



EcoStruxure™ Power for Railway and Urban Transportation

Leveraging Digital Solutions and Services to Build More Reliable, Efficient and Sustainable Infrastructure

01/2025



EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Table of Contents



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SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

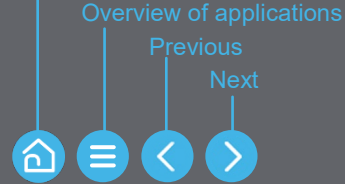
- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Table of Contents



Purpose of the Document

Target Audience

This document is intended to address Design Firms, End Users, Engineering, Operations and Maintenance, Consultants, Specifiers, EPCs and Service teams, and other qualified personnel.

Objective

To understand how EcoStruxure Power for Railway can help improve electrical safety, power reliability and sustainability across Railway and Urban Transportation facilities.

The document deep dives into the various facilities across Railway and Urban Transportation to address specific customer pain points.

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Table of Contents

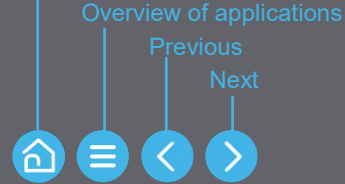


Table of Contents

SECTION 1: Introduction to the Railway and Urban Transportation Market

Introduces the market, trends, segmentation, facilities
and key challenges of the Railway and Urban Transportation
industry.

SECTION 3: Digital Solutions and Services across the Facilities

Provides information regarding the different types of facilities within
the Railway and Urban Transportation industry, and outlines
customized solutions along with electrical and digital architectures:

- 1. Overhead Lines
- 2. Traction Substations
- 3. Auxiliary Powers
- 4. Passenger Stations
- 5. eBus Depots
- 6. Tunnel Systems
- 7. Depots and Workshops
- 8. Control Center

SECTION 2: How EcoStruxure Power Can Support the Railway and Urban Transportation Segment

Describes the solutions that EcoStruxure Power
provides for the industry with an overview of
applications along with typical electrical and digital
architectures.

SECTION 4: Design considerations

Details the recommendations and guidelines to be considered
for deploying digital architecture for Railway and Urban
Transportation. Provides details of key system considerations
across communications, data, time and cybersecurity.

SECTION 5: Customer Stories

Discover our customer stories across the globe to see how
Schneider Electric has helped to overcome Railway
challenges and pain points.

BIBLIOGRAPHY

Contains useful documents and links to find out more
about capabilities and applications across the industry.

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market ▼

Railway Market Outlook

Railway Market Segmentation

Railway Facilities

Railway Challenges

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

SECTION 1

Introduction to the Railway and Urban Transportation Market

WHY READ THIS SECTION?

The objective of this section is to:

- Introduce the Railway and Urban Transportation **market growth, trends and segmentation**
- List the different **types of facilities** across Railway & Urban transportation
- Present the **industry challenges**



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

Railway Market Outlook

Railway Market Segmentation

Railway Facilities

Railway Challenges

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Railway and Urban Transportation Market Outlook

Market growth: Rail is a key driver for country's sustainable economic development

Move towards NetZero

In 2019, UIC (International Union of Railways) took the pledge to achieve **carbon neutrality by 2050**.



Increased Rail Traffic Growth

+2-3% per year expected until 2030 for passenger and freight



Maintenance Savings

Up to 40% savings in maintenance if reliability improvements are deployed in an infrastructure.



Most Preferred Public Transportation

2/3rd of business travellers from UK to Europe prefer train travel, as do 77% of leisure passengers.



Increased Electrification of Public Transport Fleets

+27.2% CAGR YoY growth of eBus market (2019-2027).

Sustainable Urbanization



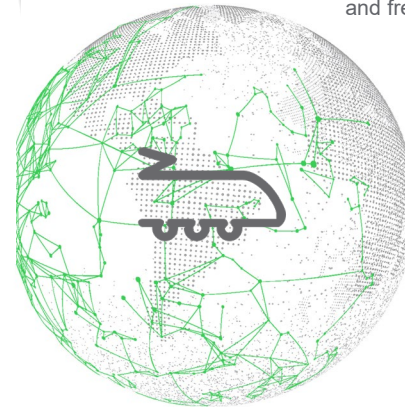
68% of the world's population will be urban by 2050 versus 55% today.

43 megacities of more than 10 million inhabitants by 2030

Acceleration of Digital Transformation



European Union invests estimated €6.2B in EU grants from CEF (Connecting Europe Facility) as strategic investment for transportation infrastructure.





Sources

OECD: Strategic Transport Infrastructure Needs to 2030:

<https://web-archive.oecd.org/2017-03-17/89986-49094448.pdf>

UN: 68% of the world population projected to live in urban areas by 2050:

<https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>

MDPI: Greenhouse Gas Emissions in Railways: Systematic Review of Research Progress

<https://www.mdpi.com/2075-5309/14/2/539>

Railway Technology: Cybersecurity: how to secure complex rail networks from digital threats

<https://www.railway-technology.com/comment/cybersecurity-how-to-secure-complex-rail-networks-from-digital-threats/?cf-view>

Businesswire: Global Electric Bus Market Size is Projected to Grow from 137 Thousand Units in 2019 to Reach 935 Thousand Units by 2027, at a CAGR of 27.2%

<https://www.businesswire.com/news/home/20200106005649/en/Global-Electric-Bus-Market-Size-is-Projected-to-Grow-from-137-Thousand-Units-in-2019-to-Reach-935-Thousand-Units-by-2027-at-a-CAGR-of-27.2---ResearchAndMarkets.com>

IDCON Inc: Reliability Improvements Drive Down Maintenance Costs

<https://www.idcon.com/resource-library/leadership-in-maintenance/reliability-lowers-maintenance-costs/>

UIC: RAILWAY CLIMATE RESPONSIBILITY PLEDGE

<https://uic.org/sustainability/energy-efficiency-and-co2-emissions/railway-climate-responsibility-pledge>

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

Railway Market Outlook ▶

Railway Market Segmentation

Railway Facilities

Railway Challenges

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Railway and Urban Transportation Market Outlook

Market trends

Increased demand for railways driven by urbanization

High-speed rail (HSR) has been set up in succession in various developed and developing countries (1).



Focus on increased energy efficiency to reduce carbon emissions

28 European UIC* members have collectively committed to reducing CO₂ emissions by 50% by 2030 (per passenger-km and per tonne-km) (2).

Massive investment in the digitalization of railway infrastructures

The size of IoT in Railway market is estimated to reach \$50.58 billion by 2030, growing at a CAGR of 9.1% during 2023-2030 (3).



Protection of railway networks against cyber threats

Railway cybersecurity market is anticipated to reach USD 13.90 billion by the end of 2030 (4).

UIC*: International Union for railways

Sources

(1) <https://www.mdpi.com/2073-445X/11/10/1790>

(2) <https://uic.org/sustainability/energy-efficiency-and-co2-emissions/>

(3) <https://www.industryarc.com/Research/iot-in-railways-market-research-800191>

(4) <https://railmarketresearch.com/product/railway-cybersecurity-market-size-share-industry-analysis-forecast-to-2030/>

**SECTION 1 – Introduction to the Railway
and Urban Transportation Market**

Railway Market Outlook

Railway Market Segmentation ▶

Railway Facilities

Railway Challenges

**SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry****SECTION 3 – Digital Solutions
and Services across the Facilities**

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations**SECTION 5 – Customer Stories****BIBLIOGRAPHY**

Railway and Urban Transportation Market Segmentation



Four types of railway segmentation



High-speed

- Long distances
- Over 250 km/h



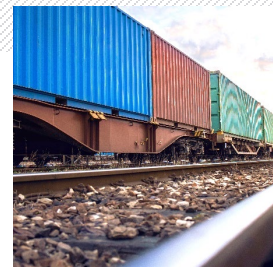
Main lines

- Medium-to-long distances
- Scheduled service



Commuter

- Short distances and many stops
- Low speed and high capacity



Freight

- Low or very low speed
- Diesel fuel

**SECTION 1 – Introduction to the Railway
and Urban Transportation Market**

Railway Market Outlook

Railway Market Segmentation ▶

Railway Facilities

Railway Challenges

**SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry****SECTION 3 – Digital Solutions
and Services across the Facilities**

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations**SECTION 5 – Customer Stories****BIBLIOGRAPHY**

Railway and Urban Transportation Market Segmentation



Four types of urban transportation segmentation

**Metro**

- High frequency & capacity
- Segregated from general roads

**Light Rail**

- Lower capacity & speed
- Operation in a street traffic environment

**Tramway**

- Lower capacity & speed
- Operation in a street traffic environment

**Buses**

- City buses stored & maintained in bus depots

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

Railway Market Outlook

Railway Market Segmentation

Railway Facilities

Railway Challenges

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

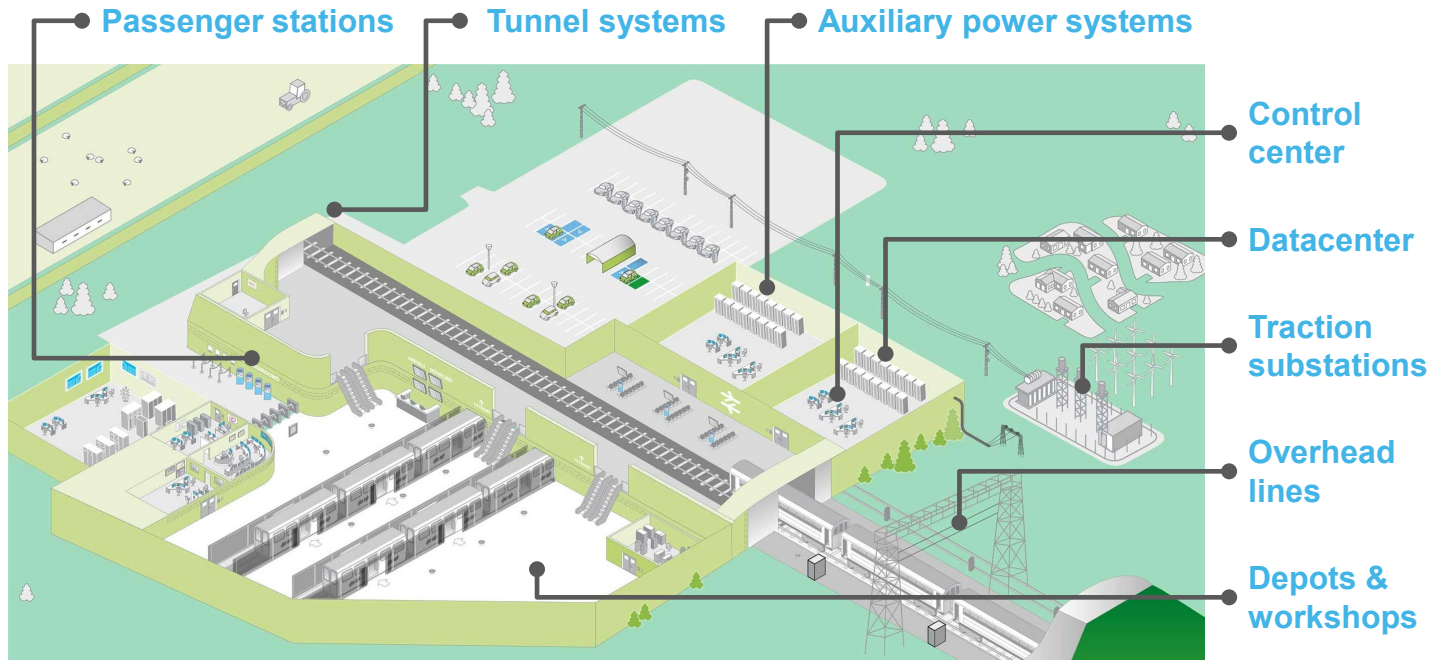
SECTION 5 – Customer Stories

BIBLIOGRAPHY

Railway and Urban Transportation Facilities

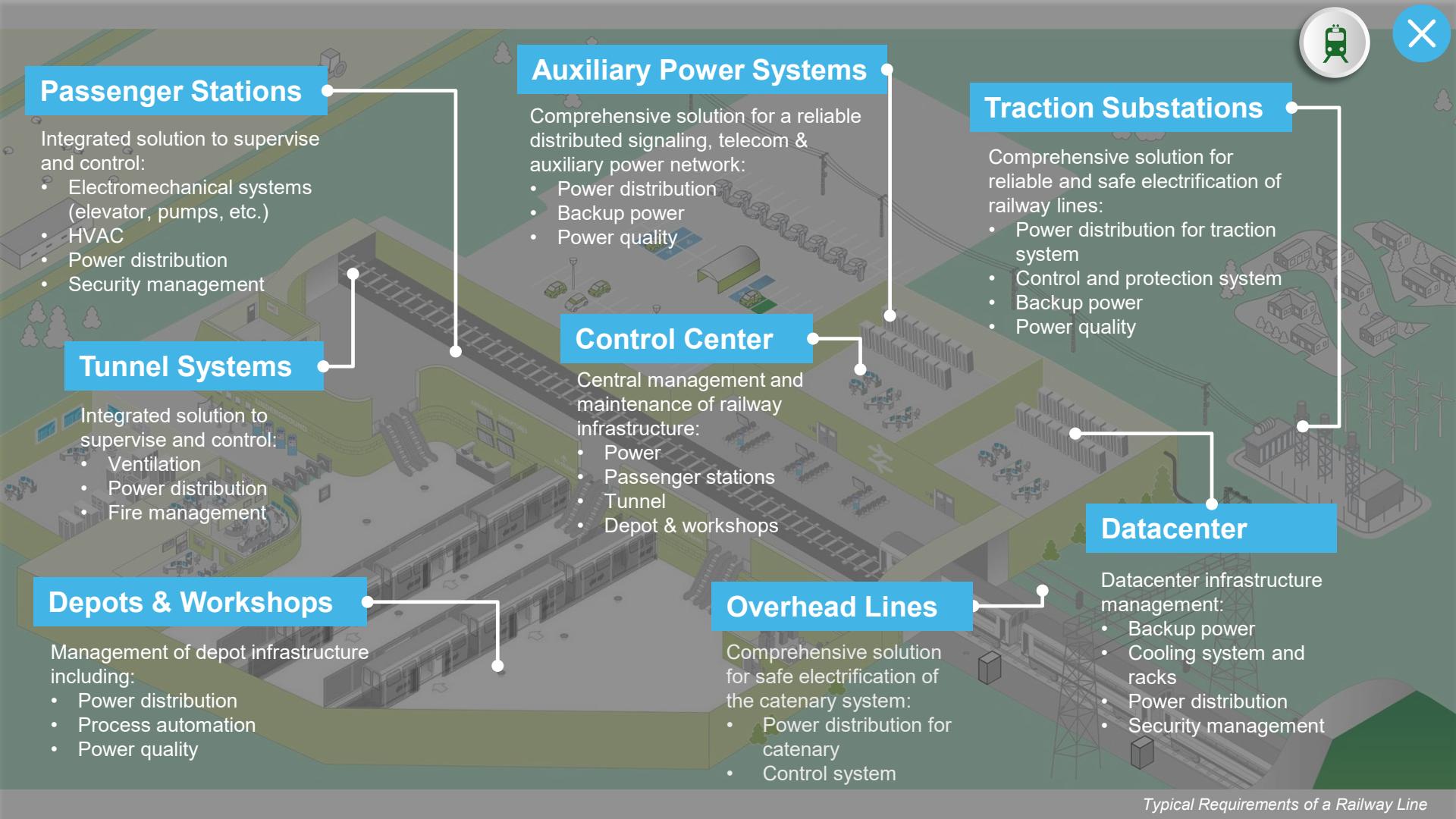


Railway facilities



[Click here for detailed view](#)





Passenger Stations

Integrated solution to supervise and control:

- Electromechanical systems (elevator, pumps, etc.)
- HVAC
- Power distribution
- Security management

Tunnel Systems

Integrated solution to supervise and control:

- Ventilation
- Power distribution
- Fire management

Depots & Workshops

Management of depot infrastructure including:

- Power distribution
- Process automation
- Power quality

Auxiliary Power Systems

Comprehensive solution for a reliable distributed signaling, telecom & auxiliary power network:

- Power distribution
- Backup power
- Power quality

Control Center

Central management and maintenance of railway infrastructure:

- Power
- Passenger stations
- Tunnel
- Depot & workshops

Overhead Lines

Comprehensive solution for safe electrification of the catenary system:

- Power distribution for catenary
- Control system

Traction Substations

Comprehensive solution for reliable and safe electrification of railway lines:

- Power distribution for traction system
- Control and protection system
- Backup power
- Power quality

Datacenter

Datacenter infrastructure management:

- Backup power
- Cooling system and racks
- Power distribution
- Security management

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

- Railway Market Outlook
- Railway Market Segmentation
- Railway Facilities
- Railway Challenges

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

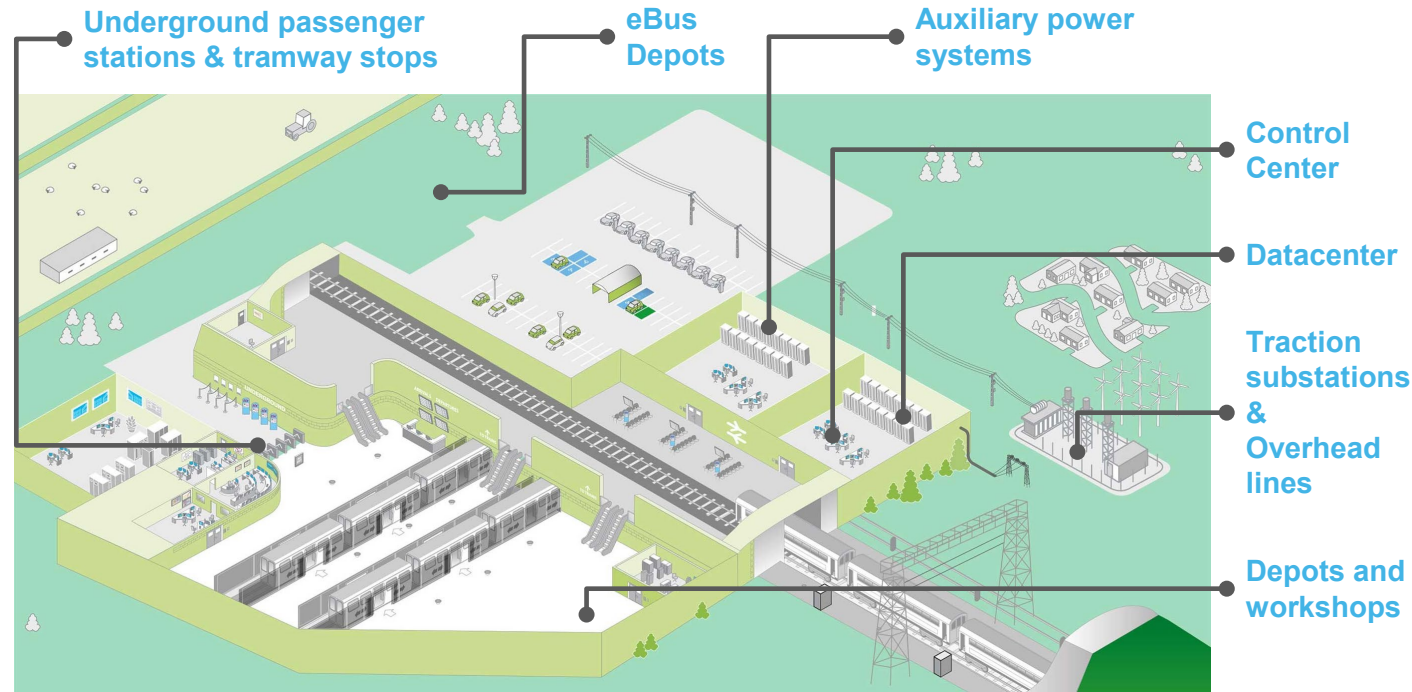
BIBLIOGRAPHY



Railway and Urban Transportation Facilities



Urban transportation facilities



[Click here for detailed view](#)





Underground Passenger Stations & Tramway Stops

Integrated solution to supervise and control:

- Electromechanical systems (elevator, pumps, etc.)
- HVAC & ventilation
- Power distribution
- Security management

Auxiliary Power Systems

Comprehensive solution for a reliable distributed signaling, telecom and auxiliary power network:

- Power distribution
- Backup power
- Power quality

eBus Depots

Integrated solution to supervise and control:

- Energy distribution
- Microgrid management
- Charging infrastructure
- Asset management

Traction Substations & Overhead Lines

Integrated solution for reliable and safe electrification of urban transportation lines:

- AC power distribution for traction system
- Integrated AC/DC control system
- Backup power
- Power quality

Depots & Workshops

Management of depot infrastructure including:

- Power distribution
- Process automation
- Power quality

Control Centers

Central management and maintenance of urban transportation infrastructure:

- Power
- Passenger stations
- Tunnel
- Depot & workshops

Datacenter

Datacenter infrastructure management:

- Backup power
- Cooling system and racks
- Power distribution
- Security management

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

Railway Market Outlook

Railway Market Segmentation

Railway Facilities

Railway Challenges

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Railway and Urban Transportation Challenges

An industry focused on the best possible passenger experience

Reliable Electrification



How to enable reliable electrification to avoid downtime, increase availability and improve operational efficiency for rail services?

Safety and Comfort



How to improve safety and comfort across the entire railway infrastructure to provide the best passenger experience?

Digitalization



How to adapt digitalization by maximizing the value from rail assets & ensure cybersecurity during the entire lifecycle?

Decarbonization



How can we contribute to the decarbonization of transportation market, reducing energy consumption, and integrating more renewable and sustainable energy sources?

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry ▼

Schneider Electric Solutions
EcoStruxure Digital Applications
Reference Digital Architectures

SECTION 3 – Digital Solutions and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

SECTION 2

How EcoStruxure Power Can Support the Railway and Urban Transportation Industry

WHY READ THIS SECTION?

The objective of this section is to:

- Describe how the **Schneider Electric value proposition** can support the industry and address the challenges and pain points
- Explain how **EcoStruxure Power applications** can support at facility level
- Recommend **digital architectures** for the infrastructure



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

Schneider Electric Solutions ▶

EcoStruxure Digital Applications
Reference Digital Architectures

SECTION 3 – Digital Solutions and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Schneider Electric Solutions to Address Railway Industry Challenges

Four pillars to meet your challenges and provide the best passenger experience

Reliable Electrification



Improve reliability of electrical infrastructure

- Provide automatic **power restoration and model digital twin** for traction substation system, passenger stations and tunnel systems along the tracks
- **Modernize** aging electrical distribution infrastructure

Safety and Comfort



Enhance safety and comfort in passenger stations and tunnels

- Enable **automation control** to improve:
- **Safety** in tunnels in case of emergency
 - **Comfort** of passengers in the stations

Digitalization



Operate centrally and maintain infrastructure efficiently

- Operate and maintain **the electrical infrastructure**, passenger stations, tramway stops, tunnels facilities and depots and workshops **centrally**
- **Break silos** and improve effective collaboration between operator's
- Mitigate **OT cybersecurity** risks

Decarbonization



Reduce energy consumption and carbon footprint

- Improve **energy efficiency** in passenger stations
- Optimize **microgrids** for passenger stations and depots
- **Electrify** bus depots. Manage and maintain the installation
- Provide sustainability consulting for **renewable energy sourcing**

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

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

Schneider Electric Solutions ▶

EcoStruxure Digital Applications
Reference Digital Architectures

SECTION 3 – Digital Solutions
and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Schneider Electric Solutions to Address Railway Industry Challenges

Why consider EcoStruxure Power solutions for your infrastructure?



From **Traction substations** to
passenger stations



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

EcoStruxure Power helps deliver an
end-to-end digital solution for efficient,
reliable and sustainable Railway and
Urban Transportation.

Our **comprehensive digital solution**,
enhanced by the Electrical Distribution
Digital Twin enables operations with
higher productivity

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

Schneider Electric Solutions

EcoStruxure Digital Applications

Reference Digital Architectures

SECTION 3 – Digital Solutions and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



EcoStruxure Power Digital Applications for Railway Industry

Discover EcoStruxure Power applications to support the challenges and pain points of the Railway industry:

List of applications by pillar and by sub-segment

	Overhead Line	Traction Substation	Auxiliary Power	Passenger Station	e-Bus Depot	Tunnel Systems	Depots & Workshops	Control Center
Reliable Electrification	Electrical Distribution Monitoring and Alarming	x	xxx	xxx	xxx	xxx	xxx	xxx
	Energy Monitoring	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Power Fault Analysis	x	xxx	xxx	xxx	xxx	xxx	xxx
	Power Quality Monitoring, Correction, and Compliance	xxx	xxx	xxx	xxx	xxx	xxx	xx
	Power Source and Load Control	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Safety and Control	Advanced Protection and Automation	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Overhead Line Protection and Automation	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Continuous Thermal Monitoring	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Guided Procedures Through Extended Reality	xx	xx	x	xx	xx	xx	x
	Vehicle Power Supply	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Digitalization	Vehicle Power Supply	x	x	x	x	x	x	x
	Control System Settings Monitoring	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Asset Performance	x	xx	xx	xx	xxx	xx	xx
	Customer Location Identification	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Unattended Remote Operation	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Decarbonization	Chemical Safety Control Management	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Asset Protection Maintenance	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Asset analytics	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Monitor Data Archive and Contextualization	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Real Time Energy Accounting	x	xxx	xxx	xx	xxx	xxx	xx

EcoStruxure Power Applications for Railway and Urban Transportation

Summary of products, Edge Control, apps and services required by application

Typical reference numbers to identify case	Overhead Line	Traction Substation	Auxiliary Power	Passenger Station	e-Bus Depot	Tunnel Systems	Depots & Workshops	Control Center
Electrical Distribution Monitoring and Alarming	x	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Energy Monitoring	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Power Fault Analysis	x	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Power Quality Monitoring, Correction, and Compliance	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xx
Power Source and Load Control	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Advanced Protection and Automation	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Overhead Line Protection and Automation	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Continuous Thermal Monitoring	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Guided Procedures Through Extended Reality	xx	xx	x	xx	xx	xx	xx	x
Vehicle Power Supply	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Vehicle Power Supply	x	x	x	x	x	x	x	x
Control System Settings Monitoring	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Asset Performance	x	xx	xx	xx	xxx	xx	xx	xx
Customer Location Identification	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Unattended Remote Operation	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Chemical Safety Control Management	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Asset Protection Maintenance	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Asset analytics	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Monitor Data Archive and Contextualization	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Real Time Energy Accounting	x	xxx	xxx	xx	xxx	xxx	xxx	xx
Electrical Distribution Monitoring and Alarming	x	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Energy Monitoring	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Power Fault Analysis	x	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Power Quality Monitoring, Correction, and Compliance	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xx
Power Source and Load Control	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Advanced Protection and Automation	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Overhead Line Protection and Automation	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Continuous Thermal Monitoring	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Guided Procedures Through Extended Reality	xx	xx	x	xx	xx	xx	xx	x
Vehicle Power Supply	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Vehicle Power Supply	x	x	x	x	x	x	x	x
Control System Settings Monitoring	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Asset Performance	x	xx	xx	xx	xxx	xx	xx	xx
Customer Location Identification	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Unattended Remote Operation	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Chemical Safety Control Management	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Asset Protection Maintenance	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Asset analytics	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Monitor Data Archive and Contextualization	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Real Time Energy Accounting	x	xxx	xxx	xx	xxx	xxx	xxx	xx

Summary for Products

Typical reference numbers to identify case	Overhead Line	Traction Substation	Auxiliary Power	Passenger Station	e-Bus Depot	Tunnel Systems	Depots & Workshops	Control Center
Electrical Distribution Monitoring and Alarming	x	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Energy Monitoring	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Power Fault Analysis	x	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Power Quality Monitoring, Correction, and Compliance	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xx
Power Source and Load Control	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Advanced Protection and Automation	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Overhead Line Protection and Automation	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Continuous Thermal Monitoring	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Guided Procedures Through Extended Reality	xx	xx	x	xx	xx	xx	xx	x
Vehicle Power Supply	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Vehicle Power Supply	x	x	x	x	x	x	x	x
Control System Settings Monitoring	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Asset Performance	x	xx	xx	xx	xxx	xx	xx	xx
Customer Location Identification	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Unattended Remote Operation	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Chemical Safety Control Management	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Asset Protection Maintenance	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Asset analytics	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Monitor Data Archive and Contextualization	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Real Time Energy Accounting	x	xxx	xxx	xx	xxx	xxx	xxx	xx

Summary for Edge Control, Apps and Services

		Overhead Line	Traction Substations	Auxiliary Power	Passenger Stations	e-Bus Depot	Tunnel Systems	Depots & Workshops	Control Center
Reliable Electrification	Electrical Distribution Monitoring and Alarming	■	■■■	■■■	■■■	■■■	■■■	■■■	■■■
	Capacity Management		■■	■■	■■■	■■■	■■	■■	■■■
	Power Event Analysis	■	■■■	■■■	■■■	■■■	■■■	■■■	■■■
	Power Quality Monitoring, Correction, and Compliance		■■■	■■■	■■■	■■■	■■■	■■■	■■
	Power Source and Load Control			■■■	■■■	■■■	■■■	■■■	
	Advanced Protection and Automation		■■■						
	Overhead Line Protection and Automation	■■■						■■■	■■■
Safety and Comfort	Continuous Thermal Monitoring		■■■	■■■	■■■	■■■	■■■	■■■	■■■
	Guided Procedures Through Extended Reality	■■	■■	■	■■	■■	■■	■■	■
Digitalization	Backup Power Testing		■■	■■	■■	■■	■■	■■	
	Circuit Breaker Settings Monitoring		■	■	■	■	■	■	■
	Asset Performance	■	■■	■■	■■	■■■	■■	■■	■■
	Operator Training Simulation								■■
	Simulate Before Operate								■■
	Cybersecurity Central Management								■■■
	Asset Preventive Maintenance								■■
	Asset analytics								■■
	Massive Data Archive and Contextualization								■■
	Rail Power Design								■■■
Decarbonization	Effective Energy Accounting		■	■■■	■■■	■■	■■■	■■■	■■
	Basic Energy Awareness			■■	■■	■	■■	■■	■■
	Advanced Energy Performance			■■	■■	■	■■	■■	■■
	Advanced Microgrid				■■	■■		■■	■■
	Energy and Environmental Compliance			■■	■■	■	■■	■■	■■
	Electrification (EV charging for eBus Depot)					■■■			■■
	Building Automation				■■■				■■■

■■■ Essential ■■ Recommended ■ Desirable



Typical reference numbers to identification

Electrical Distribution Monitoring and Alarming	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■			■	■
Capacity Management	■	■	■	■	■	■		■	■		■	■	■	■	■					■					
Power Event Analysis	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■		
Power Quality Monitoring, Correction, and Compliance			■					■			■	■			■		■	■	■	■					
Power Source and Load Control	■	■	■	■	■	■	■	■	■	■										■	■		■		
Advanced Protection and Automation		■	■	■	■																				
Overhead Line Protection and Automation																								■	
Continuous Thermal Monitoring			■	■							■				■	■									
Guided Procedures Through Extended Reality	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Backup Power Testing	■					■					■	■								■					
Circuit Breaker Settings Monitoring								■	■																
Asset Performance			■	■				■	■		■				■	■				■			■	■	
Effective Energy Accounting			■	■				■	■		■	■	■	■	■		■	■	■						
Basic Energy Awareness			■	■				■	■		■	■	■	■	■					■					
Advanced Energy Performance			■	■				■	■		■	■	■	■	■					■					
Advanced Microgrid			■	■		■		■	■		■									■					■
Energy and Environmental Compliance			■	■				■	■		■	■	■	■	■		■	■	■	■					
Electrification (EV charging for eBus Depot)																					■				■
Building Automation																					■	■			



	EcoStructure Power Monitoring Expert	EcoStructure Power Operation	etap (eTrax)	AVEVA System Platform	EcoStructure Building Operation	EcoStructure Cybersecurity Application Platform	EcoStructure Power Automation System	EcoStructure EV Charging Expert	EcoStructure Microgrid Operation	EcoStructure Asset Advisor (EcoCare)	Limble CMMS AVEVA certified partner	AVEVA Insight	AVEVA PI System	EcoStructure XR Operator Advisor	EcoStructure EV Advisor	EcoStructure Microgrid Advisor	EcoStructure Building Advisor
Electrical Distribution Monitoring and Alarming	■	■		■	■		■			■				■			
Capacity Management	■	■								■							
Power Event Analysis	■	■								■			■				
Power Quality Monitoring, Correction, and Compliance	■	■								■							
Power Source and Load Control		■				■	■										
Advanced Protection and Automation		■		■		■											
Overhead Line Protection and Automation		■		■													
Continuous Thermal Monitoring	■	■							■								
Guided Procedures Through Extended Reality													■				
Backup Power Testing	■	■															
Circuit Breaker Settings Monitoring	■	■															
Asset Performance	■	■		■					■								
Effective Energy Accounting	■	■								■							

