

Following Developments on CO₂ capture, Monitoring and Risk Assessment

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Greenhouse Gas R&D IA

IEA Network of Experts in Energy
Technology (NEET), “Integrated
Approaches to Energy Technologies”

Beijing, China 27-29th November 2012

Greenhouse Gas R&D IA



A collaborative research programme founded in 1991 as an IEA Implementing Agreement fully financed by its members

Aim: Provide members with definitive information on the role that technology can play in reducing greenhouse gas emissions.

Scope: All greenhouse gases, all fossil fuels and comparative assessments of technology options

Focus: On CCS in recent years

Producing information that is:

- Objective, trustworthy, independent
- Policy relevant but NOT policy prescriptive
- Reviewed by external Expert Reviewers
- Subject to review of policy implications by Members



BG GROUP



CEZ GROUP



TOTAL



PETROBRAS



ALSTOM

EPRI

CIAB



ExxonMobil

Schlumberger

DOOSAN Doosan Babcock



EnBW

e.on



ieaghg



SCOTTISHPOWER



REPSOL YPF

VATTENFALL



INSTITUTO DE INVESTIGACIONES ELECTRICAS

B&W power generation group

Enel L'ENERGIA CHE TI ASCOLTA.

GLOBAL CCS INSTITUTE

JGCC

RWE The energy to lead

Statoil

Partner Organisations:



GHG R&D IA Activities



- **Task 1: Evaluation of technology options**
 - Based on a standard methodology to allow direct comparisons and are peer reviewed
- **Task 2: Facilitating implementation**
 - Provision of “evidence based information”
- **Task 3: Facilitating international co-operation**
 - Knowledge transfer from existing, laboratory, pilot and commercial scale CCS projects globally
- **Task 4: To disseminate the results as widely as possible.**

Focus on Task 3



- International Collaborative research networks
- Aim to promote international collaboration
- Help to collate information on new developments in key areas
- Small interactive meetings (50-80 people)
- Open to all



International research networks



CO₂ Capture

- Post combustion capture network (PCC)
- Oxy fuel Combustion network (OCC)
- Solid looping research network (HTSLN)

Cross Cutting

- CCS Costs
- Social Research on CCS

Geological Storage

- Monitoring of Injected CO₂
- Modelling of injected CO₂
- Well bore integrity network
- Risk Management
- Environmental Impacts network

Learning's from recent meetings



- CO₂ capture – post combustion capture
- PCC-1, Yas Hotel, Abu Dhabi
- 17th – 19th May 2011



What was learnt?



- A number of pilot plants have established mass transfer and energy performance.
- Energy required for CO₂ capture from coal is settling into a range of 200-250 kwh/tonne CO₂.
 - KS-1, piperazine, AMP/PZ, MDEA/PZ are some of the superior solvents.
- Two issues of secondary environmental impact are receiving major attention:
 - Nitrosamines are made from NO₂ in flue gas, but are probably limited to accumulation in the solvent.
 - Unexpected losses of volatile amine through the water wash as aerosols must be addressed.

- Steady technical progress over 11 yrs
- A number of large pilot plants providing good scale up data but still no integrated CCS demonstration using post combustion capture in power sector
- 2nd Generation Technologies coming on but not clear about process economics
- No perceived technical show stoppers, and environmental impacts being addressed

n.b. Issues around finance, regulation, public acceptance same as for other CCS routes but not discussed at what was a very technical event

Learning's from recent meetings



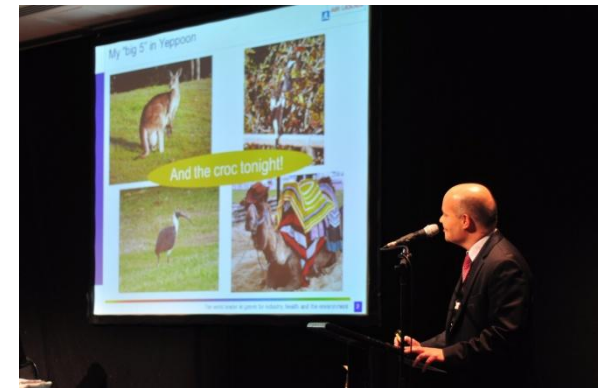
- CO₂ capture – Oxyfuel
 - OCC-2 Capricorn Resort, Yeppoon, Australia
 - 11th – 16th September 2011



Key Messages from OCC2...



- Industry would need the demonstration projects to proceed in order to sustain the RD&D investment.
- We can't afford to lose the momentum of the past 10 years of RD&D efforts.



