CCS Technical Workshop:
Efforts to address concerns over CO_2 seepage from reservoir
Tokyo, Japan, 24th January 2013

Site Selection and Environmental Impacts Assessment – Regulations and Case Studies –

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CCS development and regulatory issues

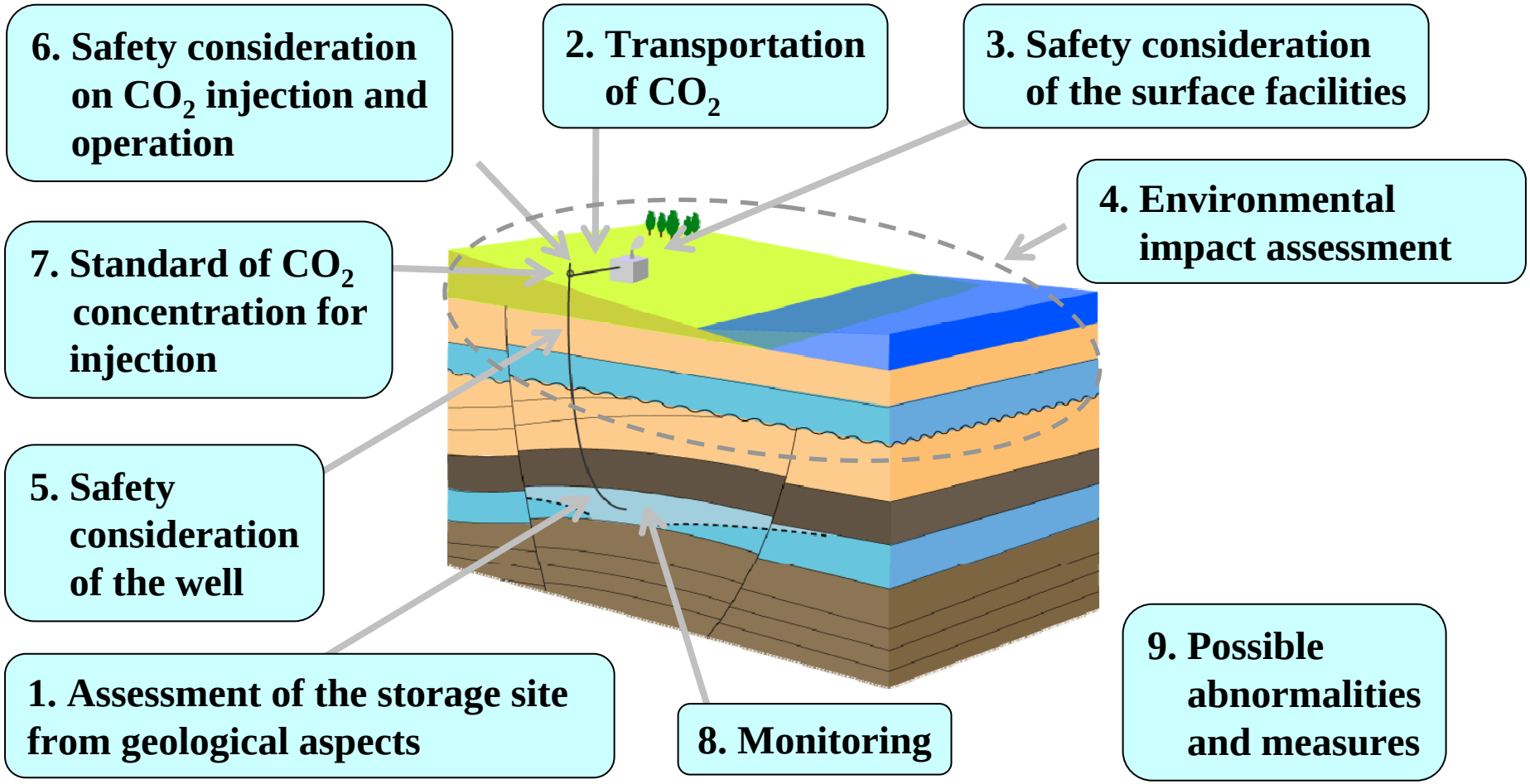
- ✓Expansion and scale-up of CCS technology
- ✓Regulatory issues associated with ensuring the protection of public health, safety and the environment
- ✓Regulations are required to build public confidence in, and acceptance of , the CCS technology
- ✓Governments have started to amend existing regulatory frameworks to allow CCS projects to move forward

Legal and regulatory review

Recent progress	
US	US Environmental Protection Agency (EPA) finalized Safe Drinking Water Act rule that sets requirements for geologic storage, including the development of a new class of injection well, termed Class VI, established under EPA's Underground Injection Control (UIC) Program.
EU	EU member states had to transpose the EU CO_2 Storage Directive109 into national legislation by 25 June 2011. CCS project proposals were submitted to NER 300 funding programme.
Australia	The Commonwealth has finalized the Offshore Petroleum and Greenhouse Gas Storage (Greenhouse Gas Injection and Storage) Regulations 2011 (Commonwealth), which came into force in June 2011.
Canada	Alberta expects to conclude the regulatory framework assessment (RFA) by the end of 2012.