More applications



	EcoStructure Power Monitoring Expert EcoStructure Power Operation etap (eTrax) AVEVA System Platform EcoStructure Building Operation EcoStructure Cybersecurity Application Platform EcoStructure Power Automation System EcoStructure EV Charging Expert EcoStructure Microgrid Operation EcoStructure Asset Advisor (EcoCare) Limble CMMS AVEVA certified partner AVEVA Insight AVEVA PI System EcoStructure XR Operator Advisor EcoStructure EV Advisor EcoStructure Microgrid Advisor EcoStructure Building Advisor																	
Basic Energy Awareness	■	■		■							■							
Advanced Energy Performance	■	■									■							
Advanced Microgrid	■							■								■		
Energy and Environmental Compliance	■	■									■							
Electrification (EV charging for eBus Depot)	■			■				■								■		
Building Automation				■	■													■
Operator Training Simulation		■	■	■														
Simulate Before Operate		■	■	■														
Cybersecurity Central Management						■												
Asset Preventive Maintenance											■							
Asset analytics												■	■					
Massive Data Archive & Contextualization													■					
Rail Power Design			■															

Back to previous applications

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

Schneider Electric Solutions
EcoStruxure Digital Applications
Reference Digital Architectures

SECTION 3 – Digital Solutions and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

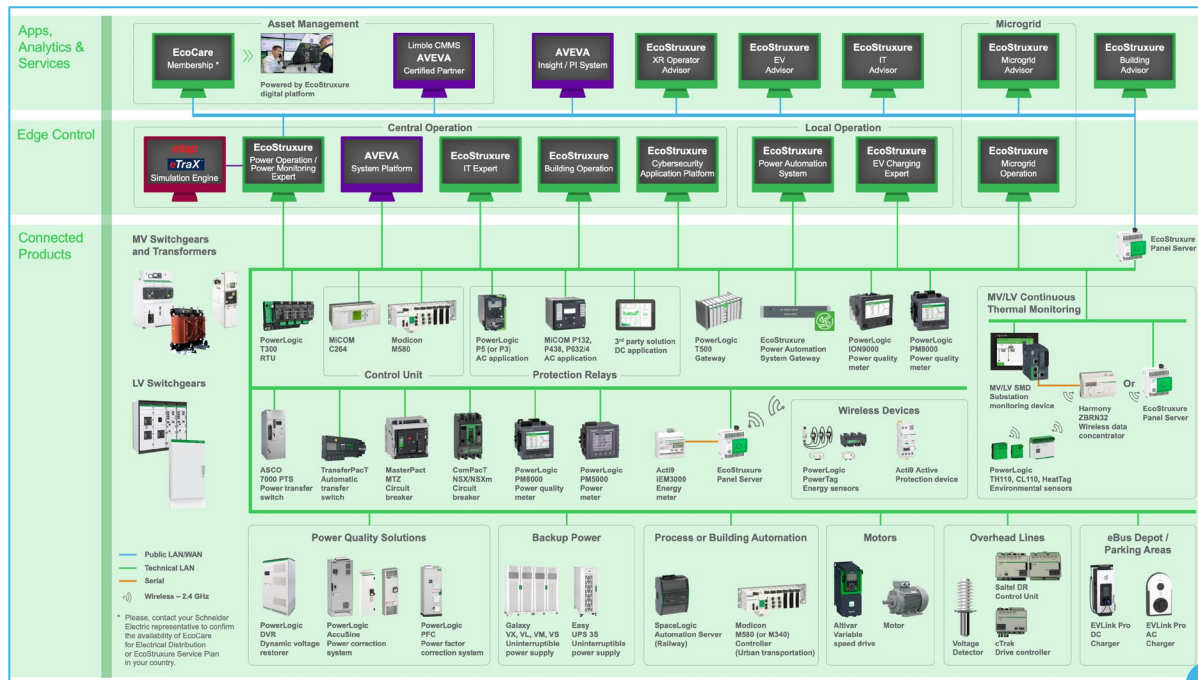
SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Reference Digital Architecture for Railway and Urban Transportation

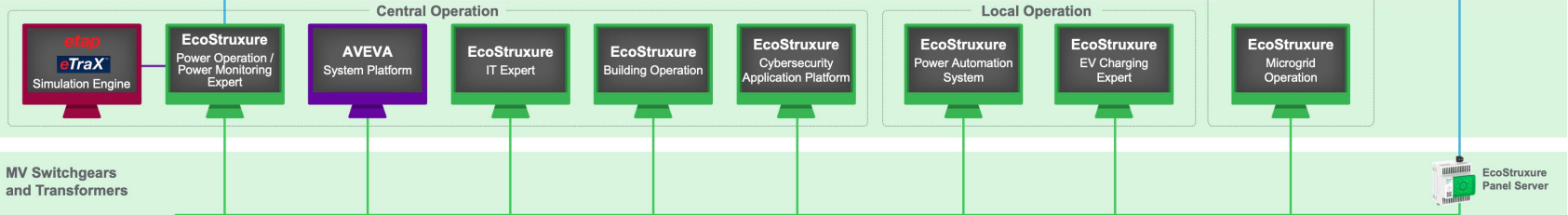
Our end-to-end digital solutions and services to digitalize your electrical distribution



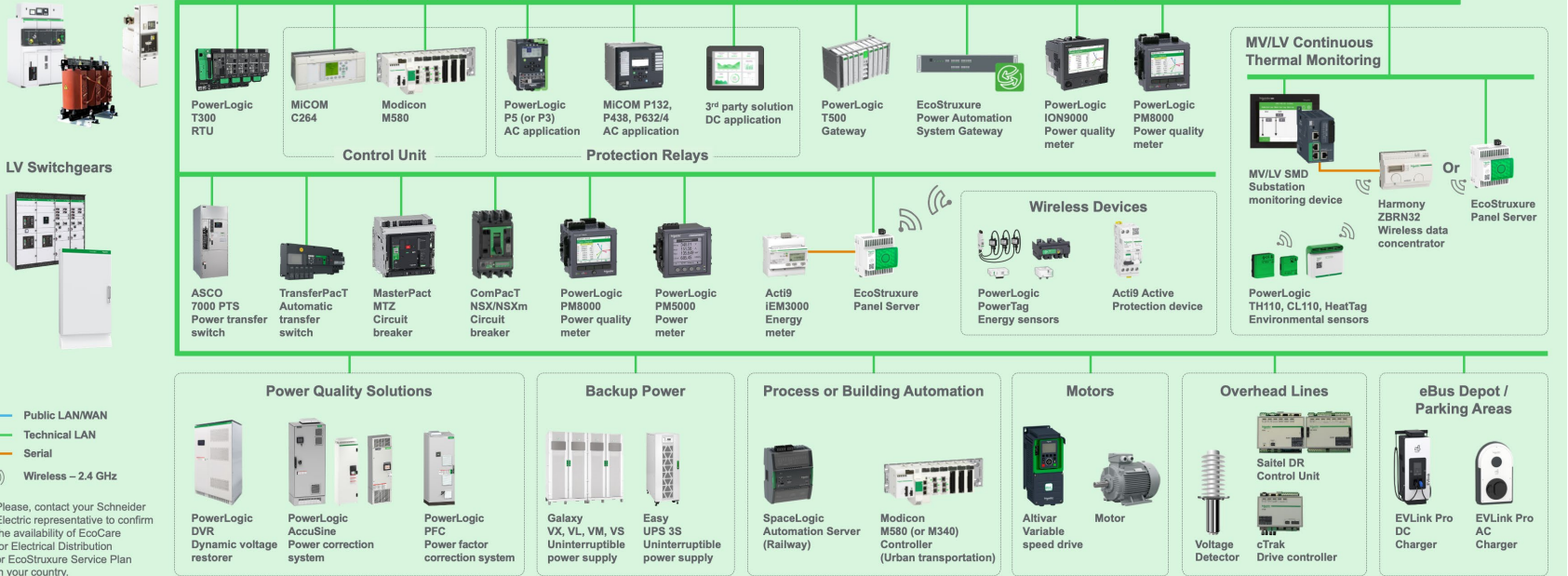
Apps, Analytics & Services



Edge Control



Connected Products



- Public LAN/WAN
- Technical LAN
- Serial
- 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.



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities ▼

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

SECTION 3

EcoStruxure Power
Digital Solutions and Services
for:

- Overhead Lines
- Traction Substations
- Auxiliary Power Systems
- Passenger Stations
- eBus Depots
- Tunnel Systems
- Depots and Workshops
- Control Center

WHY READ THIS SECTION?

The objective of this section is,
for each type of facility, to:

- Introduce **the facility**
- Review **EcoStruxure Power value propositions** and the **associated applications** for this facility
- Provide **reference electrical and digital architectures**





EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines ▼

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

SECTION 3

EcoStruxure Power
Digital Solutions and Services
for:

→ Overhead Lines

WHY READ THIS SECTION?

The objective of this section is to:

- Introduce **overhead lines**
- Review **EcoStruxure Power value propositions** and the **associated applications** for overhead lines
- Provide **reference electrical and digital architectures**



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Introduction to Overhead Lines

What is it?

The Overhead Line (OHL) system works as a distribution network from the traction substation to provide power to the moving rolling stock.

Electric trains collect their current from one of the following OHL devices:



Pantograph



Bow collector



Trolley pole

Alternative electrical power transmission schemes

Transportation means can also be supplied by:

- A third rail
- Ground-level power supply
- Batteries
- Electromagnetic induction

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

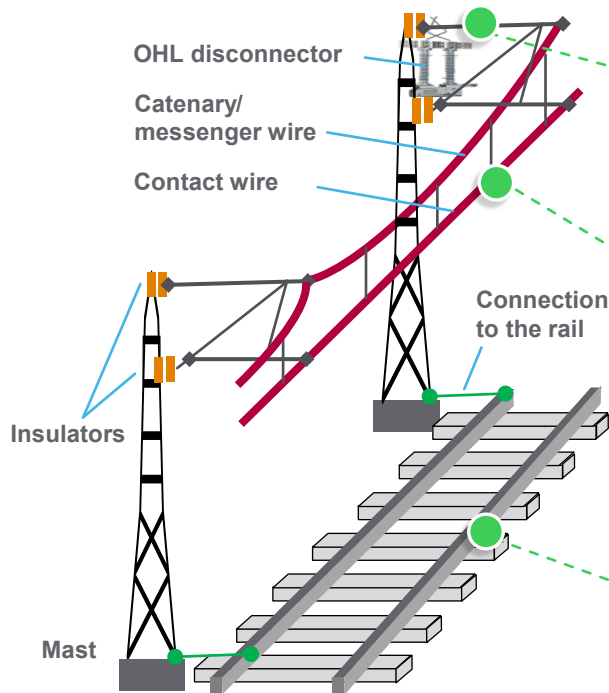
BIBLIOGRAPHY

Introduction to Overhead Lines

How does it work?

The overhead lines are located over the rail tracks and constituted of one or more:

- Contact wires supported by the catenary/messenger wires (in the case of electric trains)
- Overhead rails (in the case of rigid catenaries, like in metro and tunnels).



The overhead lines are fed with electrical energy from the traction substations which are located at regular intervals. The line is sectioned using disconnectors located at periodic intervals to:

- Allow the isolation of the sections in case of electric faults
- Allow maintenance tasks
- Separate different electrical zones

The overhead line is powered using high voltage electrical power:

- 1.5 - 3.5 kV in DC
- 25 kV in AC

Typically:

- Railway networks are serviced by AC power
- Urban Transportation networks are serviced by DC power

Rails are typically used as the return path for current, through the steel wheels of the train.



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

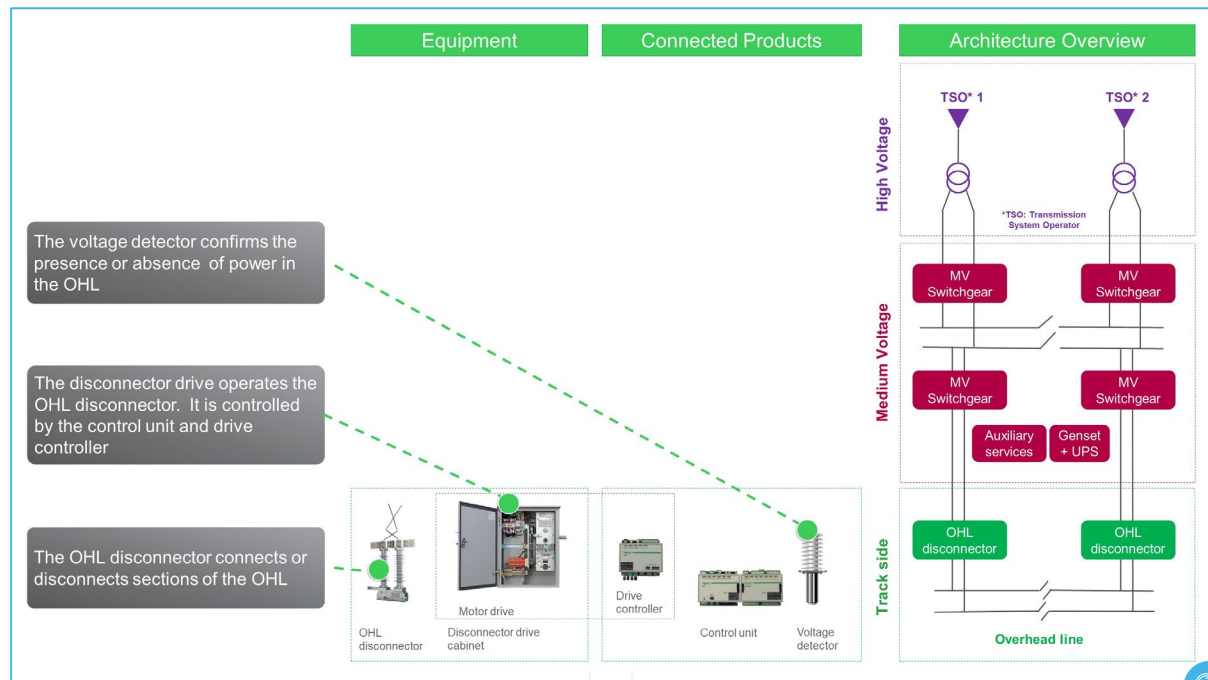
SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Introduction to Overhead Lines (OHL)

Main components of the electrical architecture solution



Equipment

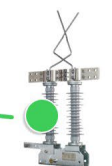
Connected Products

Architecture Overview

The voltage detector confirms the presence or absence of power in the OHL

The disconnecter drive operates the OHL disconnecter. It is controlled by the control unit and drive controller

The OHL disconnecter connects or disconnects sections of the OHL



OHL disconnecter



Motor drive
Disconnecter drive cabinet



Drive controller



Control unit



Voltage detector

High Voltage

TSO* 1

TSO* 2

*TSO: Transmission System Operator

Medium Voltage

MV Switchgear

MV Switchgear

MV Switchgear

MV Switchgear

Auxiliary services

Genset + UPS

Track side

OHL disconnecter

OHL disconnecter

Overhead line

Main Components for Overhead Lines

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

Introduction
EcoStruxure Value Proposition

Applications Overview
Reference Architectures

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

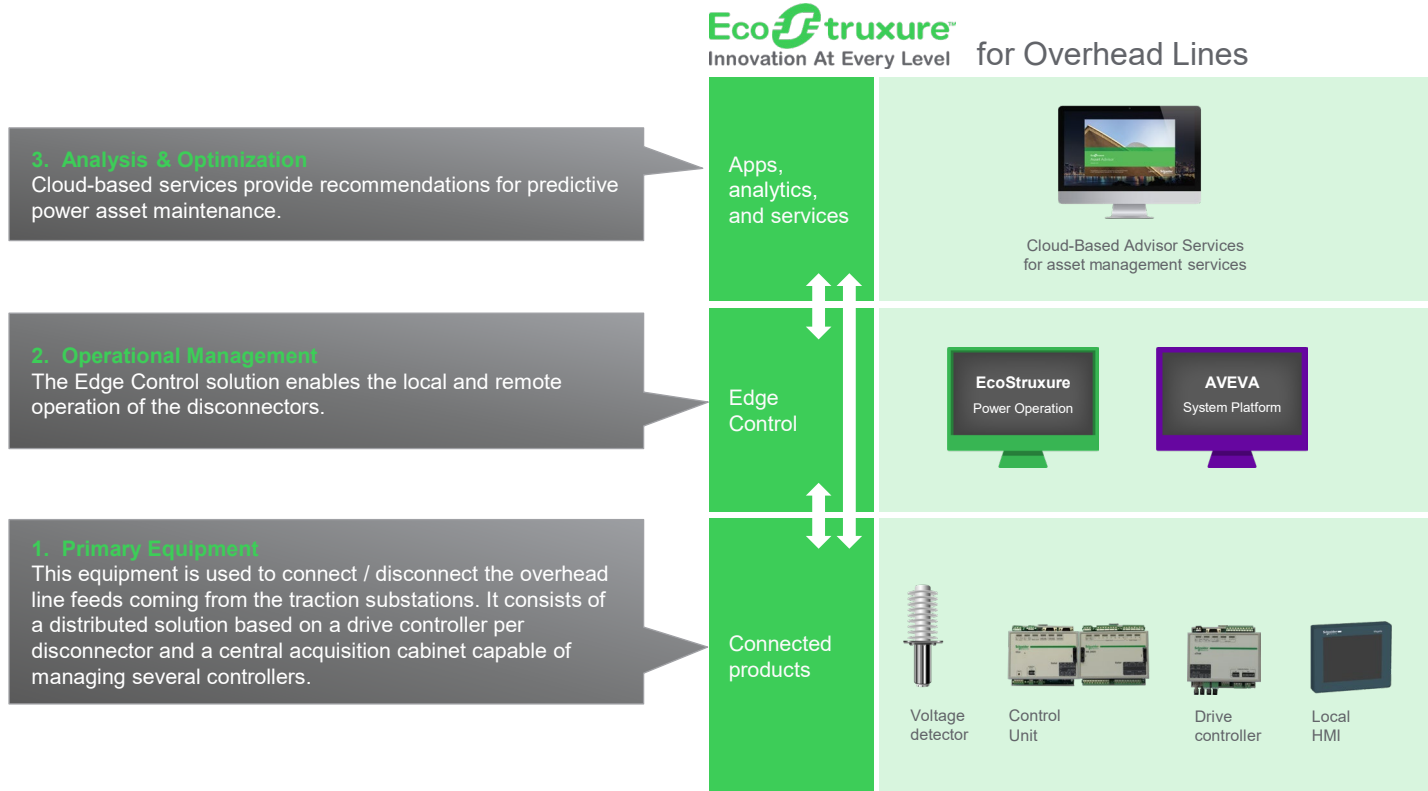
SECTION 5 – Customer Stories

BIBLIOGRAPHY



EcoStruxure Power Value Proposition

Our solution to control and supply energy to overhead lines



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

Introduction

EcoStruxure Value Proposition

Applications Overview
Reference Architectures

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

EcoStruxure Power Value Proposition

Specific pillars for overhead lines

EcoStruxure Power provides applications to support the challenges of Overhead Lines for Railway and Urban Transportation with the following pillars:

Reliable Electrification



Improve reliability of
electrical infrastructure

Electrical Distribution
Monitoring and Alarming

Power Event Analysis

Overhead Line Protection
and Automation

Safety and Comfort



Enhance safety and comfort in
passenger stations and tunnels

Guided Procedures Through
Extended Reality

Digitalization



Operate centrally and
maintain infrastructure efficiently

Asset Performance

Electrical Distribution
Monitoring and Alarming

Power Event Analysis

Overhead Line Protection
and Automation

Decarbonization



Reduce energy consumption
and carbon footprint



Our Digital Solutions and Services: Applications Overview

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Reliable Electrification

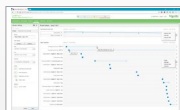
Electrical Distribution Monitoring and Alarming



- Provide real-time status of the electrical distribution system
- Help identify anomalies and notify the right personnel
- Aggregate onboard alarm data in an easy-to-understand way
- Take advantage of native integration of intelligent electrical devices

Reliable Electrification

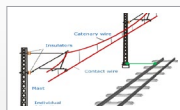
Power Event Analysis



- Provide a user-friendly graphical tool to simplify and save time in event analysis
- Provide an aggregated view of events in the same dashboard
- Enable root cause analysis

Reliable Electrification

Overhead Line Protection and Automation



- Provide distributed control and supervision of overhead (catenary) line disconnectors

Safety and Comfort

Guided Procedures Through XR



- Use Extended Reality to perform step-by-step guidance
- Benefit from "X-ray" vision and virtually overlaid contextual asset and site information, live data, events and alarms
- Take advantage of remote collaboration

Digitalization

Asset Performance



- Make asset health visible across the entire system
- Streamline inspections using continuous asset health monitoring
- Optimize maintenance planning with analytics and expert advice

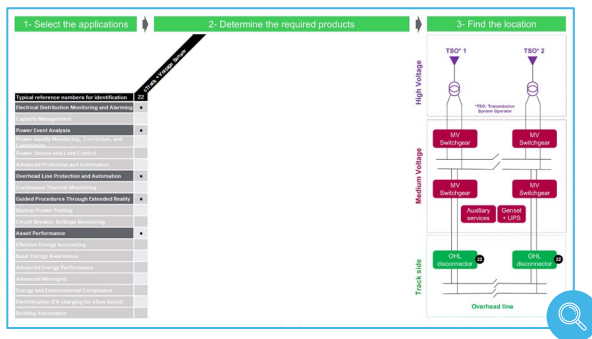


Reference Electrical and Digital Architectures

Typical electrical architecture

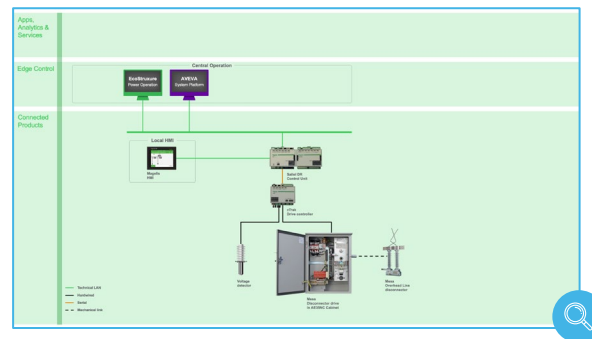
Find the Schneider Electric products necessary to implement the selected applications.

Then find their location in the electrical architecture.



Reference digital architecture

Find how the products, software solutions and cloud services are connected in the digital architecture.



1- Select the applications

2- Determine the required products

3- Find the location



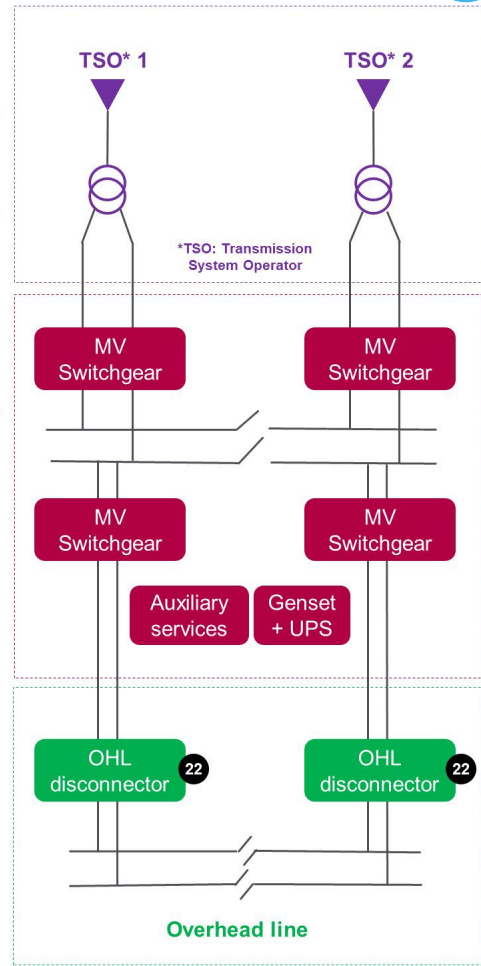
cTrack + Voltage Sensor

Typical reference numbers for identification	22
Electrical Distribution Monitoring and Alarming	■
Capacity Management	
Power Event Analysis	■
Power Quality Monitoring, Correction, and Compliance	
Power Source and Load Control	
Advanced Protection and Automation	
Overhead Line Protection and Automation	■
Continuous Thermal Monitoring	
Guided Procedures Through Extended Reality	■
Backup Power Testing	
Circuit Breaker Settings Monitoring	
Asset Performance	■
Effective Energy Accounting	
Basic Energy Awareness	
Advanced Energy Performance	
Advanced Microgrid	
Energy and Environmental Compliance	
Electrification (EV charging for eBus Depot)	
Building Automation	

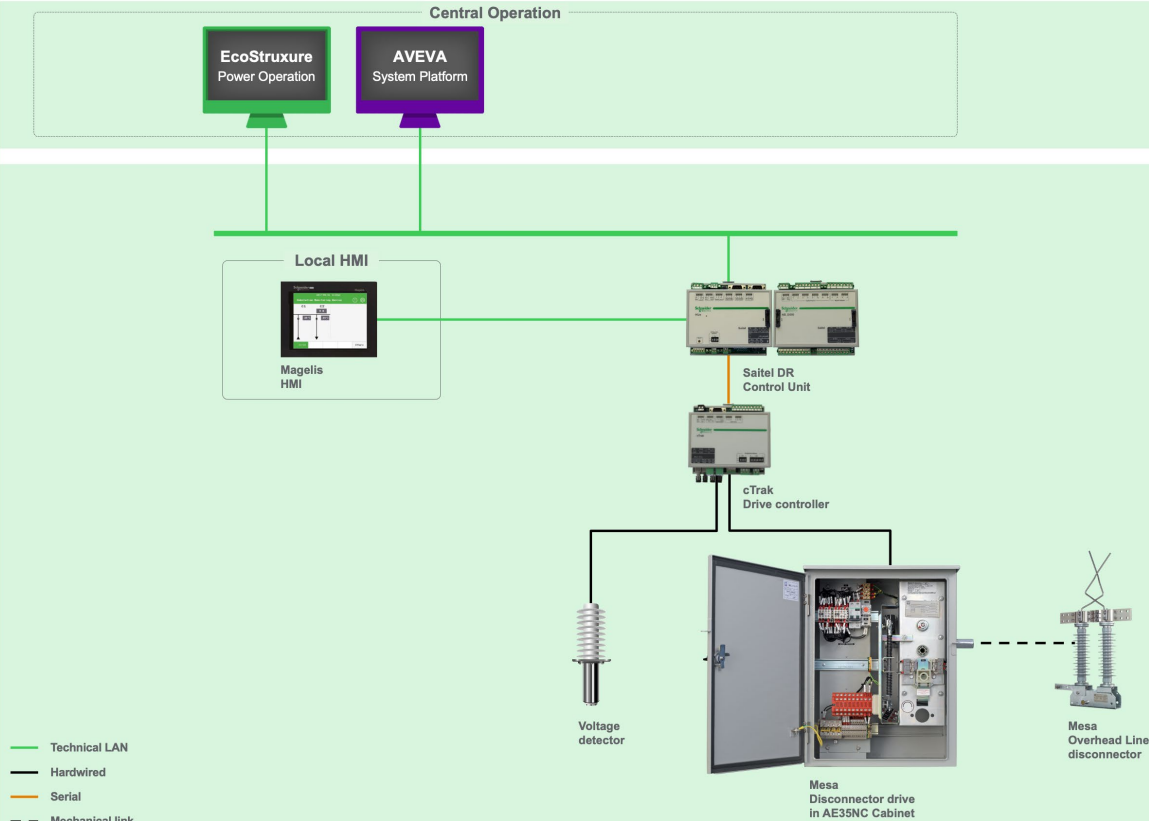
High Voltage

Medium Voltage

Track side



Typical Electrical Architecture for Overhead Lines





EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations ▼

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

SECTION 3

EcoStruxure Power
Digital Solutions and Services
for:

→ Traction Substations

WHY READ THIS SECTION?

The objective of this section is to:

- Introduce **traction substations**
- Review **EcoStruxure Power value propositions and the associated applications** for traction substations
- Provide **reference electrical and digital architectures**



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Introduction to Traction Substations

What is it?

- Electrical Traction Substations are responsible for supplying trains with electrical energy.
- These facilities manage approximately 75% of the electricity consumption of the entire railway system
- They have a direct impact on the reliability and punctuality of railway traffic.



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Introduction to Traction Substations

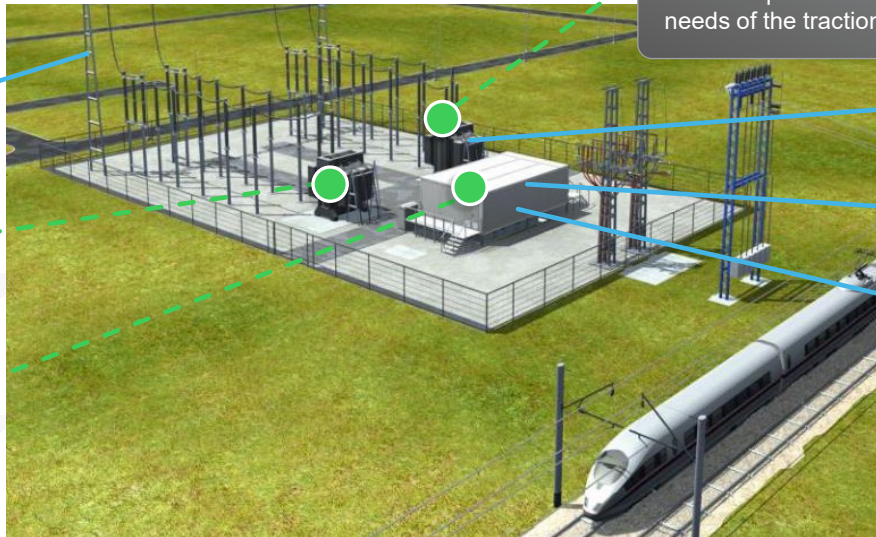
How does it work?

The Traction Substations are located at regular intervals (depending on AC or DC systems) along the railway. Their main elements are energy incomers, traction transformers, rectifiers (for DC only), feeders and auxiliary systems.

Energy incomers

Auxiliary systems
are necessary
for the operation
of the facility.

Feeders provide
energy to the
overhead line



Traction transformers and rectifiers (the latter for DC configurations) convert electrical parameters to the energy input needs of the traction system.

Traction transformers

Auxiliary systems

Feeders

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

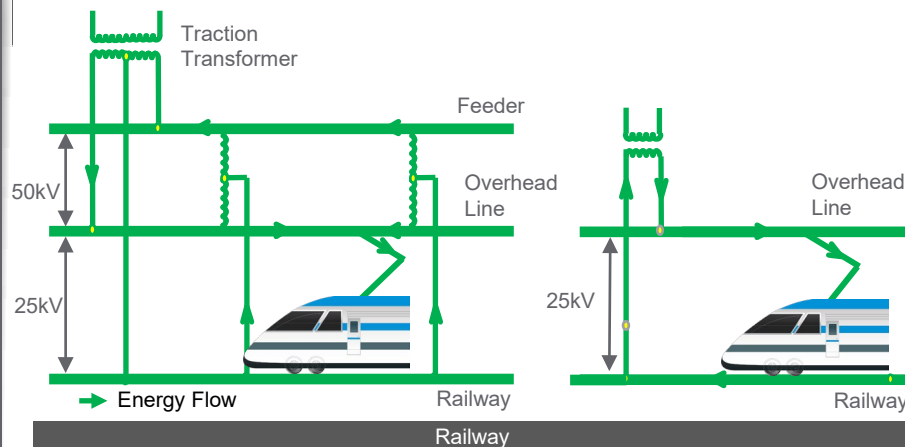
Introduction to Traction Substations

Two types of traction substations, depending on the type of traction

Type 1: Alternating Current Supply

This is most common in **Railway**.

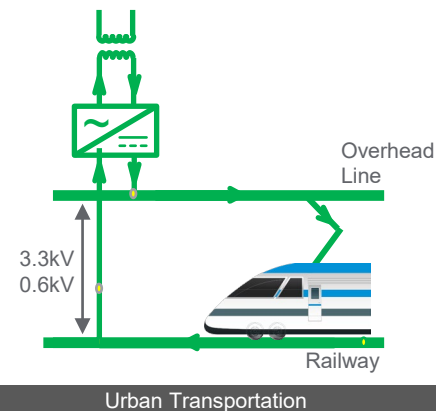
- ➔ Catenary supply voltage = **usually 25kV, sometimes 15kV**
- ➔ Two electrical configurations, depending on the number of phases in the secondary of the traction transformer:
 - 1x25 kV
 - 2x25 kV



Type 2: Direct Current Supply

It is most common in **Urban Transportation**.

- ➔ Catenary supply voltage = **600V- 3.3kV**



Comparison of Current Supplies



Depending on the installation, the overhead line is powered with a Direct Current (DC) or Alternating Current (AC) system.

Alternating Current (AC)

Main Application

Mainlines, high-speed lines

Catenary supply voltage

Usually 25kV, sometimes 15kV

Single-phase System (1x25 kV)

Supply

The overhead line is supplied with AC current with the following configuration:

- Single phase connected to the overhead line
- Current returns through a return path

Advantages

- Simple configuration. No need of intermediate transformer stations
- No need of feeder cable

Two-phase System (2x25 kV)

Supply

The overhead line is supplied with AC current with the following configuration:

- One phase connected to the overhead
- The other phase connected to a feeder conductor

Phases are 180 degrees out of phase resulting in voltage up to 50 kV voltage.

