Yokogawa Renewable Solutions
SOLAR PV

YOKOGAWA SOLAR PV SOLUTIONS

With more than 100 years of control experience, Yokogawa now offers a fully integrated solar PV plant control and monitoring solution, ranging from field instrumentation and local plant control and monitoring, to DaaS cloud-based monitoring and control of multiple renewable energy generation facilities, including managing battery storage, maximizing profitability, and maintaining power generation and system load stability. With the spread of solar PV farms comes a challenge – to produce electricity as flexibly and effectively as possible. Control systems must be able to predict weather conditions, battery health, and inverter and switchgear conditions including diagnostics, and then apply the most appropriate modes of control and optimization of power output.

Yokogawa's solar PV solutions enable you to add solar assets as your plant expands and to change the system irrespective of vendor equipment. This flexible approach is made possible by our template design and industry-standard comprehensive communication interfaces which can communicate digitally with third-party equipment such as weather stations, battery management systems, motors, switchgear and inverters.

Yokogawa's solutions monitor, control and predict the power output of the system in order to maximize the profitability of the plant. Of course, as with any Yokogawa system, the systems and equipment are engineered with supreme reliability to ensure that your plant assets deliver their full potential.

Enterprise Automation Solution (Fast/Tools)

Delivers both real-time and historical automation information from the plant or field to the enterprise level for analysis, research, asset monitoring, control and optimization of the plant.

Solar Tracking Algorithm (STARDOM)

The Stardom RTU controller uses the Solar Position Algorithm of the National Renewable Energy Laboratory of the United States Department of Energy for single- and dual-axis tracking and positioning, and offers an inverter interface via Modbus TCP as well as DNP3 and Modbus RS interface options.
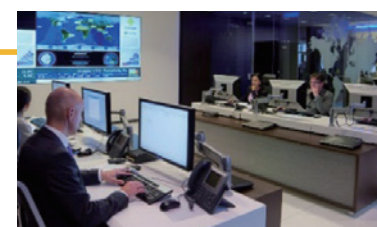
DaaS* Performance Monitoring

Real-time visibility and tools to monitor and analyze the performance of all your solar photovoltaic (PV) assets on one common platform.

* Data as a Service

Cybersecurity

Centralized, standardized cybersecurity management ensuring the distribution of OS security patches and anti-virus signature files to control systems.

Battery Energy Storage System monitoring and control

To ensure a stable supply of power to the grid even when there is a dip in power generation, many renewable energy farms use Battery Energy Storage System. Yokogawa's network-based control system with its redundant SCADA and range-free controllers play a key role in smoothing out the supply of this power to the grid.

Energy Management System

The objective of the renewable energy management system is to minimize the curtailment of renewable generation. To increase the inclusion of renewable energy in electrical power grids, its supply must be stabilized.
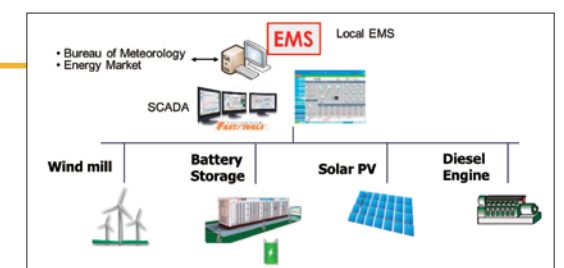
IIoT* Solution

- Wireless sensors
- Remote CCTV plant monitoring
- Inverter control
- Yokogawa DTSX distributed temperature sensing-based monitoring
- Weather data collection (wind direction, wind speed, storm activity, etc.)
- Operations management (production dashboard system)

* Industrial Internet of Things

YOKOGAWA SOLAR PV SOLUTIONS

Enterprise Automation Solution

FAST/TOOLS — Supervisory Systems ™

FAST/TOOLS provide solutions for a wide range of control and supervisory applications having one or more of the following requirements:

- Multiple process site environments
- Integration of third-party systems
- Wide-area (media-independent) communication
- Robustness against intermittent communication
- Security against unauthorized access
- Disaster recovery and high-availability architecture
- Alarm and event management, trending and reporting
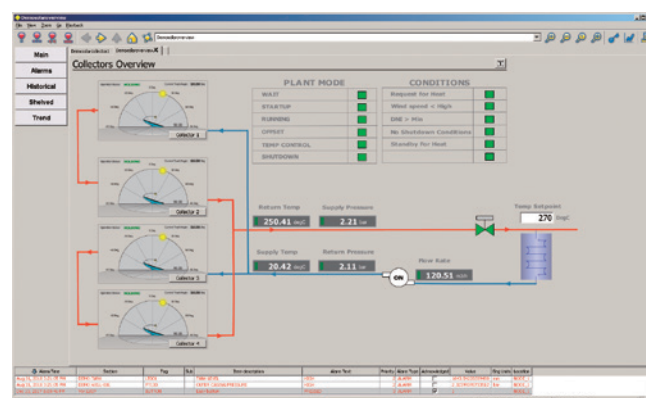
DaaS and Performance Monitoring