Source: OECD/IEA 2012 Carbon Capture and Storage Legal and Regulatory Review – Edition 3

Japanese guideline
For Safe Operation of a CCS Demonstration Project



By CCS Study Group, Industrial Science and Technology Policy and Environment Bureau, METI
August 2009 (http://www.meti.go.jp/english/press/data/20090807_02.html)

For Safe Operation of a CCS Demonstration Project

1. Assessment of the storage site from geological aspects

✓ **Formulation of hydrogeological and geological structure model**

- Hydrogeological and geological structure of the reservoir
- Injected CO2 behavior
- Environmental impact or possibility of leakage of injected CO2

✓ **Assessment to perform large-scale demonstration project**

- Confirmation of the existence of reservoir and cap rock
- Setting of adequate CO2 injection plan
- Sealing property of cap rock
- Seismic activities occurred in the past in the vicinity of CO2 injection site

✓ **Data to be acquired, acquisition methods, and time-frame for acquisition**

For Safe Operation of a CCS Demonstration Project

2. **Transportation Standard**
   - ✓ Compliance with the High Pressure Gas Safety Act
3. **Safety consideration for placing CCS-related facilities**
   - ✓ Compliance with the Mine Safety Act
4. **Environmental Impact Assessment**
   - ✓ Compliance with the Prevention of Marine Pollution and Maritime Disaster
5. **Safety consideration for the drilling, completion and plugging and abandonment for CO_2 injection and storage wells**
   - ✓ Formulation of casing plan, Blowout prevention procedure, Cementing to prevent CO_2 leakage, Well completion, Explosion protection, Compliance with the Mining Act, the Mine Safety Act, and the Petroleum and Combustible Natural Gas Resources Development Act

For Safe Operation of a CCS Demonstration Project

6. Safety considerations for CO_2 injection and operation

- ✓ Formulating plans for CO_2 injection and operation
- ✓ Optimizing CO_2 injection and operation through updating the detailed model of the storage system

7. Concentration standard of CO_2 to be injected

- ✓ Compliance with the Prevention of Marine Pollution and Maritime Disaster

8. Monitoring

- ✓ Compliance with the Prevention of Marine Pollution and Maritime Disaster

9. Measures to be taken when abnormalities occur

- ✓ Possible abnormalities, Setting standards to detect abnormalities, Assumption, preparation and implementation of measures required when abnormalities occur, Measures to be taken after settling abnormalities, Actions to be prepared to deal with abnormalities

Regulation for Environmental Impact Assessment of offshore CCS in JAPAN

Offshore CCS and London Convention

London Convention

✓An agreement to control pollution of the sea by dumping and to encourage regional agreements supplementary to the Convention.

✓1996 Protocol: The Parties are obligated to prohibit the dumping of any waste or other matter that is not listed in Annex 1 (the reverse list).

✓Adopted on 2006: Carbon dioxide streams may only be considered for dumping, if disposal is into a sub-seabed geological Formation”

Regulation for Environmental Impact Assessment of offshore CCS in JAPAN

Act for the Prevention of Marine Pollution and Maritime Disasters

✓May 2007: The act was revised for license procedure on dumping CO2 stream into sub-seabed formation.

Operator of Offshore CCS,

✓Should receive clearances from environment minister.

✓Should implement Environmental Impact Assessment.

✓Should monitor surrounding sea environment.

License application of Offshore CCS in Japan

- ✓ **Project plan**
- ✓ **Marine Environment Monitoring Plan**
- ✓ **Preliminary Assessment Document for Dumping Waste Under the Seabed**

"Point and extent, volume and the estimation method of CO_2 stream seepage on the assumption that CO_2 stream dumped into sub-seabed formation seeps out to the sea"

Demonstration Project

What is Environmental Impact Assessment?

✓The process of identifying the future consequences of a proposed action

History

✓USA, National Environmental Policy Act (NEPA) 1969

✓“EIA, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.” Principle 17, Rio Declaration on Environment and Development, 1992

Environmental Impact Assessment aims to:

✓Provide information for decision-making that analyzes the biophysical, social, economic and institutional consequences of proposed actions.

✓Promote transparency and participation of the public in decision-making.

✓Identify procedures and methods for the follow-up (monitoring and mitigation of adverse consequences) in policy, planning and project cycles.

