Department for Business,
Energy and Industrial Strategy
3rd Floor, 1 Victoria Street,
London, SW1H 0ET

16/09/19

Non-Confidential Response to the Consultation on CCUS Business Models

Dear Matt,

As you are aware the Low Carbon Contracts Company (LCCC) and The Electricity Settlements Company (ESC) are private companies wholly owned by the Secretary of State for Business, Energy and Industrial Strategy (BEIS). They perform central functions in the operation of the Contracts for Difference (CfD) and Capacity Market (CM) schemes. LCCC carries out the functions of its sister company ESC, via a cost-sharing arrangement.

We welcome the opportunity to respond to the Consultation on CCUS business models. CCUS technologies will play a vital role in delivering the Government's Net Zero ambitions.

This summer has been a busy operational period for us with the ongoing CfD Allocation Round 3 and Capacity Market restart activities. We have therefore limited the scope of our response to the following:

- The challenges of the initial deployment phase (rather than post-2030 roll-out);
- Business models for capture facilities (rather than T&S business models); and
- Consideration of commercial drivers for the above.

Our key messages are that:

1. The level of risk borne by the government versus the developer may need to be different during the initial deployment phase to what may be required for any potential future roll-out phase. Our response focuses on the challenges of the initial deployment phase.
2. Risks should be allocated where they can best be managed. In the initial deployment phase this means we would advocate that capture facilities should be protected against CCUS-specific risk emanating from the T&S infrastructure.
3. For the initial deployment stage, we consider that CfD-based solutions would work and can be implemented. We do however consider that some slight variations might be desirable, and we recommend that a hybrid of the proposed options is considered as this might enable a cross-sectoral business model to emerge.
4. All of the proposed business models are likely to require some form of interface agreement or legislative framework that would sit alongside the contract for clean electricity.

Whilst we have considered our response carefully, we recognise the need to more fully explore our ideas and stress test our proposals, as our ability to do this has been limited.

We would however like to take this opportunity to thank your officials for their responsiveness to our queries which has been essential in developing this response and we look forward to supporting this agenda in the future.

Yours sincerely,

Ruth Herbert
Director of Strategy & Development
Low Carbon Contracts Company
Electricity Settlements Company

CCUS Business models: LCCC consultation response

1. Have we identified the right parameters to guide the development of CCUS business models?

1. Yes, however we also recognise the imperative of a 2-phase process
    a. The '*initial deployment phase'* of commercial scale CCUS facilities and T&S infrastructure from the mid-2020s; and
    b. Refinement of business models and transition to a competitive process for a possible wider '*roll-out phase*' of CCUS solutions in the 2030s.
2. The goals, and therefore the key parameters, will differ between the two phases, which we have sought to illustrate in table 1 below.

Table 1 - BEIS parameter by deployment phase

BEIS parameters	**Initial deployment phase**	**Roll-out phase**
Value for economy	The option value associated with access to CCUS technology & infrastructure	Significant industrial benefits and possibly key role in power decarbonisation
Investor confidence	Initial investors are likely to be mainly equity and the associated cost of capital relatively high.	The Policy will need to attract lowest possible cost of capital.
Cost effective	Desirable, but will be limited due to lack of industry maturity. Despite best possible business models, there are likely to be high risk premiums, technology cost uncertainty and asymmetry of information in negotiations.	Achievable through competitive processes for the allocation of proven technologies, minimised cross-chain risks & tested business models. The policy may have to be broadened beyond CCUS-only solutions to avoid lock-in risks (elaborated below).
Appropriate and fair cost sharing	Government will need to take a share of the risks, particularly regarding cross-chain risks that are new to the developers.	Risk sharing can be better distributed, reducing the burden on Government.
Subsidy free	Can mitigate against changes to carbon prices.	In addition to carbon price risk mitigation, competition should help minimise costs.

2. Bearing in mind our emerging findings on CCUS business models, do you have any views at this stage on how the business models might be integrated?

