

Reliable Communication Solutions for PV Power Plants

Overview of products and services

Full control,
highest IT security,
maximum transparency

greentech
we service | new energy

greentech
Warburgstraße 50
20354 Hamburg
Germany





Blackbox photovoltaic plant? Trust on secure and reliable power plant IT!

The communication capability of photovoltaic plants is of great importance due to increasing energy industry requirements and the resulting increase in interconnections. It must be possible to monitor their functions and performance. In addition, it must be possible to control and analyse the plant remotely from different bodies at any time. At the same time, data must be transmitted securely and unauthorised access must be prevented.

Avoiding security risks – PV plants as critical infrastructure

Not only the photovoltaic industry has changed dramatically in recent years – the field of IT, data communication and digitalisation is also developing at a rapid pace. Many plants, especially older ones, cannot keep up with the requirements of modern power plant IT. An often rudimentary IT structure with simple routers, minimal firewall protection and dial-up via openly accessible IP addresses without secure VPN access, as well as unsecured access to power plant components (e.g. via unencrypted WLAN) can become a security risk for the plant. This is particularly alarming as energy production plants with a net installed capacity of 104 MW or more are considered critical infrastructure according to the KRITIS Regulation 2.0 and the IT Security Act 2.0, on which a special security focus is placed. Among other things, operators of KRITIS plants are subject to certain reporting obligations in the event of IT incidents and malfunctions. They must also establish a management system for information security and demonstrate technical and organisational measures for IT security. Apart from this, it is important to ensure that these power plants have a reliable plant IT to ensure a smooth command sequence and trouble-free communication operation.

Maximum data security and transparency

Every PV plant is different. As specialists in the field of Power Plant IT & Industrial Control Systems (PPIT & ICS), we advise, support and configure your entire power plant IT individually and ensure a secure and reliable connection of all communication participants and communication flows, including the required control systems in the network. In addition to maximum data security, we focus on flexible concepts and comprehensive data transparency for all stakeholders.

Implementation of power plant-related control solutions

In addition to a secure power plant IT, we also advise our customers on power plant control issues. Among other things, we implement solutions in the areas of remote monitoring and control, direct marketing and resulting obligations, such as **Redispatch 2.0**.

Existing and new plants connected to the grid in an adequate and safe manner

We bring **existing plants** up to the latest communications technology and configure an optimal IT infrastructure independently based on the local and structural conditions of the plant. We are also implementing individual components of the IT infrastructure, such as secure VPN access, a provider-independent SIM card, new plant routers with a dedicated firewall, or even special software solutions for data transmission. We also install control solutions in accordance with the applicable directives and standards.

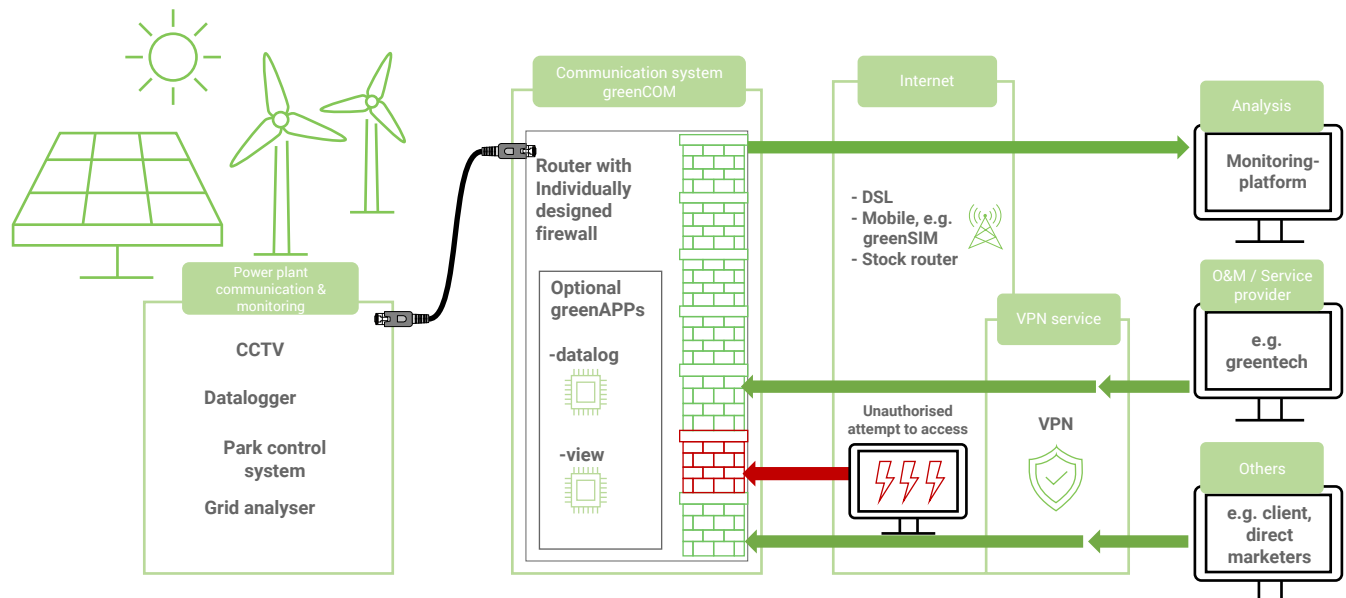
In **new plants**, we plan and implement the complete plant IT, including control technology. We care for a clean IT structure including documentation, secure and stable connections, and comprehensive transparency of all procedures and processes for the plant owner or operator. This ensures a functioning communication and control system installed by day 1.

