Role of CCS in Sustainable Energy Future

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CCS Workshop

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@Tokyo, Japan

Climate Change in Sustainability Perspectives

RITE
Research Institute of Innovative Technology for the Earth

● ” Sustainability” is an essential keyword for the 21st century. WSSD (2002) adopted five areas: WEHAB. Among them, energy and global warming are critical themes to be tackled in order to achieve a sustainable society.

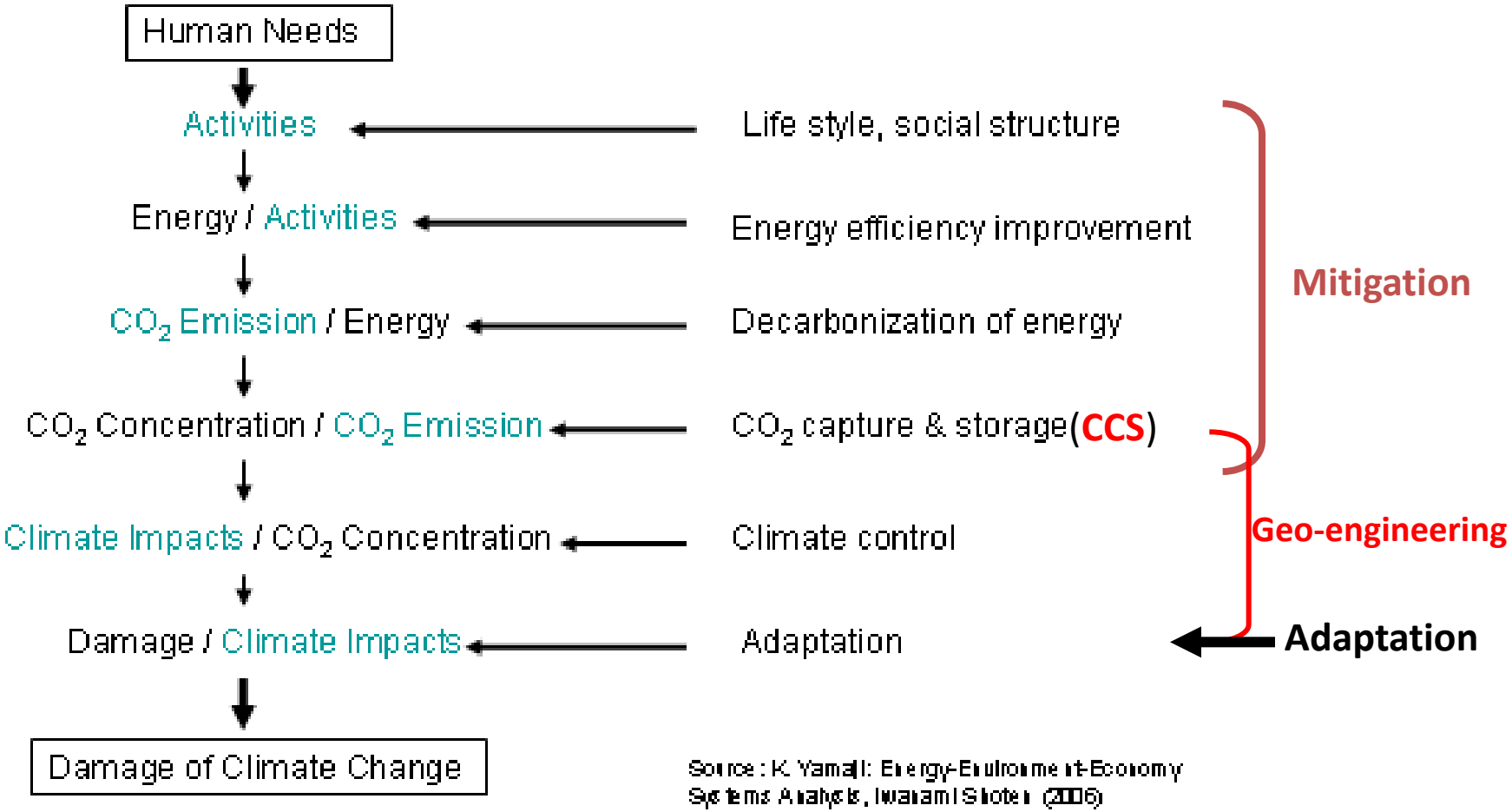
●International Energy Agency (IEA) predicts further increase of energy demands particularly in developing regions.

●The 4th IPCC Assessment Report shows warning of temperature rises for the 2000-2100 period, ranging 1.1C to 6.4C.

