



# annualreview 2012





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Images of Bryggen, Norway, and Temple Roof Detail in Kyoto are courtesy of Toby Aiken Photography.

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Sally Benson received 2012 Greenman Award / Sunset over Santa Fe, 2<sup>nd</sup> Joint Network Meeting

# Chairman's Message

**Whilst in previous years there has been much focus on negative issues with regard to CCS, I believe by the end of the year we at last saw more positive news, with CCS being included in the CDM and the beginnings of discussions on a successor to Kyoto.**

We all knew at the time that this would be a slow process so I was never certain why we expected so much from COP18 in Doha. But Doha did move us forward, by the end of the meeting it was agreed that there would be a second commitment period for the Kyoto Protocol, from 2013 to 2020. Regretfully many parties like the USA, Japan and Australia will not participate but developing countries will without legally binding reduction commitments. Many of course argue that the emission cuts proposed are too low but it could have been worse if not agreement at all had been reached.

2012 also saw the launch of a new global initiative the Climate and Clean Air Coalition (CCAC) the focus of the CCAC is to reduce short-lived climate pollutants such as: black carbon, methane and hydrofluorocarbons (HFC's). This is a voluntary initiative with 50 countries participating, and held its first ministerial meeting at COP18. Such an initiative is of course welcomed and reflects the growing recognition of the impact of these short term climate pollutants on global warming. I am also pleased to see that the CCAC itself recognises that such action should not distract from CO<sub>2</sub> emission reduction but complements it.

2012 has also seen a number of significant developments on the CCS front which include amongst many:

- The opening of the world's first CO<sub>2</sub> Capture test centre at Mongstad, in Norway
- The large demonstration-scale injection of CO<sub>2</sub> from a biofuel production facility, the Decatur project, Illinois had injected nearly 300,000 tonnes of CO<sub>2</sub> by the end of 2012. This is the world's first demonstration scale project on bioCCS.

- Shell announced in September 2012 that a final investment decision had been made on its Quest Project in Alberta Canada. This will be the first commercial-scale CCS project to tackle emissions from oil sands extraction. It will capture and store up to 1.2 million tonnes of CO<sub>2</sub> per year from the Athabasca Oil Sands extraction project.
- Despite considerable project costs increases, Chevron announced that the largest off shore injection project, Gorgon in Western Australia, would go ahead.

As well as the new developments, projects like Sleipner and Snohvit (Norway), Weyburn and the Regional carbon sequestration phase 3 projects that are on-going add to growing data set of knowledge on storage as do the many capture pilot facilities around the world. Many of these projects reported their latest results at the GHGT-11 conference in Kyoto, Japan that demonstrated both the extent of the on-going R&D worldwide on CCS but also how much we are continuing to learn from R,D&D which will stand CCS in good stead as the technology moves forward to broader implementation.

For 2013 there is much to look forward to on the CCS front, the completion of construction of the SaskPower Boundary Dam CCS demonstration project amongst others. We also need to watch developments in Asia, with China, Korea and Japan all developing CCS demonstration projects with operation planned in 2014/2015.

*K. V. Thambimuthu*

*'there is much to look forward to on the CCS front, with the completion of the construction of SaskPower Boundary Dam project... and we also need to watch developments in Asia, with China, Korea and Japan all developing demonstration projects.'*



Kelly Thambimuthu,  
Chairman of the IEAGHG Executive Committee

# General Manager's Summary



John Gale  
General Manager, IEAGHG

*'GHGT-11 in Kyoto was a tremendous success, thanks in a large part to the hosts and co-organisers, RITE of Japan.'*

Clearly for IEAGHG the big event of the year was GHGT-11 in Kyoto which I am pleased to say was a tremendous success, thanks in a large part to the hosts and co-organisers, RITE of Japan.

Some 690 papers were presented in either oral or poster sessions during the 4 day conference. The conference itself attracted some 1290 delegates from 35 countries, which was a great turn out considering the economic down turn in many parts of the worlds and the perceived slow-down in CCS demonstration project deployments in parts of the world. Two of my main takeaways from the conference was the growing interest and activity by R&D groups in South East Asia in CCS and for the first time the involvement of a major manufacturing industry, telling us of all the work that was on going globally on CCS application in the steel industry which was a revelation to many attendees whose focus to date had been on the power sector. I often hear that industry needs to ramp up its activity on CCS, but in my mind parts of industry have led the commercial deployment of CCS to date and there are more industrial projects out there to date than power sector ones so who are the slouches on CCS development.

Another success in the year was the International Journal of Greenhouse Gas Control of which I am proud to be Editor in Chief of, has once again grown in stature the 2012 Impact Factor rose to 5.11 keeping the journal firmly in the top 5 of published energy/environmental journals. We also saw a staggering 46% increase in submissions to the journal this year, that to a journal that was already heavily subscribed with papers which has caused a few issues. In the coming year we will move to 8 editions a year to help improve our publication times.

We have built an active co-operation arrangement with the IEA CCS unit in Paris and have continued to work on technical issues with GCCSI through a funding arrangement with them. We have also actively participated in; the CSLF technical Group (chairing the Academic Task Force) the EU ZEP, the London Convention transboundary issues and the UNFCCC / SBSTA discussions on CCS.

With regard to our own work we published 10 technical studies in the year all based on original research work. The split in research was nominally 50% capture, 25% storage and 25% non-technical issues. On capture we looked at the costs of gas fired power plants with CCS (a focus in the main text), the issue of flexibility of CCS plants in electricity systems (an area of increasing interest in systems with high penetration of variable renewable power), how the inclusion of CCS in power plants effects the emissions of other substances (which I can say results in positive benefits in overall emissions reduction) with CCS and finally emissions of amine based chemicals which I am pleased to say even if they are produced our study shows that can be engineered out. On the storage side we have looked at what monitoring systems can be used to quantify leakages if they occur will be an important issue in trading regimes, we looked at pressure relief as an option for injection into saline aquifers by water abstraction which looks a very promising option and of course will be tested for real at Gorgon.

On the non-technical side we examined if there were capacity constraint issues for future large scale CCS development and not surprisingly staff availability came to the fore amongst others a reason why we embarked on the International CCS summer School programme a few years ago. We also reviewed the financial issues around long term liability which is discussed in this review and did an early piece of work on the development of an ethical matrix for CCS.

