

Japanese New Clean Coal Policy

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Today's TOPICS

- **Introduction of World and Japan Energy**
- New Clean Coal Policy
on the New Strategic Energy Plan
- Shift to low-carbonization of coal-fired
power thermal power generation
- Promotion of Joint Research and
Demonstration with Australia

Energy Resource and Coal

Energy-based economic growth

➤ Energy security

The stability of coal supply is higher than that of other fossil fuels as it is abundant with recoverable reserves, and is widely distributed through the world.

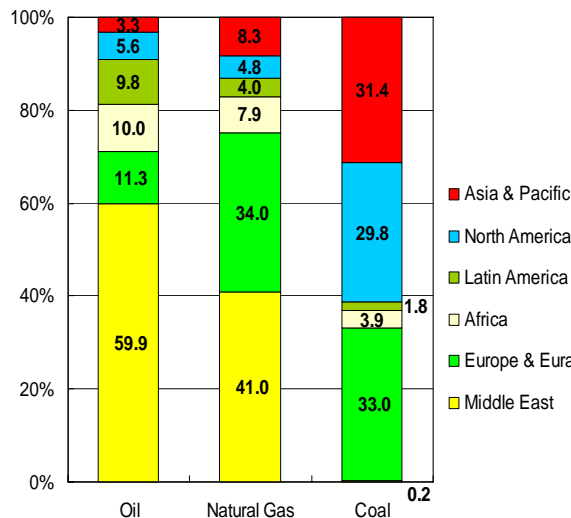
➤ Economic efficiency

The cost of coal per thermal unit is low in comparison to oil and LNG.

➤ Environment

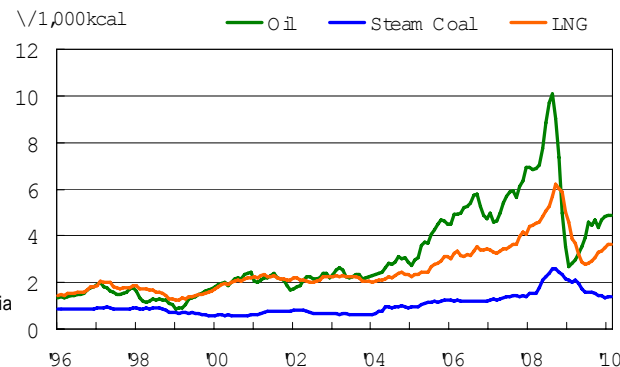
When burned, coal has the environmental drawback of emitting more CO₂ per unit amount of heat than other types of fossil fuels.

[Fossil Energy Reserves by Region]



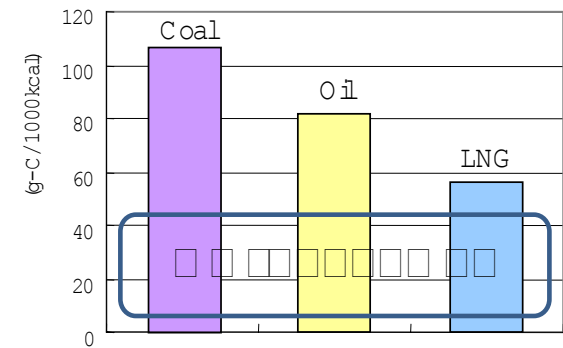
Source: BP Statistics 2009

[Trend of Fuel Price (CIF Japan)]



Source: IEEJ

[CO₂ Emission per Thermal Unit]

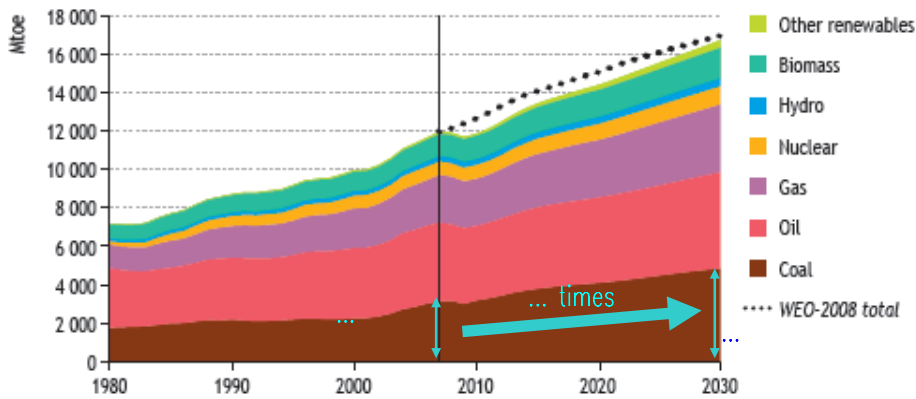


Source: based on "United Nations Framework convention on Climate Change"

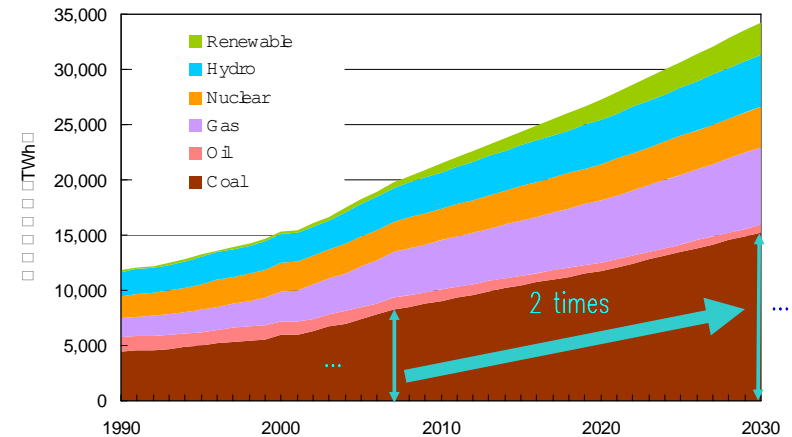
Role of Coal in World's Energy Balance

- The share of coal accounts for one-quarter of total primary energy supply in the world and its consumption is expected to achieve a 1.5 fold increases in 2030.
- Coal fired power generation represents 40% of total volume generated in the world and is projected to doubled in 2030.