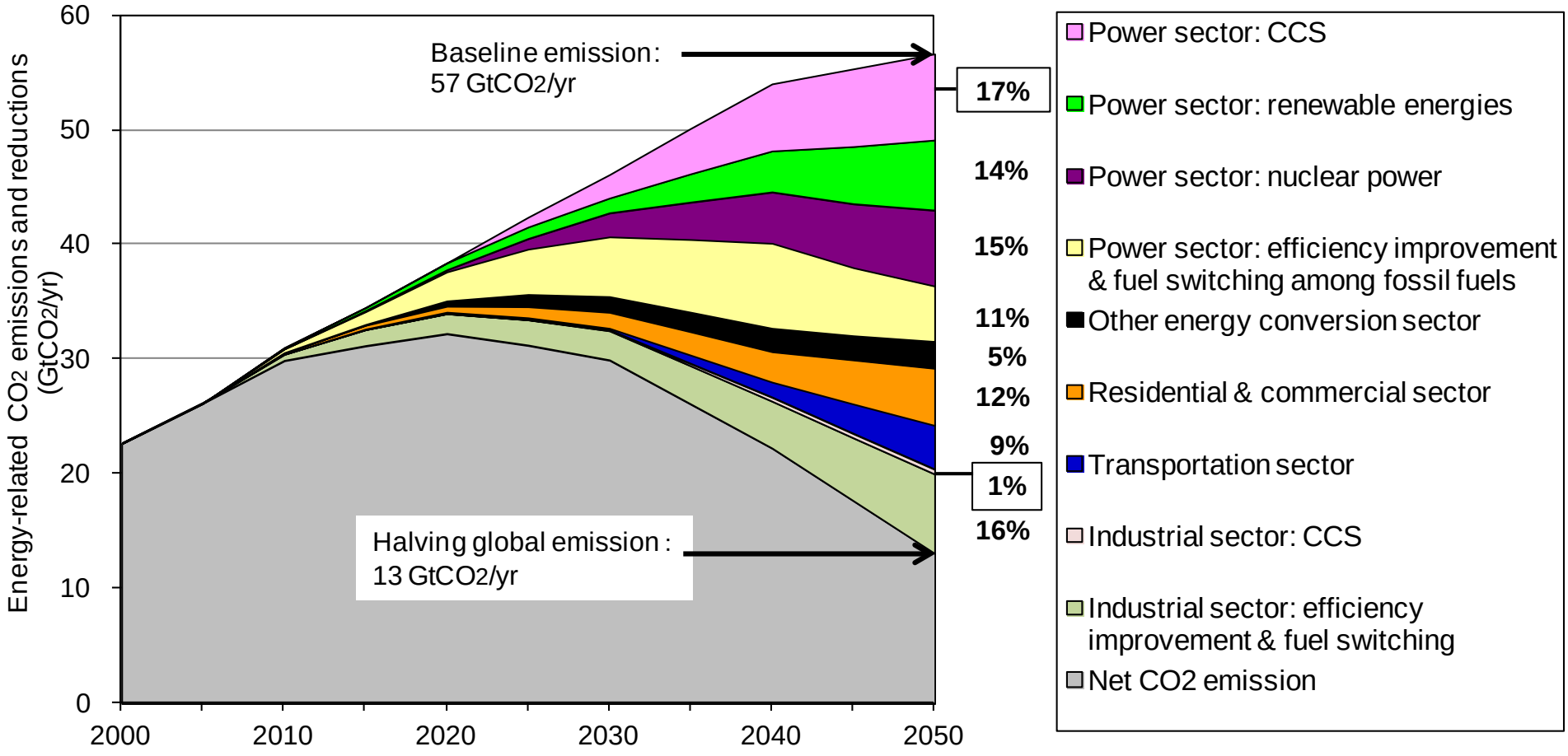
●There are growing concerns over the long-term depletion of energy resources, such as “cheap oil”. On the other hand, Fukushima Disaster shadowed the role of nuclear power.

●It is important to understand these issues from a comprehensive perspective and tackle with global warming, while endeavoring to maintain economic growth and enhance human welfare.

Structure of Response Measures



Source : K. Yamaji: Energy-Environment-Economy Systems Analysis, Iwanami Shoten (2006)

