

CCS R&D and regulation in Japan

AIST/GSJ
Toshiyuki TOSHA

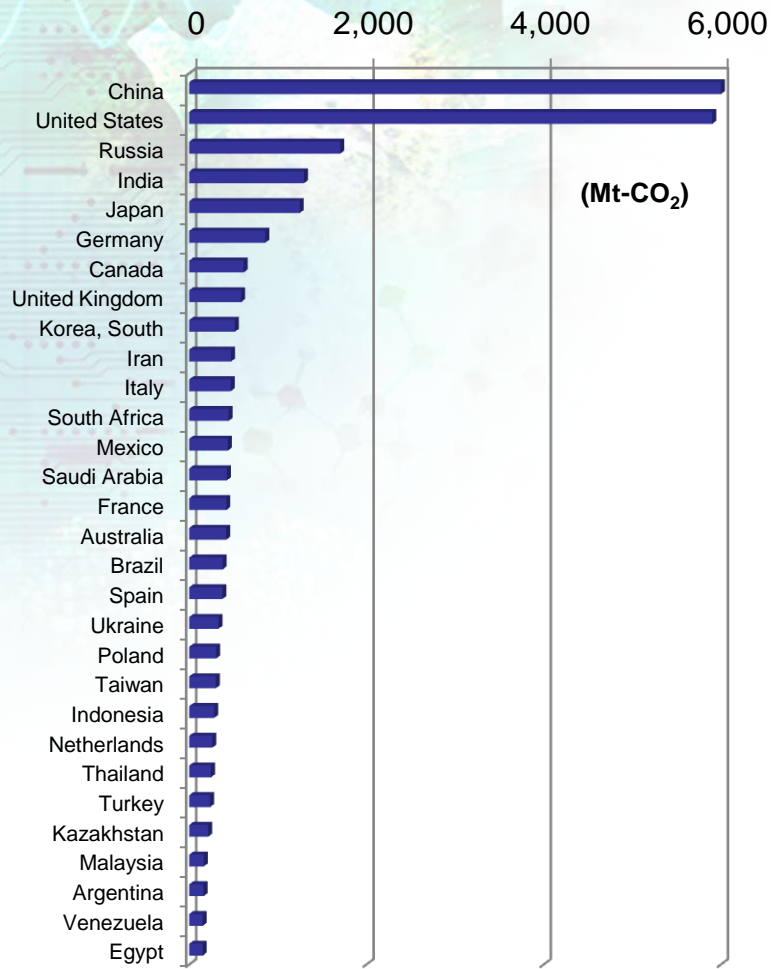
EPPM Program
Seminar on CCS Awareness & Networking of Petroleum Geoscience Institutes in the CCOP Region
16-17 November 2009, Bangkok, Thailand

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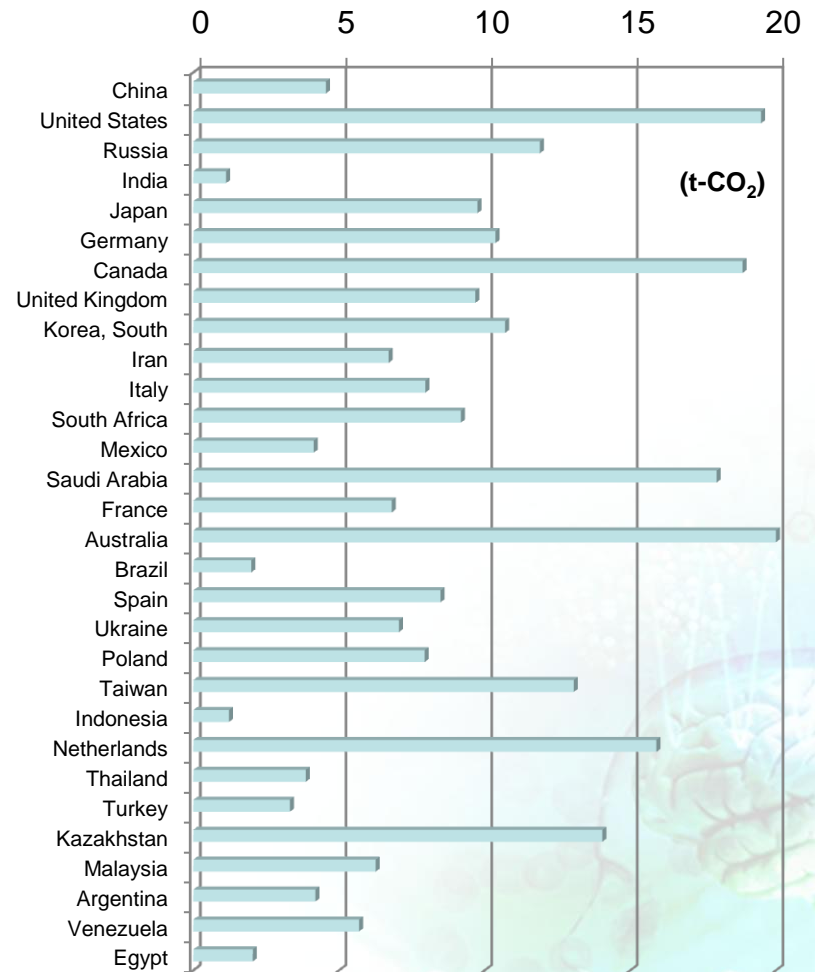
- Annual GHG (CO₂) emission in Japan
- CCS projects in Japan
- CO₂ geological storage studies in AIST
- Regulation and Guideline

