■ Topic 02

J-POWER's Cutting-Edge Coal-Fired Thermal Power Plants and Innovative, Next-Generation Coal-Fired Power Technologies

To raise the generating efficiency of coal-fired thermal power and convert to low-carbon, J-POWER is updating older thermal power plants, developing integrated coal gasification combined cycle (IGCC) and integrated coal gasification fuel cell combined cycle (IGFC) systems, and developing CO_2 separation and capture technology.

Overview of J-POWER initiatives

J-POWER is moving forward with various initiatives on the roadmap towards raising the generating efficiency of coal-fired thermal power and converting to low-carbon.

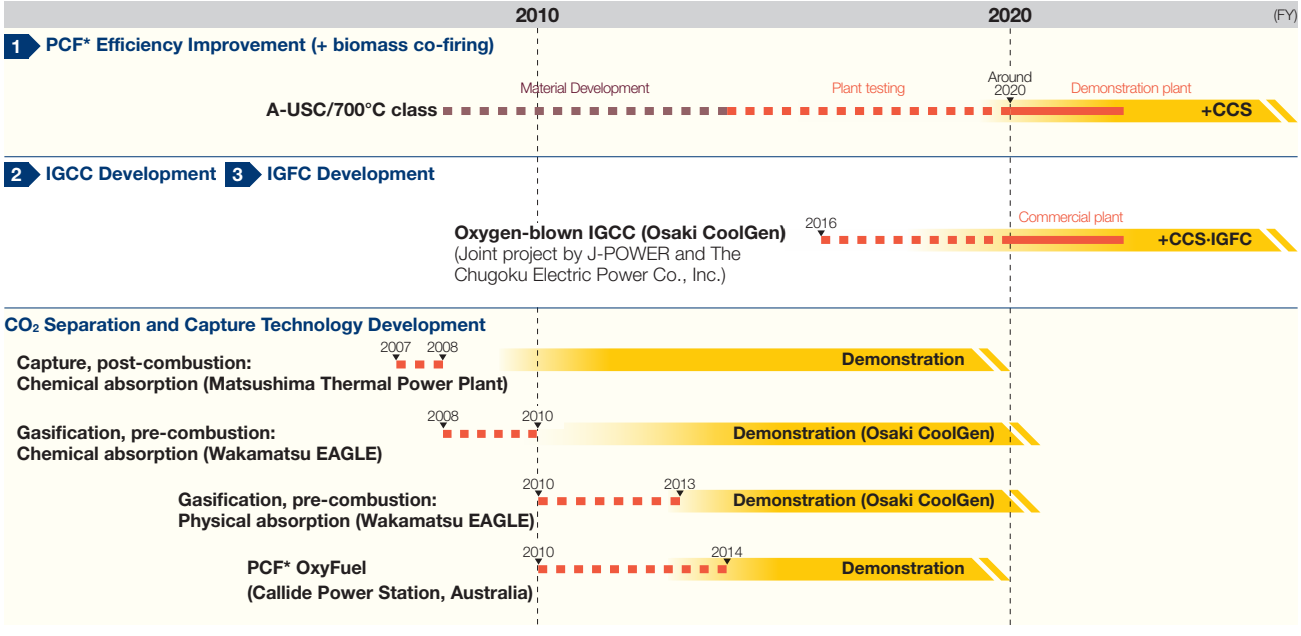
Currently, one key priority is upgrading older coal-fired thermal power plants. We are working to reduce CO_2 unit emissions by introducing Ultra Super Critical (USC) systems and other cutting-edge technologies and using combined combustion with biomass fuels.

In terms of long-term initiatives for the future, we will be making oxygen-blown coal gasification technology feasible for practical application. Establishing this technology, which is expected to be the next generation of coal-fired thermal power generation, and applying it with integrated coal gasification combined cycle (IGCC) and integrated coal gasification fuel cell combined cycle (IGFC) systems, will dramatically increase generating efficiency and make it possible to substantially reduce CO_2 emissions.

In addition, we are also developing Advanced-USC technology, which will further enhance the high-efficiency of the latest USC technology at this time.

