CLEAN COAL DAY IN JAPAN 2010 (8th Sep., 2010, ANA InterContinetal Tokyo)

Reduction of CO_2 Emissions from Coal-fired Power Generation

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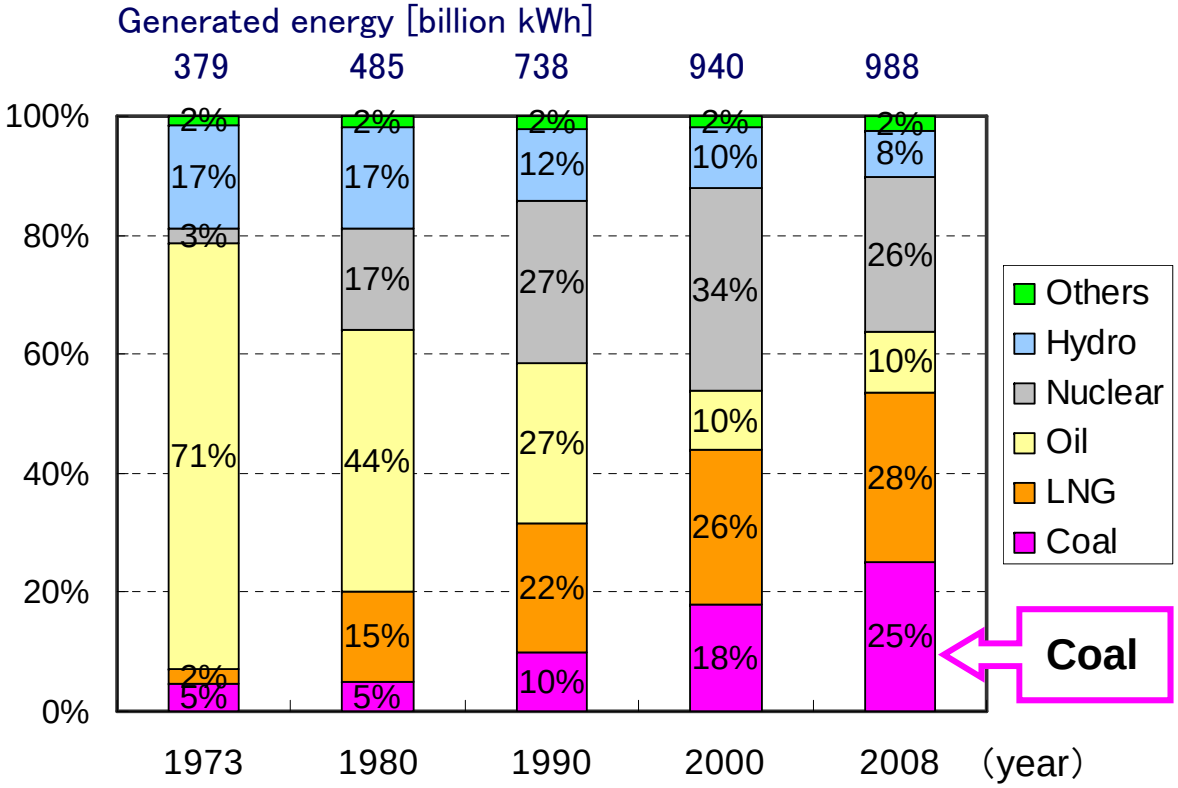
J-POWER

