# Contents



# IoT-enabled Power

## How digitizing power distribution is taking building safety, reliability, and efficiency to new limits

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# Introduction

Across the globe, the way electricity is generated, distributed, and consumed is changing rapidly. Whether you design, build, operate or service office buildings, shopping centers, hospitals, data centers, or campuses, you're facing new challenges and opportunities. Four societal and structural drivers are creating a new energy paradigm, with power distribution as the backbone tying them together.

1. **More decentralized.** Energy generation is being increasingly decentralized. Solar has grown over 30 percent in 2015 and 2016, with a forecast capacity of 79 GW in 2017.[1] Looking forward, solar energy and storage will account for 50% of new capacity by 2030.[2] Surveys have found 57% of consumers are considering an upgrade to a self-sufficient *microgrid,*[3] with a 59% year-on-year increase in solar capacity within US commercial businesses in the US[4] and 155 new on-site business projects in the UK during 2015.[5]

2. **More decarbonized.** The drive toward reducing greenhouse gas (GHG) emissions is growing stronger. In the United States, buildings account for almost 40% of national $CO_2$ emissions, out-consuming both the industrial and transportation sectors.[6] Fortunately, energy consumers hold massive potential to reduce GHG emissions. Buildings represent one of the greatest areas of opportunity, with 82% of untapped energy efficiency still remaining.[7] Recognizing this, many governments have introduced policies to promote climate-friendly buildings. In fact, 'green building' certifications in the private sector have become a sought-after badge of performance. At the same time, renewable energies are becoming mainstream: cheaper and more efficient; as such, solar photovoltaic is transforming the face of buildings today.

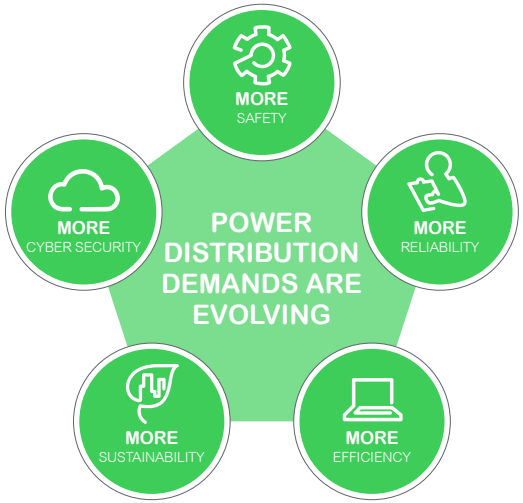
3. **More digitized.** Digitization is beginning to touch every aspect of modern society. The way we live. The way we run our businesses. The way we manage our energy. Intelligent devices are offering bright opportunities for greater efficiency, control, and value. Navigant Research notes the recent trend in owners and operators "transforming their facilities into intelligent buildings, and it's all centered around the idea of digitization."[8]


Power distribution systems are becoming more intelligent and connected to keep up with the new energy paradigm.

# Introduction (cont.)

4. **More electric.** Global electricity consumption will continue to grow at almost 2% a year[9], with demand lifted 70% by 2040.[10] New codes will be put in place to make electricity safer. Decentralization, decarbonization, and digitalization will help us manage this demand much better while creating a better world for all of us and, most importantly, for our future generations.

In the past, it was enough for low and medium voltage power distribution systems to have electrical components that work together to distribute power safely, reliably, and efficiently. But to tap into the full benefits of the new energy paradigm, we all need to take a quantum step in how power and facility performance is managed.




The goals are challenging. With more power-sensitive loads and less tolerance for downtime, smarter tools are needed to manage power reliability. Beyond simply squeezing out every watt of energy efficiency possible to optimize costs, organizations need to meet sustainability goals and comply with new standards, regulations, and codes. Equally, if using onsite energy generation and storage, it's important to know when it's most economical to use them and how to truly optimize both production and consumption. Building systems need to keep running, but operations and maintenance costs have to be minimized.

