



summary report of
the 4th IEA GHG
social network meeting



International Energy Agency

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IEAGHG 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 IEAGHG as a record of the events of that workshop.

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Delegates in Meeting Room / Central Street Bridge in Calgary

Introduction

The overall aim of the Social Research Network is “to foster the conduct and dissemination of social science research related to CCS in order to improve understanding of public concerns as well as improve the understanding of the processes required for deploying projects”.

The objectives of the Network are as follows:

- Ensure high quality social science research
 - Elevate reputation and acceptance of social science research
 - Consistency of research
- Identifying gaps
- Promoting a learning environment
- Building capacity within the Network
- Translate information from studies into tools or applied lessons
 - Apply insights to actual projects
 - Interact with technical experts
 - Communicate results to policy makers
 - Ensure application is grounded in theory
- Create a clearing house of social science research

This 2014 meeting, the fourth of the IEAGHG Social Research Network (SRN), was held at the University of Calgary in Canada, from the 14th to the 15th January. The meeting was hosted by the University’s Institute for Sustainable Energy, Environment and Economy (ISEEE) and sponsored by the ISEEE and PTRC. Over 35 delegates from 8 different countries attended the meeting.

Session 1: Scene Setting

This session aimed to review changes in the science and policy debate around climate change that might affect public attitudes.

‘Key conclusions of the IPCC 5th Assessment: the cumulative carbon budget and its implications’ Professor Myles Allen, Oxford University

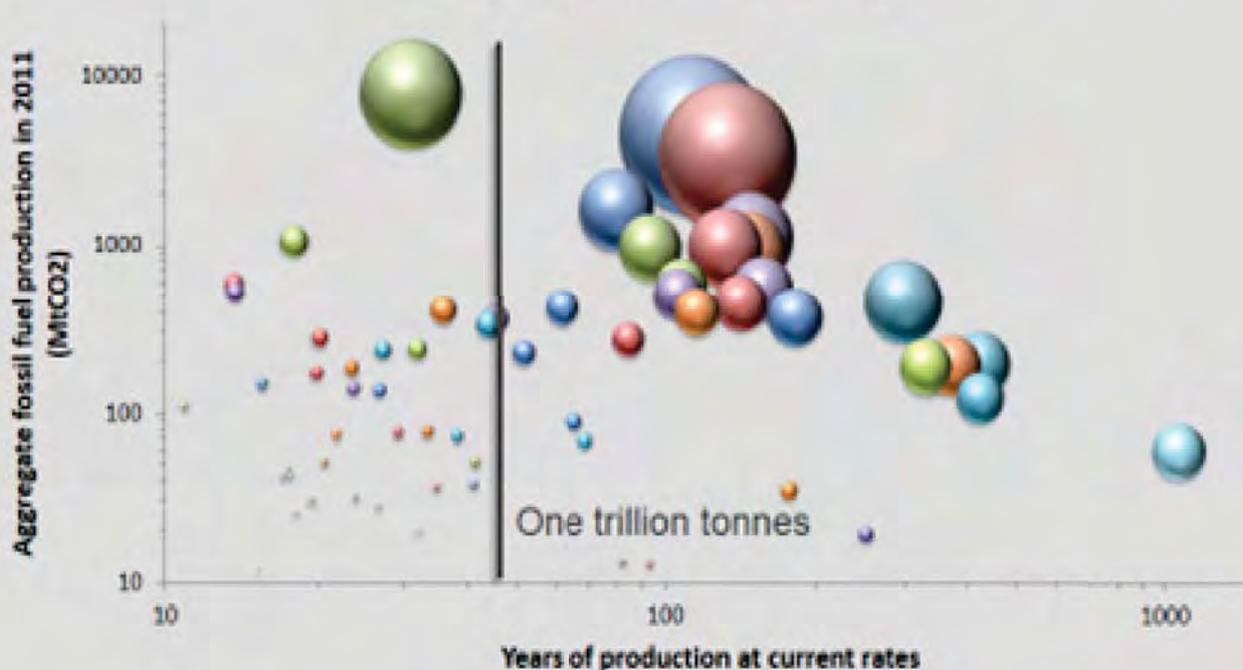
Myles shared findings from the recent IPCC report, with the major headline being there are no new headlines. That is, Myles reported the range of emissions had not changed; that uncertainty in the modelling is inevitable and will not go away; and, that we need climate policies that are helped by uncertainty – not just robust to uncertainty. Myles suggested under such conditions the introduced ‘carbon tax’ that is tied to global temperature may not work as it is intended to. Mainly because people will pay almost any price for the luxury of burning fossil fuels, and after the ‘trillionth tonne’ any tonne of carbon will need to be sequestered – but the carbon price will never be high enough to enable this.

To overcome these issues Myles proposed the Sequestered Adequate Fraction of Extracted carbon (SAFE) concept. That is, ensuring that generated carbon never exceeds the atmospheric capacity. Paying for the stored CO₂ implies a carbon price, which is then passed on to consumers. As a result of this, they might consume less (making the carbon price lower), without compromising policy. Figure 1 illustrates the concept of the ‘trillionth tonne’.

The importance of motivating countries to take action was discussed, with agreement that it is imperative that all try to generate mechanisms for this. It was recognised that a large number of CCS projects have either been stopped or placed on hold –mainly due to public perception issues (for example recent issues in Europe) and the cost of CCS. It was recognised that in the UK, in particular, the focus on energy costs and public perception is currently dominating media attention. It was suggested that while developing CCS technology will leave countries with a strong technology fix, in places like the UK, where renewables are being pushed ahead of other options, it is clearly distorting the market. From the information presented in this talk, it was clear that there is a need to prioritise CCS in the UK, at least.

And you only need 20 countries to sign up

Fossil carbon reserves by country



trillionthtonne.org
Explaining the need to limit cumulative emissions of carbon dioxide.



Figure 1. Graph showing fossil carbon reserves by country, and illustrating the 'trillionth tonne' concept

'Addressing adaptation in the oil and gas industry', Arthur Lee, Chevron

Arthur outlined the perspective that adaptation is becoming a recognised climate risk management strategy for many oil and gas companies. Arthur highlighted that there is a growing perspective on the necessary and complementary role of adaptation/climate risk management. This was seen as complimentary to oil and gas companies that already have risk management at the heart of their business decisions. However, Arthur stressed that a climate management strategy requires the development of an adaptation plan. Such a plan would include identifying and evaluating potential impacts; the evaluation of risks; and designing approaches to adapt and manage risks identified. Through a workshop, the International Petroleum Industry Environmental Conservation Association (IPIECA) identified several key messages, including that oil and gas companies continue to adapt to climate risks (whilst assessing a range of related risks); many impacts are local, therefore local adaptation assessments are needed; a flexible and robust design coupled with adaptive management practices will be critical for managing risks and adapting; and that sharing lessons with society and governments can broaden the recognitions/understanding of risks – and therefore highlight more efficient options.