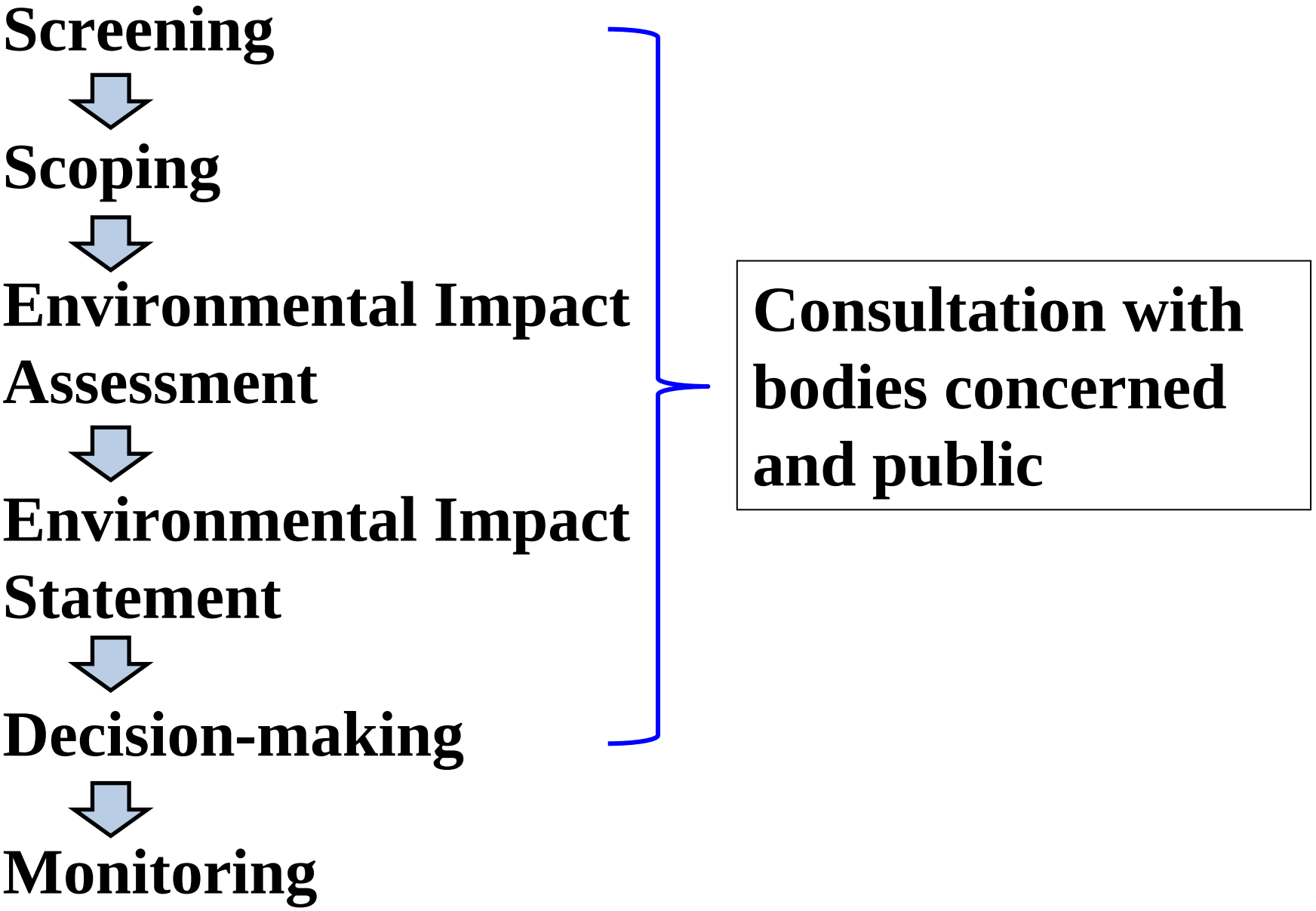
✓Contribute to environmentally sound and sustainable development.

International Association for Impact Assessment (IAIA), 2009

Comparison of Environmental Impact Assessment frameworks

Countries / Regions	Environmental Impact Assessment frameworks
US	National Environmental Policy Act (NEPA), 1969
EU	Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment, 1988
Australia	Environmental protection and biodiversity conservation act, 1999
Canada	Canadian environment assessment act, 1992
CHINA	基本建設項目環境保護管理弁法, 1981
Germany	Environmental impact assessment act, 2001
JAPAN	Environmental impact assessment law, 1997 (環境影響評価法)
Netherlands	Environmental management assessment regulations, 2005
Norway	Regulations relating to environmental impact assessment, 2005
UK (England & Wales)	Town and country planning (EIA) regulations, 1999

