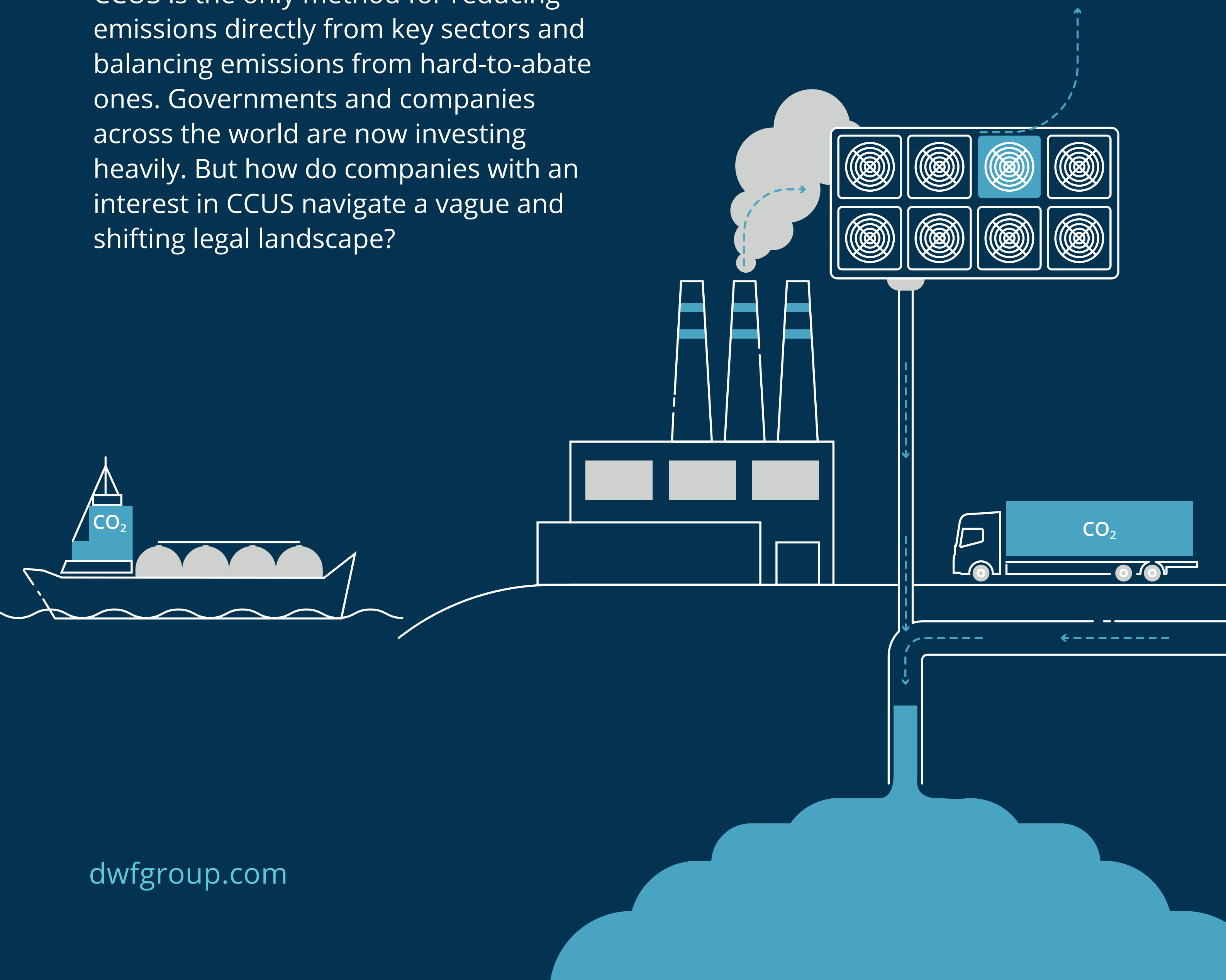
Has the time come to scale-up Carbon Capture, Utilisation and Storage?

CCUS is the only method for reducing emissions directly from key sectors and balancing emissions from hard-to-abate ones. Governments and companies across the world are now investing heavily. But how do companies with an interest in CCUS navigate a vague and shifting legal landscape?



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Executive summary

CCUS is gaining momentum as the final destination for captured CO_2 in line with global climate commitments. By 2030, deep, large-scale storage (mostly subsurface, with some mineralisation) will overtake enhanced oil recovery (EOR) as the primary destination for captured CO_2.

- Carbon capture and storage (CCS) is the process of capturing carbon dioxide (CO_2) emissions from fossil power generation and industrial processes for storage underground in geologic formations such as oil and gas reservoirs, unmineable coal seams and deep saline reservoirs. Carbon capture, usage, and storage (CCUS) is the same process but offers a choice between CO_2 reuse (the 'U' in CCUS) or storage as the final endpoint for captured CO_2.
- On the investment landscape this has translated into progress from small-scale <1 million tonnes per year (Mt/y) projects to the "cluster" model of >10-20 Mt/y combined projects, bringing together multiple emitters and/or storage sites using shared infrastructure.
- Current regulatory and contractual frameworks, although more nuanced than those of the early 2010s, still need the introduction of robust incentives to address key hurdles to investment and potential barriers to entry. These can include fit-for-purpose revenue streams and mitigation of cross-chain liability risks.
- Certain geographies have developed regional cross-border partnerships and agreements as part of increased cooperation towards meeting a common decarbonisation goal. Such agreements can pave the way for international CO_2 transport and storage (T&S) as a service.
- Recent improved incentives, particularly under tax credit schemes in the US, should provide an added boost to investor confidence by making CCUS more economic.
- The role of statutes (law, fiscal regimes, and regulation) and regulator responsibility (liabilities, co-funding) will be the most effective in addressing and mitigating (at least initially) challenges across the CCUS project value chain.
- CCUS-interested companies should move now to take first-mover advantage in relation to available opportunities (i.e. projects that are becoming commercially attractive thanks to new incentives) and secure a stable market position in readiness for future opportunities.

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How is CCUS evolving as a part of the energy transition?

There is a growing policy consensus around investing in CCUS technology as an important enabler of the energy transition.

Scenarios from leading climate action-based organisations speak to its mandatory role in order to keep the Paris Agreement's 1.5°C warming limit within reach.

The technology offers significant strategic value for net-zero ambitions. It can be retrofitted to existing power and industrial plants, and tackle emissions from hard-to-abate sectors. It is the core technology to enable low-cost "blue" hydrogen, an essential intermediary towards wide-scale adoption of renewable-derived "green" hydrogen for the future hydrogen economy, and in turn, for producing sustainable synthetic fuels. Finally, it is the enabler to cancel out unavoidable and historic emissions by combining with bioenergy (BECCS) or direct air capture (DAC).

CCUS has an uneven history.

It has been available for decades, but there are fewer than 30 commercial operational projects worldwide. Previous planned large-scale carbon capture projects were abandoned mainly because they were considered as not economically viable due to high costs, lack of supportive regulatory frameworks and of public incentives, no mature technology or chequered understanding of the technology itself, lack of a route to market, and a lack of credible returns on investment[i].

> "Past investments into CCS in the UK failed due to a weak regulatory environment, particularly around transport and storage. In the case of the Scottish projects – Peterhead and Longannet –shipping of the captured CO_2 cross-border became an issue due to disorganisation around which international conventions were to be ratified."
>
> Stephanie Smith, Senior Associate, DWF

Momentum has continued to grow strongly.

Peterhead is back on-track as a new flexible 910 MW power station equipped with 1.5 Mt/y capture technology connected into the Scottish Cluster's CO_2 transport and storage infrastructure, which underpins plans to deliver one of the UK's first low-carbon industrial clusters[ii]. Other upcoming important projects include the 8 Mt/y Drax bioenergy with carbon capture and storage project, the Klemetsrud waste-to-energy CCS project, the French Normandy Seine port-industrial cluster (including TotalEnergies, ExxonMobil, Air Liquide and other major industrials of this region) with a reduction objective of 3 Mt/y by 2030, and the world's first commercial DAC with carbon storage, ORCA, in Iceland.

In the last couple of years the intended destination for captured CO_2 has shifted. In 2021, 73% of captured CO_2 went to enhanced oil recovery (EOR) operations. By 2030, deep, large-scale storage (mostly subsurface, with some mineralisation) will overtake EOR as the primary destination for captured CO_2, with 66% of it going to dedicated storage sites[iii].

The shift is being driven by global climate policy that incentivises storage over CO_2 utilisation as a critical decarbonisation route to meet climate change goals, requiring 1-2 gigatonnes of CO_2 to be captured in 2030, an order of magnitude higher than the total capacities of announced projects.

