NETWORKS OF THE FUTURE

EFFICIENT – RELIABLE – TRANSPARENT

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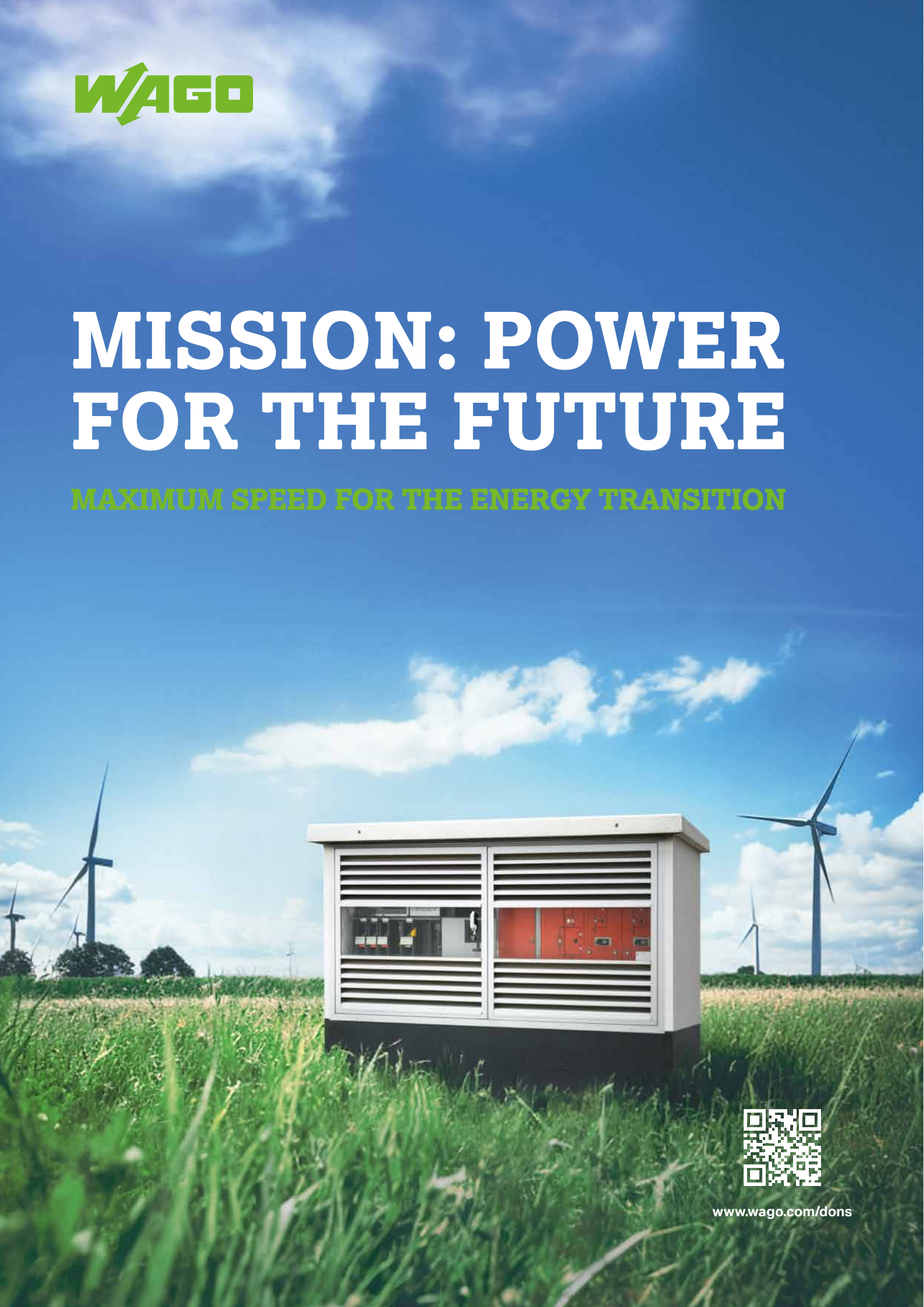
Protection for Critical Systems

MISSION: POWER FOR THE FUTURE

MAXIMUM SPEED FOR THE ENERGY TRANSITION



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WE ARE NETWORKING!

This is both a challenge and a motivation for the practitioners and experts who will meet this year for the 10th WAGO Smart Grid Symposium.

If the energy transition is to succeed, then networking will be more important than ever. This also applies to people, and it's linked to network digitization. Last but not least, preparation for § 14a of the EnWG will accelerate the pace of expansion. More data will be available as a result, which both opens up opportunities for making the right decisions at the right time, while also increasing the challenges of processing an ever-increasing amount of data in all segments of the energy sector – from heat, through water and wastewater, to electricity.

»WE HAVE TO KEEP THE BIG PICTURE IN MIND!«

At the moment, we need to keep the big picture in mind. Because it's not merely about a smooth technical rollout. Ongoing operations must be also ensured by continuous, automated updating, by proactive development of cybersecurity and, last but not least, by professional support for the customers in all of the energy segments.

WAGO traditionally produces strong, stable connections: both in practical technical applications, and also in professional exchanges, like the WAGO Smart Grid Symposium. Since the premiere ten years ago, we have provided a platform for more than 100 speakers. They have reported on their experiences, provided impetus, and offered exciting insights into current developments.

We cannot solve any specific challenges during these two days. But we can get closer. Reach out and network with each other to find workable solutions to meet growing challenges. How can we ensure transparent handling for all energy segments? How will we link individual sectors together in order to be able to use our resources more wisely? What opportunities will be introduced by integrating new technologies?

Digitalization is the foundation for the success of the energy transition. Our task now is to look into the future. We'll also be doing that at the 10th WAGO Smart Grid Symposium. When we are well connected, we are able to achieve sustainability faster.

Yours, Stephan Pufal
Local Industry Manager Energy at WAGO

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THE CONSEQUENCES OF THE CLIMATE CRISIS IN GERMANY ARE INTENSIFYING

From the Third Monitoring Report 2023 on the German Adaptation Strategy to Climate Change

Germany is regularly experiencing heat waves, is becoming warmer overall and is losing water. This is presented in the Monitoring Report from 2023 on the "German Strategy for Adaptation to Climate Change" (DAS).

According to this, we are one of the regions with the highest water loss in the world. Since 2000, the country has lost 2.5 cubic kilometers of water per year.

The continuing drought, caused by climate change, has led to a marked deterioration in the state of the forests. In 2020, 20 times as many spruces died as compared to the average of the previous ten years (2010-2019). The extremely dry weather also contributed to the occurrence of significantly more and larger forest fires. In agriculture, the water shortage led to noticeable crop losses. In 2018, for example, winter wheat yields were 15% lower and the silage maize yields were 20% lower when compared to the average of the previous six years.

Federal Environment Minister Steffi Lemke says, "The devastating consequences of the climate crisis are in-

creasing at an alarming rate. The current monitoring report clearly shows this. Increased numbers of storms, heavy rain" with large amounts of precipitation, rapidly rising water levels and floods, as well as "periods of drought and heat waves, which affect people's health, the ecosystems and the economy."

There are measurable ecological consequences associated with environmental warming and the loss of water: warmer seas are displacing fish species' habitats northwards. Species native to the North Sea are migrating to the northern waters. At the same time, species from more southerly waters are moving in. Warming is also leading to a change in species composition on land. This can be seen, for example, in the data on birds and butterflies. New species migrate in from warmer regions, which can cause health issues for humans.

Germany must prepare for extreme weather events. "Higher average temperatures will cause more weather extremes, that will also be more intense. The greatest increase will be in the number of particularly extreme and dangerous weather phenomena. The potential damages caused by extreme weather can thus also significantly increase. Germany must correctly prepare for this at an early stage." (Dr. Paul Becker, Vice President of the German Weather Service, 2017)

The monitoring report on the German government's DAS provides information about climate impacts and adaptation based on measured data, and describes the changes that have taken place in the past and present. The technical foundation of the monitoring report is based on cooperation with more than fifty federal and state authorities, universities and professional associations.