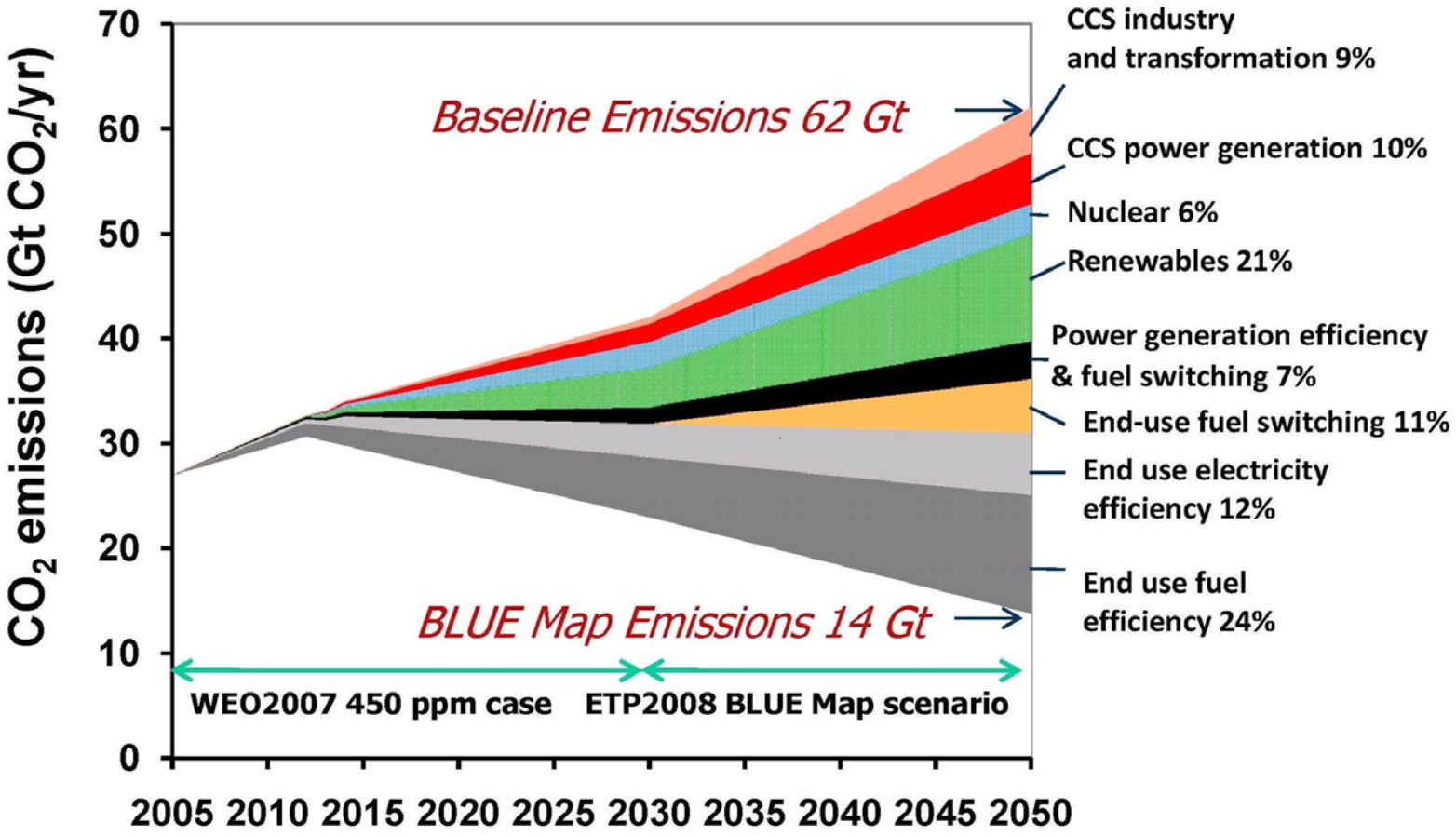


Role of CCS in Deep Cut of Global CO2 Emission

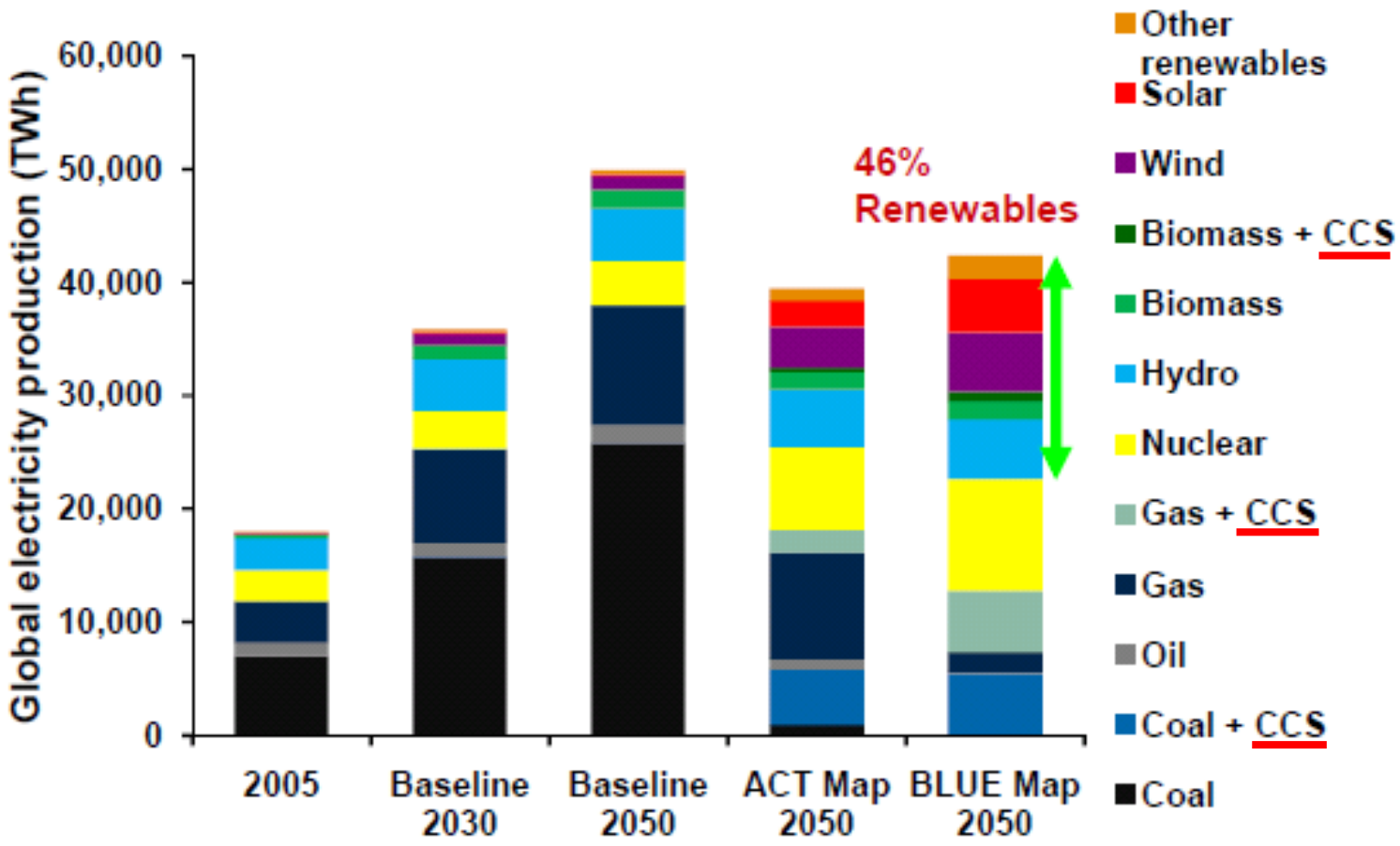
Source: K. Yamaji and K. Akimoto: CCS for Global Warming Mitigation
RITE (ed.), New Development of CCS Technologies, CMC Shuppan, 2011

Energy Technology Scenarios

IEA ETP2008: "ACT scenarios" global CO2 emissions from energy sector is reduced to current levels by 2050. "BLUE scenarios" to 50%



Power Generation Mix



Energy Technology Perspectives 2008 (IEA)

Importance of Electricity Sector

- More than 40% of primary energy is used for power generation
- Electricity can be produced from variety of energy resources, notably from non carbon resources
- CCS can be applied to fossil power plants

- Electricity is clean and efficient in end-use
- Efficient supply of low temp. heat by heat pumps
- Prospects for electric vehicle (PHEV,EV)

But,

- Difficulty in large and long distance transmission
- Stability of supply (voltage, frequency) : →smart grid?
- Difficulty for mobile use : →batteries？

Strategic Energy Plan of Japan (being reviewed)

The Strategic Energy Plan of Japan articulates the fundamental direction of energy policy in Japan, based on the Basic Act on Energy Policy.

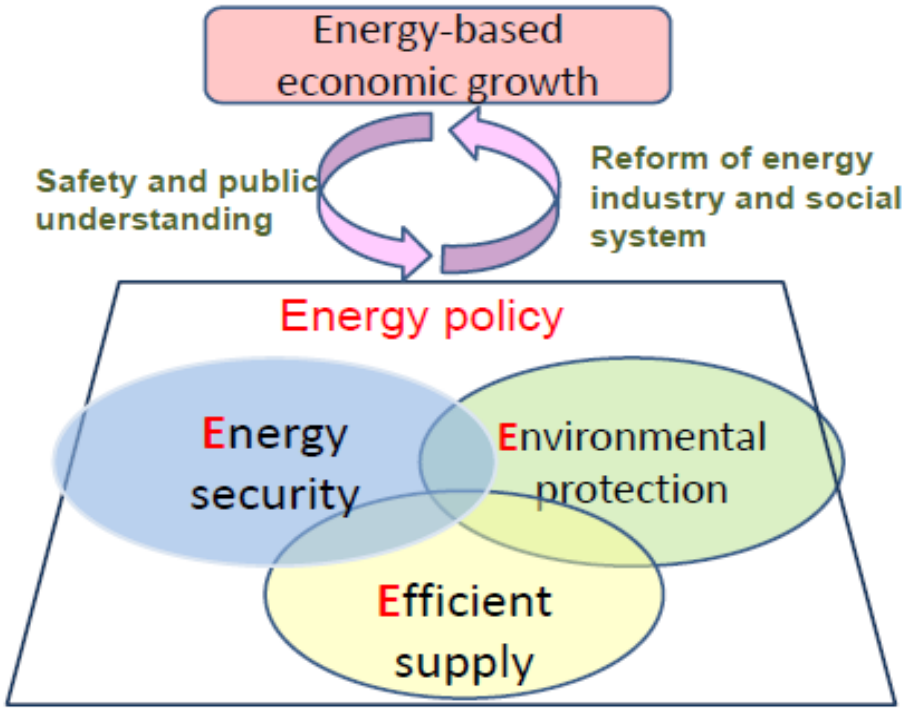
The Strategic Energy Plan of Japan is required to be reviewed at least every three years, and to be revised if needed. (Formulation: 2003, revision: 2007 and 2010)

Basic point of view

○The basic point of view in energy policy is **energy security**, **environmental protection**, and **efficient supply**.

