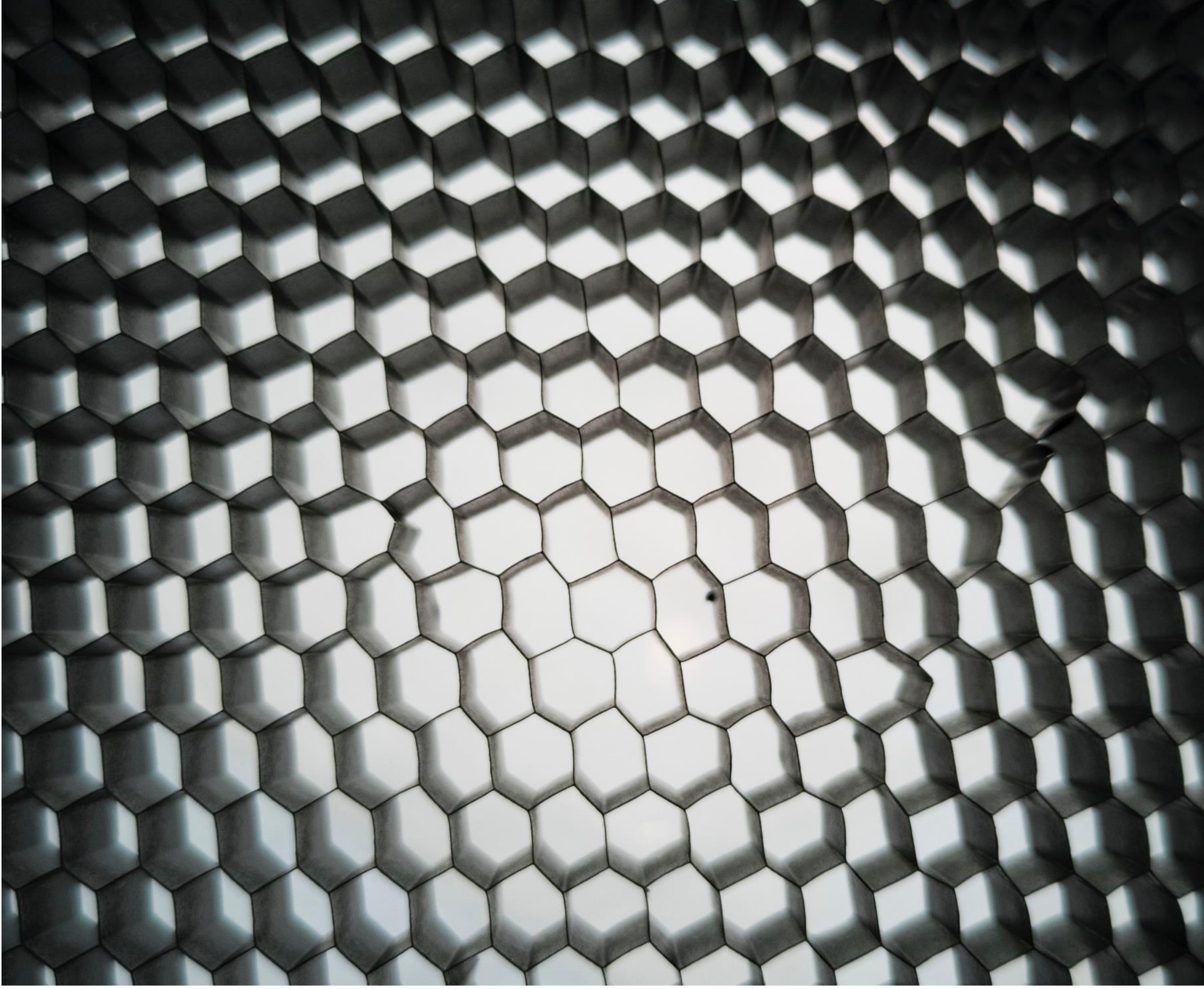


DECEMBER 2021

THOUGHT LEADERSHIP: CARBON CAPTURE – REAL DEAL OR "HAIL MARY PASS" TECHNOLOGY?

WHITEHELM
ADVISERS

INTRODUCTION

Carbon capture technology brings with it the possibility of negative emissions – the holy grail of climate science, or at least of global transition to net zero. It presents as a tool for the energy transition (or detractors argue, a stay of execution for the fossil fuel industry). It provides a vehicle for difficult to abate industries like cement – which accounts for one-fifth of global carbon emissions - to credibly commit to net zero by 2050. It promises to solve the political problem faced by politicians in countries reluctant to phase out fossil fuels, allowing the setting of ambitious targets while preserving jobs in mining communities. And more holistically, it provides a less economically disruptive way to save the planet.

But carbon capture is controversial: panacea to some, placebo to others. The key question is does it actually do what it promises? Are negative emissions truly negative? Is the carbon storage safe and permanent? Can this technology really change the carbon equation and stabilise the earth's climate?

