

# **CCS Activities and Support by Japan**



**Carbon Capture and Storage: Way Forward in Asia  
Deep Dive Workshop - Asia Clean Energy Forum 2016**

**6 June, 2016**

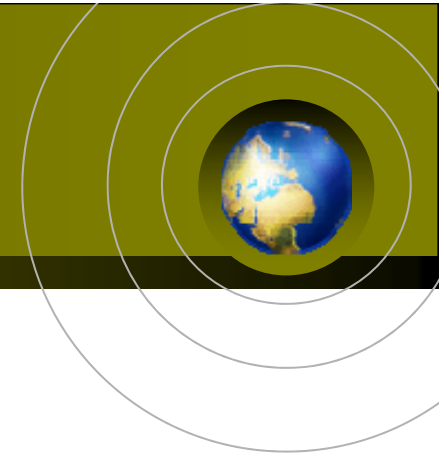
**Asian Development Bank Headquarters, Manila**

**Makoto Akai,**

**Board Director, Global CCS Institute**

**Emeritus Researcher, National Institute of Advanced Industrial Science and Technology (AIST)**

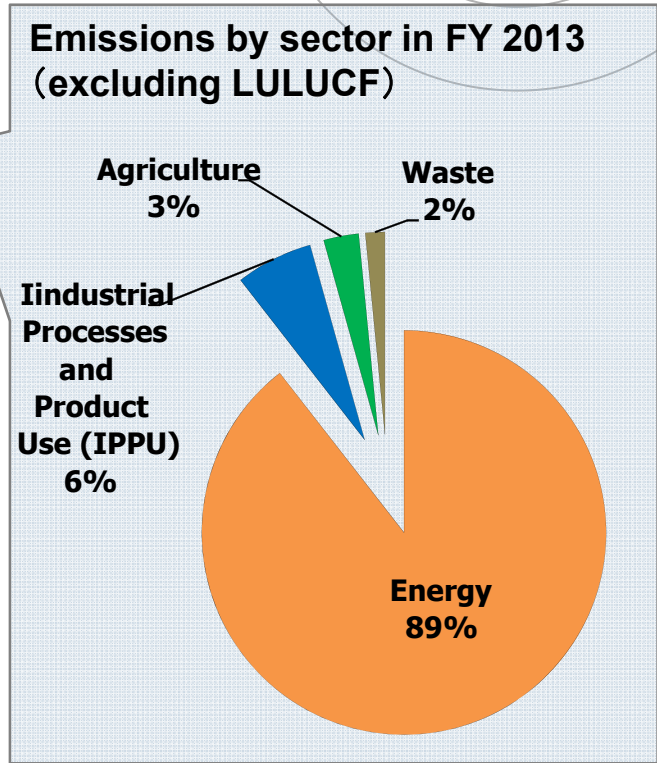
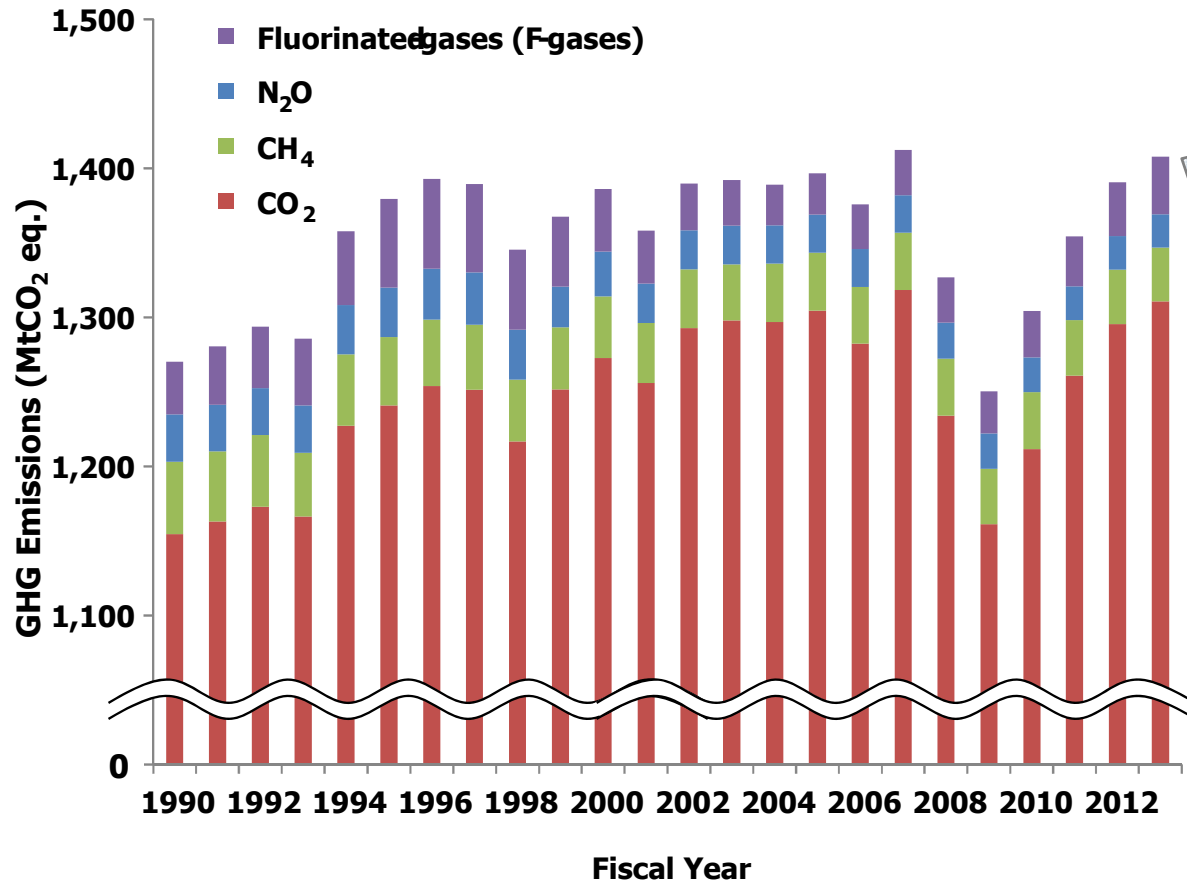
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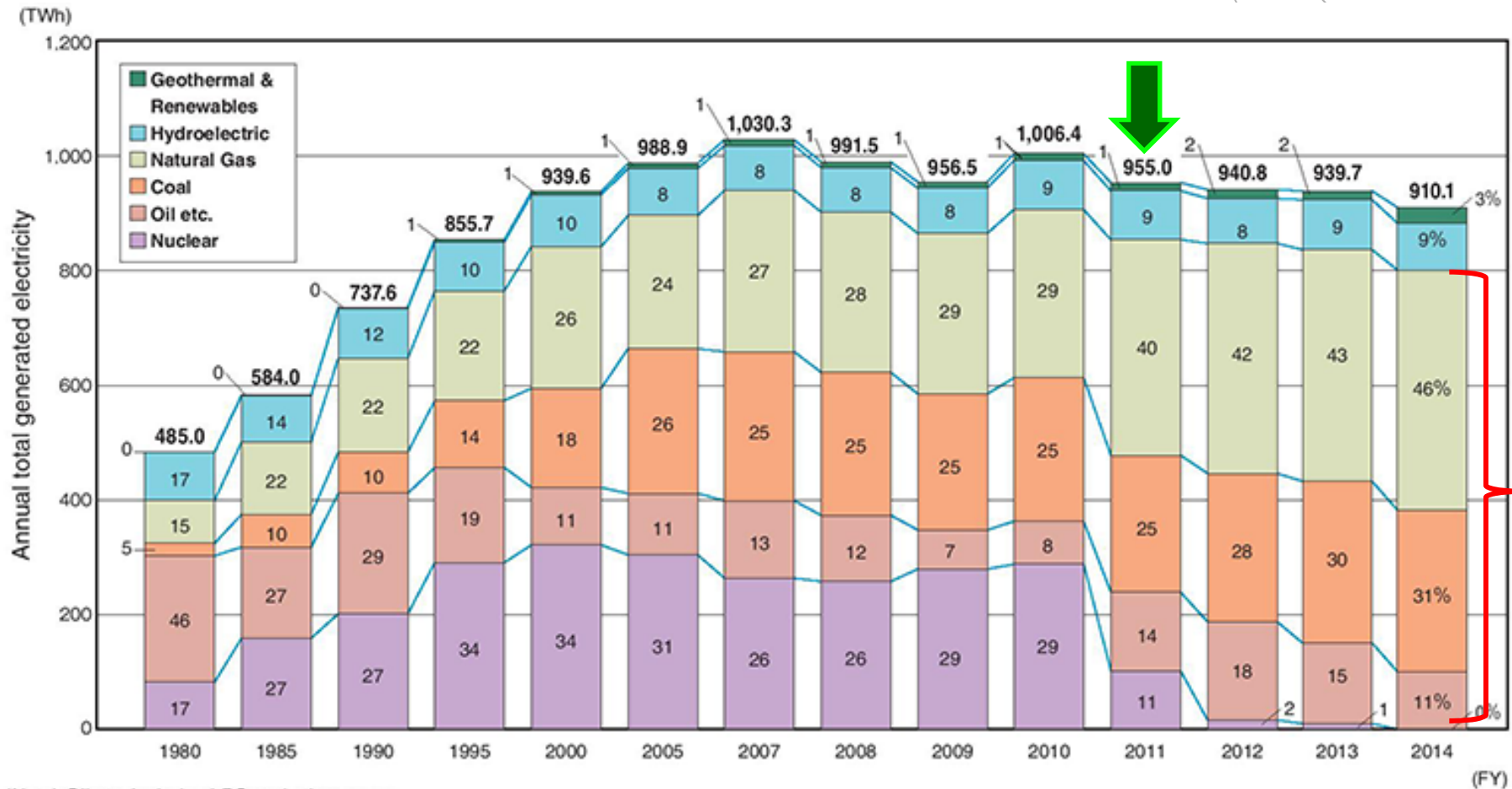
# Trend of GHG Emissions in Japan



