CCS2020

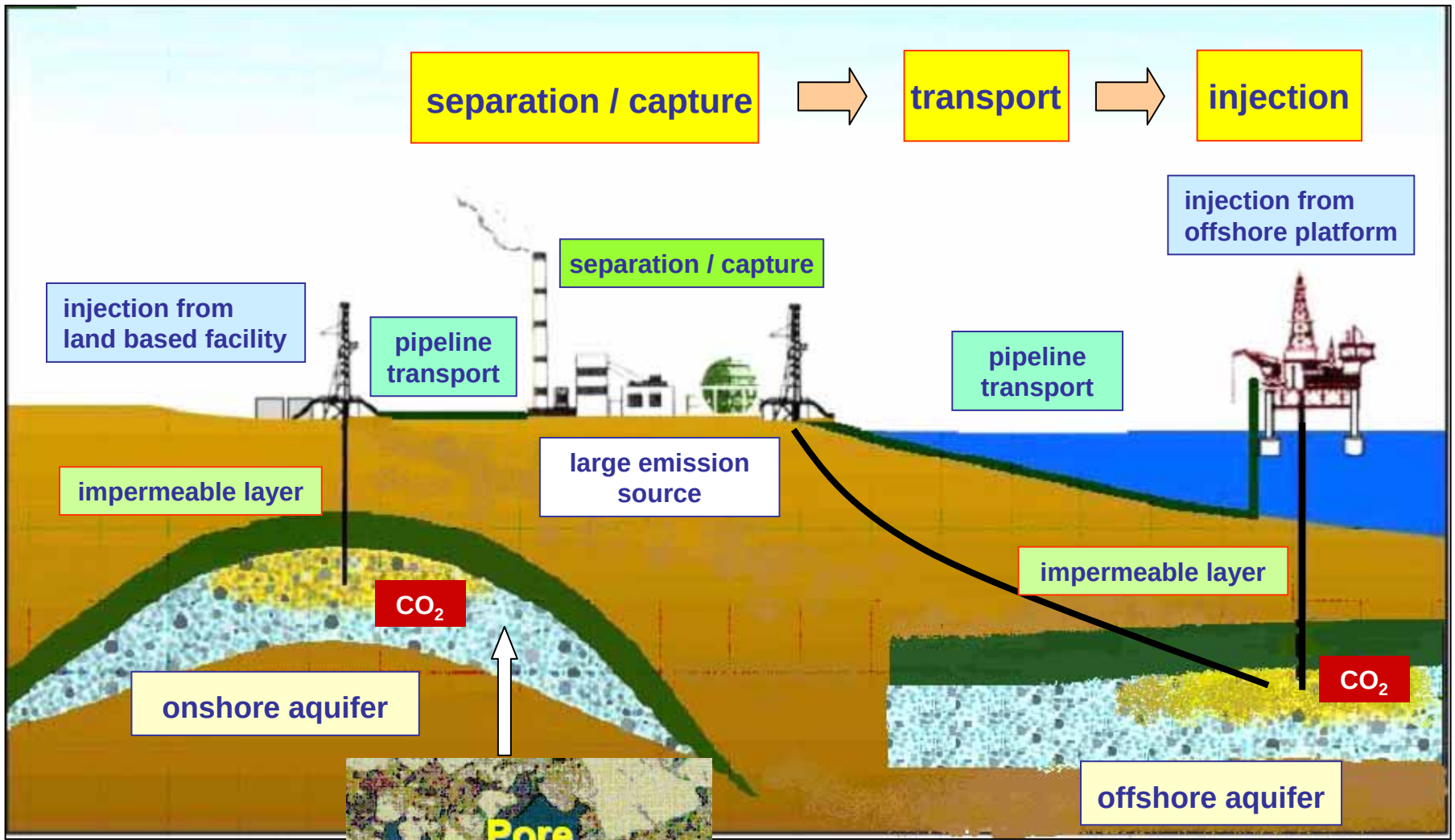
Japanese R&D Policy Option on CO_2 Capture and Its Geological Storage

February 15th, 2007

Ministry of Economy, Trade and Industry

Industrial Science and Technology Policy and Environment Bureau

Schemes of CO_2 Capture and Its Geological Storage

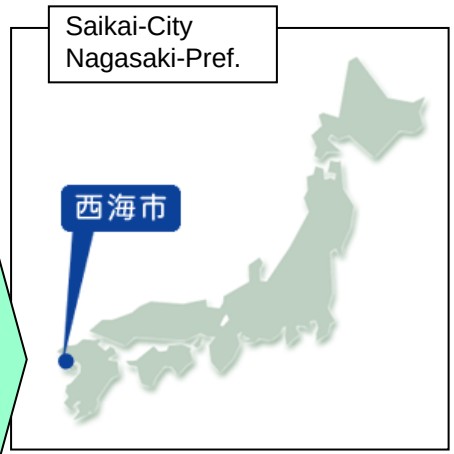


microscopic photo of aquifer rock:

