



ALL ROADS LEAD TO ELECTRICITY

SUPPORTING THE ENERGY TRANSITION.



Topics in this Issue

Customer Stations: Plug & Play Telecontroller Connections

Digital Substation: Know What is Happening in the Network – Into the Low-Voltage Grid

E-Mobility: E-Bus Charging Station Made from Second-Life Batteries

BNK: An End to Constant Night-Time Lighting at Wind Farms



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SHAPING THE WORLD OF ENERGY

In the face of increasing decentralization and fluctuating power generation, the individual elements of an energy system must be linked to each other intelligently.

Energy generation, distribution, storage and consumption – the energy transition is only possible due to the interaction of all the players. This is why WAGO has been a reliable partner to the energy industry for many years – for municipal utilities, system operators, system integrators, station builders and industrial customers alike.

Technically and technologically, WAGO is represented in many different areas of the energy market with automation technology, interface electronics and connection technology. In addition, our Smart Grid symposium promotes idea sharing among colleagues – exploiting practical experience for practical applications. Furthermore, with our WAGO Solution Provider Program, we bring project-specific clients and implementation experts together.

This is how we support the energy transition!



INNOVATION AND ECONOMIC VALUE

WITHIN THE FOCUS OF THE ENERGY TRANSITION

Dear Reader,

The power of innovation is fed on the desire to make things easier and better. It awakens a deep-seated need to understand the overall picture arising from dynamically changing demands, and, from this starting point, to develop a vision of functional solutions for a better tomorrow. Profitability tends to preserve the status quo and expand according to the principle of "precisely the same and not differently".

Are innovation and profitability categorically exclusive? I would say, "No!" It is clear within the focus of the the energy transition that the economic climate has seldom seen better conditions to exploit opportunities and boldly approach innovations, thereby remaining economical over the long term. What is needed for the first step? Empathy, community spirit, transparency and strong communication skills – both technically and also in human terms.

With this in mind, I offer you the articles in this WAGOdirect Energy, and ask you to take them to heart. Take a look at the energy sector with us (p. 6). With articles on topics like Re-dispatch 2.0 (p. 12) power plant controllers (p. 8), telecontrol connection of customer stations (p. 16), digitization of substations (p. 28), on-demand night-time marking (p. 36) and e-mobility (p. 32), this issue engages with concepts that are currently relevant to network and equipment operators and also for system integrators and station construction companies. I hope you enjoy the practical application reports, and learn how WAGO can also support you as a partner with a broad portfolio of products, solutions and expertise.

Together, we can remain full of energy – for an innovative, profitable today, and a tomorrow, that provides value to the whole community.

Heiko Tautor
Head of Industry Management Utilities at WAGO



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BRIEF ENERGETIC NOTES

Redispatch 2.0 – First meeting of municipal workers in the WAGO energy workshop

Where there's a will, there's a way. This also applies to the implementation of Redispatch 2.0 – especially as the deadline was October 1, 2021. In order to provide safety in the process, WAGO offered an energy workshop. Four public utilities have already participated

in an active exchange of knowledge and experience with Carsten Eckart and WAGO, and planned specific solutions.

[More about this topic on page 12](#)





Digitization of Electrical Grids

What must the electrical grid of tomorrow look like, so that the energy transition can succeed?

Heiko Tautor offers insights into the energy distribution sector. As a guest on the energyload podcast, the Head of Market Management Utilities at WAGO offered interesting, and sometimes quirky, background information about why the energy transition must be con-

sidered primarily from the network side. He addresses problem points, technical solutions and profitability – including information about other countries in the world.



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podcast/wago](http://www.energyload.eu/podcast/wago)

Telecontrollers for Remote Access

Regardless of whether they deliver electricity, gas, water or heat – telecontrol solutions from WAGO can be used in numerous applications in the digitization of supply networks. Discover the benefits and obtain bundled information about suitable products, possible configuration, certificates and approvals.

www.wago.com/rtu





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The controller for the energy park or generating plant (PGP) sits at the grid connection point (GCP) and regulates the target values for active and/or reactive power at the GCP. It compares these target values to the measured actual values at the GCP and communicates the calculated control variable to the individual generating units.

FEED-IN MANAGEMENT – FLEXIBLE AND NETWORK COMPLIANT

The rules related to feeding energy into the electrical grid have been tightened. The energy park controller in the power generating systems has been revealed as an essential element in this. They function as the Interface between the plant and the grid operator. Using WAGO's Power Plant Control Library, certified according to VDE-AR-N 4110, new standards can be implemented – flexibly and safely – that conform to grid compatibility.

Faltering Network Stability

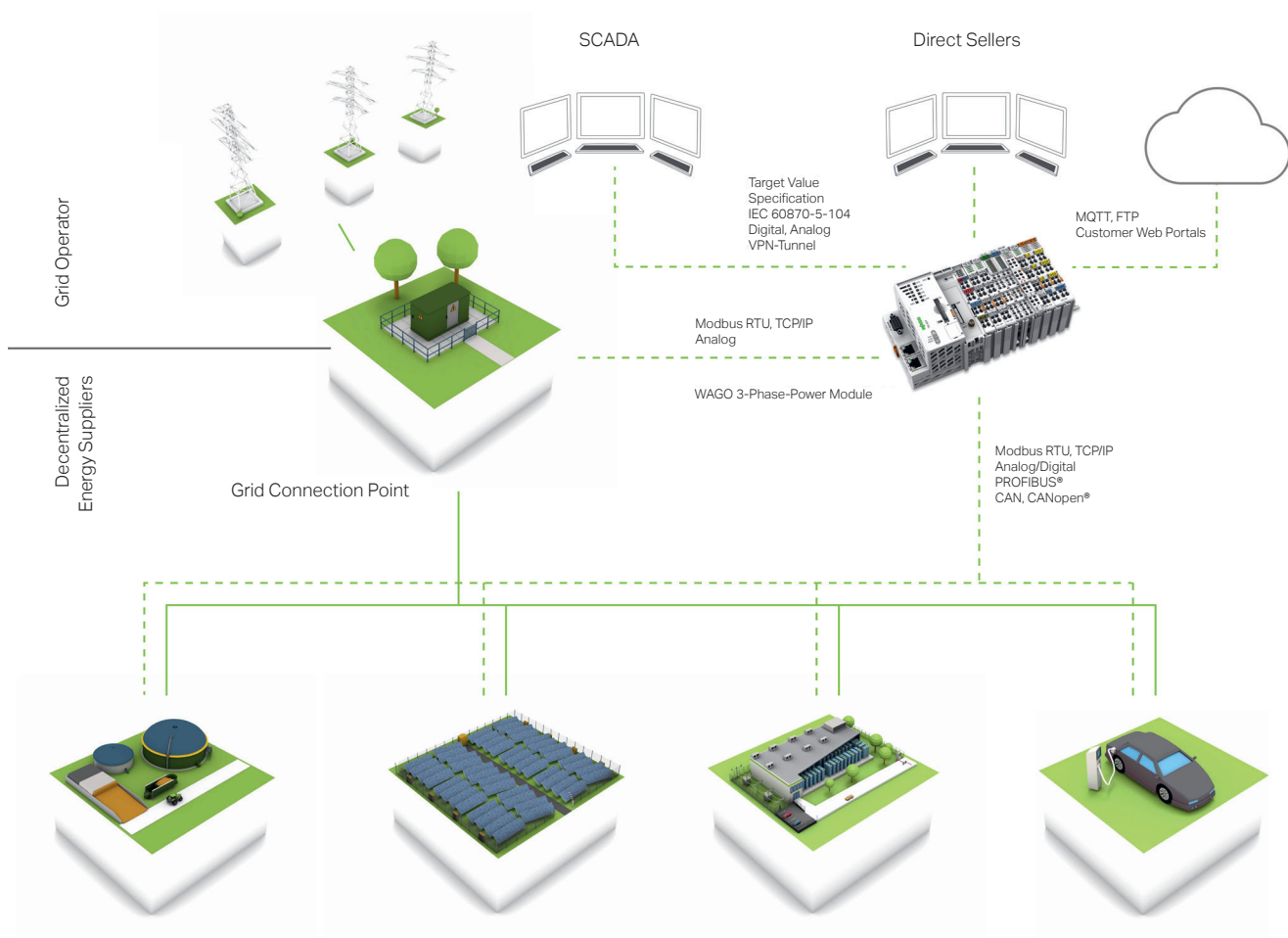
The proportion of renewable power in the electrical mixture continues to increase. In 2020, the proportion of renewable energy in the gross German electrical consumption rose to 45.4 percent (2019: 42.0 percent). The trend in 2021 shows additional increases. This is confirmed by current numbers from the Working Group on Renewable Energy Statistics (AGEE-Stat).

The corresponding generating systems, like solar, wind or biogas, primarily feed electricity into an electrical grid, which was designed for centralized generation, in a decentralized way. For network operators, this complicates their ability to retain stability in the grids. This is also the reason why these systems are increasingly mandated to contribute to grid stability. Using currently-available power electronics in combination with intelligent communication technology, these challenges can be largely overcome.

Tightened Network Connection Regulations for Generating Systems

The stricter regulations for feed-in management came into effect in April 2019. These dealt with the technical connection rules (TCRs) for decentralized power plants. These new application rules, developed together with network operators in the VDE FNN, form the technical foundation for network connection and system operations in the individual voltage levels. They elaborate on the European Network Code on Requirements for Generators (RfG) at a national level that primarily focuses on cross-border electricity trading.

The affected regulations affect combined-heat-and-power plants, biogas, photovoltaic, wind, geothermal, and hydro systems, and also storage devices and mixed systems. Innovations are also included, like capabilities for frequency stabilization, the provision of reactive power up to the so-called black start capability of larger systems. It also covers defined requirements for storage devices and mixed systems in order to harmonize generators and consumers. This covers, for example, fault ride-through of short voltage drops and the provision of reactive power by decentralized power generating plants.



With the WAGO Power Plant Control Library, the control algorithms for active and reactive power and also corresponding target value specifications, required by the operator, can be adjusted during operation according to the IEC 60870 telecontrol protocol.

Power Plant Controller as a Crucial Interface

The park controller, also called a power plant controller, functions as an interface between the plant and the power supplier, the grid operator and the direct marketer, in order to allow the control power to be sold on the exchange, for example. In the process, it regulates the target values for active and/or reactive power at the grid connection point (GCP). It compares these target values to the measured actual values at the GCP and communicates the calculated control variable to the generating systems. With the help of the power plant controller, the grid operator can control the plant feed-in via specified characteristics on the generator side.

Many grid operators additionally require an interface at the so-called intelligent customer station (ICS) with the energy supplier. This allows actual values and errors to be monitored at all times at the customer station. The grid operator has switching power within its area of authority, so it can reestablish the power supply within seconds. The grid information that is now available helps grid managers achieve better utilization.

Focus on Medium-Voltage Regulation

The so-called medium-voltage rule, VDE-AR-N 41 10, is of particular interest in this interaction between system operators and network operators, because a large portion of generation systems feed-in at the medium-voltage level. The situation is complex: additional investments and expenses arise in order to achieve compliance with regulations, which in turn drive generating costs upward. In addition to conventional system certification, all generating units, like inverters, CHPs, generators, wind turbines, energy storage devices and also individual components, like power plant controllers, must now also be certified according to the new directive. This is expensive, tedious, and has currently led to a veritable backlog at certification bodies.

Certified Library Saves Time and Money

In this difficult situation, the WAGO Power Plant Control Library, which has a control algorithm for active and/or reactive power, provides time and cost benefits for system designers and operators, and also maximum flexibility for future reliability,

particularly because it is already certified according to VDE-AR-N 4110.

The library can be used on WAGO's second-generation PFC200 controllers. This controller has two ETHERNET ports, which can be used as switches or separately, thus for two isolated networks. This enables direct communication from the controller to the grid operator and direct marketer, via a VPN tunnel with secure end-to-end encryption – for example, using standard protocols like IEC 60870 -104/101 and Modbus®, or ripple control receivers. Active power, reactive power and the power factor cos phi can be transmitted, among other things.

