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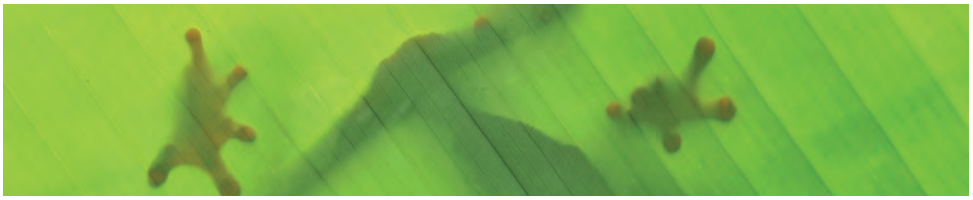


FIRST 2011 SHARING EVENT

european ccs demonstration project network report

BRINDISI

ITALY

16-17 FEBRUARY 2011

contents

The first CCS Network sharing event hosted by one of its members

Generously hosted by Enel, lead partner in the Porto Tolle CCS Project, the Network's first knowledge sharing event of 2011 took place in Brindisi, Italy. Over 50 delegates gathered for two days at the Federico II Power plant, home of Enel's Pilot CO_2 Capture plant.

The first day of the event (17 February) combined EU-US knowledge exchange activities with a site visit to the Pilot CO_2 Capture Plant.

In order to strengthen the Network's international knowledge sharing activities, the European Commission had invited key representatives from the US to participate in an interactive knowledge sharing session, with observers from both ZEP as well as GCCSI.

EU-North America knowledge sharing

Robert Wright (US Department of Energy), Edward Steadman (the Plains CO_2 Reduction Partnership PCOR) and Gerald Hill (Southeast Regional Carbon Sequestration Partnership SECARB) shared their experiences of developing CCS in the US and the role of the Regional Partnerships in accelerating this development. The presentations were followed by a highly interactive Knowledge Café that allowed the Network's US guests to learn about the nature and progress of the European demonstration projects.

The overall conclusion from the Knowledge Café was that there is a potential for knowledge sharing between US and European CCS projects. To ensure successful knowledge sharing it is important that the design of the sharing process has a specific focus and that those projects and people with direct experience and interest are involved in the activities. While differences exist - such as the importance of EOR for US projects - interesting areas for further collaboration were identified. Possible sharing areas include topics such as:

- Public awareness and stakeholder engagement;
- Differences in Monitoring, Verification and Accounting (MVA) from R&D/pilot projects to full scale (demonstration) projects;
- Amines and Health, Safety and Environment (HSE);
- Developments in capture technologies;
- Investment models.

In particular, there is a potential interest to share information on arising events that impact upon CCS projects. The recent negative publicity associated with the Weyburn project for example, may influence CCS projects in other countries. Knowledge sharing on lessons learned and experiences of reacting to incidents will be useful in planning CCS projects and in preparing for managing incidents. There may also be a potential for sharing knowledge on conducting projects with a lack of or limited experience with regulatory frameworks.

An issue that has to be considered in designing a knowledge sharing process between US and Europe is the maturity of the CCS projects, i.e. how much there is to share and how much the projects are able to share. This will inform the boundaries for knowledge sharing activities. In this context, it should be noted that the ten largest CCS projects in the US are those partly funded by American Recovery and Reinvestment Act (ARRA). These projects are now in their early stages and may not yet be able to share with the European demonstration projects on an equal footing although they projects have to spend their public funding by 2013 and will move forward quickly and generate knowledge that can be shared.

CCS Permitting Test Exercise

Following the Knowledge Café, Howard Steele and Fiona Hepplewhite presented the achievements of the Scottish Government in setting up a process for testing the adequacy of CCS permitting processes. The Scottish "permitting dry run workshop" revealed how a permitting process can be accelerated and at the same time build understanding and trust amongst the government agencies, NGOs and industrialists concerned. The learning from the workshop helped to develop a CCS Regulatory Test Toolkit that has been made available through sponsorship from the GCCSI.

NER300 update

Martina Doppelhammer of DG CLIMA (European Commission) provided the participants with a brief update on the state of play with respect to the NER300 call for proposals.

Site visit

The last session was reserved for a site visit to Enel's CO_2 Capture Pilot plant (introduced by Angela Mangiaracina of Enel), during which most of the delegates had their very first opportunity to see a working capture process and experience its scale.

Wrapping up

In his concluding remarks, Jan Panek (Head of Unit, European Commission, DG Energy) congratulated Enel for setting a very high standard for on-site meetings of the European CCS Demonstration Project Network.

Robert Wright thanked the European Commission for the opportunity to participate in the meeting and expressed a desire to continue the exchange between the US and Europe. This might be through both by attending meetings and following up direct contacts between CCS specialists and project developers.

The second day of the Network meeting followed, what is now, a well established format of knowledge sharing on a theme in break-out groups. The public engagement and permitting groups from 2010 continue their work in 2011. The Network Steering Committee has established a new group on geological storage and that the risk management group will be a virtual group on the Network intranet during 2011.

Knowledge sharing theme 1: Permitting

The agenda for the permitting session included a discussion on the Scottish CCS regulatory test and toolkit, an update from the European Commission (DG CLIMA) on the status of the EC Directive on geological storage of CO_2 and updates from each member project on the permitting process since the previous Network meeting (October 2010).

The session started with a discussion on the potential for adapting the approach of the Scottish CCS Regulatory Simulation and the Global CCS Institute toolkit in the context of the projects' respective countries. The regulatory frameworks for CCS projects, in particular geological storage of CO_2, are under development and both regulators and the industry needs to implement and develop practices for regulating CCS. Within each country, regulators and project developers involved in the permitting process for CCS need to coordinate their work to make sure that the all of the systems and processes involved in the regulation of the full CCS value chain fit together. The discussion revealed that, to date, projects experience a situation where the different regulators have not aligned their permitting processes and that these processes may not take account of the deadlines of these first CCS projects. The regulatory simulation demonstrated that coordination amongst regulators is indeed required and, furthermore, that regulations may need updating to cover all aspects of CCS projects.

The member projects were positive about the initiative of the Scottish Government and suggested that a Regulatory Test as proposed may be beneficial to both regulators and industry, while in the early stages of a CCS project. The projects found the Scottish approach relevant for their projects and some viewed this as an ideal approach for both regulators and industry. Some of the member projects, however, are more advanced (and are already in close dialogue with the regulators on all permits, whilst others thought that such a dialogue with the regulators would be challenging due to the political situation with respect to CCS or due to the current national regulatory practices.

Martina Doppelhammer of DG CLIMA then presented an update on the EC Directive on geological storage of CO_2 and the accompanying guidance documents followed by a Q&A session. The main conclusion was that the transposition of the EC Directive on geological storage is on track in most Member States, although in some States there is a strong debate on the transposition.

DG CLIMA expects the transposition to be finished before the deadline of 25th June 2011. A timely transposition of the EC Directive is important if CCS projects are to meet their planned permitting deadlines and comply with the permitting deadlines for NER300 funding. The guidance documents for the Directive are not yet publicly available[1].

To follow up the transposition of the EC Directive in the Member States, DG CLIMA has a well-established Information Exchange Group (IEG) with representatives from the Member States.

1 Since the meeting, on 1 April 2011, the documents have been published: (http://ec.europa.eu/clima/policies/lowcarbon/ccs_implementation_en.htm)

The purpose of this group is to discuss questions on interpretation and implementation of the Directive and to share knowledge on transposition of the Directive. The next meeting is 15 March 2011.

