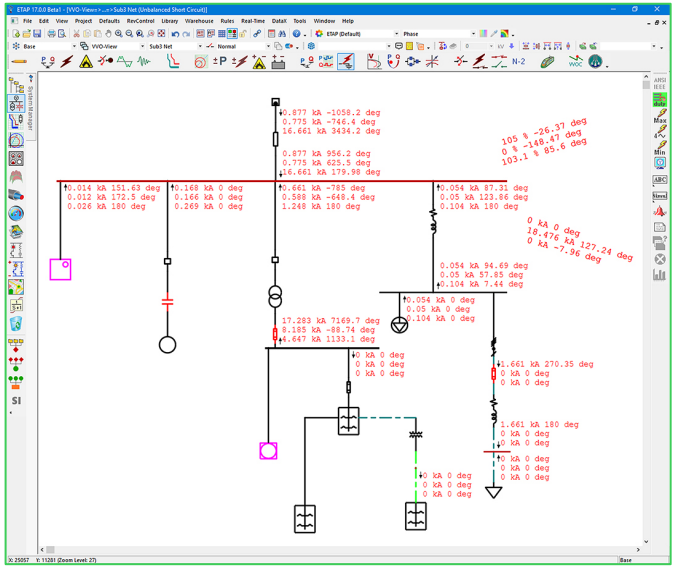
Design and simulate unbalanced short circuits

Primary Department

- Design
- Construction

Benefits

- Expedite design studies with a wide range of calculation scenarios, including advanced fault analysis
  - IEC & ANSI duty calculation for balanced and unbalanced faults
  - Simultaneous fault at selected nodes
  - Inclusive 3-Phase and 1-Phase fault analysis
  - Pre-Fault system loading consideration



Electrical Network Short Circuit Simulation in ETAP

Network Load Flow and Voltage Drop Simulation

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BIBLIOGRAPHY

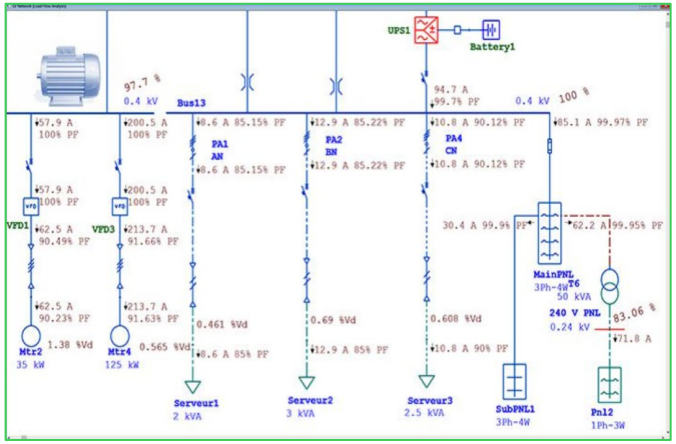
Perform power flow analysis and voltage drop calculations

Primary Department

- Design
- Construction

Benefits

- Simulation of bus voltages, branch power factors, currents, system losses, power generation versus loading
- Use of ETAP Electrical Digital Twin model with powerful calculation engines and user-friendly interface
- Simulation using multiple loading and generation conditions



Network Load Flow and Voltage Drop Simulation in ETAP

Device Coordination and Selectivity

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BIBLIOGRAPHY

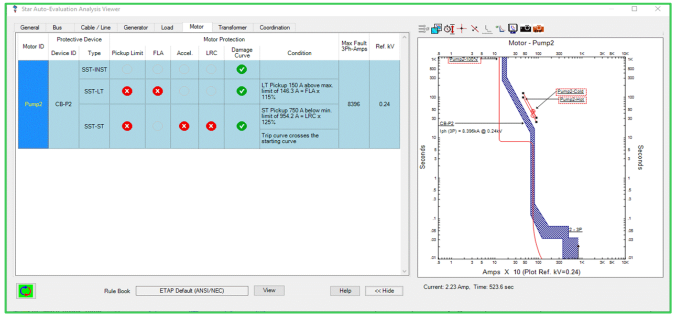
Automatically detect and evaluate the system protection and coordination/selectivity

Primary Department

- Design
- Construction

Benefits

- Verified and validated libraries
- Graphically adjustable device settings
- Detailed device settings reporting
- Continuous synchronization with one-line and integrated equipment database



Device Coordination and Selectivity in ETAP

Arc Fault Protection and Coordination

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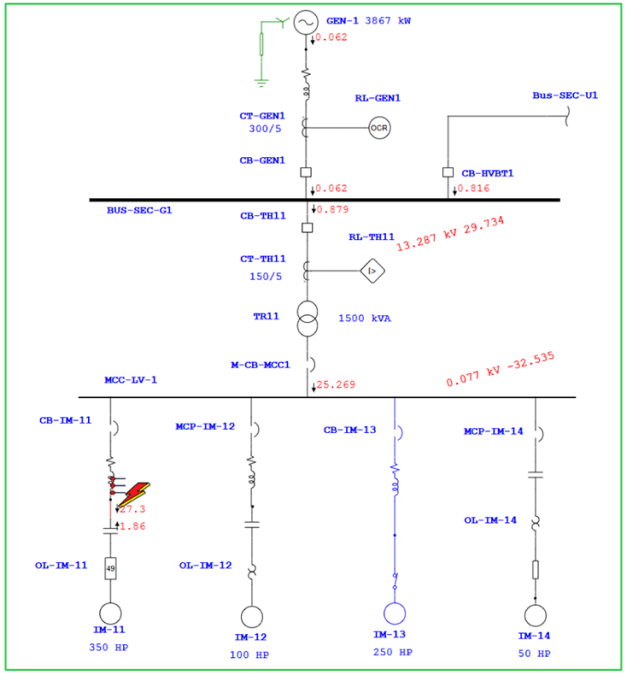
Perform sequence of operation for arc fault and bolted fault

Primary Department

- Design
- Construction

Benefits

- Evaluate, verify, and confirm the operation and selectivity of the protective devices for various types of faults for any location directly from the single-line diagram
- Animation displayed on the single-line diagram
- 3-phase / 1-phase sequence of operation



Arc Fault Protection and Coordination in ETAP

Power Quality Simulation and Modeling

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BIBLIOGRAPHY

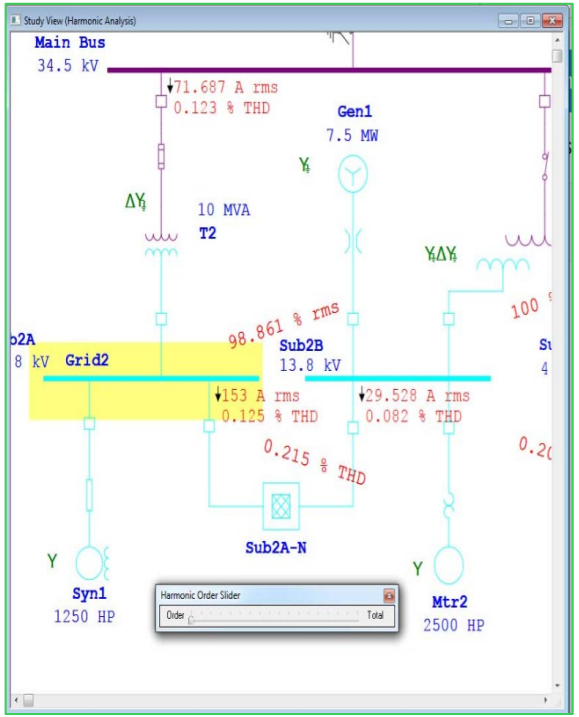
Evaluate and validate distortion due to harmonics

