

CCT-A Key toward Substantial Prevention of Global Warming

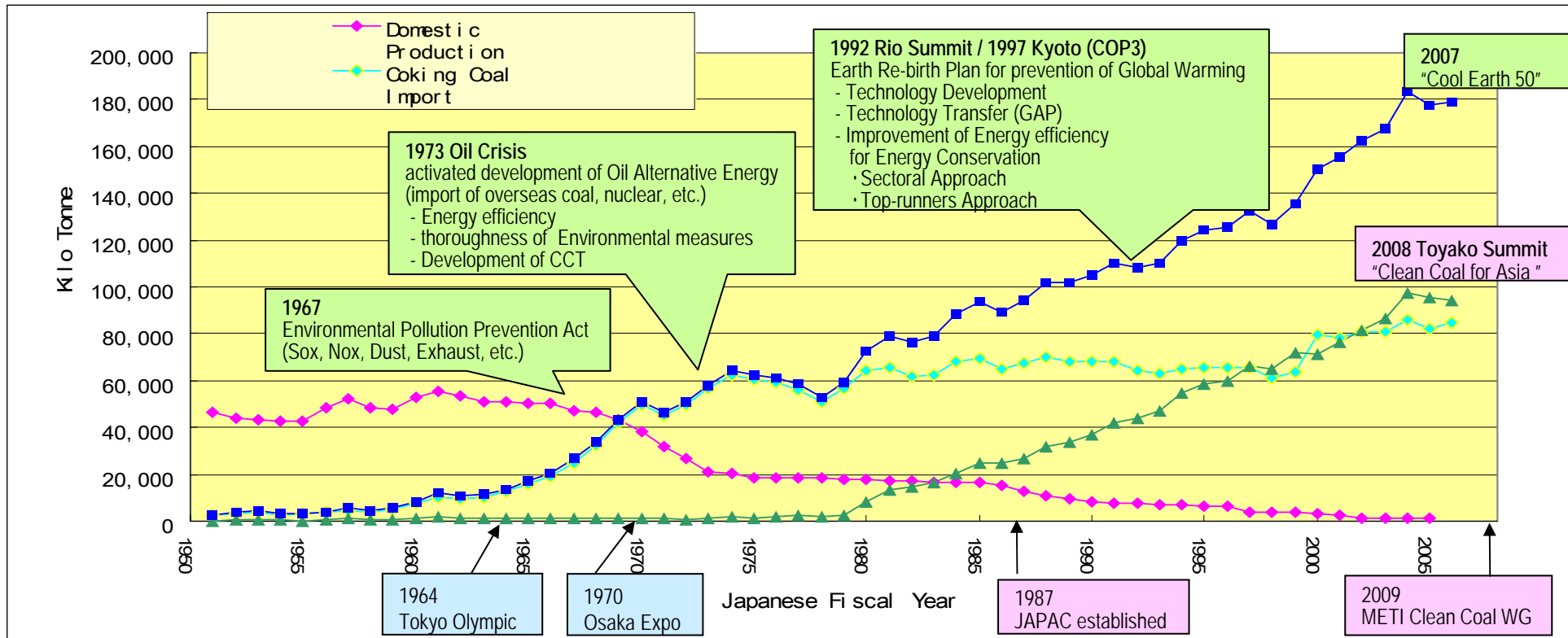
Toru Namiki
Japan Coal Energy Center
February 1, 2010
At US-Japan Research Institute
Two-Day Seminar in Washington D.C.

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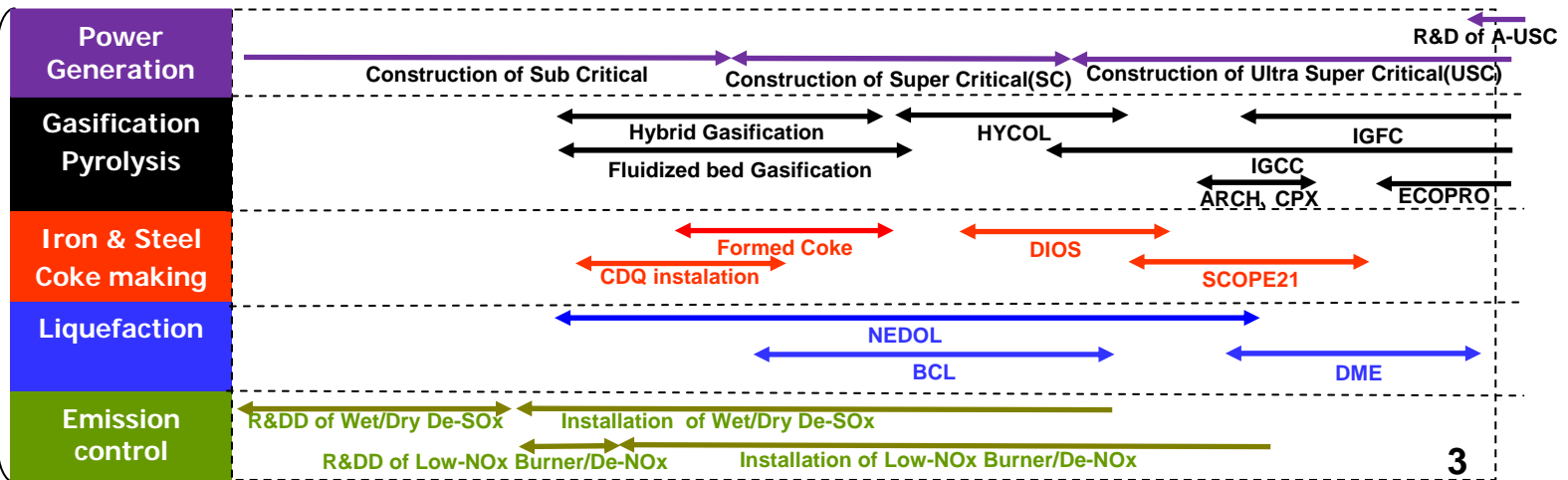
1. Significance of coal as an option of energy source and CCT in Japan
2. Global situation on coal; increasing emission according to sharp rise of demand
3. Japan's potential for contribution to address the global issues
4. CCT Policy and Measures in Japan
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1. Significance of coal as an option of energy source and CCT in Japan