Source: Federal Environment Agency, www.umweltbundesamt.de, 30.07.2024

„In a world full of challenges, there is no alternative to the sustainable use of our resources. It is our duty to the environment and a strategic choice for our future, our prosperity and the security of future generations.

For companies and individuals alike, sustainability has long since ceased to be something that "can" be considered, it is now crucial that it "MUST" be. It is the key to not only surviving, but also for living a full and prosperous life.

We are shaping the world of tomorrow today – and that means making sustainable decisions to protect our planet and ourselves."

Claudia Kleinert,
Moderator, Speaker and Coach

GRID CONDITION MONITORING ACCORDING TO § 14A MADE EASY

Scalable steps toward a tailored solution for implementing § 14a of the German Energy Industry Act (EnWG)

There are more than 600,000 local network substations in Germany, managed by almost 900 grid operators – and few actually know what is happening on the other side of the transformer in their low voltage networks. A course has long been set for digitalization, at the latest since § 14a in the Energy Industry Act (EnWG) became applicable. This is because the number of decentralized producers and consumers, both those already been connected and those still to be connected, has grown enormously. The quantity of heat pumps alone has doubled in the last few years. The market for e-vehicles is booming. 2.6 million PV systems feed energy into the grids, sometimes more, sometimes less, depending on the weather.

The number of balcony PV systems, which are now readily affordable, tripled to 300,000 registered within a year.

Yet what happens in the depths of the networks?

The numbers make one thing clear: a lot of activity occurs in the grids over the last few meters. Substations could reveal exactly what is happening there – if they were digitized. However, without reliable data, it is difficult to make sound decisions as to whether an expansion is necessary or if alternative technical measures could be used. In fact, operators must rely on login data and last year's consumption in order to estimate whether the grids will be able sustain

a requested output in the future.
The greatest risk lurks in older streets, in established neighborhoods.
That, which can be calculated in new construction areas at the planning stage, is more difficult when retrofitting older buildings on streets that typically encompass 20, 30 or 40 buildings with only one connection point. Our standard load profiles, which could be calculated for decades with their predictable loads, are now worthless for future-oriented assessments.

Power Dimming Conditions

This puts grid operators in a tight spot: the low-voltage outputs must be measurable precisely one each line. Only then can § 14a be implemented – which regulates power dimming.

This regulation makes it possible to dim power consumption levels in the event of a network overload. The sheer volume of data to be processed for this purpose clearly illustrates that this can ultimately only succeed with the help of digitalization. From the outset, it also requires a lot more IT and OT than is usually available now. "Networks must be optimized, digitized and expanded (...) at a high rate," remonstrates the Federal Network Agency. They are currently not designed for a fast start-up.
So, what is there to do? Put all your eggs in one basket and wait for the day when dimming is necessary in order to force a potential expansion the network under time pressure and at higher costs?

Or take a more relaxed approach, and equip the grid with transparent, future-oriented means and measures, in order to gradually expand while avoiding brownouts.

These are the questions that network operators are asking themselves in light of current challenges. These challenges are massive: the necessary change to digital meters and smart meters, the conversion from L-gas to H-gas, ensuring a drinking water supply that is free from interruptions in the face of extremely fluctuating groundwater levels – and, last but not least, implementing the provisions of § 14a of the EnWG that took effect on January 1 of this year.

The Path to "Network-Oriented" Control*

Since it has rectified § 14, the Federal Network Agency is now obligating grid operators to abide by the law.
In the future, the mere apprehension, that the grids might be overloaded, will no longer be accepted as a basis for intervening in network operations. Instead, network operators must prove the necessity based on collected data. § 14a specifies the configuration options for this "network-oriented control." The prerequisite for this is comprehensive digitalization. The Federal Network Agency is using this status to take a bearing for 2028.

§ 14a EnWG

WAGO clears a path for implementing § 14a.

§ 14a of the EnWG is in effect. The increasing number of distributed producers and consumers is causing increasing fluctuations in the power grid. But what is really happening in the depths of the networks?

As flying blind could negatively impact the reliable supply of power, grid condition monitoring can provide initial assistance. The technical design is handled by a group of experts from VDE FNN (Network Technology/Network Operation Forum). WAGO is part of this group – and has solutions ready for grid operators to implement § 14a.

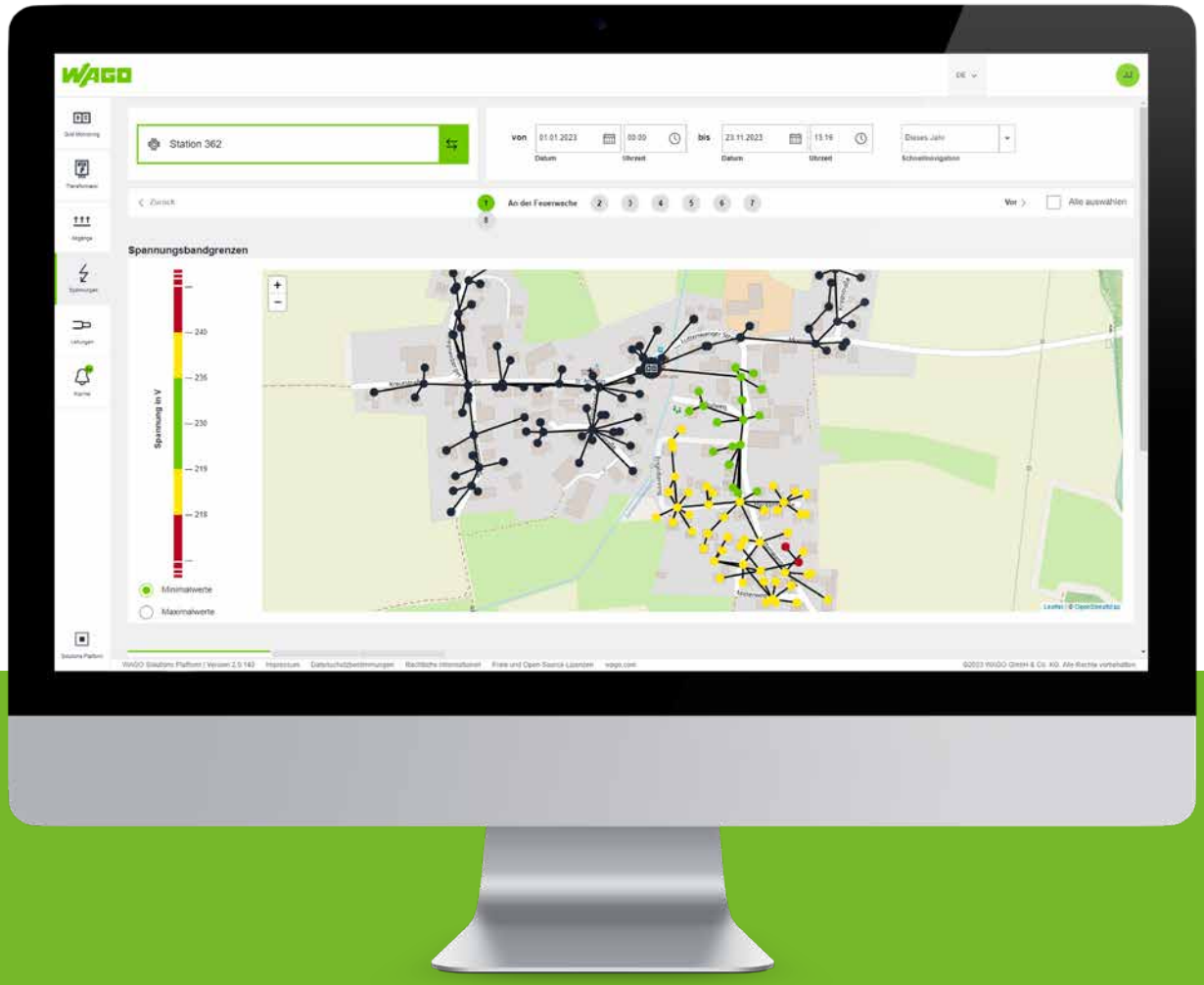
Until then, the smart meters installed in residential houses should provide individual network status data via tariff use case 10 (TAF for short). The smart meter gateways function as decentralized communication points: they digitally record the necessary data at one-minute intervals, transmit this data, and in turn, receive control commands from the metering point operation. However, such a target model cannot be comprehensively implemented from one day to the next. This is partly a function of the cost factor linked to intelligent metering systems. On the other hand, the required infrastructure is complex, as it requires a large number of interfaces in addition to IT and OT.

