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Spurring a Clean Energy Revolution in Germany

Optimizing electric-grid management with low-voltage monitoring

AT A GLANCE | BUSINESS CHALLENGE | SOLUTION | RESULTS

How Can Germany Better Support EV Adoption?

Electric vehicle (EV) adoption is increasing fast in Germany, the fourth largest auto market in the world. As part of its 2030 Climate Programme, the new German government has committed to having at least 15 million pure-electric vehicles on Germany's roads by 2030. To spur innovation and EV adoption, the government is issuing consumer incentives and funding infrastructure development that has led to EV sales soaring to 394,632 units in 2020 (encompassing battery electric vehicles, or BEVs and plug-in hybrids), meaning that 13.5% of new cars on the road are now fully electric. Similarly, the numbers of electric buses and trucks in Germany are growing, as city and regional governments seek to reduce carbon emissions and create a sustainable future for generations to come.

What stands in the way of faster growth? As with other countries, Germany needs to build out a more robust charging infrastructure and provide grid operators with the tools and insights they need to manage charging at scale. Currently, if EV charging loads on a specific feeder grow faster than anticipated, the distribution transformer that serves that load can quickly become overloaded. The worst-case scenario is a complete grid failure or blackout, which could cause major impacts to both industry and the general public. As a result, industry participants are eager to implement grid-optimized charging.

To take on this challenge, there are a number of pioneering research projects and joint projects involving utilities and IT service providers. One example is a low-voltage monitoring project from MITNETZ STROM, the largest regional distribution system operator (DSO) in eastern Germany, and Robotron, a leading provider of software for connectivity and condition monitoring that is working in cooperation with Moxa.

BUSINESS CHALLENGE

Seeing Inside Grid Operations for the First Time

A research project to determine what and where to invest in

Recognizing that EV momentum was growing, the project's participants proactively sought to improve transparency for low-voltage monitoring through a research project. Until this time, the DSO was unable to monitor the daily behavior of single feeder lines, which meant that necessary component upgrades could not be identified—a common problem for DSOs. MITNETZ STROM operates more than 45,000 kilometers of low-voltage networks, with every distribution station having between five to forty individual feeders, and a three-phase line for each of them. Equipping each station with monitoring hardware and software would cost hundreds of millions of dollars. To guarantee network stability, the operator needed a cost-efficient method of recording all relevant measured variables from their outgoing feeders in low-voltage grids, and in real time. This required data collection of measured values such as current and voltage, and transmission of this data in variable time intervals (e.g., minute values). These captured values would then need to be transferred to a scalable cloud system, in compliance with GDPR requirements. Furthermore, data access from different end devices needed to be coordinated, and configuration via remote access had to be enabled.

This pilot research project enabled the distribution system operator to get clearer visibility into their feeders and EV penetration trends, allowing the company to invest with greater confidence in physical infrastructure and equipment upgrades—such as substations, transformers, sensors, and automation—in order to better manage variability at the distribution substation and feeder level.

About MITNETZ STROM:

MITNETZ STROM, short for Mitteldeutsche Netzgesellschaft Strom, the largest regional distribution system operator (DSO) in eastern Germany. The company plans, operates, and commercializes the electric grid in the four grid regions of Brandenburg, Saxony-Anhalt, South Saxony, and West Saxony, serving more than 2.3 million consumers, companies, and municipal partners. The company's top priority is to ensure a reliable, economical, and environmentally friendly supply of energy to households, companies and municipal partners through its network.

https://www.mitnetz-strom.de/

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A Unique and Unrivaled Solution for Delivering a Safe, Reliable, and Sustainable Power Supply

Robotron as an IIoT partner

For the first pilot project in Germany, data was a key initial challenge, so data specialists were required to get the project started. Because of this, MITNETZ worked with Robotron, a well-regarded leader in the energy, utility, and IIoT sectors.

