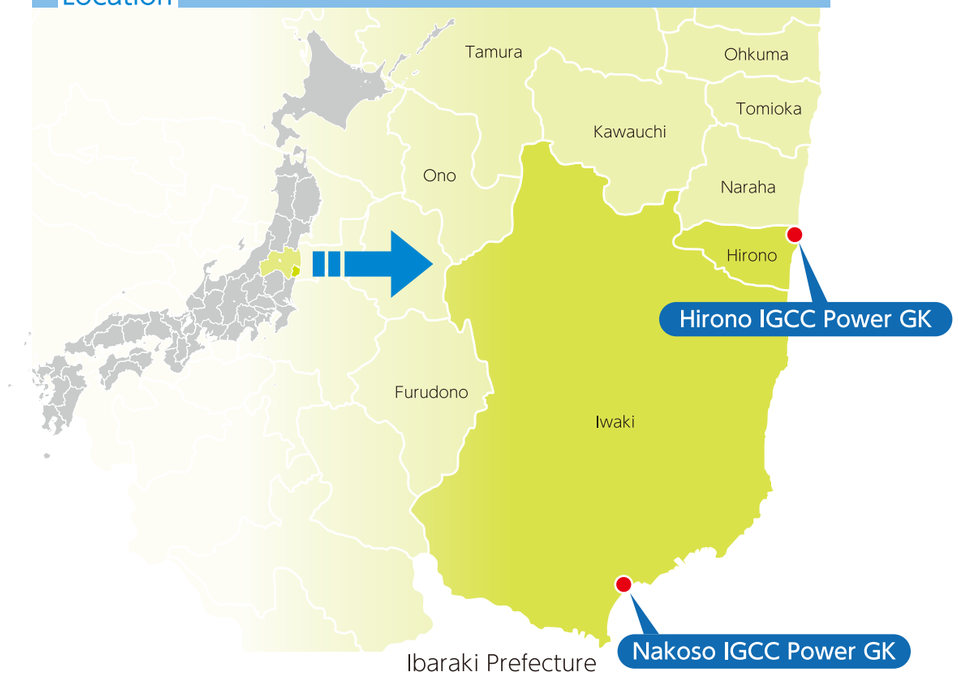
Corporate Logo

The design shaped like the letter F represents Fukushima, Fukko (Japanese for recovery) and Future.

Blue	Continuous technological development
Yellow	Continuous human resource development
Green	Continuous environmental improvements
Orange	Color of Fukushima Prefecture flag

Location



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IGCC

Integrated coal Gasification Combined Cycle

Nakoso IGCC Power GK　　Hirono IGCC Power GK

Business Overview

Nakoso IGCC Power GK and Hirono IGCC Power GK are large-scale coal-fired power plants that utilize integrated coal gasification combined cycle (IGCC) technology, which produces electricity with excellent efficiency and reduces greenhouse gases. It was established to support the stable supply of electricity in Japan, and to contribute to the economic recovery and job creation in Fukushima, where the power plant is located.

Since 2021, Nakoso IGCC Power GK and Hirono IGCC Power GK have safely operated the world's most advanced, high-efficiency IGCC power plants on a daily basis to achieve both a stable electricity supply and countermeasures against global warming.

Corporate History

Oct. 2016 : Environmental assessment completed for Nakoso and Hirono
Apr. 2017 : Started construction of Nakoso
Apr. 2018 : Started construction of Hirono
Apr. 2021 : Started commercial operation of Nakoso
Nov. 2021 : Started commercial operation of Hirono