And behind it all, the electrical infrastructure needs to keep people and property safe and be secure from cyber-attacks.

In addition, consulting engineers are looking for new digital architectures that help their clients meet increasingly challenging business objectives and standards compliance. Building owners and facility managers know that having a superior electrical system infrastructure can help building assets achieve a superior return on investment. For panel builders and contractors, it's crucial that electrical components and systems are proven and simple to implement.

And, finally, while larger and mission-critical buildings will have more demanding needs for managing power reliability and safety, the often limited in-house resources of small and mid-size buildings means that simpler solutions for optimizing operational efficiencies are needed.

## A new approach to managing power

What's needed to achieve these aggressive goals is a new, holistic approach to managing electrical power. Though facility managers are well aware that building management systems (BMS) typically include automation capabilities, many may be less aware of the recent advances in power distribution system technology.

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# Introduction (cont.)

Business can now meet these challenges by embracing the latest advances in digitization. Power networks now include greater levels of embedded intelligence, enabling greater levels of understanding and control. All of the important energy assets and systems across an enterprise are connected in a highly integrated and scalable way to help facility and services teams quickly reveal and respond to risk and opportunity. And new analytic applications give you the tools to accelerate and simplify decision-making.

Together, these innovations are unifying all aspects of power and energy management into a single, secure platform, accessible anywhere, anytime, by those that need it. It helps your facility teams and service partners to streamline workflows, predict maintenance needs, and boost building performance. It also enables a range of enhanced life-cycle services that can extract even greater savings and value from a building's infrastructure and energy contracts while making your job easier.

**Read on to learn how this evolution in power distribution is smoothing the road to exceptional energy efficiency, safety, reliability, and connectivity.**

Societal and structural drivers are creating a new energy paradigm, with power distribution as the backbone tying them together.

# Gaining Deep Insight Through Digitization

'Green' building practices are a welcome and growing trend worldwide. A survey sponsored by the U.S. Green Building Council shows respondents from 70 countries reporting 60% of their projects will be green by 2018.[11]

But, while green design and construction lay strong groundwork for more efficient and sustainable buildings, maximum gains are only achievable through continuous monitoring, control, and action. The Continental Automated Buildings Association (CABA) notes, "The highest-performing buildings have engaged operators and occupants standing on the shoulders of intelligent and integrated controls systems … the success of the control of these systems means the success of the energy goals."[12]

Actionable insights, meaningful opportunities—these ideas are the crux of value in digitization."[13]

Digitization helps you go beyond energy initiatives by leveraging smart devices to optimize power reliability and maintenance. And it can do so for new or legacy facilities.

## The new era of IoT intelligence

At the core of smart power distribution systems are smart devices. Devices have become more than actuators. They now measure, collect data, and provide control functions. They enable facility and maintenance personnel to deeply access the power distribution network. And they continue to become more intelligent.

The first step toward an intelligent power distribution system is digitization. A recent report by Navigant Research helps define digitization for today's facilities. "You've inevitably heard the buzz surrounding the Internet of Things (IoT); but in the intelligent buildings market, the IoT is not just buzz, it's the construct for actionable information. An infrastructure of devices for sensing, controlling, and communicating equipment and facility use data is redefining the capabilities of intelligent building software.

At the core of smart power distribution are smart devices.

They can include digital power meters or power quality monitors. Some may be dedicated to making a few energy measurements, while others may be multifunction devices that can capture and analyze a wide range of power reliability and efficiency characteristics. Beyond electricity, metering of other utilities such as water, compressed air, gas, or steam could be included — together, typically referred to as *WAGES*. In many places throughout your power network this intelligence may

# Gaining Deep Insight Through Digitization (cont.)

Digitization helps you go beyond energy initiatives, by leveraging smart devices to optimize power reliability and maintenance.

be embedded inside other kinds of equipment, such as the smart trip units of circuit breakers. These smart breakers can provide power and energy data, as well as information on their performance, including breaker status, contact wear, alerts, and alarms. In addition to core protection functions, many devices are also capable of autonomous and coordinated control, without any need for user intervention.

