

The 1st East Asia Energy Forum

Clean Coal Technologies and CCS for Power Generation

**Be Grand Resort Hotel,
Bohol, Philippines
9 August 2017**

Michiaki Harada
Senior Director
Japan Coal Energy Center

JCOAL

- Established as a foundation in 1990 (with its origin back to 1948)
- Member companies: 120 (as of Feb 15, 2016)
- Promoting as “One-stop Shop for Coal”
- Supervision by METI (Ministry of Economy, Trade and Industry of Japan)
- Covers all coal related issues from upstream to downstream

Promotion of sustainable coal utilization



Exploration



Mining & Preparation



Bio cokes

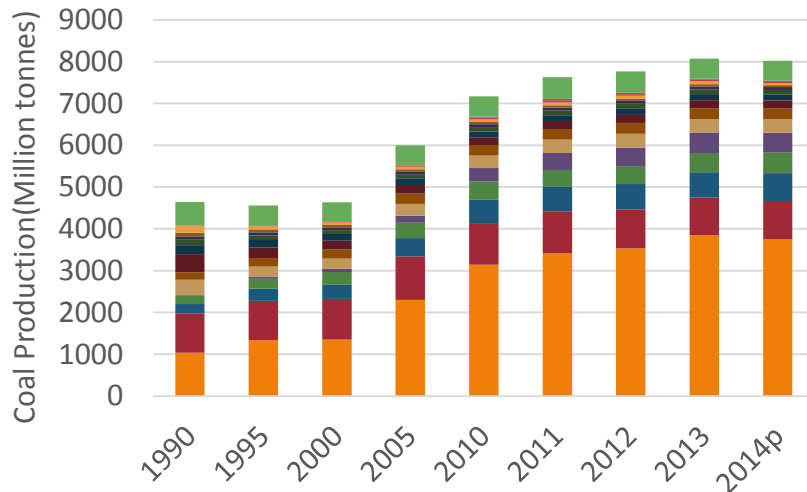
CONTENTS

- 1. Coal Now**
- 2. Clean Coal Technologies**
 - 2.1 Environmental Protection**
 - 2.2 Global Warming**
 - 2.2.1 High Efficiency**
 - 2.2.2 CO₂ Capture**

1. World Coal Production and Consumption

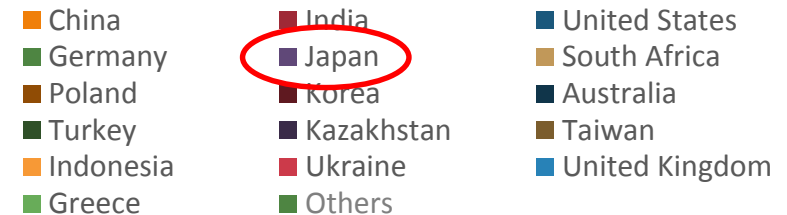
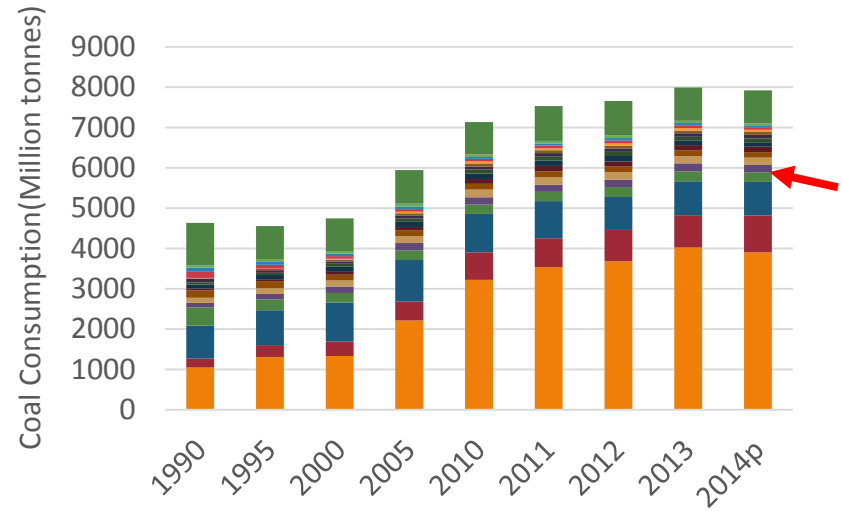
World Coal Production

