EcoStruxure™ Innovation At Every Level Power

Airports

Electrical Reference Architecture for Large Airports with 10 to 80 Million Passenger Movements

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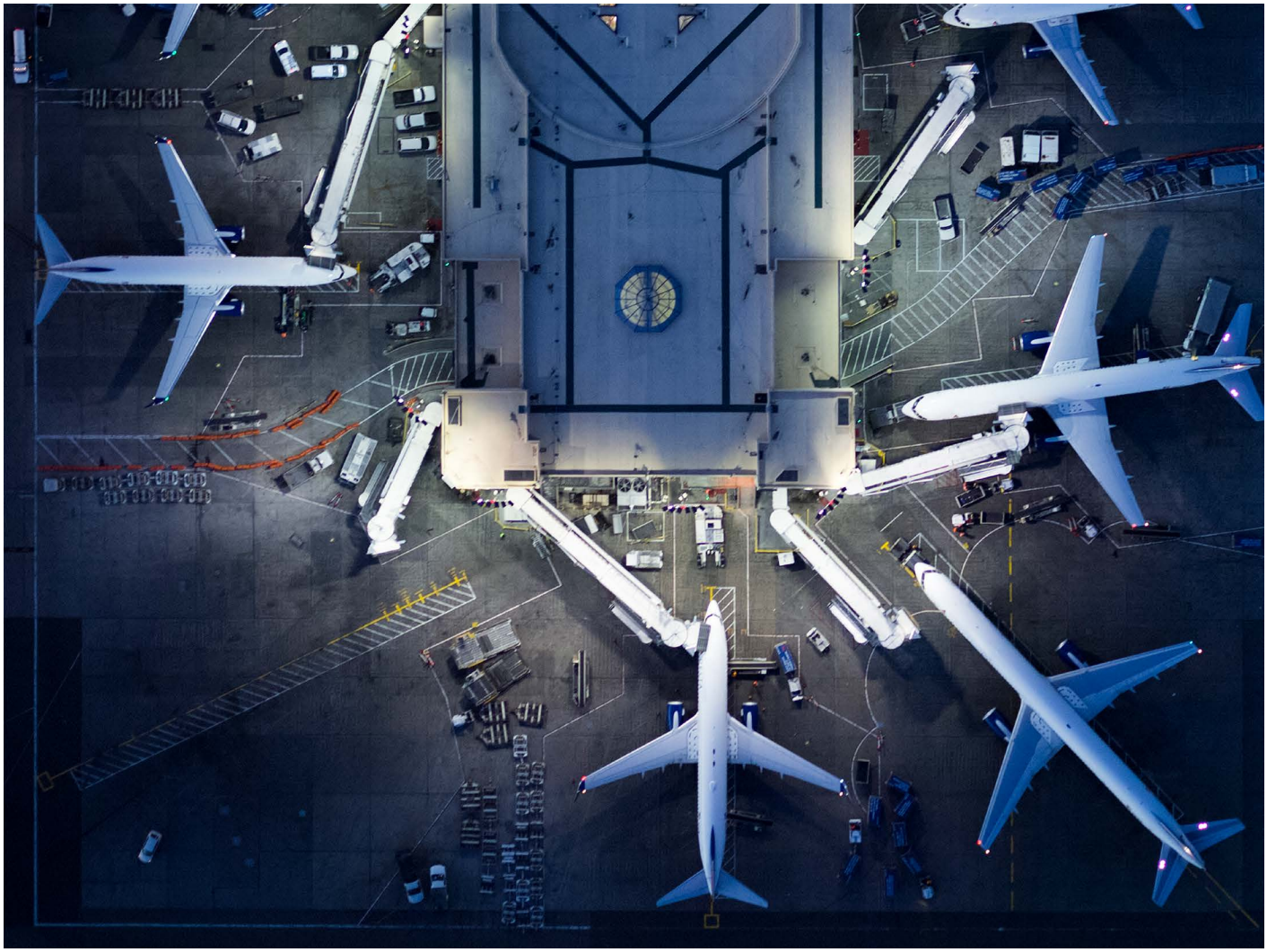

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Our vision of a New Electric World

The world is becoming more electric and digital, and power is becoming more distributed, more complex to manage, and more integrated into our everyday lives. We envision a New Electric World where building staff and occupants are safer, with zero electrical safety incidents. Where power is 100% available, with zero unplanned downtime. Where energy and operations are more efficient, with zero energy waste. And where operational systems are resilient, with zero cyber intrusions.

We strive to make this vision a reality with our IoT-enabled EcoStruxure™ Power architecture and platform, which we deliver through our connected energy management ecosystem—a collective of partners and industry experts who are openly collaborating with us to push innovation, enhance productivity, reduce risk, and unlock new growth opportunities.

List of Acronyms

Acronym	Stands for:	Acronym	Stands for:
ACI	Airport Council International	GHG	Green House Gas
ACA	Airport Carbon Accreditation	HMI	Human Machine Interface
AHU	Air Handling Unit	HS	Host Detection
ASM	Active Surge Monitoring	IATA	International Air Transport Associatio
ATS	Automatic Transfer Switch	ICT	Information and Communications Technology
BCPM	Branch Circuit Power Meter	IDS	Intrusion Detection System
BESS	Battery Energy Storage System	IFE	Ethernet interface s
BHS	Baggage Handling System	IFM	Interface Modbus
BMS	Business Management Systems	IT	Information Technology
CCHP	Combined Cooling Heating and Power	LIM	Line Isolation Monitor
CHP	Combined Heat and Power	LMS	Load Management System
CPMA	Critical Power Management Appliance	LV	Low Voltage
CTM	Continuous Thermal Monitoring	MV	Medium Voltage
DER	Distributed Energy Resource	OCPP	Open Charge Point Protocol
DMZ	Demilitarized Zone	OT	Operational Technology
EBO	EcoStruxure™ Building Operation	PAC	Programmable Automation Controller
ECC	Energy Control Center	PBB	Passenger Boarding Bridge
ED	Electrical Distribution	PCS	Power Control System
EES	Essential Electrical System	PFCC	Power Factor Correction Capacity
EMA	EcoStruxure™ Microgrid Advisor	PLC	Programmable Logic Controller
EMO	EcoStruxure™ Microgrid Operation	PME	Power Monitoring Expert
EMS	Energy Management System	PV	Photovoltaic
ePAC	Ethernet Programmable Automation Controller	ROI	Return On Investment
EPCs	Engineering Procurement Construction	SCADA	Supervisory Control and Data Acquisition
EPO	EcoStruxure™ Power Operation	SER	Sequence of Event Recorder
EPSS	Emergency Power Supply System	SLD	Single-line Diagram
EV	Electric Vehicles	SMS	Short Message Service
FD	Final Distribution	UPS	Uninterruptible Power Supply
FLD	Fault Location Detection	VGDS	Visual Guidance Docking System

Note for readers

This document presents general, non-binding information regarding the potential value that digitized power distribution products and solutions can bring to the user. Due to varying user situations and goals, Schneider Electric does not warranty or guarantee that the same or similar results represented in this document can be achieved. Please refer to Schneider Electric product and solution catalogues for actual specifications and performance

These tables will be used as a reference guide for the architecture diagrams to follow:

Recommended Connected Products

Ref.	Device	Description
1		PowerLogic™ P3 or P5 MV Protection Relay
2		PowerLogic C5 or PowerLogic T300
3		TransferPacT™ UA / ASCO 7000 Automatic Transfer Switch
4		MasterPacT™ MTZ with MicroLogic X
5		ComPacT NSX
6		Galaxy™ VM/VX/VS UPS
7		PowerLogic ION9000 or PM8000
8		PowerLogic™ PM5000

Ref.	Device	Description
9		PowerLogic PowerTag
10		VarSeT™ with VarPlus Logic Controller
11		PowerLogic AccuSine™ PCS+
12		PowerLogic TH110/CL110 Temperature and Humidity Sensors
13		PowerLogic HeatTag
14		PowerLogic V121/A125
15		ASCO Load Bank

Recommended Equipment

Ref.	Equipment	Description
A		MCSeT Medium Voltage Air Insulated Switchgear
B		Okken or BlokSeT Main Low Voltage Switchgear
C		PrismaSeT
D		ASCO 7000 Power Control System

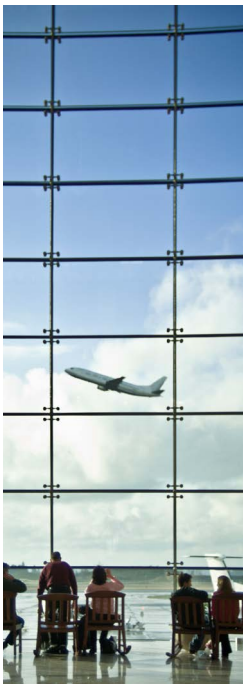
Introduction

The objective of this document is to communicate effective and sustainable electrical distribution solutions for airport facilities. Airports are the backbone of the aviation industry, and like many other industries, airports are under pressure to constantly adapt to a changing market landscape.

EcoStruxure™ Power from Schneider Electric is a sustainable solution and key element of the digital electrical distribution infrastructure that powers essential facilities.

Fundamental Market Trends

Increasing Traffic



Rising living standards, particularly in the developing world, are bringing air travel into the reach of a larger percentage of the world population. At the same time, improvements in technology, processes and systems have reduced the relative cost of flights. This has led IATA to forecast a long-term trend of rising passenger numbers of between 2.4% and 5.5% per year. Although the COVID 19 pandemic has severely impacted the industry, passenger numbers are forecast to recover by 2024 and then continue their long-term trajectory.

This long-term trend has forced many existing airports to constantly expand their infrastructure with new terminals, runways and facilities. It has also led to many new airports being designed from the beginning to grow in stages throughout their lifetime.

More Competitive Environment

Competition between regional hub airports has been increasing as they compete for airline routes and corresponding increases in passenger numbers. More passengers mean greater economies of scale and increased aeronautical as well as non-aeronautical revenues. In some markets airports also compete with other forms of transportation, such as rail, especially in the short haul market.

To meet these challenges, many airports are working hard to become more cost effective as well as improve their reputation or “Airport Brand”. This has driven airports to re-define the traveler’s experience as well as their relationship with the customer.

Sustainability

An increasing concern for the global aviation industry is the public’s perception of the industry’s impact on the environment. The aviation industry’s carbon footprint is about 2% of the entire world’s carbon emissions and airports make up about 5% of the industry’s total. This has created the perception that air travel is a luxury that needs to be minimized for the sake of the planet. To address this many airports have committed to becoming Carbon Neutral by 2030 as well as achieving the more ambitious goal of Net Zero Carbon by 2050.

To meet these goals airports will need to implement a mix of initiatives aimed at improving energy efficiency, as well as producing and/or sourcing green energy. Many of these will require the adoption of new technologies and processes that will continue to transform the industry.

Airport Council International (ACI) has created a voluntary carbon accreditation scheme to help airports keep track of their progress in a manner that is both consistent and well recognized across the industry. The Airport Carbon Accreditation (ACA) scheme is the only institutionally endorsed, global carbon management certification program for airports. It provides the industry with a common framework for active carbon management with measurable goalposts. It allows airports to receive an independent assessment of their efforts to manage and reduce their carbon levels.

Introduction, *Cont.*

Implications for Airports

Focus on the Passenger Experience

These days airports are being seen by governments as more than just a transport hub. They are now being recognized as an important tourist gateway to a city or country. It's the first and last thing that many visitors see and often leaves a lasting impression. So, given the competitive environment and growing customer expectations, many airports are re-inventing what it means to visit an airport. The concept of a "seamless passenger journey" along with creating an attractive environment for passengers to spend their time combines to create a memorable passenger experience that will encourage return patronage. It also allows airports to increase their non-aeronautical revenues by providing additional services to customers including extensive retail outlets, entertainment and dining options, lounges and on-site parking.

Improving the passenger experience is a multifaceted approach but, in the end, it generally relies on improving the airport's underlying infrastructure and software systems. This infrastructure needs to be powered by a reliable and resilient energy system. Failure of the power distribution network can not only bring your operations to a halt but can also severely impact the customer experience. Disruptions of this nature are considered unacceptable to the general public and will negatively impact the airport's brand.

Ecostruxure™ Power can improve your electrical distribution network's reliability and resilience:

- See "Energy Management and Power Reliability," page 11
- See "Asset Performance," page 31
- See "Microgrid," page 42

Healthy and Sustainable Buildings

Driven by sustainability goals as well as the desire to improve the customer experience, airports are investing in healthier and more sustainable buildings. To achieve this many airports are seeking to obtain Green Certifications for their buildings from programs like LEED, Green Mark, NABERS and BREEAM.

Healthy and sustainable buildings with a focus on high quality indoor environments provide a comfortable working environment for staff and contractors as well as a more positive experience for passengers. They are made with materials that are low in toxins and contaminates, safe to use and easy to recycle. They are designed to be energy and water efficient in order to reduce their impact on the environment.

Considerations for healthy and sustainable buildings don't end after construction is complete but continue with best in class operational and maintenance practices.

Ecostruxure™ Power can improve the health and sustainability of your infrastructure:

- See "Electrical Safety," page 23
- See "Effective Energy Accounting," page 28
- See "Asset Performance," page 31
- See "Greenhouse Gas Reporting," page 37
- See "Energy Efficiency," page 37

The Rise of Green Energy and Electrification

More and more airports around the world are committing to sustainability targets and releasing the results in yearly sustainability reports. One of their most ambitious targets is reaching Net Zero Carbon by 2050. To achieve this, airports must secure green sources of electricity from the grid or by self-consuming renewable energy generated on site. This raises the challenge of how best to manage on site electricity generation and storage, which as its size and complexity rises, may lead to the adoption of a microgrid.

Airports are also required to eliminate all direct greenhouse gas emissions on site, that cannot be directly offset by other on-site activities, as Net Zero certification does not allow for the purchase of external offset credits. One of the biggest emitters of greenhouse gases on site is the use of fossil fuels in vehicles. One of the ways that airports are tackling this problem is through the electrification of their fleets. This not only eliminates greenhouse gases on site but also reduces noise and air pollution which results in a healthier work environment.

Introduction, *Cont.*

Ecostruxure™ Power can support your move to green energy:

- See "Microgrid," page 42
- See "Electrification (EV charging)," page 45

Digitalization

Digitalization encompasses the adoption of digital technologies to automate airport processes as well as to collect and analyze data in order to provide objective business insights. It aims to increase operational efficiency, improve safety and enhance the customer experience. It is an enabling technology seen as essential to allowing airports to cope with ever increasing passenger numbers as well as building the airports of the future.

Ecostruxure™ Power can help you digitize your airport:

- See "Energy Management and Power Reliability," page 11
- See "Effective Energy Accounting," page 28
- See "Asset Performance," page 31
- See "Microgrid," page 42
- See "Cybersecurity," page 50

Target Audience for this Guide

As a technical document, this guide is intended for technically minded people requiring digital electrical distribution solutions for the airport precinct. This includes Engineering, Procurement and Construction (EPC) contractors, consultants, electrical contractors, system integrators and the infrastructure department personnel of companies administering the airport.

The digital solutions in this guide are divided into chapters which represent each of the following major use cases:

- See "Energy Management and Power Reliability," page 11
- See "Electrical Safety," page 23
- See "Asset Performance," page 31
- See "Sustainability," page 35
- See "Microgrid," page 42

Each of these chapters start by highlighting the electrical distribution products that are recommend to be monitored/controlled as part of the digital solution. We refer to these as “connected products”. The next section provides a digital architecture of the solution showing the recommended software systems along with the relevant connected products. This is followed by a range of applications that are addressed by the digital solution. Note, each digital solution is not mutually exclusive, but is part of an overarching digital architecture that can deliver all major use cases in a single EcoStruxure™ solution.

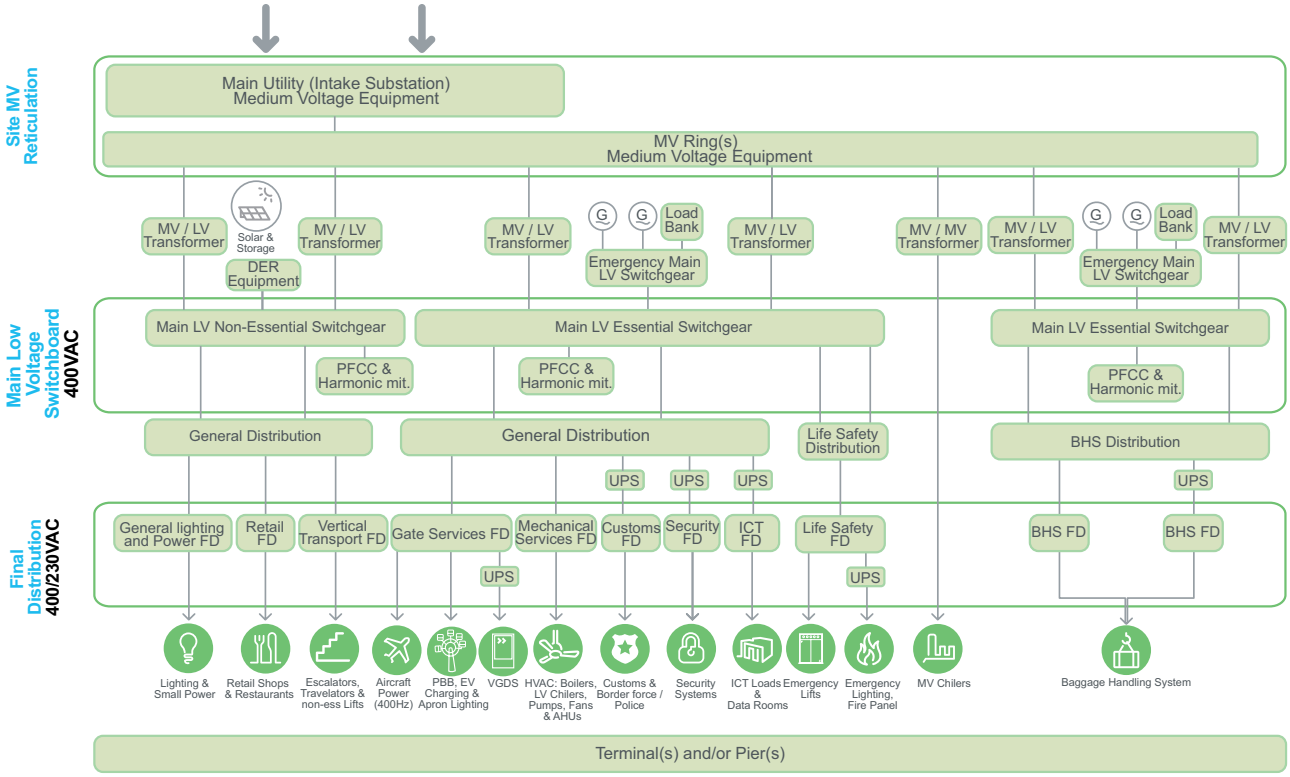
The solutions and recommendations in this guide are generally targeted at larger airports with pre-COVID 19 passenger movements of greater than 10M per year. Although a number of sections will also be applicable to smaller airports, particularly those which are planning to grow over the coming years.

Airports of any size that have an ambition to improve their energy efficiency and reduce their Green House Gas (GHG) emissions will gain insights from the sections on microgrids, EV charging, effective energy accounting and energy management. As will any airport that is working its way along the digitalization journey.

Typical Electrical Distribution Topology for a Large Modern Airport

Electrical Distribution (ED) Reference Architecture

The Electrical Distribution Reference Architecture shown below is a simplified block diagram designed to highlight a number of Schneider Electric's power solutions for airports.



Airports are large consumers of electricity with buildings and other infrastructure spread over a large geographical area. To meet their electrical energy needs most large airports will own and maintain their own private MV distribution network. Due to the critical nature of many airport loads, this MV network is often designed with a high level of power reliability. Common strategies to achieve this include:

- Utilising two (or more) feeders from the power grid (ideally from two different parts of the utility's network and from two geographically separated intake substations)
- Utilising a MV ring structure for power redundancy

MV/LV substations located on the ring are then used to distribute power around the airport. To improve power reliability each substation's main LV Switchboard may also be fed from two MV/LV transformers in a redundant configuration. Emergency power can also be supplied to the Main LV Switchboards from emergency generators. In our reference architecture these emergency generators are distributed around the site, but it is also possible to utilise a central emergency generator plant and distribute emergency power around the site using a dedicated MV network. Similarly, local power generated by Distributed Energy Resources (like solar panels) can be fed directly into the LV Switchboards or distributed around the site using the MV network. Our reference architecture has Distributed Energy Resources feeding into one of the main LV Switchboards. Automatic Transfer Switches are used to select which redundant incomers are used to supply the loads.

Power factor correction and harmonic mitigation can be applied at different levels of the power network depending on what is determined from a power quality analysis study. For our reference architecture we have applied it at the main LV switchboard level.

Typical Electrical Distribution Topology for a Large Modern Airport, *Cont.*

Main Airport Electrical Loads

All loads in an airport are categorized by their criticality.

- Normal Loads
- Emergency generator backed loads (sometimes referred to as essential loads)
- UPS backed loads (sometimes referred to as critical loads)

Typically, UPS systems are also backed up by the emergency generators.