(Source ) National Greenhouse Gas Inventory Report of Japan (April, 2015)



# Trend of Power Generation in Japan

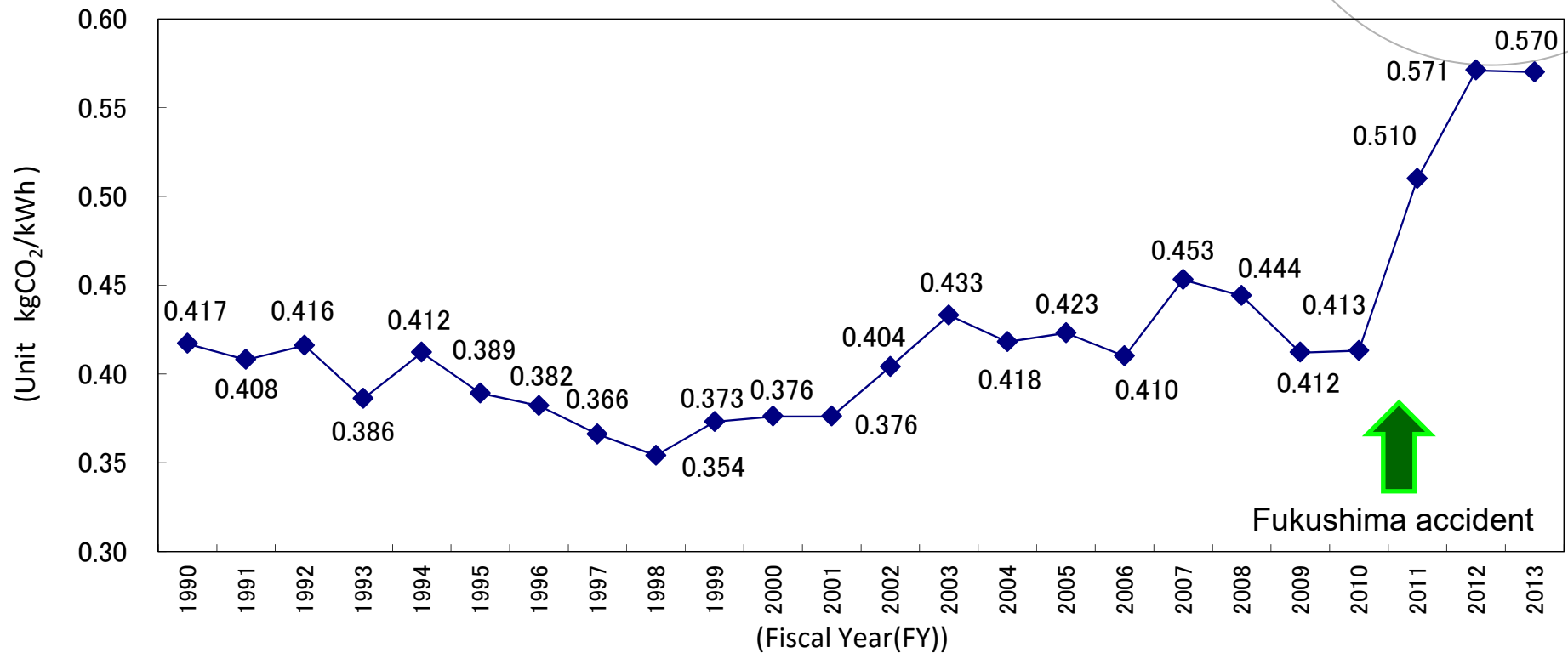


(Note) Oil etc. includes LPG and other gases.  
 Figures may not add up to the totals due to rounding.  
 Total of 10 electric power companies and power purchased.  
 Figures within the graph represent the composition ratio.

(Source) The Federation of Electric Power Companies of Japan

# CO<sub>2</sub> Emissions Intensity in the Electricity Sector of Japan

Background



(Source) Agency of Natural Resources and Energy, METI

# Plan for Global Warming Countermeasures

## Cabinet decision on May 13, 2016



Japan's sole general plan for global warming prevention; in order to promote global warming countermeasures comprehensively and strategically.

Prescribes the targets of emissions reduction and removal of GHG, the basic matters on measures to be taken by businesses and the public etc., and policies to be implemented by the National Government and Local Government.