IEA Coal Information 2015



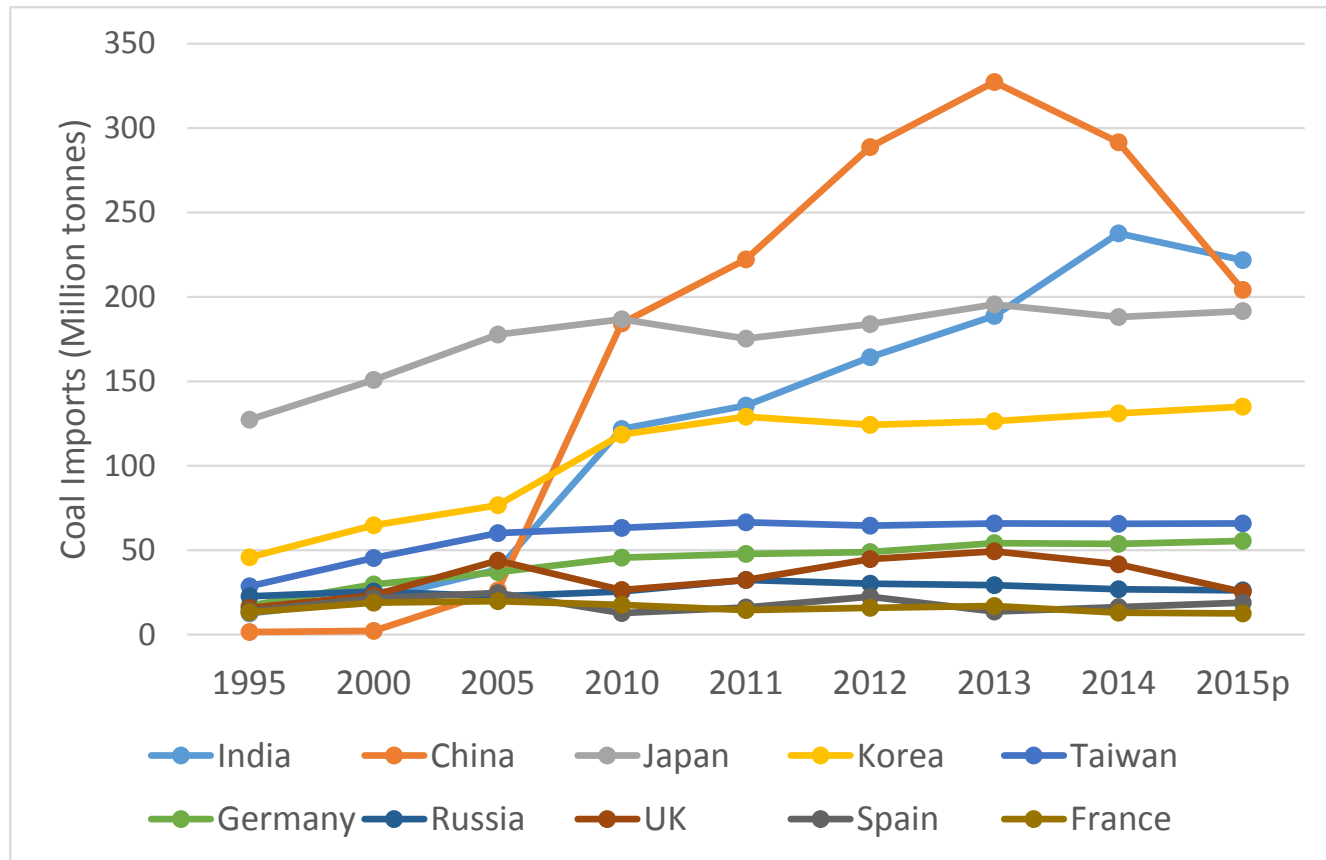
World Coal Consumption

IEA Coal Information 2015



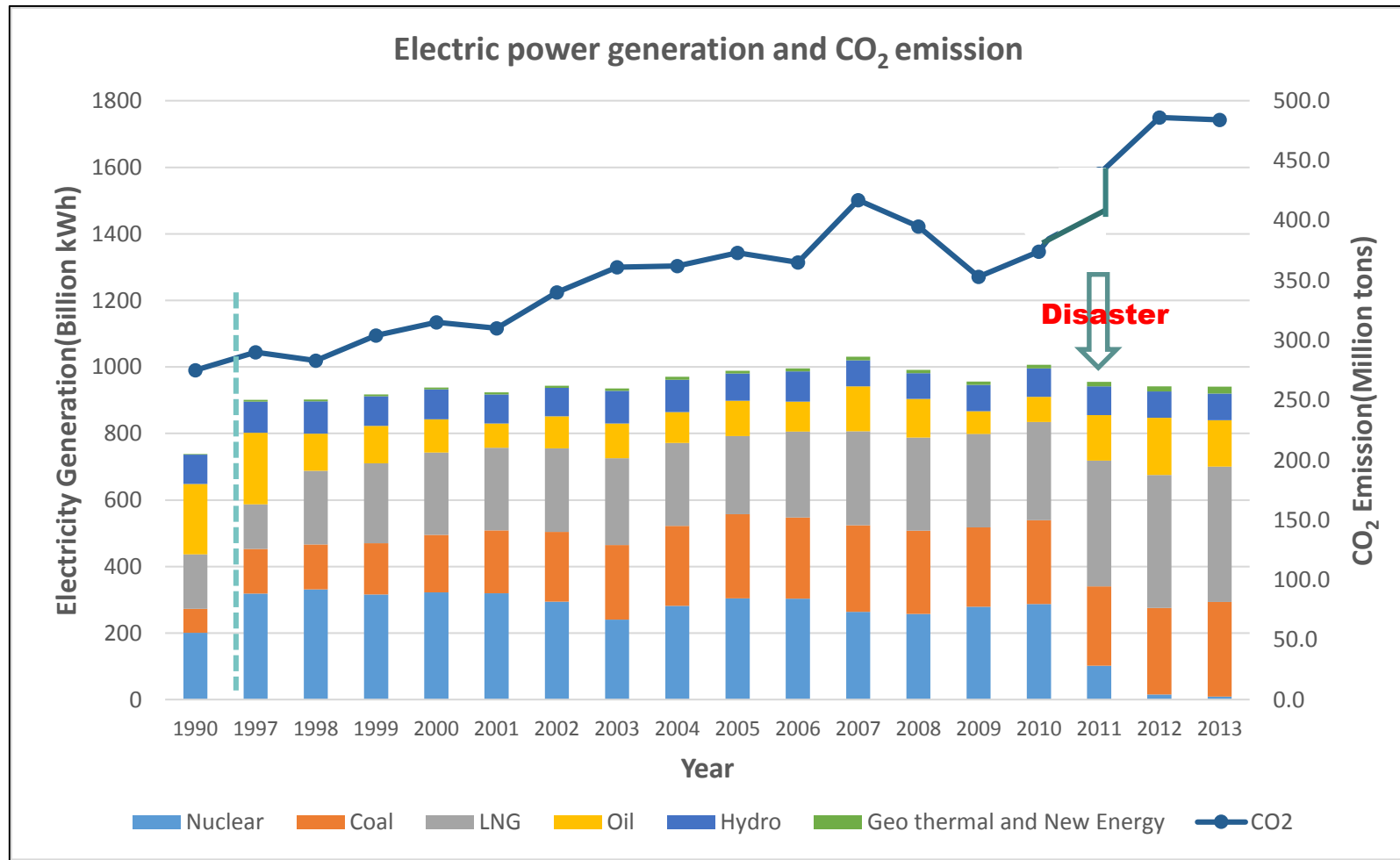