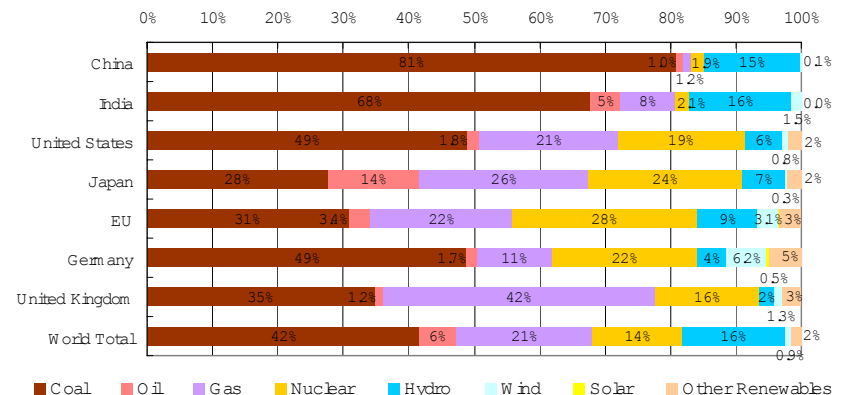
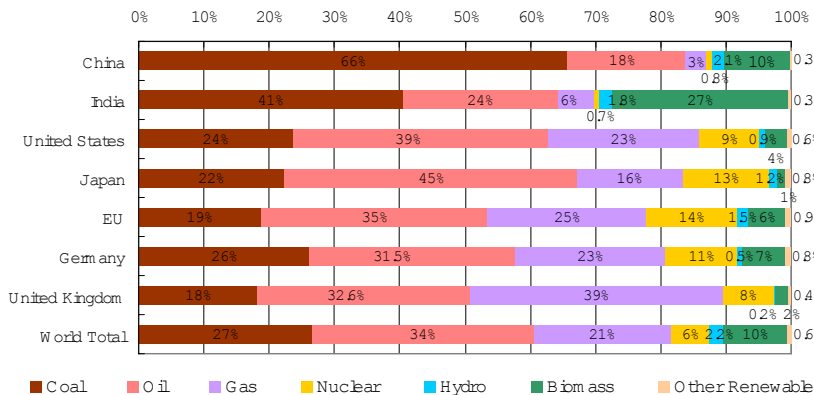
[Primary Energy Demand by Fuel: World]



[Power Generation Mix by Fuel: World]



[Composition of Primary Energy Consumption in Major Countries (2007)] [Composition of Power Generation Mix in Major Countries (2007)]



The Position of Coal on the New Strategic Energy Plan

1. Shift to low-carbon systems in coal-burning power generation

- . As global energy demand grows, coal-burning power generation worldwide will double by 2030.
- . Coal-fired power generation emits about twice as much CO₂ per unit production as LNG-fired power generation. In order to respond to climate change, it is essential to achieve greater efficiency in coal-burning power generation.
- . Japan has the world's most environmentally friendly coal-fired power generation systems.

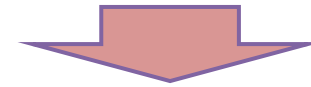


1-1 Further shift to low-carbon systems in coal-fired power generation in Japan

1-2 Shift to low-carbon systems in overseas coal-fired power generation

2. Measures for ensuring stable supply of coal resources

- . Japan is the world's largest importer of coal, depending on overseas countries for almost all the coal it consumes. Approximately 80% of coal imported by Japan comes from Australia and Indonesia.
- . As the global demand for coal is expected to grow, China, India, and other emerging economies import increasing amounts of coal. Further initiatives for ensuring stable supply of coal are critical.



2-1 Frontier development and closer cooperation with coal-producing countries

2-2 Effective use of low-quality coal for developing the new and clean energy sources

Low Carbonization of Coal Fired Thermal Power

1-1. Further Promotion of Low Carbonization and Zero Emissions of Domestic Coal Fired Thermal Power

[Short Term]

- (1) Promotion of improvements in operations of existing coal fired thermal power plants and biomass mixed firing
- (2) Replacement of machinery to state of the art machinery in antiquated coal fired thermal power plants

[Mid to Long Term]

