International Workshop on CO_2 Geological Storage

Research Institute of Innovative Technology for the Earth

Next step of the Nagaoka project
（Nagaokaプロジェクトの今後の展開）

21, February, 2006

RITE

CO_2 Sequestration Group

Senior Researcher

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Project Outline

Purpose

Establish a technology that provide stable, safe and long-term underground storage of CO_2 emitted from large-scale sources in Japan

Period

Planed 2000 – 2004 (5 years)
Extended – 2007 (3 years)

Nagaoka Pilot Test

Budget/Expenditures

US$ ca 32 M for 2000 – 2004 funded by METI
US$ ca 30 M for 2005 – 2007 being proposed to METI

Nagaoka pilot test: targets and results

Primary targets

- ✓Investigation for the possibility of CO_2 geological storage into anomalous stratum in Japan
- ✓Study on the underground behavior of injected CO_2
- ✓Modeling of CO_2 behavior
- ✓Safety assessment of CO_2 injected underground

Major results

- ✓10,400 t-CO_2 was successfully injected at rate of 20-40 t-CO_2/day into a saline aquifer of 1,100 m depth (July,2003-January,2005)
- ✓No any CO_2 leakage by Niigata Chuetsu earthquake

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- ✓Measurement of pressure and temperature at top and bottom of the reservoir formation
- ✓Micro-seismicity measurement
- ✓Well logging
- ✓Cross-well seismic tomography

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- ✓CO_2 behavior was simulated by history matching using monitoring results

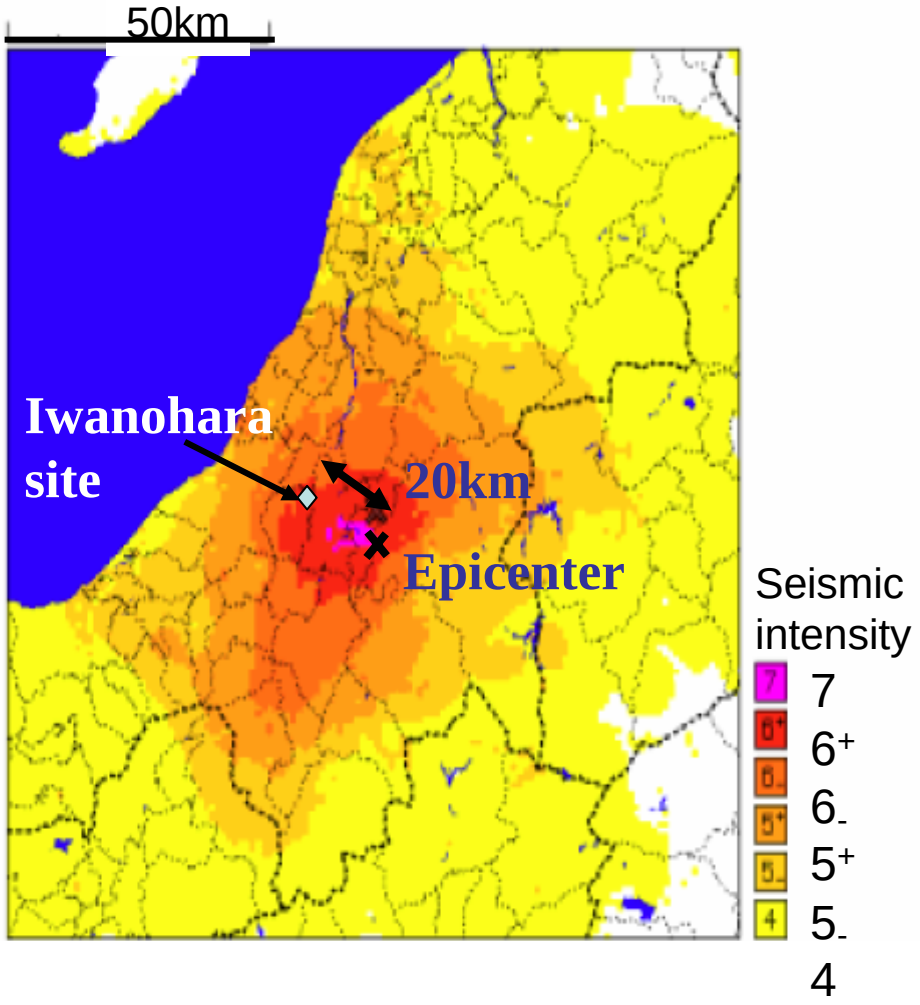
Basic knowledge of aquifer storage in Japan is obtained. Test results are utilized for the development of safety assessment and storage potential evaluation.

Effect of Earthquake

Niigata Chuetsu Earthquake
Main shock: 23 Oct 2004
M6.8 at 10km depth
Seismic intensity: 7