1. Japan : Coal Production and Import & CCT Developments

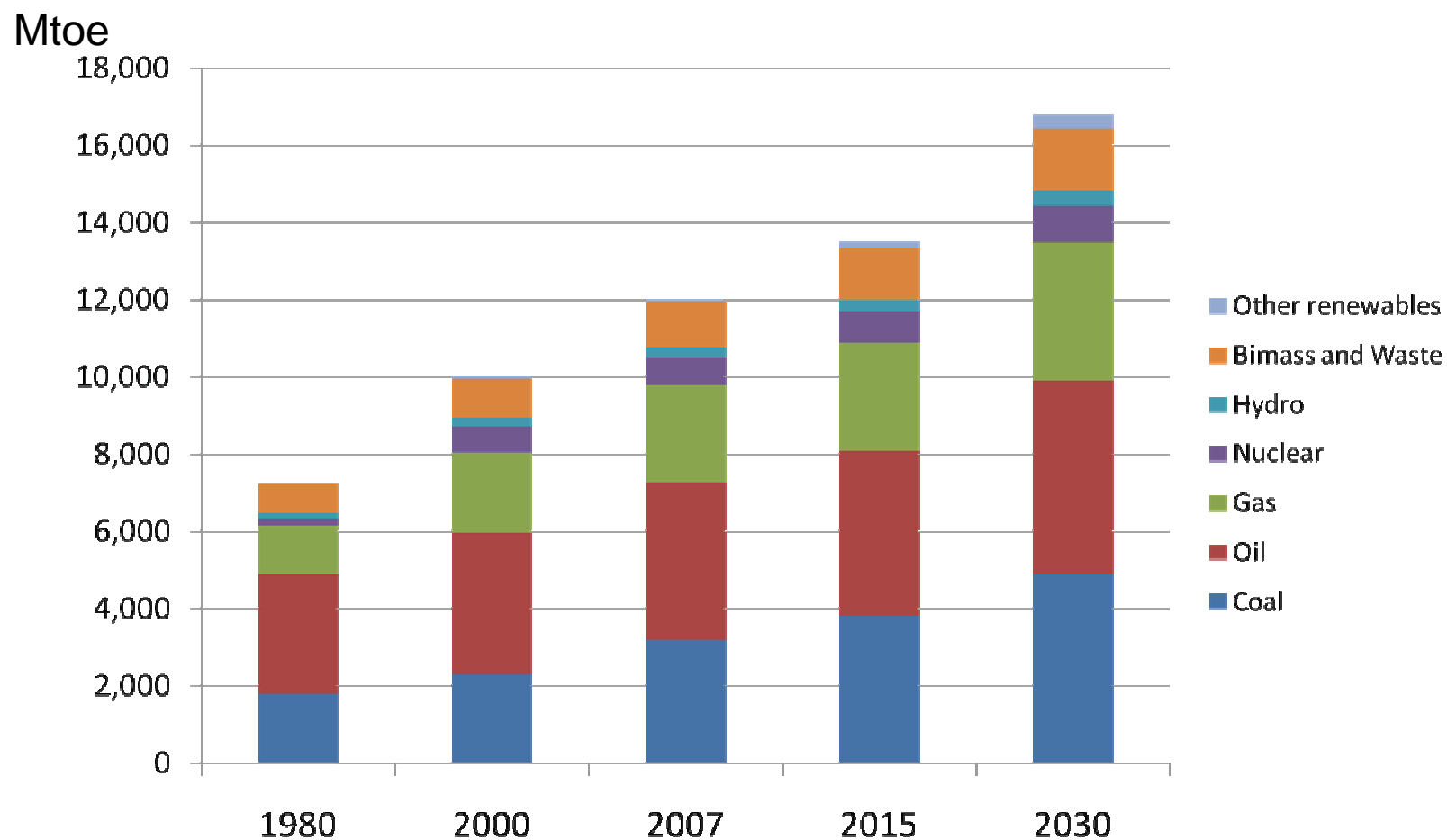


Development & Dissemination of CCT in Japan



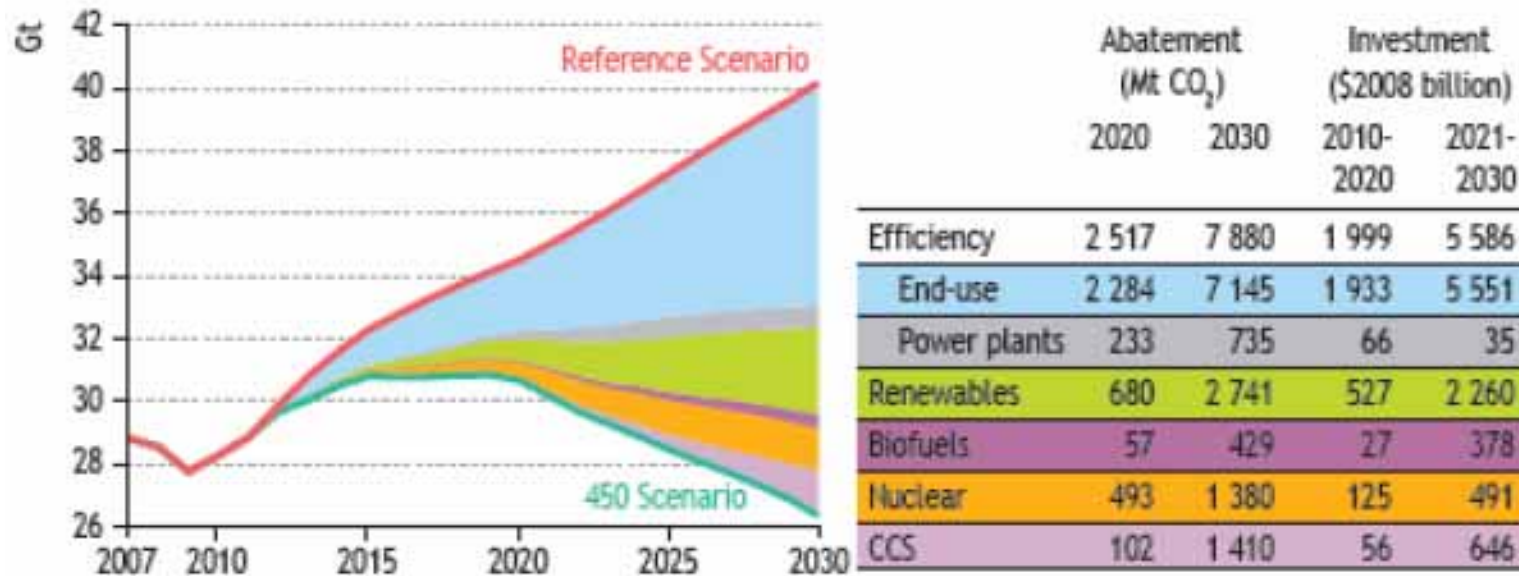
2. Global situation on coal; increasing emission according to sharp rise of demand

2.1 World primary energy demand by fuel in the Reference Scenario



Source: World Energy Outlook 2009

2.2 World energy-related CO₂ emission savings by policy measure in the 450 ppm scenario



Source: World Energy Outlook 2009

3. Japan's potential for contribution to address the global issues

3.1 Near-Zero emission coal-fired power generation technology (Ultra-Supercritical Units)



Start of operation: 2000.
Power output: 1050MW x 2
USC: 25MPa 600/610C
Net Efficiency: 41.5%(HHV)
SOx: 50ppm(Wet type De Sox)
NOx: 45ppm (SCR)
SPM: 10mg/m³N (ESP)