The remaining part of the session was dedicated to the member projects updating each other since the last meeting in Hamburg in October 2010. Each project also started to draft project permitting timelines for 2011/12. The intention with these timelines is to use them as a reference point for updating each other on the project's development in the area of permitting and identifying the potential for knowledge sharing throughout 2011. Martina Doppelhammer reminded the group of the need to include time in their permitting timelines for the European Commission's storage permit review process.

Hatfield, United Kingdom

Since October 2010, the Hatfield project has prepared a draft Strategic Options Appraisal Report discussing alternative routing for the onshore part of the CO_2 pipeline. The purpose of the report is to describe alternative routing and present the alternatives to stakeholders early in the permitting process. The report was presented to stakeholders in a consultation meeting 15 February and the report is currently out for consultation. The report and comments from stakeolders will be the basis for identifying a preferred strategic option for the pipeline routing.

The project is also following the developments in the regulatory framework for CCS in the UK closely, in particular:

- On 1st October 2010 the Storage of Carbon Dioxide (Licensing etc.) regulations 2010 came into force. This transposes into UK law aspects of the Directive 2009/31/EC, and creates a framework licensing approach;

- The UK government's Department for Energy and Climate Change (DECC) has since initiated an informal consultation on details pertaining to storage licence termination regulations;
  > Addresses the transfer of responsibility and financial mechanism of the CCS Directive and its transposition into UK Law;

- DECC has conducted a second consultation on the details of the draft National Policy Statements pursuant to the Planning Act 2008;

- DECC has initiated a 3rd party access consultation on the:
  > development of a third party access regime for both CO_2 transport and storage infrastructure;
  > views on steps government might take to develop the investment framework for CCS infrastructure.

- DECC has also launched a UK Electricity Market Review and, in tandem, HM Treasury has launched a carbon floor price consultation. The outcome of these consultations is likely to have significant ramifications for the future financial incentive regime and potential role for CCS within the UK energy sector.

ROAD, the Netherlands

Since October 2010, ROAD has worked closely with the relevant regulators in the Netherlands in developing the applications for the project. The permitting process is complex due to the fact that CCS is new to both project developers and regulators, and that there have been some recent adjustments in permitting procedures in the Netherlands. Therefore, there is a need to clarify responsibilities between regulators, which permits to apply for (in some areas several permits has been merged to one permit) and CCS specific issues. The ROAD project is currently taking a very active role towards the regulators in order to drive this process forward.

An important part of the permitting process is the Environmental Impact Assessement (EIA). The ROAD project has been preparing an extensive EIA covering capture, transport and storage which was completed end of February 2011.

ROAD is also following the transposition of the EC Directive into the Dutch regulatory framework closely. The Directive will be transposed by amending the Dutch Mining Act. The amendments have been discussed in the Energy Committee in the Parliament and on 25 January, the Parliament approved the proposed amendments. The Senate is expected to approve the Amendments in April.

Regarding the EC guidance documents to the Directive, the Dutch Ministry of Economic Affairs have take noted the documents, but the guidelines will not be implemented strictly.

The Dutch regulators are currently working with amendments to the Mining Decree and Mining Regulations that will provide the general rules for the storage permit. The amendments are under consultation and expected to be implemented in March.

The Dutch authorities are working with a long-term CCS policy taking into account other uses of the subsurface and any potential conflicts. A proposal for this policy is expected in the second quarter of 2011.

Civil liabilities and claims related to CCS that are not regulated by the EC Directive or other directives will be subject to a draft legislation proposal that is expected in late 2011 with discussions and voting in the Parliament in first half of 2012.

Bełchatów, Poland

The project expects that the updated Building Permit for the capture plant will be approved by the end of March 2011. The approved Building Permit will be followed by an update of the building documentation before construction site mobilisation by August 2011.

Currently, there are discussions on the regulation of the CO_2 pipelines, in particular the transport corridors. The National spatial planning concept is under preparation and the Belchatów CCS project has submitted their views to the regulators.

The Polish Government is currently working on transposing the EC Directive on geological storage of CO_2 within the Polish Mining and Geological Law. The Law states that the Minister for the Environment will be granting exploration and storage permits. The amendments to the Mining Law will specify the conditions that have to be met.

Jänschwalde, Germany

The main challenge to the Jänschwalde CCS project is that the German Federal Government is still working on the CCS legislation. It seems possible that the transposition deadline of 25 June 2011 may not be met and that the new law will come into force towards the end of 2011. This CCS law will most likely only apply to demonstration projects. At a later stage, the law will be reviewed and replaced by a new law to cover commercial applications of CCS.

The construction and operation of the new integrated Unit G of the power plant Jänschwalde is subject to a modification permit under the Federal Emission Control Act and water permits under Federal Water Act. Application documents are under preparation and will be submitted to the Environmental Authority of Brandenburg in January 2012.

The permitting process for the pipeline has two stages - the planning assessment and the plan approval proceeding. During the first proceeding the compatibility of the pipeline route with the requirements of regional spatial planning in the Federal State Brandenburg will be assessed. The second stage concerns the construction and operation of the pipeline. Application documents for both permitting proceses are under preparation. First meetings with the planning authority have taken place and submission of documents is planned for October 2011. The application for the plan approval decision will be submitted in April 2012. The project plans to use a decommissioned railway track for the pipeline route which may accelerate the permitting process.

Exploration permits for both potential storage sites - Birkholz and Neutrebbin - were issued in October 2009 and March 2010 under the Mining Law and a general operational plan for the exploration campaign in Birkholz was accepted by the the Mining Authority in January 2011. A special operating plan for seismic activities was submitted to the Mining Authority in January 2011, the approval is expected in the 3rd quarter 2011.

The project's main concerns are:

- Little public acceptance for the project in areas with identified potential for geological storage;
- A lack of CCS legislation and lengthy political discussions.

Porto Tolle, Italy

The application to obtain the construction and operation permit was submitted in May 2005 to the Ministry of Economic Development. This included the Environmental Impact Assessment Report in order to obtain the Environmental authorisation. In July 2009, the Environment Ministry, together with the Ministry of Cultural Heritage and Activities, issued the Environmental Authorisation.

Following the Environmental Authorisation, the Ministry of Economic Development carried out the administrative proceedings involving other competent Ministries and local entities in order to obtain the final construction authorisation. In January 2011, the Ministry of Economic Development issued the construction permit and the IPPC (Integrated Pollution Prevention and Control) authorisation is expected to be issued in spring 2011.

The process to obtain all of the authorisations needed for the Porto Tolle CCS project consists of two further permitting steps:

1 **Exploration Permit**.
The objective of this step is to obtain the permit for the exploration of the storage site;

2 **Single Permit for works related to CO_2 capture, transport and storage.**
The objective of this step is to obtain the permit to build and operate the capture, transport and storage systems.

The process to obtain the Single Permit in step 2 includes as secondary processes:

- Environmental Impact Assessment (EIA) procedure, in compliance with Italian law 152/06;
- Landscape Authorisation;
- IPPC authorisation; it will be an update on the Porto Tolle power plant IPPC (currently ongoing by the Ministry of the Environment);
- CO_2 Capture unit construction authorisation;
- CO_2 Pipeline construction authorisation;
- CO_2 Storage Permit, according to the draft decree implementing Directive 2009/31/EC

A challenge to the project is that the application for an Exploration permit cannot be submitted under the existing regulations; hence the permit is pending the implementation of the EC Directive for geological storage.

Compostilla, Spain

The EC Directive on geological storage has been transposed into Spanish law. The Law on geological storage was published in Spain's Official Journal on 30th December 2010. Several aspects of the Law need to be developed further and detailed in corresponding Regulations. There is no deadline for finalising the regulations.

ENDESA, the lead project partner, has been awarded two exclusive exploration permits for geological structures and has applied for authorisation of eight Well Drilling Administration Permits. Currently, the permits for drilling four wells have been obtained and the project is awaiting an answer from the competent authorities with respect to the remaining applications. ENDESA has also been granted an authorisation permit for the 3D Seismic Survey.

