Intelligent management system for PV parks

Time and cost savings of up to 50 percent

Due to decreasing system costs, the economic efficiency of photovoltaics (PV) is steadily increasing. In Germany, there are now plans to build the country's first large-scale PV parks without government funding. With an output of 175 MW, EnBW hopes to build the largest of these parks near Berlin. The subsidy-free electricity generated there is set to be available as early as 2020. The start-up and maintenance effort required for these types of large-scale systems can by reduced by up to 50 percent with the park management system from Phoenix Contact (lead image/Figure 1).

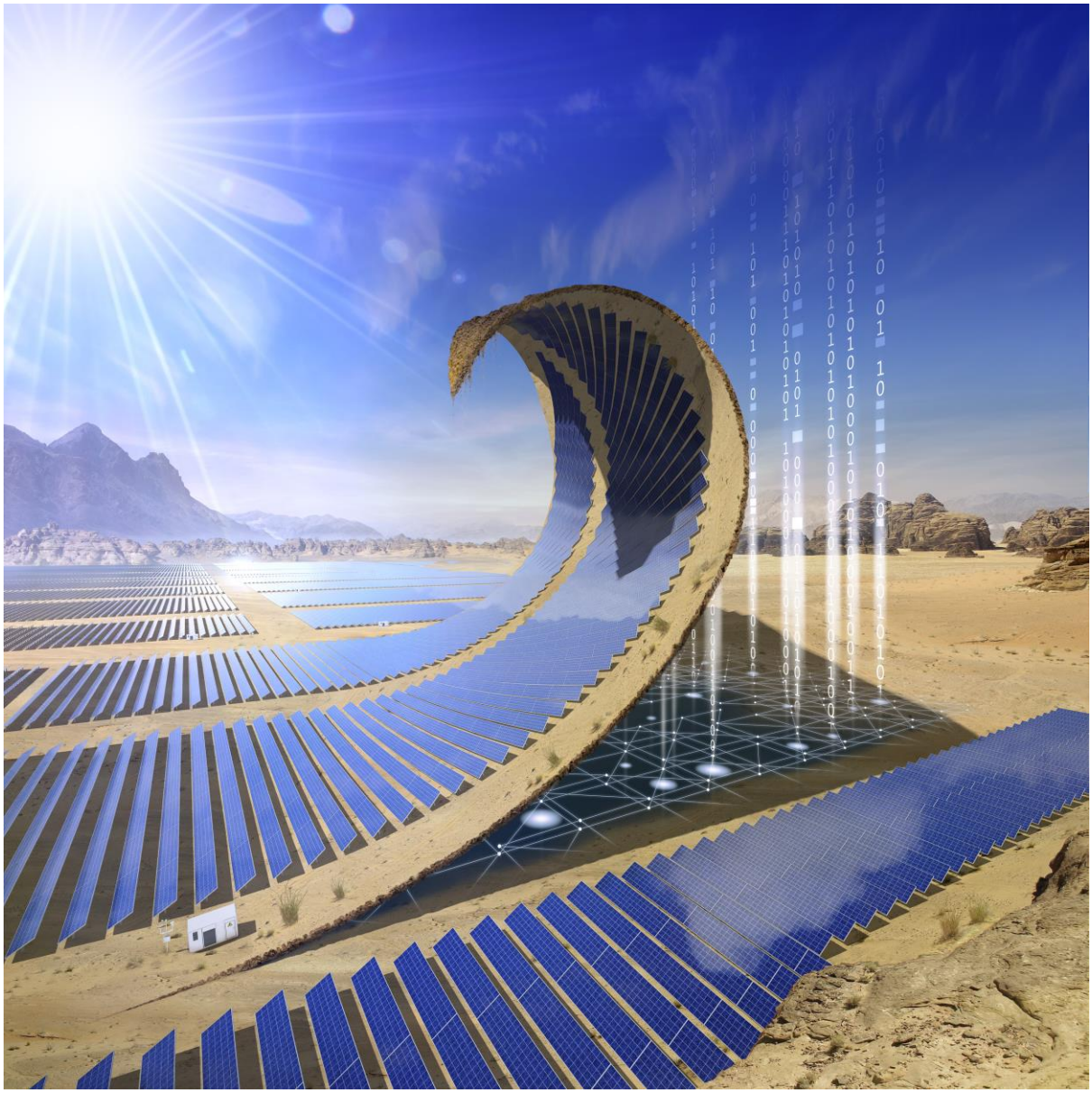

Figure 1 – Lead Image - The world's first PV park management system based on industry standards

