



4TH RISK ASSESSMENT WORKSHOP

Report No. 2009/07

November 2009

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ACKNOWLEDGEMENTS AND CITATIONS

The IEA Greenhouse Gas R&D Programme supports and operates a number of international research networks. This report presents the results of a workshop held by one of these international research networks. The report was prepared by the IEA Greenhouse Gas R&D Programme as a record of the events of that workshop.

The fourth international research network on Risk Assessment was organised by IEA Greenhouse Gas R&D Programme in co-operation with the CO2CRC. The organisers acknowledge the hospitality provided by the hosts Rendezvous Hotel, Melbourne, Australia.

A steering committee has been formed to guide the direction of this network. The steering committee members for this network are:

Tim Dixon, IEA GHG (Chairman)
John Kaldi, CO2CRC
Rick Chalaturnyk, University of Alberta / IPAC
Jonathan Pearce, British Geological Survey
Malcolm Wilson, University of Regina / IPAC
Claudia Vivalda, Schlumberger
Lisa Bacanskas, US EPA
George Guthrie, NETL
Charles Jenkins, CO2CRC
Brendan Beck, IEA GHG

The report should be cited in literature as follows:

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Summary Report of 4th Risk Assessment Network Meeting

Date: 16 – 18 April 2009
Rendezvous Hotel,
Melbourne, Australia.

Organised by IEA GHG and CO2CRC.





FOURTH WORKSHOP OF THE INTERNATIONAL RESEARCH NETWORK ON RISK ASSESSMENT

Executive Summary

The fourth IEA GHG Risk Assessment Network Meeting was held on the 16th—17th April 2009 in Melbourne, Australia, and hosted by CO2CRC.

Cliff Kavonic of Victorian Department of Primary Industries gave the official welcome. The Victorian Government was that day publishing a report by Geoscience Victoria on the storage potential in the Gippsland basin in south Victoria.

The fifty six attendees enjoyed the discussions based around the six sessions. These were on reports from other initiatives, leakage impacts, combining monitoring with modelling and risk assessment, insurance and risk, risk communication, and updates from real projects.

Of particular note were Australian presentations on impacts of CO₂ storage on groundwater, putting potential effects of CO₂ into context with other effects, and showing that there may be positive effects in terms of drinking water re-pressurisation. Work from the US and Canada was also heard on groundwater impacts.

Also, in terms of risk communication, the community engagement for two successful projects in Germany and Australia were presented, highlighting the importance of the engagement process itself as much as the information communicated.

The workshop also included a presentation and discussion of risk assessment and insurance. This included discussion of the CCS liability policies offered by Zurich Insurance, and the role of ETS in setting a price for CO₂. This is discussed in more detail in Session 4 of this report.

The workshop concluded with breakout groups to identify the gaps, recommended actions, and key learning points. In considering the future role of the Risk Assessment Network, the overall conclusion was that it continues to be necessary, but level of openness in the future may not be a great as members' desire because of increasing commercial sensitivities around real projects. In terms of what are the boundaries of the Risk Assessment Network's mission – the conclusions from most participants were that it should remain technically focused, although its results are use in the context of economic, political, social and other risks assessments.

The meeting was followed by a trip to the CO2CRC Otway project to see first-hand the site and work that had been described during the Network meeting.



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Welcome and Introduction,

Tim Dixon and John Kaldi opened the meeting, and reminded all of the remit of the Network which was established in 2005.

Cliff Kavonic of Victorian Department of Primary Industries gave the official welcome. The Victorian Government, coincidentally, that day released a report by Geoscience Victoria on the storage potential in the Gippsland basin in south Victoria. Questions followed around funding for CCS, the role of CCS within emissions trading schemes, and CCS and biomass. Cliff and Tim Dixon responded.

Neil Wildgust of IEA GHG gave a presentation on the results of the previous Risk Assessment Network meeting and the relevant conclusions from the Joint Network meeting.

Session 1: Reports from Other Initiatives, Chair: Malcolm Wilson

1.1 Modelling Network; Neil Wildgust, IEA GHG

Neil Wildgust of IEA GHG gave a presentation on the first meeting of the new IEA GHG network on modelling of CO₂ storage, held in Orleans, France, Feb. 10-13. Part of the aims of that meeting was to identify technical knowledge gaps and provide an international forum to try to identify means to address those gaps. Questions followed on whether this network had considered how it would interface with the risk assessment process. This had been discussed but without reaching a conclusion. It was suggested that each network should have its own risk assessment.