On the investment landscape this has translated into a shift away from small-scale <1 Mt/y projects to the "cluster" model of >10-20 Mt/y combined projects, bringing together multiple emitters and/or storage sites using shared infrastructure.

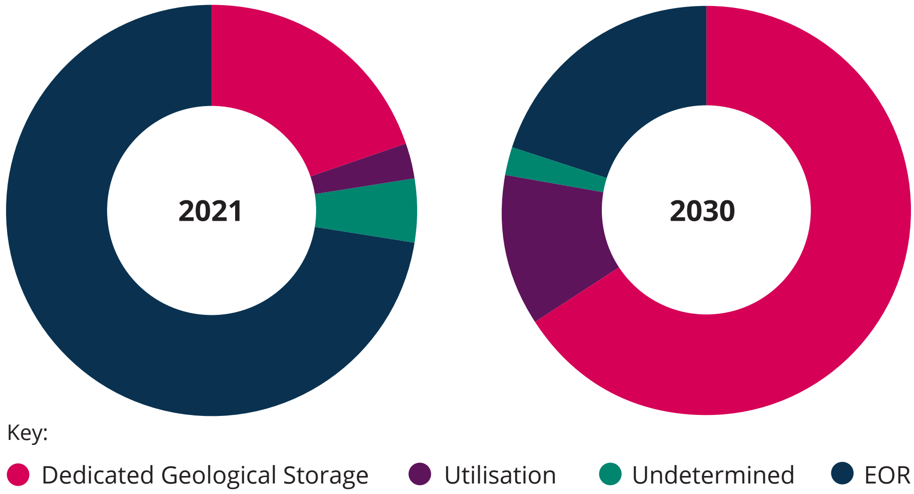


Figure 1 Global carbon capture capacity by CO_2 endpoint, 2021 and 2030[iv]

Multiple planned projects are shifting to the cluster model,

including the Drax BECCS, Northern Lights in Norway, Normandy Seine and 3D Dunkirk industrial pilot in France, and PORTHOS at the Port of Rotterdam. These projects offer several distinct advantages for network participants, compared with traditional "point-to-point" projects. They can reduce costs and risks for potential upcoming projects and enable capture from small-volume industrial facilities, but can also become complicated at the intersection of differing subnational or national jurisdictions and borders.

> "Commercial barriers were an important factor in past projects getting cancelled, mainly lack of private investment and weak public-private partnerships in building a route-to-market, as well as lack of clarity around regulations. Lack of clarity could still threaten CCUS deployment today unless resolved through the rationalisation and streamlining of regulatory regimes worldwide."
>
> Shane Toal, Partner, DWF

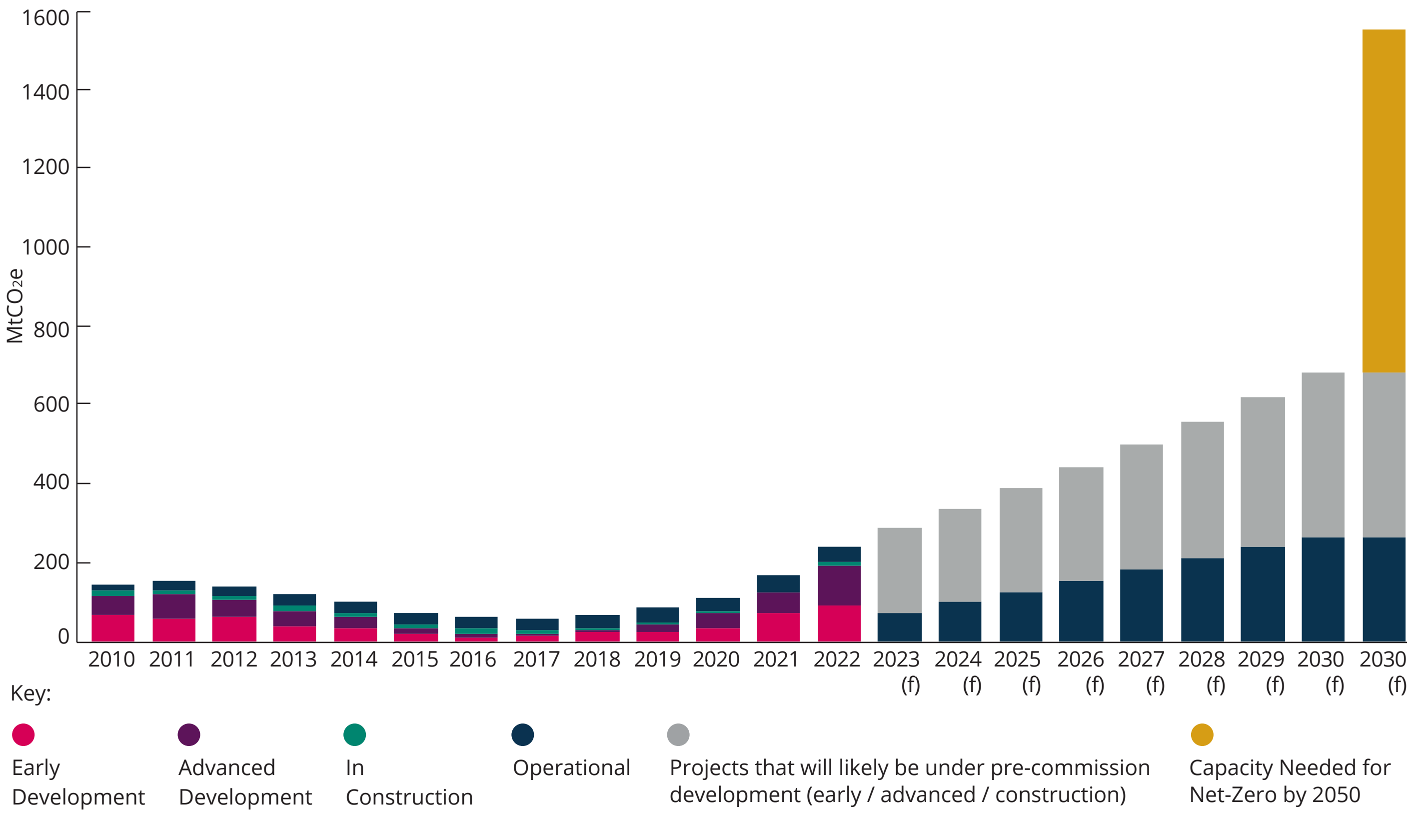


Figure 2 Global carbon capture capacity by CO_2 endpoint, 2021 and 2030[iv]

What are the barriers to CCUS development?

Current regulatory and contractual frameworks, although more nuanced than those of the early 2010s, still need the introduction of robust incentives to address key hurdles to investment. These can include:

1. Fit-for-purpose revenue streams to encourage carbon capture when current carbon prices are insufficient to justify large investment;
2. Mitigation of cross-chain risks involved as a result of co-dependent projects in the rapidly growing "cluster" model value chain, and;
3. Mitigation of long-term storage liability risks.

The world's more developed regulatory regimes are overwhelmingly concentrated in the higher-income countries, while middle/lower-income jurisdictions, which are also pursuing CCUS as a means to decarbonisation, are still quite a way off from providing sufficient incentives.

This can be seen in the very few and mainly state-led investments to date in the **Middle East**, which is one of the world's most promising regions for large-scale CO_2 storage due to favourable geology (flat and sparsely-populated terrain, extensive geological knowledge, and large, high-quality depleted or near-depleted oil and gas reservoirs and deep saline aquifers) and low public opposition.

Governments in the region "have not begun scratching the surface" in terms of developing comprehensive environmental, permitting, land consent and land use, and water use regulations for key industrial projects.

This could be regarded as beneficial by some as local governments, hungry to get CCUS off the ground as a way of future-proofing their oil and gas sectors, will not be constrained by complex legal requirements.

However, this lends significant instability to outside investors as well as private lenders and/or debt providers who typically prefer structure and well-managed tender processes to lend into at-scale projects. Future monitoring and verification of stored CO_2 will also require a robust regulatory framework.

Companies can receive support from local governments to guide legislation around a project as they see fit, but this presents a catch as rules could change at any time. Current regulation is more technical in nature and easy to tailor for injection purposes, but almost non-existent for storage, which could limit the expansion of the technology in the region.

Also, a weak overall framework for project development at the investment level could lead to a weakening in credibility or loss in the value of CCUS for the region.

