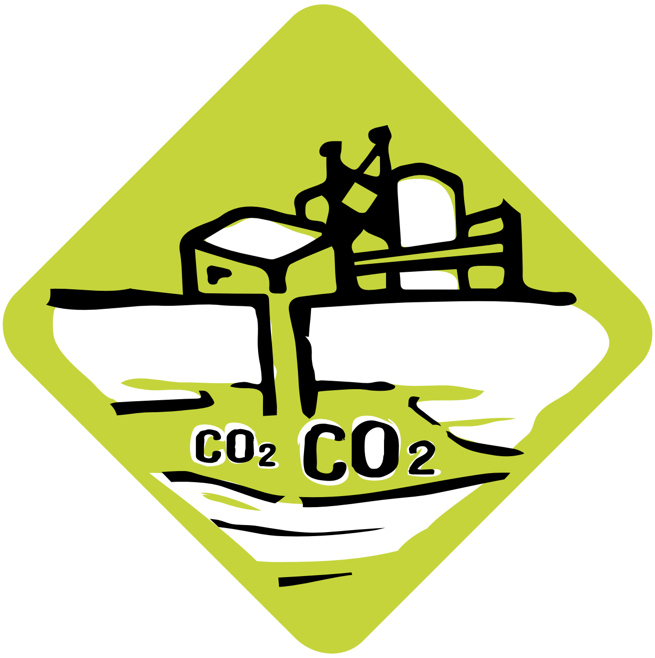

CARBON CAPTURE AND STORAGE

CAPTURING CO_2 WHERE IT IS PRODUCED, TRANSPORTING IT, AND PUMPING IT INTO UNDERGROUND STORAGE SITES TO REDUCE EMISSIONS.

THE TECHNOLOGY HAS SEVERE LIMITATIONS, LIKELY IMPOSSIBLE AT THE SCALE REQUIRED, BUT IS USED AS A SMOKESCREEN FOR THE CONTINUED EXPANSION OF FOSSIL FUEL PRODUCTION.

WHAT IS IT?

Carbon Capture and Storage (CCS) technologies are designed to take carbon dioxide from fossil fuels (either before or after they are burned) and inject it into underground storage sites, usually geological formations. Proponents of the technology (often employees of the fossil fuels industry) say that it can provide significant emissions reductions, and allow us to go on burning coal, oil, natural gas, and even unconventional fossil-fuels such as tar sands, while still reducing emissions sufficiently to stabilise the global climate. In reality it is not a viable way of effectively reducing CO_2 emissions.

There are three main types of CCS technology. The first is post combustion capture, where CO_2 is 'scrubbed' from the exhaust gases after fuel is burned. The second is pre-combustion capture, where the fuel is heated and mixed with oxygen to produce hydrogen (a clean burning fuel) and carbon dioxide, which is then removed. Thirdly, oxy-fuel combustion involves burning the fuels in oxygen rather than air, producing pure CO_2 which can then be removed. Once the CO_2 has been extracted it can be transported to storage sites in pipelines. Underground oil and gas fields (either depleted fields or declining fields as part of enhanced oil/gas recovery – see 'Other Unconventional Fossil Fuels' factsheet) are most likely to be used for storage, but underground saline aquifers (underground layers of rock containing salt water), underground coal seams, basaltic rocks beneath the seafloor, ocean storage and mineral carbonation (where CO_2 is reacted with minerals to form solids) have also been suggested.

Although the various technologies involved in CCS have been tested on a relatively small scale for some time, they have only been put together on an industrial scale in a handful of installations. There are currently no commercial installations and no large-scale installations dealing with emissions from electricity production.

EMISSIONS LIMITATIONS

Even those who have faith in CCS as a viable technology for emissions reductions admit that there are limits to its effectiveness. Removing the CO_2 will always require a certain amount of energy, with further energy expended on transportation to storage sites. It is estimated that the energy cost of CO_2 extraction from a coal power station would represent up to 40% of the energy produced by burning the coal.[1] This extra energy would require more coal to be mined and transported, and the emissions from this mining and transportation could not be captured. In addition, CCS technologies only work on power generated from coal and gas and, in theory, some industrial processes such as cement production. This means that they would not mitigate emissions from the oil-based transport system, for example. In 2010 transport was estimated to make up 22% of global greenhouse gas emissions (16% from road transport and 6% from other sources including aviation and shipping).[2]

Ultimately, even if CCS were rapidly and widely implemented, it would only have potential to reduce global emissions by a limited amount. A very optimistic projection of the development of CCS technology, with 3800 CCS projects in operation by 2050 (at enormous cost), would lead to a total of 34 Gigatonnes of carbon (GtC) stored.[3]

Measuring from the start of the industrial revolution (around 1750), a maximum of 500 GtC can be emitted to the atmosphere while still avoiding most serious impacts and the risk of irreversible and uncontrollable changes to the climate.[4] Between 1750 and now (2014), we have already emitted about 370 GtC, leaving a limit of 130 GtC that could be further added.[5] Considering that there are at least 500 GtC in remaining conventional coal reserves alone, being able to store at best 34 GtC by 2050 using CCS does not change the fact that the vast majority of all fossil fuels must remain in the ground.