1.2 Wellbore Integrity Network; Rick Chalaturnyk, University of Alberta

Rick Chalaturnyk of the University of Alberta gave a presentation on the results of the last Well Integrity Network (WIN) meeting. This included reviews of experiments on Portland based cements. The WIN identified the need to evaluate CO₂ resistant cements and to get information on frequency of failure of oil and gas wells and CO₂ EOR wells, in order to model leakage rates, so as to input to risk assessment. The network is working towards a risk based assessment of wellbores. Questions followed on whether it was possible to measure CO₂ flux in wellbores.

1.3 IPAC; Rick Chalaturnyk, University of Alberta

Rick Chalaturnyk of the University of Alberta gave a presentation on the International Performance Assessment Centre (IPAC). IPAC is proposed as an international independent evaluating body benchmarking risk technologies. It is to be based in Regina, but to have nodes & “networked” stakeholders elsewhere in the world. Comments included that IPAC may only be needed if existing risk assessments were not sufficient; that it had to do assessments with transparent indicators, including frequency and severity and type of loss. Rick responded that IPAC would not take-on liability if its assurance was wrong, as it won’t review risk quantification but only risk assessment procedures.



1.4 Risk Assessment Terminology Study; Anna Korre, Imperial College

Anna Korre gave a talk on the IEA GHG funded study on Risk Assessment Terminology. This focussed more on the risk processes than the definitions. This draft report has been peer reviewed. Further comments are welcomed by IEA GHG and IPAC will input to this report and adopt and share. The need for a standard definition of risk assessment was raised.

1.5 CSLF Risk Assessment Taskforce; Claudia Vivalda, Schlumberger

Claudia Vivalda gave a brief overview of the work of the CSLF's Risk Assessment Taskforce and its forthcoming report on an overview of risk assessment for CCS (to be finalised May, 2009). Their recent meeting in Oslo this month had recognised the need of undertaking a gap assessment on tools and methodologies to be encouraged by PIRT, and recommended to the CSLF Policy Group to consider the link between risk assessment and liability and to put the use of risk assessment in the context of stakeholder outreach and communication.

1.6 Facilitated Discussion Session 1

The discussion was around whether additional "general guidelines" were needed, suggesting there was more impetus for specific case-by-case guidelines rather than more general ones. IPAC are looking at this.



Session 2: Quantification of Leakage Impacts, Chair: Claudia Vivalda

2.1 Environmental Impacts Workshop; Jonathan Pearce, BGS

Jonathan Pearce of BGS gave a presentation on the outcomes from the IEA GHG workshop on Environmental Impacts of Leakage (EIL), with its recommendations including research needs. Specifically, there is a need for credible (post injection) leakage scenarios (how much/how long) so as to define scope of environmental impact assessments and to put leakage into context and scope the scale of experimental releases and how these might impact modelling. The workshop also considered industry needs, regulator needs and public awareness needs. Studies on analogues are recommended, and work on target indicator species. Questions followed on experiments on injecting CO₂ into groundwater, though this wasn't included at the EIL workshop. Ensuing discussion included agreement that we must engage the public, but what is communicated must match level of audience understanding; i.e. be aware of terminology and of how much of our uncertainty to discuss.

2.2 Potential Impacts on Ground Water: An Australian Perspective I; Jim Underschultz, CO2CRC / CSIRO

Jim Underschultz of CSIRO/CO2CRC gave a presentation on their work in Australia on impacts of CO₂ storage on groundwater in the Gippsland basin. This was in terms of the effects on the freshwater/brine boundaries moving and flux through cap rocks. The freshwater/brine boundary movement has to be looked at in the context of significant movements caused by mine dewatering, oil and gas extraction, water extraction for irrigation and the natural flows that exist going to offshore.

2.3 Potential Impacts on Ground Water: An Australian Perspective II; Greg Leamon & Andrew Feitz, Geoscience Australia

Greg Leamon and Andrew Feitz gave a presentation on Geoscience Australia's work on groundwater impacts. Greg described their assistance to the Commonwealth Government with the offshore acreage releases. Andrew talked about their work in the Great Artesian Basin (Queensland) looking at potential impacts in the Surat / Gallilee Basins. This region has 3,100 artesian wells deeper than 1,000m and 35,000 sub-artesian wells around 100m deep. This extraction has caused the water level to drop by 100m, and more pumping required at existing wells. Methane also exists in the water and degassing causes a risk as well as being a GHG. The main risk of CO₂ storage in this region is of contaminating the freshwater and of leakage of the CO₂. However, on the positive side, it could also boost the pressure in the depleted water reservoirs and so assist freshwater extraction. There are no proposals at present to use the Great Artesian Basin for CO₂ storage. Questions included the potential conflict in permitting different resources.