Integrated Power Plant IT & ICS solutions from greentech offer:

- maximum IT security through fully protected and encrypted internet connection in accordance with the IT security regulations of ISO 27001, ISMS, BSI EnWG Sect. 11 (1a) and the BDEW white paper "Requirements for secure control and telecommunications systems"
- KRITIS suitability according to the requirements for the energy industry
- GDPR compliance through appropriate control and authorisation systems
- Full data transparency for all relevant users
- Consideration of special requirements of other stakeholders, such as plant operators, insurers, direct marketers or energy providers, for example in retrofit and repair issues such as existing plants according to BDEW MSR 2008
- Solutions to meet legal requirements and guidelines as part of power plant control, such as certified energy production plant controllers according to VDE-AR-N 4110/4120 or direct marketer interfaces

How we proceed: Integrated IT concepts from one provider

Our integrated plant communication ensures a secure system connection to the internet. At the same time, it provides the complete plant communication of all stakeholders and grants the necessary transparency.

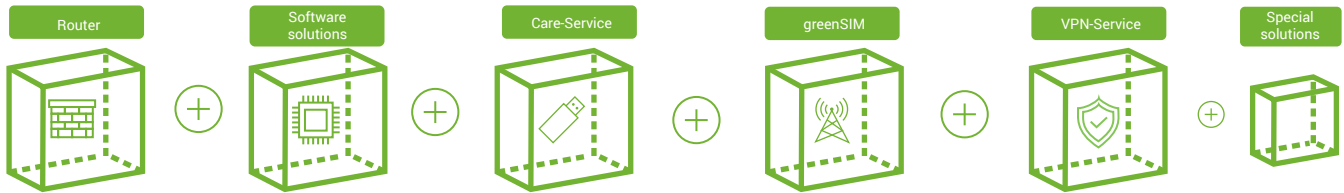


Secure and integrated power plant communication with greentech

On request, we offer our services as a full-service package: from the required hardware, relevant software and secure internet access to IT service with both on-site support and remote diagnostics. For this, we prefer to use our own, self-developed products and IT solutions as they work in an integrated manner and enable a comprehensively planned and implemented IT infrastructure and plant communication. However, many components can also be implemented in an individual or modular form – depending on the existing framework conditions

Integrated power plant communication with greentech

Components of the integrated greentech PV plant communication at a glance



The following chapters explain greentech's Power Plant IT and ICS services in detail.

Other services or those not listed are available on request for individual projects. Please feel free to contact us!



Who we are

With a team of over 100 employees, **greentech** is a leading expert in project development, engineering, technical consulting, construction as well as operation and management of photovoltaic power plants. As a fully integrated PV company, we cover all stages of the value chain in realisation and operation of PV power plants. In technical operations management, we currently manage a portfolio of over 300 plants with a total capacity of more than 900 MW for institutional, municipal and private investors. This makes greentech one of the biggest PV specialists in Europe.

greentech's own Power Plant IT and ICS team ensures professional integration and stable connection of the power plant communication to the internet and the respective interfaces. In addition, it advises plant operators with regard to control and interface solutions as well as the conception and configuration of a comprehensive and secure IT infrastructure.

Do you have any questions about secure and transparent power plant IT, specific control solutions or are you interested in a non-binding offer? Please feel free to contact us!

