

# Overview of NEDO's CCT Development

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New Energy and Industrial Technology Development Organization

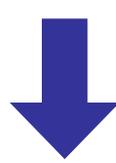
(NEDO)

Japan

- ***NEDO, an independent administrative agency under METI, promotes R&D as well as the dissemination of industrial, energy and environmental technologies.***

Japanese Government, Ministry of Economy, Trade and Industry (METI)

Budget

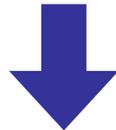


Coordination with policymaking authorities



**NEDO**

Budget: Approx. 1.5 billion US\$  
Number of personnel: Approx. 800



Funding

Academia

Industry

Public research laboratories



## <Mission>

- Solving global energy and environmental problems
- Enhancement of Japan's industrial competitiveness

# **1. NEDO Policy on CCT Development**

## **2. Coal Gasification Technology**

## **3. Dissemination of High-efficiency CCT**

## Current situation:

- Coal accounts for one fourth of global primary energy consumption and its consumption is expected to increase. However, CO<sub>2</sub> emission from coal is larger than other fossil fuels.
- As a result of continued R&D and effective O&M, Japan has achieved the highest efficiency levels of coal-fired thermal power generation in the world. On the other hand, there are many low-efficiency coal thermal power stations around the world.
- In Japan, coal has been re-evaluated as an important base-load power source in terms of stability and cost effectiveness since the Great East Japan Earthquake and will be utilized while reducing environmental load by effective use of high efficiency coal fired thermal power plant.

## Policy:

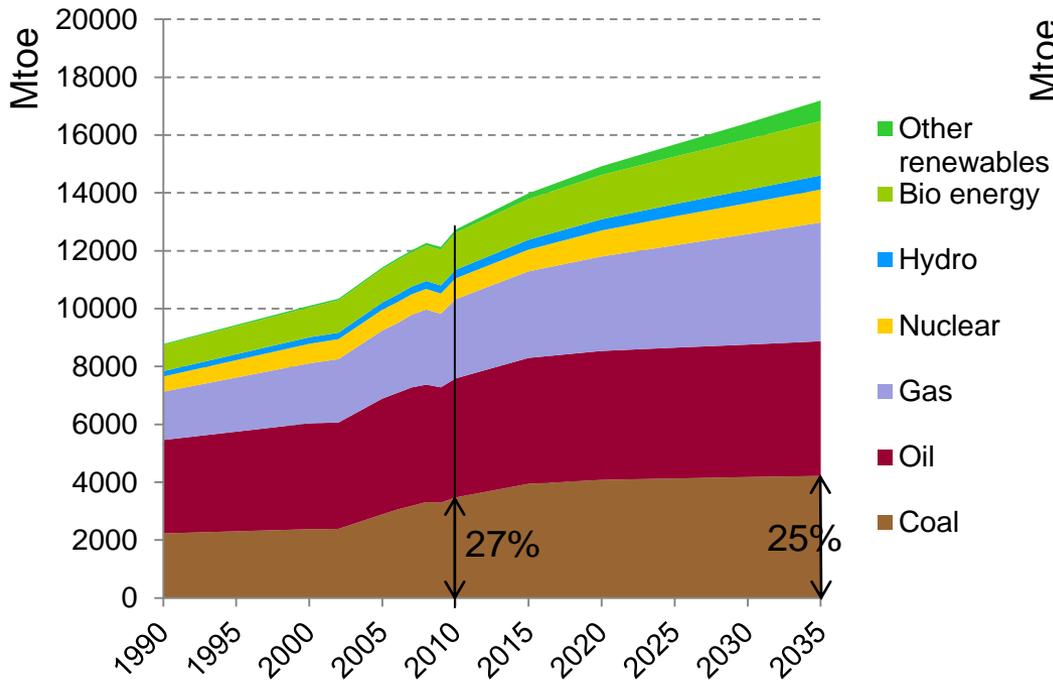
- NEDO promotes R&D on high-efficiency clean coal technology (CCT) that contribute to mitigate CO<sub>2</sub> emission form coal fired thermal power plant including CO<sub>2</sub> capture and storage technology.
- NEDO aims to utilize these Japanese technologies to promote CCT overseas particularly in developing countries, in order to stabilize energy supply and demand and contribute to the establishment of a low-carbon society.

## Priority activities:

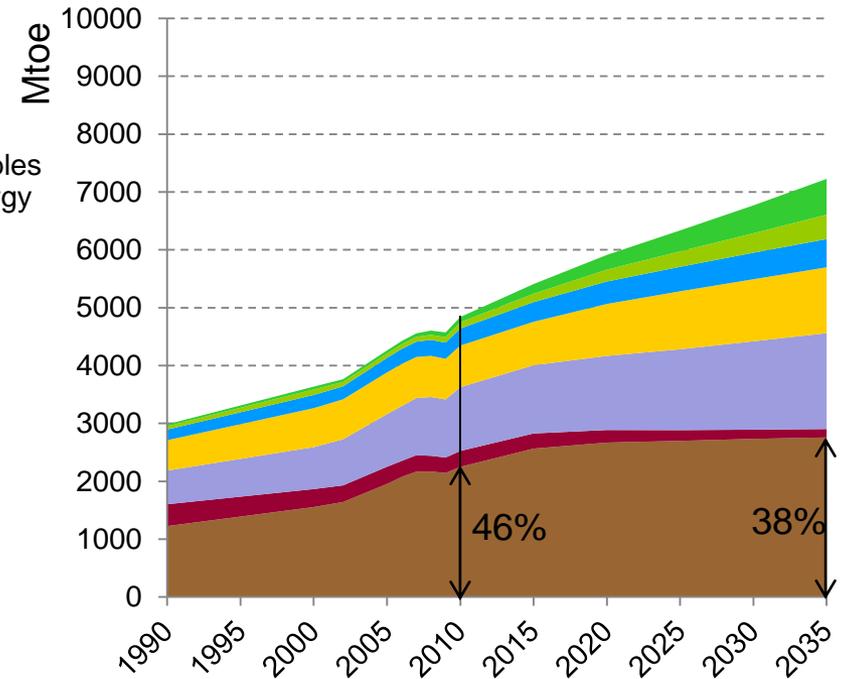
- ① Improvement of Coal-fired Power Generation Efficiency and reducing CO<sub>2</sub> Emission
- ② Development of CO<sub>2</sub> Capture Technology to realize Zero-emission Coal-fired Power Plant
- ③ Dissemination of High-efficiency Clean Coal Technology