2.4 Potential Impacts on Ground Water: Weyburn Perspective; Rick Chalaturnyk, University of Alberta

Rick Chalaturnyk of the University of Alberta gave a talk on the Weyburn project's work on potential geochemical impacts on shallow potable water, looking at wellbore leakage scenarios. The in situ geochemistry was sampled and tested with CO₂ in laboratories. The results suggest that formation of precipitates could actually have a leakage plugging effect, and that a drop in pH was caused which itself caused other geochemical changes but not at levels that would affect drinking water. Questions followed on the precipitates formed (siderite vs. iron oxide), site specific behaviour, and equilibrium in laboratory tests compared to in situ.

2.5 Potential Impacts on Ground Water: A US Perspective; Lisa Bacanskas, US EPA

Lisa Bacanskas of the US EPA gave the US perspective, reporting out on work lead by Jens Birkholzer (LBNL) on the potential impacts of CO₂ leakage on groundwater. The talk focused on research that investigated water quality changes that resulted from increased acidification, for example contaminants released from mineral sources within the shallow aquifer (release either from dissolution of minerals such as galena, a lead sulfide; from desorption, or from ion exchange sites). Results from the ZERT work were shown. Questions followed on how long the baseline data had been gathered and that rainfall was the main driver of baseline data.

2.6 Facilitated Discussion Session 2

Extensive discussion followed. Experimental data is used to build models, but models should be built first then tested with real results, this would provide more learning. In terms of well leakage, what are credible leakage scenarios for 1,000 years when no-one may be around? It was suggested that model well bores as just open to create worst case scenario. On well plugging, currently this is done to EOR standards which may not be enough for CO₂. BRGM are working on a simulation of CO₂ leakage into the Paris basin aquifer, but no results available yet.

Is model software development sufficient? It was suggested that reservoir simulators should have geochemistry added. Geomechanical effects are more for short-term, but geochemical effects are longer-term except for effects on injectivity.

From the insurance perspective, models are missing effects on groundwater. The risk assessment should happen by operational stages to reflect available tenure. Whilst there isn't the case history for actuaries to have data to build on, there are insurance-analogues to work from and other new activities don't have such data and are able to be insured.



Session 3: Combining MMV, Modelling and Risk Assessment, Chair: Rick Chalaturnyk

3.1 US Regional Partnerships; Ken Knottavange-Telleen, Schlumberger / MGSC

Ken Knottavange-Telleen of Schlumberger US gave a presentation on the work of the US regional partnerships in general and the Midwest Geological Storage Consortium in particular (MGSC) with their Decatur Project in Illinois. This used Features Events & Processes (FEP)-based risk matrix approach. Most discussion to date has been how to bring quantification to the risk assessment, and Schlumberger's work has brought risk assessment to modelling. Discussion on this approach suggested that it doesn't calculate probability of events, but is semi-quantitative in nature. It provides information to project managers for prioritisation of resources. The FEPs were looked at in isolation and weren't aggregated.

3.2 Combining MMV, Modelling and Risk Assessment at the Otway Project; Charles Jenkins, CO2CRC

Charles Jenkins of CO2CRC gave an extensive presentation on combining MMV, modelling and risk assessment at the Otway project. This covered the range of monitoring techniques, verification of predicted behaviour and development of key performance indicators. This work generates many research questions, such as what to measure, how sensitive, spatial and temporal coverage, how to interpret measurements. Questions were on whether the risk assessment drove the monitoring selection. The modelling to predict breakthrough used full deterministic modelling, and the actual breakthrough to the monitoring well was at the early end (just over 4 months) of the range predicted (4-8 months).

3.3 The TESLA Risk Assessment Tool and System Modelling; Richard Metcalfe, Quintessa

Richard Metcalfe of Quintessa gave a presentation on the TESLA risk assessment tool and system modelling. This provides whole system modelling and is a decision support tool driven by uncertainties based on value judgements by humans. Simon James of Shell (India) gave a presentation of Shell's experience in using the TESLA methodology. They have used this several times now on different projects. Their learning's were that it compliments other risk assessment methodologies. Its main benefit is in highlighting areas of insufficient evidence and where evidence is conflicting. Questions covered how the value of this approach was in the discussions it prompted between experts rather than the numbers coming out. A point was made that expert opinions still rely on experts, who are subject to human values. Benefit came from testing the results from one group of experts on another group of experts. It also creates benefit in getting focus on the evidence base.