○In this revision, two new points of views were added. These are: **energy-based economic growth** and **reform of the energy industrial structure**.

○Japan will **fundamentally change its energy supply and demand system by 2030**.



-Formulating the revised Strategic Energy Plan of Japan is consistent with the "New Growth Strategy"

-Directing bold and quantitative policy targets and specific policy measures

1

Ambitious targets toward 2030

◎**Doubling the energy self-sufficiency ratio** (18% at present) **and the self-developed fossil fuel supply ratio** (26% at present) and as a result, raising **its "energy independence ratio"** (※) **to about 70%** (38% at present).

(※) The "energy independence ratio" is an indicator that combines the self-sufficiency energy with the self-developed energy supply divided by total primary energy sources. An average energy self-sufficiency rate among the OECD countries is almost 70%.

◎Raising **the zero-emission power source ratio to about 70%** (34% at present).

◎**Halving CO2 emissions from the residential sector.**

◎**Maintaining and enhancing energy efficiency in the industrial sector at the highest level in the world.**

◎**Maintaining or obtaining top-class shares of global markets for energy-related products and systems**.

○**Domestic energy related CO2 emissions will be reduced by 30% or more in 2030** compared to the 1990 level, if we promote policies sufficiently.

○**A 30% emissions reduction** means that about **a half of the reduction to be achieved from the current level to 2050 (▲80% compared to 1990) will have been realized in 2030**.

Fukushima Disaster on March 11, 2011

被災前の
福島第一原子力発電所
(2009.11.15)

Before

After

被災後の
福島第一原子力発電所
(2011.3.18)

出典：ニューヨークタイムズ
http://www.nytimes.com/interactive/2011/03/13/world/asia/satellite-photos-japan-before-and-after-tsunami.html?ref=asia

Fundamental Objectives of Energy Policy

Damaged Points by Fukushima Disaster

3E

Energy Security → (semi-)domestic resources, upstream investment, reserve, nuclear fuel cycle, diplomacy …

Economics/Growth → green innovation/growth, export of systems, energy service co. …

+review of power costs

Environment → low carbon society, zero emission power, energy saving, CCS …

+S

Safety (Trust?)

risk of global warming

vs

skepticism

risk of low level radiation exposure

(scientific uncertainty)

vs

public concern

Power Generation Mix in 2030

Targets in current strategic energy plan

Renewables: 20%

Nuclear: 50% → **Impossible after Fukushima**

Fossil-fired: 30% → **20%? depending on the recovery of public trust on nuclear safety**

↓

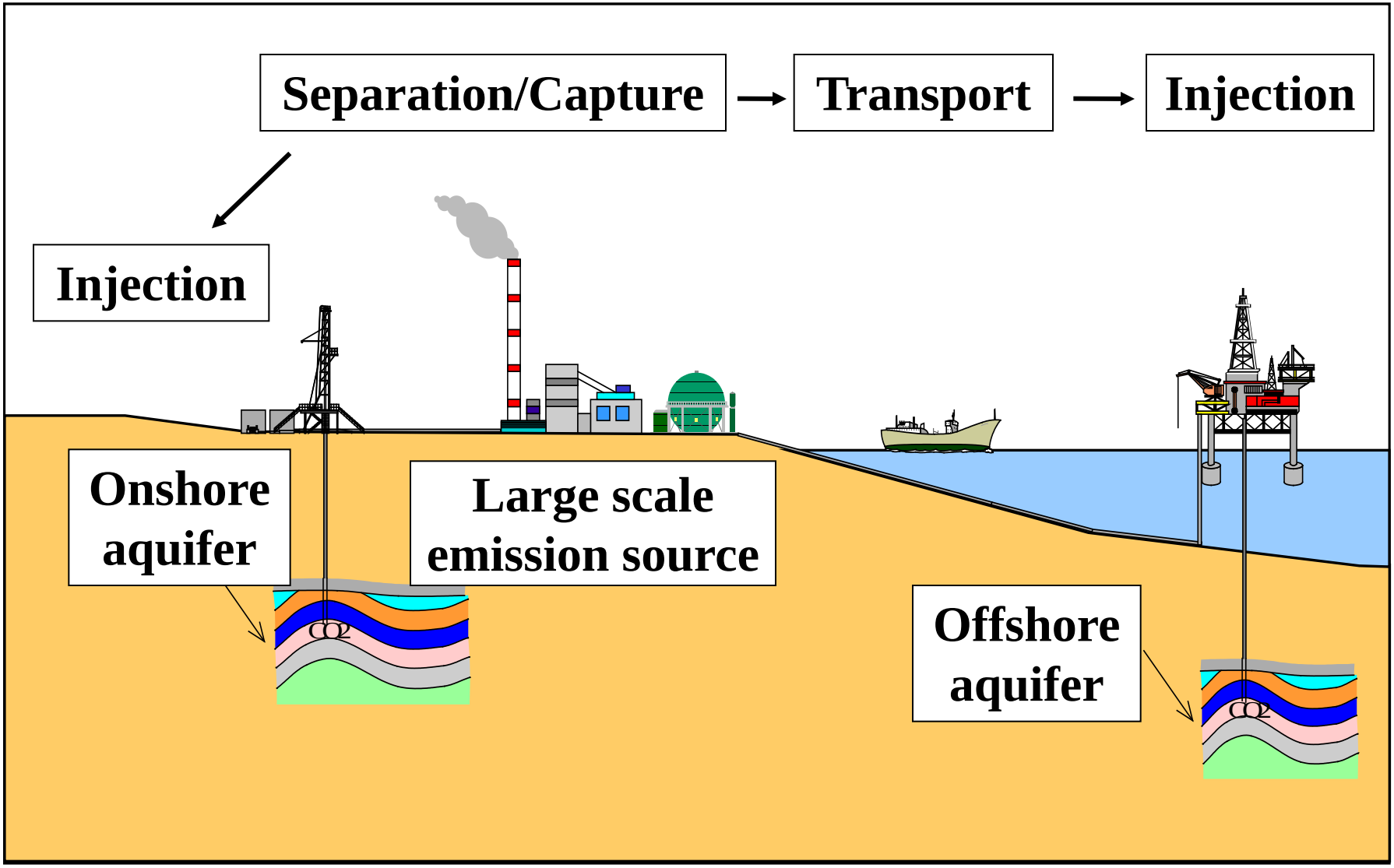
How to fill the gap of reduced nuclear power?