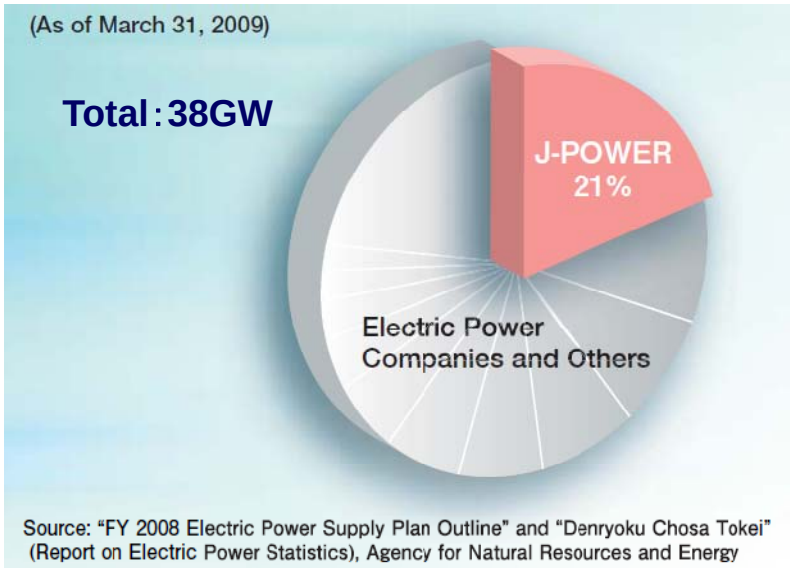
(Electric Power Development Co., Ltd.)