In general, the industry is seeing a growing trend toward even larger photovoltaic systems. There are already several parks around the world delivering a very high installed total capacity, such as those in Arizona (USA) with 579 MW, Tamil Nadu (India) with 648 MW, and in the Chinese province of Qinghai with 850 MW. Work is currently under way on even bigger projects. The Mohammed bin Rashid Al Maktoum solar park in Dubai is set to provide a capacity of one gigawatt by 2020 and will be expanded further to deliver up to five gigawatts by 2030. In China, efforts are also under way to build PV power stations with an output of several gigawatts. When implemented on this scale, power generation by converting sunlight into electrical energy can easily compete with conventional power stations.

Transferring the solution to other projects

With the world's first PV park management system based on industry standards, Phoenix Contact is addressing the challenges encountered when it comes to the start-up and operation of large-scale PV power stations. The combination of intelligent automation and comprehensive visualisation tools enables operators to continuously record and evaluate data from their solar park. From data acquisition at field level through to feed-in control and the display of information on a portal, comprehensive solutions are available to meet all requirements. The open monitoring system enables the quick and easy integration and start-up of the park. The scalable concept allows the efficient and reliable management of PV systems.

The individual subcomponents – such as data loggers, feed-in controllers, weather stations, the SCADA connection, and the web portal – intermesh seamlessly without having to adapt any interfaces. The park management system is suitable for use in systems of varying size and, where necessary, can be tailored to the relevant requirements. Comprehensive process support provided by Phoenix Contact's PV specialists from planning through to the fully assembled DIN rail during the first project establishes the foundation for the implementation of future PV parks. Thanks to the company's global sales network, Phoenix Contact is able to respond flexibly to the rapidly changing solar market. Locally produced components and systems are also characterised by their long-term availability. As a result, up to 90 percent of previously designed PV parks can be incorporated into the implementation of new solar projects (Figure 2).

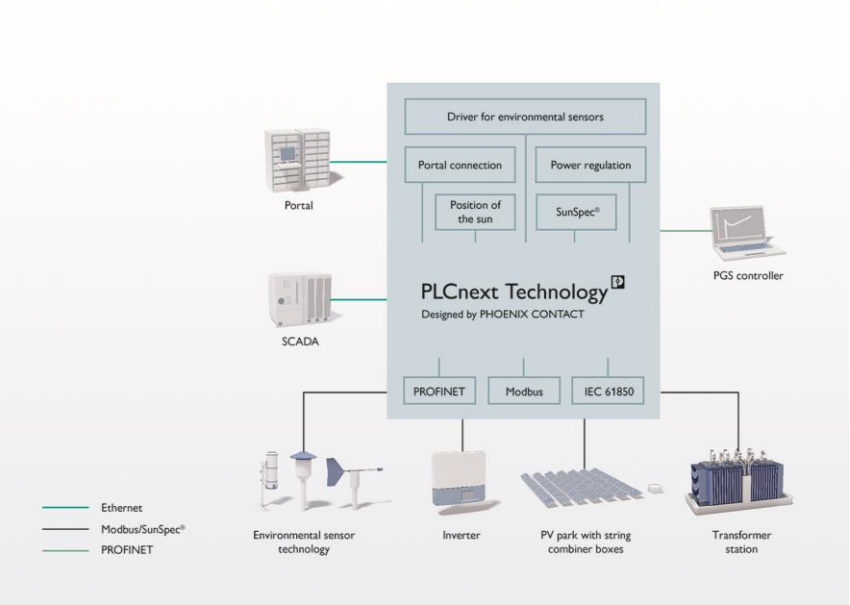

Figure 2 - From field level to the portal connection, all system components intermesh seamlessly without having to adapt any interfaces

Compatibility with third-party devices and systems

The individual solutions are already programmed and self-configuring. Once the parameters have been configured, the ready-made modular system can be seamlessly implemented because all park devices are detected automatically. Automatic Plug and Play of all components and systems greatly simplifies start-up and saves time by 50 percent. This solution also offers a high level of compatibility with devices from other manufacturers – such as inverters and sensors – as well as other park device systems.