### ■ Background

- IPCC AR5

- INDC

  - 26.0% reduction by FY2030 compared to FY2013 (25.4% reduction compared to FY2005)

- Paris Agreement

### ■ Strategic actions towards long-term goal

- ... aims to reduce greenhouse gas emissions by **80% by 2050** as its long-term goal ...

# Technological R&D on CCS in Japan

## Late 80's -

R&D History



- **Proposal of the concept of CCS as an option to mitigate climate change**
  - **Capture technologies: post-combustion, pre-combustion and oxy-fuel**
  - **Storage options: ocean sequestration and geological storage**
- **Players:**
  - **National Laboratories under MITI**
  - **Central Research Institute of Electric Power Industry (CRIEPI)**

# Technological R&D on CCS in Japan

## Early 90's -

R&D History



- **Independent research activities**
  - **National Laboratories (MITI, MOT)**
    - **Capture and storage**
  - **CRIEPI**
    - **Storage**
  - **Electric Utilities in cooperation with manufacturers (KEPCO & MHI, etc.)**
    - **Capture and storage**
  - **Universities (Tokyo Institute of Technology, etc.)**
    - **Storage**
- **Comprehensive performance and cost analysis study**



# Technological R&D on CCS in Japan

## Mid 90's –

R&D History



## Establishment of R&D projects under METI

- **CO<sub>2</sub> capture**
  - Development of chemical absorbent and membrane;  
Application to ironworks; Oxy-fuel; Pre-combustion with IGCC, etc.
- **Ocean sequestration (97 – 08; \$82M)**
  - Focused on environmental impact assessment and development on near-zero impact technology
  - International cooperation with USA, Canada and Switzerland
- **Geological storage (2000 – 2008; \$71M)**
  - Nagaoka project
    - Injected CO<sub>2</sub>: 10,405 t (2003 - 2005)
- **ECBM (2002 – 2007; \$17)**
  - Yubari project

# Non-technological R&D in Japan

## Late 90's –

R&D History



- **Public perception**
  - Identification of public's concern and development of communication strategy
- **Accounting**
  - National Inventory and Project Based Accounting
  - Contribution to develop 2006 IPCC Guideline
- **Applicability to CDM**
  - Submission of two new methodology to CDM-EB
- **Confidence building on CCS**
  - Risk assessment, communication strategy, etc.



# Development of Oxygen-Blown Gasifier

- The Osaki CoolGen Project will make highly use of the knowledge and technology acquired through EAGLE pilot test.



For commercial use



**Osaki CoolGen**  
Demonstration plant 166MW  
(1,180t/d/FY2016-Hiroshima pref. )



**EAGLE pilot plant**  
(150t/d/FY2002-2013)



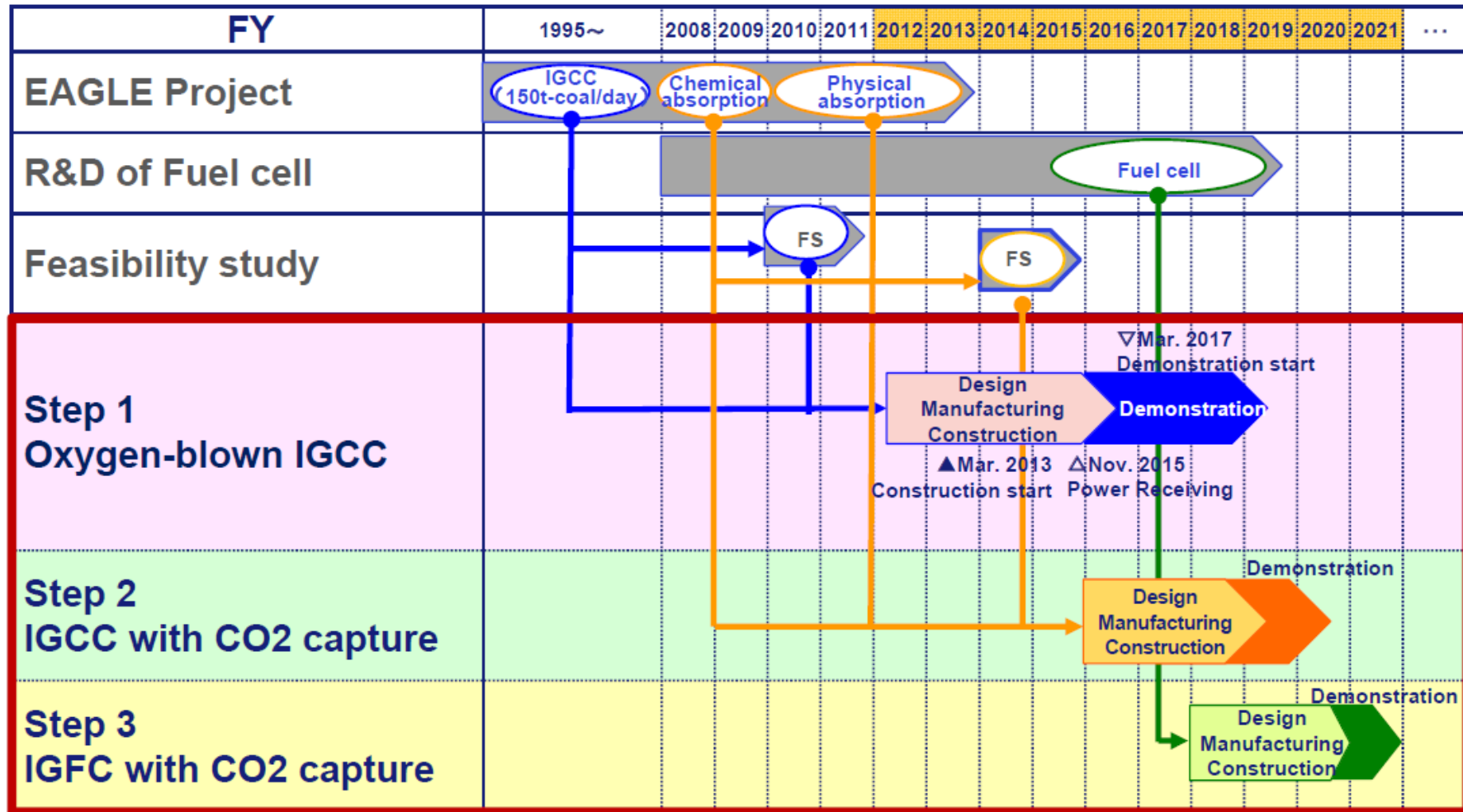
**HYCOL pilot plant**  
(50t/d/FY1990-1993)