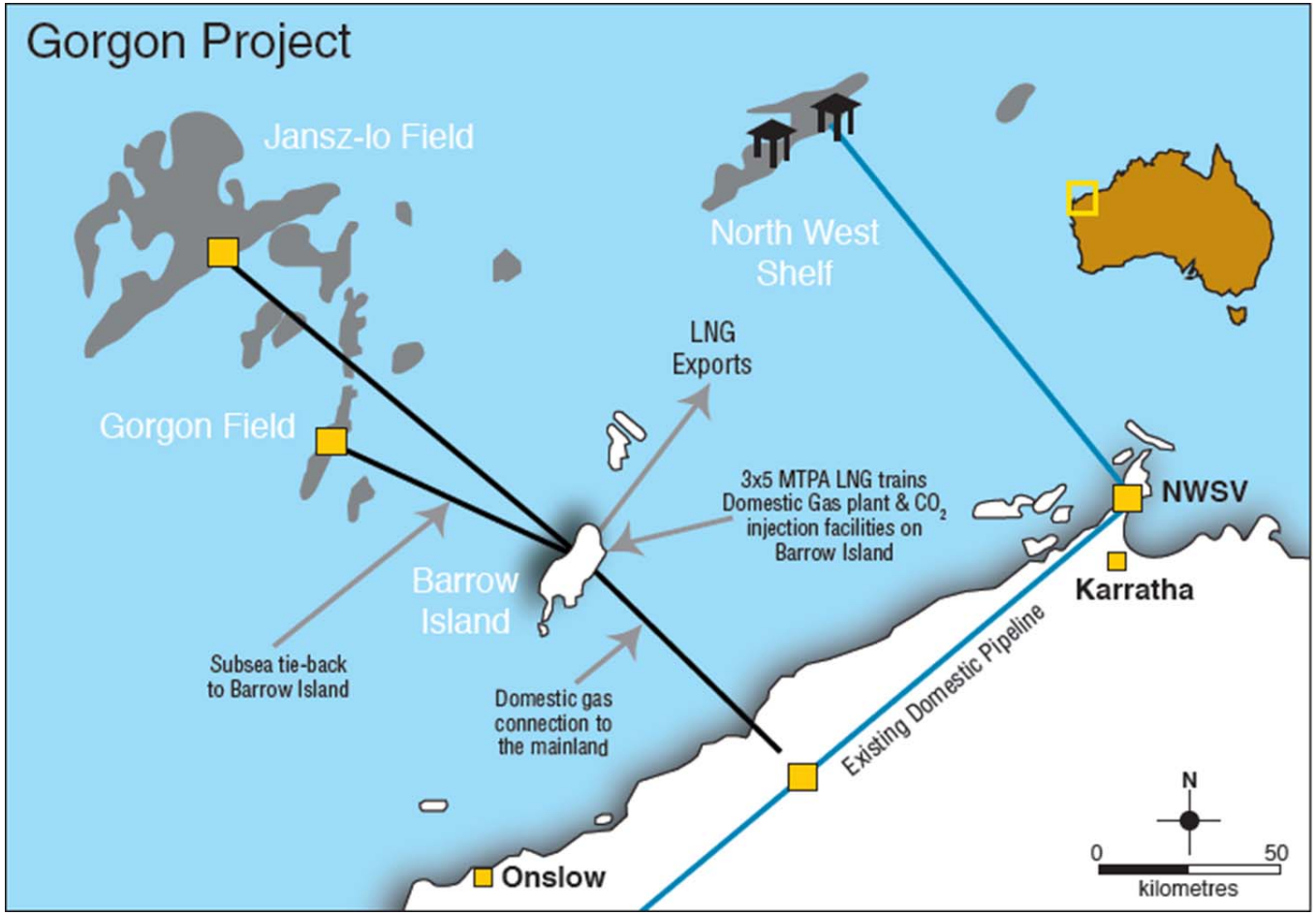
Procedure of Environmental Impact Assessment



Example of Environmental Impact Statement for the CCS

Gorgon project

Location: Barrow Island, Australia
Proponent: Gorgon Joint Venture



CO_2: captured from LNG plant, stored in deep saline formation

Progress:

- FEED: Completed,
- Construction: Sep. 2009,
- Operation: 2015, 40years

Source: www.chevronaustralia.com/ourbusinesses/gorgon.aspx

Environmental Impact Statement of Gorgon project

2005, **Draf**t EIS/Environmental Review and Management Programme (ERMP)

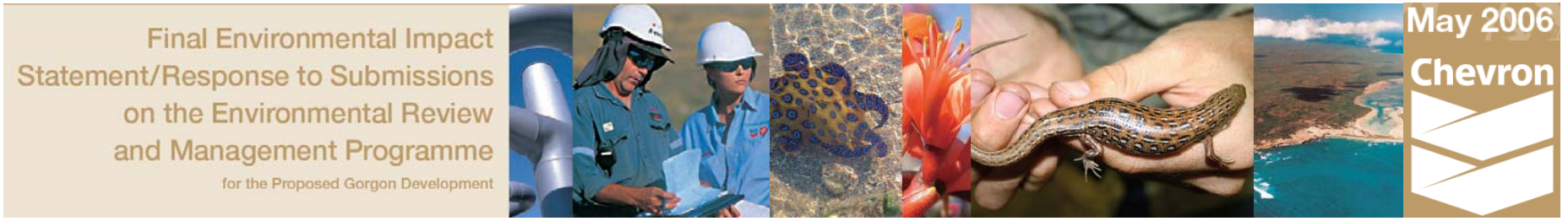
✓ Chapter 13: Greenhouse Gas Emissions – Risks and Management

- Greenhouse gas emissions from the proposed development
- Proposal to dispose of reservoir CO_2 by subsurface injection into the Deputy formation

2006, **Fina**l EIS/Response to Submissions on the ERMP

✓ Part B: Response to submissions

- Approx. 1,300 separate questions and answers to them were described in detail.



