

Yokogawa Solutions for Flue Gas Desulfurization and Denitrification

Yokogawa Solutions for Flue Gas DeSOx and DeNOx

Yokogawa FGD solutions help optimize the operation of FGD systems and achieve the Sustainable Development Goals (SDGs) while minimizing running costs. A wide variety of solutions based on our extensive experience and track record all over the world ensure the ideal operation.

Proven control and monitoring system that digitizes the FGD system

Yokogawa, with its abundant experience in multiple FGD systems and providing control and monitoring solutions, has long played a key role in FGD system control. The service is not only for new power plants but is also ideal for retrofitting existing conventional systems. Digitized FGD systems with a retrofitted control system bring financial and safety benefits to customers.



Optimization of wet-scrubber FGD

With its optimization system, Yokogawa can minimize the total cost of ownership while keeping the FGD system with wet-limestone scrubbing in the ideal condition. The optimization system has been proven to perform well at large-scale coal-fired power plants in Japan; major improvements achieved include the following:

Cost reduction by optimizing pump operation

Yokogawa's FGD optimization system determines the optimum number of recirculation pumps required to run to keep the sulfur dioxide (SO₂) concentration in the outlet flue gas below the regulatory limit, thus reducing the consumption of electricity and limestone slurry and minimizing the cost of FGD operation.

Highly stable pH of slurry

The pH value of limestone (or lime) slurry is a key parameter that can be controlled to maximize the removal of sulfur oxides (SO_x) while minimizing scale buildup, thus maintaining optimum FGD performance while avoiding unexpected problems. Yokogawa's optimization system stabilizes the pH of the slurry regardless of the process conditions.

Effective removal of SO₂ from flue gas

The primary objective of the FGD is to remove sulfur dioxide from flue gas. Yokogawa's FGD optimization system ensures that SO₂ emissions are kept below the regulatory limit at the lowest cost.



Field instruments

For accurate measurement with minimum maintenance, it is essential to select highly reliable field instruments.

Pressure/differential pressure transmitters

Yokogawa's proven pressure and differential pressure transmitters can meet almost any process measurement needs. Silicon resonant sensors developed by Yokogawa ensure reliable measurement with high performance and robustness.

Temperature transmitters

Yokogawa's temperature transmitters provide accurate and reliable temperature measurement.

Electromagnetic flowmeters

Yokogawa's electromagnetic flowmeters are an excellent choice to measure and control the flow of abrasive and erosive limestone slurry to the sprayers, etc.



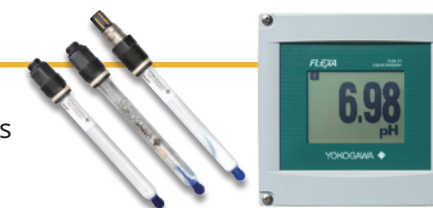
Flue gas analyzer system

Monitoring of FGD inlet and outlet flue gas is essential to measure the concentrations of SO₂ and other components. As the concentration of SO₂ in flue gas is a key index of FGD performance and compliance with emission regulations, a reliable online emission monitoring system is essential for ideal operation of an FGD plant. Yokogawa offers a flue gas analyzer system comprising a combination of high-end Yokogawa products with some third-party devices to deliver stable FGD control.



pH analyzers

Unstable pH measurement can have a significant adverse effect on the entire FGD performance, and so pH measurement is one of the critical parts of FGD control. Yokogawa's pH analyzers developed based on its extensive experience and knowledge ensure accurate and stable pH measurement.



YOKOGAWA SOLUTIONS FOR FLUE GAS DeSOx and DeNOx

Distributed Control System (DCS) for FGD Control and Monitoring

CENTUM VP

Yokogawa's CENTUM VP has a proven, ultra-high hardware availability better than "seven 9s" (99.999959%) thanks to its inherent dual-redundant design, non-stop controller technologies enabled by a "Pair & Spare" CPU configuration, the world's fastest 1-Gbps control network (Vnet/IP), and online maintenance capability. CENTUM VP is ideal for FGD, whichever type of desulfurization system is adopted.



