Ministry of Economy, Trade and Industry
Agency for Natural Resources and Energy

Japan's Energy Situation and Policy

2nd June 2014

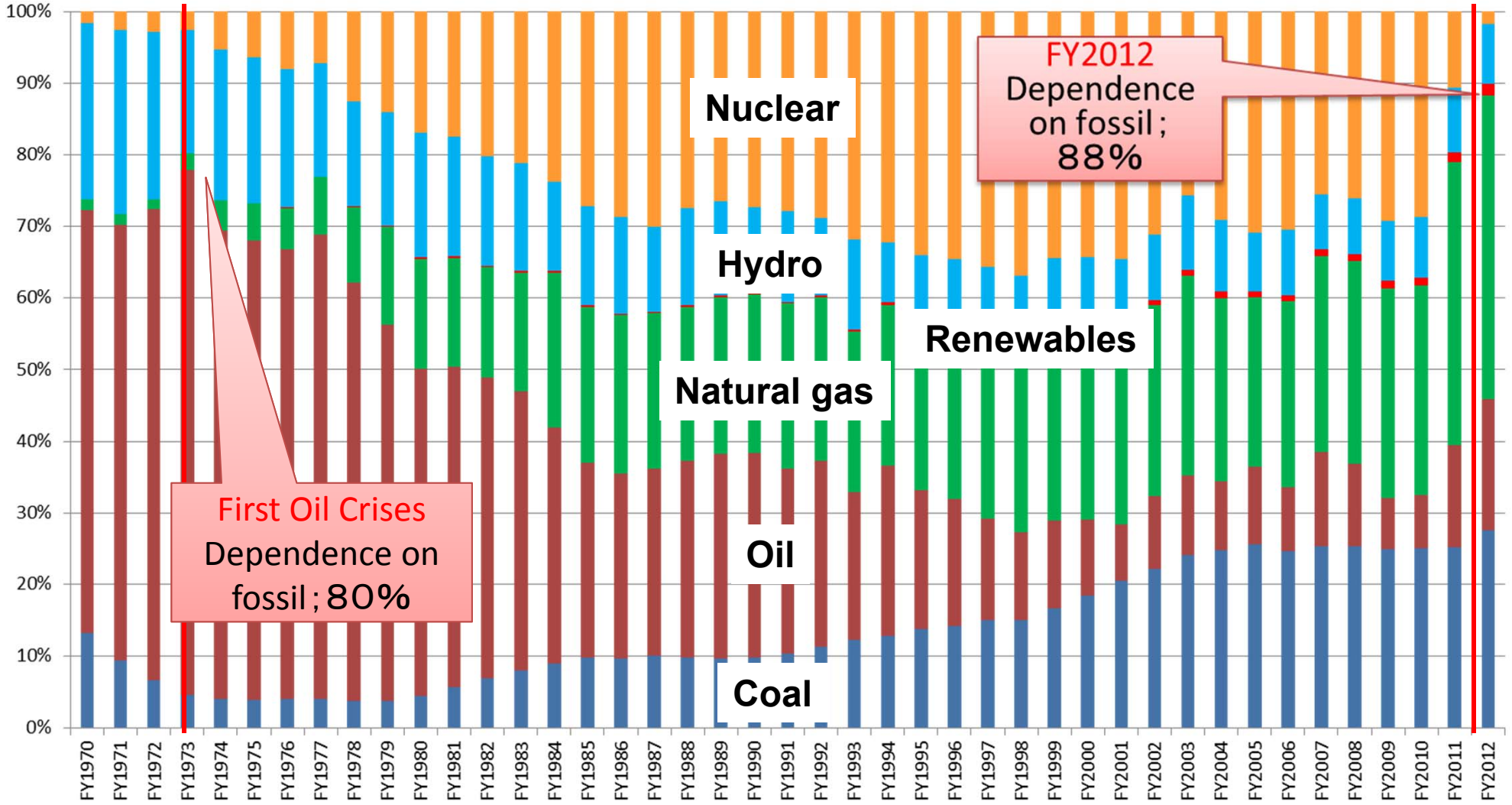
Hironori Nakanishi

Director-General for Energy and Technological Policy
Agency for Natural Resources and Energy, METI

Japan's Electricity Supply Structure

○ Japan has been so successful in deploying alternative energy, but suddenly …..

Shear of electricity supply

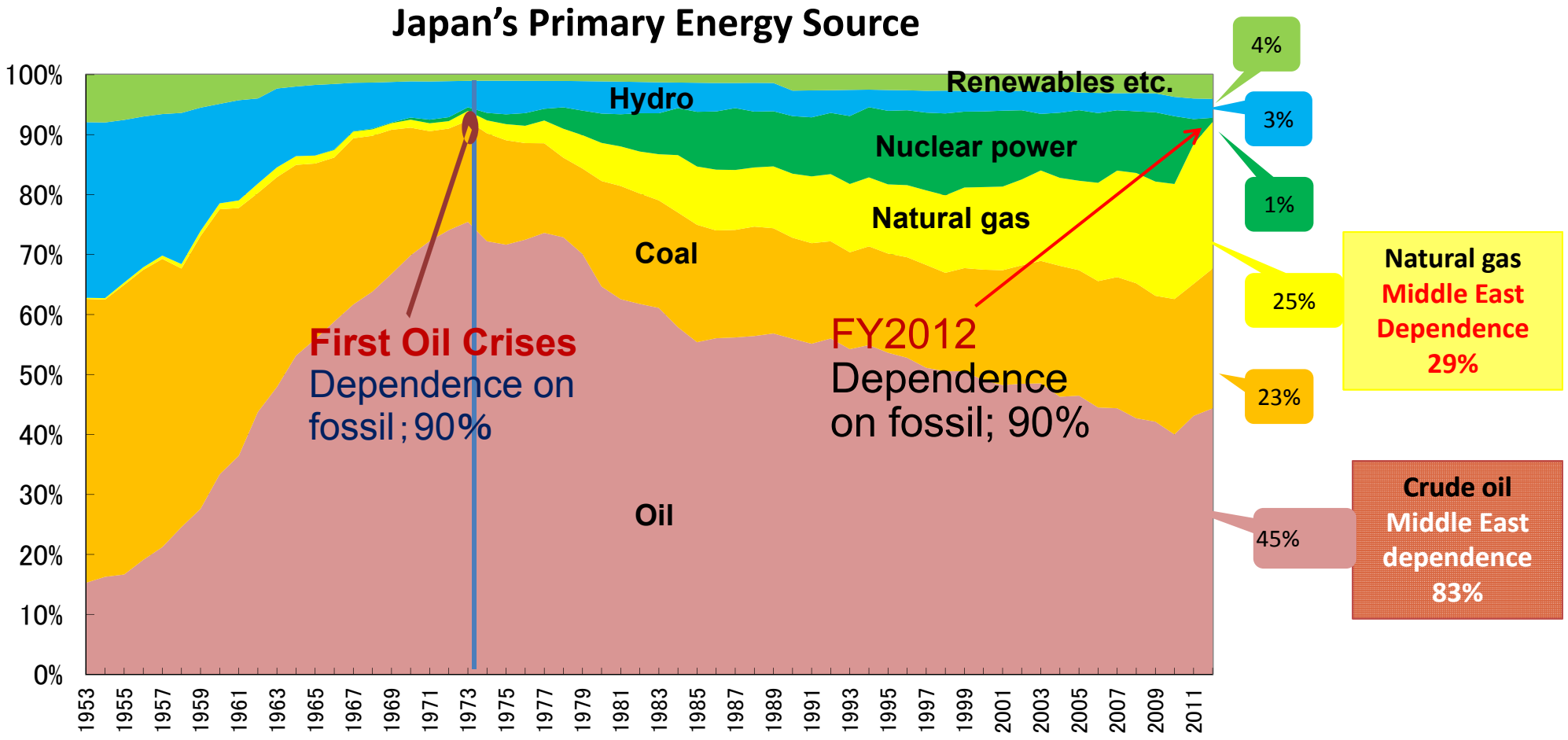


Source: Compiled by ANRE based on "Outline of Electric Power Development in FY2012" etc.

High dependence on fossil fuel and energy security

○ Japan's current dependence on fossil fuel is almost as high as that of oil crisis.

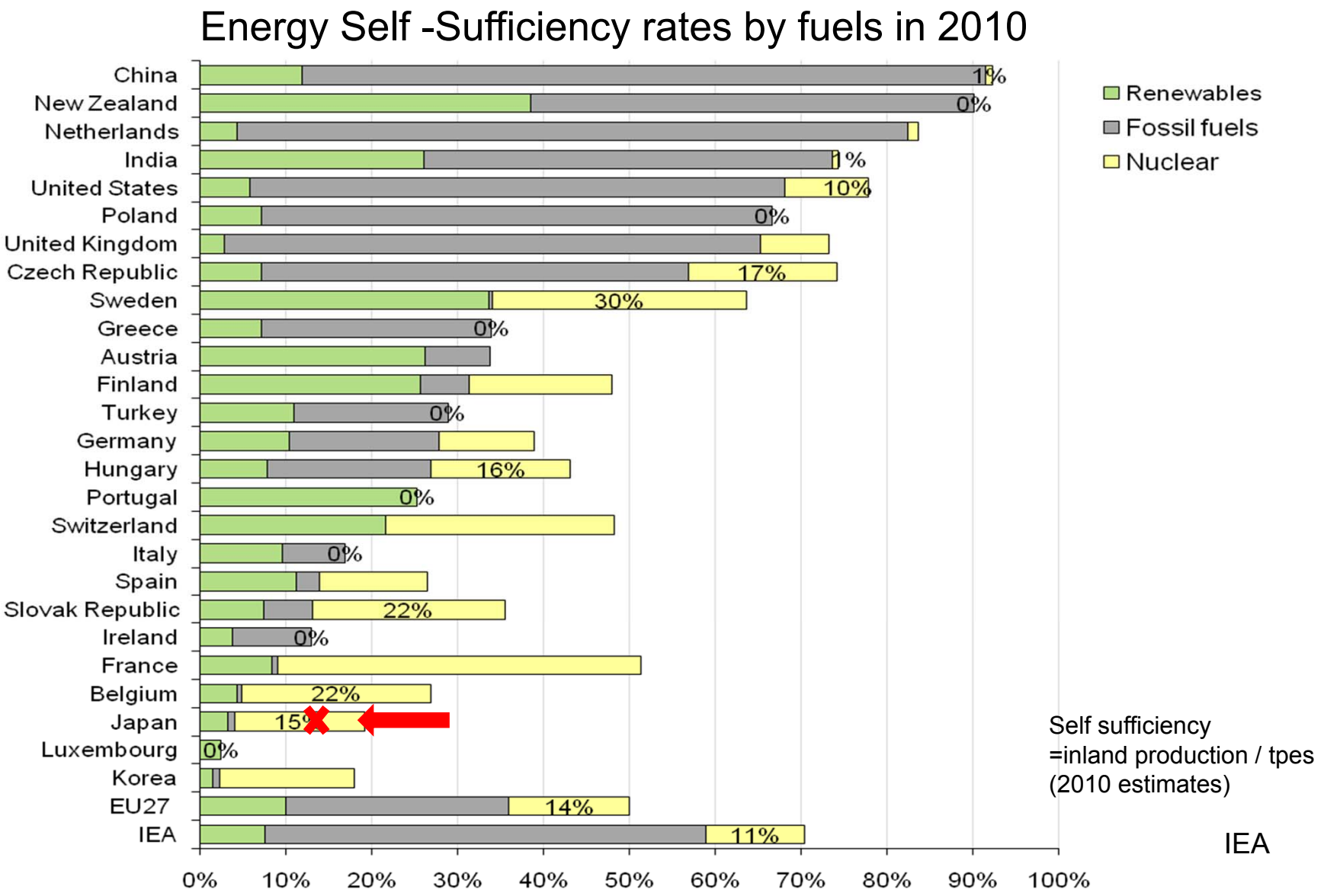
○ More than 80% of oil is still imported from the Middle East. If concerns grow, prices may surge or supply of energy and electric power may be jeopardized.