Precautionary Control Interventions

For this reason, § 14a of the EnWG provides network operators with a transitional period. The so-called "preventive control" allows operators to intervene in their network operations as a precautionary measure until 2028 at the latest. This should facilitate the transition to digitalization. At the same time, any intervention by the grid operator has consequences. Following such an intervention, the operation has only two years to completely switch to network-oriented, digitalized control. Therefore, "network-oriented control" must necessarily be derivable from objective criteria: criteria that arise exclusively from grid condition monitoring. This is the only means for providing the actual current network load of the equipment and compliance with the voltage band. As a key for implementation, "grid condition monitoring" is a mandatory component of § 14a. It is particularly well-suited for those network operators who plan to prudently approach the challenges of § 14a of the EnWG. WAGO facilitates the required determination of the network state by monitoring the transformers and their outputs.

Grid Condition Monitoring – Is It Futile without Transformer Data?

This solution operates in the WAGO Solutions Platform. It offers a server-based platform that can be hosted in both the cloud and on site, and also functions as hybrid solutions that exploit simple plug-and-play formats. It enables remote management of the substation hardware. Relevant security updates can be easily executed at any time. As part of the WAGO Solutions Platform, WAGO Grid Monitoring enables observation of all relevant parameters in the low-voltage network. The most important measuring points can be recorded using WAGO hardware. Both transformer data and output data flow equally into the grid condition monitoring, which is particularly relevant.



In addition, the voltage applied at the nodes is calculated using standard load profiles and weather data.
This data is used, along with geodata, cable length and cable types, as the basis for calculating the load of all the lines in the network. The result is an overall network analysis that facilitates the prediction of bottlenecks. The objective criteria, required by § 14a of the EnWG in case of a necessary reduction in power in the grid, can also be established with WAGO solutions.

Identifying Weak Points for Targeted Retrofitting

WAGO also supports grid digitalization that is meets demands and is proportional to needs. According to current legislation, if the values at the transformer outputs are included in grid condition monitoring, smart meter data from only 7 percent of households, instead of 15 percent, needs to be used for calculations. The data collected in this way makes a constructive analysis even more precise. Alarm thresholds are set for automatic notification about critical events. Visualization provides quick overviews for more than just those moments. Weak points can be identified early on, and remedied one by one in a well-planned and tailored fashion. These are measures that effectively limit the costs of grid expansion.

WAGO Grid Monitoring can be quickly connected through simply parameterization. The software is easy to understand and intuitive to use. WAGO offers several solutions, both in the cloud and also on site, which ensure operation in a closed network, as is often preferred by network operators. Control is implemented using a hybrid solution consisting of a server-based application and a controller app, which both satisfy the highest security requirements from the first click. All updates, both software and firmware, can be carried out remotely via the WAGO Solutions Platform. This provides an advantageous overview, especially for large projects. In light of the major changes facing the energy market, this is a "must" for everything from mass handling to simple provisioning. In order to be optimally prepared for this, it is worthwhile to begin digitization or targeted expansions networks now.
To facilitate your path to the smart grid, WAGO offers an entire portfolio from a single source – from measurement hardware at the transformer up to a cloud platform and grid condition monitoring – as a foundation for targeted development and individually scalable solutions that contribute to the necessary network-oriented control of your grid.

What is the VDE FNN?

The FNN (Network Technology/Network Operation Forum) defines the technical rules for electrical grids in Germany. The proactive development of these networks is at the heart of the undertaking, as they must be able to meet the challenges of the energy transition.

Manufacturers, grid operators, system operators and scientific institutions are working together to identify and configure technical solutions in a timely manner.

As a member of the VDE FNN's Network Status Assessment Project Group, WAGO brings its years of expertise in the digitalization of local network stations to the table, and offers its customers the best options for getting networks ready for the future: according to their needs, individually configurable and scalable – from the hardware at the transformer, through monitoring, up to grid condition monitoring.

The first joint project was a glass substation for the 2014 E-World trade fair in Essen.

THAT'S ART!

WAGO AND INGENIEURBÜRO PFEFFER: EXPERT ACCOMPANIMENT FOR CUSTOMER TRANSFER STATIONS

They aren't eye-catching. But every electrical customer with an increased demand for energy – regardless of whether they are a shopping center or a manufacturing company – is connected directly to the distribution network operator's medium voltage by a customer transfer station.

The demands on such projects have been growing over the years, because it's no longer enough to merely supply electricity. Increasingly, for example, surpluses from renewable energy generation must be fed in, heat pumps need to be connected or a charging infrastructure integrated. In order to be able to regulate and control all of this, additional measured values must be recorded and processed in continuous operation – which itself requires uninterrupted communication with the network operator's control system. This cannot function without sophisticated software in the background.

Marco Genehr describes the work of the Ingenieurbüro Pfeffer [Pfeffer Engineering Office], "Our daily work is to design local network stations and customer substations that consistently satisfy extant standards." And this is actually quite a challenge. The specialists from Rödermark design and plan customer transfer stations (KÜS) of any

size, from "small to huge". The VDE-TAR-N 4110 Technical Connection Rule specifies the general conditions for the design of customer substations. This is supplemented by the different, individual technical connection conditions (TCCs) for grid operators. At between 20 and 150 pages, TCCs include additional specifications for technical installations in these transfer stations for the almost 900 network operators throughout Germany.

Marco Genehr from Ingenieurbüro Pfeffer approaches this mammoth task with a lot of experience – and even more questions. "This approach is comparable to planning construct a house. Basically, someone just wants to live somewhere. Our customer simply needs a KÜS. The decision, as to whether this becomes, figuratively, a normal house or a smart home, is based on individual needs, requirements and possibilities."

For example, how much power does the existing or planned machinery need? Do renewable energy generation plants need to be integrated? How many low-voltage rings are required? The transfer station is developed from these specifications, precisely as the customer needs. Genehr keeps the supplier's TCC firmly in mind at every step of development. If necessary, WAGO is also on board from the very beginning, because every KÜS that is connected using telecontrol technology contains telecontrol and control components from WAGO. "A lot of expertise is required during commissioning at the latest." Ingenieurbüro Pfeffer and WAGO bundled their expertise more than ten years ago to achieve optimal results. The first jointly planned project was a substation in 2013, made from glass, which became a highly regarded exhibit at that year's E-World Energy Trade Show in Essen. Since implementing their first projects, the demands on planning and implementation have only increased. Marco Genehr compares this to the development from the slide rule to the PC.

"If, for example, a substation still used the standards applied to a slide rule ten years ago, we have now arrived at the PC level." As a result of the rapidly growing technical requirements, systems have become significantly more complex and have grown in content. Project planning today is significantly more time consuming. "As early as the first planning steps, the control tasks must be identified that will be implemented when operating the KÜS, both now and in the future." The more precisely these specifications are formulated, the better. "Exact performance specifications accelerate the planning process." Additional performance reserves are included as buffers.