CO₂ Emission in the world

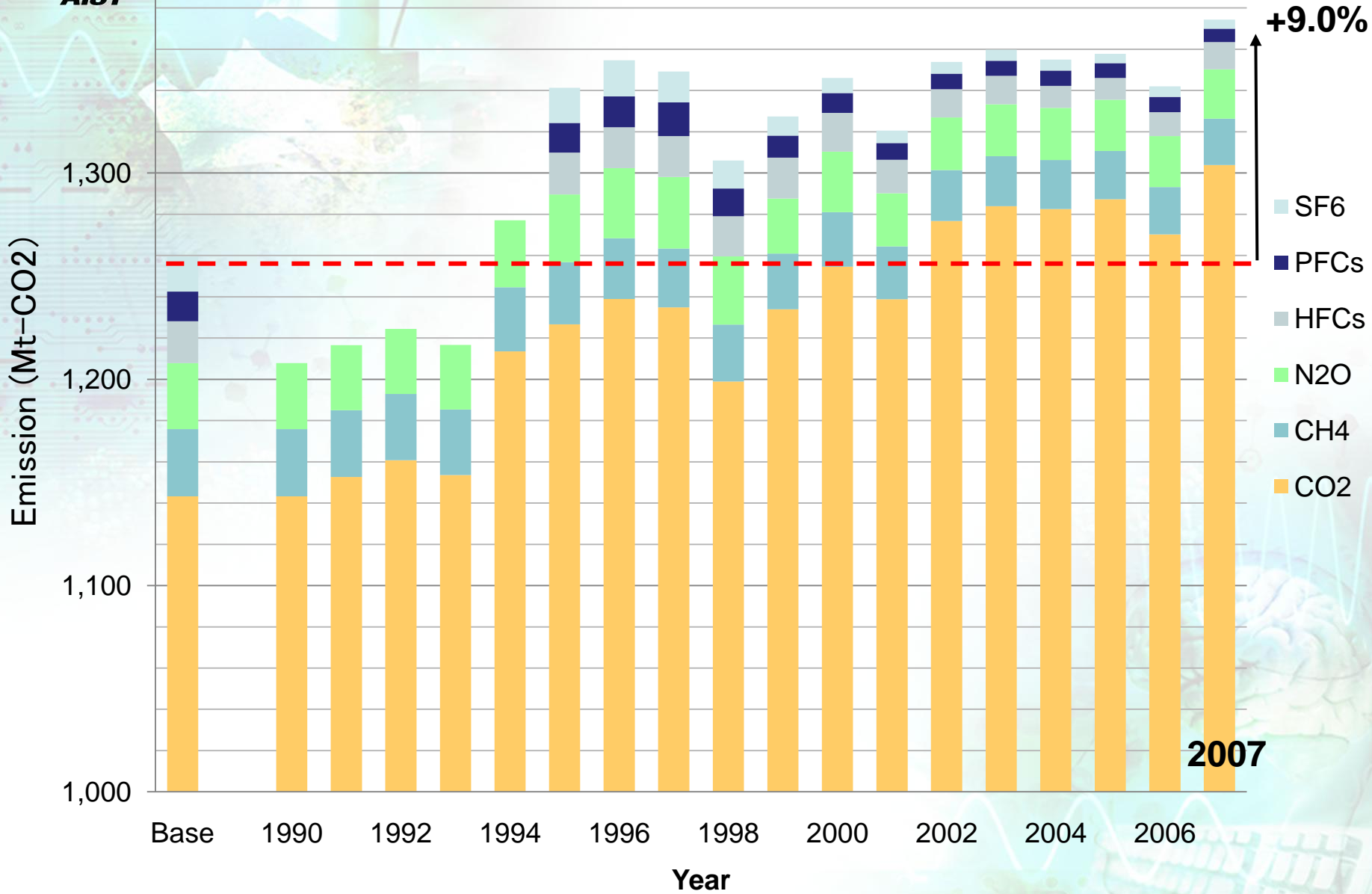
Annual CO₂ Emission in each country



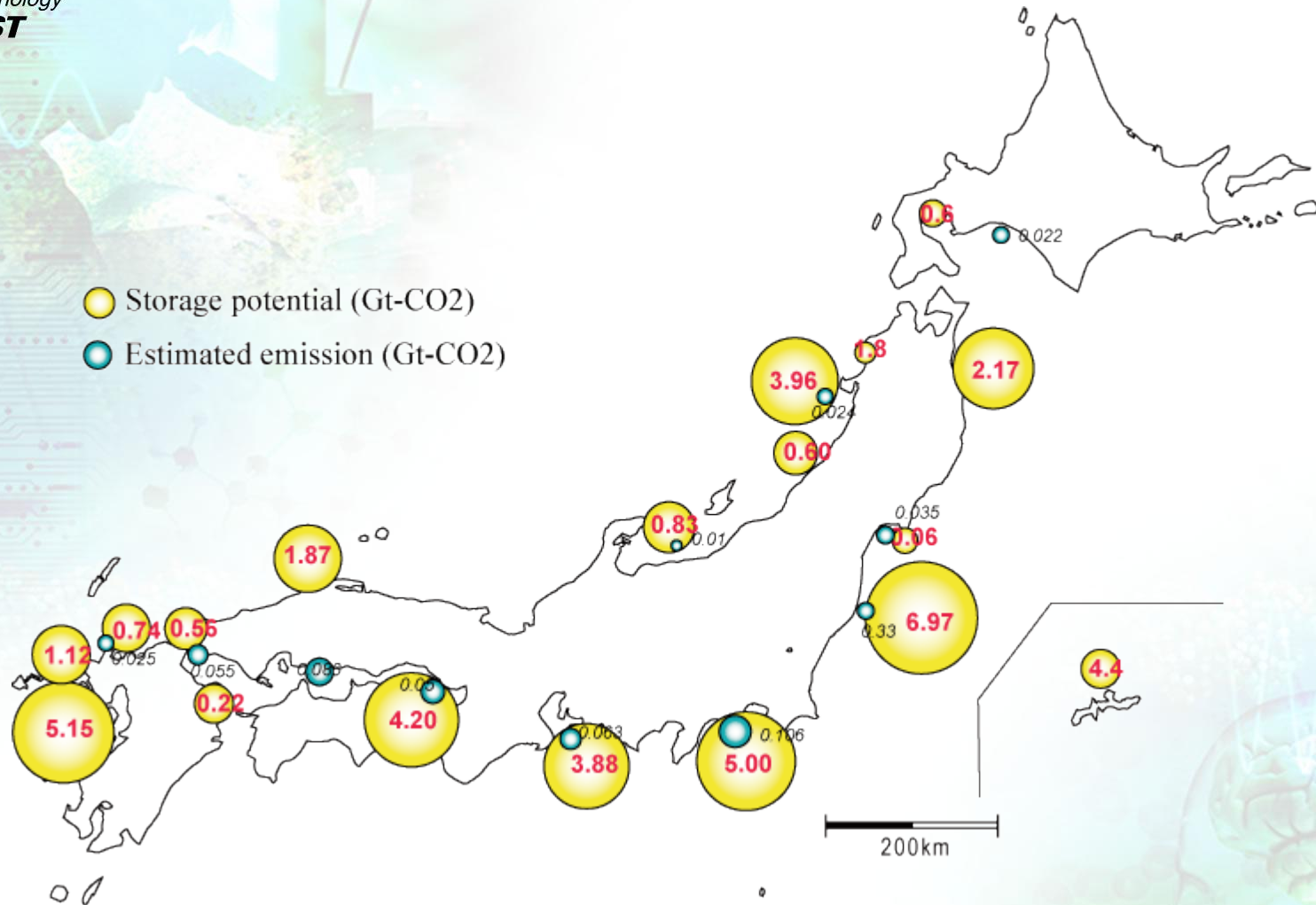
Annual CO₂ Emission in each person



Annual CO₂ Emission in Japan