CO_2 will fill the pore space

CO_2 Capture from Coal fired Power Plant Flue Gas Long Term Demonstration Test

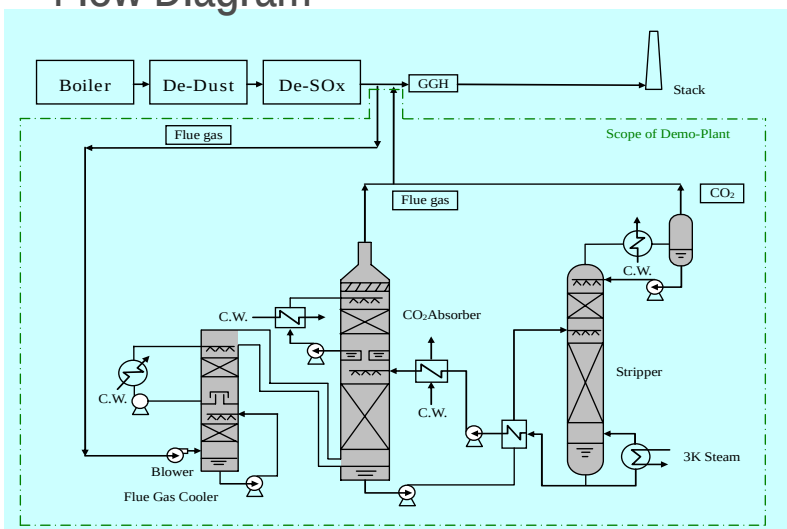
Plant Overview



Plant Outline

Organization	Mitsubishi Heavy Industries, LTD.
Location	J-POWER Matsushima Power Station
Flue Gas Source	Coal Fired Boiler
Flue Gas Volume	1,750 Nm3/h
Recovered CO_2	10 t-CO_2/d
CO_2 Content	14.1 v%
Impurities	Dust, SOx, NOx. etc.
Solvent	KS-1 Solvent

Flow Diagram



Schedule

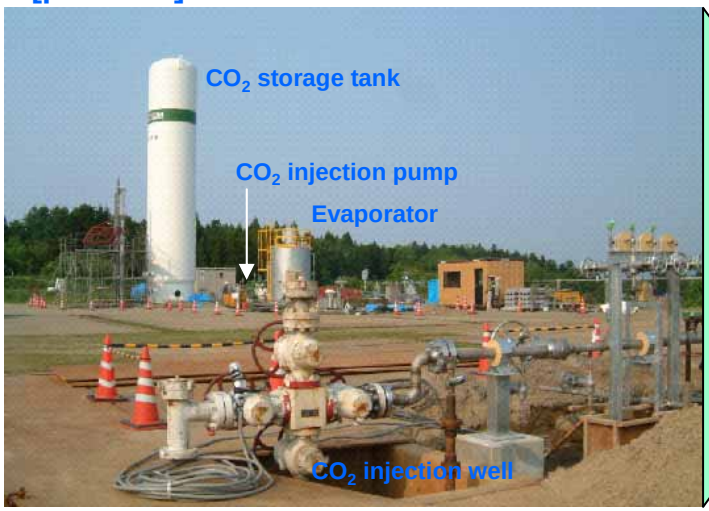
	2004		2005 FY				2006 FY			
1.Engineering	━	━	━	━	━	━				
2.Manufacturing			━	━	━	━				
3.Construction					━	━				
4.Commissioning							━			
5.Demo-Test								━	━	

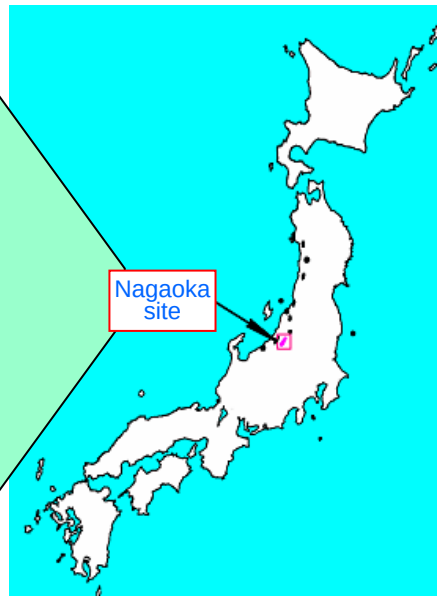
Note:
This program is supported by Japanese Government subsidy through Research Institute of Innovative Technology for the Earth (RITE) and J-Power's cooperation.

MITSUBISHI HEAVY INDUSTRIES, LTD.

