Department for
Business, Energy
& Industrial Strategy

Carbon Capture, Usage and Storage

An update on business models for Carbon Capture, Usage and Storage

December 2020

Any enquiries regarding this publication should be sent to us at: CCUSBusinessModelsUpdate@beis.gov.uk

Contents

Disclaimer

This update sets out the government's current proposals on potential business models for Carbon Capture Usage and Storage. The proposals, as set out in the document and its Annexes, in whatever form they are expressed, are indicative only and do not constitute an offer by government and do not create a basis for any form of expectation or reliance.

The proposed terms, including those within the Annexes, are not final and are subject to further development by the government, and approval by Ministers, in consultation with relevant regulators and the devolved administrations, as well as the development and Parliamentary approval of any necessary legislative amendments, and completion of necessary contractual documentation. We reserve the right to review and amend all provisions within the document and its Annexes, for any reason and in particular to ensure that proposals are consistent with any new subsidy control regime.

This update takes into account engagement that has taken place during 2020 since publication of the government response to the Consultation on Business Models for Carbon Capture Usage and Storage that was published in August 2020. This includes engagement with the CCUS Expert Groups and relevant regulators.

BEIS will continue such engagement as it works to refine its proposals, including engagement with the devolved administrations, to ensure that the proposed policies take account of devolved responsibilities and policies across the UK.

List of Annexes to this document

Section 1: Introduction

Introduction

Carbon Capture, Usage and Storage (CCUS) will be critical in helping the UK meet net zero. To enable this, we are seeking to develop CCUS clusters with Transport and Storage (T&S) networks acting as the enabling infrastructure for a range of capture projects, including gas power plants, industry, low carbon hydrogen production, bioenergy, and direct air capture.

CCUS applications can be an engine to drive clean, sustainable growth in our industrial regions and create opportunities for their low carbon economic transformation. It can also stimulate the development of new UK supply chains and attract inward investment. The UK has the potential to be a world-leader in the global CCUS market, including the use of our significant CO_2 storage potential by providing a decarbonisation service to other countries. Deploying CCUS technologies in the UK will:

- support the **net zero** transition; and
- contribute to the **levelling up** of the UK economy.

To put us on this pathway, our ambition (as stated in the Prime Minister's recent Ten Point Plan[1]) is to have a CCUS sector with an operational capability of capturing 10 $MtCO_2$ per year by 2030. This is the equivalent of around four million cars' worth of annual emissions or the current industrial emissions of the Humber.

To achieve this, we will invest up to £1 billion to support the establishment of CCUS in four industrial clusters, creating several 'SuperPlaces'. These will bring together clean industry, power, hydrogen, and transport in areas such as the North East, the Humber, the North West, Scotland, and Wales. We aim to establish CCUS in two industrial clusters by the mid-2020s and in a further two industrial clusters by 2030, subject to Value for Money (VfM) and affordability considerations, and we will use consumer subsidies to support construction of at least one power CCUS plant to be operational by 2030. In 2021, we will set out our approach to deploy CCUS clusters. This will also help support delivering our ambition of deploying 5GW of hydrogen by 2030.

Purpose of this document

This document follows the 2019 consultation, 'Business Models for Carbon Capture, Usage and Storage'[2] and the response to that consultation published in August 2020[3]. It provides an

[1] The Ten Point Plan (November 2020) can be found at: https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution
[2] Business Models for Carbon Capture, Usage and Storage consultation (July 2019) can be found at: https://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-business-models
[3] The government response to Business Models for Carbon Capture, Usage and Storage (August 2020) can be found at: https://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-business-models

update on the proposed commercial frameworks for T&S, power, and Industrial Carbon Capture (ICC) business models. A status update on the progress of the hydrogen business models is also provided.

It reaffirms the principles which will guide the development of the CCUS business models as well as setting out their objectives. This document also provides an outline of the legal and commercial frameworks for CCUS, which we assume will be applicable to all clusters.

We will continue to extensively engage with prospective developers and wider stakeholders in 2021 to test and further develop the business model designs outlined in this document. Our objective is to create frameworks which deliver on our deployment ambitions and create a sustainable market for CCUS infrastructure and capture services.

The business model update in the document is focused on development of the deployment ambition as set out in the Prime Minister's Ten Point Plan and the recently published Energy White Paper[4]. As CCUS develops from initial deployment into a mature market at the heart of a Net Zero economy we would expect the business models and broader market to evolve through the 2020s based on experience and track record.

[4] The Energy White Paper can be found at: https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future

Section 2: CCUS Deployment

Introduction

This section sets out the principles that we will apply in developing the business models. It sets out a number of unique challenges to CCUS and how the government aims to address those challenges through the design of CCUS business models.

Principles of business model design

In the August 2019 government response to the consultation on potential business models for CCUS, the following key principles were established:

Decarbonisation

Policies should incentivise efficient capture, usage and storage of CO_2 where production is necessary but should not incentivise production of CO_2 or result in perverse outcomes.

Sustainable financing

Policies should instil confidence among investors and attract new domestic and international entrants to the market in a sustainable manner and have the potential to be subsidy free.

Economy

Policies should create value to the UK economy and support high-value jobs.

Cost reductions

Policies should harness opportunities to drive down cost through innovation, learning by doing and competition as appropriate.

Market and flexibility

Policies should be market based and minimise distortions in existing markets. They should be compatible with existing market frameworks but retain the flexibility to respond to market conditions and public needs as markets and the economy evolve.

Value for money

Policies should be cost-efficient, providing value for money for taxpayers and consumers, and provide a risk-adjusted fair return to investors whilst recognising the first of a kind (FOAK) nature of the sector that with industry, we need to develop.

Fair and reflective costs

The cost of deploying CCUS should be reflective and fair to users, and not undermine UK industrial competitiveness.

These principles continue to guide our approach to CCUS business model design. Whilst there are commonalities between CCUS and other sectors (e.g. T&S networks share similar characteristics with regulated infrastructure), the fact that deployment of CCUS in the UK has not been commercially demonstrated needs to be reflected in the business model design to enable the transition to a fully market-led solution when the industry matures, risks evolve and carbon policy is developed.

A key feature of our work is to ensure that the business models and the CCS Infrastructure Fund (CIF) incentivise decarbonisation and cost reductions whilst minimising market distortions in a way that achieves VfM for the consumer and taxpayer whilst complying with subsidy control regimes and aligning with fiscal rules.

The CCUS opportunity

CCUS represents a huge opportunity for the UK economy. It will play an important part in reducing the UK's carbon emissions and reaching net zero by 2050. For some industries, CCUS will represent the only viable way of reducing emissions while remaining internationally competitive.

CCUS will require significant investment over the coming decades. This investment will develop a new industry and the UK economy will be able to develop new technologies, new skills, and high value employment opportunities. CCUS will be a sector in its own right and one that will create opportunities for UK firms to export their expertise to other countries. In later years CCUS will develop into a market-led technological solution to climate change. UK carbon storage could also take carbon from other countries and contribute to global targets and create a vibrant new industry for the UK.

CCUS represents an opportunity for investors to develop a new infrastructure at the core of a net zero economy that will provide income over the long-term as the industry develops.

Government support for CCUS

The Ten Point Plan, Energy White Paper[5] and National Infrastructure Strategy[6] set out the importance of CCUS in reaching net zero. The deployment of CCUS will be critical, enabling 'SuperPlaces' that bring together renewable energy, CCUS, low carbon industry, and hydrogen production. We believe that this will create an attractive investment opportunity for the private sector, enabling the decarbonisation of these areas whilst also generating local and national economic benefits.

To support deployment the government has allocated up to £1 billion through creation of the CIF. It has also committed to bring forward details in 2021 of a revenue mechanism to attract

[5] The Energy White Paper (December 2020) can be found at: https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future
[6] The National Infrastructure Strategy (November 2020) can be found at: https://www.gov.uk/government/publications/national-infrastructure-strategy

private sector investment into ICC and hydrogen via our new business models to support these projects.

Through our work on business models, we will create the sustainable commercial frameworks that investors need. Offshore wind deployment in the UK provides an example of how government action has encouraged the deployment of low carbon power generation activity, by stimulating new technologies and markets and bringing down costs.

Alongside the new business models for CCUS, we will build on the UK's global reputation for regulatory stability and transparency by establishing independent economic regulation for CO_2 T&S networks, enabling investors to earn a fair return under a predictable and stable framework and recognising that any economic regulator will have a duty under the relevant statutory provisions to ensure that investors can finance their activities and functions.

Recognising the immature nature of CCUS in the UK, we acknowledge that there are inherent risks that currently the market is unable to price, or price efficiently. Where this is the case, they impact investment decisions. In recognition of this, we are working to develop an appropriate risk allocation framework to underpin the deployment of CCUS this decade.

We want to ensure that the sector is set up for success to enable our ambition to deploy CCUS from the mid-2020s. That is why while the business models are being developed, through the Industrial Strategy Challenge Fund (ISCF) and Industrial Decarbonisation Challenge Fund (IDCF) we are providing £130 million of funding to support projects on front end project development activities such as planning, design, and preparation for project execution. This will help ensure that the early phase of prospective projects are deliverable and affordable before commitments to provide revenue support are made by the government.

Our aim is to create a CCUS market that will provide investors with a fair return which recognises the nature of initial deployment. However, as the sector develops and confidence grows in the market, we would expect to see a reduction in the costs of deployment.

