IEAGHG Information Paper: 2016-IP27; IChemE Report the Future of CCS.

The UK's Institute of Chemical Engineering's (IChemE) Energy Centre this week hosted the launch of a report entitled: The Future of CCS. The report was written by the CCS Forum, a group of experts from academia, industry, and government (supported by the UK Foreign and Commonwealth Office, Royal Society of Chemistry, Imperial College London and the IChemE Energy Centre) and examined the future of CCS. In particular, it aimed to identify challenges that need to be met.

Jasmin Kemper from IEAGHG was one of the report's authors. John Gale was one of the reports peer reviewers and was invited to the launch of the report in London to be on an expert panel along with representatives from Shell, the UK CCSA, and the Global Institute.

For reference:

A press release on the report can be found at:

http://www.icheme.org/media_centre/news/2016/new-report-calls-for-increased-funding-into-ccs-deployment.aspx#.V5tSBX6rReU

A report summary can be found at:

http://www.icheme.org/~/media/Documents/icheme/Media%20centre/ccs-forum-report-summary-report-july%202016.pdf

Whilst the full report can be found at:

http://www.icheme.org/~/media/Documents/icheme/Media%20centre/ccs-forum-report-full-report-july-2016.pdf

If anyone is interested in hearing the webinar of the report summary this can be found at: https://www.youtube.com/watch?v=wGKU0vz039o

Note whilst the report was delivered in the UK, the webinar was accessed by IChemE members in an impressive number of countries including: Australia, Canada, Brazil, Trinidad and Tobago, US, Sri Lanka, Malaysia, Italy, Nigeria, Colombia, Mauritius, South Africa, France, New Zealand, Hong Kong, India, UAE, Egypt and the Netherlands

Context:

The report comes after significant cuts to CCS were made by the UK government at the end of last year, including scrapping a ring-fenced budget of £1 billion for the CCS Commercialisation Programme.

The report follows the Paris Agreement, in which the world agreed to limit global warming to 2^0C, which many now consider makes CCS more important to meet such a goal in the long term.

The report comes just after a new Government has been installed in the UK; The Department of Energy and Climate Change merged with the Department of Business and industry Strategy to form a new Department of Business, Energy and Industrial Strategy. The report therefore arrives at a time during which the new Department is reviewing its future strategy within the area of low carbon technology development and deployment and the needs for industry

Not surprisingly one of the key messages from the report is a call on policy-makers to concentrate on long-term goals, and not let climate targets be missed by focusing on short-term wins.

The key messages from the report were:

1. Creation of a computational framework to understand the dynamic interplay between scientific and technological advancements, their impacts on the power markets, and the broader socio-economic consequences of deploying CCS.

2. Development of a methodology to rapidly screen new solvents and sorbents for CO2capture based on molecular level information, and provide process level cost and performance information.

3. Appropriate benchmarks must be identified and universally adopted for the successful development of new processes for CCS. We recommend the use of the Cansolv technology as the new standard against which progress with sorbent development should be compared.

4. CO_2 storage infrastructure must be de-risked around the world via exploration and characterisation of suitable geological structures. This is more urgent than the development of new capture technologies.

5. CO_2 utilisation via Enhanced Oil Recovery (EOR) is mature, and has the potential to provide a near-term, market-driven pull for the deployment of CO_2 transport infrastructure. However, EOR is not a panacea and can lead to the net emission of CO_2.

6. The environmental impact of products derived from CO_2 will be very small compared to the amount of CO_2 that is needed to be stored as part of climate change mitigation. However, using CO_2 can reduce the environmental footprint of existing chemical processes.

7. The impact of CCS must focus on the £/MWh, rather than efficiency improvements at the cost of increased CAPEX. Materials with accelerated rates of heat and mass transfer are essential.

8. The cost of power generation or industrial processes must be decoupled from CO_2 capture and the CO_2 transport infrastructure. Initial project costs are significantly inflated relative to the potential for the subsequent cost reduction once infrastructure costs are shared.

9. The role of electricity markets in the development of CCS technologies needs to be carefully evaluated, with particular attention paid to the way in which CCS power plants will interact with the electricity markets.

10. It is vital that meeting near-term targets does not come at the expense of long-term targets. Meeting the Paris Agreement depends on using bioenergy with CCS (BECCS), this cannot be implemented without a mature and established CCS industry.