Coal Power Plays a Major Role in Japan

Energy Sources for Electricity Generation in Japan

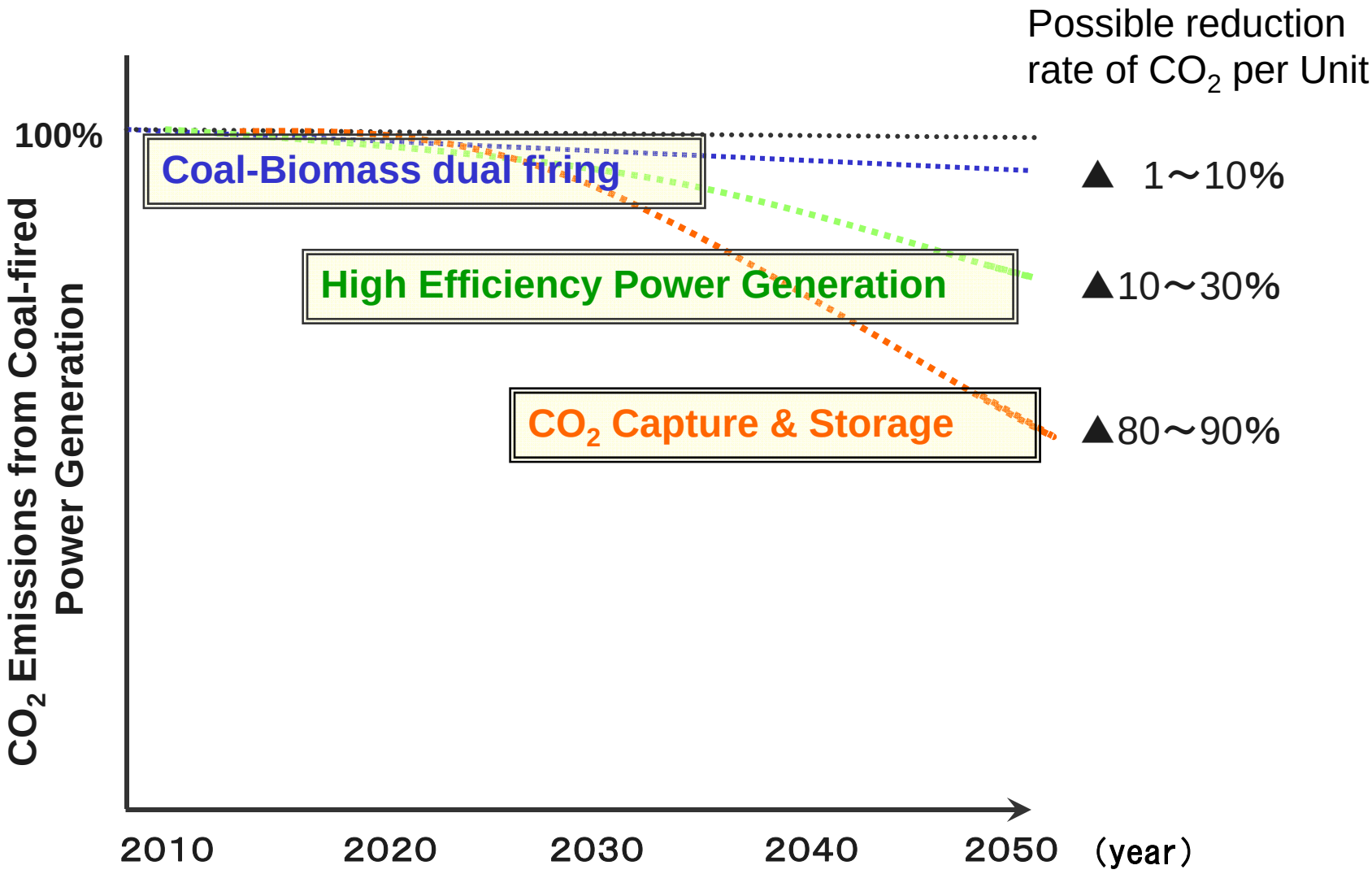


Share of Coal-Fired Power Generation Capacity in Japan



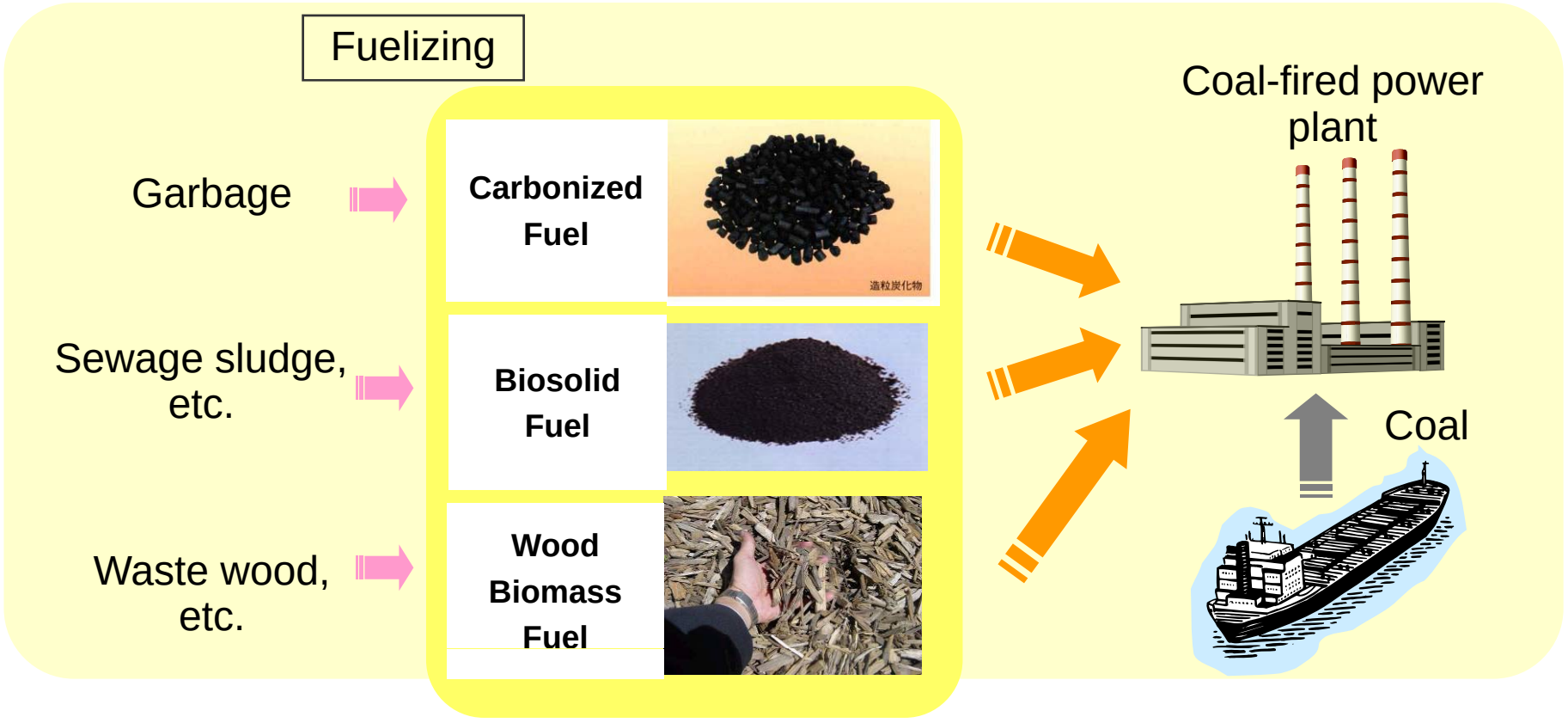
Source: "FY 2008 Electric Power Supply Plan Outline" and "Denryoku Chosa Tokei" (Report on Electric Power Statistics), Agency for Natural Resources and Energy