Project Nagaoka

[pilot site]

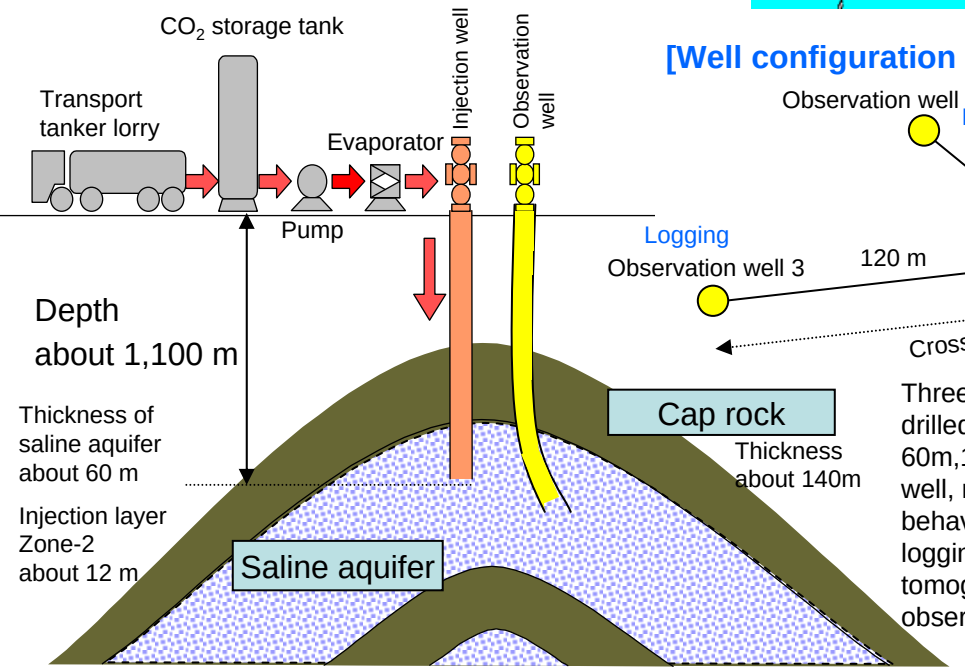




[Project overview]

Organization	Research Institute of Innovative Technology for the Earth (RITE)
Project period	2000 FY to 2007 FY
CO_2 injection period	Jul. 2003 to Jan. 2005
CO_2 injected amount	about 10,400 t-CO_2
CO_2 injection rate	20 to 40 t-CO_2/day
CO_2 source	purchased commercial CO_2
Monitoring	well logging, crosswell seismic tomography, microseismicity, formation water sampling, etc.
Misc.	Not affected by the earthquake (M 6.8) occurred in Chuetsu, Niigata prefecture on 23rd Oct. 2004

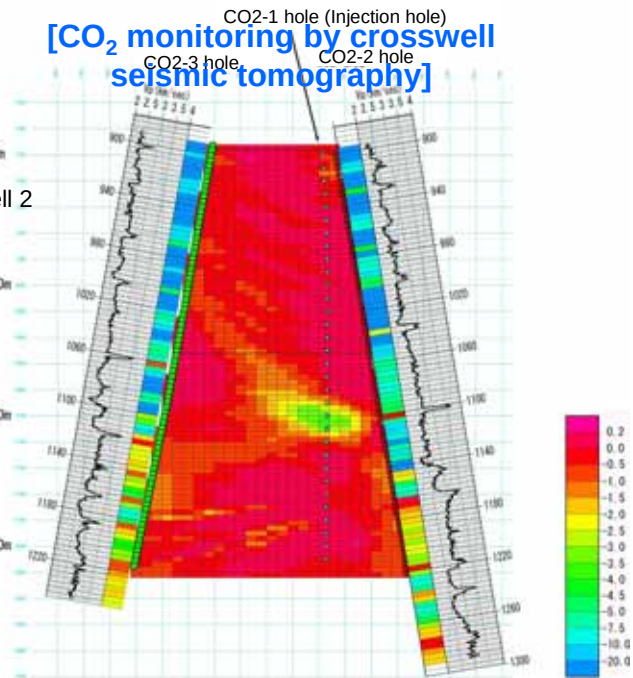
[Outline of injection demonstration experiment]