3. LCCC is currently of the view that targeted policies, such as Contract for Differences (CfDs), will be necessary for the foreseeable future and competitive mechanisms such as auctions can be an effective way of minimising costs.
4. LCCC's response therefore focuses on the short-term challenge of the initial deployment phase and considers the business models from a commercial perspective, based on our current interpretation of the underpinning policy intent and our (limited) analysis to date.
5. In this time horizon, we are of the view that CfD-based models are an appropriate approach for both the Power and Industrial sectors. In this response, we put forward some key principles to support CfD-based solutions and also suggest that BEIS might wish to consider a hybrid between the Power CCUS Dispatchable CfD and Industrial CCUS Carbon based CfD as a possible alternative to the options considered so far.
6. This stems from thinking that it might be possible for a single business model to apply across the power and industrial sectors, as well as hydrogen production, however this requires some further consideration and testing. We believe that if this can be achieved, it would better integrate the sector and possibly support a faster CCUS roll-out phase in the future.
7. In addition to business models for each part of the chain, some form of interface agreement or legislative framework is needed, to provide for risk sharing arrangements for cross-chain risks and associated liabilities.
8. Whilst we understand the drivers for policies targeted at a single technology during the initial deployment phase, particularly for technologies that have yet to scale up, we are mindful of the fact that CCUS should be competing alongside other decarbonisation solutions (both alternative clean power and carbon removal technologies) in the 2030s.

CCUS-specific risks

3. Do you have proposals to mitigate CCUS-specific risks?

9. LCCC recognises the need for two main phases in the deployment of CCUS, an initial deployment phase and a possible roll-out phase.
10. Whilst we agree that, in principle, the core set of risks identified might be low probability outcomes, it is reasonable to expect investors risk perception to be materially higher during the initial deployment phase.
11. LCCC considers that the allocation of risks should be where these can be best managed and that this risk allocation should change between initial deployment phase and the roll-out phase.
12. The mitigation solutions below are specific to the design of business models for the capture facilities, not the transport and storage ("T&S") infrastructure.

CCUS-specific risk 1: mitigating CO_2-related cross-chain risks

13. During the initial deployment phase, we suggest that it would be preferable to isolate Capture Facilities from cross-chain risks as best as possible. Power plant developers may not be currently well-placed to manage those risks, and will already be required to manage the construction risk for the Capture Facility (we use this terminology throughout the response as short hand for the Generation and Carbon Capture Facility).

Temporary unavailability of the T&S infrastructure

14. Unless the Capture Facility has temporary storage in place, the unavailability of the T&S infrastructure, even for a very short duration, will result in an interruption in the variable payments element. For the Capture Facilities, this risk will therefore be reflected in the level of the fixed payment, as proposed in the Power CCUS Dispatchable CfD solution.
15. To achieve this, the fixed payment is likely to need to cover all relevant capital and fixed operational costs. However, during the roll-out phase we would expect the fixed payment to reduce.
16. Whilst it would be disadvantageous for the Capture Facility to operate without a route-to-storage from an emissions reduction viewpoint, it would be commercially sensible to allow unabated operations for a defined period, whilst continuing fixed payments as this would reduce overall support costs.
17. Despite this approach we anticipate that the loss of variable payments as a result of the T&S being temporarily unavailable will still have some negative impact on expected revenues and liability payments from the T&S operator should be considered.

Temporary unavailability of the Capture Facility

18. If the Capture Facility is not available, it would be reasonable to expect interruption of all support payments to the Capture Facility.
19. Whilst this is a sound principle, it remains important to recognise that there is likely to be several reasons why the Capture Facility might not be available, for example routine maintenance of either the power plant or the capture equipment, and a more nuanced approach than a binary trigger may therefore be needed. Performance mechanisms in the standard CfD framework could be useful starting points, such as efficiency standards, sustainability criteria etc. These have the effect of creating a threshold for minimum operational performance standards over a given period of time (typically 12 months).
20. Further incentives or penalties could be considered for non-availability, based on system needs. For example, the mechanism used in the Capacity Market. Under the Capacity Market, financial penalties are imposed on Capacity Providers who fail to meet their Capacity Obligations during a Capacity Market Warning and a System Stress Event.[1]

CCUS-specific risk 2: stranded asset risk

21. T&S infrastructure delays that result in the Capture Facility being available before the completion of the T&S infrastructure should be treated similarly to the above proposed cross-chain risk.