# 1.1 Global Trend of the Coal Demand

**Global primary energy demand by source**

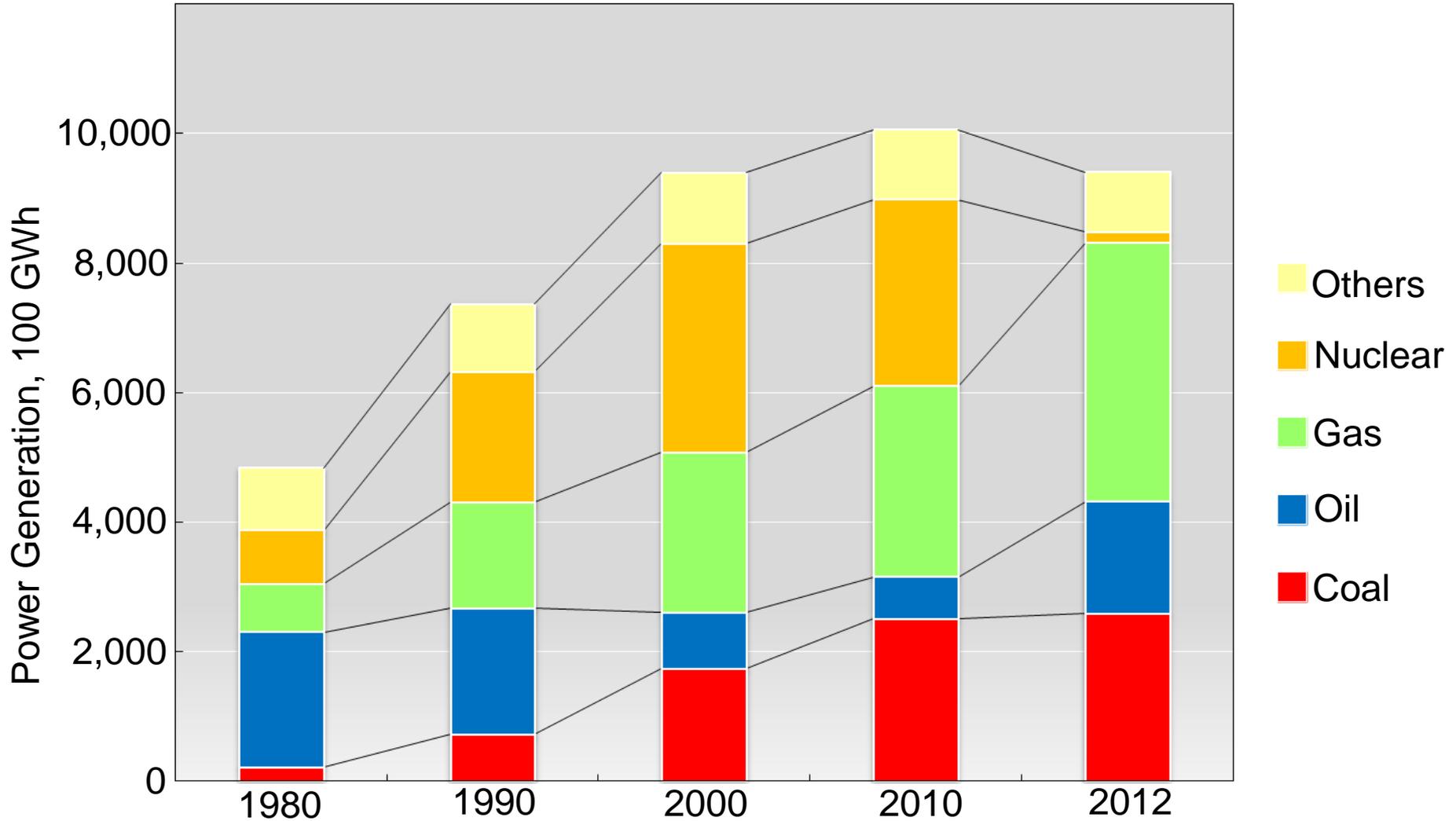


**Global power generation by source**



Source: World Energy Outlook 2002, 2004, 2007–2012

## 1.2. Importance of Clean Coal Technology



Japan's Power Generation by Source

# 1.3 “The 4th Strategic Energy Plan of Japan”



## Position and Policy Direction of Coal

### (1) Position

Though coal has a problem – it emits a large amount of greenhouse gas – it is now being re-evaluated as an important base-load power supply because it involves the lowest geopolitical risk and has the lowest price per unit of heat energy among fossil fuels. It is an energy source that we should use while reducing the environmental load through the utilization of highly efficient coal thermal power generation technology, etc.

### (2) Policy Direction

In addition to promoting the replacement of aging thermal power plants and introducing available leading-edge technology through the construction of new facilities and the expansion of existing ones, GOJ further promotes the development of technologies to drastically reduce greenhouse gas emissions per unit of generated power(e.g., IGCC) by largely improving the power generation efficiency. It is necessary to use coal while reducing the global environmental load by promoting the introduction of such high-efficiency technologies not only in Japan but also globally.