Advantages

- Higher energy capacity
- Fewer traction substations needed (but requires more simple intermediate transformer stations)
- Reduced electromagnetic interferences

Direct Current (DC)

Main Application

Urban transportation: metro, light rail, tramways

Catenary supply voltage

600V- 3.3kV

Supply

The traction system provides DC current to the overhead line.

The conversion to direct current requires the use of:

- Non-linear power electronic components (rectifiers),
- Three-winding voltage transformers
- Medium voltage feeder panels
- Electric protections specially adapted to this mode

Advantages

- Possibility to power a section with two sources in parallel
- Large installed base, making extensions easier if the rest of the line also uses DC current
- Better regulation of motor speed (before the advent of power electronics)

EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

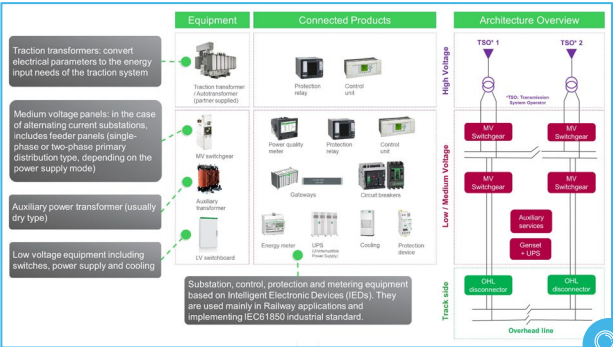
Introduction to Traction Substations

Main components of the electrical architecture

Type 1: Alternating Current Supply

Type 1 Substation

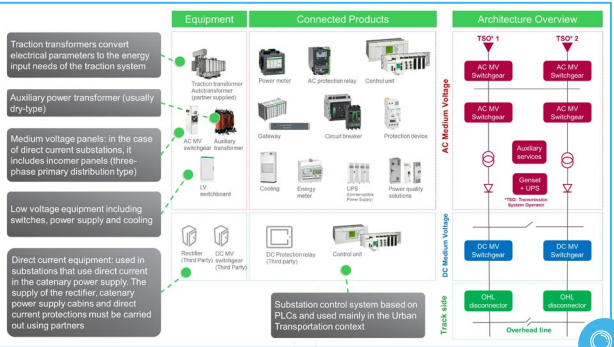
(Majorly used in Railway)
It demonstrates an alternating current (AC) design in a single/two-phase configuration, with an Intelligent Electronic Devices (IEDs)-based control system.



Type 2: Direct Current Supply

Type 2 Substation

(Majorly used in Urban Transportation)
It demonstrates direct current (DC) design with a PLC-based control system.





Traction transformers: convert electrical parameters to the energy input needs of the traction system

Medium voltage panels: in the case of alternating current substations, includes feeder panels (single-phase or two-phase primary distribution type, depending on the power supply mode)

Auxiliary power transformer (usually dry type)

Low voltage equipment including switches, power supply and cooling

Equipment



Traction transformer / Autotransformer (partner supplied)



MV switchgear



Auxiliary transformer



LV switchboard

Connected Products



Protection relay



Control unit



Power quality meter



Protection relay



Control unit



Gateways



Circuit breakers



Energy meter



UPS (Uninterruptible Power Supply)



Cooling



Protection device

Substation, control, protection and metering equipment based on Intelligent Electronic Devices (IEDs). They are used mainly in Railway applications and implementing IEC61850 industrial standard.

Architecture Overview

High Voltage

TSO* 1

TSO* 2

*TSO: Transmission System Operator

MV Switchgear

MV Switchgear

MV Switchgear

MV Switchgear

Auxiliary services

Genset + UPS

Low / Medium Voltage

OHL disconnector

OHL disconnector

Track side

Overhead line



Traction transformers convert electrical parameters to the energy input needs of the traction system

Auxiliary power transformer (usually dry-type)

Medium voltage panels: in the case of direct current substations, it includes incomer panels (three-phase primary distribution type)

Low voltage equipment including switches, power supply and cooling

Direct current equipment: used in substations that use direct current in the catenary power supply. The supply of the rectifier, catenary power supply cabins and direct current protections must be carried out using partners

Equipment



Traction transformer Autotransformer (partner supplied)



AC MV switchgear



Auxiliary transformer



LV switchboard



Rectifier (Third Party)



DC MV switchgear (Third Party)

Connected Products



Power meter



AC protection relay



Control unit



Gateway



Circuit breaker



Protection device



Cooling



Energy meter



UPS (Uninterruptible Power Supply)



Power quality solutions



DC Protection relay (Third party)



Control unit

Substation control system based on PLCs and used mainly in the Urban Transportation context

Architecture Overview

AC Medium Voltage

DC Medium Voltage

Track side

TSO* 1

AC MV Switchgear

AC MV Switchgear



Auxiliary services

Genset + UPS

*TSO: Transmission System Operator

TSO* 2

AC MV Switchgear

AC MV Switchgear



DC MV Switchgear

DC MV Switchgear

OHL disconnector

OHL disconnector

Overhead line

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

Introduction

EcoStruxure Value Proposition ▶

Applications Overview

Reference Architectures

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



EcoStruxure Power Value Proposition

Our solution to control and supply energy to traction substations

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Innovation At Every Level

for Traction Substations

3. Analysis & Optimization

- Cloud-based predictive power asset maintenance with expert recommendation provided by our Schneider Electric service experts
- Consulting Services including network and power quality audits
- Augmented reality guidance for complicated or rarely

2. Operational Management

Real-time monitoring and control of power system status and identification of abnormal temperature, insulation faults, power disturbances, etc.
The Power System Simulation Engine helps train operators and simulate the effects of switching or maintenance operations before the actual operation is performed

1. Primary Equipment

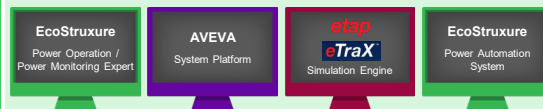
Protection, control, metering, UPS and other equipment used in Traction Substations. These are described in more detail in the following pages

Apps,
analytics,
and services

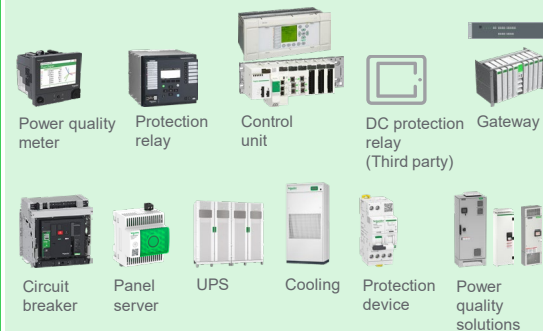


Cloud-Based Advisor Services for asset management, data integrity and workforce empowerment with extended reality guidance

Edge
Control



Connected
products



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

Introduction

EcoStruxure Value Proposition ▶

Applications Overview

Reference Architectures

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

EcoStruxure Power Value Proposition

Specific pillars for traction substations

EcoStruxure Power provides applications to support the challenges of Traction Substations for Railway and Urban Transportation, with the following pillars:

Reliable Electrification



Improve reliability of
electrical infrastructure

Electrical Distribution
Monitoring and Alarming

Capacity Management

Power Event Analysis

Power Quality Monitoring,
Correction, and Compliance

Advanced Protection and Automation

Safety and Comfort



Enhance safety and comfort in
passenger stations and tunnels

Continuous Thermal Monitoring

Guided Procedures Through
Extended Reality

Digitalization



Operate centrally and
maintain infrastructure efficiently

Backup Power Testing

Circuit Breaker Settings Monitoring

Asset Performance

Decarbonization



Reduce energy consumption
and carbon footprint

Effective Energy Accounting



EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

Introduction
EcoStruxure Value Proposition

Applications Overview

Reference Architectures

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

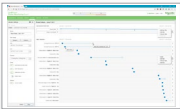
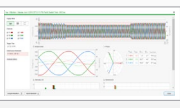
SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Our Digital Solutions and Services: Applications Overview

Reliable Electrification Electrical Distribution Monitoring and Alarming ■ ■ ■ 	→ Provide real-time status of the electrical distribution system → Help identify anomalies and notify the right personnel → Aggregate onboard alarm data in an easy-to-understand way → Take advantage of native integration of intelligent electrical devices
Reliable Electrification Capacity Management ■ ■ 	→ Visualize real-time or historical power system capacity → Monitor and trend circuit or equipment loading → Provide information for capacity planning
Reliable Electrification Power Event Analysis ■ ■ ■ 	→ Provide a user-friendly graphical tool to simplify and save time in event analysis → Provide an aggregated view of events in the same dashboard → Enable root cause analysis
Reliable Electrification Power Quality Monitoring, Correction, and Compliance ■ ■ ■ 	→ Power Quality Monitoring and Compliance: Monitor persistent steady state and event-based disturbances to better understand and analyze power quality disturbances → Power Quality Correction: Correct over/under voltages, harmonics, etc.
Reliable Electrification Advanced Protection and Automation ■ ■ ■ 	→ Help provide protection and fault-tolerant automation schemes → Help maintain continuity of service in case of outages with an autonomous and fast response to events → Enable various protection schemes to help protect the electrical distribution system

Our Digital Solutions and Services: Applications Overview

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

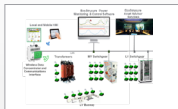
SECTION 5 – Customer Stories

BIBLIOGRAPHY

Safety and Comfort

Continuous Thermal Monitoring

■■■



- Monitor the temperature of busbar, cable, transformer, and withdrawable circuit breaker connections
- Help detect poor connections at an early stage
- Provide temperature alarming and reporting for fast response

Safety and Comfort

Guided Procedures Through XR

■■



- Use Extended Reality to perform step-by-step guidance
- Benefit from “X-ray” vision and virtually overlaid contextual asset and site information, live data, events and alarms
- Take advantage of remote collaboration

Digitalization

Backup Power Testing

■■

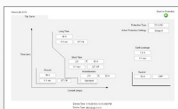


- Automatically record key backup power test parameters such as run time, engine loading, exhaust and engine temperatures
- Perform automated backup power test reporting

Digitalization

Circuit Breaker Settings Monitoring

■



- Compare current circuit breaker settings with commissioned settings
- Help detect inappropriate setting modifications periodically
- Provide information for capacity planning

Digitalization

Asset Performance

■■



- Make asset health visible across the entire system
- Streamline inspections using continuous asset health monitoring
- Optimize maintenance planning with analytics and expert advice



SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

Introduction
EcoStruxure Value Proposition

Applications Overview ▶

Reference Architectures

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Our Digital Solutions and Services: Applications Overview

Decarbonization

Effective Energy Accounting



The image shows a screenshot of a 'Monthly Shadow Bill' from Schneider Electric. It is a detailed table with multiple columns and rows, likely representing energy consumption data and associated costs for a specific facility or department.

Identify areas for possible energy conservation measures:

- [Utility Bill Verification](#): Identify billing errors by comparison with a shadow bill
- [Cost Allocation](#): Allocate energy costs to terminals or departments for accurate billing
- [Power Factor correction](#): Mitigate harmonic effects and power quality issues

EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

Introduction
EcoStruxure Value Proposition
Applications Overview

Reference Architectures

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

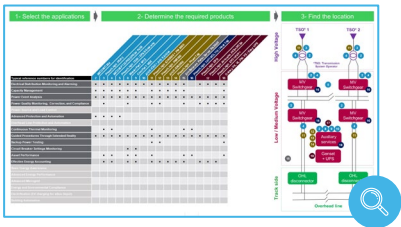
Reference Electrical and Digital Architectures

Typical electrical architecture

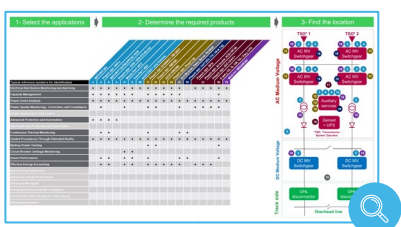
Find the Schneider Electric products necessary
to implement the selected applications.

Then find their location in the electrical
architecture.

Type 1: Alternating Current (AC) Supply



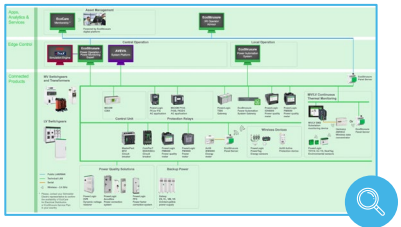
Type 2: Direct Current (DC) Supply



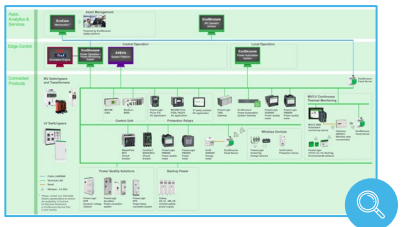
Reference digital architecture

Find how the products, software
solutions and cloud services are
connected in the digital architecture.

Type 1: Alternating Current (AC) Supply



Type 2: Direct Current (DC) Supply



1- Select the applications

2- Determine the required products

3- Find the location

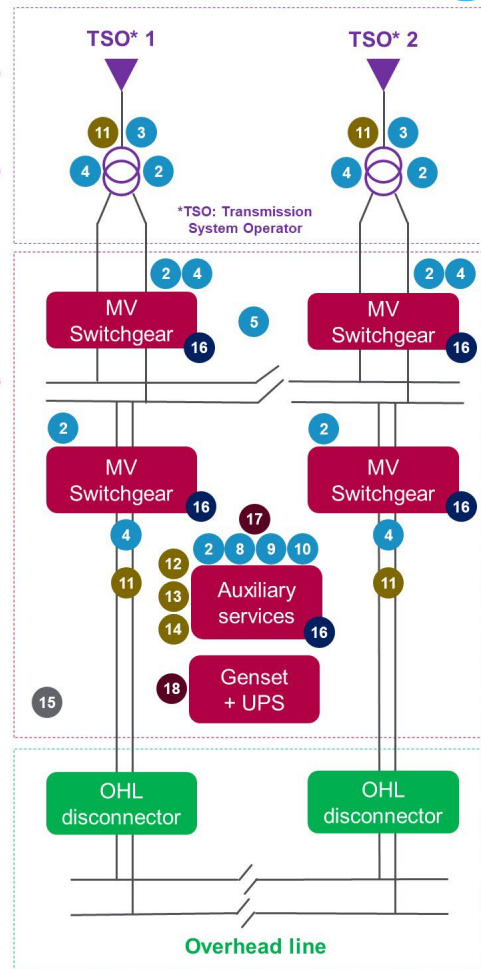


Typical reference numbers for identification	2	3	4	5	8	9	10	11	12	13	14	15	16	17	18
Electrical Distribution Monitoring and Alarming	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Capacity Management	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power Event Analysis	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power Quality Monitoring, Correction, and Compliance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power Source and Load Control	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Advanced Protection and Automation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Overhead Line Protection and Automation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Continuous Thermal Monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Guided Procedures Through Extended Reality	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Backup Power Testing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Circuit Breaker Settings Monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Asset Performance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Effective Energy Accounting	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Basic Energy Awareness	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Advanced Energy Performance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Advanced Microgrid	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Energy and Environmental Compliance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Electrification (EV charging for eBus Depot)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Building Automation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

High Voltage

Low / Medium Voltage

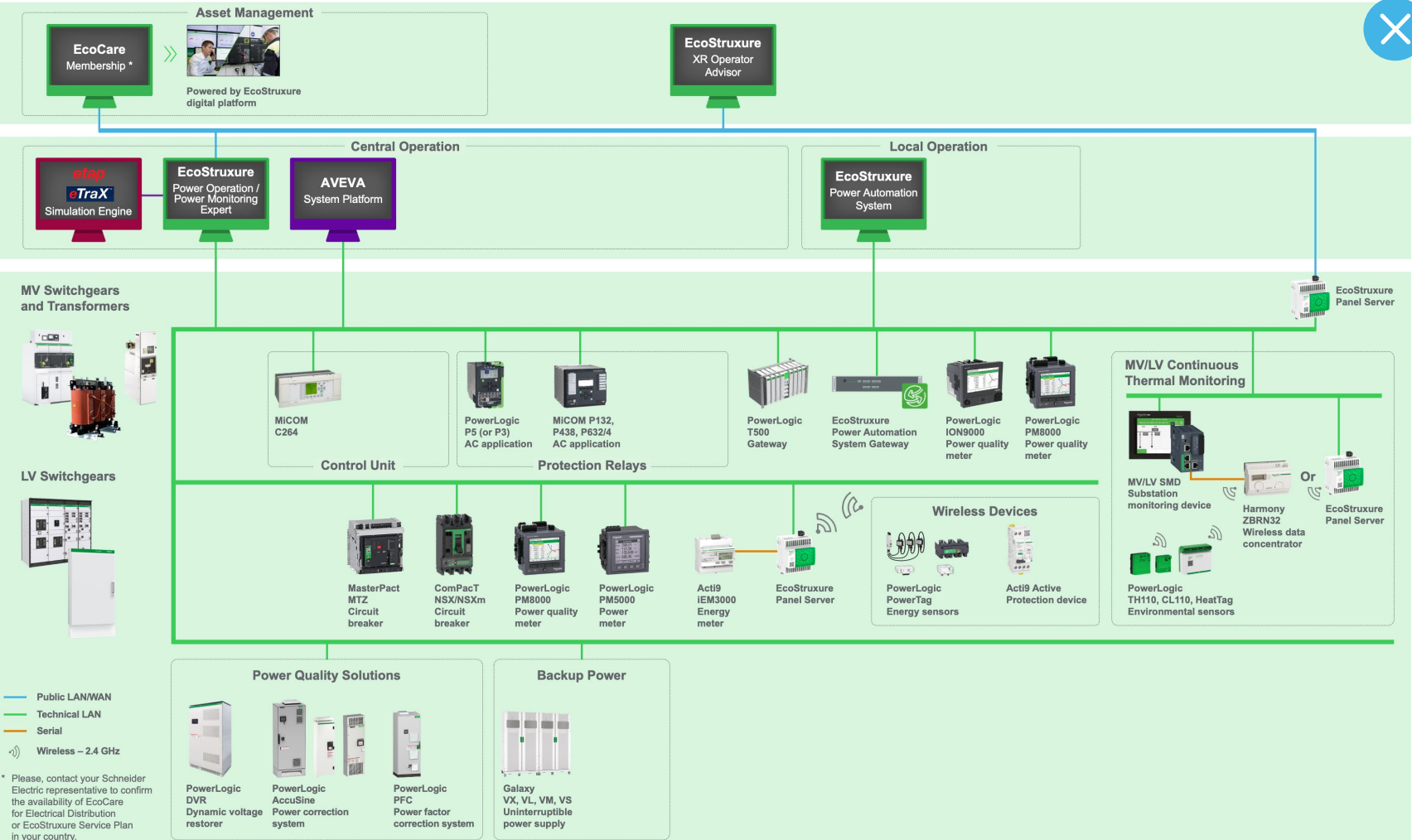
Track side

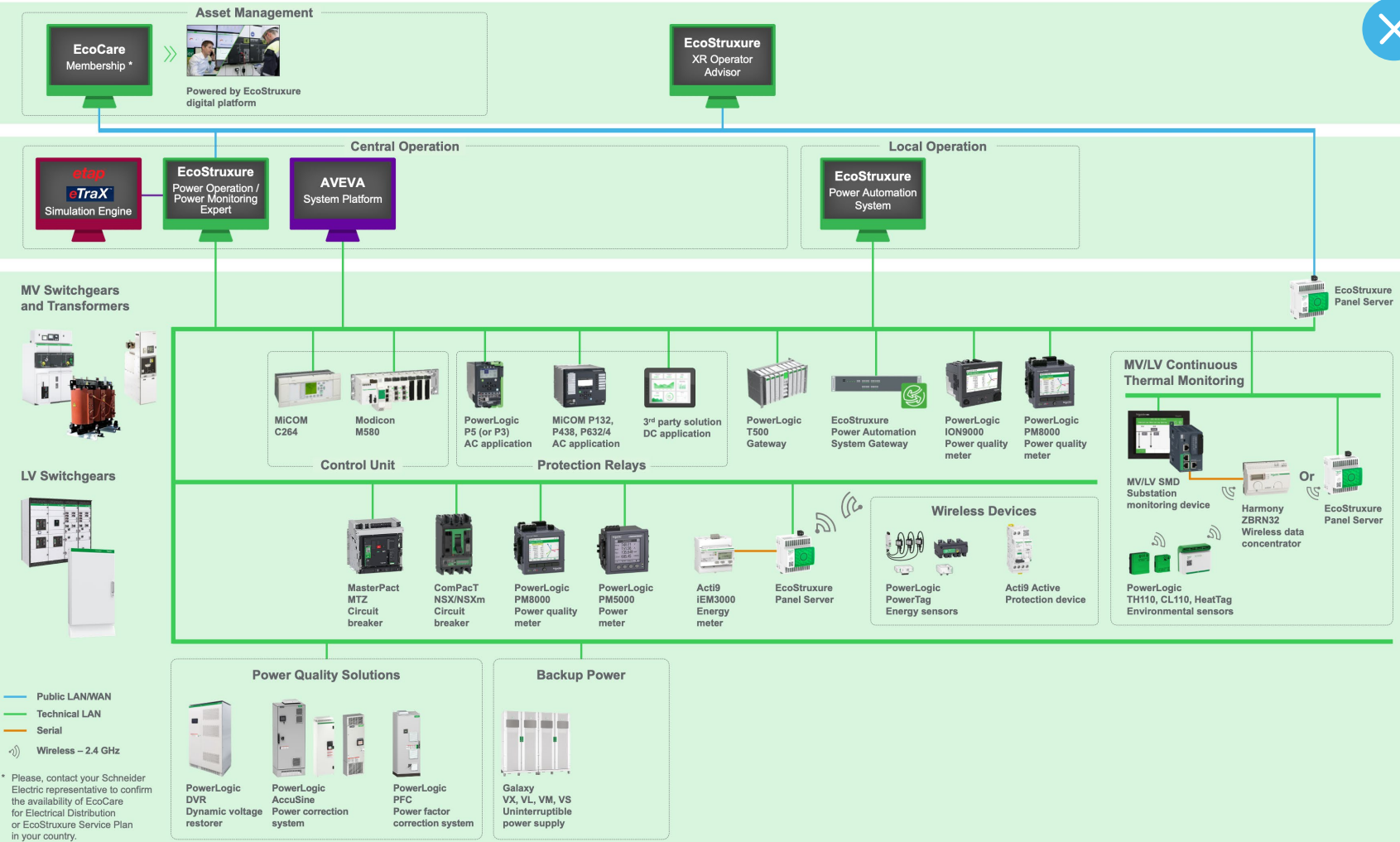




Track side









EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems ▼

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

SECTION 3

EcoStruxure Power
Digital Solutions and Services
for:

→ Auxiliary Power Systems

WHY READ THIS SECTION?

The objective of this section is to:

- Introduce **auxiliary power systems**
- Review **EcoStruxure Power value propositions and the associated applications** for auxiliary power systems
- Provide **reference electrical and digital architectures**



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

Introduction ▶

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Introduction to Auxiliary Power Systems

What is it?

Auxiliary Power Systems are electrical distribution systems incorporated in the railway infrastructure to power loads that require electricity for their operation, such as:

- Interlocks and other signaling equipment
- Track sensors
- Point heaters
- Telecommunications equipment
- Other technical buildings

They are particularly used in areas where it is not possible to find a regular supply of electricity.

➔ **25% of the total energy of the railway system** is consumed by auxiliary power systems.



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

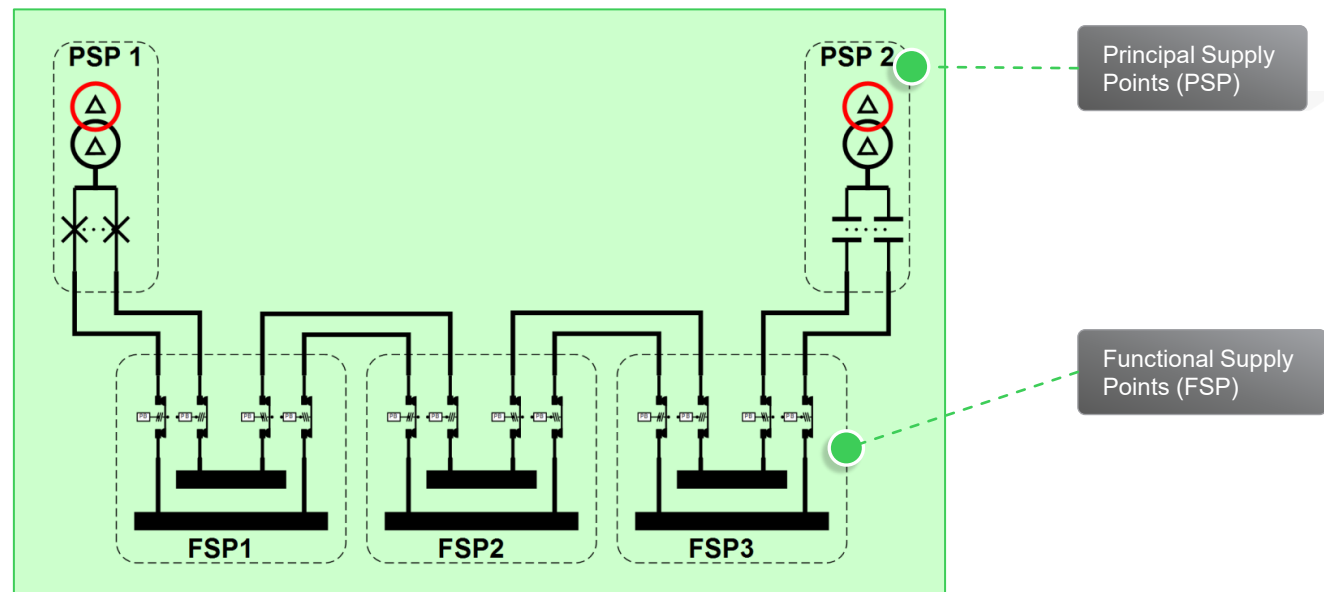


Introduction to Auxiliary Power Systems

How does it work?

Many railway consumers are highly critical about the operations and safety of their infrastructure: the reliability of their power supply must be optimum.

Power distribution loops, connected with two different sources, are used to improve availability of electrical energy.



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

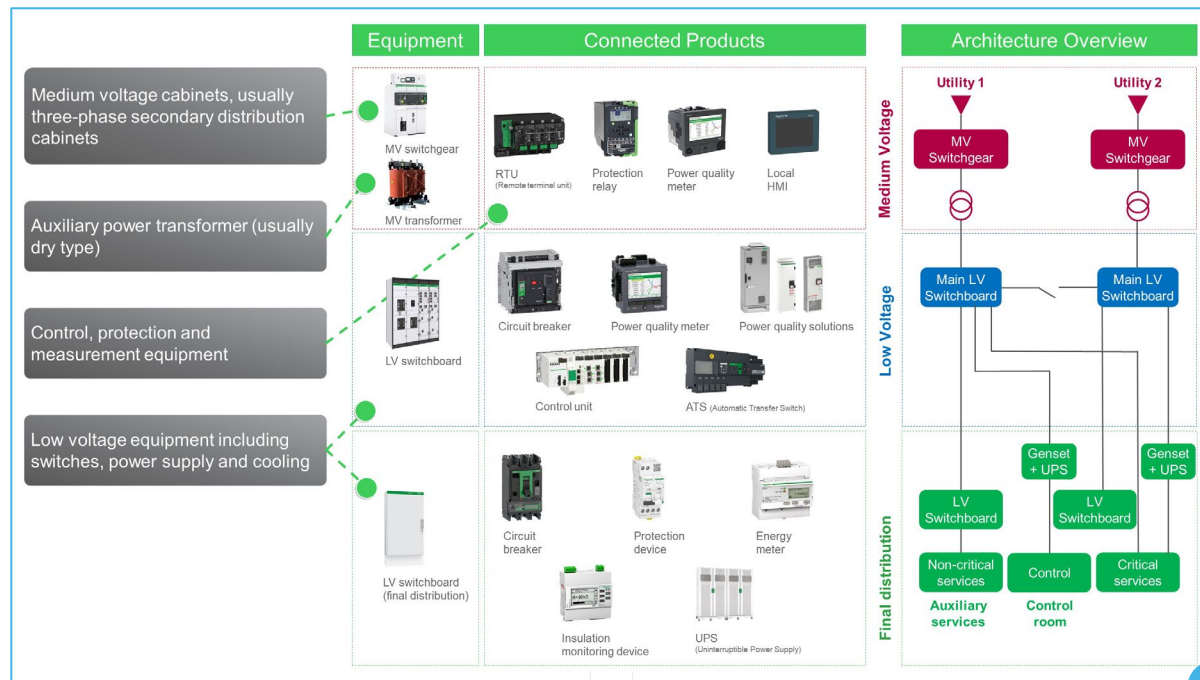
SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Introduction to Auxiliary Power Systems

Main components of the electrical architecture solution



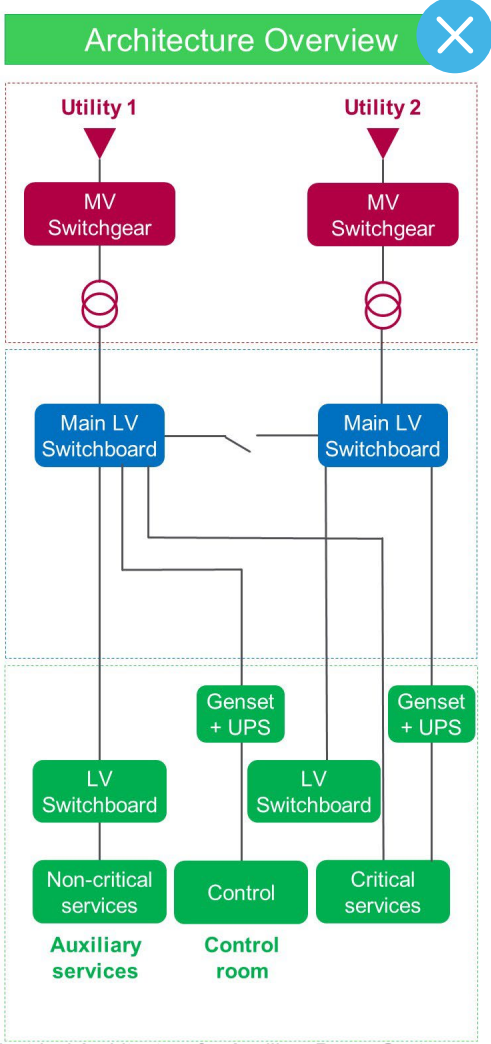


Medium voltage cabinets, usually three-phase secondary distribution cabinets

Auxiliary power transformer (usually dry type)

Control, protection and measurement equipment

Low voltage equipment including switches, power supply and cooling



Main Components of the Electrical Architecture for Auxiliary Power Systems

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

Introduction

EcoStruxure Value Proposition ▶

Applications Overview

Reference Architectures

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



EcoStruxure Power Value Proposition

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- Augmented reality guidance for complicated or rarely performed procedures

2. Operational Management

- Real-time monitoring and control of power system status and identification of abnormal temperature, insulation faults, power disturbances, etc.
- The Power System Simulation Engine helps train operators and simulate the effects of switching or maintenance operations before the actual operation is performed.