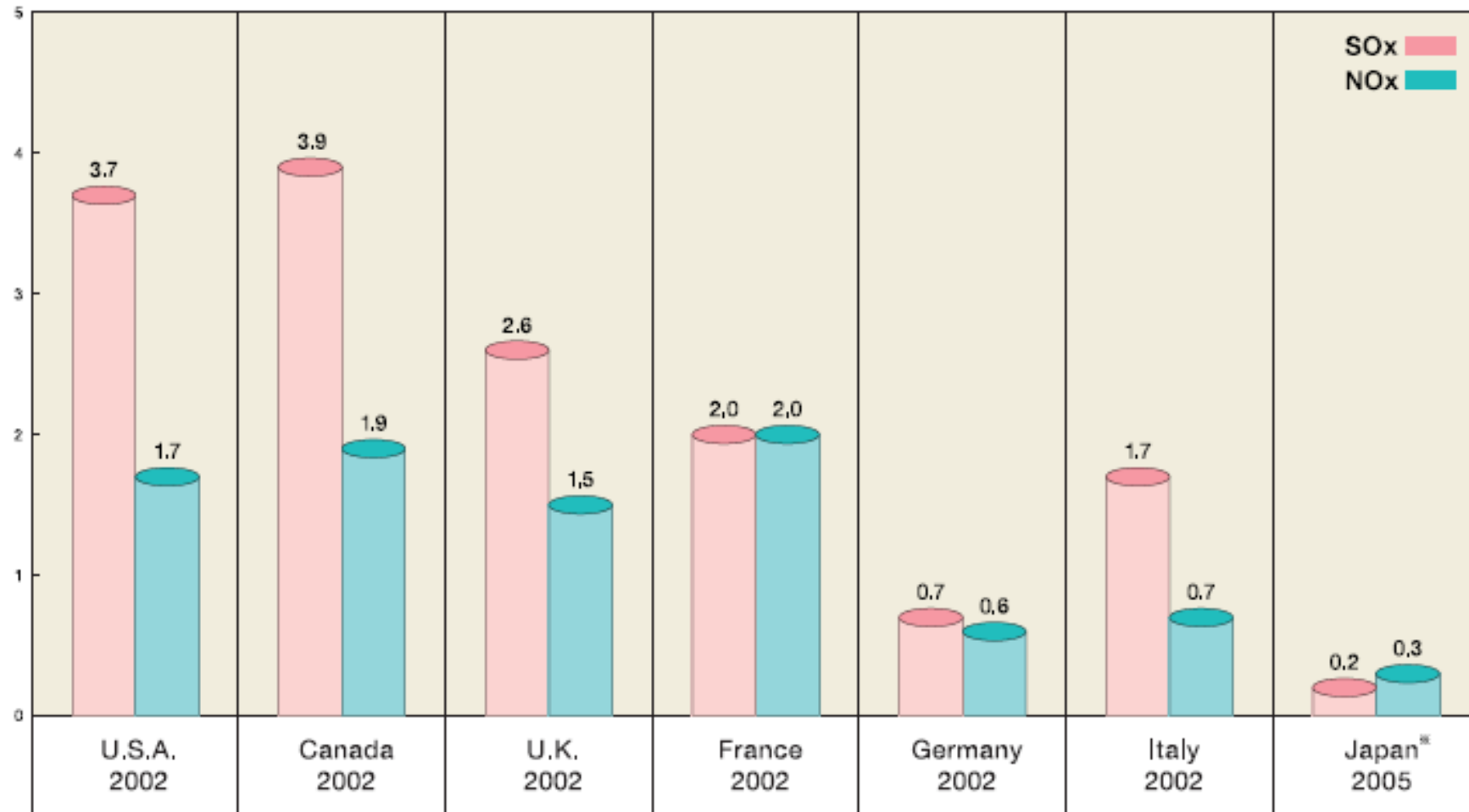
	Former No1 and No2 units	New No1 unit	New No2 unit (From Jan. 2009)
Output	500MW (265MW x 2)	600MW	600MW
Gas discharge volume (wet)	1,972,000 Nm ³ /h	2,000,000 Nm ³ /h	2,000,000 Nm ³ /h
NOx Conc.	159 ppm	20 ppm	13 ppm
SPM Conc.	50 mg/Nm ³	10 mg/Nm ³	5 mg/Nm ³
SOx Conc.	60 ppm	20 ppm	10 ppm



