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Low carbon hydrogen production business model heads of terms update – what does it mean for carbon capture

The UK government published a revised version of the Heads of Terms ("**HoTs**") for the Low Carbon Hydrogen Production Business Model on 16 December 2022. Whilst these HoTs remain in draft form, they are significantly more detailed than the preliminary and indicative draft terms that were published earlier in the year.

As we have already written about how the HoTs affect hydrogen projects generally (see here), in this article we are going to look at how specific positions taken by the government in the HoTs may affect hydrogen production coming from carbon capture projects. We won't repeat what we wrote about in the last article, so you may want to read that before getting stuck into this (if you haven't done so already).

What are the key points?

- Projects that intended to produce blue hydrogen appear to be more complicated than green hydrogen projects due to the additional interface with the CO2 transport and storage network.
- Government is seeking to mitigate some of the risks that come with this complexity by protecting the hydrogen producer from some consequences of the transport and storage network being unavailable.
- However, the government will not allow the hydrogen investors to make a return on investments in these circumstances (even though their facility is operational).
- The government is also assuming that offtakers will want to accept hydrogen even if the hydrogen production results in significant CO2 emissions – an approach that is raising eyebrows in the industry.

What is carbon capture?

First, we thought it would be helpful to describe, at a high level, what carbon capture actually is. Carbon capture is the process of removing carbon from the atmosphere or from an industrial process and burying it underground. The first stage involves separating the carbon dioxide (CO2) from other gases produced in industrial processes, such as power generation, steel or cement production, which usually produce a lot of CO2. This can be done through different carbon capture technologies, which fall into three main categories:

- **Post-combustion** – waste gas released from industrial combustion or power stations is captured and the CO2 is separated. This is the more widely spread technology that has been implemented in large scale projects.
- **Pre-combustion** – this involves a pre-treatment of fuels so that carbon is separated from the finally burnt components. For example, by first converting coal into a mixture of CO2 and hydrogen by gasification, then capturing the CO2 and burning only the hydrogen.
- **Oxy-fuel combustion** – by burning fuel with pure oxygen instead of regular air, CO2 makes up a larger fraction of the waste gas, which makes it easier to separate out and store or repurpose.

The second stage is compressing the cleverly "captured" carbon and transporting it via pipelines, road transport or ships to a site for storage. Of these transport modes, pipelines and ships are the most scalable options with the lowest cost per tonne of CO2 transported.

In the third and final stage, the stored CO2 is injected into rock formations deep underground for permanent storage. These permanent storage sites could be saline aquifers (rocks in the sea that can absorb lots of salt water) or depleted oil and gas reservoirs, which are usually 1km or more underground. This means the CO2 is often piped a fairly long way offshore and deep into the seabed.

It is likely that a number of the transport and storage networks will be established across the country for producers of hydrogen (as well as other industrial processes producing CO2) to connect into.

This process is commonly known as CCS (Carbon Capture Storage) but you may also have come across CCUS (Carbon Capture Utilisation and Storage). The difference here is that instead of storing the carbon far away, you can instead use it for industrial processes by converting it, for example, into plastics, concrete or biofuel. This doesn't lead to emission reductions but is a way to utilise the captured CO2.

The point of carbon capture technology is to prevent large amounts of CO2 from entering the atmosphere and therefore heating up the planet. This makes carbon capture a way to reduce CO2 emissions and decarbonise heavy industry. It is therefore seen as a critical part of the global transition to net zero.

So why is this relevant for hydrogen and what has it got to do with the Low Carbon Hydrogen Agreement ("LCHA")?

For an invisible gas, hydrogen certainly does come in many colours. To produce hydrogen, an energy source is required. Hydrogen can be produced from renewable energies, such as wind and solar (to make "green" hydrogen). Fossil fuels, such as natural gas and coal, can also be used to produce hydrogen. The hydrogen created through this process is known as "grey" hydrogen – it is a much less environmentally friendly method of production than the process that creates green hydrogen due to the CO_2 that is produced. CCS and CCUS technologies can reduce the carbon footprint of the grey hydrogen processes - the resulting hydrogen is then known as "blue" hydrogen.