Source: "Comprehensive Energy Statistics (2012)" ANRE/METI

Energy self-sufficiency - Diversity means energy security

○ Japan's energy self-sufficient ratio dramatically goes down due to suspension of nuclear.



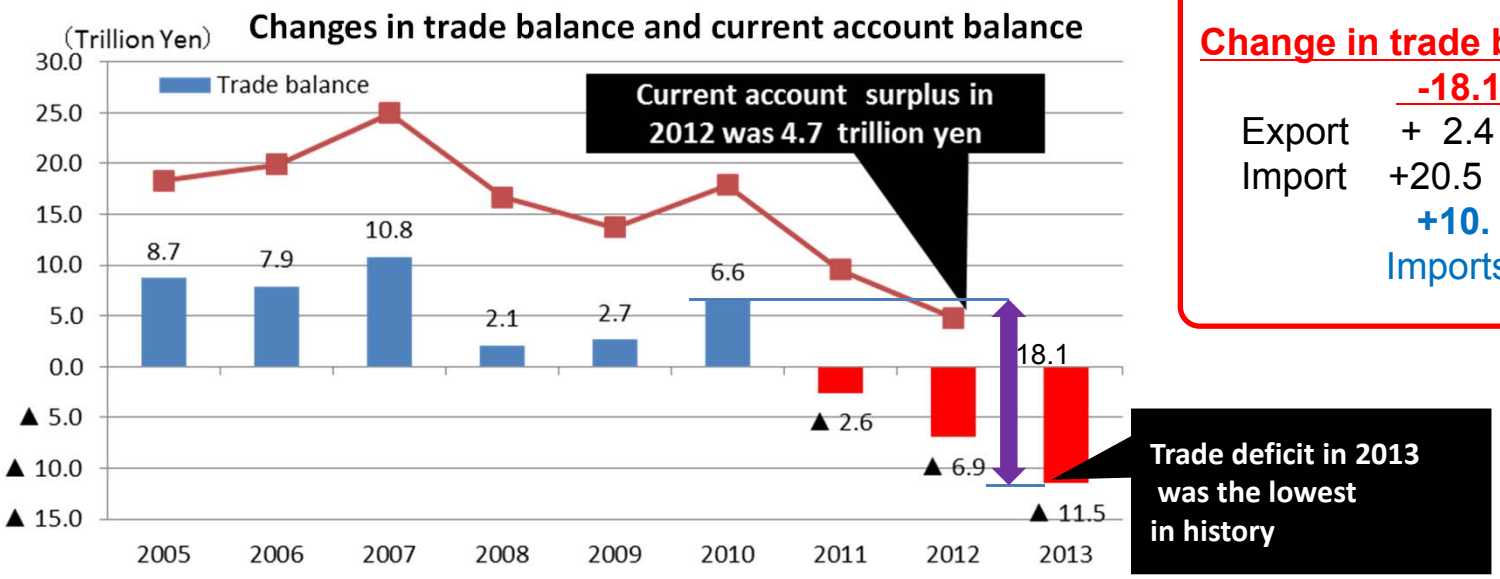
Negative impact by nuclear shutdown in Japan

○ Additional fossil fuel costs for increased thermal generation

- $36 billion in FY2013 (estimation) respectively from the fuel costs in FY2010

○ Growing trade deficit

- $26 billion in 2011 (the first trade deficit in the last 31 years)
- $115 billion in 2013 (the lowest in history)



Change in trade balance（2010→2013）:
-18.1 trillion yen

Export + 2.4 trillion yen (+ 3.5%)
Import +20.5 trillion yen (+33.7%)

+10. 0 trillion yen
Imports of fossil fuels（18.1→28.1）

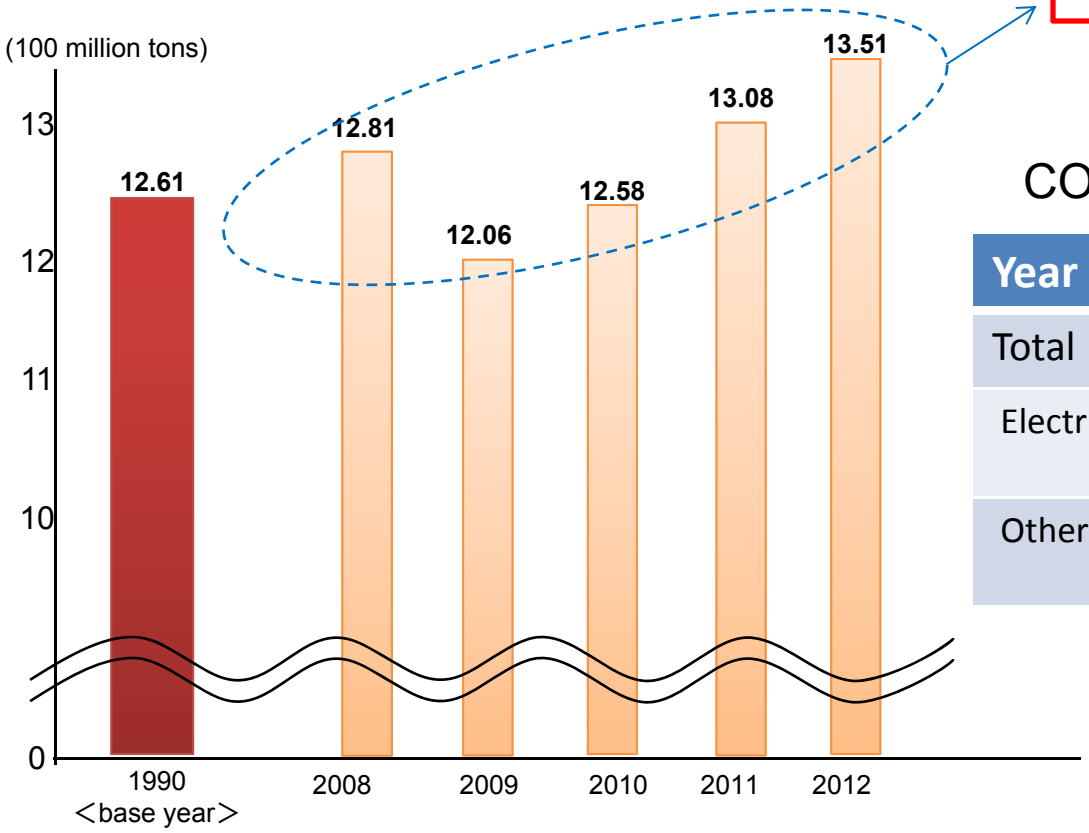
○ Increase of electricity tariffs

- About 6～10% increase for regulated sector from the tariff level in FY2011
- About 12～15% increase for liberalized sector from the tariff level in FY2011

Increase in greenhouse gasses due to the stoppage of NPPs

- Japan achieved 6% CO2 reduction target set forth by Kyoto Protocol.
- 112 million tons increase from power generation in FY2012 from the GHG emissions in FY2010

Transition of greenhouse gas emissions



6% reduction target (5.93 billion tons) over the base year 1990 was achieved.

CO2 emissions originated by energy use

Year	2008	2009	2010	2011	2012
Total	1,138	1,075	1,123	1,175	1,207
Electricity	395	353	374	439 (+65)	486 (+112)
Others	743	722	749	734 (-15)	720 (-29)

(Unit; Million t-CO2)

Three efforts toward confidence building about nuclear power in Japan

○ Administrative Reform of Nuclear Regulatory Organizations

- Separated nuclear regulatory function from nuclear promotion organization and established the Nuclear Regulation Authority (NRA) as an independent commission.