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1 https://www.emrsettlement.co.uk/documentstore/guidance/g17-capacity-provider-payments.pdf

22. In the event of permanent stranding of any assets, a longstop is needed whereby there is a need for an "Authority compensation on termination" mechanism, similar to a shutdown event in the Hinkley Point C Secretary of State Interface Agreement (SOSIA).

23. A baseline financial model will also be required to allow for relevant calculations to take place.

CCUS-specific risk 3: long-term CO_2 storage liability and leakage

24. The Capture Facilities should not be liable for any storage liabilities and leakage. The liability is transferred from the Capture Facility to the T&S operator at the point it leaves the Capture Facility and enters the T&S system.

25. We understand from discussions with the industry that there are potential CO_2 transport and storage operators who are willing to finance their operations in compliance with the EU Directive on the geological storage of CO_2 and permits have been applied for to operate CO_2 storage sites in the UK continental shelf[2].

26. In the event that the insurance market for the transportation of CO_2 has yet to develop, then the contract may need to provide a cap to the liabilities of the transport system. The Hinkley Point C (HPC) nuclear CfD deals with a similar challenge through the following mechanism:

    a. The level of insurance cover required is for a specified value, if the required cover/scope of cover changes then there is an adjustment to take account of this additional cost/reduction in cost to the Generator.

    b. If the insurance market is unable to supply insurance then HMG must put in place arrangements for insurance, if HMG is unable to or withdraws arrangements then compensation is payable if the cost of the Generator to self-insure (if this is permitted) exceeds the annual cap.

    c. If the Generator is unable to self-insure and no other arrangements can be put in place then a shutdown event occurs.

4. Are there any other CCUS-specific risks that need to be considered? If so, what are your proposals for mitigating them?

Opportunity cost: Lock-in risk

27. Investment in CCUS infrastructure has the potential to lock government and consumers into technological solutions through long term obligations and network effects.

28. There is a risk that this could stifle innovation to existing processes, stifle transition to new processes or other (potentially cheaper) decarbonisation alternatives, thus resulting in higher decarbonisation costs.

29. The Net Zero ambition provides a high enough degree of certainty that a reasonable volume of CCUS deployment is necessary and therefore we consider that lock-in risk is low during the initial deployment phase.

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[2] https://ec.europa.eu/clima/sites/clima/files/lowcarbon/ccs/implementation/docs/c_2016_152_en.pdf

30. These risks cannot however be ignored during the roll-out phase. In the absence of the right price signals in the market (e.g. price of carbon), incentive mechanisms should be technology neutral as far as possible.

Consumer cost risk: Price of carbon

31. At present, the lack of a sufficiently high carbon price supports the need for continued government intervention. However, CCUS support offered in the coming years should mitigate the risk of possible changes to carbon pricing in the future to protect consumers from windfall profits to Capture Facilities in the event of significant increases in the price of carbon.

Cost risk: Access to low-cost finance

32. The level of investment required, and cost of the capital will be a determining factor in the cost effectiveness of a roll-out of CCUS.

33. Our experience of the CfD is that the investor community will need some time get comfortable with the mechanics, implementation and operation of the scheme and legal details of new financial instruments

34. Whilst it is hard to quantify, it is reasonable to assume, drawing parallels with the financial and supply chain learning in the offshore wind industry, that it can take several years for a material amount of capital to start being directed to these solutions to drive down cost, and another few years of successful development activity, or even the first operational plant to start receiving payments, for the cost of capital to fall significantly.

35. The CfD alone will be insufficient to attract a low cost of finance. Debt providers and institutional investors are more than likely to look at any technology risk and cross-chain risks in a conservative manner. It is commonly known that HPC is 100% equity backed and some of the more innovative technologies that have secured CfDs have failed due to difficulties in achieving financial close.

36. It is for these reasons that we highlighted in our Table 1 that the initial deployment phase is primarily about creating option value.

37. However, to enable the roll-out phase, access to low-cost finance is essential. As such, the initial choice of business model is very important, as is the appetite for investors to get behind subsequent roll-out volumes will be based on the fact that the business model is “tried and tested” and this will limit to a certain extent the amount of change that can be made to the support mechanism.

