

**APGTF with the Coal Research Forum, the UK CCS Research Centre
and the Energy Generation & Supply KTN**

**13th Annual APGTF Workshop:
'Carbon Capture & Storage –
a Showcase of UK Research and Development'**

**'1VS' (1 Victoria Street) Conference Centre, Westminster, London
Wednesday 20th & Thursday 21st February 2013**

REPORT ON PANEL SESSIONS

Tony Oliver, APGTF

INTRODUCTION

2012 has seen a number of key initiatives and activities move forward in the research and development of CCS in the UK: the Department of Energy & Climate Change (DECC) has run a competitive call for R&D under its Innovation Programme and launched its CCS Roadmap; the Research Councils' Energy Programme (RCEP) and DECC have funded the establishment of the UK CCS Research Centre and this Centre has run its first call for research projects; a new group of R&D projects and feasibility studies have commenced with Technology Strategy Board (TSB) funding; and a number of key RD&D activities initiated by the Energy Technologies Institute (ETI) have reached key stages. These activities have done much to answer the question we asked at our last workshop – “*can the UK maintain its lead in CCS?*”.

This workshop provided a chance to ‘showcase’ what the UK has been doing on CCS and celebrate the progress we have made over the last year.

Day 1: Researching ‘Future Generation’ CCS and Associated Technologies

While global progress on moving ‘current generation’ CCS technologies through to large-scale, integrated demonstrations prior to commercialisation may have been disappointing, considerable activity has been happening on more basic research and facilities associated with ‘future generation’ CCS and associated technologies: The UK stands out as a success story in this regard, with a number of high-profile initiatives being supported by RCUK, TSB, ETI and DECC. Day 1 started with the official launch of two of these key initiatives funded by the RCEP, followed by a ‘showcasing’ of as broad a cross-section of the research activity as possible. Towards the end of the day, some important initiatives that under-pin the applied R&D activities (the subject of Day 2) were introduced, including some of the R&D facilities that the UK has available.

DAY 2: Developing ‘Next Generation’ CCS Technology

The UK’s strong and globally-respected CCS and associated technologies research acts as a firm foundation for more applied research and development (R&D) aimed at providing components for ‘next generation’ CCS systems. The progress of technologies through ‘readiness levels’ (ie from basic ideas to commercially available systems) is by no means a linear process, with a continuing need for research to increase our levels of knowledge in advancing technological progress.

Day 2 considered much of the applied R&D projects underway in the UK that will take us from current- through next- to future-generations of technology. We also heard from a number of large pilot-scale projects and larger-scale R&D/studies (whole-chain, clusters/hubs, storage). While these do not reduce the critical need for large-scale, integrated demonstration projects, they do address key issues associated with deployment and maintain the momentum of R&D and demonstration. Most of the projects that we heard from are funded by the TSB, ETI and DECC, with key representatives of these organisations helping to chair the day.

This 2-day workshop consisted of invited presentations (see programme at the end of the document), which can be found on the APGTF website (www.apgtf-uk.com). Each day, these were followed by panel sessions in which panel members and all delegates were invited to express their views on the themes of the day. The output from the workshop will be fed into the Government and other national and international funding agencies to help ensure success with CCS for the UK.

This document is a report of the panel sessions and the accompanying discussion sessions.

ATTENDANCE FIGURES

195 delegates attended one or both days of the workshop (158 on Day 1 and 150 on Day 2), comprising representatives of industry, commerce, academia, Government, funding agencies plus other stakeholders and interested persons.

DAY 1 PANEL SESSION

The panel was chaired by Philip Sharman, Chair of the APGTF and the panel members were:

Tony Espie	BP Alternative Energy
Mike Farley	Mike Farley Consulting
Stuart Hazeldine	University of Edinburgh
Rachel Thomson	Flex-e Plant Consortium
Jacqui Williams	EPSRC

The broad objectives of the panel session were to consider:

- What else could we, or should we, be researching?

with the focus on the Day 1 panel being on fundamental research.

The Chair started the session by posing the following question to the panel and then the delegates were invited to provide answers or comments as appropriate.

What has excited you today and what are your concerns?

A variety of answers and comments were put forward from the panel and from the floor; the main points are listed below.