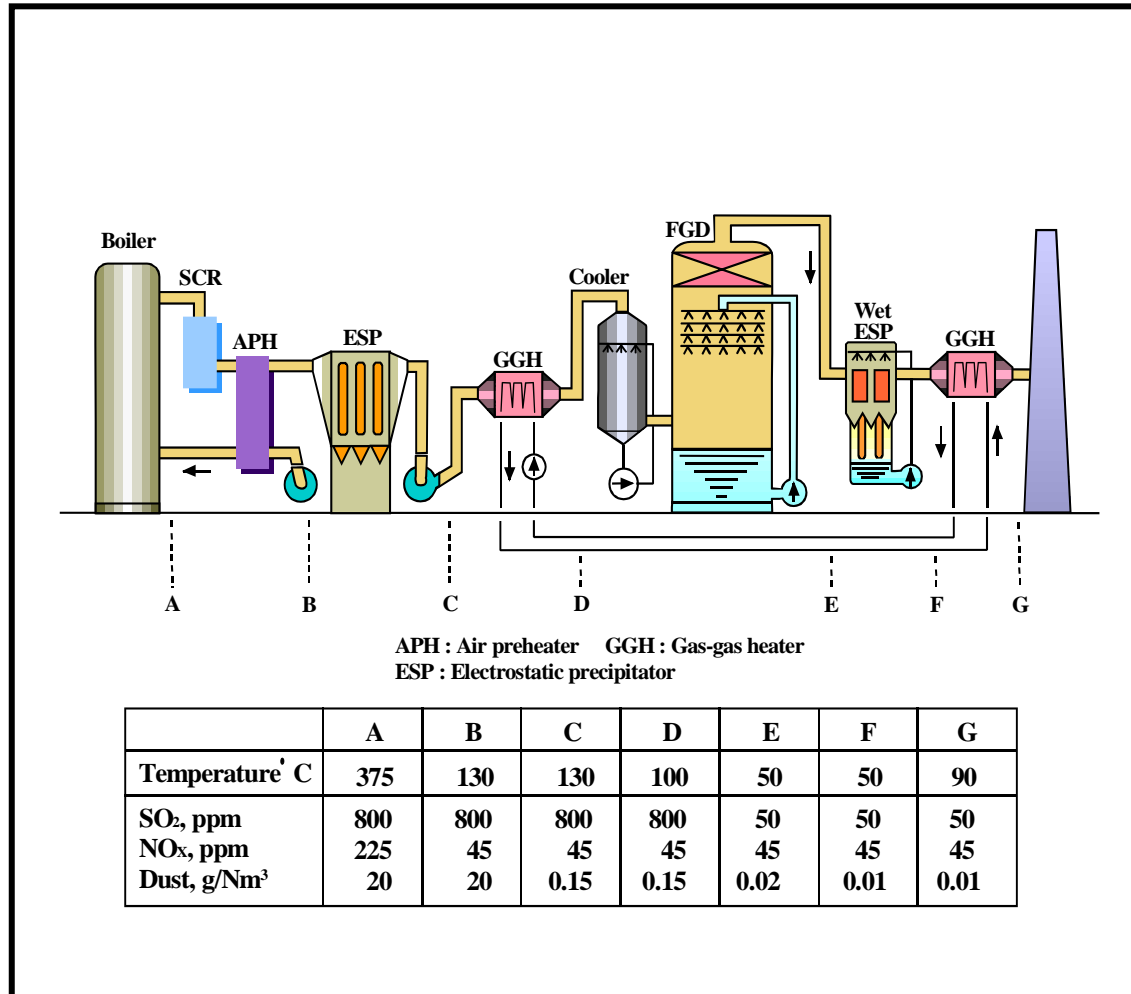
Start : 2002

3.2 SOx and NOx emissions per unit electricity generated by thermal power industry (1/2)

g/kWh



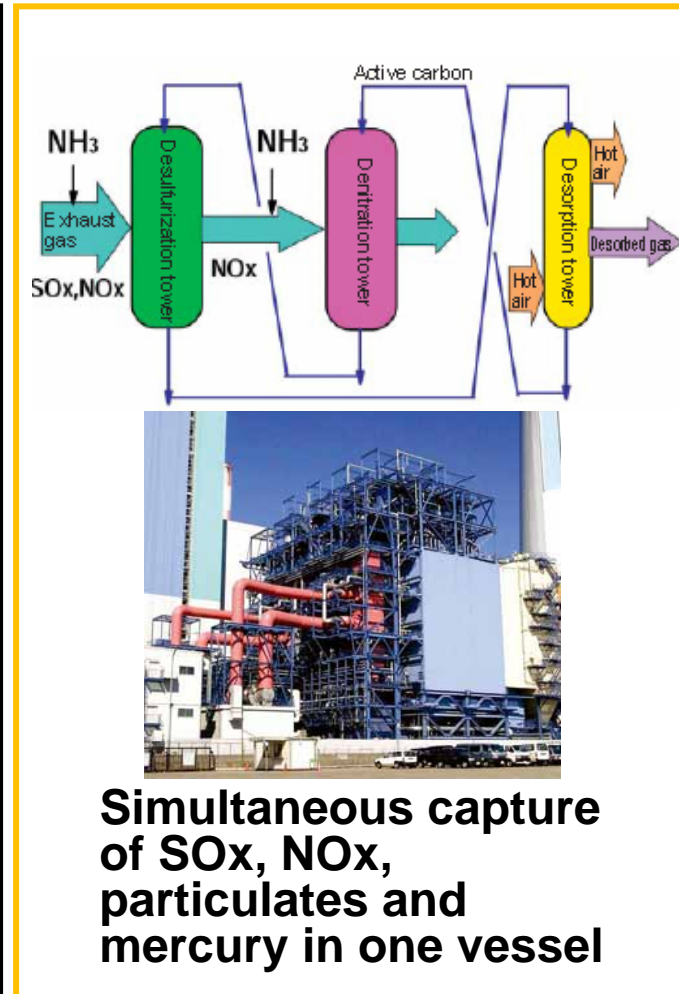
3.2 Emission control systems added to power plants (2/2)



Conventional method (Example)



Simultaneous capture and Dry system



3.3 Coal Gasification Technologies in Japan

Items	EAGLE (IGFC)	IGCC	ECOPRO (Partial Hydro-pyrolysis)
Process Flow			
Characteristic	<p>【Type】 Entrained bed, Oxy-brown (One pressurized chamber, Two stages)</p> <p>【Use】 Power generation (IGFC)</p> <p>【Merit】</p> <ul style="list-style-type: none"> • High power efficiency • Many kinds of coal correspondence 	<p>【Type】 Entrained bed, Air-brown (Two pressurized chamber, Two stages)</p> <p>【Use】 Power generation (IGCC)</p> <p>【Merit】</p> <ul style="list-style-type: none"> • No ASU • High power efficiency 	<p>【Type】 Entrained bed, Oxy-brown (Two pressurized chamber, Two stages)</p> <p>【Use】 Polygeneration (Syngas,Light oil,Char)</p> <p>【Merit】</p> <ul style="list-style-type: none"> • High energy efficiency (85%<) • High added value by the light oil
Development Status	<p>Pilot plant(150t/d);Operated 2005Fy ; Achievement of 852hr continuous operation Period ; ~ 2009Fy</p> <p>【Next step】 Demonstration</p>	<p>Demo-plant(1700t/d);Operated 2008Fy ; Achievement of 2030hr continuous operation Period ; ~ 2009Fy</p> <p>【Next step】 Commercial</p>	<p>Pilot plant(20t/d);Operated 2008FY ; Achievement of 1000hr continuous operation Period ; ~ 2008Fy</p> <p>【Next step】 Demonstration</p>