Our international research networks continue to attract interest from around the globe, and consistent with previous practise we have brought our 4 storage networks together this year in a joint meeting to look at review their aims and on objectives and how they best function going forward. We utilised the skills at this meeting to draft a rebuttal to the now infamous Zobac paper, which did the rounds this year. Another example of how we can draw extra benefit from the international collaborative activities.

In the coming year, gas fired CCS studies will probably gain more emphasis than in previous years, and we plan to look at what we can contribute not just on CO<sub>2</sub> mitigation but also on Non-CO<sub>2</sub> gases, soot and SO<sub>2</sub> from a climate perspective. We also plan more work on flexibility issues such as system design and energy storage. So with PCC2 and OCC3 we have another challenging year ahead.



John Gale  
General Manager, IEAGHG

# IEAGHG: Programme Overview

**As many of you will know, 2011 was the 20<sup>th</sup> Anniversary of IEAGHG. So what did 2012 bring to follow up on this event and move the organisation forward?**

The 2012 Executive Committee meetings were held in Bergen, Norway marking the opening of Test Centre Mongstad, and Kyoto, Japan, just before the GHGT-11 conference. Both ExCo's were well attended, and as always encouraged healthy debate over the proposed work programme.

The membership fees are determined either by national emissions (in the case of contracting parties) or are a set level (sponsors). These fees cover the management and administration of the programme, and the technical research programme which is managed by the programme team. The work programme is reviewed by the ExCo every 6 months or so at the biannual ExCo meetings. These meetings see the work of the previous 6 months presented, reviewed and accepted, and the proposed work for the following 6 months outlined and improved upon in line with comments received.



**Aerial View of the TCM facility; IEAGHG's Spring ExCo was timed to coincide with the official opening and ExCo members enjoyed a tour of the site**

**Granvia Hotel, Kyoto, Venue of 42<sup>nd</sup> ExCo, held in November before GHGT-11**



At the close of 2012, there were 45 members of IEAGHG, split between 21 Contracting Parties and 24 sponsor organisations. A number of the contacting parties operate as consortium agreements, with numerous national supporters contributing to the country subscription. Members such as this include Australia, Canada and New Zealand.

## Operating Agent

Under the terms of the Implementing Agreement, IEAGHG is required to be managed by an operating agent, and for IEAGHG, the role of operating agent is covered by IEA Environmental Projects Ltd (IEA EPL). IEA EPL is also the operating agent for the IEA Clean Coal Centre, another IEA Implementing Agreement. IEA EPL is responsible for employing IEAGHG staff, the financial management of the programme, and also governance of the programmes activities. The hierarchy of responsibility flows upwards from IEAGHG staff, through the General Manager, to the Operating Agent, and then to the Executive Committee.

| Countries           |                          | Sponsors         |                      |
|---------------------|--------------------------|------------------|----------------------|
| Australia *         | The Netherlands          | Alstom           | Exxon Mobil          |
| Austria             | New Zealand *            | Babcock & Wilcox | Global CCS Institute |
| Canada *            | Norway                   | BG Group         | IIE                  |
| Denmark             | OPEC                     | BP               | JGC                  |
| European Commission | South Africa             | CEZ Group        | Petrobras            |
| Finland             | Spain                    | Chevron          | Repsol               |
| France              | Sweden                   | CIAB             | RWE                  |
| Germany             | Switzerland              | Doosan Babcock   | Schlumberger         |
| India               | United Kingdom           | ENBW             | Shell                |
| Japan               | United States of America | Enel             | Statoil              |
| Korea               |                          | E.ON             | Total                |
|                     |                          | EPRI             | Vattenfall           |

Table 1: Participants in the IEA Greenhouse Gas R&D Programme in 2012

Country members marked with an asterisk act as consortium agreements.

IEAGHG also have cooperative agreements in place with several other groups, namely JCOAL, PTRC, CO<sub>2</sub>GeoNet and the CSLF.



Figure 1: Participants in the IEA Greenhouse Gas R&D Programme, and Partner Organisations in 2012.

# GHGT-11; Kyoto, Japan

The Greenhouse Gas Control Technologies (GHGT) conference series has for many years been firmly established as the foremost scientific conference at which to present the latest research on technological aspects of CCS. As the custodians of the series, IEAGHG always dedicate a great deal of time and effort to the build up to the conference, to ensure it is as successful as it can be.

GHGT-11 in Kyoto was no exception, and the conference organisers continued with the aims of providing an international forum in which to discuss the most recent advances, and most pressing issues in the field of greenhouse gas control technologies. The overarching aim behind the conference series is to strive to promote collaboration on international research, to provide a strong direction and support to research and development, and to encourage and facilitate the exchange of ideas and results to further the science.

GHGT-11 was held from the 18<sup>th</sup> to the 22<sup>nd</sup> of November, 2012 in Kyoto Japan, and the theme for the event was: 'CCS: Ready to Move Forward' following on from the theme of GHGT-10, (From Research to Reality) demonstrating progress in the intervening years.

In keeping with the history of continual growth, this event attracted over 1200 abstract submissions, making the role of the expert review panel of the utmost importance. This level of submission means that the papers selected for oral or poster presentation are guaranteed to be of the best possible standard, thus ensuring the technical quality of the conference.

Eleven technical sessions, each with seven parallel streams maximised the number of oral presentations and these sessions; and these sessions covered all aspects of the CCS chain, from capture, through transport and storage, to public perception, demonstrations and policy and legal issues amongst others.

## Evolution of Focus

The keynote talks at GHGT-11 came from a wider range of speakers than at previous conferences, with representation from manufacturing and steel industries, as well as talks on the potential of unconventional gas.

This change in tone is a positive step and an important development; previous conferences have been typically under-represented from other industries, and CCS in the steel and manufacturing industries are likely to be important sectors in the battle

against climate change, and it was particularly interesting to hear from Henk Reimink from the World Steel Association talking about efforts with the steel manufacturing industry to improve and develop the steel used in car bodies with the aim of making the material stronger so that the quantity of steel can be reduced, resulting in lighter weight vehicles, which will in turn use less fuel and so generate less emissions. This type of wider scale thinking is of great value, and demonstrates the impact that manufacturers can have on the end products of their materials.