CO₂ emission and storage potential

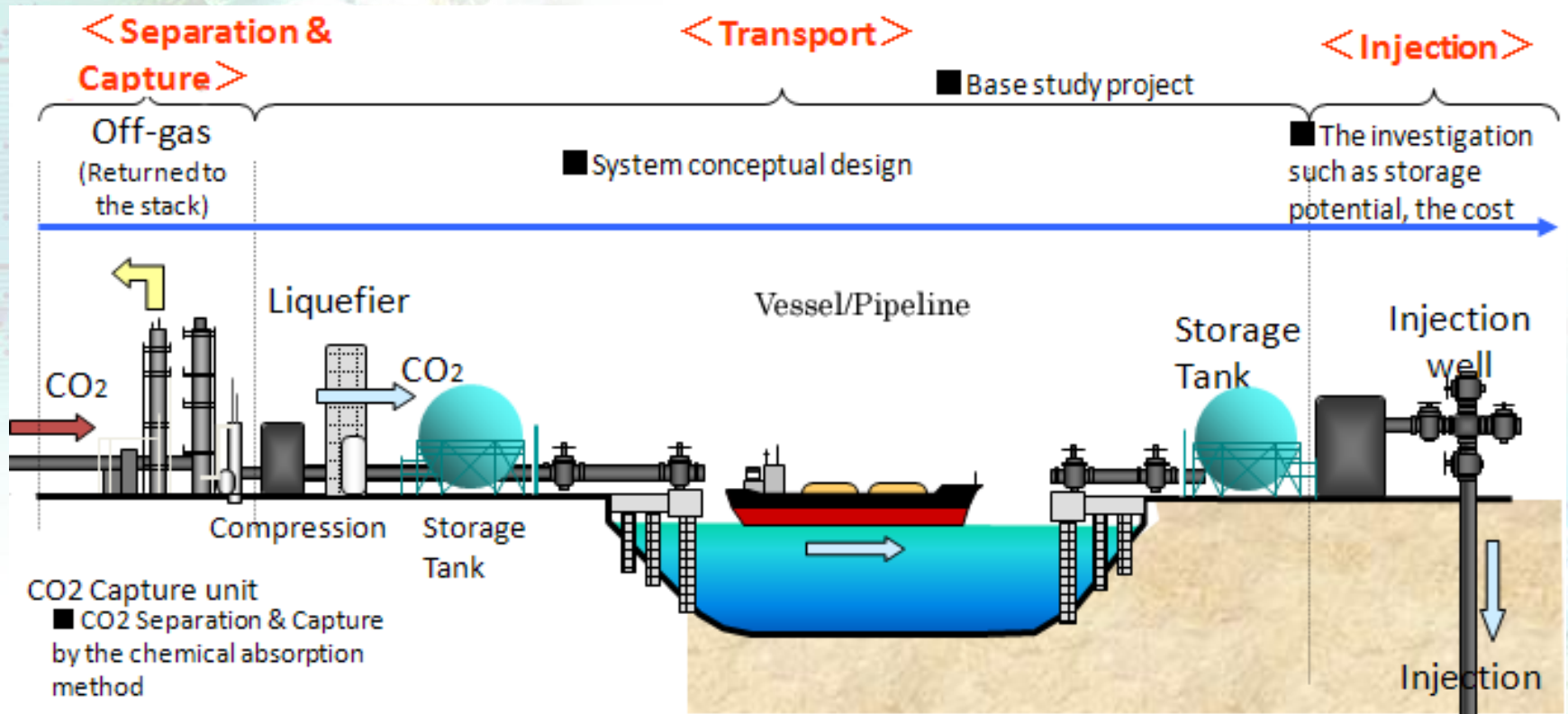


Shallow saline aquifer layers are exposed in middle to southwest Japan. Total storage capacity is estimated to be **141 Gt-CO₂**.