3.4 Super Coke Oven (SCOPE21)

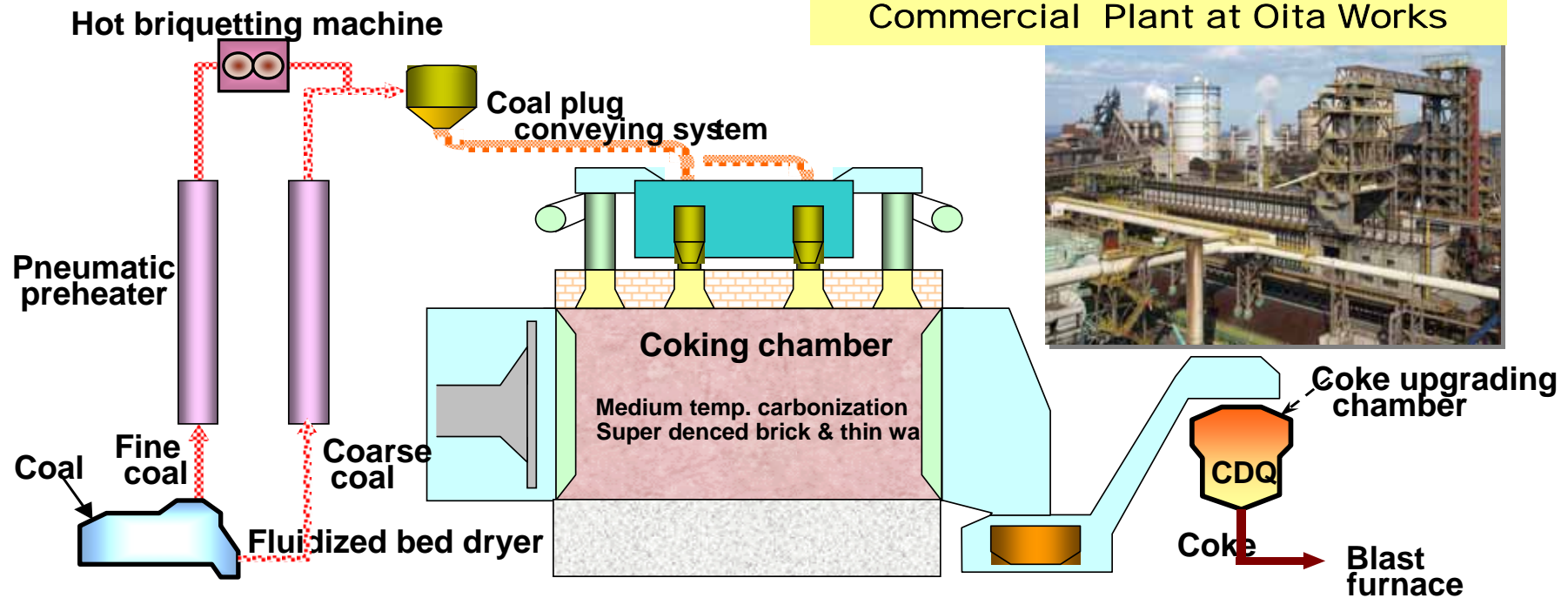
Pilot Plant at Nagoya Works



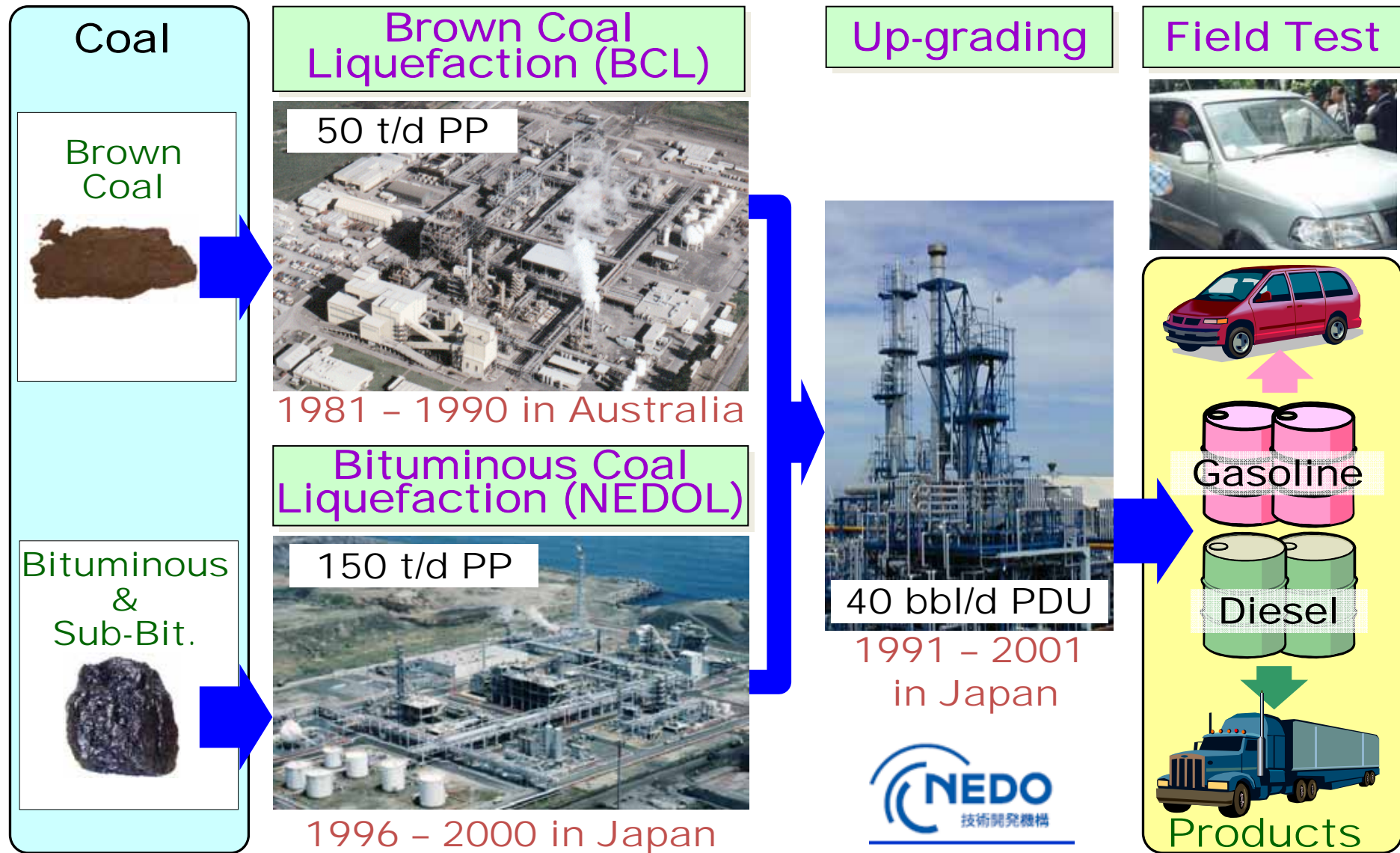
< Concept & Target >

- Effective utilization of coal resources
 - Increasing the ratio of poor coking coal (20% → 50%)
- Environmental and energy conservation
 - Energy saving rate 20%
 - Reduction of NOx 30%
- High productivity
 - 3 times in productivity than conventional process

Commercial Plant at Oita Works



3.5 Direct Coal Liquefaction



3.6 Japanese Committee for Pacific Coal Flow (JAPAC)

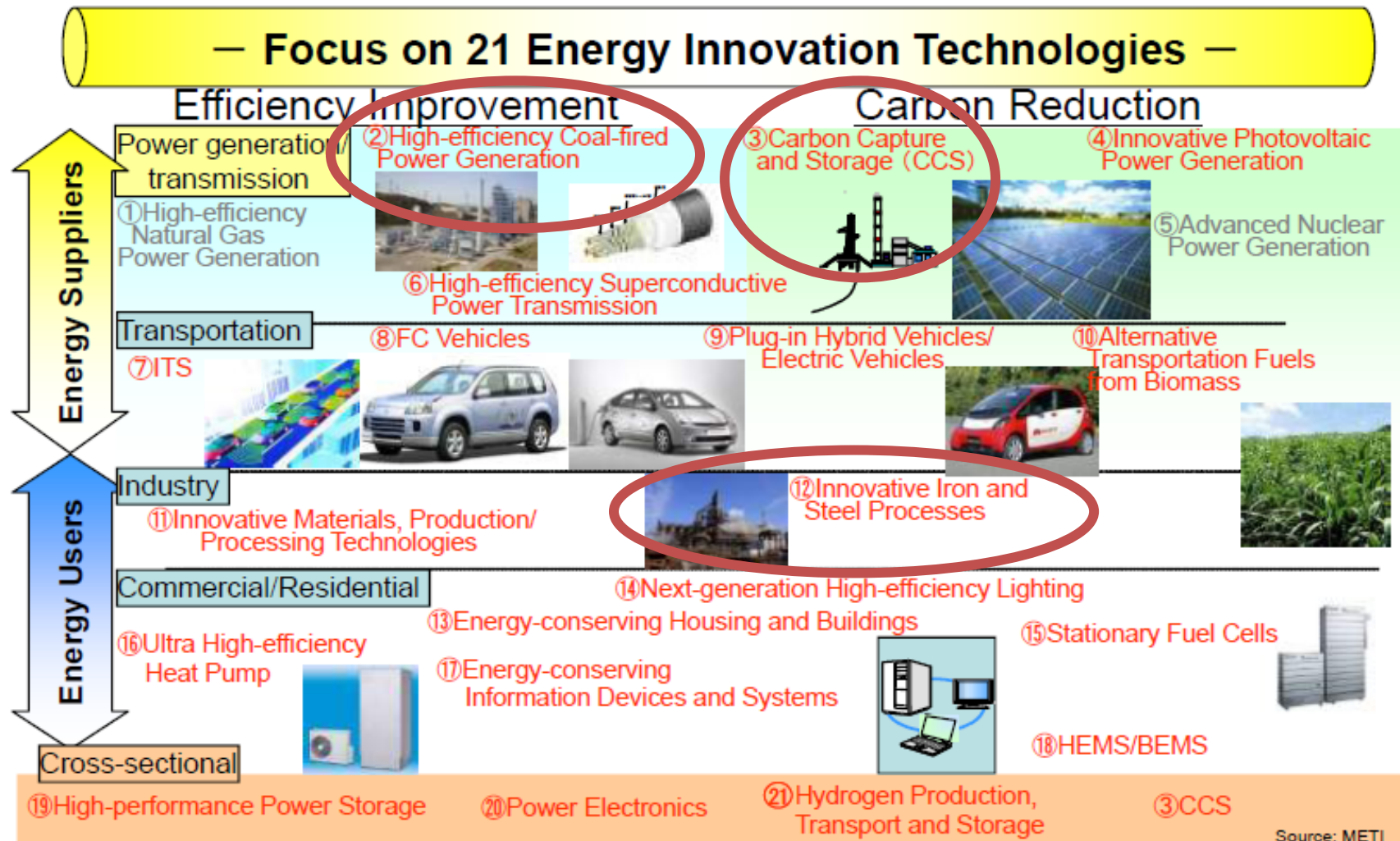
A forerunner of coal producer-consumer dialogue