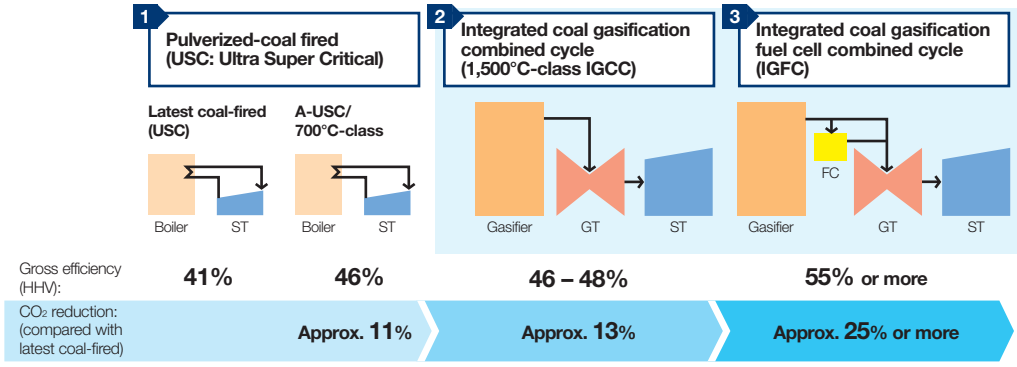
Ultimately, we will seek to bring about revolutionary, zero-emission coal-fired thermal power by combining these systems with CO_2 capture and storage (CCS) technologies.

DEVELOPMENT AND DEPLOYMENT ROADMAP FOR CLEAN COAL TECHNOLOGIES



*PCF: Pulverized Coal-Fired generation

COAL-FIRED POWER TECHNOLOGY FOR THE NEXT GENERATION



ST: Steam turbine; GT: Gas turbine; FC: Fuel cell

Ultra Super Critical (USC): USC technology is a type of technology for raising the efficiency of thermal power plants. Specifically, the USC range refers to a steam pressure of 24.1 MPa or greater with a steam temperature of 593°C or higher.

Integrated Coal Gasification Combined Cycle (IGCC) and Integrated Coal Gasification Fuel Cell Combined Cycle (IGFC): Whereas pulverized coal-fired thermal power utilizes steam turbines only, both technologies are built on coal gasification and offer substantially improved power generating efficiency relative to pulverized-coal fired thermal power. IGCC power generation employs both gas and steam turbines. IGFC power generation adds another element, fuel cells, for a triply integrated power generation configuration.

Specific J-POWER Initiatives

1. Replacing the Isogo Thermal Power Plant

Replacing older thermal power plants with cutting-edge facilities

The Isogo Thermal Power Plant, located in Yokohama, originally had two units that produced 265 MW each. The plant was built in the late 1960s in accordance with the government's coal policy. As a power plant located in a major city, a pollution prevention agreement was inked with the City of Yokohama, the first such agreement in Japan; focus was placed on environmental measures from early on, measures that included installing flue-gas desulfurizers. For over thirty years, the plant has helped stabilize power supply in Yokohama and the Tokyo metropolitan area.

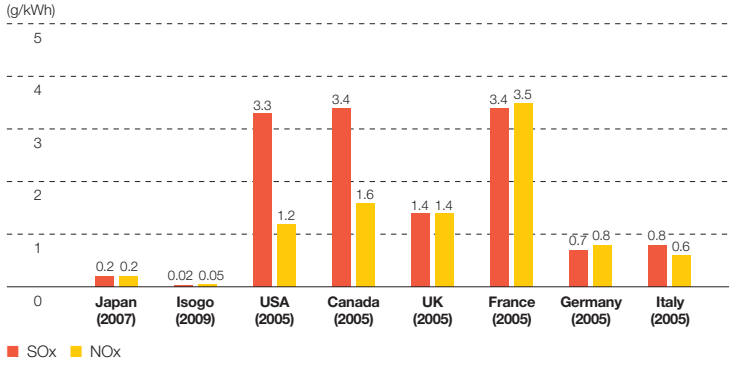
In 1996, a project was launched to replace the original plant with state-of-the-art coal-fired thermal facilities in order to comply with Yokohama's environmental improvement plan, raise the stability and reliability of power supply in the Tokyo metro area, and address aging facilities.