To Curb CO_2 Emissions from Coal-fired Power Generation

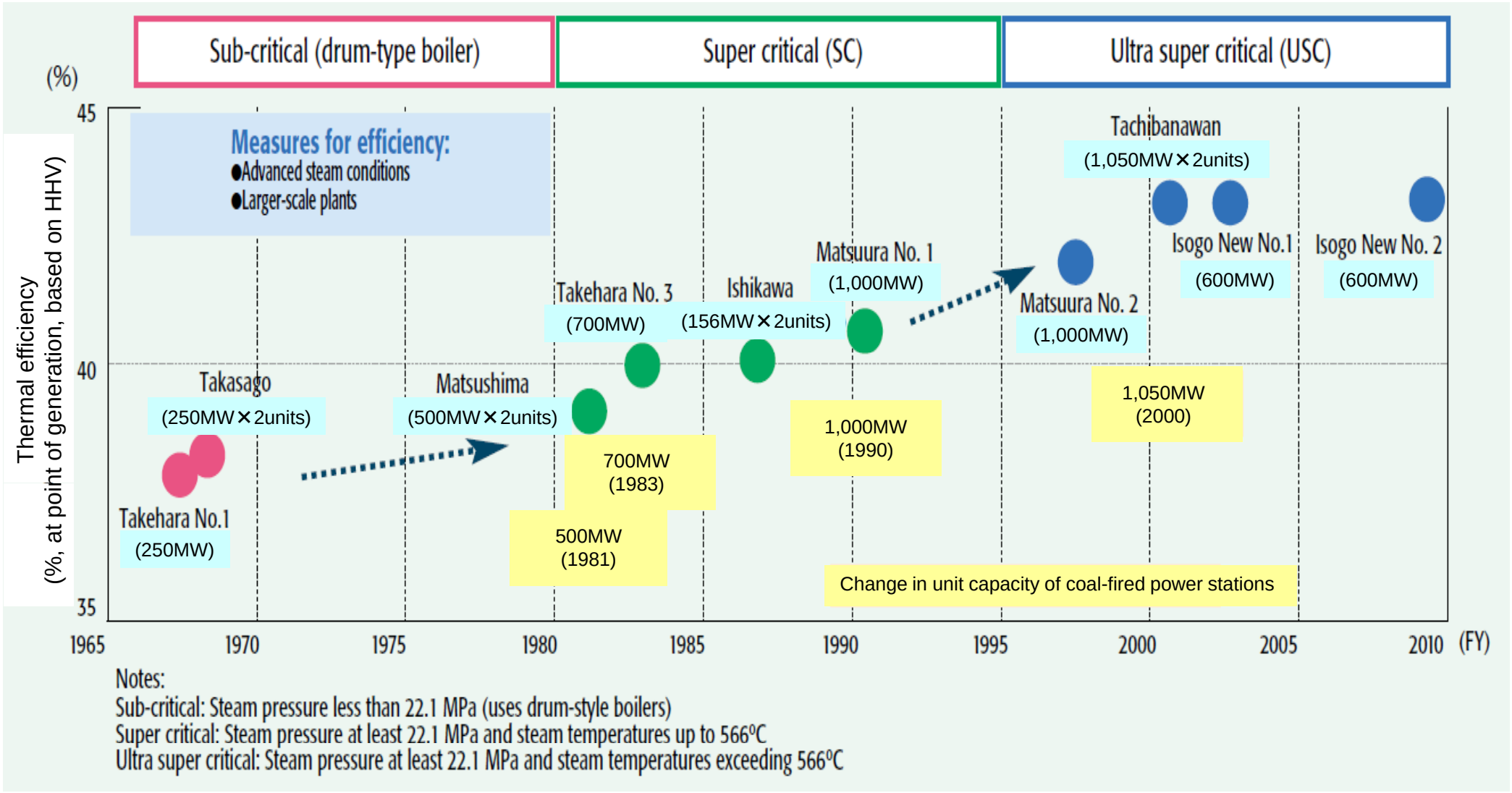


Coal-Biomass dual firing

- Coal-Biomass dual firing can reduce CO_2 emissions from coal-fired power plant without large retrofit.
- Biomass dual firing needs a stable biomass procurement (quantity and price).



Improving Efficiency of Coal-fired Power by JPOWER



Notes:
Sub-critical: Steam pressure less than 22.1 MPa (uses drum-style boilers)