DaaS

Yokogawa's DaaS monitors not only energy production but also weather and production forecasts, and the financial performance of assets. It provides user-definable alerts, displays and reports and can export data as PDFs, CSV files or streamed over a persistent direct connection.

Key features

- AC/DC monitoring
- Production and financial information
- String level up to portfolio views
- Standard and configurable displays and reports
- Data from any device
- Full analytical and drill-down capability
- Cloud-based; nothing to install or support
- Secure
- Actual vs. expected performance
- Fast to deploy
- User-configurable alerts
- Data via any communication method

Benefits

- Increased power output
- Identification of actual and nuisance alarms
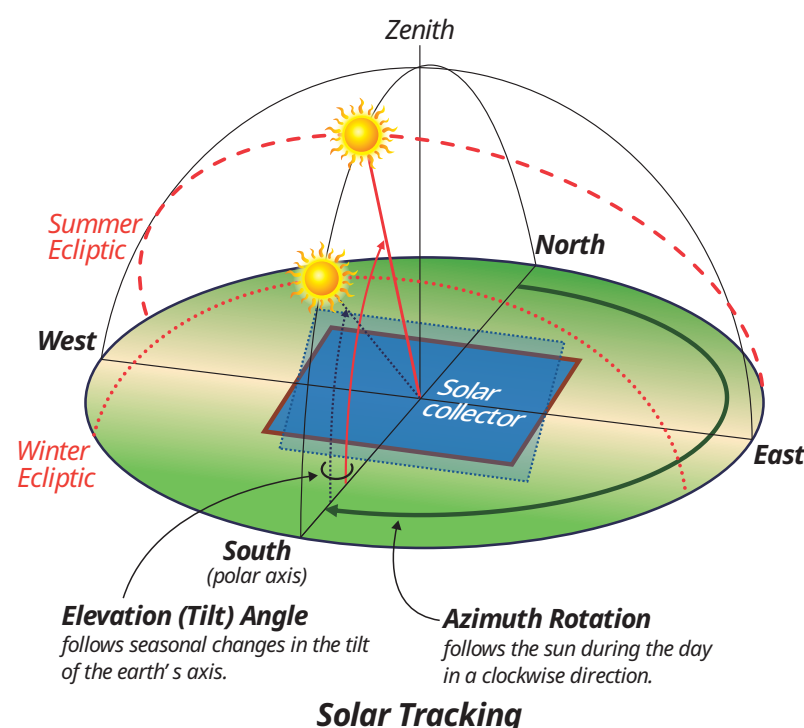- Reduced downtime and O&M costs
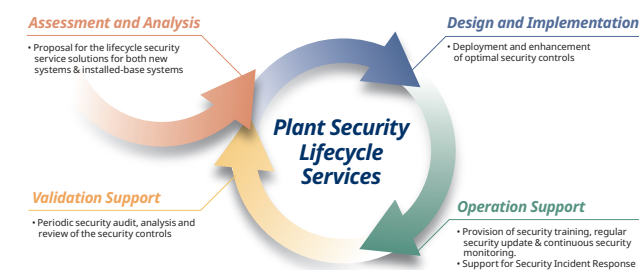- Reduction of supplier risk

Solar Tracking Algorithm

STARDOM ™

The solar tracking calculation implemented in STARDOM controllers uses the Solar Position Algorithm (SPA) of the National Renewable Energy Laboratory of the United States Department of Energy to calculate the position of the sun based on the latitude, longitude, current date and time, and so on. The calculation results including the solar zenith and azimuth angles, solar angle for each solar collector (such as a trough mirror), north/south axis tracker angle, sunrise time, culmination time and sunset time are stored and can be referenced by the user program.

Zenith

Summer Ecliptic

North

West

Winter Ecliptic

East

Solar collector

South
(polar axis)

Elevation (Tilt) Angle
follows seasonal changes in the tilt of the earth's axis.