Which loads are considered critical and which are consider essential may differ from airport to airport depending on the local country requirements and the operational needs of the airport.

The table below shows a high-level breakdown for a typical international airport terminal.

Electrical Load	Tipical Criticality
General Lighting	Normal
Small Power	Normal
Vertical Transport	Normal
Retail	Normal
Offices	Normal
EV Charging	Normal
Custom and Police	Mostly Essential
Hydraulics	Mostly Essential
Gate Services (Including PBBs)	Mostly Essential
Baggage Handling System (BHS)	Mostly Essential
HVAC	Mostly Essential
Emergency Lifts	Essential
Misc. Safety Service Loads	Essential
ICT and Data Rooms	Critical
Control Systems	Critical
Security Systems	Critical
Emergency Lighting	Critical
Fire Systems	Critical

Some equipment, such as emergency lighting, may be equipped with local backup batteries.

Applicable Electrical Standards

Standards for electrical installations in airports follow the general national and regional standards of the respective country.

There is no general international electrical standard specifically for airports, although other non-electrical airport standards may impose requirements on the electrical system in terms of reliability, maintainability and safety. These must be taken into account when designing the electrical network.

Typical Electrical Distribution Topology for a Large Modern Airport, *Cont.*

Components of a Modern Electrical Distribution (ED) Architecture

Microgrids

As mentioned above, airports have a need for strong power resilience. In addition, many of them are also trying to be green and sustainable. Faced with these multiple challenges, airports are starting to build their own microgrids to improve power availability, while relieving budgetary and environmental pressures. A complete microgrid solution intelligently coordinates a variety of onsite, Distributed Energy Resources (DER) to optimize costs and power stability, including the option to 'island' from the utility grid to avoid exposure to outages or disturbances. With their need for large amounts of continuous, clean, and affordable power, airports are excellent candidates to benefit from microgrids. Microgrid technology has reached a high level of maturity, being adopted in many types of facilities and infrastructure.

A microgrid is normally connected to the main utility grid, drawing energy from the utility when economically advantageous, using a combination of utility power and onsite energy resources. Microgrids are also configured with the ability to disconnect and run in a self-contained mode when needed. This is appropriately termed 'islanding', as the microgrid temporarily becomes its own energy island, operating separately from the main grid.

Many airports have adopted Combined-Heat-and-Power (CHP) or Combined-Cooling-Heating-and-Power (CCHP) Systems. These systems are often configured as microgrids, as they include a local energy resource supplying at least partially the electricity needs of an airport, as well as delivering useful heat. To optimize costs, sustainability, and resilience, a more comprehensive microgrid solution can encompass a variety of distributed energy resources, including CHP, renewables, fuel cells, and energy storage. Choice of DER will depend on economic and environmental considerations.

Rather than using combustion with CHP or CCHP, fuel cells provide another alternative to generate electricity based on a chemical reaction that combines hydrogen and oxygen. The only fuel cell byproducts are water and heat. As hydrogen is not a naturally occurring fuel, it needs to be manufactured. Today, hydrogen is most commonly produced from natural gas or biogas (methane) using a process called natural gas reforming. However, hydrogen can also be produced from water using a process called electrolysis that can be powered by a renewable energy source, such as solar or wind. In this case, the resulting hydrogen fuel can be considered a renewable resource. Fuel cells have a much smaller footprint and weigh less than competing alternatives. As such, they can be situated outside, inside, or on rooftops. Depending on financing, incentives, and fuel costs, these systems can also deliver significant energy savings. For these reasons, some airports are investigating to adopt fuel cells to supply electricity, heat, and hot water to their facilities.

Having the ability to store energy onsite has a wide range of benefits for airports. First, acting as part of an Uninterruptible Power Supply (UPS) system, energy storage can help support resilience against a utility grid outage, in coordination with backup generators, CHP, and renewables. Second, it can maximize the value of renewable energy generation by saving excess energy for use when photovoltaic panels or wind generators are not producing electricity output. Finally, stored energy can be dispatched for peak demand management, helping reduce the amount of energy consumed from the utility grid during periods of high energy cost. Though capital intensive, energy storage is a good option to address load peaks, while other DER (such as CHP) are more suited to support the base load.

At the operations level, the coordination of DER is managed by a microgrid control system. In the event of a utility grid outage, the control system is responsible for the disconnection from the grid and reliable transition to island mode. In island mode, the system manages all DER to maintain power stability. Further gains can be achieved by connecting the microgrid control system to the airport's Building Management System (BMS) and Energy Management System (EMS). Advances in digitalization and the Internet of Things are making power and building systems more intelligent and connected. Integrating these systems with the microgrid control system enables the flexibility of DER, including non-critical controllable loads (for example, electrical vehicle charging stations), to be fully exercised to optimize costs and reliability.

Typical Electrical Distribution Topology for a Large Modern Airport, *Cont.*

Digitalization

According to Vodaphone's 2020 IoT Spotlight Report, IoT continues to generate value and ROI for adopters and 87% agree their core business strategy has changed for the better as a result of adopting IoT.

Almost all (95%) say they have achieved a return on investment and 55% of adopters have seen operating costs decrease by an average of 21%.

From improving operational efficiency to creating new connected products and services, key benefits of IoT deployments include boosted employee productivity (49%) and improved customer experience (59%). Vodaphone 2020 IoT Spotlight Report

This certainly is no exception as it relates to critical electrical infrastructure in airports around the world, especially large international airports of focus in this document. Insights based on temperature, humidity, energy, maintenance diagnostics and other types of data can have significant impacts on safety through greater visibility and awareness of the operation and maintenance of electrical equipment. It can provide real time and analytics based recommendations on the most effective timing and most informed operational decision-making to ensure uptime and energy efficiency.

This is where EcoStruxure™ Power with its Connected Products, Edge Control software and Apps, Analytics and Services can help airport organizations maximize the benefits of digital technologies.

Energy Management and Power Reliability

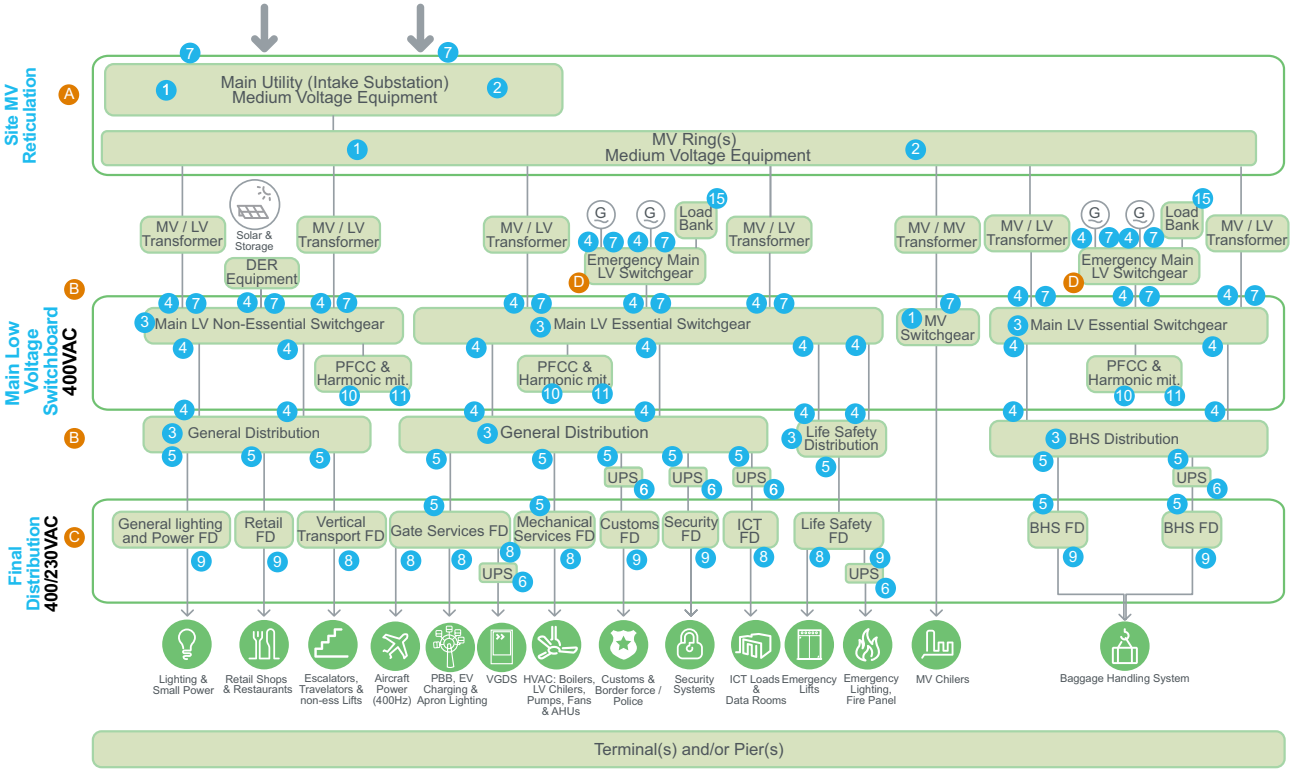
High availability and optimal power supply is essential for ensuring the continuity of airport operations. Connected devices such as digital protection relays, controllers, intelligent circuit breakers, standalone and wireless power and energy metering as well as embedded controllers in equipment strategically installed throughout the airport's entire electrical distribution from its main incomers to the final loads allows for complete visibility and insights.

This enables airport operations and maintenance to perform a range of applications to maximize availability of power, including:

- See "Backup Power Testing," page 15
- See "Circuit Breaker Settings Monitoring," page 16
- See "Electrical Distribution Monitoring and Alarming," page 17
- See "Capacity Management," page 18
- See "Power Events Analysis," page 20
- See "Power Quality Monitoring and Correction," page 21
- See "Power Control and Advanced Automation," page 22

Energy Management and Power Reliability, *Cont.*

Energy management and power reliability help to provide large airports with more sustainable solutions to manage operations. The following applications and architectures provide greater energy conservation, data-driven decision making.



*If no embedded metering, basic electrical data and events can be captured using a PM5000 device. If PQ meter is selected for PQ monitoring, no need for additional metering device for ED monitoring and alarming.

Typical Equipment

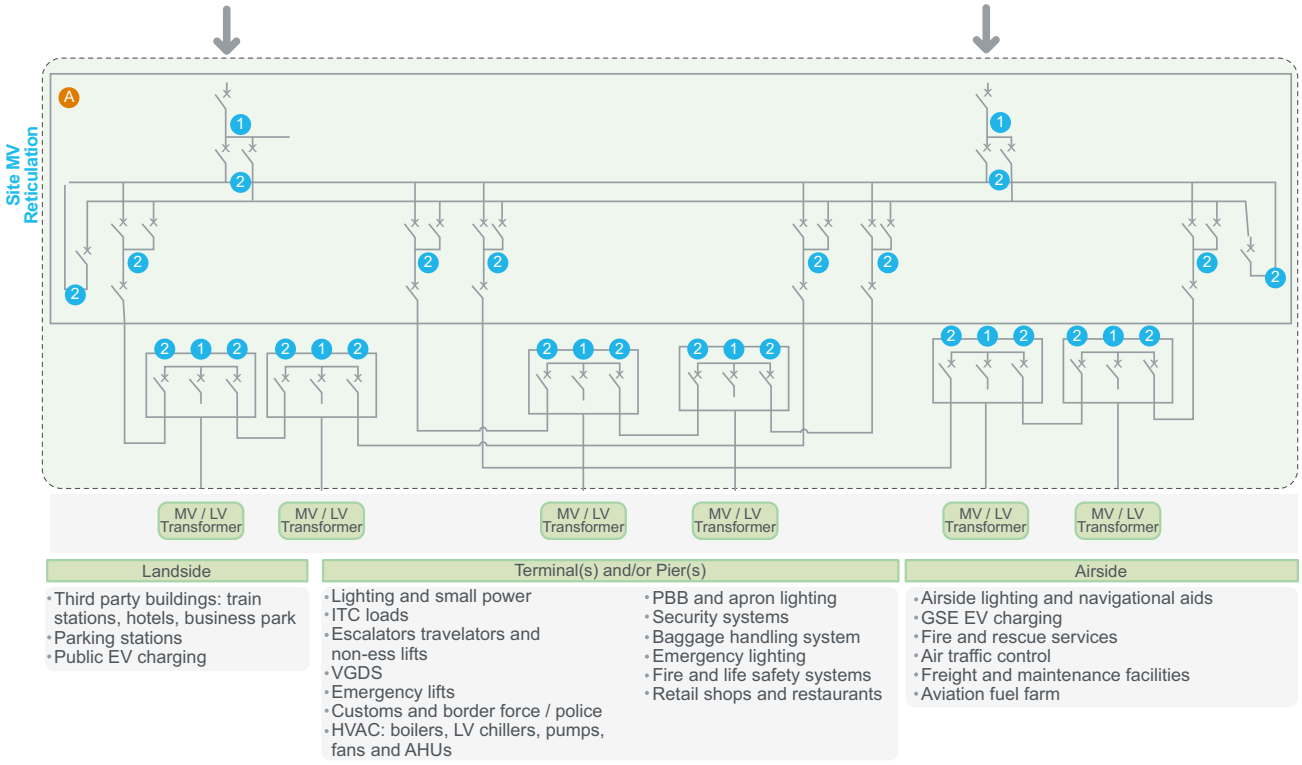
- A MCSeT
- B Okken PCC / BlokSeT
- C PrismaSeT
- D ASCO 7000 Power Control System

Recommended Connected Products

1. PowerLogic P5 or P3
2. PowerLogic C5 or T300
3. TransferPacT UA / ASCO 7000 Automatic Transfer Switch
4. MasterPacT MTZ with MicroLogic
5. ComPacT NSX
6. Galaxy VM/VS/VX UPS
7. PowerLogic ION9000 or PM8000
8. PowerLogic PM5000
9. PowerLogic PowerTag
10. VarSeT with VarPlus Logic Controller
11. PowerLogic AccuSine PCS+
12. PowerLogic TH110/CL110
13. PowerLogic HeatTag
14. Arc V121/ PowerLogic A125
15. ASCO Load Bank

Energy Management and Power Reliability, *Cont.*

Below is the recommended MV diagram for Energy Management and Power Reliability:



Typical Equipment

- A MCSeT
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- C PrismaSeT
- D ASCO 7000 Power Control System

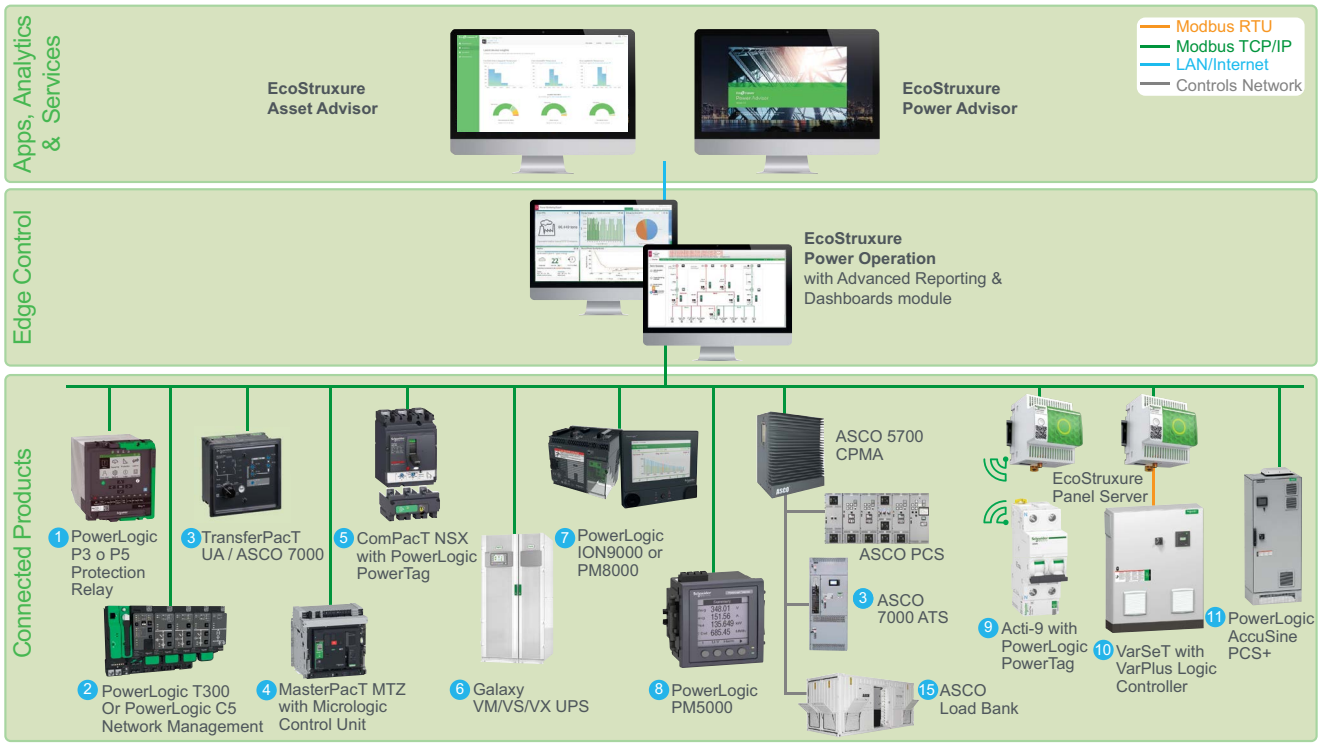
Recommended Connected Products

1. PowerLogic P5 or P3
2. PowerLogic C5 or T300
3. TransferPacT UA / ASCO 7000 Automatic Transfer Switch
4. MasterPacT MTZ with MicroLogic
5. ComPacT NSX
6. Galaxy VM/VS/VX UPS
7. PowerLogic ION9000 or PM8000
8. PowerLogic PM5000
9. PowerLogic PowerTag
10. VarSeT with VarPlus Logic Controller
11. PowerLogic AccuSine PCS+
12. PowerLogic TH110/CL110
13. PowerLogic HeatTag
14. Arc V121/ PowerLogic A125
15. ASCO Load Bank

Energy Management and Power Reliability, *Cont.*

Energy Management and Power Reliability Digital Architecture

Below is the Digital Architecture for Energy Management and Power Reliability. Connected Products pass data over various communication protocols including Modbus RTU, Modbus TCP/IP and IEC61850 to EcoStruxure™ Power Operation with Advanced Reporting and Dashboards where the data is acquired, logged and visualized through dashboards, trends, diagrams and reporting. This data can be sent securely over an Ethernet LAN connection to the cloud for optional remote services with EcoStruxure™ Power Advisor and Asset Advisor.



This architecture is designed around EcoStruxure™ Power Operation with Advanced Reporting and Dashboards. If no control capability or hot standby redundancy is required, an alternative is provided by EcoStruxure™ Power Monitoring Expert software.

Energy Management and Power Reliability, *Cont.*

Backup Power Testing

Application Context

During an interruption, power is transferred from the utility supply to the alternate power source using automatic transfer switch(es) (ATS). In many jurisdictions, codes and standards, legislate the testing procedures.

Architectural Description

A modern, digital approach to perform and record test procedures is crucial for emergency power maintenance. Connected Products at the medium voltage, low voltage, and distribution levels can help airport maintenance staff test the emergency power supply system regularly to help ensure its availability when needed.

A wide variety of Connected Products provide rich data to airport facility and maintenance staff at the Medium Voltage (MV), Low Voltage (LV) and Final Distribution (FD) network levels. The table below provides a quick summary of these products:

Device Type	Device Name	Functional Description
MV Level		
Protection Relay	PowerLogic P3 or P5	Provides detailed and specialized electrical and engine parameter data and status information from backup power systems
Stand-alone power meters	PowerLogic ION9000	
LV Level		
Micrologic trip units	MasterPacT MTZ	Provides capacity management data such as kW, kVA, current
Metering device	PowerPacT H/J/L	
Wireless temperature and humidity sensors	PowerLogic TH110 and CL110	
Equipment with controllers (Automatic transfer switches, and active harmonic filters)	Galaxy UPS, PowerLogic AccuSine, ASCO 5210, ASCO 7000	
Stand-alone power meters	PowerLogic PM5000	
Cyber Sciences equipment	SER3200 or SER2408	Provides sequence of event recorder for high-time accuracy applications
FD Level		
Simple stand-alone meters	EM3500	Insight into the electrical parameters at the load level is provided through simple stand-alone meters
Branch Circuit Power Metering	BCPM or HDPM6000	

Automated compliance reporting through Edge Control software helps ensure optimal reliability and availability of backup power systems. The EcoStruxure™ Backup Power Testing application is enabled when devices collect status and load information from the electrical distribution system. Key parameters are recorded and made available to airport facility operators and maintenance staff.