**Process Development Unit**  
(1t/d/FY1981-1985)

(Source ) K. Chiyonobu, 2014

# Schedule of Osaki CoolGen Project

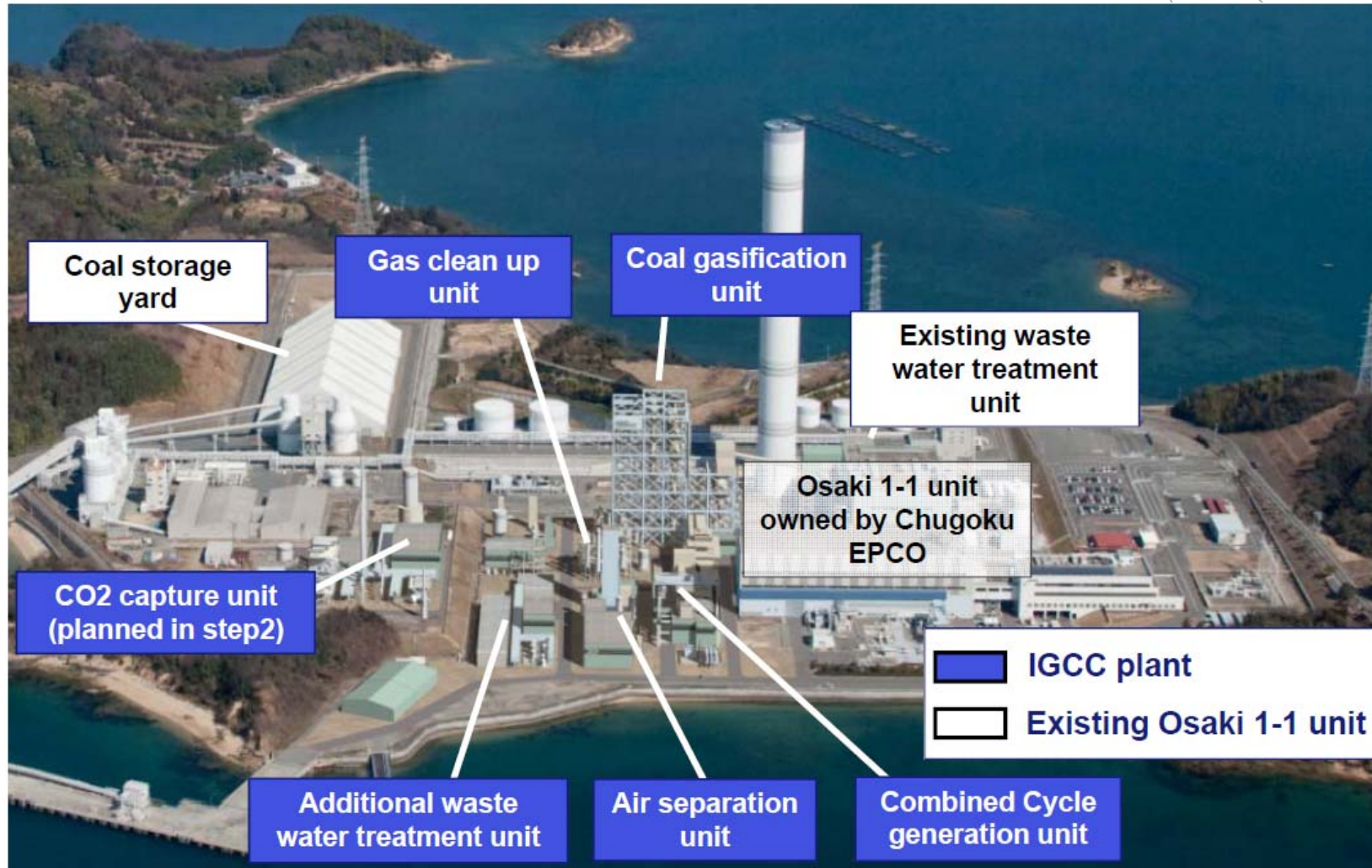
Projects



(Source ) Chugoku Electric Power Co, 2014