No. 1 market share (more than 60%) in Japan

The leader and pioneer of control solutions for all types of FGD at utility power plants in Japan

Yokogawa, the pioneer of FGD control with more than 40 years of experience, started providing control solutions to meet strict emission standards earlier than any other provider anywhere, including in Europe and North America!

Turceni Thermal Power Plant (Coal-fired, 4 × 330 MW)

Yokogawa's integrated solutions for FGD process control at Romania's largest power plant



The Turceni thermal power plant is the largest coal-fired power plant in Romania, belonging to the Romanian state-owned coal energy producer Complexul Energetic Oltenia S.A.

When Romania joined the EU in 2007, it was required to bring the sulfur dioxide (SO₂) and dust emissions from its power plants into compliance with the EU environmental standards by 2011. At the Turceni power plant, it was decided that the installation of FGD systems for Units 3, 4, 5, and 6 would be financed by the Japanese government. Yokogawa provided its CENTUM VP integrated control system (PCS); field devices such as DPharp EJX pressure/differential pressure transmitters, ADMAG electromagnetic flow meters, pH analyzers, temperature transmitters; the Plant Resource Manager (PRM) integrated device management tool; the Exaquantum plant information management system (PIMS), etc.

Tachibanawan Thermal Power Plant (Coal-fired, 2 × 1,050 MW)

Integrated system for environmental control facilities at one of the largest coal-fired power plants in Japan



The Tachibanawan thermal power plant is one of the largest coal-fired generation units in Japan consisting of two 1,050 MW units. The plant is well known not only for its stable electricity supply but also for its environmental protection measures of removing nitrogen and sulfur oxides (NO_x and SO_x) emissions and ash dust, and recycling fly ash.

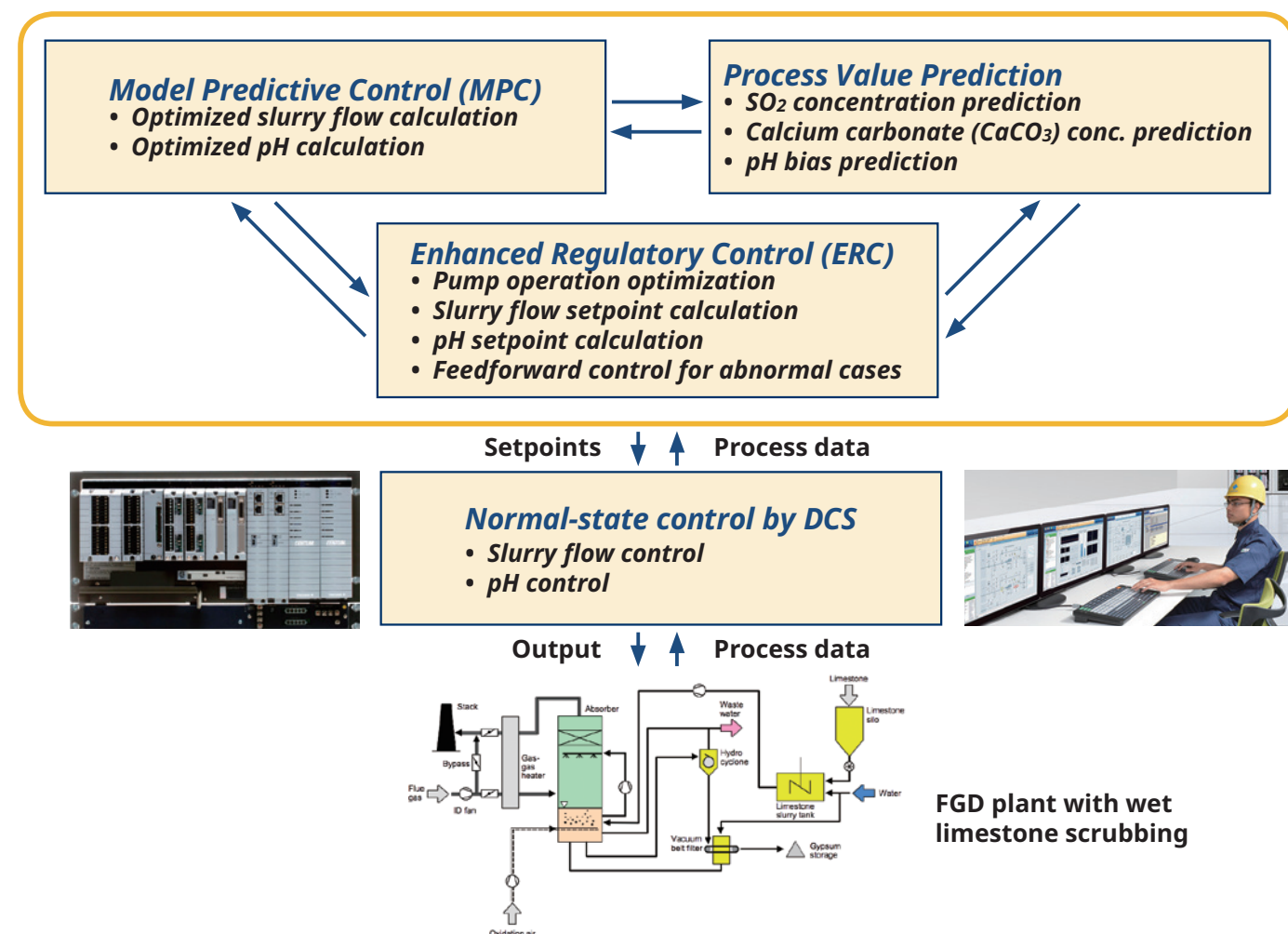
The environmental control facilities at this plant include FGD, electric precipitator, coal handling, ash handling, and wastewater treatment systems. This large application with more than 30,000 data items is monitored and controlled by Yokogawa's CENTUM CS integrated control system. Since entering commercial operation in 2000, the environmental control facilities at the Tachibanawan Power Station have been managed effectively by the CENTUM CS, achieving a stable supply of electricity with minimal impact on the environment.