So even if all the huge technical problems were overcome and CCS were to be fully employed, we still could not afford to burn even a small fraction of the conventional fossil fuels we have, let alone exploit the huge additional unconventional resources.

Further to this, CO_2 can be (and is) injected into old oil, coal and gas deposits in order to extract more resources (known as Enhanced Oil, Gas or Coal Bed Methane Recovery, EOR, EGR or ECBM). Somewhat ironically, proponents of CCS advocate the technology being used in combination with EOR/EGR to make it financially viable. So a technology that is supposed to be used to reduce emissions, in practice would actually be used to access to even greater amounts of fossil fuels.

STORAGE

All of the proposed storage options have their own problems. Ocean storage is not generally considered to be viable as it would rapidly accelerate ocean acidification. Another possibility, which can be carried out above ground, is 'mineral carbonation'. This involves allowing CO_2 to react with suitable minerals (for example some silicate minerals) to produce a rock product in which the CO_2 is effectively stored. However, mineral carbonation is also not an option due to the vast amounts of suitable minerals that would need to be mined and the enormous quantities of waste material (i.e., the CO_2-rock product) that would be produced.[6]

For CCS to be viable, gasses would have to be reliably stored at sites over very long time-scales, for hundreds or possibly thousands of years. While CO_2 and other gases can naturally remain trapped for extremely long periods in geological formations, storage of man-made CO_2 underground poses various problems.

Every potential site has its own unique geology, which will respond to the injection of high pressure CO_2 in a variety of ways. In some cases injection has resulted in earthquakes and significant changes of ground level, posing serious risk of leakage.[7] [8]

A paper published in the journal the Proceedings of the National Academy of Sciences found that in many areas, carbon sequestration is likely to create pressure build-up large enough to break the reservoirs' seals, releasing the stored CO_2.[9] They also found that there is a high probability that the injection of large volumes of CO_2 will trigger earthquakes, and that even small to moderate sized earthquakes threaten the seal integrity of storage sites. This led the authors to conclude that, "large-scale CCS is a risky, and likely unsuccessful, strategy for significantly reducing greenhouse gas emissions".

There are also concerns that contaminants within the CO_2, and the CO_2 itself, might react with water to create acids which would then damage the structure of the rock and undermine its ability to keep the CO_2 trapped.

It should be noted too that abrupt leakage could pose a significant risk to human health and the local environment. In 1986 a large natural CO_2 leakage rose from Lake Nyos in Cameroon and asphyxiated 1,700 people.

OTHER ISSUES

Scale. The amount of CO_2 that would need to be condensed into liquid and transported to storage sites (which would often be a long way from the source) is enormous, and could require a pipeline network similar in scale to the existing fossil fuel pipeline infrastructure.[10] This would of course be accompanied by the social and environmental impacts that a project of such a size would involve. There are also serious doubts about there being sufficient suitable storage sites around the world to sequester the volume of gas that would be required.[11]

Cost. No one knows exactly how much it would cost to implement a CCS system across the globe, as different parts of the technology are at various stages of development, but the amounts involved would be huge. In particular, the transportation of CO_2 by pipeline would be extremely expensive. In the best case scenario, close to a storage site, CCS is expected to increase the cost of electricity from a new power plant by 21–91%.[12]

Despite their supposed enthusiasm for the technology, there is apparently little desire for the energy industry to take on the cost of developing CCS. Several competitions for CCS demonstration projects with very generous government grants have collapsed as a result of lack of commercial interest. Despite £1 billion being made available, the UK's Longannet CCS demonstration project collapsed in 2011 after the consortium failed to keep estimated costs down. In July 2013 an EU CCS programme, NER300, attracted only one submission.[13]

Liability. A similar dilemma to that of responsibility for the long term storage of nuclear waste exists with CCS. It is far from clear who would be responsible for monitoring and maintaining the sites for hundreds or even thousands of years, or for the cost (economic, social and environmental) of any leakage. Liability issues remain very much unresolved.[14]

Other problems. Other problems include: water usage (carbon capture technologies require large volumes of water), leakage from underground storage reservoirs through old and unrecorded wells, and soil and groundwater pollution from a variety of contaminants as a result of CO_2 leakage.[15]

CONCLUSION

Even if the huge problems with CCS technology are overcome (and this currently looking extremely unlikely), it would not change the fact that we need to move away from all forms of fossil fuel, conventional and unconventional, as soon as possible. In the most optimistic (and highly implausible) scenario, CCS could be used to reduce a small proportion of emissions from fossil fuels. In reality, the promise of CCS being implemented in the future is being used to allow the continued expansion of fossil fuel production, to prevent alternatives from being developed, and to deflect attention away from approaches which tackle the underlying systemic causes of climate change and other ecological crises. Ultimately CCS is a smokescreen, allowing the fossil fuel industry to continue profiting from the destruction of the environment.