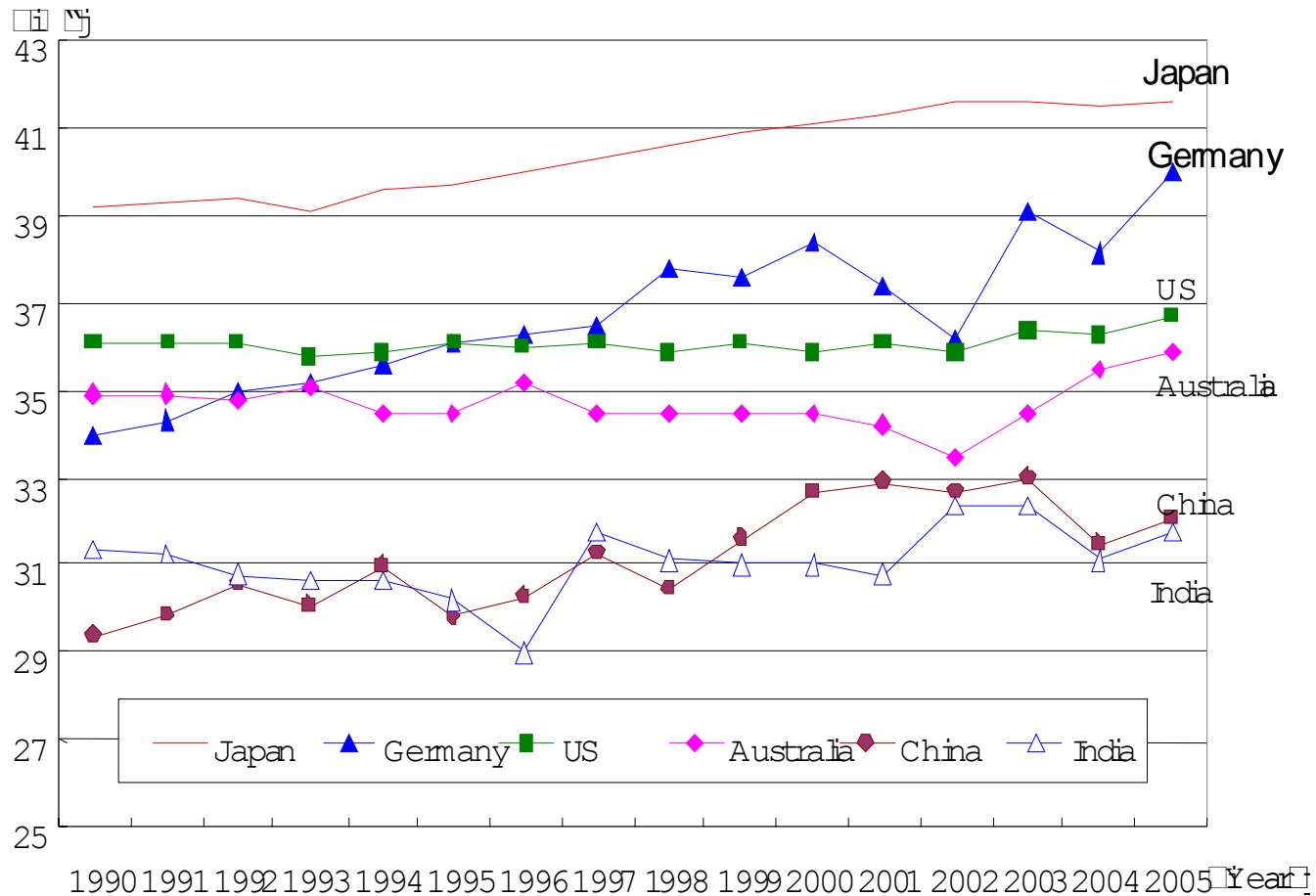
- (3) Development demonstrations and introduction of highly efficient coal fired thermal power
- (4) Development and demonstrations of CCS technologies aimed at zero emissions

1-2. Promotion of Low Carbonization by Technology Transfer to Overseas Coal Fired Thermal Power Plants

- (1) Promotion of technology transfer of highly efficient coal fired thermal power technologies according to the industrial structure of the partner countries
- (2) Export of systems with operation and management technology (O&M) of coal fired thermal power
- (3) Incentive grants for CO2 credits, etc.

Promotion of the Low Carbonization of Coal-Fired Thermal Power in the world based on the technical transfer

Thermal Efficiency (Gross, LHV)

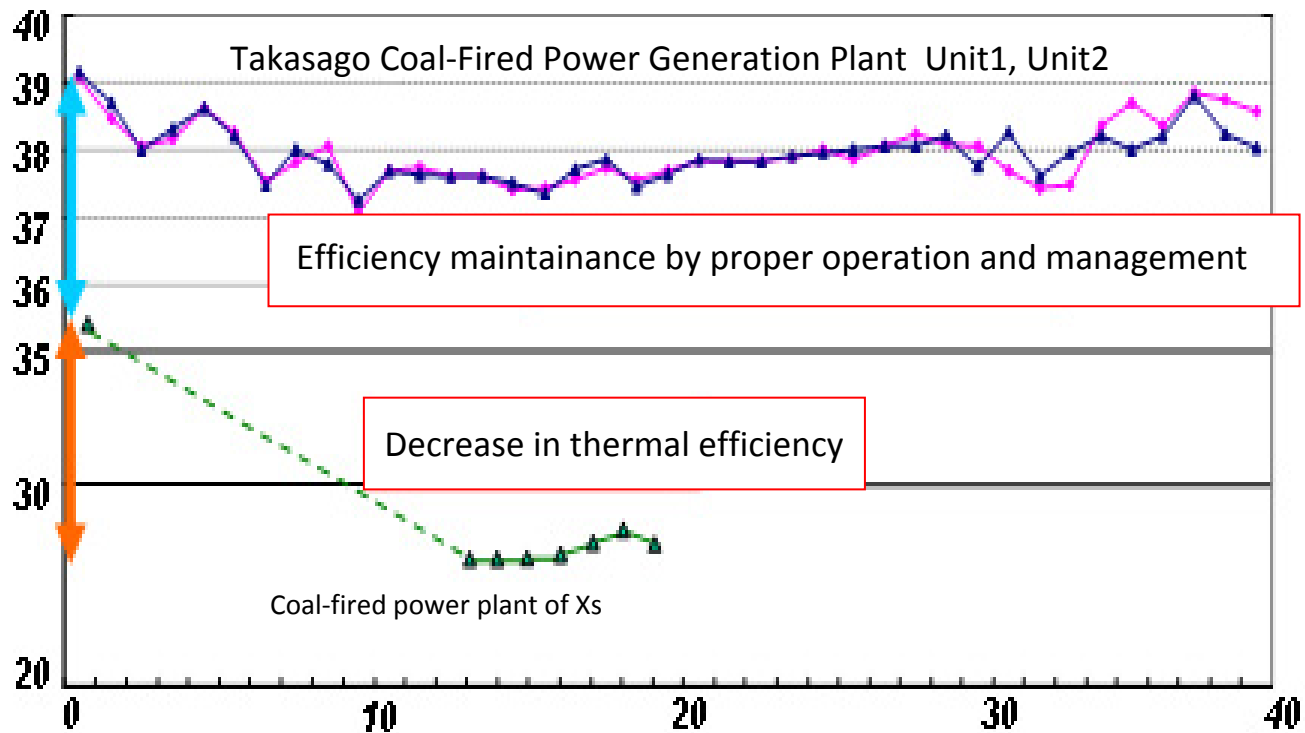


INTERNATIONAL COMPARISON OF FOSSIL POWER GENERATION EFFICIENCY (ECOFYS) (2008)