This is particularly true for players who might seek carbon credits or an equivalent auditable credit from CCUS to meet decarbonisation targets, but cannot develop a project without a mandatory tie-in with a state-led oil company.

One proposed solution to develop value for project developers in the Middle East who cannot earn money or carbon credits without a tie-in with a national oil company (NOC) is a **tolling model**. According to this model, once CO_2 is captured, a NOC can invite the developer to store it at one of its reservoirs for a certain price, passing ownership of the CO_2 to it (the NOC). Project developers can also charge fees for transporting and processing the CO_2 under this model.

Socially-driven backing for CCUS, meanwhile, might overcome the hurdle of low value-add for private investors. Large sovereign wealth funds (SWFs) could raise funding for CCUS projects as a social endeavour to drive benefit to local community and ecology as part of sustainable development mandates (including the 2030 Agenda on Sustainable Development), attracting private developers.

Despite the kind of investment that ultimately drives carbon storage in the region, operators will still want **standardised frameworks** with respect to long-term storage liability risks, such as leaks, or cross-border migrations.

In countries with a lot of small hydrocarbon licences, such as Egypt, cross-border migration monitoring will likely become mandatory for verifiability, offering a potential opportunity for opening the market and establishing a precedent that could be applied to other countries in the region.

Regulatory frameworks for CCUS in **Europe**, meanwhile, are far more complex than in the Middle East, and often translate to not only interregional and intraregional policy on a country-level, but also to Europe-level policy more broadly, particularly as rising private investment causes proposed T&S networks to cut across a number of jurisdictions.

> "The legal structures around CCUS in the Middle East are in early development, although interest towards storage as the final endpoint is progressing positively. Projects so far have been awarded on a niche basis for EOR, with smaller players in the region often looking to the large oil and gas players for environmental regulation for CCUS, despite having their own legal frameworks."
>
> Slava Kiryushin, Partner, Global Co-Head of Energy, DWF

Size and scale of planned infrastructure typically mean decisions with respect to land use, permitting, and consent often fall under several different jurisdictions and regulatory bodies. This is especially true for clusters where different capture and endpoints are considered, resulting in a lacuna where overlapping regulations present a broader challenge to promotion of CCUS in countries on their own and in the wider bloc.

Overlap in regulation can cause:

- Ambiguity around which jurisdiction has the mandate to consent infrastructure development, T&S network, and/or endpoint offtake;
- Risk of red tape due to primary and secondary legislation requirements;
- Multiple interpretations of consenting processes and regimes;
- Risk of limited users and connectivity impacting capacity expansions, and generating revenue gaps;
- Utilisation build-up risks due to differing interpretations of regulation on leasing of subsurface pore space;
- Negative implications for incentivising private investment due to differing sponsorship mandates, and;
- Lack of consensus on which jurisdiction has rights to the overarching decision in case of rejection of, or part of, the consent agreement by the jurisdictions involved.

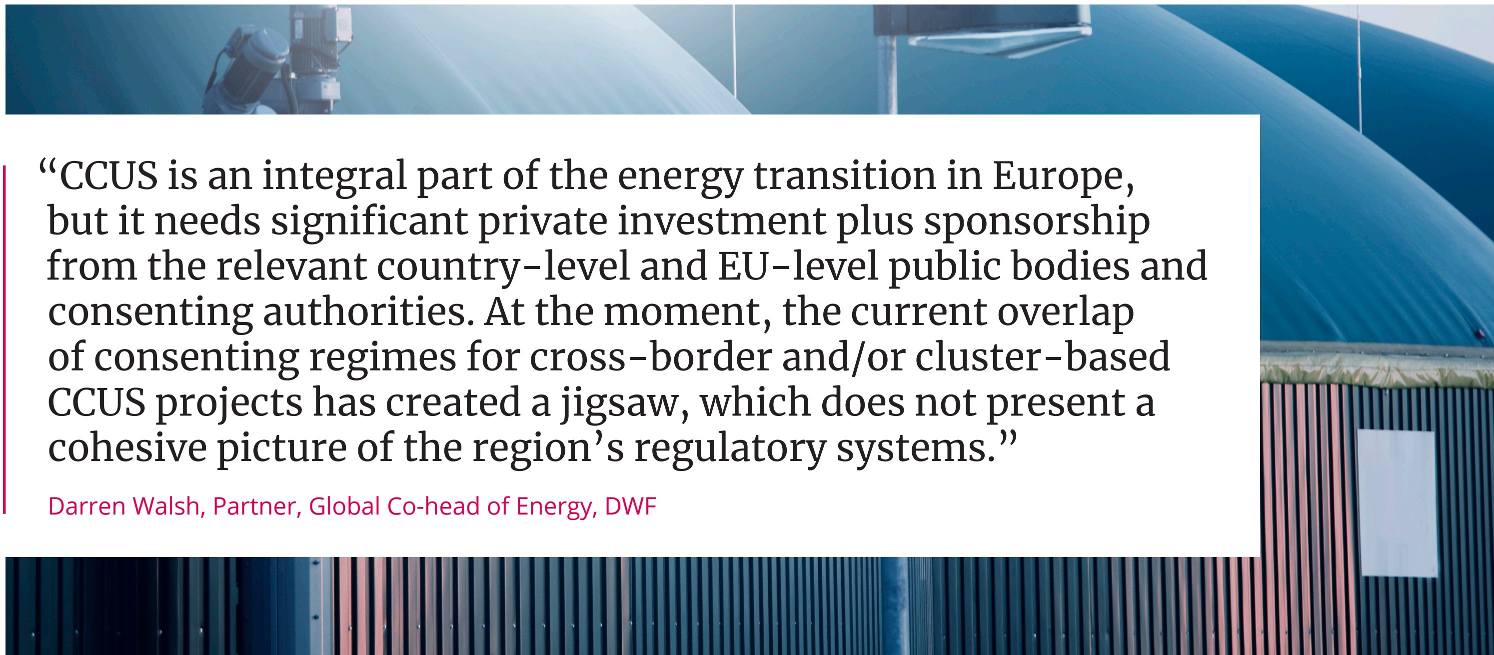
These in turn can lead to different market challenges for different players. Most of Europe's intended CCUS projects are clustered in Norway, the Netherlands, Denmark and the UK, and have set the tone for new approaches to achieve economies of scale, cost reductions, increased cooperation between governments and industry, and regional cross-border cooperation[vi].

Multiple planned projects in these countries have begun shifting to the cluster model as a trigger for new investments to decarbonise industry and have also encouraged similar ambition in other countries, although momentum there has been slower. For example, Italy's first CCS project in the Mediterranean with storage in the Adriatic, the Ravenna CCS Hub, was expected to reach FID in 2022[vi], but this is yet to happen.

In France and Germany, where CCUS is no longer a "taboo" subject, current legislation remains slow-moving to drive forward concerted industrial cluster projects, despite having excellent potential to do so as illustrated by the Dunkirk industrial pilot and Normandy Seine projects in France. Germany has Europe's largest natural gas storage, while France is the first country to have stored natural gas in deep saline aquifers, and both have strong industrial competence covering the whole CCUS value chain, including in relation to infrastructure.

"The benefit of starting now is that any regulation that is developed is unlikely to be dictated by market factors or geopolitical considerations, as regulation at a level that could be impacted by external forces does not exist currently. As verifiability and monitoring scale-up, MENA-focussed players will be able to participate on the international scene more competitively (such as by importing CO_2), increasing the material value of their storage potentials."

Slava Kiryushin, Partner, Global Co-Head of Energy, DWF



"CCUS is an integral part of the energy transition in Europe, but it needs significant private investment plus sponsorship from the relevant country-level and EU-level public bodies and consenting authorities. At the moment, the current overlap of consenting regimes for cross-border and/or cluster-based CCUS projects has created a jigsaw, which does not present a cohesive picture of the region's regulatory systems."

Darren Walsh, Partner, Global Co-head of Energy, DWF

Countries can sometimes struggle with viewing European and national-level policies for CCUS as complementary rather than competitive, which can have implications for financing and covering the difference between the cost of projects and the price of CO_2 in the European market.

Another barrier is limited support for building a route to market. The Netherlands and the UK are two of the only few countries so far to have put in place new, innovative mechanisms to commercialise CCUS projects. In the Netherlands, CCUS has been pitted against other technologies in a competition for decarbonising industry, with the government compensating the difference between the cost of these projects and the price of CO_2 on the European market for 15 years.

The UK, meanwhile, has published a business model under the Department of Business, Energy and Industrial Strategy (BEIS) on proposed CCUS commercial frameworks for financing and delivering CCUS technologies and creating an incentivised approach for CO_2 emitters through contracts for CCUS and "perks" for storage, which devolved jurisdictions, like Wales, are looking to for guidance in their own regulatory regimes.