Comments on Key messages.

From IEAGHG's perspective we would agree with all the comments made. However, I have commented on a number of these points from an IEAGHG perspective.

With regard to points (1) and (2) there is a desire here to look at a new technology or capture option at a fundamental level and be able to ask the question will my new process or capture option make an impact on the energy market and from first principles is it a viable option. The aim is to look at new innovative options and screen them to see if they have a potential or not. This is an ambitious ask and may or may not be attainable.

With respect to (3) using Cansolv as the main reference case for CO_2 capture benchmarking, IEAGHG recognised that there had been significant progress in reducing the energy efficiency penalty on solvent regeneration and has been using Cansolv as its reference case for capture rather than MEA for

some time. This point recognises the considerable progress that researchers and technology vendors have made in reducing the energy penalty from solvent regeneration over the last 20 years. With the new Cansolv second generation solvent process setting the current "best practise" standard for commercial operation.

On the issue of storage infrastructure (4) IEAGHG would concur that storage exploration, characterisation and de-risking of the storage sites is lagging behind the development of capture technology globally. In some regions like the UK, Australia, Canada and the US, however, this is not the case. The UK has just recently issued a report that has looked in depth at the available storage potential offshore UK selecting the best candidate reservoirs for storage.

On (5), CO2-EOR, the use of non-anthropogenic CO_2 has led to the development of a CO_2 pipeline network in the USA which is now being used and extended to include more captured anthropogenic CO_2. The situation in the USA/Canada is currently unique unfortunately similar market drivers do not occur elsewhere as yet so it unlikely to see this situation repeated elsewhere. This leads on to (8), the UK CCS programme has shown that to establish early mover projects that build larger pipelines that open opportunities, puts the first mover projects at a cost disadvantage. For European CCS projects to take off there is a need to build capacity around industrial hubs and clusters and build a pipeline infrastructure off shore. The business models that could be used for such infrastructure is the subject of a study now underway by IEAGHG. There was some debate about a "national" CO_2 transport and storage company formed to help take this cost burden away from projects.

Regarding (6) Utilisation of CO_2 is a topic in which interest is increasing. Conventional thinking was to use mineral carbonisation as an option but this has proven to not be cost effective. Several million tonnes of CO_2 are used each year in the food processing, brewing and fertiliser industries but there are temporary storage options. In a new study that IEAGHG will start later this year, we propose to look at new potential products that can use CO_2 and store it away from the atmosphere for timescales similar to that of CO_2 storage that could make utilisation a mitigation option.

(7) is extremely relevant if we want to reduce the costs of CCS technology going forward to make it more competitive. It can be argued that there has been a focus on getting the energy efficacy penalty down at all costs. However, adding that extra 0.5% point of efficiency make increase the overall costs disproportionately. The point made is that having made such strides in reducing the energy penalty we may now be better focused on looking at the trade-off between costs and efficacy loss and backing off on efficiency make improve the process cost overall.

There is a recognition that, whilst in the past we have looked at fossil plant as base load, this is no longer the case in many energy markets. The game changer has been the introduction of variable renewable energy (VRE) sources into electricity grids. Fossil plant with CCS will have to be flexible to meet the demands of electricity grids with varying levels of VRE included. In the discussion panel at the end of the event, the issue of comparing technology options by costs, using LCOE, was discredited as a comparator by one panel member. The reasons for this are the same as those noted in an earlier IP on the issue by ourselves. In essence they do not compare like with like. But, more importantly, they do not look at costs from a system level or grid level. It was proposed that there might be options for CCS power plant in a grid that place a higher value on those plants than for base load operation. This aspect was discussed in a presentation at the last IEAGHG Costs network meeting. IEAGHG have a report in preparation that will be presented to members at its autumn ExCo that discusses just this topic of valuing flexibility.

On the final point, BECCS, yes this needs a mature CCS industry but this is only part of the jigsaw that leads to its introduction. Other issues include; the absence of value for negative emission options in

accounting rules, plus of course the whole issue of the sustainability of biomass production for energy use and completion with food use.

Summary

Reports such as the IChemE one can be a useful calibration for IEAGHG, in general terms we are aware of or generally addressing most of the points that this report has raised as requiring attention for CCS, which is useful to know.

John Gale
02/08/16