1. Primary Equipment

Protection, control, metering, UPS and other equipment used in Auxiliary Power Systems. These are described in more detail in the following pages

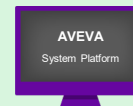
Apps,
analytics,
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Edge
Control

Connected
products



Cloud-Based Advisor Services for asset management, data integrity and workforce empowerment with extended reality guidance



Power
quality
meter



Protection
relay



Remote
terminal
unit



Circuit
breaker



Insulation
monitoring
device



Automatic
transfer
switch



Panel
server



Power
quality
solutions



UPS



Local
HMI

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

Introduction

EcoStruxure Value Proposition ▶

Applications Overview

Reference Architectures

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

EcoStruxure Power Value Proposition

Specific pillars for auxiliary power systems

EcoStruxure Power provides applications to support the challenges of auxiliary power systems for Railway and Urban Transportation with the following pillars:

Reliable Electrification



Improve reliability of
electrical infrastructure

Electrical Distribution
Monitoring and Alarming

Capacity Management

Power Event Analysis

Power Quality Monitoring,
Correction, and Compliance

Power Source and Load Control

Safety and Comfort



Enhance safety and comfort in
passenger stations and tunnels

Continuous Thermal Monitoring

Guided Procedures Through
Extended Reality

Digitalization



Operate centrally and
maintain infrastructure efficiently

Backup Power Testing

Circuit Breaker Settings Monitoring

Asset Performance

Decarbonization



Reduce energy consumption
and carbon footprint

Effective Energy Accounting

Basic Energy Awareness

Advanced Energy Performance

Energy and Environmental
Compliance



EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

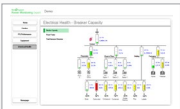
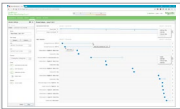
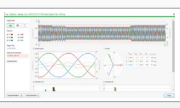
SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Our Digital Solutions and Services: Applications Overview

Reliable Electrification Electrical Distribution Monitoring and Alarming ■ ■ ■ 	→ Provide real-time status of the electrical distribution system → Help identify anomalies and notify the right personnel → Aggregate onboard alarm data in an easy-to-understand way → Take advantage of native integration of intelligent electrical devices
Reliable Electrification Capacity Management ■ ■ 	→ Visualize real-time or historical power system capacity → Monitor and trend circuit or equipment loading → Provide information for capacity planning
Reliable Electrification Power Event Analysis ■ ■ ■ 	→ Provide a user-friendly graphical tool to simplify and save time in event analysis → Provide an aggregated view of events in the same dashboard → Enable root cause analysis
Reliable Electrification Power Quality Monitoring, Correction, and Compliance ■ ■ ■ 	→ Power Quality Monitoring and Compliance: Monitor persistent steady state and event-based disturbances to better understand and analyze power quality disturbances → Power Quality Correction: Correct over/under voltages, harmonics, etc.
Reliable Electrification Power Source and Load Control ■ ■ ■ 	→ Help isolate faults with relay automation and circuit breaker coordination → Help preserve critical loads by automatically transferring to alternate power → Help restore power quickly → Get real-time visibility, automation and control of the entire electrical infrastructure

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Life Is On

Schneider
Electric

Auxiliary Powers Systems

Our Digital Solutions and Services: Applications Overview

Safety and Comfort

Continuous Thermal Monitoring

■■■



- Monitor the temperature of busbar, cable, transformer, and withdrawable circuit breaker connections
- Help detect poor connections at an early stage
- Provide temperature alarming and reporting for fast response

Safety and Comfort

Guided Procedures Through XR

■



- Use Extended Reality to perform step-by-step guidance
- Benefit from “X-ray” vision and virtually overlaid contextual asset and site information, live data, events and alarms
- Take advantage of remote collaboration

Digitalization

Backup Power Testing

■■

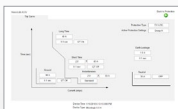


- Automatically record key backup power test parameters such as run time, engine loading, exhaust and engine temperatures
- Perform automated backup power test reporting

Digitalization

Circuit Breaker Settings Monitoring

■



- Compare current circuit breaker settings with commissioned settings
- Help detect inappropriate setting modifications periodically
- Provide information for capacity planning

Digitalization

Asset Performance

■■



- Make asset health visible across the entire system
- Streamline inspections using continuous asset health monitoring
- Optimize maintenance planning with analytics and expert advice

■■■ Essential ■■ Recommended ■ Desirable

Click on the [blue links](#) to have more information

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Our Digital Solutions and Services: Applications Overview

Decarbonization

Effective Energy Accounting



■ ■ ■

Identify areas for possible energy conservation measures:

- [Utility Bill Verification](#): Identify billing errors by comparison with a shadow bill
- [Cost Allocation](#): Allocate energy costs to terminals or departments for accurate billing
- [Power Factor correction](#): Mitigate harmonic effects and power quality issues

Decarbonization

Basic Energy Awareness

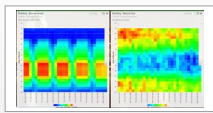


■ ■

- [Energy Monitoring](#): Increase awareness of energy usage by creating easy-to-understand graphical dashboards and reports from data
- [Cost Allocation](#): Identify "quick-win" opportunities for energy savings

Decarbonization

Advanced Energy Performance

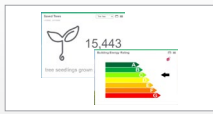


■ ■

- [Energy Performance](#): Normalize energy data (e.g. with respect to building area) to give context. Analyze energy performance in context using KPIs
- [Energy Benchmarking](#): Compare energy usage with respect to other comparable facilities
- [Energy Modeling and Verification](#): Model the energy usage versus energy drivers

Decarbonization

Energy and Environmental Compliance



■ ■

- [Energy Efficiency Compliance](#): Report effectively about local/global energy and environmental building code compliance
- [Greenhouse Gas Reporting](#): Track and report emissions effectively to help cut carbon emissions

EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

- Introduction
- EcoStruxure Value Proposition
- Applications Overview

Reference Architectures

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

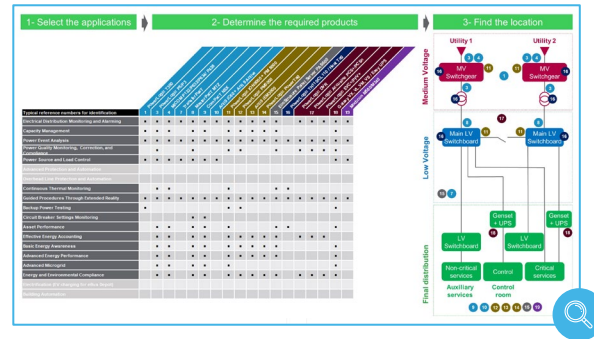


Reference Electrical and Digital Architectures

Typical electrical architecture

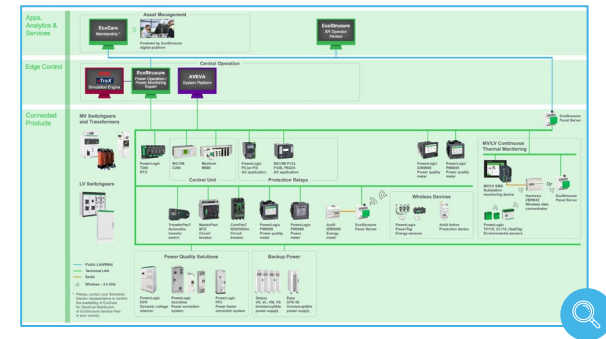
Find the Schneider Electric products necessary to implement the selected applications.

Then find their location in the electrical architecture.



Reference digital architecture

Find how the products, software solutions and cloud services are connected in the digital architecture.



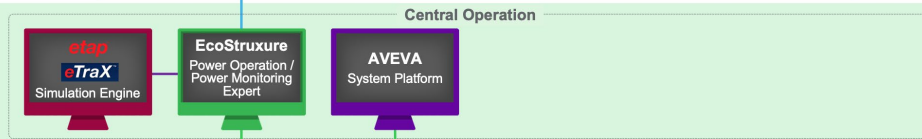
Medium Voltage



Apps, Analytics & Services



Edge Control

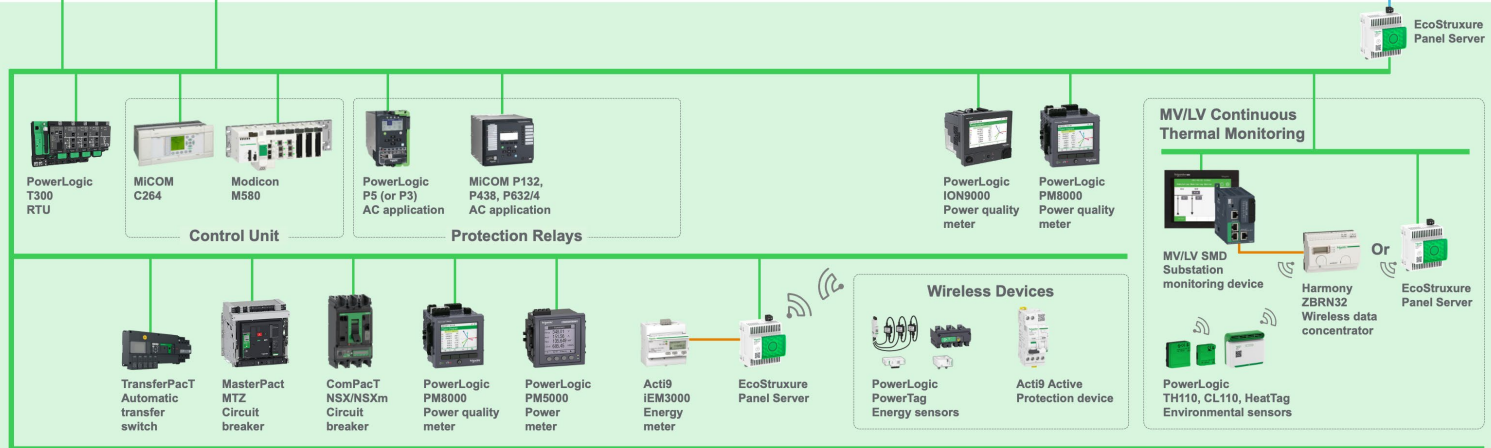


Connected Products

MV Switchgears and Transformers



LV Switchgears



- Public LAN/WAN
- Technical LAN
- Serial
- 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.



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations ▼

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Customer Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

SECTION 3

EcoStruxure Power
Digital Solutions and Services
for:

→ Passenger Stations

WHY READ THIS SECTION?

The objective of this section is to:

- Introduce **passenger stations**
- Review **EcoStruxure Power value propositions and associated applications** for passenger stations
- Provide **reference electrical and digital architectures**



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Customer Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Introduction to Passenger Stations

What is it?

A passenger station is a railway or urban transportation facility where trains stop to load or unload passengers, freight or both.

The stations themselves may be at ground level, underground, or elevated. Connections may be available to intersecting rail lines or other transport modes such as buses, trams, or other rapid transit systems.



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Customer Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Introduction to Passenger Stations

How does it work? (1/2)

It generally consists of a set of tracks flanked by passenger platforms. Usually, it also accommodates buildings for services.

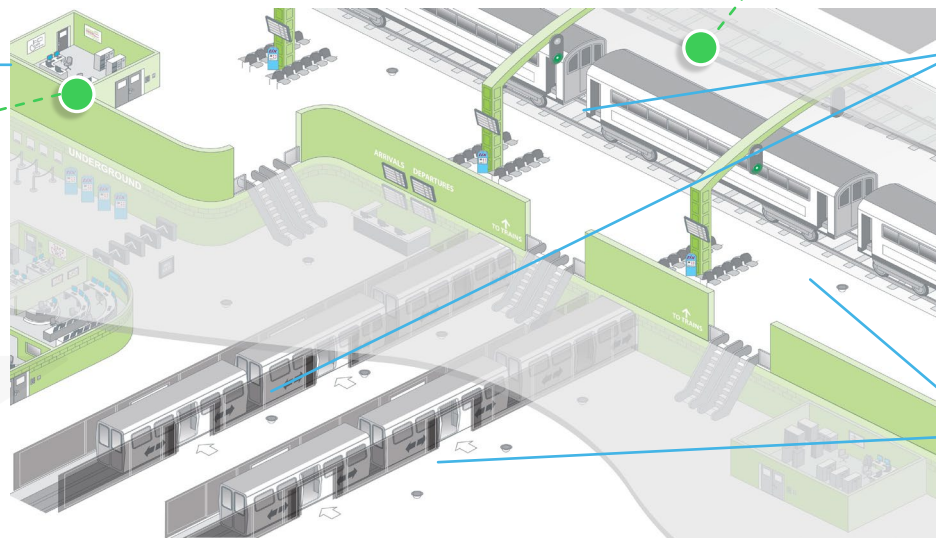
For stations with a single-track line, a passing loop is usually provided to facilitate traffic movements.

Station building

The station building provides ancillary services as ticket sales, waiting rooms and the baggage/freight service.

Track

Platform



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

Introduction ▶

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Customer Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



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Electric

Introduction to Passenger Stations

How does it work? (2/2)

A typical railway station consists of multiple technical systems that work in coordination in order to fulfill the operational plan. These include:

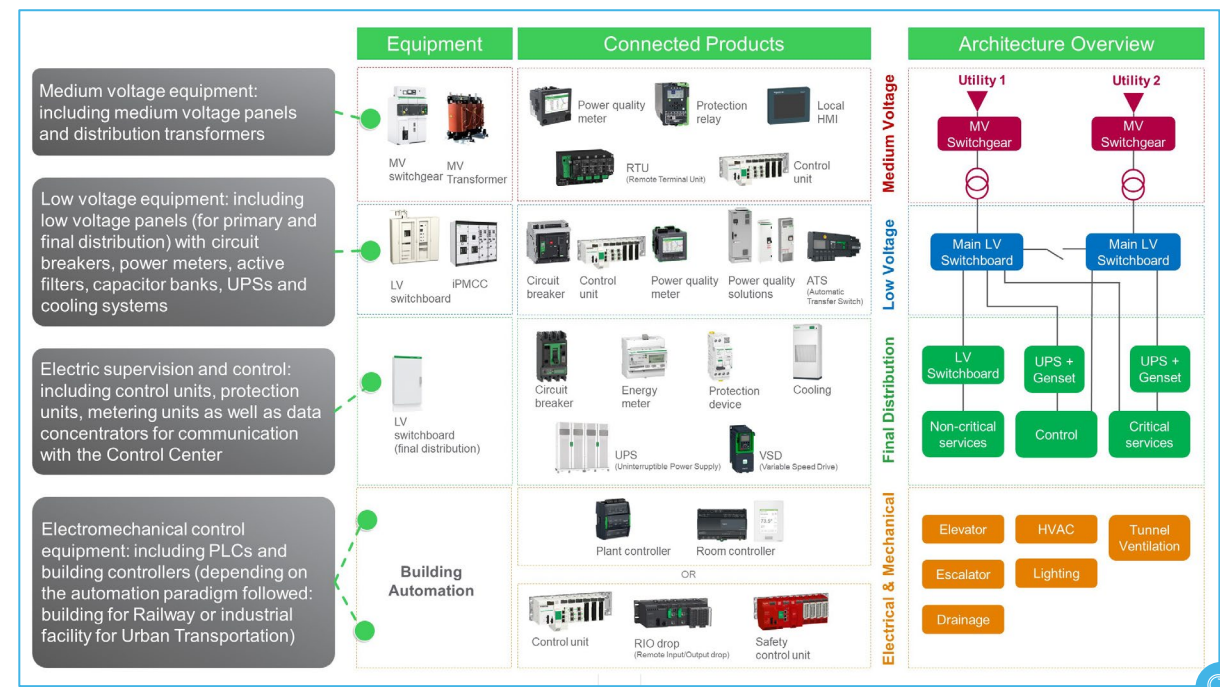


* Closed Circuit Television

** Heating, Ventilation, Air Conditioning

Introduction to Passenger Stations

Main components of the electrical architecture





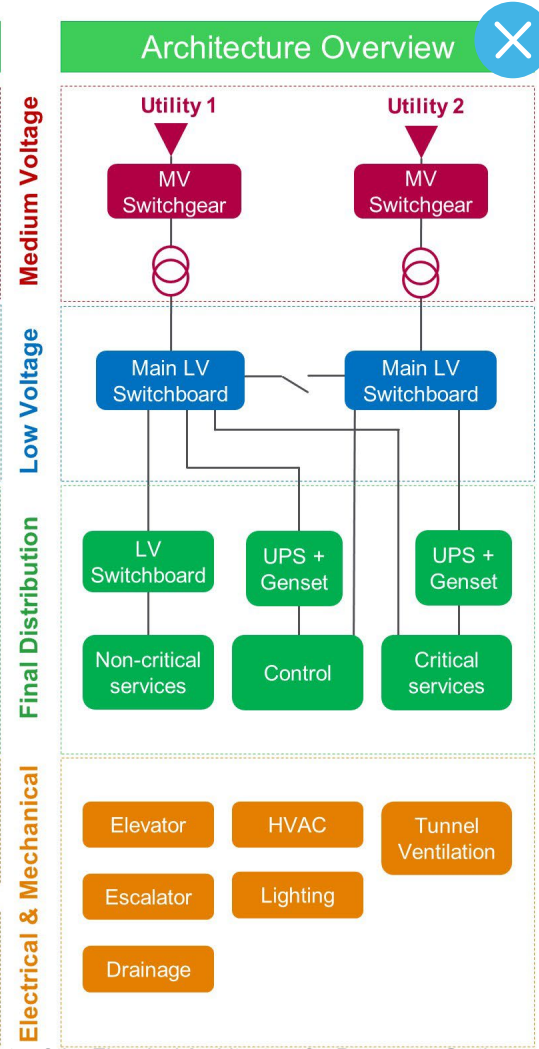
Medium voltage equipment:
including medium voltage panels
and distribution transformers

Low voltage equipment: including
low voltage panels (for primary and
final distribution) with circuit
breakers, power meters, active
filters, capacitor banks, UPSs and
cooling systems

Electric supervision and control:
including control units, protection
units, metering units as well as data
concentrators for communication
with the Control Center

Electromechanical control
equipment: including PLCs and
building controllers (depending on
the automation paradigm followed:
building for Railway or industrial
facility for Urban Transportation)

Equipment	Connected Products
 MV switchgear  MV Transformer	 Power quality meter  Protection relay  Local HMI  RTU (Remote Terminal Unit)  Control unit
 LV switchboard  iPMCC	 Circuit breaker  Control unit  Power quality meter  Power quality solutions  ATS (Automatic Transfer Switch)
 LV switchboard (final distribution)	 Circuit breaker  Energy meter  Protection device  Cooling  UPS (Uninterruptible Power Supply)  VSD (Variable Speed Drive)
Building Automation	 Plant controller  Room controller 
	 Control unit  RIO drop (Remote Input/Output drop)  Safety control unit



Main Components of the Electrical Architecture for Passenger Stations

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



EcoStruxure Power Value Proposition

Our solution to control and supply energy to passenger stations

EcoStruxure™
Innovation At Every Level

for Passenger Stations

3. Analysis & Optimization

- Cloud-based predictive power asset maintenance with expert recommendation provided by our Schneider Electric service experts
- Consulting services including network and power quality audits
- Augmented reality guidance for complicated or rarely performed procedures

2. Operational Management

Edge Control for all systems such as elevators, escalators, lighting, HVAC, drainage, ventilation, etc. These systems can be:

- Option 1: centrally controlled (from the Control Center) using Supervisory Control and Data Acquisition (SCADA)
- Option 2: locally controlled using onsite HMIs or mobile apps

A software interface is used to exchange the control perimeter between the local passenger station and the Control Center.

1. Primary Equipment

Protection, control, metering, UPS and other equipment used in passenger stations. These are described in more detail in the following pages

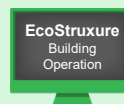
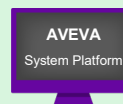
Apps,
analytics,
and services

Edge
Control

Connected
products



Cloud-Based Advisor Services for asset management, data integrity and workforce empowerment with extended reality guidance



Protection relay



Power quality meter



Remote terminal unit



Energy meter



Local HMI



Panel server



Automatic transfer switch



Circuit breaker



Protection device



UPS



Power quality solutions



Control unit



RIO drop



Safety control unit



VSD



Automation Server



Cooling

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

EcoStruxure Power Value Proposition

Specific pillars for passenger stations

EcoStruxure Power provides applications to support the challenges of Passenger Stations for Railway and Urban Transportation, with the following pillars:

Reliable Electrification



Improve reliability of
electrical infrastructure

Electrical Distribution
Monitoring and Alarming

Capacity Management

Power Event Analysis

Power Quality Monitoring,
Correction, and Compliance

Power Source and Load Control

Safety and Comfort



Enhance safety and comfort in
passenger stations and tunnels

Continuous Thermal Monitoring

Guided Procedures Through
Extended Reality

Digitalization



Operate centrally and
maintain infrastructure efficiently

Backup Power Testing

Circuit Breaker Settings Monitoring

Asset Performance

Decarbonization



Reduce energy consumption
and carbon footprint

Effective Energy Accounting

Basic Energy Awareness

Advanced Energy Performance

Advanced Microgrid

Energy and Environmental
Compliance

Building Automation



EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

Introduction
EcoStruxure Value Proposition

Applications Overview

Reference Architectures

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

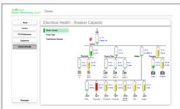
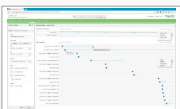
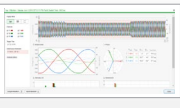
SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Our Digital Solutions and Services: Applications Overview

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Our Digital Solutions and Services: Applications Overview

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

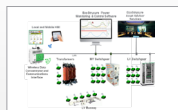
BIBLIOGRAPHY



Safety and Comfort

Continuous Thermal Monitoring

■ ■ ■



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- Help detect poor connections at an early stage
- Provide temperature alarming and reporting for fast response

Safety and Comfort

Guided Procedures Through XR

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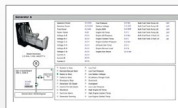


- Use Extended Reality to perform step-by-step guidance
- Benefit from “X-ray” vision and virtually overlaid contextual asset and site information, live data, events and alarms
- Take advantage of remote collaboration

Digitalization

Backup Power Testing

■ ■

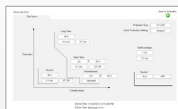


- Automatically record key backup power test parameters such as run time, engine loading, exhaust and engine temperatures
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Digitalization

Circuit Breaker Settings Monitoring

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■ ■



- Make asset health visible across the entire system
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EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

Introduction
EcoStruxure Value Proposition

Applications Overview

Reference Architectures

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

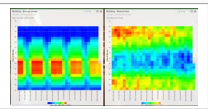
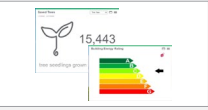
SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Our Digital Solutions and Services: Applications Overview

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EcoStruxure™ Power for Railway and Urban Transportation

**SECTION 1 – Introduction to the Railway
and Urban Transportation Market**

**SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry**

**SECTION 3 – Digital Solutions
and Services across the Facilities**

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

Introduction

EcoStruxure Value Proposition

Applications Overview ▶

Reference Architectures

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Life Is On

Schneider
Electric

Our Digital Solutions and Services: Applications Overview

Decarbonization

Building Automation

■■■



- ➔ Monitor and control the electromechanical systems present in the passenger station
- ➔ Automate processes within the passenger station
- ➔ Implement operational and emergency scenarios

■■■ Essential ■■ Recommended ■ Desirable



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



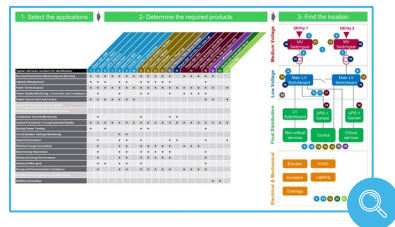
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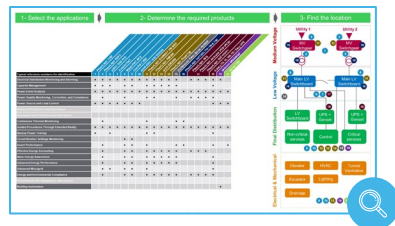
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to implement the selected applications.

Then find their location in the electrical
architecture.

Railway



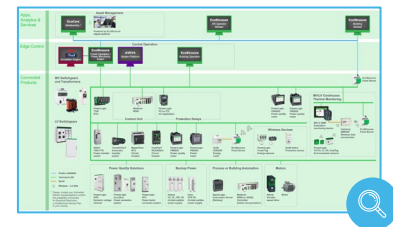
Urban Transportation



Typical digital architecture

Find how the products, software
solutions and cloud services are
connected in the digital architecture.

Railway and Urban Transportation



1- Select the applications

2- Determine the required products

3- Find the location



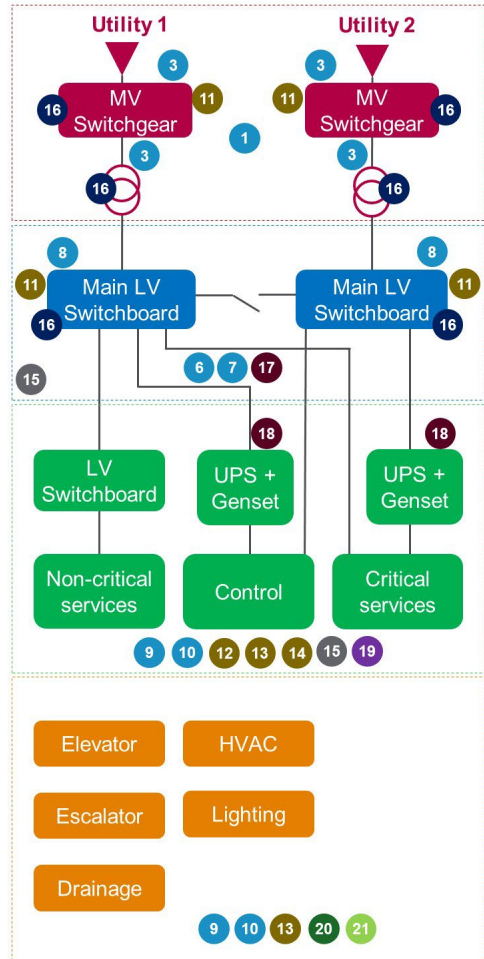
Typical reference numbers for identification	1	3	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Electrical Distribution Monitoring and Alarming	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Capacity Management	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power Event Analysis	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power Quality Monitoring, Correction, and Compliance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power Source and Load Control	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Advanced Protection and Automation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Overhead Line Protection and Automation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Continuous Thermal Monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Guided Procedures Through Extended Reality	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Backup Power Testing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Circuit Breaker Settings Monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Asset Performance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Effective Energy Accounting	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Basic Energy Awareness	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Advanced Energy Performance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Advanced Microgrid	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Energy and Environmental Compliance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Electrification (EV charging for eBus Depot)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Building Automation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Medium Voltage

Low Voltage

Final Distribution

Electrical & Mechanical



1- Select the applications

2- Determine the required products

3- Find the location



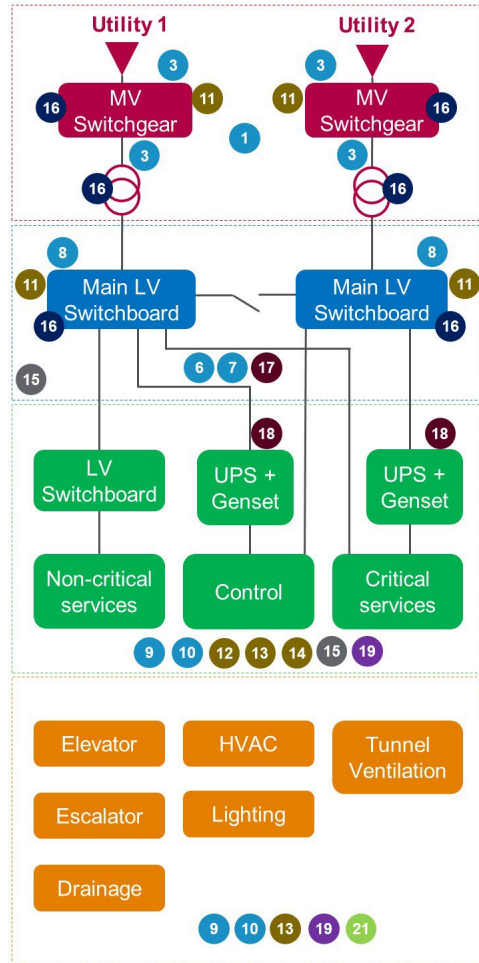
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Advanced Energy Performance																	
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Energy and Environmental Compliance																	
Electrification (EV charging for eBus Depot)																	
Building Automation																	

Medium Voltage

Low Voltage

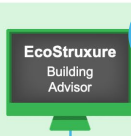
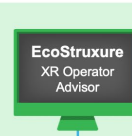
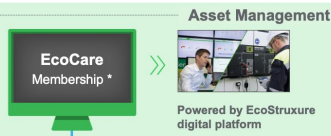
Final Distribution

Electrical & Mechanical



Typical Electrical Architecture for Passenger Stations (Urban Transportation)

Apps, Analytics & Services



Edge Control

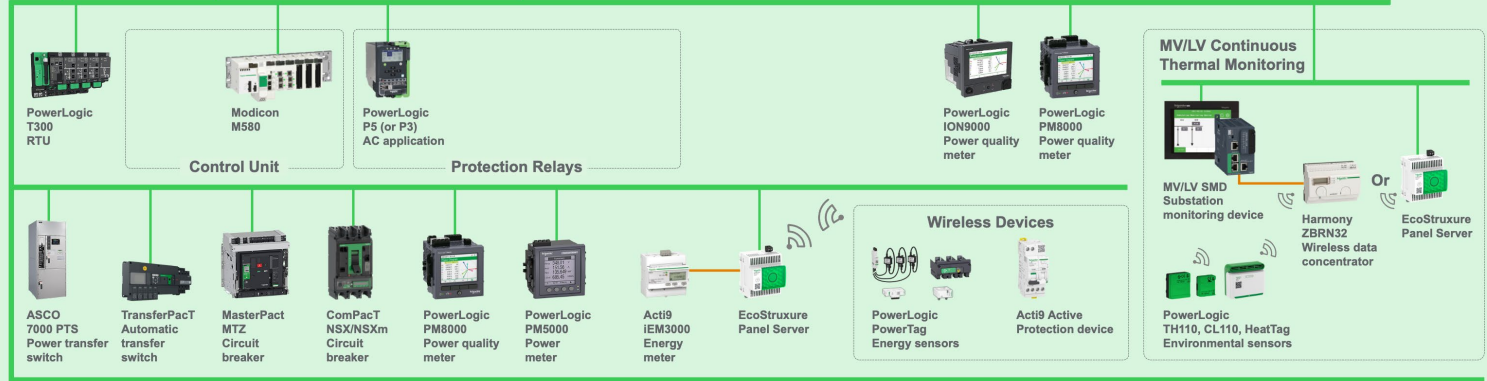


Connected Products

MV Switchgears and Transformers



LV Switchgears



- Public LAN/WAN
- Technical LAN
- Serial
- 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.



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots



Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

SECTION 3

EcoStruxure Power
Digital Solutions and Services
for:

→ eBus Depots

WHY READ THIS SECTION?

The objective of this section is to:

- Introduce **eBus depots**
- Review **EcoStruxure Power value propositions and the associated applications** for eBus depots
- Provide **reference electrical and digital architectures**



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Introduction to eBus Depots

What is it?

An eBus depot is a facility specifically designed for the maintenance, charging, and storage of electric buses (eBuses).

Two types of e-buses

Electricity is stored on board

The majority of buses storing electricity are battery electric buses, in which the electric motor obtains energy from an on-board battery.



Electricity is fed continuously from an external source

When electricity is not stored on board, it is supplied by contact with outside power sources.

For example, using:

- Overhead lines (e.g., trolleybus)
- Non-contact conductors on the ground (e.g., OLEV = online electric vehicles)



In this document, we will focus on reference architectures applied to use cases where electrical energy is stored on board.

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Introduction to eBus Depots

Two types of electrical supply for buses with battery

The supply of electrical energy to the bus can be carried out with the following strategies, which can be combined:

Charging along the way

Mainly installed at bus stops, they allow a quick charge of energy during the time the bus is stopped at the bus stop.



They are therefore high-energy fast chargers.

→ Charging time: **several minutes**

→ Power involved: **>200 kW**

Power supply in the depot areas

Once the daily commute has been completed, the bus will return to the storage facility where it will be connected to the energy charging system until it must leave again to continue with the scheduled routes.



The energy charge will therefore depend on the charger's power and the available charging time.

→ Charging time: **several hours**

→ Power involved: **50-200 kW**

The predictability of bus arrival and departure times is very important: It is necessary to optimize the charging process to enhance the operating conditions.

In this document, we will focus on reference architectures applied to use cases where charging is done in depot areas.



Introduction to eBus Depots

How does it work?

There are three main use cases recommended for the electrical installation, depending on the customer's needs:

Use case 1:
“Keep it simple, grid supply”

Build and enable the electrical infrastructure to supply energy to the eBuses.

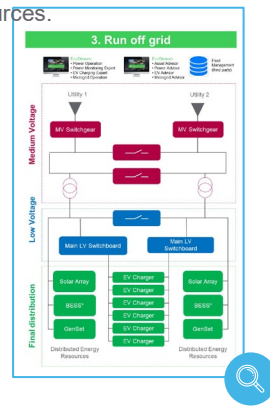
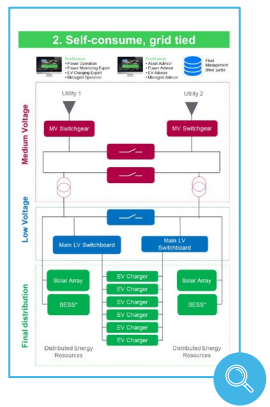
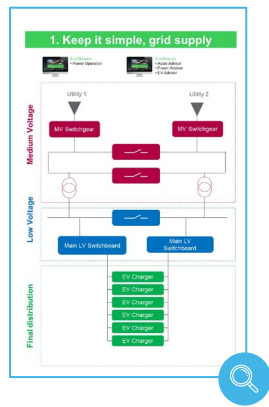
Use case 2:
“Self-consume, grid tied”

Build and enable the electrical infrastructure while integrating the renewable energy sources. Manage energy sources for the eBuses, intended to optimize both technical and economic parameters.