YOKOGAWA SOLUTIONS FOR FLUE GAS DeSOx and DeNOx

Optimization System for FGD with Wet Limestone Scrubbing

Optimization system for the best FGD performance

Yokogawa's FGD optimization system is best suited for wet limestone scrubbing among all types of desulfurization process. The typical configuration shown below can continuously adapt to varying process and plant conditions and maintains optimal FGD performance at all times.

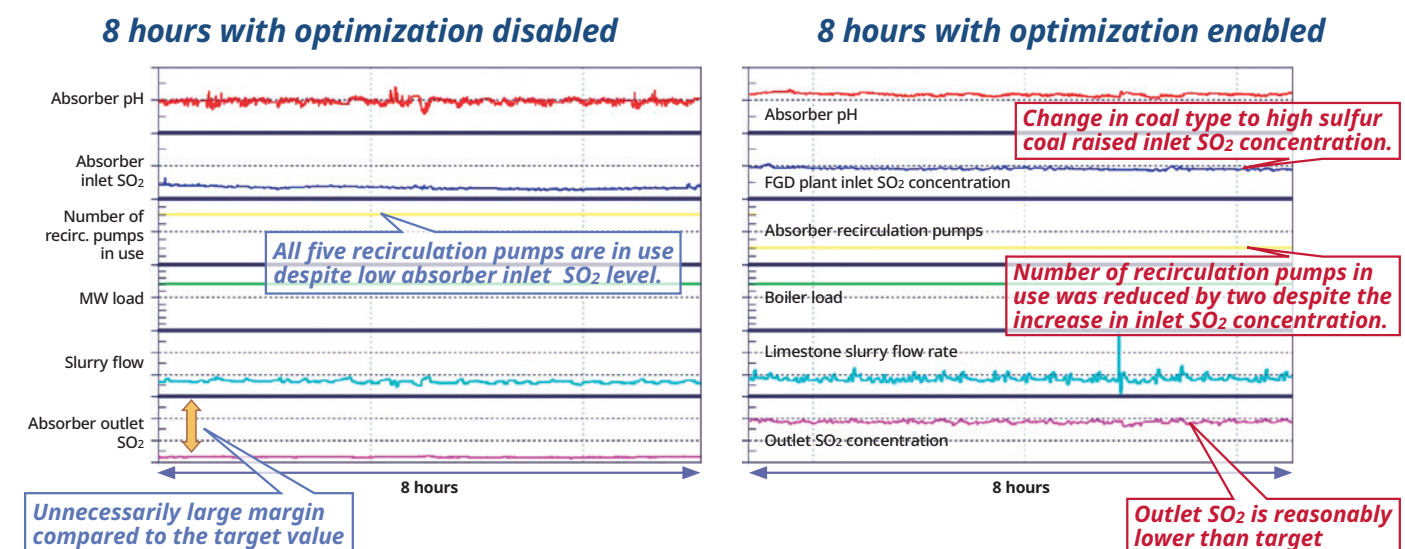


Yokogawa's optimization system:

- Effectively keeps SO₂ concentration in flue gas below regulatory limit
- Reduces load of recirculation pumps by optimizing the number of pumps in use
- Optimizes limestone slurry consumption
- Achieves stable control of slurry pH
- Enables the FGD system to adapt to various types of coal and coal-oil mixture firing
- Adapts to changes in line with plant aging
- Adapts to changes in load and other process conditions

Success at 700 MW coal-fired power plant in Japan

Yokogawa's FGD optimization system has significantly reduced costs and improved performance at large coal-fired power plants in Japan. As an example, the trend graph below shows the operation data with and without optimization at a 700 MW coal-fired unit that uses Yokogawa's optimization system.

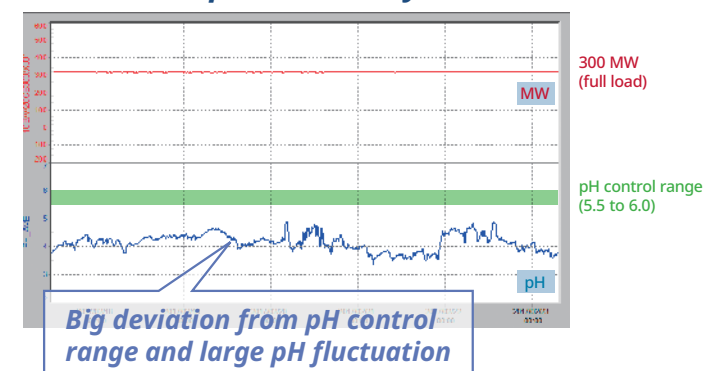


Reduced costs by US\$700-900k per unit per year and in-plant load by 12.4%

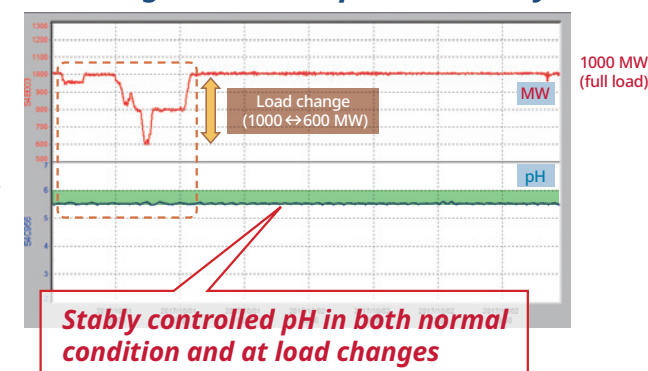
Note: This result was achieved in a 700 MW coal-fired power plant in Japan assuming operation for 300 days per year and electricity cost of US\$0.08 per kilowatt.

Yokogawa's FGD optimization system keeps FGD plant facilities operating in the ideal state by means of stable control of slurry pH, a key parameter in FGD plant control. The pH is adaptively controlled within the allowable range under varying process conditions such as load changes.

300 MW coal-fired plant without FGD optimization system



1000 MW coal-fired plant with Yokogawa's FGD optimization system



Best condition with stable control of slurry pH

YOKOGAWA SOLUTIONS FOR FLUE GAS DeSOx and DeNOx

Field Instruments

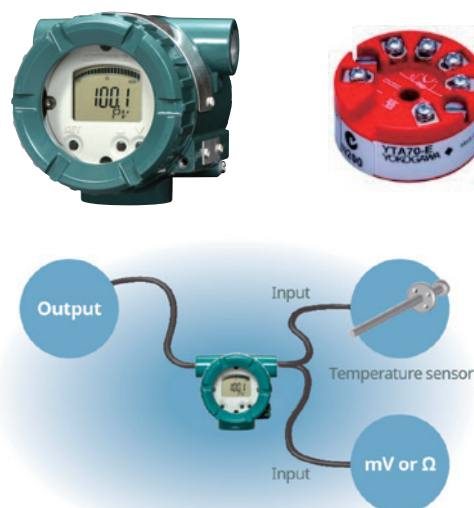
There are many important processes in an FGD plant. Adequate FGD control and monitoring requires highly reliable field instruments for accurate measurement of various process values with minimum maintenance. Yokogawa offers a broad range of field instruments to optimize the performance of FGD operation.