The EcoStruxure™ Power Monitoring Expert software records and displays:

- Transfer time for automatic transfer systems and generators
- Generator run time, engine loading, exhaust and engine temperature, fuel levels and battery health
- UPS's ability to sustain critical loads during power UPS battery health
- Load bank loading on emergency generator paralleling, engine generators, and UPS systems

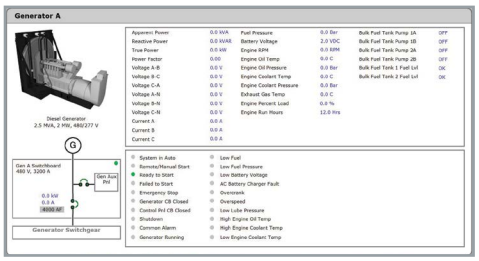
ASCO 7000 Series LV Automatic Transfer Switches

Energy Management and Power Reliability, *Cont.*

In addition, the EcoStruxure™ Backup Power Testing application monitors the:

- Analog values and status of ATSs, generators, power control systems, load banks, and UPSs
- Operating parameters and status of the backup power supply during an outage, testing, and operation using animated device diagrams

For details, refer to the Backup Power Testing section in the EcoStruxure™ Power Digital Applications Design Guide.



EcoStruxure™ Power Monitoring Expert Equipment Diagram

Circuit Breaker Settings Monitoring

Circuit Breaker settings monitoring allows you to report on any protection settings changes to your low voltage circuit brakers. For details, refer to the Circuit Breaker Settings Monitoring section in the EcoStruxure™ Power Digital Applications Design Guide.

Energy Management and Power Reliability, *Cont.*

Electrical Distribution Monitoring and Alarming

Application Context

Electrical distribution systems in airports are becoming increasingly complex. Disruption of the power distribution network can not only bring airport operations to a halt but can also severely impact the customer experience. Disruptions of this nature are considered unacceptable to the general public and will negatively impact the airport's brand.

Architectural Description

A wide variety of Connected Products provide rich data to airport facility and maintenance staff at the Medium Voltage (MV), Low Voltage (LV) and Final Distribution (FD) network levels. The table below provides a quick summary of these products:

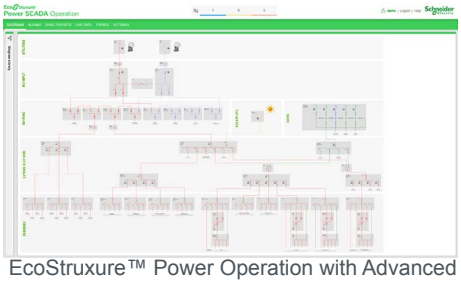
Device Type	Device Name	Functional Description
MV Level		
Protection Relay	PowerLogic P3	Provides protection and power monitoring data such as voltage, current, power, energy, etc. Alarms and events are flagging any abnormal conditions
Protection Relay	PowerLogic P5	
Wireless temperature and humidity sensors	PowerLogic TH110/CL110	Sensors installed on busbars junctions, circuit breaker connections to measure temperatures and humidity
Stand-alone power meters	PowerLogic ION9000	Provides all voltage, current, power, energy, etc. parameters as well as advanced Power Quality data, both real-time and historical. In addition, alarms and events are flagging any abnormal conditions
LV Level		
Micrologic trip units	MasterPacT MTZ with MicroLogic X	Provides protection and power monitoring data such as voltage, current, power, energy, etc. Alarms and events are flagging any abnormal conditions
Wireless temperature and humidity sensors	PowerLogic TH110/CL110	Sensors installed on busbars junctions, circuit breaker connections to measure temperatures and humidity
Stand-alone power meters	PowerLogic PM5000	Provides all voltage, current, power, energy, etc. parameters as well as some basic Power Quality data, both real-time and historical. Alarms and events are flagging any abnormal conditions
Equipment with controllers (Automatic transfer switches, and active harmonic filters)	Galaxy UPS, PowerLogic AccuSine	Capture electrical events data and rich diagnostics information (time-stamps, on-board recording of voltage, current and other electrical measurements
Stand-alone power meters	PowerLogic PM8000	Provides all voltage, current, power, and energy parameters as well as extensive Power Quality data, both real-time and historical. Alarms and events are flagging any abnormal conditions
FD Level		
Simple stand-alone meters	EM3500	Electrical parameters at the load level are provided through simple stand-alone meters
Branch Circuit Power Metering	PowerLogic PowerTag	Provides real-time voltage, current, power, energy and power factor parameters for branch circuits

Energy Management and Power Reliability, *Cont.*

Analysis tools help simplify management of complex systems. They provide airport operators and maintenance staff with tools to manage the daily operation and maintenance of the electrical distribution systems using Edge Control software.

EcoStruxure™ Power Operation with Advanced Reporting and Dashboards software: Allows drill-downs into real-time electrical events through single-line diagrams.

- Provides smart alarming that intelligently groups system alarms
- Streamlines the determination of the origin of events
- Visualizes electrical signal waveforms
- Generates historical event and trending reports
- Notifies operators via email or SMS



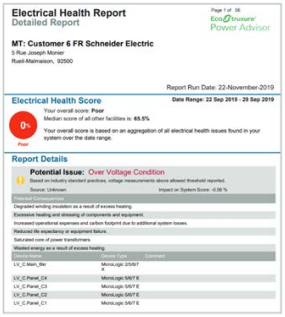
EcoStruxure™ Power Operation with Advanced Reporting and Dashboards

EcoStruxure™ Power Operation with Advanced Reporting and Dashboards Waveform Viewer

Apps, Analytics, and Services can be provided as an optional subscription. This cloud-connected analytics service helps airport operations and maintenance staff identify persistent issues and take corrective actions to improve the health and performance of the power distribution system.

For monitoring and alarming analysis, the EcoStruxure™ Power Advisor Service:

- Provides cloud-connected analytics based on power data on a regular basis
- Analyzes event and electrical data to identify issues in the system that may affect operations and maintenance
- Provides expert support from service engineers with improvement recommendations and follow up



EcoStruxure™ Power Advisor Electrical Network Health Check Report

For details, refer to the Electrical Distribution Monitoring and Alarming section in the EcoStruxure™ Power Digital Applications Design Guide.

Capacity Management

Application Context

Many airports experience electrical load fluctuations when areas undergo renovations or expansions. New equipment installations, upgrades, or movements to different locations within the facility can cause an increase or a change in loading of the electrical infrastructure. In addition, exceeding the rated capacity means nuisance trips, but it could also result in overheating or fires. In many jurisdictions, compliance with standards is also a major consideration. Therefore, it is important for facility operators to understand the loading with respect to capacity limitations or ratings of the electrical distribution infrastructure devices.

Architectural Description

The infrastructure capacity must evolve with these changing environments while not exceeding the electrical distribution equipment rating, which can impact selected products such as circuit breakers, UPSs, transformers, conductors, fuses. Capacity management can be facilitated through connected products and help facility operators plan for expansions or modifications at the medium voltage, low voltage, and distribution levels.

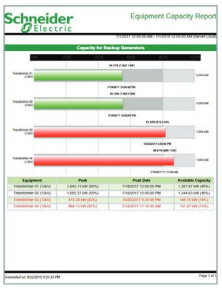
Energy Management and Power Reliability, *Cont.*

A wide variety of Connected Products provide rich data to airport facility and maintenance staff at the Medium Voltage (MV), Low Voltage (LV) and Final Distribution (FD) network levels. The table below provides a quick summary of these products:

Device Type	Device Name	Functional Description
MV Level		
Protection Relay	PowerLogic P3	Provides capacity management data such as kW, kVA, and current.
Stand-alone power meters	PowerLogic ION9000	
LV Level		
Micrologic trip units	MasterPacT MTZ	Provides capacity management data such as kW, kVA, and current
	ComPacT NSX	
	PowerLogic PM5000	
Equipment with controllers (Automatic transfer switches, and active harmonic filters)	Galaxy UPS, PowerLogic AccuSine	
Stand-alone power meters	PowerLogic PM8000	
FD Level		
Simple stand-alone meters	EM3500	Provides capacity management data such as kW, kVA, and current
Branch Circuit Power Metering	PowerLogic PowerTag	

The Capacity Management application is enabled by equipment loading, which is typically measured in amperes, watts, VA or VAR. Relays or meters can collect these measurements using Edge Control software. EcoStruxure™ Power Monitoring Expert software:

- Monitors and trends real-time and historical power system loading
- Compares maximum values to the rating of the electrical distribution equipment using simple reporting tools
- Provides analysis tools to locate the origin of the equipment exceeding rated capacity and nuisance tripping in the airport electrical system
- Notifies operators via email or SMS



EcoStruxure™ Power Monitoring Expert Capacity Management Report

Apps, Analytics, and Services can be provided as an optional Cloud-connected service subscription. For example, the EcoStruxure™ Power Advisor can analyze transformer loading to determine if loading or tap-sizing issues exist. In addition, through analytics, the EcoStruxure™ Power Advisor software:

- Provides expert support from service engineers with improvement recommendations and follow up
- Helps enhance capacity management planning by identifying common issues that can inform maintenance decision making

For details, refer to the Capacity Management section in the EcoStruxure™ Power Digital Applications Design Guide.

Energy Management and Power Reliability, *Cont.*

Power Events Analysis

Application Context

In order to diagnose electrical problems in airports (or any facility), it is crucial to have the right information and diagnostics tools available to determine the root cause and to implement preventative measures to manage those issues.

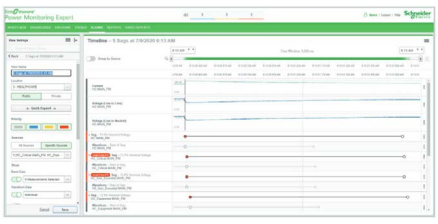
Architectural Description

Advanced intelligent Connected Products offer the capability to perform analytics, such as Disturbance Direction Detection and Load Loss Detection to help with root cause determination. Airport facility and maintenance staff can take advantage of all of this data to isolate the power system and reduce downtime. The table below provides a quick summary of these products:

Device Type	Device Name	Functional Description
MV Level		
Protection Relay	PowerLogic P3 or P5	Provides protection and power monitoring event data with accurate time stamping
Stand-alone power meters	PowerLogic ION9000	Captures and monitors power system events (for example: voltage sags, swells, transients, status changes and interruptions) with accurate time stamping on grid incomers and the main distribution
LV Level		
Micrologic trip units	MasterPacT MTZ with MicroLogic X	Provides protection and power monitoring event data with accurate time stamping
Wireless temperature and humidity sensors	PowerLogic TH110/CL110	Sensors installed on busbars junctions, circuit breaker connections to measure temperatures and humidity. This information is recorded as historical data
Stand-alone power meters	PowerLogic PM5000	Provide stand-alone metering and event capture with accurate time stamping
Equipment with controllers (Automatic transfer switches, and active harmonic filters)	Galaxy UPS, PowerLogic AccuSine	Capture electrical events data and rich diagnostics information (time-stamps, on-board recording voltage, current and other electrical measurements and electrical signal waveforms) with high-level precision and reliability, enabling post-event diagnostics.
Stand-alone power meters	PowerLogic PM8000	Captures and monitors power system events (for example: voltage sags, swells, status changes and interruptions) with accurate time stamping on grid incomers and the main distribution
FD Level		
Simple stand-alone meters	EM3500	Electrical parameters and events at the load level are provided through simple stand-alone meters
Branch Circuit Power Metering	PowerLogic PowerTag	Provides electrical parameters and events at the branch circuit level

Analyses of power system events across the entire airport electrical infrastructure is made available to staff via on-premise Edge Control software. The EcoStruxure™ Power Operation with Advanced Reporting and Dashboards software:

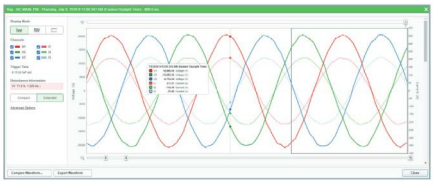
- Provides features like smart-grouping of events into correlated incidents for simple interpretation without a lot of clutter, which is common in larger systems
- Provides chronological event timeline overlays on power events to help determine the source of an issue (for example: a disturbance originating from the electric grid)
- Enables airport operators and maintenance staff to analyze detailed event logs and waveforms to find the reason and origin of electrical events



EcoStruxure™ Power Operation with Advanced Reporting and Dashboards event timeline analysis

Energy Management and Power Reliability, *Cont.*

Apps, Analytics, and Services can be provided as an optional subscription. This cloud-connected analytics service helps airport operations and maintenance staff identify persistent issues and take corrective actions to improve the health and performance of the power distribution system.

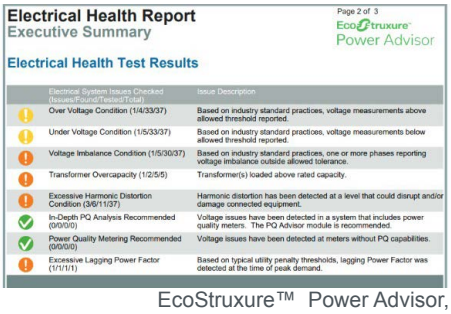


EcoStruxure™ Power Operation with Advanced Reporting and Dashboards

For power events analysis, EcoStruxure™ Asset Advisor service:

- Help analyze alarms and events to simplify the analysis of electrical health
- Provides expert support and regular health checks from service engineers on a range of electrical issues with improvement recommendations and follow up

For details, refer to the Power Events Analysis in the EcoStruxure™ Power Digital Applications Design Guide.



EcoStruxure™ Power Advisor, Electrical Network Health Analytics

Power Quality Monitoring and Correction

Application Context

Permanent monitoring of the power quality in an airport's electrical network is essential. Often, however, airports do not have dedicated electrical engineers to perform the detailed audits to identify quality issues within the power system behavior to save energy.

Architectural Description

Dedicated power quality metering through Connected Products, provides the ability to capture and monitor events (for example, voltage sags, swells, transients, and interruptions) on grid incomers and the main distribution continuously. Electrical signal waveforms and steady-state disturbances are also captured and monitored continuously, but further down in the electrical hierarchy using intelligent circuit breakers and less sophisticated energy meters.

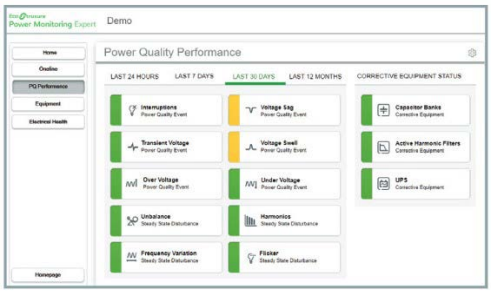
The Power Quality Monitoring and Compliance application helps airport staff monitor the maintenance parameters associated with the equipment. If devices with power quality capabilities were not installed in proper locations within the electrical distribution, then airport staff may be unaware of adverse conditions; negative impacts could occur without notice. Edge Control software can help ensure equipment is operating optimally and properly compensate and condition power. The table below provides a quick summary of these products:

Device Type	Device Name	Functional Description
Connected Products		
Stand-alone power meters	PowerLogic PM8000	Captures and monitors PQ events (for example: voltage sags, swells, transients, and interruptions) on grid incomers and the main distribution continuously
Stand-alone power meters	PowerLogic ION9000	
Power quality correction equipment	PowerLogic AccuSine PCS+	Corrects adverse power quality conditions, such as excessive voltage or current harmonics
Uninterruptible Power Supplies (UPSs)	Galaxy VM or VX	Provides power continuity in the event of electrical interruptions. Isolates and eliminates upstream PQ issues
Protection Relay	PowerLogic P3 or P5	Provides basic Power Quality data such as THD
Circuit Breaker	MTZ	

Energy Management and Power Reliability, *Cont.*

EcoStruxure™ Power Operation with Advanced Reporting and Dashboards software:

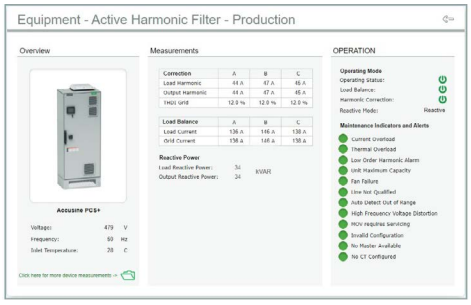
- Visualizes data acquired by power quality, digital circuit breakers and relays and energy meters throughout the electrical system in one interface
- Allows drill-downs into detailed power quality data through single-line diagrams
- Provides automated analysis to study waveforms and simplify interpretation of power quality issues
- Trends steady-state disturbances according to standards (for example, IEEE519 and determines the severity of events using standard tolerance curves (CBEMA ITIC)
- Enables comprehensive reporting on historical events



EcoStruxure™ Power Operation with Advanced Reporting and Dashboards

Apps, Analytics, and Services are provided through the optional EcoStruxure™ Power Advisor service subscription. The Cloud-connected analytics service helps airport operators and maintenance staff leverage data from the power system infrastructure. EcoStruxure™ Power Advisor software:

- Analyzes the health of the power system
- Provides insights of persistent power quality issues and recommends specific solutions



EcoStruxure™ Power Operation with Advanced Reporting and Dashboards

For details, refer to the Power Quality Monitoring and Power Quality Correction sections in the EcoStruxure™ Power Digital Applications Design Guide.

Power Control and Advanced Automation

Application Context

Growing grid instability caused by increasing power demand and unpredictable, powerful storms are impacting continuous power availability. Automatic control schemes for source transfer and load-shedding operations, including self-healing network reconfiguration is necessary to isolate any abnormal conditions and restore power quickly when lost. All sources (for example, Utilities, Genset and UPS) are monitored to launch automatic reconfigurations or to help operators decide the best path of service and relevant actions to restore power and ensure power continuity in the most critical areas. Access to diagnostic information allows for proper automatic or manual reconfiguration sequences that can result in maximum uptime for large and critical airport facilities. Determining the electrical measurements, statuses, and diagnostic information of essential loads prior to stopping or re-starting them is required to preserve the essential electrical system.

Architectural Description

Airport staff and maintenance operators depend upon the electrical distribution system to understand their facility's status and ensure reliable power to critical loads. Loading and parameters, statuses, diagnostics, trip context from circuit breakers, and automatic device reconfigurations are acquired using a combination of connected products at the medium, low, and final distribution levels. The following table provides a quick summary of these products:

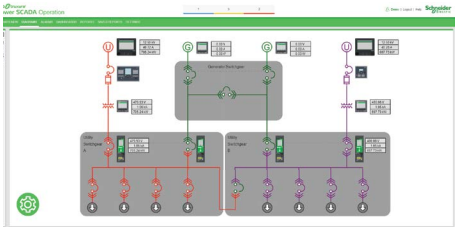
Energy Management and Power Reliability, *Cont.*

Device Type	Device Name	Functional Description
MV Level		
Protection Relay	PowerLogic P3 or P5	Provides circuit protection including overloads, short circuits, ground faults, and arc flash
Automation controllers	PowerLogic T300	A modular application building block for medium voltage and low voltage distribution network management. It offers a single solution for control and monitoring. It is a powerful Remote Terminal Unit for feeder automation
Automation controllers	PowerLogic C5	A scalable solution for critical facilities that brings software intelligence over automation schemes to help operate electrical distribution systems automatically for applications such as fast power restoration, load shedding, load restoration, MV backup gensets, and overcurrent protection
LV Level		
Micrologic trip units	MasterPacT MTZ, ComPacT NSX and and molded case circuit breakers	Protects electrical systems from damage caused by overloads, short circuits and equipment ground faults
Equipment with controllers (Automatic transfer switches, and active harmonic filters)	Genset, Galaxy VM/VX UPS, PowerLogic AccuSine	Provides backup power and PQ correction
FD Level		
Circuit Breaker	Acti-9 SmartLink circuit breakers	Provides circuit protection at the load level

The Power Control and Automation application provides control, visual, and supervisory automatic transfer and network reconfiguration schemes remotely. Remote or distributed controller-based, automated electrical network control is achieved using Edge Control software.