Primary Department

- Design
- Construction

Benefits

- Simulate harmonic current and voltage sources:
  - To identify potential harmonic problems (report of harmonic voltage and current distortion limit violations)
  - To identify the need for a harmonics filter
- Simulate and analyze the size of the harmonics filter your system will need to optimize performance and reduce nuisance trips



Power Quality Simulation and Modeling in ETAP

Renewable and Microgrid Energy Storage Sizing Simulation

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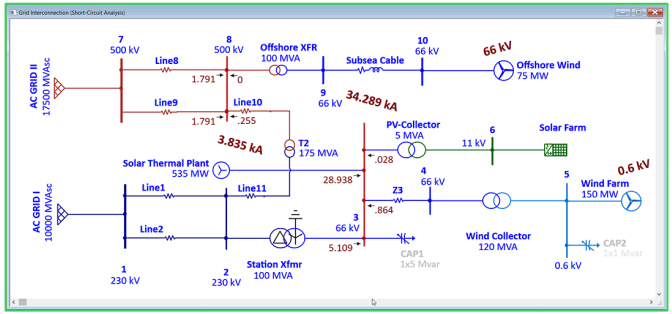
Design and optimize the microgrid system

Primary Department

- Design
- Construction

Benefits

- Build renewable energy models combined with full spectrum power system analysis calculations for:
  - Accurate simulation
  - Predictive analysis
  - Equipment sizing
  - Field verification of wind, solar farms and other DERs
- Enable designers and engineers to conceptualize the collector systems, determine wind penetration and perform grid interconnection studies



Microgrid Energy Storage Sizing Simulation in ETAP

Power System Study

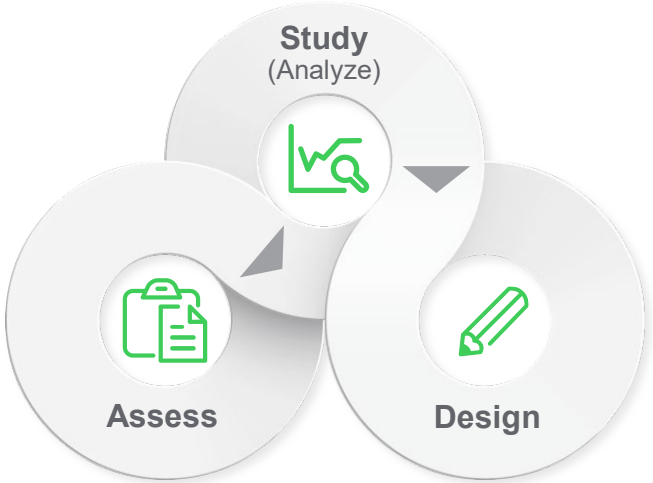
Work with engineering experts to provide Power System Studies

Primary Department

- Design
- Construction
- Facilities Electrical Department

Benefits

- Partner with a global team of experts, engaged with industry standards committees, to develop common safety standards and practices.
- Create a standardized approach to Power System Studies to support multisite deployments with consistent results



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Capabilities to Increase Efficiency

Design, Build, Commission
(Consultants & EPC)

Operate & Maintain
(Operators, maintenance team, service teams)

Improve Time to Market

- AC&DC electrical network bus design and simulation
- Electrical network short circuit simulation
- Network load flow and voltage drop simulation
- Device coordination and selectivity
- Arc fault protection and coordination
- Power quality simulation and modeling
- Renewable & microgrid energy storage sizing simulation
- Power system study

Increase Efficiency

- Operator training simulation
- Energy monitoring and usage analysis
- Energy performance, modeling and verification
- Capacity management

Improve Resiliency

- Predictive simulation
- Simulate before Operate
- Electrical distribution monitoring and alarming
- Power event analysis
- Asset performance
- Power quality monitoring and compliance
- Power quality and power factor correction
- Thermal and partial discharge monitoring
- Arc flash protection

Grow Sustainability

- Carbon neutrality consulting services
- Energy efficiency compliance
- Greenhouse gas reporting

Transverse Lifecycle Capabilities

Electrical Digital Twin

Green Premium

Cybersecurity

Operator Training Simulation

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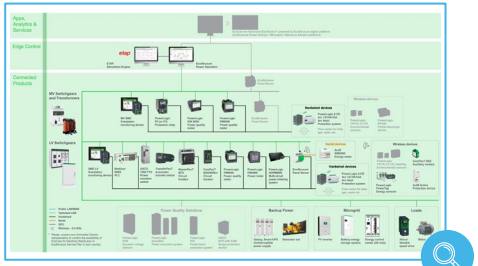
Train new employees and build confidence on new systems

Primary Department

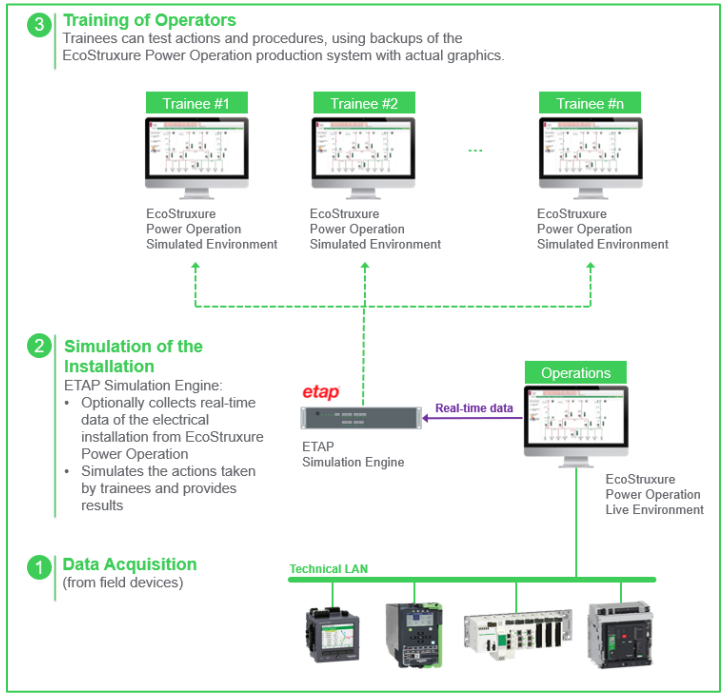
- Facility Operations & Maintenance

Benefits

- Practice operation within a simulated but highly realistic environment to enhance safety and operational efficiency
- Track and review trainee actions to analyze and challenge them



Operator Training Simulation Reference Architecture



Principle of Operator Training Simulation Application

Learn more about:

- Operator Training Simulation (IEC / NEMA)

Apps, Analytics & Services

EcoCare for Electrical Distribution* powered by EcoStruxure digital platform
EcoStruxure Power Advisor / Microgrid / Resource Advisor platforms

Edge Control

ETAP Simulation Engine

EcoStruxure Power Operation

EcoStruxure Panel Server

Connected Products

MV Switchgears and Transformers

MV SMD Substation monitoring device

PowerLogic P5 (or P3) Protection relay

PowerLogic ION 9000 Power quality meter

PowerLogic PM8000 Power quality meter

EcoStruxure Panel Server

Hardwired devices

PowerLogic A125 Arc 121/VA1DA Arc flash Protection system

Flow meter for heat, gas, water etc.