Pressure and differential pressure transmitters



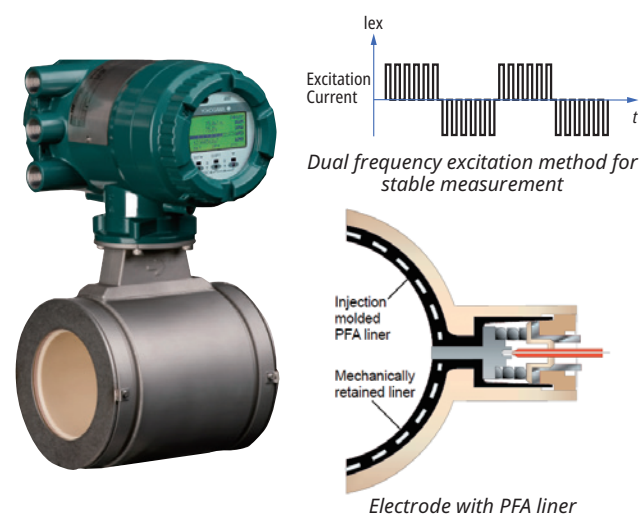
DP Harp
FOR THE DIGITAL WORLD

Temperature transmitters



VTA Series
Total Insight

Magnetic flowmeters



ADMAG
Total Insight

Coriolis mass flowmeters



ROTAMASS
Total Insight
and more!

Flue Gas Analyzer System

The SO₂ concentration in flue gas is a key index since the objective of FGD is to remove SO₂ from flue gas to meet the regulatory target for SO₂ emissions.

As a specialist supplier of sensors and analyzers, Yokogawa supplies an integrated FGD flue gas analyzer system which combines sophisticated Yokogawa products and some third-party devices to ensure stable FGD control as per the customer's requirement.

Our extensive experience and knowledge bring the following benefits to customers:

- Flexibly tailored, integrated analyzer system according to each customer's requirements with a combination of Yokogawa products and third-party devices
- O₂ correction function built into Yokogawa infrared flue gas analyzers
- Dedicated after-sale service to customers after delivery



Yokogawa infrared flue gas analyzer IR400



Flue gas analyzer cabinet (typical)

pH Analyzers

Yokogawa has over four decades of experience in providing tailored and packaged analyzer solutions to customers in various industries such as power, water, oil and gas, petrochemicals and chemicals. For the wet-limestone scrubbing type FGD, pH measurement is critical for control as unstable pH measurement can severely affect the entire FGD performance.

Therefore, reliable and accurate pH measurement is mandatory to keep the FGD system running optimally as the consumption of desulfurizing agent (lime or limestone) is controlled using online pH analyzers. Yokogawa's pH analyzers incorporating extensive experience and knowledge ensure accurate and stable pH measurement of FGD.

- High reliability
- Tailored pH analyzer system for each application as per the customer's requirement
- pH sensors with self-diagnostics
- Digital communications (HART, FOUNDATION™ Fieldbus and PROFIBUS PA)
- Dedicated after-sale service to customers after delivery



Tunable Diode Laser Spectrometer for Flue Gas DeNOx

Precision, Fast-response Ammonia Slip Monitoring

Powerful ultraviolet rays in sunlight cause a photochemical reaction of nitrogen oxides (NOx) in exhaust gas from power plants and factories, producing toxic photochemical oxidants such as ozone. This is the primary cause of photochemical smog which is harmful to most living creatures including humans. NOx in the air also reacts with water vapor to form nitric acid, which oxidizes water in lakes, rivers, and soil and also causes acid rain, which is harmful to plants and animals. NOx removal catalysts and denitrification (DeNOx) systems render NOx harmless via a decomposition reaction with ammonia, reducing atmospheric pollution.