Use case 3:
“Run off grid”

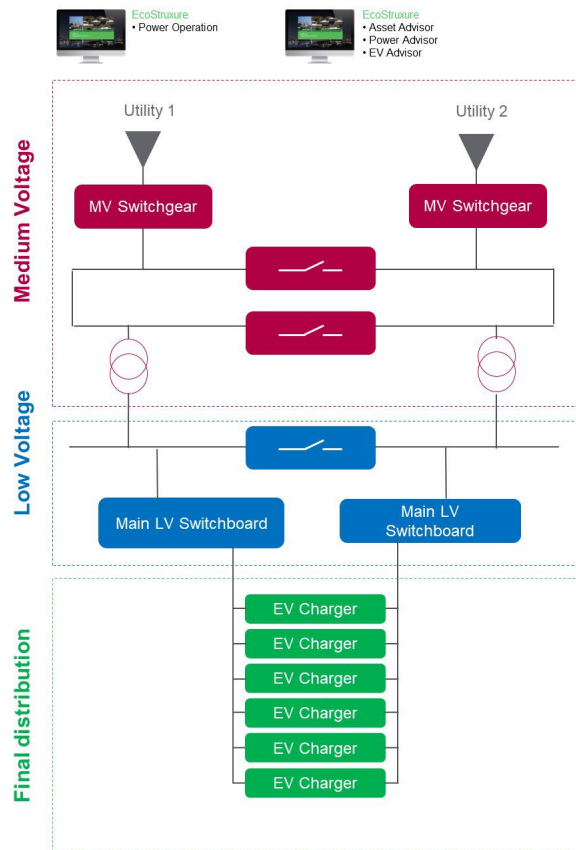
Build electrical infrastructure with the ability to disconnect from the grid to help:

- Increase availability (lack of supply from the grid)
- Optimize energy supply prices
- Enhance stability across the internal network (“microgrid”) once disconnected from external energy sources.

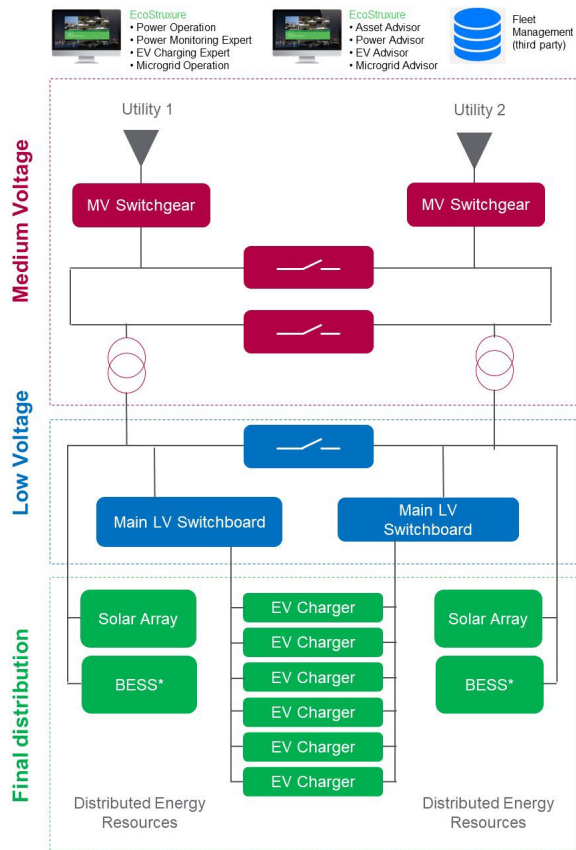




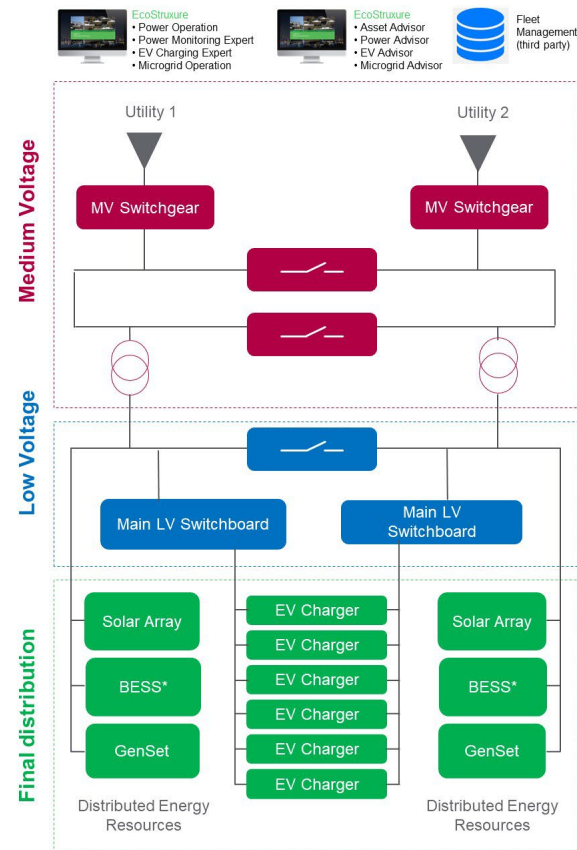
1. Keep it simple, grid supply



2. Self-consume, grid tied



3. Run off grid



* BESS = Battery Energy Storage System

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

Introduction ▶

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

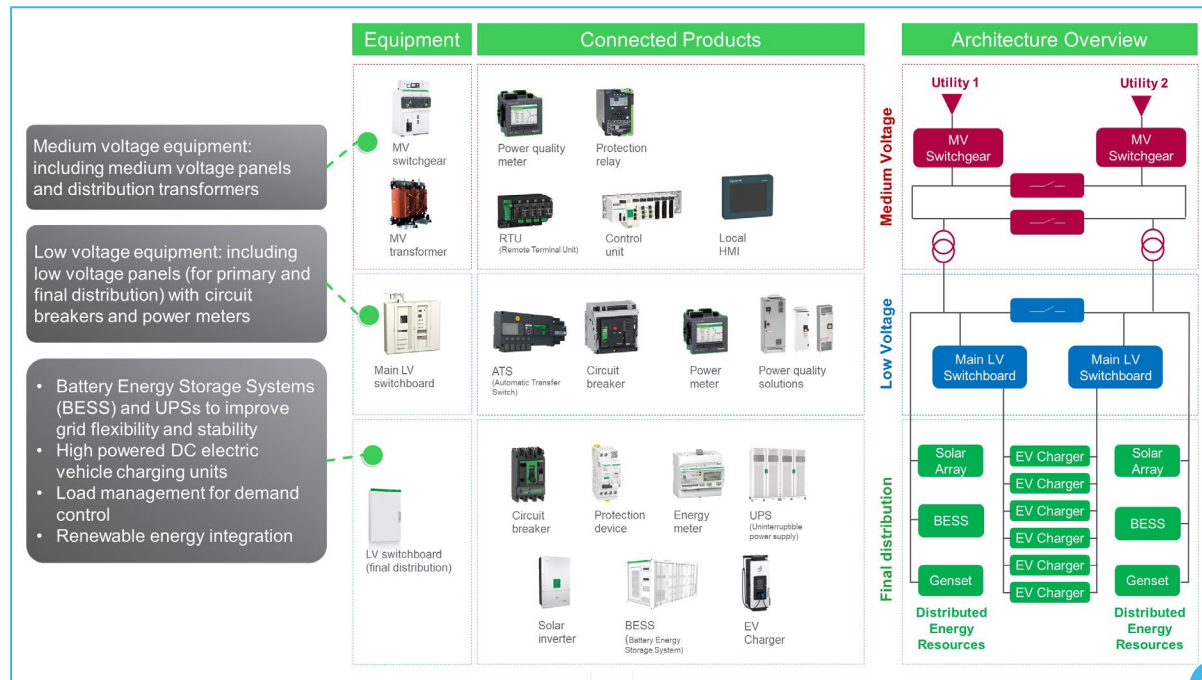
SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Introduction to eBus Depots

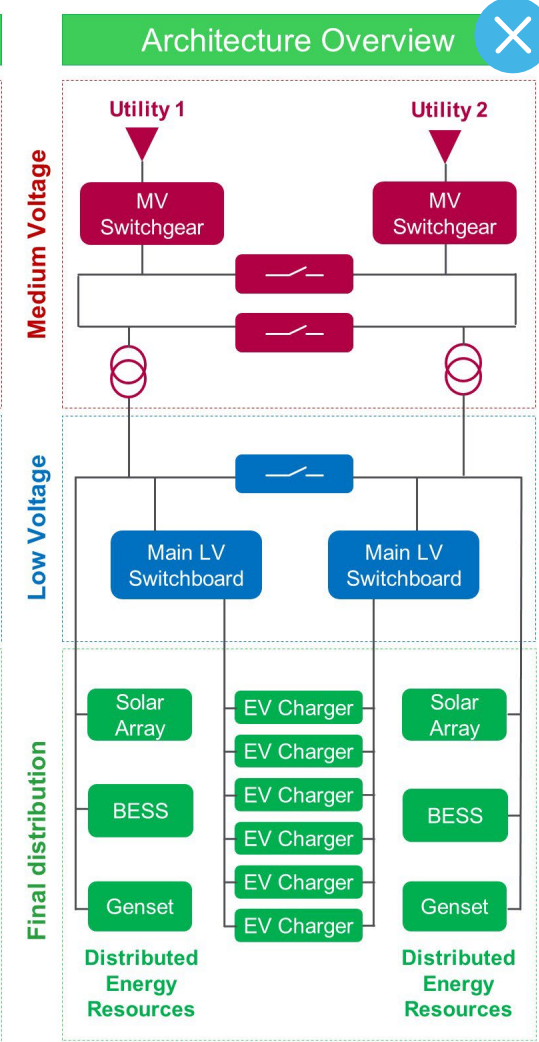
Main components of the electrical architecture



Medium voltage equipment:
including medium voltage panels
and distribution transformers

Low voltage equipment: including
low voltage panels (for primary and
final distribution) with circuit
breakers and power meters

- Battery Energy Storage Systems (BESS) and UPSs to improve grid flexibility and stability
- High powered DC electric vehicle charging units
- Load management for demand control
- Renewable energy integration



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

Introduction

EcoStruxure Value Proposition ▶

Applications Overview

Reference Architectures

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



EcoStruxure Power Value Proposition

Our solution to control and supply energy to eBus depots

3. Analysis & Optimization

- Cloud-based predictive power asset maintenance with expert recommendation provided by our Schneider Electric service experts
- Consulting services including network audits, microgrid sizing services, power systems engineering and sustainable energy procurement
- Microgrid optimization using a cloud-based platform with necessary algorithms to get the most out of the local energy resources
- EV advisor for advanced management of the charging process, connected to a route-planning application (third-party)

2. Operational Management

- Real-time monitoring and control of power system status and identification of abnormal temperature, insulation faults or power disturbances
- EV Charging Expert to optimize the use of energy between every charging point
- Microgrid Automation to manage Distributed Energy Resources (DERs) and improve real-time grid stability and reliability

1. Primary Equipment

- MV/LV range of power Connected Products for protection, power correction and monitoring
- Battery Energy Storage Systems (BESSs) to improve grid flexibility and stability
- High powered DC electric vehicle charging units



Innovation At Every Level

for eBus Depots

Apps,
analytics,
and
services

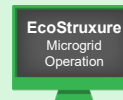
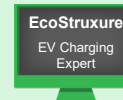
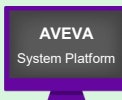
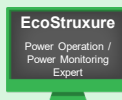
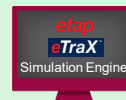


Cloud-Based Advisor Services for Asset Management, EV Charging and distributed energy resources (renewables)



Fleet Management
(Third party)

Edge
Control



Connected
products



Power meter



Circuit breaker



EV charger



Panel server



Uninterruptible power supply



Power quality solutions

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

Introduction

EcoStruxure Value Proposition ▶

Applications Overview

Reference Architectures

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

EcoStruxure Power Value Proposition

Specific pillars for eBus depots

EcoStruxure Power provides applications to support the challenges of eBus depots for Railway and Urban Transportation, with the following pillars:

Reliable Electrification



Improve reliability of
electrical infrastructure

Electrical Distribution
Monitoring and Alarming

Capacity Management

Power Event Analysis

Power Quality Monitoring,
Correction, and Compliance

Power Source and Load Control

Safety and Comfort



Enhance safety and comfort in
passenger stations and tunnels

Continuous Thermal Monitoring

Guided Procedures Through
Extended Reality

Digitalization



Operate centrally and
maintain infrastructure efficiently

Backup Power Testing

Circuit Breaker Settings Monitoring

Asset Performance

Decarbonization



Reduce energy consumption
and carbon footprint

Effective Energy Accounting

Basic Energy Awareness

Advanced Energy Performance

Advanced Microgrid

Energy and Environmental
Compliance

Electrification (eBus Depot)



Our Digital Solutions and Services: Applications Overview

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Reliable Electrification

Electrical Distribution Monitoring and Alarming

■■■



- Provide real-time status of the electrical distribution system
- Help identify anomalies and notify the right personnel
- Aggregate onboard alarm data in an easy-to-understand way
- Take advantage of native integration of intelligent electrical devices

Reliable Electrification

Capacity Management

■■■

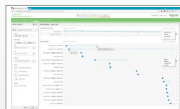


- Visualize real-time or historical power system capacity
- Monitor and trend circuit or equipment loading
- Provide information for capacity planning

Reliable Electrification

Power Event Analysis

■■■

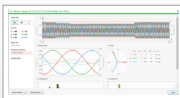


- Provide a user-friendly graphical tool to simplify and save time in event analysis
- Provide an aggregated view of events in the same dashboard
- Enable root cause analysis

Reliable Electrification

Power Quality Monitoring, Correction, and Compliance

■■■



- **Power Quality Monitoring and Compliance:** Monitor persistent steady state and event-based disturbances to better understand and analyze power quality disturbances
- **Power Quality Correction:** Correct over/under voltages, harmonics, etc.

Reliable Electrification

Power Source and Load Control

■■■



- Help isolate faults with relay automation and circuit breaker coordination
- Help preserve critical loads by automatically transferring to alternate power
- Help restore power quickly
- Get real-time visibility, automation and control of the entire electrical infrastructure



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Our Digital Solutions and Services: Applications Overview

Safety and Comfort

Continuous Thermal Monitoring

■■■



- Monitor the temperature of busbar, cable, transformer, and withdrawable circuit breaker connections
- Help detect poor connections at an early stage
- Provide temperature alarming and reporting for fast response

Safety and Comfort

Guided Procedures Through XR

■■



- Use Extended Reality to perform step-by-step guidance
- Benefit from “X-ray” vision and virtually overlaid contextual asset and site information, live data, events and alarms
- Take advantage of remote collaboration

Digitalization

Backup Power Testing

■■

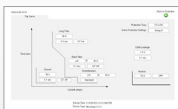


- Automatically record key backup power test parameters such as run time, engine loading, exhaust and engine temperatures
- Perform automated backup power test reporting

Digitalization

Circuit Breaker Settings Monitoring

■



- Compare current circuit breaker settings with commissioned settings
- Help detect inappropriate setting modifications periodically
- Provide information for capacity planning

Digitalization

Asset Performance

■■■



- Make asset health visible across the entire system
- Streamline inspections using continuous asset health monitoring
- Optimize maintenance planning with analytics and expert advice





Our Digital Solutions and Services: Applications Overview

Decarbonization

Effective Energy Accounting



Identify areas for possible energy conservation measures:

- [Utility Bill Verification](#): Identify billing errors by comparison with a shadow bill
- [Cost Allocation](#): Allocate energy costs to terminals or departments for accurate billing
- [Power Factor correction](#): Mitigate harmonic effects and power quality issues

Decarbonization

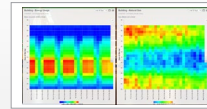
Basic Energy Awareness



- [Energy Monitoring](#): Increase awareness of energy usage by creating easy-to-understand graphical dashboards and reports from data
- [Cost Allocation](#): Identify "quick-win" opportunities for energy savings

Decarbonization

Advanced Energy Performance



- [Energy Performance](#): Normalize energy data (e.g. with respect to building area) to give context. Analyze energy performance in context using KPIs
- [Energy Benchmarking](#): Compare energy usage with respect to other comparable facilities
- [Energy Modeling and Verification](#): Model the energy usage versus energy drivers

Decarbonization

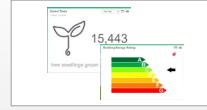
Advanced Microgrid



- Enhance power system reliability, despite grid instability often resulting from powerful storms and grid unavailability
- Reduce carbon emissions and optimize cost efficiency by leveraging Distributed Energy Resources (DERs)

Decarbonization

Energy and Environmental Compliance



- [Energy Efficiency Compliance](#): Report effectively about local/global energy and environmental building code compliance
- [Greenhouse Gas Reporting](#): Track and report emissions effectively to help cut carbon emissions

EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

Introduction

EcoStruxure Value Proposition

Applications Overview ▶

Reference Architectures

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Our Digital Solutions and Services: Applications Overview

Decarbonization

**Electrification
(EV Charging
for eBus Depot)**



- ➔ Power the bus depot with an end-to-end electrical distribution solution for charging your electrical buses
- ➔ Integrate and manage local power generation and batteries for self-consumption of renewable energy or for resiliency purposes

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

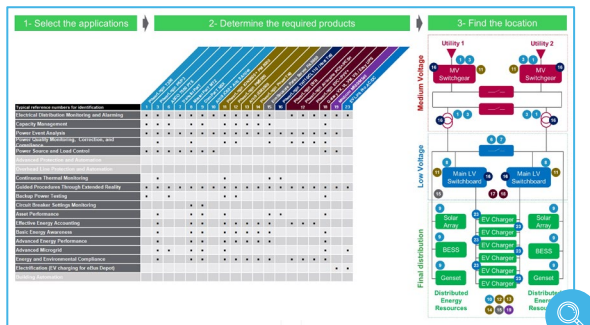


Reference Electrical and Digital Architectures

Typical electrical architecture

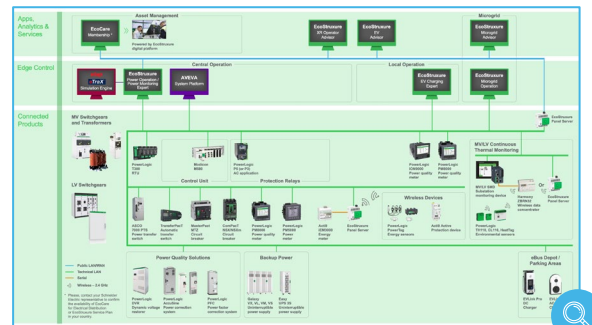
Find the Schneider Electric products necessary to implement the selected applications.

Then find their location in the electrical architecture.



Reference digital architecture

Find how the products, software solutions and cloud services are connected in the digital architecture.



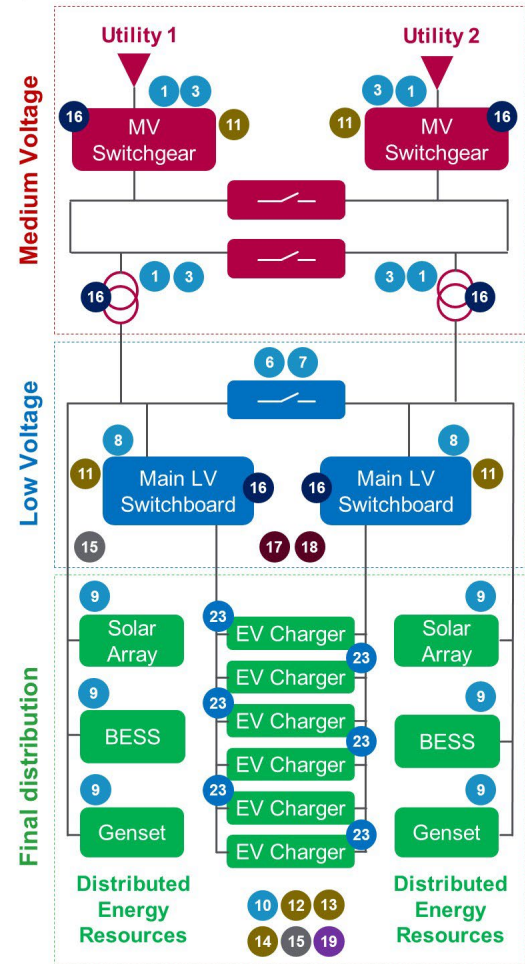
1- Select the applications

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Capacity Management	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power Event Analysis	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power Quality Monitoring, Correction, and Compliance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power Source and Load Control	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Advanced Protection and Automation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Overhead Line Protection and Automation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Continuous Thermal Monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Guided Procedures Through Extended Reality	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Backup Power Testing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Circuit Breaker Settings Monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Asset Performance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Effective Energy Accounting	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Basic Energy Awareness	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Advanced Energy Performance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Advanced Microgrid	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Energy and Environmental Compliance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Electrification (EV charging for eBus Depot)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Building Automation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■



Typical Electrical Architecture for e-Bus Depots

Apps, Analytics & Services



Edge Control

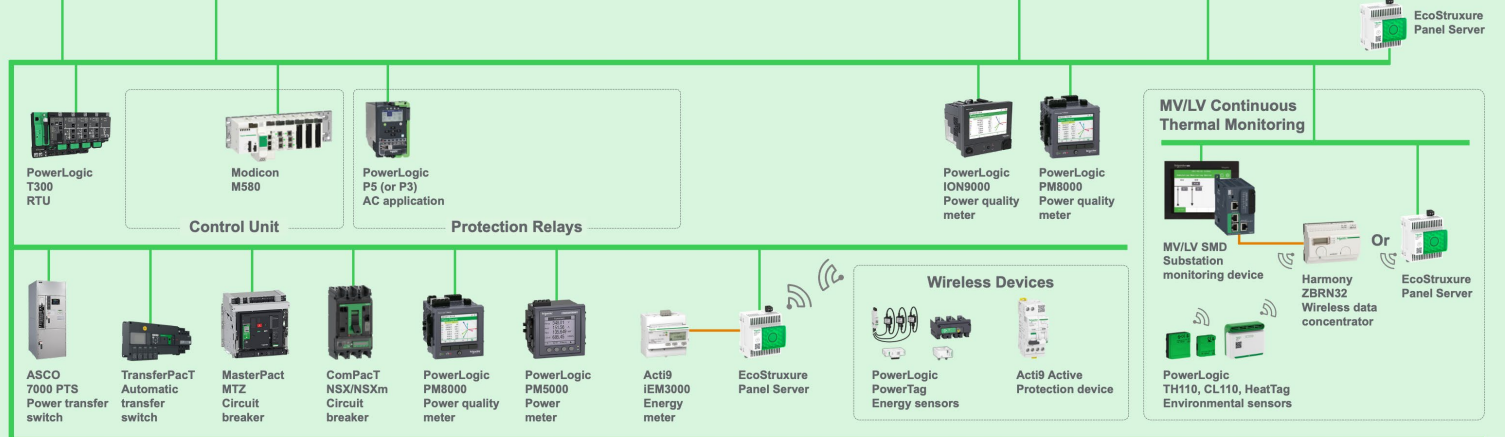


Connected Products

MV Switchgears and Transformers



LV Switchgears



- Public LAN/WAN
- Technical LAN
- Serial
- 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.





EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems ▼

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

SECTION 3

EcoStruxure Power
Digital Solutions and Services
for:

→ Tunnel Systems

WHY READ THIS SECTION?

The objective of this section is to:

- Introduce **tunnel systems**
- Review **EcoStruxure Power value propositions and the associated applications** for tunnel systems
- Provide **reference electrical and digital architectures**



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

Introduction ▶

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

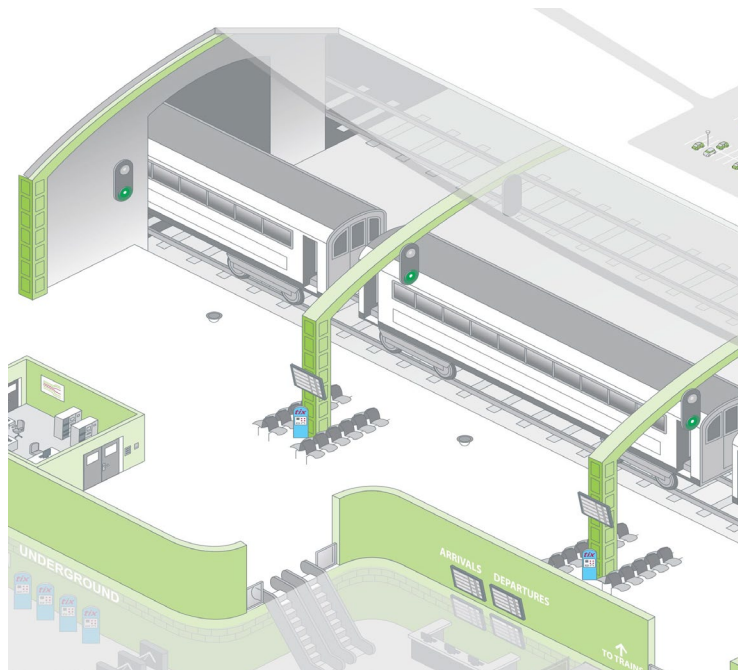
SECTION 5 – Customer Stories

BIBLIOGRAPHY

Introduction to Tunnel Systems

What is it?

Railway tunnels allow crossing of geographical landforms while respecting the layout limitations of the railway lines. They involve major civil engineering works and the supply of systems to improve the safe use of the infrastructure.



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

Introduction ▶

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Introduction to Tunnel Systems

How does it work?

A typical tunnel system consists of multiple technical systems that work in coordination in order to fulfill the operational plan. These include:



Ventilation



Telecom



Fire Detection



Power Supply



Access Control



Signaling



Drainage



Lighting



Weather
Forecasting

EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots

6- Tunnel Systems

Introduction ▶

- EcoStruxure Value Proposition
- Applications Overview
- Reference Architectures

- 7- Depots and Workshops
- 8- Control Center

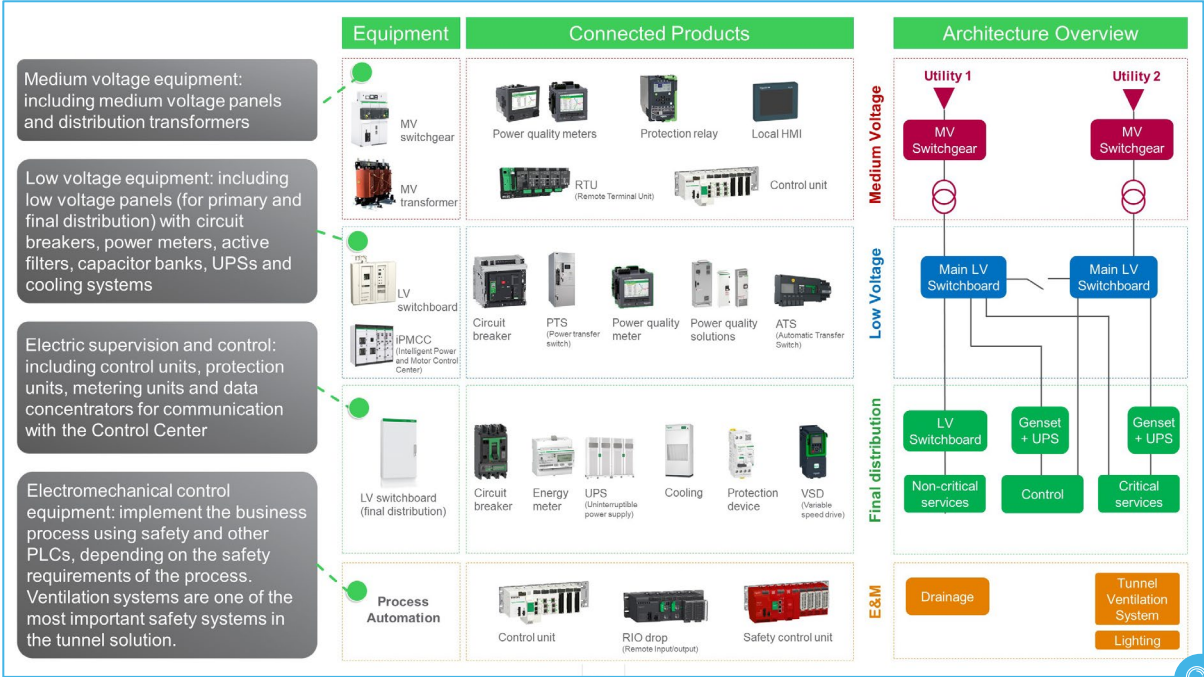
SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Introduction

Main components of the electrical architecture

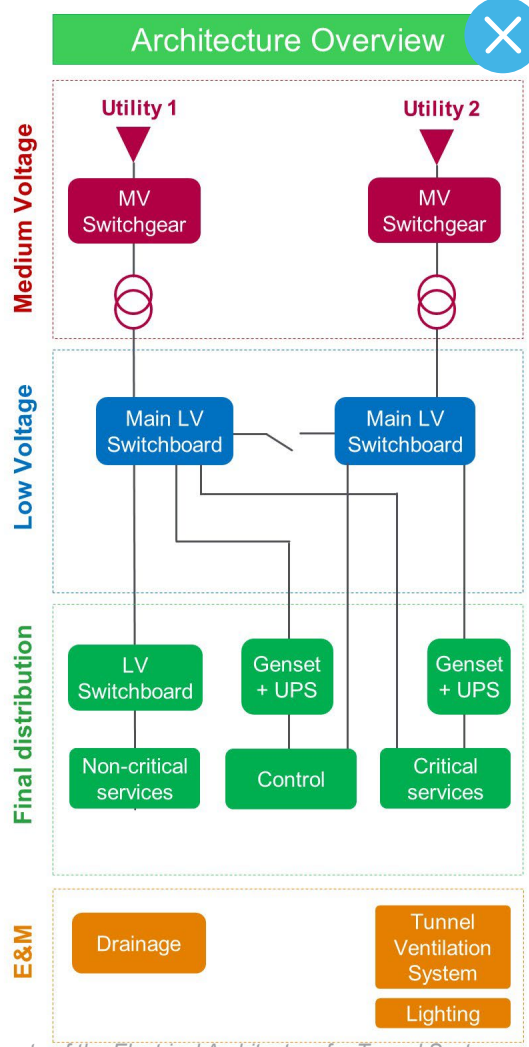


Medium voltage equipment:
including medium voltage panels
and distribution transformers

Low voltage equipment: including
low voltage panels (for primary and
final distribution) with circuit
breakers, power meters, active
filters, capacitor banks, UPSs and
cooling systems

Electric supervision and control:
including control units, protection
units, metering units and data
concentrators for communication
with the Control Center

Electromechanical control
equipment: implement the business
process using safety and other
PLCs, depending on the safety
requirements of the process.
Ventilation systems are one of the
most important safety systems in
the tunnel solution.



Main Components of the Electrical Architecture for Tunnel Systems

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

Introduction

EcoStruxure Value Proposition ▶

Applications Overview

Reference Architectures

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



EcoStruxure Power Value Proposition

Our solution to control and supply energy to tunnel systems

EcoStruxure™
Innovation At Every Level

for Tunnel Systems

3. Analysis & Optimization

- Cloud-based predictive power asset maintenance with expert recommendation provided by our Schneider Electric service experts
- Consulting Services including network and power quality audits
- Augmented reality guidance for complicated or rarely performed procedures

2. Operational Management

Edge Control for all systems such as elevators, escalators, lighting, HVAC, drainage, ventilation, etc. These systems can be:

- Option 1: centrally controlled (from the Control Center) using Supervisory Control and Data Acquisition (SCADA)
- Option 2: locally controlled using onsite HMIs or mobile apps

A software interface is used to exchange the control perimeter between the local tunnel system and the Control Center.

1. Primary Equipment

Connected products include protective and electrical network automation devices, power meters, power conditioning units (UPS and power quality solution), and building automation.