1. Further energy savings: ambitious targets are incorporated in current strategic energy plan → behavioral change using ICT as well as efficiency improvements

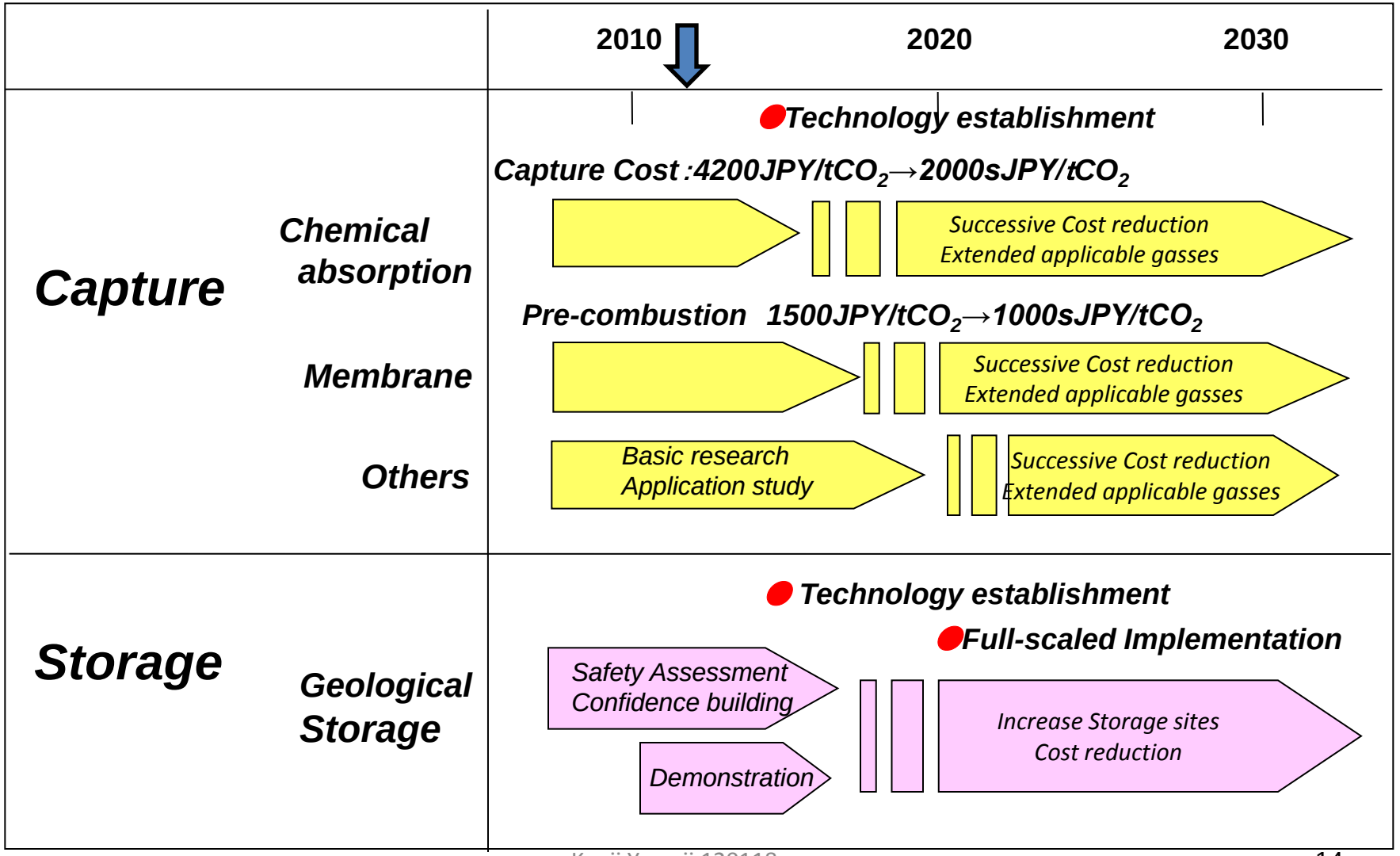
2. More renewables: PV: 53GW and wind power10GW in current strategic energy plan → power system stability issue → smart grid?; more geothermal, more small hydro, more biomass by FIT policy

3.Clean use of fossil fuels: notably natural gas, clean coal incl. **CCS**, international applications of Japanese efficient technologies

Concept of CCS



CCS Status : Roadmap



1AUS$=82.5JPY

Nagaoka Project (CO_2 Geological Storage)

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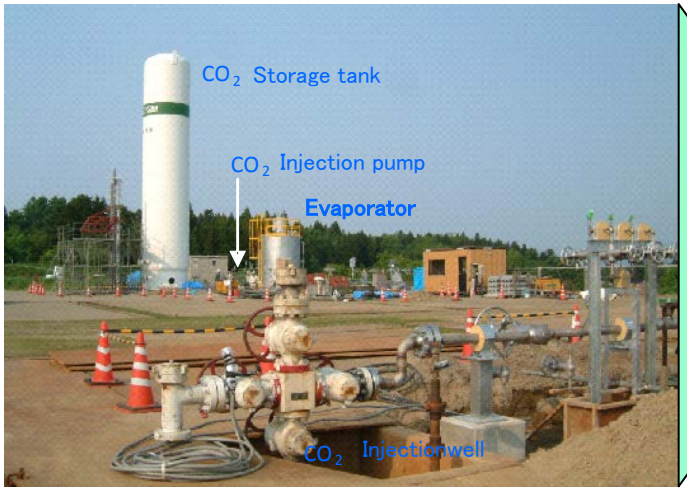
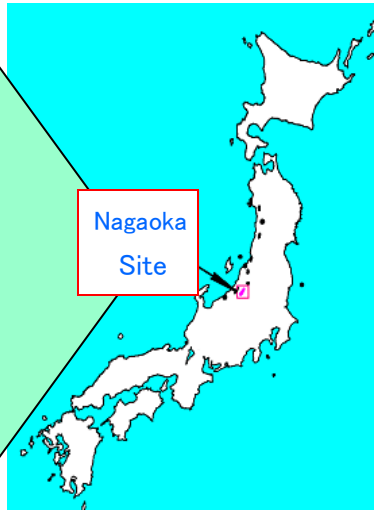
[CO_2 Injection site]