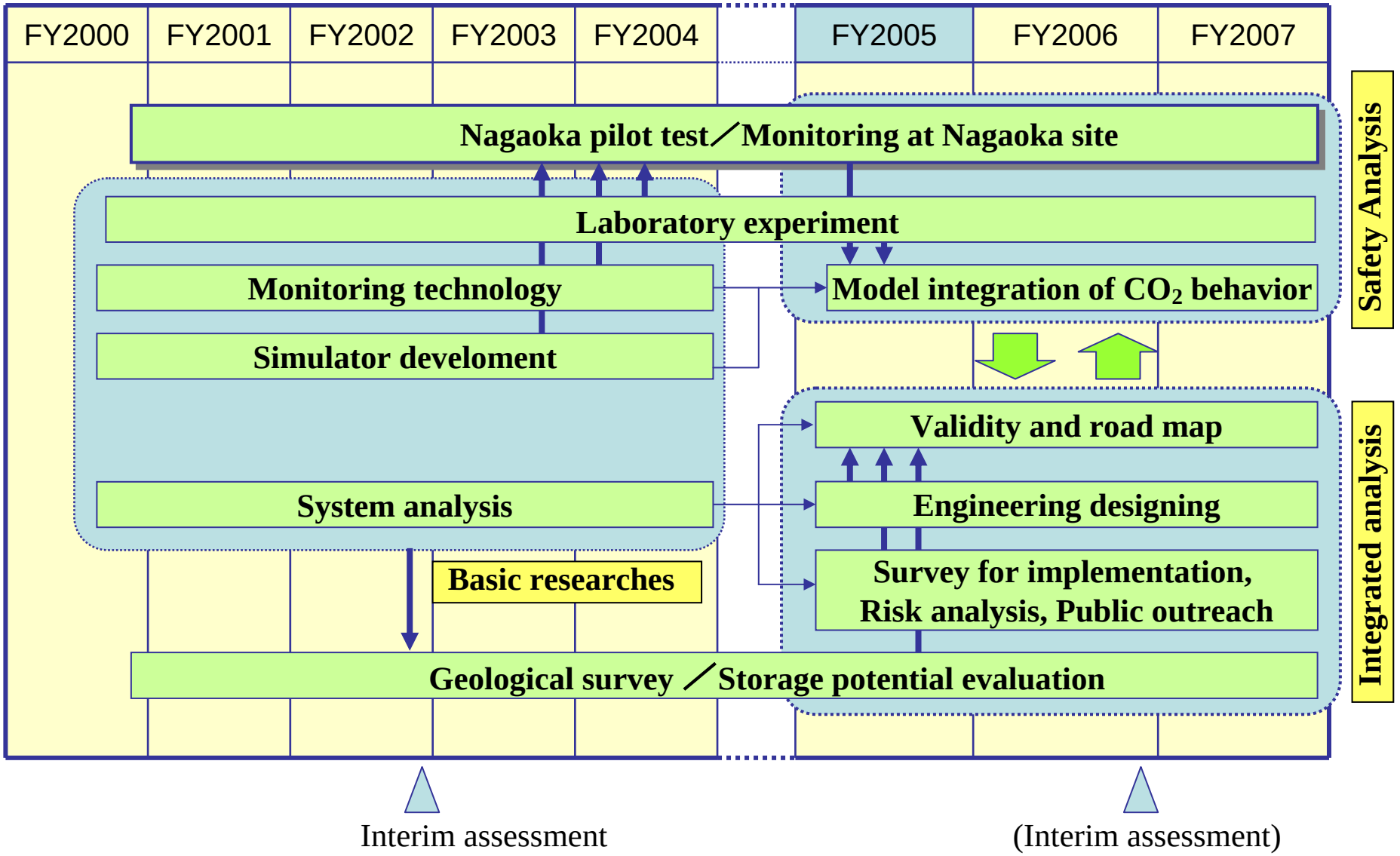
Injection was automatically stop the main shock.
Safety inspection was made:
- Surface Inspection
- Press & Temp
- Geophysical Logging
- Acoustic Borehole Televiewer
- Cross Well Seismic Tomograph

Injection was carefully resumed confirming safety (6 Dec 2004) injection rate: 40t-CO_2/day



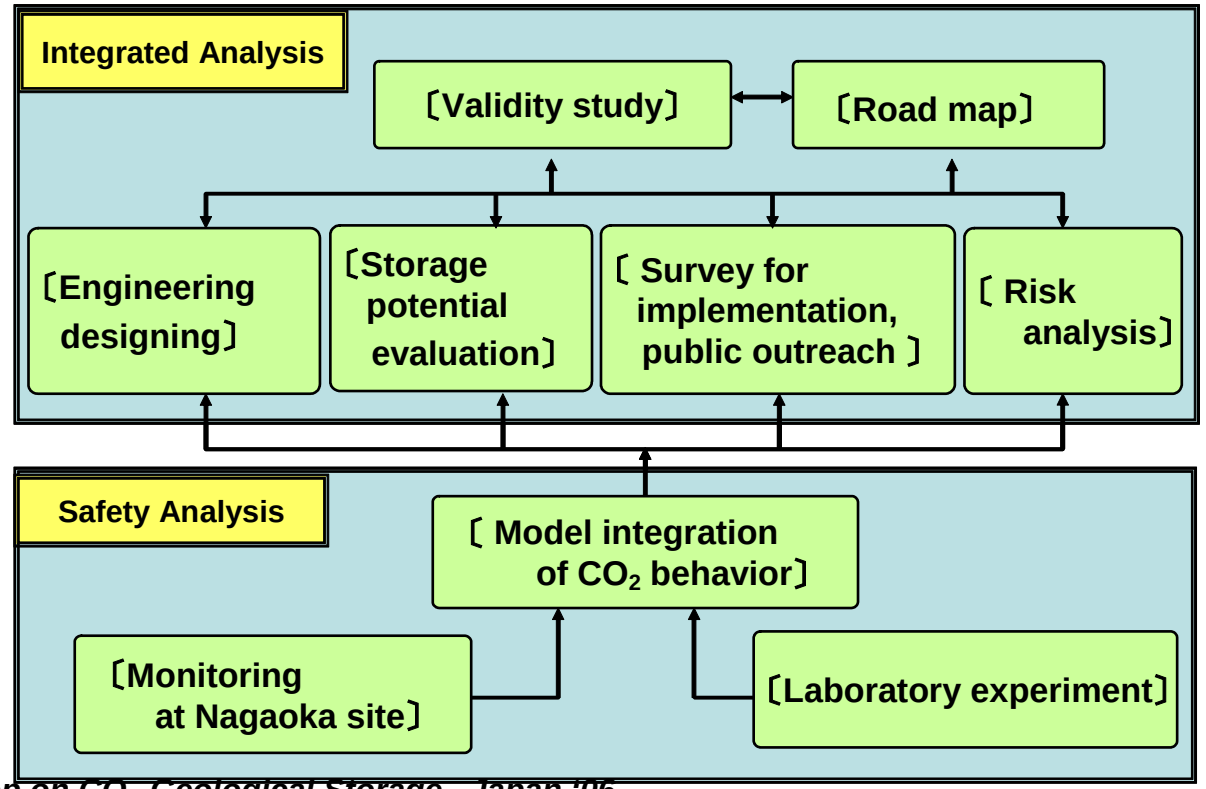
(GSJ, 2004 http://www.gsj.jp/jishin/chuetsu_1023/)