Contact



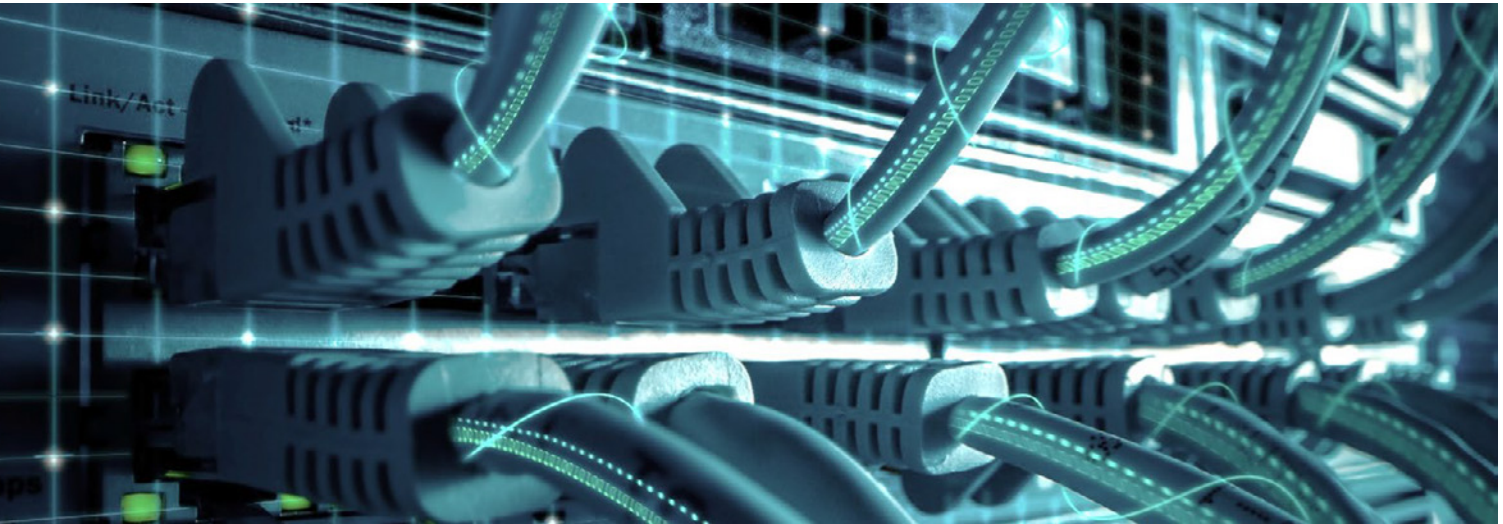
Max Langkabel

Manager Power Plant IT & ICS

T: +49 40 8060 6694-52

M: +49 160 9497 5939

m.langkabel@greentech.energy



greenCOM communication cabinet

The greenCOM communication cabinet is the most secure connection of the power plant to the internet and acts as the “heart” of the plant IT.

Ensuring communication capability for specific plant needs



greenCOM, equipped with the latest generation router with VPN, greenSIM and greenAPPs. The greentech communication cabinet also has a UPS, SPD, door contact and service socket installed.

Each **greenCOM** is unique and is equipped according to the individual plant requirements and the applicable IT security regulations and legal provisions. Within the scope of necessary KRITIS requirements and measures to be implemented respectively, we integrate, for example, a **door contact**, which sends a notification to the IT security officers in case the door gets opened. As a rule, the following basic components are included in **greenCOM** as standard and can be individually extended on request:

We install a **router** of the latest generation including a **plant-specific configured firewall** and optional **additional software** (see also *greenAPPs*). We also recommend communication via mobile data and a **provider-independent SIM card** (see *greenSIM*). In case of existing plants, the continued use of existing internet access – e.g. via existing routers and existing mobile data solutions – is also possible. To ensure the highest possible IT security, we also recommend communication via a **VPN tunnel** (see *VPN*).

In addition, we will provide the **greenCOM** centrally with an **uninterruptible power supply (UPS)**. It enables failure detection of the connected components to the second and reports this to the operation manager via the router (e.g. by e-mail). Depending on the plant and the given conditions, it is also possible to connect further network components to the UPS.

In addition, **surge protection devices (SPD)** are installed in the communication cabinet. They protect the router and other connected components from failure and defects in the event of overvoltage – triggered, for example, by a nearby lightning strike or by switching operations in the grid.

A power connection in the form of a **fused socket** in the **greenCOM** is also provided for service purposes. It provides easy access to the power supply, e.g. for on-site interventions.

In addition to the main communication cabinet, we offer the option of using further sub-cabinets as part of a so-called “master-slave system” at different plant locations. In this way, a uniform concept is realised throughout the entire plant. This extension makes it possible to protect other decentral installed communication components located on the plant. This can be realised, for example, by an SPD against overvoltage or a UPS for an uninterruptible power supply.