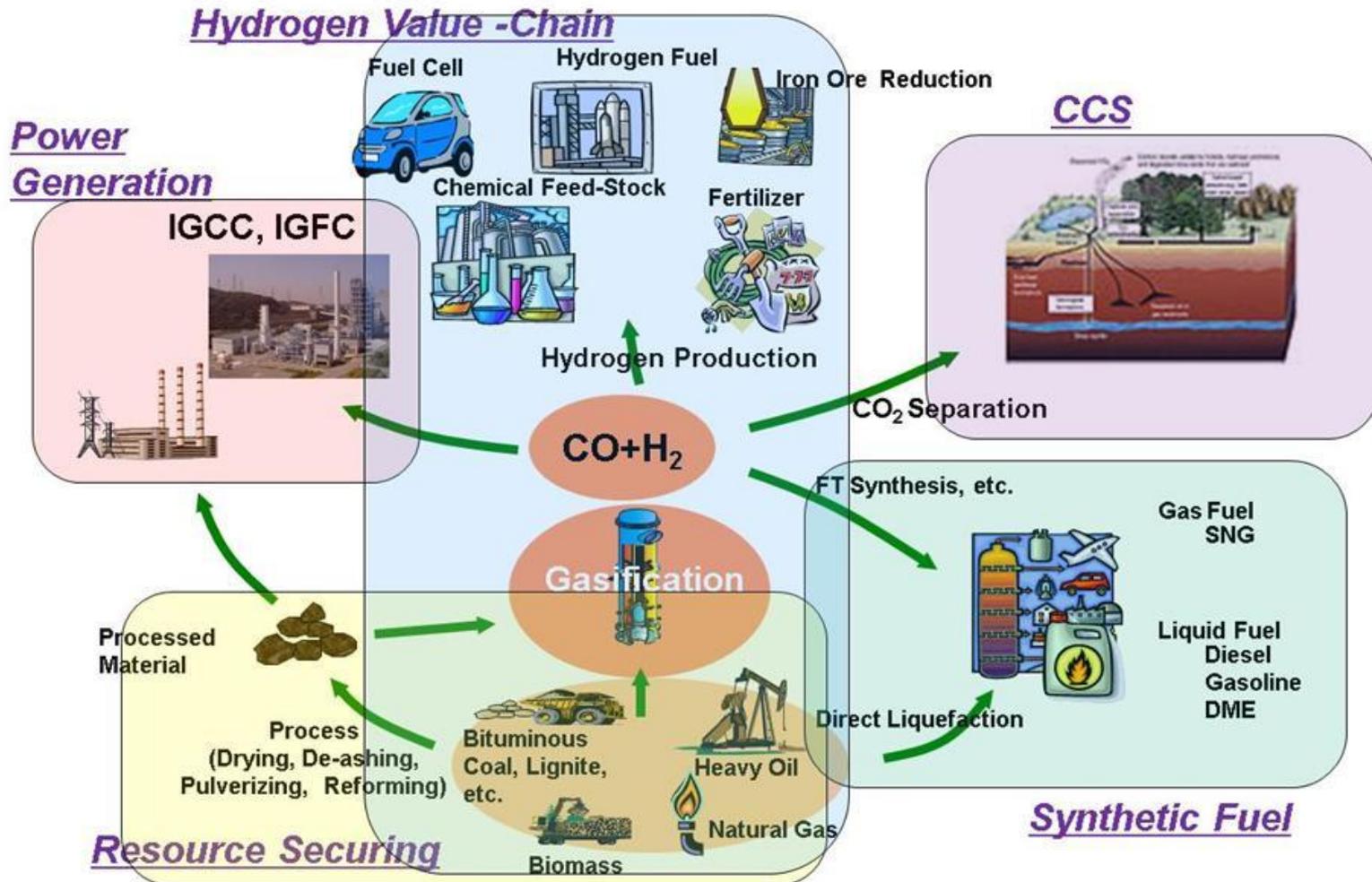
Source: Strategic Energy Plan(April, 2014)

Chapter 2 Basic policy regarding measures concerning energy supply and demand  
Section 2. Position of each energy source and policy timeframe

# 1.4. NEDO's CCT Development Strategy



NEDO regards gasification technology as a key technology, and has carried out gasification technology development utilizing coal.



1. NEDO Policy on CCT Development

**2. Coal Gasification Technologies**

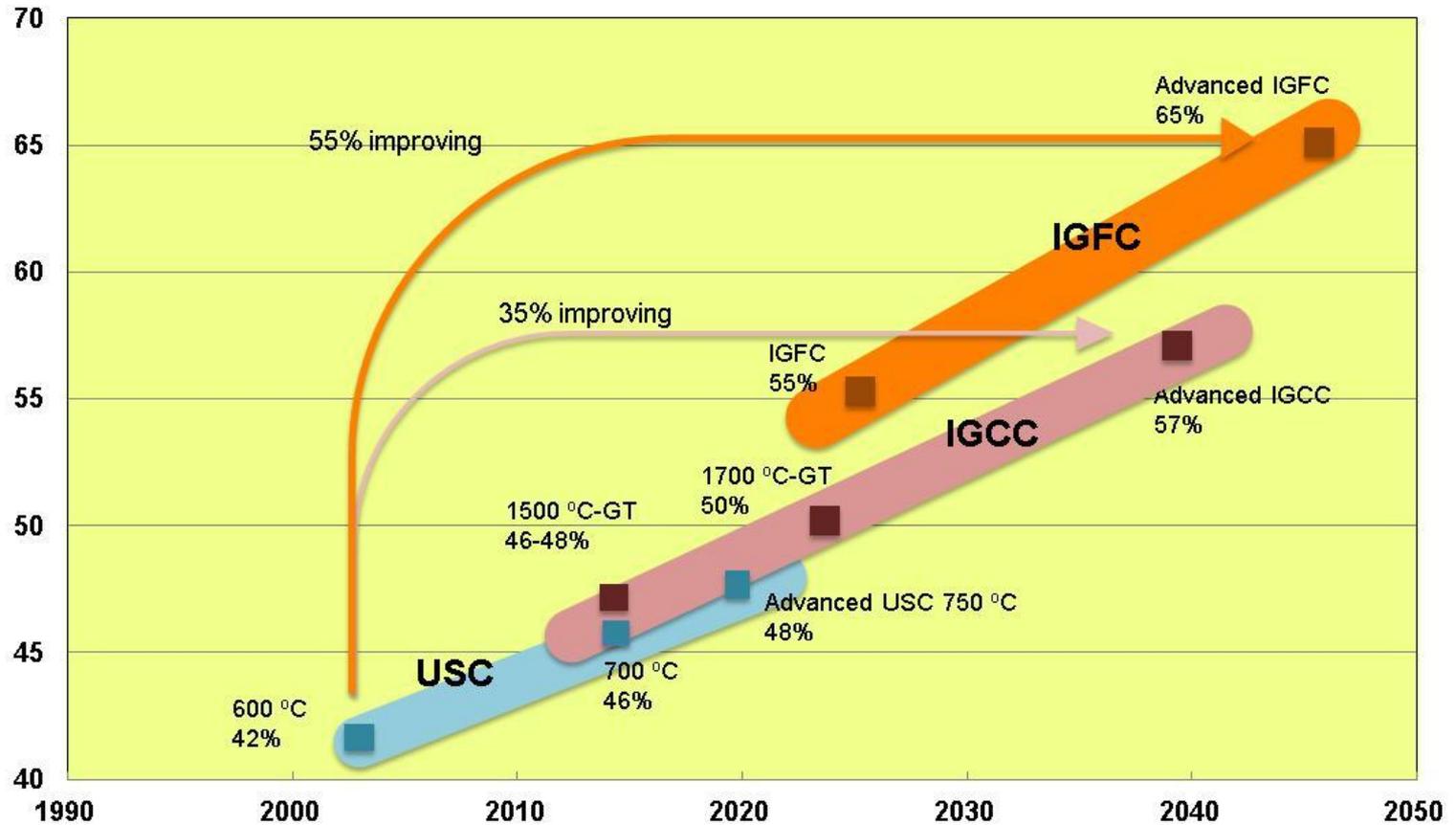
3. Dissemination of High-efficiency CCT

## 2.1. Efficiency Improvement in Coal-fired Power Generation



In order to improve power generation efficiency, NEDO has placed an emphasis on the development of IGCC and IGFC which utilize gasification as a core technology.