Although current high carbon credits have made capture from certain projects more attractive (such as DRI/steel which typically has capture costs between US$ 60-90/tCO_2e[viii], or natural gas-based combined cycle power plants, which have a capture cost of ~US$ 75-90/tCO_2e[ix]), investors still seek certainty of returns on storage. Private and debt financiers also require the mitigation of cross chain and liability related risks that can add a significant cost to projects, despite higher carbon prices.

> "A lack of public incentives and adapted regulations (such as for planning enquiries and authorisations) has been the major cause for slow movement in the CCUS space in France, despite strong industrial potential and competence. An action plan for the development of CCUS is currently under development in this regard, with an initial support of € 5 B, potentially increasing to € 10 B if 50 of France's most polluting industrial sites decarbonise urgently."
>
> Carole Arribes, Partner, DWF

Figure 3 Recent EU ETS Carbon Prices[x]

> "Governments have realised that the lack of a private sector-based approach was one of the major issues for CCS failure in the last two decades. How to partner and how to incentivise the technology to build a viable route to market have now become the most important considerations for CCUS in European regulation and could be a sign of what is to come. The next big thing for CCUS in the region would be how it interfaces with other decarbonisation technologies, such as hydrogen, to facilitate the transition, and how current and future governments will manage changes to permitting regimes and building a route to market."
>
> Shane Toal, Partner, DWF

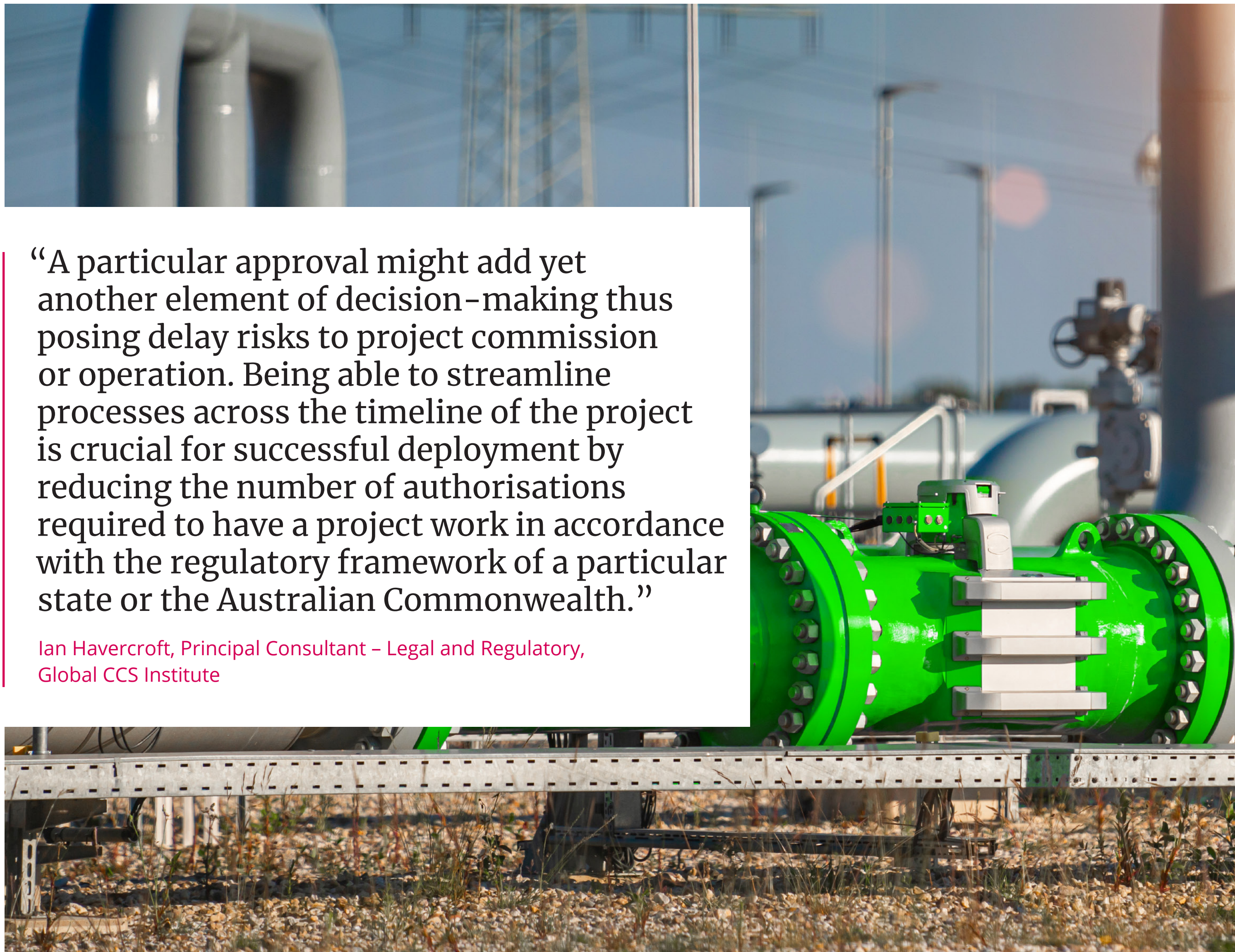
Developers in other large CCUS jurisdictions of the world, like **Australia** and the **US**, also face similar challenges in interpreting what is often the first of its kind legislation for the technology.

Most Australian states have some form of a CCUS regulatory framework in place, but the extent to which they approach the technology itself varies widely. Major issues that challenge current regulation include:

- Significant grey areas regarding procedures after the early process (i.e. after licensing and permitting for exploration of CCUS suitable sites), mainly in states like Queensland and Victoria;
- Ambiguity around “closing” a storage site, including responsibility for storage risks like leakage, and the use of insurance;
- Legal thresholds required for bringing in third-party operators;
- Increased decision-making processes due to a plethora of regulatory bodies for environmental permitting, land consent and water use, and;
- Impact of the Australian Carbon Credit Units (ACCU) policy framework and the Emissions Reduction Fund (ERF) on CCUS regulation for carbon offsets.

In the US, favourable drivers like tax incentives (45Q), opportunities for generating Californian low carbon fuel standard (LCFS) credits, federal policy support, and ESG imperatives have encouraged significant at-scale ambition, but the permitting framework is still to be fully tested. Legal issues around property rights, liability issues, and the harmonisation of other subsurface interests and uses with CCUS have remained on the backburner while governance for siting, operation, and closure and post-closure monitoring have developed.

Despite the US’s permitting programme for CCS being established in 2010 at the federal level, it has advanced only in some states such as Texas, Louisiana, North Dakota, and Wyoming. For example, North Dakota and Wyoming are the only two states to have received primacy for the federal permitting programme under the Safe Drinking Water Act for CO_2 injection for storage[xi].



> “A particular approval might add yet another element of decision-making thus posing delay risks to project commission or operation. Being able to streamline processes across the timeline of the project is crucial for successful deployment by reducing the number of authorisations required to have a project work in accordance with the regulatory framework of a particular state or the Australian Commonwealth.”
>
> Ian Havercroft, Principal Consultant – Legal and Regulatory, Global CCS Institute

How is the CCUS investment landscape changing?

Certain geographies have developed regional cross-border partnerships and agreements as part of increased cooperation towards meeting a common decarbonisation goal.

In Norway, Northern Lights is the most advanced project in Europe and is being heralded as a "game changer" by providing European industry with the ability to store its CO_2 emissions under the Norwegian Continental Shelf.

An agreement to this end was signed with Yara Sluiskil, an ammonia and fertiliser plant in the Netherlands to transport and store CO_2 captured from it under the Norwegian Continental Shelf, cementing the first-of-its-kind CCS agreement between two international jurisdictions.

Such cross-border CO_2 T&S network agreements can:

- Pave the way for international CO_2 T&S as a service;
- Establish a market for CO_2 T&S, and;
- Set new regulation and/or standards for European and other industrial companies looking to utilise CCUS cluster solutions as part of their decarbonisation strategies.

Another example is the Trans-European Networks for Energy (TEN-E) Regulation which was updated in May 2022 to include cross-border CO_2 networks[xii]. The CO_2 networks area includes CO_2 T&S infrastructure between EU member states and with neighbouring third countries, with eligible infrastructure including pipelines, CO_2 storage facilities (linked to cross-border transport), and fixed facilities for liquefaction and buffer storage with further transportation.