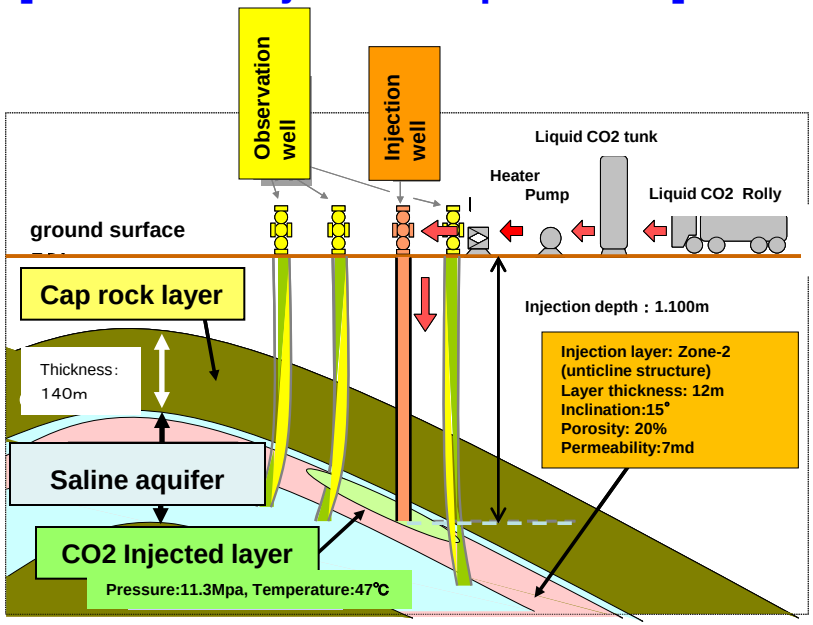
[Target of the project]

Verification of CO2 Storage
in Complex Geology of Japan

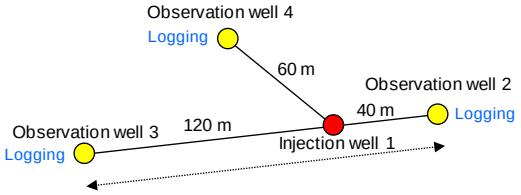
[Pilot test overview]

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.

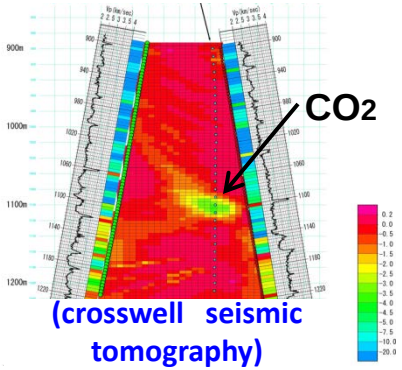
[Outline of injection experiment]



[Well configuration]

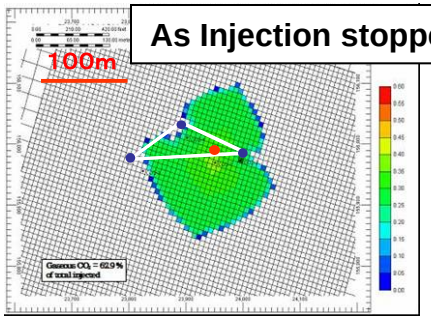


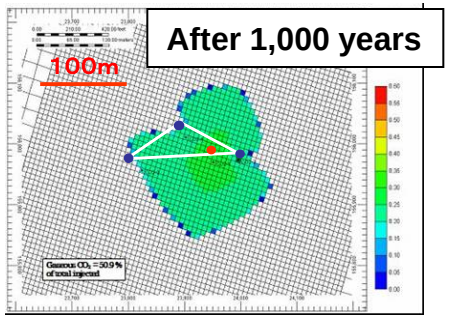
[CO_2 monitoring]



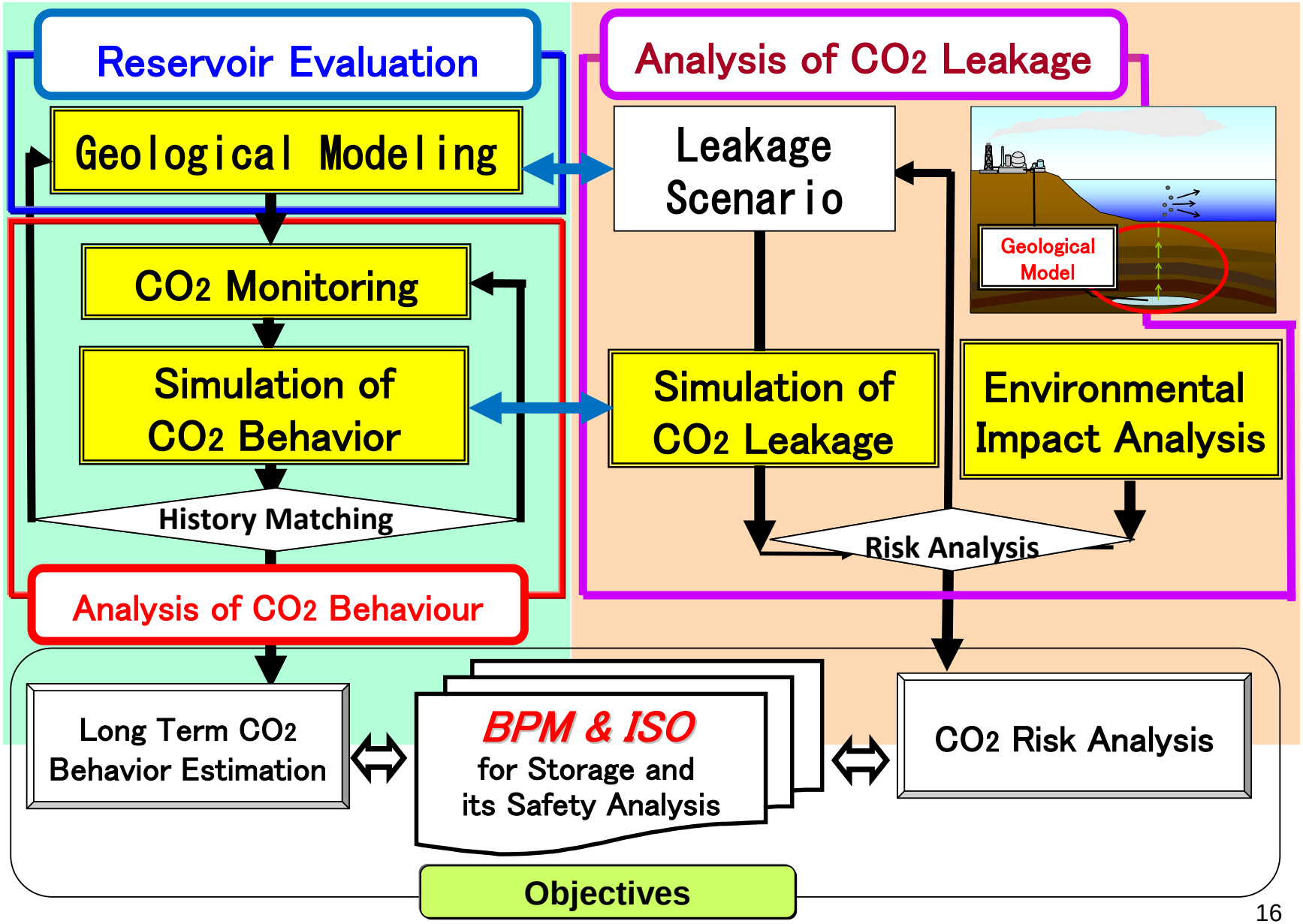
(crosswell seismic tomography)