Wireless devices

PowerLogic TH110, CL110 Environmental sensors

PowerLogic PD100 Partial discharge device

LV Switchgears

SMD LV Substation monitoring device

Modicon M580 PLC

ASCO 7000 PTS Power transfers switch

TransferPacT Automatic transfer switch

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ComPacT NSX/NSXm Circuit breaker

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Acti9 iEM3000 Energy meter

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ComPacT NSX Auxiliary contact

PowerLogic PowerTag Energy sensors

Acti9 Active Protection device

Public LAN/WAN
Technical LAN
Hardwired
Serial
OPC
Wireless – 2.4 GHz

* Please, contact your Schneider Electric representative to confirm the availability of EcoCare for Electrical Distribution or EcoStruxure Service Plan in your country.

Power Quality Solutions

PowerLogic DVR Dynamic voltage restorer

PowerLogic AccuSine Power correction system

PowerLogic PFC Power factor correction system

ASCO SPD with ASM Surge protection device

Backup Power

Galaxy, Smart-UPS Uninterruptible power supply

Generator set

Microgrid

PV inverter

Battery energy storage system

Energy control center (US only)

Loads

Altivar Variable speed drive

Motor

Operator Training Simulation Reference Architecture

Energy Monitoring and Usage Analysis

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BIBLIOGRAPHY

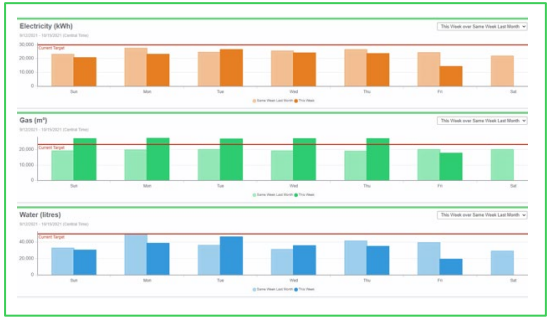
Determine where to focus energy conservation initiatives

Primary Department

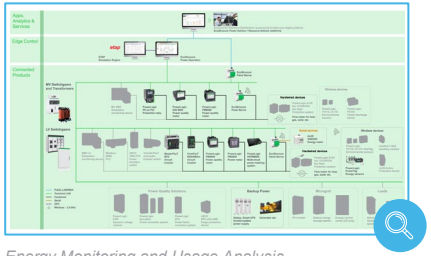
- Facility Operations & Maintenance

Benefits

- Bring awareness to utility consumption
  - Turn data into easy-to-interpret graphical dashboards and reports to raise awareness amongst key stakeholders
- Identify “quick-win” opportunities for energy savings
  - By comparing and visualizing energy usage and cost for different utilities over different time periods
  - By identifying and prioritizing which areas lend themselves to a high energy-saving return on investment



Energy Usage Analysis Dashboards in EcoStruxure Power Operation



Energy Monitoring and Usage Analysis Reference Architecture

Learn more about:

- Energy Monitoring (IEC / NEMA)

Apps, Analytics & Services

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Edge Control

etap

ETAP
Simulation Engine

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Power Operation

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monitoring device

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P5 (or P3)
Protection relay

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ION 9000
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PowerLogic
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Modicon
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ASCO
7000 PTS
Power
transfers
switch

TransferPacT
Automatic
transfer switch

MasterPacT
MTZ
Circuit
breaker

ComPacT
NSX/NSXm
Circuit
breaker

PowerLogic
PM8000
Power quality
meter

PowerLogic
PM5000
Power meter

PowerLogic
HDPM6000
Multi-circuit
power metering
system

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Auxiliary contact

PowerLogic
PowerTag
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Acti9 Active
Protection device

Public LAN/WAN
Technical LAN
Hardwired
Serial
OPC
Wireless – 2.4 GHz

Power Quality Solutions

PowerLogic
DVR
Dynamic voltage
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PowerLogic
AccuSine
Power correction system

PowerLogic
PFC
Power factor
correction system

ASCO
SPD with ASM
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Energy Performance, Modeling and Verification

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BIBLIOGRAPHY

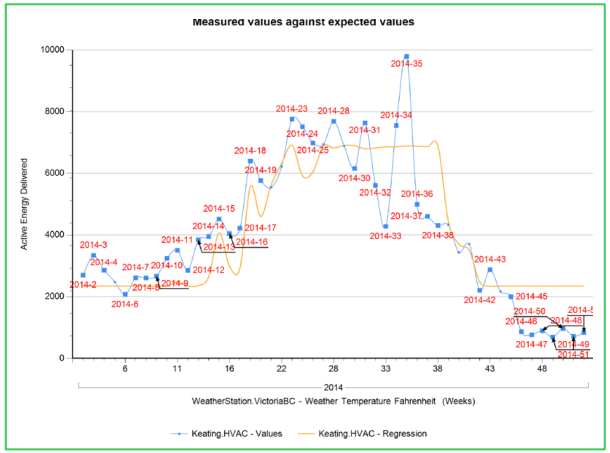
Analyze the energy performance of a plant against a model baseline

Primary Department

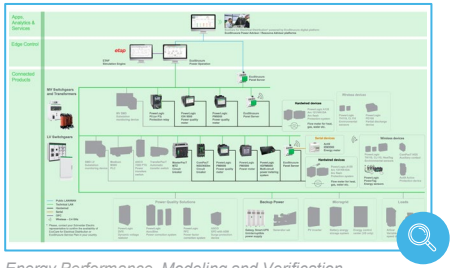
- Facility Operations & Maintenance

Benefits

- Provide energy usage information based on equipment and processes
- Compare model versus actual consumption
- Compare pre-retrofit versus post-retrofit energy consumption to track improved performance and savings as a result of energy conservation initiatives



Energy Performance, Modeling and Verification Output in EcoStruxure Power Operation



Energy Performance, Modeling and Verification Reference Architecture

Learn more about:

- Energy Performance (IEC / NEMA)
- Energy Modeling and verification (IEC / NEMA)

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Energy Performance Modeling and Verification Reference Architecture

Capacity Management

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BIBLIOGRAPHY

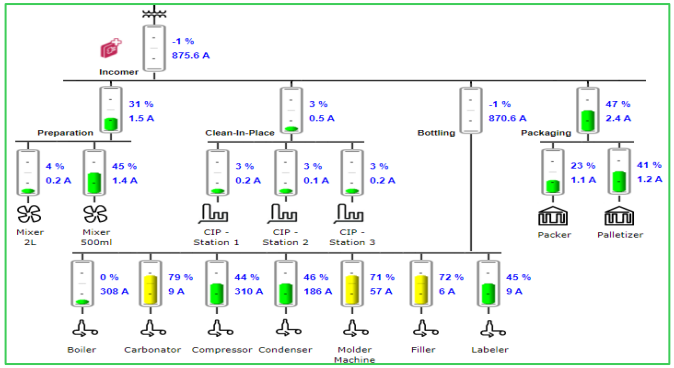
Monitor the capacity of electrical distribution

Primary Department

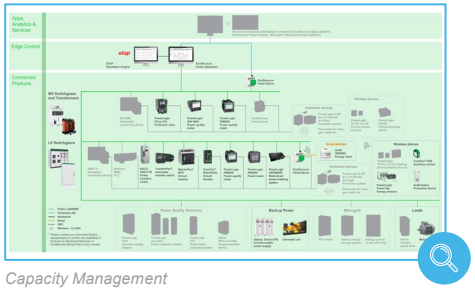
- Facility Operations & Maintenance

Benefits

- Monitor electrical network capacity
- Track and review capacity efficiency
- Minimize downtime by tracking the capacity of transformers, circuit breakers, UPSs, generators, etc.