○ Introduction of world's highest level of safety standards

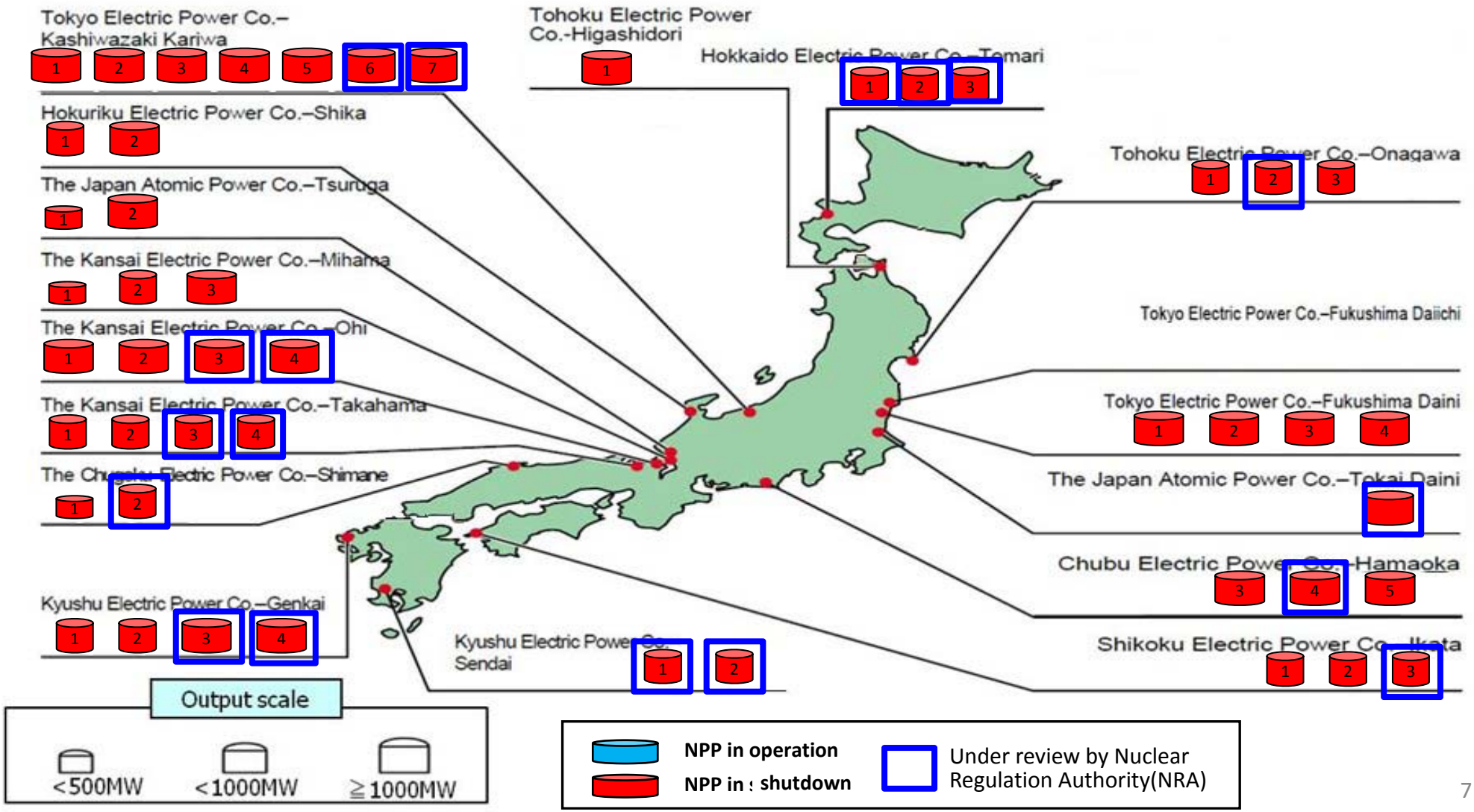
- The Nuclear Reactor Regulation Act was revised to introduce new safety standards based on lessons learnt from Fukushima accident, latest technical knowledge, overseas regulation trends, etc.
- The new regulatory standards were enforced in July 2013.

○ Industry-based initiatives in voluntary efforts toward safety enhancement

- Industry aims for new heights in pursuing the world's highest level of safety through continuous and voluntary safety improvement including introduction of Probabilistic Risk Assessment(PRA) .

Nuclear Power Plants in Japan

- There are 48 nuclear power plant units in Japan.
- **All units (in red) are in a state of temporary shutdown** as of March 31 2014.
- **18 units (in blue squares)** are under review for restart by the Nuclear Regulation Authority in accordance with its new safety regulations.



Strategic Energy Plan of Japan

- Strategic Energy Plan of Japan was approved by the Japanese cabinet. on April 11, 2014.
- The aims of the plan are
  –to realize a robust, practical and multi–layered supply structure
  –to create a flexible and efficient demand and supply structure by system reforms
  –to improve a self–sufficiency ratio by developing and introducing of domestic resources etc.
- Coal is Revaluating as an important base–load power source in terms of stability and cost effectiveness, which will be utilized while reducing environmental load (utilization of efficient thermal power generation technology, etc.) and we will promote dissemination of our highly efficient coal fired power generations (we would give assistance at the introduction).

Related Coal Policy Issue

Comprehensive policies for securing energy supply

Environmental arrangement for the efficient/stable use of fuel fossils

Promoting the effective use of high efficiency coal/gas thermal power generation

- Shortening a period for environmental assessment.
- Developing next-generation high efficiency coal thermal power generation technologies (e.g., IGCC) and carbon capture and storage (CCS) technology.
- Promoting exports of Japan's advanced coal/gas thermal power generation.

Promotion of strategic R&D

- Formulating a roadmap for technological development by next summer.
- Accelerating innovative technological development such as
  - -lower-cost storage batteries and fuel cells
  - -higher efficiency coal/gas thermal power generation
  - -technologies to reduce nuclear fuel waste and so

Coal policy in Japan

Coal will continue to be important part of energy source diversification in Japan.

Coal Policy

◆ Ensuring stable supply of coal resource

○Stabilization of energy demand / supply balance. Ensuring a stable supply of coal resources for strengthening and maintaining industrial competitions.

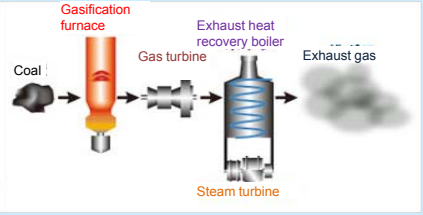
＜Acquisition of interests＞
＜Enhancement of relationships with coal producing countries＞
＜Moderation of coal demand/supply through utilization of low rank coal＞

【Policy tools】
- Policy dialogues between governments
- Utilization of budget, investment/liability assurance, ODA, yen loan, JBIC, and NEXI

◆ Promotion of coal utilization technologies

○Development promotion and overseas deployment of clean coal technologies

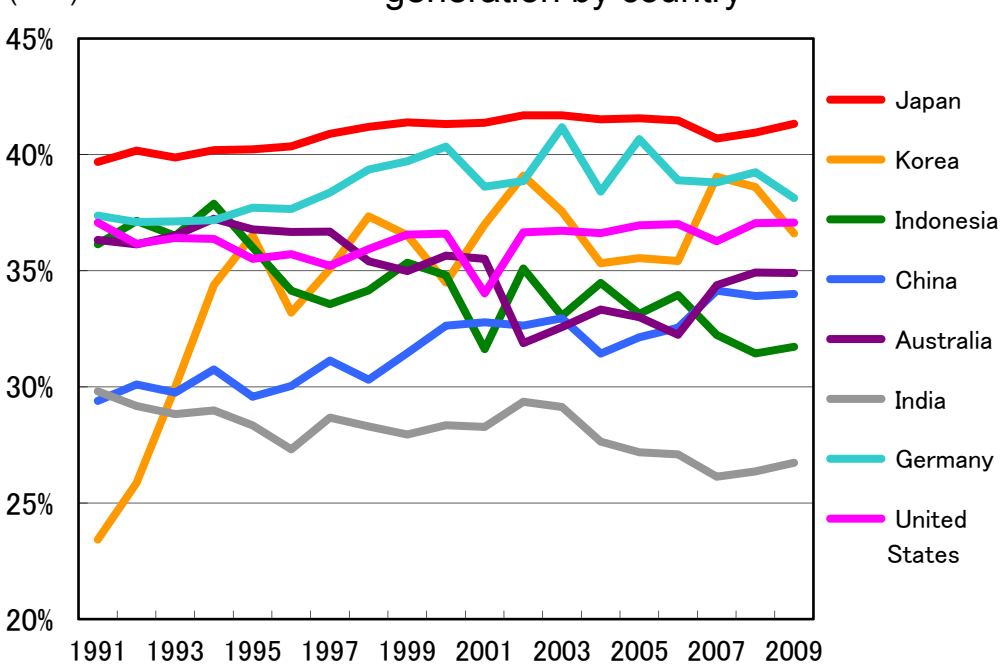
＜Efficiency improvement, CO2 reduction, utilization of low rank coal, etc. ＞
＜Contribution to CO2 reduction overseas through overseas deployment of clean coal technologies＞



Achieving Low Carbon Societies with Technical Transfers for Overseas Coal Fired Power

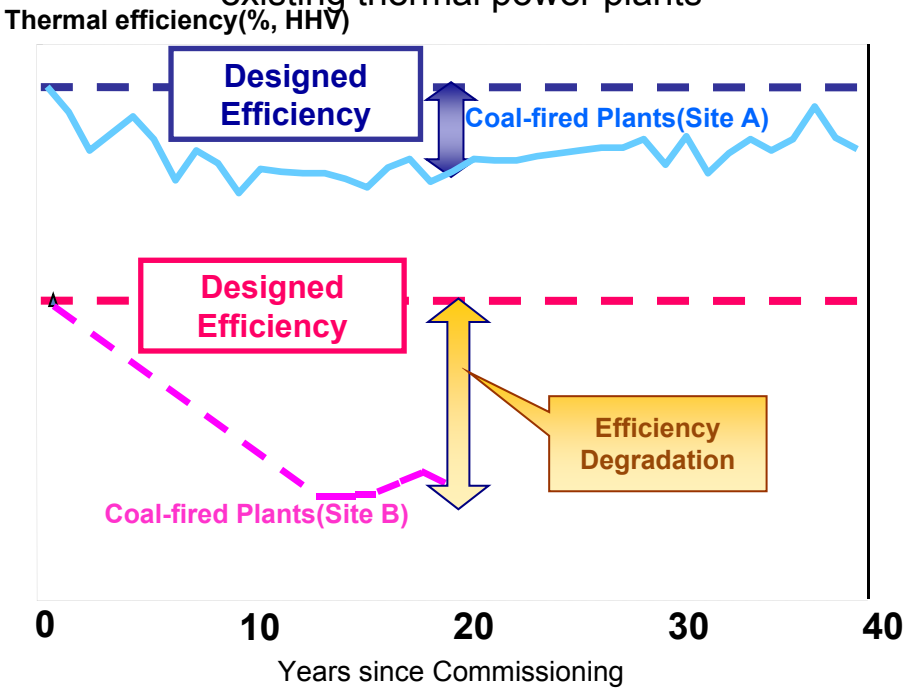
Coal fired power generation technologies in Japan is the most efficient in the world and proper operation and maintenance keeps high efficiency.