Moxa selected to provide operational technology expertise

Robotron had a turnkey IIoT platform, NeMo, that met the project's requirements. However, Robotron needed a partner that truly understood operational technology (OT), edge computing, and the utility market. Robotron partnered with Moxa, a leading global provider of industrial networking, computing, and automation solutions to head this charge.

Moxa provides solution design, consulting, and operational support for IIoT solutions across many critical infrastructures, including utility, water treatment, oil and gas, and public transportation sectors. Moxa systems are based on open-source technology, so they can be easily integrated with other systems and interfaces at the edge and cloud level. Together, Robotron and Moxa provide zero-touch-provisioning, simplifying integration device deployment.

About Robotron Datenbank-Software GmbH:

Robotron helps energy organizations develop end-to-end, cloud-based solutions to capture, measure, and enhance data, enabling customers to transform operations with new insights. In addition, the Robotron Energy Market Platform has become the standard software for European utility data management systems. While other vendor hardware solutions were tested, Robotron won the engagement because of its superior solution set, performance, and pricing.

https://www.robotron.de/

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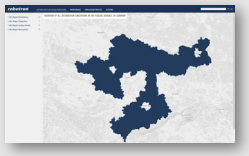
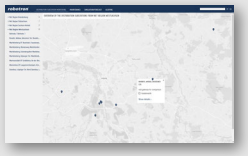
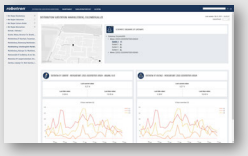
IIoT: The Missing Link in Transforming Grid Operations



Overview of all distribution substations in Germany



Overview of the distribution substations for a specific region



Distribution substation monitoring

Distribution overview of the gateway

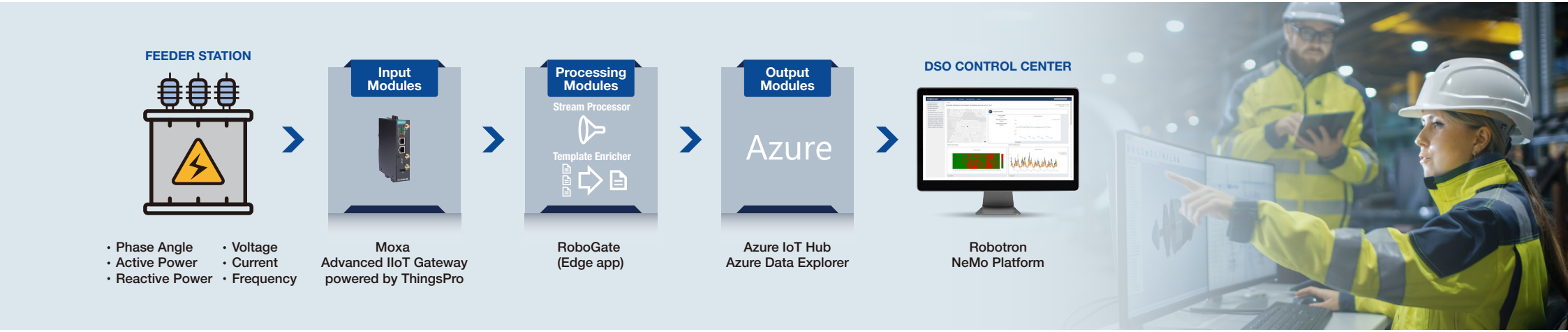
The scope of this first research project focused on gaining initial knowledge of load and consumption distributions in low-voltage networks by monitoring 20 substations and 184 feeders for a start-up period.

The Robotron-Moxa joint solution provided out-of-the-box cloud connectivity that comprises three-phase measurement sensors, an IIoT gateway, RoboGate Edge software, cloud processing, and a front-end application. MITNETZ STROM also benefitted from working with Robotron and Moxa, who brought their specialized expertise to bear on complex problems to create increased synergy with their innovative joint solutions.