The government recognises that carbon capture has a role to play when it comes to hydrogen production and reflects this in the HoTs for the LCHA. This is particularly the case where there is a concern that there is insufficient renewable electricity generation capacity available to guarantee that a base load supply of hydrogen will be available.

The LCHA will largely follow the same contract structure as for (1) the Contracts for Difference for Allocation Round 4 and (2) the draft Standard Terms and Conditions for the Dispatchable Power Agreement published in November 2022 and the draft Standard Terms and Conditions for the Industrial Carbon Capture Contract for the CCUS programme which BEIS published last month.

Timescales

	Carbon capture	Hydrogen production
Mid 2020	• At least one power CCUS plant • At least 2 CCUS clusters	• First hydrogen business model contracts awarded • 2GW hydrogen production in construction or operation (2025)
Between 2025-2030	Up to 1GW of CCUS-enabled hydrogen	• Hydrogen heating decision (2026) • Potential hydrogen heated town
Between 2030-2035	4 CCUS clusters by 2030	Up to 10GW of hydrogen production
2035	Deliver a fully decarbonised power station	

While the timelines just about fit together, there are a few question marks. Will the infrastructure be there within the next few years to deliver two CCUS clusters? It stands to reason that the construction processes should pretty much start now as the decarbonisation deadlines are not very far away. However, the government is still finalising the contracts and determining which projects will go ahead. Additionally, there also does not seem to be much slippage in the timetables – if a project runs into difficulties, then the timetable would come apart quite quickly.

CCUS specific principles at the start of the project

As well the general operational conditions precedent, for the start date to occur for CCUS-enabled facilities producers need to show that the facility is connected to the CO2 T&S Network. This requirement is called the CO2 T&S Connection Confirmation CP. As a reminder, the operational conditions precedent have to be satisfied before the Low Carbon Contracts Company ("LCCC" – the body that will enter into the low carbon hydrogen agreement) will make any payments to the producer, so this is an additional hurdle to be overcome by the producer – and one which at first blush could cause concern. What if the producer cannot connect to the T&S network because the network is not ready?

The LCHA does provide limited relief for a CO2 T&S Commissioning Delay Event if it is outside the producer's control. The producer can then request an extension to the Milestone Delivery Date (which is 18 months after the date of the agreement), the Target Commissioning Window and/or the Longstop Date. In addition, the producer is entitled to compensation if the other operational CPs are complied with.

This compensation (the "CO2 T&S Connection Delay Compensation") would cover irrevocable and out-of-pocket costs incurred by the producer in relation to the delay. In other words, the cost of mothballing the plant until the CO2 T&S connection is ready. Whilst this seems like a reasonable position for the government to ask producers to accept, it is rather less ideal for the offtaker who was expecting some hydrogen and probably had lined up a good use for it. Offtakers will probably want to reallocate some of the risk so that the producers are sufficiently incentivised to fulfil the CO2 T&S Connection Confirmation CP.

Alternatively, the producer can request a waiver of the CO2 T&S Connection Confirmation CP provided that the other operational CPs are complied with. This means the producer can achieve its start date and begin to receive payments under the LCHA in respect of Qualifying Volumes produced and sold (see our previous article for a description of the different volume supports and what they mean). If the producer goes for this option, its hydrogen doesn't have to comply with the low carbon hydrogen standard ("LCHS") until the CO2 T&S Connection Confirmation CP is complied with. In these circumstances, the full strike price agreed during negotiations will apply.

This is all very rosy, and you may be forgiven for asking why the CO2 T&S Connection Confirmation CP is there in the first place if you can just start getting payments without it. The catch is that the producer has to pay the LCCC a succinctly-named "CO2 T&S Outage Relief Event Strike Price Deduction Amount" for each unit of hydrogen that is a Qualifying Volume. This deduction is essentially the return on investment that the producer is permitted to make under the LCHA. This seems to leave the producer

and offtaker in a 'lose/lose' situation – the producer is producing grey hydrogen but is not being permitted to make a return on its investment. The offtaker will be receiving grey hydrogen rather than the blue hydrogen they were expecting and will need to account for the additional cost of using a fuel with higher CO2 emissions.