Changes in the efficiency of coal fired power generation by country



Source: Energy balances of OECD/Non-OECD countries-2011

Maintenance and improvement of Efficiency for existing thermal power plants



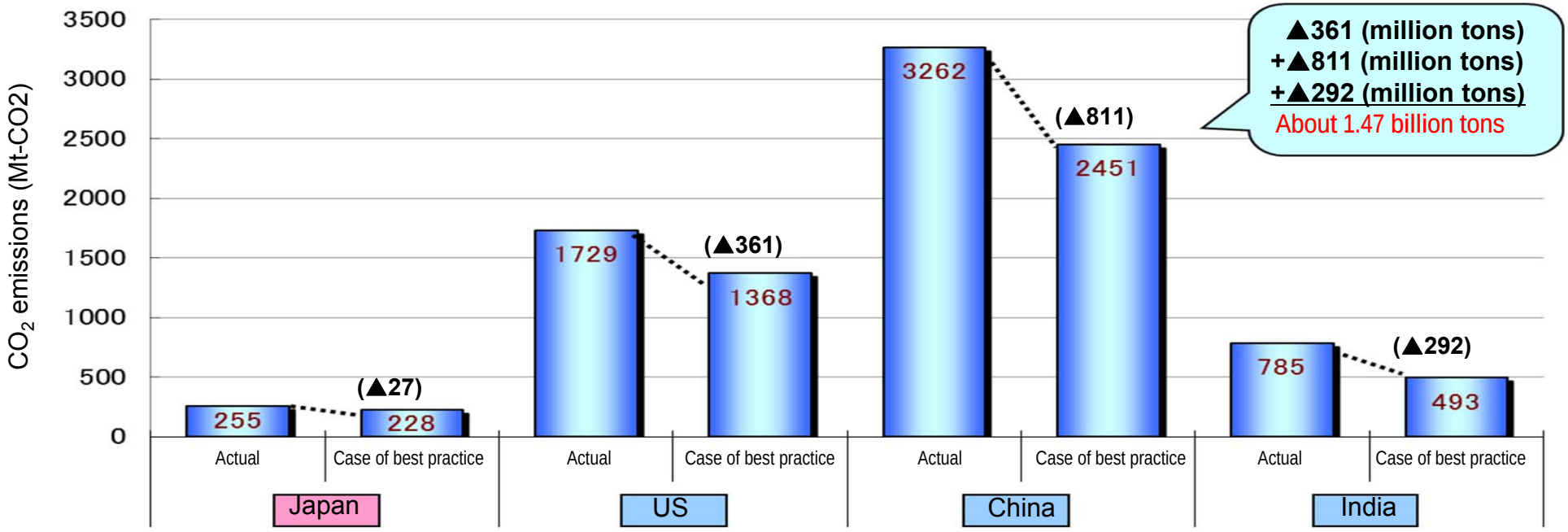
Source : The Federation of Electric Power Companies

CO2 Emissions Reduction through Technological Transfer

○ When applying the efficiency of the most advanced coal-fired power plants in operation in Japan to ones in the US, China and India, the CO2 reduction is estimated to be about 1,500 million tons.

○ With global demand for coal-fired power generation expected to continue to increase, we will promote Japan's highly-efficient coal-fired power technology by transferring highly-efficient coal-fired power generation technologies tailored to the partner countries' industrial structure and exporting systems in combination with technologies for operating and managing (O&M) coal-fired power generations.

Actual CO2 Emissions from Coal-fired Power Generation (2009) and Case of Maximum Efficiency in Japan

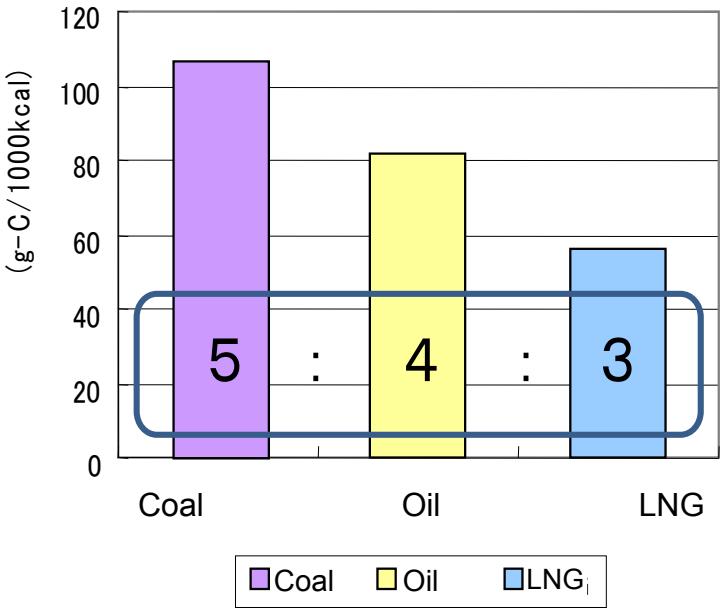


Source: "IEA World Energy Outlook 2011", "Ecofys International Comparison of Fossil Power Efficiency and CO2 Intensity 2012"

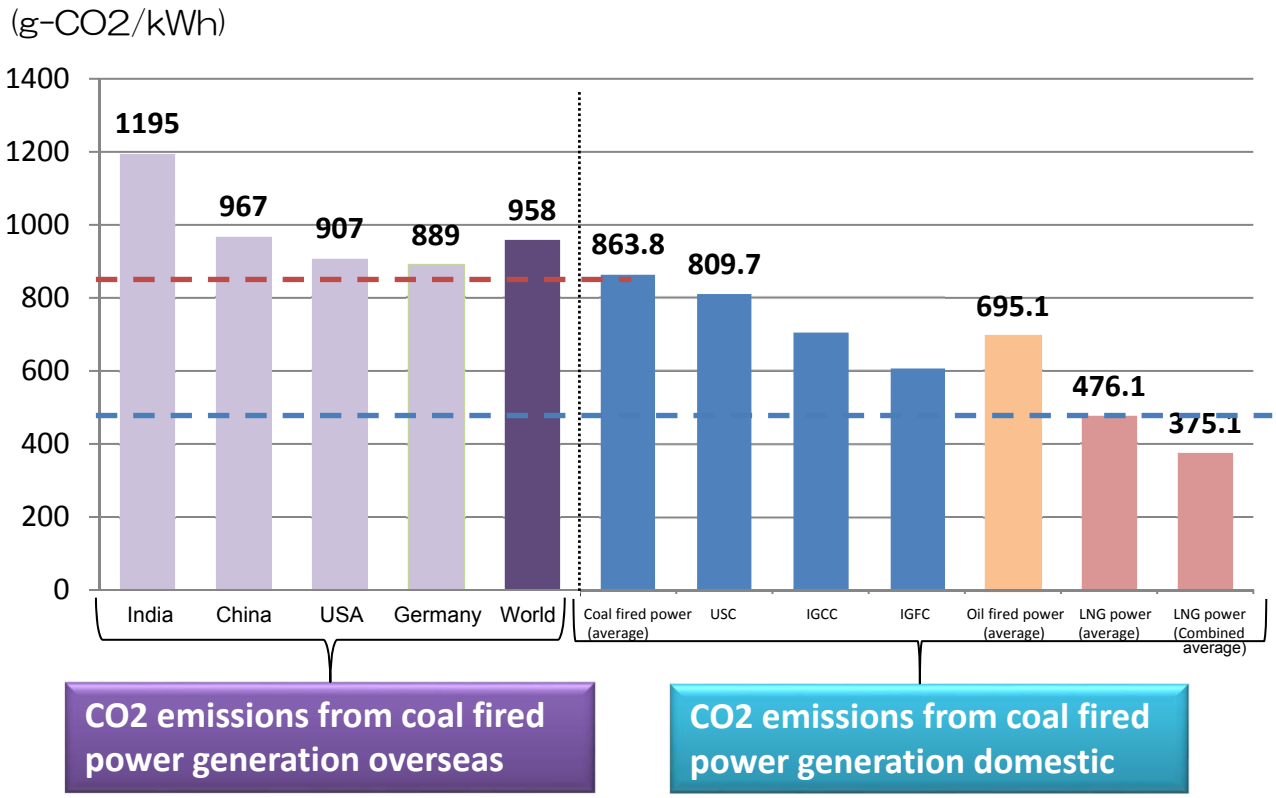
Comparison of CO2 Emissions of each Fuel in Power Generation

○CO2 emissions per thermal unit are approximately – Coal : petroleum : LNG = 5 : 4 : 3
○Coal fired power has approximately twice as much CO2 emissions per kWh compared to LNG power.
○Since coal has more CO2 emissions per unit compared to other fossil fuel, clean utilization is required.

CO2 emissions per heat



CO2 emissions per kWh from in generating fuel



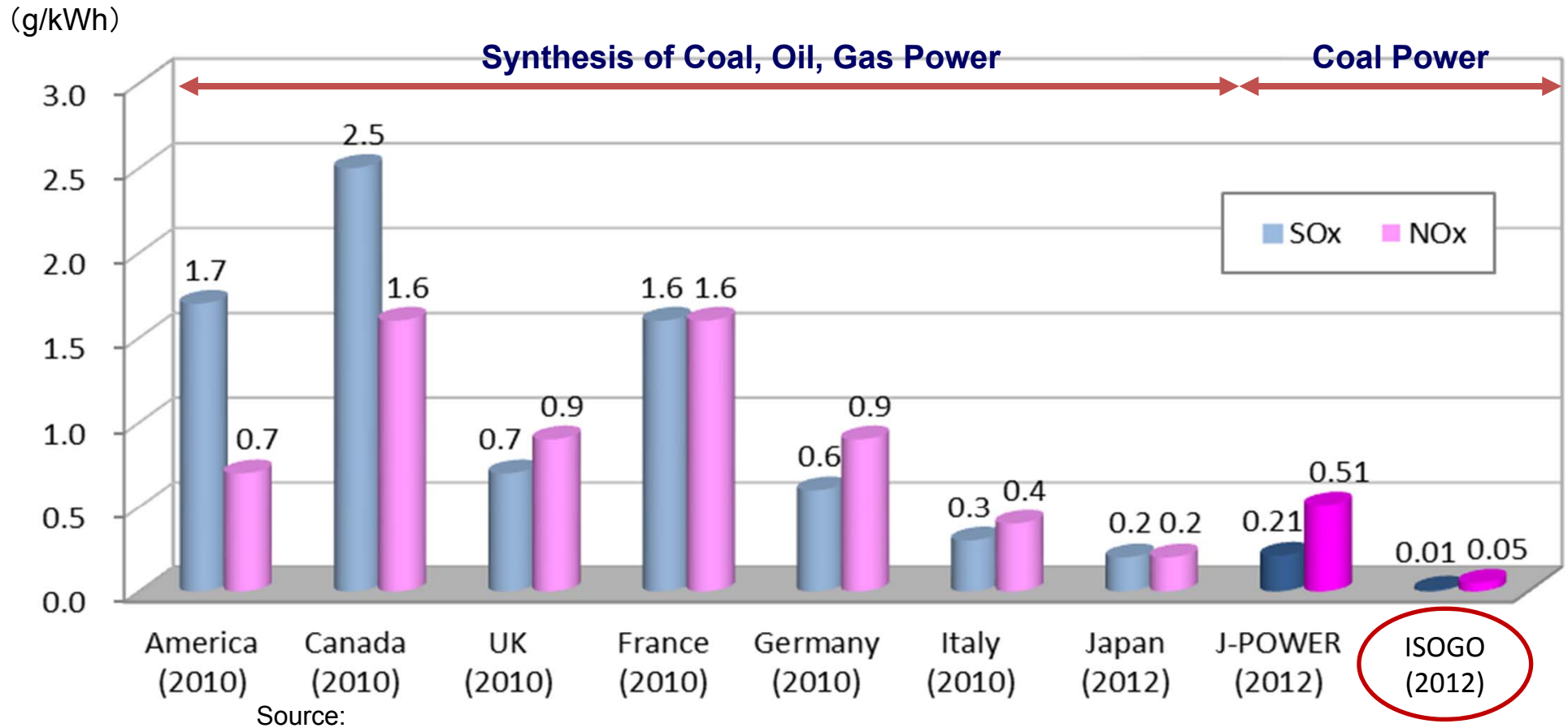
Ref.: Japanese Government's report based on "United Nations Framework Convention on Climate Change "

Source: Based on the development targets of various research businesses by the Central Research Institute of Electric Power Industry (2009) , CO2 Emissions from Fuel Combustion 2012

DeSOx and DeNOx

- SOx and NOx emissions from ISOGO Power Station is fur less than those of fossil-fired power generation in other developed countries due to advanced DeSOx and DeNOx system.

