Power Generation

Symphony Plus for Solar
Integrated automation and services
for photovoltaic plants

Power and productivity
for a better world™
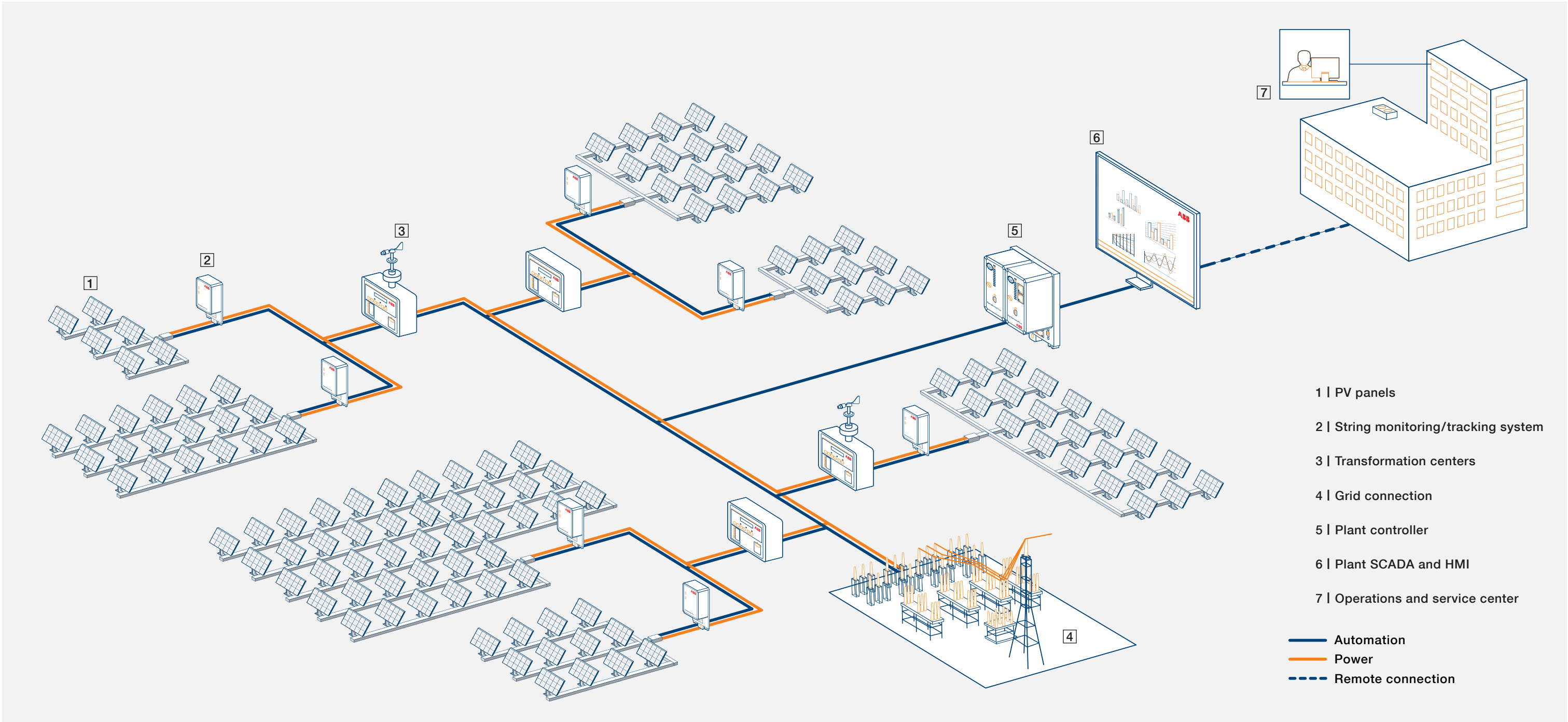
ABB

ABB – your trusted partner for PV plants

Solutions all along the value chain: from planning and design up to operations and maintenance.

ABB is a single source supplier of complete power and automation solutions for the solar PV industry. The power offerings range from a complete electrical balance of plant system, including utility scale inverters, power transformers, switchgear and low voltage components necessary to connect and protect the entire installation. These solutions are complemented by ABB's unmatched consulting expertise, which provides system designs for electrical balance-of-plant and balance-of-system.