Super critical: Steam pressure at least 22.1 MPa and steam temperatures up to 566°C
Ultra super critical: Steam pressure at least 22.1 MPa and steam temperatures exceeding 566°C

Efficiency Upgrade by Plant Replacement (Isogo Thermal Power Station)

Old Isogo, Startup:1967

New Isogo No.1, Startup: 2002
New Isogo No.2, Startup: 2009

Three Purposes

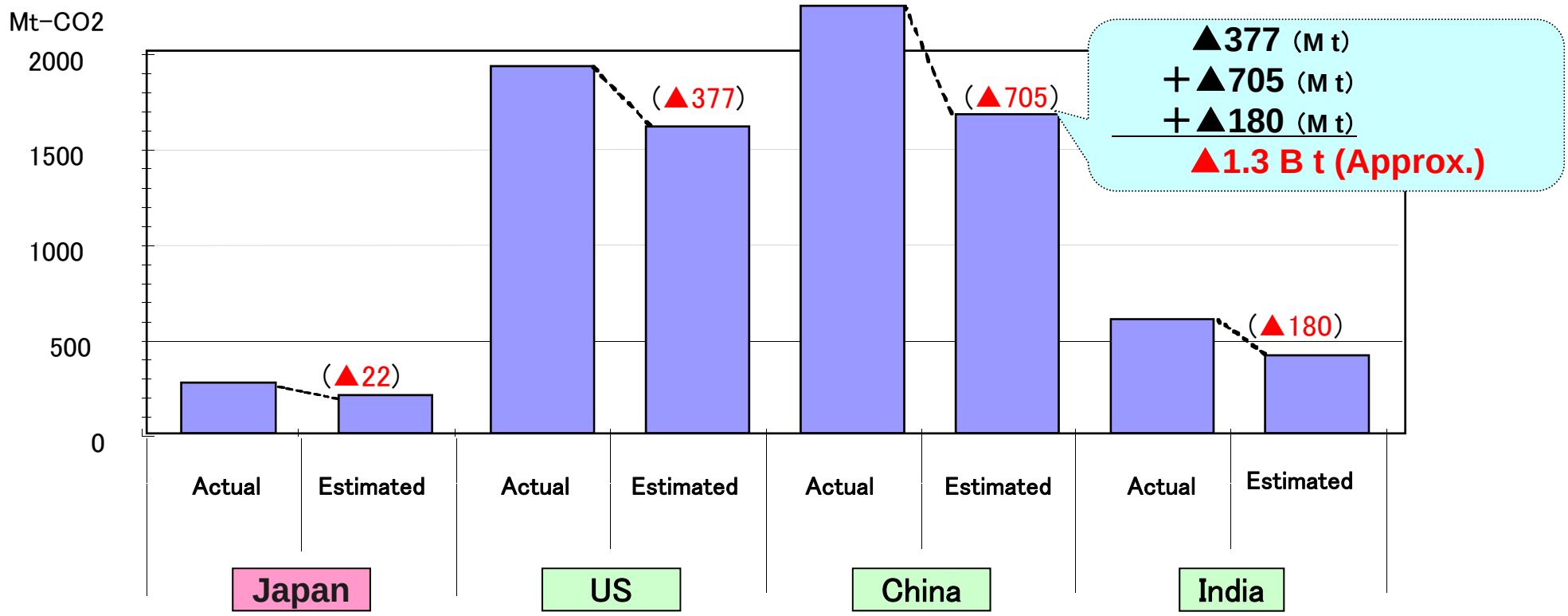
- ◇ **Output Upgrade**
- ◇ **Environmental Upgrade**
- ◇ **Efficiency Upgrade**