International comparison of the amount of SOx, NOx per thermal-power-generation

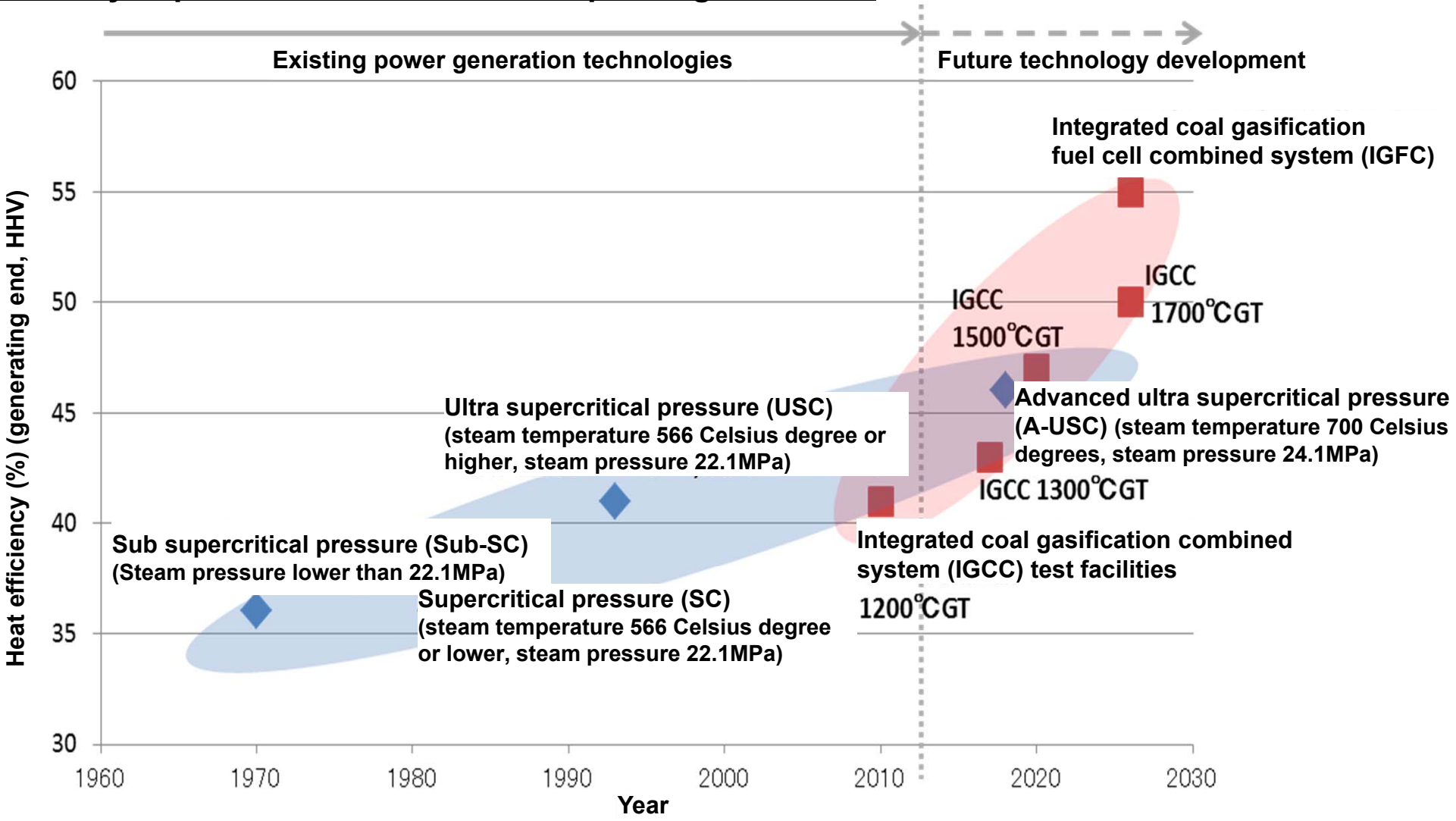


Source:
overseas: emission／OECD Stat Extract Complete database available via OECD's iLibrary
electricity generation／IEA ENERGY BALANCES OF COUNTRIES 2012 EDITION
Japan: Federation of Electric Power Companies investigation J-POWER・Isogo: actual data at 2012

Power generation efficiency and even higher efficiency of coal thermal power generation

For further improvement of coal thermal power generation efficiency, development of technologies such as Integrated coal Gasification Combined Cycle (IGCC), Integrated coal Gasification Fuel Cell combined Cycle (IGFC),Advanced Ultra SuperCritical pressure thermal power generation (A-USC) taking advantage of Japan's technologies is important.

<Efficiency improvement of coal thermal power generation>



Integrated coal gasification fuel cell combined system experiment project (Osaki Cool Gen)

Project details

- Oxygen injection coal gasification technology (oxygen blown IGCC) which makes it efficient and easy to separate and collect CO_2 is established. Experiments of triple-combined power generation technology by combining fuel cell of the hydrogen obtained by future oxygen injection gasification are conducted.

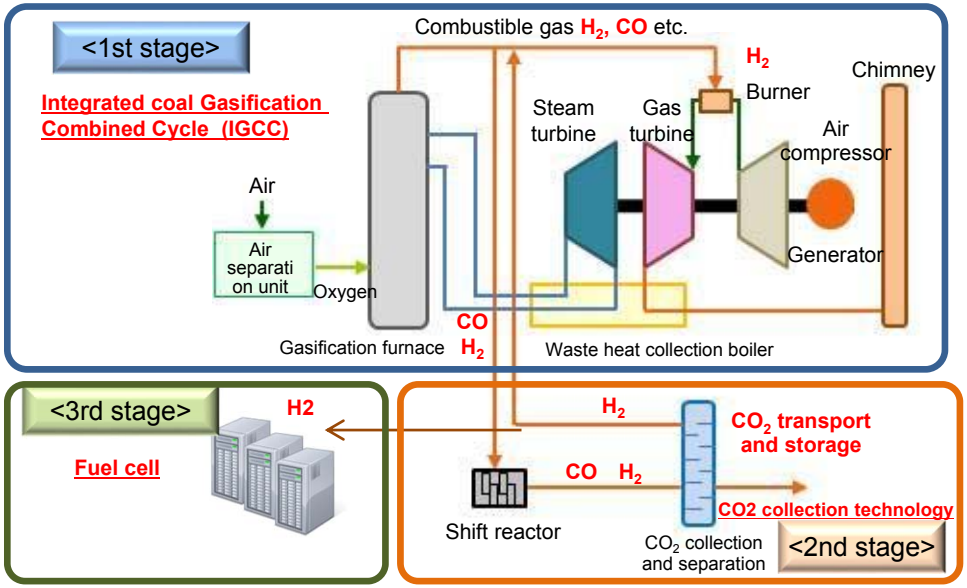
(1) Technical characteristics

- Gross thermal efficiency 55% (←current USC 41%)
- Use of subbituminous coal, which can be easily gasified (use of low-grade coal)
- Easy separation and collection of CO_2 by oxygen injection (CO_2 reduction)
- Use of hydrogen by oxygen injection (fuel cell)

(2) Organizer: Osaki Cool Gen (J-POWER, Chugoku Electric Power)

(3) Project term: 2012-2021
(Total of 30 billion yen, total project cost of 90 billion yen) *Only 1st stage

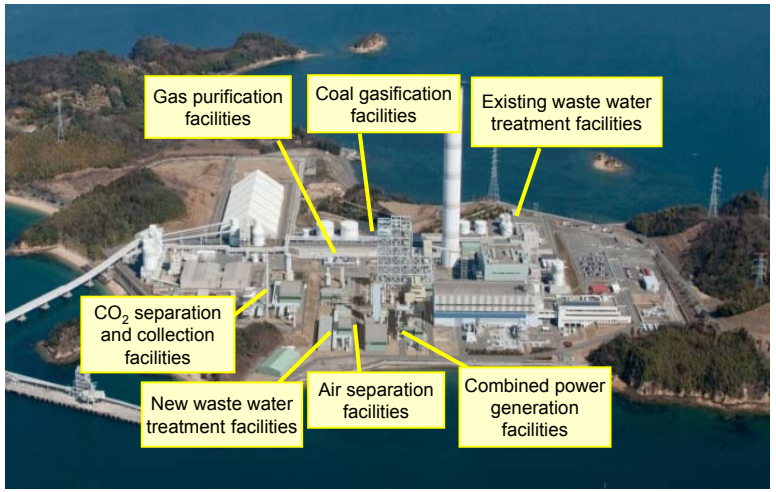
Project overview



Future schedule

FY	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1st stage Oxygen blown IGCC experiments	Oxygen blown IGCC detailed design and construction					Demonstration test				
2nd stage CO2separation and collection type GCCexperiments			Application technology assessment Image design		detailed design and construction of CO2separation and collection			Demonstration test		CO2 transport and storage test
3rd stage CO2 separation and collection type IGFC experiments					Technical survey, Image design		CO2 collection integrated type of IGCC/IGFC: Detailed design and construction			Demonstration test