IEA Coal Information 2015

1. World Coal Import



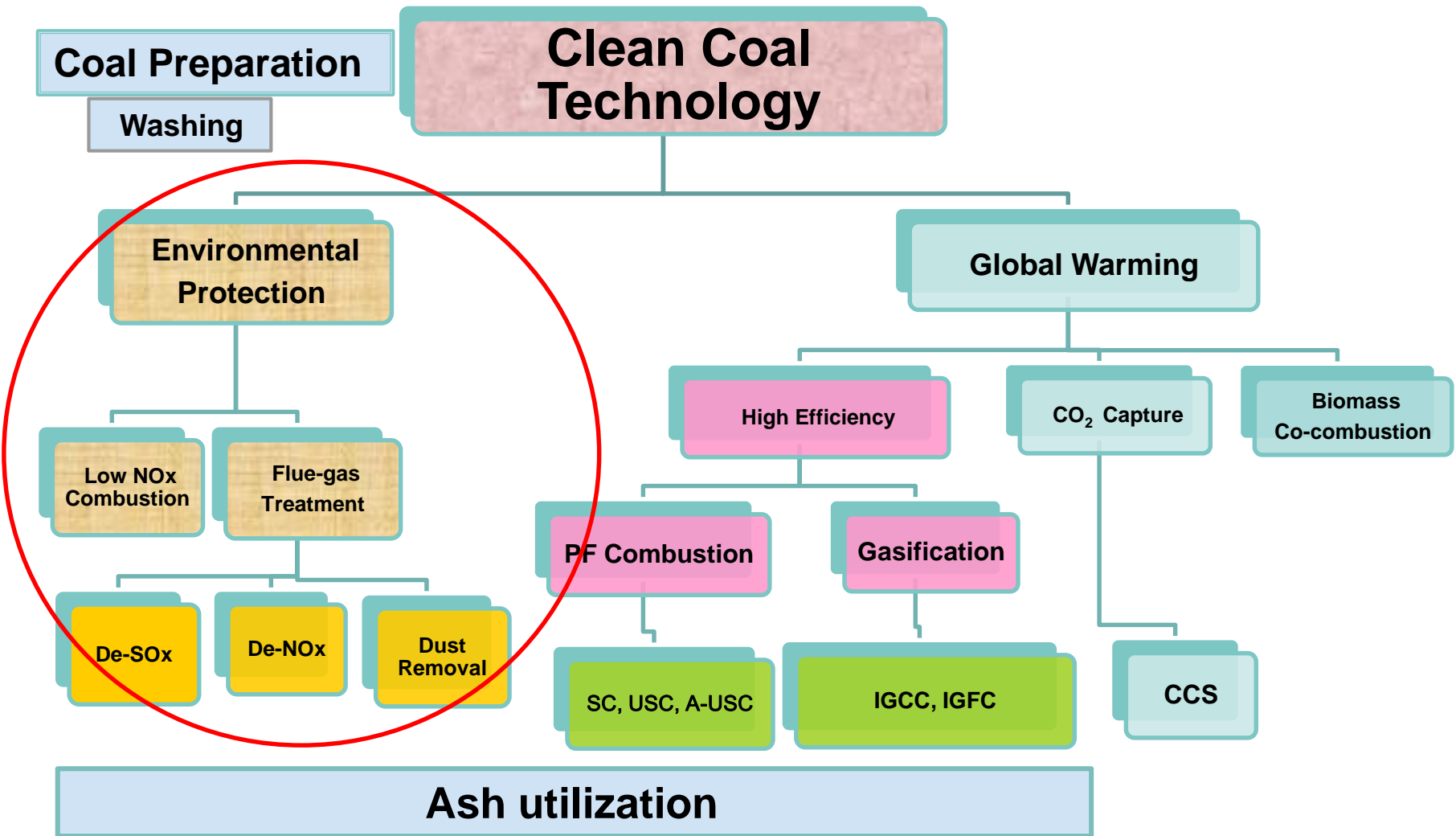
IEA Coal Information 2016

1. Japan : Electricity Generation and CO₂ Emission