Flexible Solutions for Individual Requirements

Yet how often must network operators actually make adjustments? There is no single answer to this question. It always depends on the generating consistency and the standards set by the respective grid operator. However, the WAGO system is able to adjust the status in the millisecond range, a point, which can be applied to any necessary power spectrum. Overall, our customers need a solution that is simple, flexible, secure and robust. It is likewise important that the system solution is available over the long term, and must simultaneously be, and remain, future-proof. Additionally, each system is different; therefore, our customers can't simply pull different solutions off the shelf, depending on the system constellation, and individually incorporate aspects. The WAGO solutions fulfill these customer specifications with maximum flexibility, among other things, regardless of prevailing system constellations. A great variety of projects can be realized using the Linux®-based controllers and the modular WAGO I/O System – for instance, from the building, energy and e-mobility sectors.

Network Security is the Highest Priority

An important feature in the WAGO solution is the ability to set up two, isolated networks. This permits simultaneous and secure communication with the network operator and the direct marketer – without compromising security.

Because this is also part of our truth: the risk of a blackout currently is less likely to arise from too many renewable systems placing grid stability at risk, but instead due to increasing numbers of cyber attacks. Therefore, cybersecurity is an important topic when designing network automation, in order to protect the networks from cyber attacks and to guarantee the security of our supply. Current security features are implemented in the control solution and are continuously updated. This also allows electrical

storage systems and consumers to be safely connected and directly controlled. As the 'world champion interface', WAGO's PFC200 controller recognizes much more than just the more common protocols on the market.

System Solution with Support or Complete Service

The same level of flexibility that characterizes the system solution for generating systems is also present in the possibilities for integration. WAGO can either deliver just the components and provide the necessary support, or we also offer an implementation service, backed by our network of system integrators. You can compare it to baking a cake: if you want to bake it yourself, we deliver the mix; or you can let us bake it for you. The 'homemade' solution makes sense if the user has both the necessary programming expertise and also knowledge about the new application rules. When selecting hardware, our Sales department is well situated to provide the necessary support. Good training programs in telecontrol technology and programming with the controllers, as well as free customer care, also provide suitable support for implementing the system connection and operations yourself in a way that is network compliant.

The alternative is to let us 'bake it for you', in which the customer can commission a worry-free package from a WAGO Solution Provider (WSP), who then provides a complete solution – from procuring the appropriate components, through implementing and commissioning, to documentation.



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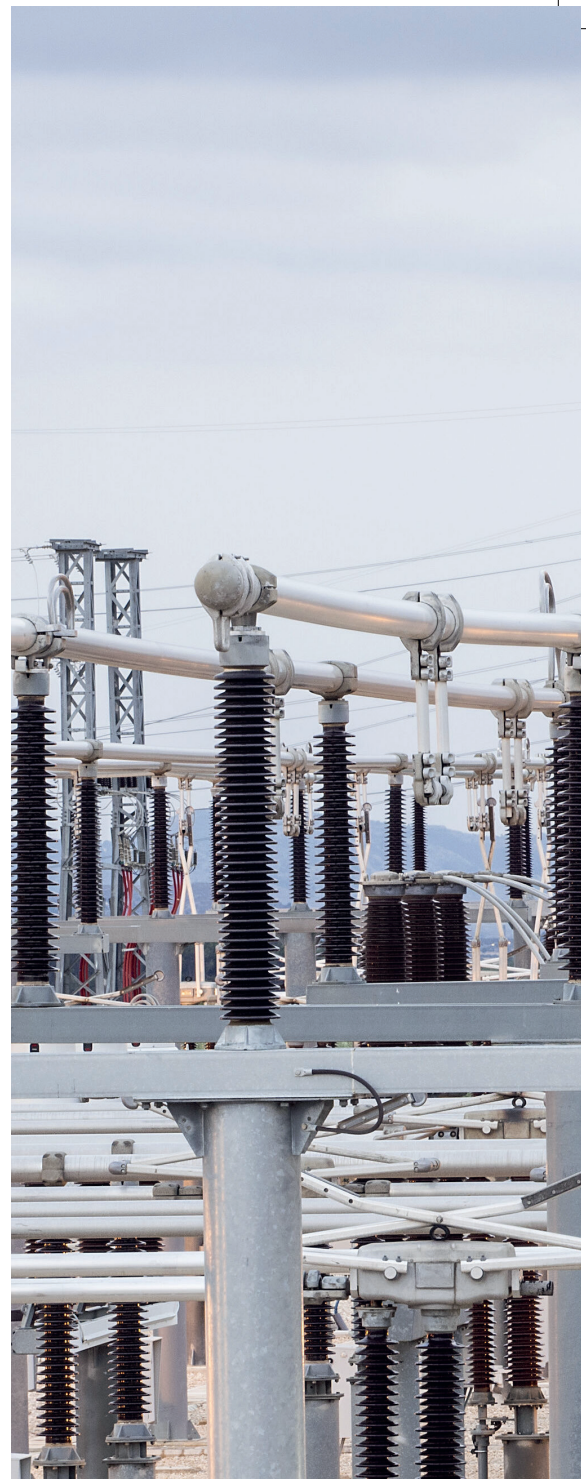
TRANSPARANCY TO THE LAST MILE

The goals of Redispatch 2.0 are clear, the requirements and implementation are becoming more specific. Starting on October 1, 2021, electrical distribution network operators are required to actively participate in avoiding network bottlenecks. Therefore, they need relevant data to make the grid transparent. But where to start? WAGO offers distribution network operators and those responsible for implementation possible solutions for overcoming these challenges in tailored ways – by exchanging experiences in an energy workshop.

Preparations for a uniform redispatch system are in full swing. One point is already clear for all involved: this will only work if everyone pulls together. This is the key message from the membership meeting of the DA/RE Grid Security Initiative in November 2020. Participants included political representatives and corporate associations, like the German Association of Energy and Water Industries. Contributors exchanged information about the next test phase of the DA/RE platform for a uniform redispatch

system. Many energy generation companies and distribution network operators have been informed about the process and current status of the project. Ultimately, network operators, with help from the DA/RE platform, should be able to satisfy the new requirements of Redispatch 2.0 according to the Network Expansion Acceleration Act – NABEG for short.

For this to work, redispatch from conventional power plants must be brought together with the feed-in management of renewable systems,





CHP plants, and energy storage devices. The goals are clear: a reduction in overall costs for grid bottleneck management, an increase in efficiencies and prevention of network bottlenecks, which secure the energy supply. Therefore, the network needs to be transparent – up to the last mile. Some data from distribution network operators already shows where potential bottlenecks could occur, or, conversely, where other suppliers or loads could be connected without this risk. This data about the state of the grid and the feed-in power or

load profiles of connected systems supports the necessary flexibility management – the control of generation and consumption systems based on actual demands on the electrical grid.

Many Network Operators Find Themselves in a Dual Role

In the new redispatch process, many network operators take on a dual role, as they are active both as those

Grid operators must cooperate more closely with other market participants – transmission network operators, downstream operators of distribution networks, and system operators – to prevent bottlenecks in a way that is inexpensive and ensures network stability and security. For this, they must collect and analyze comprehensive data and provide transparent model calculations.

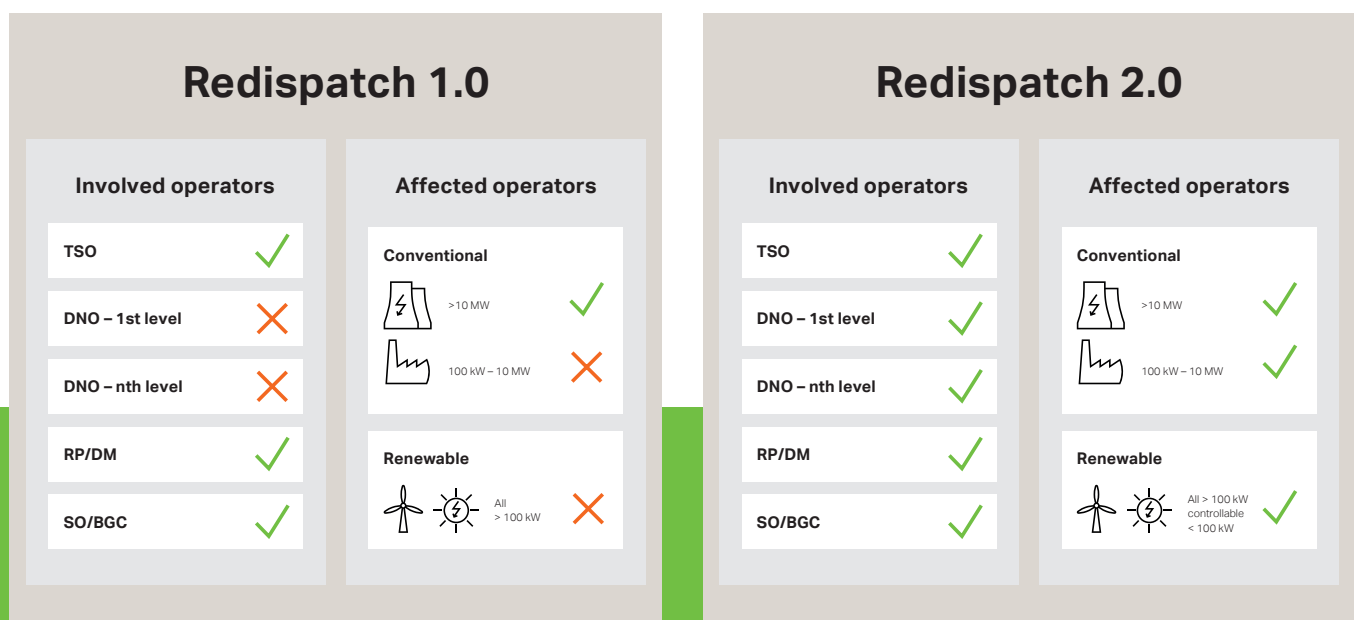
responsible for implementation and also as operators or direct marketers of generating systems. In these roles, they are required to transmit day-ahead schedules and possible redispatch potentials to the responsible network operator. When bottlenecks threaten, they receive corrected schedules, as necessary, and must implement them. The sticking point is that the equipment on site often lacks suitable systems, for example, to measure power states, which then transmit the measured values per IEC telecontrol protocol 60870-5-101 or -104 and safely reduce the feed-in supply.

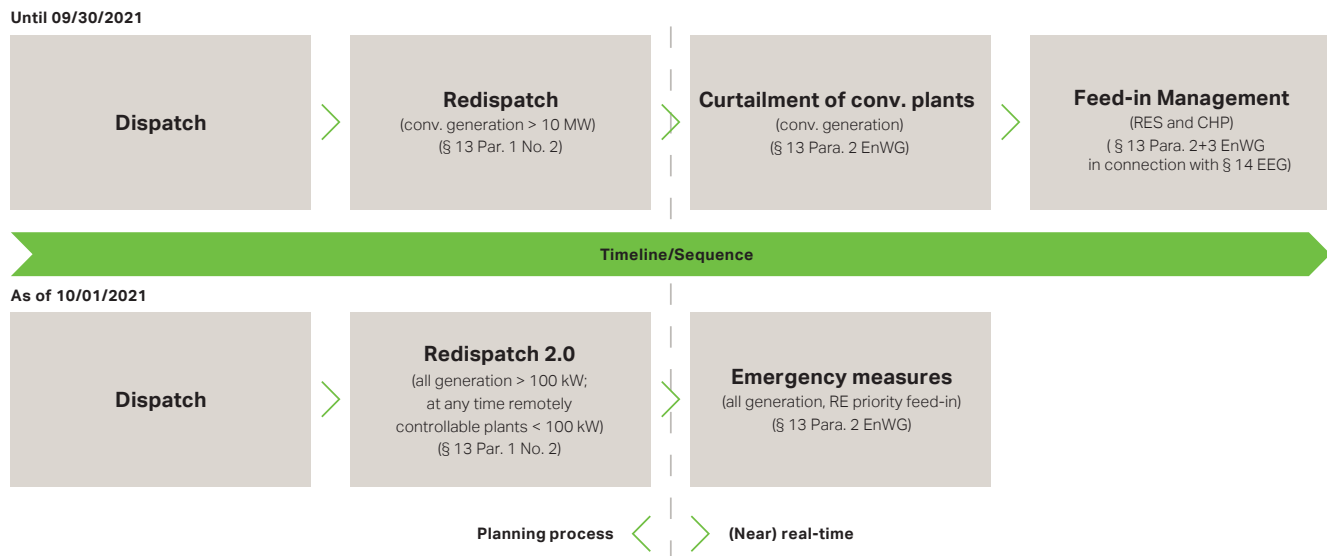
The reason for this is linked to the history of renewables: at the beginning of the boom in PV systems, many solar farms were connected using ripple control devices. These must now be equipped with a small telecontrol system in order to obtain the necessary measured values,

which are required to predict its redispatch potential and to provide flexibility in electrical grid operations. For more than a decade, WAGO has provided secure solutions for feed-in management, and the ability to intervene in these systems will remain useful in the context of Redispatch 2.0. Having said this: the entire redispatch system should function to facilitate predictive network operations, which actually avoids redispatch or emergency measures to the greatest extent, in order to configure the integration of renewable energy more efficiently and more cost effectively.