'ENGO Perspective on CCS', Duncan Kenyon, Pembina Institute

Duncan began by outlining that although there has been some growth in awareness of CCS there is a lack of understanding of what it means, how it works and what the risks are that it presents. He also suggested that there are not any really good publicly available diagrams to help with this. Critical issues were the long term liability and its impact on the individual.

ENGO's agreed on the importance of examining old assets when considering CCS; as it was felt that there was a possibility that some gains could be made from retrofitting to old assets, but Duncan stressed that it would be important to examine the whole chain to understand what the net benefits might be by doing so. It was recognised that unconventional gas extraction has been a game changer for the US as it shifts away from coal. However, although this was recognised as having a climate benefit and some felt that there was no need to fit CCS to natural gas plants Duncan expressed a concern that these discussions do not include the possibility of attaching CCS to natural gas plants.

Pembina and other ENGOs are of the opinion that CCS needs to be part of a portfolio of options, although there was some concern about CCS with EOR and Duncan expressed a view that more work was needed to be done to understand the life cycle of the process – making sure that the step to manage and build was fully accounted for. Duncan stressed that it is crucial to have proper project and Monitoring, Measurement and Verification (MMV) plans in place because long-term liability is a key issue for CCS deployment and acceptability. It is likely that as more projects are planned and deployed, the public will feel more comfortable with the technology. Governments and industry need to be seen to be stepping up, and that appropriate policy, regulations and management are needed to mitigate potential risks before acceptance will occur. CCS is a complex technology, so it often comes down to understanding versus awareness which can be challenging.

In terms of ENGOs' position on EOR, value is seen for building infrastructure but storage may not actually occur. CO₂ is an expensive commodity and there is an unwillingness to keep it underground – is the value of the CO₂ such that operators may need to extract and use it? It was noted that in British Columbia, there is a very large carbon footprint from the gas and LNG developments. Here the concern is about the overall greenhouse gas footprint, and the government here are in a good position to be energy efficient, world leaders on this – which could generate valuable learnings.

Discussion

The interaction of ENGOs with projects and the public opens up a dialogue. Pembina, for example, gives a scientific, technical-based analysis of results – a perspective that is constructive and perhaps more appropriate for industry and stakeholders (like those in IPIECA). Greenpeace, a different ENGO, uses more emotional arguments – which probably results in more influence on the public.

Canada is very active in CCS with the implementation of several large commercial CCS projects, as well as major advancements in policy related to climate change and CCS. This session provided an opportunity to explore the social science trends related to these developments.

Session 2: Social Science Trends in Canada

Canada is very active in CCS with the implementation of several large commercial CCS projects, as well as major advancements in policy related to climate change and CCS. This session provided an opportunity to explore the social science trends related to these developments.

'Developing the legal and regulatory framework for CCS in Canada', Nigel Bankes, University of Calgary

The legal and regulatory framework (LRF) in Canada has had success in providing certainty for investors and assurance for the public. The success in this area can be attributed to many factors, including that it is an oil and gas jurisdiction (meaning the population are familiar with the risks/benefits of using subsurface resources), that provincial initiatives were brought out by the government (including financial support, vesting of pore space ownership among others) and a collaborative approach was undertaken to ensure correct details. This approach, the Regulatory Framework Assessment (RFA), was a 'multi-stakeholder process to review the technical, environmental, safety and monitoring requirements for CCS and to recommend any changes' to the LRF. The RFA observed that the overall approach to the mitigation of greenhouse gases is lacking ambition and that the regulator no longer enjoys as much trust as before.

'Deploying a public outreach strategy for the Aquistore project', Aleana Young, Petroleum Technology Research Center (PTRC)

The Aquistore project, managed by PTRC, involves the storage of CO₂ for the Boundary Dam project. The strategic communications plan was established in 2010 and the efforts have undertaken a number of different outreach activities. These activities include external engagement such as kitchen table discussions, an open house, a ground breaking event, site tours and media attention, and internal engagement undertakings such as establishing/running a communications working group, an annual meeting, site tours and 'lunch and learns'. It was noted that of the concerns raised during the engagement programme, many were not particular to CCS, for example many community members had issues with a seismic company in the area who had not worked well during the project. One family was concerned that the CO₂ underground would affect the value of their mineral rights, but in terms of issues, nothing worrying came up – there were no issues raised regarding groundwater, for example, as it is likely that the site operators and communicators were open about this information from the very beginning.

'Focus group work arising from public questions raised during the Weyburn-Midale Project', Norm Sacuta, PTRC

A Best Practice Manual has been published from the Weyburn-Midale project (WMP) learnings, and The Global CCS Institute (GCCSI) and PTRC have recently worked on a joint project; 'Creating Core Messages'. This project began by reviewing the 2009 stakeholder results (along with a literature, project and web review) from the WMP to identify key questions raised by the local community – 48 most often raised questions were identified. These questions were published in a guidance report, and each question is answered and then backed up with details from the WMP results. Two focus groups (using Weyburn area participants) were held in 2013 to better understand if the public's needs are met through the explanations given in the document and to identify the effectiveness of the answers provided to the 48 key questions.

The results from the groups were positive; it was evident that the answers to the questions – providing evidence of safe storage at Weyburn – created a more positive attitude towards CCS, although the intent of the booklet was to be informational and not persuasive. There were some negative reactions were concerned with the information source and the long term security of storage. The document and group results were peer reviewed and the following recommendations were made: clearer definition of the intended audience is required; the document should be a source book for use by policy makers and communicators on other CCS projects; and the need for historical context from other projects. There was a group consensus that similar initiatives on other projects with expertise and CCS projects (with current outreach efforts) in different areas would be beneficial.

It was noted that there was a slightly higher level of general CCS knowledge in the WMP area (due to oil and gas history) but the details were not clear for most.

'Scare tactics: contracting out risk amplification', Alan Roth, Alliance Pipeline

Alan discussed the credibility struggles among activists and other stakeholders (for example scientists, regulators and industry). He explained that risk 'amplification' or 'attenuation' refers to the players in such a struggle and their communications transmitters, each of which competes for their own version of the truth. The 'Social Amplification of Risk Framework' (a concept developed by Kasperson et al., see Figure 2), a conceptual idea, was developed to analyse risk communication exchanges in the context of the many factors that can amplify/attenuate risk perceptions (psychological, social, cultural etc.).