The TEN-E Regulation has opened up the possibility of multiple projects of common interest (PCIs) in the CCUS sphere, which could be eligible for:

- Preferential treatment (including special funding) in the context of permitting and environmental assessments, and;
- Lower administrative costs from streamlined legal review processes.

Such policy would also support feasible multi-utilisation as initial capacity of shared CO_2 T&S infrastructure is sized to take into account the connection of potential future users. Governments of countries with major cluster model projects underway, such as the UK, have already begun to consider options to drive future investment, including:

- Government funding to plug any "revenue gaps";
- Incentivising T&S network operators to find and connect more users;
- Building a ring-fenced financial reserve as part of incentive rewards and allowances from uncertainty mechanisms, such as CCUS reopeners, and;
- Establishing a contingent mechanism whereby investors receive a cap on their exposure whilst the number of common utilisers is low.

> "Policies like the TEN-E Regulation are now causing countries to wake up to the very real and material possibility of shipping and transporting their CO_2 for storage in other jurisdictions. The general feeling is that there is so much coastline to use, so why aren't more inter-country agreements being signed? An interconnected network between different jurisdictions would make a lot of sense, especially for countries who have the space to be receivers, and make a commercial business case out of it."
>
> Shane Toal, Partner, DWF

Ranking Matrix (Level of Focus)

Low — High

Country/Region	Jurisdiction	Regulation/Policy	Description	Industrial Clusters	Mitigating Offtake Risk	Lowering Capital Costs	Revenue Support for Private Sector	Mitigating Technical Risks
UK	National	CCS Infrastructure Fund (CIF)	Allocates £1 billion for CCUS investment in the UK as part of the UK Ten Point Plan for a Green Industrial Revolution and the Climate Change Committee's (CCC) Carbon Budget 6 recommendation.					
UK	National	Cluster Sequencing for CCUS Deployment	A BEIS-published update on proposed CCUS commercial frameworks for business models that apply to power and industrial carbon capture, and to T&S networks.					
UK	National	North Sea Transition Deal	Joint government and oil and gas sector investment of up to £16 billion by 2030 to reduce carbon emissions, including £3 billion on CCUS.					
EU	EU-level	Innovation Fund	One of the world's largest programmes for the demonstration of innovative low-carbon technologies, including CCUS, financed by revenues from the auction of emission allowances from the EU's Emissions Trading System.					
EU	EU-level	TEN-E Regulation	Supports the modernisation of Europe's cross-border energy infrastructure to achieve the objectives of the European Green Deal; updated in May 2022 to include cross-border CO_2 networks.					
Netherlands	National	SDE++ Subsidy Fund for CCS	An operating subsidy that lasts 15 years for CCS projects and bridges the cost gap between production without CCS and production with CCS. Allocated US$ 2.56 billion in grant money for the PORTHOS project.					
Norway	National	Longship Funding Scheme	A funding scheme for carbon capture from industrial facilities for injection beneath the seabed, with the CO_2 T&S solution being developed by Northern Lights.					
Australia	National	CCUS Hubs & Technology Programme	AU$ 250 million programme to deploy CCUS technologies at scale by encouraging domestic and international R&D, lowering costs, and supporting the goal of CO2 compression, T&S cost of under AU$ 20/tonne.					
Australia	National	CCUS Development Fund	AU$ 50 million fund to provide businesses with grants for pilot or pre-commercial projects including carbon use/recycling, negative emissions, DAC, and CCS. 6 projects have already been funded under the fund, including Santos's Moomba project.					
Australia	National	Australian Carbon Credit Units (ACCUs)	Issued under the Carbon Credits (Carbon Farming Initiative) Act of 2011 to award large-scale CCS projects with tradeable carbon credits.					
USA	National	Inflation Reduction Act: Section 13104	Implements changes to the 45Q tax credit providing up to US$ 85/tonne of CO_2 permanently stored and US$ 60/tonne of CO_2 used for EOR or industry, allows direct payments, and includes a 7-year extension to qualify for the tax credit, meaning that projects have until January 2033 to begin construction.					
USA	National	Infrastructure and Jobs Act: CCUS Investment	Allocates US$ 12 billion of new investment to support CCUS, including funding for new programmes and for previously-approved demonstration programmes under the Energy Act of 2020.					
USA	State	California Low Carbon Fuel Standard (LCFS)	A trading mechanism that allows transportation fuels whose lifecycle emissions have been reduced through CCS to become eligible for credits.					
Canada	National	Investment tax credit for CCUS (Planned)	Applies to CCUS projects that permanently store captured CO_2 via dedicated geological storage or in concrete. From 2022 through 2030, the tax credit rates will be set at 60% for investment in equipment to capture CO_2 in DAC projects; 50% in all other CCUS projects; and 37.5% for T&S and use.					
Canada	National	Strategic Innovation Fund	Provides investment of CA$ 100 million to accelerate the development and adoption of innovative technologies to lower the oil and gas industry's environmental impacts, including CCUS.					

Table 1 Key CCUS-related regulations and policies worldwide and their focus

Recent improved incentives, particularly under tax credit schemes, should boost investor confidence. For example, under the US Section 45Q Credit scheme, CCUS projects now have lower annual capture requirements, a later beginning of construction deadline (before January 01, 2033), and a limited, 5-year direct pay provision (allowing for an alternative monetisation option for project developers), and provisions related to the transfer of CCUS tax credits.

Such provisions are also being pursued in other jurisdictions, although no specific mechanism for the inclusion of CO_2 removal credits (CRCs) in the EU Emissions Trading System (EU ETS) exists so far. Such a mechanism in the EU would require minimum quantities for the use of removals as opposed to ceilings (as currently discussed), given current cost estimates for CCUS technologies, particularly for CCS with bioenergy (BECCS) and DAC, to accelerate investment[xiii].

Regulatory bodies can further improve investor appetite by transitionally acting as an intermediary that buys the CRCs and supplies them subject to observed allowance prices to maintain compliance with an overall cap. This could also address the complexity that carbon credits and trading add to the commerciality of CCUS, particularly in terms of liability risks like leakage.

EU legislation already provides safeguards for physical leakage concerning CCS, placing technologies like BECCS and DAC at an advantage for being included in the EU ETS. If provisions against CCUS installations exclusively using biomass not being covered by the EU ETS are revoked, they can allow operators of such installations to sell allowances made available through the use of BECCS[xiv], further improving its investment potential.

Regulation for CCUS investment can also shift based on whether a particular jurisdiction identifies as a CCUS user (defensive) or a developer (proactive). This is especially evident in the fiscal regimes of the Middle East, where there are no carbon prices or tax incentives. Most CCUS users there are oil and gas sector companies trying to secure their hydrocarbons businesses for as long as possible, and so rely on EOR or beneficial use as the main commercialisation route.

For these users, CCUS is regarded as "the cost of doing business", whereas for developers in jurisdictions with non-oil and gas based commercialisation prospects such as credits, PPPs, and contracts for difference (CfDs) CCUS can be a potentially lucrative business.

"While tax credits have all made CCUS more relevant, there is still ambiguity around how they will deal with issues such as leakage. Would operators have to account for any leakages by surrendering their allowances? How would these be measured and over what timeframe? If liability is based on future unpredictable prices under ETSs, operators could face unknowable and potentially uninsurable risks at the time of leakage. This necessitates a cap on liabilities, which regulators can do by acting as an intermediary that trades credits based on the allowance price."

Stephanie Smith, Senior Associate, DWF

CfDs can especially incentivise additional investment into new, low-carbon, capture-based electricity generation by providing stability and predictability to revenue streams. A CfD generator could receive payments by a low carbon contracts entity if the market price is below an agreed strike price, and vice-versa, lending transparency to investors.

Still, CfDs in the power sector might require a non-pipeline solution to transport the captured CO_2, such as shipping, which would require verification of metering technology, a prospect that is either not provided for, or still very nascent, in most regimes.