CCUS Programme objectives

With these factors in mind, business models have been developed with the following overarching objectives:

- establishing a new CCUS sector;
- enabling low cost decarbonisation in multiple sectors; and
- developing a market for carbon capture

Establishing a new CCUS sector

We recognise that to attract investment there needs to be a clear and predictable framework for project developers and investors. Given the nature of CCUS deployment, there is a need for the government to address certain risks that the market, at this stage, would be unable to bear. In recognition of this, government support would take several forms including:

- direct capital contribution through the CIF;
- a set of robust revenue mechanisms;
- business models that support CO_2 capture; and
- Economic Regulatory Regime (ERR) for T&S networks.

Furthermore, a Government Support Package (GSP) is being contemplated that would seek to address high impact low probability risks for the T&S network such as stranded asset and defined CO_2 leakage risk from the storage facilities. It is intended that this will be structured in a way which overtime enables and stimulates market-based solutions to those risks, with the aim that the required level of support may be reduced.

We expect elements of government support such as capital contributions and the GSP to evolve over time. For example, as the market builds confidence in CCUS project development and in the capture business models, we would expect the degree of government support would reduce in later CCUS projects. This means government capital contribution support may be most effective in early stages of the CCUS sector to kickstart the sector and build momentum and confidence in the sector. We need to further assess private sector risk appetite in order to make an assessment of the extent of necessary government intervention.

Enabling low cost decarbonisation in multiple sectors

CCUS can both play a critical role in the sustainability of UK industry and become a key contributor to the levelling up of the UK economy by enabling 'SuperPlaces', sharing common CO_2 T&S networks so as to enable key sectors to be competitive in a net zero economy.

An integrated model will be designed to accommodate all relevant sectors and therefore be attractive to investors. CCUS also enables a source of low carbon power generation and hydrogen production, the latter of which can be used for various purposes across the economy. In order to achieve this, we are considering the following in the design of the business models:

- reuse of existing assets and government capital contributions where appropriate;
- efficient allocation of risk (i.e. risk allocated to the party most appropriate to manage it);
- effective competition at appropriate stages, promoting clean growth whilst not damaging international competitiveness;
- development of a model that will incentivise deployment of early projects, avoiding excessive costs for early users (via government capital contributions), whilst having the flexibility to evolve for later phases of deployment and being capable of supporting a range of projects across different industrial sectors; and
- the realisation of benefits and sharing of knowledge across subsequent clusters as they are developed.

Developing a market for carbon capture

When selecting initial clusters, we aim to establish ‘SuperPlaces’ to stimulate broader decarbonisation spill over benefits and then expand geographic reach beyond clusters over time. Intervention to support the development of a market for private sector investment includes the following:

- a transparent process for the allocation of funding support;
- creation of a new asset class with multiple investment entry points depending on risk appetite;
- long-term inflation linked revenue streams which provide a predictable revenue profile over the life of an investment;
- a stable and coherent regulatory regime with transparent guidance on the approach to regulatory decision making; and
- a mechanism for enabling expansion of the T&S network to meet growing demand.

Document Structure

The remainder of this document explains how we have continued to develop the business models that seek to deliver our ambitions and objectives. A summary of each section is set out below.

Section 3: CO_2 Transport and Storage Regulatory Investment (TRI) Business Model

The development of T&S networks will be fundamental to the delivery of CCUS. Initially there will be a need for greater government intervention to support private sector investment in a new and nascent sector, including potentially ensuring that T&S networks are right-sized to accommodate expected future growth in CO_2 volumes captured for storage. The regulatory framework will support a stable, predictable, and index-linked model which will underpin investor returns, so that carbon capture can play a role in the UK’s economy for decades to come supported, where needed, by appropriate levels of government intervention.

Section 4: Dispatchable Power Agreement (DPA) for Power CCUS

We have designed the DPA business model to incentivise a power CCUS plant to operate in a dispatchable mode, where the plant should be incentivised to react to market prices and generate during periods where this is required to meet demand. Conversely, this means that the plant should reduce generation output during periods of low prices, and should not displace low cost, low carbon generation capacity such as renewables or nuclear. The flexibility of power CCUS should allow it to complement the intermittency of renewables by adjusting output to meet changes in electricity demand whilst still capturing emissions from generation. Section 4 sets out how the business model has been designed to create an attractive investment proposition in CCUS power.

Section 5: Industrial Carbon Capture (ICC) Contract for Industrial Carbon Capture

The proposed ICC business model has been designed to incentivise the deployment of carbon capture technology for industrial users who often have no other option to achieve deep decarbonisation. We expect the model to proceed with an ICC Contract which covers operational expenses, T&S fees and rate of return on capital investment, with an element of capital co-funding for initial projects. This is intended for first-of-a-kind (FOAK) projects and we expect it to evolve as the technology and investment confidence matures. In the long-term we anticipate a competitive allocation process and a market-driven carbon price to promote permanent CO_2 abatement. In Section 5, we set out our 'minded-to' position on the commercial concept to incentivise ICC in the UK, funding mechanisms to deliver early ICC projects and detail on key commercial policy terms for inclusion in our proposed ICC Contract.

Section 6: Low Carbon Hydrogen

This section provides an update on the government's approach to addressing policy development relating to low carbon hydrogen business models. This builds on the response to the previous CCUS business models consultation that included a chapter on hydrogen and the Frontier Economics report on low carbon hydrogen production business models, published in August 2020[7]. The update notes our intention to support the development of both CCUS-enabled and electrolytic hydrogen production technologies, key considerations relating to policy development, and our preference at this stage for contractual over regulatory support mechanisms for large scale hydrogen production. We will consult on our preferred hydrogen business models in 2021.

[7] A link to Frontier Economics Ltd's Business Models for Low Carbon Hydrogen Production report to BEIS (August 2020) can be found at: https://www.gov.uk/government/publications/business-models-for-low-carbon-hydrogen-production

Section 3: CO_2 Transport and Storage Regulatory Investment Model

Introduction

The T&S business model ('TRI Model') is based on an economic regulation funding model. This approach seeks to balance the need to provide long term confidence to investors with predictable and stable returns within a broadly bounded range. The features set out below are derived from a range of precedents including utility regulation. We have sought to consider how the framework can be best adapted to projects with the characteristics of CCUS infrastructure and will be refining and developing the approach further based on engagement with key stakeholders including project developers and potential investors.

This chapter is structured to cover the following elements of the TRI Model:

- the objectives of the TRI Model;
- revenue model;
- ERR;
- GSP; and
- consideration of risks.

We envisage that Transport and Storage Company (T&SCo) will be responsible for the development, construction, financing, operation, maintenance, expansion, and decommissioning of the T&S network. We will continue to give consideration of the ownership model of the T&SCo as consulted in summer 2019. It will be responsible for the plant, equipment, and operational resources required to ensure that the transportation and long-term storage of CO_2 is safe, efficient, and compliant with defined requirements. We have outlined T&SCo's key roles below and note that further work is required to refine the roles of asset owner and system operator including the following:

- **Asset Owner**: T&SCo will own the onshore and offshore network, and obtain the licence for the storage site; and
- **System Operator**: T&SCo will operate the T&S network to ensure the operational parameters are within specified limits, manage network access, perform network planning, and administrate sector specific tasks (such as relevant connection codes).

As part of delivering these roles, we envisage T&SCo would review the CO_2 metering and compositional analysis equipment installed by the users at the point of connection. T&SCo would be responsible for health, safety, and environmental compliance related to the T&S network.

Objectives of the TRI Model

We believe that T&S networks represent a unique investment opportunity to support the UK's green industrial revolution and enable the transition to net zero carbon emissions, as outlined in Box 1 below.

Box 1: The CCUS T&S network investment proposition

An Environmental, Social and Governance (ESG) focused opportunity…

- CCUS is essential to achieve the UK's net zero carbon emissions target by 2050.
- The Committee on Climate Change (CCC) project that by 2050 storage of 70 to 180 $MtCO_2$ per year will be needed in 2050,[8] highlighting the expected scale of demand for T&S networks.
- In addition to transporting and storing CO_2 captured in the UK, the T&S network has the potential to benefit from global decarbonisation agenda through the provision of a decarbonisation service (i.e. storage of CO_2) to other countries.

… with the potential to contribute to economic growth…

- A T&S network holds the key to unlocking clean growth potential in the UK and to levelling up opportunities.
- Establishing T&S networks provides a strategic opportunity for other sectors to use their skills and expertise to drive the energy transition.
- Furthermore, T&S networks provide an opportunity to leverage delivery expertise in construction and position the UK as a market leader in CCUS supply chain, procurement, and construction management services.

… in a strategic sector with potential growth…

- T&S networks will attract investment from a wider pool of capital as technological feasibility and financial sustainability are established. Creating T&S networks will unlock strategic opportunities such as industrial decarbonisation, blue hydrogen, and power CCUS, and enhance the resilience of existing commodity value chains.
- T&S networks have significant opportunities in the future to expand their network and hence asset base to meet a growing demand of their services as part of the net zero transition.

… underpinned by a robust policy and regulatory framework

- T&S investors will receive a long-term inflation linked revenue stream, providing investors with revenue and cash flow predictability. Revenue will be paid by T&S

[8] The Climate Change Committee's Sixth Carbon Budget report (December 2020) can be found at: https://www.theccc.org.uk/publication/sixth-carbon-budget/

users that are in receipt of an ICC Contract or DPA to begin with, providing further confidence in the reliability of the revenue stream.