Company Profile

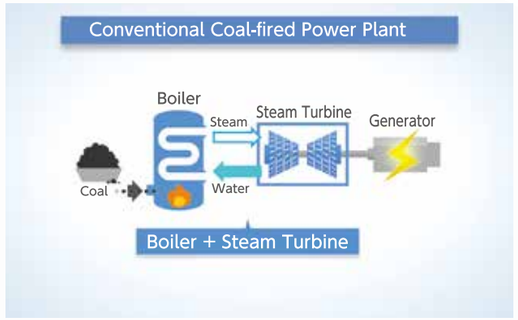
Company Name	Nakoso IGCC Power GK	Hirono IGCC Power GK
Established	Aug. 2, 2016	Same as on the left
Capital	100 million yen	Same as on the left
Shareholder	Mitsubishi Heavy Industries, Ltd.	Mitsubishi Heavy Industries, Ltd.
	Tokyo Electric Power Company Holdings, Inc.	Tokyo Electric Power Company Holdings, Inc.
	Joban Joint Power Co., Ltd.	
Representative Partner	Mitsubishi Heavy Industries, Ltd.	Mitsubishi Heavy Industries, Ltd.
Main Business	Power generation by way of IGCC system	Same as on the left
Location	Iwama-machi, Iwaki-shi, Fukushima, Japan	Hirono-machi, Futaba-gun, Fukushima, Japan

Outline of IGCC Plant

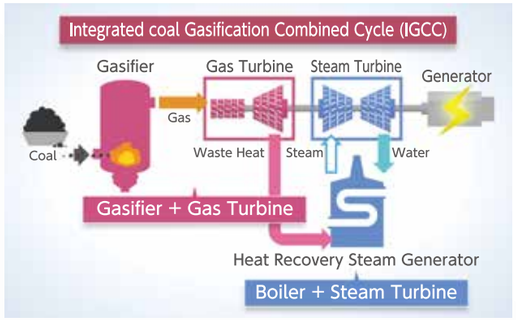
		Nakoso IGCC Power Station	Hirono IGCC Power Station
Plant Type		Air-blown coal gasification combined cycle power plant	Same as on the left
Capacity		525MW (power generation end output)	543MW (power generation end output)
Commercial Operation Date		Apr. 16, 2021	Nov. 19, 2021
Coal Consumption		Approx. 3,400 t/day	Same as on the left
Efficiency (Net)		Approx. 48% (LHV)	Same as on the left
System	Gasifier	Air-blown & Dry Feed Two Stage Entrained Flow	Same as on the left
	Gas Clean-up	Wet (Chemical Absorption) + Gypsum Recovery	Same as on the left
	Gas Turbine	Simple Open Cycle Single-shaft (1400℃-class)	Same as on the left
Flue Gas Properties	SOx	19 ppm (11.6% O_2 basis)	Same as on the left
	NOx	6 ppm (16% O_2 basis)	Same as on the left
	Dust Concentration	5 mg/m^3_N (16% O_2 basis)	Same as on the left

What is IGCC?

(Including differences with conventional coal-fired power generation)



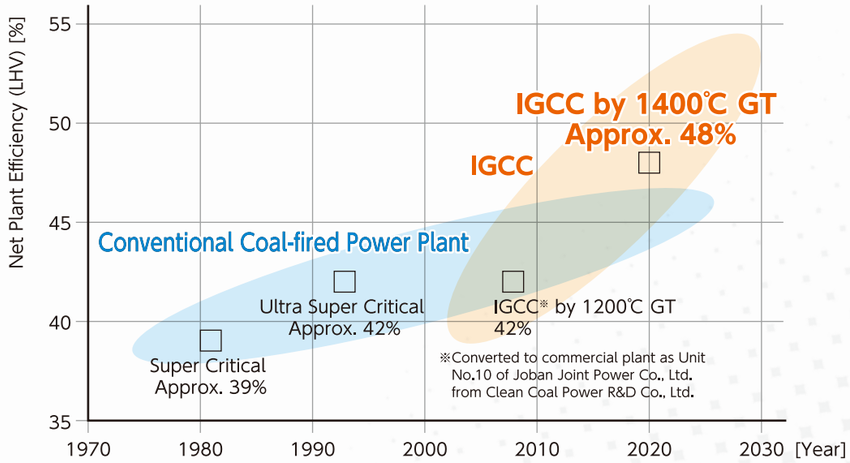
The heat generated when coal is burned in the boiler converts water into steam, and the expansion force of this steam rotates a steam turbine to generate electricity.



The coal is gasified in the gasifier. This coal gas is introduced and combusted in a gas turbine which rotates to generate electricity. Furthermore, the high-temperature exhaust gas remaining in the gas turbine is introduced into a boiler where the heat generates steam that rotates a steam turbine to generate electricity.