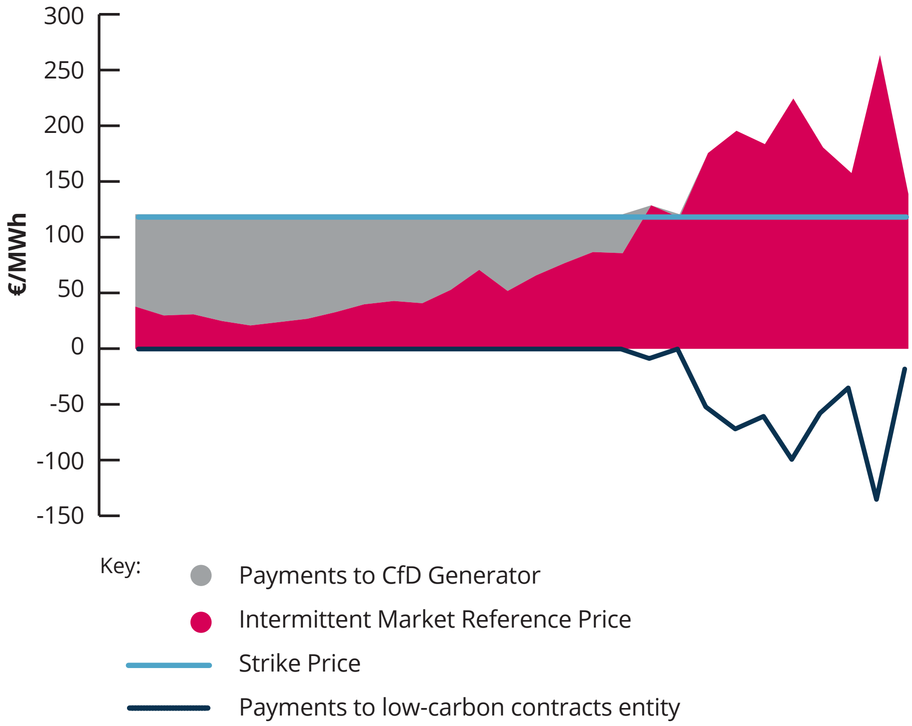
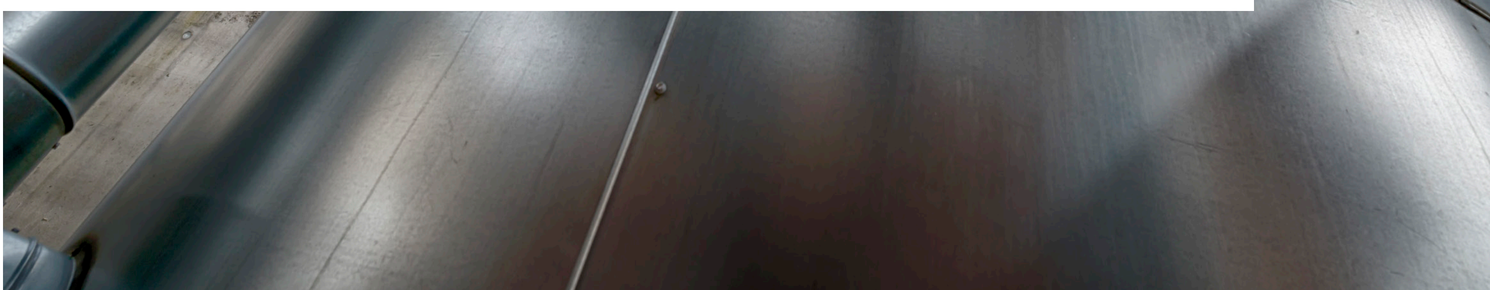


Figure 4 CfD mechanism for a low-carbon electricity generator[xv]

"Newer regulation may not have to be envisaged purely from an incentive-based perspective for the private sector to lend into CCUS projects. Industrial companies in France who are interested in CCUS solutions for their operations are making a case for the development of sector-wide decarbonisation mandates for all companies, so that those who do implement CCUS solutions are not financially crippled due to high costs compared to those who do not. This will directly cause a surge in more private sector involvement, as a higher number of industrials undertaking CCUS projects will de-risk it."

Carole Arribes, Partner, DWF



Overcoming the risk matrix

We examine the effectiveness of response measures to key CCUS investment risks.

Response measures to key CCUS investment risks are ranked by effectiveness in Table 2.

Across all seven risks identified, the role of statutes (law, fiscal regimes, and regulation) and regulator responsibility (liabilities, co-funding) stand out as the most effective in addressing and mitigating (at least initially) challenges across the CCUS project value chain.

Cross-chain risks are almost always linked with the T&S network to which the CCUS project connects.

Some common risks and their potential solutions can include:

- In the case of a timing mismatch for an industrial CCUS project, the facility could receive payment for capturing carbon while the T&S gets ready to be commissioned, or, the commissioning of the capture facility could be extended to align with that of the T&S network.
- In the case of a timing mismatch for a power CCUS project, availability payments could be paid to power CCUS generators if performance requirements are met. Variable generation could allow the generator to operate as an unabated power plant, subject to normal carbon pricing.
- In the case of a commissioning delay to the capture project, regulators could provide flexibility to operators of the T&S network through appropriate target commissioning windows (TCWs) as the BEIS has suggested.
- Underutilisation risks could be mitigated through government funding to plug any revenue gaps, and incentivising T&S companies to find and connect more users.