3.4 Facilitated Discussion Session 3

The discussion that followed continued the themes in the questions on TESLA. Such an approach has its main benefits in assisting resource decisions and not in risk quantification. Consideration was given to group dynamics in terms of consensus views versus individual views, and the benefits therein of bring in external experts from outside project teams.



Session 4: Insurance and Risk Assessment, Chair: Jonathan Pearce

4.1 Setting the Scene; Lindene Patton, Zurich

A panel session was held on insurance and risk assessment. Lindene Patton of Zurich (USA) gave the scene setting presentation, and the panel consisted of Lindene, Andy Nicol of GNS New Zealand, and Simon James of Shell. Lindene highlighted the principles of public good and private asset protection and risk profile of CCS projects (increasing with time) that underlie the CCS liability policy provided by Zurich. This policy includes risks of pollution (air and groundwater etc), business interruption, well integrity and geomechanical liability. Simon focussed on the need for enough information to make business decisions. For them risk assessment includes technical, economic, commercial, organisational and political risks. Ways of managing risks are demonstrated in their proposed CDM methodology. Andy raised questions on the interface between insurance and technical risk assessment which is mostly qualitative and dominated by judgements of experts with the primary focus being on containment. He thought that economic, political and social risks should be dealt with separately. To prompt discussion he asked: what range of activities should be included; should economics be integrated; what risk metrics should be used (e.g. dollars, human safety); how to value consequences and estimate uncertainty.

4.2 Panel Discussion

The discussion started with the price on CO₂ and the role of ETS in providing that. The question of “Who are ‘We’ in the Risk Assessment Network was asked, seeking definition of the group whose participants include technologists, regulators and project developers. The insurance industry thought that there was a reluctance to deal with the conflicts of resources issue, which is controlled by regulatory bodies. There was acknowledgement that the Risk Assessment Network was technology orientated. It was also highlighted that transport networks would be required as companies moved from single-source-sink to a portfolio approach of multiple hubs, including other mitigation options.

Consideration was given to mitigation of deep leaks or migration. However, it was although thought that the system failing in such a way would trigger regulatory action, and that this group’s focus was primarily driver by regulatory requirements and frameworks. There was celebration that this group included regulators as well as technologists and project developers. There was also a question whether the group should broaden from risk assessment to risk management, without conclusion in the discussion.



Session 5: Risk Communication, Chair: Tim Dixon

5.1 Risk Communication; Peta Ashworth, CSIRO

Peta Ashworth of CSIRO (Australia) gave a scene setting talk on risk communication in the context of public communication and consultation around CCS. She covered both theory and real-life practice and results from Australia and world-wide, including the work of the US Regional Carbon Sequestration Partnerships around their CCS projects. Essential elements in project's consultation with the public are to build trust, understand perceptions and moral acceptability, and ensure the benefits outweigh the risks.

5.2 Communication and Public Perception for the Otway Project; Sandeep Sharma, CO2CRC

Sandeep Sharma of CO2CRC (Australia) gave a presentation on the communication and public perception around the Otway project. One of the project's goals is to build public support for CCS. They created a local Stakeholder Reference Group which meets regularly. He emphasised that you need the local community to make projects happen. Key principles are: for the public to hear from the project directly and not via the media; address concerns quickly; use scientists to communicate; if can't provide data then explain why; start early; and involve government staff.

5.3 Risk Communication – A Government Perspective; Namiko Ranasinghe, Victorian State Government

Namiko Ranasinghe of Victoria Department of Primary Industries gave a talk from a government perspective, including the overlapping regulatory regimes for Otway. She got audience participation in a risk rating exercise. Frank Schilling of University of Karlsruhe (KIT) (Germany) gave a presentation on the public engagement in the CO₂Sink project at Ketzin. He emphasised their success was down to establishing trust, honesty and providing a good and direct point of contact.

5.4 Facilitated Discussion Session 5

The discussion considered the results from these and other projects, and the importance of the right terminology, e.g. “catastrophic” should be used with caution. A key conclusion was drawn that these examples of successful projects in public communication were successful essentially because of their process of communication and not just because of the actual risk answers that were provided.