Our automation systems control solar generating assets, from the precise adjustment of PV panels, to grid code compliance and remote management. ABB offers unrivaled Operation and Maintenance (O&M) services after a plant becomes operational. A comprehensive and flexible service offering helps the onwers and operators of such plants reduce maintenance costs and improve the levelized cost of solar energy.

ABB is not only a top technology supplier, but a trusted partner customers can rely on. We are pioneers in the renewable energy sector, firmly committed to the market and determined to develop the right technology and solutions in support of our customers' business.

1 | PV panels

2 | String monitoring/tracking system

3 | Transformation centers

4 | Grid connection

5 | Plant controller

6 | Plant SCADA and HMI

7 | Operations and service center

—— Automation
—— Power
---- Remote connection

Symphony Plus for Solar

Integrated automation and service for photovoltaic solar plants.

Automation solutions for PV industry

For automation of PV solar plants, ABB offers Symphony Plus for Solar, a versatile and scalable automation solution dedicated for monitoring and control of such plants. The solution spans from plant automation including panel position control, plant diagnostics and power management, going up to enterprise SCADA to enabling remote operations & management of PV plants.

Plant automation solutions

Symphony Plus for Solar employs a SCADA system for monitoring all key plant components, from PV panels (with and without tracking systems) to the inverters, transformers and switchgear, grid connection and meteorological stations. It supports a broad range of communication protocols like Modbus TCP, OPC, IEC 6087-5-104, enabling it to connect and exchange data with all plant components. With a real-time database and a historian, relevant plant data can be acquired and either stored on site, or forwarded to a remote management center.

One of the key differentiators of Symphony Plus for Solar is the capability to monitor and control plant and substation equipment using the IEC 61850 protocol. This enables ABB's solution to integrate generation and electrical components into a single information and control system. With the built in interlocking schemes, secure and easy operation of the protection equipment in the plant or at the grid connection is achieved, from site or remote.

An ergonomic human-machine interface (HMI) designed by our scientists together with our customers facilitates immediate observations of field problems and enables fast operator reactions. The HMI allows operation of all plant equipment and increases effectiveness due to its real time update features.

Power management

Symphony Plus for Solar controls the power production of the plant according to grid codes applicable in the country where the plant is located. ABB's control solution for PV solar plants manages active and reactive power, power factor and also provides voltage and frequency control.

A high-performance controller is connected to all relevant actuators (inverters, tracking systems and – if applicable – capacitor banks, STATCOMs or energy storage), and performs real-time calculations to regulate the plant's power production in accordance with the specifications.

Power management features:
– Central plant controller coordinates all inverters and other actuators to achieve the required control command.
– Provides power factor and voltage control at the point of connection to the utility grid.
– Controls the ramp rate of power production according to specifications in grid codes.
– Limits power production of the plant according to required setpoint.
– Accounts for outages and scheduled maintenance of the inverters.

Another differentiator of the Symphony Plus platform is that it is designed to last the operating life of the plant. Through our "Evolution without obsolescence" life cycle policy, each generation of the Symphony Plus family builds on and enhances its predecessors, adding new technologies and new functionalities to meet the evolving performance objectives of its users. An investment in Symphony Plus hardware and software is thus protected throughout the life cycle of the plant.

Power production forecasting

The ability to forecast power production is becoming increasingly important as solar generating plants grow larger. ABB provides a flexible power production solution applicable for single plants or a fleet of plants.

The forecasting application uses data from the panels, strings and inverters, as well as historical production and meteorological information, to predict plant output. The forecasting horizon spans from hours ahead (typically 6 hours ahead, with a time resolution of 15 minutes) to days ahead (typically one week, with hourly resolution).

ABB has also developed algorithms that track the movement of clouds in the vicinity of the PV plant. The algorithms predict the time of arrival and duration of cloud cover over the plant,

and calculate the expected drop in output. If the plant is equipped with energy storage, optimization of power balancing is achieved using the accurate short-term prediction of power fluctuations caused by the clouds shadow.

Remote management of PV plants

For customers who integrate their solar assets in their enterprise infrastructure, with or without other power generation technologies, ABB provides enterprise SCADA solutions that enable remote management of the plants. The solution integrates, monitors and manages all generation assets into a single system, independent of the plant technology or provider.