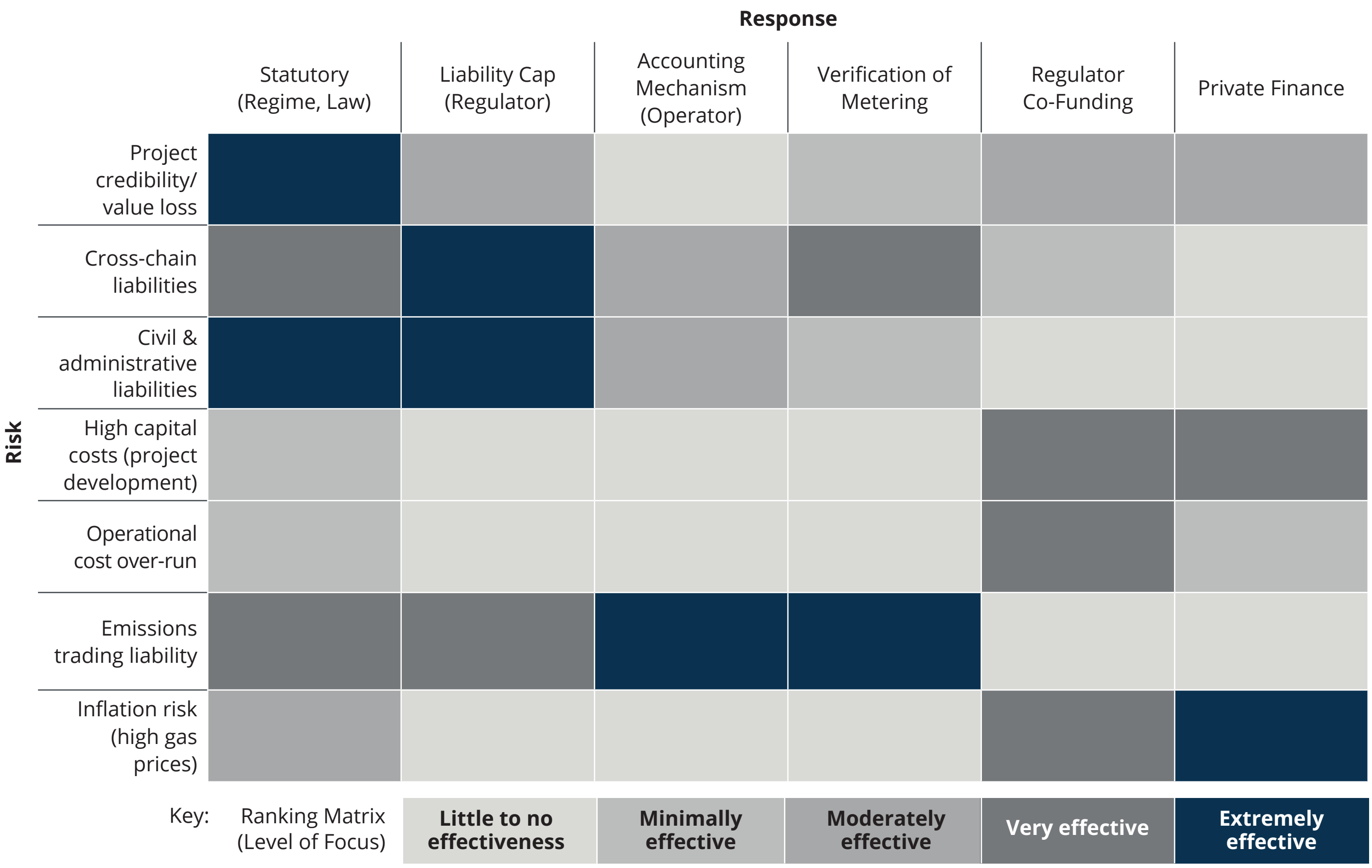


Table 2 Matrix of key CCUS investment risks and suggested response measures

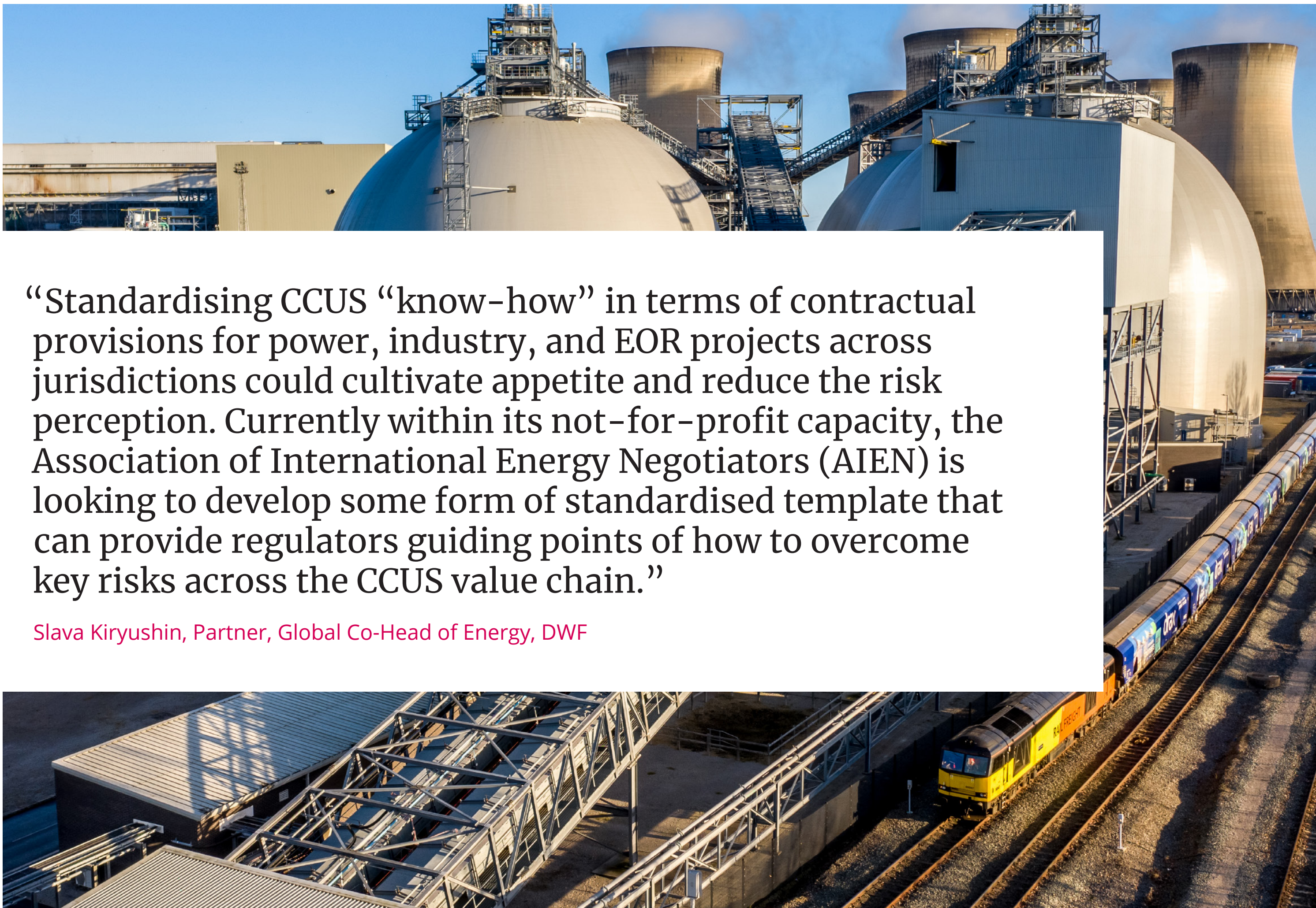
- In the case of outages in the T&S network, the capture facility could be provided with continued payment for capturing carbon. Another option is an extension to the term of the contract payments, commensurate with the duration of the outage.

Civil, administrative, and emissions trading liabilities are distinctively focussed around storage, largely due to the long time-scales involved.

- In the case of civil liabilities, a detailed statutory regulatory system of assessment and licensing can provide the primary motivator for operator standards, which can limit the risk of a potential civil claim.
- In the case of administrative liabilities, the right of appeal to an independent body or tribunal can provide prospective operators with a route to meander enforcements such as the duty to remediate to the satisfaction of the relevant authority.
- In the case of emissions trading liabilities, regulators can allow storage operators to purchase allowances to match subsequent leakages until an eventual post-closure transfer of the site to the state. However, the challenge of predicting a future allowance price over long time-scales can pose real difficulties for operators, unless provisions are applied with a degree of realism and flexibility.

High capital costs, operational cost overruns, and inflation risks can all deter investor appetite without appropriate regulator support.

- In the case of high capital costs, industrial carbon capture contracts can be coupled with government co-funding and/or private finance to provide plants with a payment to cover CAPEX plus a return for an initial period, typically 10 years, and if required, support for OPEX and T&S fees[xvii].
- In the case of operational cost overruns for a power CCUS project, a variable payment taking into account inflation risks (such as high gas prices), lower carbon costs, T&S fees, and other higher costs faced by the capture plant can be paid to the operator to incentivise generation ahead of a theoretical "reference" unabated plant[xviii].
- In the case of operational cost overruns for an industrial capture plant, a single operating expenditure reopener can mitigate the uncertainties in operating costs for first-of-their-kind industrial capture projects, particularly in the cluster model[xix].



> "Standardising CCUS "know-how" in terms of contractual provisions for power, industry, and EOR projects across jurisdictions could cultivate appetite and reduce the risk perception. Currently within its not-for-profit capacity, the Association of International Energy Negotiators (AIEN) is looking to develop some form of standardised template that can provide regulators guiding points of how to overcome key risks across the CCUS value chain."
>
> Slava Kiryushin, Partner, Global Co-Head of Energy, DWF

Five key actions for CCUS scale-up

Act now while planning ahead:

CCUS-interested companies should move **now** to invest in low-hanging fruit (i.e. projects that are becoming commercially attractive thanks to new incentives) and secure a stable market position in readiness for future opportunities to come. CCUS is gradually opening for all, from the more traditional oil and gas companies to infrastructure investors, asset managers, and pension funds, raising the potential for private equity as risks continue declining.

Choose where to play in the value chain:

Apart from capture, playing a part in the development of new technologies for the utilisation of CO_2 can help companies create further competitive advantages. Some new processes such as mineralisation are in the early stages of becoming commercial. Early adopters of new and upcoming parts of the CCUS value chain can derive a marketing benefit from selling environmentally friendly products, such as "green" steel.

Move beyond just capture and usage:

Defensive and proactive users will both have differing strategies, but need to create systemic shifts along their whole value chain to avail of the multiple benefits that CCUS can provide.

- For defensive users, a sophisticated CCUS value chain can enable not only decarbonisation, but secure access to end markets, including through the production of 'blue' hydrogen, which can utilise existing oil and gas-based infrastructure.
- For proactive users, a sophisticated CCUS value chain can enable the development of novel skills and capabilities which can form required partnerships with governments, R&D, and technology experts, yielding competitive advantages.

Assist in the development of streamlined contractual models:

For example, through partnering with not-for-profit organisations currently undertaking work to standardise contractual templates for capture initiatives, such as the AIEN, companies can help form the basis for engagement on future regulation that encompasses wider perspectives on issues of cross-border transport and cross-chain risks and informs more inclusive policy measures and financial incentives tailored to different categories of investor in the CCUS value chain.

- Such engagements can also shape markets of the future as bilateral, multilateral, regulated, or liberalised, dependent on geography and time, and;
- Establish a "one-stop shop" (such as ENTSOG) for issues of permitting and licensing within and across cross-border jurisdictions.