The string current monitoring solution from Phoenix Contact enables immediate action to be taken in the event of malfunction or power loss, even if just one string is affected. This is because Hall sensor technology can be used to measure string currents easily and reliably without causing an open circuit. By using the PLCnext Technology ecosystem, developers are also able to work in their preferred programming environment, be it IEC 61131-3 or high-level language. The easy integration of open-source software and apps, as well as current and future communication standards, means that the control technology can also quickly adapt to changing conditions.

Maintenance only in the case of yield-critical events

The intuitive portal of the PV management system provides a comprehensive overview of all PV systems and reduces operating and maintenance costs by more than 40 percent. All important information is clearly displayed, making operational management and servicing

much easier. In addition, the operator can compare the yield of all systems with the actual irradiance values taken from satellite surveillance data. The portal analyses a large number of identical error messages automatically using intelligent algorithms. The messages are listed according to their urgency and severity in order to provide a better overview. This ensures that the service team only responds to events that could have a critical impact on the yield. Unnecessary maintenance calls are prevented and gradual yield losses are a thing of the past. Automatically generated reports containing all the relevant key figures provide information about crucial system data as well as the system performance in relation to the static yield forecast. PDF versions of the reports can be automatically e-mailed to customers and investors.

Self-sufficiency of string combiner boxes

String combiner boxes (SCBs) from Phoenix Contact enable flexible networking via wireless modules as a point-to-point, star or mesh connection. Proven wireless technology enables reliable, interference-free communication over a distance of up to 500 meters. The SCBs are self-sufficient thanks to the integrated DC/DC converters, which means they do not require a separate power supply. Voltage measurement up to 1500 V DC is possible. The control cabinets feature a temperature-optimised design so that the components installed inside are protected and operate reliably (Figure 3).

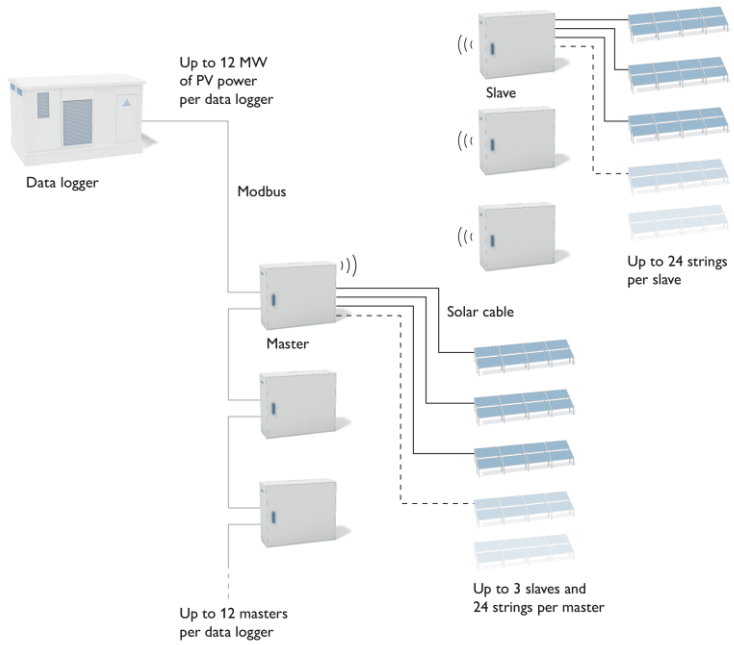

Figure 3 - Reduced cabling effort in the PV park, thanks to wireless transmission

The environmental sensors from Phoenix Contact are directly connected to the company's control system via Modbus. Thanks to the extensive portfolio of sensors, the operator can tailor the weather stations to their specific needs. The pre-configured sensors are immediately available to transmit weather data. Instead of individual wiring, the sensors are simply connected in series to Y distributors via M12 connections. This greatly reduces the amount of wiring required on site while also making it easier to integrate the sensors into the overall system (Figure 4).

Figure 4 - The pre-configured sensors are immediately available to transmit weather data

Recording of all relevant data

Solarworx from Phoenix Contact contains software libraries for the PC Worx engineering environment that have been specifically developed for the implementation of PV projects. The libraries include ready-made driver blocks for communication with common types of inverters. To keep the engineering outlay for the start-up of photovoltaic systems to a minimum, the solar specialists at Phoenix Contact continuously develop new drivers and function blocks for the connection of environmental sensors and for PV tracking systems.