In the typical processes of selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) for denitrification, however, the release of ammonia gas into the atmosphere (ammonia slip) can occur due to incomplete mixing of the ammonia reagent with the NOx or excessive ammonia injection. As ammonia is a toxic gas and depletes the ozone layer, its release must be minimized. Yokogawa's holistic control, monitoring, and measurement solutions help minimize ammonia slip while maximizing DeNOx performance.

Yokogawa's Tunable Diode Laser Spectrometer (TDLS) is an ideal analyzer for ammonia slip monitoring. It measures the concentration of a gas using laser absorption spectroscopy without the need for preconditioning of the gas, unlike many similar analyzers used in a continuous emissions monitoring system (CEMS). This makes the TDLS ideal for harsh applications that require in-situ, precision, and fast-response measurement.



Verified performance at 1000-MW coal-fired power plant

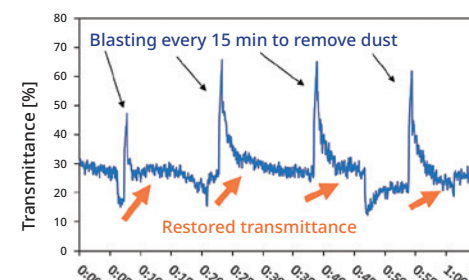
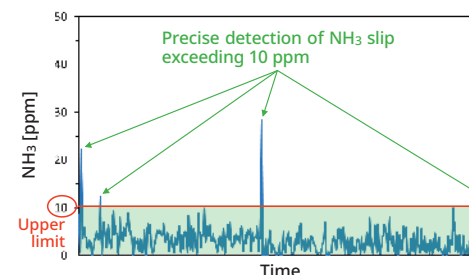
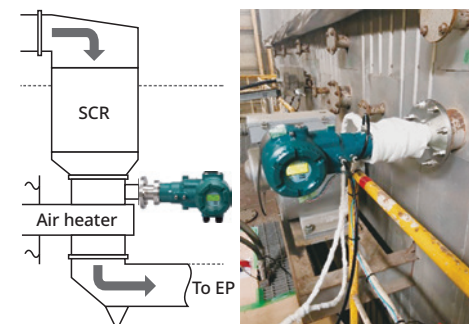
A Japanese power company tested Yokogawa's TDLS8100 probe type tunable diode laser spectrometer at its 1000-MW coal-fired power plant in Japan because it needed to measure ammonia slip from denitrification systems more accurately to keep denitrification running optimally.

The TDLS8100 has been installed at the outlet of the SCR system upstream of the electrostatic precipitator (EP) to measure the ammonia slip where the flue gas contains much dust (approx. 22 g/m³).

Thanks to the breakthrough design of the probe which minimizes dust contamination, the TDLS8100 could stably measure the ammonia slip in the flue gas, even though coal-fired power plants are extremely challenging environments for analyzers of this type because of the high dust (fly ash) loading.

During plant operation, the TDLS precisely measured the ammonia slip and detected instantaneous variations exceeding the upper limit (10 ppm).

To maintain accurate measurement of the ammonia slip during operation, dedicated units for air-blasting were installed in addition to normal air-purge to keep the laser windows clean and prevent the entry of fly ash, which would cause additional signal degradation and maintenance issues. The units periodically blast air at 15-minute intervals to remove the dust and restore the laser transmission performance, thus maintaining stable measurement of ammonia slip.



Yokogawa's long-long term vision and commitment to sustainability goals

With the adoption of the Paris Agreement at the 21st Framework Convention on Climate Change (COP21) and the Sustainable Development Goals at the United Nations Sustainable Development Summit, momentum is building in the global effort to achieve a sustainable society. In light of these developments, in August 2017, Yokogawa released a statement on its aspiration for sustainability and established three sustainability goals. These aim to make the world a better place by means such as enabling the use of low-carbon energy sources and the recycling of materials. As described below, the Company is committed to transforming itself in several key ways to better position itself to achieve these goals.