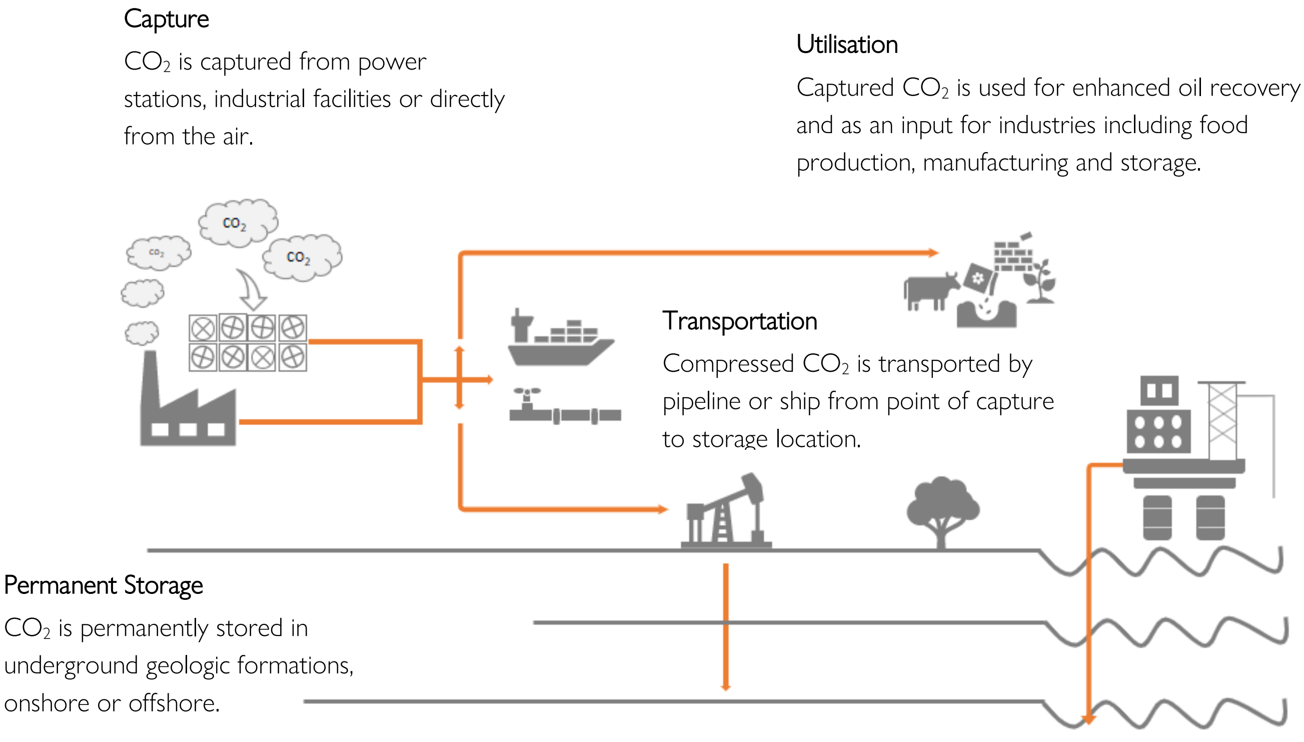
In this article, we describe carbon capture technology and take a close look at carbon utilisation and storage options. We provide a snapshot of where the carbon capture industry is at present and where capacity needs to get to according to carbon reduction pathways. We also consider five carbon capture projects that highlight the opportunities and challenges of this still nascent technology. And, of course, we provide our view on what this all means for infrastructure investors.

The physical assets of carbon capture look like infrastructure – pipelines, storage and industrial facilities – but the technologies bring with it mammoth project risk and highly uncertain cashflows. Carbon capture technology grabs a lot of headlines, but the reality is there are relatively few carbon capture and storage facilities in the world in operation today and none that capture carbon dioxide from flue gas emitted by cement and waste-to-energy facilities. It promises a lot but is it the real deal or just "Hail Mary" technology championed by industries and politicians facing extinction? Let's take a look.

WHAT IS CARBON CAPTURE, UTILISATION AND STORAGE?

Carbon capture, utilisation and storage, or CCUS, is the collective term for technologies that capture carbon dioxide (CO_2) at the site where they are emitted (including power plants and factories) and either use or store it. The process is described in Figure 1 below and starts with CO_2 being captured, compressed and then transported by pipeline or ship to a different location. This compressed CO_2 is then re-used or permanently stored[1] by injecting it into geological formations on land or deep into the ocean. Pipelines are the cheapest way of transporting CO_2 in large quantities, with large scale transportation by ship largely untested. CO_2 can also be transported by rail or truck, both of which are more flexible but expensive haulage options.