Source: www.chevronaustralia.com/ourbusinesses/gorgon/environmentalresponsibility/environmentalapprovals.aspx

Example of Environmental Impact Statement for the CCS

FutureGen project

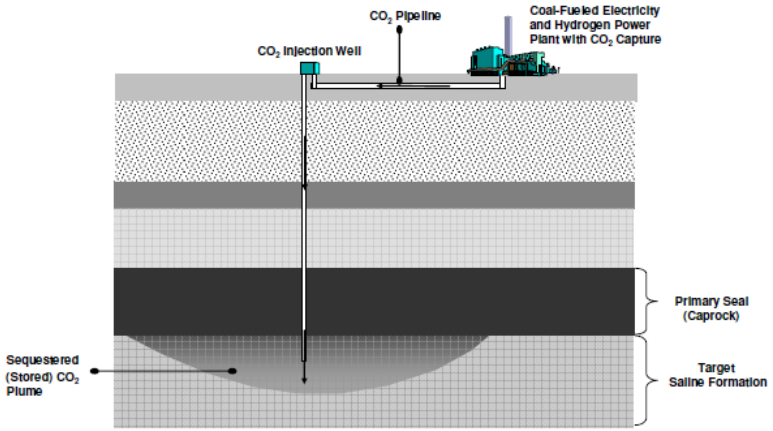
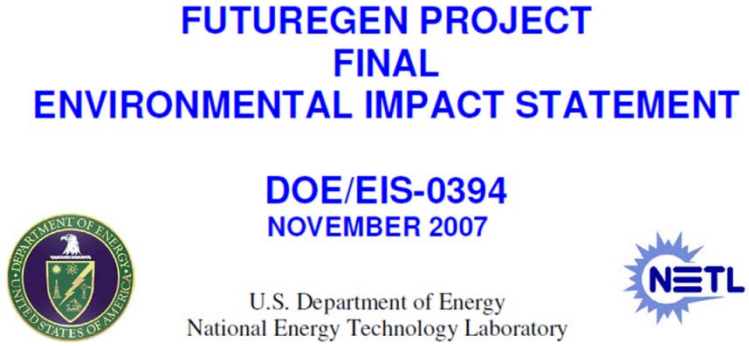


Figure S-1. FutureGen Project Overview

- ✓ US government project, 2003
- ✓ Construction of a near zero-emissions coal-fueled power plant to produce hydrogen and electricity while using CCS
- ✓ Four candidate sites, 2006
- ✓ **Final EIS**, 2007
- ✓ DOE announced a restructuring, 2008
- ✓ DOE announced a retooling, FutureGen 2.0, 2010.

Source: FUTUREGEN PROJECT FINAL ENVIRONMENTAL IMPACT STATEMENT, DOE/EIS-0394, 2007

Environmental Impact Statement of FutureGen project



approximately 2,500 pages !!

Chapter 1 – Purpose and Need for Agency Action
Chapter 2 – Proposed Action and Alternative
Chapter 3 – Summary of Environmental Consequences
Chapter 4-7 – Mattoon Site, Tuscola Site, Jewett Site, Odessa Site
Chapter 8 – References
Chapter 9 – Index
Chapter 10 – Glossary
Chapter 11 – Distribution List
Chapter 12 – List of Preparers
Chapter 13 – Comments and Responses on the Draft EIS

Risk Assessment Report

Source: www.netl.doe.gov/technologies/coalpower/futuregen/eis/

Final Risk Assessment Report

for the FutureGen Project Environmental Impact Statement

Contract No. DE-AT26-06NT42921

December 22, 2006

(Revision 1 April 2007)

(Revision 2 October 2007)

1. Intorduction
2. Conceptual site models
3. Toxicity data, benchmark concentration effect levels
4. Pre-Injection risk assessment
5. Post-Injection risk assessment
6. Risk screening & performance assessment