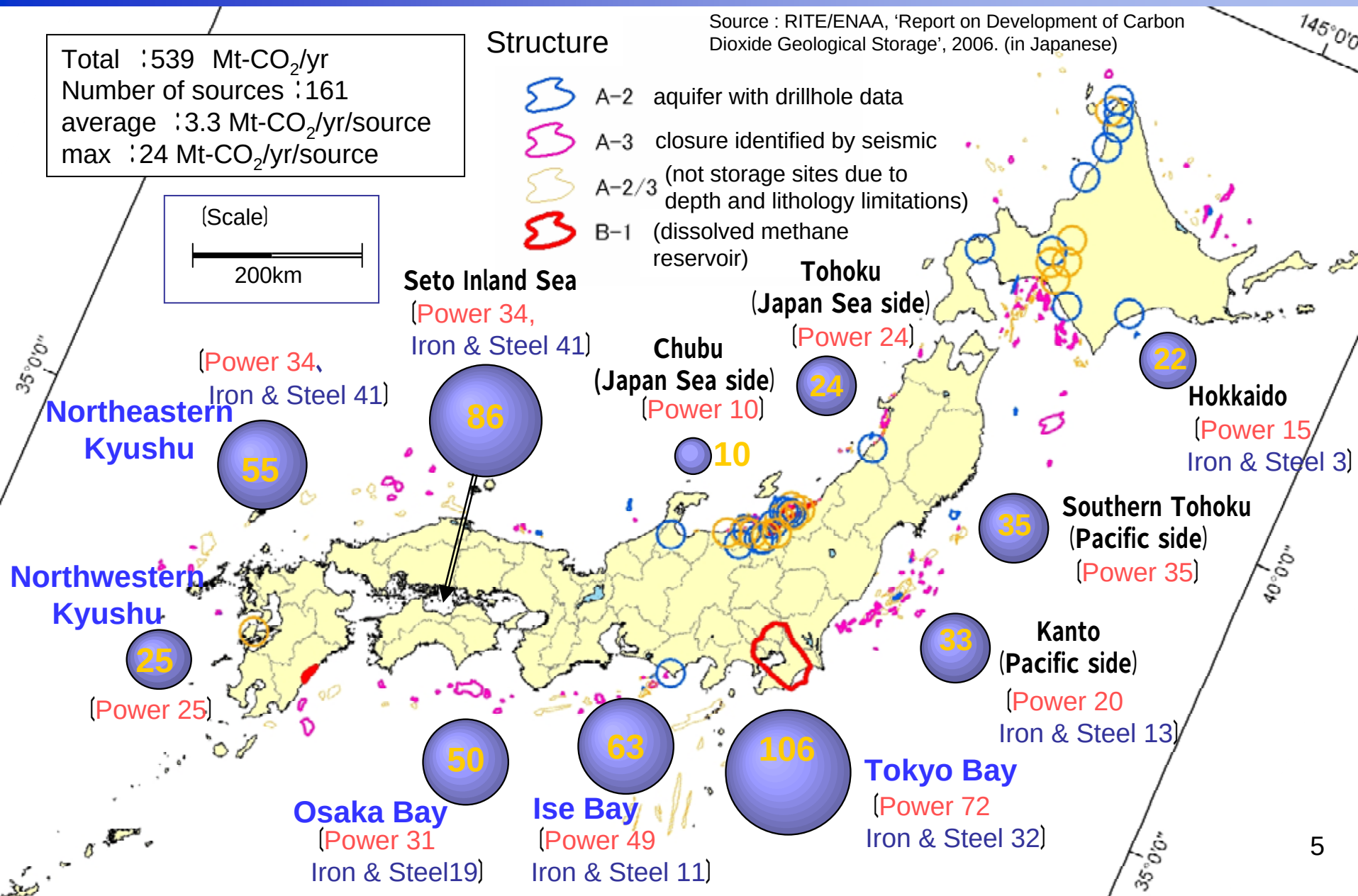
[Well configuration at the top reservoir]

Three observation wells are drilled on the sites that are 40m, 60m,120m away from injection well, respectively. CO_2 behaviour is observed by well logging and crosswell seismic tomography using the observation wells.

[CO_2 monitoring by crosswell seismic tomography]