# Osaki CoolGen IGCC Plant

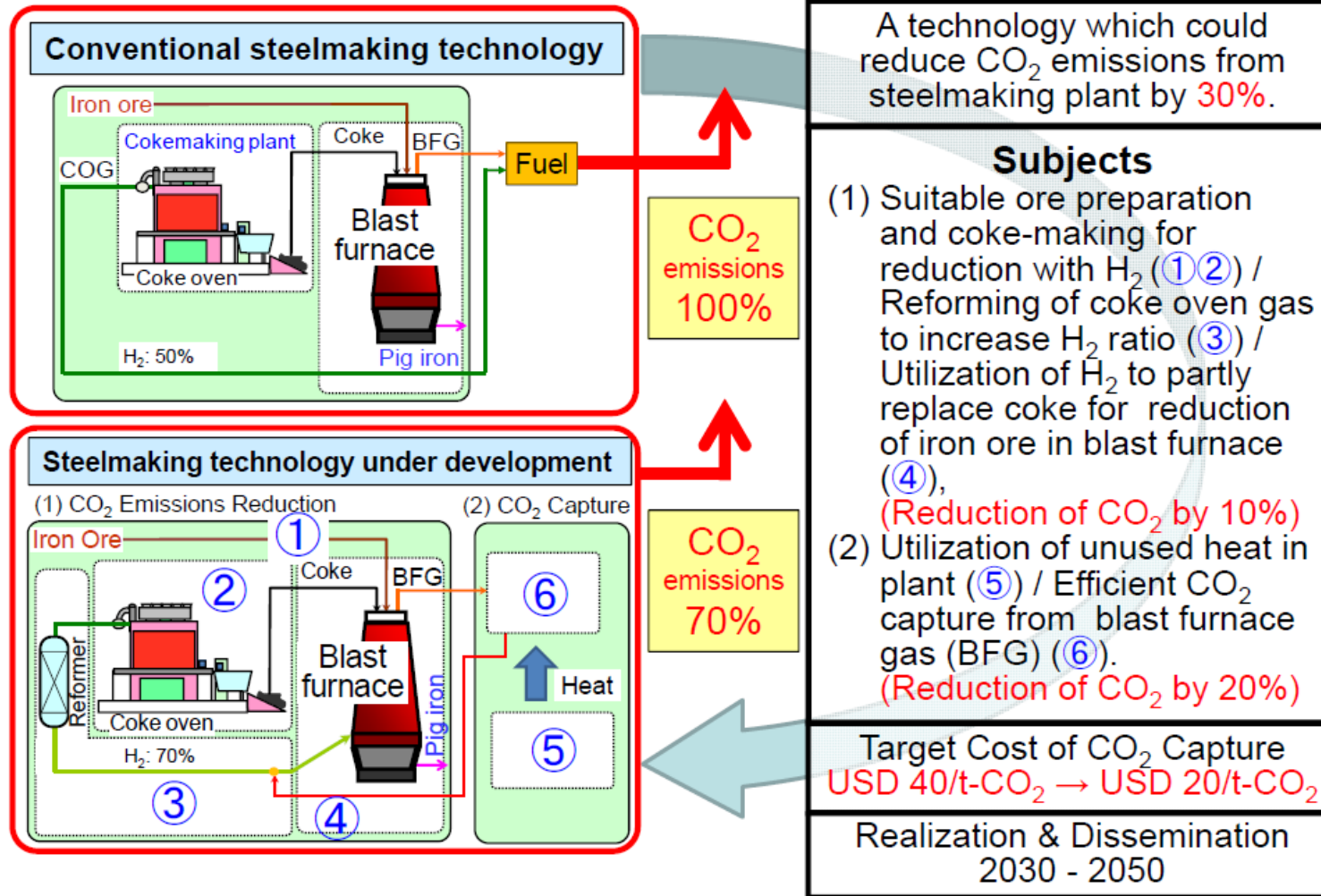


(Source ) Chugoku Electric Power Co, 2014

# COURSE50 Project

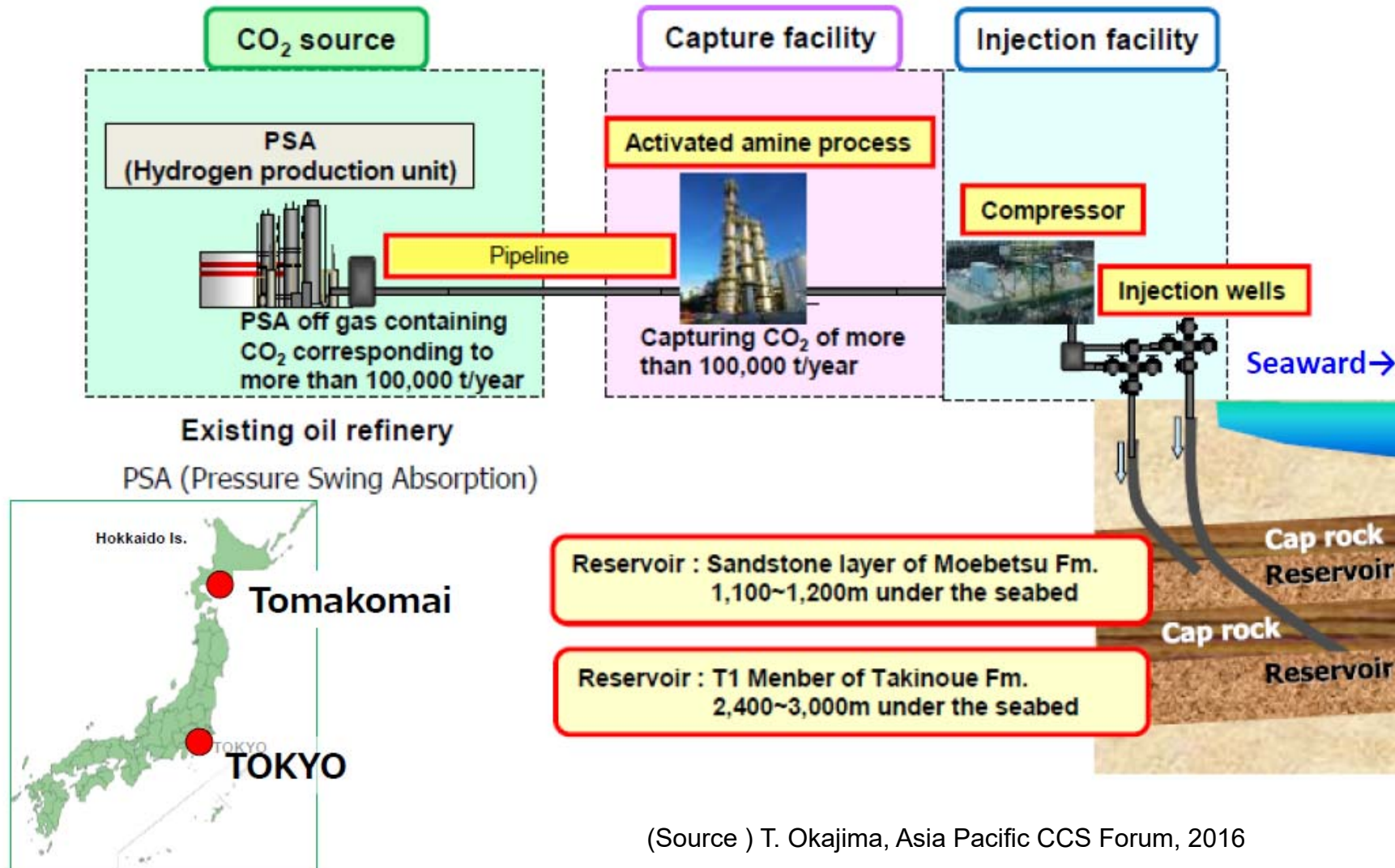
## Emission reduction from ironworks with various measures including CO<sub>2</sub> capture