Session 6: Updates from Real Projects, Chair: John Kaldi

6.1 CO₂Sink; Frank Schilling, GFZ-Potsdam

Frank Schilling of the University of Karlsruhe (KIT) gave an update on the CO₂Sink project at Ketzin. This has injected 12k t of CO₂ to date. He described the extensive regulatory approvals process, and that they will reapply for approvals when they get to 20k t CO₂ injected.

6.2 Vattenfall German Demonstration; Claudia Vivalda, Schlumberger

Claudia Vivalda of Schlumberger (France) gave an update on the Vattenfall demonstration project at Janschwald. The preliminary risk assessment used DNV's draft guidelines for site qualification. Storage is intended to start in 2014/2015, both storage options are onshore. DNV used Structured What If (SWIFT) workshops to identify hazards and evaluate the risks in a qualitative way, and a Screening and Ranking Framework (SFR) to assess containment integrity.

As the results from these exercises were confidential, this prompted a discussion about whether confidentiality was going to get in the way of future discussions in the Risk Assessment Network.

6.3 Weyburn; Adrian Bowden, URS

Adrian Bowden of URS gave an update on the risk assessment work at Weyburn. This work uses the RISQUE method developed under GEODISC, and is being extended from the technical risk around the reservoir/geological aspects to include environmental and stakeholder risks.

6.4 The Otway Project; Lincoln Paterson, CO2CRC

Lincoln Patterson of CO2CRC gave an update on the Otway project. This started injecting in April 2008 and has injected 46kt CO₂ to date. Stage 2 injection will look at non-structural (e.g. residual) trapping in the saline aquifer Paaratte formation using a second injection well.

6.5 Facilitated Discussion Session 6

Discussion continued about whether confidentiality issues are going to impede future network meetings. It seems there is no way of avoiding it as projects become more commercial, even though it might cause the public to get suspicious. There is also the question of timing, i.e. when to release information, e.g. after, rather than before, a problem is solved?



Session 7: Key Outcomes and Conclusions

7.1 Key Outcomes

Participants were then divided into three breakout groups to identify outcomes and conclusions from the Risk Assessment Network meeting, in terms of gaps, recommendations for further actions, and key learning's. These are compiled here into one set of outcomes. The individual outputs of each group are provided in Appendix 3.

GAPS:

- Projects risk (financial, social, organisational & etc)
- Data for ACQ not poss./access rights
- Benefit/cost analysis \$ CO₂ stored versus project cost
- Social Charzen (?)
- Systems approach: e.g.: risk reviews, risk management, optimisation
- Public policy: need info base? Policy drives risk ID, applying tech RA results to meeting policy goals
- List of tools, attributes
- Prioritise gaps per timing
- Understand phys, chem., coupling
- Not quant., regulators role, data, calibration of models & validation
- Evaluation of existing models including procedures
- Pressure front
- Brine movement
- Geostatistics – distribution?
- How does the risk scale?
- Understanding EQ rupture in a reservoir
- EOR - CO₂ Induced seismicity, worst case scenarios
- Consideration of effects on other resources
- Human error – well operation/included in modelling
- ERM (enterprise)
- Biosphere (deep)
- Mitigation – risk management
- Induced seismicity
- Expert elicitation process
- Acceptability limits
- Impact assessment & severity

TO DO:

- Formalise objectives for network
- Answer “who are we?”
- Selectively broaden scope & population of R.A.N. & structure
- Set problem statements, propose mission
- Rank CCS generic risks that deserve work
- Define R.A.N.
- Define our audience
- Sharing of data
- Broaden the network? Economists, political risk
- Biosphere
- Interaction with stakeholders
- Non-tech summary/guides
- Raise public awareness
- Involvement of wider audience (other disciplines)



- Regulator involvement
- IEA regulator network feedback
- Co-network meetings
- Support to international standards
- IPAC Involvement
- Explosion
- Encourage wider participation (discussions)
- Informal discussions (SPE/ATW forum)
- Very generalised conclusions

LEARNINGS:

- Chat room/blog (restricted access)
- Produce documents to publish
- Collect references
- IPAC
- Repository for methods & data sets
- Network must take care describing what it does (i.e.: performance assessment of reservoir etc)
- Provide info to mitigators & decision makers (sub surface mitigation)
- Need a formal definition of that the R.A. is for the network
- Think tank for R.A.
- IPAC relationship

7.2 Conclusions

It was concluded that this meeting of the Risk Assessment Network had addressed the key topics and technical gaps as recommended by the 3rd Risk Assessment Network and the Joint Network meetings. In terms of the rationale, scope and objectives of the network, it was concluded that the Risk Assessment Network continues to be necessary, however recognizing that the level of openness in the future may not be as great as members' desire because of commercial sensitivities. In terms of the scope of the Risk Assessment Network's mission – the conclusions from the majority of participants was that it should remain subsurface i.e. technical, in its focus. The overall objectives for the Network as described at the beginning (and are included in Appendix 4) have been followed well to date, but should these be revisited in the light of this meeting and wider developments, for example regulation did not exist in 2005 and increasingly does now. More time can be devoted to discussion of these overall objectives by including them on the agenda for the next meeting.