In order to achieve this, interest on the part of distribution network operators is growing for network monitoring, which means that now is the time to gain experience and develop suitable concepts. WAGO has a comprehensive portfolio of solutions for recording, remote

readout, and visualization, among others, of current data and voltage data in local substations. This allows for a low-threshold entry into network monitoring. Since the data are stored locally, network operators can simply look, as a first step, to see how things are actually operating in their networks, up to the last mile. The collected data provide a good first assessment as to which network sections are potentially less critical, and where more precise monitoring or reinforcing may be required. In addition, the data can be used by downstream IT systems, for example, to generate network forecasts, or to evaluate schedules, or planned redispatch measures. WAGO controllers, which are hardened according to the BDEW, also translate the data into the required communication protocols, such as IEC 60870-5-101/-103/-104 or IEC 61850, and transmit it to the control center or another system via a data line.





Exploit Opportunities, Minimize Risks

As a whole, Redispatch 2.0 offers enormous opportunities for stable and profitable operation of networks and equipment. The circumstances are ideal for developing and testing corresponding processes precisely in those cases, in which a company serves in both roles. WAGO can provide powerful, secure, and durable information, communication, and automation technology that functions as the necessary infrastructure for this.

Yet where do the energy generation companies and the approximately 890 distribution network operators in German stand when it comes to the preparations for implementing

Redispatch 2.0? A blanket statement is impossible at this point; decisions regarding what is possible and what is necessary must be made individually. Therefore, WAGO offers interested energy generation companies and distribution network operators a chance to become acquainted with and to test WAGO solutions within the context of a symbolic energy workshop. The knowledge gained here flows directly to pending or planned digitization and network operating concepts, so that they can develop solutions tailored to individual needs. This type of agile approach offers participants the possibility of advancing their investment activities, within the currently valid regulation framework, in a balanced relationship between opportunity and risk.



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Customer station connections that comply with network regulations: WAGO offers station constructors and system integrators a simple plug & play solution for telecontroller connections of customer systems according to the respective network operator's technical connection rules.

»The telecontrol connection of the customer station functioned quite well. We could install and parameterize the control cabinet easily and without any problems.«

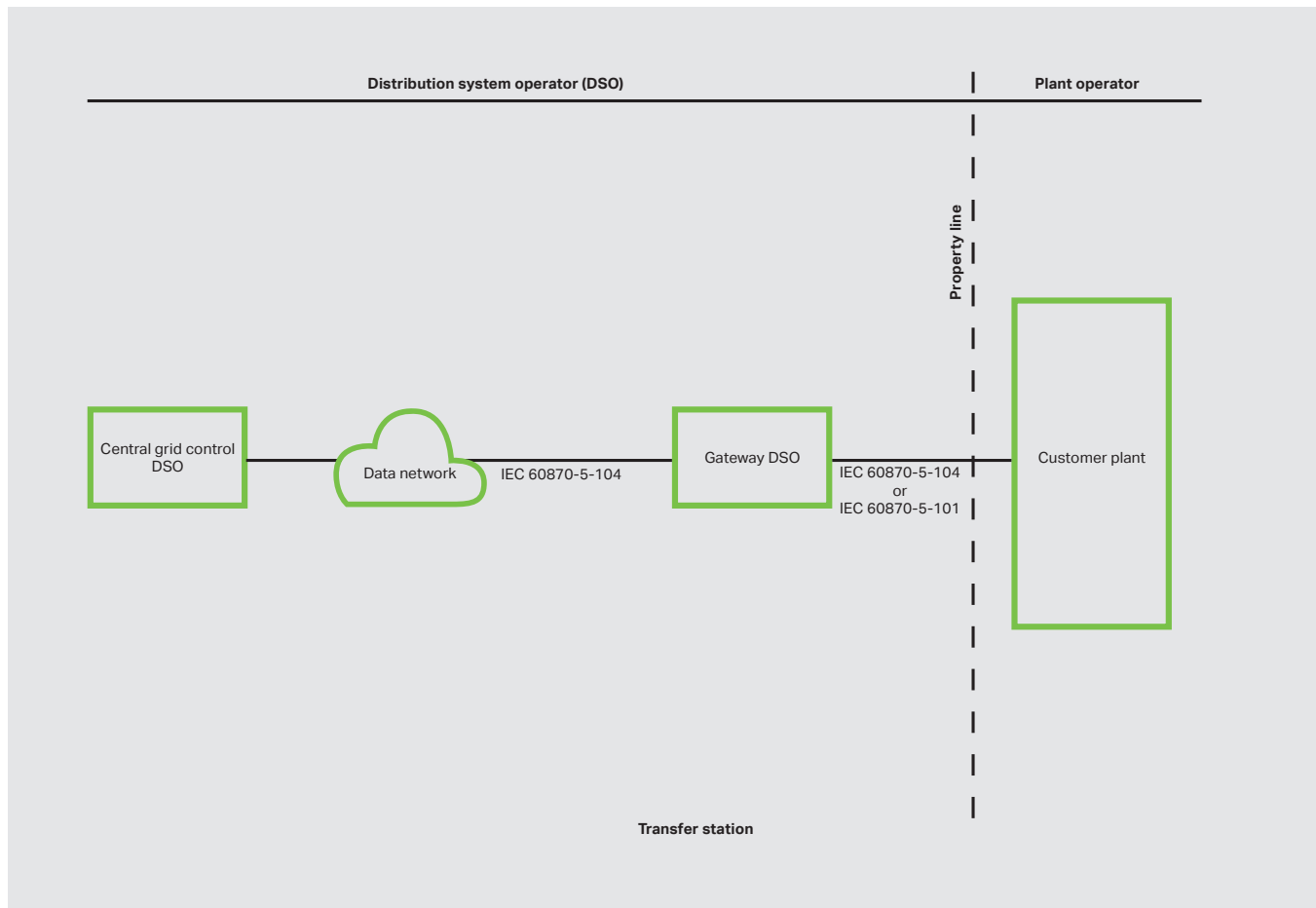
EASY CONNECTION OF CUSTOMER STATIONS

Each customer station must have a telecontrol connection to the network operator's gateway – this is according to the amended network operator specifications for medium-voltage connections. When searching for a solution to fulfill the E.ON network guidelines NT-10-24, Elektro-Montage-Nord came across WAGO. Their cooperation resulted in a simple, complete solution, which can also be applied to other grid areas.

Install the pre-wired control cabinet, select the network area, perform a bit test, deliver a customer transmission station, connect and it's done. It sounds simple, and it truly is – when using WAGO telecontrol technology and the WAGOAppRTU_Slaves communication libraries. "It worked really well. We had no problems installing the control cabinet and could easily parameterize it," states Steffen Reppmann, a sales employee at Elektro-Montage-Nord (EMN), a medium-voltage service and installation company. He was talking specifically about the connection of an industrial client's consumption system in the network area of E.ON's subsidiary, the Schleswig-Holstein grid. The customer station necessary for this provided the impetus for a pilot project. Station construction companies and system integrators across Germany can profit from the results of this project during customer-side network connection of medium-voltage switchgears in their respective grid areas.

EMN and WAGO – Complete Solutions from One Provider

EMN is a mid-sized, family-owned company located in Börnsen. The third generation is now adding to their 60 years of corporate expertise in medium-voltage technology, particularly in Germany's northern areas. "We have a proprietary, air-insulated switchgear for use in 10 kV networks in our product portfolio," Reppmann offers as an insight into the EMN business segment. From planning, design, manufacture through installation and commissioning of electrotechnical systems up to the associated services – EMN offers it all from one provider. Following this business model, the responsible parties at EMN didn't go looking for individual components, but sought a complete, turnkey solution for connecting different station types according to the NT-10-24 network guidelines, which have been applicable in E.ON grid areas since spring 2019.



The interfaces at the handover point have become more complex due to updated rules for telecontroller connections of customer stations per VDE-AR-N 4110. Whereas the actual and target values were previously transmitted from the customer side via 4...20 mA signals, they must now also exchange data with the network operator via telecontrol protocols, which can differ from one distribution network operator to another.

Connection by the Installation Company

Some background information: According to the E.ON NT-10-24 network guidelines, each customer station must have a telecontroller connection according to the technical description per IEC 60870-5-101 for connecting to the E.ON renewable energy gateway. This interface then forms the boundary between the respective properties of the network operator and customer. On the customer side, a corresponding telecontroller is deployed in the network connection point, which provides the signals required by the network operator. "It is precisely this connection that the installation company must deliver," explains Reppmann. EMN, like other station constructors, vendors, and installation companies, has been informed about this by the respective network operators at meetings related to the implementation of the medium-voltage technical connection rules, VDE-AR-N 4110.

WAGO's complete system, which arose from this, includes a finished control cabinet and simple example programs that can be parameterized via web server. This easy and

flexible automation solution takes on the network-compliant telecontrol connection of the customer station, the actuation of motorized drives, collects position signals and reads short circuit indicators and accidental ground indicators via Modbus®. An additionally incorporated battery buffer in the control cabinet enables the system to access the telecontrol equipment and the EEG handover of the network operator, and also to carry out some switching cycles of the motorized drive, even in the case of an electrical outage. "Together with employees of the Schleswig-Holstein grid, we were able to perform the bit test in the factory," explains Reppmann, adding details about the process.

Plug & Play Solution for Many Grids

A glance at the network rules from other operators shows, however, that the specifications, which determine the respectively required type of signals at the communication interface, differ somewhat from one another. Therefore, a serial interface according to the IEC-60870-5-101 protocol was provided at the gateway for telecontrol connec-

tion in E.ON's medium-voltage network, while an IP-based interface (IEC 60870-15-104) was used for Westnetz GmbH. Individually programming these complex and different interfaces would be quite expensive for station constructors and system integrators. WAGO's WAGOap-pRTU_Slaves communication libraries provide the requisite assistance here – simply select the grid territory, set the parameters and put the system into operation.

The communication libraries operate on WAGO's second-generation telecontrollers (WAGO PFC200). They are currently available for the following grid areas: Avacon Netz GmbH, Bayernwerk Netz GmbH, E.DIS Netz GmbH, HanseWerk AG (incl. network operators in the HanseWerk-Gruppe), Netze BW, EWE and Westnetz. These network area can be preselected for direct parameterization. However, WAGO can also provide support in connecting to medium-voltage grids per VDE AR N 4110 in network areas not included in the above list, by offering knowledgeable advice during hardware procurement and continuing services. A plug & play solution for telecontrol connection of consuming and generating systems at the connection point provides complete, pre-wired control cabinets. They are already adjusted to the respective specifications or to the corresponding signals required by the technical connection rules (TCRs) of the network operator, and the software can be easily parameterized in conjunction with WAGO telecontrol technology due to simple example programs.

Proven Hardware for KRITIS – Critical Infrastructure Communication Architecture

WAGO telecontrol technology has already proven itself in the energy sector – especially in network stations as data collection points and interface coordinators. In particular, the second-generation PFC200 controllers combine a small telecontrol unit, data logger and PLC into one device. Hardening is possible, in compliance with the BDEW white paper, using specialized firmware. It can thus be securely operated within the communication infrastructure of critical systems. The controller has ETHERNET ports, which can be used as switches or separately, thus for two isolated networks. This enables direct communication from the controller to various users, via a VPN tunnel with secure end-to-end encryption – for example, using standard protocols like IEC 60870-5-101, -103, -104 and Modbus®. The most varied of projects, for example, from the energy and e-mobility sectors, can be realized with this Linux®-based controller and the modular WAGO I/O system.



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The screenshot displays the WAGO web interface for configuring a station. At the top, there is a navigation bar with icons for 'Ausführen Programm', 'Anhalten', 'Datenpunkte', 'Reset Gerät', 'Speichern Konfiguration', and 'Importieren'. The main configuration area is divided into several sections:

- Netzbetreiber:** A dropdown menu set to 'E.On' with a 'Disabled' status indicator.
- Stationssignale:** A dropdown menu set to 'lokale Digitalkontakte'.
- Anzahl konfigurierbarer Zuordnungen:** A numeric input field set to '6'.
- Datenbereich im IEC60870 Profil:** A list of dropdown menus for data ranges, including 'Übergabefeld', 'Eingangsfeld', and 'unbenutzt'.
- Messwerte kommen von:** A list of dropdown menus for measurement values, including 'Kurz-/Erdschlussanzeiger A-D', 'OK', and 'keins / Simulation'.
- Falls anwendbar: Verbinde Schaltgeräte über:** A list of dropdown menus for connecting switching devices, including 'lokale Digitalkontakte' and 'gewählter Messwertgeber'.