【Simulated CO_2 distribution】



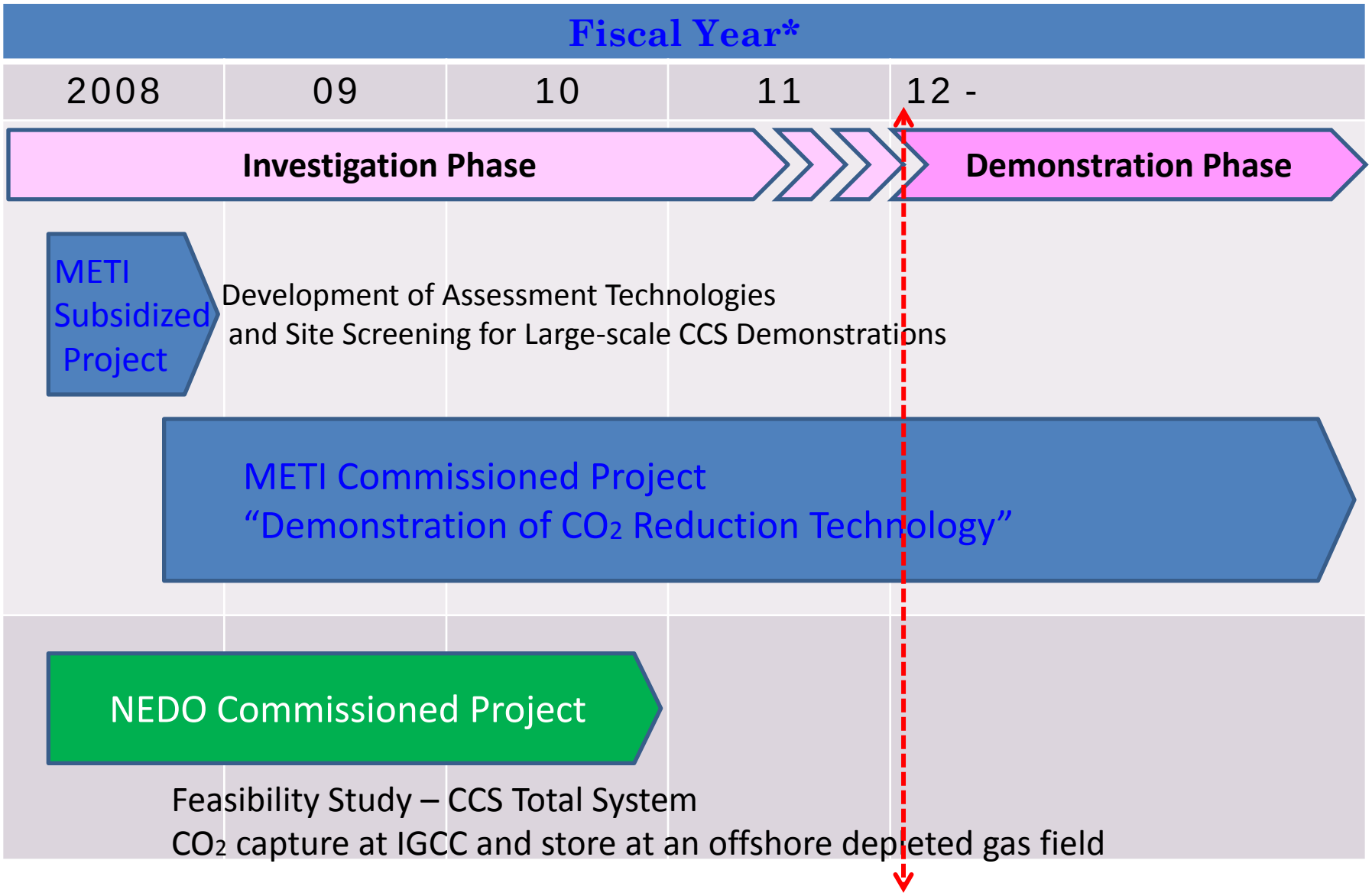


Development of Safety Assessment Technology

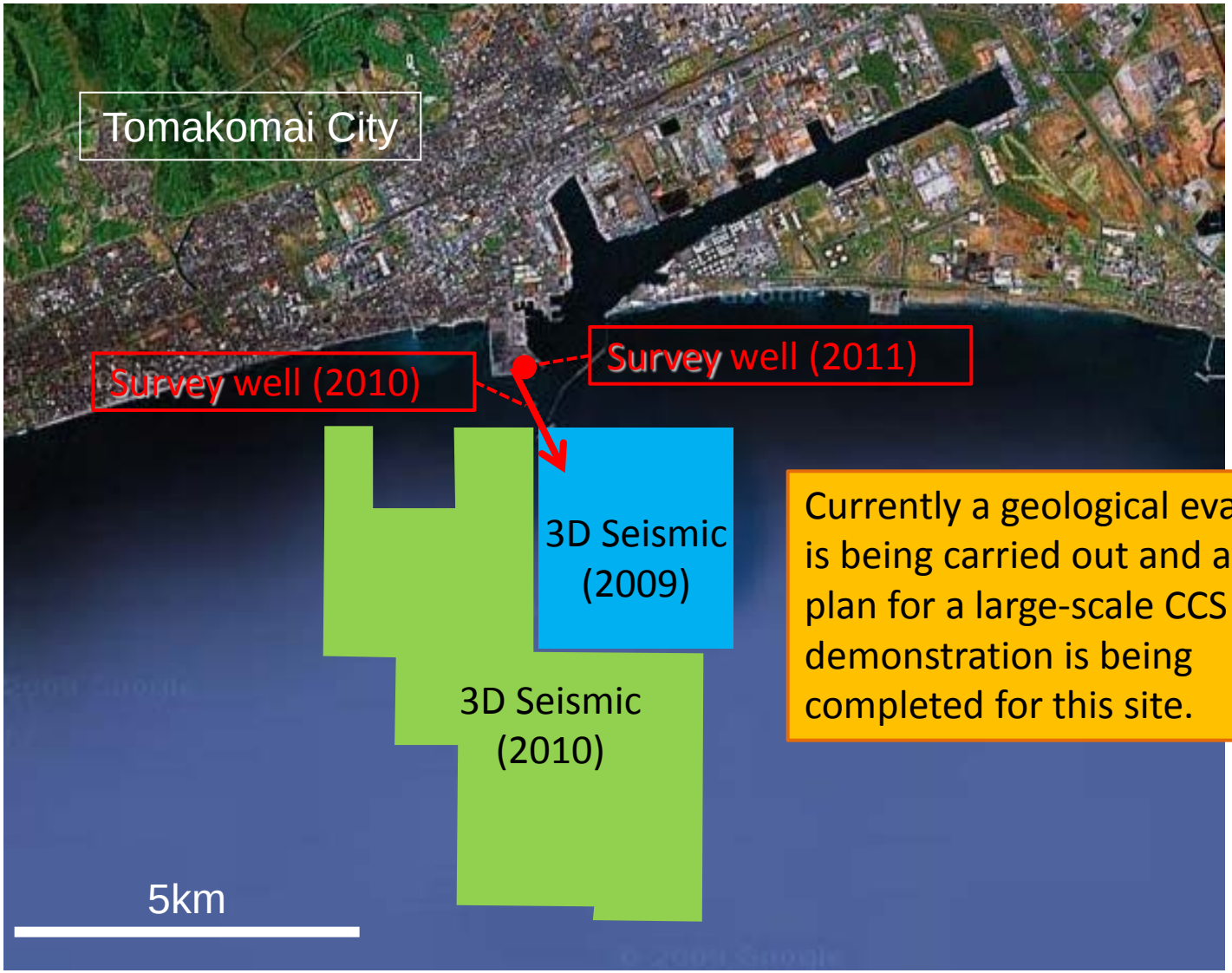


BPM: Best Practice Manual, ISO: International Organization for Standardization

CCS Demonstration Project Phase



Geological Survey at Tomakomai Candidate Site



Currently a geological evaluation is being carried out and a basic plan for a large-scale CCS demonstration is being completed for this site.

5. International Cooperation of RITE

GHGT-11
18-22, November, 2012
Kyoto
Kyoto International Conference. Center
Organized by RITE and
IEA-GHG R&D Programme

RITE
R&D
of CO_2 Capture
& CO_2 geological storage
FS on IZEC

Canada
- Weyburn-Midale Project
- AQUISTORE Projects

Europe
- Japan-EU CCS Expert Meeting
- QICS Project (UK)
- CO_2 Field Lab (Norway)
- RITE-NTNU (Norway)

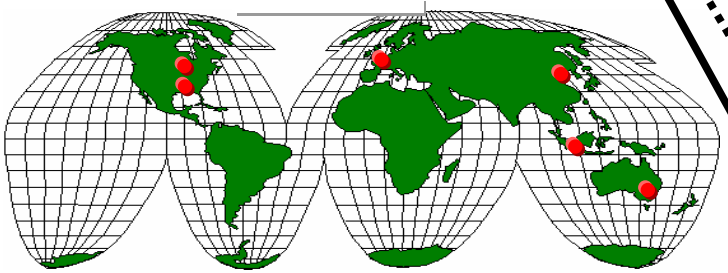
China
- CCS-EOR collaboration
  - CNPC

Indonesia
- Collaboration on CCS
  - LEMIGAS
  - PERTAMINA
  - ITB

Organization
- IEA-GHG R&D
- IEA
- CSLF

USA
- Japan-US collaboration
  - LBNL ↔ SECARB
  - METL (Capture)
- CSLF Project
  - DOE ↔ NETL
- Stanford Univ. (GCEP)

Australia
- GCCSI (Global CCS Institute)
- Callide Project
- CSIRO (Loy Yang Power)



GHGT-11

- 11th International Conference on Greenhouse Gas Control Technologies -

November 2012 - Kyoto will welcome experts in greenhouse gas control technologies from across the world!