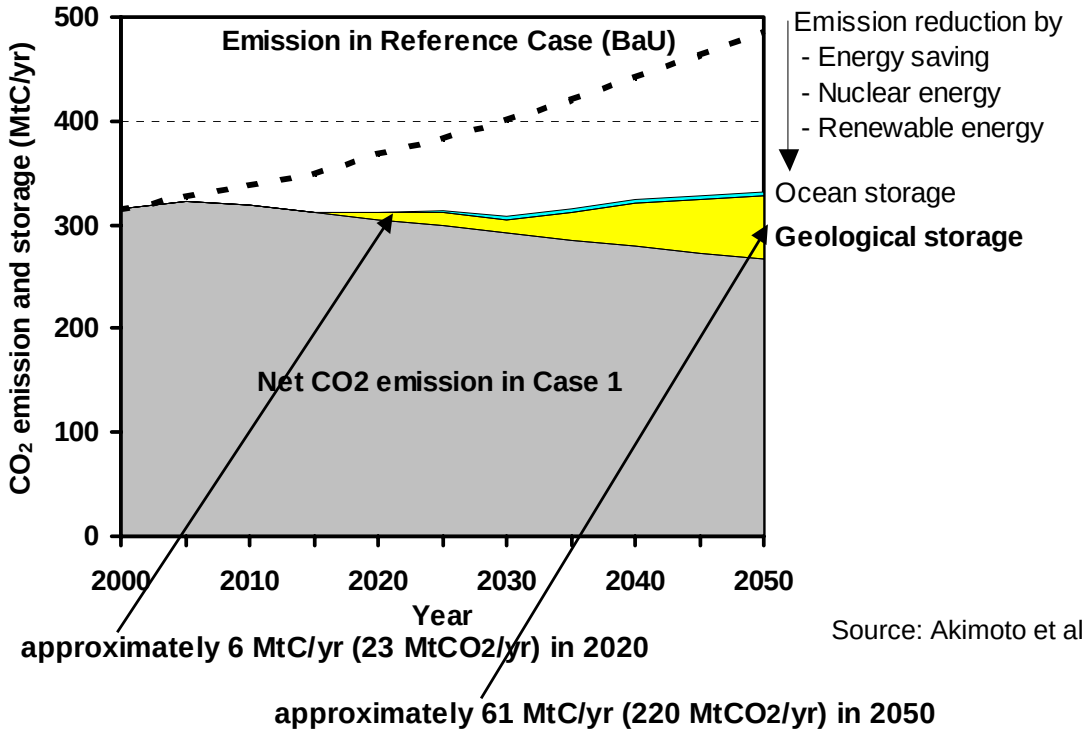


Main Emission Sources and Reservoirs



Economic Potentials of CO_2 Geological Storage under an Emission Reduction Scenario of Japan

- According to a recent study, the capacity of CO_2 geological storage in Japan is estimated to be 5.2 Gt-CO_2 even if only aquifers having anticline structure and actual boring data are considered. The capacity will be approximately 150 Gt-CO_2 if all the deep saline aquifers are considered.
- About half of 5.2 Gt-CO_2, which is the capacity of aquifers having anticline structure and actual boring data, will be included in the cost-effective options by 2050 under an emission reductions scenario that per GDP emissions should be reduced to half of that in 2000.

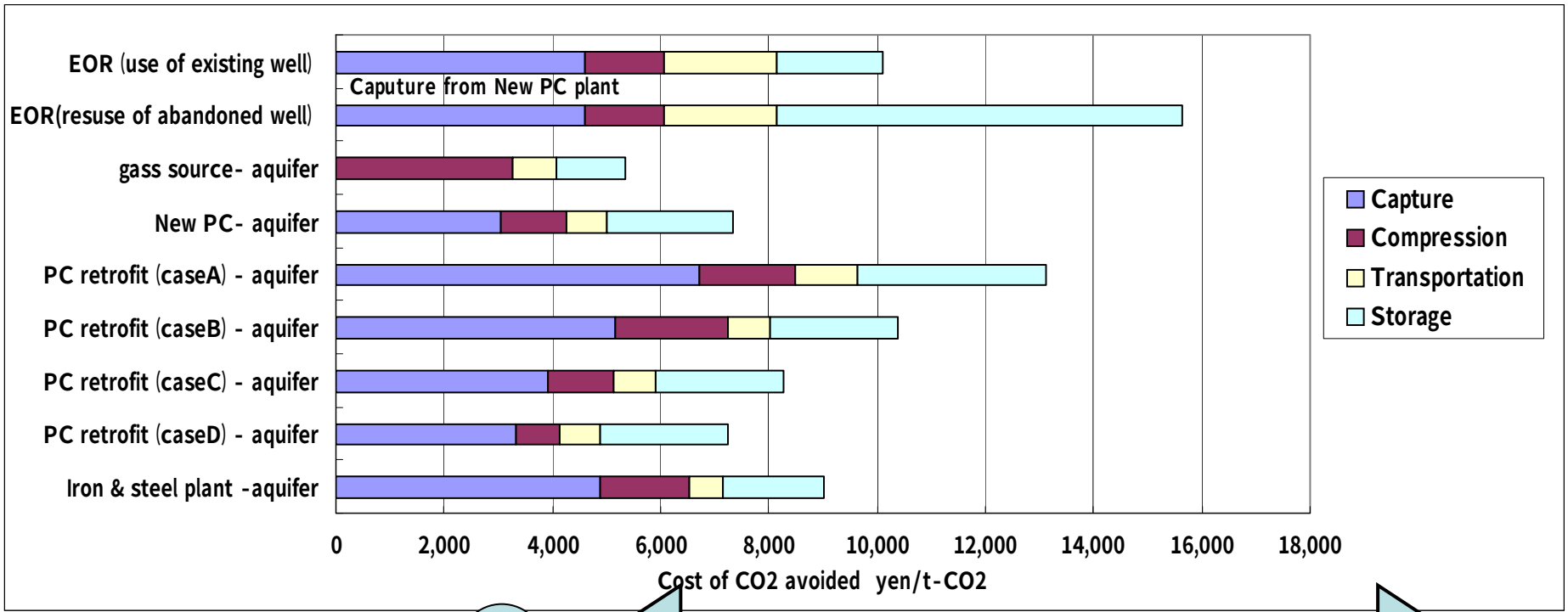


Source: Akimoto et al., GHGT8, 2006

- METI and RITE are developing technologies reducing costs of CO_2 geological storage, and the economical potentials are expected to become larger through the cost reduction by the development. In addition, the economical potentials will increase to a large extent when all the deep saline aquifers of Japan are investigated and appropriate aquifers are selected.