Advances in computational power, accuracy, integration, and communication have enabled the new era of IoT in power distribution systems and smart buildings. A new breed of smart devices has emerged, including advanced energy and power quality meters, protection relays, and circuit breakers.

It's now possible to meter energy use at every key point throughout your facility's power network, from the main utility incomer, through medium and low voltage building feeders, down to individual loads. These can include HVAC, boilers, refrigeration, lighting circuits, down to plug loads. Typically, multifunction devices are located at critical points higher in the chain, while simpler meters or sensors can be affordably installed at the load level. This level of detail is important for mining every nugget of efficiency and savings. By profiling energy consumption, energy waste can be easily revealed, whether due to equipment issues like inefficient pump or fan operation, occupant behavior, or the need to optimize HVAC setpoints, for example.

Real-time and logged data, power quality analysis, equipment status, and alarm notifications help operations and maintenance teams stay on top of conditions to identify risks that may cause downtime or equipment damage. And devices with integrated control capabilities can help them take action remotely.

The newest meters, circuit breakers, and distribution systems — such as *smart panels and smart systems* (panelboards, electrical panels) — are all designed for compactness, compatibility, and customization. This makes it easy to adapt and expand the intelligence of a power network as a facility or its operations grow.

Finally, the latest communication technologies are enabling distributed, digitized devices to connect together and to deliver the full promise of the IoT.

# Connecting to Real-time Vision and Control

On the road to 'zero net energy' facilities, CABA notes a number of game changers. At the root of these is interconnectivity.[14]

As noted in the previous chapter, digitization is embedding smart sensors and intelligence at every level of low and medium voltage power distribution. This enables deep access to real time and historical energy consumption and power conditions. Connectivity is the next important part of the story. It gives operations and maintenance teams the *wide reach* they need to the very 'edge' of the power distribution network, across an entire facility or beyond. It's real-time access to data and control from wherever they are. For example, a smartphone or tablet app can engage control actions from a safe distance from a circuit breaker, while also acting as a direct portal to expert services when needed.

The newest smart meters and smart trip units offer a number of communication options. Some support multiple, simultaneous connections to upstream information and automation systems. This can also be used to create redundant – i.e. parallel – communication links for added resilience in critical applications. In addition, communication gateways can provide further data collection, recording, routing, and user access options. Many offer on-board web servers with data accessible through any web browser. Device data can be automatically stored in a cloud-based repository that's accessible throughout the lifetime of the installation, supporting a simpler and more thorough approach to asset management. Smart devices and gateways are the nucleus of the new trend in smart panels.

## Choosing the right devices

The choices made in designing a power distribution communication network will be based on balancing performance against cost.

Where simpler energy measurements are needed at high numbers of dispersed end-load points, wireless meters may be a good choice. The IoT Institute concurs, "New generations of wireless, IP-enabled meters that simplify the process of logging and transmitting data to building management systems could slash associated cabling infrastructure costs and ultimately lower the expense of collecting and managing submeter data."[15]

Smart devices keep watch over all of the energy assets of a facility, connecting to upstream operations software.

At critical power distribution points where intensive power quality monitoring, logging, alarming, or control functions are executed, a direct connection to a building's Ethernet backbone will increase speed and data throughput. This would also typically be the case where smart panels are used to meter a large number of concentrated circuits. Power system design is made easier by new, standardized

# Connecting to Real-time Vision and Control (cont.)

specifications for smart devices, as well as industry-standard communication networks and protocols. The development of modularized components and 'plug-in' connectivity is also making it simpler and faster for panel builders and integrators to configure, customize, and upgrade smart panels and switchboards as required. It can also reduce or eliminate interruptions for a facility when scaling up their power system.