Cost risk: Overcompensation risk

38. The initial deployment phase is likely to be delivered through a negotiated process in which cost uncertainty, information asymmetry and pre-deployment risks are likely to be high.

39. It is therefore likely that there will be a material change to the risk profile of projects in the initial deployment phase and this could result in lucrative refinancing deals as investors with lower Investment Rate of Return expectations might be attracted.

40. Whilst we believe that revenue uncertainty can be managed through the use of fixed payments, depending on the contract length, the government may wish to consider a gainshare mechanism similar to the HPC model in order to mitigate the

overcompensation risk that emerges from a change in the projects risk profile over its lifetime. This would require a baseline financial model to be established at the outset and regularly updated.

Political risk: Scheme level

41. By this we meant the perceived risk associated with the running of allocation processes and access to these and how these affects the decisions to invest or not in developing a project.
42. The CCUS sector itself has gone through two aborted government support phases. Mitigation of this risk might be partially achieved through institutional arrangements and robust legislation.
43. The approach to procurement under the Capacity Market scheme provides some effective solutions to mitigate this risk.
44. More recent experience with the Judicial Review does also highlight the importance of a robust ongoing policy appraisal process, including broad stakeholder engagement strategy.

Political risk: Project level

45. Whilst the CfD creates a high 'allocation risk', that is the uncertainty associated with a project being able to secure a CfD, the CfD provides a good level of protection against political risk once it is secured.
46. The main features of the CfDs that provide this protection are the private law contract, managed by private counterparty with a robust settlement structure.

Carbon dioxide transport and storage (T&S)

5. Have we identified the most important challenges in considering the development of CO_2 networks?

47. This response does not focus on the technical solutions to delivering T&S, but on the interactions of T&S charges and the business models for Capture Facilities.
48. Cross-chain risks and associated liabilities will require clear allocation to the parties that can best manage these.
49. Our only recommendation would be, to the greatest extent possible, to isolate the Business Models for the Capture Facilities from T&S operational cross-chain risks so that the Capture Facilities effectively operate, as much as possible, as stand-alone contracts.
50. Our high-level considerations on cross-chain, stranded asset and long-term CO_2 storage liability and leakage risks is discussed in our response to question 3.

6. Do you agree that a T&S fee is an important consideration for any CO_2 T&S network? In your view, what is the optimal approach to setting the T&S fee?

51. Whilst we recognise the simplicity of looking to the power sector for a clear and established revenue stream to bear the initial burden of the T&S infrastructure, we

believe this could jeopardise the Government's power sector decarbonisation and CCUS strategy.

52. The allocation of all T&S costs to the initial capture plant in the initial deployment phase will result in very high upfront costs for the first Capture Facilities. In the power sector there are two challenges:
    a. the first will be the stark difference between the cost of renewables and the initial power CCUS station; and
    b. the second is the increased burden on electricity consumers to pay via supplier levies for any over-sizing of T&S infrastructure, which in future may be used by the same heavy industry that is exempt from those levies, at a time when the full impacts of the CfD levies (including HPC) and potential future RAB costs are likely to be felt.

53. In light of current concerns around power prices and the price cap, we believe that a more measured approach should be sought during the initial deployment phase in which T&S fees should be, as much as possible, be reflective of long-term expectations.

54. Whilst we recognise that this is challenging, we do not believe that it would be sensible for T&S fees to exceed the operational T&S costs.

55. T&S fees could be delivered through a fixed and variable element that seeks to match the structure and logic of business models for capture plant.

7. Of the models we have considered for CO_2 T&S, do you have a preference, and why?

56. LCCC has limited experience in this area and our only recommendation is that to minimise T&S fees during the initial deployment phase, ensuring that the first capture facilities do not subsidise subsequent network users.

8. Are there any models that we have not considered in this consultation which you think should be taken forward for CO_2 T&S, and why?

n/a

Power CCUS

9. Have we identified the most important challenges in considering the development of CCUS power projects?

57. The CCC Net Zero report implies that the power sector is likely to need to deliver negative emissions in 2050. We consider that at the very least all power sector services will need to be provided by low-carbon solutions. However, in the absence of materially higher and bankable carbon prices, the market is unlikely to deliver this outcome.

