Carbon dioxide capture - a multi-dimensional problem

Barry Hooper[*1], Luke Murray[1]

[1] The Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC), GPO Box 463, Canberra, ACT, 2601, Australia

Introduction

Carbon capture and storage (CCS) has the potential to mitigate very large amounts greenhouse gas emissions, but it will only be widely implemented if costs are substantially reduced. In particular, carbon dioxide (CO_2) capture constitutes around 80% of the total cost of CCS and cost reductions in this area should be a major research focus.

To make deep cuts in greenhouse gas emissions, CCS must be implemented in many different industrial applications. CO_2 should be captured from power generation and industrial plants utilising black coal, brown coal, natural gas and renewable energy. It is likely to be more cost effective to implement CCS on new-build pre-combustion and post-combustion plants, but retro-fitting existing power stations and developing new asset solutions should also be a priority.

The CO2CRC Capture Program

The CO2CRC Capture Program aims to research, develop and deploy technologies that can achieve significant cuts in capture cost (75-80%) and provide the research and education capability to support industries using these technologies. The Capture Program considers capturing CO_2 from plants with different fuel types and from different combustion applications. It also has recognised that the oil and gas industry routinely captures CO_2 and considers the capture of CO_2 from natural gas sources.

Different separation technologies are more applicable for different applications. Post-combustion capture applications (e.g. exhaust gases at power stations) typically have low concentrations of CO_2, and the gases are at low pressure. On the other hand pre-combustion capture applications typically have much higher concentrations of CO_2 and gases are at a higher pressure. Plant utilising oxfuel technology will have a stream of higher concentration of CO_2 by design.

The Capture Program has established research programs investigating solvents, gas absorption membranes, gas separation membranes adsorption processes and cryogenics involving over 40 researchers and post-doctoral students. It has developed a techno-economic model that can estimate the costs of proposed CCS projects with a high level of certainty. The results from the model have been very valuable in providing technical direction on several proposed CCS projects.

Cost reduction in capture technologies is to be achieved by reviewing a range of capture technologies and applications that might be used by the fossil fuel industry sectors, selecting those technologies most likely to allow significant reductions and developing them. A framework of economic evaluation is used to measure and validate research directions and integrate both with energy production issues and storage infrastructure.

[*] Corresponding Author: bhooper@co2crc.com.au, +61 383446622

Conclusion

Solvent separation systems remain the benchmark against where other capture technologies are assessed. The Capture Program has several research projects in solvents and has already developed IP concerning novel separation materials and processes. Pressure is a key driving force for many capture separation technologies and has a large bearing on costs. Findings from Capture Program research projects indicate that vacuum systems can provide a strong pressure driving force without the same large corresponding increase in capture costs. The range of separation technologies in the research portfolio is allowing the Capture Program to examine individual and hybrid approaches to capture cost reduction.