EcoStruxure™ Power Operation with Advanced Reporting and Dashboards software:

- Provides live, animated Single Line Diagrams (SLDs)
- Displays the status of the system (loop configuration, ATS) and is monitored permanently
- Enables preventive intervention through alarms and notification if any abnormal conditions arise in the electrical network reconfiguration system
- Logs all remote-control actions performed and makes them available for auditing and tracking



EcoStruxure™ Power Operation
Animated One-Line

Electrical Safety

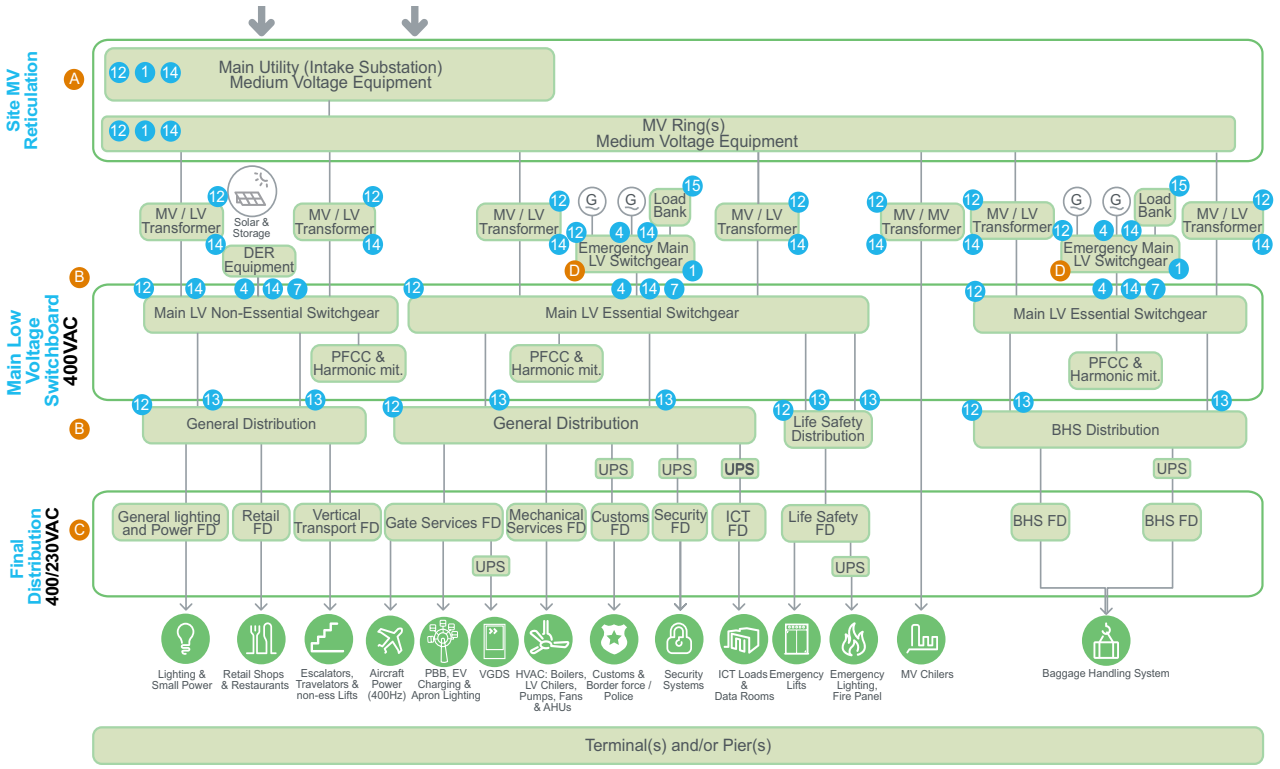
Electrical safety is top-of-mind in any airport facility. While electrical standards include safeguards to help address electrical safety, digital technologies are playing a role in helping to further enhance this through greater visibility and insights to support more informed decision making.

This enables airport operations, maintenance teams and contractors to help be proactive about electrical safety to improve operational and maintenance procedures and planning for medium voltage, low voltage and other secure power equipment through:

- See "Arc Flash Protection Relay," page 26
- See "Continuous Thermal Monitoring," page 27

Electrical Safety, *Cont.*

Electrical safety helps airports reduce the risk associated with their electrical installation both for staff and passengers. More specifically, the following applications and architectures provide ways to help improve electrical safety for both operational and maintenance considerations.



* For low voltage, a V121/A125 can be used either with a MasterPacT MTZ with MicroLogic + IO Module or with a PM8000/ION9000 to capture, time-stamp and raise the arc flash event to the Edge Control Software.

Typical Equipment

- A MCSeT
- B Okken PCC / BlokSeT
- C PrismaSeT
- D ASCO 7000 Power Control System

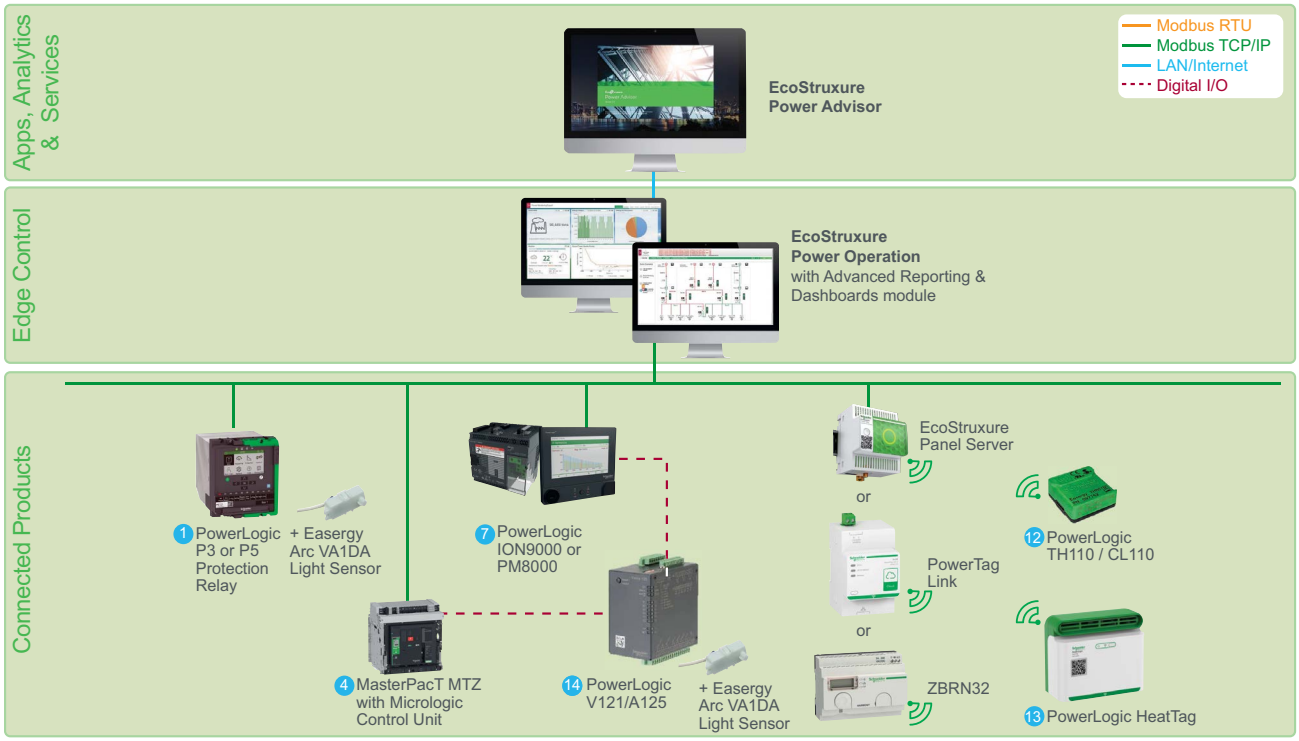
Recommended Connected Products

1. PowerLogic P5 or P3
2. PowerLogic C5 or T300
3. TransferPacT UA / ASCO 7000 Automatic Transfer Switch
4. MasterPacT MTZ with MicroLogic
5. ComPacT NSX
6. Galaxy VM/VS/VX UPS
7. PowerLogic ION9000 or PM8000
8. PowerLogic PM5000
9. PowerLogic PowerTag
10. VarSeT with VarPlus Logic Controller
11. PowerLogic AccuSine PCS+
12. PowerLogic TH110/CL110
13. PowerLogic HeatTag
14. Arc V121 / PowerLogic A125
15. ASCO Load Bank

Electrical Safety, *Cont.*

Electrical Safety Digital Architecture

Data and events are acquired by sensors installed in electrical equipment and raised to Edge Control, Power Operation with Advanced Reporting and Dashboards software through Modbus TCP/IP connections through gateways or relays. Temperature and condition data can be sent to the cloud for remote monitoring with predictive analytics and pro-active recommendations to support maintenance.



This architecture is designed around EcoStruxure™ Power Operation with Advanced Reporting and Dashboards. If no control capability or hot standby redundancy is required, an alternative is provided by EcoStruxure™ Power Monitoring Expert software.

Electrical Safety, *Cont.*

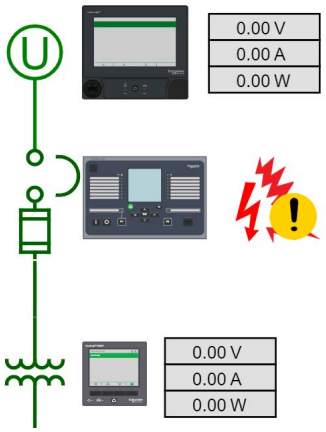
Arc Flash Protection

Application Context

Arc flash incidents can pose risks to airport operations and maintenance staff and also can lead to costly equipment damage. Refer to Schneider Electric Arc Flash Protection and Safety resources to learn more about the risks of arc flash.

Architectural Description

VAMP optical point arc sensors can be coupled with VAMP arc detection relays and installed inside critical MV and LV electrical distribution equipment. Together, they can quickly detect and trip protection devices to minimize the arc flash energy and risk to personnel and equipment. In low voltage systems, VAMP relays send trip signals to low voltage circuit breakers.



Connected Products and digital systems, like power meters and relays, enable airport operations and maintenance staff to localize and respond quickly to reduce impacts to airport operations. Additionally, Edge Control software can help determine the root cause(s) of those impacts. The table below provides a quick summary of these products:

Device Type	Device Name	Functional Description
Connected Products		
Optical point arc sensors	VAMP	VAMP arc detection relays are installed inside critical MV and LV electrical distribution equipment
Arc Flash Protection Relay	PowerLogic P3 and P5	PowerLogic and VAMP arc flash detection relays are installed inside critical MV and LV switchboards to detect arc flash incidents and protect equipment and people
Arc Flash Protection Relay	VAMP 125	

ExoStruxure™ Power Operation with Advanced Reporting and Dashboards software:

- Indicates the location within the electrical system through digital single-line diagrams
- Alarms on arc flash event(s)
- Notifies operators via email or SMS
- Provides analysis tools to perform time-based root cause analysis of arc flash events in context with other potential electrical phenomena in the airport electrical system

P3 and P5 Advanced Protection Relays can:

- Receive arcing condition communications from VAMP relays to initiate fast digital tripping of circuit breakers and minimize arc event impacts
- Raise arc flash events to an on-premise monitoring and control software for system-wide visibility

For details, refer to the Arc Flash Protection in the EcoStruxure™ Power Digital Applications Design Guide.

Electrical Safety, *Cont.*

Continuous Thermal Monitoring

Application Context

One of the leading causes of electrical fires in low and medium voltage installations is faulty power connections. For airports, this can pose a risk to operations and maintenance staff, potentially leading to unexpected downtime and equipment destruction that can impact passenger safety, on-time departures, and the bottom line.

PowerLogic™ TH110 / CL110 Wireless

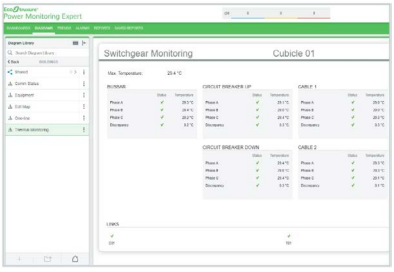
Architectural Description

The table below provides a quick summary of connected products.

Device Type	Device Name	Functional Description
MV and LV Level		
Wireless temperature and humidity sensors	TH110	Provide continuous thermal monitoring of critical MV/LV switchgear connections, busbar junctions, tap-offs and transformer connections
Wireless temperature and humidity sensors	CL110	Provide ambient temperature and humidity monitoring

EcoStruxure™ Power Operation with Advanced Reporting and Dashboards software:

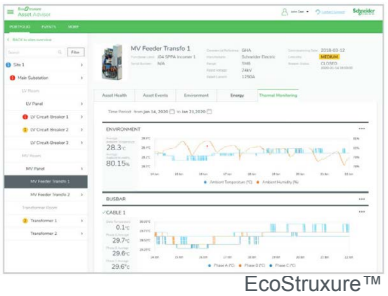
- Monitors and trends real-time temperature data
- Alarms on abnormal temperature rise
- Notifies operators via e-mail or short message service (SMS)
- Visually records temperature data with historical reporting



EcoStruxure™ Power Operation with Advanced Reporting and Dashboards

The EcoStruxure™ Asset Advisor service subscription (optional) is a Cloud-based application that helps airport maintenance staff strategically manage maintenance activities and reduce the risk of premature critical equipment help reduce the risk.
The following can be offered as a managed service subscription with EcoStruxure™Asset Advisor:

- 24/7 remote monitoring
- Support with proper maintenance practices for critical equipment using predictive analytics
- Access to regular system health and electrical network health reports
- Maintenance recommendations from qualified expert electrical distribution service engineers



EcoStruxure™ Asset Advisor

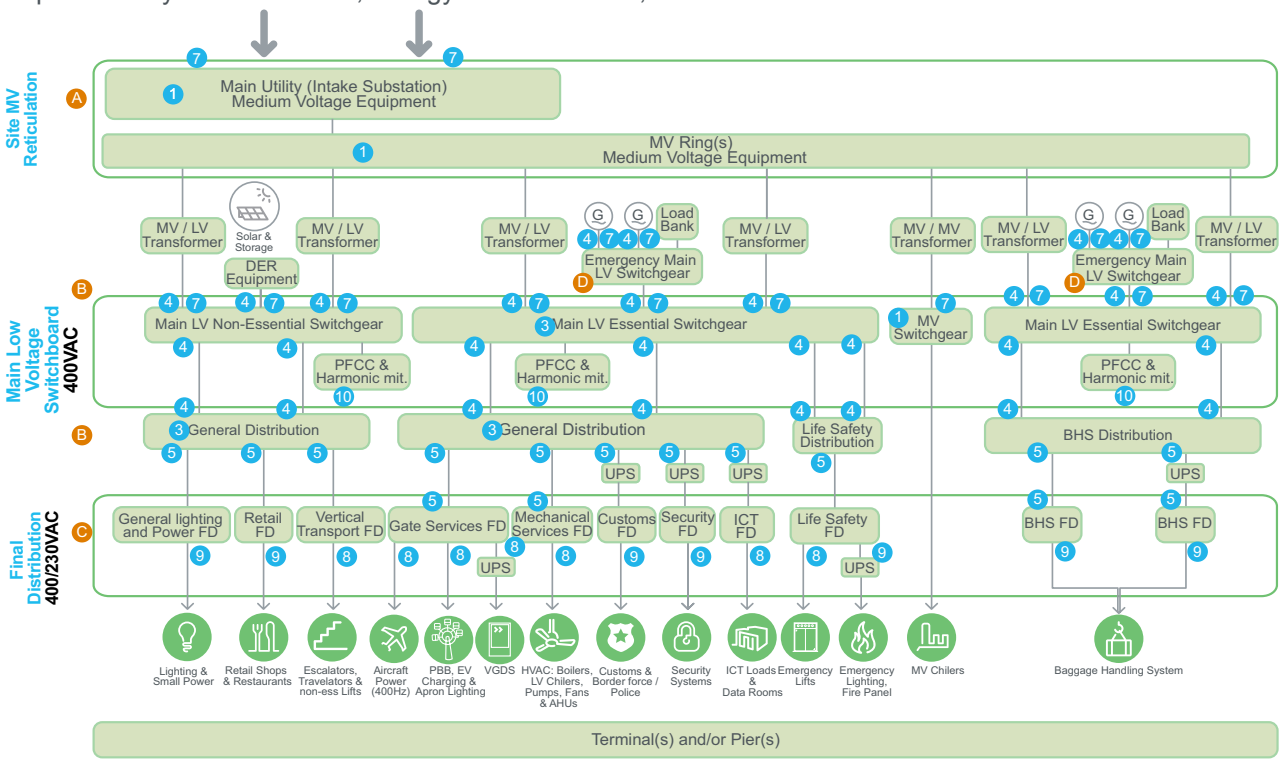
For details, refer to the Continuous Thermal Monitoring section in the EcoStruxure™ Power Digital Applications Design Guide.

Effective Energy Accounting

Airports consume a lot of energy, usually both in the form of gas and electricity. The reasons for energy accounting in airports are as follows: Verify the accuracy of utility bills, and allocate energy costs to buildings, terminals, tenants, departments, airlines.

In addition, airports can take steps to lower their energy bills by avoiding utility bill penalties for consuming excessive reactive power resulting from inductive loads such as motors. This is done using power factor correction equipment. In the following sections we will discuss the details of each of these considerations.

Digital Applications for Effective Energy Accounting are data-driven solutions that help reduce energy costs in airports: Utility Bill Verification, Energy Cost Allocation, and Power Factor Correction.



* PM5000 should be used in this situation.

Typical Equipment

- A MCSeT
- B Okken PCC / BlokSeT
- C PrismaSeT
- D ASCO 7000 Power Control System

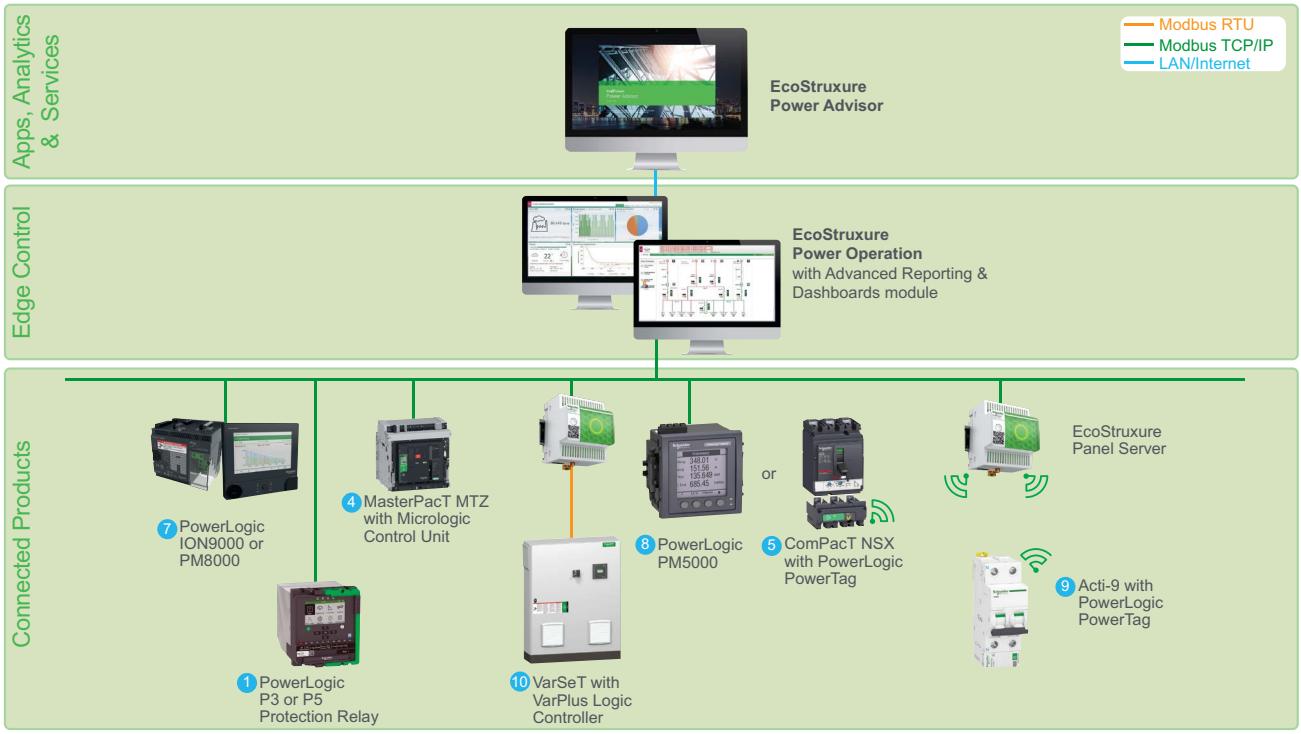
Recommended Connected Products

1. PowerLogic P5 or P3
2. PowerLogic C5 or T300
3. TransferPacT UA / ASCO 7000 Automatic Transfer Switch
4. MasterPacT MTZ with MicroLogic
5. ComPacT NSX
6. Galaxy VM/VS/VX UPS
7. PowerLogic ION9000 or PM8000
8. PowerLogic PM5000
9. PowerLogic PowerTag
10. VarSeT with VarPlus Logic Controller
11. PowerLogic AccuSine PCS+
12. PowerLogic TH110/CL110
13. PowerLogic HeatTag
14. Arc V121 / PowerLogic A125
15. ASCO Load Bank

Effective Energy Accounting, *Cont.*

Effective Energy Accounting Digital Architecture

Energy data can be captured with revenue grade metering at utility incomers, building/terminal or department feeders and acquired by EcoStruxure™ Power Operation with Advanced Reporting and Dashboards to generate shadow bills. Power Factor can be monitored over Modbus RTU via an Ethernet gateway and with pro-active support with an optional Power Advisor digital service to reduce risk of utility penalties.



This architecture is designed around EcoStruxure™ Power Operation with Advanced Reporting and Dashboards. If no control capability or hot standby redundancy is required, an alternative is provided by EcoStruxure™ Power Monitoring Expert software.

Effective Energy Accounting, *Cont.*

Utility Bill Verification

Application Context

Electrical energy has some unique characteristics such as time-of-use and demand peak charges that contribute to complicated billing. Mistakes do happen in energy billing and are surprisingly common. Some discrepancies can include:

- Invoicing errors
- Incorrect rates applied
- Incorrect meter readings
- Duplicate line items

EcoStruxure™ Power Operation with Advanced Reporting and Dashboards Billing Report

Architectural Description

The EcoStruxure™ Power Utility Bill Verification Application automatically generates a reliable shadow bill using identical measurements performed at the same location as the utility meter. This helps verify the accuracy of the utility bill and uncovers potential bill errors. The table below provides a quick summary of these products. Shadow bills are created using EcoStruxure™ Power Operation with Advanced Reporting and Dashboards.