At the bottom right of the interface, the text 'UniversalMapping v16777216' and the WAGO logo are visible.

Web interface screenshot: Easily select the grid area, set parameters, and put the system in operation.



»ENERGY STORAGE SYSTEMS ARE ONE OF THE MOST IMPORTANT PUZZLE PIECES.«

What specific roles do energy storage devices play in the context of the energy and mobility transitions? And which technical and technological challenges and solutions are linked to this? We're speaking with Dr. Carsten Jähne. He is the manager of the department for "System Technology and Production Development of Energy Storage Devices" at INTILION GmbH, a company that provides sustainable, stationary and mobile energy storage solutions for applications in commercial, industrial and municipal areas.

What roles do energy storage devices play in the energy transition?

»A big one! Broadly speaking, energy storage solutions offer the flexibility that is necessary to reconcile varying levels of electrical generation, distribution, and consumption, as needed, so that the energy transition will succeed. Specific requirements for energy storage solutions depend quite heavily on the application area. In my

opinion, the three most important areas are optimizing private consumption, network services, and charging infrastructure for e-mobility.«

Let's begin with optimizing private consumption.

What does that mean?

»Solar energy is a fluctuating energy source. That means that, for example, no energy is produced by a photovoltaic

system at night, and too much is generated on sunny days. These energy levels also don't coincide with individual energy consumption. The role of energy storage solutions is obvious here: excess energy is stored, then discharged as needed. This makes it possible to bridge times with little sunshine, and also to increase the proportion of private consumption so that one's own renewably generated power can be used more efficiently.«

And where are network services targeted?

»The goal of network services is to supply power and optimize infrastructure connected to the grid. In short, it concerns the use of energy storage to stabilize the energy grid. Energy storage solutions function as buffers for weather- and daylight-dependent power generating systems, like wind farms and solar arrays. The stored energy can then be precisely discharged when it is needed. Energy storage devices thus provide one of the most important puzzle pieces related to decentralized power generation.«

Let's move to e-mobility: How do energy storage devices solve the problem of sluggish construction and expansion of charging infrastructure?

»One critical factor in e-mobility is supplying electricity for charging infrastructure. Due to the way the electrical grid was first established, the necessary charging stations are not available at every location. By using storage systems, it is possible to reserve the necessary energy and then discharge it as needed. This allows us to provide charging infrastructure at locations that were previously considered unsuitable.«

And where is INTILION GmbH currently active?

»INTILION is an active partner in the development and supply of individual lithium-ion energy storage solutions. This includes the development of sustainable business models for industrial applications in the context of energy storage devices. We are focused on the following areas: stationary commercial and large storage systems for intermediate storage of renewable power, traction batteries for industrial trucks and high voltage systems for the primary and auxiliary electrical supply for trains and other heavy duty applications. This will allow us to continue on our journey toward zero emissions, even without available overhead lines.«

What are the technical and technological challenges in integrating and operating energy storage solutions?

»Connecting all components into an efficient and robust system to meet specific customer demands. Tailored interfaces and adjustments to the customer's system often represent an important challenge.«

Which solutions does WAGO technology offer you in overcoming these obstacles?

»WAGO's product portfolio offers a highly flexible and modular automation system with many software libraries for configuring individual interfaces, like IP-based fieldbus systems, telecontrollers or M2M network protocols for the cloud. In particular, the WAGO Power Plant Control software library for renewable energy generation controllers, with a unit certificate for 4110/4120 for network conformity for all power generating units, is very beneficial for our energy storage devices that are connected to grids, especially with regards to dynamic network support, static reactive power provision and active power reduction. In general, WAGO provides us with many possibilities for control tasks, with which we can also implement a decoupling of INTILION and customer networks.«



Personal Information:

Dr. Carsten Jähne has a PhD in physics and is Head of System Technology and Product Development for Energy Storage Devices at INTILION GmbH. In this position, he can apply his many years of research experience in the area of synthesizing and characterizing materials into lithium ion batteries, and is responsible for the system and application technology of the battery-energy storage system, project management for system solutions, the development of standardized, scaleable solution components and products as well as tailored software applications. Previously, he was the force behind product development and lifecycle management of energy storage systems for industrial power applications as a product manager at HOPPECKE Batterien GmbH & Co. KG.

LIGHTS, CAMERA, ACTION! THE ENERGY WORLD IN MOTION

Increasing Efficiency through Digitization

The Netzgesellschaft Niederrhein (NGN) plans to digitize the majority of its local network stations – with PSInsight and WAGO. The sharp increase in feed-in systems, charging infrastructure and field couplings is increasingly playing out at the low-voltage network level – a part of the grid about which we have little knowledge. The goal is to obtain reliable information about the actual network state through digitized local network stations, in order to plan and operate grids more efficiently and make them more resilient – in particular in light of the challenges that are arriving with the energy transition.



Digitization of Power Grids

Vorarlberger Energienetze GmbH is using WAGO to advance the digitization of its power grid. This is because, “Our stated goal is to achieve power independence in Austria by 2030. This means that all electricity in the country will be produced from renewable power sources,” says Johannes Türtscher, PhD engineer and Managing Director of Vorarlberg Netz. “We will support the world of tomorrow with our energy networks, since a climate-neutral world will depend greatly on electricity,” explains Project Manager Thomas Hilbe.



How Companies Use Their Own Solar Energy

In those cases where solar arrays for renewable energy generation cannot be connected to a network, the Münch Energie consulting firm works with "JPs Projects", a WAGO Solution Provider, to its customers a rewarding alternative: use the electricity in house. Using this business model, Münch Energie supplies close to 550 Megawatts per year – as much energy as half a power plant! With this much power, this company is the largest decentralized energy supplier in Germany – and WAGO Technology helps make it possible.

In this video on our website, you can learn more about the path from vision, through pilot projects, up to a trailblazing role in implementing the energy transition.



WAGO Energy Experts Provide Information

In this video, recorded at our WAGO Live SPS 2020, our experts explain how WAGO can support you in managing properties and neighborhoods with power plants.



»THIS IS HOW WIN-WIN-WIN SITUATIONS AND REAL PARTNERSHIPS ARE CREATED«

Generating projects is one thing – successful implementation is another. This is where the WAGO Solution Provider Program (WSP) comes into effect. Yet, what does the program involve? What are the goals? And what benefits result for the energy sector, in particular, for project developers and system integrators at the same time? We went to Franco Polo for answers. As Head of Business Development INDUSTRY at WAGO, he promotes the Solution Provider Program in the industrial sector.

Mr Polo, can you summarize the WAGO Solution Provider Program in a sentence?

»In casual terms: a good opportunity to use automation to make a deal.«

And who makes the deals?

»Our WAGO Solution Providers and we, as the manufacturer, but also the end customer, all take part in the deal. After all, time is known to be money. However, that should not be to the detriment of quality. Therefore, project managers are looking for integrated, reliable projects from one provider, so that they can implement their project successfully, and also quickly. If system integrators have a direct line to the manufacturer, then the end customer also benefits. The WAGO Solution Provider Program doesn't just generate win-win agreements, but win-win-win situations. This also forms a foundation, where a real partnership can evolve – in the best case, this is long term and based on trust.«

Triangular relationships are not known for trust and longevity in interpersonal matters.

»Commercially and with the right partners, this clearly functions well, and, indeed, it has for more than 20 years.

This is how long the WAGO Solution Provider Program has been in existence. In 2019, we took things to the next level, and increased both the attractiveness and also, and most importantly, the quality. There are currently a total of 85 WAGO Solution Providers – in the building sector, in industry, and 26 of them now focus on energy automation, that is, everything that is broadly linked to the topic of smart grids.«

That is an important keyword, specifically in the area of energy automation. What does the WAGO Solution Provider Program offer there?

»The energy transition must be carried out – now, and at full speed. For this reason, the number of requested projects is increasing, primarily in the area of renewable energy, that is, the connection and control of PV or biogas systems using renewable energy park controllers. The coupling of virtual power plants and digital local power stations are also becoming more common. With the WAGO Solution Provider Program, we place experienced integrators with corresponding expertise at the side of our end customers, in order to implement many of these projects. This is especially the case in the energy sector, where it often involves installations in critical infrastructure. The requirements linked to this call for certain component certificates, and also expert personnel with specific



capabilities, in order to work on these types of installations. The certification processes are complex and expensive, and trained individuals are rare.«

What are the benefits of this program for project developers and customers or end clients?

»It has to do with getting everything from one source. First, the end customer receives safe, proven, and robust

technology from an established, reliable manufacturer in the energy market. Secondly, a recommendation in their search for the right partner to implement the project. This means, they don't also have to find a suitable system integrator. Sometimes, WAGO and the Solution Provider meet jointly with the customer and look at the project. This is the only way to make reliable statements, for example, in the case of large projects.«



Participants in the WAGO Solution Provider Program (WSP) have a direct line to the manufacturer and they have fast access to good support. WAGO additionally fosters an informational exchange between the WSP partners, including an annual meeting. An in-person WSP meeting was scheduled for the 19th and 20th of October.

And what WAGO technology is used in these types of energy projects?

»As previously mentioned, the WAGO Solution Provider Program focuses on automation, and therefore, on those specific components. This means that WAGO currently provides telecontrol technology for around 90% of the applications, because it's modularly expandable, and almost all data can be flexibly collected and safely transmitted with it. That upgrades the telecontrol technology. In addition, there is also development on the product side. For this, we have WAGO Industry Management Energy, which not only observes the sector, but is also involved in the exchange of ideas, so that solutions can be refined or newly developed depending on market demands.«

What must WAGO Solution Providers do to qualify and participate in the program? And what do they get out of it?

»WAGO all but provides the WSP with projects. In return, the partner is obligated to use WAGO products wherever possible. With this, they obtain a direct line to the manufacturer, in that they are assigned a fixed system consultant as a contact. In cases of doubt, they have fast access to good support. The program is free of charge, but not gratis. WAGO additionally fosters an informational exchange between the WSP partners, including an annual meeting. We scheduled our last in-person meeting for the 19th and 20th of October, this past Tuesday and Wednesday.«

How does admission into the WSP Program take place?

»In the energy sector in particular, we must place a great deal of value on the quality of the recommended services, because we are often dealing with critical infrastructure here, and both the system builders and the network operators make no allowances for errors. Therefore, applicants should have already successfully completed their own, independent projects before being admitted, which is often initiated by one of WAGO's regional sales offices, that is, by sales representatives and system consultants. The first contact, and also the first decisions, are therefore usually on site with the regional or office manager and system consultant, and the agreement is finalized by Industry Management. There is a questionnaire, that has to be filled out at the beginning, in order to collect information about expertise and the number of employees.

In addition, this information is updated annually by the WSP partners, so that it remains current. This is used to create a summary of competencies on the website, and WAGO can then guarantee that the project under current discussion can actually be carried out by the recommended Solution Provider.«

If you would risk a prediction: in what direction could the WSP Program develop?

»Into long-term partnerships, that offer added value. Therefore, it makes sense, to participate, through the WSP Program, more deeply in the exchange of information with users, and to incorporate their feedback into WAGO products and product development.«



More information about the
WAGO Solution Provider
Program at:
www.wago.com/wsp

WAGO
**SOLUTION
PROVIDER**

2021

KNOWING WHAT'S HAPPENING IN THE NETWORK

Better network assessments, resource-efficient network coordination, efficient grid expansion – the digitization of local network stations promises all of this. By using the WAGO Grid Gateway application, distribution network operators can digitize their local network substations and thus assess network performance, in a data-supported way, in the low-voltage range. This will make the energy transition economical on the network side, at the highest levels of cybersecurity and the increased efficiencies required by regulating agencies.