Presentations are available on the Risk Assessment Network website:

www.co2captureandstorage.info/networks/riskassess.htm. IPAC offered to host the next Risk Assessment Network workshop.



Day 2 (17th April 2009)	
Session 4: Risk Assessment and Insurance, Chair: Jonathan Pearce	
08.30 to 08.45	Setting the scene; Lindene Patton, Zurich
08.45 to 10.00	Panel session involving: Lindene Patton, Zurich Andy Nicol, GNS Simon James, Shell
10.00 to 10.30 Break	
Session 5: Risk Communication, Chair: Tim Dixon	
10.30 to 11.00	Risk Communication: Peta Ashworth, CSIRO
11.00 to 11.20	Communication and public perception for the Otway project: Sandeep Sharma, CO2CRC
11.20 to 11.40	Risk Communication - a government perspective: Namiko Ranasinghe, Victorian State Government
11.40 to 12.30	Discussion
12.30 to 13.30 Lunch in the Grill Restaurant	
Session 6: Updates from Real Projects, Chair: John Kaldi	
13.30 to 14.00	CO ₂ Sink: Frank Schilling, GFZ-Potsdam
14.00 to 14.30	Vattenfall German Demonstration; Claudia Vivalda, Schlumberger
14.30 to 15.00	Weyburn; Adrian Bowden, URS
15.00 to 15.30	The Otway Project; Lincoln Paterson, CO2CRC
15.30 to 16.40	Discussion
16.40 to 17.00 Break	
17.00 to 17.30	Key learning for other networks and summing-up including topics for next meeting; Tim Dixon, IEA GHG, John Kaldi, CO2CRC
Close Day 2	



Appendix 1: Original Network Objectives

The objectives of the Risk Assessment as set out in 2005:

- *Overall aim:* To bring together key groups working on risk assessment for CO₂ storage from around the world to share knowledge and experiences. Emphasis on potential regulatory requirements with regard to CCS safety and impact assessment.
- *Specific aims and objectives:*
 - Develop an open and transparent process to allow different risk assessment approaches and associated results to be understood;
 - Provide a forum where different approaches to risk assessment can be compared;
 - Provide an 'umbrella group' for international collaboration;
 - Identify knowledge gaps and determine actions required to close these gaps;
 - Act as an informed body on risk assessment and to maintain dialogue with regulators and NGO's



Appendix 2: Breakout Group Results by Group

Group 1

GAPS:

- Projects risk (financial, social, organisational & etc)
- Data for ACQ not poss./access rights
- Benefit/cost analysis \$ CO₂ stored versus project cost
- Social Characterisation
- Systems approach: e.g.: risk reviews, risk management, optimisation
- Public policy: need info base? Policy drives risk ID, applying tech RA results to meeting policy goals
- List of tools, attributes
- Prioritise gaps per timing
- Understand phys, chem., coupling

TO DO:

- Formalise objectives for network
- Answer “who are we?”
- Selectively broaden scope & population of R.A.N. & structure
- Set problem statements, propose mission
- Rank CCS generic risks that deserve work
- Define R.A.N.
- Define our audience

LEARNINGS:

- Chat room/blog (restricted access)
- Produce documents to publish
- Collect references

Group 2:

GAPS:

- Not quant., regulators role, data, calibration of models & validation
- Evaluation of existing models including procedures
- Pressure front
- Brine movement
- Geostatistics – distribution?
- How does the risk scale?
- Understanding EQ rupture in a reservoir
- EOR - CO₂ Induced seismicity, worst case scenarios
- Consideration of effects on other resources
- Human error – well operation/included in modelling

TO DO:

- Sharing of data
- Broaden the network? Economists, political risk
- Biosphere
- Interaction with stakeholders

LEARNINGS:

- IPAC
- Repository for methods & data sets
- Network must take care describing what it does (i.e.: performance assessment of reservoir etc)
- Provide info to mitigators & decision makers (sub surface mitigation)
- Need a formal definition of that the R.A. is for the network



Group 3

GAPS:

- ERM (enterprise)
- Biosphere (deep)
- Mitigation – risk management
- Induced seismicity
- Expert elicitation process
- Acceptability limits
- Impact assessment & severity

TO DO:

- Non-tech summary/guides
- Raise public awareness
- Involvement of wider audience (other disciplines)
- Regulator involvement
- IEA regulator network feedback
- Co-network meetings
- Support to international standards
- IPAC
- Explosion
- Encourage wider participation (discussions)
- Informal discussions (SPE/ATW forum)
- Very generalised conclusions

LEARNINGS:

- Think tank for R.A.
- IPAC relationship

Appendix 3: Site Visit

The meeting was followed by a trip to the CO2CRC Otway project, kindly organized and hosted by CO2CRC, to see first-hand the site and work that had been described during the Network meeting. Delegates saw the CO₂ production well, the injection well, the monitoring well and the visitor centre, and had good discussions with the CO2CRC staff at Otway.



Photo 1: The Network attendees checking out a different source of CO₂, close to Otway.



Photo 2: Attendees viewing Otway Project's CO₂ production well.



Photo 3: Rainbow over the Otway visitor centre.

IEA GHG 4th Risk Assessment Network Meeting

16th-17th April 2009

Rendezvous Hotel, Melbourne, Australia

Grant Arnold	Dept of Primary Industries	Peta Ashworth	CSIRO
Scott Ayash	Energy & Environmental Research Center	Olivier Bouc	BRGM
Lisa Bacanskas	USEPA	Cirilo Bernardo	CO2CRC/CanSyd
Adrian Bowden	URS Australia Pty Ltd	Hannah Brackley	GNS Science
Mark Bunch	CO2CRC	Rick Causebrook	Geoscience Australia
Rick Chalaturnyk	University of Alberta	Brian Davey	Dept of Primary Industries
Tim Dixon	IEA GHG	Sevket Durucan	Imperial College
Andrew Feitz	Geoscience Australia	John Gale	IEA GHG
Matt Gerstenberger	GNS Science	Louise Goldie Divko	GeoScience Australia
Rick Hogan	AIG Australia	Ken Knottavange-Tellen	Schlumberger
Kenshi Itaoka	Mizuho information & Research Institute	Simon James	Shell Technology India
Charles Jenkins	CO2CRC	Hironobu Komaki	RITE
John Kaldi	CO2CRC	Aleksandra Kalinowski	Geoscience Australia
Anna Korre	Imperial College	Greg Leamon	Geoscience Australia
Yannick Lefebvre	Schlumberger Carbon Services	Ian McKay	ExxonMobil
Jason McKenna	Woodside Energy Ltd.	Terry McKinley	Dept of Primary Industries
Richard Metcalfe	Quintessa Ltd	Andy Nicol	GNS Science
Lindene Patton	Zurich Financial Services	Jonathan Pearce	BGS
Namiko Ranasinghe	Dept of Primary Industries	Richard Rhudy	EPRI
Dave Ryan	CanmetEnergy	Sohei Shimada	University of Tokyo
Frank Schilling	Universität Karlsruhe - KIT	Willie Senanayake	Dept. of Resources, Energy & Tourism
Sandeep Sharma	CO2CRC (Schlumberger)	Atsuko Tanaka	AIST
Steve Tantala	Dept. of Resources, Energy & Tourism	Peter Tingate	GeoScience Victoria
Kate Townsend	Dept of Primary Industries	Jim Underschultz	CO2CRC and CSIRO
Sandrine Vida-Gilbert	CO2CRC	Claudia Vivalda	Schlumberger
Charlie Voss	Golder Associates	Klaus Udo Weyer	WDA Consultants Inc
Neil Wildgust	IEA GHG	Malcolm Wilson	University of Calgary
David Wong	Dept of Primary Industries		



River, downtown Melbourne

4th Risk Assessment Network Meeting

16th—17th April 2009

Rendezvous Hotel, Melbourne, Australia

Organised by

IEA Greenhouse Gas R&D
Programme and CO2CRC

Hosted by

CO2CRC





16th April 2009 Day 1

08.15 to 08.30 Registration

08.45 to 09.00 Welcome Address: [Tim Dixon](#), IEA GHG and [John Kaldi](#) CO2CRC

09.00 to 09.30 Welcome: [Peter Batchelor](#), Victorian State Minister for Energy and Resources

09.30 to 10.00 Report from the 3rd Risk Assessment Meeting and the Joint Network Meeting; [Neil Wildgust](#), IEA GHG