58. The need for Government intervention is therefore heightened by Net Zero and the recent series of consultations on CCUS and nuclear RAB highlight this direction of travel.

59. We currently expect mature renewables to cost-effectively provide the bulk of our power needs. It is, however, not yet clear what are the most cost-effective solutions for the provision of any necessary base-load, mid-merit and peaking system services.

60. The CCC's Net Zero analysis does provide some indication of "no-regret decisions" in the short term, namely the initial deployment phase of Power CCUS, and especially considering the need for low-carbon generation providing a mid-merit service.

61. We recognise that there are "no-regret levels" of deployment of different types of system services. In the longer term there could be tensions between technologies that can provide similar system services and lock in risk referred to in our response to question 3.

62. We believe that the challenge above justifies rapid initial deployment of Power CCUS which will require Government to take a higher level of risk allocation than is likely to be necessary in the longer term.

10. Of the models we have considered for power CCUS, do you have a preference, and why?

Standard CfD vs Dispatchable CfD

63. LCCC has considered the objectives set-out in the CCUS power section and we consider that with the current evidence, it is appropriate that government procurement of Power CCUS is not aimed at replacing low-marginal cost renewables generation.

64. It is therefore appropriate for the Power CCUS business model to be focused on providing system services that cannot be delivered by variable renewable technologies, i.e. firm, dispatchable and flexible low carbon power that also contribute to grid stability.

65. It is possible that whilst early deployment of CCUS might be more rapidly achieved under a standard CfD, as this requires less legislative change to implement, there remains significant complexity around the need for fuel and carbon indexation to manage associated risks. Even under the Standard CfD approach we would anticipate significant changes to the contract and an overarching framework would also be needed.

66. LCCC has therefore focused on exploring the operational challenges behind the Dispatchable CfD and how to best achieve the desired outcome of efficiently substituting unabated fossil fuel generation in the merit order.

67. We have not included any considerations around the possible need for negative emissions solutions in this response.

Dispatchable CfD proposal

68. After an initial review of the proposed solution, LCCC has concluded that the BEIS solutions should be technically and operationally deliverable.

69. There are challenges in getting the dynamic determination of a SRMC at half-hourly granularity right and it might be worth exploring a variety of mechanisms to achieve this outcome. For instance, it might be possible to use a mechanism like the negative pricing rules in the existing CfD but applied from the base of an SRMC of low-marginal cost renewables.

70. We have also given some thoughts to the appropriate Reference Price to use to settle the difference payments, which is also challenging and requires further development.

71. To expedite our initial analysis, we have only considered these models against BEIS's initial focus on new-build CCGT plant with post-combustion CCUS, i.e. excluding retrofit

and low-carbon fuels. Assumptions have not been stressed tested through modelling work.

72. To ensure that any design is effective and does not result in unintended consequences we will need more detail and time to undertake analysis than has been available to us thus far.

Dispatchable CfD - Key mechanics

73. Setting aside implementation details around the setting of the SRMC and reference price, the proposed fixed and variable payments appear effective methods to support the desired outcomes.

74. We recognise that these solutions help manage technology and cross-chain risks by allowing an initially greater proportion of CfD revenue to be fixed with an additional variable element.

75. We are also of the view that the gearing (or balance) between the fixed and variable payments could be adjusted over time to reflect changes in the revenue profile that would result for a shift from baseload type operation to mid-merit profile. Thus providing increased revenue certainty for the generator.

76. In addition, the separation of the fixed and variable payments creates an interesting opportunity to make the payments available at different times in the project life-cycle. For instance, in a future where technology and project delivery risks are mostly mitigated, the fixed payment could in theory be made available prior to operation, thereby acting like a simplified RAB model to support further cost reduction, if this were deemed to be necessary.

Dispatchable CfD – alternative ideas

77. Using these building blocks, LCCC has identified a possible variation to the Dispatchable CfDs. We believe that a hybrid of the Power Sector Dispatchable CfD and the Industrial CCUS Carbon based CfD proposal could provide a functional long-term solution.

78. We believe such a hybrid model could present some significant implementation advantages whilst achieving the overarching BEIS objectives and remaining relatively simple.