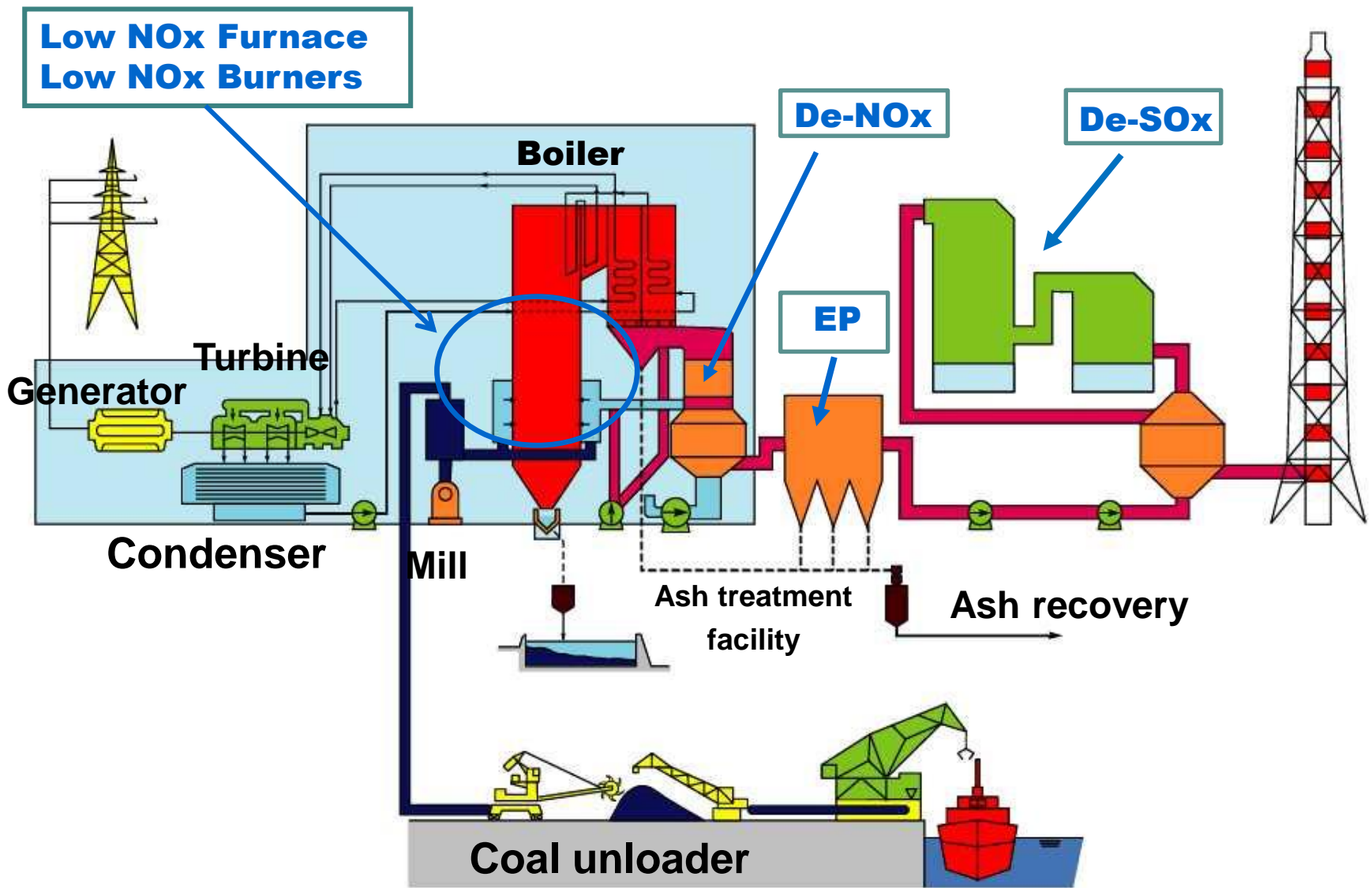


Annual Report on the Environmental, the Sound Material-Cycle Society, and Biodiversity in Japan 2015