Contact



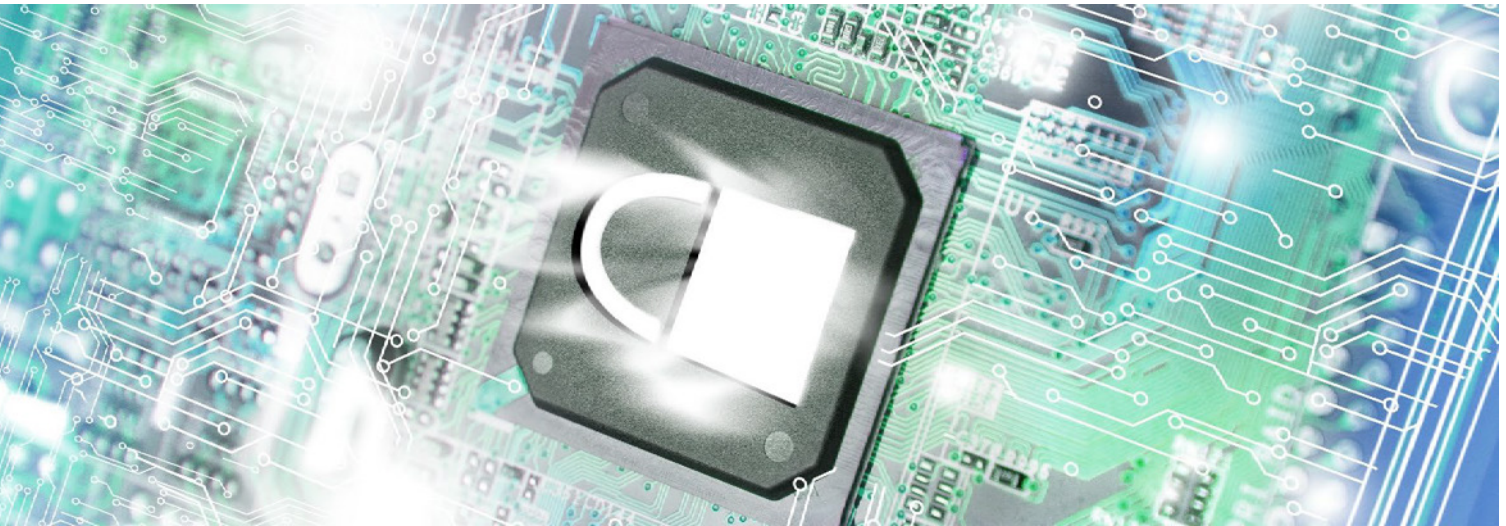
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Manager Power Plant IT & ICS

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M: +49 160 9497 5939

m.langkabel@greentech.energy

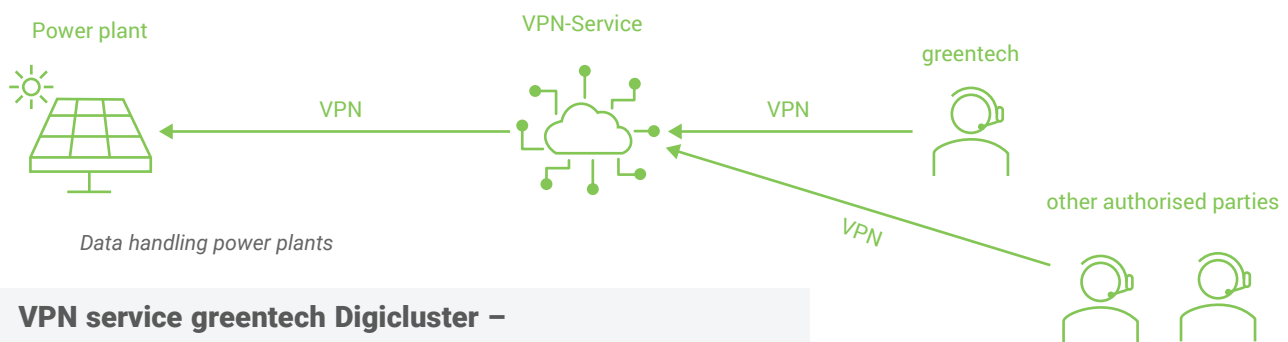


VPN – Protected plant communication for maximum IT security

The topic of data security has increasingly come into focus in recent years. This is of importance for PV power plants because sensitive data are collected, processed and sent, and in most cases there is external access to the plant communication via the router. To ensure the protection of this data and access, we recommend setting up an encrypted **VPN service** that is KRITIS-suitable as well as GDPR-compliant.

The route via our **VPN service greentech Digicluster** offers all authenticated stakeholders the possibility to connect securely to the power plant communication via the plant router. All data and actions are optimally protected against unauthorised access and manipulation, from the power plant data of the data logger to the energy production plant controller, the grid analysis device or the cameras used for plant monitoring as well as the control and analysis of the operating data. If the VPN connection should ever be lost, the service re-establishes automatically.

Access is GDPR-compliant within the framework of individual or group-based authorisation management, which can be flexibly extended to other users. For example, the operator can be granted access to certain components.