Time frame of RITE's R&D project for CO_2 geological storage



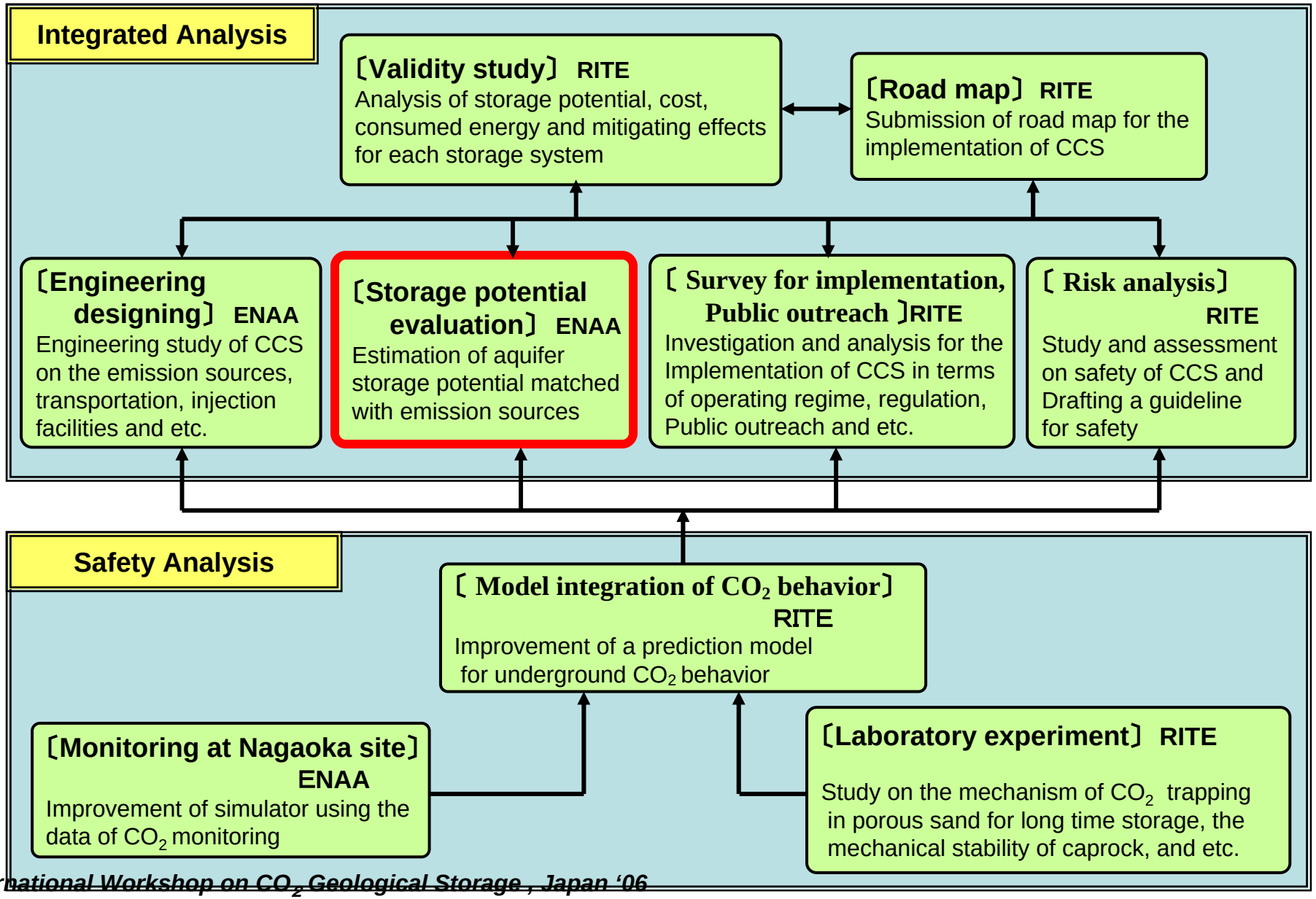
Extended works（FY2005～）

- In order to fill the remaining gaps for the implementation of CCS, the project was extended for at least three years.
- The purpose is to clarify the feasibility of CO_2 geological sequestration, to present a road map toward actual applications, to establish safety assessment methods and to submit a R&D plan of CCS demonstration.