Figure 1: Carbon Capture, Utilisation and Storage



Source: International Energy Agency

[1] https://www.iea.org/reports/about-ccus

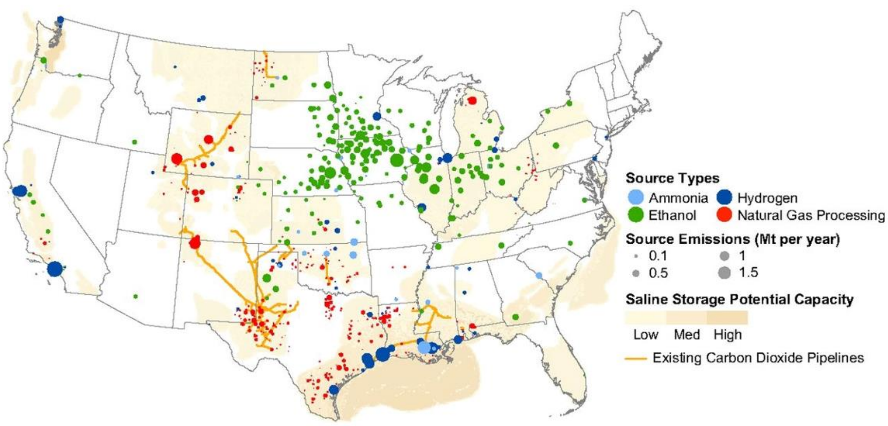
Carbon capture technology was pioneered in the natural gas processing, fertiliser, ethanol and chemical production industries, with the first project being Val Verde Natural Gas Processing Plant (now known as Terrell) established in 1972 in the United States. In 1996, the Norwegian Sleipner project came online as the first large-scale carbon capture project with a purpose of emissions reduction. Sleipner was incentivised by the imposition of CO_2 emissions tax in Norway and has injected close to 1 million tonnes of CO_2 annually into the Utsira Formation under the North Sea.[2] Today, new carbon capture facilities are being developed in a much broader range of industries, including waste-to-energy, cement production and gas and coal power generation, reflecting the high and difficult to abate carbon emissions of these operations.

There are several different acronyms when referencing carbon capture technologies: (1) CCUS, which we defined earlier and (2) CCS which is carbon capture and storage but excludes utilisation; we use both abbreviations throughout our article, with CCS being a subset of CCUS. An additional technology is direct air capture (DAC) that captures CO_2 directly from the atmosphere and is not specifically located near a high emissions operation.

Carbon Utilisation

There is a thriving market for CO_2, even while governments and companies around the world focus on reducing emissions. Since the early 1970's, CO_2 has been used to rejuvenate mature oil fields and residual oil zones, a process known as enhanced oil recovery (EOR). EOR involves injecting CO_2 into the oil reservoirs to induce additional production, but also results in the CO_2 being permanently stored. EOR activities are concentrated in North America, particularly in the United States, where there is an existing onshore pipeline network of more than 8,000km in combined length dedicated to transporting CO_2, shown as orange lines in Figure 2 below. Furthermore, the map in Figure 2 provides insights into future potential CCUS facilities in the United States, including commercially implemented capture technologies and existing large-scale carbon capture projects as well as the location of deep saline aquifers with potential for geological carbon storage.[3]

Figure 2: Location and Size of Low-Capture-Cost Sources in the United States



Source: Proceedings of the National Academy of Sciences of the United States of America[4]

[2] Celia, Michael A 2017, 'Geological storage of captured carbon dioxide as a large-scale carbon mitigation option', *American Geophysical Union*, vol. 53, issue 5 ,pp. 3527-3533.

[3] https://www.pnas.org/content/115/38/E8815

[4] Ibid

CO_2 is also widely used in the food industry, as described in Figure 3. Interestingly, in the recent gas shortages in the United Kingdom and Europe, the food industry faced CO_2 shortages. The food industry tends to source its CO_2 from fertiliser producers which were halting production in response to soaring natural gas prices.[5]

Figure 3: Carbon Dioxide Uses in the Food Industry

Carbonated beverages
Manufacture of soft drinks and beer as well as dispensing of drinks at hospitality venues.

Packing and preserving food
Extends the shelf life of meat, fresh goods including salad and baked products.

Meat industry
Used to immobilise animals prior to slaughter.

Dry ice and snow
Frozen food transportation.

Commercial greenhouses
Optimised productivity and yields of fresh food including tomatoes, strawberries and lettuce.

Carbon Storage

To thrive as an industry, carbon storage must be safe and permanent with capacity sufficient to help balance the global carbon budget. There are two main contenders for permanent CO_2 storage: firstly deep underneath the ocean, and secondly, geologic storage, either on land or offshore. Deep ocean storage refers to the process whereby captured CO_2 is directly injected deep into the ocean and is scientifically possible because beyond a certain depth, CO_2 is denser than seawater and thus sinks to the ocean floor. The ocean is vast and the opportunity for large-scale storage is significant, however, there remains much uncertainty and a lack of data and research on the safety and permanence of deep ocean storage; the key risk is ocean acidification.[6]

In 2018, the Intergovernmental Panel on Climate Change (IPCC) undertook a detailed analysis on the deliberate injection of captured CO_2 into the deep ocean.[7] The findings were that '*injection up to a few GtCO$_2$ would produce a measurable change in ocean chemistry in the region of the injection, whereas injection of hundreds of GtCO$_2$ would eventually produce measurable change over the entire ocean volume*'[8] but also that '*dissolving mineral carbonates, if found practical, could cause stored carbon to be retained in the ocean for 10,000 years, minimise changes in ocean pH and CO_2 partial pressure, and may avoid the need for prior separation of CO_2*'.[9]

The IPCC also identified the relevance of the law of the sea and wondered if deep ocean storage would be accepted by humans around the world.