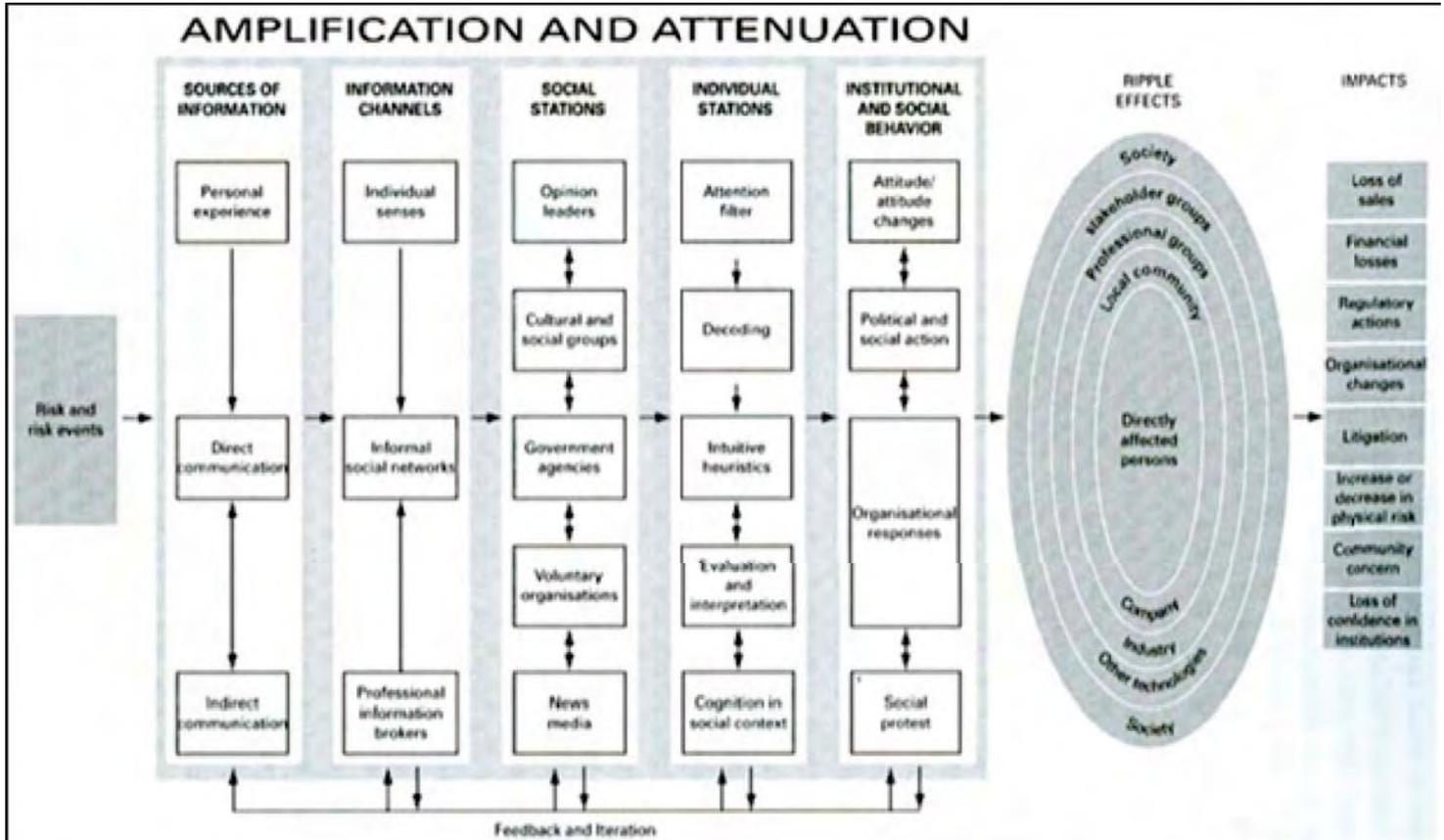


Figure 2. 'Social Amplification of Risk Framework', Kasperson et al., 1988

The struggle between anti-fossil fuel/oil sands activists and pro-fossil fuel industry players is a classic example of such 'risk amplification' by the activists, and this has been particularly evident in Canada. It has been interesting to see the huge influence that such activists, the media and certain ENGOs can have on the Canadian public (risk amplification), despite the fact that the oil sands accounts for just 7.8% of Canada's emissions. Alan suggested that the Internet, for example, has acted almost as an accelerant for such negative attention (note that it could be positive too) and pre-dispositioning can be hard to overcome when trying to gain public acceptance.

Discussion

When looking at practical ways to link with trusted information sources, it is important to determine whether the source has constructed the narrative consciously or unconsciously and to understand what the narrative is comprised of (i.e. be aware of your intended audience and think about where they're coming from). Public opinion can have a huge amount of influence on potential or operational projects (as it should – their voice MUST be heard). There is a huge issue with trusted sources and speakers, particularly with celebrities (who have tremendous clout) who can be very influential and become trustworthy to the public. However, it was recognized that this can also be an opportunity for projects to focus on and much of the early work that Emma ter Mors and Bart Terwel have done on trust can be helpful here.

Session 3: Social Science Trends and the International Atmosphere

Moving beyond Canada, this session provided an opportunity to explore social science trends and research related to CCS in the rest of the world.

'Stakeholders' Views on Financing Large-scale Integrated CCUS Projects in China: From Hypothetical to Real', Xi Liang, University of Edinburgh

The development of large-scale integrated CCS projects in China are still all at a very early stage and it is recognised that stakeholder communication is an important area in 'formulating timely policy support and overcoming barriers associated with deploying and demonstrating CCS technologies'. It appears that the Chinese government see this as an essential technology for long term mitigation strategy but for now the focus of storage has been on EOR and offshore storage as the target associated with large industrial projects. This work has demonstrated that Chinese stakeholders have a better understanding of CCUS than previously, but they still hold some concerns about the impacts of extra costs/energy penalties on the Chinese energy system and economy. The Chinese national government has begun work on policies to support a few CCUS demonstration projects and some Chinese banks have expressed interest in financing these early CCUS projects. That is the banks are generally demonstrating a high risk appetite for new, clean energy technologies. There is no comprehensive policy support framework for financing large CCUS projects in China, but alternative choices include carbon markets, capital grants and feed-in tariffs. Therefore, a key component of the project that Xi is involved in is to understand how to finance a large scale integrated CCUS project in China. In the research it was thought by many that the risk of legal and regulatory changes would be a top priority (when in fact leakage was the highest perceived risk), but it was noted that in the Guangdong area, there is a carbon price so a financial liability for emissions.