2. Clean Coal Technologies



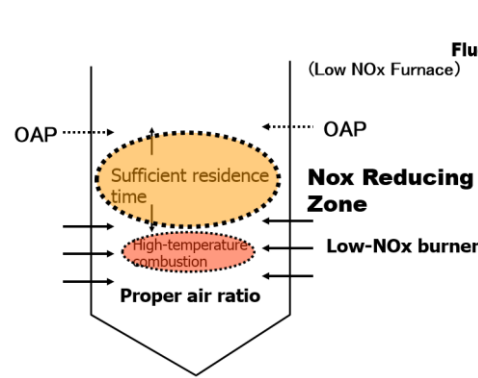
2.1 Environmental Protection



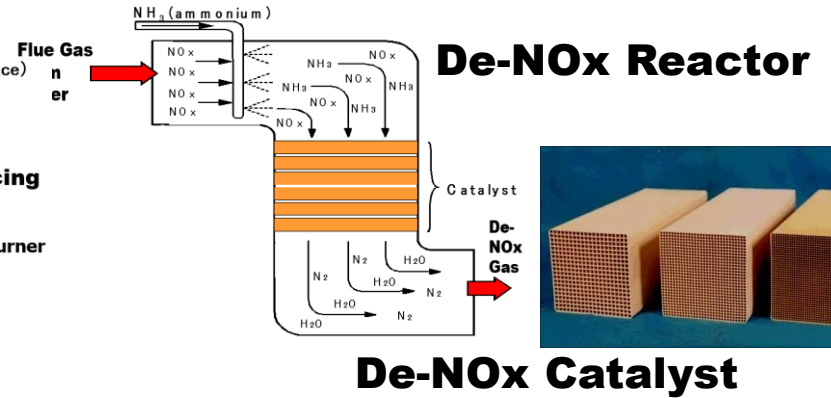
2.1 Flue Gas Treatment Facilities



Low NOx Burner



Low NOx Furnace



De-NOx Catalyst



De-Sulphur Facility



Electrostatic Precipitator

2.1 Drastic Change of Air Pollution in Japan



Tokyo industrial area 1955



Tokyo industrial area 1970

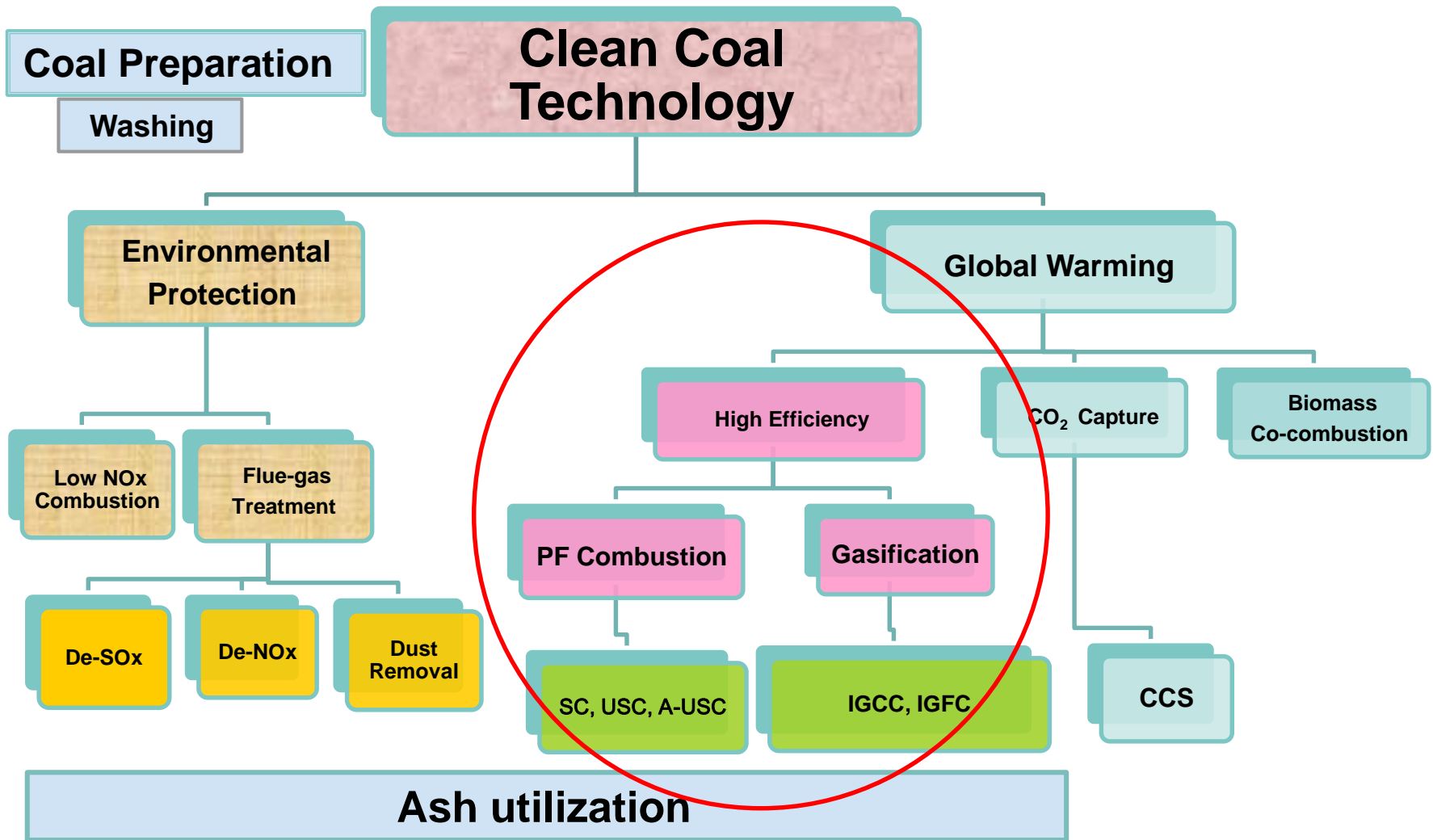


Present Tokyo



Tokyo industrial area 1970

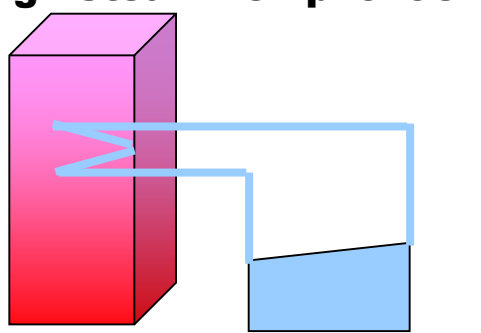
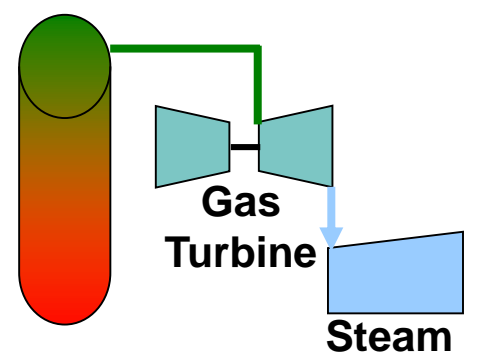
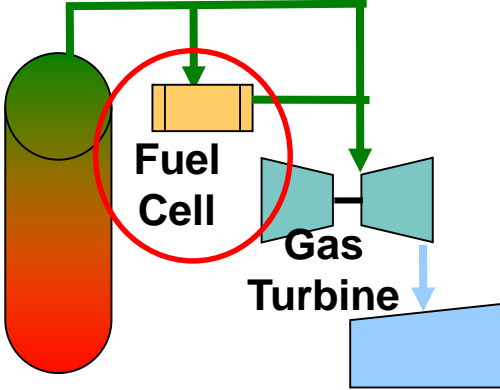
2. Clean Coal Technologies



2.2.1 High Efficiency