- JAPAC established in 1987 and have been played active roles for stable supply of coal and promotion of cooperation in the Asia-Pacific region.
- JAPAC initiated Coal Producers-Consumers dialogue at dawn.
- Main activities:
 - Exchange of information and views through international symposiums in cooperation with APEC (established in 1989).
 - Investigation of coal-related projects and project-finding surveys
 - Seminars by overseas experts and PR/dissemination activities by publication issuance, etc.
- JAPAC reorganized in April 2008 with JCOAL, in compliance with proposals in “Cool Earth 50” addressing needs of the Government and the coal industry,
- New JAPAC has extended its activities to making proposals / suggestions to coal policy makers and the coal industry .

4. CCT Policy and Measures in Japan

4.1 Innovative energy technology program

- to reduce global green house gas emissions by half compared to the current level by 2050 (Cool Earth 50)



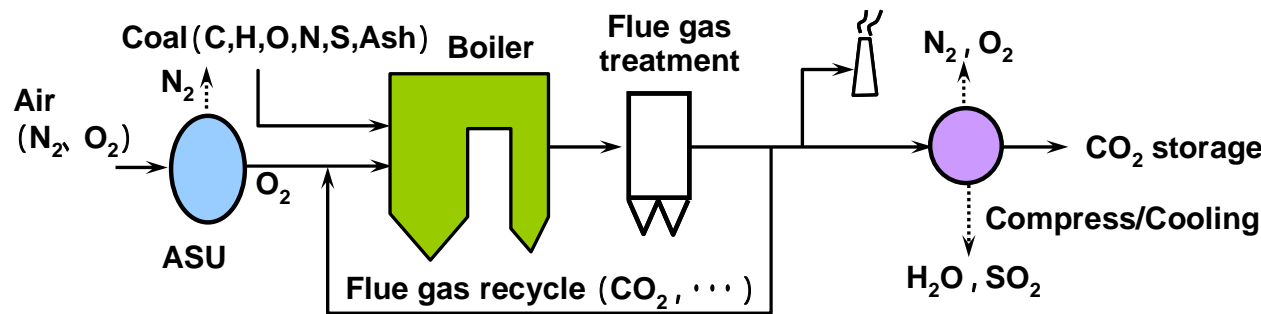
4.2 International cooperation project in Australia

Callide power plants and CCS



World's first "Series system of Coal utilization, Power generation, CO₂ capture and CO₂ storage in the application to existing power plant system"

Oxy-fuel combustion system



Power Plant
Callide-A #4 unit (30 MWe)

CO₂ storage site
 • Store 50-100 x10³ tonCO₂
 • Depleted gas reservoir or Aquifer
 • Approx. 300km west of power station

Schedule

- LETDF Announcement: 30 Oct 2006
- APP Flagship Project: 15 Oct 2007
- Signing JV Agreement: 20 March 2008
- Launch Ceremony: 14 Nov 2008
- Oxy-firing: 2011 - 2014
- CO₂ storage & monitoring: 2011 - 2016



Callide
Oxyfuel Project

Oxyfuel Project Partners

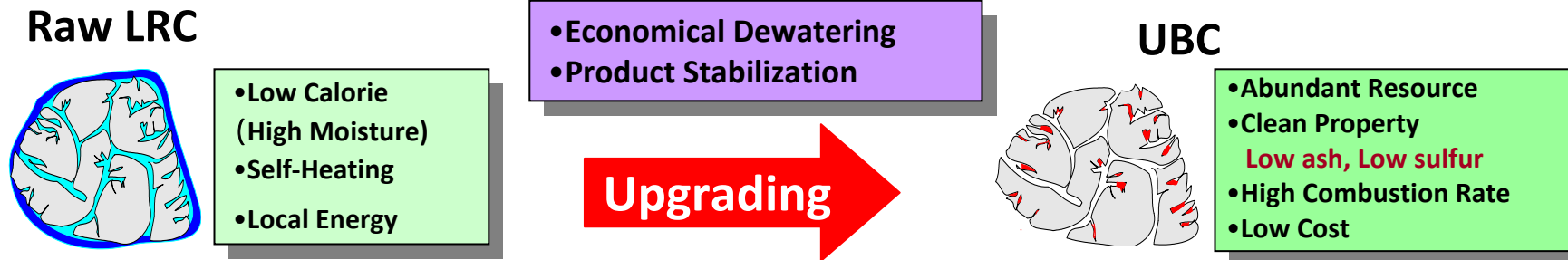


4.3 International cooperation project in Indonesia

UBC (Upgrading of Low Rank Coal)



- World Demand for Coal is surging in many countries as well as in China and India. It is anticipated that low rank coal, which is well-distributed all over the world, will be utilized on a large scale.
- UBC process changes low rank coal into **high quality coal** with **clean property** and that will be utilized in the international market energy source.
- UBC process can be applied for **Indonesian low rank coal** to improve the characteristics of coal.



UBC Demonstration Project in Indonesia

	2006	2007	2008	2009	2010~
Design & Construction					
Commissioning & Operation					
Product evaluation & F/S					
Commercial Plant (1~1.5Mt/y)					➔

- 600t/d plant was constructed at the end of July 2008, and opening ceremony was conducted on December 4th 2008.
- Demonstration of technology and feasibility for the commercialization of UBC process would be confirmed in 2009.



600t/d Demonstration plant

4.4 International cooperation project Clean Coal for the Earth (CCfE)

Objectives

Previously implemented as "Clean Coal for Asia (CCfA), this Clean Coal for the Earth (CCfE) aims at stabilizing demand for coal and mitigating environmental degradation in the world, by dissemination of CCT with focus on efficiency and environmental improvement of coal-fired power plants.

Project outline

Promotion of CCT dissemination

Sharing achievements and collecting information by holding international seminars and other ways, in order to promote and establish CCT in Asia.

Facility diagnosis and other cooperation activities

Dispatching Japanese specialists to coal thermal power plants in China and other nations to offer facility diagnosis and advices for reducing SO_x and NO_x emissions and disseminating CCT.

Training

Dispatching specialists to companies in the nations, inviting trainees for promotion of technology dissemination.
Scope of the project to be enhanced to include advanced technology, coal thermal power plant operations, and maintenance technology.