Takeaway Messages



- Tremendous Technical Progress over 6 yrs
- Four substantial large pilots; 2 operating; 2 in commissioning
- 3 large burner testing facilities
- Oxy CFB making good progress
- No perceived technical show stoppers
- 2nd generation in development e.g. Chemical looping combustion
- **Issues around finance, regulation, public acceptance**

Learning's from recent meetings



- CO₂ capture – Solid looping
 - 4th High Temperature Solid Looping Cycles Network Meeting, Xijiao Hotel, Beijing
 - Hosted by Tsinghua University
 - 20th August – 21st August 2012
 - 48 delegates



Status for HTSLCN Meeting



- 50%/- 35%
Delegates/papers

CLC+CaOL
Iron&steel
Cement
Paper
H₂ prod.
PCLC

Range of processes

Sorbent development
Effect of impurities
Conversion efficiency
Capture efficiency

Performance

CO₂ avoidance costs
Techno-economics

1+ MW
Size of demo plants

1000+ hs
Hours of operation

Challenges and next steps



- Techno-economic performance figures
- Demonstration of extended operating times
- Addressing emissions/environmental impacts
- Sorbent design/tailoring and cyclic stability
- Identifying first commercial opportunities
- Scale-up to commercial size (> 50 MW)

Monitoring Network



- **Potsdam, Germany, 1-3rd June 2011,**
- Theme: EU criteria for transfer of responsibility : *Actual behaviour of the injected CO₂ conforms with modelled; No detectable leakage*
- *Actual behaviour of the injected CO₂ conforms with modelled*
- Seismic detection limits discussed for real projects.
- Will always be the case that the models improve with more info.
- Combinations of tools can reduce overall uncertainty. Results from pilot sites are key for understanding and demonstrating processes

Monitoring Network



- *No detectable leakage*
- Traditional techniques include soil-gas and atmospheric monitoring as well as monitoring of shallow water. Very important to capture the full natural variation of CO₂. A 2 step approach to first locate the leak, then quantify it.
- New process based approach to soil monitoring.
- Use of risk assessments to define monitoring programmes
- Results from monitoring at the Ketzin project

- Visit to Ketzin project.

Learning's from recent meetings



- Monitoring injected CO₂
 - Large developing tool kit of monitoring techniques

Developed online software tool to present monitoring techniques

Scenario summary: New Scenario [2012-11-06 16:46:31]

Onshore; Depth: 1500 to 2500 m; Type: Aquifer; Quantity: 500,000 Mt (50,000 Mt/yr for 10.0 yrs); Package: BGS+Arnd+Post-injection+Core

	Rating %	Plume	Seal	Migration	Seismicity	Integrity
	75	4.0	4.0	4.0	0.0	3.0
	55	1.0	4.0	1.0	2.0	3.0
	45	1.0	2.0	2.0	0.0	4.0
	35	1.0	2.0	2.0	0.0	2.0
	25	1.0	1.0	1.0	2.0	0.0
	20	0.0	0.0	1.0	0.0	3.0
	0	0.0	0.0	1.0	0.0	3.0
	0	0.0	0.0	1.0	0.0	2.0
	0	0.0	0.0	0.0	0.0	2.0

Interactive tool can be found at:
<http://www.ieaghg.org/index.php?/Monitoring-Selection-Tool.html>

Risk Assessment Network Meeting



- **Pau, France, 21-23rd June 2011**
- Induced seismicity lessons from other activities
- Understanding potential groundwater impacts: In-situ CO₂-water-rock interactions may not be as important as migrated brine interactions; Buffering and scavenging processes may control trace element mobility
- Microbial activity can have both physical (e.g. porosity) and chemical impacts (e.g. catalysis of mineral reactions)
- Shell, BP, TOTAL updates on projects' risk assessments – combining several risk assessment techniques and driving monitoring programmes

Risk Assessment Network Meeting



- Key recommendations:
 - monitoring programmes should be risk-based;
 - the need for benchmarking of outputs of methodologies;
 - community asset values being included;
 - investigation into microbial influences;
 - consideration of induced seismicity for larger projects;
 - the importance of baseline data;
 - further work on the evolution of risk through time.

Overall Outcomes



- Improvements in application and understanding of techniques
- More real experience and results from projects (particularly monitoring)
- Real examples of projects' risk assessments integrating all network disciplines
- Monitoring programmes should be based on risk assessments
- Each considered relevant issues from UNFCCC Cancun Decision, fed into Abu Dhabi workshop.



Meetings in 2013

- Joint Modelling/Risk Assessment meeting, June, Trondheim, Norway
 - Dates to be confirmed
- OCC-3. September 9th -13th, Leon Spain
 - Includes visit to Ponferrada oxy CFB plan
- PCC-2. September 17th -20th, Bergen, Norway
 - Includes visit to Mongstad TLM
- Joint Monitoring/Environmental Impacts meeting, October, Canberra, Australia
 - Dates to be confirmed
- 5th HTSLN University of Cambridge (UK)
 - Dates to be confirmed



How to participate



- Go to IEAGHG home page:
www.ieaghg.org
- Register and choose option to receive updates on networks of interest.
- Small admin. fee for each meeting
- Costs of travel/accomodation covered by delegates





Thank You

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