ENDNOTES

1 Abanades, J. C., et al. Metz, B., et al, ed. 'Summary for Policymakers in IPCC, Special Report on Carbon Dioxide Capture and Storage'. *Cambridge University Press* (2005) ‹https://www.ipcc.ch/pdf/special-reports/srccs/srccs_wholereport.pdf ›

2 'Trends in Global CO_2 Emissions: 2013 Report'. *PBL Netherlands Environmental Assessment Agency* (2013) http://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2013-trends-in-global-co2-emissions-2013-report-1148.pdf]

3 'Unburnable Carbon 2013: Wasted capital and stranded assets'. *Carbon Tracker & The Grantham Research Institute, LSE* (2013). ‹http://www.carbontracker.org/wp-content/uploads/downloads/2013/04/Unburnable-Carbon-2-Web-Version.pdf›

4 Hansen, James, Pushker Kharecha, Makiko Sato, Valerie Masson-Delmotte, Frank Ackerman, David J. Beerling, Paul J. Hearty, et al. 'Assessing "Dangerous Climate Change": Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature'. Edited by Juan A. Añel. *PLoS ONE* 8, no. 12 (3 December 2013): e81648. doi:10.1371/journal.pone.0081648. ‹http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0081648›

5 Ibid

6 Op. Cit. (Abandes et. al. 2005) -see sections 23 and 24 of ‹http://www.ipcc.ch/pdf/special-reports/srccs/srccs_summaryforpolicymakers.pdf›

7 Verdon, J. P., J.- M. Kendall, A. L. Stork, R. A. Chadwick, D. J. White, and R. C. Bissell. 'Comparison of Geomechanical Deformation Induced by Megatonne-Scale CO2 Storage at Sleipner, Weyburn, and In Salah'. *Proceedings of the National Academy of Sciences* 110, no. 30 (8 July 2013): E2762–E2771. doi:10.1073/pnas.1302156110. ‹http://www.pnas.org/content/early/2013/07/03/1302156110.abstract ›

8 Gan, W., and C. Frohlich. 'Gas Injection May Have Triggered Earthquakes in the Cogdell Oil Field, Texas'. *Proceedings of the National Academy of Sciences* 110, no. 47 (4 November 2013): 18786–18791. doi:10.1073/pnas.1311316110.‹http://www.pnas.org/content/early/2013/10/31/1311316110›

9 Zoback, M. D., and S. M. Gorelick. 'Earthquake Triggering and Large-Scale Geologic Storage of Carbon Dioxide'. *Proceedings of the National Academy of Sciences* 109, no. 26 (18 June 2012): 10164–10168. doi:10.1073/pnas.1202473109. ‹http://www.pnas.org/content/early/2012/06/13/1202473109.abstract›

10 'Developing a Pipeline Infrastructure for CO_2 Capture and Storage: Issues and Challenges'. *INGAA Foundation* (Feb 2009). ‹http://www.ingaa.org/cms/31/7306/7626/8230.aspx›

11 Ehlig-Economides, Christine, and Michael J. Economides. 'Sequestering Carbon Dioxide in a Closed Underground Volume'. *Journal of Petroleum Science and Engineering* 70, no. 1–2 (January 2010): 123–130. doi:10.1016/j.petrol.2009.11.002. ‹http://twodoctors.org/manual/economides.pdf›

12 'The Cost of CCS'. *British Geological Survey* (BGS). Accessed 9 March 2014. ‹http://www.bgs.ac.uk/discoveringGeology/climateChange/CCS/TheCostofCSS.html›

13 'White Rose the Sole CCS Project in Europe's NER300 Competition'. *Utility Week*. Accessed 9 March 2014. ‹http://www.utilityweek.co.uk/news/white-rose-the-sole-ccs-project-in-europes-ner300-competition/894062#.UxyW7s7xHSd›

14 Op. Cit. (Abandes et. al. 2005) see sections 29 of ‹http://www.ipcc.ch/pdf/special-reports/srccs/srccs_summaryforpolicymakers.pdf›

15 Little, Mark G., and Robert B. Jackson. 'Potential Impacts of Leakage from Deep CO_2 Geosequestration on Overlying Freshwater Aquifers'. *Environmental Science & Technology* 44, no. 23 (December 2010): 9225–9232. doi:10.1021/es102235w. ‹http://www.sciencedaily.com/releases/2010/11/101111111022.htm›

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A GUIDE TO UNCONVENTIONAL FOSSIL FUELS

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