Japanese experiences, Takuma Mohri, Japan NUS Co. Ltd (JANUS) & Kenshi Itaoka, International Institute for Carbon-Neutral Energy Research (I2CNER)

I2CNER have been researching public perceptions/societal attitudes in Japan before and after the early 2011 Fukushima event and found that the risks associated with nuclear meltdowns had not been officially communicated to the local residents (living close to nuclear plants) or to the general public (including those beyond the official zone of emergency evacuation, but who might be exposed to radioactivity). Work has also been done on the attitude of the Japanese public after the event; the "best-mix" of energy has become a major issue in Japan. JANUS used an online survey in the September of 2011 to gain an insight into public attitudes, using a sample of over 1000 in the Tokyo area. The researchers found that the Fukushima incident made the Japanese public more energy-conscious; that their preferred energy source would be solar (because it is environmentally friendly – an opinion shared with the global public); but that in reality, this public is more cost-conscious than environmentally concerned.

It was noted before the event, there was some opposition to nuclear, but this was not a widespread opinion. As a nation, nuclear accounted for 30% of Japan's energy and it seems that attitudes towards the technology is similar to that of CCS – people were not supportive but didn't necessarily oppose it. It was interesting in the survey that oil and coal were rated below nuclear (even after Fukushima) and it was thought this may be because in Japan, fossil fuels are a foreign commodity (99% are imported from other countries) whereas nuclear is run, operated and controlled by Japanese stakeholders.

Discussion

It was noted that across so many different contexts, cost is a limiting factor – it will always have a major influence. CSIRO have undertaken some work (see session 4) that examines where people trade off with costs, which shows that once it becomes too expensive, personal preference does not play such a role. Events such as the Fukushima incident have shown that risk and risk communication is tricky in an active project – much the same as in CCS operations and the notion of transparency around risk is much to do with different people having different perspectives. For example, the Decatur project has done three rounds of risk assessment (pre and during operation) and has looked into how you go about communicating these risks and how you use the risk assessment process to mitigate the risks – tasks which all tie in to each other. It is important to start by defining the risks and looking into worse case scenarios (and remembering that the worst case scenario is unlikely and the more likely incidents would be the low consequence events). CCS projects are

Session 4: Methodologies

This session provided an opportunity for the participants to review and explore different methodologies for social science research related to CCS.

'Looking at alternative deliberative processes: An example of Q methodology in use', Anne-Maree Dowd, CSIRO

CSIRO's social choice project aimed to explore stakeholder engagement models around sustainability and natural resources; to better understand the underlying aspects of sustainability problems; and to build a knowledge base that complements technical, theoretical and policy models for sustainably futures. The Q methodology was used in individual and group questionnaires, and is a quantitative process of capturing personal orientations, enabling the elicitation, evaluation and comparison of human subjectivity on a certain topic. Researchers found that external blame/accountability to the government (or big organisations) was diffused through the collaborative Q sort, and that fragility, climate change, responsibility and action is just as important at the individual level as well as through industry/government. This tool is useful as it can be used to specifically focus on CCS discourses and project contexts, individual Q sorts can be compared with group Q sorts – allowing analysis of the influence of information and deliberation, and it's a different approach to feed into engagement plans.

'Using social media to conduct social science research in an educational context', Sallie Greenberg, ISGS

Social media (SM) is a huge potential mechanism for engagement, but there has been limited empirical work on the effectiveness of SM for this purpose. This work examined the role of SM in an active learning environment and used various measures to analyse attitudes, including monitoring of SM posts, pre- and post-test surveys, self-reports, interviews, and course artefacts. The study concluded that SM use did in fact impact student attitudes about global climate change (the treatment group showed an attitude shift toward greater concern about climate change and reported a higher level of intent to socially engage on the topic); and it facilitated the active learning environment. However, in this study, SM did not impact student knowledge gains. These results demonstrate that SM can be effective when used in an educational context, but that implementation takes time and effort; its use must be purposeful, intentional and meaningful in the educational environment.

'Exploring the use of an interactive online tool for information provision and how it impacts public attitudes to energy technologies', Peta Ashworth, CSIRO

The current rising energy prices in Australia make this a topic of huge interest to the public, and this online tool (the 'MyPower tool', see Figure 3) allows the public to see the impact of different energy mixes on emissions and costs (i.e. energy bills). CSIRO used the values beliefs norms (VBN) theory to try and understand who individuals feel is responsible for depletion of energy sources. The results showed that most felt that this depletion is increasingly a problem for society, but they did not feel any individual responsibility for this, which is despite the fact that we all use the resources indirectly in our daily lives. Not surprisingly, our early analyses showed that renewables for energy generation were the most popular choice, with gas and coal also popular. CCS was fourth after these and nuclear was the least popular choice. On average, people were reluctant to agree to price increases, but when given the options in the online tool, they chose a more stringent emission reduction/price increase combination than their original answer indicated. This may indicate that people are reluctant to give a figure on price increases when asked an open question, but when given specific detail about cost-emission trade-offs and how to achieve them they are more comfortable selecting something with reasonable ambition.

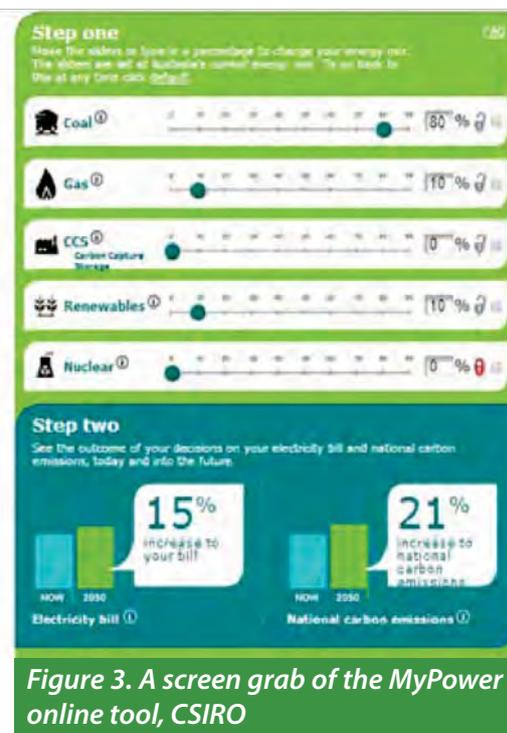


Figure 3. A screen grab of the MyPower online tool, CSIRO

Discussion

Delegates looked further into the research presented in Session 4 and the reliability of results over time. Surveys are generally a good representation of a certain point in time, especially as attitudes can change very quickly. The Q methodology research was longitudinal in nature, so it can be replicated over time but the work on social media may not be as replicable because the population of concern (i.e. 18 – 25 year olds) constantly evolve the ways in which SM is used. It was noted that group interaction was a key factor in some results and that group interaction has been used successfully as part of the communications process.