For J-POWER, the Isogo New Thermal Power Plant is the current model for coal-fired thermal power, bringing together various clean coal technologies. It provides the highest generating efficiency of any coal-fired thermal power plant in Japan by raising steam turbine pressure and temperature to extremely high levels, called Ultra Super Critical, or USC.

In replacing the power plant, J-POWER has signed a new pollution prevention agreement with the City of Yokohama in the form of an environmental protection agreement. The new agreement stipulates more stringent standards for SOx, NOx and other substances.

Isogo Thermal Power Plant (after replacement)

(Graph 6) INTERNATIONAL COMPARISON OF SOx AND NOx EMISSIONS PER UNIT OF COAL-FIRED THERMAL POWER GENERATION



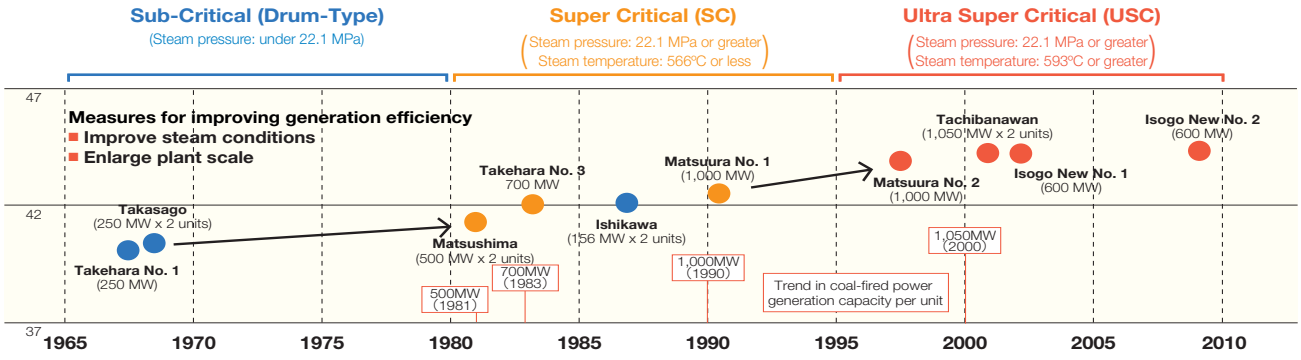
Source: The Federation of Electric Power Companies of Japan
* 10 major Japanese EPCOs and J-POWER
* Figures for Isogo are actual results for fiscal 2009.

Moreover, to maintain power supply stability, an unprecedented “build, scrap and build” approach was employed. The New Unit 1 (600 MW) was constructed while the original power facilities were still in operation (530 MW). When the New Unit 1 went online, the old facilities were shut down and removed. In their place the New Unit 2 was built. Construction began on the New Unit 1 in 1998 and operations were launched in 2002. The New Unit 2 broke ground in 2005 and went online in July 2009.

For our next project, we plan to replace Unit 1 (250 MW) and Unit 2 (350 MW) at the Takehara Thermal Power Plant, located in Takehara, Hiroshima Prefecture, with a new Unit 1 capable of producing 600 MW.

GENERATION EFFICIENCY OF J-POWER COAL-FIRED THERMAL POWER STATIONS

Designed Thermal Efficiency
(%, Gross efficiency, LHV basis)



■ Specific J-POWER Initiatives

2. Innovative High-Efficiency Coal-Fired Thermal Power Technologies and CO_2 Capture Technologies

Large-scale demonstration test of oxygen-blown coal gasification technology (joint test with Chugoku Electric) toward commercialization of IGCC