Promotion of the Low Carbonization of Coal-Fired Thermal Power in the world based on the technical transfer

Comparative example of coal-fired thermal power and aged deterioration

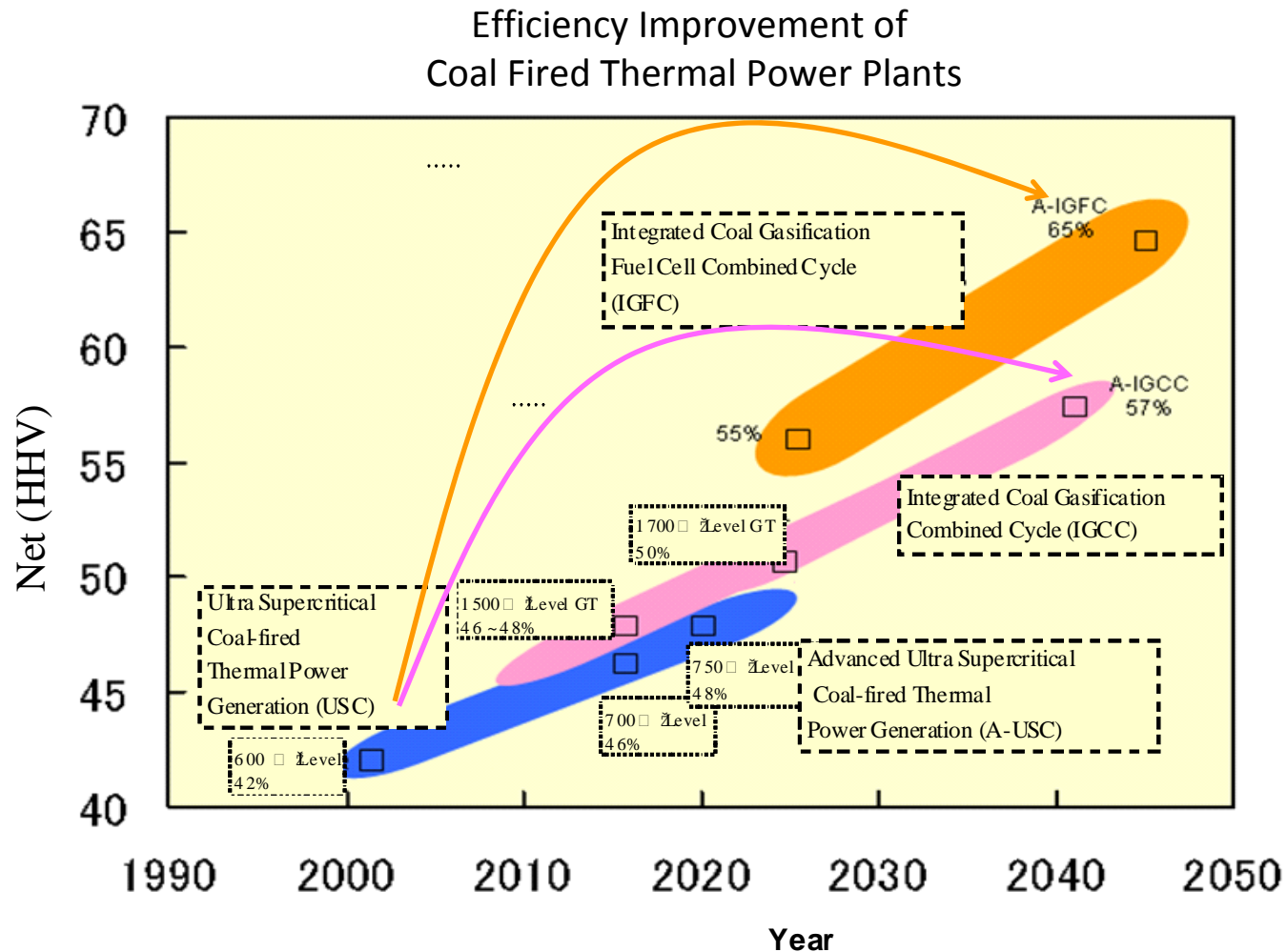
Power generation edge thermal efficiency(% , H MV)



The Federation of Electric Power Companies of Japan

Promotion of the further Low Carbonization of Coal Fired Thermal Power in Japan

(1) Development, demonstrations and introduction of highly efficient coal fired thermal power



Source: "Cool Earth 50 – Energy Innovative Technology Plan"

Promotion of the further Low Carbonization of Coal Fired Thermal Power in Japan

(1) Development, demonstrations and introduction of highly efficient coal fired thermal power

. Important Projects.

. A-USC

. Study on next generation, high efficiency Integrated Coal Gasification
Electric Power Generating Process (A-IGCC(700.))

.. Period: 2008-2016

. Nakaso IGCC Oroject (air-blown IGCC)

. R&D. 11 power companies and CRIEPI

. Coal feed rate. 1,700./d(250MW)

. Period. 2009-10 (CCS Feasibility Studies)

. Osaki CoolGen Project (oxygen-blown IGFC)

. R&D. J-POWER

The Chugoku Electric Power Co, Inc.