VPN service greentech Digicluster – highlights at a glance:

- Optimisation and reduction of expensive on-site interventions through remote access and monitoring
- Flexible with regards to the type and provider of internet access
- High failure protection through redundancy and regular backups of the service
- Direct Link for easy temporary access
- KRITIS-suitable
 - Time limit of individual connections
 - Transparency: Extended log functions
 - Continuous ruggedisation of the system security
- Maximum data security and GDPR compliant
 - 2-factor authentication
 - Server location Germany
 - X.509-based authentication
 - All communication secured via AES-256-CBC OpenVPN tunnel

Contact



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 Manager Power Plant IT & ICS
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 M: +49 160 9497 5939
m.langkabel@greentech.energy



greenSIM – always the best connection

Necessary control and regulation activities, the reporting of current sensor data or the continuous monitoring of the plant should nowadays take place in real time. In this way, any faults that occur can also be identified as quickly as possible. The prerequisite for consistent and trouble-free data transmission are internet access and a stable network.

Global network coverage

The **greenSIM** is a mobile phone card without a fixed provider for national and international roaming. It always selects the strongest available network and thus ensures that data and commands from the plant can always be reported or processed as quickly as possible. This can be a great advantage especially in remote, rural areas with limited network availability or in border regions. Your contractual partner always remains greentech, regardless of which mobile network the SIM card dials into.

Estimation of the required data volume

greenSIM offers a monthly data volume of 1 GB. This volume is usually sufficient for plants with a capacity of up to 2 MWp. However, the use of cameras or video surveillance can noticeably increase the data consumption of the plant. In addition, data loggers of bigger and newer plants send a large amount of data and require a higher data volume for transmission.

The additional data volume consumed in excess of 1 GB is billed monthly in precise 1-KB increments.

We will gladly assist you in determining the appropriate amount of data volume for your plants and an estimate of the monthly costs for the **greenSIM** that will apply for your plants.

Contact



Max Langkabel

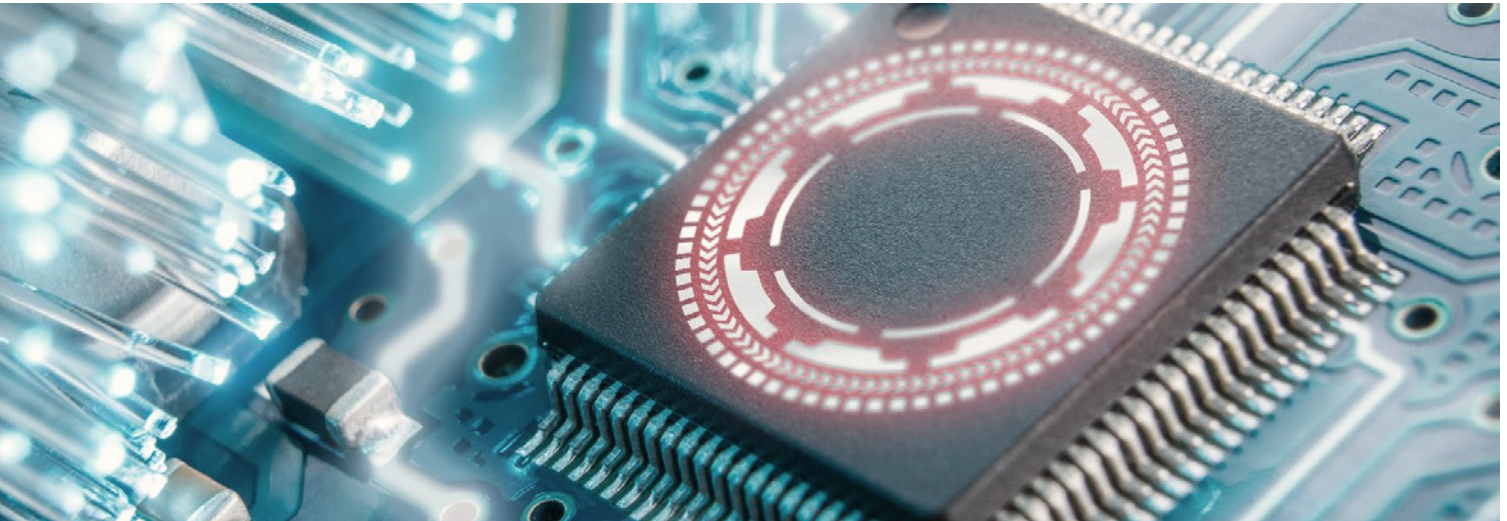
Manager Power Plant IT & ICS

T: +49 40 8060 6694-52

M: +49 160 9497 5939

m.langkabel@greentech.energy





green -APPs

Our **greenAPPs** are complementary software applications that additionally simplify and expand power plant communication.