Trend of Coal-fired Power Plants

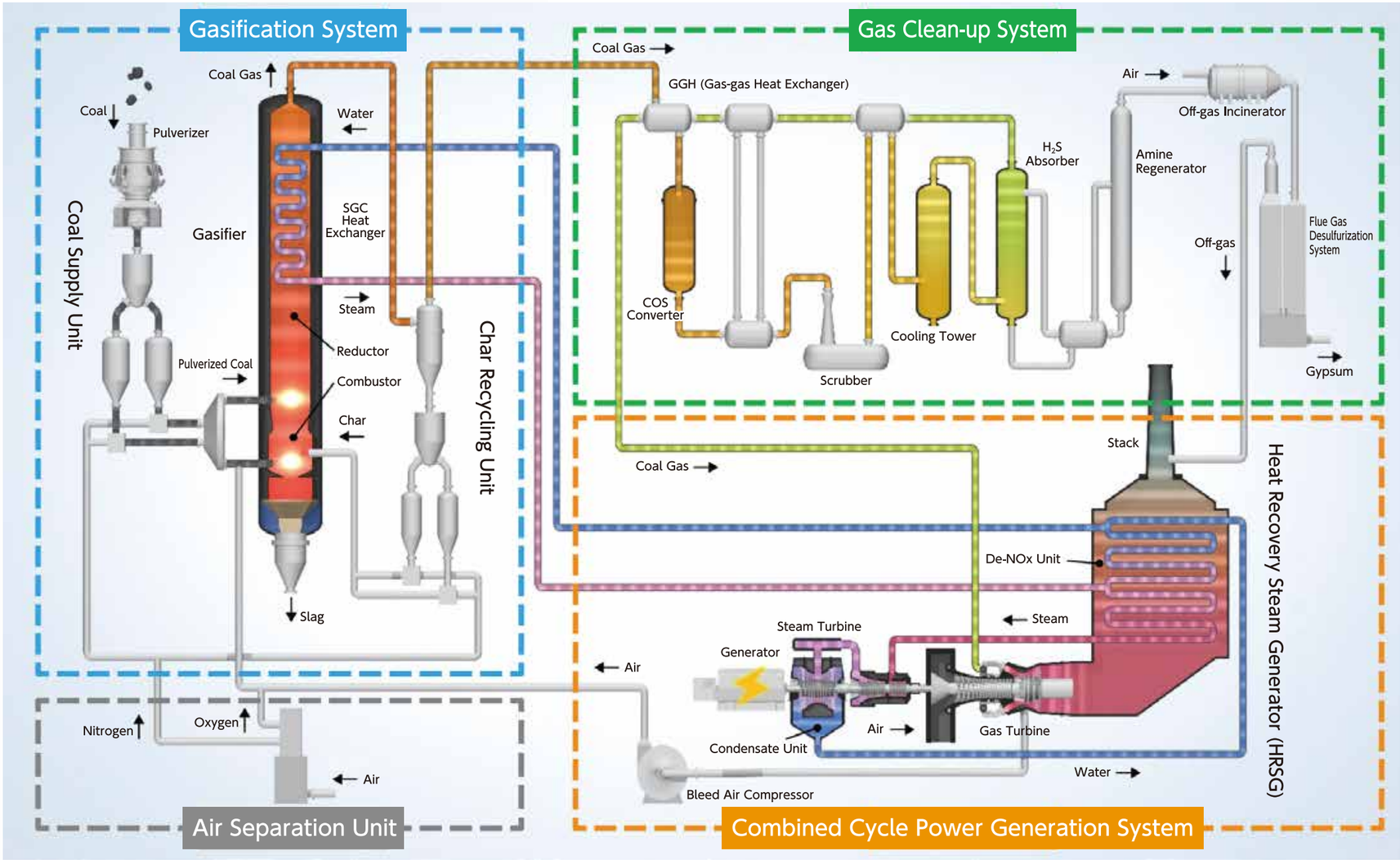
The increased thermal efficiency saves fuel used and reduces CO_2 emissions.
IGCC has improved thermal efficiency over conventional coal-fired power generation.