Subsequent expansion options are also taken into account. "And last but not least, good planning always keeps an eye on the cost aspect, which should not be exceeded. Finally, we begin to prepare the technical documentation for the construction of the system." This addresses those details. At this point, decisions are made regarding which transformer is installed, what the correct protection looks like and so on. In addition to telecontrol hardware, WAGO also supplies the software that is responsible for communicating with the network operator. WAGO Application Customer Substation ensures easy connection of each customer

transfer station to the energy supplier's control center. The foundation is standardized and equipped with software that is pre-configured for a wide variety of network areas. As a universal "out-of-the-box" solution, it offers the greatest degree of usability and simplicity. In addition to the required communication protocols, it also includes the cybersecurity required in this area. "The KÜS is commissioned by the WAGO Application Customer Substation via parameterization, using an easy-to-understand visual user interface. This is as simple as it is effective. The user does not require any programming knowledge; however, certain basic knowledge of telecontrol technology is


© Ingenieurbüro Pfeffer

important. You need to know which parameters need to be set," explains Genehr, referring to an important issue – the shortage of specialists. "This trend is becoming increasingly obvious in the field of power engineering, especially in relation to station technology and telecontrol technology."

To keep a close eye on the future, Ingenieurbüro Pfeffer is working together with the Darmstadt University of Applied Sciences in the Smart Grid LAB in Hessen to research the changes that result from new energy flows. "Network configurations and changes can be simulated in the lab." Load curves can be extrapolated and energy flows simulated under a wide variety of conditions. The goal is to recognize how future loads will flow in the network before they are generated, and to correspondingly expand the grid so that it meets the requirements of the energy transition in the next decades. "These flows must be optimized, especially in the local network area."

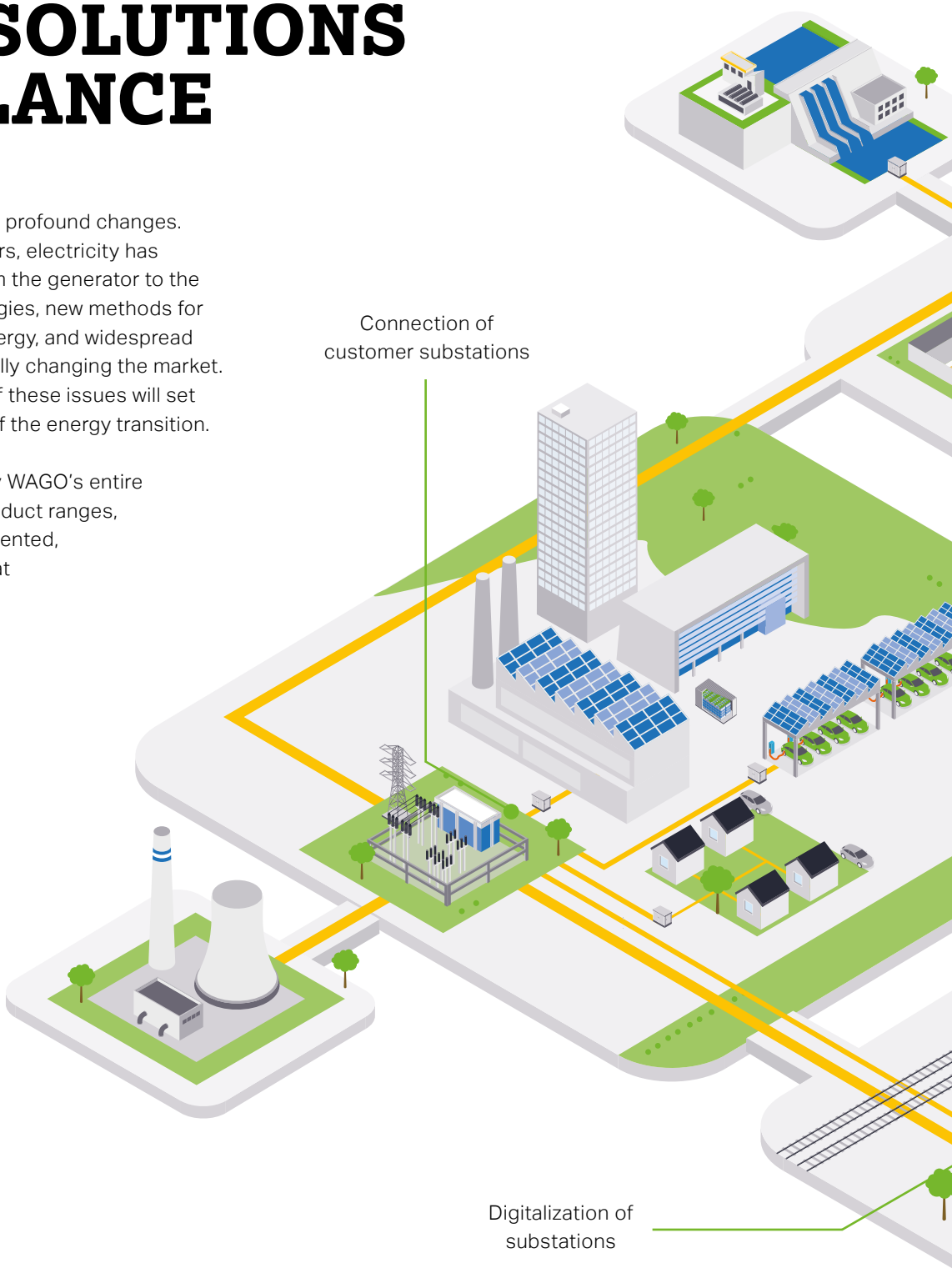
Optimizing the planning and implementation of customer transfer stations is a common concern for Ingenieurbüro Pfeffer and WAGO. Both provide their expertise, support and service for this – even after successful commissioning of the customer transfer station.

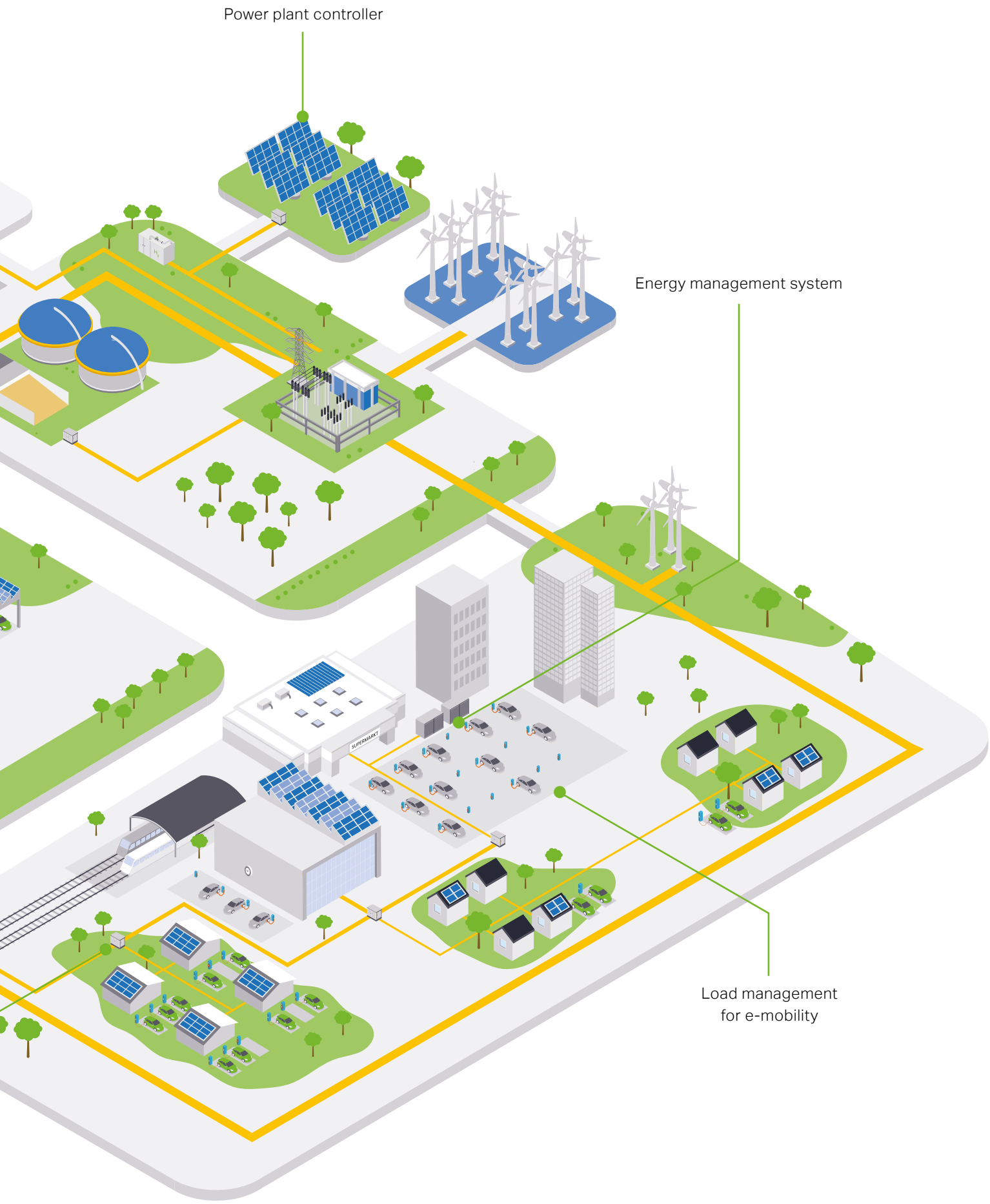
»Our daily work is to design local network stations and customer transfer substations that consistently satisfy extant standards.«