- Allowed revenues will be determined based on efficient and economic costs incurred and consideration of events within T&SCo reasonable control.
- The independent economic regulator (the Regulator) will operate and exercise its functions within a defined regulatory framework, including a duty to ensure that an efficient T&SCo can finance its operation and to support delivery of Government's objectives for CCUS deployment. Regulatory guidance will be provided to clarify how the Regulator intends to approach any regulatory decision making providing greater visibility to investors.
- T&SCo investors will earn returns that are commensurate with the risks that they bear, with an opportunity to earn additional returns when outperforming target performance.
- T&SCo investors will be incentivised to maintain the availability of the T&S network and attract new users to connect to the T&S network. The design of such an incentive to attract new users will be further considered to take into account what is in the control of T&SCo.

We have developed the TRI Model to unlock investment in T&S networks and deliver our objectives for the CCUS programme (as set out in Section 2). We have drawn on learnings from other industries (e.g. regulated utilities), the government's former CCS Commercialisation competition, international programmes, recommendations from the CCUS Advisory Group (CAG), and our consultation on CCUS business models.

Our key objectives for the TRI Model and their implications for the design of the TRI Model are discussed below.

- *Attracting investment in the T&S network to establish a new CCUS sector*

In order to establish a commercial framework that enables and supports stable investment in projects that are likely to have long operating lives, it is vital that suitable financing structures and funding structures are developed. This will ensure that investors have clear sight of the long-term revenue model to ensure they can earn a reasonable regulated return on their investment.

- *Enabling low cost decarbonisation in multiple sectors*

Each T&S network must be able to accommodate multiple and different types of users with varying demand profiles and be sufficiently flexible to implement various potential network designs and growth profiles. Developers, investors, and users of T&S networks need visibility over the allocation of T&S specific risks such as stranded asset risks, varying build out rates between a capture plant and T&S network and potential long-term storage leaks.

We understand the importance of balancing the need for anticipatory investment to address future demand on the T&S network with the economic attractiveness of the network to near term users. We will also consider how T&SCo can be incentivised to attract more users to their T&S network in support of decarbonisation.

- *Developing a market for carbon capture – a long-term vision*

The Regulator will administer the ERR and ensure that costs are economic and efficient whilst also incentivising T&SCo to attract more users into the T&S network to drive higher utilisation and therefore spread the costs and benefit from economies of scale. The ERR would be designed to have sufficient flexibility to allow for future CO_2 market expansion (potentially including shipped CO_2) whilst ensuring affordability and VfM for the users.

Design implications

For T&SCo to attract stable investment, the TRI Model needs to recognise that the investment proposition will evolve as the T&S network moves through different stages/phases of the project/asset lifecycle and as the CCUS market develops. For initial T&S projects in the UK we:

- believe that the construction of the T&S network requires that techniques and skills tried and tested in other sectors are applied in a new sector;
- consider the construction phase as the period between Final Investment Decision (FID) and end of commissioning of the T&S network (i.e. Commercial Operational Date (COD)) unless otherwise stated;
- assume the risk profile will change in the post-construction phase, once operation of the T&S network and the resulting revenue streams are well established; and
- assume the risk profile during the steady state operational phase for T&SCo will be comparable with but may not be identical to the ongoing operation of other network assets.

The engagement with stakeholders to date has identified a number of characteristics of CCUS deployment which need to be addressed in developing a sustainable business model (discussed below). The objective of the outline TRI Model in this document is to provide a framework for addressing these risks. The risk allocation in the business model will inform the level of potential returns available for the construction and operation of the infrastructure.

We will continue to assess risk appetite of various sources of finance in order to make an assessment of the extent of necessary government intervention during the early period of CCUS deployment.

Benefits of the TRI Model

In achieving the aforementioned objectives, the TRI Model has the benefit of being able to address the following risks to provide greater investment confidence:

- **revenue risks**: uncertain demand and potentially a small userbase initially means that T&SCo may face a higher degree of underutilisation and counterparty risks than existing gas and electricity networks;
- **user timing mismatch risk**: we envisage CO_2 capture and T&S projects being developed simultaneously, which means there is a risk that anticipated early users may connect to the T&S network later than planned; and
- **CO_2 leakage risk**: the long-term storage of CO_2 and the low probability of leaks from the store give rise to some unique risks for T&SCo.

Noting the objectives and challenges outlined previously, and building on the government's response to the consultation on potential business models for CCUS published in August 2020, this section sets out the government's latest position on the following elements of the TRI Model including:

- **revenue model**: a route for T&S fees to be collected from users of the T&S network and potential recourse to consumers and taxpayers in limited circumstances;
- **ERR**: a framework set out in the licence for determining the allowed revenue including return to T&SCo. This would be based on efficient and economic costs incurred by T&SCo in respect of its duties and outputs and subject to appropriate performance targets underpinned by appropriate risk allocation between T&SCo and the users; and
- **GSP**: a package providing protection, through a set of contractual arrangements for investors and users against specific high impact low probability risks.

Details of each element are described below. The section concludes by outlining how the proposed TRI Model delivers the government's objectives, including how it addresses the key challenges to a successful TRI Model.

Revenue model

The User Pays revenue model

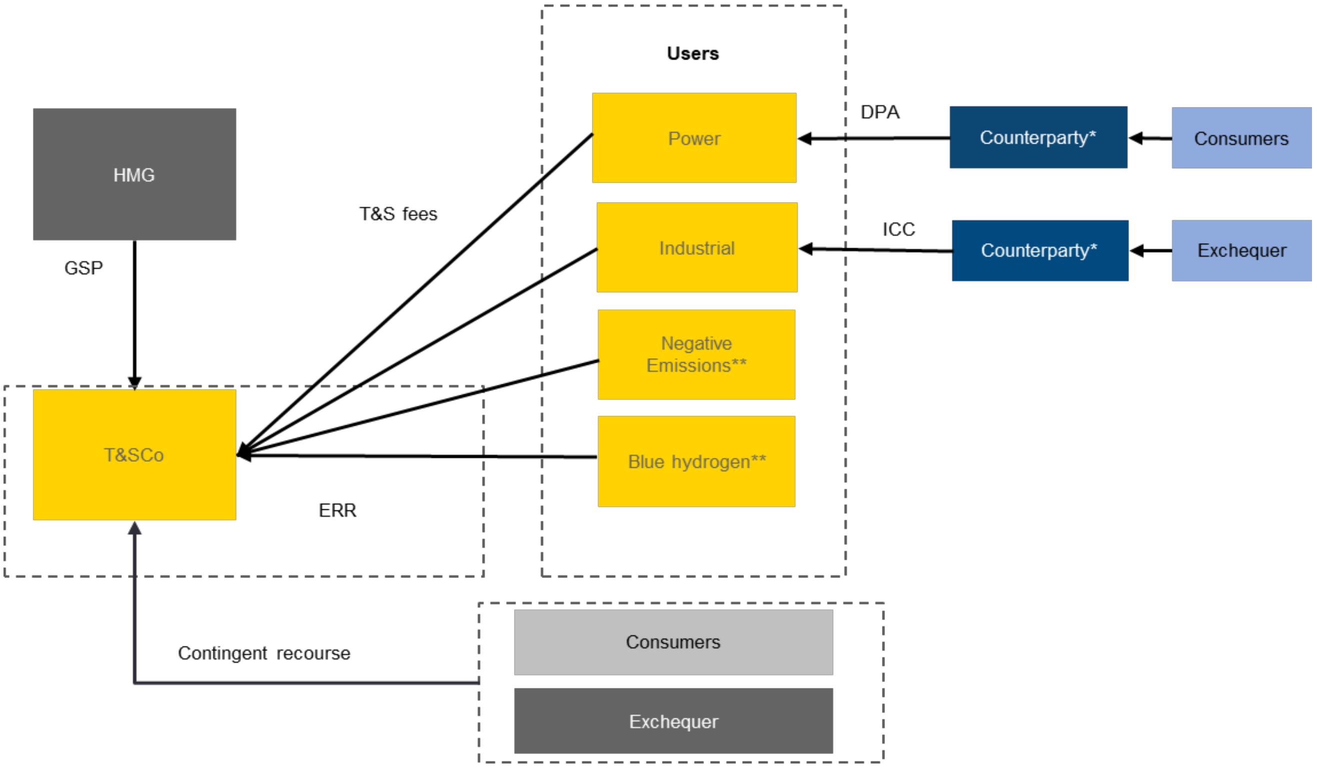
We believe that the revenue stream for T&SCo needs to:

- provide confidence to investors that it is a reliable way to channel revenue so that T&SCo is able to finance its functions;
- provide a predictable cost allocation which is commensurate with capacity and volume to ensure that those who use or directly benefit from the T&S network make payments to T&SCo for doing so; and
- enable future users to join the T&S network and be flexible in response to how markets might change in the future.

The proposed revenue model for T&SCo is a User Pays model. Under this model, T&SCo's revenue stream will be made up of payments from those who use the T&S network to have their captured CO_2 transported and stored. T&SCo would also have contingent recourse to consumers and/or taxpayer support to ensure the revenue stream from users is predictable and robust from a financing perspective. This is covered in further detail below.

The User Pays model can also be extended to accommodate the import of CO_2 from sources external to the T&S network (i.e. by injecting CO_2 at a T&S network or storage access point) or enable the reuse of CO_2 in the future, (i.e. those who connect to the T&S network to offtake CO_2 will make payments to T&SCo too).