Increases in decentralized energy generation and e-mobility have placed more emphasis on monitoring, in particular at the low-voltage level. By supporting these assets at an early stage, WAGO and their partners and customers have put significant thought into how to map even more functions into a small telecontrol system, in order to record measurement data primarily from the low-voltage range. Awareness about this is increasing,

both because there are currently diverse incentives from regulating authorities, for example, in the context of Redispatch 2.0, which requires distribution network operators to provide

transparency in their networks for upstream grid operators. Monitoring at the distribution network level is therefore necessary, and networks can receive subsidized hardware, or secondary technology, to support this. It is also in the interests of the distribution network operators to come to grips with e-mobility, heat pumps and feed-ins. This difficult situation has led to the development of a digital local network substation – a refinement of the intelligent local network substation.

Small-Scale Telecontrol System with Added Value

The WAGO Grid Gateway application is an important component here. Without the need for additional, third-party software, distribution network operators can quickly and easily bring a small-scale telecontrol system online in an existing or new local network substation via a web server. This pertains to

- Simplicity in use,
- Compliance with critical infrastructure rules,
- Security management,
- Largest possible data use for diverse user groups,
- Robustness and sustainability.

Automation at the medium-voltage level, which was implemented several years ago, was also taken into consideration in this approach.

By using a software interface, it is possible to parameterize the system quite easily, and preprocess and provide all of the data in a targeted way in the small-scale telecontrol system – for the network operators, asset managers and grid planners, who need the monitoring information, and also for network management in the control system.

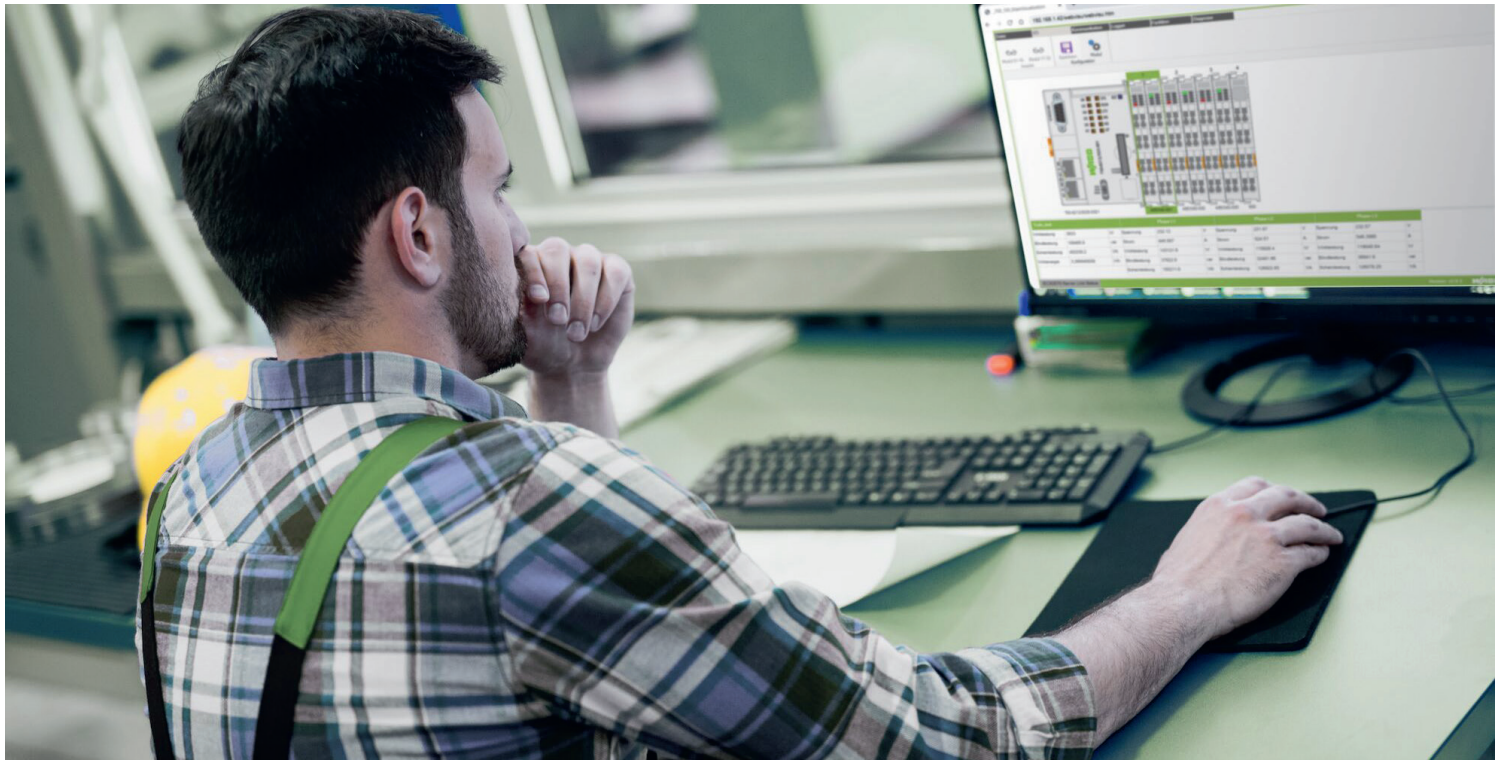
In short, for everyone who needs the network data. This does not require the installation of additional software on a PC or laptop. Users need only 'select' the WAGO small telecontroller at a fixed IP address via https in an ISMS-compliant browser, 'log in' with their user name, and the Grid Gateway application interface appears immediately.

Furthermore, an app can be used to incorporate additional functions into the substations, for example, a calculation of a medium voltage based on measured low-voltage values, the integration of an MQTT broker for recording external sensors, or SQL for communication with an external database. This adds significant value to the small telecontrol system and also future-proofs it. Hardware, that is already present, can be expanded with new functions. The advantage is that the small-scale telecontrol system from WAGO is already part of an open technology platform, which can be programmed per IEC 61131 in a standard language. It is also possible to incorporate Docker® applications and use an integrated web server. Communication with any remote station is always carried out in encrypted formats.



IEC 60870-5-104-, MQTT- and Modbus® interfaces, which function, specifically at the low-voltage level, by recording state data as high-resolution, 3-phase measurements. These data are then directly preprocessed in a targeted way at the small telecontrol system in the network station, then securely stored, accurate to the second, and can be remotely monitored. At the current maximum configuration, up to 2 transformers, each with 15 low-voltage outputs, can be transparently recorded in one substation. During development, WAGO pursued five basic approaches, in consultation with network operators:





WAGO's Grid Gateway application provides for easy commissioning of a small-scale telecontrol system in the local substation through simple parameter setting.

Transparency Prevents Unnecessary Grid Expansion

Ultimately, this approach allows network operators to better assess the condition of their distribution networks from within the location network station, which prevents unnecessary grid expansion: while expansions are surely necessary, they are not needed everywhere. More cables and larger transformers mean high investment costs, and it is often difficult to carry out these construction plans. Therefore, distribution network operators have a greater interest in knowing what is actually happening at the medium- and low-voltage levels. This means, for example, that the transformer output measurement that displays a type of digital slave pointer can be more attractive. This can be realized using 3- or 4-wire measurement modules, which can be installed as needed at WAGO's small telecontrol system, in order to provide transparency in the low-voltage network at the transformer output or cable outlets. The data logger has the ability to record

80 channels, which means that users can create measurement channels, which they can log every second in an 'X' grid and store directly on the small telecontroller as a csv file. In addition, it is possible to visualize the whole using a data plotter, for example, to display and compare trends in the low-voltage measured values. In case an on-site display is desired, this can also be included during installation of incorporated measuring devices, and the data can then be collected using Modbus®. Otherwise, the small-scale telecontrol system depicts on-site displays through a web server. Of course, data from the external measuring devices can also be visually displayed. These include low-voltage measuring devices, and also short circuit indicators and accidental ground indicators for the medium-voltage level.

Predictive Maintenance for Local Network Stations

In addition to grid management, network operators can also generate added value for other user groups with the WAGO Grid Gateway application: for

example, asset managers can more accurately plan the maintenance cycles of local network stations by accessing the recorded measured values. In the event of maintenance or grid errors, remote access helps prepare grid managers for the on-site conditions. Follow-up questions can also be determined more accurately.

The possibility of remote updates for security patches, software modules and extensions can eliminate expensive travel times. In comparison to automation in the industrial sector, predictive maintenance has not played a large role in network operations: local network stations were usually inspected and tested at fixed maintenance cycles. However, new technologies in digital local network stations has created the potential for establishing predictive maintenance at municipal utilities. This means that maintenance is only carried out when the detected values get out of hand. This saves money, because respective stations are only visited as necessary. 'Transformer age' estimates can also be checked remotely. Additional temperature measurements can also be integrated and likewise consulted in the assessment. If an uninterruptible power supply is also installed, this can be similarly monitored in a targeted way.

Compact Incorporation in Existing Systems

Distribution network operators are encouraged to digitize, and are required to measure their networks; however, no network operator can build every station anew. This is unfeasible from a time standpoint, and economically unsustainable. Therefore, retrofitting existing stations has become important. This is easy in larger, accessible stations, because there is enough space for cable transducers and a control cabinet. It is much more difficult to accommodate new technology into smaller, compact stations. Sometimes, this requires installation in the primary area, which means specially-trained personnel

are required in order to make changes there. This is less critical in the secondary areas; however, the technology must still be compact. Even then, it is not always possible to include everything. If operators would like to carry out 12-15 measurements, but there is no space for the technology, then they may also need to be satisfied by measuring only 2 or 3 outputs using easily retrofitted Rogowski coils. Yet even this little bit of information on the low-voltage side is better than having no information at all about the network state. WAGO's very compact, small telecontroller, which includes the WAGO Grid Gateway application, is suitable for all systems in which there is sufficient space. There is also a solution for installing the small telecontrol system on a free, unused, low-voltage output.

From Network State Evaluations to Network Calculation

Due to volatile and decentralized energy generation, storage and distribution, the topic of network calculation in local networks is attracting increased attention. If more generators and consumers congregate in one network, which makes the network even more interconnect-

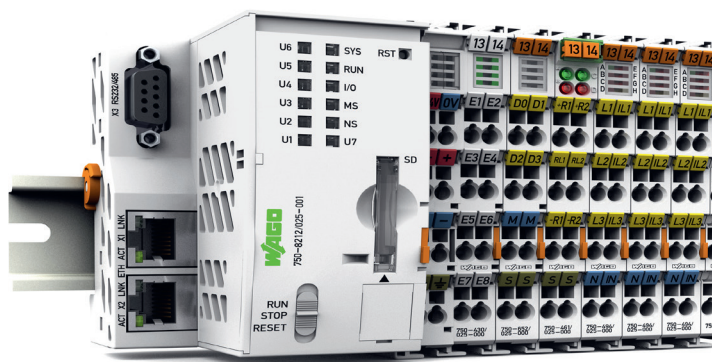
ed, then pure measurements are not always sufficient. Additional supporting measurements can bring assistance to the network, for example, by monitoring diverse feed-in systems at the feed-in point or cable distributor. These values can then be transferred to the digital local network station via Modbus TCP or MQTT using a powerline connection or LoRaWAN, and then correspondingly recorded and utilized. This provides network operators with even more reference points. Frankly, the complete network state can not yet be fully determined this way. That would require the implementation of a network calculation code, which is also possible.



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Digital input and output modules for controlling medium-voltage switchgears can be added to WAGO 2nd and 3rd generation telecontrollers, including 3- or 4-wire measurement modules, as needed.





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**A different kind of charging station:
E-buses from the Cologne transport
authority can charge at the bus stop,
by extending a pantograph.**

BREATHING NEW LIFE INTO SECOND-LIFE BATTERIES

An e-bus charging station whose energy is supplied from sources including the braking energy from street cars – implemented by the Dortmund engineering firm Ingenieurbüro Fehring for the energy supplier RheinEnergie AG and the Cologne transport authority, Kölner Verkehrs-Betriebe (KVB AG). The linchpin: a sophisticated battery and energy management system for decommissioned car batteries – perfectly balanced and extensively interconnected, thanks to WAGO automation technology.

Since the end of December 2020, an e-bus charging station with a charging capacity of up to 500 kW has stood the Bocklemünd district of Cologne; final commissioning was completed in April 2021. This was the practical result of a research project funded by the German Federal Ministry of Transport and Digital Infrastructure (BMVI) and Project Sponsor Jülich (PTJ). Externally, the e-bus charging station resembles a huge concrete block, but its interior shows off the results engineering expertise and a good dose of innovative spirit. The goal is to electrify local public transport bus networks – and do so sustainably. First of all, the required electricity is generated from the braking energy released by streetcars, which would otherwise be wasted. Secondly, the energy storage system in the e-bus charging station is made from second-life batteries.