Device Type	Device Name	Functional Description
The EcoStruxure™ Power Utility Bill Verification Application	PowerLogic ION9000 or PM8000	Bill Verification measurements such as kW, kVA, kVAR, PF, and kWh are recorded using revenue accurate metering

For details, refer to the Utility Bill Verification section in the EcoStruxure™ Power Digital Applications Design Guide.

Cost Allocation

Application Context

"You can't change what you don't measure!" Studies show that buildings or facilities with sub-metering and cost allocation use less energy than those that allocate energy cost by area or other non-metered allocation methods. Typically, a 10 to 20% reduction in usage can be achieved due to behavior change and conservation. This in turn requires that occupants or cost centers are provided with the right information to make the right decisions.

Architectural Description

Facility manager and cost center owners need to gain visibility into which departments, processes, building, or floors are contributing to energy cost. This in turn improves energy accountability and identifies key areas for energy saving opportunities. Cost Allocation data can be recorded using metering devices. The table below provides a quick summary of these products:

EcoStruxure™ Power Operation with Advanced Reporting and Dashboards Cost Allocation Report

Device Type	Device Name	Functional Description
Metering devices	PowerLogic ION9000, PM8000, PM5000, EM3500 Branch Circuit Power Meters PowerLogic P3 or P5 MasterPacT MTZ PowerPacT trip units	Capture kWh, kW, kVA, kVAR, and other WAGES parameters to allocate costs to departments, buildings, floors and processes

For details, refer to the Cost Allocation section in the EcoStruxure™ Power Digital Applications Design Guide.

Effective Energy Accounting, *Cont.*

Power Factor Correction

Application Context

For large electricity consumers such as airports, utilities often charge penalties on the energy bill for reactive power consumption or lagging power factor. Reactive power and lagging power factor are primarily caused by inductive motor loads and can be compensated using power factor correction equipment. Power Factor Correction is a common way of achieving fast return on investment.

Architectural Description

Power Factor correction equipment such as VarSet LV is engineered to maintain power factor at an ideal level for optimal power system efficiency and cost reduction. Dashboards and diagrams in EcoStruxure™ Power Operation with Advanced Reporting and Dashboards are available to show equipment status, real time data and estimated cost savings. The table below provides a quick summary of these products:

Device Type	Device Name	Functional Description
Power Factor correction equipment	VarSet LV	Engineered to maintain power factor at an ideal level for optimal power system efficiency and cost reduction
Stand-alone power meters	PowerLogic ION9000 / PM8000	A power meter at the utility entrance or at the service entrance to buildings is used to check that the combined power factor, as seen by the utility, is within allowable thresholds to avoid power factor penalties

For details, refer to the Power Factor Correction section in the EcoStruxure™ Power Digital Applications Design Guide.

Default Diagram for Capacitor Banks

Power Factor Impact Dashboard

VarSet LV with PowerLogic VarPlus Logic Power Factor Correction solution

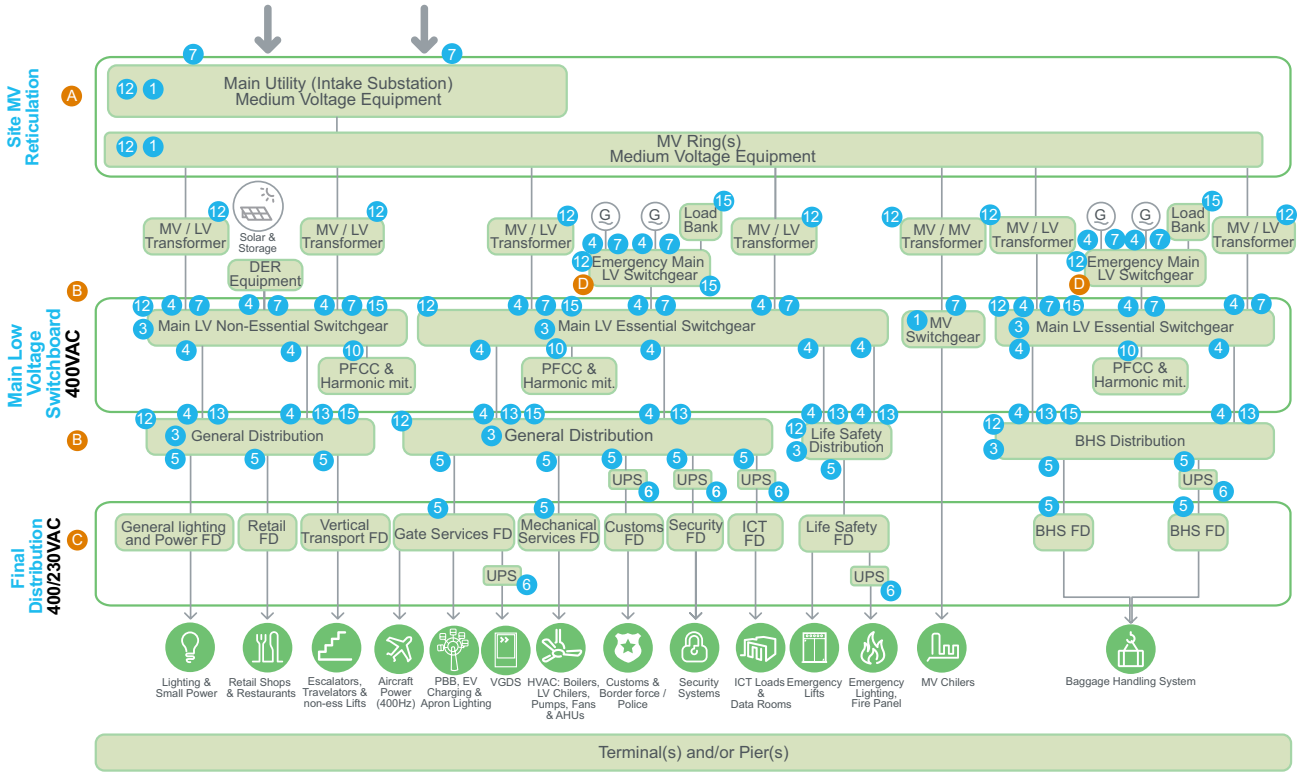
Asset Performance

An airport's electrical infrastructure represents a significant part of its maintenance activities. The critical dependency an airport has on its power availability can make maintenance activities a large commitment. Scheduled, or preventative maintenance can be time-consuming and unnecessary in many cases. However, even worse, reactive maintenance once something has failed can have catastrophic effects on an airport's ability to provide continued operations. Therefore, being able to manage maintenance on actual condition can optimize time and effectiveness of such activities.

With the availability of digital tools, software and analytics, managing the performance of electrical assets can not only make airport maintenance staff more efficient, but it can increase the overall resilience of the airport from unexpected downtime and extend the overall lifetime of critical infrastructure.

Asset Performance, *Cont.*

By leveraging asset diagnostics data, preventative and condition-based maintenance models can help facilitate maintenance planning to reduce risk of early degradation, optimize maintenance activities and optimize maintenance related spending. The following applications and architectures help improve operational and maintenance procedures.



* These devices are only used to provide a current reading to normalize temperature thresholds for Continuous Thermal Monitoring.

Typical Equipment

- A MCSeT
- B Okken PCC / BlokSeT
- C PrismaSeT
- D ASCO 7000 Power Control System

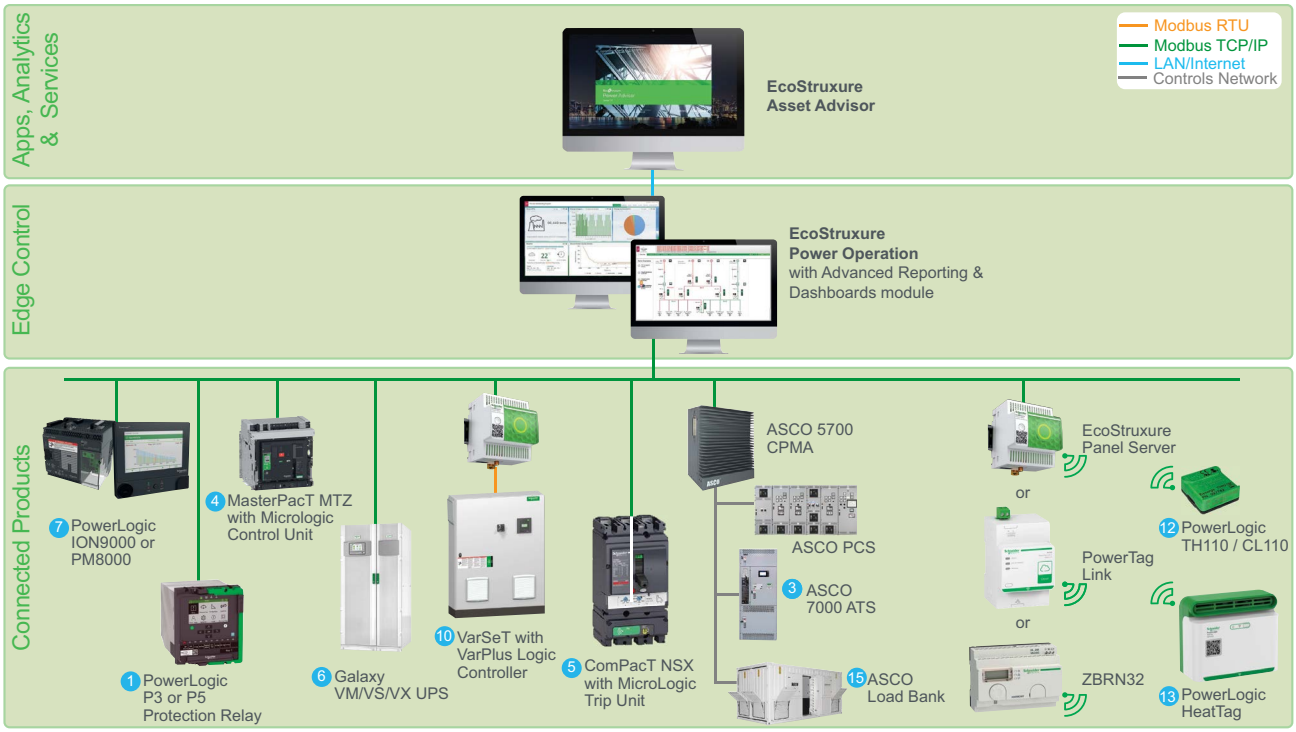
Recommended Connected Products

1. PowerLogic P5 or P3
2. PowerLogic C5 or T300
3. TransferPacT UA / ASCO 7000 Automatic Transfer Switch
4. MasterPacT MTZ with MicroLogic
5. ComPacT NSX
6. Galaxy VM/VS/VX UPS
7. PowerLogic ION9000 or PM8000
8. PowerLogic PM5000
9. PowerLogic PowerTag
10. VarSeT with VarPlus Logic Controller
11. PowerLogic AccuSine PCS+
12. PowerLogic TH110/CL110
13. PowerLogic HeatTag
14. Arc V121 / PowerLogic A125
15. ASCO Load Bank

Asset Performance, *Cont.*

Asset Performance Digital Architecture

Diagnostics and condition data for electrical equipment such as Switchgear, Transformers, Busway, Capacitor Banks, Active Harmonic Filters, UPS and other devices such as Circuit Breakers can be acquired wirelessly and over Modbus RTU or Modbus TCP/IP to an on-premise software – EcoStruxure™ Power Operation with Advanced Reporting and Dashboards. Data can be sent to the cloud with predictive analytics, pro-active notifications and recommendations as a remote service with EcoStruxure™ Asset Advisor.



This architecture is designed around EcoStruxure™ Power Operation with Advanced Reporting and Dashboards. If no control capability or hot standby redundancy is required, an alternative is provided by EcoStruxure™ Power Monitoring Expert software.

Asset Performance

Application Context

For installations as large and complex as an airport's infrastructure, more sophisticated asset management strategies can further enhance productivity and reliability of the assets over the long term. With condition-based data accessible through connected equipment, real-time status monitoring, alerts, analytics and services can enable an airport's maintenance staff to perform predictive, or condition-based maintenance.

Architectural Description

Connected products in critical Medium Voltage, Low Voltage distribution equipment, transformers, UPS and other electrical equipment like generators, ATS and generator starter batteries can be natively integrated with on-premise, Edge Control software such as EcoStruxure™ Power Operation with Advanced Reporting and Dashboards. The following table provides a quick summary of these products:

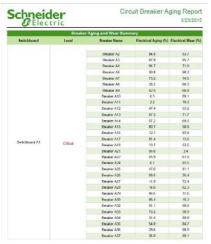
Asset Performance, *Cont.*

Device Type	Device Name	Functional Description
Protection Relay	PowerLogic P3 / P5	Electrical Measurements(1): Depending on the asset, electrical measruements and status information can be provided as for example - 3 phase currents and voltage - Active, reactive power - Cumulative breaking current - Trip circuit, auxiliary voltages - Power quality metrics
Circuit Breaker	MasterPacT MTZ, CompacT NSX	
Stand-alone power meters	PowerLogic PM8000	
Stand-alone power meters	PowerLogic ION9000	
UPS	Galaxy VM, VX, VS	
Temperature Sensor	PowerLogic TH110 / CL110	Environmental Measurements: Temperatures are measured for cable and busbar connection points and transformer windings Humidity and ambient temperatures are measured to detect potential condensation cycles inside equipment

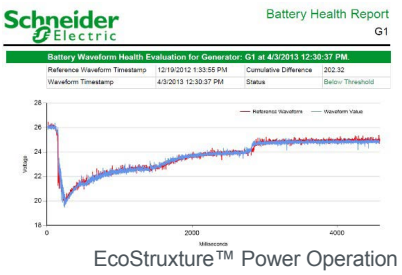
1 This is not a comprehensive list. Other data may be available and continue to asset health analytics.

With EcoStruxure™ Power Operation with Advanced Reporting and Dashboards software, the airport's operations and maintenance staff have access to:

- Real-time monitoring and trending of electrical parameters (voltage, current, demand, temperature and humidity) that serve as operational indicators of equipment performance
- Analytics on diagnostics data from equipment such as UPS, power factor and power quality correction equipment
- Automated reporting of the mechanical and electrical aging, as well as on the remaining lifetime of the circuit breaker
- Generator battery health to signal a potential need for maintenance



Breaker Aging Report

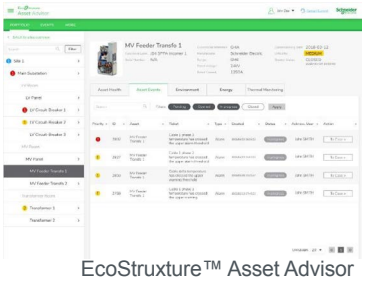


EcoStruxure™ Power Operation with Advanced Reporting and Dashboards software

For more in-depth predictive analysis, alerts and maintenance recommendations, Schneider Electric also offers a managed service with 24/7 support from expert engineers.

The following can be offered as a managed service subscription with EcoStruxure™ Asset Advisor:

- 24/7 remote monitoring
- Support proper maintenance practices for critical equipment with predictive analytics
- Access to regular system and electrical network health reports
- Maintenance recommendations from qualified expert electrical distribution service engineers



EcoStruxure™ Asset Advisor

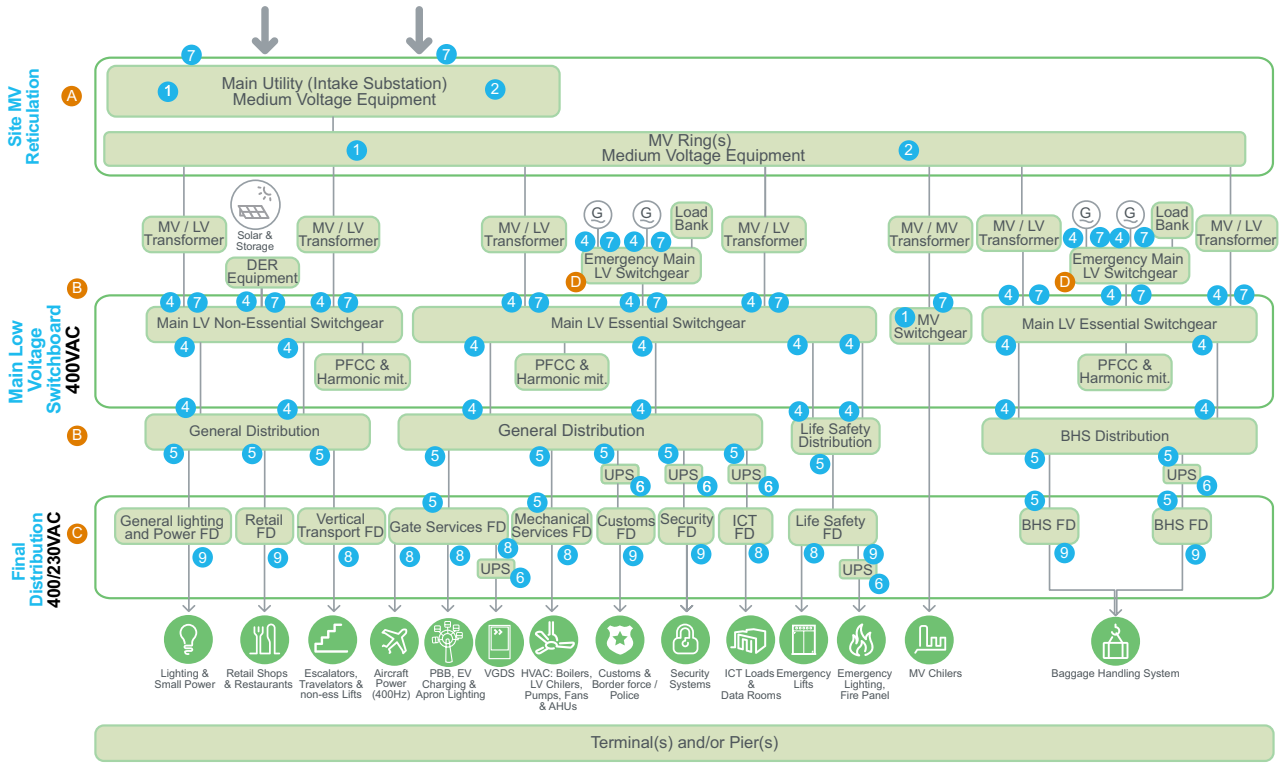
For details, refer to the Asset Performance section in the EcoStruxure™ Power Digital Applications Design Guide.

Sustainability

Digital Applications for Sustainability are data-driven solutions that help airports in their pursuit for carbon neutrality through energy efficiency and conservation measures and CO_2 emissions reduction.

Electrical consumption data is a key source of data that helps contribute to sustainability initiatives with the help of software and analytics for:

- See "Greenhouse Gas Reporting", page 37
- See "Energy Efficiency Compliance", page 40
- See "Energy Procurement Optimization", page 41



Typical Equipment

- A MCSeT
- B Okken PCC / BlokSeT
- C PrismaSeT
- D ASCO 7000 Power Control System

Recommended Connected Products

1. PowerLogic P5 or P3
2. PowerLogic C5 or T300
3. TransferPacT UA / ASCO 7000 Automatic Transfer Switch
4. MasterPacT MTZ with MicroLogic
5. ComPacT NSX
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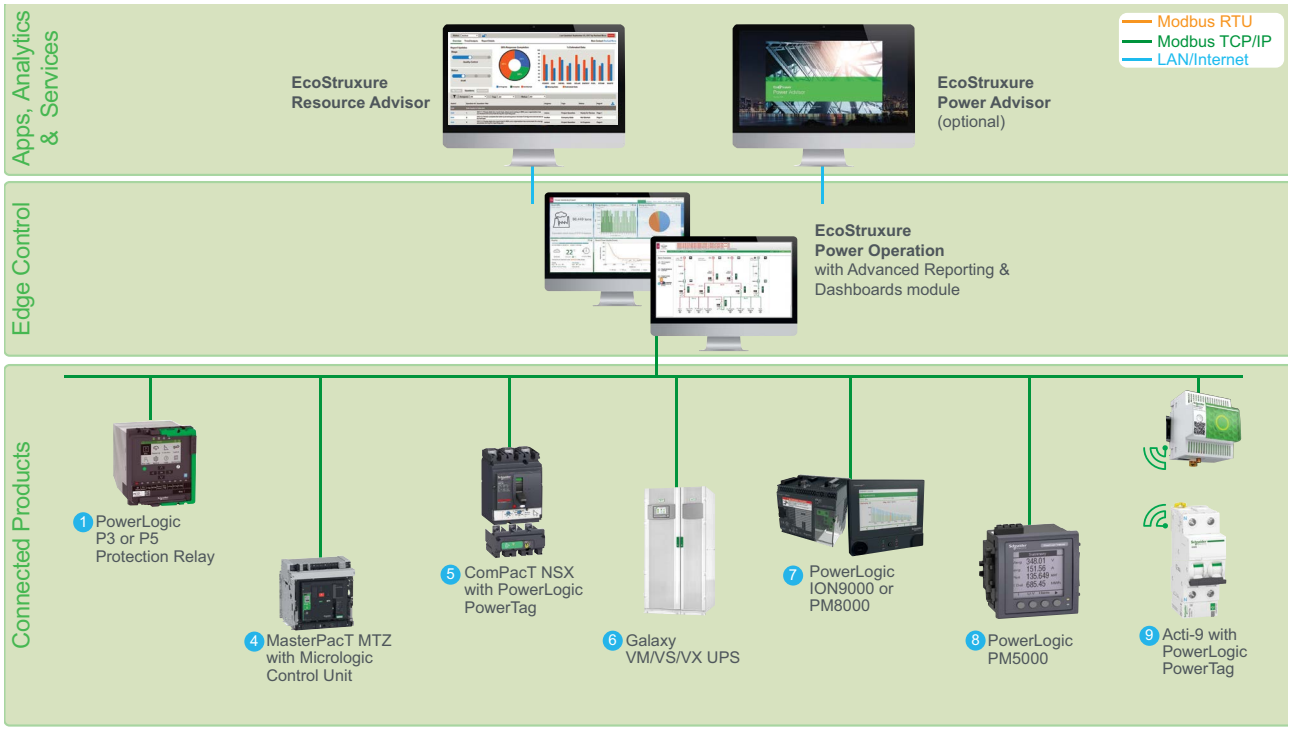
9. PowerLogic PowerTag
10. VarSeT with VarPlus Logic Controller
11. PowerLogic AccuSine PCS+
12. PowerLogic TH110/CL110
13. PowerLogic HeatTag
14. Arc V121 / PowerLogic A125
15. ASCO Load Bank

Sustainability, *Cont.*

Sustainability Digital Architecture

Energy data can be captured using standalone metering or embedded metering at key points of interest and acquired by EcoStruxure™ Power Operation with Advanced Reporting and Dashboards to generate sustainability dashboards. Pro-active support with an optional Power Advisor digital service ensures data accuracy and integrity. EcoStruxure™ Resource Advisor also provides cloud based sustainability dashboards.