Knowledge sharing theme 2: Public engagement

The public engagement session featured updates from the member projects on their activities since the last sharing event in October 2010 and a lively discussion emerged on the role of social media in technology advocacy and organisation of the public voice. Taking the pulse of public debate has, with the accessibility of social media, become relatively easy (although resource-intensive), but the sense of control that used to underpin corporate communication has to be replaced by the notion that one cannot control communication anymore. It was felt that a mix of reactive monitoring and proactive engagement in social media is needed by CCS projects, with the strong message that one should be open about one's own identity when using such media. Any attempt to try to influence the public debate in an 'undercover' mode should be avoided, as this would be unethical as well as risky: exposure could result in considerable reputational damage.

Hatfield, United Kingdom

The Hatfield project shared some recent experiences, particularly in the context of the fact that the project's parent company went into administration (Powerfuel Plc owns two companies, Mining and Power. Powerfuel Power owns the CCS project. Powerfuel power is not under administration).

The project has distributed a press release on its NER 300 application, to demonstrate its commitment to delivering the project, and it shared its opinion that a project needs to make sure it participates in the debate and is visible. For this, the project has teamed up with the CCSA, a UK trade association.

The project has been very actively engaged in discussions about third party access to pipelines and storage sites and has channelled its responses through CCSA.

The project believes that storage is rapidly becoming a more important area of interest. The pipeline route options are now becoming clear, as are the storage locations, so the public engagement objective for 2011 is to make clear what the economic benefits are and to minimise any arising objections.

The Hatfield project is expecting to be able to share experiences following public engagement activities that are planned in relation to pipeline routing consultations.

ROAD, the Netherlands

The ROAD project updated the workshop with its progress and plans for 2011. ROAD has chosen to create a project branding that is independent of the corporate branding of the consortium partners (E-ON and GDF Suez) and finds the Dutch government supportive, both in terms of money and process facilitation.

Interestingly, the ROAD project is now aiming to further position the project as a regional project that provides economic benefits for the Rotterdam region.

For this, stakeholder management is very important, and that it must be put on the same level as the technical issues. The ROAD project sees integral stakeholder management as core to successful project delivery: you are only as strong as your weakest link.

The ROAD project has trained team members that deliver presentations to external stakeholders to handle situations that could become emotionally charged.

ROAD is not yet exploring social media, but is not ignoring them and believes it must find a way to include them, with the observation that negative voices seem to be better organised that those in favour. The communications team in ROAD finds utility in the use of an argument map to organise its thoughts (www.cato-2.org).

ROAD has learned that understanding the local context and history is very important. For example, in the project geographical area a lot of promises had been made earlier and these have been broken. Residents have long memories. Your communication will be put into this context and you will be reminded about what happened on earlier occasions.

The workshop observed that if a project is next to an existing plant, the people may perceive it as not much of an issue if you change it, but there is likely to be more interest if something is being built at a new location. You might not draw the public's full attention until the bulldozers are coming, but you do need to put in effort to inform stakeholders over the course of the entire project.

For ROAD, visible government support has been critical to the project. It was commented that this is not seen as possible in other countries. For example, in the UK, the government, although supportive of CCS, cannot be seen to support a specific project for reasons of fairness of competition.

In practical terms, ROAD has now set up two stakeholder platforms. One is a top-down (Regional Advisory Committee) and one a bottom-up (Community Advisory Panel) and ROAD has identified around six persons who are also represented in comparable panels (for example panels set up by Shell in the region).

The team has discovered that it needs to put more focus on the economic benefits of CCS as it makes more impact in the region, also on a governmental level. Working on the premise of climate change, the counterargument received is quite often: 'Your contribution is quite small' and even people question the existence of the climate problem.

Further understanding and sharing of information with respect to the economic impact (direct and indirect) has been flagged as an area for collaboration in the Network.

Bełchatów, Poland

The Bełchatów project informed the Network that in October 2010, PGE GiEK SA signed an agreement with an external PR company to undertake social group characterisation and organisation of three information meetings with stakeholders. Up to the end of 2010, the PR company provided surveys and all necessary activities for data collection.

In January 2011, the contractor presented the results of the SWOT analysis specifying the strengths and weaknesses of the public consultations, the opportunities and threats related to the conducted communication activities and recommendations for further communication activities as well as a method for organising these.

On 10th and 31st of January, 2011, meetings with the Work Group for CCS public consultation in Poland were held. The Work Group was appointed in the second half of 2010 by the Polish Ministry of Economy. The group consists of representatives from the governmental as well as the energy sector in Poland (PGE SA, Vattenfall, ZAK SA, PKE SA, PGNiG SA). During the meetings, overall principles and ideas for a national CCS consultation programme were discussed.

This CCS National Consultation Programme will focus on providing reliable information, not only on CCS, but on global warming and the use of clean coal technologies as well.

The Work Group intends to invite the Chairman of the EU Parliament, the Polish Minister of Economy and well-known scientists and experts to support the initiative as reliable sources of knowledge and information. The Group will develop special information materials for all representatives to speak with one voice and deliver the same information. Furthermore, a special CCS link will be developed on both the Polish Ministry of Economy and Ministry of the Environment website, where relevant information concerning CCS can be found.

Moreover, the Programme aspires to deliver a wide, national information campaign through various media, including TV programmes, articles, brochures, leaflets, special workshops and meetings. The schedule for the campaign runs into 2012 and commences in early 2011.

Bełchatów's public engagement activities in 2011 will be dedicated to the second phase of the storage workstream in the project, starting after the final decision on the storage site location.

A detailed plan of communication activities will be developed on the basis of an internal guideline ('The Principles of Conducting Public Consultations with Respect to Investment Projects to be Executed by PGE Górnictwo i Energetyka Konwencjonalna S.A.'), which has been adapted for the CCS project. The plan will constitute an executive document which will be a basis for the execution of tasks related to the organisation of public consultations. The materials developed by the external PR company will be a key element in this.

An information meeting under the auspices of the Lodzkie Viovodeship Marchal is planned for the first half of 2011. In the meeting, regional and local authorities, local NGOs representatives, scientists and experts from the Polish Geological Institute and the Technical University of Lodz as well as investor representatives will participate.

An information brochure concerning the legal procedures associated with CCS investment in Poland is being prepared by the outreach team.

Also, various information updates are planned: to the project website and to a Q/A brochure used for social group characterisation. Finally, interviews with investor representatives are prepared for publication in national media.

The project believes that it could benefit from sharing various ideas of key incentives for local communities, sharing of communication proven practices and the development of an EU-wide information campaign.

Jänschwalde, Germany

Due to unforeseen circumstances, no input was obtained from the Jänschwalde project during the meeting.

Porto Tolle, Italy

The Porto Tolle project provided an update to the meeting and shared a number of lessons:

Over the course of last year, Enel has tried to present the concept of CCS with a new meaning: CCS as a Climate Change Solution and has focussed its public engagement activities to meet four objectives:

- To provide information on CO_2 and CCS, leveraging Enel's role as a first mover;
- To increase the visibility of Enel's Brindisi pilot capture plant;
- Promote CCS in Italy by sponsoring the Italian Observatory on Carbon Capture and Storage, an initiative of the Sustainable Development Foundation.
  The Observatory is an expert and independent forum for the promotion of CCS in Italy. All relevant sectoral stakeholders are amongst its promoters, including, inter alia, the technicians of the Economic Development and Environment Ministries, ENEL, ENEA, ENI, ISS, INGV, OGS and the Rome and Florence Universities. The Observatory, with public meetings, workshops, activities in communication and training, gathers information and documentation on technological aspects of CCS, on the development of research and its applications and on ongoing projects at European and international level. It provides research and studies on the theory and practice of CCS technology and constitutes a permanent forum for comparisons, assessments, analyses and regular meetings among administrators, institutions, research teams and companies involved in CCS. The Observatory monitors national and European regulations, treaties and international agreements on CCS and develops a dialogue with local, regional, national and European experiences;
- To work on opinion building and perception monitoring by targeted research.