High-Efficient Coal Fired Power Generation

Efficiency: HHV Basis

Pulverized Coal (USC)	IGCC	IGFC
<p>High Steam Temp. 620C</p>  <p>Boiler Steam Turbine</p>	 <p>Gas Turbine Steam Turbine</p> <p>Gasifier</p>	 <p>Fuel Cell Gas Turbine Steam Turbine</p> <p>Gasifier</p>
<p>Gross Efficiency :44%</p> <p>Net Efficiency :41%</p> <p>Commercialized</p>	<p>Gross Efficiency :49%</p> <p>Net Efficiency :46% (1500C Class Gas Turbine)</p> <p>Commercialized</p>	<p>Gross Efficiency :60%</p> <p>Net Efficiency :54%</p> <p>Under Development</p>

2.2.1 World Highest Efficient Coal Fired Power Plants

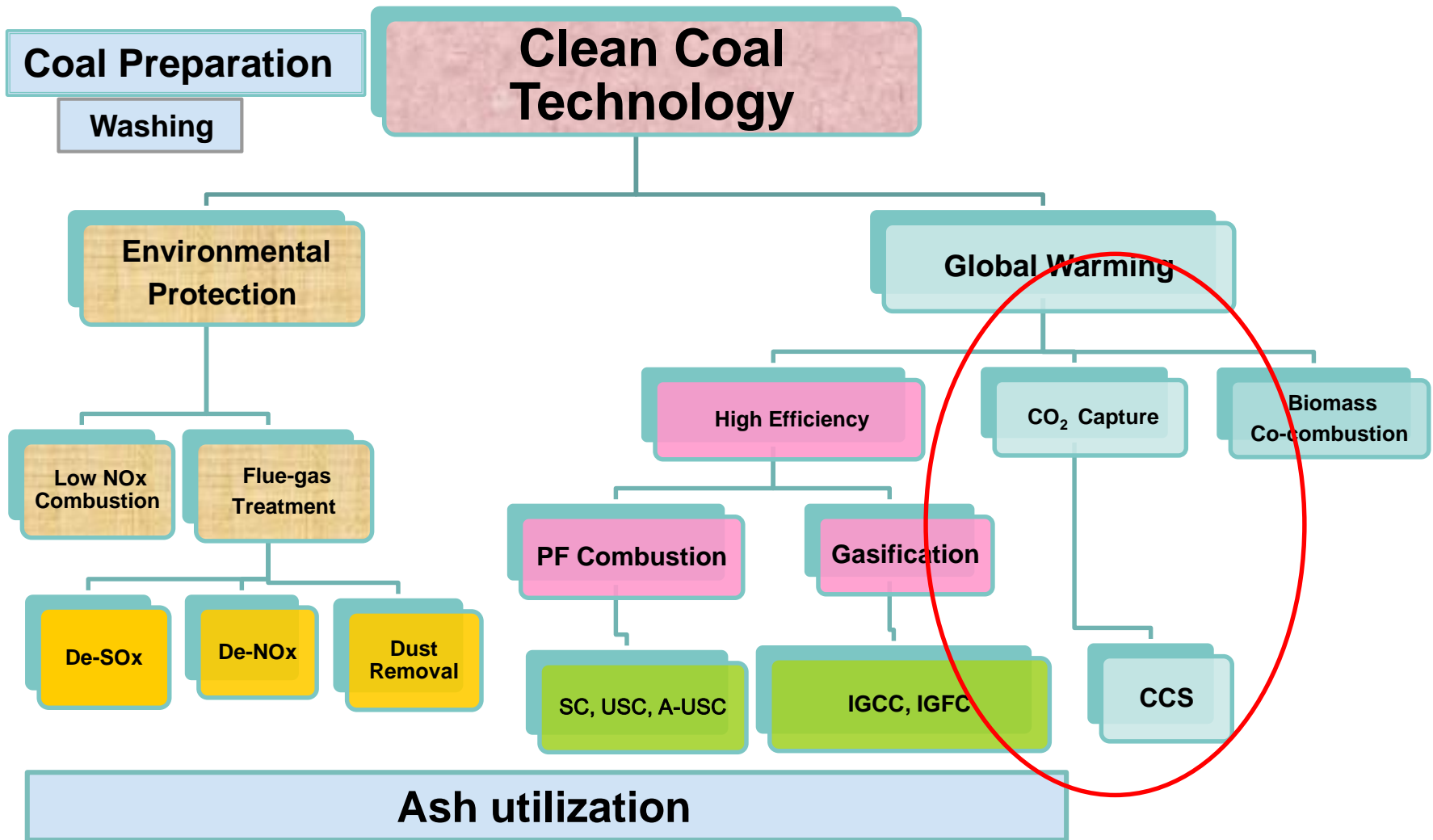
Shin-Isogo No.1 600MW 600/610 C
Shin-Isogo No.2 600MW 600/620 C