Current Cost of Capture and Storage in Japan

- Current CCS cost was estimated to be 5,000 – 10,000 yen/t-CO_2 avoided.
- 3,000 yen/t-CO_2 avoided was adopted as a target cost of CCS out of consideration of marginal mitigation cost in 2010.



Target

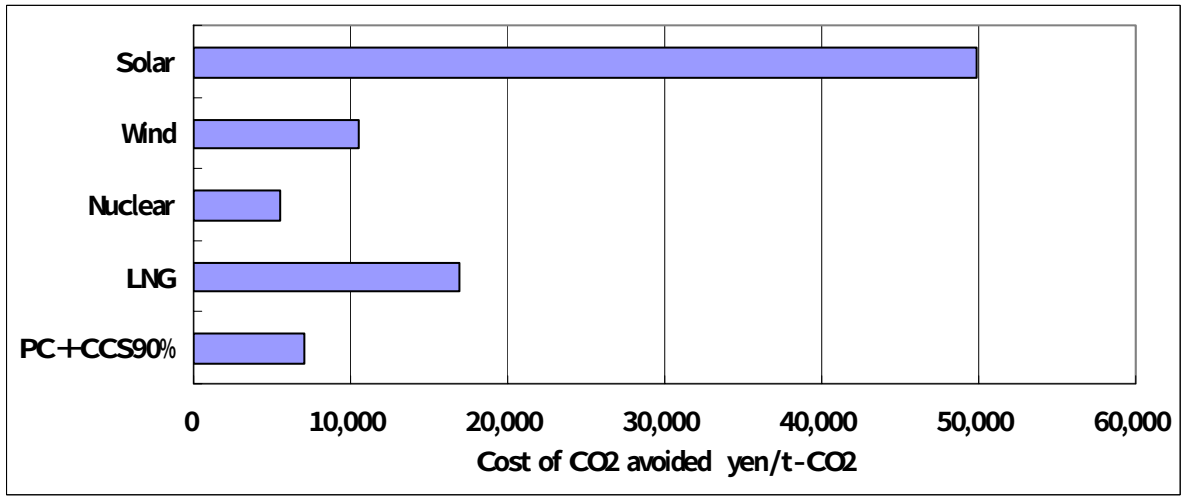
Marginal mitigation cost in 2010 for achieving goal of Kyoto Protocol (IPCC TAR)
97-645 US$/t-C (1990 base) →3,830-25,450 yen/t-CO2

* Baseline assumption: amount of CCS 1Mt-CO2/yr、Transportation distance 20 km、Injection pressure 10 MPa, ERD, Potential injection rate per well :0.1 Mt-CO2/yr
* New pulverized coal power plant :cost of electricity 5 yen/kWh
* Pulverized coal power plant retrofit: (case A) auxiliary coal boiler、cost of electricity 5 yen/kWh
  (case B-D) steam extract from steam cycle of power plant, cost of electricity **B**: 10 yen/kWh, C: 5 yen/kWh, D 2.6 yen/kWh
* Iron & steel Industry: steam 2,500 yen/t-steam, electricity 10 yen/kWh
* EOR:0.2 Mt-CO2/yr of CO2 is captured. Transportation distance 20km.
* Gas source: storage 0.1 Mt-CO2/yr, transportation distance 9k**m**

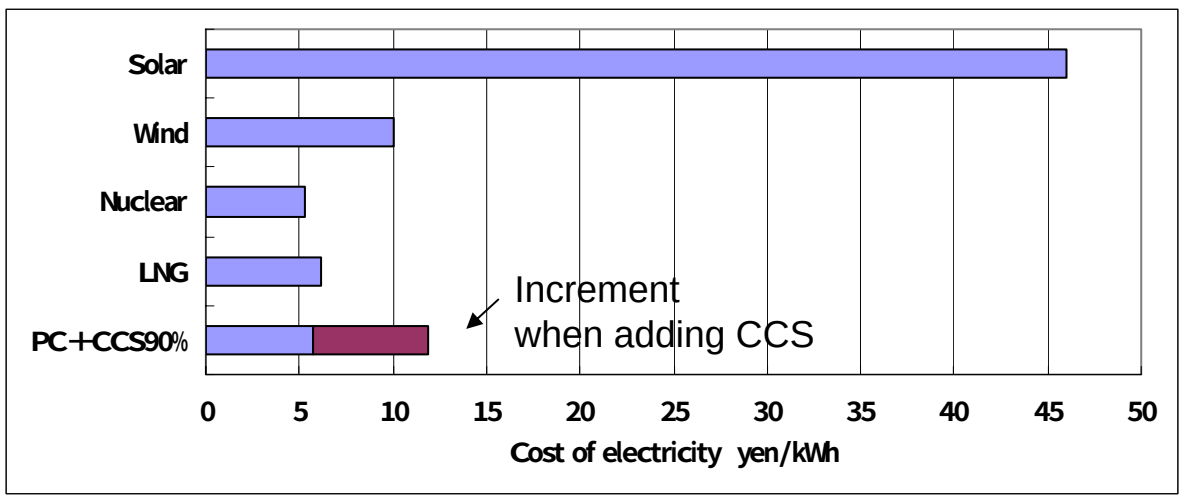
Comparison with Other Mitigation Options