Projects



(Source ) N. Zaima, Clean Coal Day 2015

# Tomakomai CCS Demonstration Project

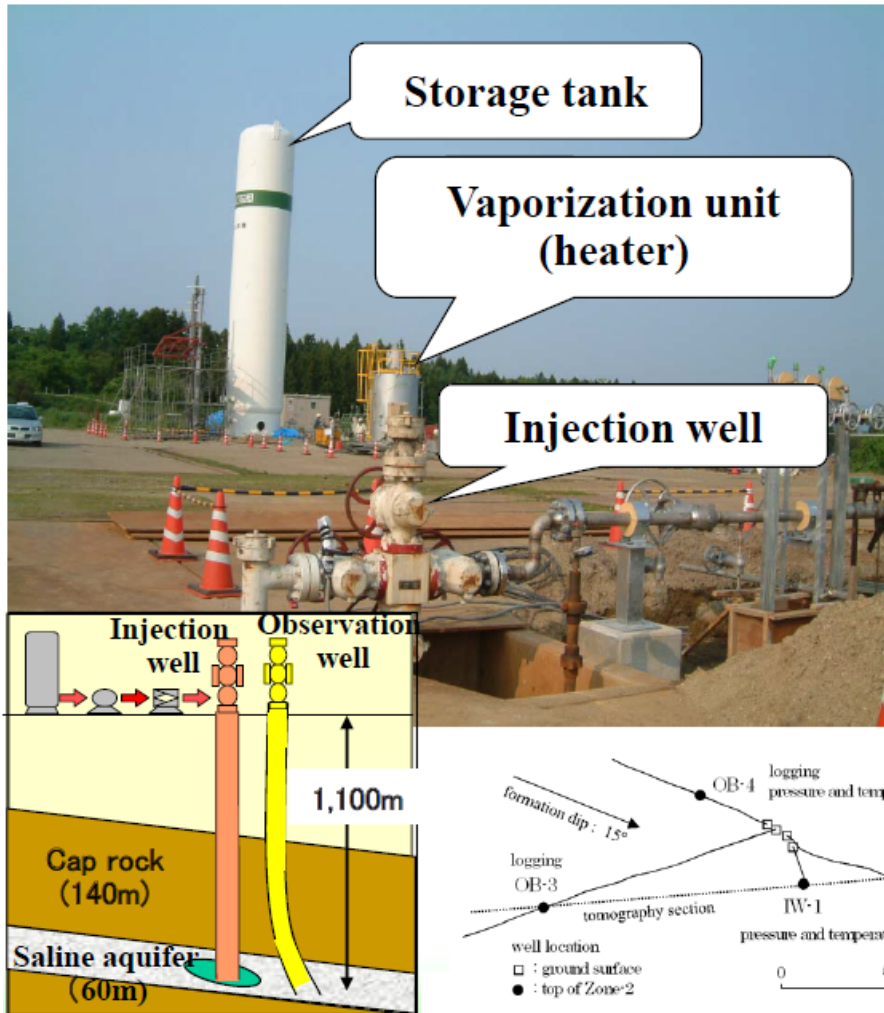


(Source ) T. Okajima, Asia Pacific CCS Forum, 2016

# RITE/ENAA - NAGAOKA project

## Geological Storage Experiment

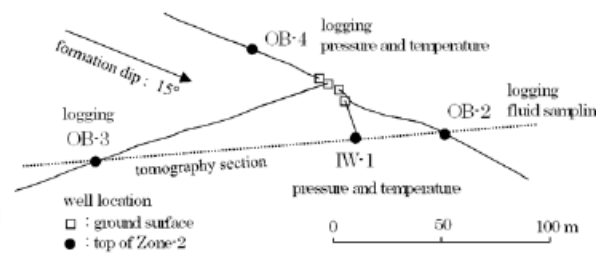
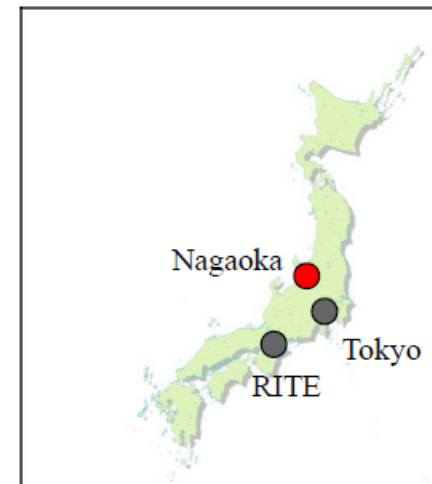
Projects



Location :  
Nagaoka, Niigata pref.

Amount of injected CO<sub>2</sub> :  
10,000 tons

Period :  
July 2003 —  
January 2005



(Source ) H. Tsuzuku, Clean Coal Day 2015

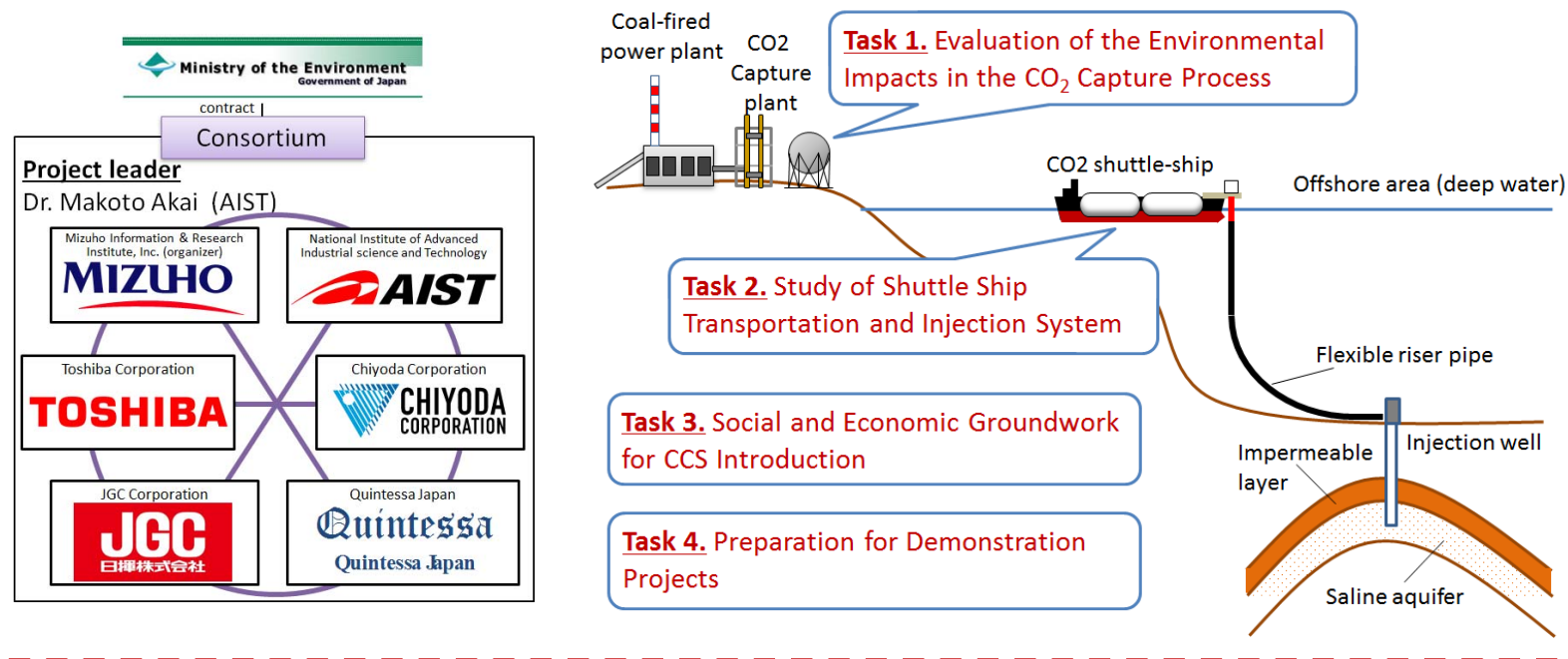


# CCS R&D under the Ministry of Environment (2014 - )

Projects



1. Survey and Identification of CO<sub>2</sub> Storage Site
2. Feasibility Study for the Introduction of Sustainable CCS Technology (Phase 1: 2014 – 2015; **Phase 2: 2016 - 2020**)



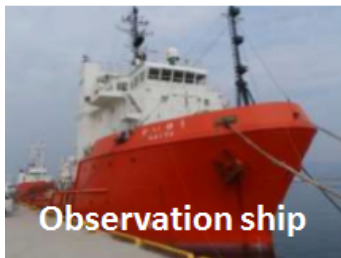
- Phase 2 include 1) demonstration of **large scale capture plant** for existing coal fired power plant, and 2) strategic studies for CCS to become a vital policy option in Japan.

# Survey and Identification of CO2 Storage Site (2014 – 2021)

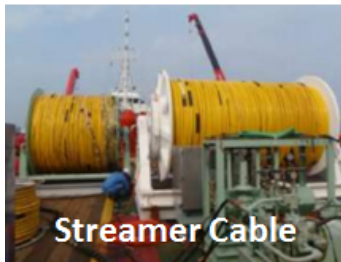
Projects



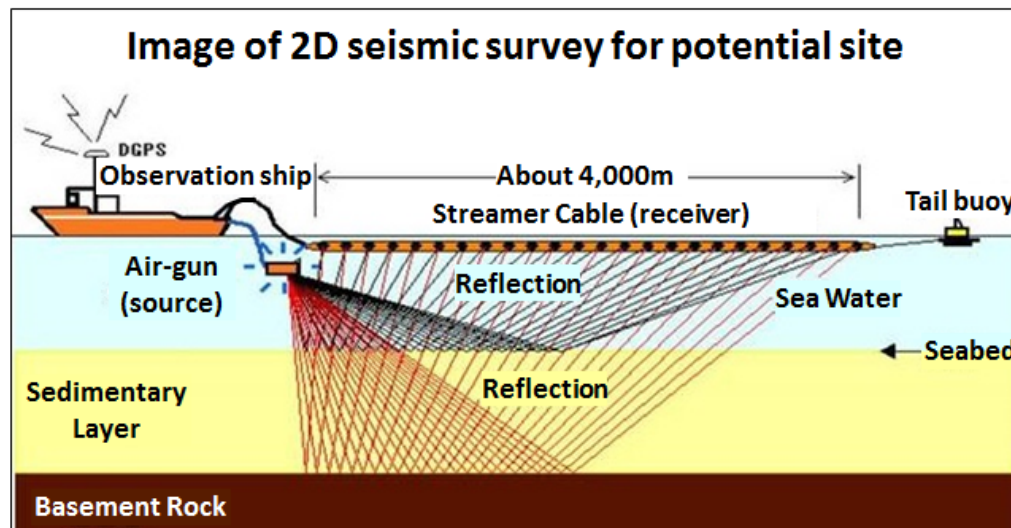
- **Co-sponsored project under the Ministry of Environment (MOE) and the Ministry of Economy, Trade and Industry (METI)**
  - **To identify potential CO2 storage sites in waters surrounding Japan through two and/or three-dimensional seismic and boring surveys**