Excited by:

- The breadth of activity is a very significant asset in capability
- Much of the science is impressive
- The work on biological enzymes and on chemical looping
- The breadth of work being undertaken
- The quality of the people involved and the focus on bringing in and developing new people

Worried by:

- How will all this activity make a difference, will it lead to practical results?
- There was a lack of commercial context in the presentations. The challenge is to identify areas of potential commercial benefit
- There needs to be more engagement and networking with a linking up or collaboration in relevant activities
- The Treasury's push on unabated gas
- The apparent focus of BIS on nuclear and renewables only
- Still no £1bn full scale demonstration project(s)
- Will there be jobs created?

The Chair then asked if we had the priorities correct with one proposal being: Policy - highest; Storage - high; Transport - medium; Capture - lowest priority.

A variety of answers and comments were put forward and the main points are listed below.

- The main issue with storage is uncertainty, it is not so much a risk or danger
- There is a lack of activity on learning from one storage trial to support the next one
- We must ensure that there is feedback from the £1bn projects to drive supporting R&D
- Academia need more support from industry when working up proposals
- Policy/socio/economics are key but there was a lack of presentations on this
- Policy/socio/economics are covered by ESRC and the belief is that Energy is not a high priority for them

The discussion was then opened up to cover any relevant topic and the additional points that were made are listed below

- Companies will not get into CCS unless policy and financing are right
- If there are only 1-2 projects that go ahead under the £1bn demonstration, then there is a risk that the others currently in the competition will pull out of CCS in the UK
- The potential leading from the £1bn demonstrations is very exciting and it should promote innovation and future growth
- It is becoming more and more important to get the balance right between industry pull and academic push, particularly once the demonstration(s) start
- For industry, identifying commercial potential is key
- Academia is good at techno/economics but industry do not believe this. Industry and academia need to work closer together on this
- Cost/tonne of carbon abated should be a key driver

DAY 2 PANEL SESSION

The panel was again chaired by Philip Sharman, Chair of the APGTF and the panel members were:

Jeremy Carey	SSE
Andrew Green	ETI
Bryony Livesey	Costain
John Oakey	Cranfield University
Judith Shapiro	CCSA

The broad objectives of the panel session were to consider:

- What else could we, or should we, be researching?

with the focus on the Day 2 panel being on applied R&D.

The Chair started the session by posing the same question to the panel as for Day 1 and then the delegates were invited to provide answers or comments as appropriate.

What has excited you today and what are your concerns?

A variety of answers and comments were put forward from the panel and from the floor; the main points are listed below.

- There is an impressive bunch of projects from the £20m Innovation call
- There is a good balance between "blue sky" and industry needs
- Some concerns that there is no work covering commercial risks
- Work on future solvents is important
- Monitoring CO₂ in storage and quantifying amounts, is critical

The chairman then asked if we had the balance right between coal and gas. A variety of answers and comments were put forward and the main points are listed below.

- The balance for R&D is about right
- We can't be certain of the future. There is likely to be a mix of fuels, so we should not put 'all our eggs in one basket'
- Current outlook suggests not much new coal in the UK, although this may change if nuclear does not happen or is delayed a long time. Bulk of new fossil generation for foreseeable future likely to be gas
- Impact of shale gas in reducing demand for coal (particularly in US) may make coal more attractive
- It would be beneficial to try and maintain flexibility between fuels in the technologies being developed

The next question to be asked was whether we had the right balance in R&D between power generation and industry. Comments were:

- There is a need to think more on industrial applications for CCS; in many cases it is easier
- Industry may not want CCS and often it has the option of moving abroad, which power generation does not have
- A future possibility is for trading CO₂ emissions between power and industry if one is cheaper to reduce than the other
- Power has options (fossil/renewables/nuclear), industry has not.