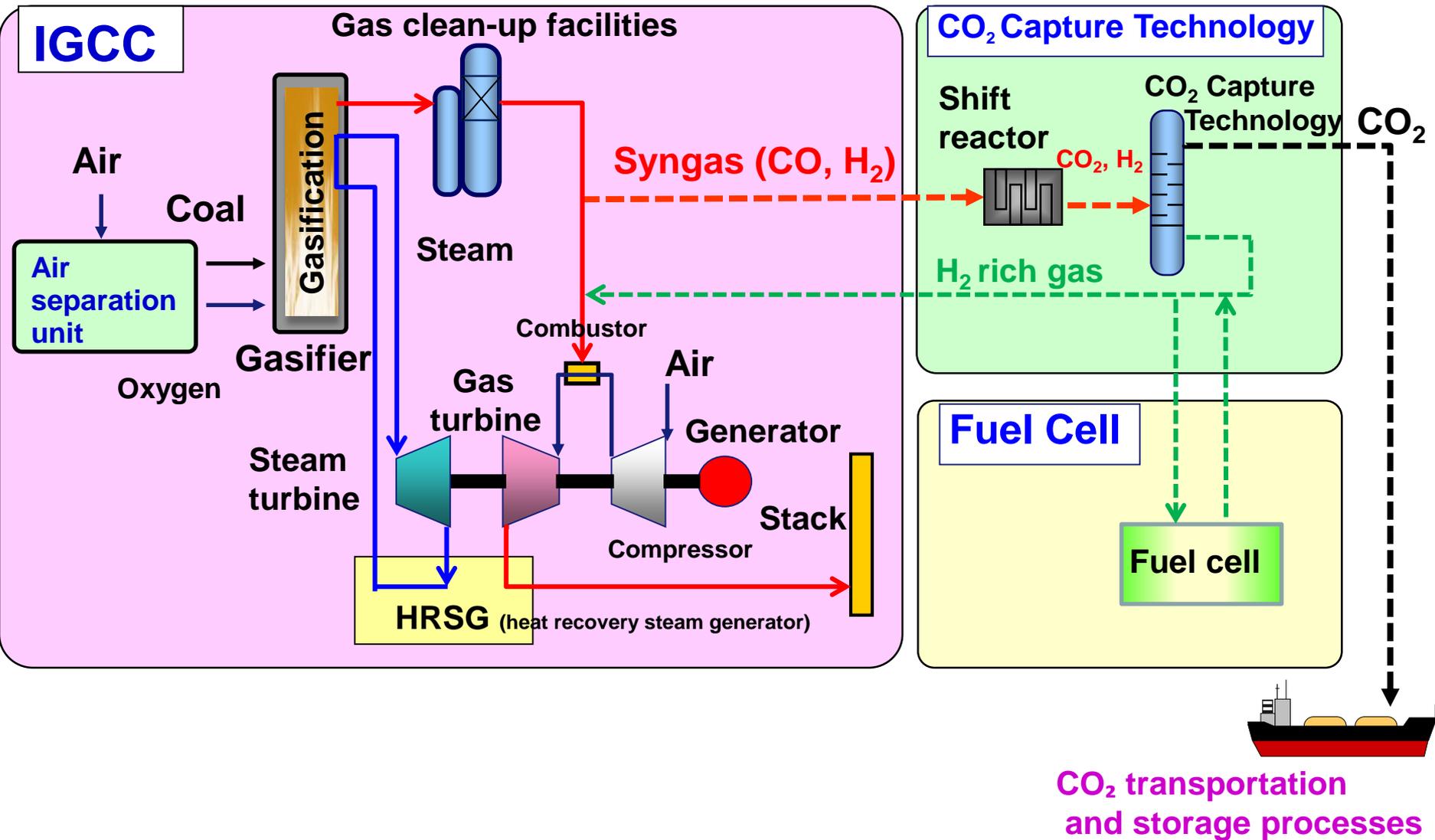
Net Generation Efficiency, HHV (%)



Source : Cool earth technology development road map in Japan

- Integrated Coal Gasification Combined Cycle (IGCC)
- Integrated Coal Gasification Fuel Cell Combined Cycle (IGFC)
- Advanced Ultra-super Critical Steam Condition (A-USC)