Cost of CO_2 avoided and electricity when pulverized coal power plant being replaced was estimated. (Cost of CCS was assumed to be 7,000 yen/t-CO_2 avoided.)

Cost of CO2 avoided



Cost of electricity



Ref. CO_2 emission rate：Report of CRIEPI
Cost of electricity in PC, LNG conventional, and nuclear power plant：ANRE, METI
Cost of electricity in wind power: NEDO Roadmap, in solar cell：JPEA etc.

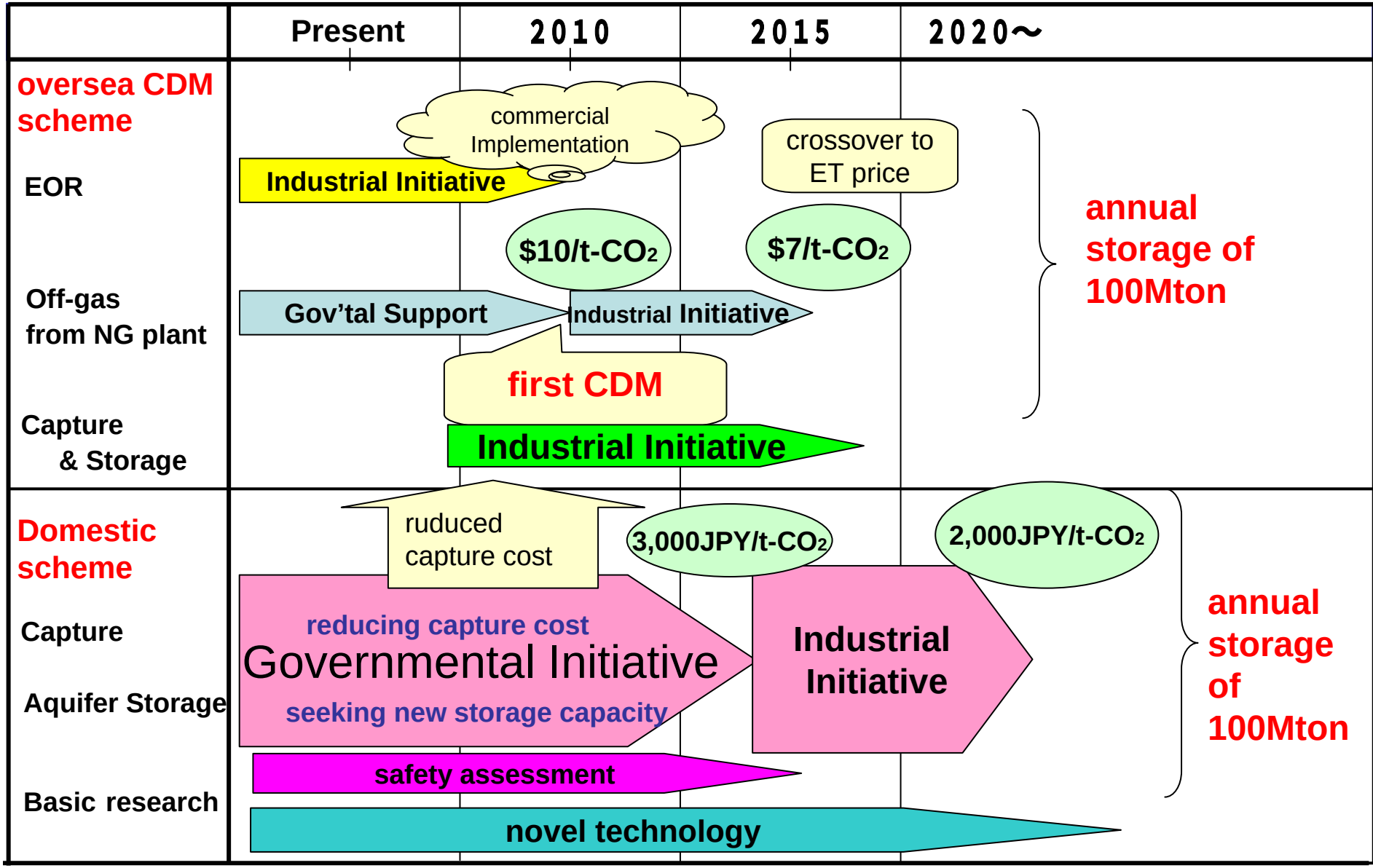
Policy perspective on CCS Implementation

- Governmental Initiative
  - Continued R&DD by governmental initiative to reduce CCS cost lower than 1.5 times level for market-in.
  - Followed by encouragement through regulatory measures.