Apps,
analytics,
and services



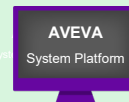
Edge
Control



Connected
products



Cloud-Based Advisor Services for asset management, data integrity, and workforce empowerment with extended reality guidance



Protection relay



Power quality meter



Remote terminal unit



Energy meter



Local HMI



Panel server



Automatic transfer switch



Circuit breaker



Protection device



UPS



Power quality solutions



Control unit



RIO drop



Safety control unit



Variable speed drive

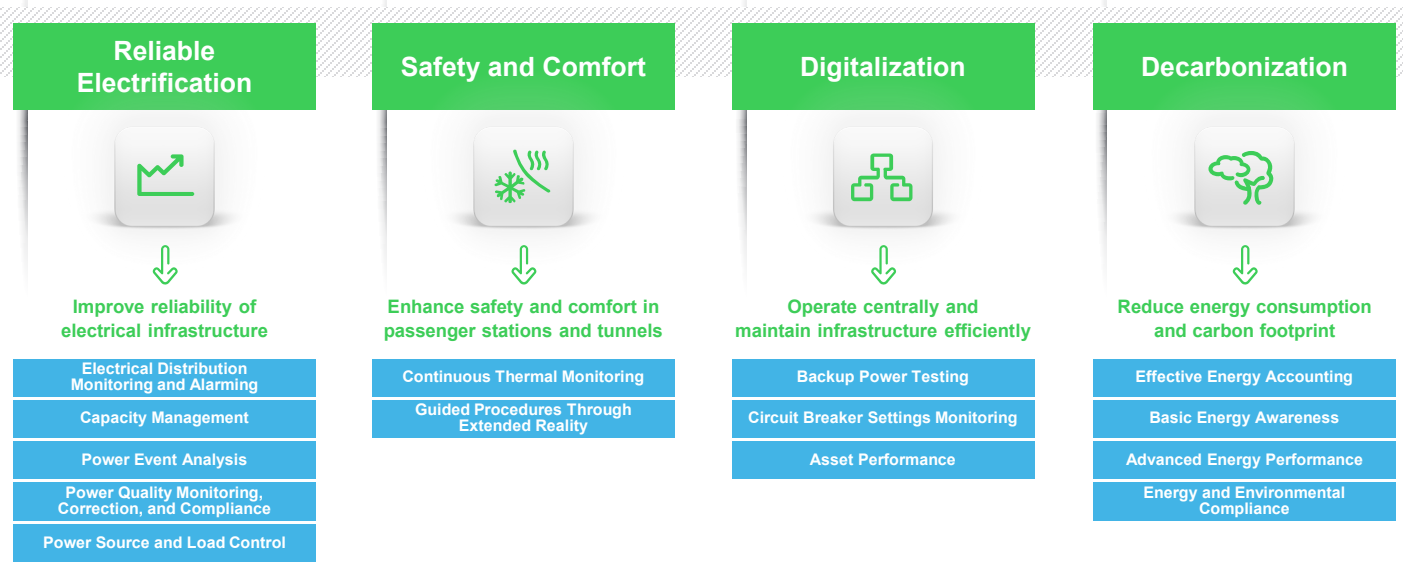


Cooling

EcoStruxure Power Value Proposition

Specific pillars for tunnel systems

EcoStruxure Power provides applications to support the challenges of tunnel systems for Railway and Urban Transportation, with the following pillars:



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Our Digital Solutions and Services: Applications Overview

Reliable Electrification

Electrical Distribution Monitoring and Alarming

■■■



- Provide real-time status of the electrical distribution system
- Help identify anomalies and notify the right personnel
- Aggregate onboard alarm data in an easy-to-understand way
- Take advantage of native integration of intelligent electrical devices

Reliable Electrification

Capacity Management

■■

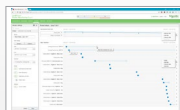


- Visualize real-time or historical power system capacity
- Monitor and trend circuit or equipment loading
- Provide information for capacity planning

Reliable Electrification

Power Event Analysis

■■■

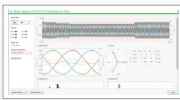


- Provide a user-friendly graphical tool to simplify and save time in event analysis
- Provide an aggregated view of events in the same dashboard
- Enable root cause analysis

Reliable Electrification

Power Quality Monitoring, Correction, and Compliance

■■■



- **Power Quality Monitoring and Compliance:** Monitor persistent steady state and event-based disturbances to better understand and analyze power quality disturbances
- **Power Quality Correction:** Correct over/under voltages, harmonics, etc.

Reliable Electrification

Power Source and Load Control

■■■



- Help isolate faults with relay automation and circuit breaker coordination
- Help preserve critical loads by automatically transferring to alternate power
- Help restore power quickly
- Get real-time visibility, automation and control of the entire electrical infrastructure



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

Introduction

EcoStruxure Value Proposition

Applications Overview ▶

Reference Architectures

7- Depots and Workshops

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Our Digital Solutions and Services: Applications Overview

Safety and Comfort

Continuous Thermal Monitoring

■■■



- Monitor the temperature of busbar, cable, transformer, and withdrawable circuit breaker connections
- Help detect poor connections at an early stage
- Provide temperature alarming and reporting for fast response

Safety and Comfort

Guided Procedures Through XR

■■■



- Use Extended Reality to perform step-by-step guidance
- Benefit from “X-ray” vision and virtually overlaid contextual asset and site information, live data, events and alarms
- Take advantage of remote collaboration

Digitalization

Backup Power Testing

■■■

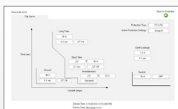


- Automatically record key backup power test parameters such as run time, engine loading, exhaust and engine temperatures
- Perform automated backup power test reporting

Digitalization

Circuit Breaker Settings Monitoring

■



- Compare current circuit breaker settings with commissioned settings
- Help detect inappropriate setting modifications periodically
- Provide information for capacity planning

Digitalization

Asset Performance

■■■



- Make asset health visible across the entire system
- Streamline inspections using continuous asset health monitoring
- Optimize maintenance planning with analytics and expert advice





Our Digital Solutions and Services: Applications Overview

Decarbonization

Effective Energy Accounting



■ ■ ■

Identify areas for possible energy conservation measures:
→ [Utility Bill Verification](#): Identify billing errors by comparison with a shadow bill
→ [Cost Allocation](#): Allocate energy costs to terminals or departments for accurate billing
→ [Power Factor correction](#): Mitigate harmonic effects and power quality issues

Decarbonization

Basic Energy Awareness

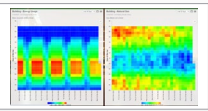


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→ [Energy Monitoring](#): Increase awareness of energy usage by creating easy-to-understand graphical dashboards and reports from data
→ [Cost Allocation](#): Identify "quick-win" opportunities for energy savings

Decarbonization

Advanced Energy Performance

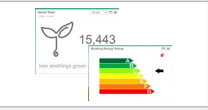


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→ [Energy Performance](#): Normalize energy data (e.g. with respect to building area) to give context. Analyze energy performance in context using KPIs
→ [Energy Benchmarking](#): Compare energy usage with respect to other comparable facilities
→ [Energy Modeling and Verification](#): Model the energy usage versus energy drivers

Decarbonization

Energy and Environmental Compliance



■ ■

→ [Energy Efficiency Compliance](#): Report effectively about local/global energy and environmental building code compliance
→ [Greenhouse Gas Reporting](#): Track and report emissions effectively to help cut carbon emissions

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots

6- Tunnel Systems

- Introduction
- EcoStruxure Value Proposition
- Applications Overview

Reference Architectures

- 7- Depots and Workshops
8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Reference Electrical and Digital Architectures

Typical electrical architecture

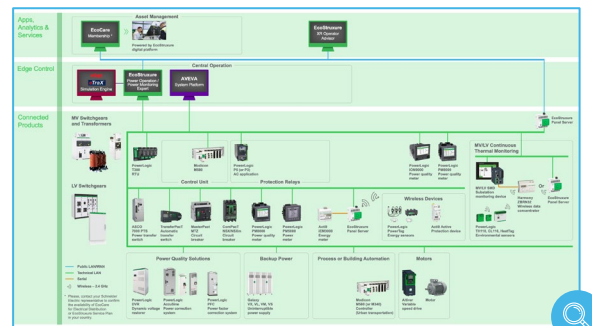
Find the Schneider Electric products necessary to implement the selected applications.

Then find their location in the electrical architecture.



Typical digital architecture

Find how the products, software solutions and cloud services are connected in the digital architecture.



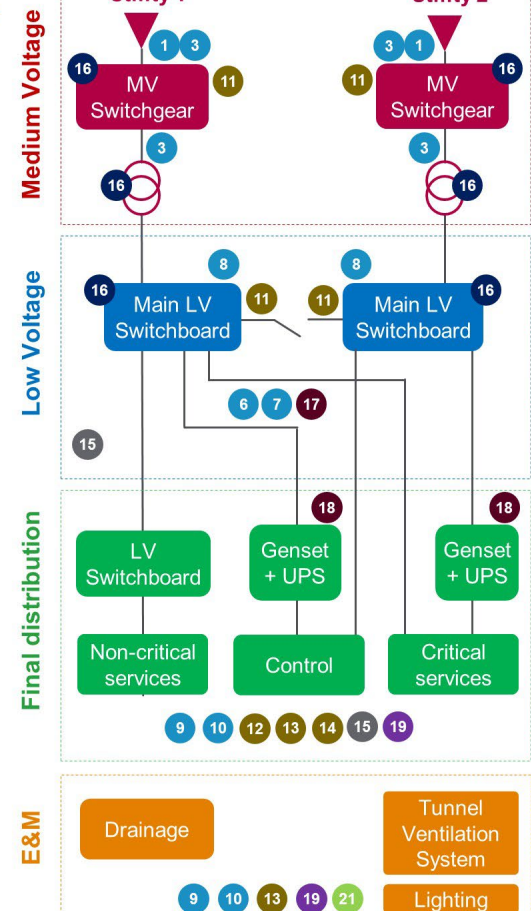
1- Select the applications

2- Determine the required products

3- Find the location

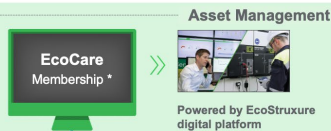


Typical reference numbers for identification	1	3	6	7	8	9	10	11	12	13	14	15	16	17	18	19	21
Electrical Distribution Monitoring and Alarming	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Capacity Management	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power Event Analysis	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
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Power Source and Load Control	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
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Effective Energy Accounting	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
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Advanced Microgrid	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Energy and Environmental Compliance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Electrification (EV charging for eBus Depot)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Building Automation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■



Typical Electrical Architecture for Tunnel Systems

Apps, Analytics & Services



Edge Control

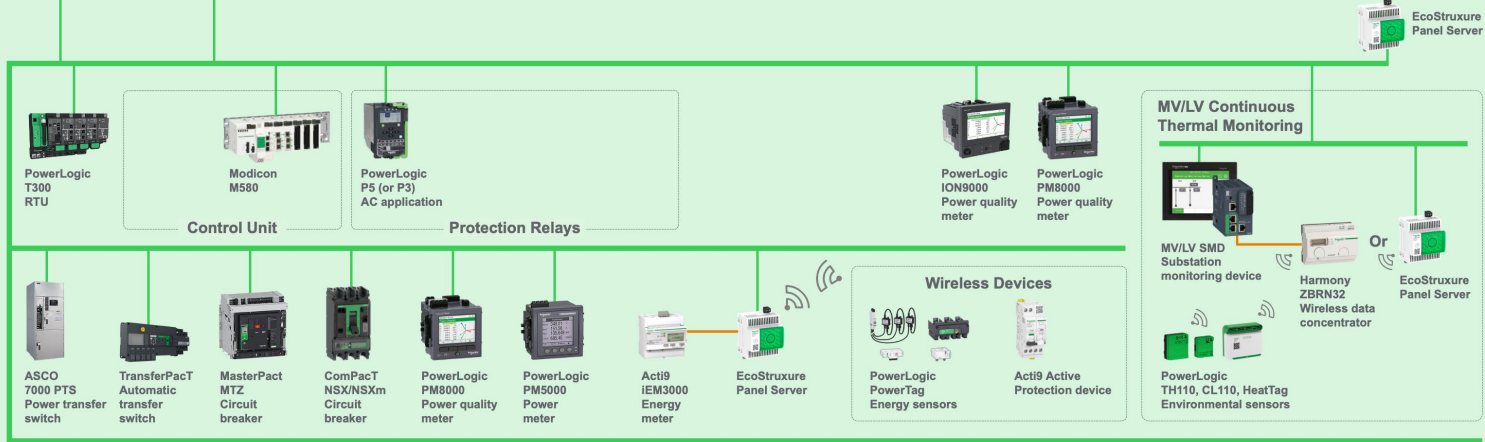


Connected Products

MV Switchgears and Transformers

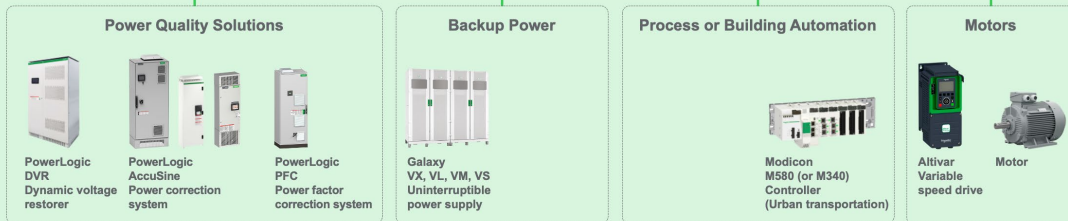


LV Switchgears



- Public LAN/WAN
- Technical LAN
- Serial
- Wireless – 2.4 GHz

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EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops ▼

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

SECTION 3

EcoStruxure Power
Digital Solutions and Services
for:

→ Depots and Workshops

WHY READ THIS SECTION?

The objective of this section is to:

- Introduce **depots and workshops**
- Review **EcoStruxure Power value propositions and the associated applications** for depots and workshops
- Provide **reference electrical and digital architectures**



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



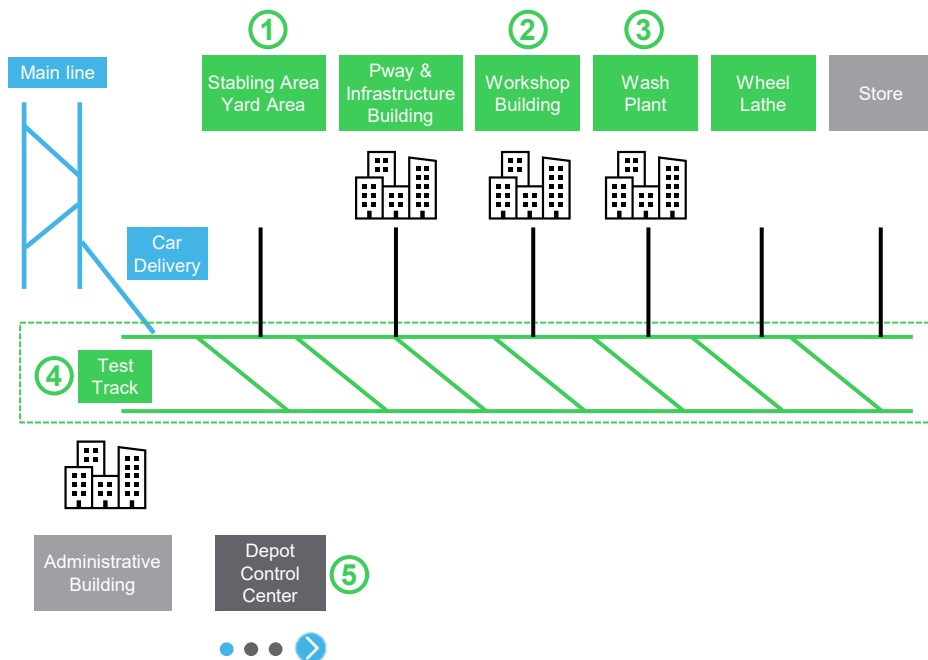
Introduction to Depots and Workshops

What is it?

A depot or workshop is a railway facility where preventive and corrective maintenance tasks are carried out on rolling stock. The difference between the two is not totally clear, but the former is usually more focused on train storage and their periodic maintenance, while the latter is more focused on major repairs. However, it is common for both types of services to be carried out within the same building.

A train depot/workshop has the following main areas:

1. Train yard
2. Train workshop building
3. Train wash plant
4. Test track
5. Depot control center



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

Introduction ▶

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Introduction to Depots and Workshops

How does it work?

Typical depots and workshops consist of multiple technical systems that work in coordination in order to fulfill the operational plan. These include:



Power Supply



Traction
Power



Microgrid
Management



Maintenance
Safety Process



Access Control



Fire Detection



Drainage



Lighting



HVAC*

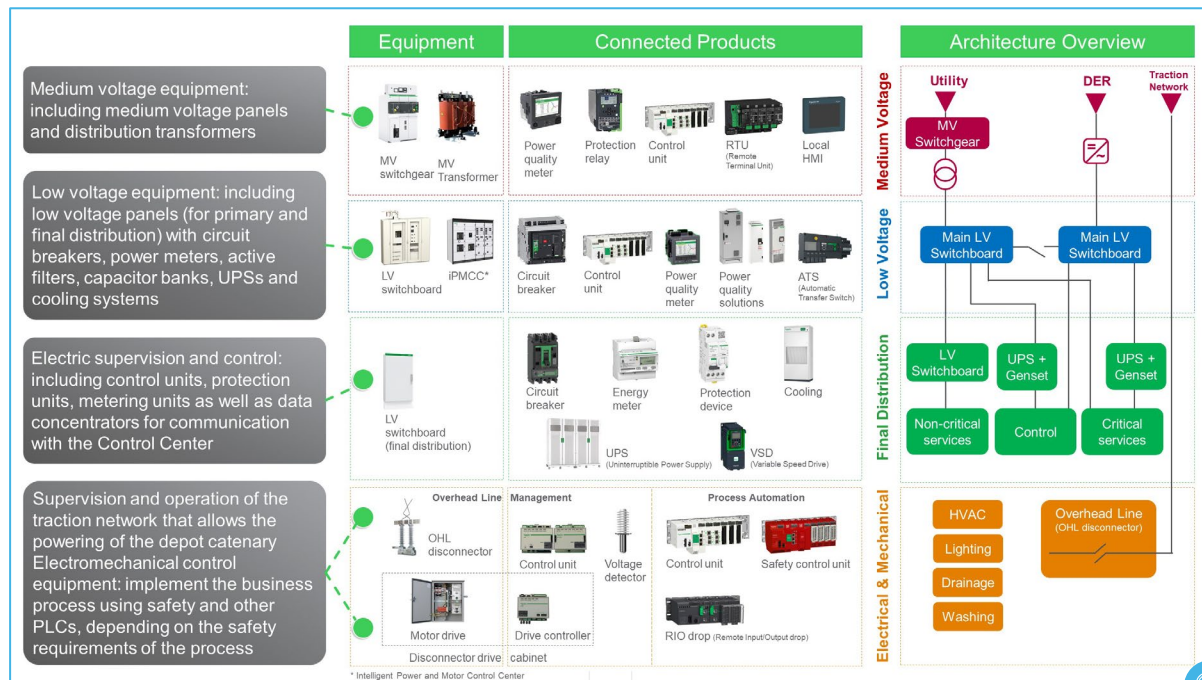


Washing

* Heating, Ventilation, Air Conditioning

Introduction

Main components of the electrical architecture

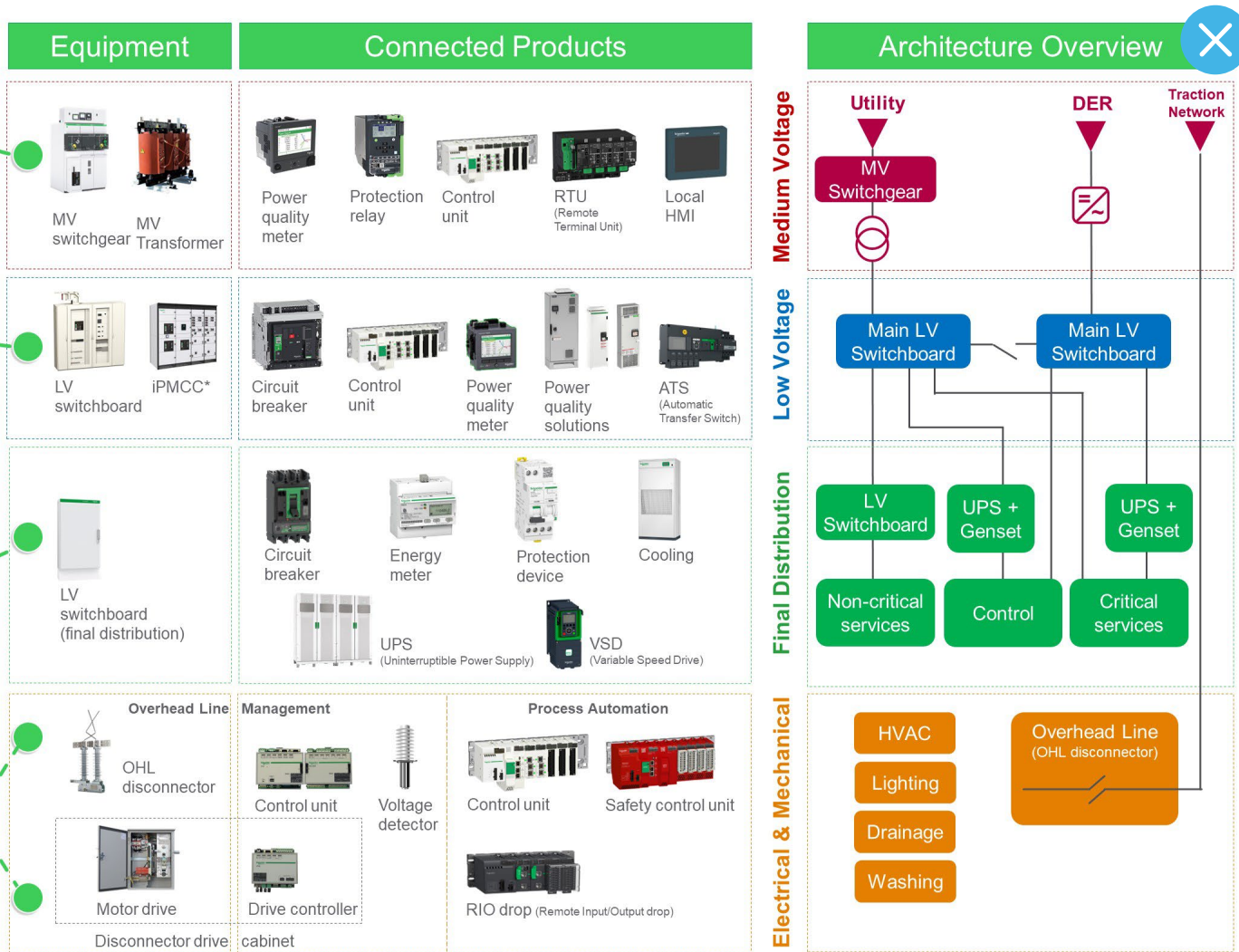


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breakers, power meters, active
filters, capacitor banks, UPSs and
cooling systems

Electric supervision and control:
including control units, protection
units, metering units as well as data
concentrators for communication
with the Control Center

Supervision and operation of the
traction network that allows the
powering of the depot catenary
Electromechanical control
equipment: implement the business
process using safety and other
PLCs, depending on the safety
requirements of the process



* Intelligent Power and Motor Control Center

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

Introduction

EcoStruxure Value Proposition ▶

Applications Overview

Reference Architectures

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



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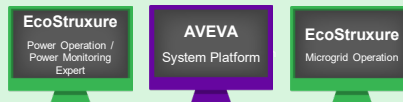
Apps,
analytics,
and services

Edge
Control

Connected
products



Cloud-Based Advisor Services for asset management, data integrity, and workforce empowerment with extended reality guidance



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems

7- Depots and Workshops

Introduction

EcoStruxure Value Proposition ▶

Applications Overview

Reference Architectures

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



EcoStruxure Power Value Proposition

Specific pillars for depots and workshops

EcoStruxure Power provides applications to support the challenges of depots and workshops for Railway and Urban Transportation, with the following pillars:

Reliable Electrification



Improve reliability of
electrical infrastructure

Electrical Distribution
Monitoring and Alarming

Capacity Management

Power Event Analysis

Power Quality Monitoring,
Correction, and Compliance

Power Source and Load Control

Overhead Line Protection and
Automation

Safety and Comfort



Enhance safety and comfort in
passenger stations and tunnels

Continuous Thermal Monitoring

Guided Procedures Through
Extended Reality

Digitalization



Operate centrally and
maintain infrastructure efficiently

Backup Power Testing

Circuit Breaker Settings Monitoring

Asset Performance

Decarbonization



Reduce energy consumption
and carbon footprint

Effective Energy Accounting

Basic Energy Awareness

Advanced Energy Performance

Advanced Microgrid

Energy and Environmental
Compliance

Our Digital Solutions and Services: Applications Overview

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Reliable Electrification

Electrical Distribution Monitoring and Alarming

■■■



- Provide real-time status of the electrical distribution system
- Help identify anomalies and notify the right personnel
- Aggregate onboard alarm data in an easy-to-understand way
- Take advantage of native integration of intelligent electrical devices

Reliable Electrification

Capacity Management

■■

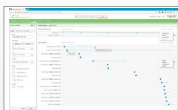


- Visualize real-time or historical power system capacity
- Monitor and trend circuit or equipment loading
- Provide information for capacity planning

Reliable Electrification

Power Event Analysis

■■■

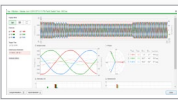


- Provide a user-friendly graphical tool to simplify and save time in event analysis
- Provide an aggregated view of events in the same dashboard
- Enable root cause analysis

Reliable Electrification

Power Quality Monitoring, Correction, and Compliance

■■■



- **Power Quality Monitoring and Compliance:** Monitor persistent steady state and event-based disturbances to better understand and analyze power quality disturbances
- **Power Quality Correction:** Correct over/under voltages, harmonics, etc.

Reliable Electrification

Power Source and Load Control

■■■



- Help isolate faults with relay automation and circuit breaker coordination
- Help preserve critical loads by automatically transferring to alternate power
- Help restore power quickly
- Get real-time visibility, automation and control of the entire electrical infrastructure



Our Digital Solutions and Services: Applications Overview

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

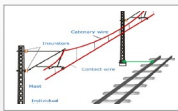
BIBLIOGRAPHY



Reliable Electrification

Overhead Line Protection and Automation

■■■



- Provide distributed control and supervision of overhead (catenary) line disconnectors

Safety and Comfort

Continuous Thermal Monitoring

■■■



- Monitor the temperature of busbar, cable, transformer, and withdrawable circuit breaker connections
- Help detect poor connections at an early stage
- Provide temperature alarming and reporting for fast response

Safety and Comfort

Guided Procedures Through XR

■■



- Use Extended Reality to perform step-by-step guidance
- Benefit from "X-ray" vision and virtually overlaid contextual asset and site information, live data, events and alarms
- Take advantage of remote collaboration

Digitalization

Backup Power Testing

■■

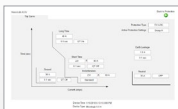


- Automatically record key backup power test parameters such as run time, engine loading, exhaust and engine temperatures
- Perform automated backup power test reporting

Digitalization

Circuit Breaker Settings Monitoring

■



- Compare current circuit breaker settings with commissioned settings
- Help detect inappropriate setting modifications periodically
- Provide information for capacity planning



EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Our Digital Solutions and Services: Applications Overview

Digitalization

Asset Performance



- Make asset health visible across the entire system
- Streamline inspections using continuous asset health monitoring
- Optimize maintenance planning with analytics and expert advice

Decarbonization

Effective Energy Accounting



- Identify areas for possible energy conservation measures:
- [Utility Bill Verification](#): Identify billing errors by comparison with a shadow bill
 - [Cost Allocation](#): Allocate energy costs to terminals or departments for accurate billing
 - [Power Factor correction](#): Mitigate harmonic effects and power quality issues

Decarbonization

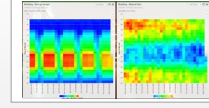
Basic Energy Awareness



- [Energy Monitoring](#): Increase awareness of energy usage by creating easy-to-understand graphical dashboards and reports from data
- [Cost Allocation](#): Identify "quick-win" opportunities for energy savings

Decarbonization

Advanced Energy Performance



- [Energy Performance](#): Normalize energy data (e.g. with respect to building area) to give context. Analyze energy performance in context using KPIs
- [Energy Benchmarking](#): Compare energy usage with respect to other comparable facilities
- [Energy Modeling and Verification](#): Model the energy usage versus energy drivers

Decarbonization

Advanced Microgrid



- Enhance power system reliability, despite grid instability often resulting from powerful storms and grid unavailability
- Reduce carbon emissions and optimize cost efficiency by leveraging Distributed Energy Resources (DERs)

EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

Introduction

EcoStruxure Value Proposition

Applications Overview ▶

Reference Architectures

8- Control Center

SECTION 4 – Design Considerations

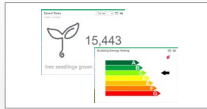
SECTION 5 – Customer Stories

BIBLIOGRAPHY

Our Digital Solutions and Services: Applications Overview

Decarbonization

Energy and
Environmental
Compliance



- [Energy Efficiency Compliance](#): Report effectively about local/global energy and environmental building code compliance
- [Greenhouse Gas Reporting](#): Track and report emissions effectively to help cut carbon emissions

EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems

7- Depots and Workshops

- Introduction
- EcoStruxure Value Proposition
- Applications Overview
- Reference Architectures

8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Reference Electrical and Digital Architectures

Typical electrical architecture

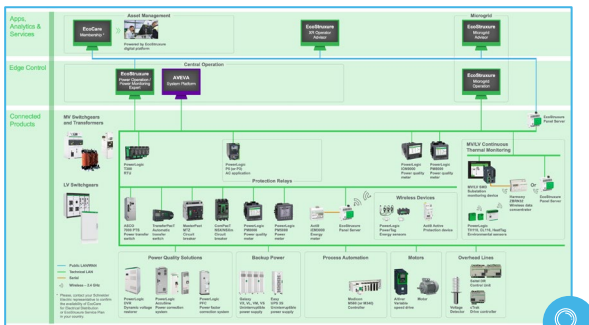
Find the Schneider Electric products necessary to implement the selected applications.

Then find their location in the electrical architecture.



Typical digital architecture

Find how the products, software solutions and cloud services are connected in the digital architecture.



1- Select the applications

2- Determine the required products

3- Find the location



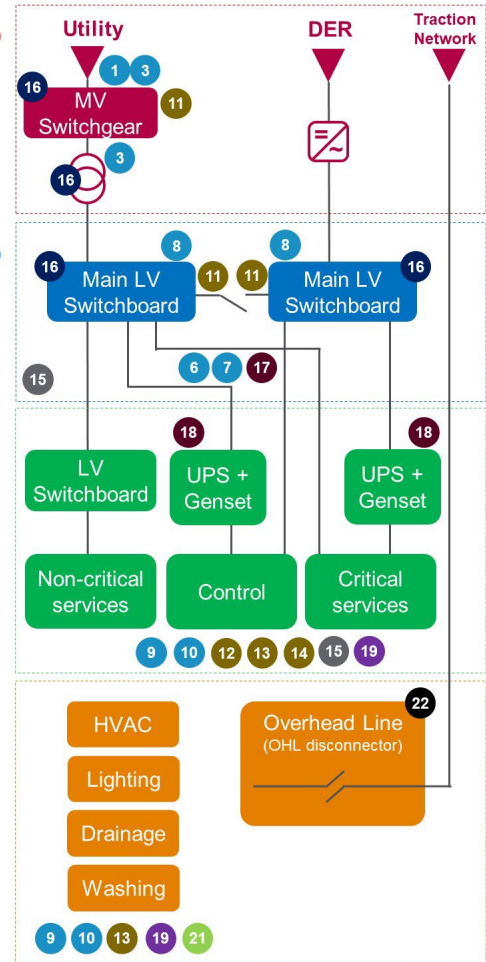
Typical reference numbers to identification	1	3	6	7	8	9	10	11	12	13	14	15	16	17	18	19	21	22
Electrical Distribution Monitoring and Alarming	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Capacity Management	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power Event Analysis	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power Quality Monitoring, Correction, and Compliance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power Source and Load Control	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Advanced Protection and Automation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Overhead Line Protection and Automation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Continuous Thermal Monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Guided Procedures Through Extended Reality	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Backup Power Testing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Circuit Breaker Settings Monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Asset Performance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Effective Energy Accounting	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Basic Energy Awareness	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Advanced Energy Performance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Advanced Microgrid	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Energy and Environmental Compliance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Electrification (EV charging for eBus Depot)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Building Automation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Medium Voltage

Low Voltage

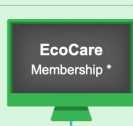
Final Distribution

Electrical & Mechanical



Typical Electrical Architecture for Depots and Workshops

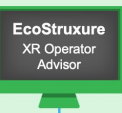
Apps, Analytics & Services



Asset Management

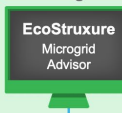


Powered by EcoStruxure digital platform



EcoStruxure
XR Operator
Advisor

Microgrid



EcoStruxure
Microgrid
Advisor

Edge Control

Central Operation



EcoStruxure
Power Operation /
Power Monitoring
Expert



AVEVA
System Platform



EcoStruxure
Microgrid
Operation

Connected Products

MV Switchgears and Transformers



LV Switchgears



PowerLogic
T300
RTU



PowerLogic
P5 (or P3)
AC application

Protection Relays



ASCO
7000 PTS
Power transfer
switch



TransferPacT
Automatic
transfer
switch



MasterPact
MTZ
Circuit
breaker



ComPact
NSX/NSXm
Circuit
breaker



PowerLogic
PM8000
Power quality
meter



PowerLogic
PM5000
Power
meter



Acti9
iEM3000
Energy
meter



EcoStruxure
Panel Server



PowerLogic
ION9000
Power quality
meter



PowerLogic
PM8000
Power quality
meter

Wireless Devices



PowerLogic
PowerTag
Energy sensors



Acti9 Active
Protection device

MV/LV Continuous Thermal Monitoring



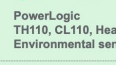
MV/LV SMD
Substation
monitoring device



Harmony
ZBRN32
Wireless data
concentrator



EcoStruxure
Panel Server



PowerLogic
TH110, CL110, HeatTag
Environmental sensors

Power Quality Solutions



PowerLogic
DVR
Dynamic voltage
restorer



PowerLogic
AccuSine
Power correction
system



PowerLogic
PFC
Power factor
correction system



Galaxy
VX, VL, VM, VS
Uninterruptible
power supply



Easy
UPS 3S
Uninterruptible
power supply

Process Automation



Modicon
M580 (or M340)
Controller

Motors



Altivar
Variable
speed drive



Motor

Overhead Lines



Voltage
Detector



Saltel DR
Control Unit



cTrak
Drive controller

- Public LAN/WAN
- Technical LAN
- Serial
- 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.