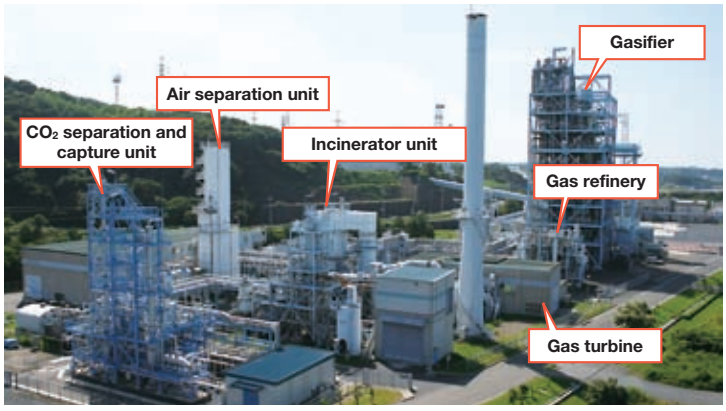
Two stages of pilot testing, called EAGLE Step I and EAGLE Step II, were conducted at the J-POWER Wakamatsu Research Institute in Kitakyushu, Fukuoka Prefecture. Step I, which ran from 2002 to 2006, involved conducting a pilot test on oxygen-blown coal gasification in order to facilitate development of an oxygen-blown coal gasifier and gas purification technologies. Step II was conducted from 2007 to 2009 and involved testing to establish CO_2 separation and capture technologies and expand applicable coal types.

There are two methods of coal gasification: oxygen-blown and air-blown. With the oxygen-blown technique, the gas that is generated is composed of CO and H_2, which can be used for multiple purposes and CO_2 separation and capture is easier.

J-POWER is currently preparing a large-scale demonstration test that incorporates the results from the pilot tests for oxygen-blown coal gasification technology and CO_2 separation and capture technology. It will be run at Chugoku Electric’s Osaki Power Station (located in Osakikamijima-cho, Toyota-gun, Hiroshima Prefecture). In July 2009, we established the Osaki CoolGen Corporation through a joint investment with Chugoku Electric.

This test will involve the construction of a demonstration plant with output on a scale of 170 MW (coal processing volume of approx. 1,100 tons/day), and it will investigate the reliability, economic efficiency, operability and other features of power generation based on oxygen-blown integrated coal gasification combined cycle (IGCC) technology. In parallel, we

intend to perform trials on the application of cutting-edge CO_2 separation and capture technology, with a plan of conducting a large-scale demonstration project on CCS, as stipulated in Japan's national Cool Gen Project. Environmental assessments started in August 2009, and plans call for construction to begin in 2013 with demonstration testing to get underway in 2017.



The EAGLE Pilot Test Facility


CO_2 separation and capture facility

Cool Gen Project
The Cool Gen Project is a plan proposed by the Clean Coal Subcommittee and Mining Committee of the Advisory Committee for Natural Resources and Energy of Japan's Ministry of Economy Trade and Industry (METI). The plan calls for promoting experimental research projects aimed at realizing "zero-emissions coal-fired thermal power generation" through a combination of IGCC, IGFC (aimed at ultimate coal-fired thermal power generation), and carbon dioxide capture and storage (CCS) technologies.

Development of CO_2 separation and capture technology

Surveys and trial projects for carbon capture and storage (CCS) are currently making headway around the world. CCS involves separating and capturing CO_2 given off by large-scale emission sources and storing it permanently underground or in the ocean. Of the three distinct elements comprising CCS—separation and capture, transport, and storage—J-POWER has focused most intently on the development of CO_2 separation and capture technologies. This is because we are able to leverage our operations and maintenance knowledge to design the technologies to be suitable for power plants and because CO_2 separation and capture is the most cost-intensive component of the entire CCS process.

J-POWER is engaged in the development of technologies for separating and capturing CO_2 from the gas produced by oxygen-blown coal gasification because we believe that this holds the most potential in terms of efficiency and other factors. Utilizing the EAGLE pilot testing facilities, in EAGLE Step II we are running demonstration tests on the chemical absorption method; we are planning demonstration tests on the physical absorption method over four years from fiscal 2010 to fiscal 2013.

We are also actively working to develop separation and capture technologies for combustion exhaust from pulverized-coal-fired thermal power, currently the most common method of power generation from coal. We conducted pilot trials from 2007 to 2008 at our Matsushima Thermal Power Plant in collaboration with Mitsubishi Heavy Industries, using the chemical absorption method. Additionally, J-POWER is a participant in the Callide OxyFuel Project using the OxyFuel method, which is scheduled to be held at the Callide A Power Station in Queensland, Australia. This joint demonstration project between Japan and Australia, planned to run from 2010 to 2014, will be the world's first demonstration test of an integrated CCS and underground storage system at an existing power plant.


Test facilities for CO_2 separation and capture at the Matsushima Thermal Power Plant's Unit 2


Callide A Power Station (Australia)