The prerequisite for the applications is the equipment with a **router** provided by greentech (either as a stand-alone solution or in combination with our greenCOM communication cabinet) and the connection to the greentech **VPN service**.

greenAPP -datalog

Communication and control components with outdated technology are usually installed on older existing plants. They cannot provide the level of data that is required or demanded today for advanced, comprehensive plant monitoring and control. The **greenAPP -datalog** fills this gap and, with its application options, ensures that the information and communication requirements of the various stakeholders are met even with an older technology.

Services:

- Protocol conversion:** ModBus and other common protocols can be converted for third parties (e.g. energy provider or operation managers) into the format required for their purposes, including e.g. IEC60870 101/104 or OPC UA. The protocol conversion also allows older plants equipped with the **greenAPP -datalog** to meet the requirements of **Redispatch 2.0** without major conversion.

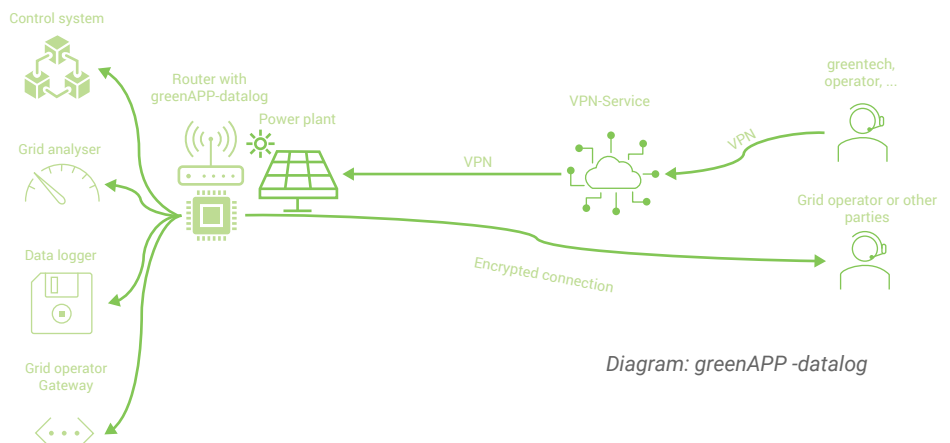


Diagram: greenAPP -datalog

- Monitoring:** The **greenAPP -datalog** can be used to define fault conditions and anomalies in the plant. The threshold value monitoring is of particular importance here. If certain predefined values are exceeded, the system alerts the relevant contact person.
- Data logger:** The data of components (such as sensors, controllers, meters) recorded with the **greenAPP -datalog** are stored on a periodic or event-based basis and linked to a monitoring portal, for example, for verification, fault analysis or for reporting as a CSV file with any protocol or sent by e-mail to a specific recipient for evaluation.
- Cloud connection:** The cloud connection, if available to the customer, provides permanent live data from the plant. This real-time display makes it possible, among other things, to continue checking the operating data of the plant live in the event of a monitoring failure. In addition, the plant provides real-time information in the cloud about the functionality of the SIM card or VPN service. The cloud connection via the **greenAPP -datalog** is the optimal supplement to the regular monitoring connection.

- **Remote control:** The remote control function of the **greenAPP -datalog** can be used to switch digital and analogue outputs of the router and to transfer parameters to the connected controllers, data loggers or controllers using the respective protocol. Different communication participants with the adequate access authorisation can thus exercise different control options.

greenAPP -datalog at a glance:

- No additional cost-intensive and failure-prone hardware necessary
- Retrofitting of existing systems is easily possible
- Protocol conversion for proprietary protocols, cloud formats or uniform interfaces of control systems
- Controls, sensors and controllers from industry and the energy sector can be integrated

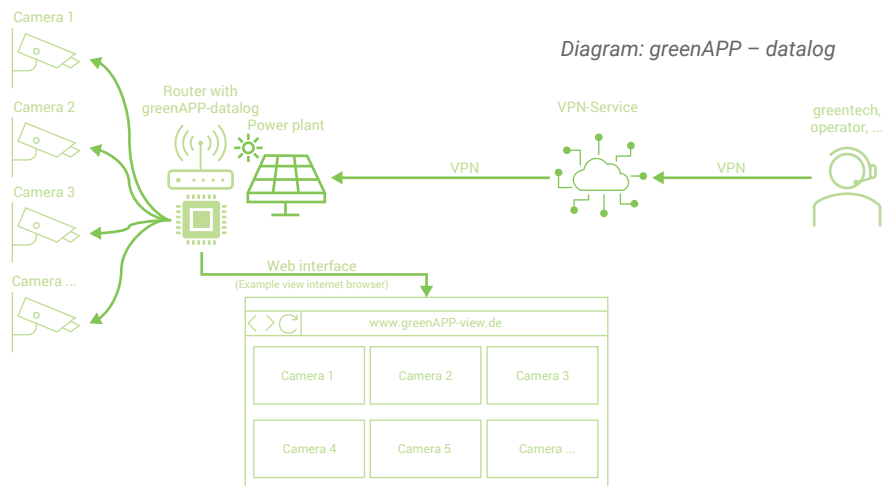
greenAPP -view



The **greenAPP -view** software provides a web interface that clearly displays all camera images of the power plant at a glance. This simplifies the control of the power plant – moreover manual switching from one camera image to the next is no longer necessary.