The flexible and versatile SCADA system built on a hierarchical architecture allows for effective management of only a few or hundreds of plants. The remote management system is based on the same Symphony Plus technology, therefore the HMI, the power management module and the forecasting application can easily be deployed also at enterprise level.

Renewable energy management and trading is enabled by the forecasting and power management functions. The power production of the entire fleet can be controlled in real time and scheduled for intraday planning. This facilitates the virtual power plant concept and allows renewables to participate in enegy markets.
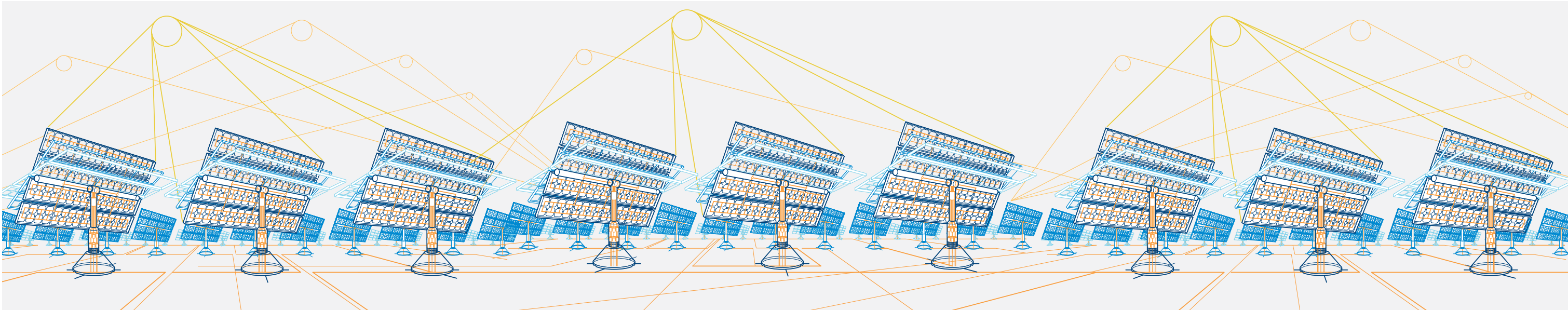
Our global automation and service footprint
More than 50 utility PV plants in operation worldwide