Figure 1 an illustration of the User Pays revenue model in the steady state operational phase and associated assumptions are set out below



** LCCC is being considered as a potential counterparty.*

*** Revenue models for 'blue' hydrogen and negative emissions (i.e. bioenergy and direct air capture) under development.*

The User Pays model consists of the following elements:

- **T&S fees**: fees that are paid by users to T&SCo for using the T&S network and storage site;
- **DPA revenue and ICC Contract revenue**: power and industrial users of the T&S network who have entered into DPA and ICC Contract will be entitled to revenue under those contracts. See Sections 4 and 5 for further details about the DPA and ICC Contract respectively. The contract price would take account of the cost of the T&S fees through indexation; and
- **consumer payments and taxpayer payments**: for example, consumers and taxpayers will ultimately contribute to the cost of the DPA and ICC Contract, or directly through the

TRI Model in the event of contingent resource being required in certain limited circumstances.

T&S fees

The allowed revenue would be determined under the ERR under the economic licence and largely represents the cost of establishing and operating the T&S network including any incentives. Further details of the ERR are set up in section below.

Once the allowed revenue is established, T&SCo will collect its revenue through T&S fees paid by users of the T&S network. We expect the T&S fees will be determined using a methodology initially developed by the government and the Regulator, informed by a set of guiding principles and in consultation with industry. We expect T&SCo would administrate the methodology in the future once the CCUS sector is established, including making updates to the methodology in consultation with users and seeking ultimate approval from the Regulator (this is similar to practices in other regulated network sectors such as gas and electricity). In addition, T&SCo would have contingent recourse to taxpayers and/or consumers if there is a revenue gap to ensure that T&SCo would receive income at the level of allowed revenue.

Further work will be undertaken on the design of the T&S fees that all users will pay, but it could be structured similarly to gas network charges and include the following elements:

Potential elements of the T&S fees

Connection fee	• Payments related to the costs of the specific and sole-use of infrastructure required to connect a given capture plant to the T&S network.
Capacity fee	• Payments related to the costs incurred by T&SCo for shared network assets i.e. infrastructure that cannot be solely attributed to a single user.
Volumetric fee	• Payments related to the costs incurred by T&SCo that are linked to the volume of CO_2 being transported and stored.

The inclusion of a capacity component and a volumetric component within the overall T&S fees is important to reflect the fact that T&SCo will incur both costs driven by the capacity of the T&S network and costs driven by the volume of the CO_2 transported and stored. Similarly, the inclusion of a connection fee is important to reflect the specific cost associated with connecting a user (or a group of users) at that specific location when the T&S network and its userbase is expanding.

Establishing a robust revenue model

The User Pays model will be a sustainable revenue model for T&SCo once the CCUS cluster has matured (i.e. in a steady state operational phase), as is the case for gas and electricity networks. However, we recognise that there are a number of areas where T&SCo may be exposed to risk which need to be considered in developing a robust revenue model. These are considered further below:

a) utilisation build-up during the early operational phase;

b) timing mismatch of when capture projects connect;

c) underutilisation of the network; and

d) bad debt of users.

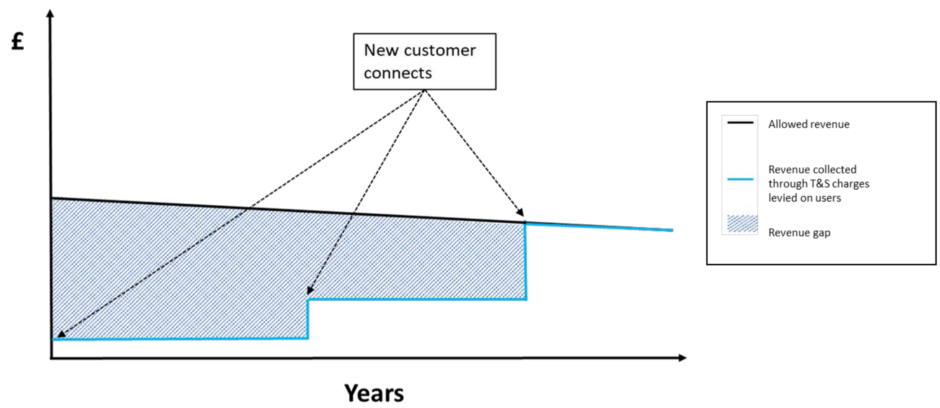
The model includes various measures such as a contingent funding mechanism from consumers and taxpayers in the event of non-payment by users of the network.

a) Utilisation build-up during the early operational phase

It is likely that the T&S network would initially be sized to take account of future users joining the T&S network and to retain the benefit of economies of scale. We expect users will be scheduled to join the T&S network in phases with the result that initially, the T&S network will not be fully utilised.

This means that if initial users pay T&S fees that reflect the proportion of their use of the T&S network, the amount of revenue that T&SCo collects during the early operational phase could be less than its total allowed revenue (as illustrated in the diagram below) for the T&S network as a whole. This is because a proportion of the T&S network capacity will not be used and no user will be charged for that proportion, yet T&SCo will still incur costs related to that proportion of T&S network capacity, (e.g. finance and maintenance costs). This creates a potential revenue gap.

Figure 2: illustration of the impact of planned underutilisation during early operational phase



Note:
- Allowed revenue is shown as decreasing over the years due to depreciation
- This figure is for illustrative purposes only.

In order to close this potential "revenue gap" between T&SCo's total allowed revenue and the revenue it collects from users, the government is considering the following list of potential options – which are not intended to be mutually exclusive nor is this an exhaustive list of potential options:

- **upfront capital contribution through the CIF**: the provision of upfront capital funding through the CIF would reduce the capital cost incurred by T&SCo which it has to finance, and in turn this would reduce T&SCo's annual revenue required. We are considering the different forms of government capital through the CIF;
- **TRI Model design**: the allowed revenue profile overtime could be shaped to match the expected utilisation profile of the T&S network, i.e. deferring revenue from the early operational phase to later in the operational phase. For example, we are considering the potential for profiling of the depreciation of the regulated asset value (RAV) (as is the case for gas distribution networks under the RIIO regulatory regime), as opposed to using straight-line depreciation. Similarly, the decommissioning accrual profile could be profiled instead of using a straight-line subject to further work as part of wider CCUS decommissioning policy development;
- **T&SCo's utilisation incentive**: the ERR may contain incentives for T&SCo to find and/or connect more users to the T&S network, in addition to the anchor projects[9]. Calibration of the incentive would require further consideration including government support on capture projects recognising limitation on T&SCo's control; and
- **contingent mechanism**: if the proposals described above were not sufficient to enable T&SCo to recover its allowed revenue, we will explore the potential for consumers or taxpayers to pay for any remaining under recovery of allowed revenue.

b) User timing mismatch risk – Anchor project does not connect on time

T&SCo will only receive revenue from users when they connect to the T&S network and so no T&S fees are payable by users until the first user is connected.

The risk that the first user(s) does not connect to the T&S network when expected, i.e. its connection is delayed (referred to as "user timing mismatch risk"). If this risk were to materialise T&SCo would not begin to earn revenue when expected. This would create a potential revenue gap equal to T&SCo's lost revenues due to the delay in the user joining the T&S network and lead to a potential cashflow shortfall. This is because T&SCo will still incur costs such as finance costs, salaries, and some supply chain cost, despite no T&S fees being collected from users.

Once a user is connected to the T&S network the risk of timing mismatch dissipates as T&SCo will begin collecting revenue. Beyond the first user, subsequent users failing to connect would be treated as an underutilisation event, discussed further below.

We expect support from the government for the development of a cluster would be allocated on the basis of information provided by T&SCo with regards to the timing of connection, especially on the timing of anchor users. However, we understand that T&SCo generally does not have significant influence over user's construction or retrofitting programme. As such it is considered that T&SCo should be provided with protection in the event this timing mismatch risk materialises. However, in exchange for this protection, there will need to be some form of

[9] Anchor projects are capture projects that will be confirmed as the first users of the network when the T&S network is being constructed

incentive to bring on the anchor users proposed by T&SCo. The nature of this incentive and how it should be calibrated requires further consideration.

In order to reduce the “revenue gap” that would result if the timing mismatch risk were realised, the government is considering the following list of potential options – which are not intended to be mutually exclusive nor is this an exhaustive list of potential options:

- **Rolled Up Interest (RUI)**: the return and depreciation that T&SCo would have been able to collect as part of its allowed revenue if the first user had connected to the T&S network on time could be deferred and “rolled up” into the allowed revenue that T&SCo can recover across the remaining operational life of the T&S network. This mechanism would be in place until a user connects to the T&S network;
- **recovery of operating expenditure (opex)**: T&SCo’s opex (which is determined to be efficient by the Regulator) will be paid for each year until a user connects to the T&S network. The opex could be paid for by consumers or taxpayers, for example, if a power user was supposed to connect first, consumers would pay the opex. We are considering the feasibility of this proposal, noting it would have implications for the design of the DPA and ICC Contract for industrial capture projects and we will continue to review this option. We are also considering the feasibility of payment from the delayed user (e.g. power project or Industrial Capture project) to contribute towards opex;
- **incentivising T&SCo to present a robust cluster plan**: the allowed revenue could be reduced as part of the incentive regime under the ERR until the proposed anchor users are connected to the T&S network; and
- **contingent mechanism**: if the proposals described above were not sufficient to enable T&SCo to recover its allowed revenue, we will explore the potential for consumers or taxpayers to pay for any remaining under recovery of allowed revenue.