Observation ship

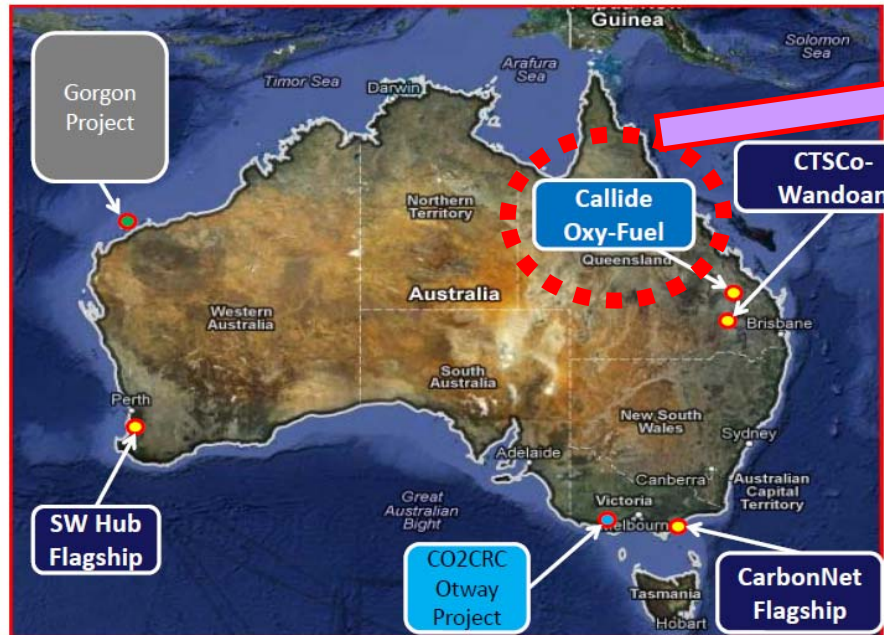


Streamer Cable



# Callide Oxyfuel Project (2004 – 2015)

Intl' Projects



## ■ Project objectives

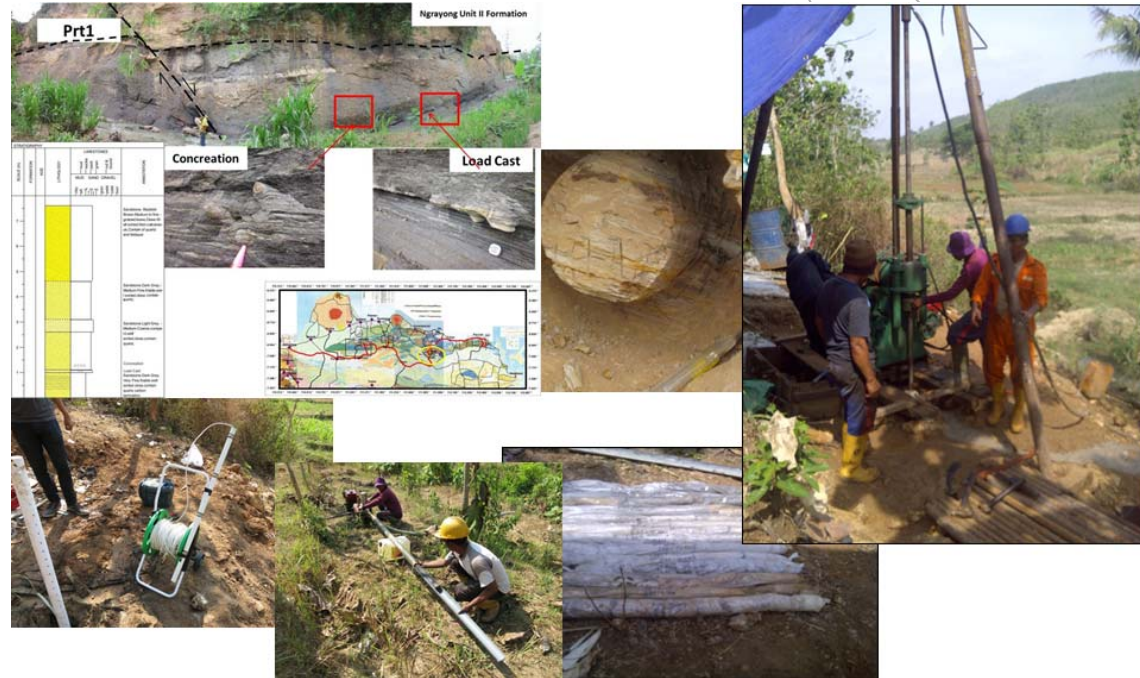
- Demonstrate a complete and integrated process of oxy-fuel combustion with CO<sub>2</sub> capture as the main goal, and near zero emissions of NO<sub>x</sub>, SO<sub>x</sub>, Mercury and other heavy metals.
- Obtain detailed engineering design and costing data, and operational experience