WAGO SOLUTIONS AT A GLANCE

The energy industry is facing profound changes. For more than a hundred years, electricity has flowed in one direction – from the generator to the consumer. But new technologies, new methods for generating and procuring energy, and widespread digitalization are fundamentally changing the market. The successful integration of these issues will set the course for the success of the energy transition.

This process is supported by WAGO's entire portfolio of products and product ranges, in order to develop future-oriented, groundbreaking solutions that span all industries from individual challenges.




Power plant controller
Energy management system
Load management
for e-mobility
SUPERMARKET

»CONCENTRATED EXPERTISE FOR STABLE NETWORKS.«

Partnerships: Overcoming Challenges Efficiently and Reliably

If we want to stop climate change, the energy transition must succeed. This requires innovative solutions; however, critical infrastructure, in particular, presents challenges. Stefan Döbbe, Head of IT for the IT system partner Telemark, draws a dramatic comparison:

»Water management is a vivid example. We are increasingly struggling with incidents of flooding. Livelihoods depend on it, human lives. There is nothing that demonstrates more clearly how important it is to continuously measure and monitor water levels.«

Does this apply to all networks in your opinion? Our power grids, too?

»Yes, the example can also be transferred to our electrical grids. Digitalization is absolutely necessary. And as soon as and as widely as possible.«

Why the rush?

»Up until now, we have been proud to have our networks under control. However, until now, electricity has always flowed in only one direction: from the producer to the customer. Today, the number of producers has multiplied due to PV systems and other possibilities. We need to be able to bring unpredictable amounts of electricity into the grids, while meeting fluctuating needs. Because eventually we'll hit the end of the line. Therefore, we must be able to prevent grid overload – and, where required, dimming according to § 14a of the EnWG.«

What does a quick initial response look like?

»Only digitalization based on sensible, carefully executed expansion planning can help.«

And on the horizon?

»... we must clarify when and where the energy is used. In order to answer this, we need to map the energy flows in the network using IT technology.«

What is Telemark doing to implement this requirement?

»What is needed is software development in conjunction with Smart Services. We offer this as a complete package. To achieve this, we rely on sustainable, reliable partnerships, like that with WAGO. Together, we have implemented several hundred projects over the past ten years. For suppliers like municipal utilities, and disposal companies or commercial enterprises. All those who deal with gas, water, district heating and/or electricity benefit from Telemark's comprehensive expertise, as well as WAGO's background in development.«

What are the advantages for the customer?

»WAGO provides complete control cabinet solutions tailored precisely to the needs of the energy sector. Combined with Telemark's security solutions, this creates a service offer that is highly efficient for end customers and meets all requirements for critical infrastructure protection (KRITIS).«

Stefan Döbbe,
IT Manager for IT System Partners
Telemark

As a partner, what is your specific approach to a new project?

»We create a catalog of requirements, together with the customer and our partner. This is an intensive process that we carry out on site at the customer. We then develop a prototype together, starting from these requirements. WAGO supervises the implementation. If the project is standardized, Telemark carries out hardware installations as needed, adjusts the parameterization, coordinates and supports ongoing operation as requested, up to regular maintenance and servicing.«

What are the key challenges within these projects?

»Timely, future-oriented software solutions that must be flexible and adaptable. WAGO speaks the various protocol languages and provides the software. WAGO Application Grid Gateway offers a set of solutions that integrates changes and configurations – both for older and existing substations and also for new construction. After parameterization, the programmable logic controller (PLC) transmits measurement data to the network control system in one-second cycles. This includes data about the medium voltage, the transformer, the low-voltage outputs, position messages and temperatures. External measurement technology can be parameterized for a multitude of other data and commands – such as short circuit and ground fault direction indicators or power quality measurements.«

A lot of data goes back and forth. How do you ensure cybersecurity?

»With DIN ISO 27001, we have achieved the necessary certification for digitalization in critical environments. The advantages for customers lie in the combination of digitalization and security expertise – from development, through commissioning, up to updates during continuous operation. Telecontrol and remote control provide the ability to continuously update systems for longer periods of time, while keeping the expense for network operators low.«

What happens in the future? What are the potentials and possibilities for securing the energy supply?

»Today, all deliberations go beyond mere network expansion. We cannot continue to operate our networks piecemeal into the future. We must make point control possible. We need predictions. Network control in the future must be based on data models. We need to be able to predict where something needs to be done. And if the energy transition is to succeed, we will need AI (Artificial Intelligence). There is no way around this.«

FOR MONITORING CHARGING PARKS

STAY CONSISTENTLY UP-TO-DATE WITH WAGO CHARGING PARK MANAGEMENT

The WAGO Solutions Platform simplifies project planning, commissioning, monitoring, visualization and control of multiple systems through its growing number of cross-device applications. For instance, the new WAGO Charging Park Management App plays a key role in the simultaneous management of multiple or larger charging parks. It expands upon the WAGO Application Load Management, which regulates individual charging stations.

WAGO Charging Park Management consolidates key information for larger charging parks into a single, real-time view of their current status. Despite the complexity in operating all of the individual charging points, the app remains user-friendly, intuitive, and efficient. Even employees without technical expertise can easily use the parking lot overview to view the charging point assignments at any time. This app focuses explicitly on customer service. The WAGO Solutions Platform streamlines the administration, operation and management of charging parks, making it ideal for managing a larger number of charging points. It allows users to create overviews of current charging point availability, and link them to charging park data. This allows for easy monitoring of parking lot conditions and potential error messages.

All of this is possible without needing to log into a single controller. A central website provides all the necessary information for smooth operation, which means that relevant data is available online, around the clock, from anywhere in the world. Any user who is granted access can remain informed about the charging infrastructure status.

For simplified service, scenarios can be preconfigured in the WAGO Charging Park Management system to trigger automated alarms when certain conditions occur. These conditions could include user-defined limit values, such as maximum charging park occupancy or other special circumstances. Technicians can remotely adjust the configuration of the charging park, ensuring flexibility. Additionally, the intuitive overview of all key performance parameters facilitates easier maintenance. WAGO Charging Park Management also enables comprehensive monitoring of energy flows. This includes tracking consumption data for one or all locations, as well as the status of the connected charging points. The performance data of the charging points and energy meters, configured in the app, is also included in the charging park's performance monitoring.