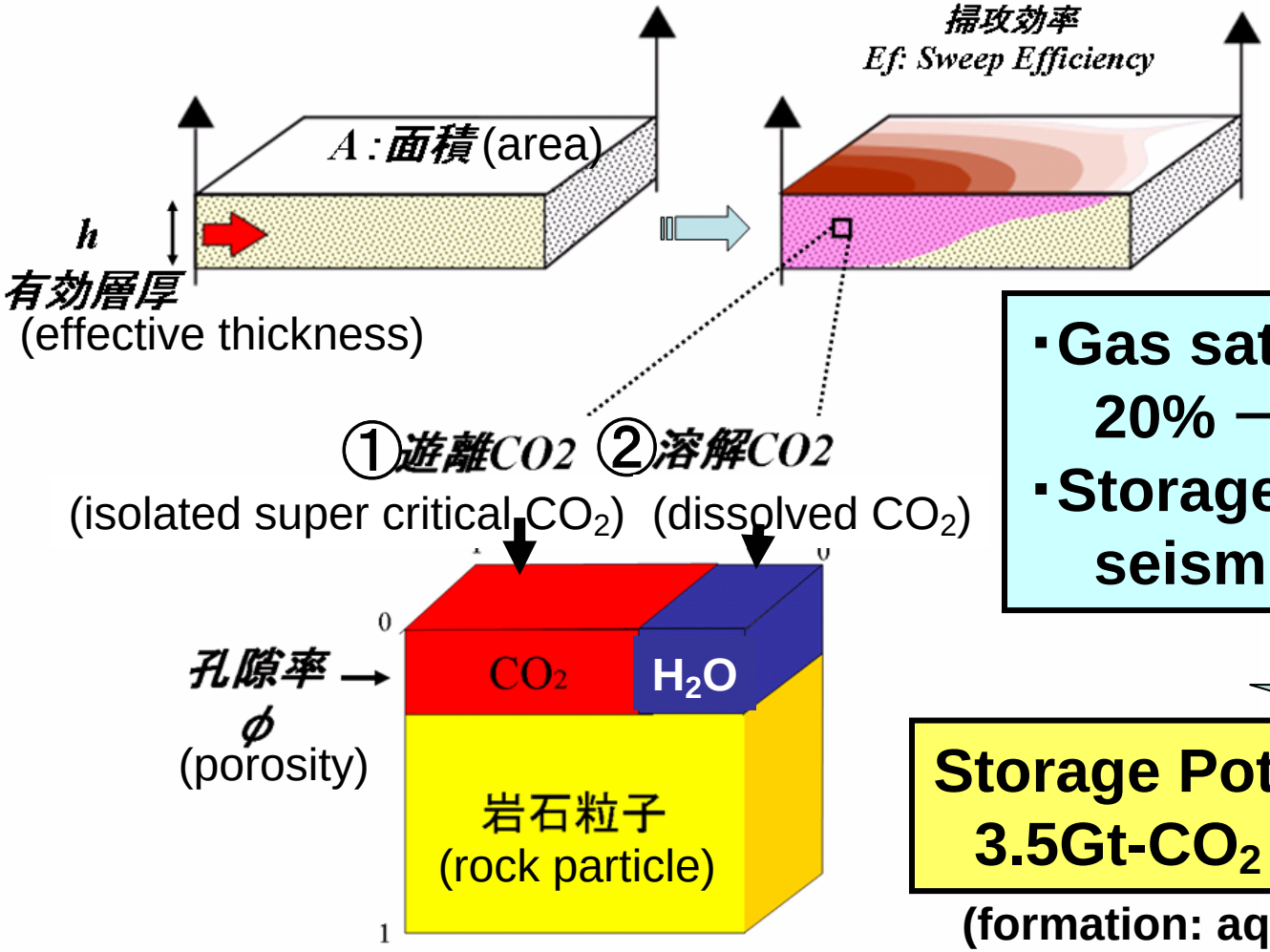


R&D Scenario of RITE's CCS project (FY2005 to FY2007)

-from scientific study to technical assessment for implementation of CCS-



〔Storage potential evaluation〕
・Revision of CO_2 trapping parameter and supposed storage site



under discussion

・Gas saturation（Sg):
20% → 50%
・Storage site: including seismic surveyed area

Storage Potential in Japan:
3.5Gt-CO_2 → ca 30Gt-CO_2

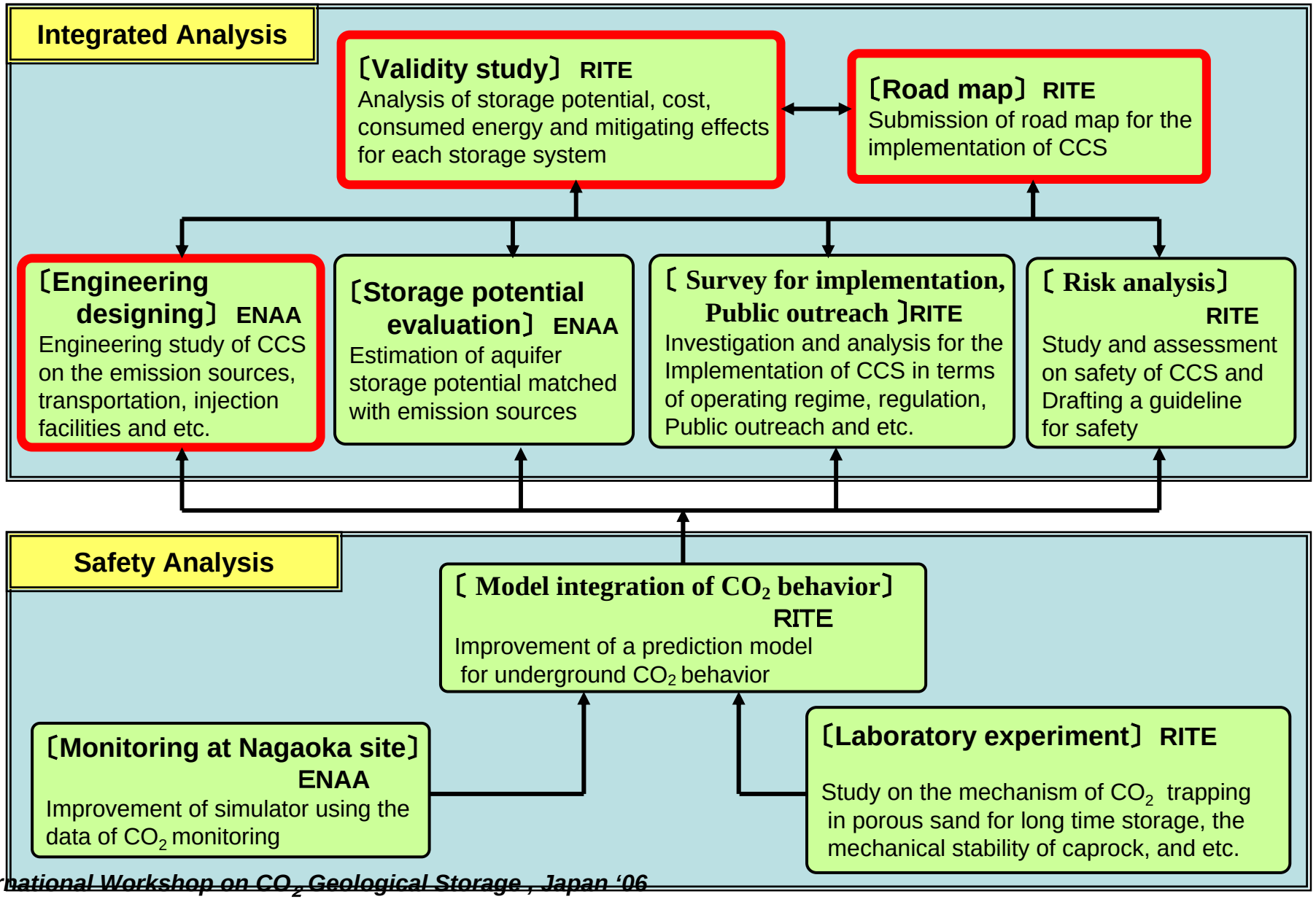
(formation: aquifer of unticline trap)