Statement on Yokogawa's aspiration for sustainability

Yokogawa will work to achieve net-zero emissions, make a transition to a circular economy, and ensure the well-being of all by 2050, thus making the world a better place for future generations.

We will undergo the necessary transformation to achieve these goals by 1. becoming more adaptable and resilient, 2. evolving our businesses to engage in regenerative value creation, and 3. promoting co-innovation with our stakeholders.

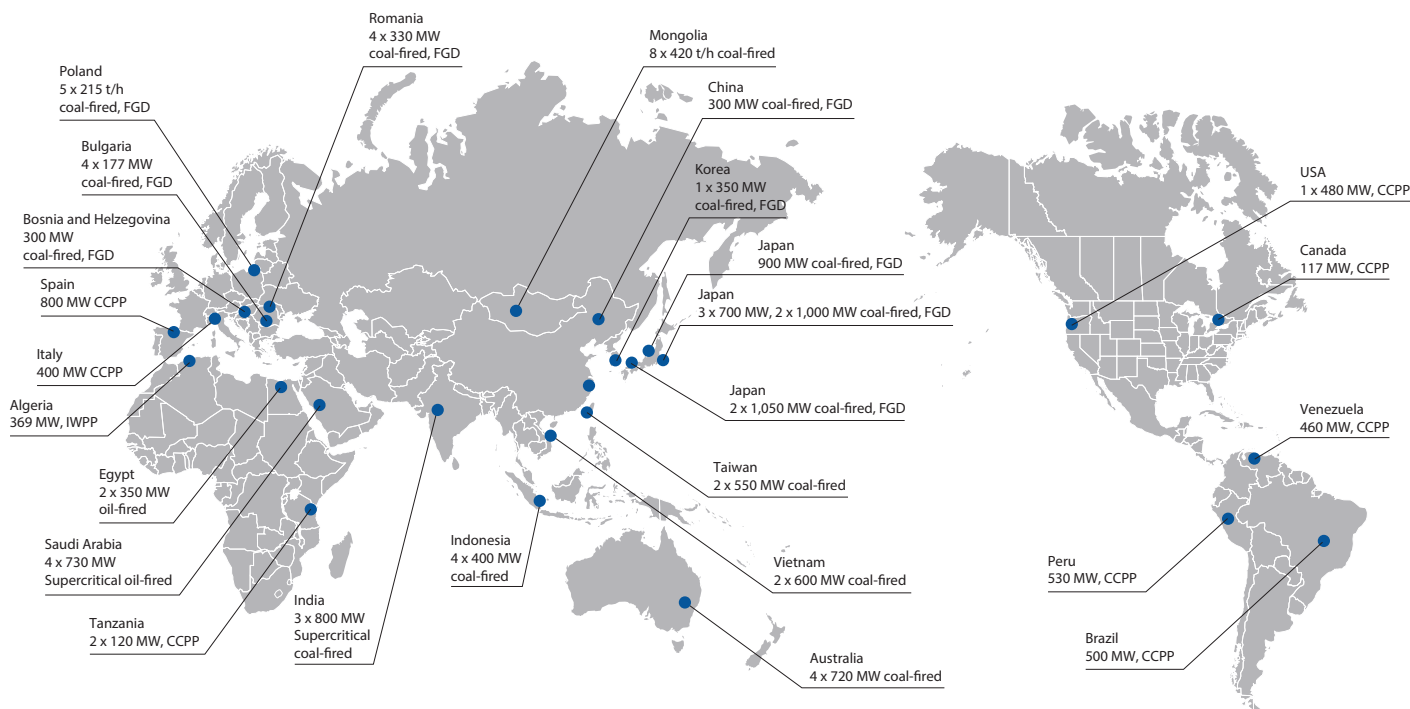
Three sustainability goals



Achieve net-zero emissions; stopping climate change

Climate change is an urgent issue that requires a global response. We aim for net-zero emissions, which means that the greenhouse gas concentrations in the atmosphere do not rise due to the balance of emissions and the absorption of greenhouse gases, which can be accomplished through the introduction of renewable energy and efficient use of energy. We are also working to reduce the impact of natural disasters and respond to biodiversity issues.

Yokogawa's recent fossil fuel fired power plant projects



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.

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Printed in Japan, 008(KP) [Ed : 02/b]