11. In your view, should any potential funding model(s) be applicable across all power CCUS technologies (including but not necessarily limited to CCGT with post-combustion capture, BECCS, and pre-combustion capture or hydrogen turbines)?

79. A one size fits all model would be ideal and support maximum competitive tensions in any competitive allocation process.

80. Our experience of the CfD to date, however, is that there are challenges to having a one size fits all contract. However, as we stated earlier, the more standardised a solution is, the greater the familiarity and experience benefits for investors will be, reducing the cost of capital through allowing greater levels of debt financing.

81. The principles of a fixed availability payment and an operational payment incentive could in theory be extended to:
    a. Any Carbon Capture process, including Industrial process and hydrogen

b. To any dispatchable power generation technology, including ACT and possibly pumped storage type technologies

82. In the longer term, for the roll-out phase it might be worth exploring how the dispatchable CfD principles could be delivered through existing mechanisms.

83. Indeed, the Dispatchable CfD model presented by BEIS is effectively a hybrid of the business models in the Capacity Market and the Contract for Difference scheme and effectively allows revenue stacking and value of capacity (with an adjustment to the market price of carbon) to be reflected in the CfD payment element.

84. At the time EMR was being developed, the European Guidelines for State Aid were in the process of being reviewed and the Government explicitly ruled out access to support from both schemes by making these schemes mutually exclusive to applicants.

85. Our understanding of the aims of the State Aid Guidelines is however to avoid 'over compensation' and does not preclude a single project or entity from the receipt of multiple sources of state aid.

86. LCCC is aware of industrial clusters or private networks in which low-carbon generation is receiving CfD payments, and Energy Intensive Industrial sites within the same network are receiving levy exemptions and also have assets that receive Capacity Market payments for generation or storage assets. We see no reason why CCUS projects could not provide services across several markets and be compensated accordingly.

87. It is possible to put in place solutions that mitigate the risk of over compensation whilst still allowing generators to access CM payments and enter CfD auctions and this might be worth considering.

12. Are there any models that we have not considered in this

88. A hybrid of the Power Dispatchable CfD and the Industrial CCUS Carbon based CfD proposal could provide a simpler and functional long-term solution.

89. Such a business model might be able to achieve all the BEIS objectives, whilst being expandable to other technologies in the power sector, retrofit plant and even other sectors such as industrial CCUS and hydrogen.

90. We would welcome exploration of the viability of such a solution. In the meantime, we have laid out some key principles that we deem are likely to be key to any business model.

Common principles for the initial deployment phase

91. There are many features of any 'CfD' based business model that will need further discussion. Below we highlight some of the key elements associated with the remuneration processes.

92. Payment structure

a. Fixed payments should be defined to minimise exposure of the facility to cross-chain risk, in the short term this is likely to cover CAPEX and fixed OPEX for the CCUS plant. New build unabated CCGTs are unlikely to be built without Capacity Mechanism support therefore, to level the playing field, the fixed payment might need to account for some of the CCGT costs.

b. CfD payments should be defined to incentivise abated generation and ensure that it is dispatched before unabated CCGT. This will require that CfD payments exceed the total operational costs of the Capture process by an agreed margin (as merely matching the operational costs would only equalise CCGT and CCGT + CCUS dispatch decisions, not provide preferential CCUS dispatch).

c. To increase revenue certainty throughout the lifetime of the plant, where generated volumes are uncertain, a mechanism to adjust gearing between the Fixed and variable CfD payment should be considered.

93. **System & Asset optimisation**

a. Minimising costs to consumers means we need to consider optimising the use of assets to ensure lowest overall system costs. We therefore consider that any business model should consider allowing any CCUS plant to operate unabated in specific circumstances, providing that the capture plant remains available. Examples of scenarios in which it might be desirable to allow the plant to operate on an unabated basis could include:

   i. The plant should not be prevented (or disincentivised) from participating in the balancing market or from providing ancillary services.

   ii. In the event of a system stress event, as defined under the Capacity Market, maximum output from the facility that can only be achieved in unabated mode is likely to be desirable.

   iii. We also recognise that the capture process will have technical constraints which could for instance limit the facility's ability to operate efficiently at low power output.

b. We believe that the standard CfD includes mechanisms that could be used to achieve this outcome.

c. At its most basic, the carbon emissions from a Power CCUS facility are comparable to those from fuelled low-carbon generation such as Biomass and Advanced Combustion Technologies (ACT) in which the fuel is not always 100% renewable.

d. Examples of such mechanisms are the Fuel Measuring System and Sustainability Criteria or the new efficiency criteria for ACT. Whilst these solutions might, as of themselves, not be fully appropriate for CCUS they do provide useful precedents for how to deal with similar challenges.