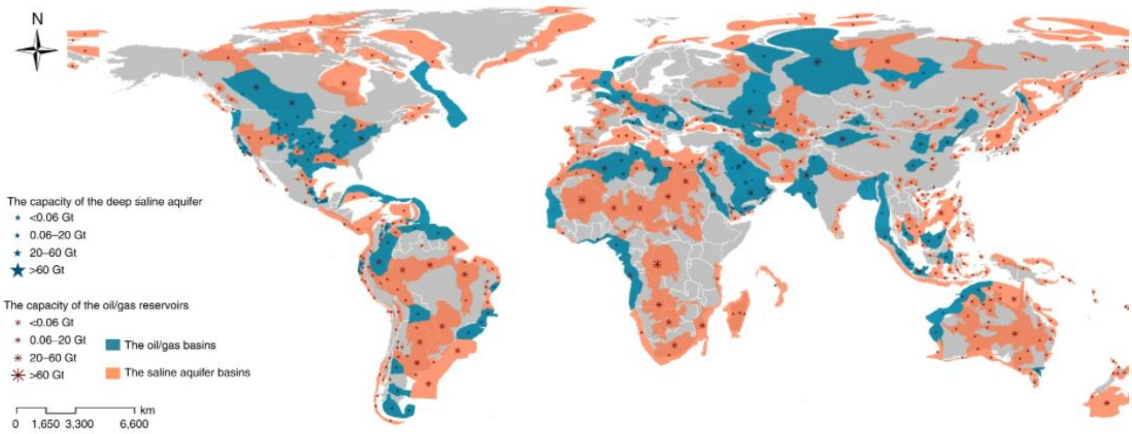
[5] https://www.ft.com/content/22497cb0-aaf3-4afa-87e1-e66b67814e48
[6] Goldthorpe Steve 2017, Potential for Very Deep Ocean Storage of CO2 Without Ocean Acidification, Energy Procedia, Vol. 114, pp. 5417-5429.
[7] https://www.ipcc.ch/site/assets/uploads/2018/03/srccs_chapter6-1.pdf
[8] ibid
[9] ibid

We note that previous attempts to gain approval for small scale injection near both Hawaii[10] and Norway were rejected on environmental grounds and subject to intense grassroots environmental campaigns. So, it seems deep ocean storage is scientifically possible and an open research question, likely to be the subject of future consideration, investigation and seed funding. But the road ahead for this technology is long with huge uncertainty, and stakes that couldn't really be any higher.

Moving now to geologic storage, a practice that has been in play globally for several decades and while certainly not straightforward, is established and has a track record. Geologic storage is the injection of CO_2 into deep geological formations (often more than one kilometre below the surface of the earth and well below drinking water aquifers)[11], including deep saline aquifers and depleted oil and gas reservoirs. The IPCC found in 2018 that *'injecting CO_2 into deep geological formations at carefully selected sites can store it underground for long periods of time: it is considered that 99% or more of the injected CO_2 will be retained for a 1000 years'*.[12]

There is significant global capacity for geological storage, estimated to be 2,082 Gt and distributed as shown below in Figure 4. Australia is geologically well placed in terms of both saline aquifers and oil and gas basin capacity, with the offshore Gippsland Basin off Victoria, regions off Western and northern Australia and the onshore Cooper and Surat Basins all deemed suitable.[13]

Figure 4: Global Distribution of Effective CO_2 Storage Potential of Different Basins



Source: nature climate change[14]

However, there remain many open questions on geologic storage, including leakage risk, possible induced seismicity (earthquakes)[15] as well as regulatory and liability frameworks. The technology remains nascent despite it being used for almost 40 years now and every geological formation has different characteristics and suitability for permanent carbon storage.

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[10] https://sequestration.mit.edu/pdf/defig_thesis.pdf

[11] Celia, Michael A 2017, 'Geological storage of captured carbon dioxide as a large-scale carbon mitigation option', *American Geophysical Union*, vol. 53, issue 5 ,pp. 3527-3533.

[12] https://www.ipcc.ch/site/assets/uploads/2018/03/srccs_chapter5-1.pdf

[13] https://www.afr.com/companies/energy/carbon-capture-and-storage-has-to-work-to-reach-net-zero-20211115-p598y7

[14] Wei, Yi-Ming, Kang, Jia-Ning, Liu, Lan-Cui, Li, Qi, Wang, Peng-Tao, Hou, Juan-Juan, Liang, Qiao-Mei, Liao, Hua, Huang, Shi-Feng & Yu, Biying 2021, A proposed global layout of carbon capture and storage in line with a 2°C climate target, *nature climate change*, 11, pp. 112-118.

[15] Celia, Michael A 2017, 'Geological storage of captured carbon dioxide as a large-scale carbon mitigation option', *American Geophysical Union*, vol. 53, issue 5 ,pp. 3527-3533.

CARBON CAPTURE STATE OF PLAY

Carbon capture technology has been assigned a key role by the organisations leading the global response to climate change. The Glasgow Climate Pact committed its 197 signatories to transitioning away from '*unabated coal power generation in the 2030's (or as soon as possible thereafter)*',[16] effectively rubber stamping the continued use of coal power with carbon capture technology. The International Energy Agency (IEA) includes carbon capture of 7.6Gt in its net zero by 2050 roadmap for the global energy sector. And the IPCC, in its most recent report released in August 2021, acknowledges that CO_2 removal (a broad category that includes carbon capture technologies[17]) is required in '*virtually all scenarios*'.[18]

But while carbon capture has a lot of potential, the reality is that there are currently only 27 commercial CCS facilities operating around the world with a combined capacity of 37 million tonnes per year, as shown below in Table 1. Table 1 also breaks down future capture capacity currently being developed, with only four facilities in construction phase, but much more capture capacity in early and advanced development.