4.4 International cooperation project in China (1/2)

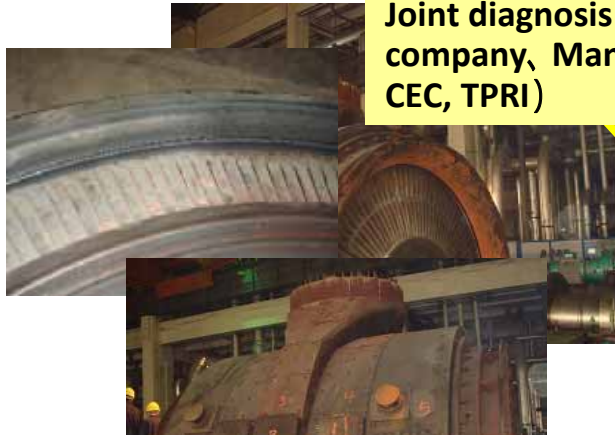
Renovation of coal-fired power plants in China – 10 units in 2008-2009

- The cooperation was initiated by the top leaders of both governments, and commenced by **an MOU among Japan Coal Energy Center(JCOAL), Central Electricity Council(CEC) , Japan Bank for International Cooperation(JBIC)** in 2007. A full package of technical cooperation and CDM financial support is investigated.
- Joint diagnosis and performance were conducted by Japanese and Chinese experts consisting of members from power companies and manufacturers for an optimal improvement proposal.
- JBIC financially supports the project including CDM process as well as long term loan.
- Improvement and renovation is on a business-to-business basis in cooperation with power companies/ manufacturers on both sides.

4.4 International cooperation project in China (2/2)



Joint diagnosis for optimal improvement proposal and subsequent renovation by financial support including CDM



Joint diagnosis G (Japanese power company, Manufacturer, JCOAL, CEC, TPRI)

Power station manager and staff



- Step 1 Collection of design and operational data on the power plant and of its maintenance and trouble records for assessment.
- Step 2 Collection of a diagnosis report and performance test reports by Chinese diagnosis companies/organizations and assessment.
- Step 3 Joint diagnostic activities with the Chinese diagnostic organization, i.e. on-site observation of the plant operation and of the regular maintenance, discussion with engineers based on the drawings and the operation data.
- Step 4 Drafting of a renovation proposal.



4.5 Update of Japan's CCT Policy and Measures : Major Points of the Interim Report by the Clean Coal Working Group (1/2)

Background

Increase in the Coal Use for Economic Growth in the World

- Global coal consumption shall increase by approximately 60% on 2006-2030.
- Coal consumption: double in China; 2.5 times in India; 15% increase in US
- Coal-fired power generation shall continue to increase as a major power generation source.

Japan has the most Environmentally-Conscious Coal Utilization Technology

- Essential to continue clean utilization of coal, which is economically competitive and stable in supply.
- Many low-efficiency coal-fired power plants exist in the world.
- Measures being taken by Japan for further high-efficiency utilization of coal is among the best in the world.

4.5 Update of Japan's CCT Policy and Measures : Major Points of the Interim Report by the Clean Coal Working Group (2/2)

Implementation of the “*Clean Coal for the Earth*” Initiative

- Position Japan as a demonstration site for environmentally friendly coal-fired power generation as it possesses coal-fired power plant with the world's highest level of power generation efficiency, and will contribute to alleviate global warming issues through disseminating this technology not only to Asia but to the entire world.
- Simultaneous achievement of the 3 Es related to global coal utilization can be realized through transfer of its coal utilization technology to other countries.

Information Dissemination / Human Resources Development Regarding Coal Utilization

- Enhance information dissemination on economic competitiveness and advanced utilization technology of coal, etc.

Implementation of the “*CoolGen*” Initiative

- Engage in practical applications of high-efficiency coal-fired power plants upon replacement in the future, and realize low carbon emissions of coal-fired power plants.
- Furthermore, promote a demonstration project (“CoolGen” Initiative) for realization of “Zero-Emission Coal-fired Power Plant” by integrating IGCC and IGFC, which aim to achieve ultimate power generation efficiency, with CCS.
- Continued effort for efficiency improvement is necessary to achieve the goal of reducing CO₂ emissions in half by 2050.

Enhancing Multi-layered Relations with Coal Producing Countries

- Enhance government-level policy dialogues with major coal producing countries.
- Construct multi-layered cooperative relations with major coal producing countries.

5. Future prospect of the worldwide development on the Japan-U.S. axis

5.1 Japan – U.S. energy and coal cooperation

1. Energy cooperation:

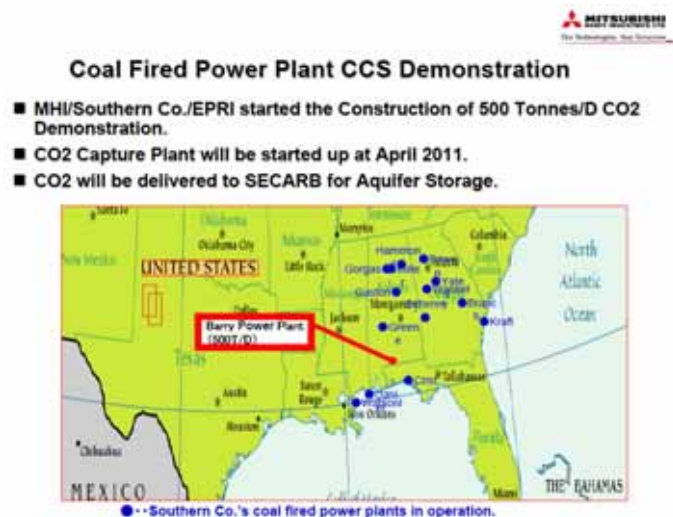
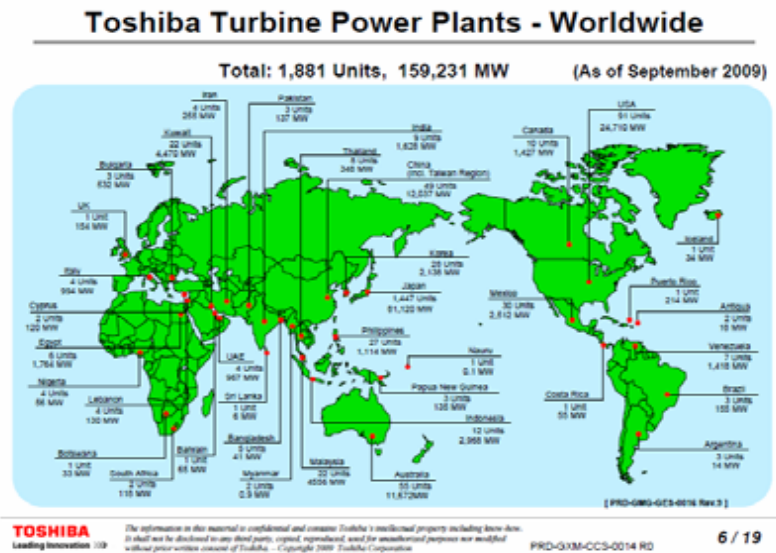
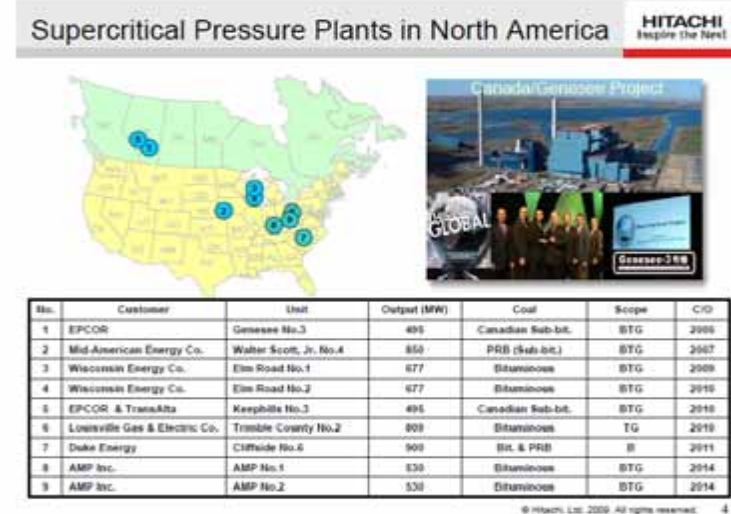
Speeding up of Japan-U.S. overall cooperation in energy sector covering from coal to nuclear and renewable has been and will be crucial in the context of achieving 3Es.