Enel aimed to test a project model without a dedicated CCS communications team. This has required the development of internal coordination mechanisms within a large organisation. On the plus side, this model has proven to mobilise the best available talent to be working on CCS. Furthermore, joint definition and sharing of a messaging strategy within the internal pool of communications experts has demonstrated to be a good internal coordination mechanism. On the minus side, integration of activities requires constant attention and effort.

Signage at Enel's Brindisi Pilot Capture Plant

Signage at Enel's Brindisi Pilot Capture Plant

The Porto Tolle project is also developing a capacity to tailor targeted communication to stakeholder groups. Furthermore, the project has set itself a target to undertake a deep characterisation of stakeholders and the set-up of territorial data-gathering teams. The project believes that it has a unique opportunity in which it can be tested how the CCS experience can help the overall acceptance of the conversion of an existing oil-fired plant into a coal-fired plant.

The project shared the information that it will train an internal pool of 'CCS communicators' and will continue to develop a multi-level (overall environmental strategy; specific plant; R&D) publishing as well as a multi-level (Institutional site; CCS Project site; Environmental site) web strategy.

As part of the communications mix, Enel has developed a corporate identity for the Brindisi Pilot Plant, adapting the site for institutional and educational visits. With specific signage, tailored explanations have been provided for visitors.
The project has found that the main concerns are related to storage and that local stakeholders have a tendency to associate their idea of CO_2 storage with that of nuclear waste storage and thus think that is not a long-term solution. Interestingly, the project has also found that the EU brand adds credibility to its activities.

It was suggested that the Edelman Trust Barometer is a good source for understanding trust (the 2010 findings for Europe suggest that NGOs are amongst the most trusted organisations across Europe, with academics and experts as being the must trustworthy spokespeople).

The project is exploring the mapping of off- and on-line communities that are active with regard to CCS and is therefore interested in methodologies and experiences to apply social network analysis to this activity.

With respect to further sharing, the project indicated an interest in learning more about how other projects communicate the magnitude of the potential risks of transport and storage and in learning about experiences with employee engagement to support the introduction of innovations.

Workshop participants indicated their positive impressions of Enel's professional approach to communications and CCS. It was suggested that those who cannot draw on internal resources to maintain this level of professionalism could benefit from either national platforms (for example, the CCSA in the UK) or international platforms (such as the Zero Emission Platform) and indeed the Network itself.

The group was convinced that it has a responsibility to reduce public uncertainty and to ensure that any opposition is at least well informed.

Compostilla, Spain

The Compostilla project presented its updated communications plan (which is detailed in the 2010 Public Engagement Thematic Report, forthcoming). The project is planning to use Facebook and Twitter actively in its communications strategy. Also, the project invests in supporting tours of the facilities for different groups, such as politicians, schools, etc.

An important target for 2011 is to increase the project's visibility in Spain and to develop knowledge sharing activities with NGOs.

Risk communication

After the update round from the member projects present, DNV provided an input on risk communication, a topical area suggested by the Network's Advisory Forum. The input was based on original research from Tversky & Kahneman[2] in the mid seventies into how people make judgements under uncertainty. It appears that laypeople find it very hard to interpret figures and will use several supportive heuristics to make judgements about likelihoods, so also about likelihoods of negative consequences. People tend to look for the familiar (the easier it is to recall examples of something, the more common that something must be) and for the representative (the more a story is consistent with an archetype, the higher its probability must be, even though base rate frequencies suggest otherwise). This may mean that in communication risks, one has to put cold data in contexts that are familiar to the receiver, otherwise they will be misinterpreted.

Conclusions

concluded that, over and above the continued sharing of experiences emanating from the execution of the member projects' communication plans, the public engagement group would work further on understanding the role of social media in their communication (monitoring) activities.

A discussion topic on risk communication will be started and it was agreed to develop lessons and a communication toolbox in this area. This latter toolbox would be linked to the risk register that the Network is developing. Furthermore, work was undertaken to strengthen the Network's own external messages, e.g. by inclusion of economic arguments for CCS.

In relation to the potential for trans-Atlantic knowledge sharing, it was felt that a number of opportunities could be further explored:

- Sharing of specific outreach materials (e.g. the PCOR partnership has produced four videos on storage);
- The development of a video showing what Europe and the US are doing;
- Mobilisation of capacity through University outreach programmes.
  It might be worthwhile to explore whether there are university courses in the area of public engagement that could take on some work in the area of CCS;
- Site visits to one or two demonstration projects in the US, with involvement of the media, project proponents, local authorities and regulators.

2 Tversky, Amos, and David Kahneman. 1974. Judgment Under Uncertainty: Heuristics and Biases. Science 185:1124-1131.

Knowledge sharing theme 3: Storage

The Network Steering Committee decided at the end of 2010 to add 'Storage' as a new stand-alone theme for 2011.This was based on several inputs: storage related topics were listed as 3rd priority in a knowledge market held during the last Network meeting in Hamburg, were specifically mentioned in the Advisory Forum and listed 5th in the Risk assessment exercise undertaken in 2010.

The Network Steering Committee set the following targets for the Network:

- Identify technical topics of interest related to storage;
- Facilitate a structured discussion amongst discipline experts around these topics;
- Identify best practices and communicate them amongst Network members;
- Hold a joint event with the Permitting group to discuss their findings related to storage permitting;

Storage as a theme potentially covers a wide array of topics, ranging from technical topics such as reservoir engineering to winning public trust and convincing authorities to issue required permits. As public engagement and permitting are already covered in other Network workstreams, it was decided that this workstream should primarily focus on the technical aspects of storage.

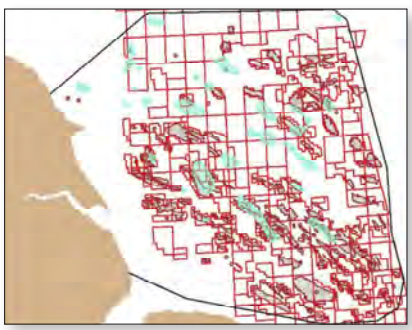
The objectives of the storage session held in Brindisi were defined as follows:

- Share the status of storage preparations and activities in each of the member projects;
- Understand the state of the art in storage;
- Identify the most promising topics for sharing in 2011;
- Propose a way forward for the Network.

The update round from each of the member projects resulted in the following.

Hatfield, United Kingdom

The Hatfield project's ambition is to develop a CO_2 infrastructure capable of transporting and storing 20-25 $MTCO_2/y$. As a result the site selection activities have been focused on finding sufficient storage capacity to accommodate this ambition.



The Site selection process is almost completed. The process has focused on both offshore saline aquifers as well as offshore depleted gas fields near the coast of the Humber area. The selection process used gas production data, 3D seismic and well data to assess over two hundred structures in the initial screening process. Over 700 well bores have been drilled in the area, and there are many seismic survey datasets available.

The process revealed that from a potential storage capacity of 3Gt CO_2 in gas fields estimated by previous public domain studies, 268$MtCO_2$ is qualified as high ranked. In a similar process a potential of 14,3$GTCO_2$ storage capacity was identified in 30 Aquifer structures.

Structural assessment left 1080MtCO_2 dynamic capacity as high ranked potential storage locations. Drilling of exploration wells is planned for 2012. Development will require the cooperation of 2 governmental bodies: DECC and The Crown Estate.