Users will also be incentivised to connect to the T&S network as planned through the DPA and ICC Contract for power and industry users, respectively. For example, the DPA contains provisions to incentivise the commencement of operations within a specific window, with delays impacting on the term of the DPA.

c) Underutilisation risk

Once the first ‘anchor’ project has connected to the T&S network, the T&S network could still risk being underutilised if: an expected user does not connect (on time or at all); a user disconnects earlier than expected; or connected users do not inject as much CO_2 into the T&S network as expected.

As T&SCo will collect its revenue largely through the T&S fees, which is expected to include a capacity fee and a volumetric fee, any underutilisation will result in T&SCo receiving income less than the allowed revenue leading to a potential revenue gap.

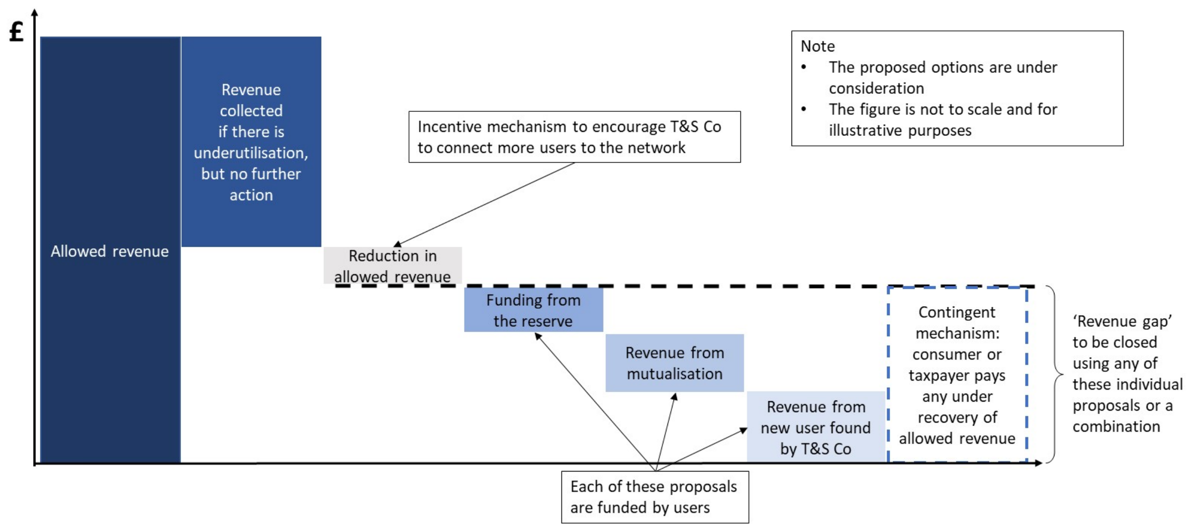
This risk could potentially materialise during the operational life of the T&S network. However, the revenue gap that results from any underutilisation may be more significant in the early operational phase compared to in the steady state operational phase, as the loss of any revenue from a small user base could represent a larger proportion of total expected revenue.

T&SCo does not have the ability to require local emitters to join the T&S network. On that basis, it would be appropriate that T&SCo should be provided with protection in the event this risk materialises. However, we believe T&SCo could facilitate more emitters to connect to the T&S network through promoting the T&S network and proactive engagement with potential users including overseas opportunities.

In order to address the "revenue gap" that would result if the underutilisation risk were realised, the government is considering the following list of potential options – which are not intended to be mutually exclusive nor is this an exhaustive list of potential options:

- **building a financial reserve**: a financial reserve would be included as part of the allowed revenue. The reserve could be held in a ring-fenced account and potentially be used for mitigation of other risks such as unplanned outage and CO_2 leakage;
- **mutualisation over the remaining userbase**: T&S fees for remaining users of the T&S network would be increased in order to close the revenue gap. A user's DPA or ICC Contract would be indexed to the T&S fees. This mechanism is more suitable in the steady state operational phase when there will be a larger user base over which to mutualise the revenue gap, compared to in the early operational phase;
- **T&SCo's utilisation incentive**: the Regulator is expected to provide an incentive to the T&SCo to connect more users to the T&S network (refer to the ERR subsection for further detail). If the utilisation is below a set target, T&SCo allowed revenue could be reduced as part of the incentive regime. Calibration of the incentive would require further consideration including government support on capture projects recognising limitation on T&SCo's control; and
- **a contingent mechanism**: if the proposals described above were not sufficient to enable T&SCo to recover its allowed revenue, we will explore the potential for consumers or taxpayers to pay for any remaining under recovery of allowed revenue.

Figure 3: illustration of how the "revenue gap" could be addressed if there is underutilisation



** A user's ICC Contract and DPA will be adjusted to cover the cost of any of these proposals being adopted*

d) Bad debt risk (non-payment)

Bad debt risk arises when there are unforeseen delays in payment of T&S fees or non-payment by users[10] (e.g. insolvency of a user). This could result in a revenue gap.

This risk can be realised at any point during the operational life of the T&S network. However, the revenue gap that results from any bad debt may be more significant in the early operational phase compared to in the steady state operational phase, as the loss of any revenue from the small user base could represent a larger proportion of total expected revenue.

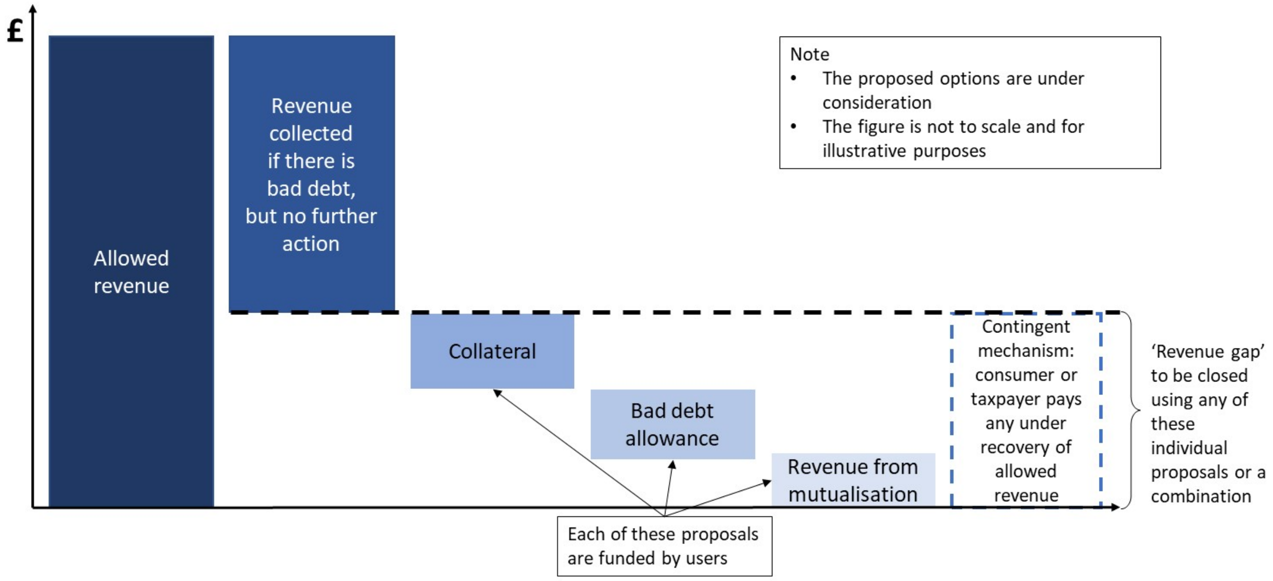
The likelihood of this risk materialising in the early operational phase may be mitigated somewhat as it is expected that most users of the T&S network will receive DPA revenue or ICC Contract revenue for a period of time, which will cover the costs of the T&S fees.

T&SCo will not have control over the financial operations of users and T&SCo should be provided some protection in the event this risk materialises. In order to reduce the "revenue gap" that would result if the bad debt risk were realised, the government is considering the following list of potential options – which are not intended to be mutually exclusive nor is this an exhaustive list of potential options:

- **collateral**: users of the T&S network could be required to post collateral equal to a certain percentage of their expected annual T&S fees or users could buy insurance (if available) against not being able to pay T&S fees. T&SCo would use the collateral that has been posted or the money paid out from the insurance policy to close the revenue gap. The right size of collateral or the appropriate insurance policy requires further consideration;
- **bad debt allowance**: the ERR would include a "use it or lose it" bad debt allowance in the calculation for T&SCo's allowed revenue. T&SCo would use the allowance to close the revenue gap if instances of bad debt arise, but they would not be able to use the allowance otherwise. The right size bad debt allowance required may be based on practice in other sectors;
- **mutualisation over the remaining userbase**: T&S fees for users of the T&S network (including any user that has not been paying their T&S fees) could be increased in order to close the revenue gap. A user's DPA or ICC Contract would be indexed to the T&S fees. This mechanism is more suitable in the steady state operational phase, compared to in the early operational phase; and
- **contingent mechanism**: if the proposals described above were not sufficient to enable T&SCo to recover its allowed revenue, we will explore the potential for consumers or taxpayers to pay for any remaining under recovery of allowed revenue.

Figure 4: illustration of how the "revenue gap" will be addressed if bad debt arises

[10] If this is as a result of the user becoming insolvent, the user will be subject to the normal insolvency processes



Economic Regulatory Regime (ERR)

The ERR is a framework that provides an annual allowed revenue to T&SCo, reflecting efficient costs and a reasonable rate of return. As well as containing the measures described above, it is also envisaged that the ERR may also include a suite of performance targets ('outputs') and mechanisms ('incentives') to allocate and manage risks. It is envisaged that the ERR will establish the overall framework that sets the allowed revenues and defines T&SCo's business activities monitored by the Regulator through regular price controls. The features outlined below are based on a number of precedents including utility regulation with adaptions for CCUS.