GHGT-11 is officially opened with the ceremonial breaking of the seal on a traditional Sake barrel



### Closing Comments

The final closing session summed up the thoughts and feelings from the 4 days of technical presentations and keynote talks. Juho Lipponen (IEA) looked at the current situation for CCS globally, summarising that;

- We have technology and knowledge, but are lacking strong enough climate policy.
- We have demonstration projects, we don't have political attention and recognition.
- We have pilot projects, we don't have enough national visions and strategies.
- We have funding available for first demonstration projects, we don't have incentives.
- We have a small number of governments active in CCS, we don't have widespread acceptance.
- We have research and development, we have a lack of messages on benefits and synergies.
- We have a growing body of laws and regulation.

### Delegates were treated to a display of traditional dancing by Maiko, trainee Geisha, at the Conference Dinner

Jae Edmonds described the aims we need to target as developing lower costs and deeper emissions mitigation. Research has shown that costs of CO<sub>2</sub> mitigation are cut in half when CCS is available as an option. Delaying action increases costs greatly, and in such a world, the difference CCS makes to long term costs is greatly increased.

Prof. Kikkawa then looked at how humans can overcome climate change. There will have to be a trade off between affluence and global salvation, and energy conservation must be the trade off.

Mr Tachibana addressed the delegates, looking at the prospects for CCS over the next five years. CCS needs a large scale industry similar to the oil and gas industry; if we are serious about deployment we need to be ready in all elements... Are we there yet?

### Conclusions

We should learn from the nuclear industry, and the enthusiasm shown within our area is encouraging, but we must manage risk so that no single issue can destroy the entire industry. Delegates were also encouraged not to believe in silver bullets, they generally don't live up to their promise, and we need to learn to rely on a range of options. This conference has seen a lot of different options presented, and this is evidence of the potential we have at our fingertips to ensure that this range of options is ready as and when the economy and policy facilitates deployment; we must be ready!

In final closing, John Gale commented on the motto for the conference, CCS: Ready to move forward, and commented that in fact, the overarching message appears to be that CCS is moving forward, perhaps not as swiftly as we would like, but progress is being maintained.

# 2012 in Pictures



1

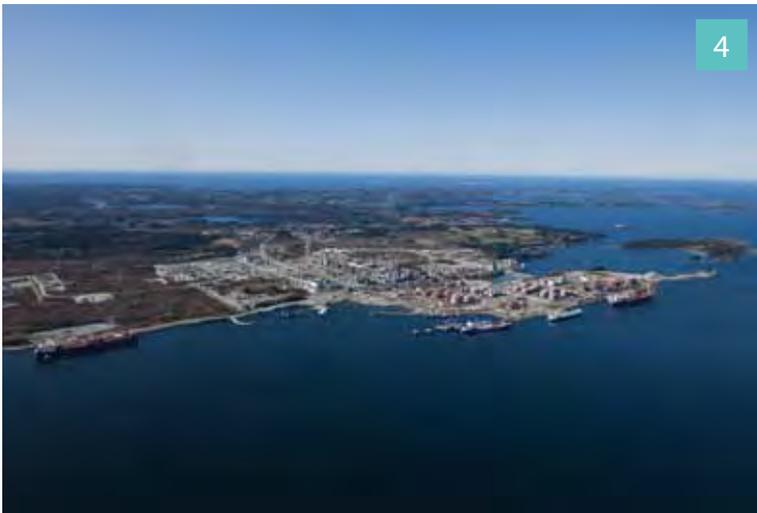


2



3

In these pages, we show snapshots of the events and milestones of 2012, from ExCo meetings, to the conferences and networks and the International CCS Summer School, plus some other significant milestones in the wider CCS community.



4



5

- 1 ICC Kyoto, venue for the GHGT-11 Conference, held in Japan in November, attracting almost 1300 delegates from 48 countries.
- 2 Sunset, Santa Fe, New Mexico, USA, the 2<sup>nd</sup> Joint Network Meeting was held here, bringing together all the IEAGHG storage networks.
- 3 IEAGHG Summer School visits the Forbidden City in Beijing during the 6<sup>th</sup> International CCS Summer School.
- 4 TCM from the air, in May the IEAGHG ExCo was held in Bergen, Norway, and members were invited to the official opening of TCM.
- 5 GHGT-12 Announced; The University of Texas at Austin will host GHGT-12 in 2014, announced at the closing session of GHGT-11.



6 Work underway at Boundary Dam in Canada, to be the worlds first large scale demonstration project to capture and store CO<sub>2</sub>.

7 Bryggen, UNESCO world heritage site in Bergen, Norway; the 41<sup>st</sup> IEAGHG ExCo was held in Bergen in May 2012.

8 Sally Benson receives the 2012 Greenman Award, Sally was presented with the award at theGHGT-11 Conference Dinner in Kyoto.

# IEAGHG International CCS Summer School:

An Interview with Samantha Neades, Project Officer and Summer School Alumni



*'I'd advise those who want to apply to spend time on their application – this is crucial as the decision will be made on these application forms alone, and there is a lot of fierce competition for the limited spaces.'*

Samantha Neades  
Project Officer, IEAGHG

## 2012 saw the 6<sup>th</sup> event in the annual IEAGHG CCS Summer School, held in Beijing, PR China.

Although the summer school is usually held within IEAGHG member countries, the offer to host the event at Tsinghua University and to work towards capacity building in a developing country was an opportunity the IEAGHG Executive Committee agreed could not be passed up.

The week-long programme included talks from academic and industry experts on the full CCS chain, from capture to storage and also looked into economics, regulations and health and safety. The group work was the highlight of the week, where groups of students worked on various topics – from applying CCS to various-sized sources and sinks, to an investigation into CCS in the developing world – throughout their stay.

At this school, IEAGHG sent 2 staff members as students to improve their knowledge on the CCS chain, and the following interview with Samantha Neades gives an insight into what it is like being a student at the event.

### You were a student at the 2012 Summer School in Beijing, what were your expectations before you attended?

As a student representative of IEAGHG, I probably didn't have the same expectations as other students may have had of the School. I was very familiar with the IEAGHG Summer School Series and the curriculum before I attended, having been involved with much of the build-up work before the School itself.