94. **Cross-chain risk**

a. Fixed payments should be managed through some form of availability or performance standard to allow for commercial flexibility in the operation of the plant and maintenance requirements. This should be sufficiently low to penalise ineffective operation of the Capture Facility however fixed payments should not be suspended in the event that T&S is not available whilst the Capture Plant is.

b. Variable payments should be suspended if the T&S is unavailable however it would be commercially sensible to allow a Power CCUS plant to continue to operate in unabated mode for a period of time.

c. Termination clauses will be required to manage the event of sustained suspension or default of operation of either asset.

95. **Consumer levies**

a. LCCC assumes that the monies necessary to pay for the required support will be levied on electricity consumers following a similar pattern to current CfDs.

b. We further assume that that EII exemption schemes will continue to apply and whilst we do not believe that this will result in State Aid cumulation for any industrial user in receipt of CCUS related support, this will require further investigation.

96. **Settlement**

a. To settle payments, LCCC will need metered information for the carbon captured and exported to the T&S network, this will require metering standards. The settlement of the current CfD is linked to BSC code and metering arrangements and these arrangements are broadly replicated in the Private Wire network arrangements (for projects not connected to the network). This would need developing from scratch for CCUS.

b. To mitigate against risks of gaming of the support mechanism, e.g. availability issues or increases in the carbon intensity of the process to secure increased payments, it is likely that monitoring and audit arrangements will need to be in place around the facility to measure energy inputs (including power and fuel) and CO_2 outputs.

c. A mechanism to define payments suspension in the event of temporary Carbon Capture Facility unavailability will also be needed. A CfD payment based on £/MWh is likely to require Fuel Measurement arrangements, and Qualifying Multipliers along the lines of the Renewable Qualifying Multiplier used for Biomass and ACT currently.

97. **Minimising political risk**

a. The current CfDs have been set up as Private Law contracts with an operationally independent Private counterparty, LCCC, in order to provide investors protection from political interference and this continues to be important for investors.

b. In addition, whilst LCCC is an independently operated company, it remains government-backed which provides further confidence to investors in the value of these contracts.

c. Finally, the organisational set-up of LCCC and the settlement process means that contractual liabilities are not part of government debt calculations.

CCUS industry

13. Have we considered the most important challenges in considering the development of CCUS for industry?

Lock-in risks

98. There are a variety of industries, processes and possible use of alternative low carbon substitutes in the industrial sector meaning that this sector is likely to require an approach to decarbonisation that goes beyond just Carbon Capture during the roll-out phase.

Carbon leakage

99. LCCC is responsible for the implementation of Energy Intensive Industries Levy Exemption (EII) scheme related to CfD levies. As such, we are acutely aware that the Government's active policy is to mitigate against the risk of offshoring as a result of its decarbonisation policy.

100. We are therefore of the view that the short-term deployment of Carbon Capture will need to be through a support mechanism, not a "penalty" regime.

101. We are also mindful of the need to protect consumers from windfall profits for industrial CCUS plants that might be created through future carbon pricing policy.

102. This is why we believe that a Carbon Base CfD is an appropriate solution for the initial phases of CCUS deployment.

Perverse incentives to increase CO2 production

103. The remuneration of the absolute carbon exported to the grid could create an unintended perverse incentive to increase the carbon intensity of a process in order to secure increased CfD payments.

104. e have touched up this in the 'Common principles' section in our response to question 12.

14. Of the models we have considered for industry CCUS, do you have a preference, and why?

105. For the initial deployment phase, we prefer a carbon based CfD model.

106. This approach could provide a good balance between revenue certainty for generators and protections for consumers it would be compatible with carbon pricing policy.