Rendering

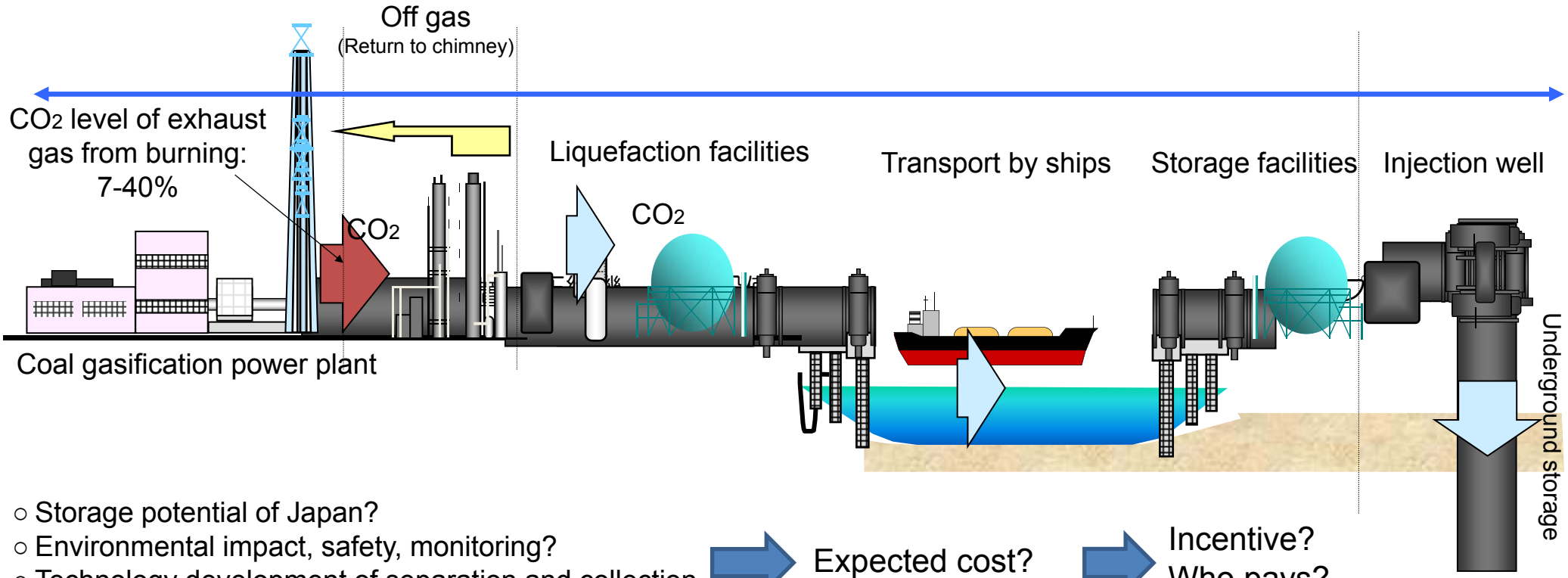


Project site: Kamijimacho, Osaki, Toyoda, Hiroshima

Total System of Highly-efficient Low-carbon Coal Thermal Power Generation

- ○ Reduction of CO_2 emission from coal thermal power plants is strongly demanded to respond to the global warming issues.
- ○ Realization of a total system from power generation to CO2 storage is aimed at by combining efficiency improvement of coal thermal power plants and CCS.

<Gasification, burning> **<Separation, collection>** **<Transportation>** **<Underground storage>**



- ○ Storage potential of Japan?
- ○ Environmental impact, safety, monitoring?
- ○ Technology development of separation and collection

→ Expected cost? → Incentive? Who pays?

At Callide A pulverized coal power station (generation capacity: 30MWe) in Central Queensland, Australia, low-emission coal thermal power generation using Oxifuel Combustion Technologies will be demonstrated toward practical application of CCS (Carbon Capture and Storage) technology.

Oxifuel Combustion is:

Technology to facilitate CO2 recovery by burning fuel such as coal using only oxygen to make CO2 the principal component of exhaust gas from the boiler.

System

- Oxygen generation (air separation) equipment is installed.
- Exhaust gas is re-circulated and flame temperature is adjusted to use existing boiler technology.

Features

- Applicable to both existing and new power plants
- Has a potential to reduce CO2 recovery energy and costs
- Has a potential to reduce NOx emissions

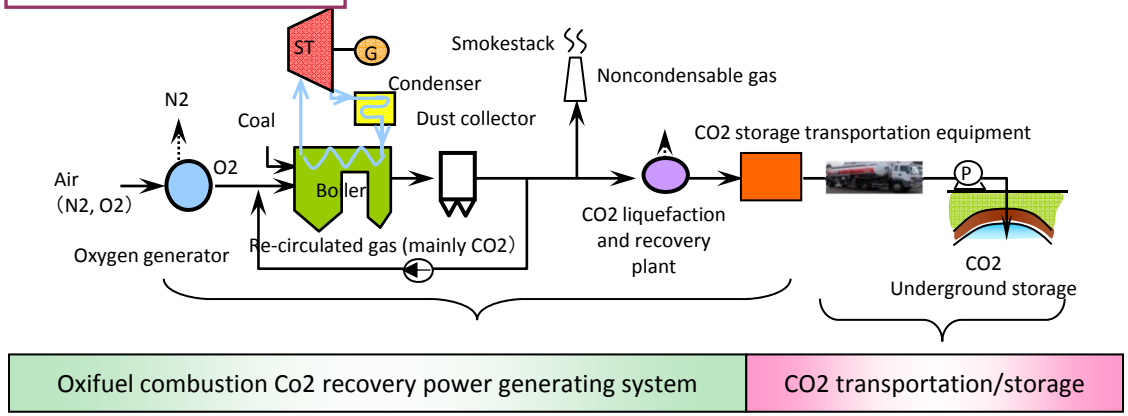
Partners

Japan : Japan-Australia Oxifuel Combustion Demonstration Project Japan Limited Liability Partnership(formed by J-POWER, IHI and Mitsui & Co.)
JCOAL (Supporting Collaborator)
Australia: CS Energy, Xstrata, Schlumberger, Australian Coal Association (ACA)

Schedule

2008 – 2012 Retrofit of existing power station
2012 – 2014 Oxyfuel demonstration operation
2014 – 2015 CO2 injection and monitoring

Project image



Callide A pulverized coal power station

The President's Climate Action Plan

1. The U.S. Climate Action Plan

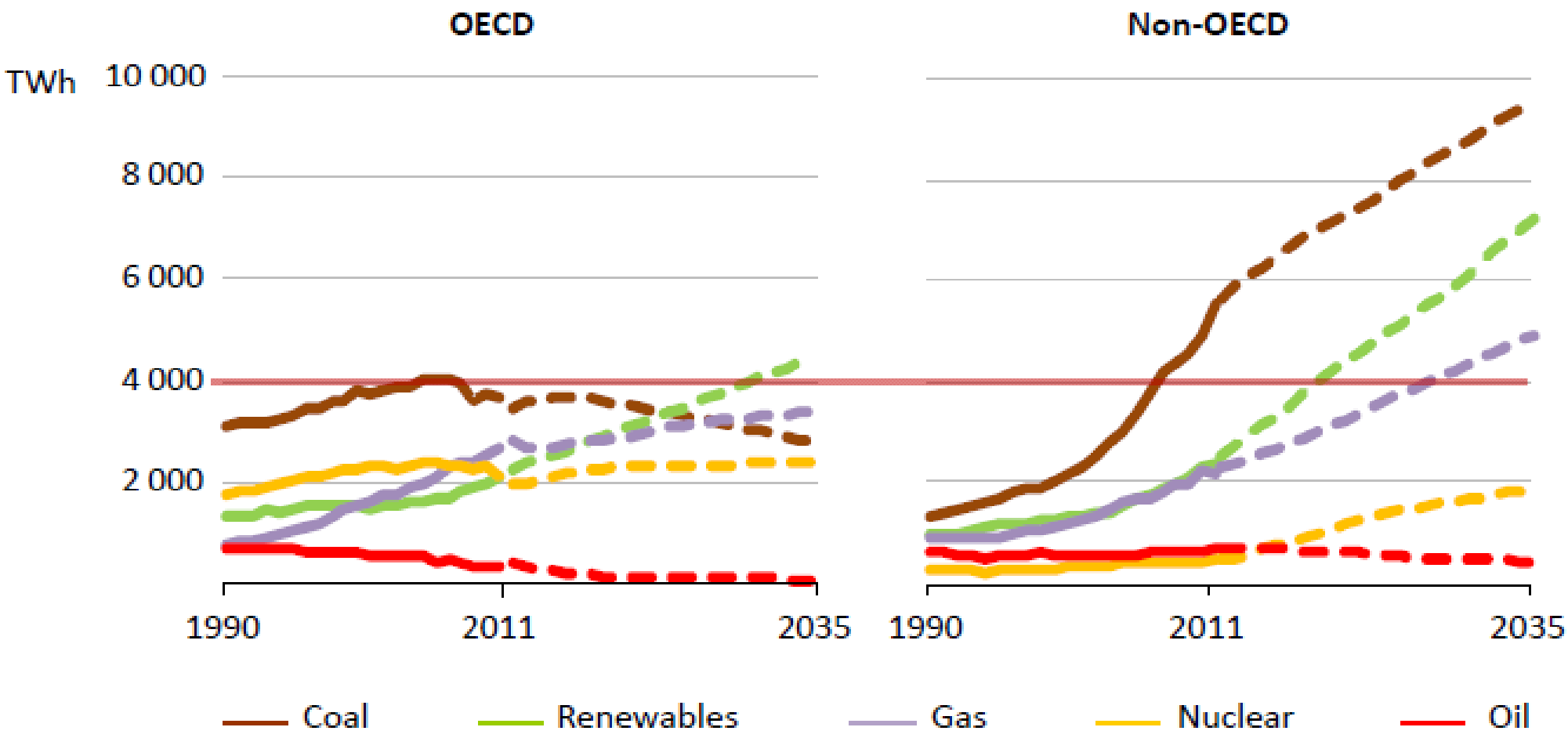
- President Obama's June 2013 Climate Action Plan outlines the Administration's measures domestically and internationally. To help lead international efforts to address global climate change, the section entitled "Leading Global Sector Public Financing Towards Cleaner Energy," states the following:

> • Leading Global Sector Public Financing Towards Cleaner Energy: Under this Administration, the United States has successfully mobilized billions of dollars for clean energy investments in developing countries, helping to accelerate their transition to a green, low-carbon economy. Building on these successes, the President calls for an end to U.S. government support for public financing of new coal plants overseas, except for (a) the most efficient coal technology available in the world's poorest countries in cases where no other economically feasible alternative exists, or (b) facilities deploying carbon capture and sequestration technologies. As part of this new commitment, we will work actively to secure the agreements of other countries and the multilateral development banks to adopt similar policies as soon as possible.