a

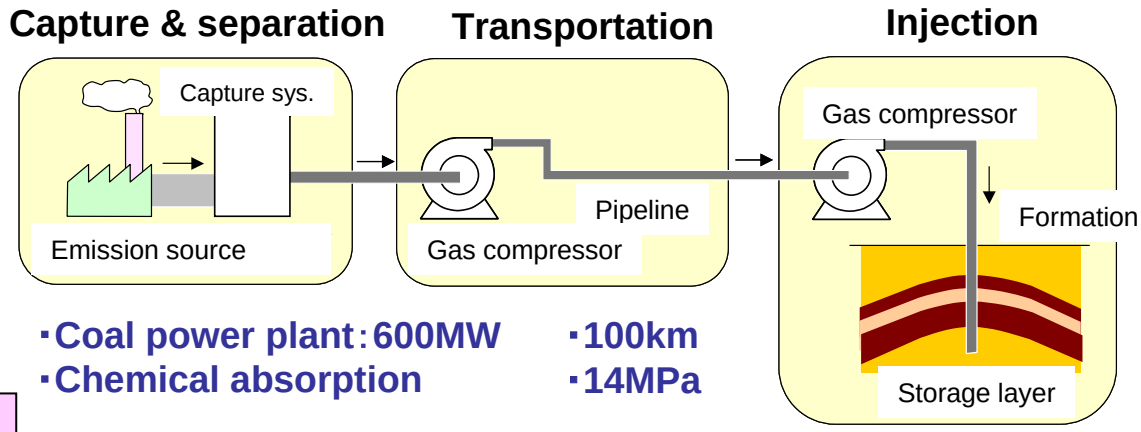
① super critical CO_2: Ef x A x h x ϕ x Sg /BgCO_2 x ρ
② dissolved CO_2: Ef x A x h x ϕ x（1－Sg）x RsCO_2 x ρ

R&D Scenario of RITE's CCS project (FY2005 to FY2007)

-from scientific study to technical assessment for implementation of CCS-

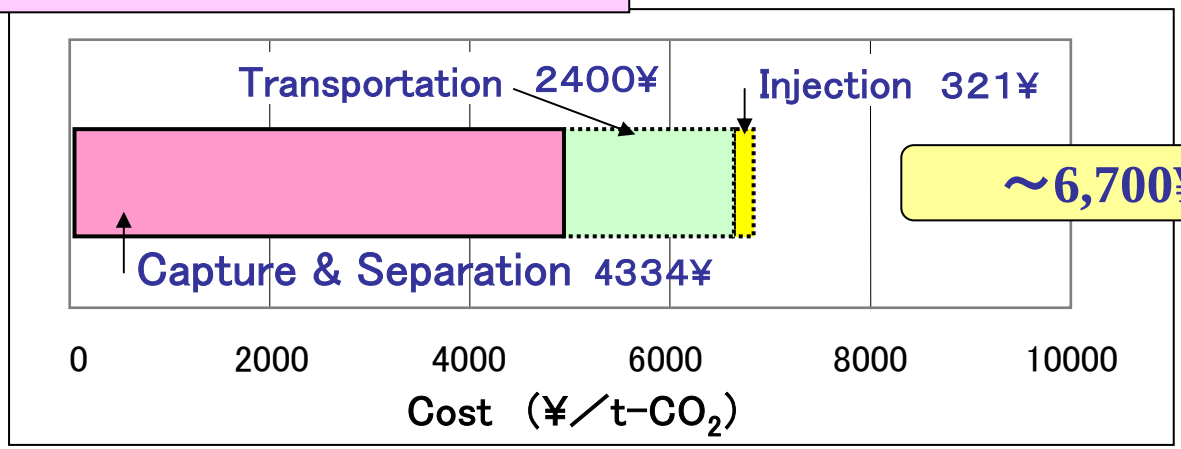


〔Validity study〕 Analysis of storage cost



- Coal power plant：600MW
- Chemical absorption
- 100km
- 14MPa
- ERD
- 10km offshore
- 1,000m depth