By using the data overview provided by WAGO Charging Park Management, users can optimize the use of available capacities. The data also enables operators to make informed decisions on expanding the charging infrastructure. Traditionally, the configurations necessary for commissioning a charging park could only be carried out on-site by experts. With the help of the WAGO solution, time-consuming and labor-intensive assignments on site are a thing of the past: the entire configuration of the charging park can be carried out remotely from the office, inde-

pendently from the commissioning process.

The setup of WAGO Charging Park Management is easily completed by scanning a QR code through the WAGO Solutions Platform. The application runs in the cloud or on-site.

TRANSPARENCY IN THE SUPPLY NETWORK

Knowing the energy flow at the medium-voltage level is crucial for stabilizing a supply network. Therefore, the Rümlang electrical utility relies on a monitoring system that works with real-time data from the transformer stations.

Renewable energies are one reason why it is becoming increasingly difficult for energy suppliers to assess the quality of their networks.

"Our supply network was originally built for one-way traffic, and everything flowed in one direction," explains Managing Director Willi Flükiger from Rümlang, adding, "with the supply of decentralized energy, we suddenly have completely different load ratios in the network. These make it difficult to keep the voltage stable."

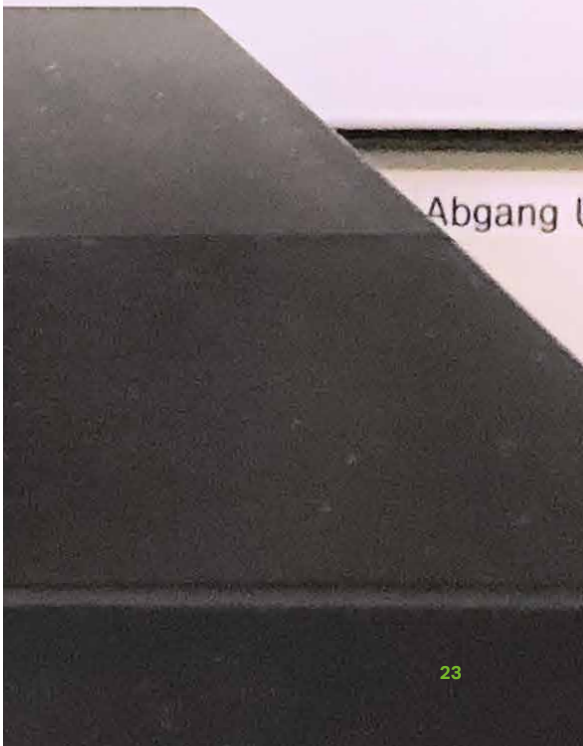
The inverters in photovoltaic systems, which feed solar current into the grid, are primarily responsible for these quality fluctuations. Since these are clocked, the feed in is associated with massive interference. Another reason is the increase in e-mobility. Since the vehicles are not charged at a defined

time, but rather when their owners consider it necessary, it is very difficult to predict the associated energy demands and flows.

Reliable Measured Values in Real Time

So how do you get a grip on these changing load conditions? "In order to maintain voltage stability, we need reliable measured values from our transformer stations," explains Flükiger. The problem is getting to this data easily! Regularly sending an employee to the transformer stations to record the performance data is time-consuming and expensive.

In addition, the measured values are sometimes no longer current by the time the employee makes their rounds. If, for example, the sun breaks through the clouds on rainy day, the solar panels will suddenly surge into production, and any data collected prior to this event will be worthless. Since there are now many companies in Rümlang that operate high-performance photovoltaic systems on their roofs, this type of weather volatility requires real-time data for a reliable response.



The transformers are monitored in real time.

A reliable reaction time was made possible by replacing the coax cable network in the municipality of Rümlang. In this process, Brütsch Elektronik AG incorporated all of the transformer stations into the new fiber optic network, creating the prerequisite for real-time monitoring and reactions. "However, a fiber optic network is not a criterion for remote access," asserts Pascal Klingele from the Rümlang electrical utility. According to the system engineer, a neighboring community also wants to access its transformer stations remotely, but plans to do so using a different transmission medium. In Rümlang, they decided on a fiber optic network because the compact network structure guaranteed a low level of underground construction, and the smart meters above it should also continue to be read out in the future.

Expertise Ensures Project Contract

Why did the Rümlang utility not choose a vendor from the local area for this project? After all, Beringen is about 35 kilometers away and does not necessarily have ideal traffic connections. "Brütsch Elektronik AG has an excellent reputation and has already installed various similar solutions in the power plant sector. We were looking for a company like that," Flükiger explains the decision. Klingele also cites Brütsch Elektronik AG's approach, with a solution based on WAGO hardware, as another reason for awarding the project: "The PFC200 Controller is scalable and flexible in use. This allows connection without high initial costs."

The PFC200 Controller reliably collects all sensor data in the transformer stations and transmits it securely via a telecontrol protocol to the control center, where the data is visualized. "We know what voltage is present and what type of current flows at what frequency in every medium-voltage line in the supply network of the Rümlang utility," says Martin Triet. According to the Automation Team Leader at Brütsch Elektronik AG, even the values of reactive current and apparent power are recorded and can be viewed at any time. In addition to this data, the controller also transmits the room temperature in the transformer stations and the transformer temperatures. All switch positions and the status of the protective devices are also documented. Water level sensors provide additional safety.

Data Foundation for Further Optimizations

For Flükiger, this variety of data is the greatest benefit." Based on single-line diagrams, we now monitor the entire supply network and trigger alarms via stored limit values." Another advantage for the CEO is the seamless documentation of the network status, which is relevant for claims for damages, among other things. Flükiger explains exactly what this means using the example of a lightning strike, "If it comes from another network, we can now clearly prove it."

Commissioning of the grid control system came off as planned. After the first transformer stations were integrated and providing data, the next step was using this data to make the supply network and its expansion more efficient. Dominik Haas is considering threshold value monitoring, which can be used to switch transformers on or off, in a targeted way, to reduce conversion losses. "The data obtained serves as the basis for our model calculations, from which we can derive various optimization measures," he concludes.

From left: Pascal Klingele, Beat Büchler, Dominik Haas and Willi Flükiger

WAGO AND RADIFLOW: A PARTNERSHIP TO STRENGTHEN OT SECURITY.

WAGO and Radiflow plan to pool their expertise in the near future: as a specialist in operational technology (OT) cybersecurity, Radiflow offers globally successful cybersecurity solutions and services for critical infrastructure and industrial automation. Together, WAGO and Radiflow aim to enhance resilience against potential cyber threats and to provide the greatest possible security for OT networks in critical infrastructure and industrial environments.

In an interconnected world, cyber threats are more acute than ever. This presents companies with great challenges. Cyberattacks on OT networks, systems and devices can disrupt operations, jeopardize security, and lead to substantial financial losses. Radiflow's innovative cybersecurity software solutions are integrated into WAGO's industry-leading products and services.

Enhanced Threat Detection:
WAGO Cybersecurity Network Sight software is based on iSID from Radiflow and enables real-time monitoring and detection of anomalous network behavior. Continuous monitoring helps companies identify cyber threats at an early stage and respond to them as quickly as possible.

Increased Security through Network Segmentation:
WAGO Cybersecurity Analysis, based on Radiflow's CIARA, is an automated risk assessment and management platform for companies in the industrial and building sectors. On the basis of the analysis results, users can implement robust network segmentation strategies and minimize the risk of unauthorized access.

Inventory and Risk Assessment:
WAGO Cybersecurity Analysis is used to tailor resource management for a specific customer and carry out a risk assessment. This allows companies to take an updated inventory of implemented OT measures, proactively identify vulnerabilities, and measure the effectiveness of risk mitigation strategies.

With this end-to-end approach, WAGO and Radiflow will help companies reap the maximum benefit from Industry 4.0 while minimizing the risks associated with cyber threats.