From Hazardous Waste to Temporary Storage

The second-life batteries used are decommissioned e-car batteries from Ford Werke GmbH. On its own, each battery is now too weak to serve as a drive battery for an e-vehicle. However, when combined, these batteries are still powerful enough to be used for temporary storage. “We breathe new life into these batteries,” exclaims Nicolaj Fehring, managing director of the Fehring consulting engineering firm. “Otherwise, these batteries would have ended up as environmentally hazardous waste, even though they still have up to 80 percent of their original capacity.”

The crux of the matter is that each individual battery has its “own history, its own character.” This makes it difficult to combine second-life batteries in series to form a stable energy storage system for an e-bus charging station. Our solution was “to develop a battery management system to bring these batteries to a common voltage level. For this purpose, each individual battery’s voltage is measured and balanced,” explains Nicolaj Fehring. That sounds simpler than it is: a separate battery management system had to be developed for this technology and specially

tailored to the concept, which is based on second-life batteries. The higher-level energy management system, which was also newly developed for this purpose, handles the functional interaction between the technical components.

Balancing energy sources is a key component in this system. It took an eight-member team from Fehringler over a year and a half of laborious development work to program the necessary algorithms – on Linux®-programmable logic controllers from WAGO. “This simple, open Linux® programmability is exactly what tipped the scales in favor of using WAGO technology for communication and control,” says Nicolaj Fehringler. This was important “in order to connect our Linux®-based database system to the energy storage system.”

WAGO PFC200: The Flexible Controller for Complex Automation Tasks

WAGO's PFC200 programmable logic controller (PLC) was designed to be “open and easy” – it can be used to implement complex algorithms and interfaces in classic IEC 61131 programming languages, and also to work with open programming languages such as C++, Python, or NodeRed, and to easily implement functions via Docker®, for example. The WAGO PFC200 is used to direct the energy data flows of the e-bus charging station's energy storage system. “We can use it to adapt a large number of interfaces and

visualize, analyze and process the resulting data flows.” This creates a data hub that links complex systems with an industrial hardware platform that has been proven in practice for over twenty years. The final part of the whole system is the option for decentralized, user-friendly visualization of these processes, for example in HTML5 or Grafana, on the PFC controller. “The data collected and processed in this way is exactly what we need to further optimize the charging of the buses via the 10 kV grid or the battery and energy management system – depending on the requirements and availability.”

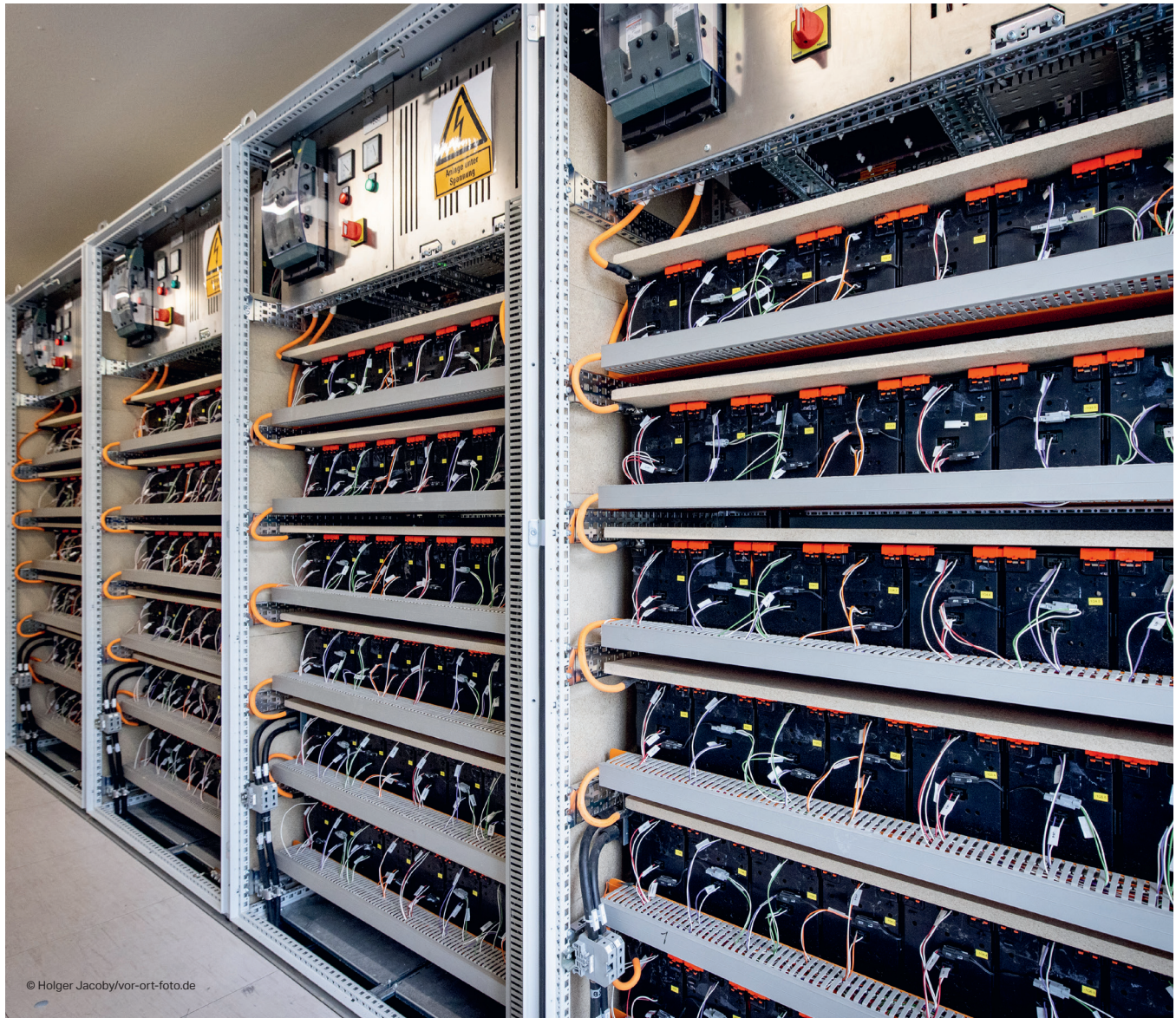
A Flagship Project for Greater Sustainability

In this complex system, the electricity must be converted twice: from direct current (DC) braking energy to the alternating current (AC) used by the battery storage units, and from there into direct current (DC) at the charging station for the e-buses. “Despite this, the electromobility efficiencies remain greater than that of gasoline-powered vehicles,” states Fehringler with conviction. In addition, the use of braking energy harnesses a previously wasted energy source and gives decommissioned e-car batteries a second life. With its innovative battery and energy management system, this e-bus charging station serves as a “flagship project” that reduces the negative aspects of e-mobility and improves the energy balance toward greater sustainability. Jeff Witting of RheinEnergie AG, the



Externally, the e-bus charging station resembles a massive concrete block, but its interior shows off the results engineering expertise and a good dose of innovative spirit, as Viktor Koch (left) from the Fehringler engineering consulting firm and Daniel Wiese from WAGO well know.

© Holger Jacoby/vor-ort-foto.de



A total of total of 288 decommissioned e-vehicle batteries from Ford Werke GmbH are used as the second-life batteries, which are combined for use as temporary storage.

principal client, agrees, "We are thrilled. This multimodal e-bus charging station is a testament to a strong innovative spirit. The concept is unique in Germany: it demonstrates research, innovation, technical expertise and exactly the kind of sustainability that the energy industry is under so much pressure to achieve."



More pictures at:
www.wago-com/e-bus-ladestation



© Dark Sky

LIGHT THE BEACONS! ...



**..BUT ONLY
AS NEEDED!**

ON-DEMAND NIGHT-TIME MARKING OF WIND TURBINES IS IMPLEMENTED NATIONWIDE

The constant flashing of red lights on wind turbines at night is coming to an end. The solution: on-demand night-time marking (BNK). Implementation becomes mandatory in Germany for land-based wind turbines by December 31, 2022, and for wind turbines at sea by December 31, 2023.

These deadlines have already been extended twice. This was caused by delayed adaptations in the aviation framework, and also by the fact that there are currently only a handful of vendors on the market. Two of them, PROTEA TECH and Dark Sky, rely on WAGO technology in order to implement their solutions as flexibly, safely, and economically as possible for their customers. Both passed the necessary type examination at the end of March 2021.


At the end of 2018, legislators included on-demand night-time marking (BNK) of wind turbines in the Energy Collection Act (EnSaG). This ensures that the red lights on wind turbines only flash when planes are currently in their vicinity during the night – measured at a radius of four kilometers and at a flight altitude of less than 600 meters. In general, on-demand night-time marking (BNK) is mandatory for existing and new constructions with a total height of more than 100 meters. These systems must be equipped or retrofitted with the corresponding technology prior to the deadline. “This affects more

than 13,000 systems,” according to Ingo Lange, CEO of PROTEA TECH GmbH & Co. KG from Filderstadt near Stuttgart. The PROTEA Group has operated wind farms for more than 20 years, and, as a certified WAGO Solution Provider, builds controllers for renewable energy systems, including BNK systems.

Reducing Light Emissions – by up to 98 Percent

The goal of BNK is to reduce light emissions and to thereby increase community acceptance of wind farms as sources for renewable energy.

“With on-demand night-time marking, we can reduce night-time light emissions from wind farms by up to 98 percent,” states Thomas Herrholz, CEO of Dark Sky GmbH. Dark Sky, located in Neubrandenburg, also offers BNK systems, and is part of the ENERTRAG Group, headquartered in Uckermark. The team supporting CEO Herrholz has many years of experience in systems, lighting, and radar technologies, and has gained diverse experience in radar projects.



No BNK, No Renewable Energy Payment – What’s to Do?

Wind farm operators, who do not install BNK in the future, risk their claim on market premiums or renewable energy payments. The Federal Network Agency has also stated that, “as long as system operators violate this obligation (BNK, editor’s note), the value applied is reduced to the monthly market value (§ 52, para. 2, clause 1, no. 1a EEG 2017). For directly marketed electricity, no more payments would be made according to § 19 EEG 2017.” The managers at Dark Sky and PROTEA TECH understand that the implementation of on-demand night-time marking is not longer a question of if, but instead a question of when. “Every system operator will have to do it, from a purely economical standpoint. The red lights that flash all night have already contributed to too many losses,” notes Ingo Lange. A substantial challenge in implementing BNK is manufacturing the interfaces between the BNK systems and the current beacon systems. Therefore, why not simply swap out the entire beacon system? This is not necessary, in Thomas Herrholz’ opinion, “We have specialized

in connecting beacon systems. From our point of view, it is not necessary to replace the entire beacon in order to enable on-demand night-time marking. With our infrastructure and the WAGO system, we have multiple connection possibilities, and can connect to the existing beacon in many cases, which is much cheaper than many of the retrofit packages for BNK, which are currently being introduced by wind farm system manufactures.”

Open Technology: Transponder or Radar?

The legislators left the question about technology open with respect to how on-demand night-time marking is to be achieved. While previously the far-reaching platform of radar technology was permitted for detecting planes for BNK, amendments to the “General Administrative Regulation for the Marking of Aviation Obstacles” (AVV) in May 2020 also allow for the use of transponder systems. This has an economic advantage. A radar system can easily become ten-times more expensive than a system based on transponder technology. In addition, fixed radar systems continue to emit emissions, and cannot be scaled as quickly or as high. The employees at Dark Sky have been working on systems for on-demand night-time marking of aviation obstacles since 2007 – initially using primary radar, but also with transponder receivers since the new AVV took effect. “We’re switching towards transponders, also because detection has to reach the ground, according to the new AVV, which is impractical when using primary radar. Nonetheless, our radar systems have a five-year inventory protection for new installations,” explains Herrholz from Dark Sky. “We will also continue to connect and integrate these systems into wind farms,” adds Sandy Schnitzer, Technical Manager at Dark Sky. From the beginning, PROTEA TECH relied on

transponder solutions, and has its own transponder network. "All of the wind farms share their data. This way, each customer profits from an improved database and reduced costs," states Ingo Lange from PROTEA TECH.