The following content sets out the key building blocks of the ERR, covering the construction phase and operational phase.

1. Economic Regulator ("the Regulator")

The Regulator's role is to establish the ERR that provides the framework for T&SCo to earn revenues for the services it provides to users. Administrative fees for the Regulator would be paid by T&SCo and from revenues collected from users and potentially consumers and taxpayers.

In practical terms this means that:

- an independent body (the Regulator) would be established in statute to regulate the T&S sector, and its duties and objectives would be prescribed in legislation;
- the Regulator would be able to authorise (via a licence) T&S network companies, in this case T&SCo, to perform certain activities for certain users – which would be defined through a price control process; and
- a licenced T&SCo would be authorised to charge its network users for the services it provides.

The duties and objectives of the Regulator are being considered further but could include duties for the Regulator to protect the interests of current and future users of the T&S network, to enable an economic and efficient T&SCo to finance its activities and to support the deployment of CCUS to meet governments Net Zero target. The Regulator is obliged to act in line with its statutory duties and obligations. The Regulator would develop full detail on the licence and building blocks of the business model, ahead of a FID to provide clarity and transparency to T&SCo, users and investors. Furthermore, the Regulator will develop a guidance to clarify its approach to the ERR (an example of this type of guidance can be observed in Ofwat's guidance for Thames Tideway Tunnel)[11].

2. Periodic price controls

Periodic price controls are the framework of rules that determine T&SCo's activities, the level of service expected and the allowed efficient and economic costs. The allowed revenue would be collected from users through T&S fees and potentially consumers and taxpayers. The approved price control settlement would offer revenue certainty to T&SCo over the duration of the relevant settlement period subject to system availability and pre-defined revenue adjustments.

The duration of each price control is being considered further. During the price control period, in addition to some parameters of allowed revenue which are indexed, there may be a set of very limited and defined in-period reopeners for elements that could not be efficiently estimated during the price control review or for Force Majeure type events.

3. Allowed revenue

The allowed revenue is the revenue to which T&SCo is entitled in each year of the price control period to fund T&SCo's activities. The allowed revenue is a function of a number of 'building blocks' as set out below:

$$Allowed\ revenue = (RWACC\ x\ RAV) + Depreciation + Opex + Decom + \ Tax + Adjustments$$

- **RWACC**: the Regulated Weighted Average Cost of Capital (RWACC) during operations to compensate T&SCo for the cost of capital investment. RWACC is discussed in more detail below;
- **RAV**: returns to T&SCo's debt and equity investors would be provided through a RAV x WACC building block based on established regulatory precedent. The RAV is the efficiently incurred capital investment into the project including construction, asset expansion and a 'rolled up' cost of capital (i.e. Interest During Construction (IDC)). RAV is discussed in more detail below;
- **Depreciation**: the revenue collected from users to cover asset depreciation over the operational period. This could be profiled to reduce payments early in the early operational period to support the initial stages of the project;

[11] https://www.ofwat.gov.uk/publication/ofwat-guidance-on-approach-to-the-economic-regulation-of-the-infrastructure-provider-for-the-thames-tideway-tunnel/

- **Decom**: an allowance to cover the decommissioning cost of the T&S network at the end asset life (see further explanation on the proposed decommissioning regime below); and
- **Adjustments**: items that adjust the allowed revenue and includes pass-through costs (e.g. insurance costs), any required true-ups and incentives such as for leakage, timely connections and availability.

Decommissioning (includes monitoring)

T&SCo, as with other infrastructure owners in the oil and gas sector, is responsible for decommissioning activities at the end of the project's life. These may include asset removal, sealing wells, and monitoring the integrity of the CO_2 store. Decommissioning activities would be subject to regulatory and government scrutiny, and international obligations such as the Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR Convention) Decision 98/3.

Decommissioning costs are allowed as part of the building blocks forming the allowed revenue. The money collected for decommissioning would build up a reserve over the operational period following a short period after COD. T&SCo would be required to ring-fence the decommissioning revenues to meet the future decommissioning obligation. We are considering further how to address a potential shortfall in the decommissioning reserve if there is an early closure of the T&S network, as part of wider CCUS decommissioning regime work.

Where existing oil and gas assets are transferred into the TRI Model for CCUS application, the total decommissioning liability would be separated into two components: i) non-CCUS decommissioning liability for hydrocarbon extraction-related activities and ii) decommissioning liability associated with re-use or modification for CCUS activities. The TRI Model would only fund the decommissioning liability related to CCUS activities, as is the case for new build T&S assets. We are considering how the non-CCUS decommissioning liability would be covered as part of wider reuse transfer.

We will undertake further work to develop a holistic decommissioning regime for the CCUS sector and consult the proposed design in 2021.

RAV

The RAV is a regulatory construct that reflects T&SCo investment. It is calculated as follows:

$$RAV\ (at\ a\ specific\ time) = \sum Devex + \sum Capex + \sum IDC - \sum Depreciation$$

It is considered that these investments would be established in real terms (with inflation factored into their values) and on a cumulative basis (e.g. cumulative capex). Practically this means an inflation uplift is added to the revenues. Development expenditure (Devex) is development spend and capex is capital spend.

The Regulator would verify the **opening RAV** for the beginning of the operational phase following successful commissioning of the T&S network. We are considering the feasibility of a combined ex-ante and ex-post assessment of the construction for the same project.

- **Ex-ante assessment of the construction of transport facilities**: the Regulator would perform an ex-ante assessment of T&SCo's proposed costs for the transport facilities and set a base case to inform the starting RAV before FID. A post-construction review would be performed by the Regulator to adjust the associated transport assets RAV under a very limited and defined set of conditions that are considered outside of T&SCo's reasonable control.
- **Ex-post assessment of the construction of storage facilities**: the Regulator would assess the efficiency of T&SCo's spend on storage facilities on an ex-post basis. This is because construction of storage facilities could have a high degree of uncertainty, compared to the transport facilities. T&SCo could price in significant risk contingency if the construction cost were to be estimated on an ex-ante basis, potentially leading to an overall higher cost to the users.

  The assessment would not be a simple pass-through and the Regulator would not allow any non-economic or efficient costs to be logged into the RAV. The Regulator would seek to provide a base expectation at the start of construction, or assessment principles for interpreting what is considered as an efficient and economic cost, to support developers in managing the construction programme under an ex-post assessment. As with interconnectors and Offshore Transmission Owner (OFTO) regime, the timing of this ex-post assessment could be near construction completion, though the final actual value will depend on the spend profile and time required for the assessment.
- **Ex-post assessment of transferred existing assets for CCUS application**: assets previously deployed in the oil and gas industry may be utilised/transferred as part of setting up the CCUS T&S network to save costs from building a new T&S network. As the asset is already largely constructed, the capital expenditure-based methodology for determining RAV as described in the above bullet points would not be suitable to be applied directly on the transferred assets. We are considering the methodology for determining the transferred assets RAV and would provide an update to the proposed methodology in 2021.
- **Interest During Construction (IDC)**:

  $$IDC = (BWACC\ x \sum (RAV\ in\ construction\ phase)) + Adjustments$$

  as the T&SCo would not receive revenue until successful commissioning of the T&S network, IDC represents an accrued interest on the capital investment in the construction phase and would be 'rolled up' during construction and added to the opening RAV. BWACC is the Weighted Average Cost of Capital (WACC) during the construction phase of the project and RAV is the efficient and economic capital expenditure in the construction phase.

During the operational phase, **the RAV would be adjusted to account for further asset expansion**. It is likely that T&SCo will need to expand the initial T&S network during the operational phase to connect new users or construct new storage assets. The Regulator will provide ex-ante allowances during the periodic price control process for upcoming construction. Where there is uncertainty, the Regulator may use various uncertainty mechanisms to ensure T&SCo and users are not unnecessarily exposed to risks of excessive gains or losses, such as the use of reopeners or potentially volume drivers.

WACC

The WACC (including RWACC and BWACC) building block represents the remuneration to the T&SCo for the capital investment into the T&S network. The risks of investing in T&SCo may vary over time depending on the project's risk profile and we expect that RWACC would likely be different from BWACC.

We are considering whether BWACC would be set through competition or, more likely for early projects, a bespoke process to provide a fair rate of return to investors for the risks they bear.

A number of factors influence the setting of both BWACC and RWACC including benchmarking where possible of analogous industries with similar levels of risk and reward. The process would also need to have regard to T&S Co's ability to finance its operations and deliver on any other duties set by the Regulator.

RWACC would be set periodically by the Regulator through the operational price control review process (described above) and similarly to BWACC, the Regulator would take into account T&SCo's financeability in setting RWACC along with any other duties and the associated guidance. Other factors typically used in setting RWACC include notional gearing levels, cost of capital (both debt and equity), and any adjustments for additional risks.

We will consider further the methodology for setting BWACC and RWACC next year. In particular, we will consider how best to mitigate any uncertainties in the underlying assumptions and parameters to provide investors with visibility as T&SCo progresses from construction into the steady-state operational phase.