Social and group identity can be measured and it is interesting to see how this impacts various things; the group members identify with one another, build trust and then build on their opinions – in public engagement like this, people need to be challenged and the best way to do this is working with others they trust – presenters that are trusted by people are likely to have more influence in the discussion. Much of the qualitative data gained show that in such environments, there was a real sense of community, indicating a certain level of comfort in that those activities were supported by the public and it was observed that the activities under discussion (climate change mitigation etc.) were supported. The work on SM demonstrated that outreach and engagement does not have to be costly – the technology exists and that open forums and groups can be used to facilitate this interaction. CSIRO have been experimenting with using this method for social research, and noted that it is much cheaper and similar results are achieved. One concern, however, is that risk amplification can easily become a problem in the online forum versus the face-to-face forum. It is, however, important to note that there will be certain tools or methodologies that will not work in certain populations – one size does not fit all.

The group discussed the potential positive effects of discourse in small groups and it was asked whether the presenters' experiences have been self-selecting; that people attending an energy group or event are more likely to have positive opinions, therefore leading the results? It was noted that the CSIRO work advertised the group as a 'workshop of national significance' rather than being specific on the topic. The social media research actually saw a vast range in opinions and differences throughout the group, despite the attendees being aware of the topic beforehand. It is possible that when using this methodology, biases may have come into play due to the self-selecting nature of the effort, but the results seem representative of the real world.

Longitudinal, attitudinal studies would be beneficial to use as part of a project's public engagement plan – this could then be used as a baseline, can be tracked over time and is a reliable method. It was noted that early engagement is important, but often there is no point unless the government is on board and sometimes it may be detrimental to engage too early if there is no chance of the project continuing – raising false hopes so to speak. There are many tools that could be used by social researchers, but there are some fundamental things that must be considered, such as the local population, time you can give to public engagement, acceptable trade-offs in the community etc. It is critical to take the time to understand where you are, how the local community works, what is important to the local community and then use this information to inform what you then choose to do for that specific project.

Session 5: Communication of CCS and Scientific Issues

At the 3rd Social Science Research Network meeting in Noosa, Australia (held in 2012), the group heard preliminary presentations on the in-depth focused studies presented during this session. This session provided an opportunity for the group to reflect on what had been learned over the course of some research projects.

'Framing CCS (-research): Using choice experiments as a novel way to explore communication issues'; Kevin Broecks, Utrecht University

Kevin suggested that information on the influence of different types of content on attitudes towards CCS is currently lacking. This particular research used choice experiments to determine the persuasiveness of elements of a communicated message. The first survey showed that a focus merely on arguments about climate change mitigation is not helpful. Arguments should instead focus on appeals to norms (such as 'properly disposing of your CO₂ garbage') and arguments about the role of CCS in the energy mix. The second survey extended the approach to argument frames and sources. It showed that longer arguments with more explanation are more credible and persuasive than one-liners. The third survey showed that citizens can be classified according to their motivation and ability to read CCS information in depth. Interested citizens examine arguments closely, but other mostly look at information source or social norms (x% percentage of the population agrees). Overall, this work demonstrates that the application of choice models to communication issues is valuable. It enables studying several elements of a message in conjunction and can provide valuable information about population segments when combined with latent class analysis. Critical issues are the selection of elements to include in the study and the language and cultural specificity of the results.

'Motivated audiences: Belief and attitude formation about science topics'; Cydney H. Dupree, Princeton University

A lack of knowledge is not the only important issue; research has shown that there is another side of attitudes. Attitudes are evaluations that tap both cognition and affect, and attitudes include motivation and cognitive capacity. This work looked first at communicator credibility, which is comprised of expertise (the knowledge and ability to be accurate in forming an argument) and trustworthiness (the motivation to be truthful). The following are core motives that rule people's social interactions (therefore driving their behaviour): belonging; understanding; controlling; enhancing self; and trusting – with trust being seen to be hugely important. This research used a US sample and looked into where science communicators fall in the 'warmth vs competence chart' (which measures the public's trust in them) and found that researchers and scientists are viewed as cold but competent – qualities that are actually resented by the public (see figure 4). Generally however, distrust of climate scientists does not run high – such scientists are trusted by the public for reasons of humanity and saving the environment; the main trust issue seems to be with money (i.e. money funds their research, so they are biased). The public seem to trust impartiality rather than persuasive agendas.

The merits of media and communication training was discussed, namely whether 'warmth' is something that could be taught so that communicators are perceived as more trustworthy. Cydney suggested that there are ways to up one's warmth and competence ratings, and people can be trained to improve these qualities, but as perception is very quick, this could be seen as fake. There is evidence that fairly minor things, such as the way the communicator dresses, can affect the group perceptions and feelings of credibility or identity.

'CCS communications: Pitfalls and remedies'; Gardien de Vries, Leiden University

This research by Gardien and colleagues looked into the extent that the different strategies in CCS communication (scattering; emphasis framing; greening) are used in persuasive communication, and any pitfalls that these strategies may have.

- Scattering (the sharing of a lot of information at one time) aims to persuade the public, but a pitfall of this method is that irrelevant information can weaken the persuasive effect of relevant information. Gardien found that irrelevant information does dilute the persuasiveness of communication about CCS (positive and negative), but that moderately relevant information does not have a dilution effect.

- Emphasis framing (giving more weight to advantages over disadvantages, or vice versa) aims to persuade but a major pitfall is the subsequent perceptions of manipulation. This research found that emphasis framing is regarded as illegitimate when done by press agencies (because people expect balanced information from this source), but this mediation effect does not hold true for oil companies (which are perceived as manipulative as this is expected by the public).
- Greening (presenting involvement in CCS as environmentally friendly) aims to give CCS a positive reputation, but the pitfall is that people think that a company misrepresents corporate activities as 'green' in order to look more environmentally friendly than it is. When looking at greening, this work concluded that people perceive 'greenwashing' when an oil company invests in CCS, and an economic motive decreases these perceptions but an environmental motive does not. It is interesting to note that an environmental motive is regarded as strategic behaviour.

Gerdien's research suggests that remedies to the pitfalls associated with the three strategies are to be relevant (to avoid the dilution effect), to be credible (to avoid perceptions of greenwashing) and to be cautious with persuasive communications (to avoid perceptions of manipulation).

Discussion

It was interesting to note that other research on trust and competence suggests that when there is a need to be perceived as more warm, people may actively downplay their competence (either consciously or unconsciously) – so there is a trade-off which needs to be kept in mind. Climate scientists talk about anthropogenic climate change and research shows that people don't want to claim personal responsibility for this, but it must be considered that this is part of the problem – that we're pushing people to think about something they don't want to accept responsibility for. Other recent research suggests that people who know more about global climate change seem to feel less responsible. It is important to find the line between imparting knowledge/information and perhaps pushing people away. It is essential to examine ways that trust can be established – trustworthy communicators could then establish themselves as experts. There is an identified group that believe that NGOs are a credible information source and some work also shows that consortiums work well as an information source, as they are seen as reliable. There is a lot of motivation for companies to join groups/organisations so that they appear more credible, when in fact scientists are often seen as more credible than organisations themselves.