CCS model in Japan

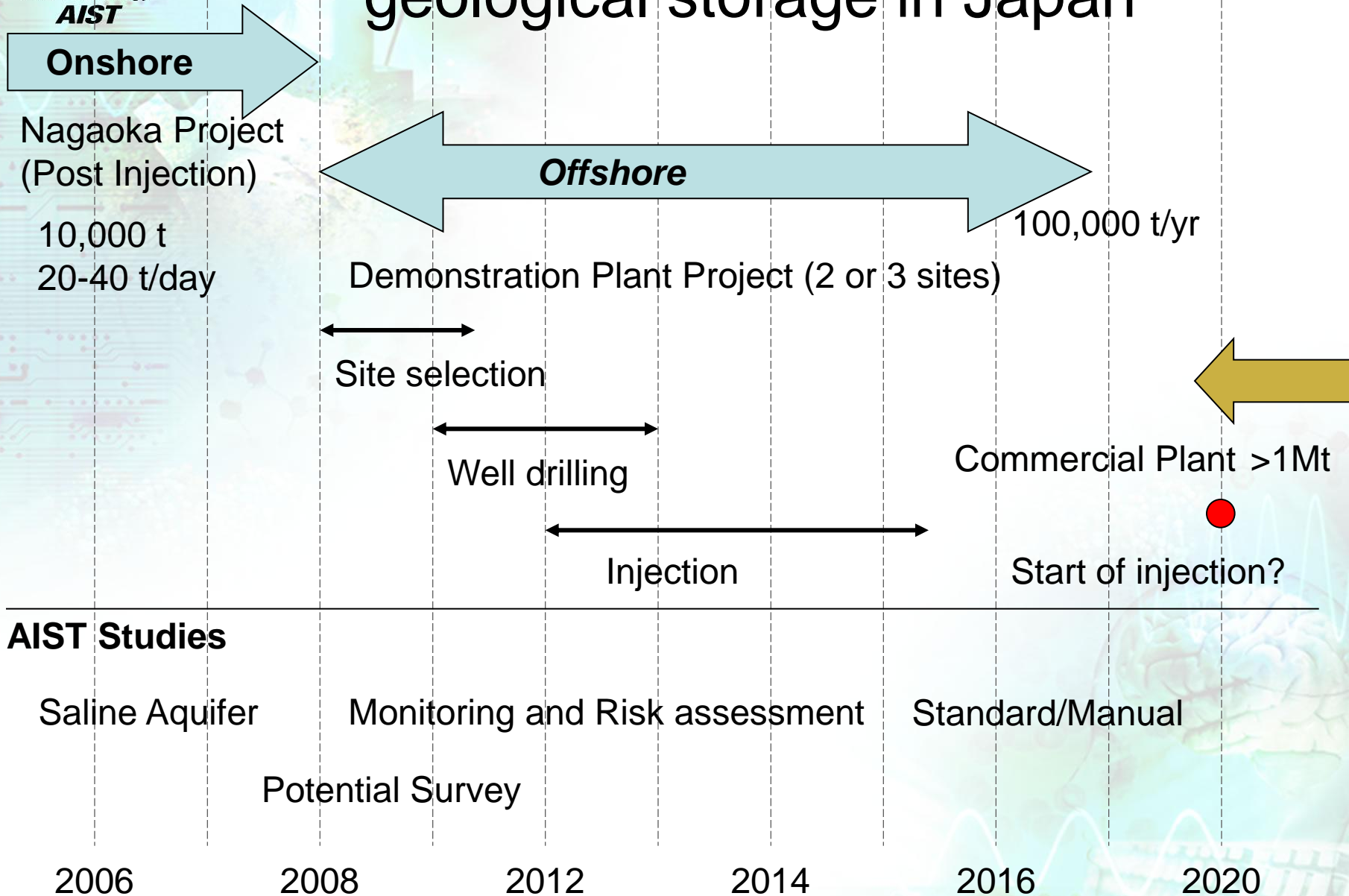
CCS: Carbon dioxide Capture and Storage

One of the most effective CO₂ discharge control technology which suppresses the CO₂ emission into the atmosphere with the continuous usage of the fossil energy.



CO₂ storage at the **offshore saline aquifer** is a possible solution for the commercial CCS in Japan

Current progress schedule for CO₂ geological storage in Japan



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Pilot plant at Nagaoka

Teikoku Oil, Niigata

(2003~2005)

Prefecture

10,400 t-
CO₂ was
injected.

AIST Tsukuba.