107. For the roll-out phase, it will be key to enable provides a level playing field across abatement solutions, including energy efficiency and process and product substitution. In the absence of an effective economy wide Carbon Price with broader adjustments, it is not yet clear to LCCC how this might be best achieved.

108. A carbon-certificate solution could be a step in this direction however the scope of the system and offshoring risk would need further consideration.

15. Are there any other models that we have not considered in this consultation which you think should be taken forward for industry CCUS, and why?

109. For the initial deployment phase, we believe that the proposed CfD model should include a fixed payment element and generally follow the principles we have laid out in the 'Common principles' section in our response to question 12.

110. An important, unresolved issue, for the industrial sector remains the source of finance or levy to pay for support under this business model.

111. Levying the charge on the industrial output would reduce the capturing industry's global competitiveness and could lead to carbon leakage. It is also very hard to justify a levy on non-energy intensive electricity customers who already foot the bill for Energy Intensive Industries exemptions on green levies in the power sector.

112. Other options could include adding levies to fossil fuels (e.g. gas and oil). A rebalancing of the levy from electricity to gas should be relatively easy to implement and could support the wider decarbonisation agenda by reducing the subsidies needed by government to drive adoption in these areas.

113. Finally, the government could cover the payments directly although such a solution is likely to introduce political risk in the settlement process which is likely to be undesirable from an investor perspective.

16. In your view, are there any models which best work across all industrial sectors where CCUS could have a role to play?

114. For the initial deployment phase, we believe that a Carbon based CfD model with a fixed element should be applicable across all industrial sectors.

115. During the roll-out phase, a wider market signal, such as carbon pricing or certification, will likely be needed to drive optimal outcomes.

17. What actions should Government and industry take to establish demand for low-carbon industrial products?

116. Though not an area of LCCC expertise, information provision or product labelling on CO2 intensity could support change in end consumer behaviour..

CCUS for hydrogen production

18. Do you agree that a future business model should focus on hydrogen production costs? If not, what are the benefits of considering other parts of the hydrogen value chain in the next phase of our work?

n/a

19. Do you have views on whether the model should seek to support both CCUS-enabled hydrogen production and renewable production methods? If so, how might this work?

117. We believe that in the initial phase of deployment, support should be for both enabled hydrogen production and renewable production methods (biomass) though this could be done separately.

118. During the roll-out phase, business models should aim to support competition between these technologies as well as consider the interaction with electrolysis using excess variable renewable energy (though this is likely to be much more costly).

20. Have we identified the most important challenges in considering the development of a business model for hydrogen production?

119. As part of the hydrogen strategy, the government will need to consider the status of hydrogen production in code governance and exposure to consumer levies.

120. In the power sector, any generation asset and electricity storage asset is exempt from consumer levies and we can see strong parallels. Implementation of such exemptions can be complicated, however, and despite the Smart Flexibility plan being published in 2016 full implementation of storage site exemptions is likely to take at least another 2 years.

121. As per the industrial sector, there remains a funding challenge, however in light of the roll of hydrogen in 'greening' the gas network, a direct levy on gas users might be easier to justify and, as previously mentioned, we believe this would be relatively easy to implement.

21. What reflections do you have on the approaches we have identified to address the main challenges in designing the model?

n/a

22. Do you have views on which business models we should evaluate in the next phase of our work?

122. We believe that the Carbon based CfD with a fixed payment element should be considered.

Delivery Capabilities

23. What capabilities are needed for the delivery of CCUS in the UK?

123. We support the deployment strategy being overseen by an independent body.

124. We touch upon the political risks that such a body could seek to mitigate in our response to Question 4.

125. LCCC is of the view that there are 4 key elements to a successful deployment strategy:

a. The ability to identify no regret deployment of CCUS in the power and industrial sector. This will require analytical and commercial capability and the ability to operate under public scrutiny.

b. Institutional arrangements that will support strong evidence-based and coordinated procurement decisions that seek to minimise political risks.

c. Institutional arrangements that will allow for effective change management of business models whilst minimising political risks.

d. A reliable, independent delivery body, to oversee implementation and settlement.