Table 1: Global Commercial CCS Facilities (Sept 2021) – Number of Facilities and Total Capacity

	OPERATIONAL	IN CONSTRUCTION	ADVANCED DEVELOPMENT	EARLY DEVELOPMENT	OPERATION SUSPENDED	TOTAL
Number of facilities	27	4	58	44	2	135
Capture capacity (Mtpa)	36.6	3.1	46.7	60.9	2.1	149.3

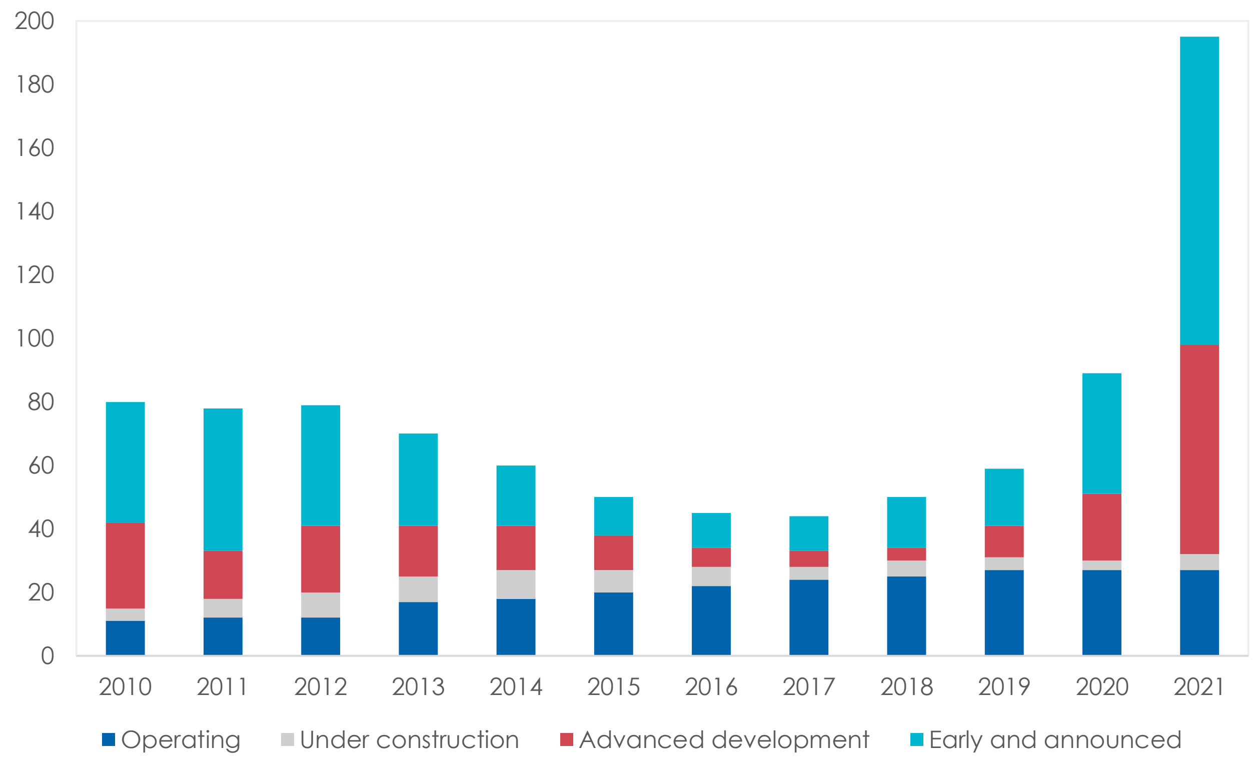
Source: Global CCS Institute

16 https://unfccc.int/sites/default/files/resource/cma2021_L16_adv.pdf

17 Other CDR technologies explicitly referenced by the IPCC are: afforestation and reforestation, land restoration and soil carbon sequestration, enhanced weathering and ocean alkalinization.

18 https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf

Figure 5: Global Pipeline of Commercial CCUS Facilities in Development 2010-2021



Source: International Energy Agency

Figure 5 provides a similar narrative for CCUS, illustrating how rapidly future capture capacity increased in 2021 but also underlining the length of time it takes to get to construction phase and how stable the number of facilities in operation has been over the past decade. The International Energy Agency scenario for limiting warming to 2°C requires CCS capacity to increase from its current base of 37 Mtpa to more than 5,600 Mtpa by 205019. Such an increase will require massive investment, estimated to be somewhere between US$655 billion and US$1.28 trillion by 2050.20

Development Process

Carbon capture is expensive and risky. Identifying and investigating a storage resource requires massive upfront investment, money that is completely at risk if the site is ultimately deemed unsuitable. Further, carbon capture has a very long timeframe, typically thought to take somewhere between 7-10 years from concept study through to feasibility, design, construction and then operation.[21] A recent study found that more than 80% of proposed CCS projects end in failure, and highlighted policy design as the single most important factor in determining this success or failure.[22] We now provide a snapshot of a series of carbon capture technologies and projects under development and one in operation, highlighting the heterogeneous nature of the technology as well as the opportunities and challenges.