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center ▼

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

SECTION 3

EcoStruxure Power
Digital Solutions and Services
for:

→ Control Center

WHY READ THIS SECTION?

The objective of this section is to:

- Introduce the **control center**
- Review **EcoStruxure Power value propositions and the associated applications** for the control center
- Provide **reference architectures**



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

Introduction ▶

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Introduction to the Control Center

What is it?

The Control Center is a central location from which the following facilities (described in the previous sections) are operated:

- Traction Substations
- Overhead Lines
- Auxiliary Power System
- Passenger Stations
- Tunnel Systems
- Datacenters

Its purpose is to achieve compliance with the operational plan, with the minimum necessary resources.

Comment:

- Initially, the responsibility was located at the local levels of the facilities.
- Now, process automation makes it possible to delegate responsibility to a higher hierarchy facility and increase the operational efficiency.



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops

8- Control Center

Introduction ▶

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Introduction to the Control Center

How does it work? (1/2)

The control center is the facility that centrally manages the railway installations. The most relevant element of this facility is the control room, from which the system operators are mandated to perform the following functions:

Real-time Operation

Objective

Manage the operational plan of the facilities remotely and centrally. This helps to optimize the state of operation under various situations.

How

- **Monitor and control the facilities** including the implementation of automated systems that facilitate any changes in the configuration of the tasks.
- **Manage operations** for all the facilities (full delegation, exceptions for abnormal situations).
- **Manage emergency scenarios** for passenger stations and tunnel systems.

Asset Management

Objective

Add advanced facility maintenance strategies to traditional corrective and preventive maintenance. This helps optimize asset availability without increasing maintenance costs.

How

- Collect data from field devices to monitor asset health and perform:
- **Condition-based maintenance:** Proactive monitoring depending on the condition of the asset. Maintenance is triggered when critical parameters vary beyond their “normal” range.
 - **Predictive maintenance:** a maintenance task is performed when measured variables of an asset deviate from those indicated as normal by a digital model of the asset.

Operational Efficiency

Objective

Optimize operations with the analytics applied to data acquired from the field devices. This helps to empower the workforce.

How

Use data collected at operational level to implement advanced functionalities such as:

- **Electrical simulation:** commonly used for operator training or operation support, and during the facility electrical design phase.
- **Basic and advanced reporting:** advanced representation of information and generation of new data, using data processing techniques and AI models.

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

Introduction ▶

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Introduction to the Control Center

How does it work? (2/2)

A Redundancy-based Strategy

The Control Center is responsible for the operations of all the facilities (except in abnormal situations mainly related to maintenance and telecom network issues). Therefore, **it has a huge responsibility, and its availability is critical.**

To improve availability of the control center, essential services are usually implemented with redundancy:

- Redundancy of the components inside the control center
- Redundancy of the control center in other locations (emergency control center).



In case of failure of a component or of unavailability of the control center, the redundant component / control center takes over the function/service until repair/availability.



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

Introduction

EcoStruxure Value Proposition ▶

Applications Overview

Reference Architectures

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



EcoStruxure Power Value Proposition

Our solution to control and supply energy to control centers

3. Analysis & Optimization

Applications for advanced asset management, analysis and optimization of operations:

- Predictive and condition-based maintenance for electrical assets
- Integration, contextualization, analysis, and representation of information
- Advanced management of microgrids and electric chargers, including technical and economic aspects.
- Consulting Services, including network and power quality audits
- Augmented reality guidance for complicated or rarely performed procedures

2. Operational Management

Among the usual tasks to be carried out by the operators of the control center, we can highlight the following:

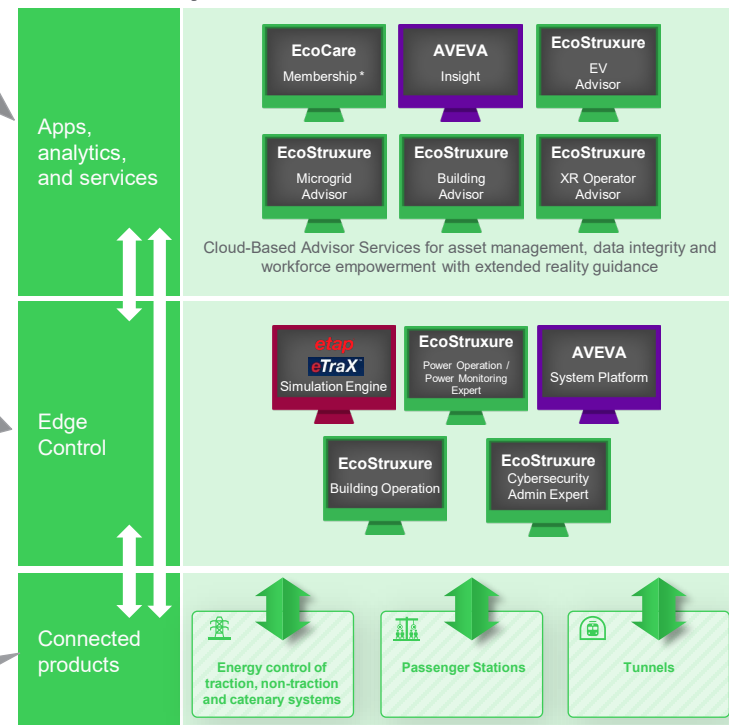
- Assurance of power supply to trains and rail consumers
- Mitigation of the impact of electrical faults in the railway traction scope.
- Implementation of the different operational / emergency scenarios defined for passenger stations and tunnels.
- Central management of the cybersecurity for the full architecture.

1. Primary Equipment

Data provided by connected products from the different facilities

EcoStruxure™
Innovation At Every Level

for Control Centers



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

Introduction

EcoStruxure Value Proposition ▶

Applications Overview

Reference Architectures

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



EcoStruxure Power Value Proposition

Specific pillars for control centers

EcoStruxure Power provides applications to support the challenges of control centers for Railway and Urban Transportation, with the following pillars:

Reliable Electrification



Improve reliability of electrical infrastructure

Electrical Distribution Monitoring and Alarming

Capacity Management

Power Event Analysis

Power Quality Monitoring, Correction, and Compliance

Overhead Line Protection and Automation

Safety and Comfort



Enhance safety and comfort in passenger stations and tunnels

Continuous Thermal Monitoring

Guided Procedures Through Extended Reality

Digitalization



Operate centrally and maintain infrastructure efficiently

Circuit Breaker Settings Monitoring

Asset Performance

Operator Training Simulation

Simulate Before Operate

Cybersecurity Central Management

Asset Preventive Maintenance

Asset analytics

Massive Data Archive and Contextualization

Rail Power Design

Decarbonization



Reduce energy consumption and carbon footprint

Effective Energy Accounting

Basic Energy Awareness

Advanced Energy Performance

Advanced Microgrid

Energy and Environmental Compliance

Electrification (EV Charging for eBus Depot)

Building Automation

Our Digital Solutions and Services: Applications Overview

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Reliable Electrification

Electrical Distribution Monitoring and Alarming

■■■



- Provide real-time status of the electrical distribution system
- Help identify anomalies and notify the right personnel
- Aggregate onboard alarm data in an easy-to-understand way
- Take advantage of native integration of intelligent electrical devices

Reliable Electrification

Capacity Management

■■■

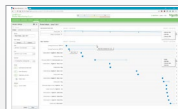


- Visualize real-time or historical power system capacity
- Monitor and trend circuit or equipment loading
- Provide information for capacity planning

Reliable Electrification

Power Event Analysis

■■■

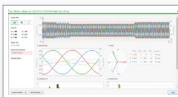


- Provide a user-friendly graphical tool to simplify and save time in event analysis
- Provide an aggregated view of events in the same dashboard
- Enable root cause analysis

Reliable Electrification

Power Quality Monitoring, Correction, and Compliance

■■

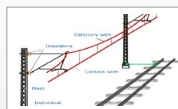


- **Power Quality Monitoring and Compliance:** Monitor persistent steady state and event-based disturbances to better understand and analyze power quality disturbances
- **Power Quality Correction:** Correct over/under voltages, harmonics, etc.

Reliable Electrification

Overhead Line Protection and Automation

■■■



- Provide distributed control and supervision of overhead (catenary) line disconnectors



Our Digital Solutions and Services: Applications Overview

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Safety and Comfort

Continuous Thermal Monitoring



- Monitor the temperature of busbar, cable, transformer, and withdrawable circuit breaker connections
- Help detect poor connections at an early stage
- Provide temperature alarming and reporting for fast response

Safety and Comfort

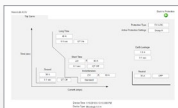
Guided Procedures Through XR



- Use Extended Reality to perform step-by-step guidance
- Benefit from “X-ray” vision and virtually overlaid contextual asset and site information, live data, events and alarms
- Take advantage of remote collaboration

Digitalization

Circuit Breaker Settings Monitoring



- Compare current circuit breaker settings with commissioned settings
- Help detect inappropriate setting modifications periodically
- Provide information for capacity planning

Digitalization

Asset Performance



- Make asset health visible across the entire system
- Streamline inspections using continuous asset health monitoring
- Optimize maintenance planning with analytics and expert advice

Digitalization

Operator Training Simulation



- Train new employees and build confidence on new systems
- 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



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Our Digital Solutions and Services: Applications Overview

Digitalization

Simulate Before Operate



- 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

Digitalization

Cybersecurity Central Management



- Integrate cybersecurity solutions allowing the operations team to have visibility of key cybersecurity data
- Help manage/maintain cybersecurity control points
- Align to cybersecurity standards and best practices to strengthen OT security

Digitalization

Asset Preventive Maintenance



- Minimize inventory costs and improve spare part availability
- Manage mobile work for more accurate and timely data collection
- Receive proactive maintenance information by identifying labor/material/tools/drawings on work order

Digitalization

Asset Analytics



- Analyze utilization, efficiency, and condition-management of assets. Receive alerts and notifications
- Provide automated analytics using supervised or unsupervised machine learning
- Create dynamic data visualizations and asset frameworks for contextual data viewing

Digitalization

Massive Data Archive and Contextualization



- Collect and store in one single place real-time data from operating assets with sub-second granularity
- Contextualize and visualize data



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

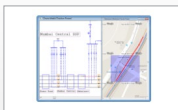
BIBLIOGRAPHY



Our Digital Solutions and Services: Applications Overview

Digitalization

Rail Power Design



- Visualize and analyze traction power systems using synchronized geospatial and schematic views
- Simulate and analyze operation of combined DC and AC power supply networks
- Model traction power-specific devices with built-in components and engineering libraries

Decarbonization

Effective Energy Accounting



Identify areas for possible energy conservation measures:

- **Utility Bill Verification:** Identify billing errors by comparison with a shadow bill
- **Cost Allocation:** Allocate energy costs to terminals or departments for accurate billing
- **Power Factor correction:** Mitigate harmonic effects and power quality issues

Decarbonization

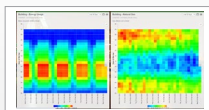
Basic Energy Awareness



- **Energy Monitoring:** Increase awareness of energy usage by creating easy-to-understand graphical dashboards and reports from data
- **Cost Allocation:** Identify "quick-win" opportunities for energy savings

Decarbonization

Advanced Energy Performance



- **Energy Performance:** Normalize energy data (e.g. with respect to building area) to give context. Analyze energy performance in context using KPIs
- **Energy Benchmarking:** Compare energy usage with respect to other comparable facilities
- **Energy Modeling and Verification:** Model the energy usage versus energy drivers

Decarbonization

Advanced Microgrid



- Enhance power system reliability, despite grid instability often resulting from powerful storms and grid unavailability
- Reduce carbon emissions and optimize cost efficiency by leveraging Distributed Energy Resources (DERs)



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

1- Overhead Lines

2- Traction Substations

3- Auxiliary Powers Systems

4- Passenger Stations

5- eBus Depots

6- Tunnel Systems

7- Depots and Workshops

8- Control Center

Introduction

EcoStruxure Value Proposition

Applications Overview

Reference Architectures

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Our Digital Solutions and Services: Applications Overview

Decarbonization

Energy and Environmental Compliance



■ ■

→ **Energy Efficiency Compliance:** Report effectively about local/global energy and environmental building code compliance

→ **Greenhouse Gas Reporting:** Track and report emissions effectively to help cut carbon emissions

Decarbonization

Electrification (EV Charging for eBus Depot)



■ ■

→ Power the bus depot with an end-to-end electrical distribution solution for charging your electrical buses

→ Integrate and manage local power generation and batteries for self-consumption of renewable energy or for resiliency purposes

Decarbonization

Building Automation



■ ■ ■

→ Monitor and control the electromechanical systems present in the passenger station

→ Automate processes within the passenger station

→ Implement operational and emergency scenarios



EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops

8- Control Center

- Introduction
- EcoStruxure Value Proposition
- Applications Overview

Reference Architectures

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

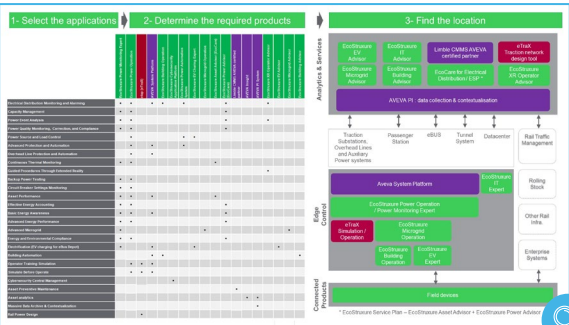
BIBLIOGRAPHY

Reference Electrical and Digital Architectures

Typical reference architecture

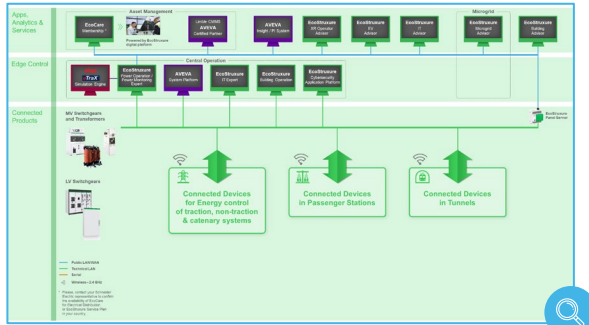
Find the Schneider Electric digital solutions and services relevant to implement the selected applications.

Then find their location in the reference architecture.



Typical digital architecture

Find how the products, software solutions and cloud services are connected in the digital architecture.



1- Select the applications

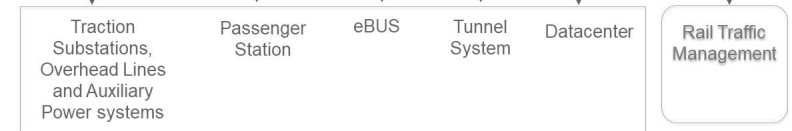
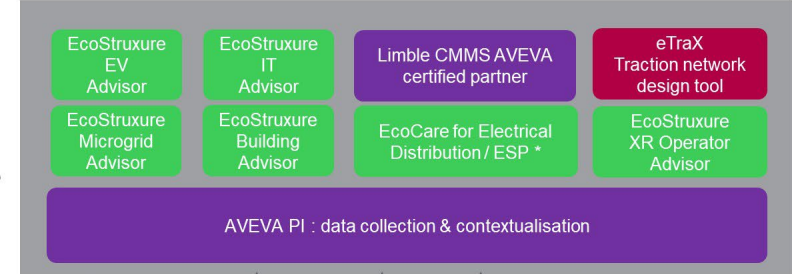
2- Determine the required products

3- Find the location

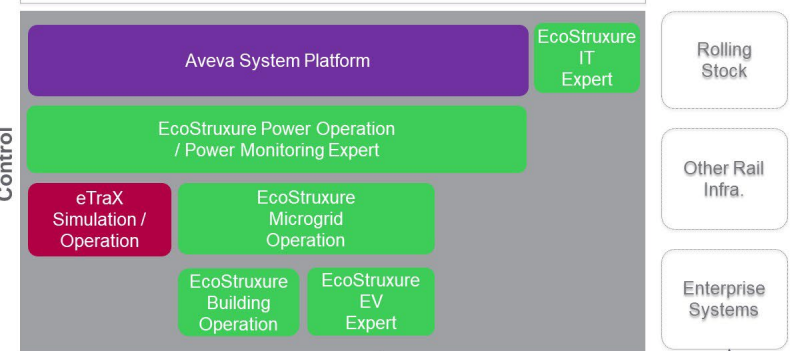


	EcoStruxure Power Monitoring Expert	EcoStruxure Power Operation	eTap (eTraX)	AVEVA System Platform	EcoStruxure Building Operation	EcoStruxure Cybersecurity Application Platform	EcoStruxure Power Automation System	EcoStruxure EV Charging Expert	EcoStruxure Microgrid Operation	EcoStruxure Asset Advisor (EcoCare)	EcoStruxure Power Advisor (EcoCare)	Limble CMMS AVEVA certified partner	AVEVA Insight	AVEVA PI System	EcoStruxure XR Operator Advisor	EcoStruxure EV Advisor	EcoStruxure Microgrid Advisor	EcoStruxure Building Advisor
Electrical Distribution Monitoring and Alarming	■	■		■	■		■				■							
Capacity Management	■	■									■							
Power Event Analysis	■	■									■					■		
Power Quality Monitoring, Correction, and Compliance	■	■									■							
Power Source and Load Control		■					■	■										
Advanced Protection and Automation		■		■			■											
Overhead Line Protection and Automation		■		■														
Continuous Thermal Monitoring	■	■								■								
Guided Procedures Through Extended Reality															■			
Backup Power Testing	■	■																
Circuit Breaker Settings Monitoring	■	■																
Asset Performance	■	■		■						■								
Effective Energy Accounting	■	■									■							
Basic Energy Awareness	■	■		■							■							
Advanced Energy Performance	■	■									■							
Advanced Microgrid	■							■									■	
Energy and Environmental Compliance	■	■									■							
Electrification (EV charging for eBus Depot)	■			■				■								■		
Building Automation				■	■													■
Operator Training Simulation		■	■	■														
Simulate Before Operate		■	■	■														
Cybersecurity Central Management						■												
Asset Preventive Maintenance												■						
Asset analytics													■	■				
Massive Data Archive & Contextualization														■				
Rail Power Design			■															

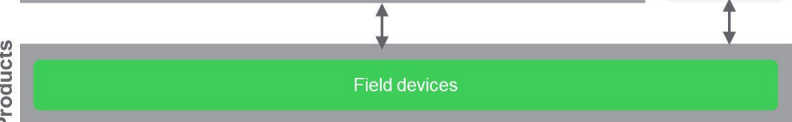
Analytics & Services



Edge Control



Connected Products



* EcoStruxure Service Plan – EcoStruxure Asset Advisor + EcoStruxure Power Advisor

Typical Reference Architecture for the Control Center

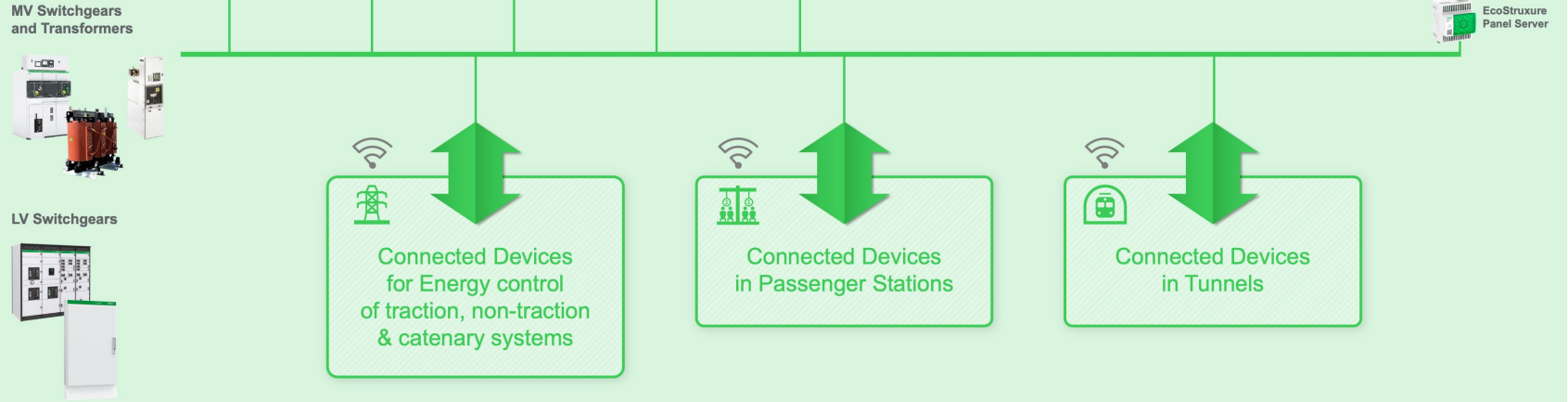
Apps, Analytics & Services



Edge Control



Connected Products



- Public LAN/WAN
- Technical LAN
- Serial
- 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.

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

SECTION 4 – Design Considerations ▼

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY

SECTION 4

Design Considerations

- Control Center Solutions
- Control Strategies for Passenger Stations
- Control Strategies for Traction substations
- Communication Protocols
- Time Synchronization
- Integration with BMS
- Cybersecurity
- Environmental Data Program

WHY READ THIS SECTION?

The objective of this section is to:

- Provide the details of the **critical system design components** to be considered while designing digital architecture
- Addresses **design considerations of the electrical installation** in the context of communications, data, time and cybersecurity



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions ▶

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY



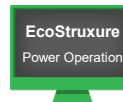
How to Choose a Solution for Operation Control Centers

The control center centralizes the operation of railway facilities.

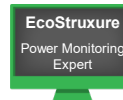
Schneider Electric offers the following solutions for effective management and control:

Management of Energy

Basic functionalities



- Basic operation and monitoring
- Alarm management
- Access control
- Automatism and interlocks
- Basic reporting



- Continuous thermal monitoring
- Power event analysis
- Power quality monitoring
- Energy usage analysis
- Energy efficiency & power quality compliance

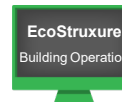
Complex systems



- Advanced alarm management
- Advanced reporting & data analytics tools
- Emergency control center
- Graphical event replay
- Scalability

Management of Passenger Stations

Building approach



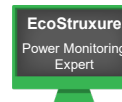
- Railways
- Building element integration
- Building management
- Interoperability protocols

Industrial approach



- Urban Transportation
- Higher integration needs of external systems
- Industrial interoperability protocols

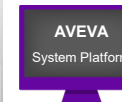
Additional analysis



- Continuous thermal monitoring
- Power event analysis
- Power quality monitoring
- Energy usage analysis
- Energy efficiency & power quality compliance

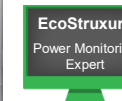
Control of Railway Tunnels

Tunnel Management



- Good capabilities for integration with external systems
- Industrial interoperability protocols

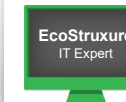
Additional analysis



- Continuous thermal monitoring
- Power event analysis
- Power quality monitoring
- Energy usage analysis
- Energy efficiency & power quality compliance

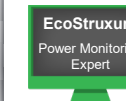
Control of Datacenters

Datacenter Management



- Management of power supply
- Monitoring of environmental conditions

Additional analysis



- Continuous thermal monitoring
- Power event analysis
- Power quality monitoring
- Energy usage analysis
- Energy efficiency & power quality compliance

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations ▶

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Control Strategies for Passenger Stations

Passenger stations can be conceptualized in various ways, depending on the approach to automation and the perception of the facility.

Surface-installed passenger station

Application

- Mainlines or in high-speed rail systems

Control strategy

- Considered as a specialized type of building
- Alignment with building management system

Typical equipment

- Floor controllers (AS-P)
- Room controllers (RP-C)
- Building Operation & Building Advisor for centralizing station information.

Telecommunication Protocols

- KNX
- DALI
- Other standard telecontrol protocols.

Underground passenger station

Application

- Urban transportation

Control strategy

- Considered as an industrial facility
- Use of industrial automation for critical components like ventilation

Typical equipment

- PLCs based solutions (M580 and M340)
- AVEVA System Platform for centralizing information

Telecommunication Protocols

- OPC (for advanced data modeling and cybersecurity features).
- Modbus (for interconnexion with legacy systems)



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations ▶

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Control Strategies for Traction Substations

Control strategy is different whether the system is supplied with alternating or direct current:

Alternating Current (AC)

Application

Mainly in high performance systems such as mainlines or in high-speed rail systems

- Railway systems with very high energy demand
- High-speed travel
- Railway systems with a very high frequency of train movements

Control Strategy

- Use elements borrowed from electrical distribution

Typical equipment

- Specialized controllers for managing electrical devices with a native implementation of most of the necessary functions for substation automation

Interoperability standard

- IEC 61850: describes the implementation of the functions present in a substation from both a constructive and functional perspective

Advantage

- Fully adapted to control an electrical process
- Analysis of electrical events
- Excellent performance
- Maintenance management & engineering tools
- Good interoperability due to the use of IEC 61850
- Cybersecurity requirements

Drawback

- Higher price

Direct Current (DC)

Application

Mainly urban transportation

- Systems with lower energy demand (tramways)
- Networks with a strong tradition in this technology (metros)

Control Strategy

- Choose a general-purpose programmable logic controller (PLC) as the main element for their automation

Typical equipment

- Use general-purpose programmable logic controllers (PLCs) for automation

Interoperability standard

- Modbus (and variants)

Advantage

- Simple configuration
- Price competitive

Drawback

- Limitation in meeting usual standards of the electrical world
- Limited performance
- Limitations due to Modbus: deficiencies in electrical object modeling, event dating, and cybersecurity. Can be addressed using non-standard versions of the protocol or OPC UA protocol (widely used in industrial environments).

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols ▶

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Communications Protocols

Modern electrical distribution systems, especially in critical infrastructure like railways and urban transportation, use various industrial protocols for data communication from devices such as circuit breakers, relays, controllers, and sensors. Key protocols include:

Modbus RTU and Modbus TCP/IP

Common in low voltage systems for metering, protection, and control.

Can convert serial Modbus to Modbus TCP/ IP for data integration with a power monitoring or SCADA software.

Wireless (IEC 802.15-4, e.g. Zigbee)

Enables low-powered simple data communication for energy and condition monitoring sensors.

Can be aggregated and converted to Modbus TCP/IP for integration with a power monitoring or SCADA software (using a data concentrator and protocol converter device)

IEC 61850

Commonly used for high-speed medium voltage automation.

Provides:

- Consistent measurement naming
- Fast device-to-device communication (GOOSE messaging)
- Communication to a SCADA system

EcoStruxure Power natively integrates with Schneider Electric devices to obtain real-time, historical event and data logs, as well as waveforms. However, it is common for 3rd party devices to store event logs and waveform data in proprietary formats. The EcoStruxure Power platform can acquire data from any device using the open protocols mentioned above, provided the data is available in non-vendor-proprietary formats.



Learn more about:

• Communications



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EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Time Synchronization

Why consider time synchronization of connected products?

To operate, EcoStruxure Power applications **collect data from the connected products of the electrical installation** (such as relays, trip units, power meter, sensors).

When applications analyze and correlate timestamped data from multiple connected products, it is crucial to make sure that their internal clocks are accurate relative to other devices and local time. **The setting of devices to a single time reference is called time synchronization.**

The choice of the time synchronization solution must be defined during the system design phase. **It depends on the time criticality of the applications deployed** to monitor and control the different parts of the installation.

Refer to next page for further explanations about time criticality.

For a detailed coverage of time synchronization, refer to:



- [Data recording and Timestamping section](#) in the EcoStruxure Power Design Guide
- [“How to Optimize Time-Synchronization and Data Recording for EcoStruxure Power Digital Applications”](#) Technical Guide



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Time Synchronization

What is the time criticality of an application?

The time criticality of an application defines the **level of time accuracy** required for data timestamping to enable the proper operation of the application.

EcoStruxure Power categorizes applications **into three levels of time criticality**:

Digital Application Time Critical	Time Accuracy Upper Limit	Time Accuracy Lower Limit
High	± 1 ms	± 10 ms
Medium	± 10 ms	± 1 s
Low	± 1 s	± 10 s

Example of time criticality:

- **Continuous Thermal Monitoring:** This application monitors the progressive rise in busbar connection temperature to help prevent fires. It has a **low time criticality**.
- **Power Event Analysis:** This application reconstructs the sequence of events among multiple electrical equipment to help understand the cause(s) of an incident. It has a **high time criticality**.

Refer to next page to learn how to select the appropriate time synchronization solution based on the time criticality.



Learn more about:

• [Time criticality of applications](#)



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Time Synchronization

How to select the time synchronization solution based on time criticality?

There are many options available for time synchronization protocols, which can make it challenging to develop a cohesive strategy for all connected devices. To achieve optimal performance while minimizing costs, it is common to enforce the most accurate protocols only in the sensitive areas of electrical distribution (e.g., the electrical supply of core industrial processes) and use less accurate solutions in areas with lower sensitivity (e.g., utilities).

The table below provides an overview of the solutions based on achieved time criticality and related costs:

Application Time Critical	Typical Time Accuracy	Protocol Media	Protocol	Typical Cost
High	± 1 ms	Ethernet	PTP (IEEE 1588)	\$ \$
High	± 1 ms	Serial	IRIG-B	\$ \$ \$
Medium	± 10 ms to 100 ms	Ethernet	NTP	\$
Medium	± 100 ms	Serial	DCF77	\$ \$
Low	± 1 s	Ethernet	SNTP	\$
Low	± 1 s	Ethernet	Over Modbus / ION from Edge Control	\$
Low	± 1 s	Serial	1 per 10	\$ \$

To summarize the table :

- **PTP** provides the best performance versus cost option available today for highly time-critical applications, but is not available on all devices
- **IRIG-B** offers similar performance to PTP but comes with a much higher installation cost.
- **NTP** is the next best alternative for medium time-criticality needs.
- **SNTP** or **Modbus** are adequate for low time-critical applications.

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS ▶

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Integration with Building Automation Systems (BMS)

Why integrate mechanical and electrical systems?

Need for data aggregation

Facility infrastructure is experiencing a convergence of information and operational systems. This is particularly true for Railway and Urban Transportation applications, where mechanical and electrical systems are essential infrastructure.

These systems are rapidly generating increasing amounts of data, with the addition of new sensors, meters, and other smart equipment. It is crucial to have robust software system with proper data aggregation from these devices.

Benefits of systems integration

Integrating the systems:

- Creates a unified interface for visualizing, analyzing, and reporting data, simplifying daily tasks for operations and maintenance staff;
- Enables applications to utilize context from both systems to optimize the decision-making processes;
- Enhances overall Operational efficiency

Examples of mechanical and electrical systems integration in Railway

- **Energy performance monitoring** : Track and model facility energy usage;
- **Asset management**: View mechanical and electrical asset performance in one place;
- **Fault management**: Detect faults and respond through an integrated interface.



Learn more about:

• [Data Integration and Interoperability between Systems](#)



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**EcoStruxure™ Power for
Railway and Urban Transportation****SECTION 1 – Introduction to the Railway
and Urban Transportation Market****SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry****SECTION 3 – Digital Solutions
and Services across the Facilities****SECTION 4 – Design Considerations**

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS ▶

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories**BIBLIOGRAPHY**

Integration with Building Automation Systems (BMS)

Why plan the integration at the design phase?

Costly retrofit of existing installations

Traditionally, Power Management Systems (electrical systems) and Building Management Systems (including mechanical systems) are designed in silos. The consequence is that it leaves the end user with little to no electrical data in operational systems.

Retrofitting this into an existing system can be quite costly. Therefore, it is essential to design the proper IoT electrical systems far in advance.

Advantages of early system integration

Enabling the BMS and PMS to integrate directly to relevant data allows the systems to perform as designed. Additionally, it also:

- Reduces cost and complexity by minimizing excessive wiring of electrical devices to mechanical control systems.
- Helps system integrators by enabling a seamless interface to manage facility operations and maintenance;



Learn more about:

[• Data Integration and Interoperability between Systems](#)

**EcoStruxure™ Power for
Railway and Urban Transportation****SECTION 1 – Introduction to the Railway
and Urban Transportation Market****SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry****SECTION 3 – Digital Solutions
and Services across the Facilities****SECTION 4 – Design Considerations**

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS ▶

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories**BIBLIOGRAPHY**

Integration with Building Automation Systems (BMS)

How is data acquired and integrated within the architecture? (1/2)

Data acquisition

Digital electrical monitoring and control software acquires data from intelligent electrical devices via open communication protocols. This includes:

- Real-time information
- Historical power events
- Data logs
- Electrical signal waveforms
- Service diagnostics.

By default, BMS (Building Management Systems) cannot retrieve certain data from the electrical distribution, such as event logs, waveforms, and diagnostic data. Trying to do this directly with the BMS would require a tremendous amount of engineering. It is more efficient and native to let a PMS (Power Management System) collect the data from the electrical distribution and then integrate the PMS with the BMS.