Intelligence under one roof – anytime, anywhere

Robotron uses Azure IoT Hub to ingest sensor data collected by a Moxa gateway and processed by Robotron's RoboGate software at the edge. Azure Data Explorer is then used to enhance, transform, and visualize this information, making the data available for advanced analytics and alerts. Users can access a simple web interface to review network station data for each location. A dashboard provides easy-to-interpret charts and key performance indicator (KPI) data. NeMo shows data for the last 8 and last 72 hours and also provides heatmaps, enabling users to compare data on an hourly basis over the previous seven days.

The NeMo solution provided by Robotron is a streaming data platform with the potential to process vast volumes of data in near-real-time. NeMo monitors local networks and stations, providing condition monitoring and alerts at the distribution station level. Users obtain early indicators of which stations are too heavily loaded or about to become overloaded, as well as any anomalies that exist due to fixed or learned limits. The solution can be easily adapted to fit many different industries and applications.



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Unprecedented scalability and manageability over the air

Moxa provides intelligent IIoT gateways that securely collect sensor data on energy use, including the phase angle, voltage, current, and power frequency. What makes Moxa's IIoT gateways special is that they can be easily integrated with Robotron systems and interfaces from the edge to the cloud. Key enablers are the RoboGate field gateway solution, the RoboGate ControlCenter, and RoboGate RemoteService. Combined with the local device management interface of Moxa's IIoT gateway, they form the basis for data acquisition, remote management, configuration, and reliable over-the-air updates of devices.

Moxa IIoT gateway provides a clear interface to the operating system of each device for life-cycle management of services running on the devices. This also makes Robotron's NeMo solution easy to implement and manage. The ability for staff to remotely patch all the Moxa devices installed in their substations at once saves time and eliminates the need for travel to individual sites for service and maintenance.

Moxa IIoT gateways enable zero-touch provisioning, ensuring that authorized devices are connected to the correct system. Moxa's distribution and IIoT service partner, Sphinx Computers, ordered the solution components, installed Robotron's software, configured the gateways, and registered the individual gateways to the Robotron ControlCenter cloud. This completed the zero-touch provisioning process. Robotron's engineers can now simply take these Moxa IIoT devices and connect them to the DSO's network. The devices will then connect to the NeMo cloud device management platform automatically. After the devices and platforms mutually authenticate each other, cloud settings are automatically imported, and device activation is completed automatically. This process eliminates tedious activation processes that must be performed for each device, and the complete process is simple enough for any authorized engineer to use to install devices.

RESULTS

"The monitoring of low-voltage grids is an essential building block for ensuring future grid stability. With proven expertise in critical infrastructure and a robust portfolio, we consider Moxa as a long-term, reliable, and trusted partner that fully meets our expectations when it comes to environmental requirements, longevity, and hardware-based security. Together with Moxa, we believe, we can transform power grids for EV integrations." - Ulf Heinemann, CEO at Robotron

Futureproofing Grid Management for the Clean Energy Revolution

As of today, 20 local transformer stations are equipped with Moxa intelligent gateways. Almost 150,000 measured values per hour are supplied from the NeMo platform. With the data provided through continuous and real-time monitoring, the distribution system operator now has the information they need to improve maintenance of the voltage band at the network connection point and avoid cable and transformer overloads. Furthermore, the project created a blueprint suitable for a large-scale rollout to MITNETZ STROM's entire grid that requires minimal effort.

Robotron is currently expanding the deployment to encompass a total of 65 sites, which will provide another 600,000 data points. The Robotron and Moxa joint solutions can easily be rolled out to other parts of the company's overall grid, which will help provide visibility in a cost-controlled manner. That visibility will enable MITNETZ STROM to achieve its NetzFlex ambition of tapping EV battery storage capacity and restoring energy to the grid. The DSO can then use new insights gathered from harvested data to explore other opportunities to improve operational efficiency.

As German citizens embrace EVs and cleaner, greener forms of transportation, MITNETZ STROM, Robotron, and Moxa will help ensure that they have access to charging capacity when and where they need it.

With more reliable charging, consumers can commute more easily, take longer trips, and return excess energy stored in car batteries to the grid. Viva la green revolution! The future of energy management is taking shape in Germany.

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