Estimation of current cost



～6,700¥/t-CO_2

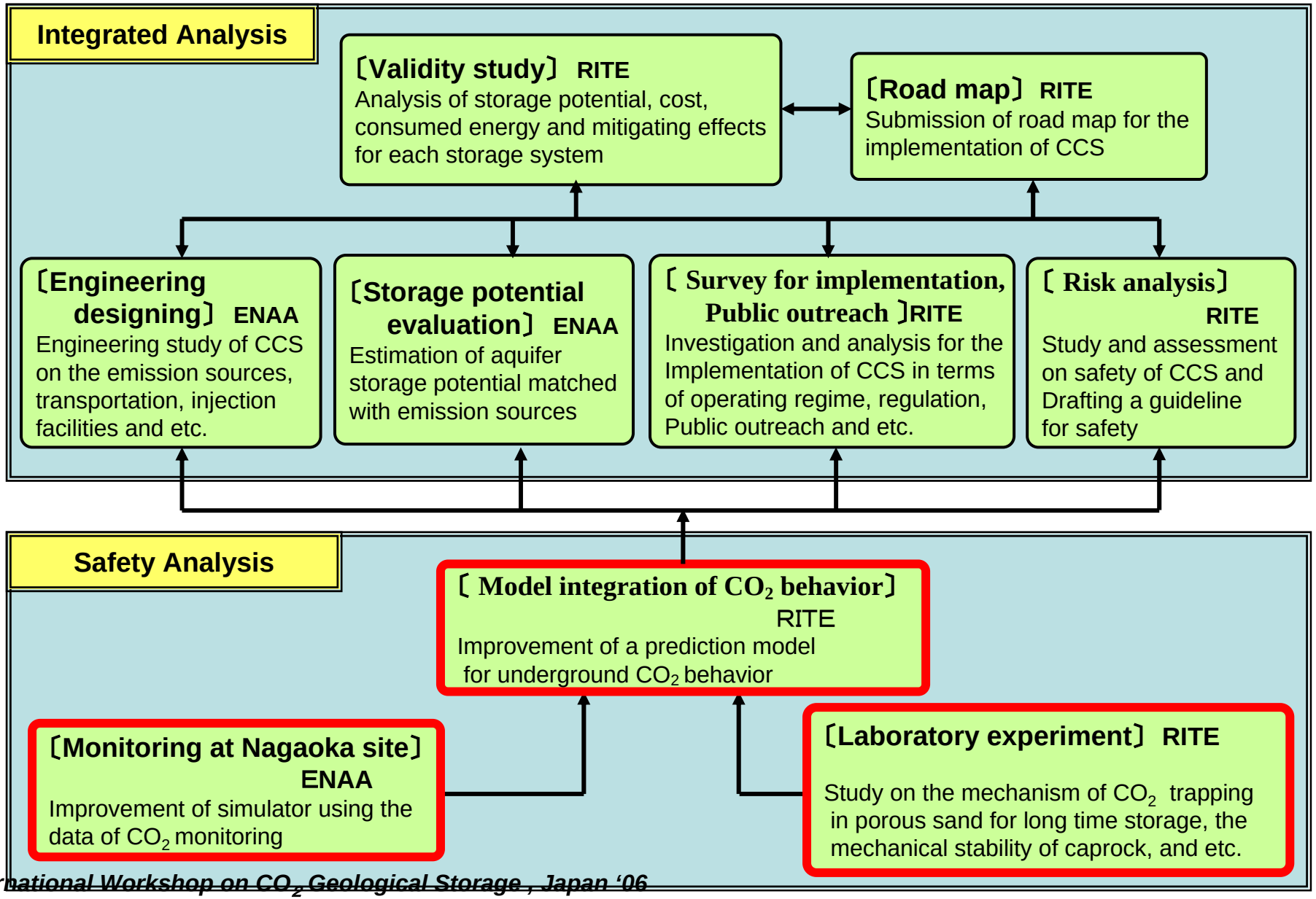
- Improvement of capture liquid
- Cost reduction of heat source
- Use of unutilized heat source
- Use of high pressure pipeline
- Increase of injection amount/well
- Optimal selection of injection site, etc.

under discussion

Target of Cost：3,000¥/t-CO2（untill 2015）

R&D Scenario of RITE's CCS project (FY2005 to FY2007)