ROAD, the Netherlands

The ROAD project aims to capture 1.1 Mt CO_2/y on a new 250 MW unit on a power plant near the Dutch coast. The projected storage off shore location is gas field P18-6 which is currently operated by Taqa. This storage location should be secured by 2012.

Rich data is available for P18-6. It is very deep at 3500 m, requiring 350 Bar. There is a very thick layer of halite over the target storage formation (Zechstein Salt). This salt is opaque to seismic signals, so traditional seismic monitoring is not possible at this site. On the other hand, the storage target is a depleted natural gas reservoir, so storage containment below the salt can be assumed to be achievable. There are some concerns about the cementing of the existing wells. Cement bond log quality data are not always available. One lesson learned is that existing gas fields are not always easy to use.

ROAD is negotiating the cost of storage. As no precedents are available, common pricing mechanisms are not in place yet.

The ROAD project is well advanced in its MMV plan and currently believes that regulatory issues are manageable.

The use of available abandoned wells has been considered, but they would be difficult to re-use, requiring the (expensive) intervention of a drilling rig. The storage capacity is less than what would have been expected on the basis of the original Natural Gas production data. The reason for this is that the pressure for CO_2 storage will remain lower to stay well below the pressure where cracking might occur.

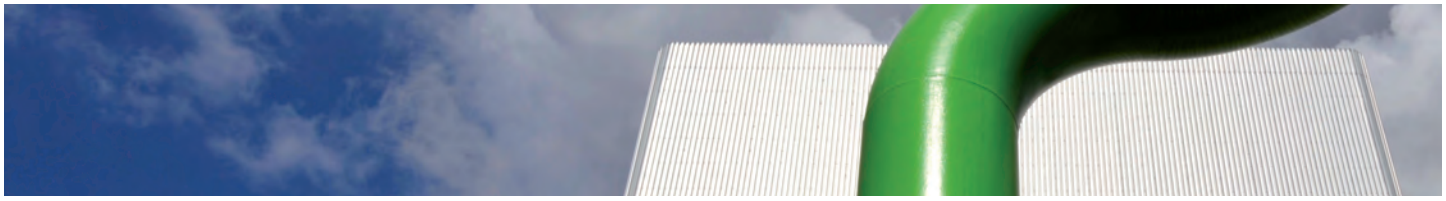
The project reports to have a corrective measures plan finished by April 2011.

Bełchatów, Poland

The key components of the project include a 1.8 MTCO_2/year (as a baseline assumption) post combustion capture unit based on the Alstom's Advanced Amine Process, an infrastructure for transporting compressed CO_2 and a storage site (deep saline aquifers).

Three potential storage sites (Budziszewice, Lutomiersk –Tuszyn and Wojszyce) have been identified, ranging from 40 to 140 km from the capture site. These have been appraised and the final site selection is planned within the first half of 2011. Final storage selection, public acceptance and CCS directive implementation are seen to be the main project challenges.

Following the site selection, site characterisation will last until the end of January 2014. Storage site construction will start in early 2015.



Site selection studies have been completed for the Budziszewice structure. The study is based on archive data, constructed 3D models of the storage complex, reservoir simulations, sensitivity and risk analysis/appraisal and baseline monitoring. Similar studies are ongoing for the Lutomiersk -Tuszyn and Wojszyce structures.

Analytical and modelling work (by Schlumberger) will take into account site capacity, containment, risk estimations, monitoring requirements. Schlumberger will undertake seismic inversion, fault interpretations, advanced log interpretation, geomechanical log interpretation and 1D mechanical earth modelling, 3D model construction in depth domain, 3D reservoir modelling, preliminary risk assessment and site ranking.

Jänschwalde, Germany

The Jänschwalde project is in the process of selecting storage locations. Two potential locations have been identified in the federal state of Brandenburg and a third in the federal state of Saxony-Anhalt. The Altmark structure in Saxony-Anhalt is an almost depleted natural gas field. The structures in Brandenburg are saline aquifers. All structures are thoroughly mapped and their storage potential is believed to be large enough for the full project. From today's perspective the saline aquifer structure in Birkholz (Brandenburg) is the preferred storage location. Its target storage formation is a series of sandstone layers at about 1300 m depth below surface. The storage complex includes 3 cap rock layers of several hundred meters each. Data is however available from exploration wells drilled nearby (offsets).

The MMV plan includes groundwater monitoring and soil gas monitoring and selected exploration wells are planned to be converted to injection wells afterwards.

An operational model is being developed that will assume power plant operation as leading or otherwise having priority. In other words, the CCS chain must be capable to follow operational changes at the power plant. A typical operational parameter in this context is installing additional equipment to deal with normal variations in operating pressures and flow rates downstream of the capture plant. This may result in e.g. additional valves in the system to maintain pressure while the power plant is on stand-by. Nevertheless also the power plant part (capture unit) needs to be modified to fit in best into the overall technology chain.

Exploration permit was confirmed by the mining authority who is regulating underground gas storage projects (in Brandenburg the LBGR = Landesamt für Bergbau, Geologie und Rohstoffe Brandenburg) in October 2009. The main operating plan was approved by the authorities at the beginning of 2011. The actual approval for the permit for the detailed operating plan for the seismic survey was submitted to the mining authority and is expected to be approved in the second quarter of 2011.

The project stresses that its main lesson learned is that Public Acceptance is key to storage.

Porto Tolle, Italy

Two potential offshore sites (at a water depth of ca. 40 meters) have been chosen after screening a large region of the Adriatic Sea. Site data is primarily from public sources, secondly by means the Italian major oil & gas company property data; the two sites have older exploration well bores and a good quality 3D seismic data. A large number of exploration wells have been drilled in the Adriatic and these have also been used to construct regional model of the basin. There is low seismicity in the area.

A digital, 3D static model has been constructed for one of the site structures by OGS. Similar studies are ongoing on the second site. IFPEN (IFP Energie Nouvelle), the supplier for the project, has begun dynamic modelling. A survey of natural processes of gas seepage through the sea floor in the area is underway.

A general concern was how to define and satisfy the minimum site data collection and characterisation required for the various modelling studies required for storage site approval. Annex I of the EU Directive lists a set of prescriptive types of storage site modelling studies, and particularly for the geomechanical and geochemical studies, the project notes that there are few software packages available that are recognised to be fit-for-purpose.

Compostilla, Spain

Two parallel storage site projects were reported by the project. One project is for storing CO_2 from the power plant, while a second project is being organised for research purposes. Over its lifetime it will store less than 100 thousand tons CO_2, thus qualifying as a research site according to the EU Directive on CCS (this exempts it from requiring a storage permit). This brief summary is for the power plant storage site activities only. Unless stated otherwise the following text is for the Duero basin site only.

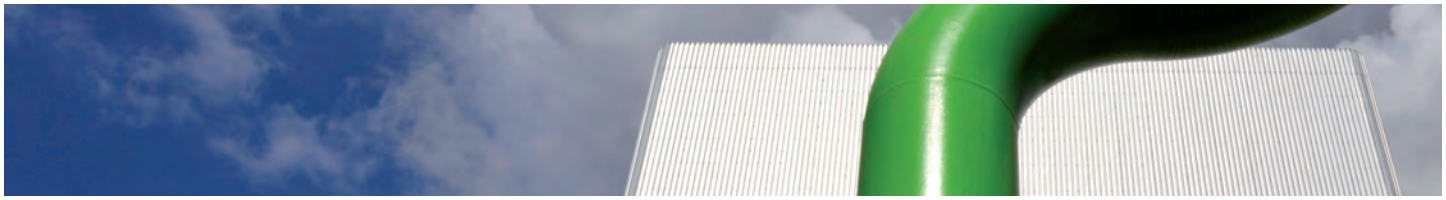
The soil gas baseline survey that started in June 2010 was regarded as of particular interest to other onshore sites.