Learn more about:

[• Data Integration and Interoperability between Systems](#)

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

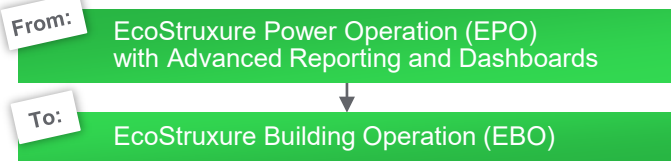
BIBLIOGRAPHY

Integration with Building Automation Systems (BMS)

How is data acquired and integrated within the architecture? (2/2)

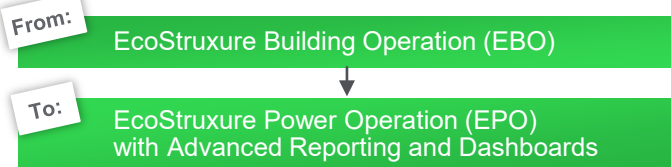
Data Integration

The method/tool to integrate the data depends on the data type, and on the direction of the transfer:



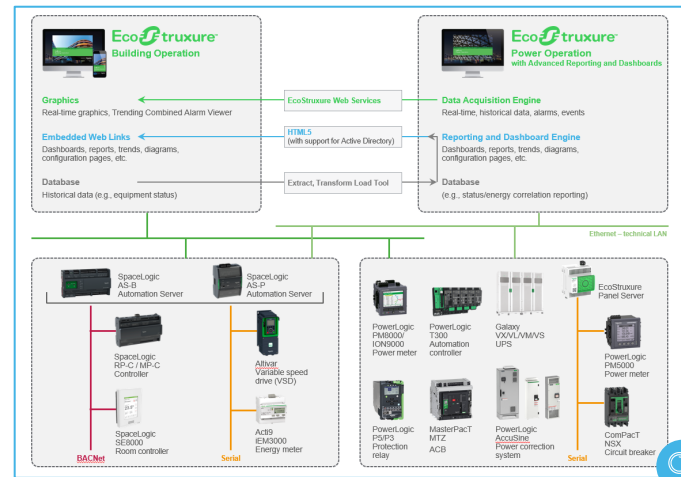
The integration is performed through:

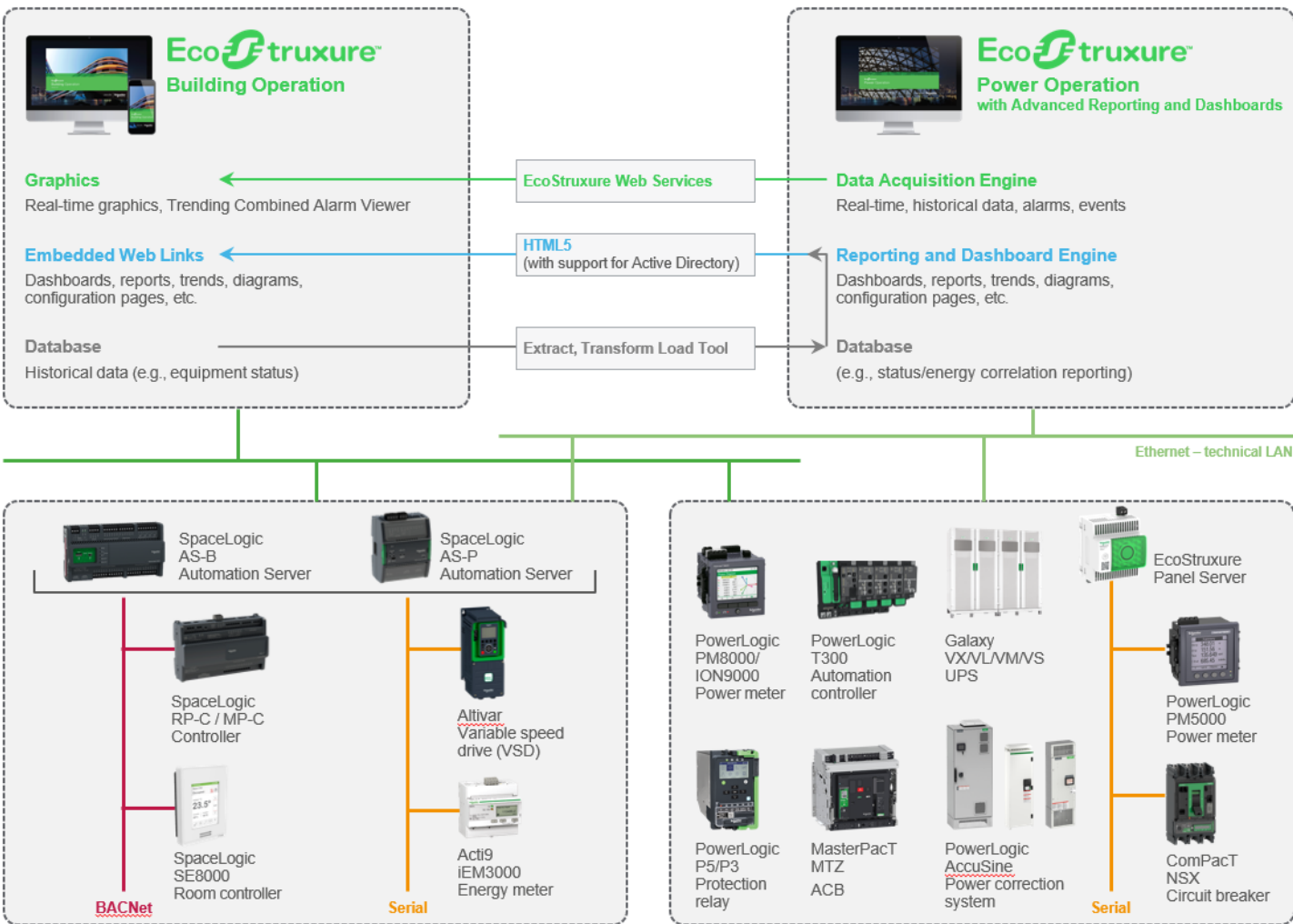
- **EcoStruxure Web Services**
Used for real-time data, alarms, and historical data
- **Web interface integration** (Single Sign On)
Used for power and energy dashboards, graphical diagrams, trends, reports, and configuration pages



The integration is performed through:

- **An Extract Transform Load functions**
Used for historical building management data to enable energy data correlation.





Example of Combined Solution with EcoStruxure Building Operation and EcoStruxure Power Operation with Advanced Reporting and Dashboards

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

SECTION 4 – Design Considerations

- Control Center Solutions
- Control Strategies for Passenger Stations
- Control Strategies for Traction Substations
- Communications Protocols
- Time Synchronization
- Integration with BMS
- Cybersecurity ▶
- Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Cybersecurity

Seven pillars to strengthen cybersecurity

Cybersecurity is no longer a question of competitive advantage or even minimizing damage. It is a fundamental requirement for doing business today.

Here are the seven essential pillars for improving it:

- 1 ACCESS CONTROL
- 2 USE CONTROL
- 3 DATA INTEGRITY
- 4 DATA CONFIDENTIALITY
- 5 DATA FLOW
- 6 TIMELY RESPONSE TO EVENTS
- 7 RESOURCE AVAILABILITY



Access Control

Protect electrical components by verifying the identity of any user requesting access to a component before activating the communication with that component.

When used in conjunction with security event logging, this will include ensuring 'non-repudiation,' for example, a person cannot deny that they performed a particular action.

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Cybersecurity

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Use Control

Protect against unauthorized actions on component resources by verifying that the necessary privileges have been granted before allowing a user to perform the actions.

This must address what a hacker can potentially do if they access the system and counteract that by only giving the minimum level of access necessary for that user to perform their role.

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Cybersecurity

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TIMELY RESPONSE TO EVENTS

7

RESOURCE AVAILABILITY



Data Integrity

Ensure that the components will perform as intended during operational and non-operational states, such as energy production and storage, or a maintenance shutdown.

Consider a Circuit Breaker that is detecting potential issues in its operation: if the SCADA system is hacked and is forced to indicate everything is okay, that could cause an unexpected and dangerous event.

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Cybersecurity

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Cybersecurity is no longer a question of competitive advantage or even minimizing damage. It is a fundamental requirement for doing business today.

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5

DATA FLOW

6

TIMELY RESPONSE TO EVENTS

7

RESOURCE AVAILABILITY



Data Confidentiality

Protection of component-generated confidential or sensitive nature information, whether at rest or in transit.

Also, protection of data to avoid hackers who aim to break in.

Data regarding energy profiles and usage could provide information into confidential Railway operations.

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Data Flow

Ensure the connection of the device to a segmented network where disconnection strategy, unidirectional gateway, firewall, and demilitarized zones are defined to avoid unnecessary data flow.

Network segmentation is a strategy that can stop a cyberattack from going from one connected system to another (for example, from the electrical communication network to the business network).

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Cybersecurity

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Cybersecurity is no longer a question of competitive advantage or even minimizing damage. It is a fundamental requirement for doing business today.

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1

ACCESS CONTROL

2

USE CONTROL

3

DATA INTEGRITY

4

DATA CONFIDENTIALITY

5

DATA FLOW

6

TIMELY RESPONSE TO EVENTS

7

RESOURCE AVAILABILITY



Timely Response to Events

Detect, identify and respond to security violations by notifying the proper authority, reporting needed evidence of the violation, and taking timely corrective action when incidents are discovered in mission-critical or safety-critical situations.

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Cybersecurity

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1

ACCESS CONTROL

2

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DATA INTEGRITY

4

DATA CONFIDENTIALITY

5

DATA FLOW

6

TIMELY RESPONSE TO EVENTS

7

RESOURCE AVAILABILITY



Resource Availability

Ensure the availability of the application or device against the degradation or denial of essential services.

**EcoStruxure™ Power for
Railway and Urban Transportation****SECTION 1 – Introduction to the Railway
and Urban Transportation Market****SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry****SECTION 3 – Digital Solutions
and Services across the Facilities****SECTION 4 – Design Considerations**

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity ▶

Environmental Data Program

SECTION 5 – Customer Stories**BIBLIOGRAPHY**

Cybersecurity

Recommendations for selecting your partners for an optimal cybersecurity journey

The IEC 62443 standard provides essential guidelines for enhancing the security of connected electrical distribution systems, including network, control, and safety solutions.

When selecting partners, it is important that they understand the standard well and implement it effectively.

It's crucial to choose a partner with robust internal processes who can certify that products and solutions are developed according to well-defined procedures.

CONSULTANT

SOLUTION PROVIDERS

SERVICE PROVIDERS

Find an electrical power distribution specialist with a deep understanding of cybersecurity requirements. They should:

- Help you with the risk assessment;
- Define the levels of security you require, compliant with IEC 62443;
- Provide guidance on implementing best practices for cybersecurity.

At Schneider Electric, we have dedicated services to support throughout the cybersecurity journey.



**EcoStruxure™ Power for
Railway and Urban Transportation****SECTION 1 – Introduction to the Railway
and Urban Transportation Market****SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry****SECTION 3 – Digital Solutions
and Services across the Facilities****SECTION 4 – Design Considerations**

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity ▶

Environmental Data Program

SECTION 5 – Customer Stories**BIBLIOGRAPHY**

Cybersecurity

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CONSULTANT

SOLUTION PROVIDERS

SERVICE PROVIDERS

Choose an electrical system technology provider that has adopted the IEC 62443 standard and has a secure development lifecycle process in place that:

- Ensures systems are resilient in case of cyberattack;
- Provides a formal process to inform and assist customers if any security vulnerabilities are discovered;
- Fully tests and validates the security of all components and systems;
- Demonstrates third-party cybersecurity certification;
- Delivers customized and flexible solutions that align with your business requirements.

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**EcoStruxure™ Power for
Railway and Urban Transportation****SECTION 1 – Introduction to the Railway
and Urban Transportation Market****SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry****SECTION 3 – Digital Solutions
and Services across the Facilities****SECTION 4 – Design Considerations**

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity ▶

Environmental Data Program

SECTION 5 – Customer Stories**BIBLIOGRAPHY**

Cybersecurity

Recommendations for selecting your partners for an optimal cybersecurity journey

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It's crucial to choose a partner with robust internal processes who can certify that products and solutions are developed according to well-defined procedures.

CONSULTANT

SOLUTION PROVIDERS

SERVICE PROVIDERS

Choose partners with the required capabilities:

- A system integrator with deep IT and OT experience including cybersecurity within the context of critical operational systems
- Cybersecurity services that can deliver quick response to help assess and recover from a cyberattack.

At Schneider Electric, we have dedicated services to support throughout the cybersecurity journey.



EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program

SECTION 5 – Customer Stories

BIBLIOGRAPHY

Cybersecurity

Our solutions to support cybersecurity journey

At Schneider Electric, we can:

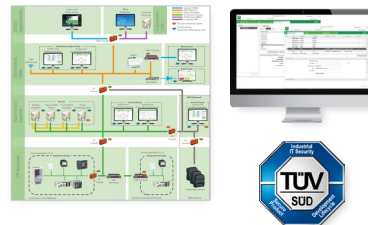
- Provide a selection of cybersecurity certified products
- Provide certified system architectures and solutions
- Deliver lifecycle services

Certified products



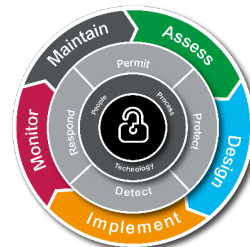
Certified products developed according to IEC 62443 functional requirements with Secure Development Lifecycle processes.

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](#)



EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program ▶

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Environmental Data Program

The need to address ESG regulations (ESG = Environmental, Social, and Governance)

Governments are committing to carbon neutrality by 2050, **leading to new regulations promoting sustainability**: ESG reporting is becoming crucial.

The Corporate Sustainability Reporting Directive (CSRD) expands disclosure requirements to nearly 50,000 companies, including those outside the EU. **This enhances transparency and accountability.**

Consumer Expectations and Greenwashing Risks

Consumers demand sustainable practices, with a rise in repairing, reselling, and reusing products.

However, **greenwashing remains a challenge**, as some companies make unsubstantiated sustainability claims. Regulators are cracking down on false claims, **emphasizing the need for credible and verifiable environmental data.**

**At Schneider Electric, we have deployed an Environmental Data Program to address this need.
Discover more next page**

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

SECTION 4 – Design Considerations

Control Center Solutions

Control Strategies for Passenger Stations

Control Strategies for Traction Substations

Communications Protocols

Time Synchronization

Integration with BMS

Cybersecurity

Environmental Data Program ▶

SECTION 5 – Customer Stories

BIBLIOGRAPHY



Life Is On

Schneider
Electric

Environmental Data Program

Next-level transparency for better-informed product choices

The Environmental Data Program is a framework for how we, at Schneider Electric, measure, categorize, and compare the environmental attributes and footprint of our products.

Using a rigorous, fact-based methodology, the program provides environmental data from across the product lifecycle.



Use Better: How sustainable a product is, including environmental footprint, materials and substances, packaging, and energy efficiency.

Use Longer: How a product's lifetime can be effectively extended in terms of repairability and updatability.

Use Again: How a product can be reused, from dismantling and remanufacturing to recyclability and manufacturer take back.

With this transparent, fact-based data, customers and partners are empowered to make conscious environmental choices and accurately evaluate and report on sustainability performance.

All our hardware offers have an associated environmental data available on se.com product pages.



Learn more about:

• [Schneider Electric Environmental Program](#)



EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories ▼

- Railway: Europe
- Urban Transportation: US
- Urban Transportation: Europe

BIBLIOGRAPHY

SECTION 5

Customer Stories

WHY READ THIS SECTION?

The objective of this section is to:

- Showcase our solutions provided across globe in the Railway and Urban Transportation sectors, addressing our customers' challenges and key needs.

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

Railway: Europe

Urban Transportation: US

Urban Transportation: Europe

BIBLIOGRAPHY



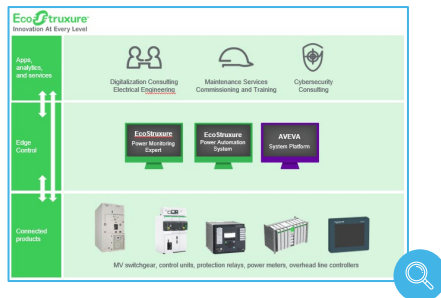
Railway: A Leading Railway Operator in Europe



Customer Challenges

Manage and operate efficiently a country-wide network:

- Nearly 6.000 km mainlines railway network with almost 340 electrical substations;
- Nearly 4.000 km of reliable high speed national rail network with almost 175 traction electrical facilities.



Customer Benefits

- Real-time single view of the national rail network, through integrated main and back-up control centers
- Optimized energy through integrated monitoring and energy management systems

Solution Provided

Services

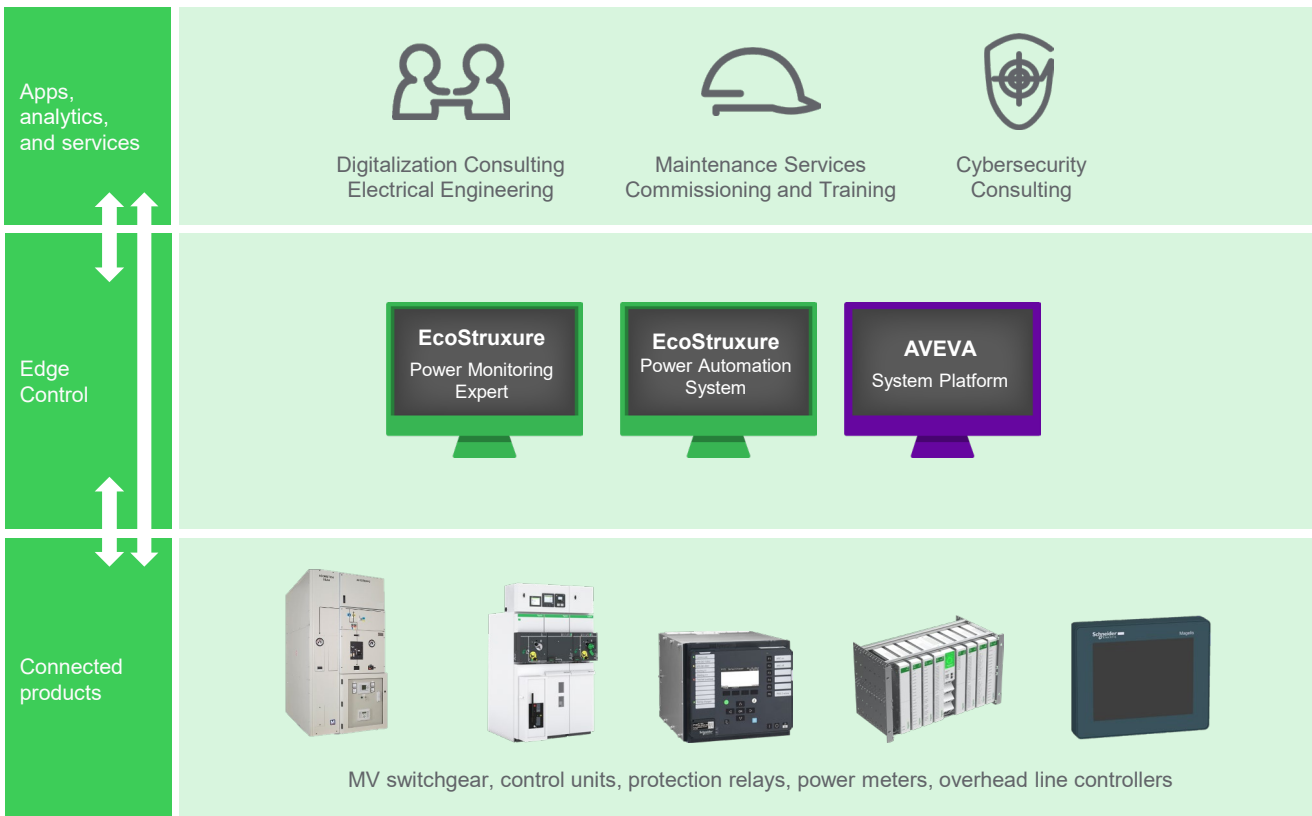
- Maintenance services: corrective and preventive
- Engineering and electrical substation design
- Cybersecurity

Edge Control

- AVEVA System Platform for energy and building management at Control Center level
- EcoStruxure Power Automation System as the substation automation solution
- EcoStruxure Power Monitoring Expert for power management with Power Quality improvements

Connected products

- AC MV Panels for traction network: 25 kV AC high speed and 3.3 kV DC mainlines
- Cabinets for auxiliary power line
- Overhead line disconnectors (OHL): 25 kV AC high speed and 3.3 kV DC mainlines
- PowerLogic T500 (formerly Saitel) for data acquisition and concentration
- Building Management System for Passenger Stations
- Tunnel Automation System



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EcoStruxure™ Power for Railway and Urban Transportation



Urban Transportation: Brookville Smart Energy Bus Depot in US

SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

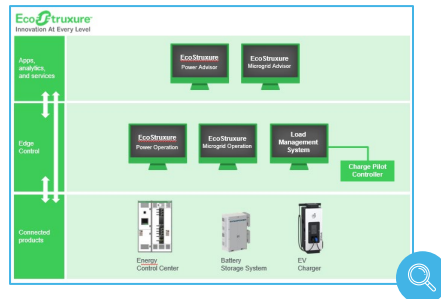
- Railway: Europe
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BIBLIOGRAPHY



Customer Challenges

- **Electrification**
Converting municipal bus fleet to electric
- **Resilience**
Extreme weather and extended past power outages
- **Sustainability**
GHG reduction targets of 80% by 2027 and 100% by 2035



Customer Benefits

- 44 buses transitioning from diesel to electric, and powered by on-site low-carbon energy
- 62% of reduced lifetime emissions expected from the microgrid (equivalent to 155,000 tons of GHG)
- 99.9% resilience and reliability of operations, sized to handle peak demand

Solution Provided

Services

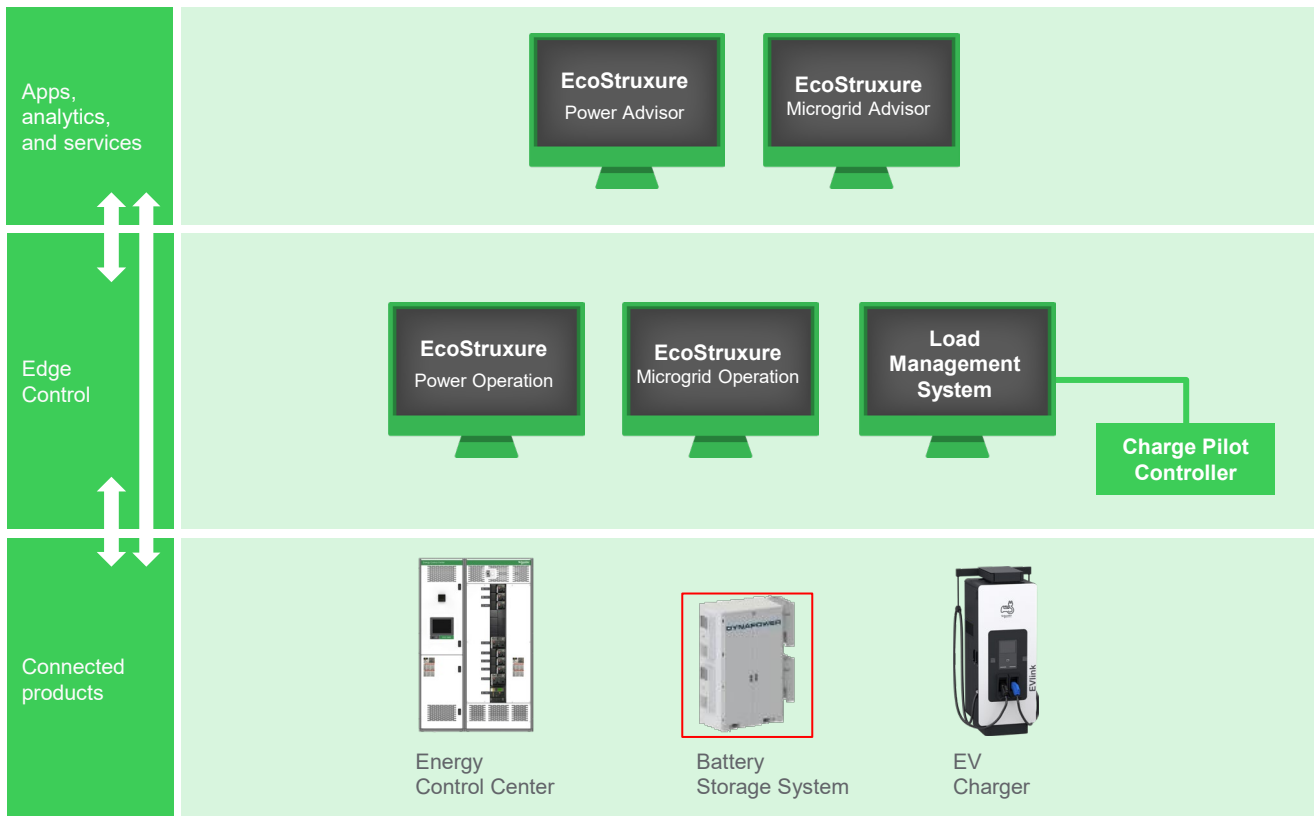
- **EcoStruxure Microgrid Advisor** implementing:
 - Tariff Management,
 - Self-consumption
 - Demand charge reduction
- **EcoStruxure Power Advisor** for power management with Power Quality improvements

Edge Control

- **EcoStruxure Power Operation** for power management
- **Load Management System** for optimizing the charging process from technical and economical point of view
- **EcoStruxure Microgrid Operation** to integrate removable energy and manage the potential islanded situation from the grid

Connected products

- **EV Charger** as main charging element to provide energy to the bus fleet
- **Battery Storage System** to store energy and help in the optimization of the charging process
- **Energy Control Center**, integrating all LV equipment needed



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EcoStruxure™ Power for Railway and Urban Transportation



SECTION 1 – Introduction to the Railway and Urban Transportation Market

SECTION 2 – How EcoStruxure Power Can Support the Railway Industry

SECTION 3 – Digital Solutions and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

- Railway: Europe
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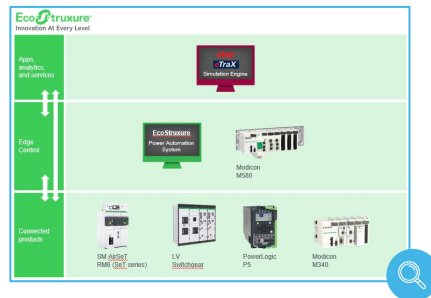
BIBLIOGRAPHY



Urban Transportation: A Leading Metro Operator in Europe

Customer Challenges

- **Centralize view** for informed decision-making in energy management and passenger stations.
- **Improve safety and operational efficiency** with end-to-end visibility across facilities.
- **Facilitate seamless integration** with legacy and modern systems.



Customer Benefits

- **Improvement of operational efficiency** with new extended remote operation capabilities.
- **Open platform** integrating multiple external systems with many certified system integrators.
- **Enhanced modeling, design, analysis, operation planning, predictive simulation and automation services** enabled by ETAP real-time solution.

Solution Provided

Services

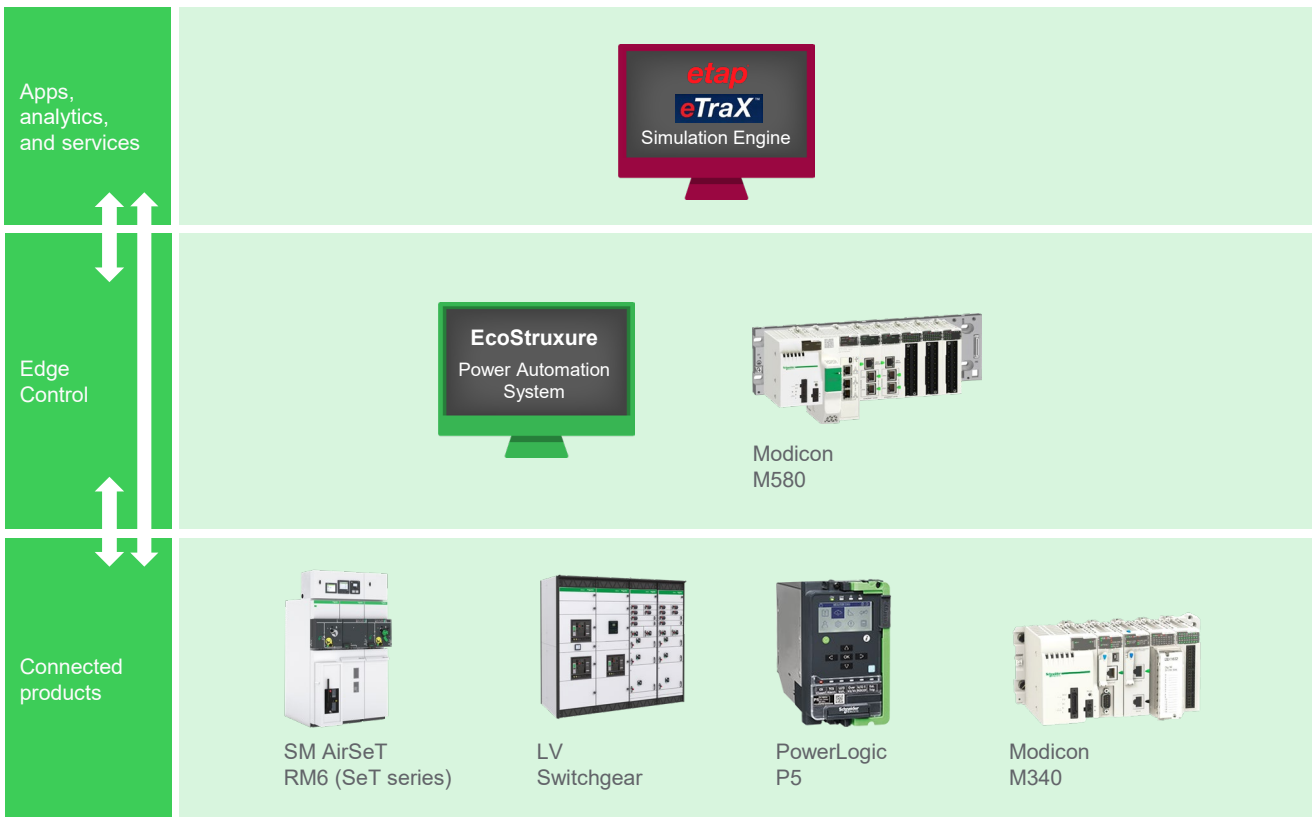
- **ETAP eTraX Simulation Engine** for:
 - Modeling, design, and analysis
 - Predictive simulation of power networks
 - Operator training simulation (OTS)

Edge Control

- **AVEVA System Platform** to operate energy systems and passenger stations from the control center level
- **Modicon M580** to automate energy systems and passenger stations

Connected products

- MV panel solutions: **RM6** and **SM AirSeT**
- **PowerLogic P5** to implement electrical protection functions
- **Modicon M380** to implement basic automation and information acquisition



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EcoStruxure™ Power for
Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

BIBLIOGRAPHY ▼

Reference Document

Useful Links

BIBLIOGRAPHY

EcoStruxure™ Power for Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

SECTION 2 – How EcoStruxure Power
Can Support the Railway Industry

SECTION 3 – Digital Solutions
and Services across the Facilities

- 1- Overhead Lines
- 2- Traction Substations
- 3- Auxiliary Powers Systems
- 4- Passenger Stations
- 5- eBus Depots
- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

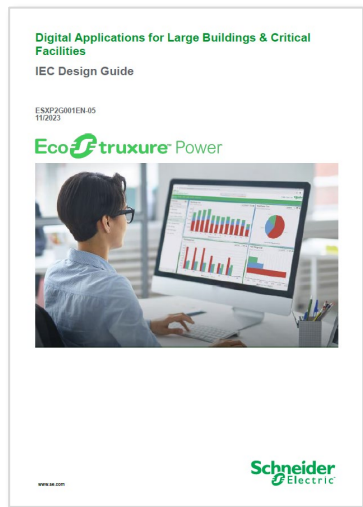
BIBLIOGRAPHY

Reference Document ▶

Useful Links

Reference Documents

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.

Access the Design Guide online from the Landing page (IEC/NEMA)

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Railway and Urban Transportation

SECTION 1 – Introduction to the Railway
and Urban Transportation Market

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- 1- Overhead Lines
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- 6- Tunnel Systems
- 7- Depots and Workshops
- 8- Control Center

SECTION 4 – Design Considerations

SECTION 5 – Customer Stories

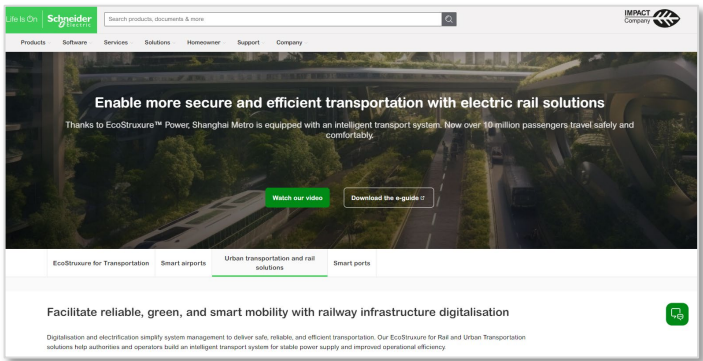
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Reference Document

Useful Links

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