Breaker Capacity Single-line Diagram in EcoStruxure Power Operation



Capacity Management Reference Architecture

Learn more about:

- Capacity Management (IEC / NEMA)

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(Consultants & EPC)

Operate & Maintain
(Operators, maintenance team, service teams)

Improve Time to Market

- AC&DC electrical network bus design and simulation
- Electrical network short circuit simulation
- Network load flow and voltage drop simulation
- Device coordination and selectivity
- Arc fault protection and coordination
- Power quality simulation and modeling
- Renewable & microgrid energy storage sizing simulation
- Power system study

Increase Efficiency

- Operator training simulation
- Energy monitoring and usage analysis
- Energy performance, modeling and verification
- Capacity management

Improve Resiliency

- Predictive simulation
- Simulate before Operate
- Electrical distribution monitoring and alarming
- Power event analysis
- Asset performance
- Power quality monitoring and compliance
- Power quality and power factor correction
- Thermal and partial discharge monitoring
- Arc flash protection

Grow Sustainability

- Carbon neutrality consulting services
- Energy efficiency compliance
- Greenhouse gas reporting

Transverse Lifecycle Capabilities

Electrical Digital Twin

Green Premium

Cybersecurity

Predictive Simulation

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- Capabilities to Grow Sustainability

BIBLIOGRAPHY

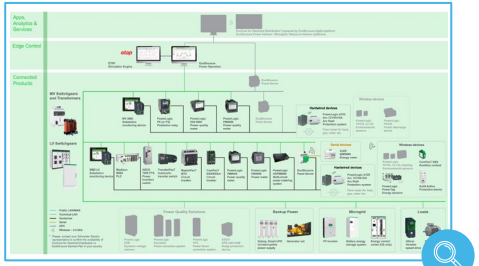
Help employees make better decisions

Primary Department

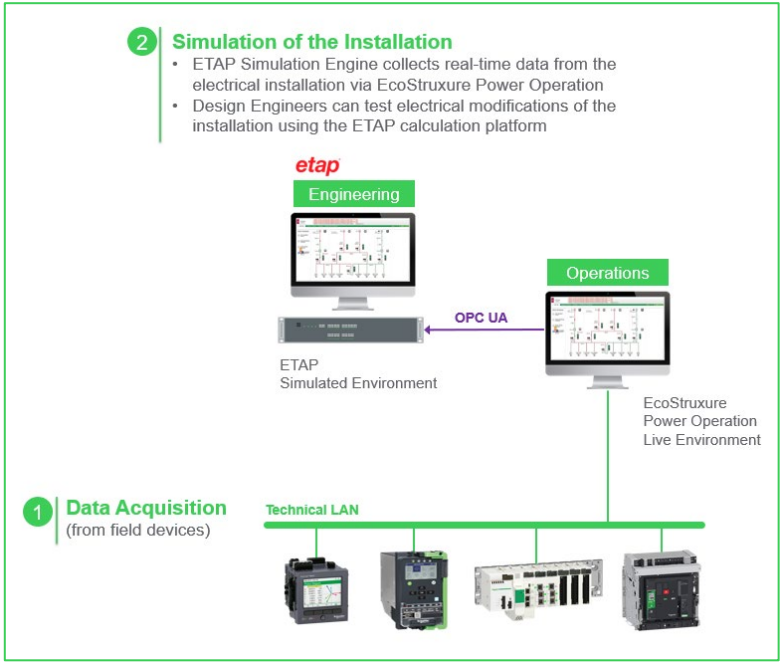
- Facility Engineering
- Design Engineering

Benefits

- Reduce safety risks by practicing emergencies and high-risk situations
- Enhance operational efficiency by running “what-if” scenarios
- Provide faster analysis response to incidents



Predictive Simulation Reference Architecture



Principle of Predictive Simulation Application

Apps, Analytics & Services

EcoCare for Electrical Distribution* powered by EcoStruxure digital platform
EcoStruxure Power Advisor / Microgrid / Resource Advisor platforms

Edge Control

ETAP Simulation Engine

EcoStruxure Power Operation

EcoStruxure Panel Server

Connected Products

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PowerLogic PD100 Partial discharge device

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SMD LV Substation monitoring device

Modicon M580 PLC

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OPC
Wireless – 2.4 GHz

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Power Quality Solutions

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Battery energy storage system

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Loads

Altivar Variable speed drive

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Predictive Simulation Reference Architecture

Simulate Before Operate

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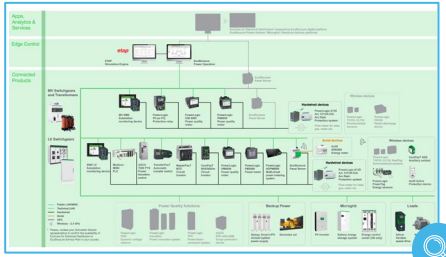
Empower operators with predictive outcomes

Primary Department

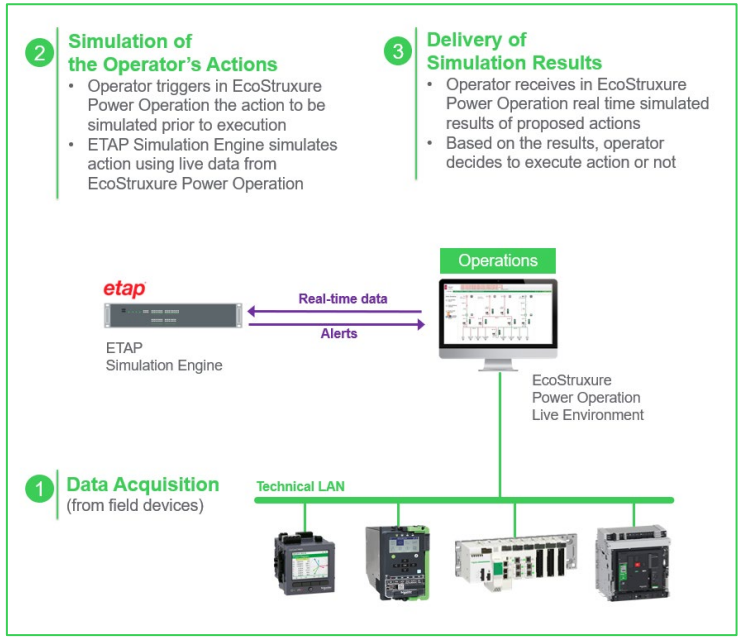
- Facility Operations & Maintenance

Benefits

- Provide operators with a list of potential side effects, prior to executing a command
- Empower employees to feel more confident when operating their facilities by providing real time guidance
- Reduce human error that could lead to outages or safety concerns



Simulate Before Operate Reference Architecture



Principle of Simulate before Operate Application

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Simulate Before Operate Reference Architecture