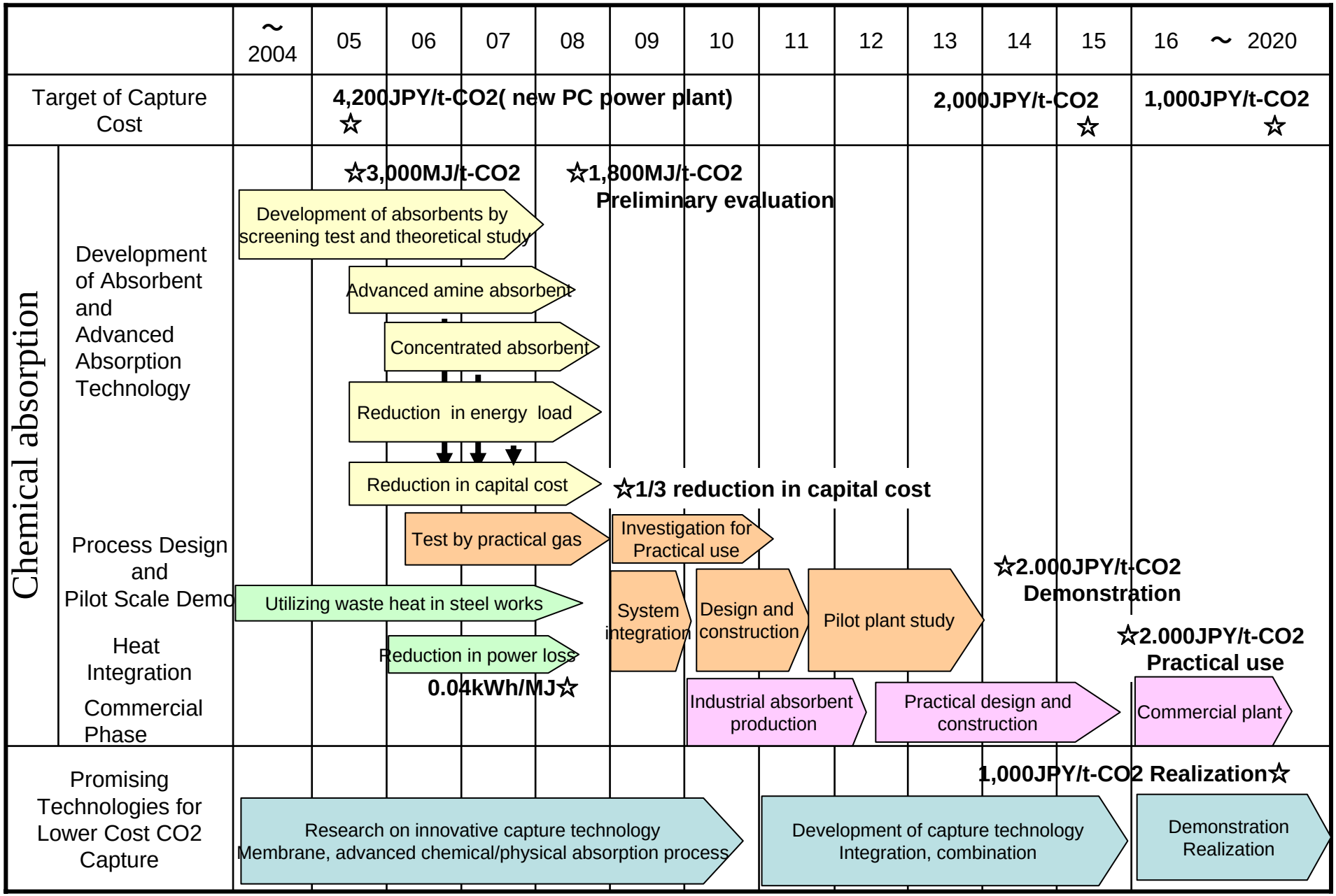
- Overseas Deployment
  - Contribution of CCS to CO_2 concentration level stabilization is the same for those in domestic and overseas deployment.
  - If CCS is regarded as CDM, CCS in overseas contributes to Japan's Commitment to the Kyoto target.

- Stepwise Implementation
  - Early opportunity for storage is encouraged, such as existing streams with high concentration CO_2, where the additional cost is only for compression, transport and injection.
  - Experience in these early opportunities is the key for large scale implementation.

Milestone of Cost and Implemented Storage Rate



CO_2 Capture Roadmap



Road Map of CO_2 Sequestration in Sub-seabed Geological Formations of Japan