-from scientific study to technical assessment for implementation of CCS-

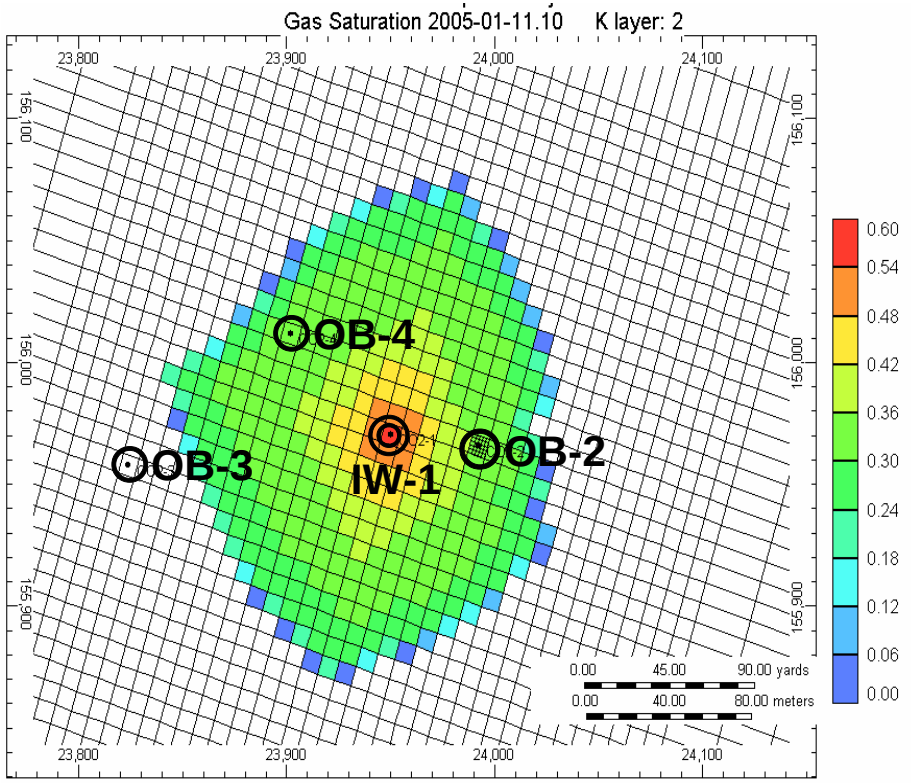


〔Model integration of CO_2 behavior〕
Improvement of a prediction model for underground CO_2 behavior

Result of simulation study (～FY2004)

Prediction of CO_2 Behavior

CO_2 Saturation Distribution
Zone-2 Mid Layer as injection stopped



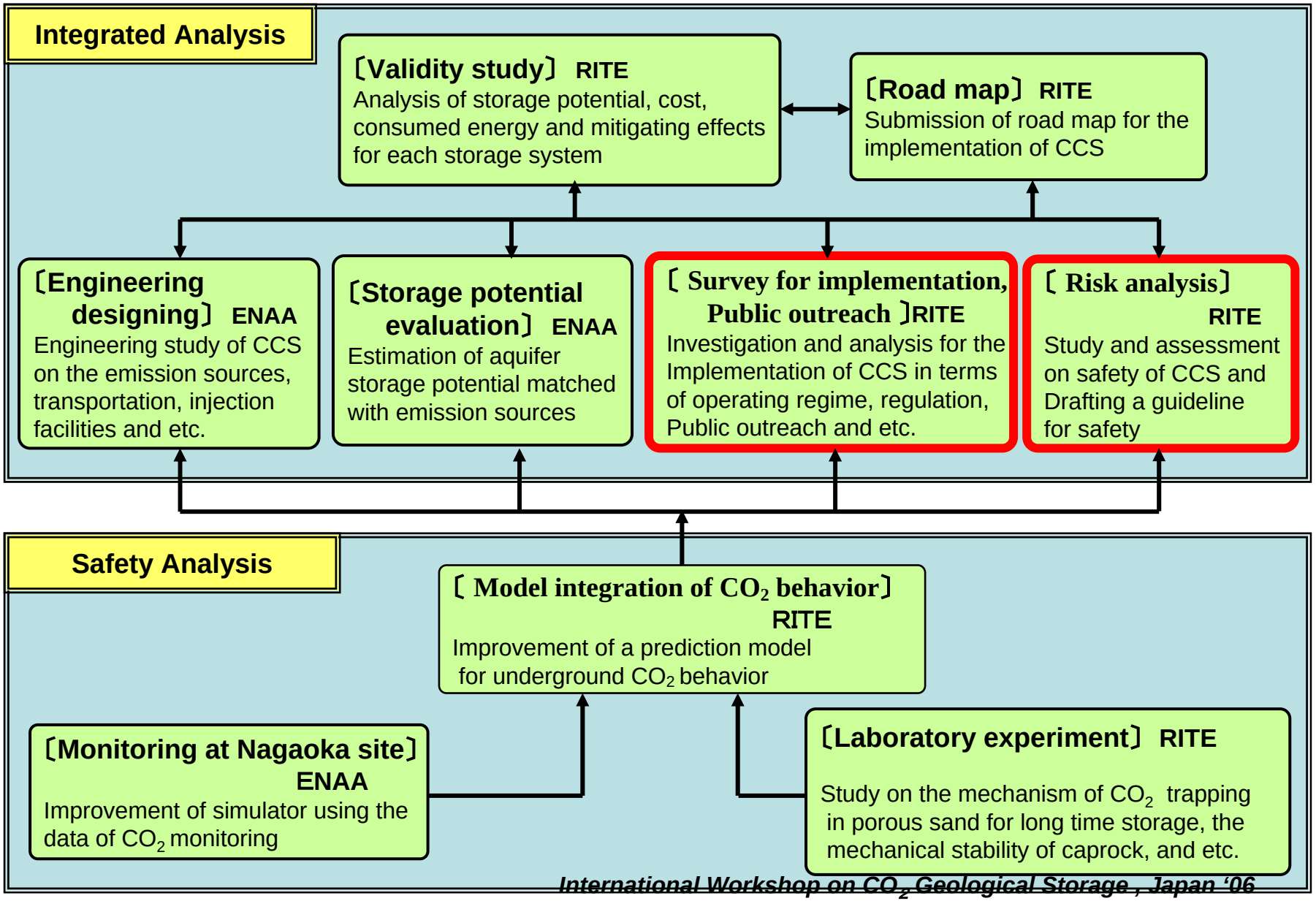
Current study

1. Monitoring of well logging, cross-well seismic tomography, and water sampling by CHDT
2. Study on relation between CO_2 saturation and acoustic velocity by Gassmann theory, and on mechanical property of cap rock
3. Study on the CO_2 storage potentiality of flat aquifer, and the CO_2 behavior in shallow underground formation

1. Acquisition of more accurate data at Iwanohara／Nagaoka
2. Basic study on properties of aquifer and cap rock
3. Improve the precision of CO_2 behavior model

R&D Scenario of RITE's CCS project (FY2005 to FY2007)

-from scientific study to technical assessment for implementation of CCS-



〔 Survey for implementation of CCS 〕

Investigation and analysis in terms of operating regime, regulation, Public outreach and etc.