The data loggers automatically detect park devices, which is why all the systems installed in the PV park can be easily integrated into the management system via Plug and Play. This considerably reduces the start-up time because there is no configuration required. Operating large PV systems requires continuous monitoring and control at segment level. This is handled by the data logger. It records all the relevant data regarding the ambient conditions and the status of the inverter. The information is then forwarded to the higher-level portal.

Certification for international use

Phoenix Contact works together with independent institutes to ensure that its solutions are certified for international use. Standardisation ensures reliable system operation in addition to a high level of quality. Measuring devices acquire the network parameters at the grid connection point and transmit these to a central PCU controller. The manipulated variables calculated from the reactive power controller are sent to the inverter.

The portal provides an overview of all the collected system data. To avoid data gaps in monitoring and reporting, data is automatically stored locally in the event that the Internet connection between the PV system and the portal is interrupted. The portal can be connected to existing portals thanks to the open system interfaces. The automated error algorithm reduces maintenance costs (Figure 5).

A PV system in Germany is one of the first to be equipped with the park management system. Additional international systems will follow.

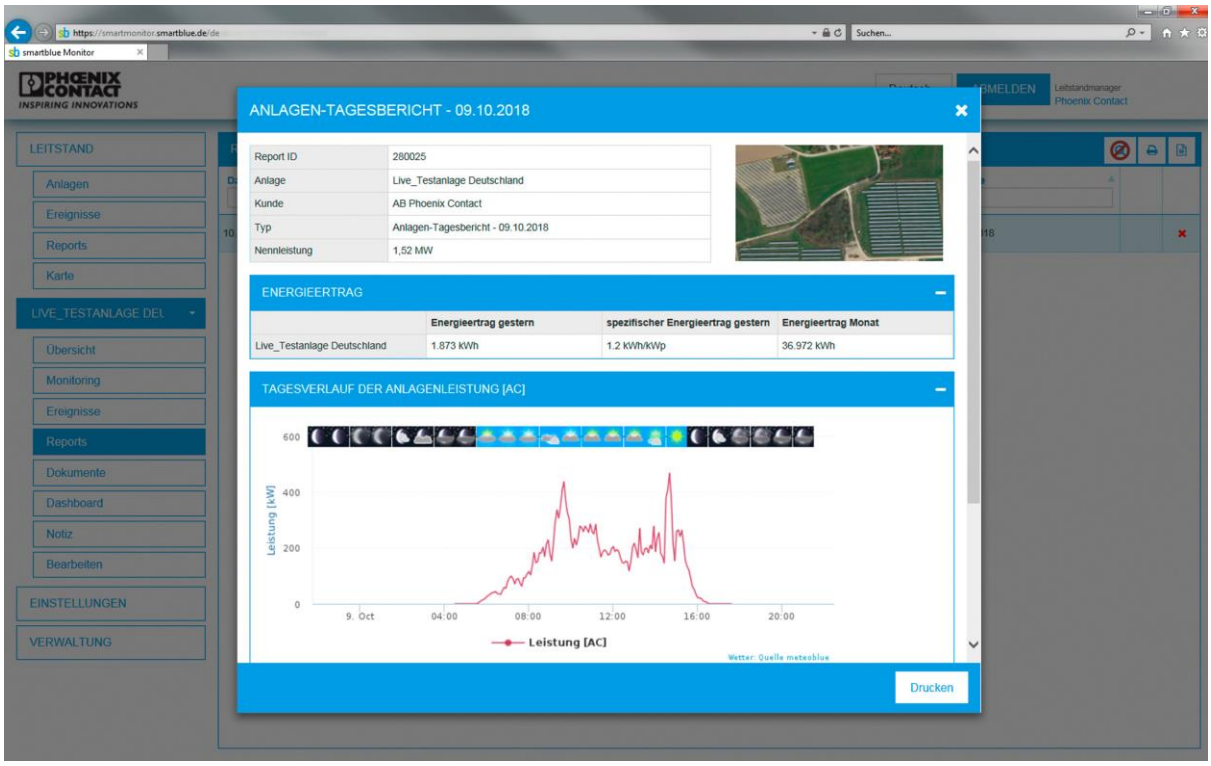

Figure 5 - The portal from Phoenix Contact enables park operators to view all relevant system data at a glance

More information: www.phoenixcontact.de/pv

If you are interested in publishing this article, please contact Becky Smith: marketing@phoenixcontact.co.uk or telephone 0845 881 2222.