Tokyo

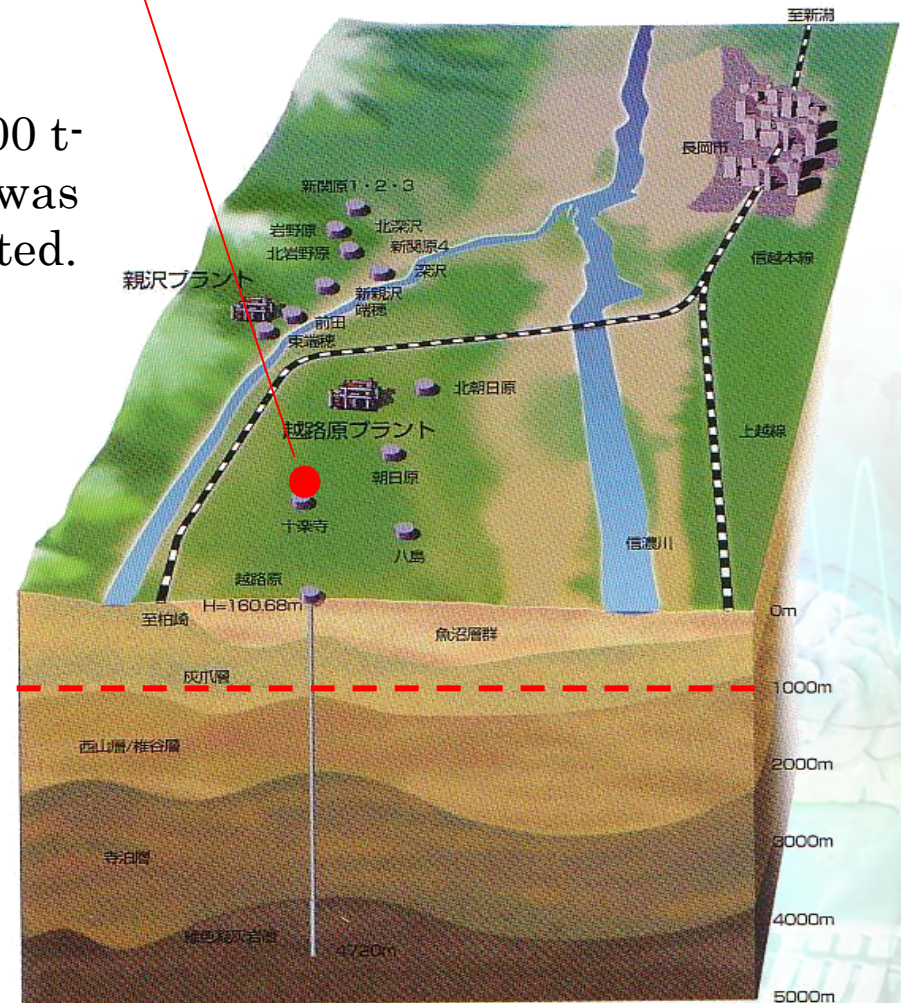
**Nagaoka
Site**

CO₂ storage
layer

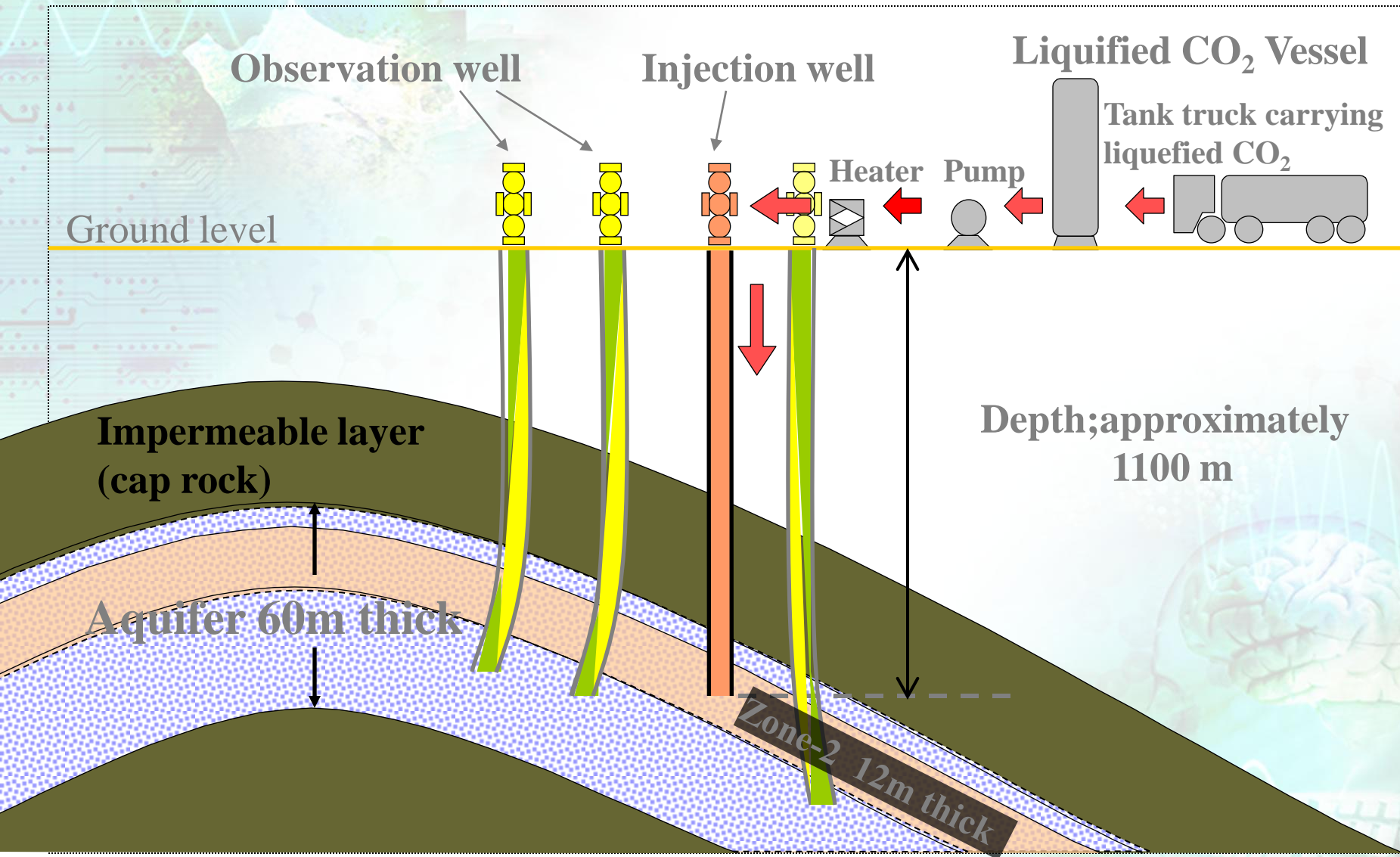
1000m

gas reservoir

5000m

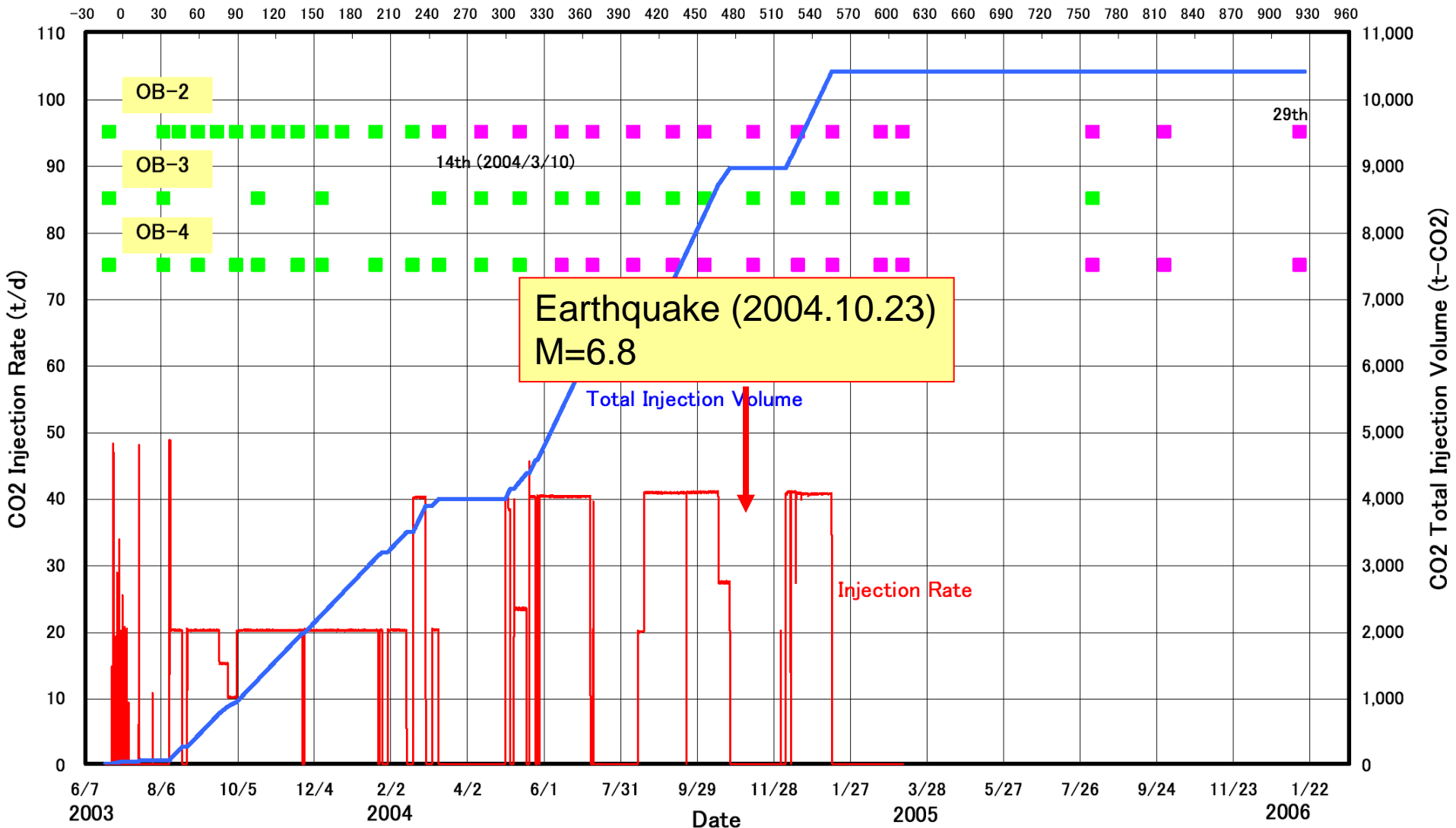


Sketch of Injection at Nagaoka

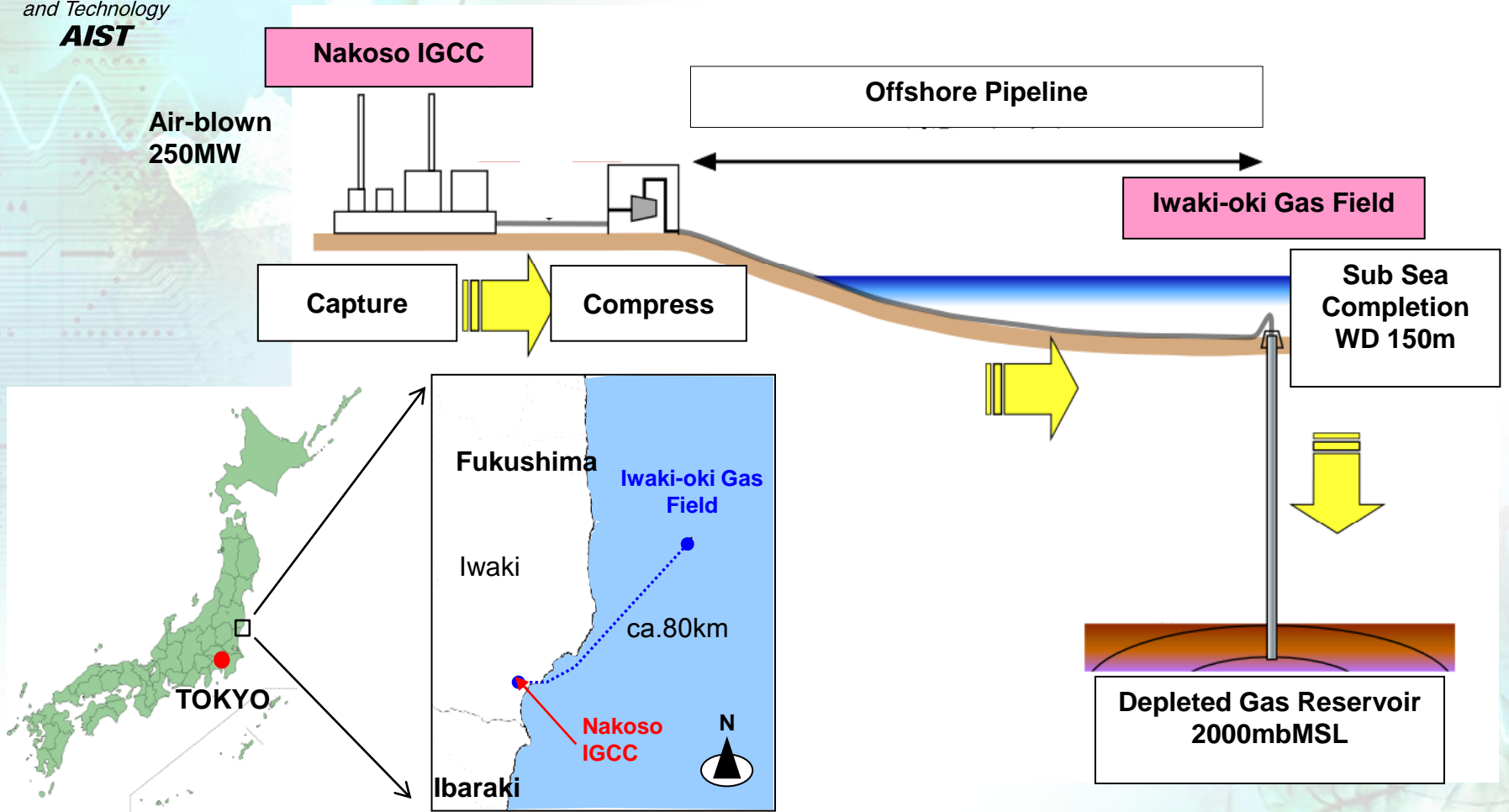


CO₂ injection and monitoring

Elapsed Days : (Base Date 2003/7/7)



A candidate of the demonstration plant



Offshore sub-sea completion well

CO₂ to be captured at the Nakoso IGCC Demonstration Plant, transported to Iwaki-oki Gas Field and injected into the depleted reservoir

- coal Gasification Combined Cycle, demonstration plant is owned and being operated by Clean Coal Power R&D Co., Ltd. (CCP).