»Protection for critical systems.«

Kilian Fröhlich,
Manager in OT Security Consulting
at WAGO

The EU has recently introduced new directives to strengthen cybersecurity, such as the Cyber Resilience Act (CRA) and the NIS 2 Directive. What should companies consider when implementing security measures?

»Companies need to monitor both their OT and IT networks and implement a comprehensive security concept, as required by the NIS 2 Directive.

With the WAGO Cybersecurity Analysis, we offer an innovative tool based on Radiflow's CIARA that identifies threats, assesses risks and facilitates the derivation of targeted security measures, like network segmentation.

The platform also supports continuous monitoring and adaptation of security strategies to ensure compliance with international standards such as NIST, IEC 62443 and ISO 27001.«

How can the insights gained from the analyses be best implemented?

»The findings from these analyses should be translated into concrete security measures and implemented, for example, using robust network segmentation strategies. This includes, among other things, hardening systems, implementing security updates and patches, and adjusting network configurations. Companies can use the insights gained to continuously monitor and adapt their security strategies as necessary.«

For some, this will all sound like a significant expense. What advice would you give to these companies?

»Proactive action is crucial to prevent long-term damages and downtimes.

We advise companies to address the most significant security vulnerabilities first and then gradually implement further measures. It is important to first identify what is in the network – as I can more effectively protect that which I can see. At WAGO, we stand by our customers with advice and guidance and offer comprehensive support.«

Read the complete interview in "Computer & Automation" 9/2024.

A TAILWIND FOR THE HYDROGEN INDUSTRY

AUTOMATED TEST SYSTEMS OPTIMIZE HYDROGEN ELECTROLYSIS STACKS.

Hot on the heels of the fourth industrial revolution – the digital revolution – the German economy is already undergoing another transformation. The goals: consistent use of renewable energy, integrated electrification in production and mobility, and the establishment of a new hydrogen economy. The good news is that both the necessary expertise and the innovative products are available for this transformation. This is demonstrated by an automated test system for optimizing electrolyzers.

All the forecasts agree on one point: As we transition to a more sustainable economy, the demand for green hydrogen will increase significantly. In addition to today's large consumers of hydrogen, such as in ammonia or methanol production, steel producers will also be expected to reduce their emissions of climate-damaging greenhouse gases in the future by using green hydrogen directly in their blast furnaces for processing iron ore. Studies show that, in Germany alone, completely substituting hydrogen for the coal or coke used in steel production would increase the demand for hydrogen by 2.4 megatons per year. This corresponds to an energy equivalent greater than Belgium's electrical consumption for an entire year. An enormous demand! In addition, there

are also plans to operate airplanes, heavy-duty transports, and overseas ships with hydrogen from renewably generated electricity.

The European Union has also recognized that steps need to be taken quickly to realize this type of a huge hydrogen economy. Last year, the EU competition regulators allowed the member countries to promote the development of the hydrogen industry with up to 5.4 billion euros. Economists expect this government funding to be leveraged into an additional private investment of almost nine billion euros. When discussing such vast sums of money, it is not surprising that a certain euphoria for hydrogen-generation has erupted. The number of companies that store or transport the gas, or offer solutions for its distribution, is growing. And the number of people working on the core of hydrogen production, the electrolysis stack, is also increasing. Dozens of cells are combined into so-called bundles. Within the bundles, electrons supplied from photovoltaics and wind energy split purified water into its components: 1.25 megawatts of output per hour generate more than 20 kilograms of hydrogen at an output pressure of 30 bar.

The Competition Begins

The intricacies of electrolysis stacks are now being polished in anticipation of the enormous production quantities expected and the gigantic size of the market. Power density, H_2 output pressure, flexibility, space requirement, durability, operational reliability – the list of differentiating features is long. Every manufacturer wants to increase the quality and yield of their systems, while simultaneously keeping them as inexpensive as possible. However, in a complex system with hundreds of parameters, how can you evaluate the impact of one single, seemingly insignificant, change?

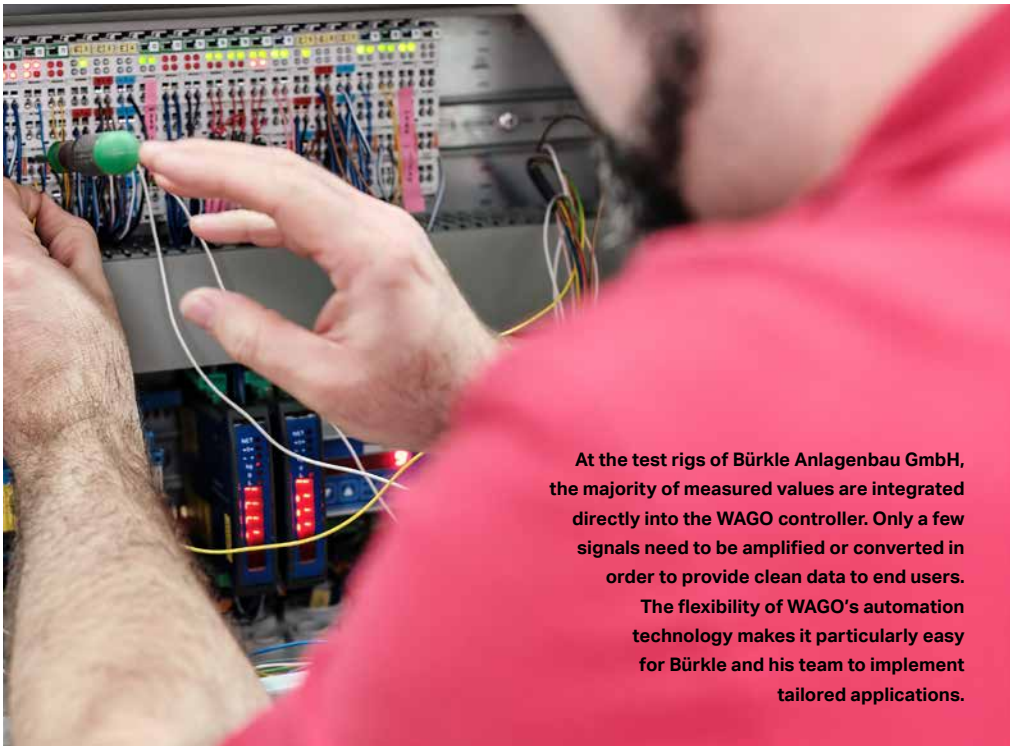
One person, who is especially familiar with calculating the performance of electrolyzers is Jörg Bürkle. The current CEO of Bürkle Anlagenbau GmbH from Stuttgart, he began his work in hydrogen technology at the German Aerospace Center (DLR) in Stuttgart. More than ten years ago, he began to study the topic that would become his foundational work. "As part of our research, we learned what it takes to be able to evaluate different parameters of an electrolyzer," reports Bürkle. His company, which he founded only a few years ago, already produces measuring stands and test rigs in small batches.