If the CP has been waived, the producer is then not entitled to any other extension of time as the start date will have occurred. Once the T&S network is then available, the producer will have to fulfil the outstanding CP as soon as reasonably practicable (which is apparently within six months) – the CO2 T&S Connection Confirmation Deadline. If it doesn't, the LCCC will have the right to terminate the LCHA. So the producer has to be sure it would be able to get going with the hydrogen project were it not for the pesky CO2 T&S Commissioning Delay Event.

Price support and capacity

A hydrogen facility has to have a commissioned In terms of strike price, reference price and price discovery, these all follow the same mechanisms as for electrolyser-based green hydrogen. The only difference is that for CCUS-enabled facilities, the full strike price is not just indexed to CPI. Instead, the natural gas component is indexed by multiplying the monthly Gas Reference Price by an agreed proportion of up to 1.15 MWh per 1MWh of hydrogen produced/sold (with the agreed proportion of hydrogen being set based on project's design efficiency). The rest of the strike price is otherwise indexed to CPI.

Capacity for carbon capture projects will follow the same rules as for electrolyser-based projects, which you can read about in our previous article.

Special treatment for CCUS

The LCHA takes into account another scenario for CCUS enabled projects which is if something happens to prevent the project from fully accessing the T&S network ("CO2 T&S Outage Relief Events"). Unless this is the producer's fault, a CO2 T&S Outage Relief Event means that hydrogen volumes produced by the project won't have to comply with the LCHS if the hydrogen otherwise counts as a Qualifying Volume. In this case, the strike price agreed will apply but the CO2 T&S Outage Relief Event Strike Price Deduction Amount will be taken off it for the purposes of calculating the Difference Amount.

The CO2 T&S Outage Relief Event Strike Price Deduction Amount varies over the life of the project. The deduction amount is the agreed return on investment (the "Capital Return Component"), other than during the first two years when the hydrogen facility is ready to connect to the T&S network but the network is not ready to receive the connection. During those two years (sometimes called the "easement period"), the deduction amount is set at zero – in other words the full strike price is paid.

As is the case where the hydrogen facility starts production before the T&S network is operational, the hydrogen facility will be producing hydrogen, but this is grey hydrogen rather than blue hydrogen, as the CO2 is not being captured. There is a clear incentive on the producer to continue to produce and sell grey hydrogen because its LCHA payments are triggered by sales. Without sales of hydrogen, the producer has limited scope to receive an income, even if that income does not allow the producer to make a return on its investment.

However, this approach will only work if the offtaker is equally happy to receive grey hydrogen, even though grey hydrogen is likely to be more expensive ultimately for the offtaker given the additional carbon costs associated with grey hydrogen. It is entirely possible therefore that the carbon costs would result in grey hydrogen being more expensive than switching back to natural gas for the offtaker.

In other words, the LCHA is based on the premise that if an offtaker cannot receive blue hydrogen, it would prefer to take grey hydrogen instead. As this is likely to have a more negative environmental impact and be more expensive, it may well be that an offtaker would rather switch back to gas in these circumstances.

If this risk allocation remains then it is going to result in difficult conversations about what happens if there is a CO2 T&S outage given that the government's current position does not seem to satisfy anyone.

CCUS specific principles at the end of the contract

The events of default are largely common across hydrogen projects (for a description, please see our previous article) but there are a few termination events specific to CCUS projects as well.

As we mentioned earlier, the LCHA can be terminated for not satisfying the CO2 T&S Connection Confirmation CP, or if the LCCC waives the CO2 T&S Connection Confirmation CP and the producer fails to fulfil the CO2 T&S Connection Confirmation Requirement by the CO2 T&S Connection Confirmation Deadline.

The LCCC can also terminate if a "CO2 T&S Prolonged Unavailability Event" means that CO2 is not being exported from the hydrogen facility for a

protracted period. This is to ensure that the government is only supporting low carbon hydrogen in the longer term whilst hopefully giving enough time to fix the problem with the T&S network.

A CO2 T&S Prolonged Unavailability Event could be:

- a six month outage of the T&S network that means that the hydrogen facility cannot access the T&S network or export hydrogen to it;
- an event that delays the development, construction, completion and/or commissioning of the T&S network lasting for six months; or
- a cessation event, such as a notice of discontinuance to the CO2 T&S operator or it loses its licence, or a relevant authority determines that the producer's connection to the CO2 T&S network is no longer viable,

(in each case not caused by the producer).