Chapter 5

CO_2 leakage from the reservoir

✓Relevant industry experiences

✓Natural analog studies

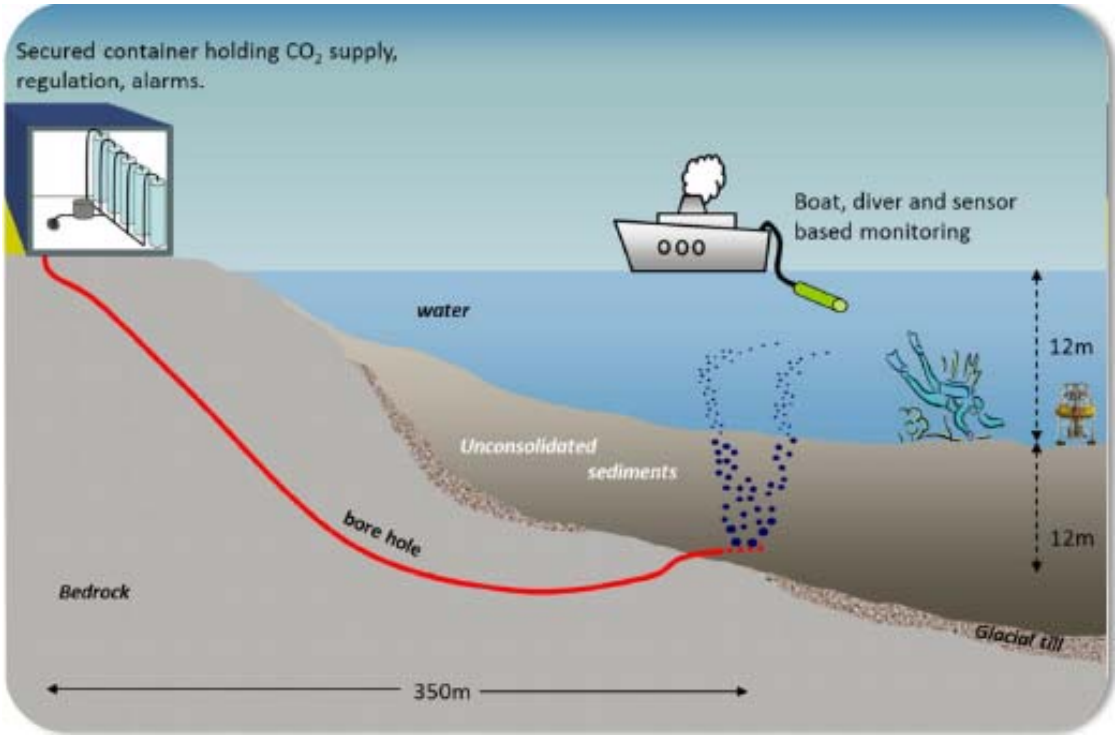
✓Modeling

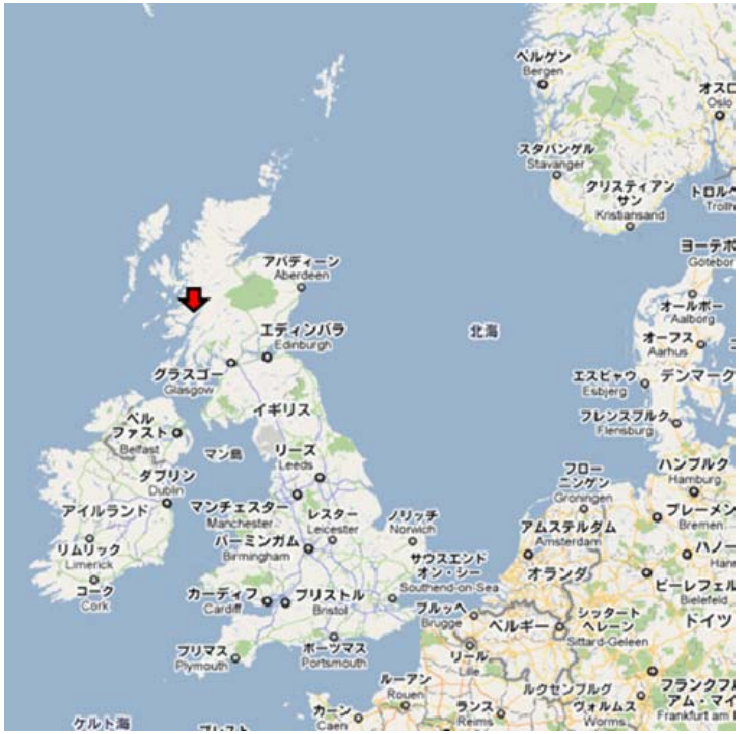
✓Expert judgment

Collaboration with QICS project UK

Quantifying and Monitoring Potential Ecosystem Impacts of Geological Carbon Storage

Funded by the Natural Environment Research Council of the UK, with support from the Scottish Government





- ✓ Information that will support an ecological risk assessment of CCS.
- ✓ A guide to minimising potential ecological impacts from CCS.
- ✓ Models that can evaluate a variety of hypothetical leak scenarios.
- ✓ Guidelines for the detection and monitoring of leaks.