Type Examination as a Central Element

The method for approvals also plays a role in the economics of transponder-based, on-demand night-time marking, as each individual wind farm must be locally mapped for primary radar. While BNK solutions based on transponder signals require a general type examination, individual acceptanc-


es by inspection bodies are then no longer mandatory. The Federal Ministry of Transport and Digital Infrastructure (BMVI) has currently named three test bodies as responsible for type examinations: Airsight GmbH, AviaCert GmbH and DFS Aviation Service GmbH. This type examination is most certainly no trifling matter. For example, BNK providers must provide evidence of a certified quality management system according to DIN ISO 9001. The type examination thus remains a central challenge for transponder-based BNK systems. Both Dark Sky and PROTEA TECH both successfully completed this complex process of type examination for their systems at the end of March,

2021. "We are particularly proud of the simple, systems-based test criteria, which were accepted by the type examination test boards, and enable us to render both the theoretical and practical proof, as the AVV stipulates," state both Dark Sky CEO Herrholz and PROTEA TECH CEO Lange.

The respective BNK solutions

PROTEA TECH – pages 42/43

Dark Sky – pages 44/45




BNK ensures that the red lights on wind turbines only flash when planes are currently in their vicinity during the night – measured at a radius of four kilometers and at a flight altitude of less than 600 meters.

© Dark Sky

Special Regulations and BNK Exemptions

While overhauling the deadline, applications for exemption from on-demand night-time marking were readjusted and financially substantiated. The Federal Network Agency has allowed exemptions in individual cases, upon request, in particular for small wind farms, insofar as satisfying this obligation would be economically untenable. "When the amended Renewable Energy Sources Act and Tenders (EEGAusGebV) took effect, renewable energy fees and expenses were increased to 1,736 euros for decisions about the granting of exemptions from on-demand night-time marking per § 9, para. 8, clause 5. This applies for all applications made after January 20, 2021. When a case is denied, this fee is reduced to 1,302 euros," according to Ruling Chamber 6 of the Federal Network Agency (Ref.: BK6-19-059).



The goal of BNK is to reduce light emissions and to thereby increase community acceptance of wind farms as sources for renewable energy.

© Dark Sky

Time Pressures Have Been Mitigated – But Still No Relief in Sight

The pending retrofitting marathon of existing systems requires very specialized knowledge and high numbers of employees at BNK vendors. And even if the time pressure has been mitigated, the twice-postponed deadline indicates that there will be a scramble against time. Keep in mind, the Federal Network Agency has already extended the deadline for implementation by a year: from July 1, 2020 to June 30, 2021 (Ref.: BK6-19-142). Upon pressure from wind energy associations, who submitted a joint statement to the Federal Network Agency in mid-June, 2020, Ruling Chamber 6 of the Federal Network Agency granted another extension, and, in November 2020, determined that the new deadline would differentiate between systems based on land and at sea (Ref.: BK6-20-207). The result is a requirement for BNK equipping and retrofitting for land-based wind turbines by December 31, 2022, and for wind turbines at sea by December 31, 2023.



/// PROTEA TECH

READY FOR BIG DATA AND HEAVY TRAFFIC

Transponder-based on-demand night-time marking technically requires signal detection in Mode S, and also the demanding preparation of Mode A/C data. Therefore, PROTEA TECH has built a nationwide transponder network of widely distributed transponder receivers. "This allows us to detect planes beyond the horizon of a wind farm. This increases safety in the overall system, and can reduce the number of receivers required per wind farm to such an extent that it is possible that some wind farms won't even need receivers," explains Lange. Due to the unique selling point of multilateration, for Mode A/C signals as well, exact position determinations are possible and lead to reduced power-on times than required for other systems. However, the accruing data amounts are not to be underestimated. Even in the time of reduced air traffic due to the

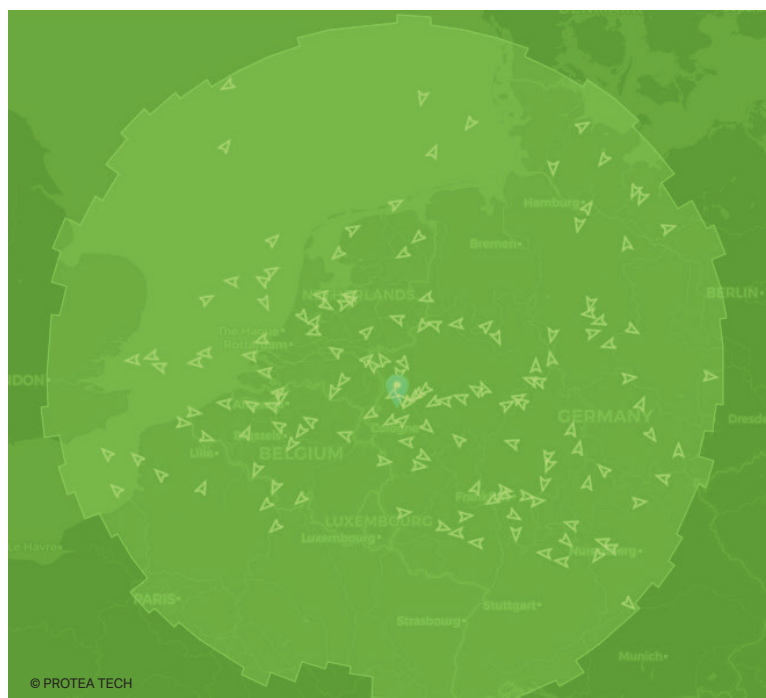
Corona virus, one receiver collected up to 2000 messages per second just in Mode S, and up to 10000 messages per second in Mode A/C. "We collect all accruing data on a server system in Germany. With this abundance of data and central data processing, we can justifiably discuss the use of big data," states Lange. "SeRo Systems, our cooperating partners for transponder technology and evaluating transponder data, also operate the transponder network for Eurocontrol, the European organization for securing air traffic," continues Lange, thus underscoring the system's reliability and performance.

Collect and Transmit Data – Flexibly and Securely

In this case, the WAGO automation technology functions as an interface

manager. It ensures that the relevant data can be recorded, stored, forwarded and evaluated. "The PFC200 was predestined for use in renewable energy systems." Lange affirmative judgment on WAGO's telecontroller. A VPN router connects one PFC200 controller per wind farm to the server. "Due to the variety of protocols, like IEC 60870, IEC 61400-25, Modbus RTU and Modbus TCP, I can securely control any wind farm in the world with a PFC200." The wireless network between the nacelles of individual turbines in a wind farm are implemented using corresponding relays and WAGO PFC100s. "Establishing two networks for this functions super straightforwardly." Particularly in cases of large numbers of units, it is important to remove complexity, and to transfer the often critical data

Due to the unique selling point of multilateration, for Mode A/C signals as well, exact position determinations of aircraft are possible with the BNK solution from PROTEA TECH. This also leads to reduced power-on times than required for other systems.

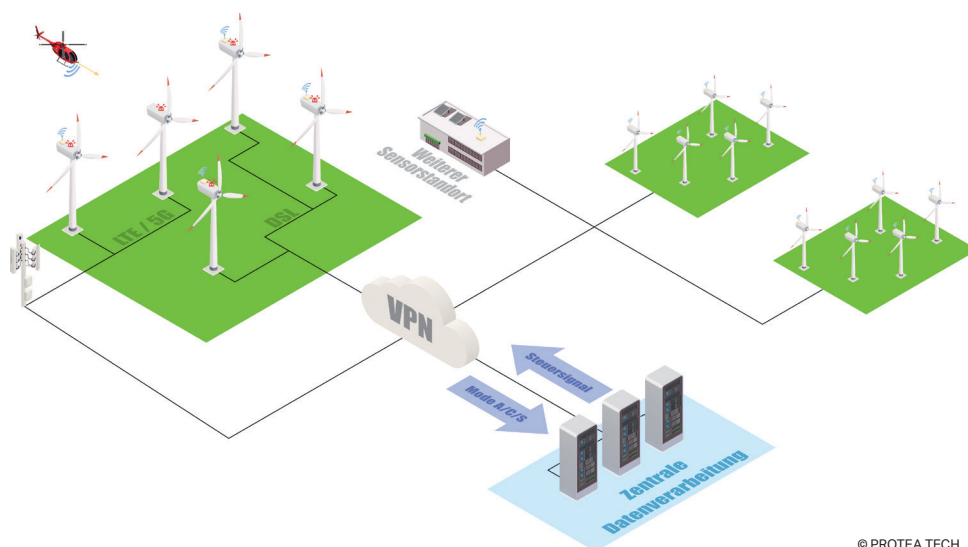


securely to the system controllers at distant transmission stations. This functions seamlessly when using WAGO technology.

PROTEA TECH's strictly cloud-based approach is completely supported by the PFC200. "All PFC200s receive the same program; we only need to input our serial number and the WAGO controller retrieves its individual configuration from the cloud, which also activates the necessary modules

and interfaces. Later, it also records its status messages in the cloud. This modern approach is the core element for implementing the high numbers of units required for the BNK roll out and for the operation of our system. We have certainly found the right partner for this in WAGO," Lange concludes his explanation of the technical set up of PROTEA TECH's BNK solution. He is also intrigued that "our BNK controllers can be expanded to a renewable energy plant controller. This

will provide the seamless integration of wind farm expansions, repowering, battery storage devices and much more," concludes Lange.



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Transponder-based on-demand night-time marking technically requires signal detection in Mode S, and also the demanding preparation of Mode A/C data. Therefore, PROTEA TECH has built a nationwide transponder network of widely distributed transponder receivers.

DECENTRALIZED SYSTEM – FOR A GOOD REASON

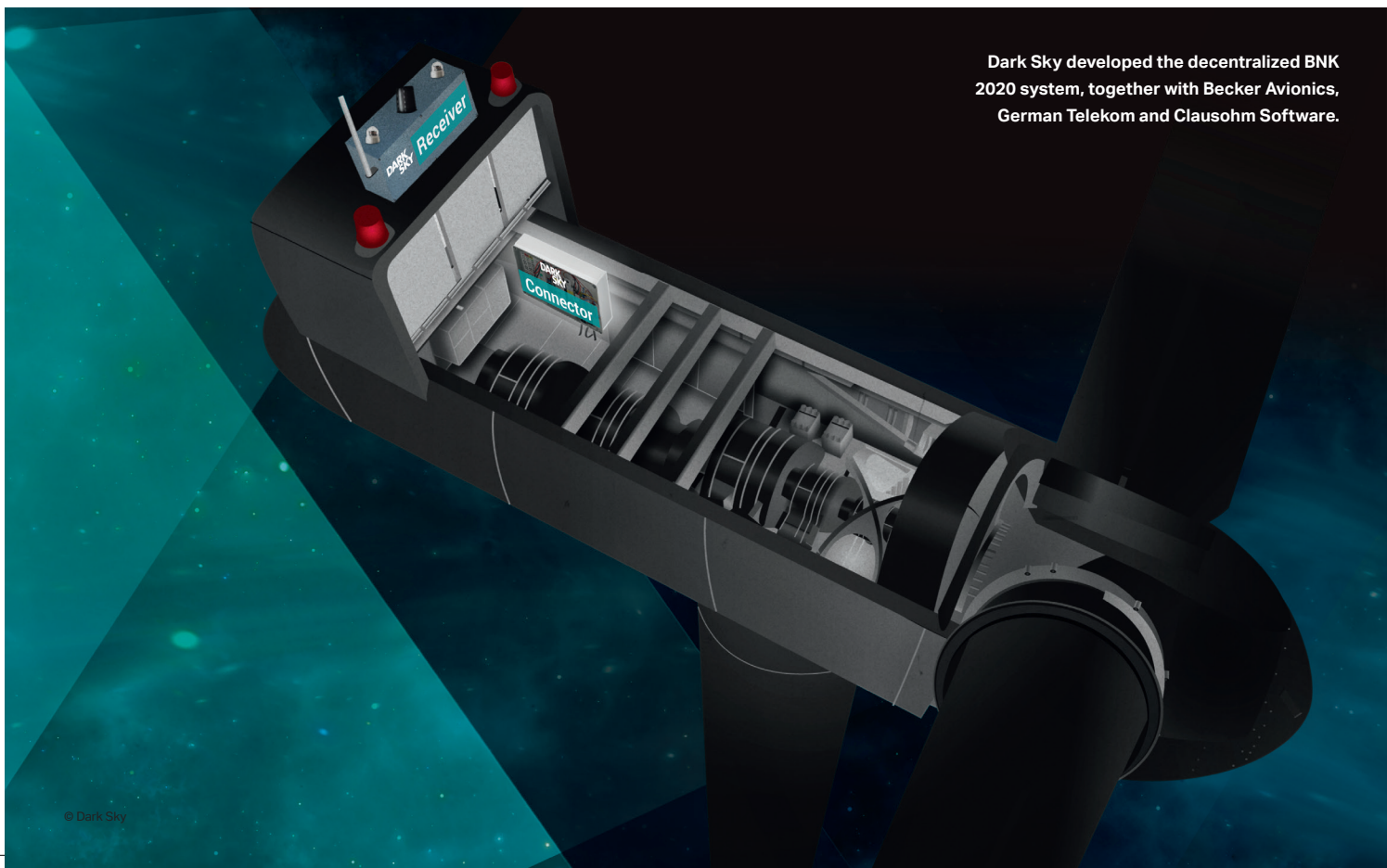
After the political decision to permit transponder-based system, Dark Sky developed the decentralized BNK 2020 system, together with Becker Avionics, German Telekom and Clausohm Software, and had already equipped 20 projects with the technology by the end of April, 2021.