If any of the above happens, the LCCC can issue a notice to the producer that gives the LCCC 30 months until it has the right to terminate the LCHA. The producer then has 18 months to come up with a feasible alternative route to permanent storage for the captured CO2. The LCCC has six months to review the plan in which it can accept or reject it, or require changes.

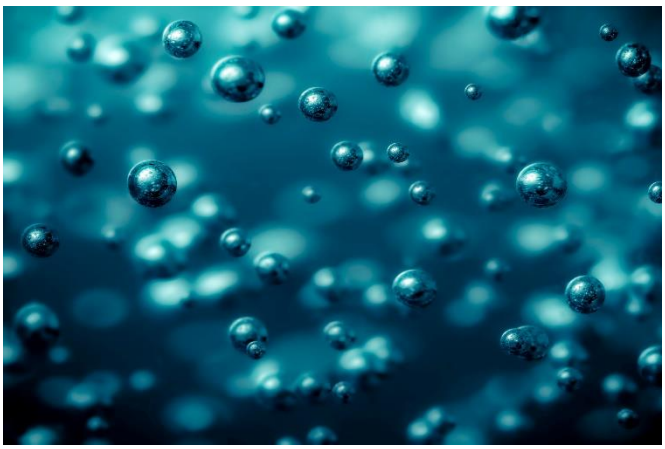
The producer then has 20 days to come back to the LCCC's response. If it can't be fixed and the plan isn't approved, then the LCCC can terminate the project.

If the LCHA is terminated as a result, the producer will be compensated for its out-of-pocket costs which have been incurred on the Project. This compensation includes development costs, decommissioning costs, contractual break costs or any other construction costs. These costs are capped at the "Total Capex Payment" (the total capital expenditure for the project that is subsidised by the LCHA). Certain other costs, however, are excluded such as the producer's pre-LCHA development costs, capital return, interest on debt, cost of compliance with the UK's emissions trading scheme, as well as any other lost forms of revenue.

This means that while the producer does not come away empty-handed in these circumstances, it will still incur cost and miss out on its projected return.

For offtakers, the position is tougher. The implication of the LCHA is that the producer should try to pass down as much as possible of the risk that it is left with to the offtaker. As, by definition, the offtaker is likely to be of reasonable covenant strength, this may prove to be difficult in practice. Moreover, the underlying assumption that the offtakers would be prepared to accept grey hydrogen and at a higher price may well not hold true in every case. It would not surprise us therefore if the government has a further look at this point.

As ever, the producer's financiers will play a key role in these projects. They will want to understand and see fully mitigated the additional risks that the T&S network introduces. Producers can therefore expect their projects to be subjected to very close scrutiny to ensure that they will work as planned.



Conclusion

The government has generally tightened its support for producers in these HoTs. However, when it comes to carbon capture, the government recognises that producers may need a little more support to push forward the more complex technologies. The process of making hydrogen is complicated enough for most people, without adding the extra layer of capturing carbon (and then perhaps using that carbon for something else). The more challenging the process becomes, perhaps inevitably, the more likely it is not to work. The government has therefore given CCUS projects a bit more of a break, but it seems they will only extend this generosity to the producers (and only to the extent that costs are covered but not returns on investment). There has to be a question about the appetite of investors to risk their investment returns on the ability of a third party to construct and operate a successful T&S facility that is in many ways completely outside their control.

Equally, the government assumes that offtakers will be willing to support and sign up to the riskier carbon capture technology in the name of net-zero targets, even to the extent that the offtaker would be prepared to receive very-much-not-net-zero grey hydrogen if the carbon capture aspects are not working for some reason. Although offtakers may be prepared to concede some worsening of their current

position when it comes to transitioning to cleaner energy, the replacement options will still need to make commercial sense to them, and fit within their overall environmental aspirations, especially in a tough economic climate and an ongoing energy crisis.

All in all, it's set to be a big year for hydrogen; engagement with the HoTs and then with the draft full form LCHA are both coming up before the publication of the final LCHA in Q3. We'll let you have our thoughts on those as well.

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