The overall process for site selection and qualification began by screening several large sedimentary basins across Spain for potential CO_2 storage. Two basins in the northern basis have been selected. The Duero basin is much closer to the power plant than the second selected basin (Andorra).

All current candidate sites are on-shore and the working assumptions for storage needs are 30 years of injection of 1.25 Mt/yr of CO_2.

With this volume of CO_2 and the geologic model which has been developed with the current available data it has been concluded that the Duero site has enough capacity for the storage needs and the optimum injection strategy will be with five vertical injector wells with 1000 m spacing.

In order to provide detailed data of the site, four appraisal wells will be drilled in 2011, starting in May. The main objective is to obtain geological, hydrological, petrochemical and petrographic data from the site. With this new data, the static and dynamic model will be run in order to update and validate them.



State of the art in CO_2 geologic storage

Todd Flach (DNV) offered a presentation on the state of the art in CO_2 geological storage and a summary is provided here.

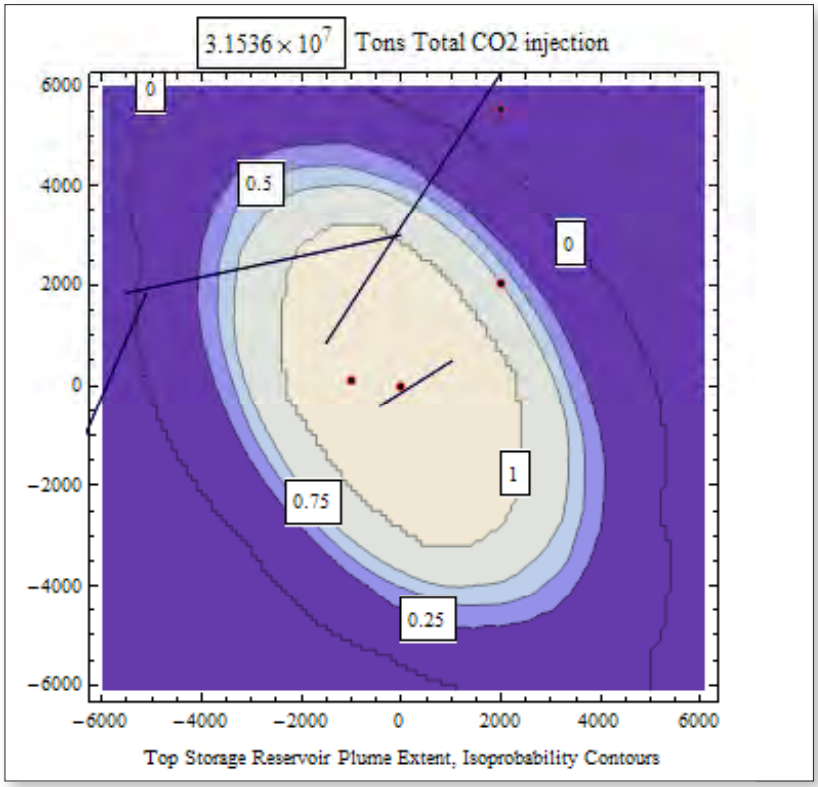
The main initial task for evaluating storage containment and integrity is to identify all potential leak paths out of the defined storage complex. The storage complex[3] should be chosen with the shallowest layer of cap rock (aquitard or aquiclude) as the uppermost "lid" of the storage complex. For onshore storage sites, this is below the shallowest source of drinking or irrigation water. For offshore sites, this should be the base of the uppermost cap rock (aquitard or aquiclude). In all cases the storage site developer should avoid defining the base of the primary cap rock as the "lid" of the storage complex because it will in general be too difficult to guarantee a priori that this first barrier will not be breached. However it is the overall integrity of the system that is of importance and this is represented by the barrier that cannot realistically suffer a significant breach (i.e. the uppermost cap rock). This was shown graphically in the presentation slides and is referred to as the "multi-barrier" storage concept.

Once the location of all potential leak paths (primarily faults and abandoned wellbores, but there can be others for some sites) are identified and placed in the storage site model and maps, these should be compared to simplified estimates (before fully-detailed dynamic simulation models are available) of the maximum lateral extent of the CO_2 at the level of the top storage reservoir target. This map comparison should show the probability of "intersection" or "collision" of the stored CO_2 in the target reservoir and the mapped potential leak paths. This is the starting point of a probabilistic estimate for leakage out of the defined storage complex. Only storage sites that can provide sufficient evidence for very low probabilities of potential future leakage can apply for storage permits.

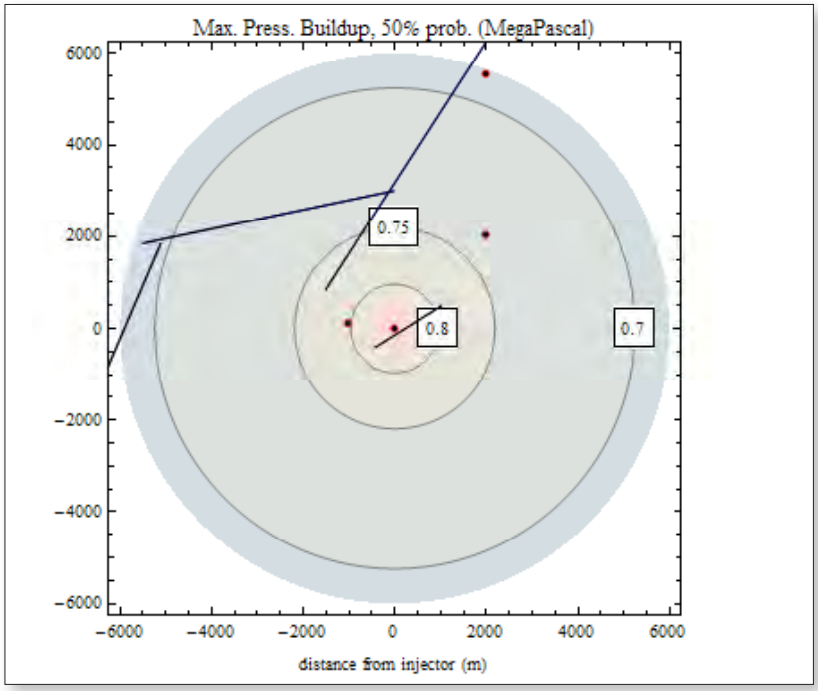
Todd presented a simplified Monte Carlo calculation result to give a hypothetical example of what this can look like. The calculation result shown on Figure 1 is based on analytic expressions published in the peer-review literature (Jan M. Nordbotten, Celia, M., Bachu, S., Dahle, H. (2005). "Semianalytical Solution for CO_2 Leakage through an Abandoned Well," Environ. Sci. Technol. 2005, 39, 602-611.). The equations were implemented in a *Mathematica* notebook. This was not included in the PowerPoint slide series, so the example is included here on Figure 1. Note that contour labels show 1=100% certain inside the interval that the CO_2 will contact. The contour labelled 0.75 is the 75% certainty of CO_2 contact, etc. The dots on this plot represent hypothetical wellbores. The central-most wellbore is the CO_2 injection well. Some of the more peripheral wellbores may be legacy wellbores and may require that they be re-sealed and abandoned if they are in long-term contact with the stored CO_2. The risk-management question then becomes:

"What is the maximum probability of CO_2 contact with this wellbore that we tolerate before we decide to re-seal the wellbore with a CO_2-proof solution?"