. Coal feed rate. 1,100./d(170MW)

. Period. 2010 - 2011(Feasibility Studies)

Promotion of the further Low Carbonization of Coal Fired Thermal Power in Japan

(2) Development of CCS for Zero Emission Coal Fired Thermal Power Generation

.Roadmap for technology demonstration]

.Target for cost reduction (capture of CO₂ 2,000yen/ton by 2015 and 1,000yen/ton by 2020)

.Start a large scale demonstration project as soon as possible after 2009FY

Promotion of the further Low Carbonization of Coal Fired Thermal Power in Japan

(2) Development of CCS for Zero Emission Coal Fired Thermal Power Generation

[Important Projects]

- . Post combustion .Matsushima Project
 - . R&D: JPOWER/MHI . CO2 capture. 10 t-CO2/d
 - . Period.2007 - 2009

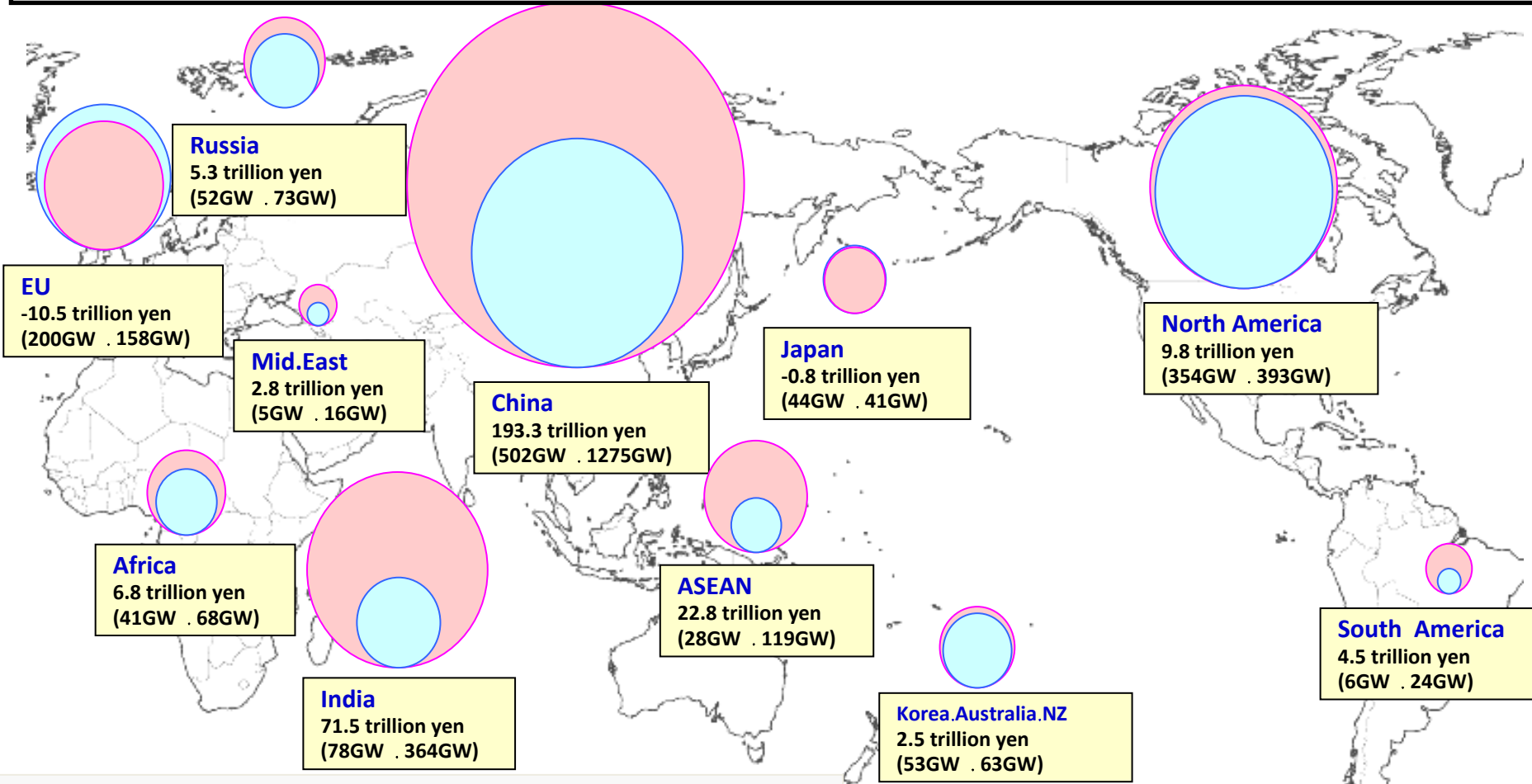
- . Oxyfuel combustion .Callide Oxyfuel Combustion Project
 - . R&D.Japan (J-Power, IHI., etc.) /Australia
 - . Scale.30MW . CO2 capture.30,000 t-CO2/year

 - . Period.2011.2014

- . Pre-combustion.EAGLE Project
 - . R&D.J-Power/NEDO . CO2 capture: 20t-CO2/d
 - . Period.2008 - 2009 Chemical Absorption test
2010 - 2013 Physical Absorption test

Expansion of prospects of coal thermal power generation of the world

- Market scale of 10 to 20 trillion yen/year. Capacity of power-generating facility will double by the year 2030.
- Regionally, it is remarkable that China and India, and other Asian countries are expanding their demand.
- Foreseeing the necessity of global warming alleviation, the demand for high-efficiency coal power generation plant in both developed countries and developing countries will be increase.



- Numbers above are estimation of the expected amount of money of market scale by 2030 (assumption of 250 billion yen/1GW)
- Numbers below (in parentheses) are installed capacity in 2007 and equipment capacity expected by 2030

2007's Result
2030's Prospects



.Unit.GW)

.Replacements of aged plants in developed countries should be expected, but those numbers are excluded in this data.