Often, the public considers climate change as a global problem rather than a local problem – until the issue surfaces in their back yard and then it is interesting to see what extent people will distance themselves from it. In the past there have been pushes in the US to get global climate change more into the public domain (by a range of different methods) and they actually found people were so fatigued by the push of information that they couldn't take it all in.

An important fact to consider in public engagement is that different descriptions or names for terms (i.e. describing CO₂ as a 'pollutant') can affect public perceptions, and the public's response to such differences. There has been some CCS-specific research done in this space, but it is an important area that should be considered when thinking about the gaps in research.

Session 6: Risk Perception

Risk mitigation is an essential element of energy generation – there are risks in all energy technologies. A challenge comes from effectively communicating both the nature of the risk and the mitigation strategies. This session examined a number of activities that related to risk communication and mitigation and public's responses to them.

'Protocol for response to claims of CO₂ leakage'; Katherine Romanak, The University of Texas at Austin

This work was based on the success of a technical response to the allegation of a CO₂ leak at the Weyburn-Midale project in Canada. In this case, a landowner has complained about impacts from an oil operation for more than 8 years. These complaints cited a number of different causes and problems and had gone largely unresolved. The last complaint alleged that CO₂ injected as part of the Weyburn-Midale project had leaked to the surface and was causing harm to farm animals and the local environment. An international technical team was brought in to determine if injected CO₂ was leaking to the surface. The team developed an innovative and cost-effective method for determining the source of CO₂ detected at the surface (it was finally determined that any present CO₂ was the result of natural seasonal flux). In the course of completing this study, the technical team interacted with the complaining landowner, building enough of a relationship that the final results were trusted and resolved that complaint. The work was developed into a protocol for use at other CCS sites.

The results show the influence of social science. One key learning was that it is important to avoid the battle of going back and forth in the media for various reasons, and this work proposes the importance of a Claim Response Protocol – a response to an 'allegation of an unintentional release of a gas associated with a specific CCS project'. This protocol would be composed mainly of site assessment (to validate the allegation) and risk communication (correspondence and document review). Adopting a protocol for quickly addressing leakage claims in advance of a CCS project is beneficial for avoiding long-running allegations, for avoiding unqualified sources reaching incorrect conclusions, and to avoid inaccurate information affecting public perception of CCS. The tools to implement such a protocol are readily available and relatively simple to use. They include steps like a process-based approach to fingerprinting anomalies (i.e. the process-based soil gas method). However, the key learning is that they need to be initiated from the start and the data collected longitudinally over time.

'Risk perceptions of and emotional reactions to CCS: Forming closed attitudes'. Charlotte Koot, Leiden University

Implementation of new technologies, for example CCS, often do not succeed without acceptance or support by the public. Compared to open (or unfinished) attitudes, closed attitudes – attitudes about which people have achieved a state of cognitive closure – are known to be more stable and more predictive of actual behaviour than open attitudes. As such, closed attitudes are also more predictive of support of and opposition to the issue at stake. The ability to achieve closure (AAC) is the ability to form judgments and decisions confidently and with certainty, and this work examined factors that are important in the context of technologies and that are potentially related to people's AAC – risk perception of CCS and emotional reactions to the idea of CCS. The results show correlations between general and specific risk perception, emotions and cognitive closure achieved, which supports the notion that risk perception and emotional reactions are important for people's ability to achieve closure. From the results, we can tell that both risk perception of a technology and people's emotional reactions are significantly related to people's AAC. Catastrophic potential and outcome uncertainty-related emotions were predictors of the level of closure achieved and results emphasise the importance of focusing on both cognitive and affective influences on the ability to achieve closure. The knowledge gained through this research could be used to improve CCS communication (as we know what aspects should be focussed on to help achieve cognitive closure) and it has emphasised the importance of people's safety concerns (so taking uncertainty emotions seriously).

'More than a message: Connecting stakeholder engagement and decision support for carbon management initiatives'; Joe Arvai, University of Calgary

Decisions about energy and carbon management are complex – there are significant technical challenges/uncertainties, you cannot proceed without communication with multiple stakeholders, and this requires trade-offs across economic,

social and environmental concerns. There are four key questions that need to be answered:

1. What is the scope and background of the decision that needs to be made?
2. What is the range of objectives that will guide the decision?
3. What is the broad range of alternatives available to decision makers?
4. What are the trade-offs that decision makers/stakeholders need to make?

All of this leads to decision-focused deliberation. Social research for this work was carried out in Michigan, in relation to the decommissioning and retiring of a coal-fired power station, using an online web tool for the survey. The results show that nuclear was the most popular choice, followed by biofuel with CCS and coal with CCS not too far behind that. The researchers aim to integrate this work with other decision support models and look further into holistic versus decomposed judgements.

Discussion

The decision support model is currently being used mostly by governments, but there is the potential that such a model could be used within an organisation or company. There was some surprise that nuclear was rated so high in people's preferences. It was thought that this is probably due to the number of perceived benefits of this technology, such as the cost, the greenhouse gas emission reduction potential, and the use of legacy infrastructure (to name a few). It was agreed by all that local context and individual values and worldviews are key factors to consider when looking at the communication of CCS and it would be interesting to see how emotional factors may influence how different people would respond to models such as the decision support one presented in this session.

Session 7: Responses to CCS

This session presented case studies to explore how communities are responding to real-life proposed CCS projects and the communication and engagement activities that have been undertaken to in conjunction with these projects.

'Social site characterisation: The experience of the SiteChar project in Europe', Leslie Mabon, University of Edinburgh

This work compared two sites (one in Scotland, one in Poland) that are near to potential onshore and offshore CO₂ storage sites, and aimed to build understanding of social context through social site characterisation and to raise public awareness through engagement. Some similarities were observed, such as the importance of context, that public engagement was expected as part of the project development and that both groups felt that discussions can involve both local and national scales. In Scotland, however, there was more concern and focus on economic benefits and the relationship to renewables, whereas in Poland the most concern was centred on the potential risks and leakage.

The work has implications for governments and developers:

- The public's expectation for governments to clarify their stance on CCS;
- The need for open dialogue on the risks of CO₂;
- The importance of managing public expectations regarding jobs and the effectiveness of participation;
- The importance of effective engagement i.e. that which makes citizens feel listened to and empowered.