In general terms, I hoped to obtain a more broad education in aspects of CCS that I don't deal with in my everyday working life and more of a thorough understanding of those areas I was already familiar with. I was aware there would be a group work task throughout the week and I was intrigued as to which topic I would be assigned and how I (and my group!) would respond to such an activity.

### How did the experience differ from these preconceptions?

I think the main difference between what I expected and what I experienced was that the actual event was much more focussed on the group work task and social interaction with others, rather than academic lectures delivered in a less interactive nature. I knew it was a big task but didn't anticipate just how big! The group work task in particular encourages students to work in a different subject area than usual, with new people and really challenges everybody involved to get a high-quality end result.

### What do you feel you most gained from the Summer School?

I learned a lot throughout the week at this School in China. The lectures were really useful and full of relevant information – I enjoyed learning about things not necessarily in my usual field of expertise. It was good to be given more information on areas that I do work in also. The group work itself was a huge challenge – many very late nights (well, very early mornings) were seen in trying to produce a good presentation – but an extremely valuable part of the School and I think all of us really benefitted from being involved with such a task.

### How have you put these learnings into practice in your work?

I think that although I don't specifically utilise the key learning points from the Summer School in my day-to-day working life, the knowledge and experience I gained has helped me to understand much more fully the work of others in my organisation, and the work that is underway around the world. It also helped to inform me about those subject areas I don't usually come across in my role – such as capture – and give a little information on the basics of such topics.

### What was your overall impression as a student, and what would you say to any potential student thinking of applying for next year's school?

I think the course is perfectly suited to a post graduate in terms of the pitch of the curriculum to the stage within their education, or for an individual in the early stages of their career in CCS. I'd encourage these young people to apply as soon as possible! I'd advise those who want to apply to spend time on their application – this is crucial as the decision will be made on these application forms alone, and there is a lot of fierce competition for the limited spaces. Those fortunate enough to be selected will reap the short and long term benefits of this valuable, interesting and extremely informative School.

## Key Studies in 2012

### CO<sub>2</sub> Capture at Gas Fired Power Plants, IEAGHG 2012-08

study managed by John Davison

Gas-fired power generation currently accounts for around 20% of global electricity production capacity and in the past twenty years it has been a popular choice for new power generation capacity, particularly in many developed countries, due to its high efficiency, low installed costs and good reliability and flexibility.

The 2008 IEA BLUE map scenario shows Gas with CCS as a relatively small contribution to the overall suite of mitigation options that will be needed to combat climate change, but since the BLUE map was formulated, gas reserves estimates have been subjected to significant increased revisions, coupled with increased concerns over nuclear power following the Fukushima incident suggest that CCS with gas would be a larger component of the eventual energy mix.

A switch from coal to gas can help to reduce emissions from power generation substantially but it is not a CO<sub>2</sub>-free generation option. In the longer term it is likely that new gas fired power plants will be required to be built and operated with CO<sub>2</sub> capture and storage (CCS) technology to achieve deep reductions in emissions. Most of the work on CCS has so far concentrated on coal and relatively little information on the performance and costs of gas fired power plants with CCS has been published. IEAGHG therefore commissioned Parsons Brinckerhoff to undertake this techno-economic study on CO<sub>2</sub> capture at natural gas fired power plants.

The conclusions of the study were as follows:

- Adding post combustion capture reduces the thermal efficiency of a natural gas combined cycle plant by about 7-8 percentage points, increases the capital cost per kW

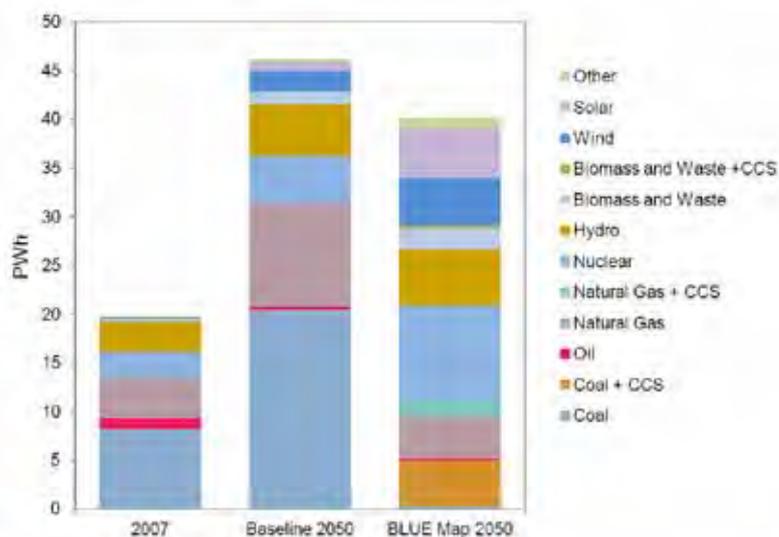


Figure 2: IEA BLUE map emissions reduction plan, from IEA (2010), Energy Technology Perspectives 2010: Scenarios & Strategies to 2050, OECD/IEA, Paris

by about 80-120% and increases the cost of base load electricity generation by about 30-40%.

- The cost of CO<sub>2</sub> emission avoidance (i.e. the carbon emission cost required to give the same electricity cost from base load NGCC plants with and without CCS) is about €65/tonne in the lowest cost case evaluated in this study (post combustion capture with a proprietary solvent). The abatement cost compared to an alternative base line such as a coal fired plant may be lower.
- Recycling part of the cooled flue gas to the gas turbine compressor inlet would increase the CO<sub>2</sub> concentration in the feed to the CO<sub>2</sub> capture unit, which could

increase the thermal efficiency by up to 0.3 percentage points and reduce the cost of electricity by up to 8 percent.

- Natural gas combined cycle plants with CCS may operate at annual capacity factors lower than base load, particularly in electricity systems that include large amounts of other low-CO<sub>2</sub> generation. In the lowest cost case, reducing the annual capacity factor to 50% would increase the cost of CO<sub>2</sub> avoidance to €87/tonne.

The study indicates that, based on current technology, pre-combustion capture in natural gas fired combined cycle power plants is not economically competitive with post combustion capture.