## Every asset supervised

The flexibility and extensibility of such networks allow all important energy assets to be included. This includes emerging *distributed energy resources* (DER), which analysts estimate will proliferate "three times faster than central station generation between 2015-2019 in the US."[16]

For example, onsite solar generation and energy storage can be carefully monitored and coordinated to maximize their value in providing cost reductions and emergency power backup. Increasing numbers of electric vehicle charging stations can be metered and their charging regimes scheduled for lower electricity rate periods. And while combined heat and power systems have traditionally been the domain of industrial sites, the commercial sector is expected to host more than half of new capacity in the future.[17] These systems can be accurately metered and controlled to ensure they operate at peak efficiency.

Power system design is made easier by new, standardized specifications for smart devices, as well as industry-standard communication networks and protocols.

Ultimately, large numbers of smart devices keep watch over all of the energy assets of a facility, or even across an entire portfolio of buildings, like a university campus. Two-way communication connects downstream devices with upstream operations software.

## From data to actionable information

New cloud-based applications continuously upload and aggregate power infrastructure data, while smartphone-ready digital logbooks track equipment and maintenance activity. Power network data is transformed into actionable insights, with information and alarms shared with facility personnel as well as a service partner. This enables the partner to provide regular consultation and recommendations to the facility team, based on energy, operations and advanced analytic reports provided from the system, and from remote engineering services teams. Applications catering to the new energy 'prosumer' take into account real-time operational data from business processes and DER assets, as well as weather prediction and energy pricing. From these inputs, decisions can be made regarding the optimal way to manage onsite energy production and consumption.

These cloud-hosted solutions are accessed through PCs and mobile devices by facility personnel and contractors. This

# Connecting to Real-time Vision and Control (cont.)

new 'energy cloud' taps into even greater value by enabling information sharing and collaboration between all parties. It keeps everyone engaged with the smart distribution network, making sure they immediately receive and quickly respond to equipment alarms, helping avoid failures and downtime.

## Unifying power and building perspectives

At the next level of integration, interoperability between power management systems and building management systems (BMS) can further streamline workflows and catalyze collaboration. Data can be shared between systems or power management capabilities can be embedded directly into the BMS platform. This helps put occupant comfort and energy efficiency in proper, balanced context while enabling facility staff to gain a wider operational perspective from a single interface.

With all the connections between smart devices, panels, systems, and the cloud, the threat of cyber-attacks have become a growing concern both inside and outside of the buildings industry.

## Securing against cyber threats

With all of these new connections between smart devices, panels, systems, and the cloud, the threat of cyber-attacks have become a growing concern both inside and outside of the buildings industry. Intel defines IoT security as connecting "securely to things in the built world, in a trustworthy fashion ..." [18] To ensure this, many manufacturers now follow a disciplined process that includes providing security training to developers, adhering to security regulations, conducting threat modeling and architectural reviews, ensuring secure code practices, and executing extensive security testing. Schneider Electric also provides partners and customers with full documentation, secure deployment instructions, security lifecycle services, and responsive assistance and support when incidents and vulnerabilities are reported.

With your operations team well-armed to stay on top of real-time conditions, new analytic tools will help proactively investigate ways to further optimize reliability, efficiency, and sustainability.

## Connectivity application examples

1. **Remote breaker control.** A breaker trips in a building's power network. The facility manager can immediately see which breaker it was, in which piece of equipment, why it tripped, and a complete history of the breaker's power consumption. Armed with this information, the dispatched electrician will be more likely to fix the equipment in one trip. If an overload caused the trip, the facility manager can reset the breaker from his/her office after loads have been redistributed to other breakers to remove the danger

# Connecting to Real-time Vision and Control (cont.)

of another overload, and nonessential equipment has been shut down that the breaker is protecting.