.Figures are based on "IEA World Energy Outlook2009 Reference Scenario"

Promotion of the Low Carbonization of Coal-Fired Thermal Power in the world based on the technical transfer

CO2 emissions caused by energy generation in the world:

280 billion tons

Out of the number above, CO2 emissions caused by coal-fired power generation:

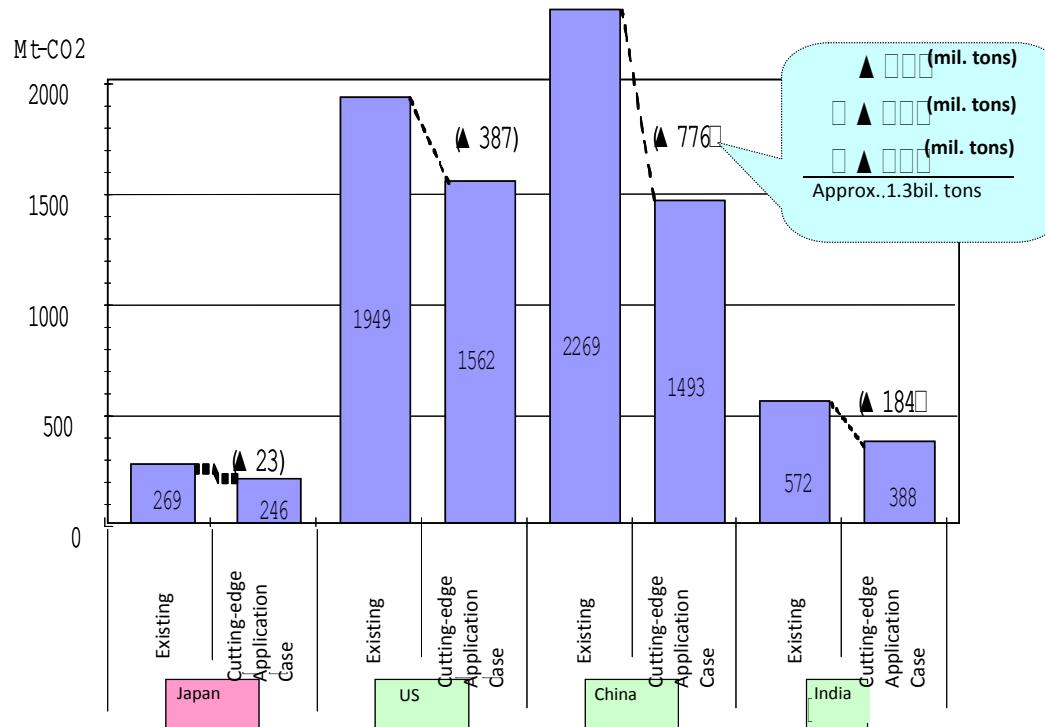
80 billion tons.30..

CO2 emissions in Japan.

13 billion tons . 4..

Out of the number above, CO2 emissions in Japan caused by coal-fired power generation. 2.7 billion tons (1..

CO₂ Emission of Coal-fired Thermal Power Plants (2004)



*In the *case of applying* the best practice (highest efficiency level of commercial power plants) of Japan to the existing plants of each country.

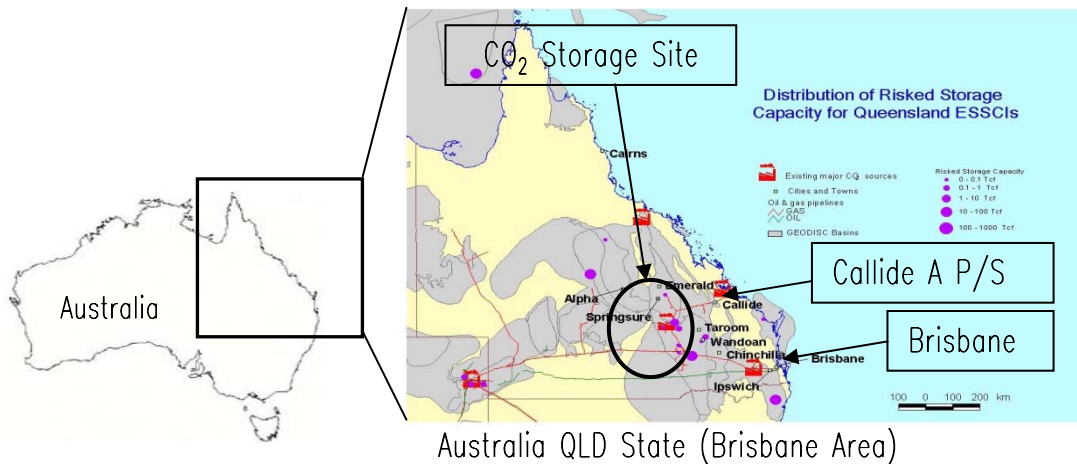
Source: The Institute of Energy Economics, Japan (IEE JAPAN), Achievement data: World Energy Outlook 2006 (IEA)

Development and verification of CCS

towards zero emission coal-fired power generation

.Callide Oxyfuel Project

Australia – Japan joint demonstration project in which an existing boiler of Callide A Power Station in Queensland, Australia, is retrofitted to introduce oxyfuel system which can easily capture CO₂, and captured CO₂ is geologically stored.