[19] https://www.globalccsinstitute.com/wp-content/uploads/2021/10/2021-Global-Status-of-CCS-Report_Global_CCS_Institute.pdf
[20] https://www.globalccsinstitute.com/wp-content/uploads/2021/06/Unlocking-Private-Finance-for-CCS-Thought-Leadership-Report-1.pdf
[21] https://www.globalccsinstitute.com/resources/global-status-report/
[22] https://iopscience.iop.org/article/10.1088/1748-9326/abd19e

- CarbonCure seeks to reduce embodied carbon (carbon emitted during the construction of a built asset[23]) by retrofitting technology into concrete plants and enables concrete producers to inject captured CO_2 into fresh concrete during mixing. Once injected, the CO_2 reacts with the concrete mix and becomes a mineral that is permanently embedded.
- The company generates revenues from licensing fees from the construction companies that use the technology and from selling carbon credits from the captured CO_2.[24]
- CarbonCure is a privately held Canadian company. Amazon's Climate Pledge Fund and Breakthrough Energy Ventures (established by Bill Gates) co-led an investment syndicate comprising Microsoft, BDC Capital, 2150, Thistledown Foundation, Taronga Group and GreenSoil Investments.[25]

- 1PointFive is a development company formed to commercially develop the world's largest Direct Air Capture (DAC) facility in the Permian Basin in West Texas, United States. The CO_2 captured will be transported by pipeline and geologically stored.
- The project will use technology developed by Carbon Engineering that pulls air into a large contactor system where CO_2 molecules are concentrated, purified and compressed. This CO_2 is delivered in a gas form ready to be used or stored.[26]
- 1PointFive is a joint venture between Occidental Petroleum venture capital arm Oxy Low Carbon Ventures LLC and private equity firm Rusheen Capital Management LLC. United Airlines has also made a 'multimillion dollar investment[27]' in the project as part of its net zero by 2050 strategy. Australian engineering company Worley has been awarded the initial engineering phase contract, with construction expected to begin in 2022 and operations by 2024.

- Australian companies Santos and Beach Energy have confirmed they will proceed with a US$165 million CCUS project in the Moomba gas fields in South Australia. The project is slated to start in 2024 and sequester 1.7 million tonnes of carbon emissions annually in depleted oil and gas reservoirs. Santos will be the operator and own 66.7% interest while South Australian oil and gas producer Beach Energy will own the remaining share.[28]
- In Australia, recent regulatory changes mean CCS projects are eligible to generate carbon credit units under the governments Emissions Reduction Fund.[29]
- Santos has also just signed a Memorandum of Understanding (MOU) with the Timor-Leste regulator to progress CCS at Bayu-Undan in the Timor Sea, with possible storage of up to 10 million tonnes a year.[30]

[23] https://www.ukgbc.org/wp-content/uploads/2017/09/UK-GBC-EC-Developing-Client-Brief.pdf
[24] https://www.ft.com/content/24d610a0-fb65-45bb-b747-e015e1f10c1a
[25] https://www.businesswire.com/news/home/20200917005545/en/Amazon-and-Breakthrough-Energy-Ventures-Co-Lead-Investment-in-Cleantech-Company-CarbonCure
[26] https://carbonengineering.com/
[27] https://www.united.com/en/us/newsroom/announcements/united-pledges-100-green-2050-2649438060
[28] https://www.beachenergy.com.au/wp-content/uploads/Media-release-Moomba-CCS.pdf
[29] https://www.legislation.gov.au/series/F2021L01379
[30] https://www.santos.com/news/mou-signed-on-bayu-undan-carbon-capture-and-storage/

Northern Lights

- European company Northern Lights is set to begin operations in mid-2024 as the first ever cross-border, open-source CO_2 transport and storage infrastructure network.[31] Northern Lights will provide carbon transportation by ship to a terminal in western Norway for intermediate storage and then transportation by pipeline for permanent storage in an underwater reservoir 2,600 metres below the seabed of the North Sea.[32] Phase one of the project will have a capacity of up to 1.5 million tonnes of CO_2 annually.
- Northern Lights is the transportation and storage component of the Norwegian Government's Longship project, and is a collaboration between Equinor, Shell and Total. These companies are the owners and developers of the project with revenues coming from CO_2 storage but the project has benefitted from significant state aid.
- Longship is the Norwegian Governments project on carbon capture, transport and storage, a plan it hopes will stimulate global investment in carbon capture and storage technology. Carbon will be captured from industrial sources in the Oslo-fjord region (including cement and waste-to-energy), providing an example of CCS networks, a proliferating project type that involve shared transportation and storage infrastructure.

Chevron

Gorgon Project

Operated by Chevron Australia in joint venture with ExxonMobil Osaka Gas | Tokyo Gas | JERA

The Chevron-operated Gorgon Project is a joint venture between the Australian subsidiaries of Chevron (47.3 percent), ExxonMobil (25 percent), Shell (25 percent), Osaka Gas (1.25 percent), Tokyo Gas (1 percent) and JERA (0.417 percent).