## 2.2. IGCC/FC Technology

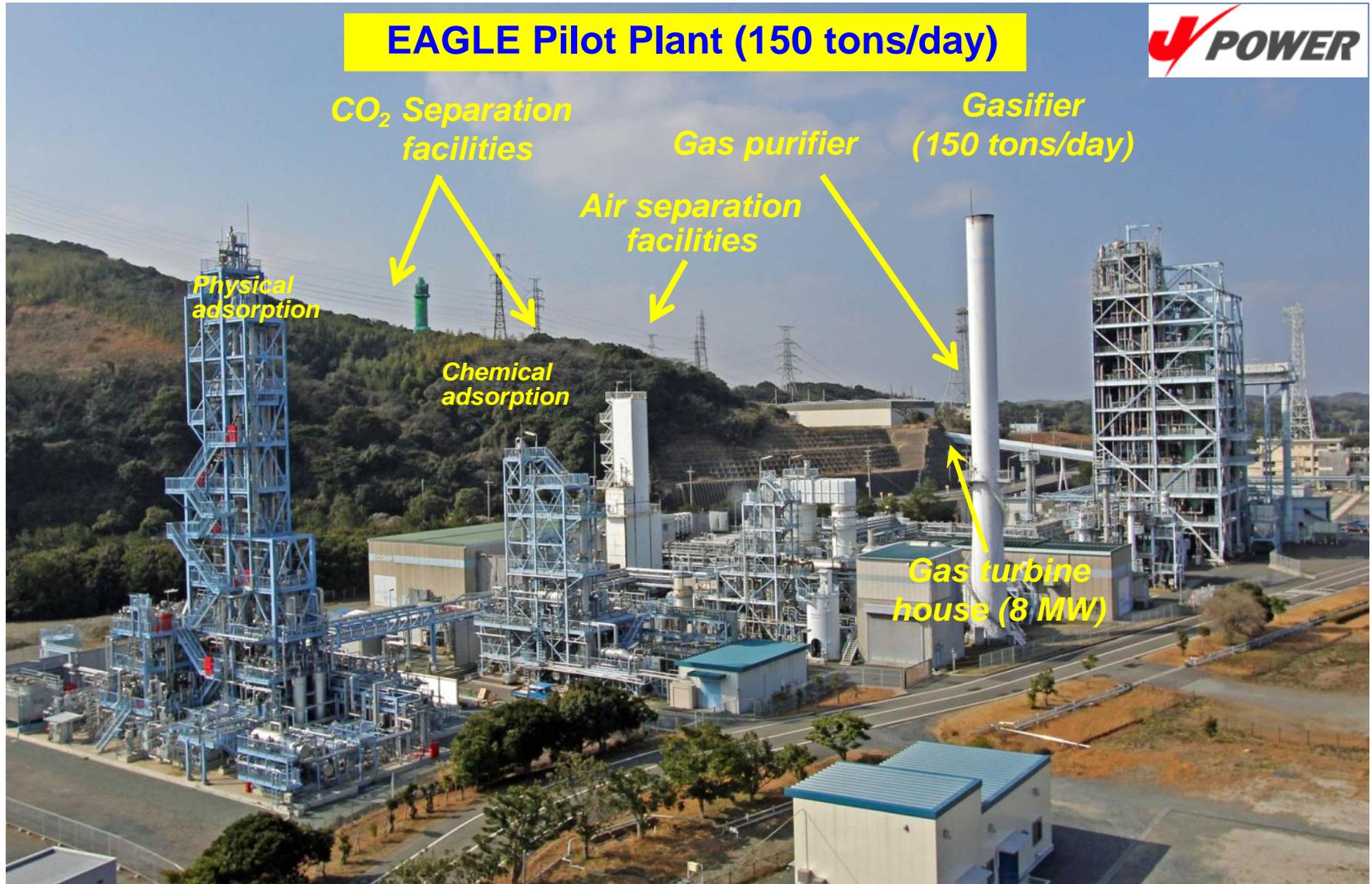


## 2.3. Coal Gasification Projects



	Project	Place	Technology	Stage	Power	Operation
Oxygen-blown entrained flow gasification	EAGLE Project	Fukuoka	IGCC + CO2 Capture	Pilot	8 MW	2002-2014
Air-blown entrained flow Gasification	Nakoso IGCC Plant	Fukushima	IGCC	Demonstration Commercial	250 MW	2007-2013 2013-
Oxygen-blown entrained flow gasification	Osaki Cool Gen Project	Hiroshima	IGCC/FC + CO2 Capture	Development	170 MW (IGCC)	2016- (IGCC) 2019- (IGCC+CCS) 2020- (IGFC+CCS)

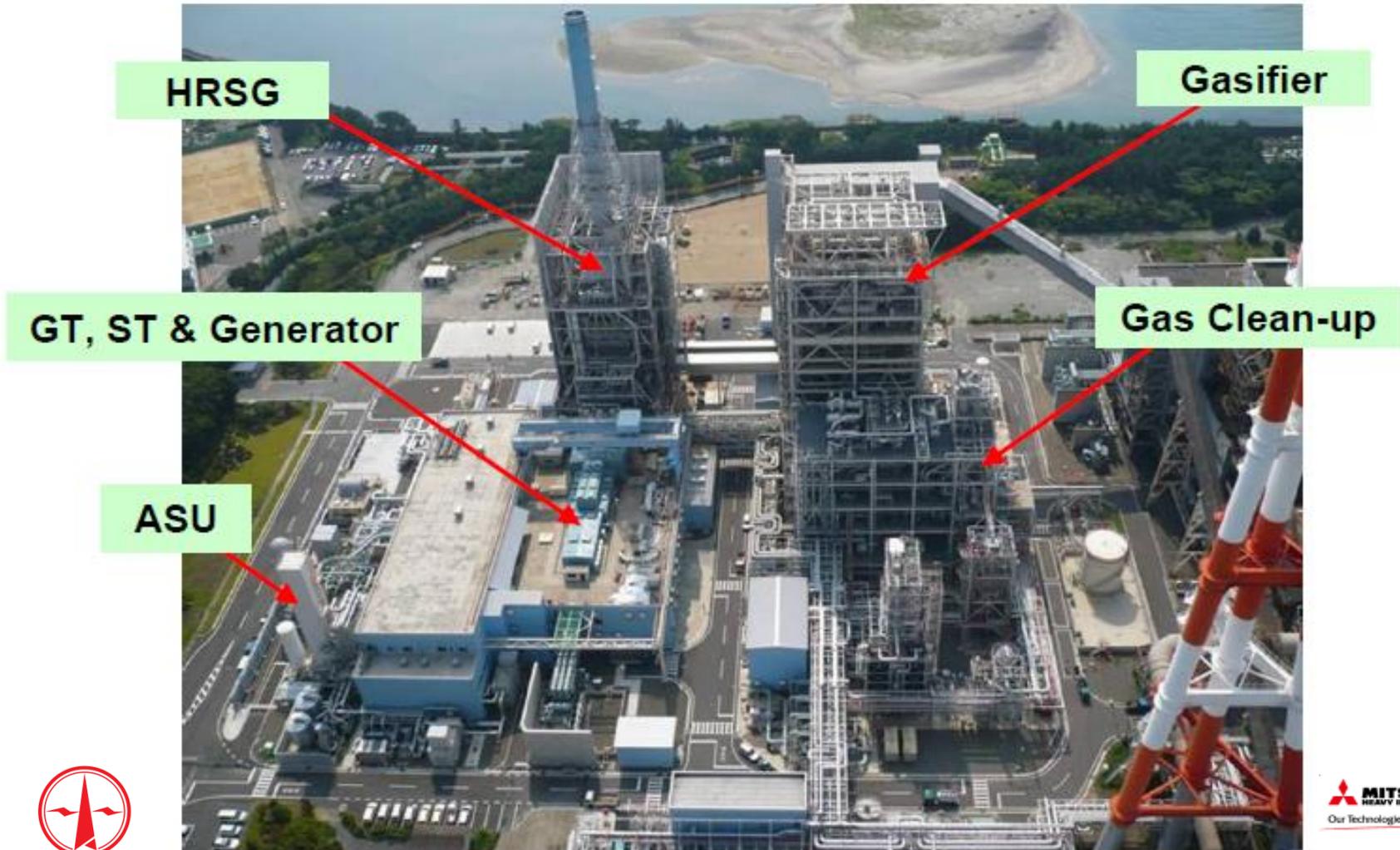
## 2.4 Coal Energy Application for Gas, Liquid & Electricity (EAGLE)



## 2.5 Results of the EAGLE Project

	Contents/Target	Results
Stage-1 (2002-2007)	Cold gas efficiency	82%
	Continuous Operation	>1,000 hours
	Diversification of Coal Type	5 type of coal (unique)
	Scale-up Data Collection	Design data obtained for scale-up
Stage-2 (2008-2010)	Coal with High Ash Fusion Temperature	+3 coals (unique)
	CO2 Capture (chemical absorption)	Approx. 30% of energy saving (2points efficiency improvement)
	Trace Elements Behavior	Design data obtained for scale-up
Stage-3 (2010-2013)	CO2 Capture (physical absorption)	Approx. 10% of energy saving than chemical absorption (Future application for higher gas turbine temperature)