Callide A Power Station

Partners

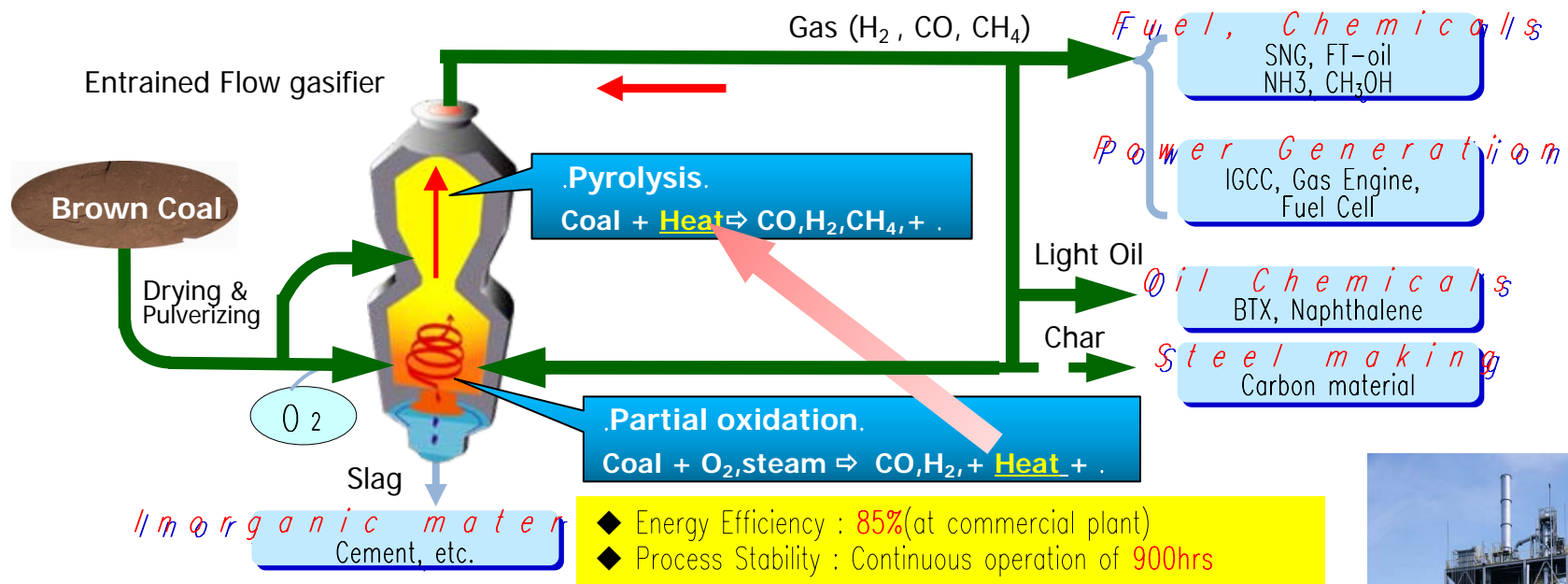
Japan : J-POWER, IHI, Mitsui & Co.
JCOAL (Supporting Collaborator)
Australia: CS Energy, Xstrata, Schlumberger,
Australian Coal Association

Schedule

2008 – 2011 Retrofit of existing power station
2011 – 2013 Oxyfuel demonstration operation
and CO₂ geological storage
2013 - 2015 Post injection CO₂ monitoring

. Highly Efficient Pyrolysis Integrated Coal Gasification Project

- The Australia/Japan joint demonstration project to do a gasification of low rank coal (Brown Coal) which the utilization at the state of Victoria in Australia is expected in the future, to produce substituted natural gas (SNG) and to implement CO₂ capture and storage (CCS)
- The implementation for demonstration research of highly efficient pyrolysis technology which is developed by national project in Japan.