◆ Output	530MW（265MW×2）	⇒	1,200MW（600MW×2）
◆ SOx	60 ppm	⇒	20 / 10 ppm
NOx	159 ppm	⇒	20 / 13 ppm
Dust	50 mg/m^{3}N	⇒	10 / 5 mg/m^{3}N
			No.1 / No. 2
◆ Steam condition	Sub-critical	⇒	Ultra Super Critical（USC）
Efficiency	38%（Gross%; HHV）	⇒	42～43%（Gross%; HHV）
CO_2 Emissions	**100**	⇒	**83** ※

※ A comparison of the CO_2 emission per gross output (kWh) with an old plant (100 basis).

Estimated CO_2 Reduction Potential by Applying the Best Practice of Coal-fired Power Plant in Japan

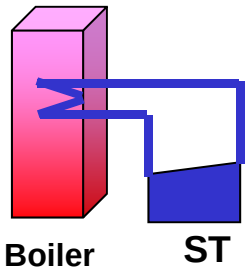
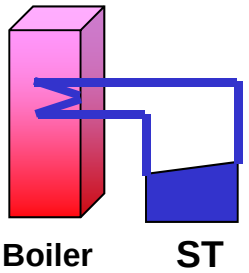
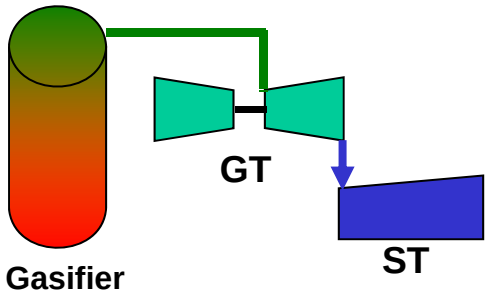
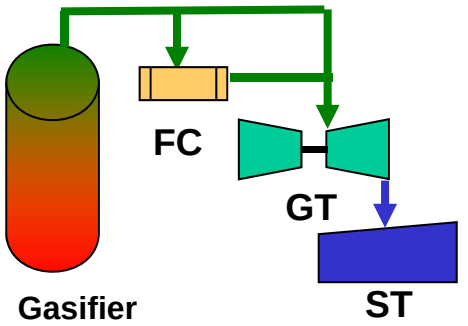
Approx. 1.3 billion tons (Almost equivalent to total CO_2 emission from Japan)



Source : IEA World Energy Outlook 2007, Ecofys International Comparison of Fossil Power Efficiency and CO2 Intensity 2008

Towards Higher Thermal Efficiency
Development of Coal-fired Power Generation

- **Pulverized Coal-Fired System (PCF)**: Efficiency upgrade by increasing steam temperature and pressure; A-USC（Advanced USC, 700℃ class）is under development
- **Integrated Coal Gasification Combined Cycle System (IGCC)**: Combined Gas turbine (GT) and steam turbine (ST) cycle; Higher thermal efficiency than PCF; Increasing the GT inlet gas temperature is necessary for efficiency upgrade
- **Integrated Coal Gasification Fuel Cell Combined Cycle System（IGFC）**: Triple combined cycle (GT+ST+FC); Higher thermal efficiency than IGCC