In this decentralized approach, a transponder receiver is installed at each individual wind turbine, and connections to the beacons are implemented directly on site. "This allows us to completely bypass the time-sensitive information structures. We can transmit the status of each individual receiver to a server using wireless technology, which is of interest to single turbine systems, older and smaller wind farms, and wind farms with

widely distributed turbines from different manufacturers," explains Thomas Herrholz.

Dark Sky's decentralized approach was developed against the background of radar technology: in the past, a centralized approach prevailed, in which one large sensor was centrally located in the wind farm. "It has since been demonstrated with the transponder-based solution that a decentralized approach is more logical, since the reception technology is relatively inexpensive, and network issues in a wind farm are relatively complex," notes Herrholz. This is because well-documented networks in existing systems are only available in the rarest of cases. "Instead, we have to deal with network topologies that we neither

know, nor can we have access to, due to security reasons." In addition, it costs time to calibrate to these communication networks, according to Sandy Schnitzer, Technical Manager at Dark Sky, "Based on our experience in radar projects, we examined where we lost the most time – and that was in calibrating with communication networks." Furthermore, these projects have also demonstrated that, even in the case of new configurations of networks already in operation, these were usually not conceived of with BNK signaling in mind – "at which point the lights went on. However, we can now exclude these sources of errors, because the BNK 2020 does not depend on these communication systems," explains Schnitzer.



Robust Hardware, Simple Connections, Multiple Languages

Dark Sky uses 24 volt power supplies from WAGO in their solution, which regulate the 230 volt architecture downward. However, the main component is a WAGO PFC100, a programmable logic controller (PLC). This version includes an expanded temperature range, as the control box sits on top of a wind turbine. "This PFC100 satisfies the demands that we have in this exterior area," says Schnitzer. Another benefit is the simple communication connection and configuration using the **e!COCKPIT** engineering software, which includes different languages for respective beacons. "We find beacon systems in all states, from different manufacturers, and some are even up to 17 years old. In our radar projects, we showed that we could use WAGO technology quite well to transmit orders, so that even existing beacons could understand the signals and we could switch them on and off." This allows us to offer a flexible system, which is intuitive to operate using **e!COCKPIT**, and thus simple to adjust to multiple beacon systems – without needing

specific software expansions. Herrholz adds, "The reasons for using WAGO were simple: Modbus® as a BNK standard, a real-time clock, functional visualization and ease of applicability, even from the outlook of experts with far less experience. We have a broad team, including service technicians for wind turbines, structural engineers, electricians as well as mechanical engineers, and did not want to also have to add programmers in order to guarantee the logic functions, of which there are only a few, but they are important." The WAGO system is easier to manage in this regard than competitive systems, which are very strongly aligned with industrial automation needs. "Additionally, we received very good support from WAGO for our first attempts."



Thomas Herrholz, CEO of Dark Sky GmbH



Sandy Schnitzer, Technical Director at Dark Sky GmbH

In Dark Sky's decentralized approach, a transponder receiver is installed at each individual wind turbine, and connections to the beacons are implemented directly on site.



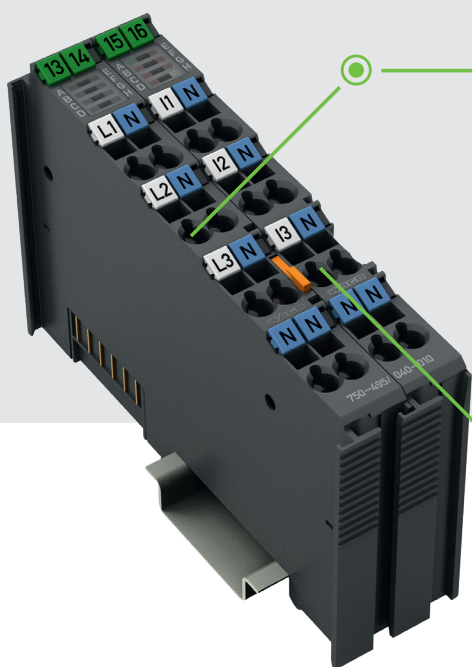
© Dark Sky

Retrofitting Medium-Voltage Switchgears with Measuring Technology – Easily and Inexpensively

The new 3-phase power measurement module for the WAGO I/O System 750 XTR can be easily integrated into existing medium-voltage switchgears, regardless of whether in a local network station or customer transmission station. It measures the electrical data of a 3-phase supply network in the medium voltage range up to 20 kV using voltage sensors per IEC 60044-7 (new IEC 61869-11) and current sensors per IEC

60044-8 (new IEC 61869-10).

With this module, existing switchgears can be expanded quickly and easily without extensive modifications. Integration into the flexible WAGO I/O System 750 XTR makes installation of additional devices unnecessary.



3 x U-sensor
per
IEC 61869-11

3 x I-sensor
per
IEC 61869-10



The benefits of the 3-Phase Power Measurement Module: measurement of important network parameters in medium-voltage systems, simple integration into existing switchgears, WAGO I/O System 750 XTR for harsh environmental conditions

(Item Number: 750-495/040-010)

The benefits of the PFC200 4G: wireless modem for LTE networks, space-saving combination of controller and cellular modem, high security to withstand unauthorized manipulation

PFC200 4G Controller: item number 750-8217

Magnetic-mount antenna: item number 758-975

WAGO PFC200 Controller with 4G Cellular Modem and Magnetic-Mount Antenna

WAGO's PFC200 Controller is now available with an integrated 4G cellular modem for communication within LTE networks. The great advantage of mobile communication is that data can essentially be transmitted worldwide. The further development of the proven PFC200 makes automation solutions with mobile connectivity future-proof. Combining a controller and cellular modem into one compact solution saves space in the control cabinet while offering several cybersecurity advantages because replacing or tampering with the modem is not possible. The new version of the PFC200 for LTE networks is particularly powerful thanks to G2 hardware. The 1 GHz Cortex A8 CPU offers ample computing power for complex control tasks. The PFC200 can connect to the Internet via the cellular modem. The mobile communication settings can be configured directly via the controller's Web-Based Management. The IEC 60870-5-101, -103 and -104 telecontrol

protocols, which are important for the energy industry, can be enabled on the controller.

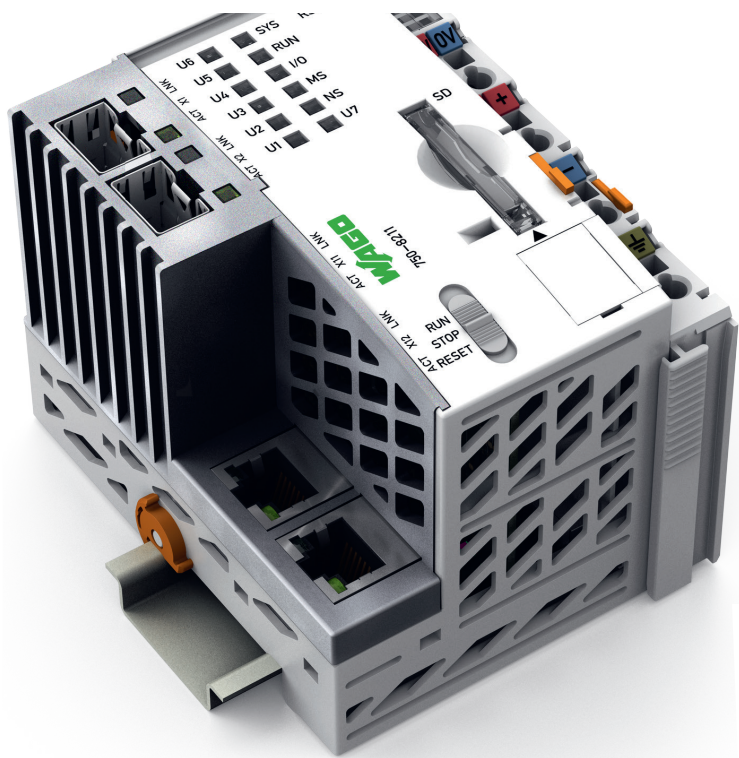
A magnetic-mount antenna with a 2.5 m connecting cable and an SMA right-angle plug is also available. The antenna supports the standard wireless technologies LTE, GSM, UMTS, *Bluetooth*® and WLAN. The following frequency ranges are supported: 698 ... 960 MHz, 1400 ... 1518 MHz and 1710 ... 2700 MHz.



plug is

This new second-generation WAGO PFC200 Controller features two additional SFP slots. The benefits: ports for different SFP modules, direct connection without an additional switch, ideal for high EMC applications or long transmission paths.

(Item Number: 750-8211)



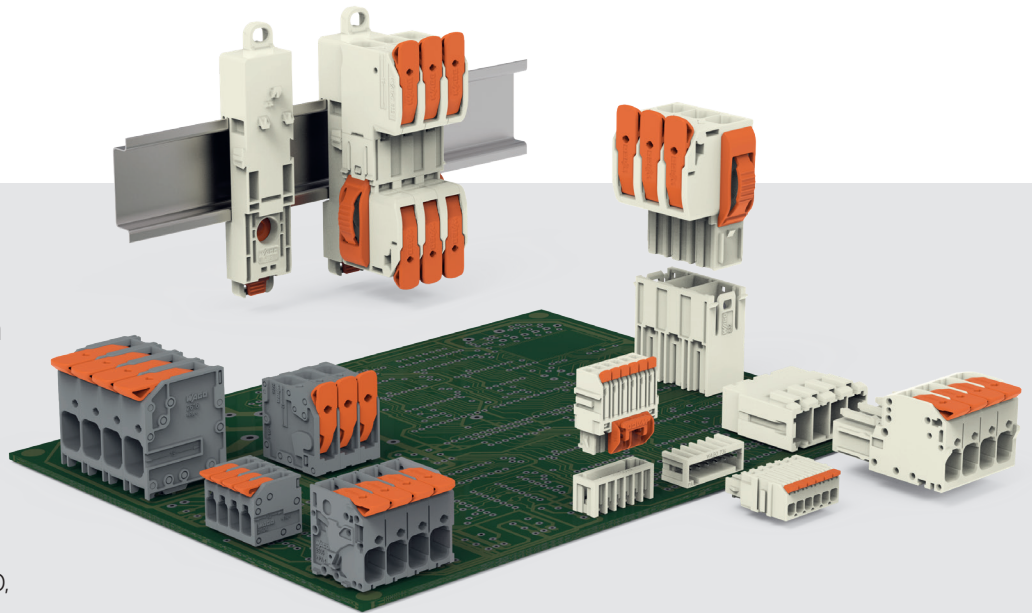
Flexible Connection of Fiber Optic Cables

Fiber optic cables excel at transferring data over long distances or in environments with many interfering electromagnetic signals. For such applications, WAGO has expanded its portfolio with this new PFC Controller model that dramatically simplifies fiber optic communication. The PFC200 has two SFP (Small Form-factor Pluggable) connection slots; SFP is a common IT interface. The PFC200 also has two RJ-45 ports for 100BASE-TX. Various modules can be installed in

the SFP slots (e.g., for connecting single-mode or multimode optical fiber), allowing LC connectors to be plugged into these. For users who need a fiber-optic network connection, the PFC200 eliminates the need for an additional media converter in the control cabinet.

PCB Terminal Blocks and Pluggable Connectors with Levers

From inverters to energy storage devices – WAGO’s interconnection technology for PCBs is used in applications in the energy sector. The lever technology, developed by WAGO, is universally self-explanatory for safe, tool-free and intuitive operation for a wide variety of conductor cross-sections. The lever technology is particularly well suited for connecting devices in the field.



Learn more at:
www.wago.com/pcb-connections-with-lever



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