The next question concerned the international agenda and the chairman asked if we are doing enough to get UK technologies onto the world stage. The following comments were made:

- We are probably not doing enough although industry knows where the markets are
- We need technologies for the global market - UK burns less than 1% of world traded coal but coal burn is increasing in China etc
- There is a need for more global collaborations or we risk being left behind
- There is a risk that UK plc will just buy the technologies it needs from overseas
- Academic teaching and R&D must keep a global perspective

The discussion was then opened up to cover any relevant topic and the additional points that were made are listed below

- If the global target of 2degC remains, this could result in an oversupply of fossil fuels that could drive prices down
- Important issue is proposed difference in Cfd's for nuclear and fossil with nuclear's being more beneficial. Why should they be different?
- e need to keep promoting the flexible capability of fossil fuels when debating Cfd's
- There are some disadvantages for Cfd's for CCS
- If we do not do the £1bn demonstration(s), then the UK will risk losing credibility

CHAIR'S CLOSING REMARKS

The APGTF Chair thanked the speakers, panellists and delegates for making it a successful workshop and he thanked the main sponsors and co-organisers for supporting the event. The output from the workshop will be fed into the Government and other national and international funding agencies to help ensure success with CCS for the UK. Finally, the Chairman said that he hoped there would be significant progress on the main issues raised for CCS to report at next year's workshop.

13th Annual APGTF Workshop: 'Carbon Capture & Storage – a Showcase of UK Research and Development' PROGRAMME

Day 1

09:30 – 10:00	Registration and refreshments	
10:00	Welcome and introduction	<i>Philip Sharman, APGTF Chair</i>
10:10	Overview of the UK's CCS R&D Programme	<i>Matthew Billson, DECC</i>
10:25	Keynote talk 1: CCS in the UK – Direction of Travel	<i>Chris Pook, BIS</i>
Part 1	'Future Generation' CCS and Related Technology Research [Chair: Philip Sharman, APGTF]	
10:45	Research Councils' Energy Programme initiatives	<i>David Delpy, EPSRC</i>
11:00	The UK CCS Research Centre	<i>Jon Gibbins, UKCCSRC</i>
11:15	'Flex-e Plant' – the Future Conventional Power Consortium	<i>Rachel Thomson, Flex-e Plant Consortium</i>
11:30	Research Councils' Energy Programme – Activity Summary	<i>Jacqui Williams, EPSRC</i>
11:45	The CO ₂ Chem Network	<i>Nora De Neeuw, CO₂Chem</i>
12:00	The Biomass and Fossil Fuel Research Alliance	<i>Greg Kelsall, BF2RA</i>
12:10	Q&A and discussion	
12:30 – 13:30	Lunch and poster display	
Part 1 (cont.)	'Future Generation' CCS and Related Technology Research [Chair: Jacqui Williams, EPSRC]	
13:30	Gas-brine-rock interactions during an EOR injection phase	<i>Mike Bickle, University of Cambridge</i>
13:40	New solvents: new solutions	<i>Paul Fennell, Imperial College London</i>
13:50	Solid looping cycles for energy applications	<i>John Oakey, Cranfield University</i>
14:00	Developing solid sorbents for CCS	<i>Trevor Drage, University of Nottingham</i>
14:10	Evaluating North Sea storage capacity: managed water production & EOR vs. storage	<i>Stuart Haszeldine, University of Edinburgh</i>
14:20	Impacts and monitoring of CO ₂ flow in marine systems: The 'QICS' release project	<i>Jerry Blackford, Plymouth Marine Laboratory</i>
14:30	CO ₂ pipeline transportation: technical and safety challenges	<i>Haroun Mahgerefteh, University College London</i>
14:40	Integration of CCS with gas turbines	<i>Richard Marsh, University of Cardiff</i>
14:50	Gas – Future advanced capture technology options	<i>Mohamed Pourkashanian, University of Leeds</i>

15:00 – 15:20	Refreshment break	
Part 1 (cont.)	'Future Generation' CCS and Related Technology Research [Chair: Greg Kelsall, Alstom]	
15:20	CCS Systems Modelling Toolkit project (ETI)	<i>Mark Matzopoulos/Adekola Lawal, Process Systems Enterprise</i>
15:30	UK Storage Appraisal Project and future developments (ETI/The Crown Estate/BGS)	<i>Sam Holloway, BGS and Tom Mallows, TCE</i>
15:40	Pilot-scale Advanced Capture Technologies (PACT) Facilities (DECC)	<i>Mohamed Pourkashanian, University of Leeds</i>
15:50	Industry perspectives: Feedback on the importance and direction of CCS research	<i>Mike Farley, Mike Farley Consulting</i>
16:10	Panel discussion with speakers from the day – what else could/should we be researching?	<i>Chaired by Philip Sharman, APGTF</i>
17:00 – 18:00	Reception (hosted by the Energy Generation & Supply Knowledge Transfer Network)	