Refinancing

Following successful commissioning of the T&S network, T&SCo may look to refinance the project. The Regulator would undertake careful consideration of the refinancing opportunity in setting RWACC to balance between potential excessive profit and financeability. The government is considering the following options (which need not be mutually exclusive):

- **duty to ensure financeability and guidance**: we expect the Regulator would have a duty to ensure an efficient licensee is able to finance the activities in the economic licence. This is similar to other regulated utilities. The Regulator will also set out guidance on its approach to regulatory decision making which should provide additional clarity to T&SCo;
- **independent dispute resolution**: if the T&SCo were to challenge the Regulator's decision, it may require the Regulator to refer the matter to an independent body. This would provide an independent dispute resolution route if T&SCo considered the regulatory settlement is inappropriate;

- **extension of BWACC**: the BWACC may be extended into a period following COD drawing on precedents such as Thames Tideway Tunnel project specifically only in this context. This would provide certainty to T&SCo on the cost of capital until a time where the cluster is likely to be more established (e.g. successful operation of the T&S network as designed, a robust userbase where revenue risks are reduced etc). BWACC in this case would be a blended WACC reflecting the degree of risks borne by the T&SCo in the construction and operational phase;
- **gain share mechanism**: a reopener may be established to share the benefits of refinancing with users. The actual calibration of the gain share mechanism would be explored further to achieve the balance between preventing excessive profit and incentivising T&SCo to seek lower cost of capital; and/or
- **actual gearing**: the Regulator could set the RWACC based on actual financial gearing ratio of the T&SCo in the early operational phase. This could potentially limit the incentive for T&SCo to seek cheaper sources of capital where it is available.

4. Managing risk through efficient allocation, outputs and incentives

T&S networks are likely to have similar characteristics to other networks which are also subject to economic regulation. As with other networks, in order to encourage companies to innovate so they become more efficient, to minimise costs to consumers and taxpayers and invest for future needs, we believe there is value in establishing appropriate incentives. Similar to other regulated sectors, we consider that establishing a robust set of performance incentives for T&SCo would drive better outcomes for users, taxpayers, and consumers.

The Regulator would set a series of key outputs and incentives through the ERR to help ensure T&SCo delivers an economic and efficient service to users and to allocate risks between different users. All cost incurred by T&SCo would be linked to specific outputs to ensure a clear traceability between users' cost and benefits that users receive through the actions of the T&SCo.

The section below describes a number of the key outputs and incentives covering the early phases of the T&S network. These along with other outputs and incentives, will be developed and tested further.

We divide the key risks, outputs and incentives into construction and operation phases.

Construction phase:

a) Incentive to manage construction cost of the transport network

T&SCo would be responsible for any overspends and underspends relative to the initial ex-ante allowance set by the Regulator. Our assessment is that construction risk is best placed with the T&SCo developer and that the risks are within the bounds of a typical project. The construction period returns (i.e. BWACC) would be calibrated to reflect the specific risks for which T&SCo is responsible.

b) Incentive to manage construction cost of the storage facilities

We are considering the risks associated with construction of new storage facilities and how the Regulator should mitigate the risk of inefficient costs during the construction period. Where the efficient costs are difficult to estimate by the Regulator, we currently consider that an ex-post efficiency assessment by the Regulator may be an appropriate way to calculate those costs. The Regulator would only allow efficient and economic cost to be logged onto RAV.

c) Incentive to complete construction of the T&S network as planned

Any delay in commissioning the T&S network means a delay in the revenues T&SCo receives from users. This forms a natural incentive for T&SCo to deliver on time. A delay in completion of the T&S network could lead to a knock-on impact to the users where CO_2 captured cannot be transferred away from users. As a result, the government is considering a penalty which would reduce the starting RAV under a T&S network construction delay scenario.

Users would continue to receive support through their funding model such as a DPA and ICC Contract, in the event where T&S network COD is delayed.

d) Incentive to reduce through-life cost when acquiring existing asset for CCUS application

In a scenario where an existing asset is proposed to be transferred into the CCUS regulated regime, T&SCo would be incentivised to propose an asset that could provide the most value to the users by considering the cost saving potential over the lifecycle of the T&S network. We are considering the methodology for determining the transferred assets RAV and will provide an update in 2021.

Operations phase:

e) Incentive to maintain availability of the T&S network within set target

The T&S network should be available for users to inject CO_2. There may be planned (e.g. for maintenance) and unplanned outages (e.g. caused by damage or capacity constraints). T&SCo may be subject to an availability incentive that rewards higher levels of availability than what is considered as industry best practice but penalise worse performance relative to a pre-set target. The government is considering the following:

- **in-year penalty**: when availability falls below the set target, penalties would initially reduce allowed revenue for that charging year;
- **multi-years penalty**: if availability falls below an in-year penalty threshold (e.g. to a level undermining short term cash flow and financeability), T&SCo would continue to incur penalties, however these could be spread over subsequent charging years; and
- **penalty floor**: if availability falls further below a floor (such that T&SCo's financeability is undermined over the price control period), lower availability would not result in additional penalties. Further actions may be taken by the Regulator, with options ranging from a

users' loan (to be repaid in future price control period) to eventually revoking T&SCo's economic licence if enforcement processes do not resolve the problem.

If the T&S network is unavailable, users would continue to receive funding support. For example, power CCUS users would continue to receive an availability payment but not variable payment, while industrial CCUS users would be paid for based on a deemed CO_2 captured rate as defined by ICC Contract.

f) Incentive to maintain leakage rate within set target:

T&SCo would be responsible for all the cost associated with leaks from the T&S network.

Similarly, T&SCo would be responsible for the costs associated with leakage from storage facilities during operations and following decommissioning until the site is returned to the government. We expect that T&SCo would seek to transfer away a degree of leakage risks from storage facilities through commercial insurance products. Where private insurance is not available, or is prohibitively priced, the government is considering its role through the GSP (see GSP section for details).

In addition, we are considering the feasibility of a reserve from which T&SCo could draw to fund part of the costs associated with the leaks associated with the store if the cost is above a certain threshold.

In the event of significant leakage from the storage facilities, the allowed revenue may include a cost allowance to support T&SCo to conduct leakage repairs or regulatory intervention.

g) Incentive to manage expenditure of T&S network expansion (during the operational phase)

T&SCo would be responsible for any expansion of the T&S network where required to connect new users or meet an increase in overall demand. Efficient asset expansion would be funded by the users as part of regulatory allowances. We expect that T&SCo will be incentivised to deliver this efficiently.

h) Incentive to ensure anchor projects connect to the T&S network as scheduled

The T&S network will have anchor capture projects. Anchor projects will be expected to connect and use the T&S network according to an agreed schedule. Where these users, or their demand, do not materialise then T&SCo would incur a small degree of reduction in its allowed revenue until all anchor projects (or users of equivalent size) have connected to the T&S network. This encourages robust forecasting and submission of a robust future demand scenario as part of the cluster selection process to ensure spend and timing of the T&S network's construction is efficient. Calibration of the incentive would require further consideration including government support on capture projects recognising limitation on T&SCo's control.

i) Incentive to provide connection to users within an agreed timeframe

We are considering an incentive mechanism to further encourage T&SCo to ensure new users are connected in a timely fashion.

j) Incentive to seek new users to utilise the T&S network

We are considering an incentive mechanism to further encourage T&SCo to take a proactive approach with new connections. Calibration of the incentive would require further consideration including government support on capture projects recognising limitation on T&SCo's control.

k) Incentive to maintain the capacity at the level agreed with users

T&SCo will provide an agreed capacity to users. In the event of T&S network constraints that prevent users injecting the agreed level of CO_2, T&SCo will receive less revenue from users to account for the lower volumes. In addition, to incentivise T&SCo to manage constraints effectively, the Regulator may impose performance penalties on T&SCo. It is intended that Users that are constrained would be protected through their funding model, see "T&S capacity constraint risk" in Section 4 and 5 for more details on the impact to users.

l) Incentive/obligation to ensure the T&S network is compliant with wider regulatory, safety and legal requirements

We will consider the interfaces between economic regulation and wider regulation including cost allowances for T&SCo to meet the wider regulatory, safety and legal requirements. We are considering options such as licence obligations and financial incentives/penalties.

m) Incentive to manage operation expenditure

The Regulator will provide an allowance for efficient opex during the operational period. The Regulator may consider risk sharing arrangements such as the use of reopeners (which allow for adjusting revenues from users to T&SCo) under a narrow set of circumstances.

In addition we would expect the ERR to include detail on what an appropriate financing structure would be for T&SCo – evolving over time as the nature of the asset and market evolves.

Government Support Package (GSP)

If required, a GSP would offer protection to investors for specified remote high impact low probability risks that the private sector would not be able to bear at an efficient price or indeed any price. The GSP would also protect users of the T&S network from exposure to these risks. These risks are defined leakage events of CO_2 from storage facilities and asset stranding. Our intention is for the GSP (if required) to be for very remote risks, for a finite period of time, limited in its response, and only for specific events.

Stranded asset risk

This is the risk that there is a complete and permanent loss of demand for the T&S network such that the T&S network assets become redundant or deemed uneconomic. T&SCo would lose its user revenues meaning that the T&S asset is no longer economically viable. The impact on T&SCo could be the loss of remaining investment; an end to business-as-usual operating expenditure, which may be offset by increased operating expenditure to preserve the asset for future use, or to prepare it for accelerated decommissioning and an accelerated decommissioning process resulting in a shortfall in decommissioning funding.