- Iwaki-oki IGCC : Integrated gas field was operated by INPEX (Teikoku Oil).

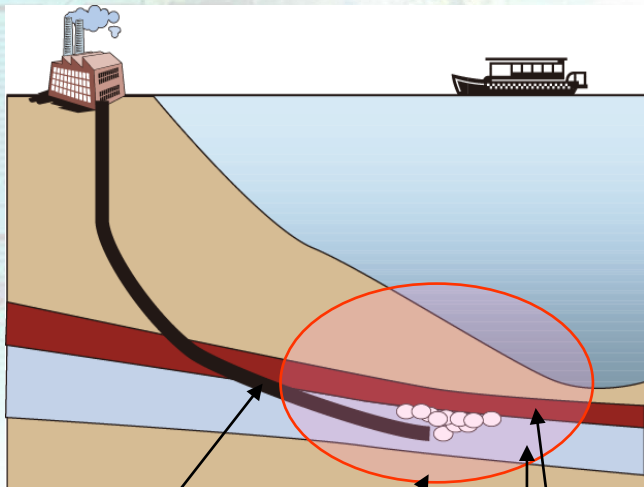
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Proposed CO₂ storage by AIST

Emission source at
sea coast

Offshore storage



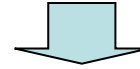
Monocline strata

Pressure and
temperature for CO₂
supercritical condition

Saline aquifer

Cap rocks

Commercial CCS in Japan: Offshore
saline aquifer storage



Problems to be solved

How CO₂ is stored in a saline aquifer? (**mechanism**)

- 1) To increase the understanding on CO₂ injection into a saline aquifer
- 2) To make a standard hydrological model of the saline aquifer

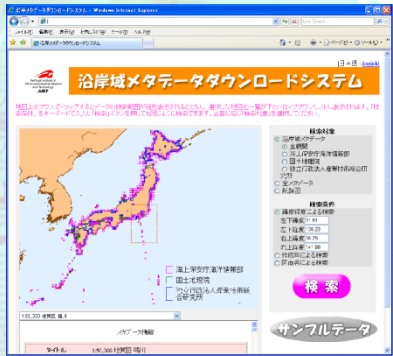
How to detect CO₂? (**monitoring**)