This architecture is designed around EcoStruxure™ Power Operation with Advanced Reporting and Dashboards. If no control capability or hot standby redundancy is required, an alternative is provided by EcoStruxure™ Power Monitoring Expert software.

Sustainability, *Cont.*

Greenhouse Gas Reporting

Application Context

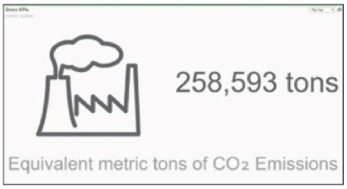
Airports are faced with mounting global pressure to cut carbon emissions and become more efficient by reducing energy usage, water consumption and waste. To do this, they require accurate and timely environmental reporting. Energy managers need to convert energy consumption into greenhouse gas equivalents to communicate the results of reduction efforts to stakeholders (shareholders, public, regulatory bodies) in order to better promote a green image.

Architectural Description

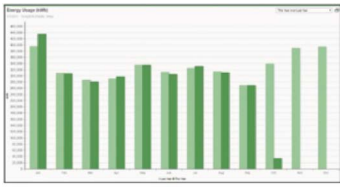
Energy consumption and waste is converted to carbon emissions and represented as equivalent tons of CO_2

In addition, Schneider Electric's modules can communicate water waste, and provide period over period usage comparison.

The data is collected using various field devices and transducers capable of measuring the relevant quantities. This data is then aggregated and converted as described above. The conversion is performed in the Energy Equivalency gadget in EcoStruxure™ Power Operations with Advanced Reporting and Dashboards. Alternatively, the cloud portal of EcoStruxure™ Resource Advisor can also be used to calculated equivalent tons of CO_2. The table below provides a quick summary of these products:



Energy Equivalency Gadget Report


Period Over Period Gadget Report

Device Type	Device Name	Functional Description
Metering devices	PowerLogic ION9000, PM8000, PM5000, EM3500 Branch Circuit Power Meters PowerLogic P3 or P5 MasterPacT MTZ PowerPacT trip units	Capture kWh, GJ, and other WAGES parameters and convert these to CO_2 equivalency for greenhouse gas reporting

For details, refer to the Greenhouse Gas Reporting section in the EcoStruxure™ Power Digital Applications Design Guide.

Energy Efficiency

Energy costs are one of an airport's biggest operational expenditures. Some of these can be recovered through cost allocation or tenant sub billing as described in the previous section on Effective Energy Accounting. However, energy efficiency improvements and energy cost reduction are still important operational considerations. These can be tackled using the following:

- Energy Monitoring and Performance: Understand energy costs by load type and help identify energy conservation opportunities
- Energy Modeling and Verification of Energy Programs: Understand energy drivers such as weather and occupancy and verify the effectiveness of energy conservation programs

Many airports are compliant with energy efficiency standards such as LEED, Green Mark, NABERS, BREEAM, ISO 50001. This can be to improve their green image or due to regional code compliance requirements. These energy efficiency considerations are discussed in more detail below.

Sustainability, *Cont.*

Energy Monitoring and Performance

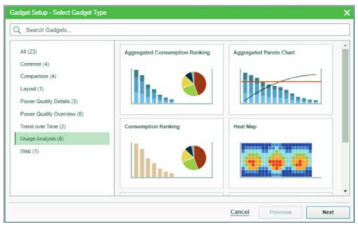
Application Context

Energy monitoring leverages energy consumption data to understand and raise organization awareness of how much energy is consumed and where within a facility. It helps analyze usage patterns and understand which factors contribute most to energy usage and thereby lend themselves for the quickest return on investment for energy conservation measures. This takes what is achieved in the “Cost Allocation Report” and looks at energy consumption in more detail by raising awareness of where, when and how energy is used. It helps prioritize opportunities for energy conservation.

Architectural Description

This is also accomplished by turning data into information and representing energy usage and consumption within easy to interpret graphical dashboards and reports to raise awareness to key stakeholders. It helps identify “quick-win” opportunities for energy savings by:

- Comparing and visualizing hourly, daily, weekly, monthly, and yearly energy usage, and associated cost for different utilities
- Identifying and prioritizing which load types, equipment, processes, areas or buildings lend themselves for the better return on investment for energy conservation initiatives
- Understanding how peak demand affects energy costs (see previous section on Utility Bill Verification page 30)



Configurable Dashboard Gadget Library for Analyzing Energy Usage

Finally, once the basics are taken care of, the next step in the energy management journey is to continuously optimize energy usage efficiency. Understanding the true energy efficiency is best achieved by normalizing energy usage within the context of process throughput, building area, shifts, working hours or other contextual data to further identify areas to optimize through operational or behavioral changes. The table below provides a quick summary of these products:

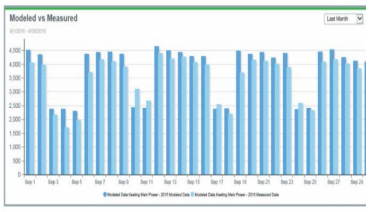
Device Type	Device Name	Functional Description
Metering devices	PowerLogic ION9000, PM8000, PM5000, EM3500 Branch Circuit Power Meters PowerLogic P3 or P5 MasterPacT MTZ ComPacT NSX trip units Galaxy UPSs	Capture kWh, kW, kVA, kVAR, and other WAGES parameters to allocate costs to departments, buildings, floors and processes

For details, refer to the Energy Monitoring and Energy Performance sections in the EcoStruxure™ Power Digital Applications Design Guide.

Modeling and Verification of Energy Programs

Application Context

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



Modeled Values vs Measured Values Gadget

Architectural Description

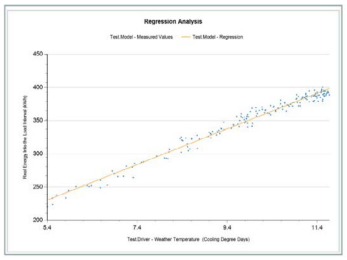
This is achieved by defining modeled data of energy consumption related to energy drivers, which provides a feedback loop between energy managers and operations. Energy performance of the facility, building

Sustainability, *Cont.*

or process against a modeled baseline considers all relevant energy drivers such as outside temperature, occupancy or productivity.

Energy Modeling can also be used to track the improved performance, verify and report savings by determining the difference between pre-retrofit and post-retrofit energy consumption. The data for the Energy Modeling and Verification applications can be recorded using metering devices, the table below provides a quick summary of these products:

For details, refer to the Modeling and Verification of Energy Programs section in the EcoStruxure™ Power Digital Applications Design Guide.



Energy Regression
(Create Model Report)

Device Type	Device Name	Functional Description
Metering devices	PowerLogic ION9000, PM8000, PM5000, EM3500 Branch Circuit Power Meters PowerLogic P3 or P5 MasterPacT MTZ ComPacT NSX trip units Galaxy UPSs	Capture kWh, kW, kVA, kVAR, and other WAGES parameters to allocate costs to departments, buildings, floors and processes

Energy Benchmarking

Application Context

Benchmarking is the practice of comparing the measured performance of a device, process, facility, or organization to itself, its peers, or established norms, with the goal of informing and motivating performance improvement. When applied to building energy use, benchmarking serves as a mechanism to measure energy performance of a single building over time, relative to other similar buildings, or to modeled simulations of a reference building built to a specific standard (such as an energy code). In the case of airports, benchmarking can be used between terminals or airports in similar climate zones.

Architectural Description

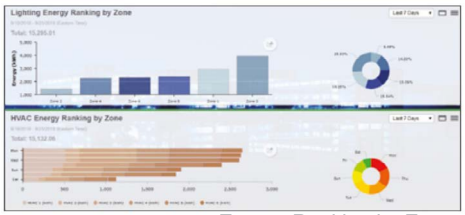
Energy Benchmarking is best achieved using the following reports and dashboards in EcoStruxure™ Power Operation with Advanced Reporting and Dashboards:

- Energy Comparison and Ranking dashboards
- Building Energy Rating gadget

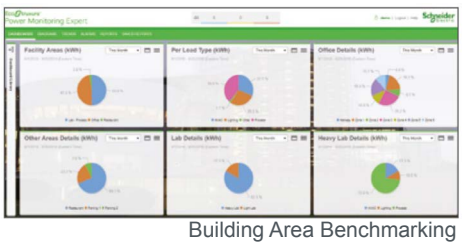
Reports

- Consumption Ranking Report
- Energy Comparison Report
- Calendar Trend Reports for Benchmarking Energy usage by load type and day of the week

Alternatively, more advanced Energy Benchmarking is provided by EcoStruxure™ Resource Advisor.



Energy Ranking by Zone



Building Area Benchmarking

For details, refer to the Energy Benchmarking section in the EcoStruxure™ Power Digital Applications Design Guide.

Sustainability, *Cont.*

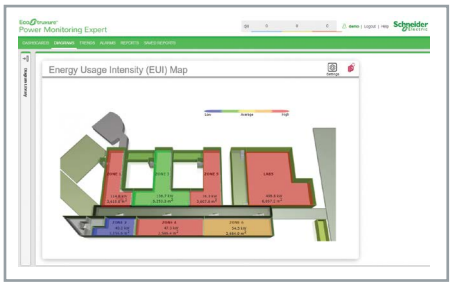
Energy Efficiency Compliance

Application Context

Building codes, and green building certifications are increasingly driving the ways in which airports are designed for energy efficiency and sustainability. More specifically, airport electrical systems are increasingly required, as is outlined in standards such as LEED, Green Mark, NABERS, BREEAM, ISO 50001 and IEC 60364-8-1 to provide sub-metering and monitoring systems to measure and alert facility staff of energy over-consumption and demand. The typical minimum parameters required include Energy (kWh), Power, Demand (kVA, kW) and Power Factor. It is often recommended in codes and standards to log these parameters on a certain interval, commonly 15 minutes to 1 hour with historical data by time (hour, day, month, year) for a minimum duration of time, such as 36 months as outlined in LEED.

Architectural Description

Many standard or certification requirements recommend that data quality of the energy data be verified. With EcoStruxure™ Power Advisor Digital Service, a qualified service engineer analyzes and provides reports and recommendations to support facility managers to ensure proper data quality. Additionally, Power Advisor provides analytics and recommendations on how to improve the electrical health using the same energy and power data acquired by the system.



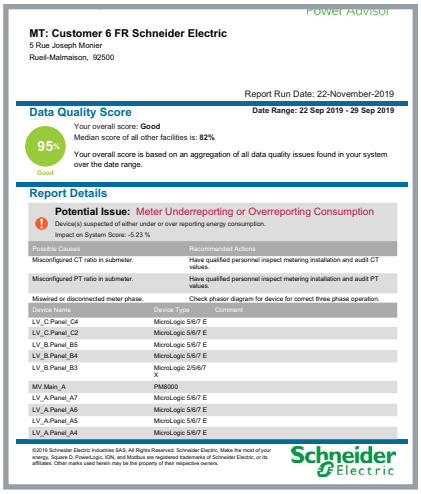
EcoStruxure™ Power Operation with Advanced Reporting and Dashboards Energy Usage Intensity Diagram

Device Type	Device Name	Functional Description
Metering devices	PowerLogic ION9000, PM8000, PM5000, EM3500 Branch Circuit Power Meters PowerLogic P3 or P5 MasterPacT MTZ ComPacT NSX MCCB with MicroLogiC Trip Units Galaxy UPSs	Capture kWh, kW, kVA, kVAR, and other WAGES parameters to allocate costs to departments, buildings, floors and processes

System power monitoring software such as EcoStruxure™ Power Operation with Advanced Reports and Dashboards enable historical data logging, storage as well as a wealth of features such as the following to visualize, analyze and report on energy usage in line with recommendations made by codes and standards.

Visualizes Real-Time Energy and Standards

- Live data display – Real time energy and power data can be visualized in context of equipment, floor, department or building
- Events and alarms – Smart alarms and notifications can be configured to alert energy or facility managers of energy over consumption and peak demand thresholds
- Real-time and historical data trends – Measured or ratios of measured values can be trended over time using historical and or real-time data
- Dashboards and reports – Historical measured data can be visualized in consumption or cost comparison, heatmap, Sankey diagram, and other configurable dashboard gadgets. Energy Cost, load profile, calendar energy use, key performance indicators (for example, kWh/m^2) and other energy usage reports can be configured and generated manually or automatically via e-mail



EcoStruxure™ Power Advisor Data Quality Analytics

For details, refer to the Energy Efficiency Compliance section in the EcoStruxure™ Power Digital Applications Design Guide.

Sustainability, *Cont.*

Energy Procurement Optimization

Application Context

Electrical energy is one of the main operating expenses airports are having to deal with. As discussed in the previous sections, this cost can be controlled by making the airport more efficient and thereby using less energy. Alternatively, energy costs can also be controlled by buying energy smarter, at a better price.

EcoStruxure™ Energy and Sustainability Services help airports purchase energy more cost effectively using:

- Rate / tariff optimization
- Commodity Risk reports to guard against volatility
- Market Intelligence reports from energy and sustainability experts
- Participation, setup and performance management of emissions trading program

Resource Advisor

In conjunction with EcoStruxure™ Resource Advisor, energy efficiency goals and improvements can be tracked and visualized, and forecasting and what-if scenarios can be used to anticipate and plan.

EcoStruxure™ Energy and Sustainability Services include energy expertise to:

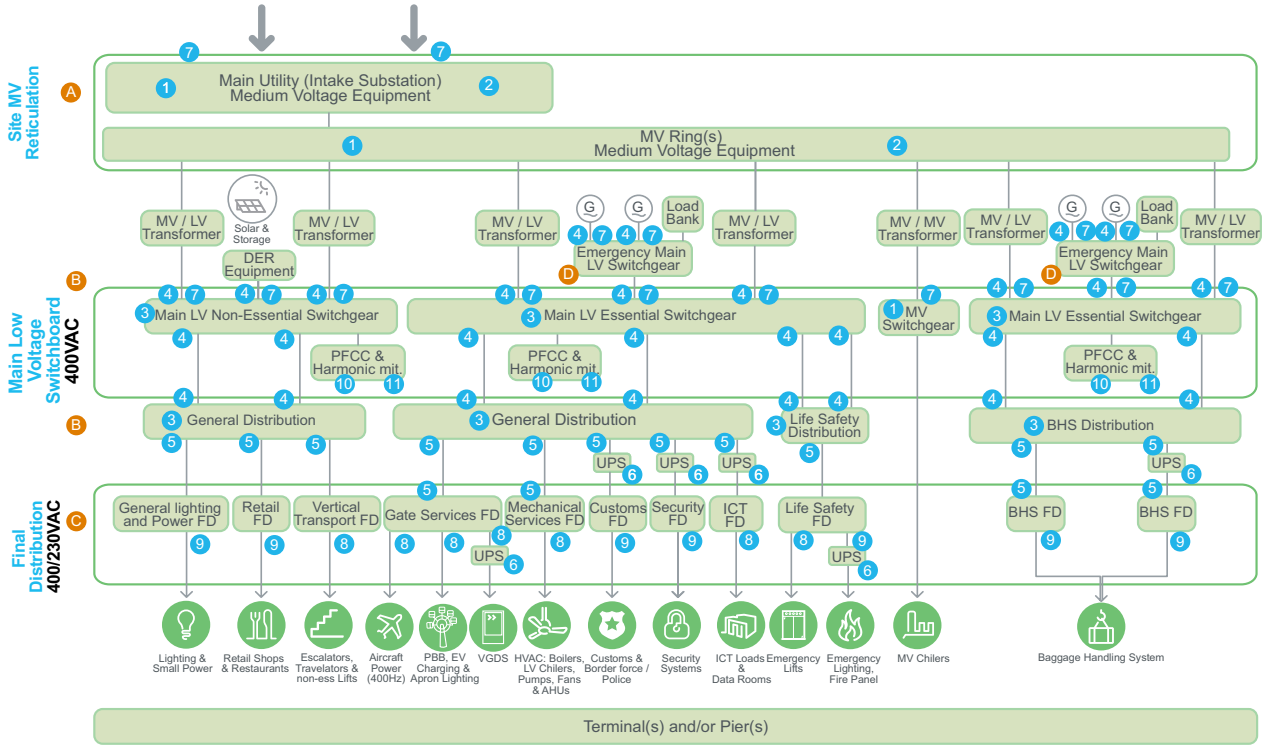
- Interpret results, provide guidance and recommend clear client actions
- Design and execute energy conservation measures in one or many locations

Architectural Description

Energy data can be manually loaded into EcoStruxure™ Resource Advisor from utility bills or automatically uploaded from digital metering. This is supported by data quality management, which ensures the accuracy of data. Digital interval data can be uploaded from EcoStruxure™ Power Operation with Advanced Reporting and Dashboards, or directly from metering devices using the EcoStruxure™ Universal Panel Server.

Microgrid

Digital Applications for Sustainability are data-driven solutions that help reduce energy costs in airports. Microgrids and distributed energy resources are starting to be investigated more and more by airports, mainly to improve sustainability and reduce energy costs, but also to improve resilience. Managing multiple sources of energy production can be complex, especially when it comes to making optimal decisions to produce locally generated energy compared to consuming grid energy.



Typical Equipment

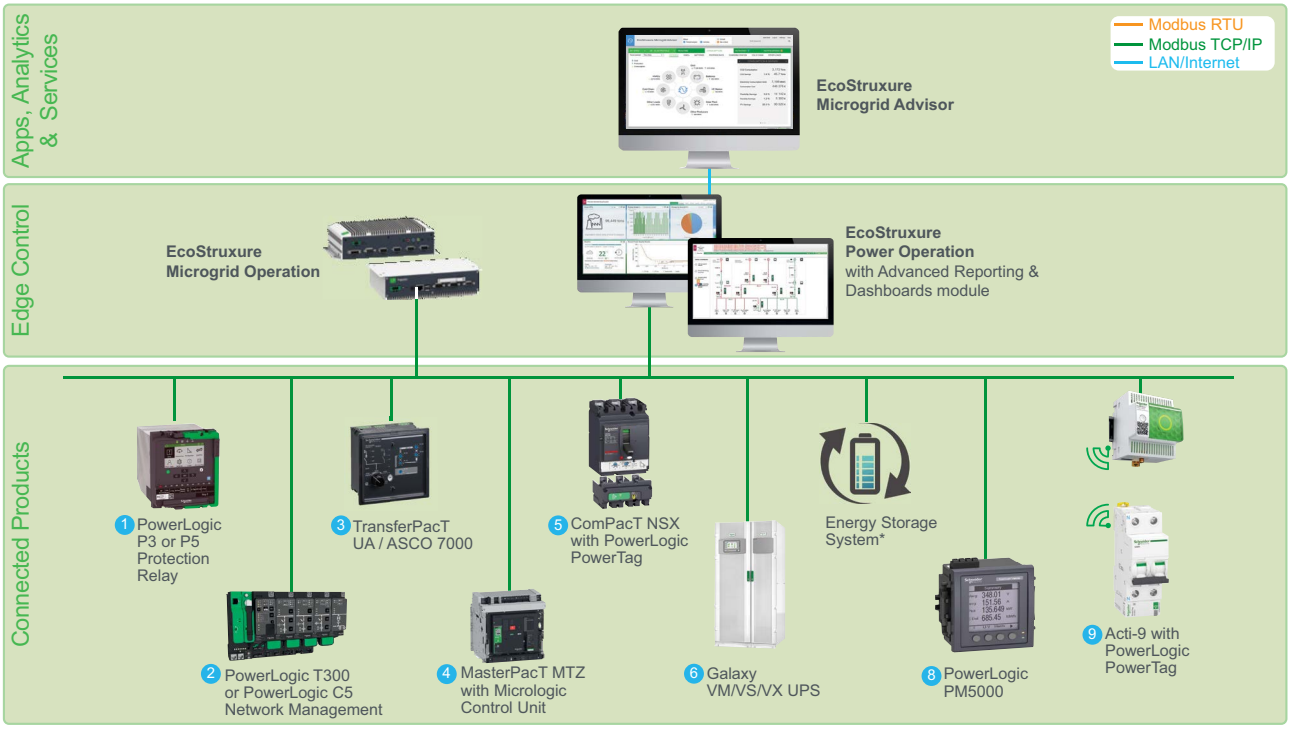
- A MCSeT
- B Okken PCC / BlokSeT
- C PrismaSeT
- D ASCO 7000 Power Control System

Recommended Connected Products

1. PowerLogic P5 or P3
2. PowerLogic C5 or T300
3. TransferPacT UA / ASCO 7000 Automatic Transfer Switch
4. MasterPacT MTZ with MicroLogic
5. ComPacT NSX
6. Galaxy VM/VS/VX UPS
7. PowerLogic ION9000 or PM8000
8. PowerLogic PM5000
9. PowerLogic PowerTag
10. VarSeT with VarPlus Logic Controller
11. PowerLogic AccuSine PCS+
12. PowerLogic TH110/CL110
13. PowerLogic HeatTag
14. Arc V121 / PowerLogic A125
15. ASCO Load Bank

Microgrid, *Cont.*

Microgrid Digital Architecture



*Third party system

Application Context

As one of the most energy-intensive building types, airports face growing demands to increase power resilience and minimize energy costs, all while meeting sustainability goals. Microgrid solutions can enhance power system reliability, despite grid instability often resulting from powerful storms and grid constraints that affect power availability. These solutions also enable optimal energy usage and cost efficiency, which leverages Distributed Energy Resources (DERs) to reduce, reuse, and optimize energy consumption. DERs can include Combined Heat and Power (CHP) or Combined Cooling, Heating and Power (CCHP), solar, wind and hydrogen fuel cells.