Azimuth Rotation
follows the sun during the day in a clockwise direction.

Solar Tracking

Cybersecurity

Assessment and Analysis
- Proposal for the lifecycle security service solutions for both new systems & installed-base systems

Design and Implementation
- Deployment and enhancement of optimal security controls

Plant Security Lifecycle Services

Validation Support
- Periodic security audit, analysis and review of the security controls

Operation Support
- Provision of security training, regular security update & continuous security monitoring.
- Support for Security Incident Response
- Prompt recovery from incident

To benefit from the connected world, cybersecurity issues need to be addressed by professionals of both information technology and operational technology. As your proven and trusted partner, Yokogawa will deliver plant security lifecycle services to ensure plant safety and security for mission-critical industries. Based on the defense-in-depth approach and Yokogawa's global standard in compliance with international standards, we provide a comprehensive approach to enhance operational resilience.

Yokogawa's cybersecurity approach is composed of four phases, spanning from assessment of the system to validation of the security controls. This approach ensures that the design and implementation are suitable for the industry and also tailored to each customer's unique environment.

Yokogawa developed a comprehensive network and system security for its industrial process control systems. These security solutions address common and known internal/external system vulnerabilities and can be deployed to both green-field and brown-field facilities.

YOKOGAWA SOLAR PV SOLUTIONS

Battery Energy Storage System Monitoring and Control

To ensure the stable supply of power to the grid even when there is a dip in power generation, many renewable energy farms use battery energy storage system (BESS) as a backup power supply. Yokogawa's network-based control system with its redundant SCADA play a key role in smoothing out the supply of this power to the grid. The system is applicable for remote monitoring and control for multiple facilities.

Following key functions of BESS monitoring and control will help materializing your stable and profit-maximized operation.

- **Operation planning and monitoring: Display required information of every BESS integrated in the system in remote control center by multi-screen, and let operators make the setting of schedule for constant power or load following for each BESS.**

- **Control and operations: Distributing the information to BESS for stable operations such as reference value for demand-power- level, reference-power (active/reactive) from the distribution management center and schedule warning alert.**

- **Battery monitoring: The charge-discharge rate, charge status and operation status of each battery are displayed.**

IIoT

Yokogawa offers an IoT-enabled ISA100 compliant gateway, access point, media converter, and management station and a full range of instrumentation. All Yokogawa ISA100 compliant products can be integrated into any ISA100 compliant network.

Distributed temperature sensing (DTS) enhances site safety and asset monitoring, and the facilities maintenance function monitors solar fields remotely with a Yokogawa Field Eye CCTV solution, which enables real-time image monitoring and camera operations such as pan, tilt and zoom through a Web browser. Yokogawa's security experts have been actively involved in drawing up international industrial standards from ISO, IEC and ISA such as IEC/ISA62443 (ISA99). Yokogawa was one of the founding members of the ISA Security Compliance Institute.

Yokogawa has research and development centers in Singapore, Japan, India, and the U.S. which are developing technologies to optimally apply security techniques to control systems. With long experience of integrating control systems, these centers develop security techniques and solutions optimized to each industry, application, and system configuration. The results are used to help customers secure their control systems against ever-evolving security risks.
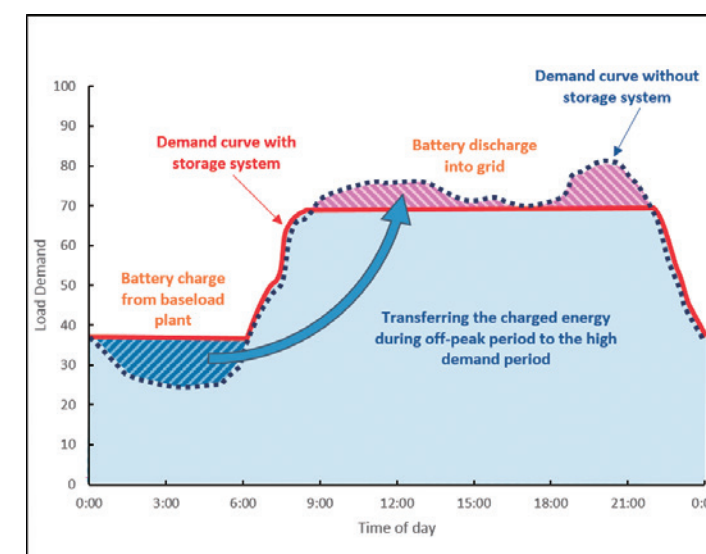
Energy Management System

The objective of a renewable energy management system is to minimize the curtailment of renewable generation and to provide steady, dispatchable power to support power purchase agreements by optimally scheduling the charging and discharging of storage systems based on participating market signals (to take advantage of price volatility), wind and solar generation forecasts, and weather and market conditions.