Research Laid the Foundation

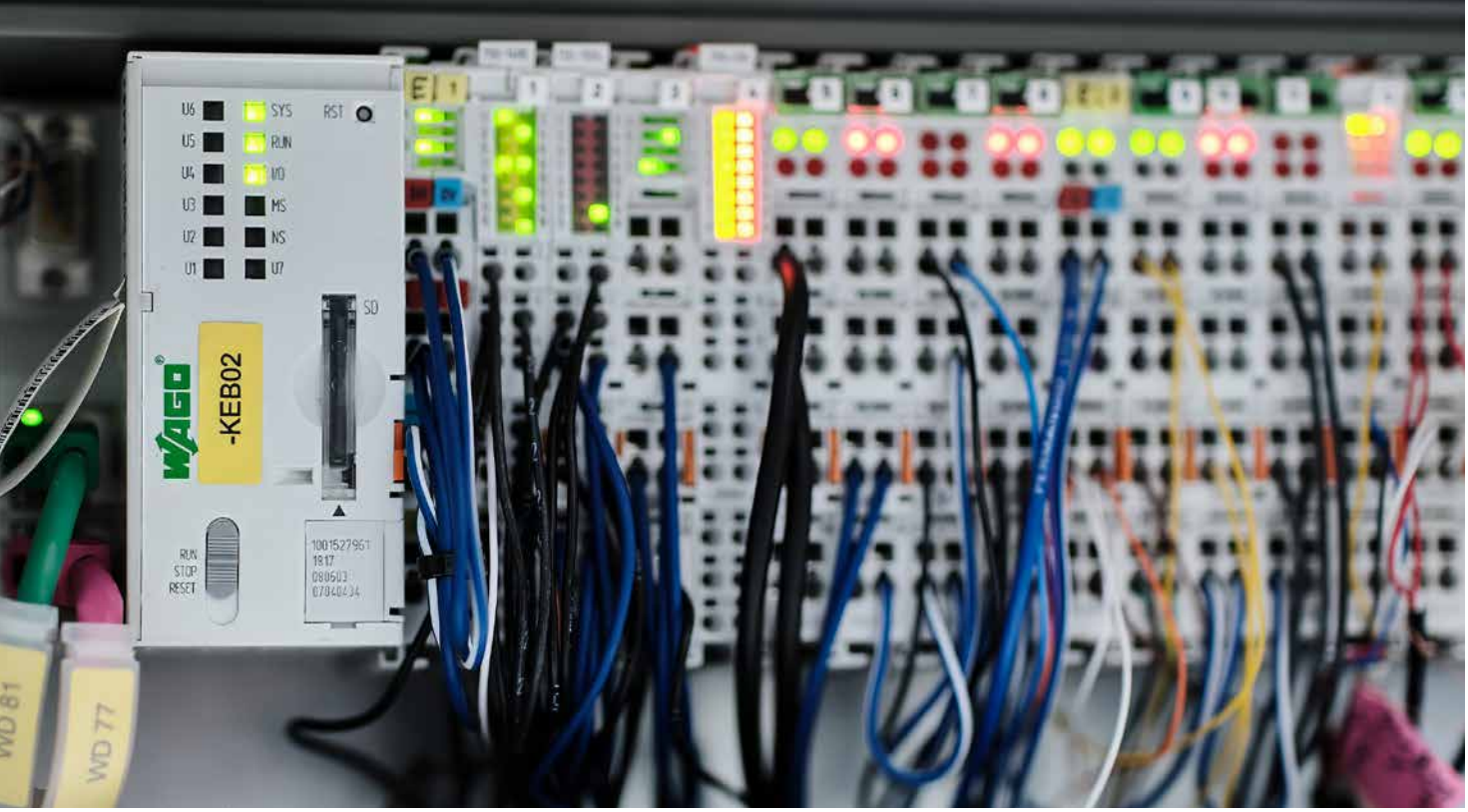
"The technological advances in the construction of electrolyzers marked the beginning of our work. The DLR wanted to leave its own mark, using its own technical group for low-temperature electrolysis," says Bürkle. The approach was to test different materials for proton exchange membrane (PEM) electrolysis cells and anion exchange membrane (AEM) electrolysis cells, according to strict scientific criteria.

For more information on the competing procedures, see the text box on page 7. In 2017, Bürkle founded a business in order to meet the increasing market demands. Around five years later, that company had become Bürkle Anlagebau GmbH. The young team from Bürkle Anlagebau built test rigs, back then as well as today, that are capable of metrologically determining advances and improvements in quality. In light of the ongoing mass production, these met with a great deal of interest from the pertinent producers and operators of hydrogen electrolyzers.

"We had already tested benchmark materials in the electrolysis test rigs at the DLR and compared them with new materials. And that's precisely what we're doing now to economically optimize the cells. The difference is that we are now able to offer rapid series production, which still takes every customer request into account," Bürkle reports about the first successful and trend-setting fiscal years with pride.



At the test rigs of Bürkle Anlagenbau GmbH, the majority of measured values are integrated directly into the WAGO controller. Only a few signals need to be amplified or converted in order to provide clean data to end users. The flexibility of WAGO's automation technology makes it particularly easy for Bürkle and his team to implement tailored applications.



Many production-related questions must be answered on the path to producing a commercial PEM or AEM cell: What materials are available? Which production methods make sense? What geometrical properties or production residues affect operation? How do materials react under the subsequent production pressure of 30 bar?

Material and process alternatives developed in the laboratory to answer these questions are subjected to the test rigs at Bürkle, where they cycle through different current intensities to determine how the components behave under stress. Standard load profiles are fired up, and also profiles that correspond to those of typical renewable energy sources. "Our system records all of the relevant metrics. It determines whether required temperatures are reached and maintained, or whether temperature fluctuations occur. We set targeted pressure fluctuations or maintain a constant pressure, depending on the wishes of our customers," says Bürkle. Using measurements obtained by electrical impedance spectroscopy, the experts are provided with information about whether cells behave rather more capacitively or inductively.

"By taking phase shifts into consideration, we can make statements about whether unwanted resistances are arising in the area of the mass transport, of the water or of the gas. Increased resistances may also exist in the membrane at the ion line, or may have occurred due to contact points in the cell stack," explains Bürkle. In addition, the systems record the gas purity at the anode and cathode to ensure that no oxygen is contained in the hydrogen and vice versa – a safety measure that is indispensable for Ex protection reasons.

A Complex System from a Single Source

These comprehensive measurements, and the accompanying provision of digital results, would not be possible without end-to-end automation. Integrating the necessary sensors was a great challenge. "We use many different sensors, some of which are also supplied by customers and are experimental, i.e., they have no standard signals. However, the system must function for users as if it were from a single source," explains Bürkle.

To reconcile these two requirements, the automation engineers rely on WAGO controllers, both then and now. "With the open-source approach from WAGO, we can integrate any signal, no matter how exotic." The necessary support – from the right switch, to the right controller, to software integration – began in the first days; then, under the DLR umbrella. "At the beginning, we had a dedicated line to Minden to get to know all the possibilities," recalls Bürkle. At WAGO, he has Benjamin Böhm as a partner at his side. Böhm also confirms this, stating, "We were very happy to provide this support." The electrical engineer works as a Global Industry Manager at WAGO. Böhm has many years of experience in the energy sector, and has provided customer support to many others who were engaged with demanding automation projects. However, a project like this stands out, because from his point of view:

"Decarbonization basically affects every industry. The topic of hydrogen has been assigned a special role at WAGO. We envision it as a powerful lever that we can use with our automation solutions to provide for a more sustainable future," says Böhm.

At the test rigs of Bürkle Anlagenbau GmbH, the majority of measured values are integrated directly into the WAGO controller. The team only needs to amplify or convert a few signals in advance in order to provide clean data to end users.

Due to the flexibility of the WAGO solution, Bürkle can also accommodate specific customer requirements. "We always receive special requests and must be able to program them as well," says Bürkle. As an example, he reports about a user, who wanted to have measurement data sent directly from the controller to his proprietary data pool. Intermediate computers were undesirable, because they are represent a vulnerability. "The customer was surprised by how quickly we could implement his requirements directly from the WAGO controller," according to the CEO.

Böhm sees this example as representative of many others: "Our open approach to protocols and interfaces pays off, precisely when it comes to hydrogen technology. We not only support test systems like Bürkle's, but also support our customers from a wide variety of sectors in the hydrogen economy – from production, through gas transport, up to chemical transformation processes or its use in the mobility sector," explains the WAGO expert. All of these users would expect that a wide variety of data sources will be integrated and that their individual systems will receive clean data from the controller. "What motivates me most is that we, as a team, use our expertise to personally contribute to a future, in which the huge amounts of green hydrogen that will be needed, are actually produced," Böhm concludes with pride.

You can find the entire reference on our website:
www.wago.com/buerkle

»We see an extremely large potential in the topic of hydrogen – and from the most diverse industries. Our open approach to interfaces and protocols helps us to be able to respond to individual questions.«

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