1. Dates : Sun. 18 – Thur. 22 November, 2012
2. Venue : Kyoto International Conference Center, Japan
3. Organizers : RITE & IEAGHG
4. Call for Paper open : Late-September, 2011

GHGT-10 Plenary session

Themes are: Capture; Geo Storage; Other Storage; Industrial sources; Transport; Negative CO2; CO2 utilisation options; Demonstration; Tech Assess & Integration; Commercial Issues; Public Perception; Policies; Legal & Regulatory; Education, training, and capacity building

5. On-line Conference Registration

Early Bird open: Late-April 2012 / Late on-line registration: Late-July 2012 – November 17th, 2012

6. Programme Overview (Subject to change)

	Sun.Nov. 18	Mon. Nov. 19	Tues. Nov.20	Wed. Nov.21	Thurs. Nov.22
AM		Welcome and Keynote Address	Plenary Session	Plenary Session	Plenary Session
			Technical Session 4	Technical Session 7	Technical Session 10
		Technical Session 1	Technical Session 5	Technical Session 8	Technical Session 11
PM		Technical Session 2	Poster Session A	Poster Session B	Panel Discussion
		Technical Session 3	Technical Session 6	Technical Session 9	Closing Session
Night	Registration and Welcome Reception		Networking Reception	Conference Dinner	

GHGT-10 : Poster session

7. Website http://www.ghgt.info/ **!!! Sponsors are now being sought !!!**

Thank you for your attention!
Join us on GHGT-11, in Kyoto, 2012 !

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