## 2.6 Nakoso IGCC Commercial Plant (Nakoso Unit 10) - First IGCC Commercial Plant in Japan

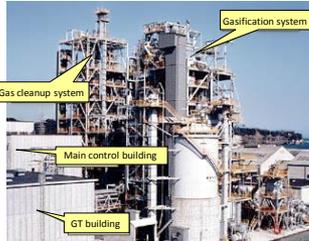


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# 2.7 Nakoso IGCC Project

## Status

Pilot plant (200t/d)



Demonstration plant (1700t/d)

Commercial plant (1700t/d)



1990

1995

2000

2005

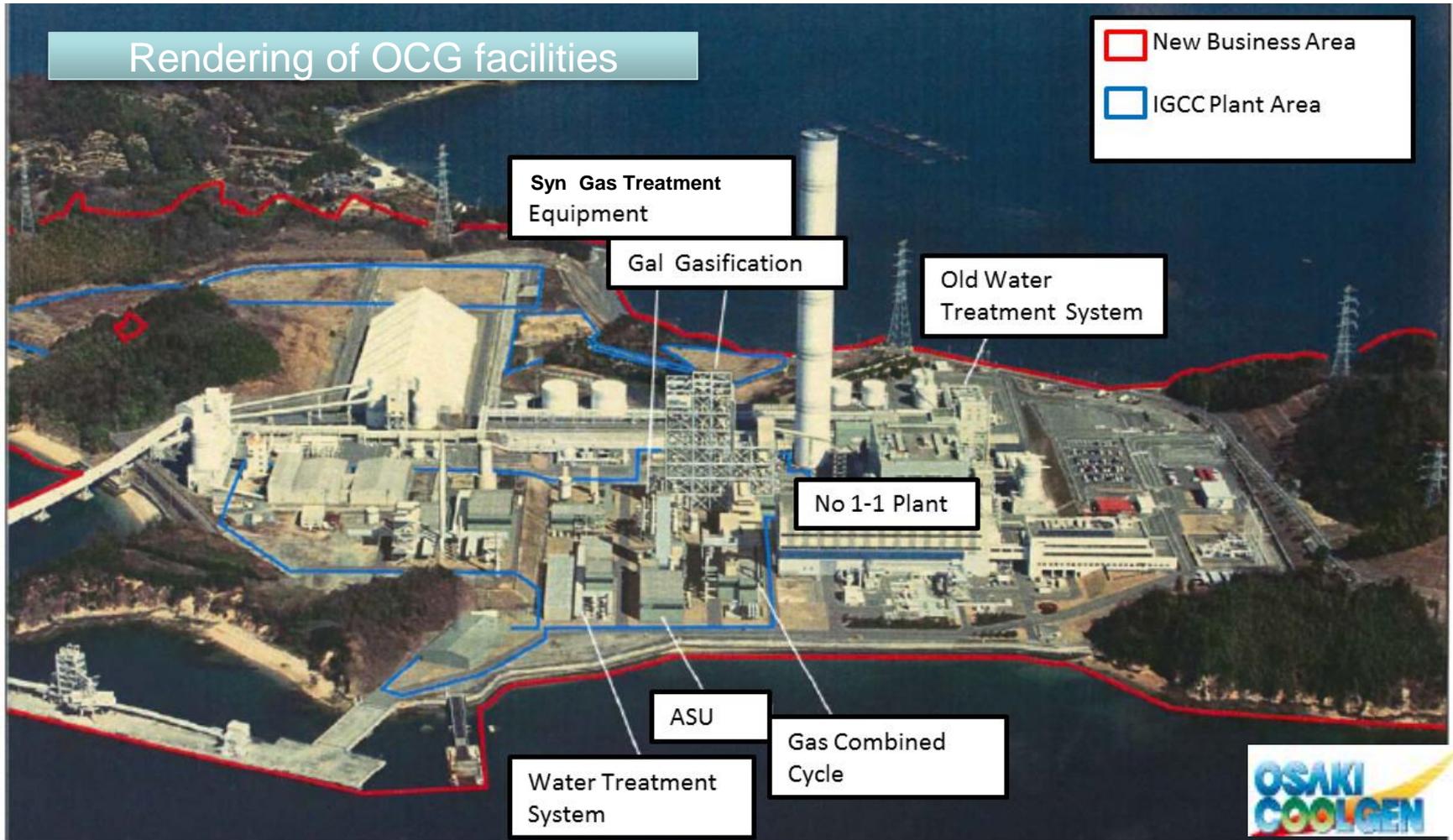
2010

2015

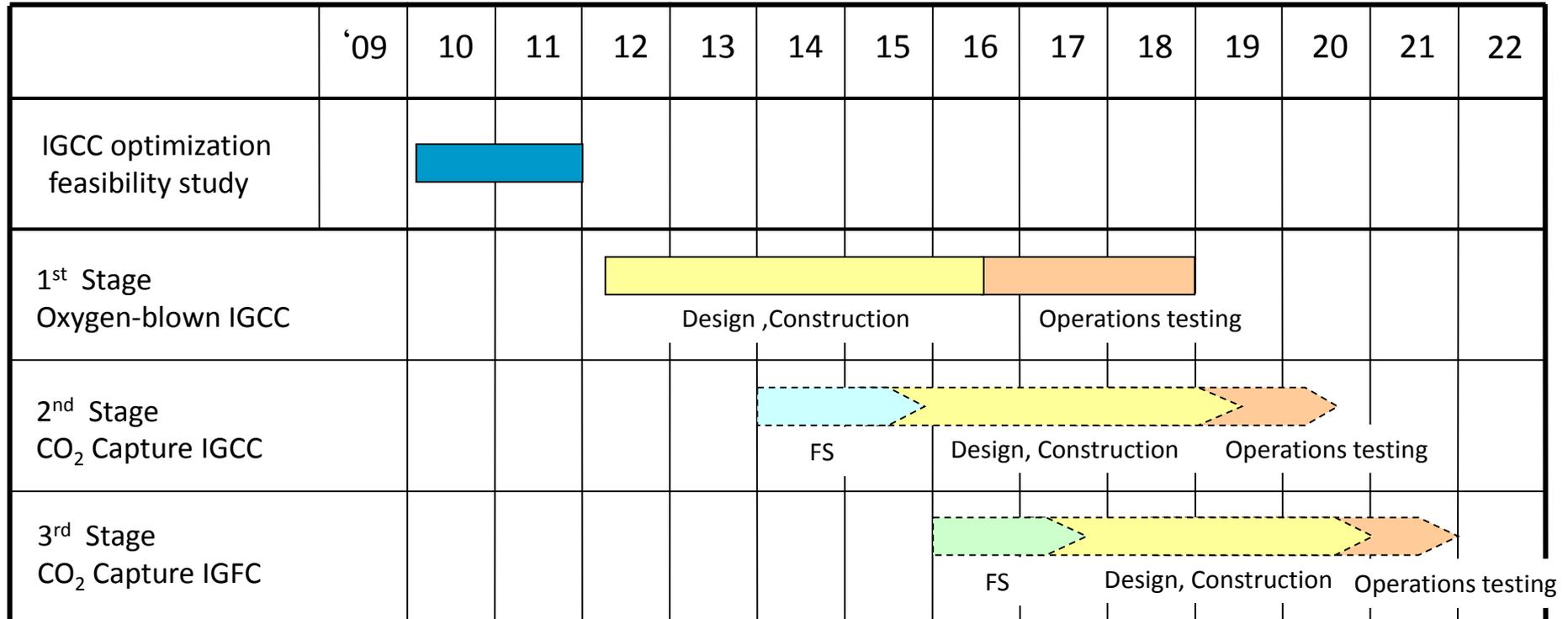
## Achievement

		Results
Demonstration test	Long Term continuous Operation	2238hr
	Net Thermal Efficiency	42.9% (LHV basis)
	Carbon Conversion Rate	>99.9%
	Coals	Chinese (B) ,Russian (B), USA (2SB) Indonesian (B,2SB) , Colombian (B) Canadian (B)

# 2.8 Osaki Cool Gen (OCG) Project



## 2.9 Schedule for Osaki Cool Gen (OCG) Demonstration project



### **Schedule :**

**September 10<sup>th</sup>, Wed. 10.00-17.00hrs.**

International Symposium on the Coal Gasification Technology  
at Hotel Okura Tokyo

**September 11<sup>th</sup>, Thu. 10.00-17.00hrs.(TBC)**

Site visit to Nakoso IGCC Power Station, Fukushima, Japan