3 The legal definition from the EU Directive on CCS: "Storage complex" means the storage site and surrounding geological domain which can have an effect on overall storage integrity and security; that is, secondary containment formations.



↑ Figure 1. Example of a probabilistic contour map showing the maximum extent of the stored CO_2 projected onto the top reservoir, seen from above. Uncertainties in reservoir thickness, porosity, water mobility, CO_2 mobility, residual CO_2 saturation are included as triangular probability distributions. This plot was produced by DNV using its own software implementation.



↑ Figure 2. Example of a probabilistic-value (50% probability) contour map and cumulative probability distributions for two radii from the injection well showing the reservoir pressure build-up due to injection of CO_2, at the end of the injection period (assumed to be the maximum for the lifetime of the storage). Uncertainties in reservoir thickness, permeability, porosity, water and CO_2 viscosity, are included as triangular probability distributions. This plot was produced by DNV using its own software implementation.

The long lines on show hypothetical fault traces projected onto the top storage reservoir level.

Some of these faults may be suspected of allowing stored CO_2 to move upwards. The same risk management question above can be posed. There is currently no "proven" way to seal a fault (although researchers at Heriot-Watt University are making great progress, and may indeed have a practical solution). So in this case the strategy could be to try to inject CO_2 in such a way as to avoid it contacting the fault. In any case it may be required to install very effective monitoring equipment to monitor reservoir pressure and rock stress changes in the near vicinity to the potential leaking fault. This would allow anticipating a potential future change in the stress state of the fault which might allow it to leak. A viable mitigative response would be to modify the injection strategy to reduce the reservoir pressure and thereby reduce the probability to a sufficiently low level of the suspected fault to leak in the future.

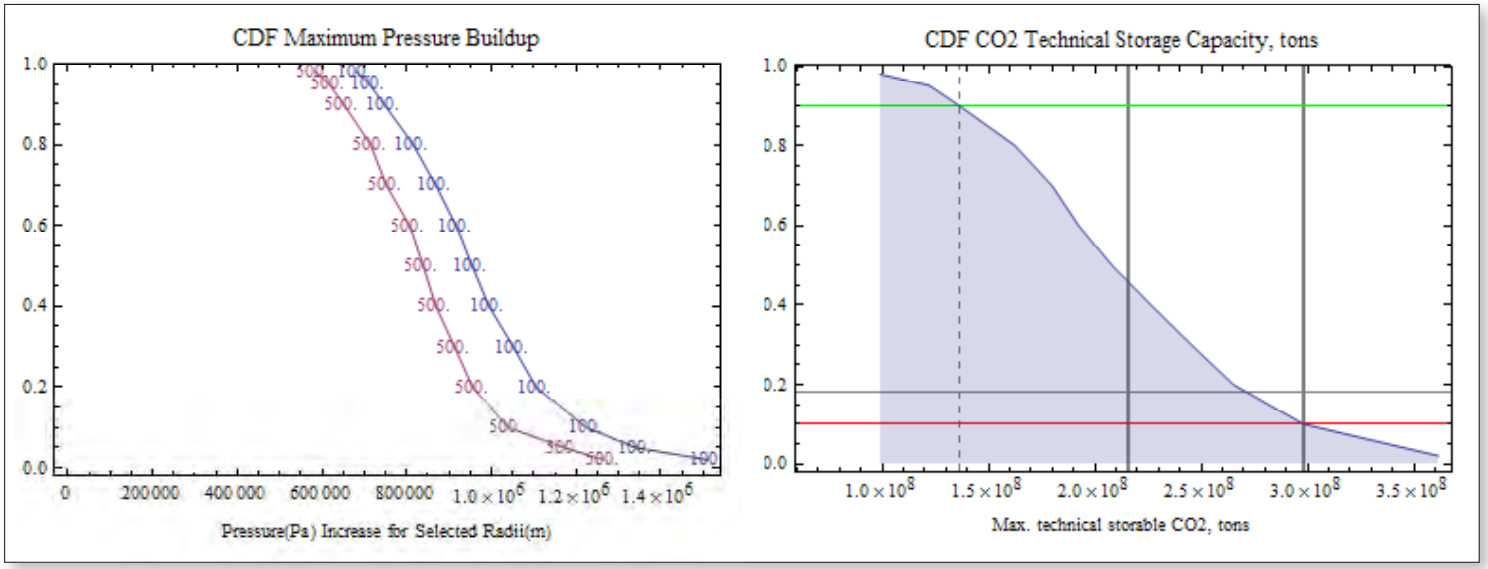
An additional very essential consideration is the potential that prolonged injection of CO_2 will cause increasing reservoir pressure above certain thresholds that define failure of essential "barriers" to leakage out of the target storage reservoir. Examples of this are pressure limits defining:

- cap rock shear failure
- cap rock capillary entry pressure threshold,
- fault "re-activation", "valving" or otherwise become hydraulically conductive,
- failure of wellbore cement-rock-casing bond in abandoned wellbores due to changes in the geomechanic stresses around the wellbore.

Estimates of increase in reservoir pressure due to CO_2 injection can be produced using relatively simple analytic expressions and simplified descriptions of the target reservoir and fluids. These estimates can be put into a probabilistic framework in straightforward way, and compared with geomechanical failure estimates for each individual potential leak path.

The graphics in Figure 2 were based on analytical equations developed especially for CO_2 storage reservoirs (Simon A. Mathias, Hardisty, P. E., Trudell, M. R. and Zimmerman, R. W. (2008). "Pressure buildup during CO_2 injection in brine aquifers using the Forchheimer equation". 2008 Virtual Conference on Climate Change and CO_2 Storage Imperial College London and Second Nature). The uppermost graphic is a contour plot of maximum pressure increase (at end of injection period) with the injection wellbore in the center. The lower graphic shows the whole probabilistic outcome for two radii from the injection wellbore, namely 500 m and 1000 m away from the wellbore. The Monte Carlo calculation and output graphics were implemented by DNV using *Mathematica*. Note that the dots and lines represent the same wellbore and fault trace locations as shown in Figure 1.

Any static calculation estimates of storage capacity must be resolved against these two considerations (plume collision with leak paths, and reservoir pressure increase limits defined by geomechanical failure estimates for various cap rock, abandoned wellbore and fault/fracture features with in the defined storage complex).



↑ Figure 3. CDF of storage capacity assuming max. 2 MegaPascal increase in avg. reservoir pressure