[Reference] "Japan Revitalization Strategy", METI/MOE"Reference Table of Best Available Technology (February 2017)"

How IGCC works

(System diagram and description of each facility)



Gasification System

- Coal is pulverized in the pulverizer and fed with nitrogen into the gasifier (dry feed).
- The gasifier adopts a two-chamber, two-stage entrained-flow gasifier system comprising a lower combustor (combustion chamber) and an upper reductor (reaction chamber).
- The combustor burns pulverized coal at high temperature to generate the high-temperature heat source needed for the gasification reaction in the reductor.
- The reductor uses the heat rising from the combustor to gasify pulverized coal and generate high-temperature coal gas (syngas).
- The syngas cooler (SGC) heat exchanger uses the heat from the coal gas to generate steam. This steam is sent to the steam turbine.
- Unburned material that could not be fully gasified (char) at the gasifier outlet is collected by the char recovery unit and fed into the combustor. The char is repeatedly sent to the gasifier until it is completely gasified.

Combined Cycle Power Generation System

- Combined cycle power generation plant that combines a 1,400℃-class gas turbine and a steam turbine achieves high power generation efficiency, while the uniaxial configuration of the gas turbine, steam turbine, and generator saves space.
- The coal gas cleaned in the gas clean-up system is combusted to rotate a gas turbine to generate electricity.
- The high-temperature exhaust gas after combustion is sent to the heat recovery steam generator (HRSG), and the recovered heat generates steam that rotates the steam turbine to generate electricity.
- Since heat is also recovered by the syngas cooler (SGC) heat exchanger in the gasifier, the amount of power generated by the steam turbine is greater than a combined power generation plant fueled by natural gas. (The output ratio of the gas turbine and steam turbine is approximately 3:2)
- The air required for gasification is extracted from the air compressor of the gas turbine to reduce power consumption in the plant.
- NOx (nitrogen oxide) emissions are reduced by the denitration system incorporated in the heat recovery steam generator.

Gas Clean-up System

- Gas clean-up system removes the impurities such as sulfur compounds (H_2S※1 and COS※2) from the syngas by using water and chemical solutions.
- COS in coal gas is converted to H_2S by a converter (catalyst).
- Trace components such as halogen and ammonia are removed by washing in a scrubber or cooling tower.
- H_2S is removed by absorption into a chemical solution called amine solution in the H_2S absorber.
- H_2S is separated from the amine solution in the amine regenerator. The separated H_2S is burned and recovered as gypsum in a flue gas desulfurizer.

※1 H_2S: hydrogen sulfide
※2 COS: carbonyl sulfide

IGCC History

Air-blown IGCC has been developed for over 30 years in Japan.

Utilization of Coal with Low Ash Melting Point

IGCC can use coal with low ash melting point (below about 1,400℃), which is difficult to use in conventional coal-fired power generation.

High ash melting point coal is suitable for conventional coal fired power plant

The use of high ash melting point coal prevents molten ash from adhering to boiler walls and causing heat transfer problems.

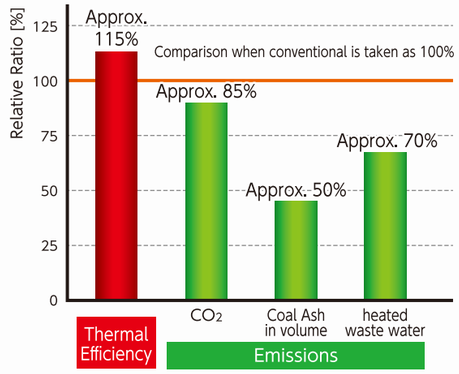
Low ash melting point coal is suitable for IGCC

Use of low ash melting point coal is suitable since ash is drained from the gasifier as molten slag.

Diversification of energy supply with the expansion of available coal class.

Superior Environmental Performance

In addition to 15% lower CO_2 emissions than conventional coal-fired power generation, IGCC also reduces the volume of coal ash and heated wastewater.



The volume of ash is reduced by around 50% since the ash is dissolved as glassy slag instead of coal ash. The slag can be recycled such as for road materials and cement components.

Fly Ash (from conventional coal firing)　　Glassy Slag (from IGCC)

Nakoso IGCC Power Station

Hirono IGCC Power Station