QICS project: Research consortium

UK

PML | Plymouth Marine Laboratory

The University of Edinburgh

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Heriot Watt University

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

University of Southampton

Durham University

Scottish Association for Marine Science

University of Bristol

Managing Risk

DNV

JAPAN

RITE
Research Institute of Innovative Technology for the Earth

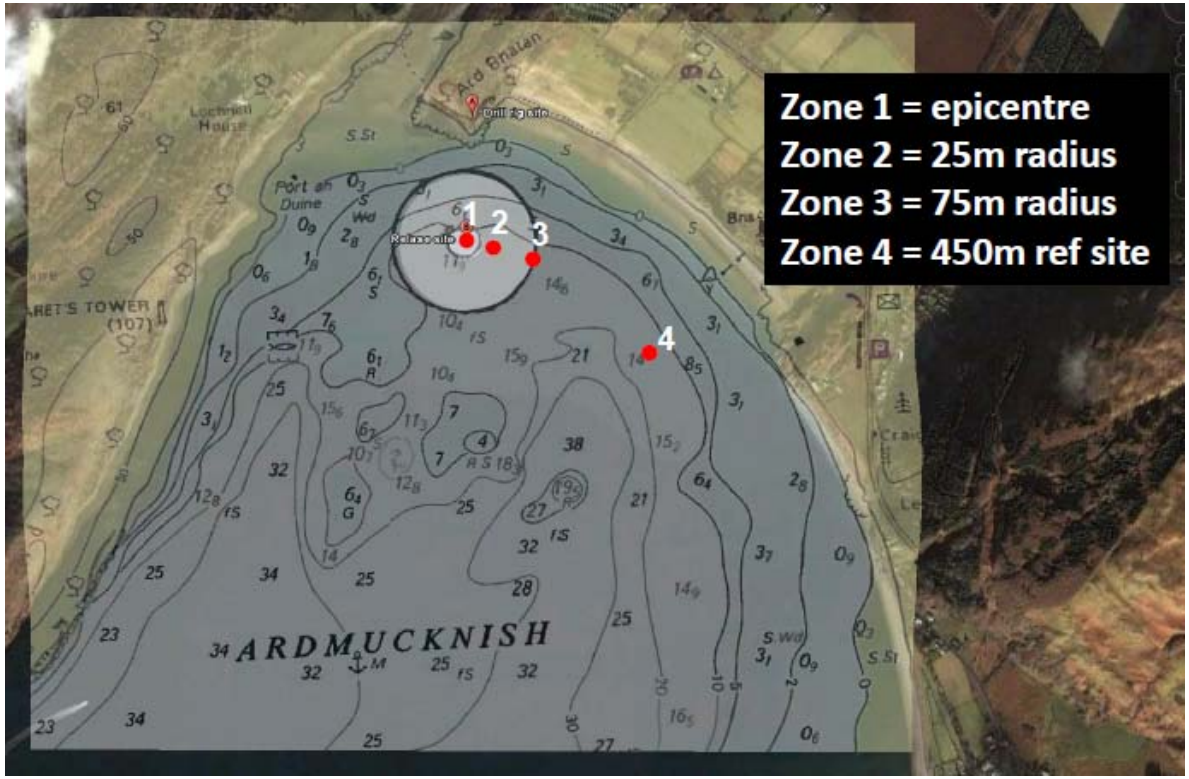
AIST
National Institute of Advanced Industrial Science and Technology (AIST)