- Chevron's Gorgon project is a 15.6 million tonnes per annuum LNG facility and a domestic gas plant with capacity of 300 terajoules of gas per day, with a predicted project lifespan of more than 40 years.[33] This project includes the world's largest CCS system, a project that has so far cost $3.1 billion and received $60 million from an early Australian government development fund, permanently stores CO_2 in a giant sandstone formation two kilometres underneath Barrow Island.
- As part of the approval, the Western Australian government required Chevron to capture at least 80% of its produced CO_2 on a five year rolling average.[34] The first five year period ended in July this year and the company fell short on this obligation, meaning Chevron will be required to buy 5.23 Mt og carbon offsets and have also announced their intention to invest $40 million in *'low carbon energy projects'*.[35] The offsets being considered by Chevron ranged in price between $15-37 per tonne, meaning the cost of the shortfall would be somewhere between $78-194 million. The reason for the shortfall was reported as technical problems that delayed the CO_2 injection.

31 https://northernlightsccs.com/about-the-longship-project/

32 https://northernlightsccs.com/what-we-do/

33 https://australia.chevron.com/our-businesses/gorgon-project

34 https://www.smh.com.au/environment/climate-change/chevron-s-five-years-of-gorgon-carbon-storage-failure-could-cost-230-million-20211110-p597uf.html

35 https://australia.chevron.com/news/2021/chevron-announces-aud40-million-western-australian-lower-carbon-investment

IMPLICATIONS FOR INFRASTRUCTURE INVESTORS

We have called carbon capture 'still nascent' several times during this article, terminology our readers may consider unusual for technology that has been in use since 1972. However, our nomenclature reflects the emerging potential of carbon capture projects developed for the purpose of carbon reduction. As we discussed earlier, the use of CCUS for EOR is well established in North America but the objective of this practice has been to increase the productivity of oil reservoirs, something it has successfully done for almost 40 years. What we do consider nascent is the aspects of CCUS, CCS and DAC projects that seek to reduce global carbon emissions, either directly associated with a particular operation or more generally from the atmosphere. The value of these projects is anchored to their ability to safely store CO_2 permanently, because by doing so, they shut down the stranded asset risk of a carbon intense operation and/or provide access to a separate revenue stream associated with the monetisation of this carbon removal (that is, by selling carbon offsets).

Unsurprisingly then, investors with carbon intense assets are attracted to carbon capture, primarily to futureproof their existing investments. The key risk for carbon-intense assets today is the risk of becoming stranded, with the exit value of these investments at risk of being materially lowered because the market appetite for high emissions assets is reducing. Other investment motivations include to reduce the impact of any carbon tax on investment returns as well as to meet portfolio carbon reduction targets. Further, carbon intense assets are finding it increasingly challenging to access insurance and debt financing, something carbon capture technology is likely to rectify. But infrastructure investors generally have a growing appetite for sustainable and impact assets and CCUS, CCS and DAC may fall under this classification. However, as we saw illustrated in our case studies, carbon capture is not straightforward and while physically it fits the infrastructure description, the investment characteristics can be wildly different.

Table 2 below identifies the characteristics Whitehelm consider important for an investment to be considered an infrastructure asset.

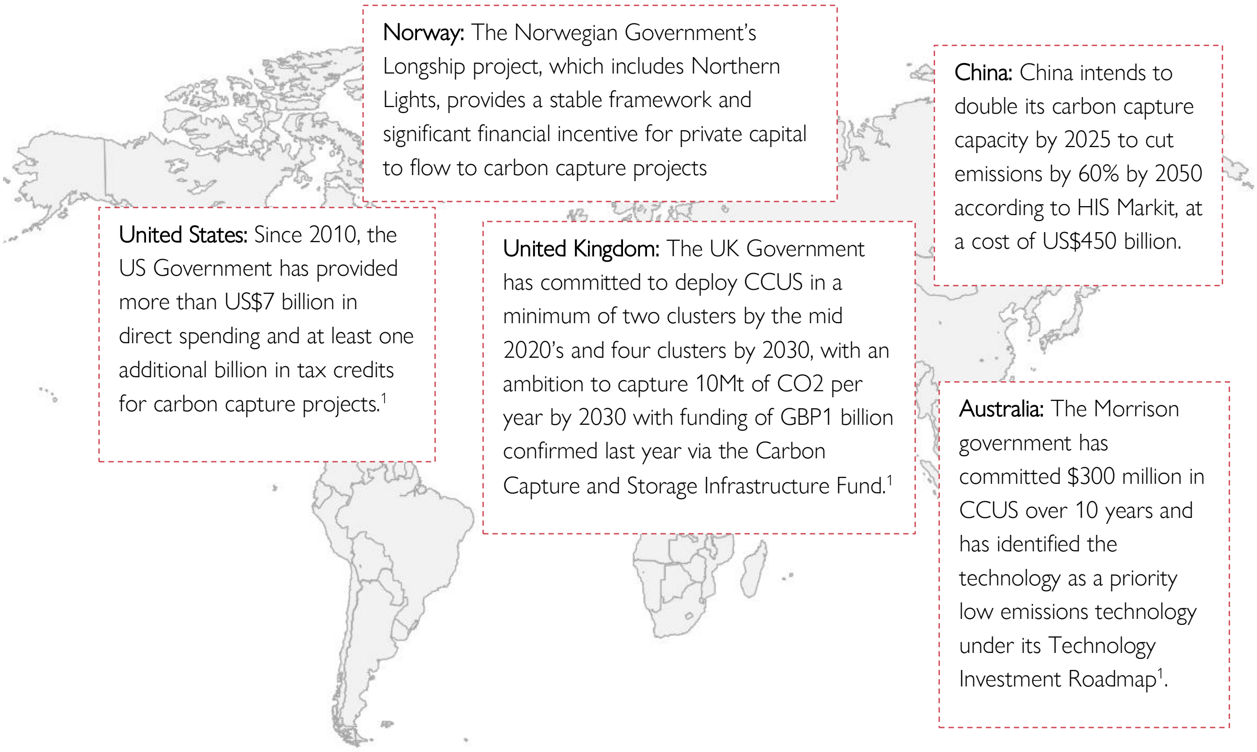
Table 2: Is Carbon Capture Core Infrastructure?