## Financial Mechanisms for Long-Term CO<sub>2</sub> Storage Liabilities, IEAGHG 2012-11

study managed by Samantha Neades

In November 2012, IEAGHG published a new study, 'Financial Mechanisms for Long-Term CO<sub>2</sub> Storage Liabilities'. Contracted out to ICF International, this study looks at current laws and emerging regulations on long-term aspects of liability and assesses the various potential financial mechanisms for supporting CO<sub>2</sub> liability.

The study aimed to review current CCS-specific and non-CCS regulations worldwide, with a focus on financial mechanisms for long-term liability and to investigate potential financial mechanisms for long-term CCS liability. The contractors also aimed to provide recommendations on such mechanisms and assess liability transfer issues that may arise.

The report identified the types of liabilities that financial requirements typically apply to in relation to CCS. Within the EC, such liabilities could include monitoring, corrective measures and certain site operations. The US EPA advise that the CCS liabilities that are covered by financial instruments must include (and cover): corrective action for plugging abandoned wells/mines; injection well plugging; post-injection site care/closure and emergency and remedial response.

The report identifies, describes and assesses eighteen types of financial mechanisms, including third party, first party and government mechanisms. It also goes some way in analysing key generic aspects of frameworks for the

transfer of long-term CCS liability to the government – aspects including threshold technical requirements, technical requirements, post-transfer cost recovery provisions and the specification of which and whose liabilities should be transferred.

Although the study does not recommend any one liability transfer framework option, it is concluded by providing two examples of frameworks which show different balances between the evaluation criteria used. In this conclusion and for these example cases, they focus on balancing the assignment of costs between government and industry, incentives to industry and providing environmental protection.

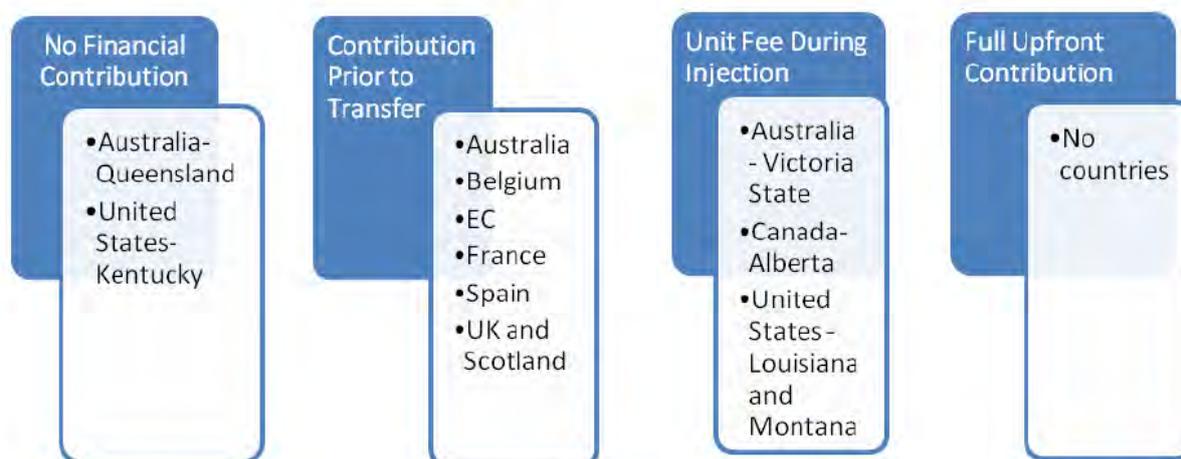


Figure 3: Current CCS frameworks cover a range of scenarios:

- no required financial contribution,
- requiring a financial contribution immediately prior to transfer,
- requiring a per-unit fee,
- contribution secured early in the life of the facility.

Options b-d are intended to cover all post-transfer site care, which may include an amount for possible remediation requirements.

## IEAGHG Storage Network Activities, 2012

In 2012, IEAGHG again brought together its' storage based research networks in the second IEAGHG Joint Network Meeting. The aim was to ensure the Networks are working in the most efficient way (without duplication or gaps), to identify cross-cutting issues, and their consequences, and to set the framework for the future direction of the Networks.

The common needs recognised throughout the workshop included:

- systematic iterative links between risk assessment (including monitoring and WBI), monitoring, verification and best practices,
- dealing with uncertainty,
- consequences and mitigation plans, and
- defining criteria, thresholds and acceptable deviations from trends.

Many suggestions were made during the plenary session, including the strong potential of holding smaller, more focussed, topic-based meetings in the future. The monitoring network proposed organising special sessions in other international conferences (e.g. Pittsburgh, Trondheim, GHGT), although these meetings are extremely busy as it is and perhaps do not have the time or space for such a session. The steering committees intend to look into this possibility further in the future.

The usefulness of combined meetings was discussed and highly praised, with CO2CRC having agreed to host the monitoring and environmental impacts networks in 2013 as a combined meeting – and subsequently Statoil have confirmed they will host the modelling and risk assessment networks, also as a combined meeting.

The main conclusions and recommendations from the meeting were:

- to have more network to network collaborations,
- hold virtual meetings on hot topics,
- to hold topic based workshops such as performance assessment and remediation, and
- to refresh the steering committees on a more frequent basis.

Overall, IEAGHG is happy to report that the networks are operating effectively. Also it was noted that within the maturing regulatory environment that we find ourselves, the technical knowledge and methodologies now exist in the area of CO<sub>2</sub> storage, to the extent that there are no significant technical barriers to project implementation, and that it is possible for projects to meet the stringent regulations in place in many regions of the world.

The IEAGHG research networks have contributed to this move from research to application, and this accomplishment should not be overlooked. It is something for all network members to be proud of, and is quite an achievement for IEAGHG to have managed such an accomplishment.



Delegates of the 2<sup>nd</sup> Joint Network Meeting during summary presentations

## Facilitating Implementation and International Cooperation: Highlights

### COP-18

Last year, the Annual Review included an interview with IEAGHG's Tim Dixon on the inclusion of CCS in the CDM. This year, Tim once again attended the COP meetings as part of the UK delegation, and was able to convey messages and conclusions from the IEAGHG Research Networks into negotiations, negotiations that resulted in a second commitment period for the Kyoto Protocol.