CRIEPI

i²CNER
Kyushu University

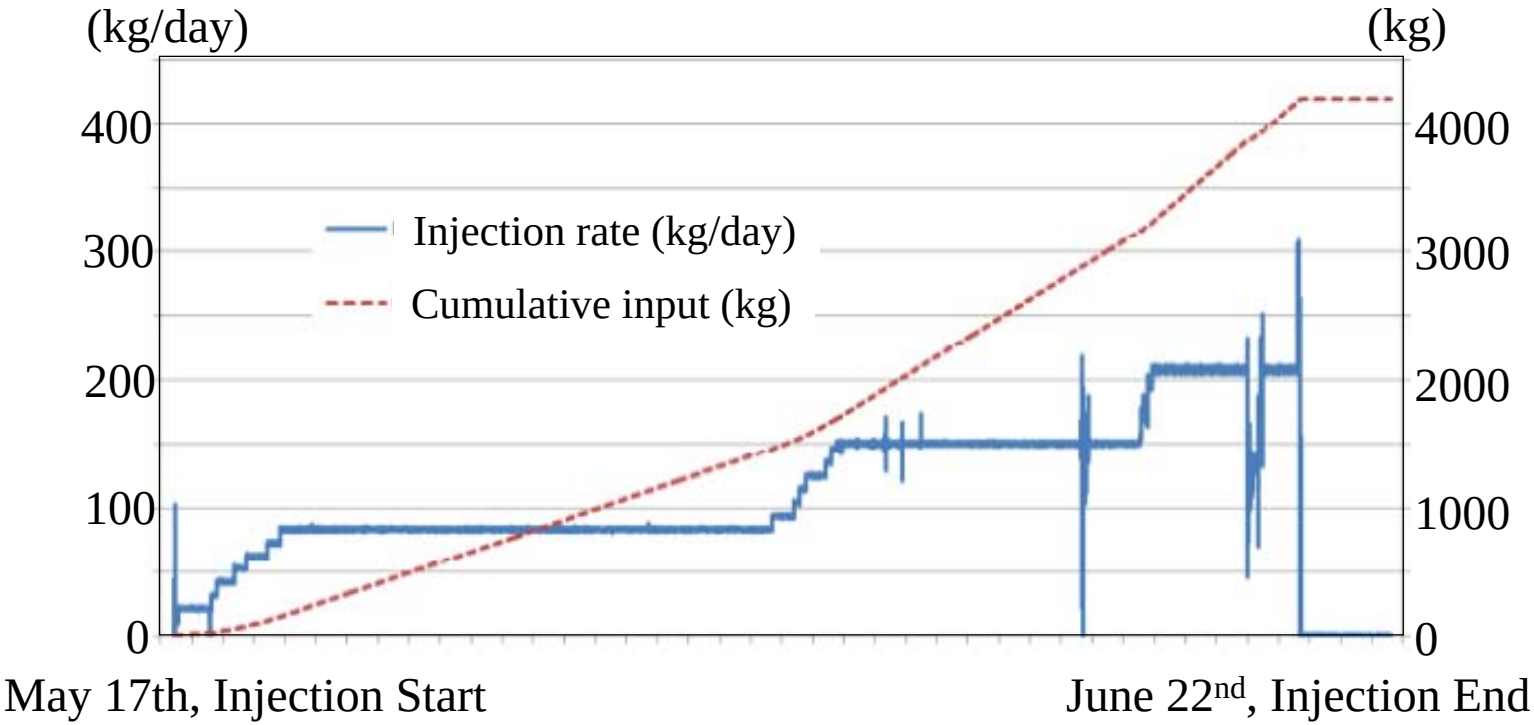
The University of Tokyo

QICS project: CO_2 injection facility



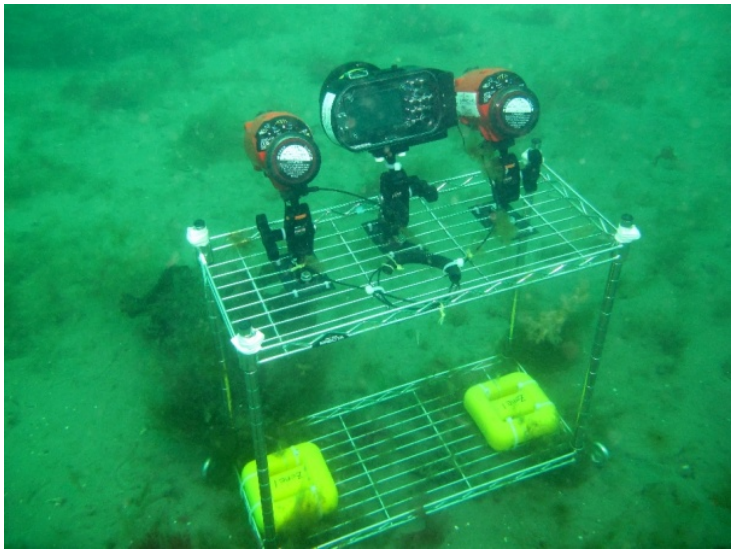
QICS project: CO_2 injection, 2012

May	June	July	August	September
	CO_2 injection 36 days	Recovery phase 90 days		

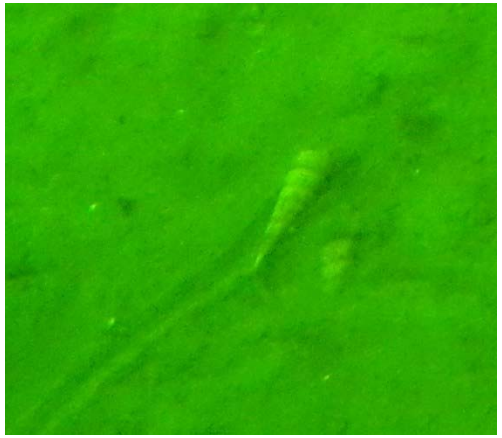


QICS project: RITE's experiment

- ✓ **Underwater camera observation for Macro-organisms behavior**
- ✓ **Effect on nitrification (Ammonium oxidation rate) of benthic micro-organism**



Macro-organisms



Snail

Sea star

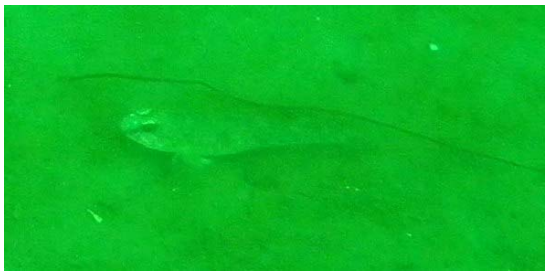
Sea pen

Hermit crab

Swimming crab

Spider crab

Cod



Goby

Conclusion

- ✓ Laws and regulations for CCS has been provided in the world.
- ✓ Site Selection and Environmental Impact Assessment are important for public acceptance of CCS
- ✓ Gaps in knowledge, such as “monitoring method” and “leakage scenario” for offshore CCS is filled through the field experiment.
- ✓ International collaboration is highly desirable