2. **Preventative maintenance.** Metered data from smart panels improves asset management by helping predict when equipment maintenance may be needed. It also indicates when electrical loads need to be redistributed or rebalanced to help prevent overloads and downtime from occurring. Facility managers can see if a particular breaker has tripped more than once, helping find and fix the problem to prevent it from reoccurring.

For an industrial plant, remote control capabilities help prioritize essential equipment that must be kept powered during an outage.

Smart devices and systems are helping facilities avoid downtime by predicting equipment maintenance needs.

# Using Energy Analytics to Uncover Opportunities and Risks

With IoT devices in place through a power distribution system and vast connectivity enabling aggregation of data from across a building or campus, facility teams are well-positioned to take the next step toward true operational efficiency, reliability, and occupant satisfaction.

However, Bhavesh Patel of ASCO Power Technologies cautions that the result of having so many smart sensors at so many points is 'Big Data'. And facility managers will be expected to interpret it to extract its full value, e.g. reducing energy consumption, projecting capacity requirements, streamlining maintenance, resolving operational issues, and meeting reporting requirements. "And that's the short list of benefits." [19]


For the first time, a complete picture of energy consumption throughout one or more facilities is available.

Fortunately, advanced analytic software is available today that helps make sense of everything. Each corporate, energy, facility, and maintenance leader gets appropriate, actionable power and energy data tailored to his or her needs to simplify and speed decision-making.

It's also easier to share information across the enterprise in formats everyone can understand. Raising energy awareness can encourage energy-efficient behaviors, while allocating costs to cost centers or tenants can lead to actions that reduce energy consumption.

For the first time, a complete picture of energy consumption throughout one or more facilities is available. Dashboards and reports help compare floor-to-floor or building-to-building performance. Teams can then set performance baselines, accurately track the progress of efficiency initiatives, and validate savings.

GHG emissions and total carbon footprint can be automatically calculated to support corporate sustainability reporting. Deloitte observes that "sustainability analytics can help commercial real estate companies decrease their carbon footprint, have more sustainable properties in their portfolio, and eventually differentiate themselves in the marketplace." [20]

## A clear view of efficiency and reliability

For organizations wanting to optimize their energy costs and avoid penalties on their utility bill, new energy analytic applications can be used to model and predict energy needs. These take into account energy pricing and weather forecasts, then provide the necessary decision inputs to automated peak shaving or load shifting. The high accuracy

# Using Energy Analytics to Uncover Opportunities and Risks (cont.)

of onsite metering can be used to validate utility bills to uncover potential errors. Analytics can also enable participation in programs such as demand response. Signals received from the smart grid are evaluated based on the opportunity. If accepted, deployment of onsite DER is then coordinated in response to load curtailment requests. Analytic capabilities can also help determine the most cost-effective periods to either self-consume renewable energy resources or recharge onsite energy storage.

With analytic tools providing a 'microscope' on every hidden risk and opportunity, 'managed services' can deliver even greater rewards.

Analytic capabilities can also help maintenance teams go beyond the confines of scheduled maintenance by using new techniques to predict breaker aging. These take into account not only contact wear and operational cycles, but also environmental conditions including corrosive gases, dust, and temperature. Predicting equipment conditions in this way makes for better capital planning, as teams can perform repair or replacement only when required. It can also improve service continuity by catching high-risk situations before failures can occur.

Power analytic tools help diagnose problems and improve response times. Data analysis helps isolate problem sources in the network, including when and where conditions might be getting too close to safe tolerances. Rich data visualization tools can help improve system efficiency by balancing loads or uncovering losses or hidden spare capacity. You can maximize the use of your facility's power infrastructure without compromising its reliability. This is critical for minimizing CAPEX, as overbuilding and unnecessary equipment upgrades are avoided.

Integrating data from BMS and other systems can help evaluate their true power and energy consumption and, in turn, optimize their settings to boost efficiency.

With analytic tools providing a 'microscope' on hidden risks and opportunities, 'managed services' can deliver even greater rewards.