This second commitment period will run from 2013 until 2020 and entails new and legally binding emission commitments for the developed countries that remain in the Kyoto Protocol. The downside of this second commitment period is that the emissions targets have been criticised for not being stringent enough, and the list of countries included is not expansive enough to significantly reduce

global emissions, but it has to be recognised that this commitment is better than none.

### Sleipner Benchmark Model

Statoil, in conjunction with Permedia Research, have prepared a Sleipner based benchmark model using layer 9 with a focus on modelling enhanced gravity segregation. The aim of the benchmark model is to reduce reservoir uncertainties and to help standardise the problem and study simulation sensitivity in detail.

IEAGHG have assisted Statoil in making this dataset available to the modelling community by hosting it on the modelling pages of the IEAGHG website. The dataset consists of the grid coordinates, the injection rates for Layer 9, permeability in the X and Y directions and the injection point.

There are several existing benchmark models, but these may be hypothetical in nature and unconstrained by monitoring data, omitting detailed geological and reservoir engineering aspects. For a benchmark, the monitoring data should be of sufficient detail and duration to calibrate key uncertainties; the Sleipner benchmark model aims to do this by defining a well-constrained real case.

This type of activity may well prove very valuable in developing modelling simulations and calibration of monitoring tools in the future, and IEAGHG are well placed to facilitate such sharing. It is hoped that in the future we will be in a position to facilitate similar sharing scenarios with other projects.

## Information Dissemination & Social Media Development

The year of 2012 saw IEAGHG continue to make improvements to their communications activities.

IEAGHG are now more active than ever before in social media and communications through these routes. Our presence on FaceBook has grown considerable, with 273 followers on the FaceBook page, and we have also established an information providing 'community-page' on CCS.

Our Twitter followers have continued to grow throughout 2012 as well, and we now have 220 followers, and we published around 300 Tweets in 2012.

Using these new forms of mass communication is key in terms of providing information to interested parties who may not otherwise have known of IEAGHG, and this is something we intend to continue to develop throughout 2013.

IEAGHG have also continued to blog throughout 2012, and in particular, we launched and managed a GHGT-11 blog, with several hundred blog views per day throughout the conference. This proved very popular, and was highly regarded amongst delegates, allowing them to hear about sessions and messages that they may have missed. With 7 parallel streams, the blog allowed delegates to gain a wider picture of GHGT-11 than they may otherwise have managed.

## Presentations made in 2011

| Date | Location   | Presentation Title   | Speaker  |
|------|--|--|----------|
| Jan  | Workshop on Practical Use and Commercialisation of CCS, Tokyo, Japan | Challenges for practical use and commercialisation of CCS  | JG       |
| Jan  | TREC STEP, India   | CCS and the UNFCCC   | TD       |
| Feb  | Carbon Management Technology Conference, Orlando, USA                | Potential Impacts of CO <sub>2</sub> Storage on Groundwater Resources  | TD & LBR |
| Feb  | CERT Seminar, Sydney Australia                                       | Technology Update: Where Do We Stand with CCS Technologies?  | KT       |
| Feb  | EPRI Generation Sector Programme Advisory Meeting, Arizona, USA      | IEAGHG Programme Updates and status of CCS   | JG       |
| Mar  | 12 <sup>th</sup> Annual APGTF Workshop, London UK                    | A summary of CCS Developments Worldwide  | JG       |
| Mar  | MSc. CCS Course, University of Edinburgh                             | Solvent Development for CO <sub>2</sub> Absorption Process   | PS       |
| Mar  | Instituti de Inginieria UNAM   | Consideration in the Engineering and Design of Post-Combustion Capture Technology for Power Plant Application  | PS & SS  |
| Mar  | " "  | Developments in Oxyfuel Combustion Technologies for Coal Fired Power Plants with CCS (Pt 1: Boiler and Burner Development)                           | SS       |
| Mar  | " "  | Developments in Oxyfuel Combustion Technologies for Coal Fired Power Plants with CCS (Pt 2: Air Separation Unit for Oxyfuel Combustion)              | SS       |
| Mar  | " "  | Developments in Oxyfuel Combustion Technologies for Coal Fired Power Plants with CCS (Pt 3: Flue Gas Processing and CO <sub>2</sub> Processing Unit) | SS       |
| Mar  | " "  | Oxygen Production for IGCC   | SS       |
| Mar  | " "  | The Challenges to the Deployment of CCS in the Energy Intensive Industries (Pt 1: General Overview)  | SS       |
| Mar  | " "  | CO <sub>2</sub> Transport via Pipeline and Ship  | SS       |
| Mar  | Future Combined Cycle Plant, Berlin                                  | Reduction of Emissions from Combined Cycle Plants by CO <sub>2</sub> Capture and Storage   | JD       |
| Apr  | Big Sky RCSP Annual Meeting, Great Falls                             | Global Status of CCS   | NW       |

Table 2: List of 2012 Presentations

| Date | Location  | Presentation Title   | Speaker     |
|------|---|--|-------------|
| Apr  | EGU Meeting, Vienna, Austria  | The Status, Potential and Research Progress of CO <sub>2</sub> Storage Worldwide   | LBR         |
| Apr  | CAGS Symposium, Beijing, China  | Current Research in CCS  | LBR         |
| May  | EGRD Seminar, Copenhagen, Denmark   | Forming Tomorrow's Leading Experts on CCS  | JG & TD     |
| May  | 11 <sup>th</sup> Annual Conference on CCUS, Pittsburgh  | CCS in the CDM   | TD et al    |
| May  | " "   | Getting Science into International Climate Policy Making: A Success Story! CCS in the Clean Development Mechanism  | TD et al    |
| May  | " "   | What Have We Learnt from Operational CCS Demonstrations. Phase1b   | SN, TD & AC |
| Jun  | JCOAL CCT Seminar   | A Summary of CCT/CCS Developments Worldwide  | JG          |
| Jun  | CCS Regional Awareness Workshop, Ankara, Turkey   | CO <sub>2</sub> Capture Technologies for Industry - Iron & Steel, Oil Refinery and Cement  | PS          |
| Jun  | " "   | CO <sub>2</sub> Capture Technologies for Power Generation. The Challenges Ahead  | PS          |
| Jun  | 3 <sup>rd</sup> International Forum on the Transportation of CO <sub>2</sub> by Pipeline, Newcastle, UK | Understanding Different CO <sub>2</sub> Compression and Drying Processes from Various CO <sub>2</sub> Capture Technologies for Design of CO <sub>2</sub> Transportation Pipeline to Storage Site | PS, MH & SS |
| Jun  | EU-GCC Clean Energy Network, Brussels   | Opportunities for EU-GCC Cooperation on Clean Energy Projects  | JG          |
| Jul  | Meeting with EC   | Direct Reduced Iron (DRI) and CO <sub>2</sub> Capture  | SS          |
| Jul  | " "   | Challenges to the Deployment of CCS in the Energy Intensive Industries   | SS          |
| Aug  | US RCSP Meeting, Pittsburgh   | IEAGHG Activities in CO <sub>2</sub> Geological Storage  | JG          |
| Aug  | CCS Seminar, ONS 2012, Stavanger, Norway  | Thoughts on the Issues Facing CCS Globally   | JG          |
| Sept | Meeting with Tupras, Turkey   | IEAGHG Overview  | PS          |