① PCF		② IGCC（1500℃ class）	③ IGFC
Latest PCF（USC）  	700℃ class (A-USC)  	 	
Gross：42～43%(HHV) Net ：41%(HHV) （Basis）	Gross：48% Net ：46% CO_2 reduction：approx. 11%	Gross：51～53% Net ：46～48% CO_2 reduction: approx. 13%	Gross：60%～ Net ：55%～ CO_2 reduction: approx. 25%～

Overview of CCS Projects by J-POWER

J-POWER covers three major CO_2 Capture technologies from thermal power stations

PCF

Post-combustion

Pilot Plant

- **Partnership: J-POWER/MHI @J-POWER Matsushima P/S**
- Method: Chemical Absorption (KS-1)
- Gas flow rate: 1,750Nm3/h
- CO_2 Capture rate: 10 t/day
- Test period: July ‘06 – October ‘08

PCF

Oxyfuel Combustion

Demo. Plant

- **Partnership: CS Energy, ACA, Xstrata Coal, Shlumberger / J-POWER, IHI, Mitsui @ Callide A P/S in QL, Australia**
- **Fund: Australian Gov. and Japanese Gov.**
- Plant Capacity: 30MWe
- CO_2 Capture rate: Up to 75t/d
- Storage: Depleted gas field / Saline Aquifer
- Test period: August ‘11 – Mid ‘14

Coal Gasification

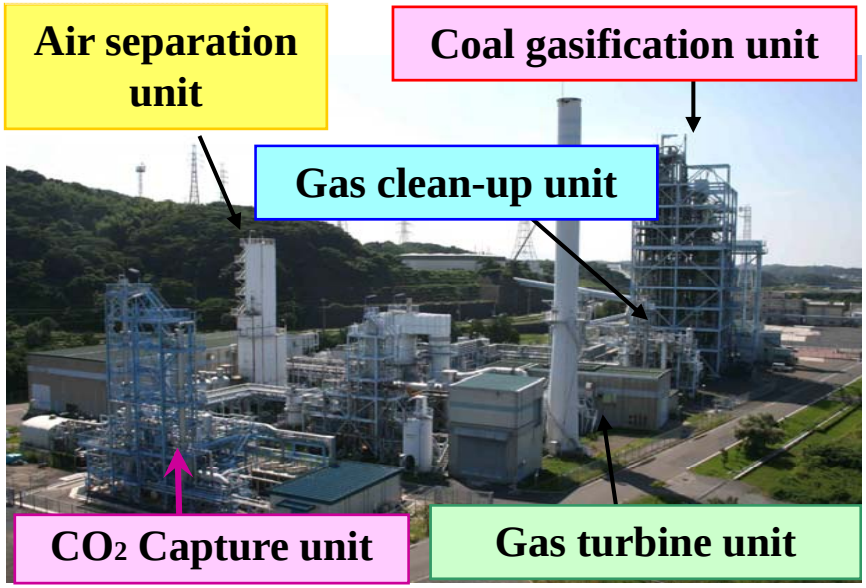
Pre-Combustion

Pilot Plant

- **Partnership: J-POWER/NEDO @J-POWER Wakamatsu Research Institute, EAGLE plant**
- Method: Chemical Absorption (MDEA)
- Gas flow rate: 1,000Nm^3/h
- CO_2 Capture rate: approx. 20 t/d
- Test period: Nov. ‘08 – March ‘14

EAGLE Pilot Plant Test

J-POWER Wakamatsu Research Institute
(Kitakyushu City, Japan)



Innovative CO_2 Capture Technology for EAGLE

- The main purpose of this project is to research physical absorption CO_2 capture technologies for a coal gasification process by using the oxygen-blown coal gasification pilot plant (EAGLE).
- To have two types of CO_2 capture process (i.e. chemical absorption and physical absorption) in the EAGLE pilot plant, and conduct an experimental study with comparing two types of CO_2 capture technology.