The authorised user is granted access to the cameras via the user-authenticated VPN access. The **greenAPP -view** does not store the recordings or transmit the camera image to third parties. This ensures the GDPR-compliant use of the **greenAPP -view**.

The camera images are displayed as a fixed image. The view is refreshed by refreshing the page. Because of that, a camera PC or a browser plug-in for viewing the individual camera images on site is not necessary. This not only eliminates the need for additional hardware on site, but also reduces data consumption to a minimum.



The **greenAPP -view** focuses on the real-time display of the plant. It is particularly suitable

- for monitoring current weather conditions
- for monitoring growth and mowing
- for overall monitoring of the site at the current time

Contact



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 Manager Power Plant IT & ICS
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greenCARE – Firmware update and configuration backup

greenCARE provides annual data backups and firmware updates for the network components of your power plant. These include routers, data loggers, industrial PCs or cameras.



The prerequisite is a connection to the greentech VPN service.

Data backup

Data backup and corresponding security backups play an important role, especially in the event of a total failure, for example as a result of overvoltage or ageing. They provide the option of keeping downtimes as low as possible after an incident by quickly reconfiguring the components. The plant can be quickly restored to working order and can also be controlled. This reduces potential financial losses due to claims from the direct marketer or the grid operator.

Updating the firmware

Time and again, outdated firmware versions or missing software application updates with known security vulnerabilities allow cybercriminals to gain access to the system. Data manipulation or blocking the system for ransom payments, or even a power plant failure, may be the result.

greenCARE ensures that your network components are regularly equipped with the latest firmware and that security gaps from old versions are closed as quickly as possible.

A valuable time advantage in an emergency

All data backup and update services are provided at no additional efforts to the operator. Furthermore, greentech is very familiar with the installed hardware via this service and can provide rapid support in the procurement of replacement components. In an emergency, this procedure offers an important time advantage: In the event of a system or component failure, there is no need to go through a third party to procure and reconfigure the system. Depending on the size of the power plant, saving a week's time can already save a large amount of losses.

greenCARE at a glance:

- Current security backups of the power plant components
- Security gaps are regularly closed
- Cost-intensive power plant outages and claims are reduced
- Important time saving in case of component failure
- Procuring and configuring the required replacement components conveniently from a single source

Contact



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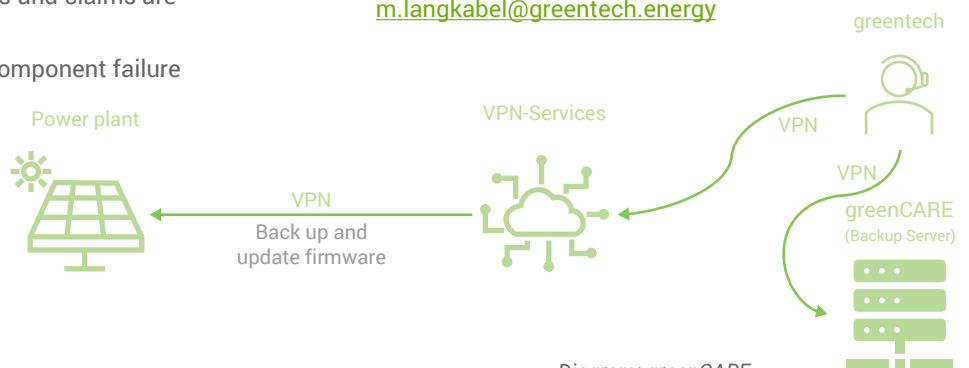


Diagram: greenCARE



Consulting, developing and implementing control concepts

The decentralisation of the energy supply makes power plant control in the context of a PV park very important. Among other things, it implements specifications from the grid operator and may also be supplemented with a direct marketing interface. We offer advice and support in the implementation of control concepts and the integration of the direct marketing interface. As a result, you receive a control concept that is adapted to your plant and the specifications of the grid operator and direct marketer. We also implement individual and sustainable control concepts for more complex projects, such as plant portfolios with the interaction of different generating units.