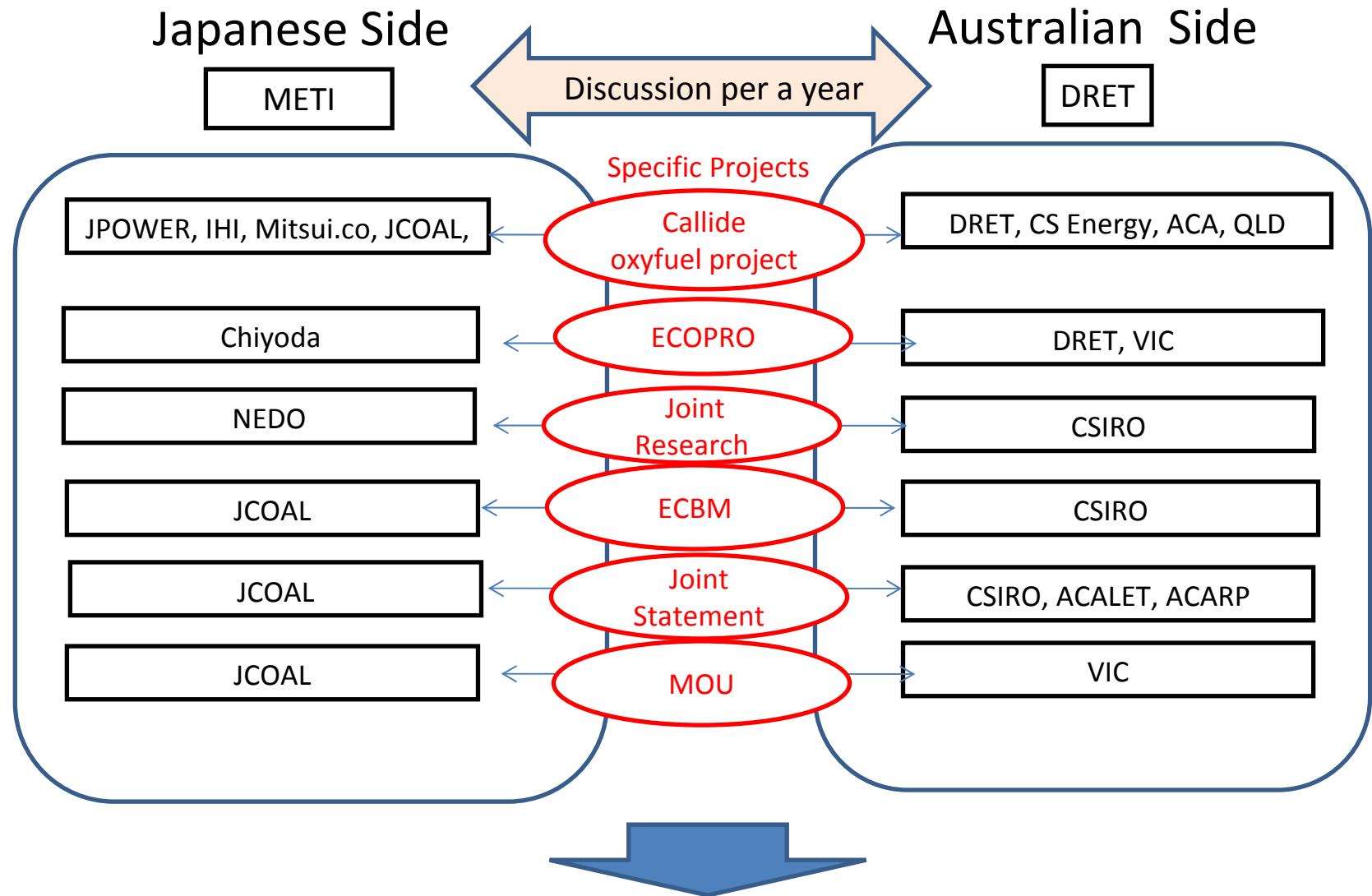


Schedule

- Preliminary Feasibility Study
- Plant Construction
- Operation for Demonstration



Formation of Clean Coal and CCS Cooperation between Japan and Australia



Expansion of Cooperation Projects between Japan and Australia

NEDO's International Collaborative

Basic Research Projects on Clean Coal and CCS

- . International Collaborative Research on Efficient Utilization Based on Victorian Brown Coal Gasification
Japan: Kyushu Electric Power, Kyushu University
Australia : Monash University
- . Feasibility Study for Future Energy System with CO₂ Free Fuel Derived from Low Rank Coal (Hydrogen Chain Model)
Japan: Kawasaki Heavy Industries(KHI)
Australia : HRL, CSIRO, CO₂CRC
- . R&D to assess safety of CO₂ storage underground and its effect on the surrounding environment as well as to establish an environment evaluation method
Japan: TAISEI CORP.
Australia: QLD University

..CO₂ Geological Storage Project (Nagaoka Project)

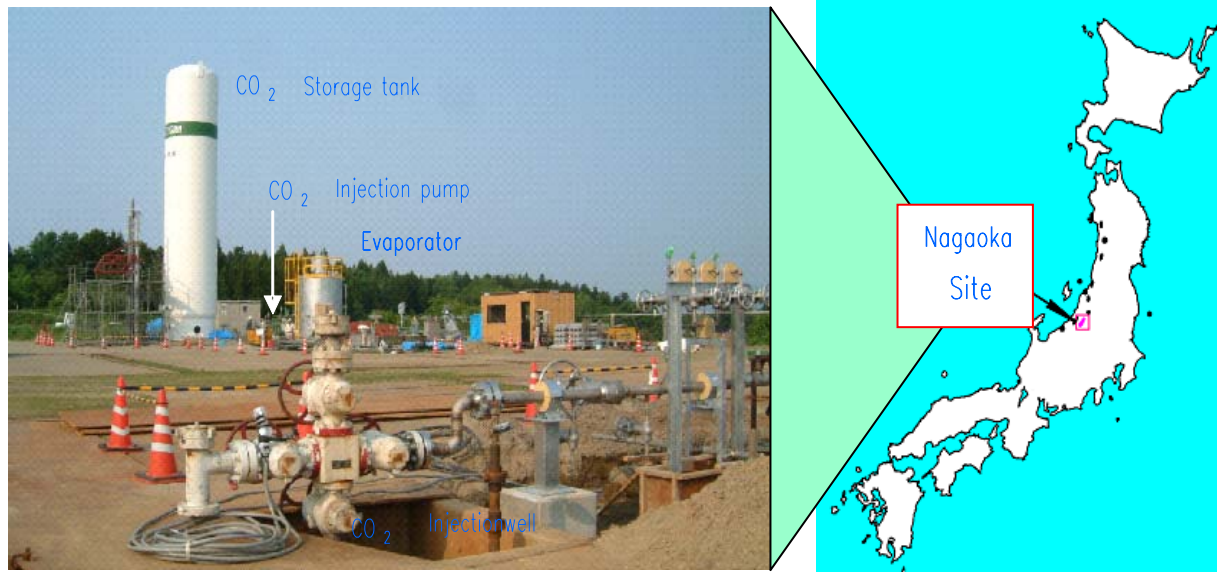
.Total Budget.61M US\$ (1US\$ = 85JPY)

.CO₂ injection period. Jul. 2003 to Jan. 2005

.CO₂ injected amount. about 10,400 t-CO₂

.CO₂ injection rate. 20 to 40 t- CO₂/day

. **Implementing body .RITE (Research Institute of Innovative Technology for the Earth)**



CCS Demonstrations Project in Japan

..Demonstration project.....

Total Budget. ca. 183.5M US\$ in 2010 (1US\$ = 85JPY)

.Tomakomai in Hokkaido prefecture

System : Large emission sources (Refinery Plants) + Offshore Aquifer

.3D seismic survey in 2009 and 2010

.Drilling a Survey Well from in 2010

.Nakoso - Iwaki oki in Fukushima prefecture

System : IGCC + Offshore Depleted Oil and Gas Field

.Offshore pipeline route survey in 2009

.Kitakyushu

System : Offshore Aquifer

.Preliminary survey well

. Implementing body

.Japan CCS Co. Ltd.

* the current shareholders : 36 companies (Electric power, Petroleum, Engineering, Iron and Steel and so on)

* Date of Incorporation May 26, 2008