【Partnership】J-POWER / NEDO
【Test Period】4years（Summer 2010 - March 2014）

(FY)

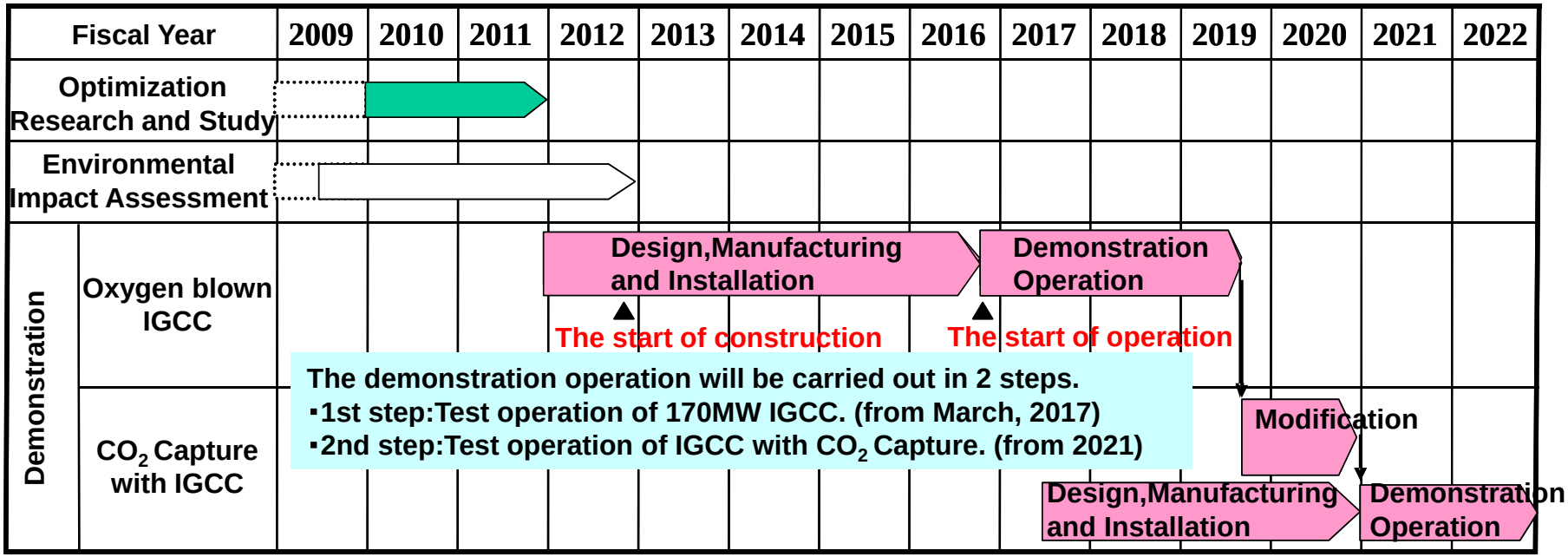
1995～2001	STEP-1					STEP-2			Plan			
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Design & Construction	Trial operation	Performance Test					Gasifier Modification CO_2 capture system installation	CO_2 capture - Chemical Absorption -		CO_2 capture - Physical Absorption -		
			Coal Flexibility Test					Coal Flexibility test		Design, Construction, Test		
				Scale-up Test				Survey of Trace Element behavior				
			Reliability Test		Reliability Test							

Osaki CoolGen Project (IGCC demo.)

◎ The Chugoku Electric Power Company and J-POWER agreed to jointly demonstrate a large-scale oxygen-blown coal gasification technology (IGCC) and CO_2 capture technology in Osaki, Hiroshima.

◎ We have jointly established the Osaki CoolGen company in Hiroshima in July, 2009, and are executing environmental assessment for the demonstration now.

Plant Output : 170MW Class
Coal Feed Rate : 1,100t/day Class



Summary

Challenge for reducing CO_2 emissions from coal-fired power generation;

1. To improve efficiency by using USC, A-USC, or IGCC technologies

2. To develop a commercially available CCS technology

3. A government financial support and a necessary legislation needed for CCS technology

4. CCS technology would be able to reduce CO_2 emissions from coal-fired power generation


J-POWER
Thank you for your attention.