Electrical Distribution Monitoring and Alarming

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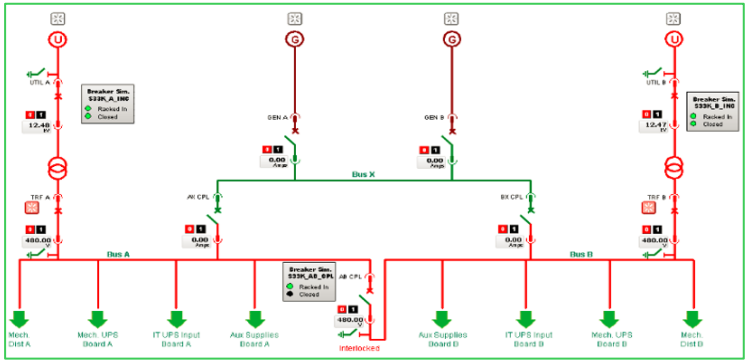
Monitor and control electrical network

Primary Department

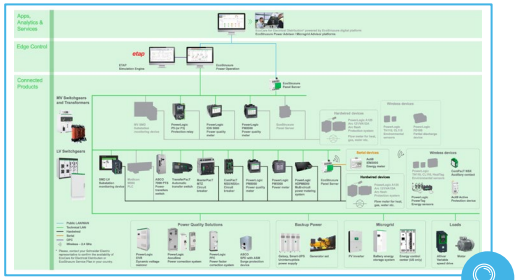
- Facility Operations & Maintenance

Benefits

- Show real-time status of the power distribution
- Customized single-line diagram
- 24/7 power monitoring and alarm notification



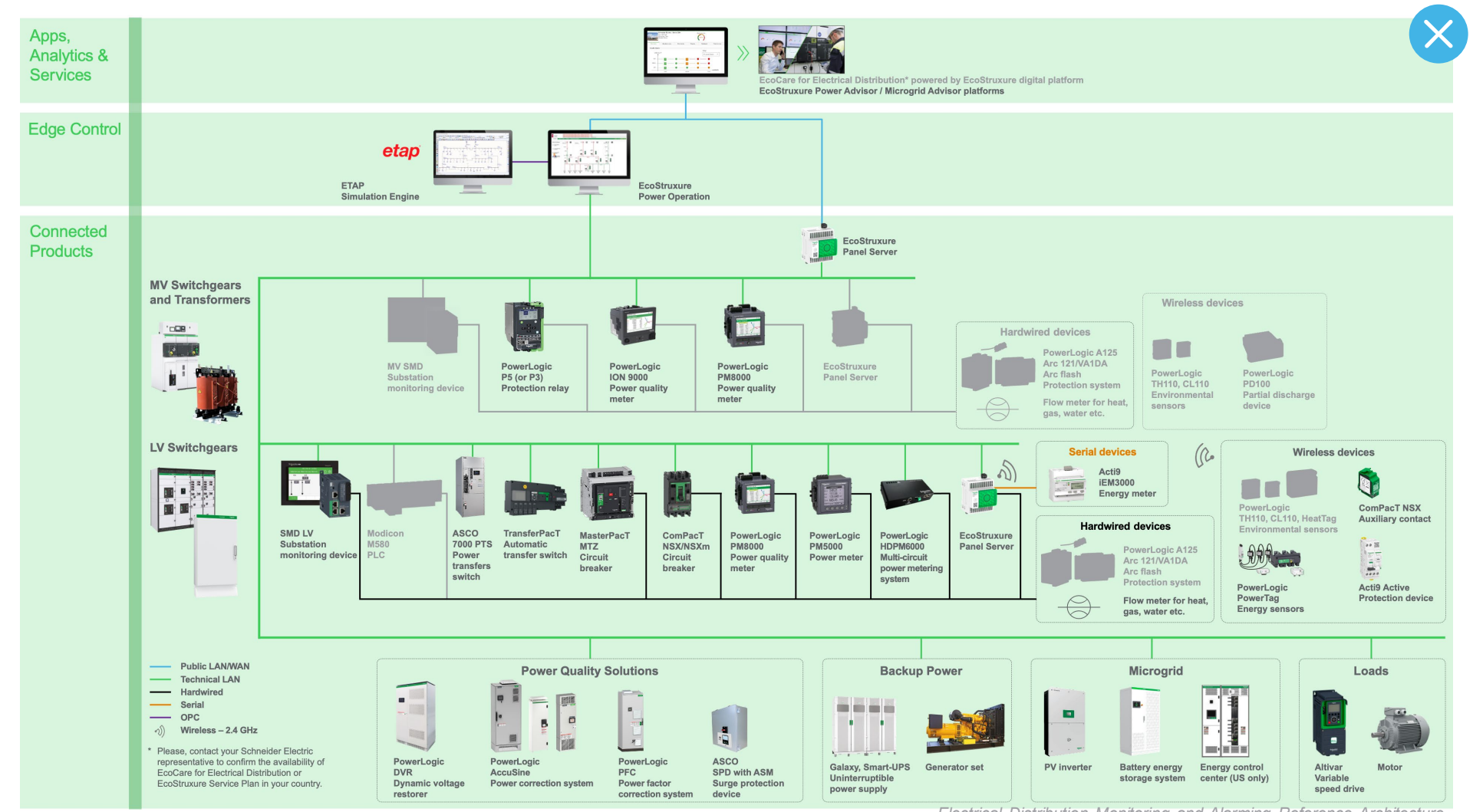
Electrical Distribution Monitoring and Alarming Single-line Diagram in EcoStruxure Power Operation



Electrical Distribution Monitoring and Alarming Reference Architecture

Learn more about:

- Electrical distribution monitoring and alarming (IEC / NEMA)
- Power Source and Load Control (IEC / NEMA)



Electrical Distribution Monitoring and Alarming Reference Architecture

Power Events Analysis

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BIBLIOGRAPHY

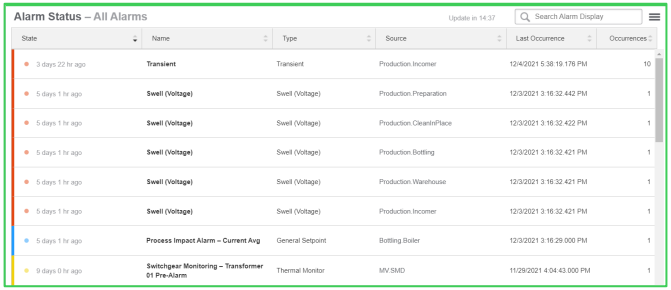
Analyze the root causes of electrical events

Primary Department

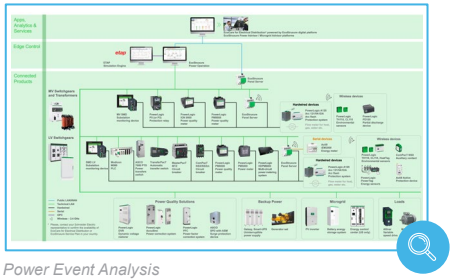
- Facility Operations & Maintenance

Benefits

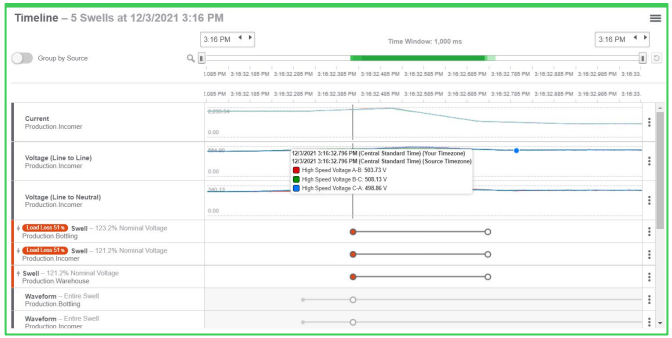
- Automatically classifies and describes any electrical events
- Uses system intelligence to determine root cause and location of events
- Shows context and sequence of events using the timeline analysis interface