2. Impact of climate plan

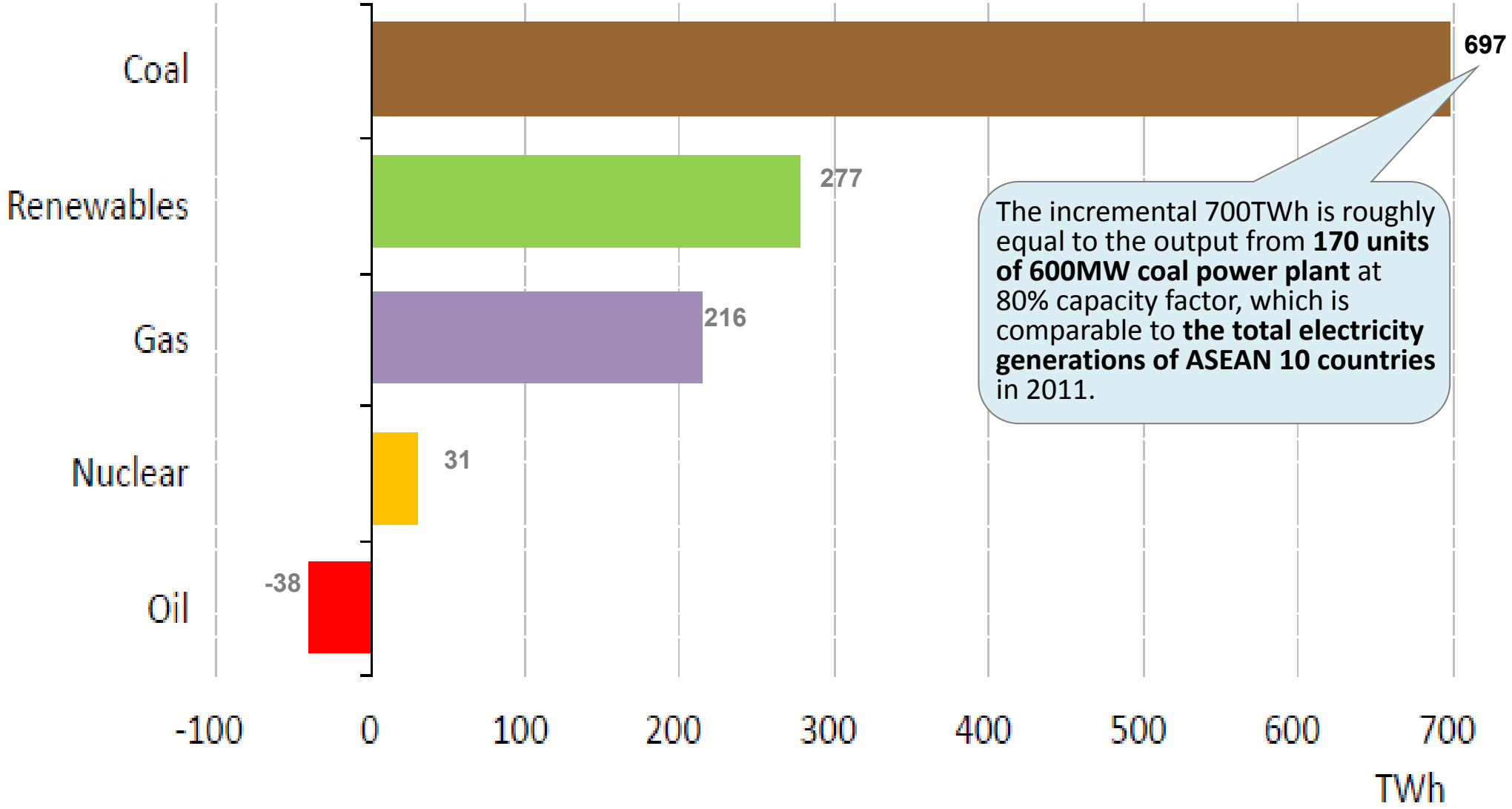
- In September, 2013, the leaders of Denmark, Finland, Iceland, Norway, and Sweden agreed to "join the United States in ending public financing for new coal-fired power plants overseas, except in rare circumstances." They further agreed to "work together with the United States to secure the support of other countries and MDBs to adopt similar policies."
- In July, 2013, the World Bank Group announced that it would restrict funding for new coal plants in developing countries except "in rare circumstances", and the European Investment Bank (EIB) also adapted the lending policy, including the restriction of its support for fossil fuel power plants. In December, the European Bank for Reconstruction and Development (EBRD) adapted new Energy Sector Strategy Stipulating that the bank will not finance any greenfield coal-fired power plant except in rare circumstances, where there are no economically feasible alternative energy sources.

Electricity Generation in non-OECD countries has only begun to rise



Source: IEA “WEO 2013”

ASEAN incremental electricity generation by fuel, 2011-2035

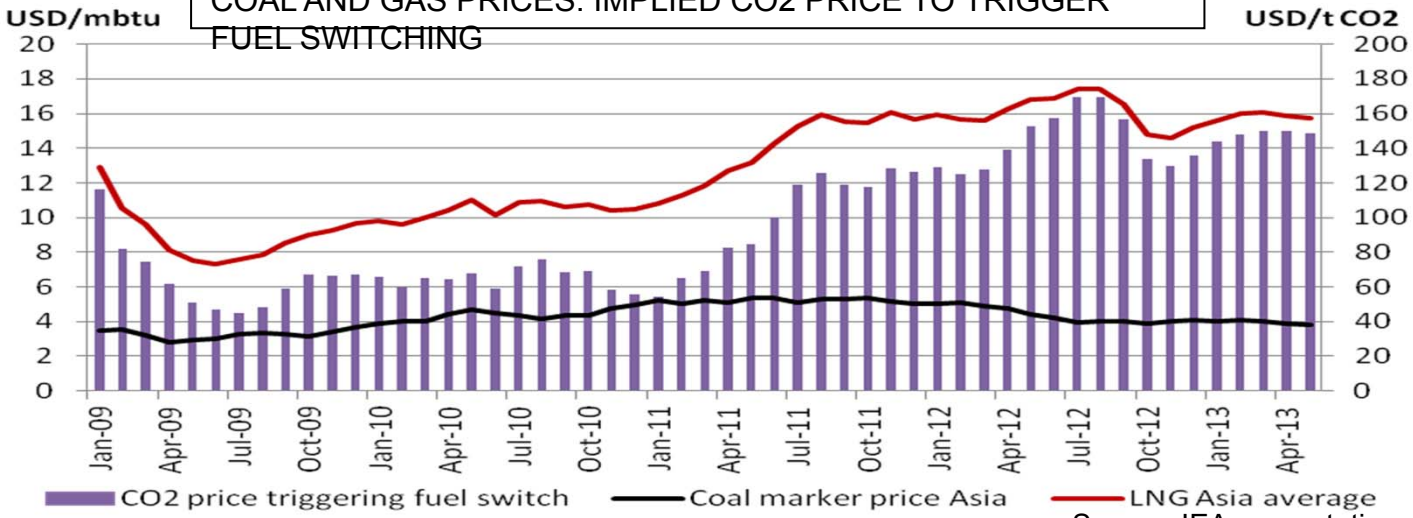


Source：Southeast Asia Energy Outlook, WEO Special Report 2013

Achievement of low carbonization by highly efficient coal-fired power generation

・It is clear that the world especially Asian countries continue to choose coal-fired power generation due to **stable supply of coal** and **economy** to keep economic growth and ensure energy security.

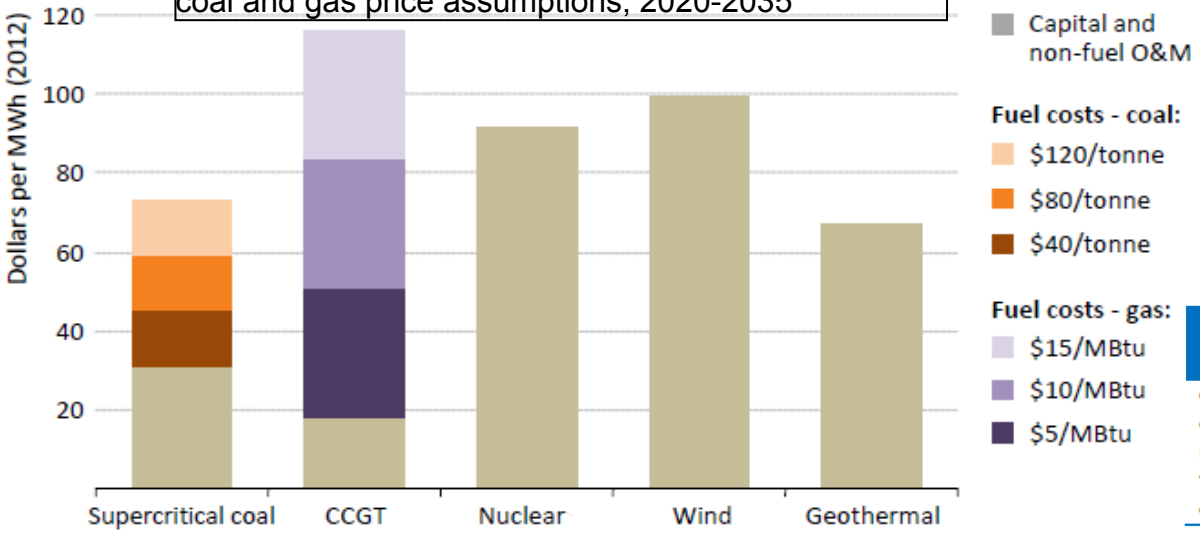
COAL AND GAS PRICES. IMPLIED CO2 PRICE TO TRIGGER FUEL SWITCHING



Source: IEA presentation material

No supply security issues in coal trade

Electricity generation costs in ASEAN under different coal and gas price assumptions, 2020-2035