**Efficiency
(Unit No.2)
Gross 44%
Net 41%
(HHV Basis)**

Courtesy J-POWER

2. Clean Coal Technologies



IGCC and CO2 Capture

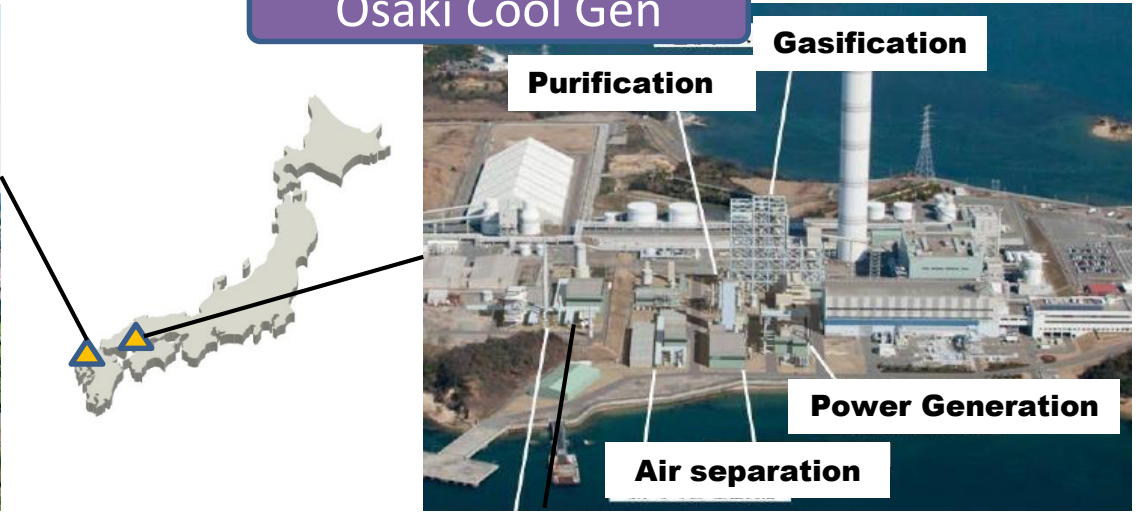
IGCC + CCS (J-POWER)

No.	Project	Operation	Capacity Pressure	CO2 Capture	Remarks
1	EAGLE (gasification test plant)	2008 to 2014	1,000 Nm3/h (150 t-coal/day) 2.5MPa	24 t/day	- The world's first CO2 capture from syn gas of IGCC in 2008 - Results show: Chem. Absorption: 1.4 GJ/ CO2-ton Physical Absorption: 0.4 GJ/ CO2-ton
2	Osaki Cool Gen. (IGCC + CCS)	Under construction 2016 : IGCC 2020 : CCS 2023 : Fuel Cell	170 M We 2.5 MPa	400 t/day (planned)	- CO2 capture for 15% of exhaust gas with Physical absorption (planned)

EAGLE Plant

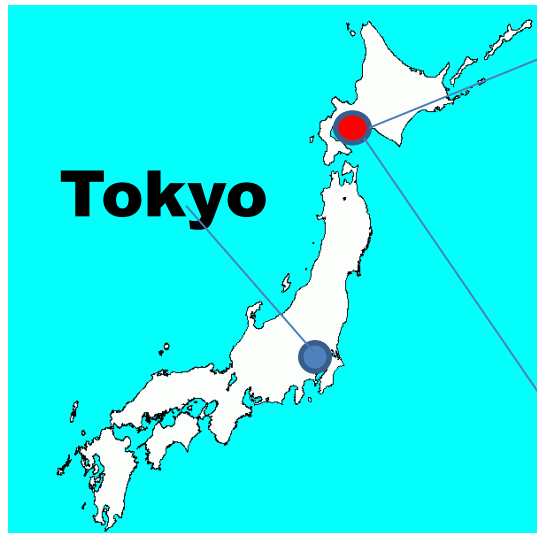


Osaki Cool Gen



quoted from materials of METI's consultation meeting, held on June 16 & 22 in 2015, on thermal power technology development.