### **Organizer :**

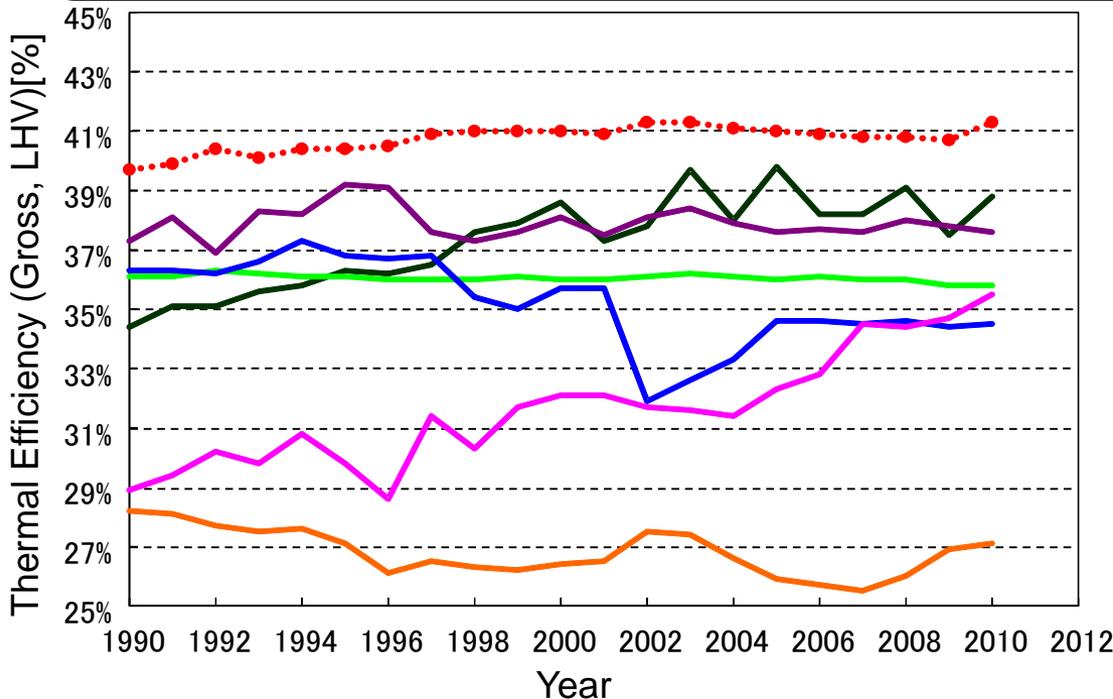
NEDO with the support of the Ministry of Economy, Trade and  
Industry of the Japanese Government (TBC)

1. NEDO Policy on CCT Development
2. Coal Gasification Technologies
- 3. Dissemination of High-efficiency CCT**

### 3. Dissemination of High-efficiency Clean Coal Technology



As Japan has achieved the world's highest efficiency levels for coal-fired power generation technology, feasibility studies for project formation are currently being conducted on high-efficiency CCT, such as USC and IGCC in order to disseminate the technology worldwide and reduce global CO<sub>2</sub> emissions.



Feasibility Studies utilizing following Clean Coal Technologies:

- USC, A-SUB, USC + CCS
- IGCC, IGCC + CCS
- Coal gasification
- Upgrading or drying of low rank coal
- Operation know-how



# 3.1. Japanese High-efficiency Clean Coal Technology



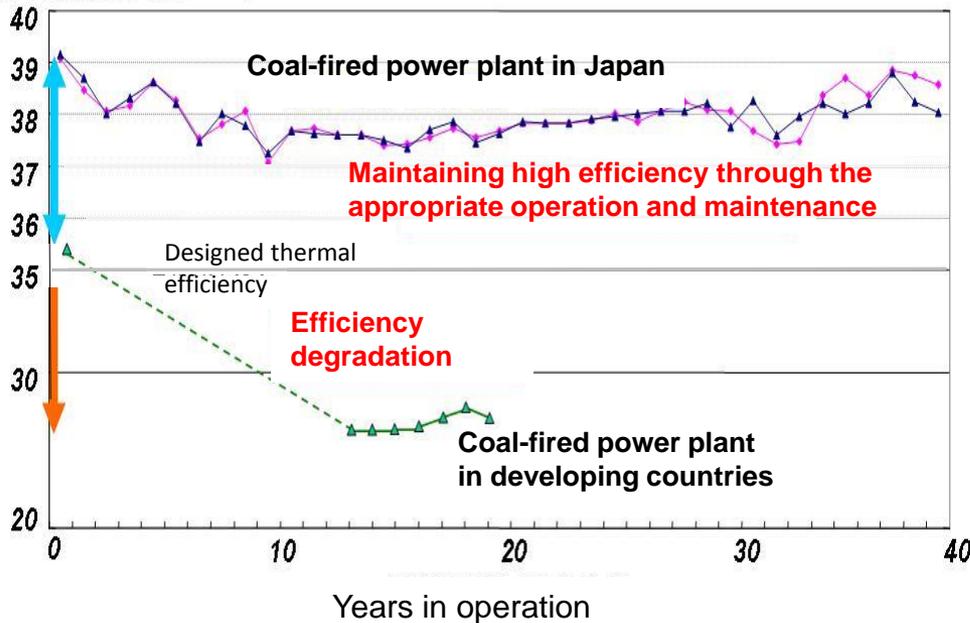
Beside the highest level of the thermal efficiency utilizing USC technology,