'The unique challenges for CCS public engagement with respect to the pilot CO₂ storage project – SACCCS', Polly Modiko, South African Centre for CCS (SACCCS)

The South African Centre for CCS' mandate is to undertake research into CCS and also public engagement. The pilot project has been proposed to demonstrate storage in South African conditions, but to also gain experience and develop South African capacity in handling/storing CO₂, whilst providing an educational facility for the public and stakeholders. The potential storage sites are within the Zululand and Algoa Basins, where the majority of the population does not speak English and where poverty is rife, with many not having access to basic electricity. Language is a difficulty and presents a huge challenge, for example in such areas there is no phrase suitable to describe CCS. CCS is not a familiar concept

in South Africa and various recommendations have been made for this pilot project, including the compilation of an Integrated Communications Action Plan (ICAP) and a community liaison working group has been created. The SACCCS have embarked on public outreach programmes with various stakeholders and to date, consultations have been held with national, provincial and local governments and concerns arose around permitting, compensation, jargon used and costs. There is also the challenge in how locals are engaged in South Africa which is quite different from some of the more developed contexts most of the CCS researchers work in.

Discussion

There was some discussion on how realistic it actually is to bring CCS into the public eye in such a poor country and perhaps considered as unrealistic when much of the community itself doesn't even have access to water or electricity. CCS is not a current priority of the government of South Africa, but it is key to raise awareness ahead of the potential pilot project. In this particular case, it is imperative to manage the public's expectations (for example, here it is not likely that the project will create many jobs as the expertise needed is just not in the area). All agreed that more work in developing countries would be extremely useful to the entire Network and beyond.

The idea of engaging the public, in order to understand what they are thinking (and to not push a technology) is an important one, but it can be misconstrued. Whether consciously or not, sometimes a social researcher could come across as if they are lobbying for the technology and it is essential they are clear in their objective for the research, and that the public actually understands how the research works – what are the proposed outputs, outcomes etcetera.

Session 8: Social Science Research Related to Transport / Pipelines

This session explored social science research related to concerns about the surface equipment associated with CCS – namely CO₂ pipelines and injection wells.

'Public perceptions of CO₂ transportation in pipelines', Clair Gough, the Tyndall Centre

The aim of this research was to assess the social impacts arising from, and public perceptions of, CO₂ transport in pipelines. Four different case studies were examined and six key themes were identified as being important:

- History and local context;
- Physical risk;
- The role of scientific argument;
- Trust;
- Contingencies; and
- Procedural/distributive justice.

The COOLTRANS pipeline project has a proposed route corridor in the north of England and the Tyndall Centre used focus groups to assess the social aspects that could potentially affect the project.

Some positive feelings about the concept of CCS came from the focus groups (including benefits in terms of local jobs; acting on the global issue of climate change), along with some negative thoughts, such as that CCS perpetuates the continued use of coal-fired power stations and a lack of confidence in the modelling of the stored CO₂. Some issues that arose specifically on pipelines included potential disruption during construction, safety and trust in the companies involved. These results show that the public do consider the nature and implications of perceived risks, and that there is acceptance of the broader context (i.e. CCS as a mitigation option). An honest and clear approach to communicating motivations is absolutely crucial, trust in the processes (site selection, regulating operations and maintenance) is imperative and it is important to consider how developers and other proponents of the technology are perceived.

'Putting CO₂ well blowouts into perspective: A study of the incidence, impact and perception of loss of well control', Sarah Wade, Wade LLC & Sean Porse, The University of Texas at Austin

One often cited concern with CCS is the fear that injection wells will explode. Arguably this fear has been stoked by media coverage of CO₂ well blowouts that focuses on the sensational headlines and by an actual dearth of concrete data regarding the incidence, magnitude, and impacts of well blowouts. Coverage of a well blowout in 2013 motivated the authors to attempt to develop a response to public concern about well safety. The methodology used in the study included identifying relevant literature resources, gathering data on the incidence/effects of well blowouts and calculating incident rates based on well populations in respective US regions. There is surprisingly little information available about well blowouts. Based in initial review, it seems that that the risk profile for an oil or gas well is likely to evolve over time. At first, there is some risk of encountering unknown problems in the subsurface while drilling the well (e.g., pockets of gas/fluid, changes in rock density). Risks typically drop during routine operations after the well is completed and reduce even more when the well is shut in. Risk can then increase if the well is reworked for a new purpose. In all of these stages, the incidence of well blowouts remained very low. Given this preliminary conclusion, the lack of information is even more surprising. This is a story of an identified risk that is reasonably well mitigated – the frequency and impacts of incidents is low. Yet it the industry seems reluctant to share this information. Further work is being conducted to develop more incident information and to begin to better understand the real and perceived risk communications challenges.

The work on well blowouts has raised several interesting social science questions:

- How much of a concern will arise over CO₂ blowouts? Will it have a material impact on timing, cost, and project deployment?
- Are incident data a compelling counter-argument? (How much risk is acceptable?)
- Do incident data move the dread/familiarity scale?
- What are the appropriate methods for sharing this data?

Pipeline infrastructure, Dr Michal Moore, University of Calgary

The goals for infrastructure are mainly that it is adequate, timely, cost effective, flexible and safe. Issues that could potentially arise with pipelines are related to the approval process, competition with other land uses, issues with proximity and regulations/authority, and the public perception issues related to pipelines including location/visibility, press reports, toxic cargos and security. Michael suggested that from experience, what operators may say is not necessarily what the public will hear, so there needs to be some common lexicon to translate the project without actually degrading the actual utility of the systems we have. Michael suggested that the public should be reminded that we use (and rely upon) toxic commodities all the time and provide them with real examples of this to make it easy for them to understand. In terms of public policy, it is important that all stakeholders are involved with the location proposals and hearing process – all will have an opinion but it's about knowing WHO to get involved and WHERE. Emerging issues with public policy in pipelines include metallurgy, inspection and data, the pipeline lifespan, capacity and commodities. How to communicate with the public, and the science of good policy, is dynamic and ever-evolving. It is important to respond and adapt as this evolution happens.

Discussion

This session was good for making all attendees think about a piece of the CCS value chain that can often be overlooked; a value chain of pipelines is a conduit by which we move things, which is optimised when it is full (e.g. for CCS it works best when you take full advantage of it) – pipelines are only making money when transporting a commodity and operating at optimum capacity. Trying to get the approval process for pipelines unified ahead of time is important, in terms of cost and public engagement.

In the UK, pipelines for CCS will affect a large number of people, and many different communities. As the pipeline proceeds, controversy can carry on with it, and in the UK there are current considerations to bury future pipelines to minimise such controversy. However, this should not be generalised to all regions – in less densely populated regions (such as North America), some pipeline projects have still had much controversy (i.e. the Keystone 2 pipeline). Perhaps in the UK, the public are most used to living near natural gas pipelines (which is arguably more hazardous than CO₂), so are therefore

more accepting to the prospect of CO₂ pipelines. It was observed that in the US, there was a lot of strategic opposition to aspects of the value chain and it is a way of bottlenecking the project. With infrastructure such as CO₂ pipelines, the likelihood is that they will have a high profile and perhaps controversy during construction, which will then fade as time progresses.