### Speaker Abbreviations:

AC: Aameena Camps

LBR: Ludmilla Basava-Reddi

SN: Samantha Neades

JD: John Davison

MH: Mike Haines

SS: Stanley Santos

JG: John Gale

NW: Neil Wildgust

TD: Tim Dixon

KT: Kelly Thambimuthu

PS: Prachi Singh

## Reports, Technical Reviews and Information Papers, 2012

| Report No. | Report Title  | Issue Date     |
|------------|---|----------------|
| 2012/01    | Wellbore Integrity Network Summary Report   | January 2012   |
| 2012/02    | Quantification Techniques for CO <sub>2</sub> Leakage   | January 2012   |
| 2012/03    | Emissions of Substances Other than CO <sub>2</sub> from Power Plants with CCS                               | March 2012     |
| 2012/05    | Summary Report of the 6 <sup>th</sup> Rish Assessment Network Workshop                                      | March 2012     |
| 2012/06    | Operating Flexibility of Power Plants with CCS  | July 2012      |
| 2012/07    | Gaseous Emissions from Amine Based Post-Combustion CO <sub>2</sub> Capture Processes and their Deep Removal | May 2012       |
| 2012/08    | CO <sub>2</sub> Captured at Gas Fired Power Plants  | June 2012      |
| 2012/09    | Barriers to Implementation of CCS: Capacity Constraints   | July 2012      |
| 2012/11    | Financial Mechanisms for Long Term CO <sub>2</sub> Storage Liabilities                                      | November 2012  |
| 2012/12    | Extraction of Formation Water from CO <sub>2</sub> Storage  | November 2012  |
| 2012/TR1   | Integration of Solar Technologies with CCS  | March 2012     |
| 2012/TR3   | Microbial Effects on CO <sub>2</sub> Storage  | October 2012   |
| 2012-IP1   | Rebuttal to Zoback Paper  | June 2012      |
| 2012-IP2   | Air Conditioning & Climate Change   | June 2012      |
| 2012-IP3   | UK CCS Roadmap  | June 2012      |
| 2012-IP4   | Direct Air Capture Update   | June 2012      |
| 2012-IP6   | Rio +20   | July 2012      |
| 2012-IP9   | Renewable Energy Issues   | July 2012      |
| 2012-IP10  | Public Acceptance of Wind Energy  | July 2012      |
| 2012-IP11  | Second Joint Network Meeting  | July 2012      |
| 2012-IP12  | Ocean Fertilisation   | July 2012      |
| 2012-IP13  | Power Generation from Saline Water  | September 2012 |
| 2012-IP14  | ONS Stavanger 2012  | September 2012 |
| 2012-IP15  | CO <sub>2</sub> Injection into Methane Hydrates   | September 2012 |
| 2012-IP16  | Environmental Assessment of CO <sub>2</sub> Storage   | September 2012 |
| 2012-IP17  | Metal Organic Frameworks  | September 2012 |
| 2012-IP18  | COP-18 Outcomes   | December 2012  |
| 2012-IP19  | Update on Ocean Fertilisation   | December 2012  |
| 2012-IP20  | Climate & Clean Air Coalition   | December 2012  |

Table 3: List of 2012 Reports, Studies and Information Papers

# Financial Summary

The IEAGHG is a not-for-profit organisation. The expenditure for the Programme is therefore managed to match the income received in each calendar year. The principle income comes from member's annual subscriptions.

In addition, income is generated from sponsorship of individual network meetings and the summer school activities and also from monies held in deposit in the Programme accounts. The total income in 2012 was £2,253,659.

The breakdown of expenditure in 2012 is summarised in Figure 4. The IEAGHG provides its members annually with an audited set of accounts. The audited accounts are approved by the IEA EPL Board of Directors.