Event and Alarm Status view in EcoStruxure Power Operation



Power Event Analysis Reference Architecture



Event and Alarm Status Timeline in EcoStruxure Power Operation

Learn more about:

- Power Event Analysis (IEC / NEMA)

Apps, Analytics & Services

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Power Events Analysis Reference Architecture

Asset Performance

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BIBLIOGRAPHY

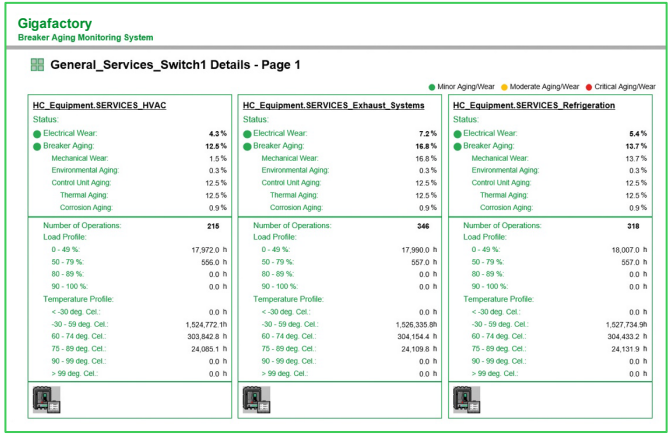
Benefit from a strategic maintenance approach

Primary Department

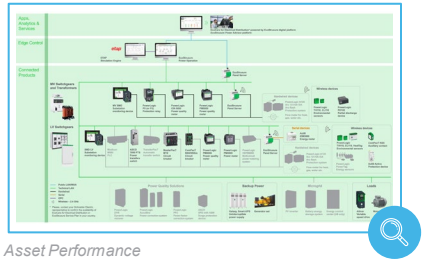
- Facility Operations & Maintenance

Benefits

- Move from reactive or preventive to condition-based (predictive) maintenance strategies for critical assets like circuit breakers, gensets, transformers, etc.
- Provide event details and notification to the operator if a protection setting has been changed
- Receive notifications and diagnostics reports from expert service engineers with recommendations to optimize maintenance by asset or site



Aging Diagram for Circuit Breakers in EcoStruxure Power Operation



Asset Performance Reference Architecture

Learn more about:

- Asset Performance (IEC / NEMA)

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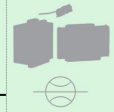

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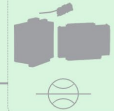

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Power Quality Monitoring and Compliance

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BIBLIOGRAPHY

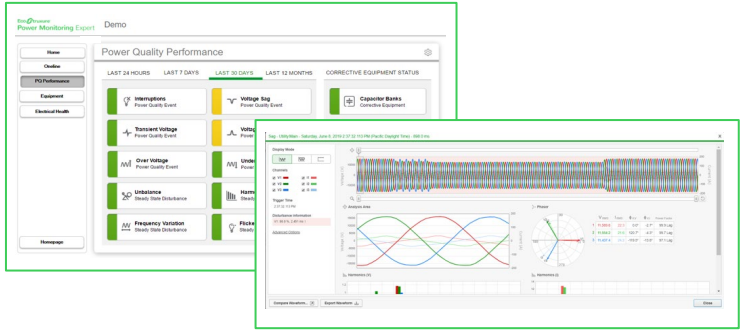
Gain insights to improve power quality and comply with standards

Primary Department

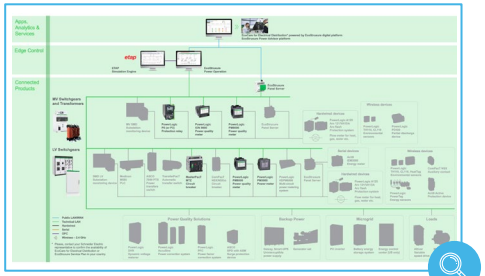
- Facility Operations & Maintenance

Benefits

- Bring awareness of power quality
- Enhance operational efficiency by making sure clean power is fed to sensitive process equipment
- Help protect sensitive equipment by tracking power quality problems before they arise



Power Quality and Compliance Dashboards in EcoStruxure Power Operation



Power Quality Monitoring and Compliance Reference Architecture

Schneider Electric — EN50160

4/12/2016 12:00:00 AM - 5/12/2016 12:00:00 AM (Server Local)

Complete Compliance in this Summary?											
					No						
Victoria_Bertram.DataCenter_Lab		Power Frequency	Supply Voltage Magnitude	Flicker	Supply Voltage Dips	Short And Long Interruptions	Temporary Overvoltages	Supply Voltage Unbalance	Harmonic Voltage	Interharmonic Voltage
Observation 1	4/16/2016	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observation 2	4/23/2016	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observation 3	4/30/2016	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observation 4	5/7/2016	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes

Power Quality and Compliance Report in EcoStruxure Power Operation

Learn more about:

- Power Quality Monitoring and Compliance (IEC / NEMA)

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Power Quality Monitoring and Compliance Reference Architecture

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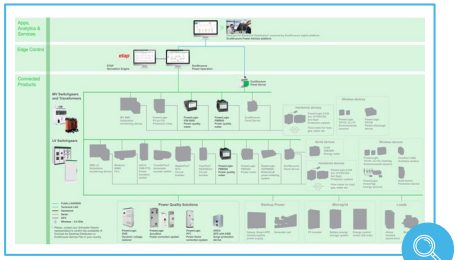
Help protect sensitive equipment from power quality issues

Primary Department

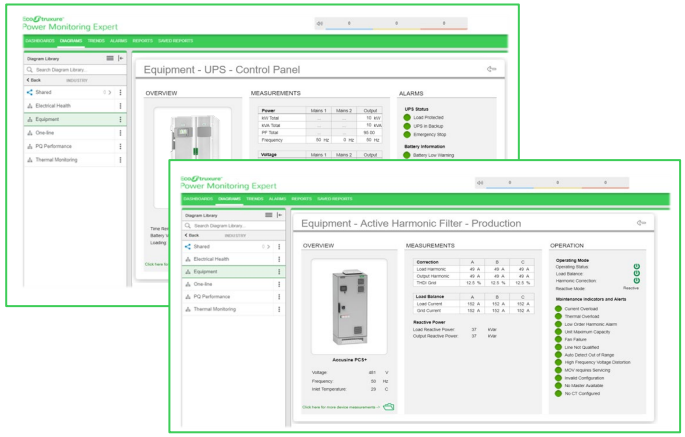
- Facility Operations & Maintenance

Benefits

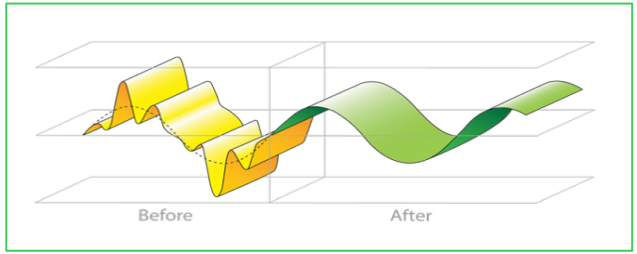
- Monitor sensitive process lines and busbars
- Provide clean power to sensitive process equipment
- Track Power Quality problems to help avoid downtime
- Reduce financial impact of power factor on energy bill