Source: IEA “Southeast Asia Energy Outlook”,

Assumed costs and operational features

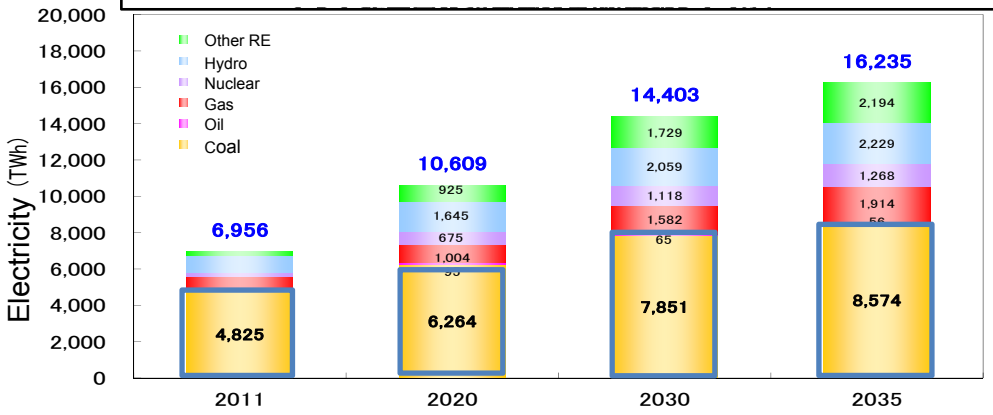
	Capital cost ($/kW)	Non-fuel O&M cost ($/kW)	Thermal efficiency	Capacity factor
Coal supercritical	1 500	60	41%	80%
Gas CCGT	700	25	58%	60%
Nuclear	4 500	123	33%	85%
Wind	1 600	21	n.a.	22%
Geothermal	4 000	40	15%	75%

Achievement of low carbonization by highly efficient coal-fired power generation

- If financial restriction forces developing countries to choose cheap but low efficient facility, this eventually prevent our goal of global low carbonization.
- Developed countries are responsible for introducing each country's BAT facility and contributing to the low carbonization. **Public financial support** is essential tool for practical global environmental policy.

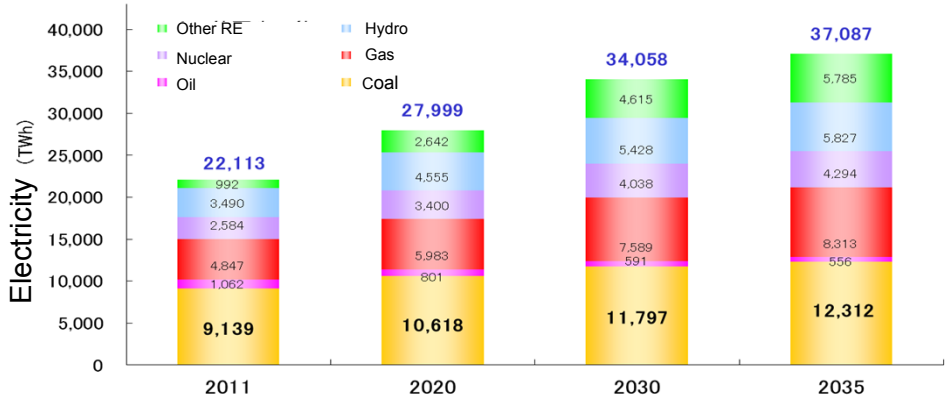
Electricity from coal-fired power plant will be almost double by 2035 in Asia

Electricity of developing country in Asia (New policy scenario)



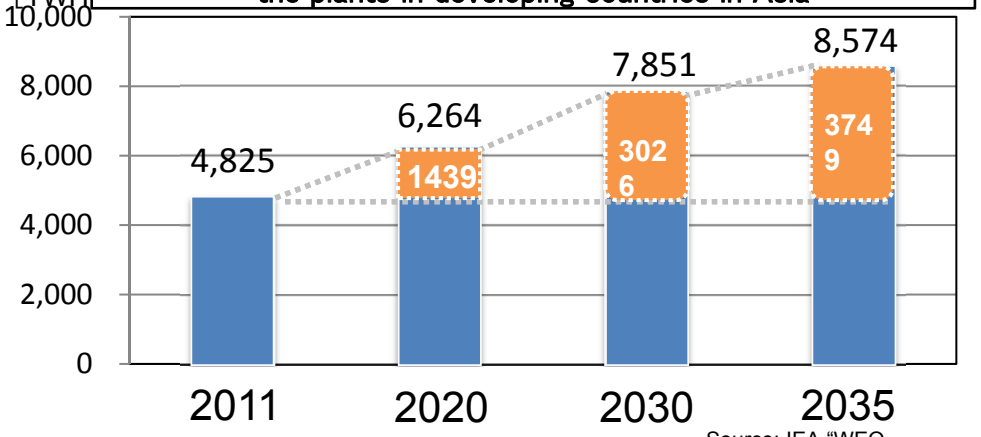
Source: IEA "WEO 2013"

Electricity of the World (New policy scenario)

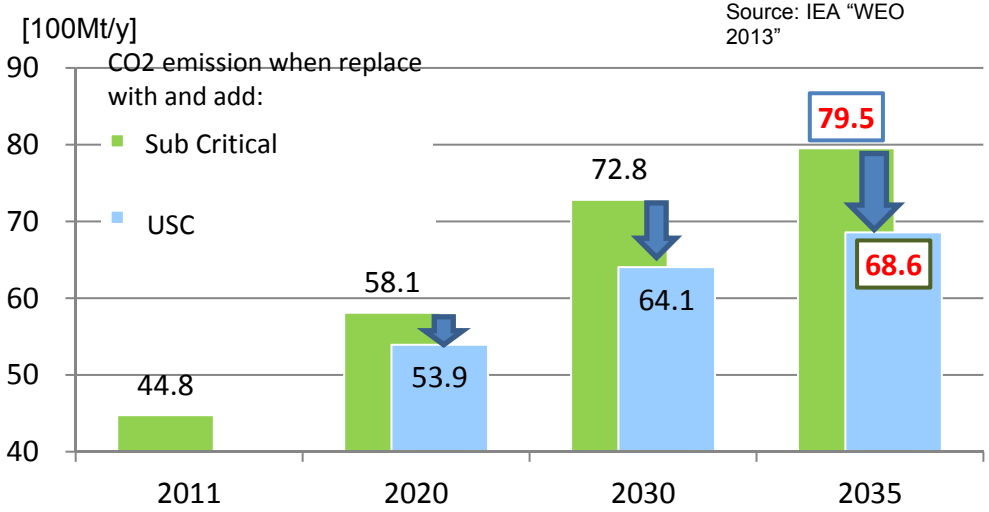


Source: IEA "WEO 2013"

Electricity from coal-fired power plant and CO2 emission from the plants in developing countries in Asia



Source: IEA "WEO 2013"



*Assumption: Facilities are replaced in 40 years; Existing plants in 2011 are replaced by 25% in every 10 years; New plants and replacements are USC.
[CO2 emission unit] Sub-C: 927.6gCO2/kWh, USC: 726.7gCO2/kWh

Thank you very much
for your attention.

nakanishi-hironori@meti.go.jp

METI
Ministry of Economy, Trade and Industry

Ⅰ. Problems on Japan's Energy Supply/Demand Structure

1. Basic Problems

- Japan's energy supply would be easily affected by external factors due to its high dependency on oversea fossil fuel.
- Population decline and innovation in energy conservation technology have caused structural changes in Japan's medium/long-term energy demand.
- Increased energy demand in emerging countries has led rapid increase in natural resources' prices and global greenhouse gas emission.

2. Problems exposed just before and after 3.11

- Concerns regarding safety of nuclear power plants and weak public confidence toward GOJ and utilities.
- Due to an increase of fossil fuel imports, Japan faces further dependency on the Middle-East, a rise in electricity prices, a rapid increase of greenhouse gas emissions, and an outflow of national wealth.
- Exposed structural defects, such as difference in electricity frequency between East and West in Japan, a lack of emergency system to deliver oil products
- New trend for energy saving by household and industries.
- New trend in global energy supply structure such as energy independency of North America due to shale gas, emerging regional differences in energy prices.

Ⅱ. Principles of Energy Policy and Viewpoints for Reform

1. Principles of Energy Policy and Viewpoints for Reformation

(1) Confirmation of basic viewpoint of energy policies (3E + S)

- Stable Supply (**E**nergy Security)
- Cost Reduction (**E**conomic Efficiency)
- **E**nvironment
- **S**afety

+

Global Viewpoint

-Developing energy policies with international movement appropriately

-Internationalizing energy industries by facilitating business overseas.

Economic Growth

-Contribution to reinforce Japan's locational competitiveness.

-Activating Japan's energy market through energy system reform.

(2) Building multilayered and diversified flexible energy demand-supply structure

- Establishing resilient, realistic and multi-layered energy supply structure, where each energy source can exert its advantage and complement others' drawbacks.
- Creating a flexible and efficient supply/demand structure where various players can participate and various alternatives are prepared by system reforms.
- Improving self-sufficiency ratio by developing and introducing domestic resources to minimize influence from overseas' situation.

Ⅱ. Principles of Energy Policy and Viewpoints for Reform

2. Evaluation of each energy source

(1) Renewables (solar, wind, geothermal, hydroelectricity, biomass)

- Promising, multi-characteristic, important, low carbon and domestic energy sources.
- Accelerating their introduction as far as possible for three years, and then keep expanding renewables.

(2) Nuclear Power

- Important base-load power source as a low carbon and quasi-domestic energy source, contributing to stability of energy supply-demand structure, on the major premise of ensuring of its safety, because of the perspectives; 1) superiority in stability of energy supply and efficiency, 2) low and stable operational cost and 3) free from GHG emissions during operation.
- Dependency on nuclear power generation will be lowered to the extent possible by energy saving and introducing renewable energy as well as improving the efficiency of thermal power generation, etc.
- Under this policy, we will carefully examine a volume of electricity to be secured by nuclear power generation, taking Japan's energy constraints into consideration from the viewpoint of stable energy supply, cost reduction, global warming and maintaining nuclear technologies and human resources.

Ⅱ. Principles of Energy Policy and Viewpoints for Reform

(3) Coal

- Revaluating as an important base-load power source in terms of stability and cost effectiveness, which will be utilized while reducing environmental load (utilization of efficient thermal power generation technology, etc.) .

(4) Natural Gas

- Important energy source as a main intermediate power source, expanding its roles in a variety of fields.

(5) Oil

- Important energy source as both an energy resource and a raw material, especially for the transportation and civilian sectors, as well as a peaking power source.

(6) LP Gas

- A clean and distributed energy source that can not only be utilized in everyday life but also in emergency situations.

□ Energy Mix

✓ Energy mix will be shown soon after this plan, taking into consideration factors including restart of nuclear power plants and expansion of renewable energies, and so on.