10.00 to 10.30 Coffee Break in The Vestibule

Session 1: Reports from Other Initiatives Chair: [Malcolm Wilson](#), University of Regina

10.30 to 10.50 Modelling Network: [Neil Wildgust](#), IEA GHG

10.50 to 11.10 Well Integrity Network: [Rick Chalaturnyk](#), University of Alberta

11.10 to 11.30 IPAC: [Rick Chalaturnyk](#), University of Alberta

11.30 to 11.50 Risk Assessment Terminology Study: [Anna Korre](#), Imperial College

11.50 to 12.00 CSLF Risk Assessment Taskforce: [Claudia Vivalda](#), Schlumberger

12.00 to 12.30 **Discussion**

12.30 to 13.30 Lunch at the Grill Restaurant

Session 2: Quantification of Leakage Impacts Chair: [Claudia Vivalda](#), Schlumberger

13.30 to 13.45 Environmental Impacts workshop: [Jonathan Pearce](#), BGS

13.45 to 14.00 Potential Impacts on Ground Water: An Australian Perspective 1: [Jim Underschultz](#) CO2CRC/CSIRO

14.00 to 14.15 Potential Impacts on Ground Water: An Australian Perspective 2: [Greg Leamon](#) and [Andrew Feitz](#), Geoscience Australia

14.15 to 14.30 Potential Impacts on Ground Water; Weyburn Perspective: [Rick Chalaturnyk](#), University of Alberta

14.30 to 14.45 Potential Impacts on Ground Water; A US Perspective: [Lisa Bacanskas](#), US EPA

14.45 to 15.30 **Discussion**

15.30 to 16.00 Coffee Break in The Vestibule

Session 3: Combining MMV, Modelling, and Risk Assessment Chair: [Rick Chalaturnyk](#), University of Alberta

16.00 to 16.20 US Regional Partnerships: [Ken Hnottavange-Telleen](#), Schlumberger/MGSC

16.20 to 16.40 Combining MMV, Modelling and Risk Assessment at the Otway Project: [Charles Jenkins](#), CO2CRC

16.40 to 17.00 The TESLA Risk Assessment Tool and System Modelling: [Richard Metcalfe](#), Quintessa

17.00 to 18.00 **Discussion**

Close Day 1

19.30 Dinner in the Ballroom



17th April 2009 Day 2

Session 4—Risk Assessment and Insurance: Chair: Tim Dixon, IEA GHG

08.30 to 08.45 Setting the Scene: Lindene Patton, Zurich

08.45 to 10.00 Panel Session involving:
Andy Nicol, GNS
Simon James, Shell
Pat Concessi, Deloitte & Touche
Lindene Patton, Zurich

10.00 to 10.30 Coffee Break in The Vestibule

Session 5—Risk Communication: Chair: Tim Dixon, IEA GHG

10.30 to 11.00 Risk Communication: Peta Ashworth, CSIRO

11.00 to 11.20 Communication and Public Perception for the Otway Project: Sandeep Sharma, CO2CRC

11.20 to 11.40 Risk Communication - a Government Perspective: Namiko Ranasinghe, Victorian State Government

11.40 to 12.30 Discussion

12.30 to 13.30 Lunch at the Grill Restaurant

Session 6— Updates From Real Projects: Chair: John Kaldi, CO2CRC

13.30 to 14.00 CO2 Sink: Frank Schilling, GFZ-Potsdam

14.00 to 14.30 Vattenfall German Demonstration: Claudia Vivalda, Schlumberger

14.30 to 15.00 Weyburn: Adrian Bowden, URS

15.00 to 15.30 The Otway Project: Lincoln Paterson, CO2CRC

15.30 to 16.00 Discussion

16.00 to 16.30 Coffee Break in The Vestibule

16.30 to 18.00 Workshop Conclusions: Key learning for other networks and summing-up including topics for next meeting: Tim Dixon, IEA GHG, Neil Wildgust, IEA GHG, John Kaldi, CO2CRC

Close Day 2



18th April 2009 Day 3

Itinerary for the Otway Project Tour

- | | |
|----------------|---|
| 08.00 | Bus departs Rendezvous Hotel |
| 12.00 | Arrive Boggy Creek Pub for lunch |
| 13.30 | Depart Boggy Creek Pub |
| 14.00 to 16.30 | Tour of the Otway CCS Project Site |
| 20.00 | Bus arrives back at the Rendezvous Hotel via Melbourne Tullamarine Airport. |