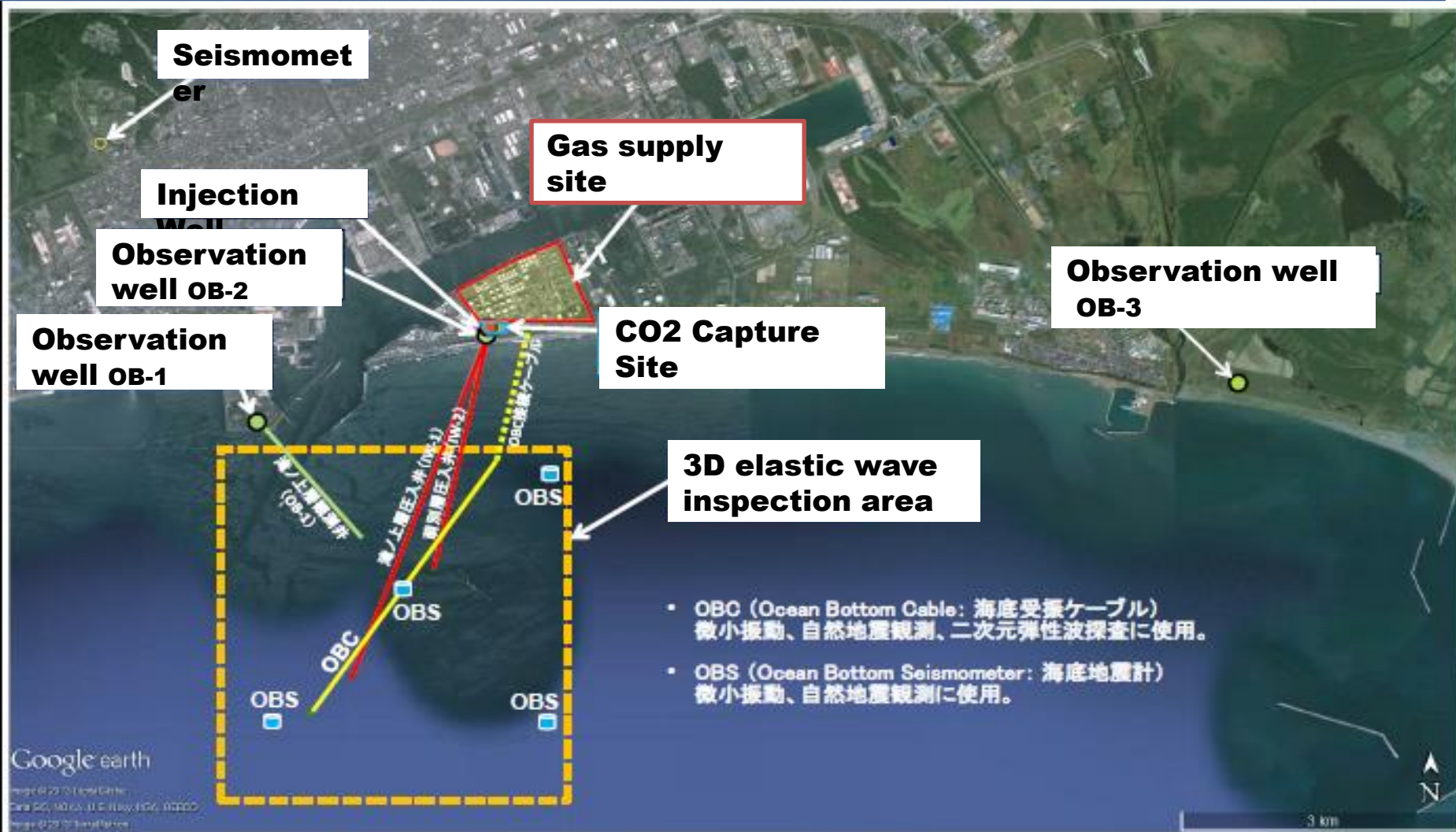
CCS Demonstration Site (Japan CCS Co.)



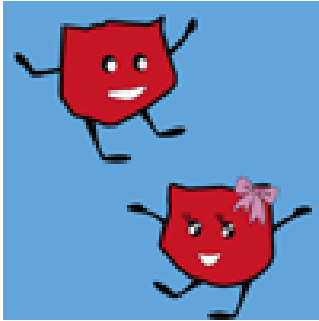
CO2 Source		CO2 Capture		Transportation		Storage Site	
Refinery plant		Chemical absorption (PSA)		none		Saline layers under Sea Bed (Structured/non-structured)	
Injection well		Capacity		Monitoring		Schedule	
Two 1,200 m deep 3,000 m deep		100,000 ton/year		Elastic wave method Three observance wells		2016 : injection & monitoring 2018 : end of injection 2020 : end of monitoring	

quoted from materials of METI's consultation meeting, held on June 16 & 22 in 2015, on thermal power technology development.

CCS Demonstration Site (Japan CCS Co.)



quoted from materials of METI's consultation meeting, held on June 16 & 22 in 2015, on thermal power technology development.



**Thank you
for your attention.**



<http://www.jcoal.or.jp>