- 3) To develop a new monitoring technology using seismic and resistivity data
- 4) To establish a long-term monitoring standard

How to obtain the reliability? (**risk analysis**)

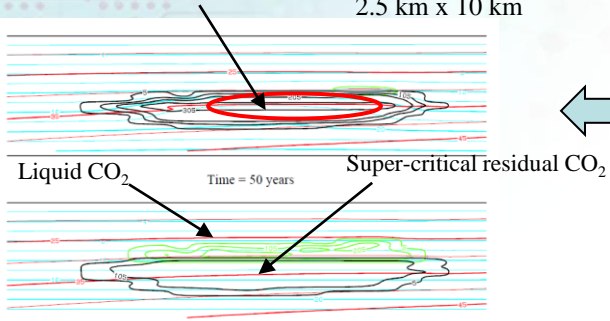
- 5) To detect the expansion (or leakage) of the injected CO₂ and to develop observation tools at a shallow sea
- 6) To make a business model for the CCS and to obtain a public acceptance

Current research works in AIST

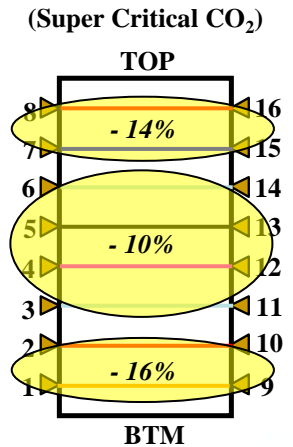


Web system to download offshore data (well log data, seismic reflection data etc.) for the CO₂ geological storage (**Potential Estimation**)

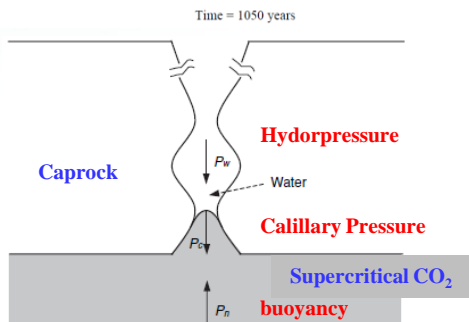
CO₂ injection: 10 million tons per year
2.5 km x 10 km



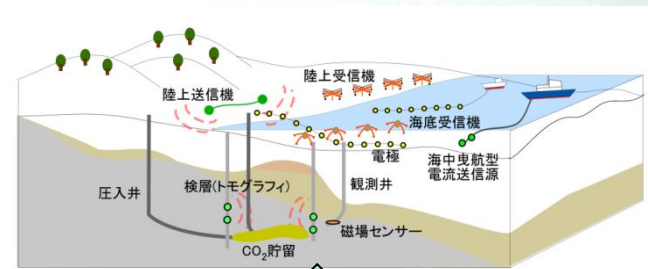
P-wave velocity change during CO₂ injection into a core sample (**Basic Research using core samples**)



Simulation study using a fluid flow simulator indicates that the supercritical CO₂ moves up by its buoyancy and changes to immobile liquid phase (**Simulation and modelling**).



Estimation of the capillary or seal pressure at the cap rocks (**leakage evaluation**)



Development of geomagnetic and geoelectric measurements and joint inversion to reveal the movement of CO₂ (**Monitoring**)

Others: Ground water data base , Geochemical reaction, Permeability of micro faults

Development of the risk analysis tools

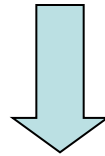
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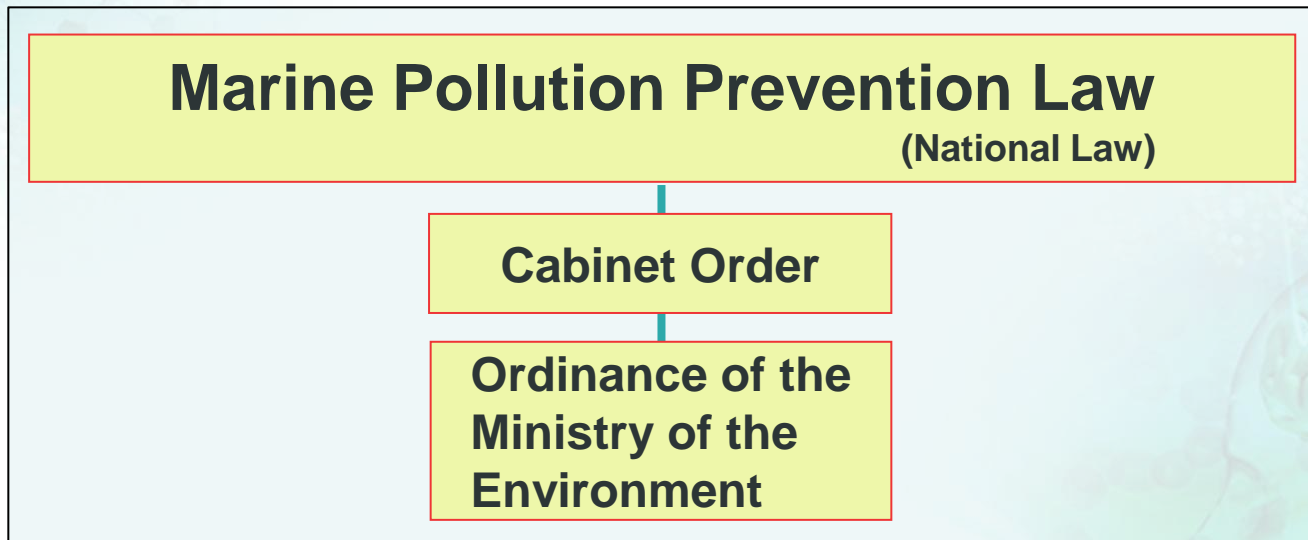
Regulation on CCS

Amendments to the London Protocol 1996

Permission of offshore CO₂ geological storage



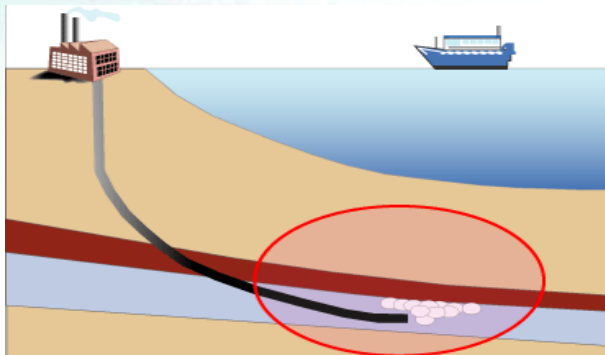
In Japan,



Amendment was accepted in the Diet
(2007.05.23)