Day 2

08:30 – 09:00	Registration and Coffee	
09:00	Vice-Chair's introduction	<i>Jeremy Carey, APGTF Vice-Chair (acting)</i>
09:10	Keynote talk 2: De-risking CCS – Now or Never?	<i>David Clarke, ETI</i>
Part 2	Next Generation CCS Technology Applied R&D	
09:30	The Investors	<i>Matthew Billson, DECC; Derek Allen, TSB; Andrew Green, ETI</i>
Part 2(a)	CO₂ Capture Projects [Chair: Derek Allen, TSB]	
09:50	Next Generation Capture Technology for Coal (ETI)	<i>Bryony Livesey, Costain</i>
10:00	E-WAGs – CO ₂ Capture using Water Gas Shift (TSB)	<i>Jim Abbot, Johnson Matthey</i>
10:10	The NetPower System Project (DECC)	<i>Robb Kirchner, NetPower</i>
10:20	Next Generation Capture Technology for Gas (ETI)	<i>Jim Cooper/Richard Smith, Howden</i>
10:30 – 10:50	Refreshment break	
10:50	C-Capture: Step change solvent technology for CCS	<i>Richard Dennis, C-Capture</i>
11:00	Carbon Clean Solutions – new solvent for post-combustion capture (DECC)	<i>Aniruddha Sharma, Carbon Clean Solutions Limited</i>
11:10	Ferrybridge CC100+ Pilot Project (TSB/DECC)	<i>Jeremy Carey, SSE</i>
11:20	Millennium Generation (TSB/DECC)	<i>Brian Sweeney, Calix</i>
11:30	Carbon-Water Exchange Capture Technology (DECC)	<i>Sharif Hendawi, Future Environmental Technologies (FET) Group</i>
11:40	OxyCoal™ burner technology development (DECC)	<i>David Sturgeon, Doosan Power Systems</i>

11:50	Aberthaw Pilot Capture Plant	<i>David Carlton, RWE</i>
12:00	Keynote talk 3: Cost reduction potential in CCS systems	<i>Jeff Chapman, CCSA</i>
12:20 – 13:20	Lunch and poster display	
Part 2(b)	CO₂ Transport, Metering and Clusters [Chair: Matthew Billson, DECC]	
13:20	COOLTRANS – Introduction and overview	<i>Julian Barnett, National Grid</i>
13:30	Clusters	<i>James Watt, AMEC</i>
13:40	Understanding Metering (DECC)	<i>Robert Sale, Interconnector Ltd</i>
Part 2 (c)	CO₂ Storage, Monitoring and Verification [Session Chair: Andrew Green, ETI]	
13:50	Understanding Risks (DECC)	<i>Claus Otto, Shell</i>
14:00	The SeaSequestor Project (TSB)	<i>David Bone, Ocean Resource Ltd</i>
14:10	Innovative Monitoring (DECC)	<i>Paul Williams, Premier Oil</i>
14:20	C-SAVE (TSB)	<i>Allan Peart, Signal Group</i>
14:30	CO ₂ Monitoring – NASCOM (TSB)	<i>Tony Espie, BP</i>
14:40 – 15:00	Refreshment break	
Part 2 (d)	CO₂ Utilisation [Chair: Judith Shapiro, CCSA]	
15:00	CO ₂ use in plastic materials (DECC)	<i>Michael Kember, Econic</i>
15:10	Carbonation technology for building materials	<i>Colin Hills, Carbon8 Systems Ltd</i>
15:20	Creating high-value chemicals from CO ₂ using novel algae and bioreactor technology (DECC)	<i>David Hogg, CO₂ Sequestration Ltd</i>
15:30	CO ₂ to synthetic methane for natural gas substitution and gas grid injection (DECC)	<i>John Newton, ITM Power Ltd</i>
Part 3	Next steps? [Chair: Philip Sharman, APGTF Chair]	
15:40	Keynote talk 4: Enabling the roll-out of CCS through the Electricity Market Reform	<i>Ashley Ibbett, Office of CCS, DECC</i>
16:00	Panel discussion with speakers from the day	<i>Chaired by Philip Sharman, APGTF</i>
16:50	Round-up and close of workshop (17:00)	