■ PV plants in operation
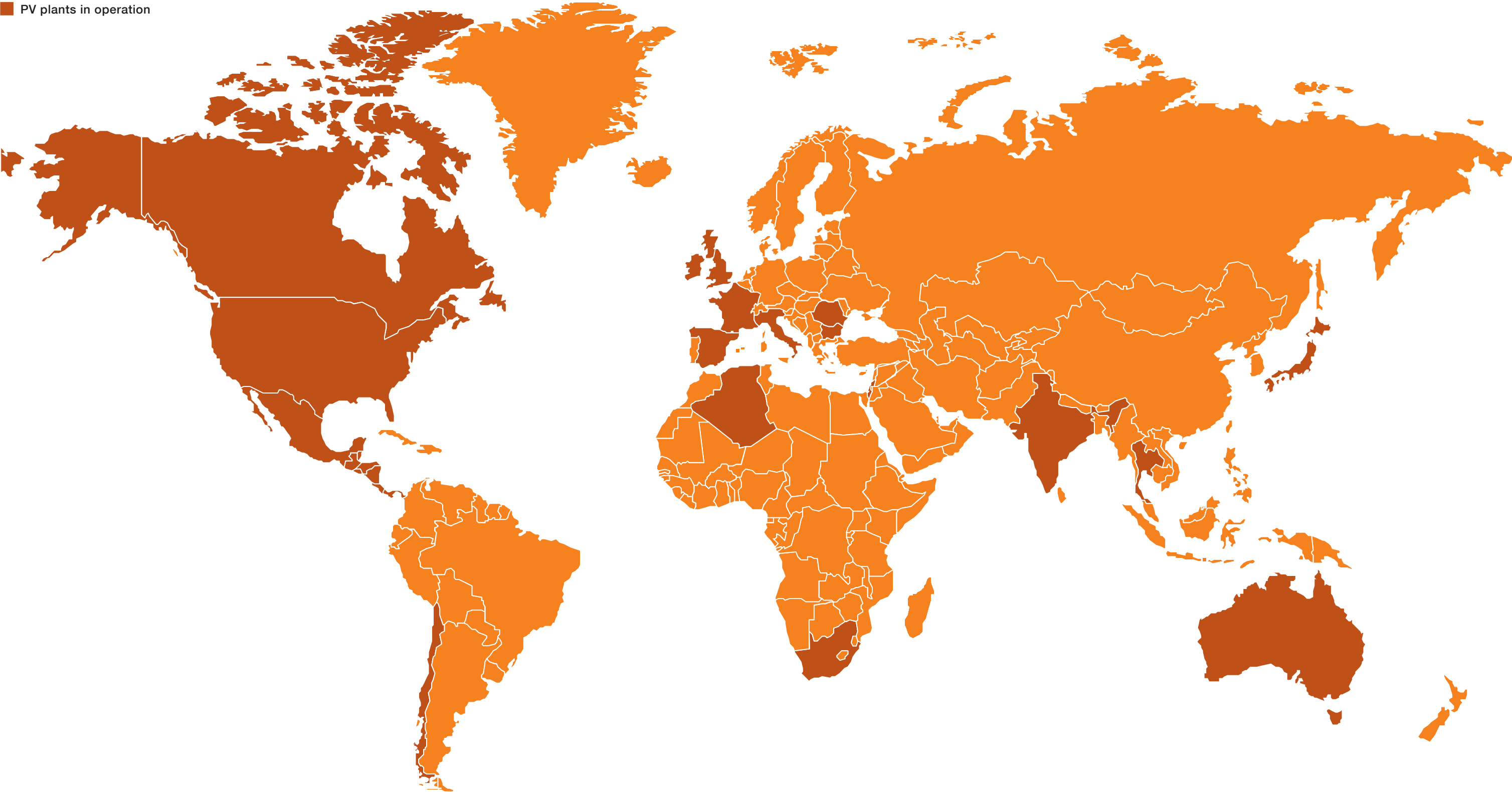
PV Remote – a complete service portfolio for solar PV plants

The ServiceGrid^{SM} offering provides comprehensive services that address the full range of remote monitoring and plant maintenance. This improves plant availability and performance.

In conjunction with automation and control functions, ABB also offers a broad range of services for PV solar plants. This is supported by a remote service center, where an array of services are provided to customers (i.e. performance ratio calculations, power forecasting, shading estimations, soiling detection, ageing, alarm handling, etc.). The service center can connect to either a single plant, or an entire fleet of plants.

To ensure easy delivery of services, a state-of-the-art web portal is used to provide data access to end-customers or service personnel. The portal enables users to monitor and track plant data, reported in predefined or customer-specific KPI's. This is delivered as "Software-as-a-Service" (SaaS) on a subscription basis, through the ServiceGrid^{SM} program.

ServiceGrid^{SM} is a site based program to support customer sites which may have different support needs. These levels represent different customer profiles from the "self sustainer" (Core Level) to large, fleet based customers (Enterprise Level). Each of the program levels has an increasing amount of support and services included that are built upon the previous program level.

ServiceGrid^{SM} customers can select from four (4) program levels, **Core, Select, ProActive, or Enterprise,** that meet the specific needs of their plant and/or fleet:

– **Core** provides a threshold level of support for self-maintaining facilities or facilities with limited budgets, supplying data hosting, web portal access to reports and dashboards, alert services and phone support.

– **Select** provides enhanced services and options for customers who want to continue to work on their own to a large extent and additionally want the reassurance and support by ABB. It adds services such as data validation, customized dashboards and reports, etc. to the Core level.

– **ProActive** offers the greatest value by relying on the resources of ABB for comprehensive services such as predictive maintenance, performance and availability guarantees, management of spare parts and warranties, etc. Typically for customers who recognize the benefits they get from a partnership with ABB.

– **Enterprise** adds logistics and site maintenance service for a plant, or scalable services for a fleet, to ensure that standard and best practices are used to reduce overall O&M costs. Typically for customers having a central engineering or support function that understands the value they get from a partnership with ABB as service provider delivering coordinated support across their fleet.