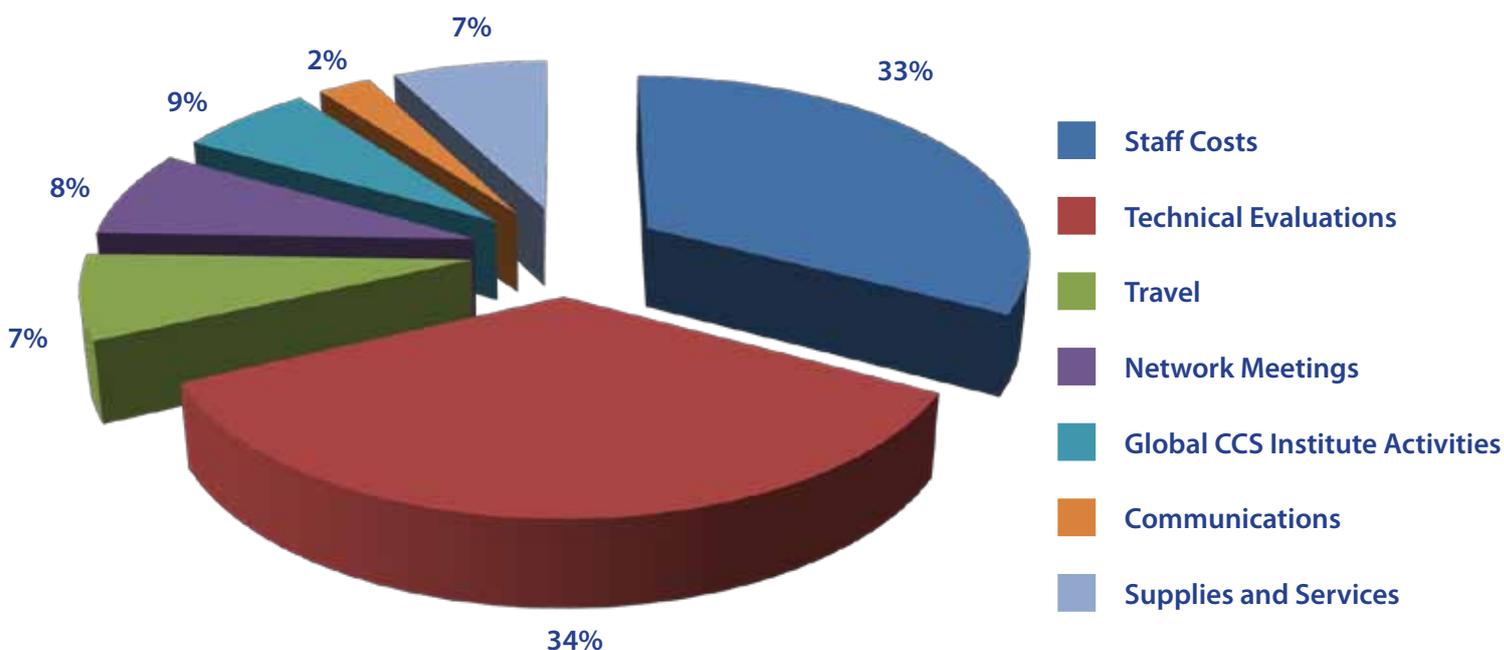


Figure 4 - Breakdown of Expenditure 2012

# Programme Team



**John Gale,**  
General Manager

The IEAGHG Programme Team remained unchanged during 2012, however changes in early 2013 will lead to changes being made, but at present this is not confirmed.

John Gale is the General Manager of the programme, and he is responsible for operating the programme, and managing the research programme fund to meet members needs and requirements. The programme team is organised into 5 teams as described below.

Some team members can cover more than 1 discipline, which allows us to remain dynamic and provides flexibility to respond to changes in demands on resources at any given time.

## Capture & Integrated Systems Team

This team consists of 4 members of staff, with experience in areas such as Oxyfuel Combustion, Post Combustion, and Integrated Systems amongst others.

The capture & integrated systems team undertake technical activities related to the capture of CO<sub>2</sub> and technical evaluations and manage the capture networks and mini-conferences.

Staff members are: Stanley Santos, John Davison, Jasmin Kemper and Prachi Singh.

## Regulatory Support Team

The regulatory support team manage part of the technical studies programme and some of the geological storage networks, but also co-ordinate the programmes activities relating to technical implementation.

Staff members are: Tim Dixon, Ameena Camps and Samantha Neades.

### Capture & Integrated Systems Team



**Stanley Santos,**  
Project Manager



**John Davison,**  
CO<sub>2</sub> Capture & Integrated Systems Analysis



**Jasmin Kemper,**  
Project Officer



**Prachi Singh,**  
Project Officer

### Regulatory Support Team



**Tim Dixon,** Manager  
CCS & Regulatory Affairs



**Ameena Camps,**  
Senior Project Officer



**Samantha Neades,**  
Project Officer

### Geological Storage Team

The geological storage team undertake activities relating to the geological storage of CO<sub>2</sub>, perform technical evaluations, and manage some of the geological storage networks.

Staff members are: Ludmilla Basava-Reddi, and Samantha Neades.

### Communications & Dissemination Team

The communications & dissemination team provide support to the programme in producing literature for research networks and meetings, managing the technical content of the company website, and production of all technical reports and publications. The team also manage the dissemination of technical and summary information to the rest of the team, the programme members and a wider public audience.

Staff members are: Toby Aiken and Becky Kemp.

### Programme Support Team

The programme support team provides administrative and non-technical support to the General Manager, and oversees the day-to-day running of the company and related administration.

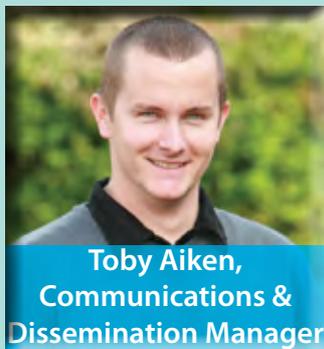
The team are also responsible for managing the administrative and logistical issues of running research networks, conferences, workshops and meetings.

Staff members are: Tricia Watkins, Sian Twinning and Laura Davis.

#### Geological Storage Team



#### Communications & Dissemination Team



#### Programme Support Team



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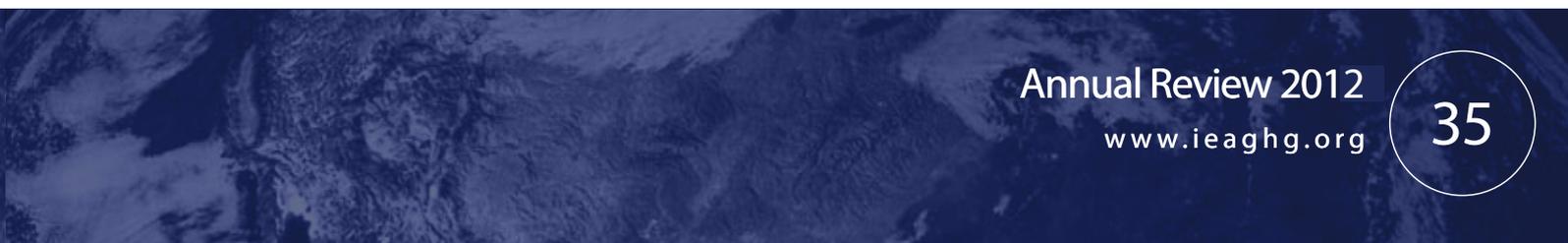
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