Results of system analysis (FY2000～FY2004)

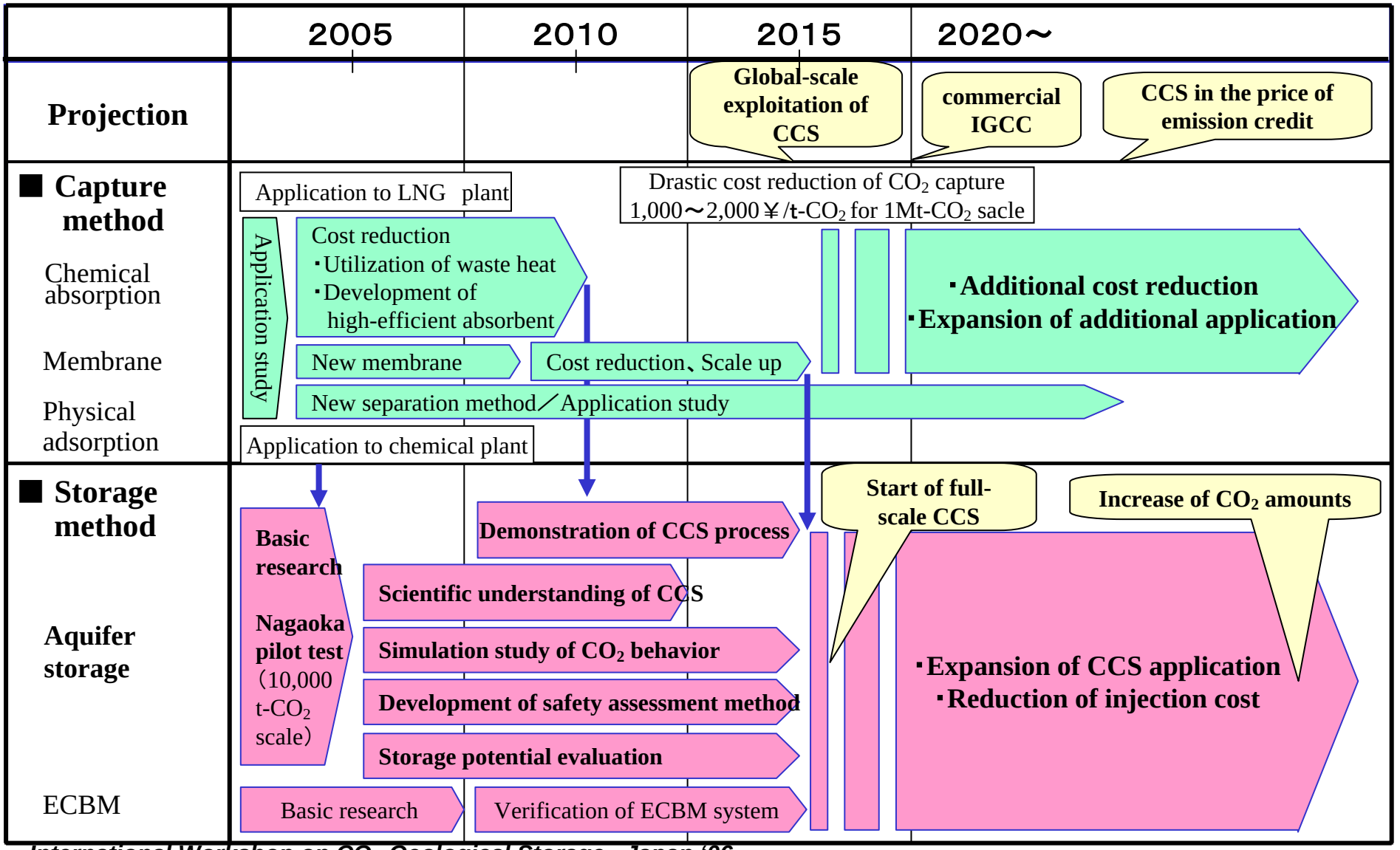
1. Study on economics of CO_2 geological storage in Japan
2. Risk analysis of extreme case for CO_2 leak
3. Study on public acceptance for CO_2 geological storage

Current study

1. Study on IPCC-SRCCS
2. Survey on technology, business potential, public outreach, and political trends
3. Study on legal issue in London Convention and legal framework
4. Study on environmental impact and FEP methodology
5. Case research on consensus formation, etc

1. Promoting the understanding of aquifer storage for policymaker, business people, academian, public people, and etc.
2. Preparing the methodologies of monitoring, environmental assessment for CCS technology deployment
3. Accounting for the legal and regulatory issues of long-term liability, and the methodologies of emission inventories

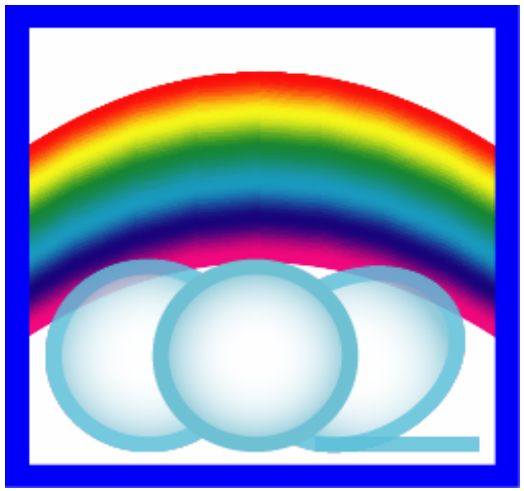
METI's road map of CO_2 capture and storage



(after METI's road map of technology strategy, 2005)

Next Step of Nagaoka Project

Thank you!



RITE CO_2 Geological Sequestration