Architectural Description

An Edge Controller specific for microgrid applications interacts with the connected products, allowing the EcoStruxure™ Microgrid Operation controller to perform control and management functions that optimize energy usage and production modes. The table below provides a quick summary of these products:

Device Type	Device Name	Functional Description
Connected Products		
LV circuit breakers, MV protection relays, metering devices, battery storage and inverters, switches, controllers	MasterPacT MTZ, ComPacT NSX, PowerLogic P3 / P5, ION9000, PM8000(1)	Supply field data, such as status, control and energy monitoring to the microgrid system
Microgrid controller	EcoStruxure™ Microgrid Operation software	Performs control and management functions that optimize energy usage and production modes

1 This is not a comprehensive list. Other devices may be used for Microgrid applications.

Microgrid, *Cont.*

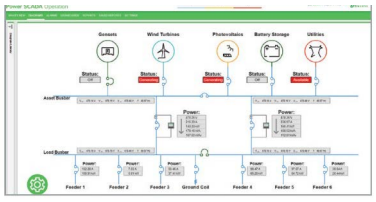
The Microgrid application helps airport operators and maintenance staff increase power system resilience through visualization with on-premise Edge Control Software. EcoStruxure™ Power Operation software:

- Allows drill-downs into real-time electrical events through single-line diagrams to gain situational awareness of the power system from anywhere
- Visualizes microgrid power system historical data and forecasts contextual energy consumption and production data
- Enables operators to perform remote control with proper credentials
- Enables comprehensive reporting on the microgrid's electrical network
- Provides operators with automatic or scheduled, user defined alarm notifications of single or multiple events via email or SMS

EcoStruxure™
Microgrid Advisor

The EcoStruxure™ Microgrid Advisor service subscription (optional) is a cloud-connected application that helps optimize the energy production, storage, and consumption of on-premise DERs. EcoStruxure™ Microgrid Advisor software:

- Performs forecasting and optimization functions based on electricity tariff rates, site constraints, weather forecast information, and demand response requests
- Displays potential savings and earnings



EcoStruxure™ Power Operation
Equipment Diagram

For details, refer to the Microgrid section in the EcoStruxure™ Power Digital Applications Design Guide.

Electrification (EV charging)

Electrification is the process of updating equipment to be powered off electricity rather than another power source such as carbon-based fuels. For airports looking to reduce their greenhouse gas emissions, electrification can provide a mechanism for eliminating the use of fossil fuels by replacing them with electricity from green energy sources. A popular trend in airports at present is to support the use of electric vehicles in and around the airport. These vehicles can fall in to one of 4 categories:

1. Passenger Cars - Passenger vehicles are used by people traveling to and from the airport. They are also made available to customers by hire car companies.
2. Buses - Airports act as intermodal hubs where bus stations are located to transfer passengers to and from the airport and their final destination. Many airports also utilize buses to transfer passengers between airport terminal buildings. Bus operators who deploy electrical vehicles may make use of EV charging infrastructure setup at airport bus stations or depots.
3. Ground Support Equipment (GSE) - As the name suggests, ground support equipment is there to support the operations of aircraft whilst they are on the ground. They include specialize airside vehicles like pushback tractors, baggage tugs, portable stairs and container loaders. Buses that take passengers to and from parked aircraft can also be consider GSE. These are often specialized vehicles called Apron Buses. Passenger Vehicles used airside may also be considered GSE.
4. Freight and supply vehicles – A number of logistics companies use vehicles such as vans, trucks and even passenger cars to move freight to and from their processing facilities at the airport. Likewise, a number of airport supply companies run their own fleet of vehicles to and from the airport. Both these types of companies have the option to deploy electric vehicles in their fleet.

By providing EV charging infrastructure the airport can not only support the electrification of their own vehicles, but also those of the airport's suppliers, contractors and customers.

Passenger Vehicles

The number of EV passenger vehicles has been steadily building in many countries around the world. This trend is expected to increase exponentially over the next couple of decades. Along with rising EV vehicle ownership comes the public expectations that infrastructure will be installed to support the convenient use of these vehicles in society. This applies to airports where both customers and staff will park their cars for extended periods of time. EV charging infrastructure will need to be installed in the airport carpark, at hire car company depots and at business premises located in the airport precinct.

With larger and large quantities of high power EV chargers, powering these new installations at existing airports can present some challenges.

Electrical Distribution Architecture

Airports are already large users of power with extensive local electrical distribution networks. The addition of EV charging stations on this network can have a significant impact on power demand due to the power level required by electric vehicles to charge. This may require the existing electrical distribution infrastructure to be upgraded. The extent of these upgrades will depend on the number of EV chargers being installed, the power rating of the chargers, their location around the airport and the spare capacity of the existing switchboards at these locations.

In some cases, EV chargers can be fed from existing local LV switchboards but in other instances new LV switchboard must be installed. Large installations may even require the installation of a new distribution transformer to supply the extra power required. As such, each architecture needs to be tailored to suit the unique requirements of the airport.

For greater flexibility and efficiency, a Load Management System (LMS) can be used to allow more EV charging units on a single switchboard than it can handle when all units are at maximum load. In addition, if less power is available due to other loads in the facility, the LMS can proactively limit the power available for EV charging purposes.

For airports that want to promote greener credentials, or those that have limited access to additional power from the grid, the installation of EV charging infrastructure can be combined with onsite generation and microgrid technology. See the section on "Microgrid", page 42.

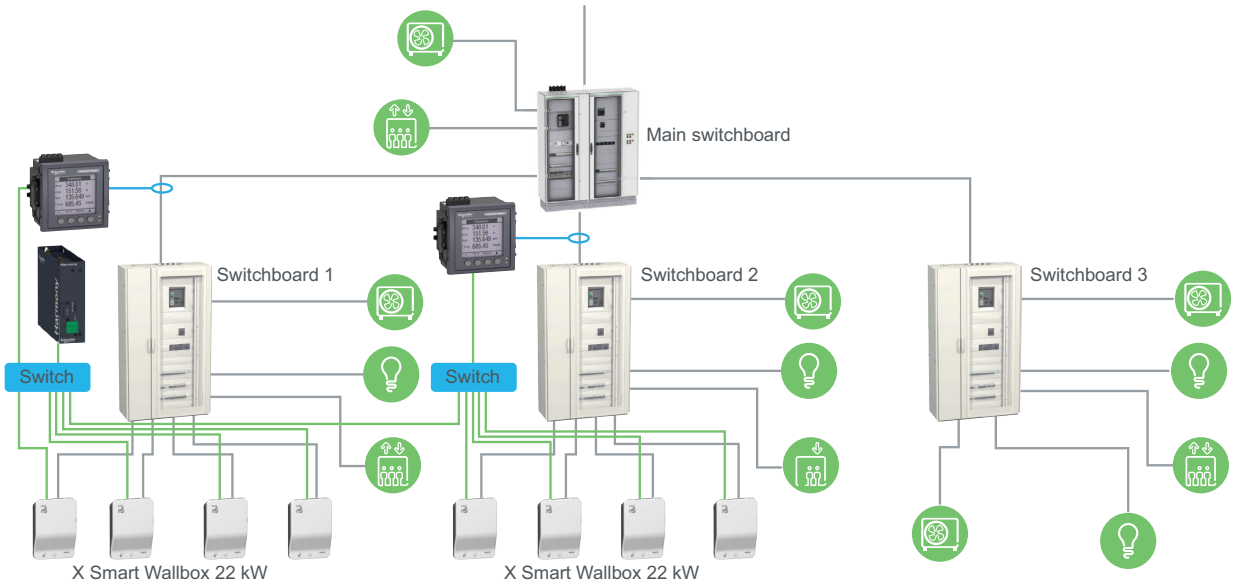
Electrification (EV Charging), *Cont.*

EV Chargers

Schneider Electric offers a range of EV charging stations under its EVlink brand. They are suitable for daily use and compatible with almost all electric vehicles on the market. EVlink Parking (outdoor) and Smart Wallbox (indoor) offer energy metering capabilities plus the connectivity you need to ensure user authentication, generate reports and perform remote maintenance. The EVlink products can connect to any Schneider Electric or 3rd party energy, control and billing system using the Open Charge Point Protocol (OCPP).

EVlink charging stations can be easily connected to the EcoStruxure™ cloud platform to generate energy management reports and allocate costs to individual users.

EVlink Load Management System (LMS) is able to distribute available power among the EV charging stations with flexible, smart rules defined by system algorithms. This is achieved by reducing the max power available from each unit or by load-shedding units on a rotational basis. This favors optimal power allocation for EV charging. The system also allows airport operators to remotely manage their charging stations in real time all while making the most of their existing available power and ensuring building power availability. Each LMS controller can manage up to 100 EV charging stations. A primary LMS controller can also be installed which can manage up to 9 EVLink LMS servers and up to 100 charging stations by itself. Using this configuration EVLink LMS can therefore manage up to a total of 1000 stations in a single system.



Example Architecture for an Indoor Multilevel Airport Carpark

Electrification (EV Charging), *Cont.*

Buses

Charging infrastructure for e-buses will vary greatly depending on the service's operational requirements as well as the status of the airport's existing electrical distribution network.

Inter-city transit buses are often run by third party transport companies with some infrastructure provided by the airport at bus stations located in the airport precinct. This may include the installation of fast charging stations to service e-buses that are in-transit, particularly those that need to travel long distances.

Buses that operate entirely within the airport precinct on the other hand only need to shuttle passengers between terminals, train stations and on-site parking facilities. They are either directly owned by the airport or contracted to the airport to provide these services. The shorter distances mean that the buses can often operate an entire shift on a single charge. This allows the buses to be charged back at a central bus depot with no need for opportunity charging locations along the route.

Due to the high-power demand requirements to charge e-buses, there must also be considerations given to how best to source that power. If the charging stations are connected to the airport's electrical distribution network it can represent a large additional load that must be catered for with additional infrastructure. It is also possible that the bus depot is located far away from the Airport's distribution network and therefore more practical to be connected directly to the utility grid. To improve the sustainability credentials of the solution, the airport may also be looking to implement a more complex energy mix of solar power, battery storage and grid connection.

It is recommended that consulting services be procured to tailor a solution that best suits the needs of a particular airport.

Ground Support Equipment

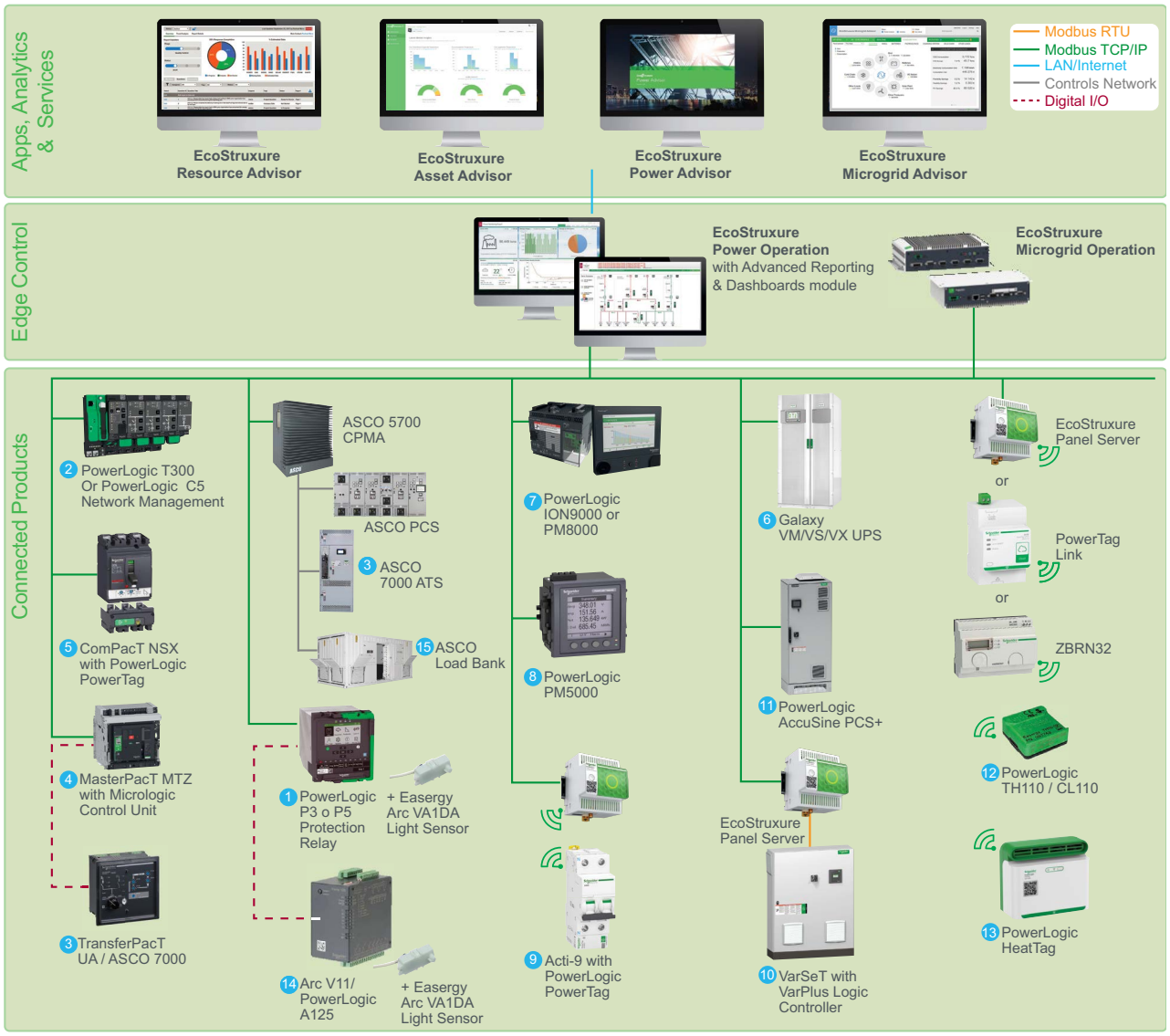
There is no one size fits all solution for GSE EV Charging infrastructure as there are many requirements that need to be taken into consideration including:

- The airports operational needs
- The airport layout
- Status of existing electrical distribution network
- GSE ownership model
- Current GSE available to be electrified and status of local suppliers
- The charging voltage and plug type required
- Local Regulations
- Government incentives, budget and ROI

It is recommended that consulting services be procured to tailor a solution that best suits the needs of a particular airport.

Design Considerations

All of the EcoStruxure™ Power Applications described before can be delivered as a complete, integrated system of application architectures. When integrating the system, there are several considerations to be accounted for in the design including communication protocols, cybersecurity, integration with other operational systems like the Building Management Systems (BMS).



Communications Protocols

Modern electrical distribution systems, like those found in highly critical infrastructure such as airports, benefit from several industrial protocols and other data exchange technologies. These protocols enable data communications between intelligent electrical devices such as circuit breaker trip units, digital protection relays, controllers and wireless sensors. The common data acquisition protocols found in an airport's digital electrical distribution architecture include:

- **IEC 61850** – Commonly used for high speed medium voltage automation. Not only does this protocol provide a data model for consistency in measurement naming, but also allows for fast device-to-device communications (GOOSE Messaging) and communication to a SCADA system
- **Modbus RTU and Modbus TCP/IP** – commonly found in low voltage electrical distribution metering, protection and controllers. Ethernet gateways can be used to convert serial Modbus to Modbus TCP/IP for data integration with a power monitoring or SCADA software
- **Wireless** – Wireless communications according to the IEC 802.15-4 standard (such as Zigbee)enables low-powered simple data communications for energy and condition monitoring sensors. Such wireless protocols can be aggregated using a data concentrator and protocol converter device to transform the data to Modbus TCP/IP for integration with a power monitoring or SCADA software
- **Bluetooth** – Used for near-by data monitoring, device configuration and secure local control (for example, the Schneider Electric MasterPacT MTZ or PowerLogic Protection relays)

EcoStruxure™ Power natively integrates with Schneider Electric devices to obtain real-time, historical event and data logs, as well as waveforms. It is common that 3rd party devices store event logs and waveform data in proprietary formats. EcoStruxure™ Power platform can acquire data from any device using the open protocols mentioned above as long as the data is available in non-vendor-proprietary formats. For more information on these topics refer to the EcoStruxure™ Power Digital Applications Design Guide.

Design Considerations, *Cont.*

Cybersecurity

It's no surprise that cybersecurity is becoming an increasing concern for airport infrastructure as digital technology becomes pervasive in airport facilities.

Using operational technology cybersecurity standards can help to reduce the additional risk. One widely adopted standard, IEC 62443, defines several foundational principles that should be considered during the design of electrical distribution systems in airports:

1. **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.
2. **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.
3. **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.
4. **Data Confidentiality:** Protection of component-generated confidential or sensitive nature information, whether at rest or in transit. Data regarding energy profiles and usage could provide information into confidential airport operations.
5. **Restrict Data Flow:** Ensure the connection of the device to a segmented network where disconnection strategy, unidirectional gateway, firewall, and demilitarize 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).
6. **Timely Response to Events:** 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.
7. **Resource Availability:** Ensure the availability of the application or device against the degradation or denial of essential services.

Guided by the IEC 62443 standard, there are a few important recommendations that system designers and airport operators should follow to ensure that their connected electrical distribution systems including network, control, and safety system solutions are as secure as possible.

1. **Consultation:** Find an electrical power distribution specialist with a deep understanding of cybersecurity requirements to help you with a risk assessment and to define the levels of security you require, compliant with IEC 62443.
2. **Solution provider:** Choose an electrical system technology provider that has adopted the IEC 62443 standard and has a secure development lifecycle process in place that:
   - Assures resilient design practices
   - Provides for a formal customer response in the event of discovered vulnerabilities
   - Fully tests and validates the security of all components and systems
   - Demonstrates third-party cybersecurity certification
   - Can deliver customized and flexible solutions that align with your business requirements
3. **Service providers:** Choose partners with the required capabilities:
   - System integrator with deep IT and OT experience including cyber-security within the context of critical operational systems
   - Cybersecurity services that can deliver quick response to help assess and recover from a cyberattack

Design Considerations, *Cont.*

Time Synchronization Architecture Recommendations

Why consider time synchronization of connected devices?

Connected Devices (for example, relays, trip units, and power meters) are key for capturing power system related events and using those events to trouble shoot or perform sequence of event analyses. For these reasons, it is important to consider time synchronization of these devices during the system design.

What are the best performance and cost-effective time sync protocols?

Many options are available for time synchronization protocols (PTP, IRIG-B, NTP, SNTP, Modbus). Unfortunately, this makes it difficult to develop a cohesive strategy for all Connected Devices. The best cost versus performance option available today is PTP. This protocol, however, is not available on all devices. IRIG-B provides similar performance, but at a much higher installation cost. NTP is the next best alternative, but for less time-critical applications, SNTP or Modbus are adequate. The table below provides a quick summary of these protocols, along with selection criteria (cost and time accuracy):

Application Time Criticality	Typical Time Accuracy	Protocol Media	Protocol	Typical Cost
High	+/-1 ms	Ethernet	PTP (IEEE1588)	$$
High	+/-1 ms	Serial	IRIG-B	$$$
Medium	+/-10 ms to 100 ms(1)	Ethernet	NTP	$
Medium	+/-100 ms	Serial	DCF77	$$
Low	+/-1 s	Ethernet	SNTP	$
Low	+/-1 s	Ethernet	Over Modbus / ION from Edge Control	$
Low	+/-1 s	Serial	1per10	$$

For a detailed coverage of time synchronization, refer to the Design Guide, Part 1 and the technical guide "How to Optimize Time-Synchronization and Data Recording for EcoStruxure™ Power Digital Applications."