1. Prohibition of disposal of oil, hazardous liquid substances, and wastes under the seabed

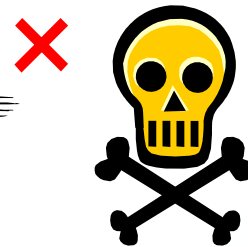
No one shall dispose oil, hazardous liquid substances, and wastes under the seabed, **except for CO₂ stream storage** under the seabed with permit from Minister of the Environment (Article 18.7)



Subsurface under the seabed



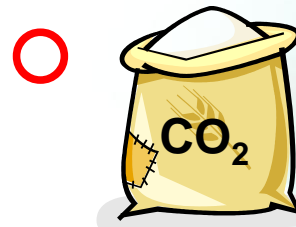
Oil



Hazardous Liquid



Wastes



Carbon Dioxide

2. Provisions for the permit for CO₂ stream storage under the seabed

- (1) Anyone intending to dispose CO₂ stream under the seabed must **obtain a permit** from Minister of the Environment (Article 18.8)



Minister of
the Environment



- (2) The Minister of the Environment shall not issue a permit for the CO₂ stream storage under the seabed unless it meets all conditions required such as “the storage site under the seabed and the method taken for the storage **will not harm marine environmental protection** at the storage site” and “there is **no other appropriate disposal** is available other than storage under the seabed”. (Article 18.9)



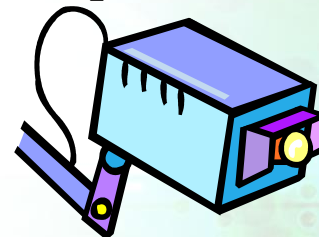
No impact to marine
environment



No other appropriate
disposal way

- (3) A person holding a permit for CO₂ stream storage under the seabed **must monitor** status of the pollution at the storage site and report monitoring results to Minister of the Environment. (Article 18.12)

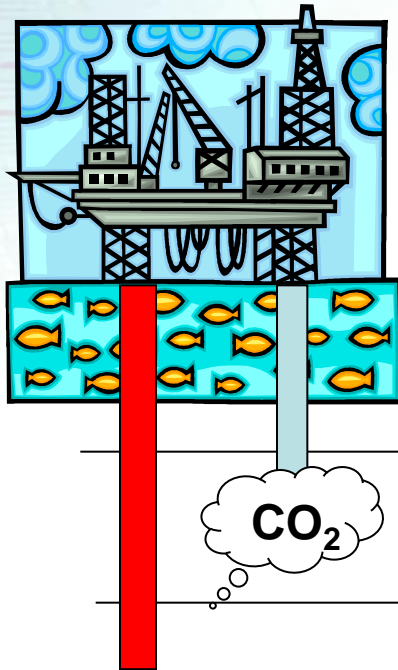
Monitoring and
Reporting



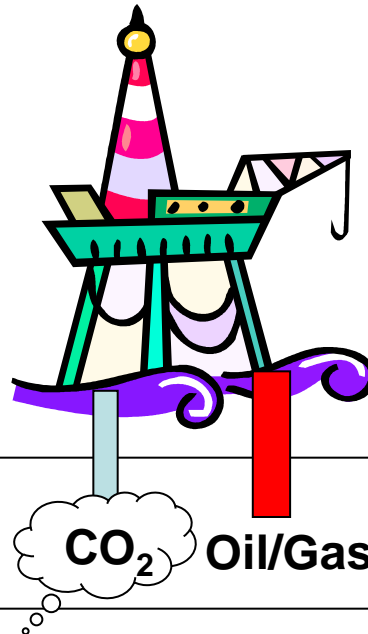
3. Exemption

- ✓ CO₂ from offshore operation
- ✓ EOR/EGR operation (Cabinet Order Article 11.4)

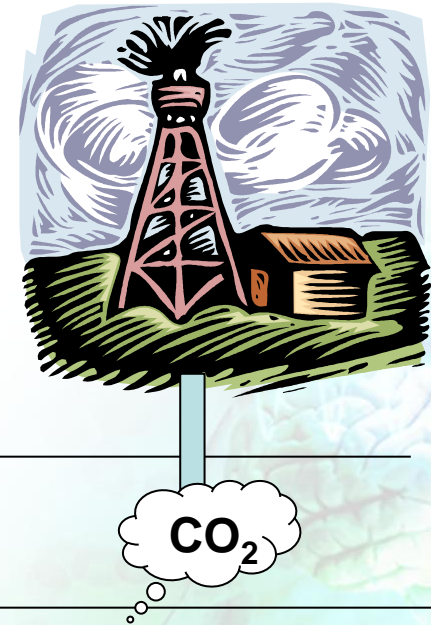
CO₂ separation



EOR/EGR Operation



Onshore injection



Natural Gas

4. Purity Standards

Law

CO₂ stream should consist “**overwhelmingly**” of CO₂ and meet the standards set by Cabinet Order

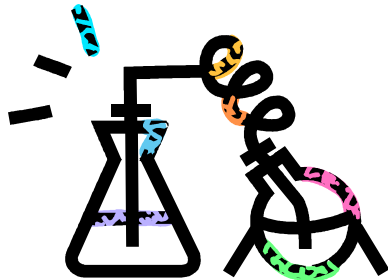
“overwhelmingly”purity by London Protocol

Cabinet Order (Article 11.5)

Post combustion using amine solvents

CO₂ purity: $\geq 99\%$ (vol)

**** $\geq 98\%$ (vol) for the stream captured from hydrogen production process at petroleum refinery**



99%(Vol) by amine solvents

Application 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)**

For safe operation of a CCS demonstration project

mapped by METI in August 2009

Contents

- 1. Things to be assessed for CO₂ storage from geological aspects**
- 2. Transportation Standard**
- 3. Safety consideration for placing CCS-related facilities**
- 4. Environmental Impact Assessment (EIA)**
- 5. Safety consideration for the drilling, completion and P&A
(plugging and abandonment) for CO₂ injection and storage wells**
- 6. Safety considerations for CO₂ injection and operation**
- 7. Concentration standard of CO₂ to be injected**
- 8. Monitoring**
- 9. Measures to be taken when abnormalities occur**

http://www.meti.go.jp/english/press/data/pdf/090807_02PDF.pdf

Thank you for your attention



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