Power Quality and Power Factor Correction Reference Architecture



Power Quality Information in EcoStruxure Power Operation



Before and After Power Quality and Power Factor Correction Implementation

Learn more about:

- Power Quality Correction (IEC / NEMA)
- Power Factor Correction (IEC / NEMA)

Apps, Analytics & Services

EcoCare for Electrical Distribution* powered by EcoStruxure digital platform
EcoStruxure Power Advisor platform

Edge Control

etap

ETAP
Simulation Engine

EcoStruxure
Power Operation

EcoStruxure
Panel Server

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MV Switchgears and Transformers

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Substation
monitoring device

PowerLogic
P5 (or P3)
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ION 9000
Power quality
meter

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Power quality
meter

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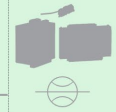
Panel Server

Hardwired devices



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Arc flash
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MTZ
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PowerLogic
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power metering
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EcoStruxure
Panel Server

Serial devices

Acti9
iEM3000
Energy meter

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Auxiliary contact

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PowerTag
Energy sensors

Acti9 Active
Protection device

Public LAN/WAN
Technical LAN
Hardwired
Serial
OPC
Wireless – 2.4 GHz

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Power Quality Solutions

PowerLogic
DVR
Dynamic voltage
restorer

PowerLogic
AccuSine
Power correction system

PowerLogic
PFC
Power factor
correction system

ASCO
SPD with ASM
Surge protection
device

Backup Power

Galaxy, Smart-UPS
Uninterruptible
power supply

Generator set

Microgrid

PV inverter

Battery energy
storage system

Energy control
center (US only)

Loads

Altivar
Variable
speed drive

Motor

Power Quality and Power Factor Correction Reference Architecture

Continuous Thermal Monitoring & Partial Discharge Monitoring

SECTION 1 – Introduction to the Semiconductor Fab Industry

SECTION 2 – How EcoStruxure Power Can Support the Semiconductor Fab

SECTION 3 – Digital Solutions and Services

- Introduction
- Overview of Digital Solutions and Services
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- Capabilities to Improve Time to Market
- Capabilities to Increase Efficiency
- Capabilities to Improve Resiliency
- Capabilities to Grow Sustainability

BIBLIOGRAPHY

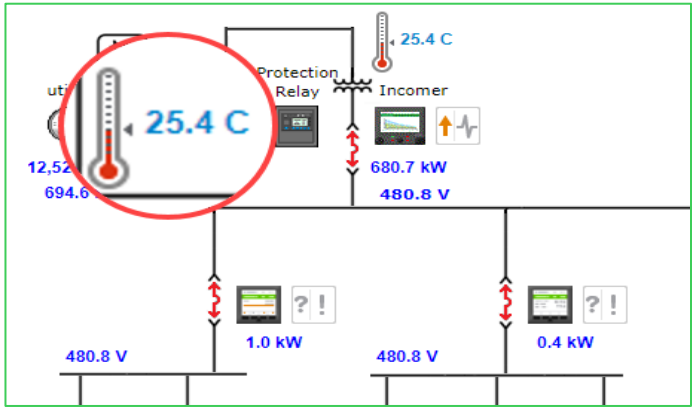
Help prevent electrical fires and help protect employees and equipment

Primary Department

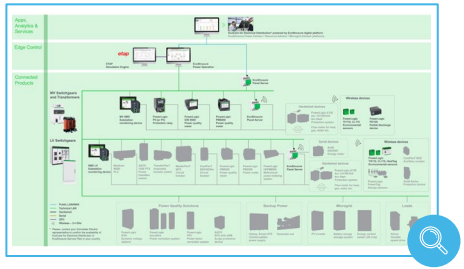
- Facility Operations & Maintenance

Benefits

- Provide early detection of internal arcing or temperature abnormalities in equipment that can cause damage
  - To help reduce the risk of equipment and electrical room damage
  - To improve service continuity
- Enable optimized maintenance schedules by providing continuous monitoring vs calendar-based service



Continuous Thermal Monitoring in the Single-line Diagram of EcoStruxure Power Operation



Continuous Thermal Monitoring & Partial Discharge Monitoring Reference Architecture

Learn more about:

- Continuous Thermal monitoring (IEC / NEMA)

Apps, Analytics & Services

EcoCare for Electrical Distribution* powered by EcoStruxure digital platform
EcoStruxure Power Advisor / Resource Advisor / Microgrid Advisor platforms

Edge Control

etap

ETAP
Simulation Engine

EcoStruxure
Power Operation

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OPC
Wireless – 2.4 GHz

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Altivar
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Continuous Thermal Monitoring and Partial Discharge Monitoring Reference Architecture

Arc Flash Protection

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- Capabilities to Improve Resiliency
- Capabilities to Grow Sustainability

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Primary Department

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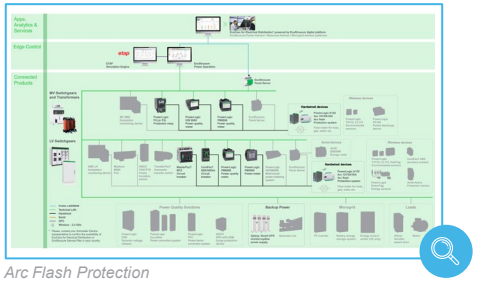
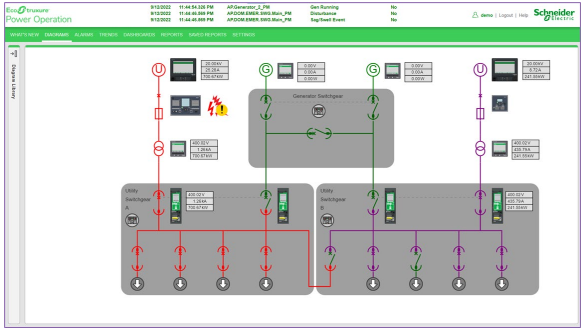
Benefits

- Help prevent loss of life and reduce the risk of equipment and electrical room damage
- Improve maintenance team awareness to help troubleshoot and identify the root cause of arc flash events

Arc Flash in a Switchboard



Arc Flash Protection Reference Architecture



Arc Flash Alert and Location in EcoStruxure Power Operation

Learn more about:

- Arc Flash Protection (IEC / NEMA)

Life Is On Schneider Electric

Apps, Analytics & Services

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EcoStruxure Power Advisor / Resource Advisor / Microgrid Advisor platforms

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SECTION 3 – Digital Solutions and Services

Introduction

Overview of Digital Solutions and Services

Transverse Lifecycle Capabilities

Capabilities to Improve Time to Market

Capabilities to Increase Efficiency

Capabilities to Improve Resiliency

Capabilities to Grow Sustainability ▶

BIBLIOGRAPHY

Capabilities to Grow Sustainability

Design, Build, Commission
(Consultants & EPC)

Operate & Maintain
(Operators, maintenance team, service teams)