The ServiceGrid^{SM} offerings, for PV Remote, provide significant benefits to a variety of stakeholders:

– Plant owners and investors can easily monitor their plant and fleet KPI's and track financial performance of their assets.

– Service providers and O&M staff are able to adopt proactive strategies and avoid penalties which would be caused by low performance and down-time of equipment.

– Equipment manufacturers and EPC's are able to use automated diagnostic tools and remote experts can resolve issues faster, when emergency support is needed.

– In addition to predictive, preventive and corrective maintenance, process analysis and remote diagnostics, the service center can also provide remote operational control. The ability to analyze, fine-tune and control energy production remotely, is an added value for grid operators.

	Services	Core	Select	ProActive	Enterprise
Remote Monitoring	Web access support	✓	✓	✓	✓
	Data hosting	✓	✓	✓	✓
	Portfolio-wide reports and dashboards	✓	✓	✓	✓
	Monitoring and alerts service 24x7x365	✓	✓	✓	✓
	Phone support 24x7x365	✓	✓	✓	✓
	Data validation, editing	O	✓	✓	✓
	Customized reports and dashboards	O	✓	✓	✓
	Telecontrol service		✓	✓	✓
	Health and safety support		✓	✓	✓
	Management of warranties		✓	✓	✓
	Preventive maintenance		O	✓	✓
	Corrective maintenance		O	✓	✓
	Designated support leader			✓	✓
	Guaranteed intervention and fixing time			✓	✓
	Spare parts			✓	✓
	Performance and availability guarantee			✓	✓
	Logistics (handling of spare parts)			O	✓
Full O&M	PV panels cleaning			O	✓
	Grass cutting, Snow removing			O	✓
	Site maintenance (cleaning, civil works, etc.)			O	✓

Options	Core	Select	ProActive	Enterprise
Key components retrofit	O	O	O	O
PV energy forecast app.	O	O	O	O
Predictive maintenance apps.	O	O	O	O
Power plant optimization	O	O	O	O

O = Optional   ✓ = Included

Remote monitoring and asset management

Plant owners need to minimize O&M costs by quickly identify underperforming components, use predictive maintenance to reduce downtime, extend equipment life cycles and evaluate the impact of equipment failure. They also require speedy access to service engineers and product experts.

End-users need an easy and fast access to the key plant data They get this through a powerful web portal which includes alarms and notifications, dynamic data presentation, predictive maintenance, production forecasting, production and performance cockpits, a reporting and ticketing system, and health checks.

Alarms and notifications
Besides receiving standard types of alarms from the plant such as faulty inverters and plant equipment, users can generate their own alarms for situations like "Low KPI value." When an alarm is activated the platform conducts a preliminary diagnosis of possible operating failures and immediately notifies the responsible personnel by SMS or email.

Dynamic presentation of collected data
Maps show the geographical location of the fleet plants with icons. An adjoining frame contains a list of the plants in the fleet and uses dynamic traffic lights and icons to show the status of contractual KPI's, the presence of open maintenance tickets and the status of the plant connection.

Predictive maintenance
The service center hosts a set of tools to detect and correct the most common reasons for underperforming assets. The tools analyze the plant in small sections (typically individual strings) to pinpoint local problems at an early stage before they develop into larger production problems. They detect soiling (dust accumulations on the modules); total and partial shading of strings; and aging, which analyzes the efficiency of the PV modules over time to determine the loss in performance caused by degradation.

Production and performance cockpits
Other applications that monitor and analyze plant production include performance ratio monitoring, which is a real-time cockpit for monitoring plant production and KPI's. Equipment condition trending monitors the performance of critical plant equipment in real time; and fleet analysis provides a historical data dashboard for comparing and analyzing fleet performance.

Reporting and ticketing system
The service center stores data from the PV plants and the web portal uses the data to, for example, automatically generate reports on production, interventions and actions by operators, an O&M log book that collects tickets relating to O&M activities and tracks operators' actions. Executive-level reports are available, with information on financial performance of the plants.

Security
For remote service and control centers, cyber security and remote secure connections are very relevant. Undesired user intrusion must be avoided to ensure the security of power supply.

The remote management system provides secure remote connections to every plant. The plant automation system and the remote management system perform two-way authentication prior to initiating communication.