Clear and measurable cashflows	✗
High EBITDA margins	✗
Stable returns, resilient to shock scenario and downside sensitivities	✗
Inflation hedge	✗
Limited exposure to non-infrastructure risks	✗
Monopolistic traits	✓
Strong sustainability characteristics	✓
Value	Subjective

For carbon capture investments to meet this core infrastructure criteria, significant deal structuring would need to occur to ensure that each investment was underpinned by long-term revenue contracts with high quality counterparty CO_2 producers or for such revenues be subject to predictable regulatory frameworks. Furthermore, such contracts should be structured to ensure a linkage between revenue and inflation, thereby protecting theses CCS investments in an environment of rising prices. Finally, to qualify for introduction into the infrastructure asset class, carbon capture investments should limit exposure to non-infrastructure risks such as commodity prices or volumes, energy prices, development approvals or permitting costs.

Finally, there is a compelling case for government assistance in carbon capture projects. In fact, as we mentioned earlier, credible policy design was identified as a key success factor for carbon capture technology.[36] We specifically point to the Longship project pioneered by the Norwegian Government, which not only provides a stable framework and significant financial incentive for private capital to flow to carbon capture projects but also seeks to 'stimulate technological development in an international perspective'.[37] And we note that government incentives are happening in many jurisdictions around the world, as shown below in Figure 6.

Figure 6: Government Incentives for Carbon Capture Technology around the World



In addition to the significant incentives offered by the United States government and described in Figure 6, on 5 November 2021, the US Secretary of Energy announced a new target dubbed the 'Carbon Negative Shot'.[38] This initiative is focussed on reducing the cost of CO_2 removal to less than US$100 per net metric tonne of CO_2 equivalent as well as incentivising robust lifecycle emissions accounting and high quality, long term storage. Together, these targets significantly strengthen the policy framework for carbon capture technology, in turn increasing the probability of successful projects in the United States.

[36] https://iopscience.iop.org/article/10.1088/1748-9326/abd19e
[37] https://ccsnorway.com/the-project/
[38] https://www.energy.gov/articles/secretary-granholm-launches-carbon-negative-earthshots-remove-gigatons-carbon-pollution

CONCLUSION

Failure is not an option when it comes to balancing the global carbon budget. But restoring balance means reducing emissions to net zero. The difficulty of this task cannot be overstated, complexity on display in the complicated tears shed by Alok Sharma at the conclusion of COP26 in Glasgow.[39] The burning of fossil fuels has propelled the developed world to unprecedented prosperity and walking away from it increases the risk that this same prosperity may not be accessible for people living in poverty in developing countries. Global transition to renewable energy mitigates this risk but requires new technology, enormous capital flows and a leap of faith.

Removing enough carbon from the atmosphere to get to zero by 2050 would avoid the worst impacts of climate change.[40] Carbon capture technology is a vehicle for carbon removal and has been written into the world's most plausible climate transition scenarios. However, whilst there are operational carbon capture facilities in the world today that are permanently and safely storing carbon, there are also graveyards of projects that didn't work as planned or didn't even get off the ground. If this technology was a no-brainer, there would be much greater operational carbon capture capacity today.

However, just because it is hard, doesn't mean it's impossible. The pandemic has demonstrated that science, technology, money and governments can solve complex global problems. We think that with these same ingredients, carbon capture will play a significant role in getting the world to net zero. But this will not happen without significant government intervention, which must include global carbon pricing, incentives for research and development, stable regulatory frameworks and in some instances, a willingness for the public purse to guarantee high risk projects. We do not call for such intervention lightly; we are long time believers in markets being the most efficient allocators of capital. However, climate change highlights a series of market failures including greenhouse gas externalities, lack of information about emissions reduction, network effects and a lack of innovation incentives[41] that justify intervention.

And governments around the world are listening. Norway and the United States in particular are acting to unlock technology and private capital flows to build and grow the global carbon capture industry. Particularly incentivised are those investors that own carbon intense assets and seek to mitigate stranded asset risk with carbon capture technology. We expect other investor types to focus on this asset type in time as the technology becomes more established, less risky and moves further along the infrastructure investment spectrum towards core (although we acknowledge this is likely to still be some time away).

Carbon capture technology is the real deal. It simply must be because humanity cannot afford it not to be. To date, progress has been slow, failures many and learnings are iterative, but public and private investment must continue to flow to build the capacity required to stem global warming.

39 https://www.theguardian.com/environment/video/2021/nov/14/i-am-deeply-sorry-alok-sharma-fights-back-tears-as-watered-down-cop26-deal-agreed-video

40 https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf

41 https://www.lse.ac.uk/granthaminstitute/explainers/why-do-economists-describe-climate-change-as-a-market-failure/

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