Integration with Building Management System (BMS) and Digital Services

Why integrate mechanical and electrical systems?

Facility infrastructure is experiencing a convergence of information and operational (IoT) systems. This is especially true in airports where mechanical and electrical systems are essential infrastructure. These systems are growing quickly within the industry, generating data with new sensors, meters, and other smart equipment. Therefore, they need to be designed up front with data in mind, thus ensuring proper data aggregation through operational software systems used for visualizing, alerting, and reporting.

Traditionally, electrical and mechanical systems are designed in silos, where electrical data (energy and power data, circuit breaker status) is integrated into the mechanical control systems. This is often value-engineered, which leaves the end user with little to no electrical data in operational systems. It can be more costly to retrofit this in existing systems, so it is essential to design the proper IoT electrical systems far in advance.

Intelligent electrical devices commonly support Ethernet IP connectivity, either natively or through a gateway. Energy and power monitoring software systems are designed to support the specific data types that engineering and maintenance staff need for proper electrical system management. Enabling the digital mechanical and electrical systems to integrate directly to the relevant data allows the systems to perform as designed. It also yields savings by cutting the cost and complexity of excessive wiring of electrical devices to the mechanical controls systems. With data available to monitor and control systems properly over the Ethernet IP network, system integrators can conjoin the data at the software layer, thereby enabling a seamless interface to manage facility operations and maintenance.

Design Considerations, *Cont.*

What are the benefits of integrated mechanical and electrical systems for airport operations and maintenance staff?

Benefits of integrated systems include a single interface for airport mechanical and electrical operations and maintenance staff to utilize for visualizing, analyzing, and reporting data. This allows applications that require context from both systems to enable the proper decision-making processes. Examples of benefits include:

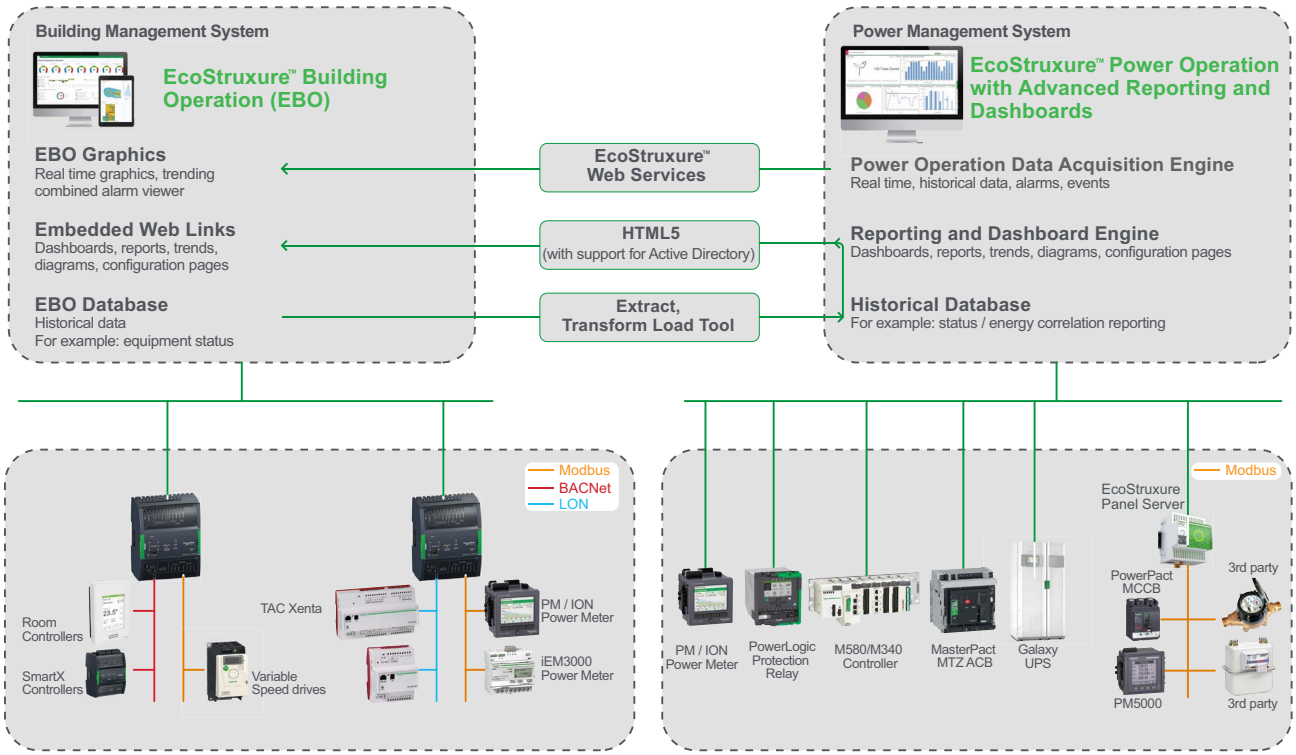
- Energy monitoring performance, and modeling of facility energy
- Integrated asset tracking and performance management (mechanical and electrical) asset performance information in a single view
- Fault detection and response in an integrated interface

How is data acquired and integrated within the architecture?

Data acquisition: The digital electrical monitoring and control software is designed to acquire the specific data types that the intelligent electrical devices make available over open communication protocols. These data types include real-time, historical power event and data logs, electrical signal waveforms, and service diagnostics. Connecting to a mechanical control system, however, does not acquire event and data logs, waveforms, or some diagnostics data by-default, which can lead to excess engineering in the project phase.

Data Integration:

- EcoStruxure™ Web Services for real-time data, alarms, and historical data integration with EcoStruxure™ Building Operation (EBO)
- Web interface integration of power and energy dashboards, graphical diagrams, trends, reports, and configuration pages (Single Sign On)
- Historical building management data for energy data correlation using an Extract Transform Load function



Connected Products

Protection Monitoring, and Control Devices

PowerLogic P3

Compact Protection Relays for Standard MV Applications

Easy-to-use protective relays for Medium Voltage applications with fast delivery, ideal for panel builders, contractors and partners to save time. From overcurrent to advanced protection, with arc detection and Ethernet communication including IEC 61850.

PowerLogic P5

Compact Protection Relays for Standard MV Applications

Easy-to-use PowerLogic P5 protective relays for Medium Voltage applications with fast delivery are ideal for panel builders, contractors, and partners who want to save time. These relays provide overcurrent to advanced protection, as well as arc detection and Ethernet communication, including IEC 61850.

PowerLogic T300

Distribution Network Management for MV and LV Applications

The PowerLogic T300 is a modular platform of hardware and firmware. As an application building block for medium voltage and low voltage distribution network management, it offers a single solution for control and monitoring, from a simple pole-top device to a large MV/LV substation. It's a powerful Remote Terminal Unit for feeder automation with remote control and monitoring for energy distribution automation.

MasterPacT™ MTZ

High Current Air Circuit Breakers up to 6300 A Embedding Advanced Digital Technologies for LV Applications

Future-ready MasterPacT MTZ is a comprehensive range of air circuit breakers designed to help protect electrical systems from damage caused by overloads, short circuits, and equipment ground faults. MasterPacT MTZ embeds advanced digital technologies, and MicroLogic™ X control units help contribute to safety and energy efficiency.

ComPacT NSX

Molded Case Circuit Breakers up to 630 A for LV Applications

ComPacT NSX is a full range of high-performance molded case circuit breakers in 2 frame sizes designed to meet your needs from thermal-magnetic to advanced MicroLogic trip units. MicroLogic allows for wired communication, whereas PowerTag NSX is designed for wireless communication.

Acti9 iC60

Miniature Circuit Breakers for Final LV Applications

Acti9 iC60 is a range of DIN rail miniature circuit breakers that provide circuit protection and continuity of service up to 63 A. It is especially ideal for polluted environments and networks.

Connected Products, *Cont.*

Protection, Monitoring, and Control Devices, Cont.

Acti9 Active
All-in-one Final Distribution Device
Acti9 Active devices come with integrated earth leakage protection, miniature circuit breaker, Arc Fault detection device, and over-voltage protection. It helps protect people, appliances and circuits against fire risks - enabled by a compact all-in-one device. Through advanced notifications, diagnostics, analytics, it gives business owners and maintenance personnel greater control over their building's electrical health and, in-turn, enhances service continuity.

ASCO 7000 Series Power Transfer Switch
Reliable Power Transfer Switch and Controls for LV and MV Applications
ASCO 7000 Series Power Transfer Switches are the industry standard for reliable power switching and controls. They are offered in single transfer switch or redundant bypass configurations. Automatic controls are available in open, delayed, closed and soft load transfer transition modes.

ASCO 7000 Series Power Control System
Advanced Power Control Automation Systems for LV and MV Applications
ASCO 7000 Series Power Control Systems are the industry's most advanced power control automation systems for facility power sources, load, and electrical distribution. They provide configured and engineered-to-order autonomous control sequences for maximum value and flexibility.

ASCO Load Banks
Intelligent Load Banks for LV and MV Engine-generator and UPS testing applications
ASCO Load Banks are designed for outdoor operation and can intelligently generate resistive, capacitive, and inductive loads for power testing applications. They incorporate intelligent Sigma control and dynamically adjust loads and help protect power sources. ASCO Load Banks are available in genset radiator, permanently, and trailer-mounted configurations.

ASCO 5702 Power Management Gateway and
ASCO 5706 Critical Power Management Appliance (CPMA)
ASCO Power Management Gateways centralize power testing, monitoring, and reporting, while delivering aggregated power information to facility monitoring systems via standard open protocols.

TransferPacT™
Automatic Transfer Switch
TransferPacT Active Automatic is a range of transfer switch for source changeover. It can transfer the power from one source to another source for power continuity. This offer is driven by solenoid with fast transfer speed(<500 ms) which is suitable for application in aiports. The product has a modular controller, the interactive functions can be extended any where depending on customer’s requirements


Arc V121 / PowerLogic A125


Easergy Arc VA1DA Light Sensor

PowerLogic Arc
Arc Flash Protection System
PowerLogic Arc is a range of ultra-fast and flexible arc flash protection products which help eliminate or minimize costs resulting from arc flash damage - downtime, repair time, interruption of processes and equipment. PowerLogic Arc helps avoid personal injury due to arc flash events.

Connected Products, *Cont.*

Power Meters

PowerLogic™ ION9000 Series

Power Quality Meters for Utility Incomers or Highly Critical Applications

Innovative and advanced, PowerLogic ION9000 Series meters are designed to provide the highest accuracy in energy cost calculations, network management, and power quality requirements.

PowerLogic PM8000 Series

Power Quality Meters for Critical Applications

PowerLogic PM8000 Series meters are high-performance power meters for cost and network management applications on feeders and critical loads. They are compact, simplify power quality, and maximize versatility.

PowerLogic PM5000 Series

Power Meters with Basic Power Quality Functionality

High-end, cost management capabilities are found in the affordable PowerLogic PM5000 Series power meters. They are compact, versatile power meters used for energy costs and basic network management applications.

PowerLogic PowerTag

Wireless Energy Sensors

PowerTag is a range of wireless energy sensors that provide precise, realtime data on energy, currents, power, voltage, and power factor. These sensors accurately monitor energy consumption and wirelessly communicate this data in real time via a gateway.

Connected Products, *Cont.*

PLC and PAC

Substation Monitoring Device (SMD)
Local and/or Remote Monitoring for MV Applications
The Substation Monitoring Device performs analytics on temperature and environmental data for monitoring and alarming via a local HMI or SCADA system. The Condition Monitoring Device consists of an M251 PLC and optional Magelis™ HMI. It is configured in the factory and automatically integrates with Edge Control software. The SMD can also send SMS messages in case of alarms. The optional color display provides SLD representation with overlaid temperature values.

Modicon™ M580
Ethernet Programmable Automation Controller (ePAC)
This high-end ePAC features redundant controllers, new stand-alone safety controllers (safety PLC) with native Ethernet, and cybersecurity embedded in its core.

Modicon M340
Programmable Automation Controller (PAC)
The Modicon PAC is built to suit the needs of the process industry and a wide range of demanding automation applications, such as a multitasking system for optimum reflex time.

Power Quality Mitigation, Power Factor Correction, and UPS Devices

PowerLogic AccuSine PCS+
Active Harmonic Filter
The PowerLogic AccuSine PCS+ is a flexible, high performance, cost-effective solution for stabilizing electrical networks by providing harmonic mitigation, power factor correction, and load balancing.

VarSet™ LV with PowerLogic VarPlus Logic
LV Capacitor Bank
VarSet LV is a complete range of high quality power factor correction solutions and is engineered to compensate reactive power and harmonic distortion. These are easy and flexible solutions that can immediately boost a facility's energy efficiency and productivity. Thanks to VarSet, your power factor is maintained at an ideal level for optimal power system efficiency and cost reduction.

Galaxy™ VM
UPS for Midsize Facilities
This 3-phase UPS power protection seamlessly integrates into medium data centers and industrial or facilities applications.

Galaxy VX
UPS for Large Facilities
This scalable, high-performance extension of the Galaxy V-Series solution is designed for large data center and industrial applications.

Galaxy VS
3-phase Uninterruptible Power Supply (UPS)
Galaxy VS is a highly efficient 3-phase UPS from 20 to 100 kVa (400 V/480 V) and 10 to 50 kVA (208 V) for edge, small, and medium data centres and other business-critical applications.

Connected Products, *Cont.*

Communication Devices and Gateways

EcoStruxure™ Panel Server

Wireless and Modbus serial to Modbus TCP Gateway

EcoStruxure™ Panel Server is the next generation of gateway, providing a seamless connection of wired or unwired smart IoT devices to your edge control software or advisor.

- The Universal Panel Server is an all-in-one gateway to retrieve data from both your wireless devices and Modbus devices.
- The Entry Panel Server is an optimized gateway to retrieve data from your wireless devices.

Enerlin'X IFE, EIFE and IFM

Communications Interfaces for MasterPacT and PowerPacT Circuit Breakers

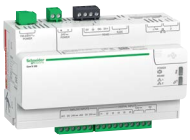
IFE: This is an Ethernet interface for MasterPacT and PowerPacT circuit breakers.
EIFE: This is an Ethernet interface for drawout MasterPacT MTZ air circuit breakers.
IFM: This is a Modbus Serial interface for MasterPacT and PowerPacT circuit breakers.

Harmony™ Sologate ZBRN32

Data Concentrator for Wireless Sensors and Serial Modbus Gateway

Each Zigbee concentrator has 60 inputs, numbered from I0 to I59. A sensor is paired with one input of the Zigbee concentrator, meaning the sensor's ID is associated with the concentrator input. All information concerning the sensor can be read in the Modbus table using the input index.

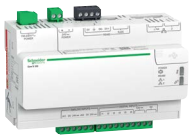
Data Loggers


Enerlin'X Com'X 200/210

Enerlin'X Com'X 200/210

Energy Servers and Data Loggers

Data collector: This unit collects and stores energy data from up to 64 field devices, connected to either Ethernet or Modbus serial networks. It also has embedded digital and analog inputs.
Data publisher: Batches of collected data are transmitted periodically to an Internet server as XML or CSV files.
Gateway: The gateway makes all data from connected devices available in real-time in Modbus TCP/IP format over Ethernet or Wi-Fi.


Enerlin'X Com'X 510

Enerlin'X Com'X 510

Energy Servers and Data Loggers

Data collector: This unit collects and stores energy data from up to 64 field devices, connected to either Ethernet or Modbus serial networks. It also has embedded digital and analog inputs.

Embedded Energy Management Software: The Com'X provides immediate visibility into energy consumption throughout the site. As soon as the Com'X is connected to the Local Area Network (LAN), several web pages are accessible via any standard web browser. These web pages display real-time data as it is collected in easy to understand tabular and summary formats. In addition, users can get simple analysis of historical data in bar graph or trending formats.

Data publisher: Batches of collected data are transmitted periodically to an Internet server as XML or CSV files.
Gateway: The gateway makes all data from connected devices available in real-time in Modbus TCP/IP format over Ethernet or Wi-Fi.

Cyber Sciences CyTime SER 2408/3200

Sequence of Event Recorder for high time accuracy applications:

- Record status changes of 32 channels, timestamped to 1 ms.
- Achieves Time synchronization via PTP (IEEE 1588), IRIG-B, DCF77, NTP, Modbus TCP or an RS-485 signal from another SER.
- Has one CyTime SER that serves as PTP master. All other CyTime SER devices sync automatically within 100 microseconds—without special Ethernet switches.

Connected Products, *Cont.*

Sensors

PowerLogic TH110

Wireless Thermal Sensor for Critical Connections

The PowerLogic TH110 is a battery-free, wireless temperature sensor that performs the continuous thermal monitoring of all the critical connections made in the field, like:

- MV cable connections.
- MV busbar connections.
- Withdrawable circuit breaker connections.
- MV transformer input, windings, taps, LV output

Linked to a cloud-connected service, the solution can send an event notification in real time in case of overheating.

PowerLogic CL110

Wireless Thermal Sensor for Ambient Temperature

The PowerLogic CL110 is a wireless temperature and humidity sensor with a battery for continuous ambient temperature monitoring of:

- LV busway junctions and tap-offs.
- Internal to electrical switchgear.

Microgrid

Energy Control Center

Microgrid Energy Distribution

The ECC system is the “brains behind the operation”. Information is constantly moving into and out of the ECC so it can make decisions based on current electrical availability. The ECC uses advanced algorithms to assess available power sources and their condition, as well as analyze load priority and energy requirements to determine when and what DERs to engage. The ECC has the ability to make critical decisions and physically make adjustments to power sources and loads to help ensure energy reliability.

Unlike most installed PV systems, the ECC is able to operate even during a grid outage by using one of the other DERs as an anchor resource to be grid forming.

Apps, Analytics, and Services

Advisor Services

EcoStruxure™ Asset Advisor

Cloud-connected Asset Monitoring Service for Predictive and Preventive Maintenance

This 24/7 vendor-neutral solution provides peace of mind and fast issue resolution, enabled by a community-based chat with your own team or the Schneider Service Bureau. Monitor your critical equipment insights and smart alarming directly to your smartphone and proactively minimize downtime.

EcoStruxure™ Power Advisor

Cloud-connected Data Quality and Power Quality Monitoring Service

EcoStruxure™ Power Advisor raises metering diagnostics from device-based troubleshooting to full system analysis. It combines expert advice with advanced algorithms—applying it to data from your PME system—to identify gaps or issues in your power management system, as well as power quality issues within your larger electrical distribution system.

Edge Control Software

Software

EcoStruxure™ Power Monitoring Expert (PME)
Power Management Software
EcoStruxure™ PME is the window to your digitized power network. It leverages IoT connectivity and distributed intelligence.

The software maximizes power reliability, reduces energy costs, optimizes equipment performance, and facilitates standards compliance.

EcoStruxure™ Power Operation (EPO) with Advanced Reporting and Dashboards
High Performance SCADA Software System for Electrical Distribution Monitoring and Control with Historical Dashboards and Reporting Applications
Advanced Power Monitoring Expert reporting and dashboards are embedded in the EcoStruxure™ Power Operation. With its redundancy, high speed data acquisition, and alarming, it is aimed at very large sites with many devices and high availability requirements.

The software gives operators exceptional knowledge and control of their networks through an intuitive, interactive and customizable interface. With fast, consistent access to actionable information, EPO operators are more effective at protecting and optimizing their electrical distribution network, improving both its efficiency and productivity.

EcoStruxure™ Building Operation
Integrated System for Monitoring and Optimization of Building Performance
This one-stop solution combines Building Operation software and field-level control devices and hardware with engineering, installation, services, and analytics to create seamlessly connected buildings. EcoStruxure™ Building Operation integrates any building management application and provides native support for open protocols including LON, BACnet, Modbus, and web services.

EcoStruxure™ Microgrid Operation
Microgrid Controller Solution
EcoStruxure™ Microgrid Operation is a complete microgrid controller solution associated with an ergonomic HMI. It provides network balancing features and protection adaptation for stable and optimized microgrids. EcoStruxure™ Microgrid Operator synchronizes load voltage and frequency to preserve customers' microgrid power supply, enabling grid continuity and stability when disconnecting and reconnecting to the grid.

EcoStruxure™ Microgrid Advisor
Microgrid Forecasting and Optimization
EcoStruxure™ Microgrid Advisor enables you to control on-premise energy resources and loads dynamically to optimize your facility's performance. The software connects seamlessly to your distributed energy resources to automatically forecast and optimize how and when to consume, produce, and store energy. The web-based user interface makes it easy to understand your real-time savings, earnings, and CO_2 emissions data.

EcoStruxure™ Resourse Advisor
Measuring and analyzing resource consumption can help you reduce risk, avoid costs, improve efficiency, and operate more sustainably. Proactive companies are able to move from 'how do we work to collect data?' to exploring 'how can our data work for us?'. Resource data is available from across your enterprise, including electricity, water, gas, steam, waste, and more. Leverage this data by making it active, and providing the context needed for decision-making. To do this effectively, you need a data catalyst. That catalyst is Resource Advisor.

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