To provide end-to-end security, the remote management system utilizes standard secure communication protocols with encryption. The system allows for setting granular permission on remote activities. Such activities include data collection, desktop sharing and file transfer. Secure data transmission begins at the source, with control over the types of data being collected for transmission. The platform is configurable, in that data access can be enabled or disabled based on the asset owner's security policy.
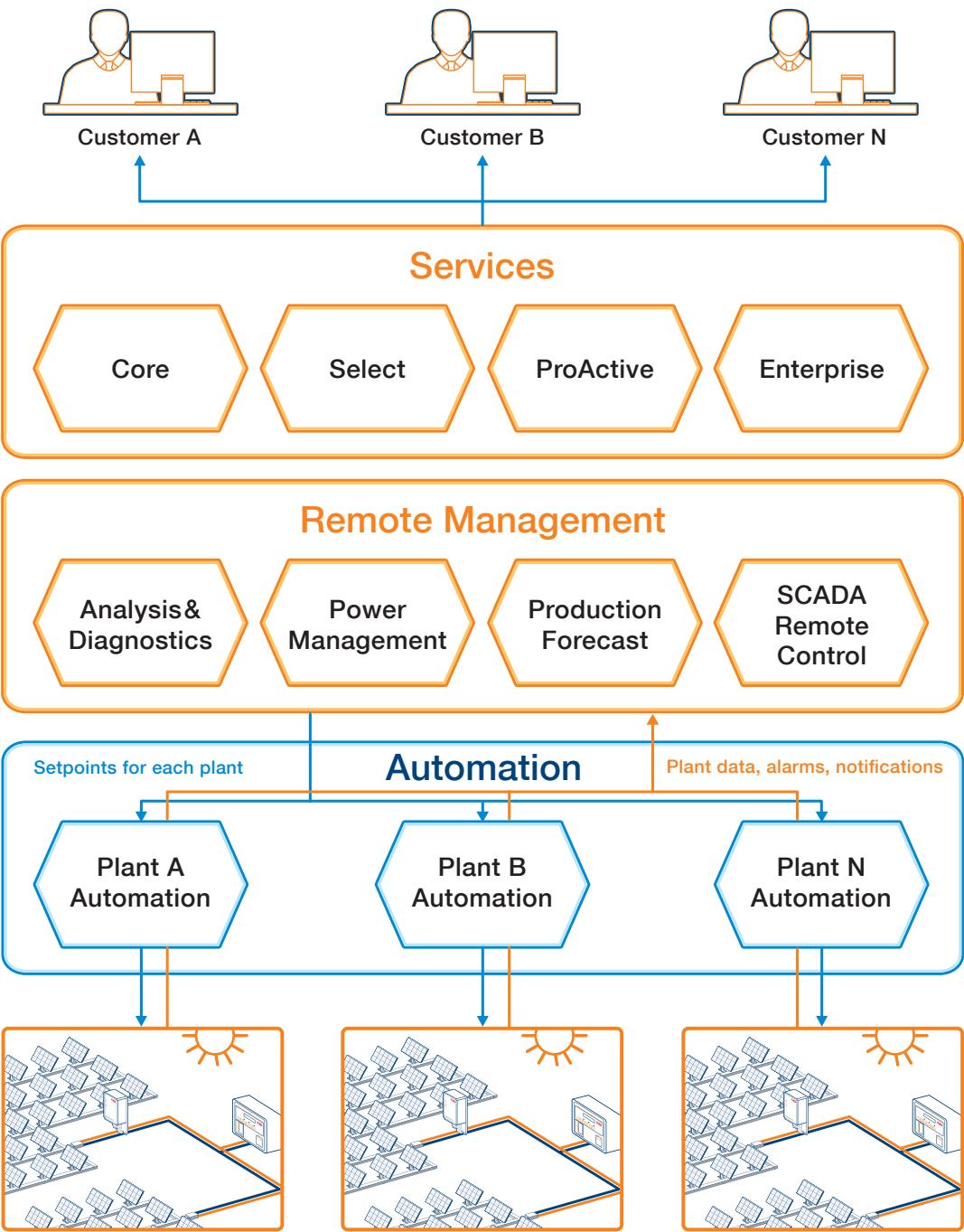
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