- ✓ Japanese coal-fired power plant has impressive track record of thermal efficiency
- ✓ Japanese utilities and manufacturers have long history of utilizing USC technology and lots of O&M experiences

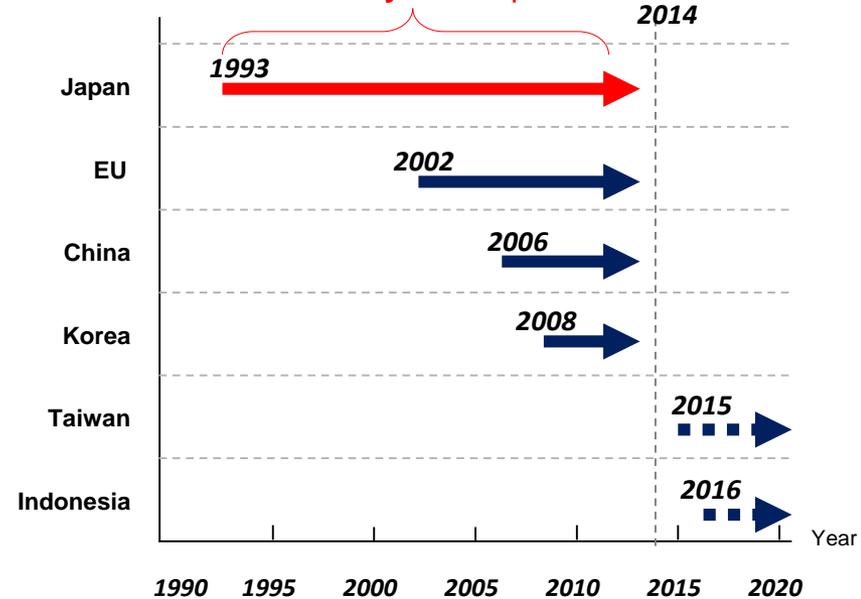
Thermal efficiency across the ages

Long history of utilizing USC technology

Gross thermal efficiency (% , HHV)



About 20 years experience



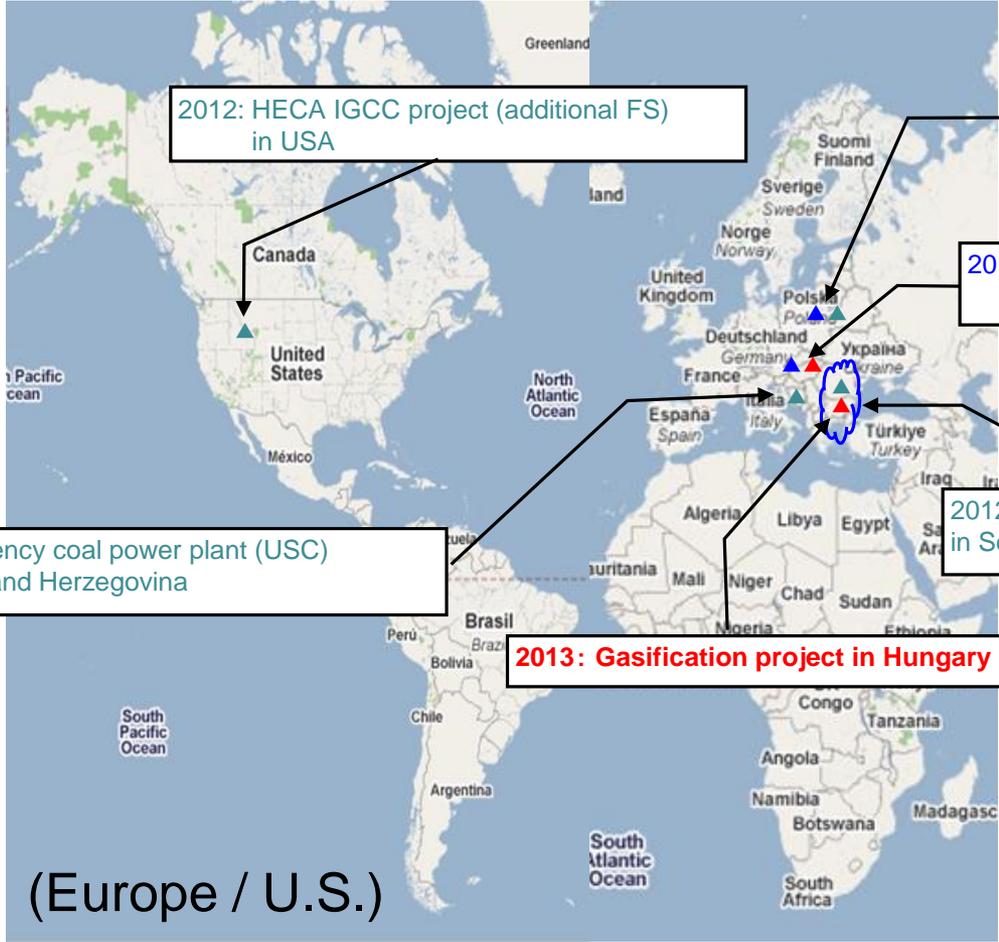
\* According to METI FS research 2010 & 2011.

# 3.2. NEDO Project Formation Research on High-efficiency CCT



**32 feasibility projects in 19 countries around the world.**

▲ 2011 ▲ 2012 ▲ 2013  
▲ 2012 Basic Research



(Europe / U.S.)

### 3.3. F/S for New Coal-fired Power Plant Project in Poland

- The Chugoku Electric Power Co., Inc., one of Japanese utility companies, conducted a feasibility study of Tauron Wytwarzanie's new coal fired power plant project from June 2011 to March 2013, as a part of a research program for “Developing Projects Using High-efficiency Coal Utilization Systems” sponsored by NEDO.
- In the project site, there are aged power plants to be replaced in near future.
- Realization of this Project will contribute to improve plant thermal efficiency and to reduce CO2 emission.

#### Proposed project outline in FS

New plant	1 unit of 1,000MW class
Fuel	Polish domestic hard coal
Steam condition	<USC> 600/620 deg C, 25MPa
Plant thermal efficiency	45.1%
Ref : Existing plants	2 units of 125MW class (45 years aged) 4 units of 225MW class (40 years aged)





Thank you for attention