- **Are configured at individual locations to visualize operational statuses and energy consumption using IIoT.**

- **Connect each plant via the cloud to predict and accumulate energy demand and make energy supply plans with optimized cost.**

- **Can efficiently operate a co-generation system based on accurate energy supply planning.**

Energy Management System

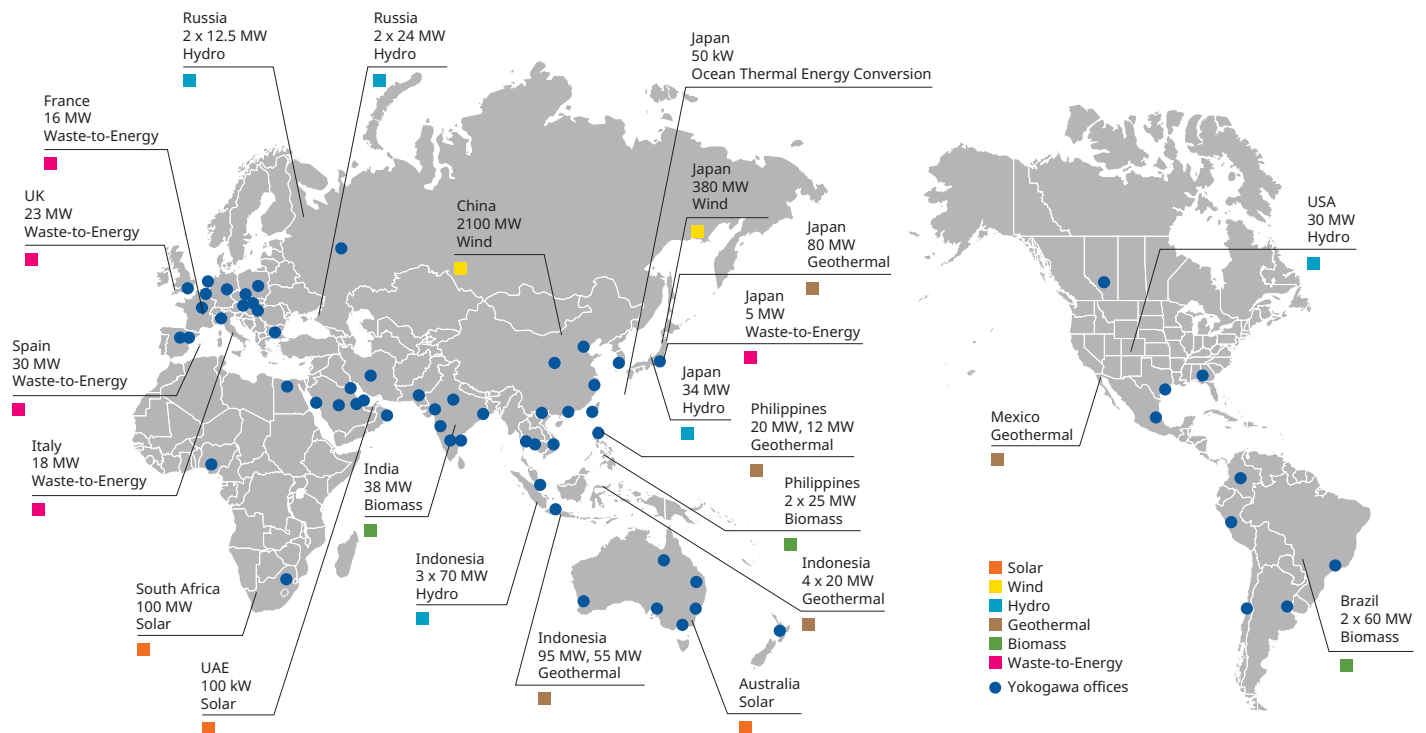**Wind farm**   **Solar field**   **Battery**
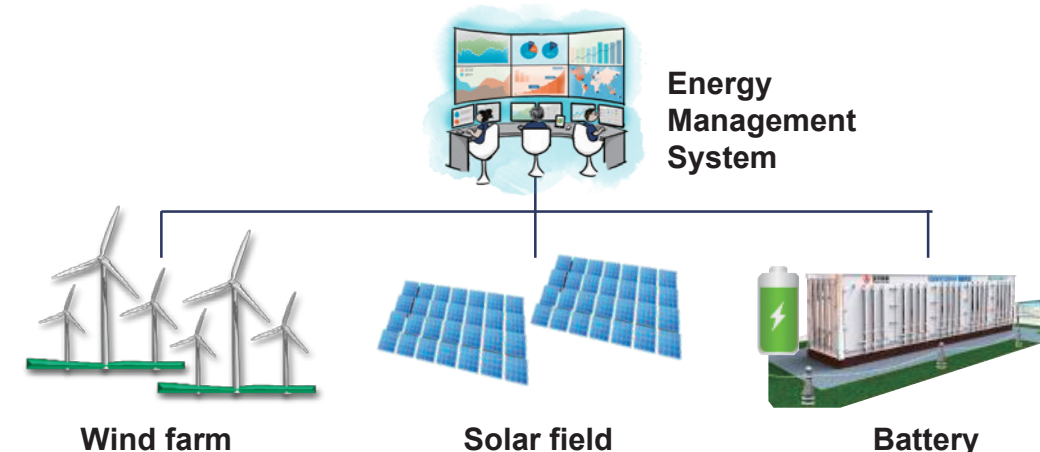
The EMS provides an integrated operation and revenue maximization system to renewable energy generation facility operators, by providing energy balancing and scheduling between various forms of renewable energy (wind, solar, etc.), conventional generation (thermal, hydro, etc.), energy storage systems (batteries, pumped hydro, and/or flywheels), and dispatch instructions from the market operator. Useful features include:

- **Reduces total community energy cost by configuring the demand response (DR) system.**

- **Works out peak cut or negawatt power by the DR in the community and responds to DR requests from the utility grid.**

Yokogawa's renewable energy projects

Russia
2 x 12.5 MW
Hydro

Russia
2 x 24 MW
Hydro

Japan
50 kW
Ocean Thermal Energy Conversion

France
16 MW
Waste-to-Energy

Japan
380 MW
Wind

Japan
80 MW
Geothermal

UK
23 MW
Waste-to-Energy

China
2100 MW
Wind

Japan
5 MW
Waste-to-Energy

USA
30 MW
Hydro

Spain
30 MW
Waste-to-Energy

Japan
34 MW
Hydro

Philippines
20 MW, 12 MW
Geothermal

Mexico
Geothermal

Italy
18 MW
Waste-to-Energy

India
38 MW
Biomass

Philippines
2 x 25 MW
Biomass

South Africa
100 MW
Solar

Indonesia
3 x 70 MW
Hydro

Indonesia
4 x 20 MW
Geothermal

Brazil
2 x 60 MW
Biomass

UAE
100 kW
Solar

Indonesia
95 MW, 55 MW
Geothermal

Australia
Solar

Legend:
- Solar
- Wind
- Hydro
- Geothermal
- Biomass
- Waste-to-Energy
- Yokogawa offices

OpreX™ Yokogawa achieves operational excellence by providing products, services, and solutions based on the OpreX comprehensive brand that cover everything from business management to operations.

YOKOGAWA ELECTRIC CORPORATION
World Headquarters
9-32, Nakacho 2-chome, Musashino-shi, Tokyo 180-8750, Japan
http://www.yokogawa.com/

YOKOGAWA CORPORATION OF AMERICA
12530 West Airport Blvd, Sugar Land, Texas 77478, USA
http://www.yokogawa.com/us/

YOKOGAWA EUROPE B.V.
Euroweg 2, 3825 HD Amersfoort, The Netherlands
http://www.yokogawa.com/eu/

YOKOGAWA ENGINEERING ASIA PTE. LTD.
5 Bedok South Road, Singapore 469270, Singapore
http://www.yokogawa.com/sg/

YOKOGAWA CHINA CO., LTD.
3F TowerD Cartelo Crocodile Building,
No.568 West Tianshan Road, Shanghai 200335, China
http://www.yokogawa.com/cn/

YOKOGAWA MIDDLE EAST & AFRICA B.S.C.(c)
P.O. Box 10070, Manama,
Building 577, Road 2516, Busaiteen 225, Muharraq, Bahrain
http://www.yokogawa.com/bh/

Visit our website at:

**https://www.yokogawa.com/
industries/power/renewable-energy/**

Represented by:

Printed in Japan, 908(KP) [Ed : 02/b]

YOKOGAWA ◆ Co-innovating tomorrow™