# CCS Pilot Project at Gundih Field, Central Java, Indonesia

Intl' Projects



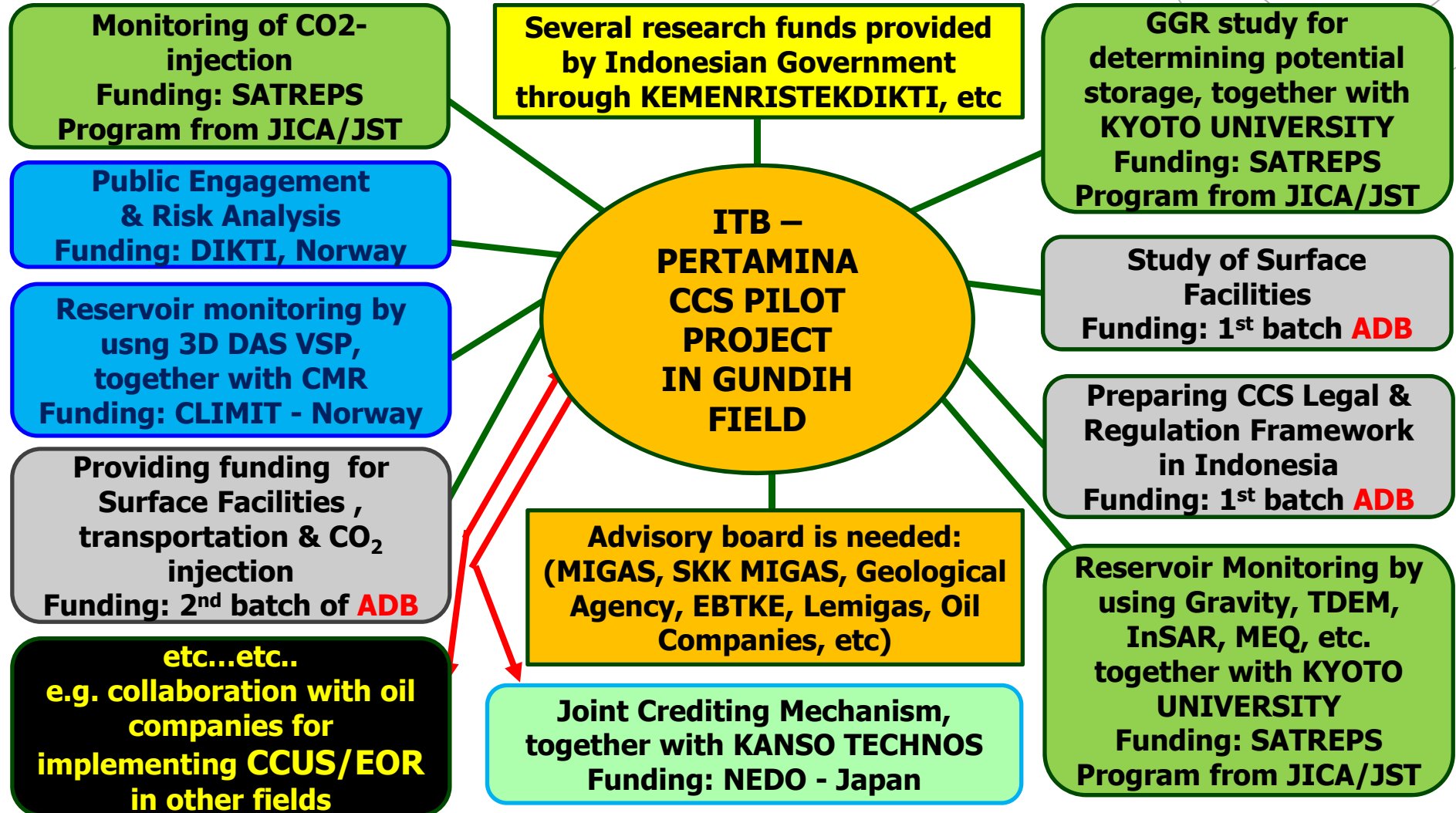
- Started in 2012 under the SATREPS program as an international joint research project between Indonesia and Japan with the leadership of Kyoto University.



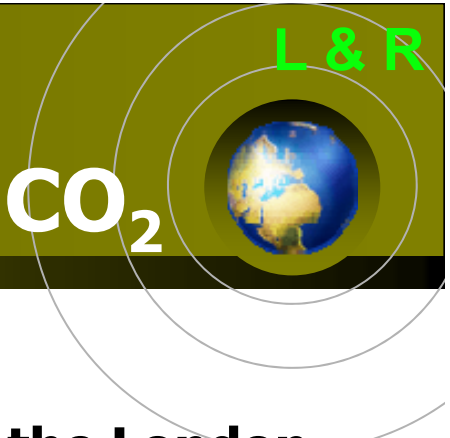
- SATREPS is a Japanese government program that promotes international joint research. The program is structured as a collaboration between the Japan Science and Technology Agency (JST), which provides competitive research funds for science and technology projects, and the Japan International Cooperation Agency (JICA), which provides development assistance (ODA).
- Based on the needs of developing countries, the program aims to address global issues and lead to research outcomes of practical benefit to both local and global society.

# Gundih CCS Pilot Project (initial activity, 2012-2025)

Intl' Projects



# Regulatory Framework for Sub-seabed Storage of Captured CO<sub>2</sub>



## Background

- In conjunction with the amendment of Annex I to the London Protocol 1996 in order to manage and implement CO<sub>2</sub> sequestration in **sub-seabed geological formations** in an appropriate manner.

## September 25, 2006

- Environment Minister consulted Central Environment Council

## February 20, 2007

- The Council submitted the report to the Minister.

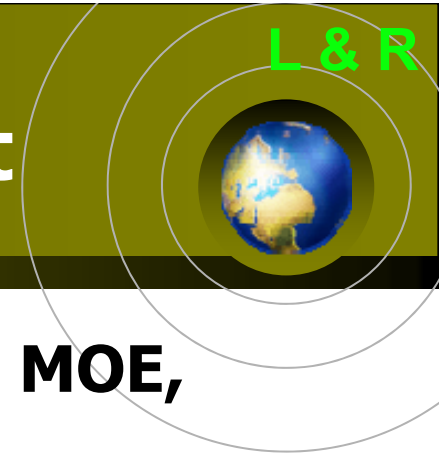
## March 9, 2007

- Draft bill on the **revision of Marine Pollution Control Law** was submitted to the Diet.

## May 23, 2007

- The bill was adopted by the Diet (promulgated on May 30).

# Documents Required for a Permit



- **Application for a Permit (Ordinance of the MOE, Article 1)**
  - **Project Plan**
  - **Monitoring Plan**
- **Attachments (Ordinance of the MOE, Article 4 and 5 )**
  - 1. Site selection report**
  - 2. Environmental impact assessment report**
  - 3. Explanation for no appropriate disposal is available other than sub-seabed storage**
  - 4. Financial capability of the applicant**
  - 5. Technical capability of the applicant**
  - 6. Outline of the entire project (beyond permitting period)**

# Public Funding for Typical CCS RD&D in Japan

Governmental Support



Project	Duration	Public Funding (1 USD = 100 Yen)	Note
Research in National Labs. and Universities	1990 - 2000	Several millions of USD	
Supporting R&D in National Labs., Non-profit organizations, etc.	2000 -	Several to tens of millions of USD	
Ocean Sequestration	1997 - 2008	\$82M	
Nagaoka Proj.	2000 - 2008	\$71M	
ECBM (Yubari Proj.)	2002 - 2007	\$17M	
Tomakomai Demo Proj.	2008 - 2020	\$610M (- 2016)	
COURSE50	2008 - 2017	\$251M (- 2016)	
Osaki CoolGen Demo Proj.	2012 – 2020 (Step 1 & 2)	\$326M (- 2016)	Public-Private Partnership
Survey of Storage Site	2014 - 2021	\$76.5M (- 2016) METI: \$32.5M; MOE:\$44M	
MOE CCS Proj.	2014 – 2020 (Phase 1 & 2)	Phase 1 (14 – 15): \$12M Phase 2 (16 - 20): > \$180M (?)	

NOTE: The figures are derived from publicly available documents by the author, and might not always be correct.



# Summary – Observation and Issues



## ■ Political uncertainties for the CCS

- CCS is not included in the mitigation portfolio for 2030 both in *INDC* and *Plan for Global Warming Countermeasures*



- Basic Energy Plan(2014) says “ ... accelerate technology development of CCS for the practical use of CCS technology around 2020”.

- Agreement of METI & MOE (April 2013) suggests:

- In relation to 2050 goal of GHG emission reduction:
  - To accelerate **technology development of CCS** and conduct **survey on potential CO<sub>2</sub> storage sites** for **commercialization of CCS by around 2020**
  - To **consider introduction of CCS at coal-fired power plants by 2030** and identify **requirements for CCS Ready**

## ■ Consolidation of political, legal and regulatory framework to establish enabling environment