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# Achieving the Ultimate Performance

In response to facility and maintenance teams needing more insight and control over electrical power, new smarter power distribution systems have arrived. Digitization, connectivity, and advanced analytics have merged to deliver the relevant information needed to improve asset management, reliability, operational efficiency, and sustainability.

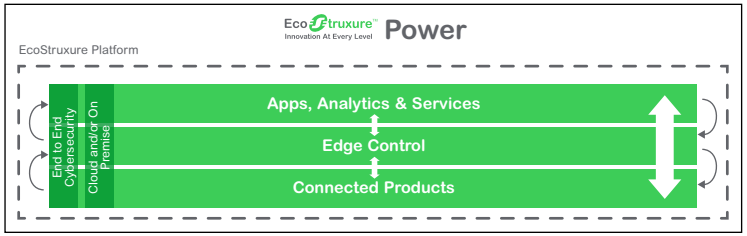
Schneider Electric has been leading power distribution innovation for over 50 years. And, once again, we are redefining power distribution to help you take full advantage of the new decentralized, decarbonized, and digitized energy paradigm. Our unified, IOT-enabled EcoStruxure™ Power architecture delivers innovation at every level, from connected products, to edge control, apps, analytics, and services.

Smart power distribution is at the core of a smart building or campus. With EcoStruxure Power, your facility teams and occupants will be empowered with new levels of visibility and actionable information. This will help you meet business objectives, share best practices, and respond to opportunities on the smart grid. In fact, by driving active energy management with real-time usage optimization, stakeholders in buildings and smart districts are contributing to a flexible and sustainable grid ecosystem through demand side energy integration.

The EcoStruxure Power platform can also act as a cloud-based services enabler, giving facility managers a range of choices for further improving efficiency, occupant comfort, and productivity without having to increase in-house staffing. Services are available to support the entire building and power distribution life cycle, from design and build through operation and maintenance.

As research firm Verdantix recommends, “Solutions that reduce equipment downtime can reduce the total cost of ownership of equipment, providing business owners with a better return on their facility and equipment investments, as well as improved operational performance. Integrating energy management into a comprehensive facility optimization strategy can improve the size of potential cost savings by using energy as an indicator of overall facility performance. Retailers, such as Tesco, have avoided over $1 million annually in maintenance-related costs through a focus on facility optimization strategies.“ [21]

If you’re a building owner or part of a facility team, EcoStruxure Power helps you make sure power uptime is maximized, operational costs are optimized, and maintenance is performed on a predictive, preventative basis. If you’re a specifying engineer, contractor, or panel builder, EcoStruxure Power gives you the peace of mind that power architectures are proven and interoperable, while making your job easier.




The Schneider Electric EcoStruxure™ Power solution provides new levels of visibility, information, and control to meet business objectives, to share best practices, and to respond to opportunities on the smart grid.

With EcoStruxure Power, you’ll be prepared for today and for an even brighter future.



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# Additional Resources

Learn more about how the EcoStruxure™ Power is redefining power distribution to deliver efficiency, reliability, safety and connectivity to every level of your facility.

**EcoStruxure Power apps. analytics and services**

- EcoStruxure Facility Advisor (formerly Facility Insights)
- EcoStruxure Building Operation

**EcoStruxure Power edge control**

- EcoStruxure Facility Expert (formerly Facility Hero)
- EcoStruxure Power SCADA Operation (formerly StruxureWare PowerSCADA Expert)
- EcoStruxure Power Monitoring Expert

**EcoStruxure Power connected products**

- Masterpact™ MTZ
- PowerLogic Meters
- Easergy Range
- PowerTag®
- Smart Panels

**White Papers**

"How Predictive Maintenance for Circuit Breakers Optimizes Safety, Reliability, and Costs"

"Guide to Energy Measurement Applications and Standards"

"Three Steps for Using the Digital Revolution to Reduce Downtime and Improve Operational Efficiencies"

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# Footer Notes

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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.





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