In the incidence of CO₂ well blowouts in particular, it is crucial to not confuse the public – which can be done by giving them the correct, important information (such as clarification as to what the impact may be, the procedures followed when such an incident occurs etc.).

Session 9: Outcomes & Recommendations

This final session provided a recap on all of the presentations and what it might mean for future ongoing social science research. To summarise:

- Session 1 examined setting the scene for social science research in CCS. It was suggested by Myles Allen that having climate policies that can cope with uncertainty are developed. As well it is clear that risk adaptation will play a major role in the future of CCS projects. The idea of a cumulative emission budget is positive for CCS (industry will have to pay for it over time) and shows that CCS has a goal. EOR is one method of facilitating and perhaps encouraging the implementation of CCS, but researchers are still missing good visual tools to communicate each component. For NGO's it was discussed that there is a potential role for CCS with old assets, when the hidden value of current assets are factored in, but the EOR 'jury' is still out given the total project lifecycle.
- Session 2 presentations, on the policy and practice in Canada, showed that structural arrangements, considerable preparation and a bit of scepticism (!) matters. The policy environment is a driver and provides an important context for the entry of new technology into the public arena. Legal, regulatory and financial decisions can help to frame the significance of an issue. For practicing communicators who want to build a stronger base for practice it is imperative to prepare – to start where the public is, to explore their perceptions, to understand their concerns and use these to inform communication approaches. It is equally as important to understand the framers' interests and strategies for amplifying or attenuating risk.
- When looking at social science trends and the international atmosphere – session 3, a survey (about CCS risk/returns) of Chinese bankers showed that there is an improved understanding of CCS over the last 7 years, but there are still concerns regarding cost and energy penalties. The prioritisation of risks has been acknowledged as a key aspect but there is no policy in place for large CCS projects. A catastrophic event such as the Fukushima nuclear incident (2011) can cast a negative light over other, similar technologies. It is important to understand the limitations of risk assessments and the different views of experts – science and policy need to be 'bridged' to enable decision-making. It is interesting (but not unexpected) to see that after such an event, the public will often change its opinion – in Japan, the public became more energy-aware, had some appetite for increased costs for cleaner (and safer) energy and preferred more renewable energy sources (e.g. solar) over coal and nuclear.
- Session 4 looked into the methodologies used in social science research and CCS. The Q methodology illustrates how people value subjective topics and the individual versus group ranking showed the impact of a deliberative process. It was demonstrated that the active use of social media can create an enhanced learning environment and interest in action, without increasing (or decreasing) the content learned. The attitudes of those within the environment suggested the value of community formation and deliberation was high. An online interactive tool has been utilised successfully to gain views on energy sources and costs; a tool which requires the users to consider trade-offs and that could be considered as an analogue for deliberative process. The value of creating a group process for social research and public engagement activities in CCS is important and should be considered.

- Session 5, looking at communicating CCS and science, is obviously a hugely important aspect to consider. It is important to know what elements of a risk message regarding CCS are viewed by people as persuasive, but it is much easier to persuade someone with negative arguments than with positive ones. Understanding how people perceive the sources of scientific information – some groups may not be as credible and trustworthy as we think or hope – can also be a critical component of project communication. There are potential pitfalls associated with three of the common risk communication strategies for CCS – scattering, emphasis framing and greening. We saw that the public seem to trust impartiality rather than persuasive agendas.
- The perception of risk (Session 6) is a key topic in communications and is extremely important with CCS. A protocol for response to claims of the leakage of CO₂ has been developed by researchers as a potential way to avoid many communication problems. It was felt this will be beneficial in avoiding long running allegations, and avoid unqualified sources reaching incorrect conclusions. At the same time, preventing (or minimise the amount of) inaccurate information influencing the public. It is well known that public acceptance impacts implementation success and that the emotional reaction to complex technologies is important, as it affects people's ability to make a decision. If there are more perceived risks, it is likely that the public will find it more difficult to form an opinion, which is important to the formation of closed attitudes. Stakeholder engagement and decision support was looked at in Session 6, which considered risk communication as a boundary process (so merging content and intent). CCS is being considered by the public, but their concerns are centred around costs, greenhouse gas emissions and air quality.
- Much research has been done on the responses to CCS, visited in Session 7, including work on social site characterisation which noted the similarities (i.e. understanding that CCS is part of climate policy) and differences (risk perception or economic benefit being of most importance) in the local public's opinions on two potential CCS sites in different countries. It was recognised that an open dialogue is key. In developing countries such as South Africa, the development of basic infrastructure is still an issue. The language problem for communication needs to be addressed for different cultures and stakeholder engagement is especially important; the government and head of the local community concerned should be involved from the very beginning.
- It was recognised that the perceptions of pipelines (Session 8) was similar to CCS in general and seemed to centre around specific themes including trust, safety, visibility and local impact. The risk profiles for a project evolve with the stages of operation and it is crucial that the safety record of a project is explicit. It was observed that the terminology used in communications can present challenges with many different projects – something which can perhaps be further looked into. Issues recognised at pipelines were similar to those seen in CCS projects – approval, land use, proximity to other activities and regulations.

Suggestions for Moving Forward

Recommendations

The following recommendations were made at the end of the 4th IEAGHG Social Research Network Meeting:

- Combine conclusions & results together from different levels of research to allow connections to be seen, for example qualitative and quantitative research, different theoretical frameworks, hands-on focus groups etc. Physically drawing these connections together in real time as they occur, and then perhaps mapping the connections together in a virtual space where all can contribute ideas would be beneficial,
- Develop a database for research instruments and papers relevant to social science and CCS was recommended – a repository of instruments, measures and researchers carried out by those in the network would be useful on many levels
- PhD students bring a lot of new research to these Network meetings so it is important to include the next generation in the future meetings and research opportunities,
- This network brings together lots of disciplinary perspectives to examine CCS (which is very valuable), but it may be useful to expand the network to other disciplines that are perhaps not present,

- The topic of CCS could be reframed by placing it into a larger context that may make it easier for the public to understand, which may also help to expand the network however this would need to be done in consultation with IEAGHG and other SRN members to determine what might be appropriate,
- Further research could be undertaken in less developed countries, particularly in relation to understanding the cultural context in which projects will have to operate,
- There is also only a small component of work examining the ethics of CCS (particularly in less developed countries) which is an opportunity and something of importance that should become a priority,
- There may be an opportunity to build on current methodologies and tools which could actually come about by expansion of the network to other disciplines and somewhat beyond just a focus on CCS,
- There is an opportunity to focus more on how to communicate about CCS as the related sciences, in particular to understand when personal opinions become group opinions,
- Transport and pipelines is also an important component of CCS research and needs to be considered going forward.

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