Generating plant controller according to VDE-AR-N 41XX

Energy production plant controller (certified)
greentech designs **energy production plant controller** with component certificate according to VDE-AR-N 4110/4120 as standard including the option of direct marketing connection on request in a control cabinet such as the **greenCOM**. It can be flexibly adapted to all connection conditions and specifications of the grid operator's telecontrol interface. Every communication participant can be operated and – if required – read and write data, equipped with a smart interface technology. The control cabinet is pre-configured after detailed project design and in close coordination with the grid operator, and is delivered as a plug-and-play solution only requiring an internet connection. Remote access can also be set up via our **VPN service** to allow convenient access to the network of the plant.

Plant control (uncertified)

No certified energy production plant controller is required for replacement in existing systems according to BDEW MSR 2008. In this case, we can offer a more price-sensitive solution with a **non-certified energy production plant controller**.

Contact



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Direct marketer interface

Since 01/01/2016, all plants with an installed capacity of 100 kWp or more in Germany must participate in direct marketing. For this purpose, the direct marketer receives a data processing interface through which he can control the photovoltaic system.

greentech's **data processing interface** is a slim plug & play component that comes fully pre-configured. Older plants that can only be controlled by the energy provider and were commissioned without the option of direct marketing can also be retrofitted simply and quickly on request and within the framework of the requirements of **Redispatch 2.0**.

The **data processing interface** is compatible with national and international direct marketers and grid operators. greentech's VPN service allows convenient access to the plant network from anywhere. The data processing interface is supplied on request as a Lan-to-Lan or as a fully integrated plant router with a **greenSIM**. This means that the older existing router can also be replaced by a technically up-to-date component.

Our compact interface solution brings all renewable energy production plants into direct marketing. The streamlined solution in a single component means that even a smaller existing plant can switch to voluntary direct marketing without any problems at reasonable costs.



Power Plant IT Security Audit

How does the plant communication work in your power plant? How are the various components interconnected in terms of communication? How are the individual devices connected to the internet and which instance may access which device with which authorisation?

Overview of the status of your power plant IT provides fast assistance in case of emergency

Our **IT security audit** provides an accurate view of the current status of your PV power plant's communication infrastructure. The network system, for example, is clearly displayed in a single-line diagram including the names and locations of the end devices used. On the one hand, this reveals weaknesses and risks in the plant itself, which should be remedied as quickly as possible in order to enable the required level of IT security for plant communication. On the other hand, the information listed can also be used in the event of an emergency, for example, to find the causes more quickly in the event of a failure, malfunction or defect, to procure spare parts in a targeted manner and to install them in such a way that all affected systems, instances and persons are able to act again as quickly as possible according to their needs.

Additional consulting services on various topics related to power plant IT

From defective patch cables and suitable IT equipment to a complete IT security concept in accordance with the KRITIS regulation and GDPR requirements. We support you in all questions relating to the issue of plant IT. This includes for example:

- Integrated communication design and implementation of the power plant IT
- Consulting on IT infrastructure changes and implementation
- Developing individually coordinated security concepts
- Subsequent preparation or revision of documentation and network plans
- Support in the event of unplannable failures of IT components from remote diagnosis, in-depth analysis and subsequent troubleshooting
- Consulting and implementing suitable software solutions for the respective plant
- Continuous support for power plant IT availability and acceptance of IT responsibility
- Individual training on relevant power plant IT issues and IT security



Contact



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 Manager Power Plant IT & ICS
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We are here for you!



greentech
Warburgstraße 50
20354 Hamburg
Germany



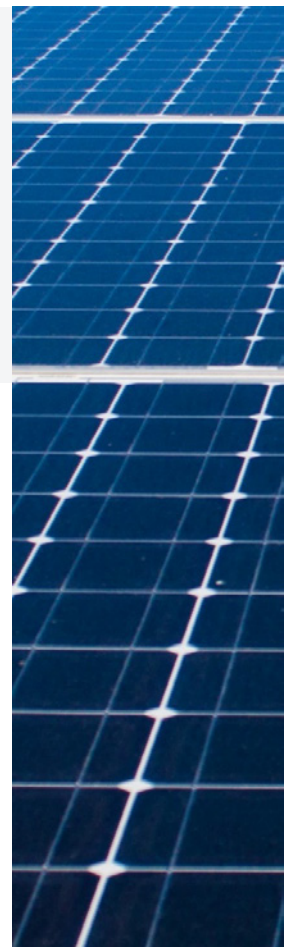
contact@greentech.energy



+49 40 8060 6694 0



www.greentech.energy



Your contact person

Max Langkabel
Manager Power Plant IT & ICS
T: +49 40 8060 6694-52
M: +49 160 9497 5939
m.langkabel@greentech.energy