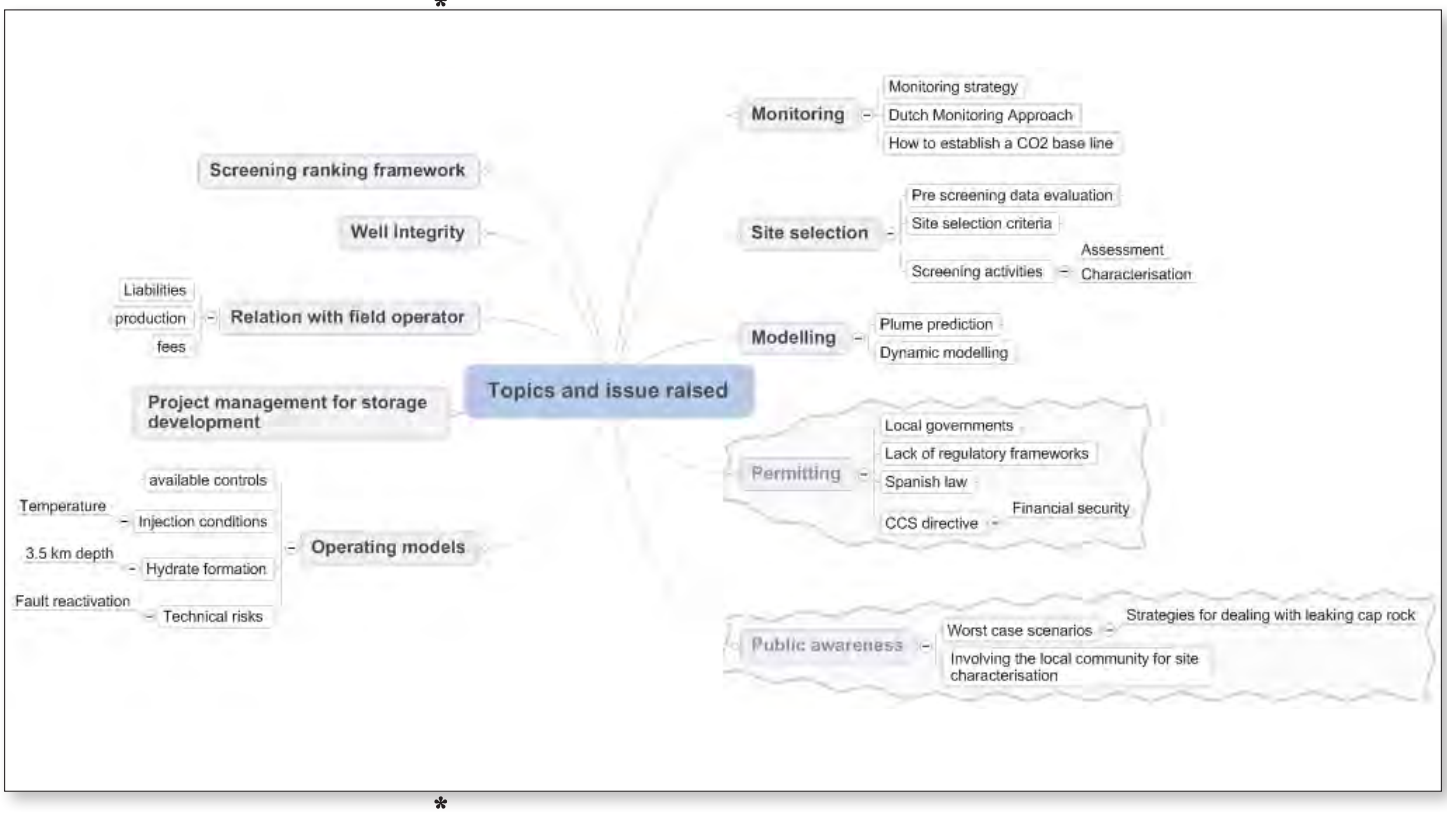
We show for the sake of completeness here a cumulative probability distribution produced using a Monte Carlo implementation of a static storage capacity estimate conditioned to a maximum of 2 MegaPascal increase in average reservoir pressure. The same data was used as for Figure 1 and Figure 2.

In the discussion following the presentation, it became clear that leaks can be detected at leak rates far below 1%. Also, when imagining a worst case scenario (e.g. high leak rate to a confined area like a valley, and no wind), it would take days to weeks before CO_2 levels would become hazardous. Detection would provide sufficient time to execute mitigative actions (that must be identified for all possible leak scenarios).

Also, it was suggested that model results could used as proof in liability issues, but would require considerable computing power. It was concluded that the margins for CCS are tight. Projects will look for right balance between cost of e.g. MMV and modelling versus the cost of mitigative actions.

Identification of sharing topics for 2011

During the presentations of the projects and DNV and following discussions a list of potential topics and issues was collected and clustered:

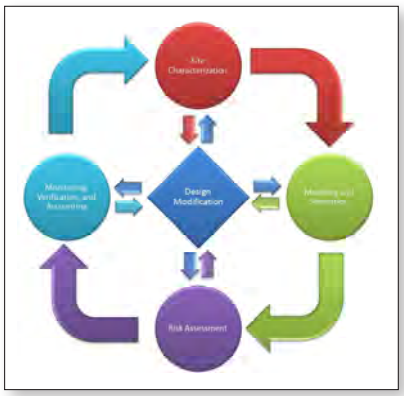


Topics and issues identified during the workshop

Some issues relate to permitting and public awareness and are outside the scope of this group. These topics will be brought to the attention of the other themes.

Six topics were identified and the projects voted on these, resulting in three focus areas, marked in bold:

Topic	of interest to
Site Selection & Site Screening	
Site Characterisation	*Porto Tolle, Hatfield, Belchatów*
Modelling *- Static and Dynamic modelling* *- Compliance with CCS directive*	*Porto Tolle, Compostilla, Hatfield*
Monitoring Concept incl. CCS Baseline	*Jänschwalde, Porto Tolle, Compostilla, Hatfield, Belchatów, ROAD*
Operating Models	*Jänschwalde, ROAD*
Well Integrity	*ROAD*



↑ Integrated model presented by Ed Steadman, PCOR

To provide more focus on the topics, three leading questions were defined. It is the intention to work during the year ahead to address these questions. PCOR recommended taking an integrated approach to site characterisation, Modelling and MVA strategy as it is more effective than addressing these topics separately. PCOR has experience in such an integrated approach.

The session was finalised with a short brainstorm about potential activities on each of the questions.

Priority Questions for 2011

1 *"How to design a risk driven MVA plan for a demonstration project?"*

Activities could include:
a. CO_2 REMOVE and similar R&D project results;
b. Current planning and practice from the projects.

2 *"How to define Quality requirements for modelling that will add confidence to the storage approach and will satisfy permitting requirements?"*

Activities could include:
a. Compare modelling assumptions;
b. Compare modelling sensitivities;
c. Consultation of local authorities;
d. Identification of Best Practices;
e. Development of a uniform approach.

3 *"How to create an Integrated , Iterative Feed-back Learning Approach to Site Characterisation, Modelling and MVA"*

Activities could include:
a. Evaluate available models like the model presented by the US guests;
b. Focus on design principles (as projects will not have executed more than a single cycle before injection starts).

Concluding remarks

Simon Bennett (Project Manager of the CCS Network, European Commission) concluded that with its first event in 2011, the CCS Project Network has started sharing knowledge across a few clear areas:

- *Public engagement:* work on social media; development of a risk communication toolkit; development of key messages and case studies - putting theory to practice;
- *Permitting:* development of guidance documents and sharing experiences on directive implementation with a focus on storage;
- *Storage:* sharing of monitoring methodologies and common modeling assumptions;
- *Risk management:* continued updating of the Network's risk register.

The element of a site visit as part of the Network sharing events is valuable for seeing real progress and commitment on the ground.

The meeting has seen the highest level of participation so far and the discussions have been open and detailed.

The level of trust that clearly now exists between projects is an excellent foundation for the coming year. The momentum needs to be maintained and it is crucial that knowledge products are presented at the Network's open fora (the planned dissemination event on 10 May and the next Advisory Forum meeting on 16 June). The reporting template provides a good basis for this.

It was also felt that the building of a presence internationally will be important this year and that it will be efficient to interact with global bodies with one voice.

The Network is at the beginning of the year and getting good results will require commitment from all member projects. This is especially true for the completion of the thematic reports 2010-11, for substantial contributions to the dissemination activities, for the timely completion of the knowledge sharing template each 6 months, and for continuation of work that is not high profile, such as the work on risk management that now takes place virtually.

The planned calendar of Network events is as follows:

- **29/30 March 2011**: site visit and discussion day at invitation of Total, Lacq, France;
- **10 May 2011**: CCS Project Network Dissemination Event, following GCCSI Members' Meeting, Rotterdam, The Netherlands;
- **8-9 June 2011**: Project Network sharing event, site visit, Compostilla, Spain;
- **16 June 2011**: Advisory Forum & Steering Committee meeting, Brussels, Belgium