Innovate and land the groundwork for DAC and CaaS:

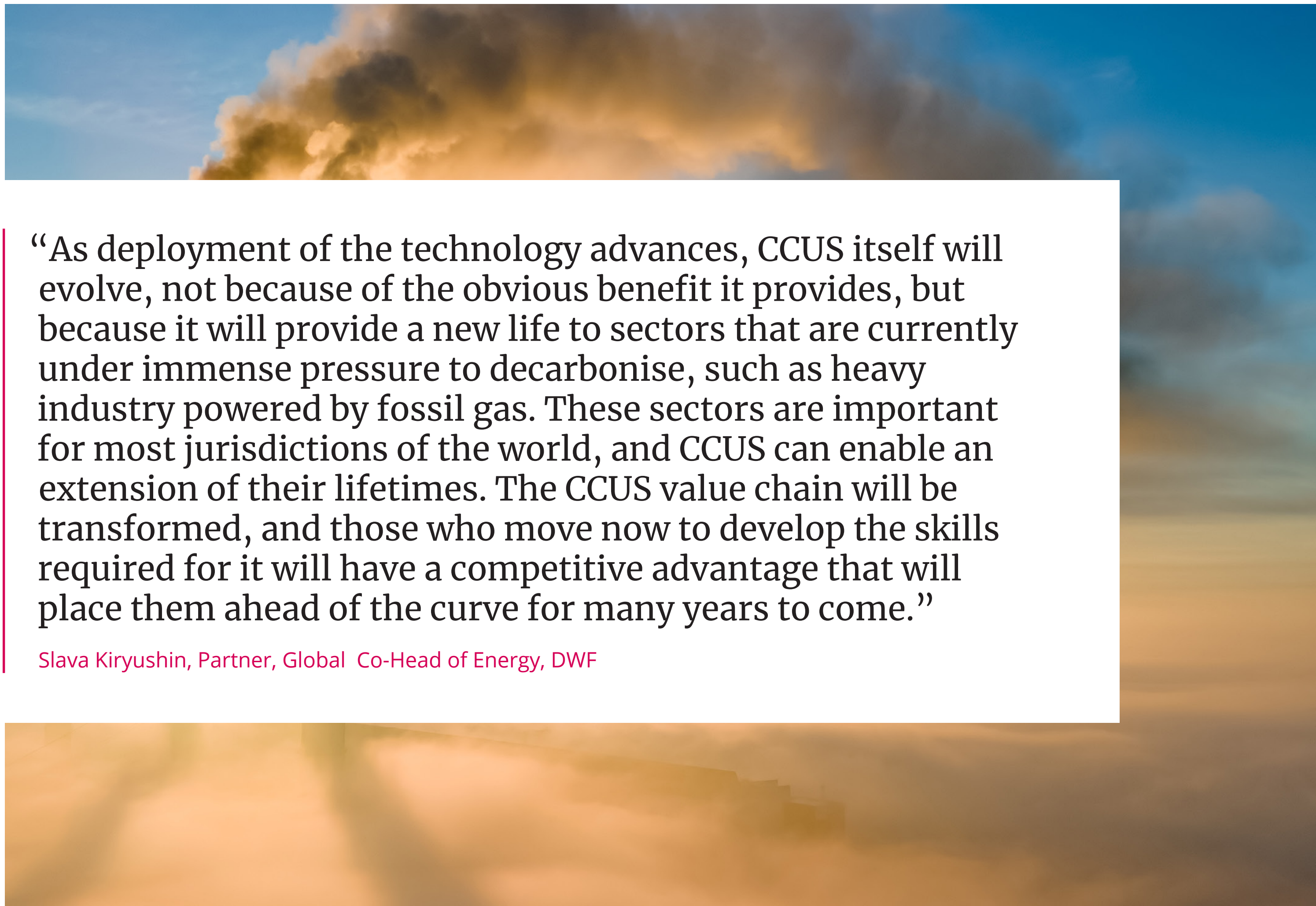
Longer-term plays exist in potentially game-changing technologies like DAC which could alter the economics of decarbonisation in fundamental ways. The aviation and maritime industries can invest in DAC-based synthetic fuel creation to decarbonise their operations. Capture-as-a-Service (CaaS) can become particularly lucrative for technology companies who want to become part of the cluster model by charging to capture and store the emissions of multiple nearby emitters.

Conclusions

Improvements in incentives and regulation for CCUS represent a significant opportunity for carbon intensive areas, including heavy industry and oil and gas activity, in key parts of the world. These include the upcoming cluster and hub models in the North Sea, elsewhere in Europe, and the US, as well as future prospective ones in the Middle East, North Africa and South-East Asia and Australia.

These regions could be at the forefront of the global energy transition. However, work remains to be done on the more granular and project-specific details of commercial models, as well as on the regulatory and operational parameters required to mitigate investment risks.

The CCUS risk matrix is complex and has many elements that need to be resolved quickly to scale-up the sector to meet crucial global decarbonisation targets. CCUS can ultimately be a very big industry in its own right, and those who move fastest to develop the required skills, technology access, and partnerships will have a competitive advantage that goes beyond just capture and use.



> "As deployment of the technology advances, CCUS itself will evolve, not because of the obvious benefit it provides, but because it will provide a new life to sectors that are currently under immense pressure to decarbonise, such as heavy industry powered by fossil gas. These sectors are important for most jurisdictions of the world, and CCUS can enable an extension of their lifetimes. The CCUS value chain will be transformed, and those who move now to develop the skills required for it will have a competitive advantage that will place them ahead of the curve for many years to come."
>
> Slava Kiryushin, Partner, Global Co-Head of Energy, DWF

DWF's energy team

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From government policy through to strategic development, funding, consenting, design, construction & operation to transmission, route to market, regulation, acquisition and disposal, insurance and dispute resolution, we work with clients at every point of market entry and across all technologies.

Please get in touch if you would to discuss CCUS or your business challenges more broadly.

For references please **click here**

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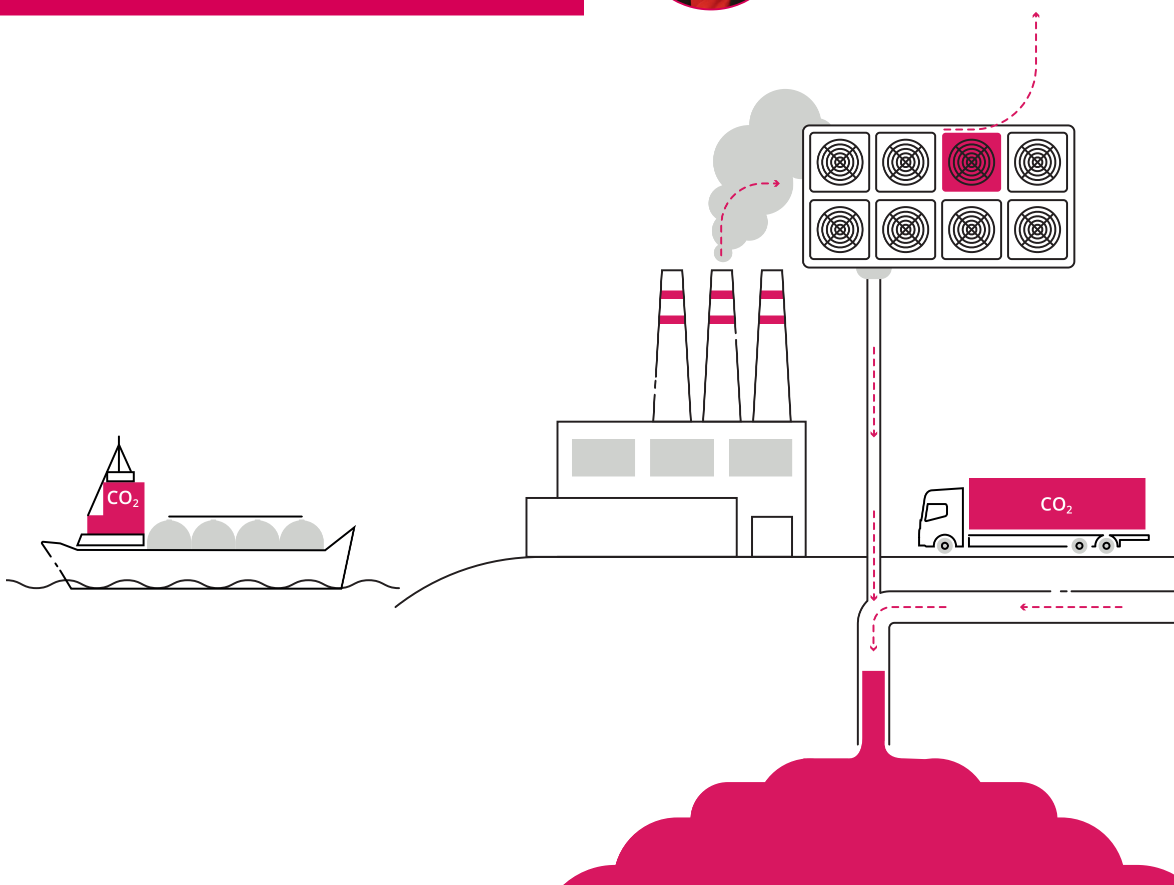

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