Improve Time to Market

- AC&DC electrical network bus design and simulation
- Electrical network short circuit simulation
- Network load flow and voltage drop simulation
- Device coordination and selectivity
- Arc fault protection and coordination
- Power quality simulation and modeling
- Renewable & microgrid energy storage sizing simulation
- Power system study

Increase Efficiency

- Operator training simulation
- Energy monitoring and usage analysis
- Energy performance, modeling and verification
- Capacity management

Improve Resiliency

- Predictive simulation
- Simulate before Operate
- Electrical distribution monitoring and alarming
- Power event analysis
- Asset performance
- Power quality monitoring and compliance
- Power quality and power factor correction
- Thermal and partial discharge monitoring
- Arc flash protection

Grow Sustainability

- Carbon neutrality consulting services
- Energy efficiency compliance
- Greenhouse gas reporting

Transverse Lifecycle Capabilities

Electrical Digital Twin

Green Premium

Cybersecurity

Carbon Neutrality Consulting Services

EcoStruxure + Services

Track and reduce carbon emissions to demonstrate the carbon neutrality of the company

Primary Department

- Facility Operations & Maintenance
- Sustainability Office

Benefits

- Get support from our consulting services to define your strategy for achieving carbon neutrality

Carbon neutrality

1 Reduce Carbon Emissions	2 Produce Renewable Energy	3 Purchase Renewables/Offsets
Energy Efficiency • Sustainable building design & operations – HVAC Efficiency – Lighting Efficiency – Operational Efficiency	**Behind-the-Meter Renewables** • Solar Panels / Heating • Wind • Geothermal	**Purchase Renewables** • Renewable Power Purchasing Agreements (PPA) • Renewable Energy Certificates (REC) • Biofuels
	Supporting Technologies • Microgrid with Smart Management • Battery Storage • Fuel Cells	**Purchase Offsets** • Carbon Credits – Carbon Capture – Tree Planting

Energy Efficiency Compliance

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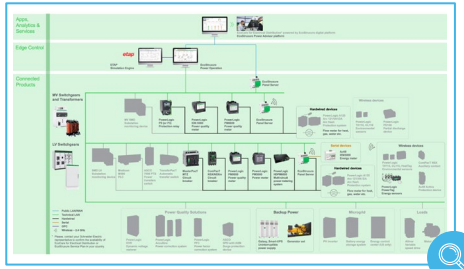
Comply with standards related to energy management systems

Primary Department

- Facility Operations & Maintenance
- Sustainability Office

Benefits

- Report and show facility compliance to local sustainability requirements
  - To benefit from tax credits
  - To gain credibility to participate in new projects



Energy Efficiency Compliance Reference Architecture

Sustainable Organizations and Standards

EcoStruxure Resource Advisor Dashboard in EcoStruxure Power Operation

EcoStruxure Power Operation Energy Star Compliance Dashboard

Learn more about:

- Energy Efficiency Compliance (IEC / NEMA)

Apps, Analytics & Services

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Edge Control

etap

ETAP Simulation Engine

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Loads

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Motor

Energy Efficiency Compliance Reference Architecture

Greenhouse Gas Reporting

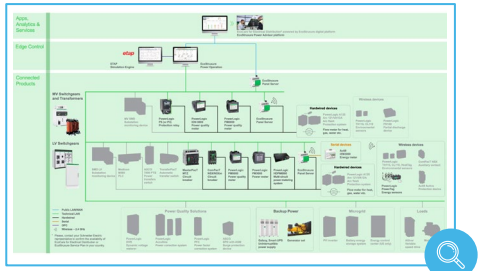
Track and report carbon emissions

Primary Department

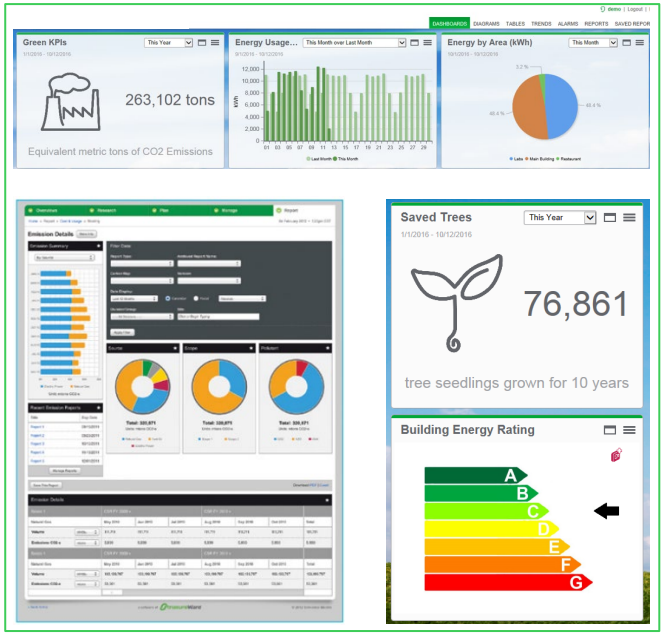
- Facility Operations & Maintenance
- Sustainability Office

Benefits

- Track and report carbon emissions and waste (e.g., water) in one single place
- Provide period-over-period usage comparison to detect a drift



Greenhouse Gas Reporting Reference Architecture



Greenhouse Gas Reporting and Dashboard Examples in EcoStruxure Power Operation

Learn more about:

- Greenhouse Gas Reporting (IEC / NEMA)

Apps, Analytics & Services

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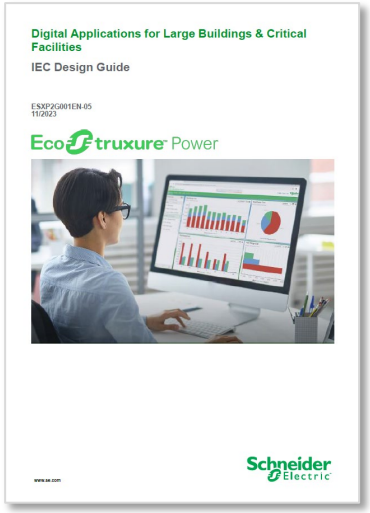
Design Guide



Digital Applications for Large Buildings and Critical Facilities

The Digital Applications Design Guide provides comprehensive details on the building blocks of EcoStruxure Power: the IoT applications are driven by a software layer to control the traditional electrical distribution infrastructure.

Developed to help engineering consultants and designers, this guide is an invaluable resource for specifying, designing and prescribing EcoStruxure Power architectures capable of performing one or more of the business-driven applications described within.

Landing page:
https://www.se.com/ww/en/work/campaign/innovation/power-digital-applications-design-guide.jsp

IEC EcoStruxure Power Design Guide
Ref: ESXP2G001EN
02/2024

Web version
https://www.se.com/ww/en/download/document/ESXP2G001EN/

PDF version
https://go.schneider-electric.com/WW_202004_Digital-Applications-for-Large-Buildings-and-Critical-Facilities_EA-LP.html

NEMA EcoStruxure Power Design Guide
Ref: 0100DB1802
01/2024

Web version
https://www.se.com/us/en/download/document/0100DB1802/

PDF version
https://go.schneider-electric.com/WW_202004_Digital-Applications-Design-Guide_EA-LP.html

SECTION 1 – Introduction to the Semiconductor Fab Industry

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SECTION 3 – Digital Solutions and Services

BIBLIOGRAPHY

Reference Documents

Legal Information ▶

Legal Information

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France
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