2. Coal cooperation:

The governments of Japan and U.S. have worked together through ambitious projects such as Coal to Liquid (SRC I, II) and IGCC (The Cool Water Coal Gasification Program). During the same period, Japan has been benefited by importing metallurgical coal from U.S.

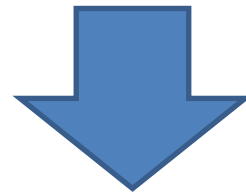
5.2 Japan – U.S. energy and coal cooperation (Cont.)

- b. Japanese private sectors like Hitachi, Mitsubishi and Toshiba have been engaged in technology development and dissemination in cooperation with their counterparts in U.S.
- c. Looking into the future, we as the top runners of CCT, are supposed to proceed to fully utilizing IGCC-CCS and USC, especially for the replacement and upgrade of those existing facilities.



5.3 What options we would be able to implement on G-to-G base

- a. Implementation of R&D on most advanced and potential technologies
- b. Making of comprehensive international rules that are to be shared worldwide, which should go along with improvement of investment environment by the private sector, in seeking for realization of ***a free and competitive global market.***



Toward such a global market, both governments of Japan and U.S. should work together in close cooperation with each other while involving each private sector, without participation and contribution of which the tasks may not be well completed.

Thank you !

**CCT-A Key
toward Substantial Prevention of Global Warming
Executive Summary**

Toru Namiki, JCOAL

I. The Thrust

1. Significance of coal as an option of energy source

It is taken as a matter of course that coal is important for Japan and U.S. respectively as an option of energy source in achieving 3E; i.e. Economy, Energy Security and Environment, which is also crucial in addressing global issues in China, India, Russia, etc., for which both Japan and U.S. can work together in close cooperation. In the course of attaining 3E facilitation and dissemination of **Clean Coal Technologies therefore will play a key role.**

2. Global situation on coal; increasing emission according to sharp rise of demand and how to mitigate it through shared efforts

As of 2006, the total CO₂ emission from coal is approx. 12Gt out of 28Gt from all primary energy sources is forecasted to reach 34.5Gt in 2020 without any efforts, mainly due to outstanding growth of economy in emerging economies such as BRICs and the trend of their energy security policies.

While we acknowledge that many countries have begun to demonstrate an interest in expanding their use of non-carbon-emitting renewable energies and nuclear power in recent years, in part to stem the growth of greenhouse gas emissions, even in case that these energies are introduced, disseminated and utilized worldwide and to a full extent. I would like to mention that U.S. is not an exception, which means we respectively should make

strenuous efforts in making our coal-fired power generation facilities as clean as possible, which is a matter of globally-shared interest.

3. Japan's potential for contribution to address the global issues

- (1) Japan is the world 5th coal consumer, the world largest coal importer with the top-level clean coal technologies.**
- (2) Japan has achieved highest efficiency of coal-fired power generation both at the state-of-the-art facilities and aged ones and of coal using facilities such as industrial furnaces and combustors, respectively equipped with emission control measures against NO_x, SO_x, etc.
- (3) Japan is a forerunner in initiating coal producer-consumer dialogue** by establishing and developing of **JAPAC (the Japan Committee for Pacific Coal Flow)**, through which we have been facilitating technology transfer with an emphasis on environment and mining safety as well as investment, through exchange of information and views through international symposiums in cooperation with the Asia-Pacific Economic Cooperation (APEC) forum that was established in 1989.

II. Japan's Coal Policy and the Future Prospect of the Worldwide Development on the Japan-U.S. Axis

4. Japan's Coal Policy and Measures indicated by the Clean Coal Working Group in 2009

- (1) Given its top-level efficiency and environmentally-friendliness of coal-fired power generation, Japan can be regarded as a demonstration site of CCTs and as an ideal base for R&D, from which a variety of economically competitive and well established CCTs can be globally disseminated in most applicable manner.

(2) Japan, closely working with its counterparts, has been one of the earnest initiator of international cooperation on CCT.

We see good examples in Callide Oxifuel Project in Queensland, Australia, where we have been demonstrating the World's first system of coal utilization, power generation, CCS-CO₂ capture and CO₂ Storage- applied to an existing power generation facilities.

Another good example we are proud of is our UBC (Upgraded Low Rank Coal) project in Indonesia that is now being implemented on a large scale for demonstration in South Kalimantan, the successful completion of which is anticipated by the industrial circle both in Japan and Indonesia.

(3) Japan is going to launch **Clean Coal for the Earth (CCfE)**.

Previously implemented as "Clean Coal for Asia (CCfA), this CCfE aims at stabilizing demand for coal and mitigating environmental degradation in the world, by dissemination of CCT with focus on efficiency and environmental improvement of coal-fired power plants. Under the former CCfA and based on the top-level agreement between the two governments, we have been implementing 10 studies so far, accompanied by diagnosis activities in China, the results of which are to be realized into projects of upgraded efficiency and environment in compliance with the relevant policy of the government of China. I would like to emphasize that Japan has provided a funding scheme through Japan Bank for International Cooperation (JBIC) as well as CDM supporting scheme, which are extraordinarily appreciated by relevant Chinese authorities.

5. Future Prospect of **the Worldwide Development on the Japan-U.S. Axis**

(1) Japan-U.S. Energy Cooperation

I would like to enforce that speeding up of Japan-U.S. overall cooperation in energy sector covering from coal to nuclear and renewable has been and will be crucial in the context of achieving 3E.

(2) Japan-U.S. Coal Cooperation

- a. The governments of **Japan and U.S. have progressively worked together through rather ambitious and challenging projects** such as Cool Water Project, SRC (Solvent Refined Coal) I & SRC II, etc. During the same period, Japan has been benefited by importing metallurgical coal from U.S.
- b. The above efforts by both governments was followed by Japanese private sector players like Hitachi, Mitsubishi, Toshiba, J-Power, Tokyo Electric Co., etc. that have been engaged in development and dissemination of CCT, in cooperation with their counterparts in U.S.
- c. Looking into the future, we as the top runners of CCT, are supposed to proceed to fully utilizing IGCC-CCS and USC, especially for the replacement and upgrade of those existing facilities.

(3) What options we would be able to implement on G to G base

- a. **Research and Development and/or demonstration of most advanced and potential technologies**
- b. **Making of comprehensive international rules** that are to be shared worldwide, which should go along with improvement of investment environment by the private sector, in seeking for realization of **a free and competitive global market.**

Facing these globally challenging tasks that should be done toward such a global market, both governments of Japan and U.S. should work together in close cooperation with each other while involving each private sector without participation and contribution of which the tasks may not be well completed.

Indeed, this applies not only to coal but also to all other energies, accordingly, on this important occasion of having most important leaders of both governments and industries, academics and other stakeholders from Japan and U.S., I would like to invite all of you to work together to toward this shared goal.