The government considers this a low probability risk but recognises that the market may currently be unable to bear this risk and that some form of government support to manage it may initially be required. The government will ensure taxpayer exposure is sufficiently remote, for example by using the below conditions before the GSP could be triggered:

- **where commercial insurance is unavailable or inadequate**: commercial insurances should be acquired by T&SCo, where available and GSP would only step in as insurer of last resort for uninsurable risk or where there is insufficient capacity in the market or high deductibles;
- **where the risk has been proactively minimised through new connections**: T&SCo would be incentivised to seek users through the connection incentive;
- **where regulatory involvement is inadequate**: there could be potential regulatory interventions at the appropriate time to support either asset repurposing or development of an import market (to effectively acquire a new type of user);
- **where further revenue options are exhausted**: the options of consumers and taxpayer providing revenue support in an underutilisation and timing mismatch scenario is being explored;
- **where cost profiles have been adapted to reduce the likelihood of asset stranding**: adjustments to the depreciation (and decommissioning) profile may be applied to match the risk profile of stranded assets over the operational period; and
- **where GSP exposure is offset by asset sale and reduced spend**: sales of T&S assets to recover any remaining values from the investors, as well as potentially halting construction if it becomes clear that users are not demonstrating progress to build capture equipment.

The GSP would only cover the complete stranding of assets in circumstances where it is considered outside T&SCo's reasonable control. Temporary or reduced demand risk (i.e. underutilisation) would instead be mitigated through the revenue model.

We are considering how the GSP might act as an 'insurer of last resort' and compensate T&SCo up to the remaining RAV, and/or any remaining critical opex associated with mothballing or early decommissioning.

Risk of defined CO_2 leakage from storage facilities

T&SCo's responsibility for leakage costs would remain until the liability is transferred to the government. T&SCo should use the private insurance market where possible to mitigate this exposure.

Where private insurance is not available, the GSP would potentially provide insurance of last resort. However, before the GSP would be triggered, the government is considering the following but not exhaustive mitigations to ensure taxpayer exposure is sufficiently remote:

- **careful selection of storage sites**: T&SCo is required to carry out appropriate due diligence and substantiation on the containment integrity of the proposed storage facilities. The government would also carry out independent due diligence on proposed storage facilities, taking advice from the relevant regulatory authorities as necessary;
- **effective incentive regime**: T&SCo would be incentivised to minimise CO_2 leakage and bear the risk of CO_2 leakage to a financeability threshold through ERR (see ERR section for details); and
- **use of commercial insurance**: T&SCo will be required to procure commercial insurances where available at an efficient cost to cover transport and storage leakage risks where possible, as the government expects a commercial insurance market to develop.

Consideration of risks

Management and allocation of risks is critical to the investability of the CCUS sector. This section sets out how risk which could potentially affect the T&S network are dealt with in the TRI Model. This includes cross-chain risks which arise where an event originating in the T&S network affects power or industrial users and vice versa. We would continue to develop and refine the risk allocation in the future as we engage with stakeholders.

Risk	Description	Allocation
T&S specific risks		
T&S construction delay	Risk that the T&S network is not completed to schedule as agreed with the Regulator. Delay to completion could lead to users having no facility to transport and store CO_2 (i.e. T&S timing mismatch risk).	There would be a delay in T&SCo beginning to receive revenue. The Regulator may also impose penalties on T&SCo through an adjustment to the opening RAV. Users would be protected from T&S timing mismatch risk through the corresponding business model. See T&S timing mismatch risk in Section 4 and 5 for more details on user protection.

Risk	Description	Allocation
Construction cost overruns	Risk that outturn construction costs are higher than base case or inefficient construction cost incurred.	T&SCo would bear the construction cost overruns risks. Overrun above base case in an ex-ante assessment for transport facilities, or inefficient cost incurred in an ex-post assessment for storage facilities would not be logged onto the opening RAV.
T&S construction incompletion	Risk that the construction of the T&S network is not completed. Incompletion of T&S network could lead to users' capture plants becoming stranded.	T&SCo would not be receiving any revenue or compensated for capital investment if T&S network is not completed, with the exception of Force Majeure events. Users would be protected from stranded asset risk through the corresponding business model. See user stranded asset risk in Section 4 and 5 for more details on user protection.
T&S unplanned outage	T&S network is unavailable to transport and store CO_2 from users. T&S unplanned outage could result in a knock-on impact on users including unable to inject CO_2 into the T&S network and users were forced to emit CO_2 or shutdown the entire plant.	T&SCo would bear the majority of unplanned outage risk. An availability incentive would reduce allowed revenues in-year and across multiple years to incentivise T&SCo to maintain the availability within the set target. The reduction in allowed revenue would be limited to ensure financeability of the T&SCo through provision of a penalty floor. Users would be protected from unplanned outage through their corresponding business model. See T&S unplanned outage risk in Section 4 and 5 for more details on user protection.

Risk	Description	Allocation
T&S capacity constraint	Lower than expected level of capacity (injection/offtake rate or storage volume) available in the transport and/or storage facility. This could result in a knock-on impact on users including injecting less CO_2 into the T&S network and users could be forced to emit CO_2.	T&SCo would bear the majority of capacity constraint risk if within T&SCo's reasonable control. A capacity incentive would reduce allowed revenues for T&SCo if the outturn capacity is less the set target. Users would be protected from T&S capacity constraint risk through their corresponding business model. If users were causing the constraint (over injection compared to the injection rate agreed with T&SCo), users would be subject to a penalty. See T&S capacity constraint in Section 4 and 5 for more details on user protection.
User timing mismatch	Timing mismatch risk will arise if the first users are connected to the T&S network later than planned.	T&SCo would bear a small degree of user timing mismatch risk. T&SCo's return would be reduced and deferred until a user connects to the T&S network. T&SCo would be protected from cashflow shortfall impacts for opex through compensation from the delayed user or recourse from consumers and/or taxpayers.

Risk	Description	Allocation
Underutilisation risk	Risk that T&S network utilisation is lower than expected, leading to a shortfall in revenue from users to T&SCo.	T&SCo allowed revenue would be subject to a small degree of reduction if utilisation is reduced. However, underutilisation risk would be shared with users and government through potential government capital contributions to T&SCo, provision of a financial reserve, mutualisation mechanism (only triggers when there is a large user base) and contingent recourse to consumers and/or taxpayers. There are various causes that could lead to underutilisation risk including user unplanned outage, user construction delay or user construction incompletion. Users would bear the majority of these risks. See underutilisation risk (users unplanned outage, construction incompletion and delay risks) in Section 4 and 5 for more details on risk to users.
T&S stranded asset risk	Complete and permanent loss of demand for the T&S network as a result of events outside the control of T&SCo (e.g. change of regulation or government policy) such that the T&S network assets become economically redundant.	T&SCo would be protected from stranded asset risk in certain circumstances. GSP would act as 'insurer of last resort' and compensate T&SCo up to the remaining RAV, and/or any remaining critical opex associated with mothballing or early decommissioning.

Risk	Description	Allocation
CO_2 leakage from T&S network	Risk of CO_2 leakage from the transport or storage facilities. This could result in a knock-on impact on users similar to T&S unplanned outage risk.	T&SCo would bear the leakage risks from transport facilities. For leakage from storage facilities, T&SCo would bear the leakage risks up to a very remote threshold. T&SCo would be expected to seek commercial insurance products in the market. GSP would provide insurer of last resort protection to T&SCo above the remote threshold. Users would be protected from CO_2 leakage from T&S network risk through their corresponding business model. See T&S unplanned outage risk (due to the equivalent impact) in Section 4 and 5 for more details on user protection.
General risks		
Regulatory and political risk	General change in government policy or change of Law during construction and operation that has a material impact on the T&S network.	These risks are outside the control of T&SCo and if materialise, the Regulator may consider adjustment to agreed base case. Further consideration would be required to establish the definition and scope of regulatory and political risk. In the event that stranded asset risk arises from change in regulation or change in government policy, then T&SCo may be supported by the GSP.
Development	Investor risk of investing in the development of the project without the certainty of regulatory approval.	Investment would only be recoverable if the prospective licensee receives an economic licence and spend is deemed efficient by the Regulator. Development cost risk may be shared to the extent of any government support such as Industrial Decarbonisation Challenge fund.
Force Majeure	Extraordinary and unforeseeable risks that are beyond reasonable control by T&SCo.	Regulatory adjustments to the revenue, provided appropriate mitigations were in place.

Risk	Description	Allocation
Inflation	Risk that costs inflate more than anticipated by the price control, impacting expected returns.	T&SCo allowed revenue building blocks would be linked to mitigate the risk of inflation.
Bad debt	Risk that users default on T&S fees payments to T&SCo.	T&SCo would be protected from bad debt risk above a threshold. T&SCo would have access the following measures: • users' collateral; • the bad debt allowances; • mutualisation over the remaining user base once sufficient users established; and • potential contingent recourse to consumers and/or taxpayers.
Decommissioning shortfall risk	There is a risk where the decommissioning reserve is not accrued sufficiently to cover the decommissioning cost.	T&SCo would bear the decommissioning shortfall risk. We are considering how this can be implemented as part of the wider CCUS decommissioning regime. In a remote scenario where shortfall remains after exhausting all T&SCo measures and mitigations. We would consider the role of government as a 'decommissioner of last resort'.

Section 4: Dispatchable Power Agreement for Power CCUS

Introduction

Decarbonising the power sector has led the UK's efforts to reduce greenhouse gas emissions. In 1990, electricity generation accounted for 25% of UK emissions. In 2018, it was only 15%. Thirty years ago, fossil fuels provided nearly 80% of electricity supply. Today, the country gets over half of its power from low carbon technologies. The rapid growth of renewables has been a critical feature of this transformation.

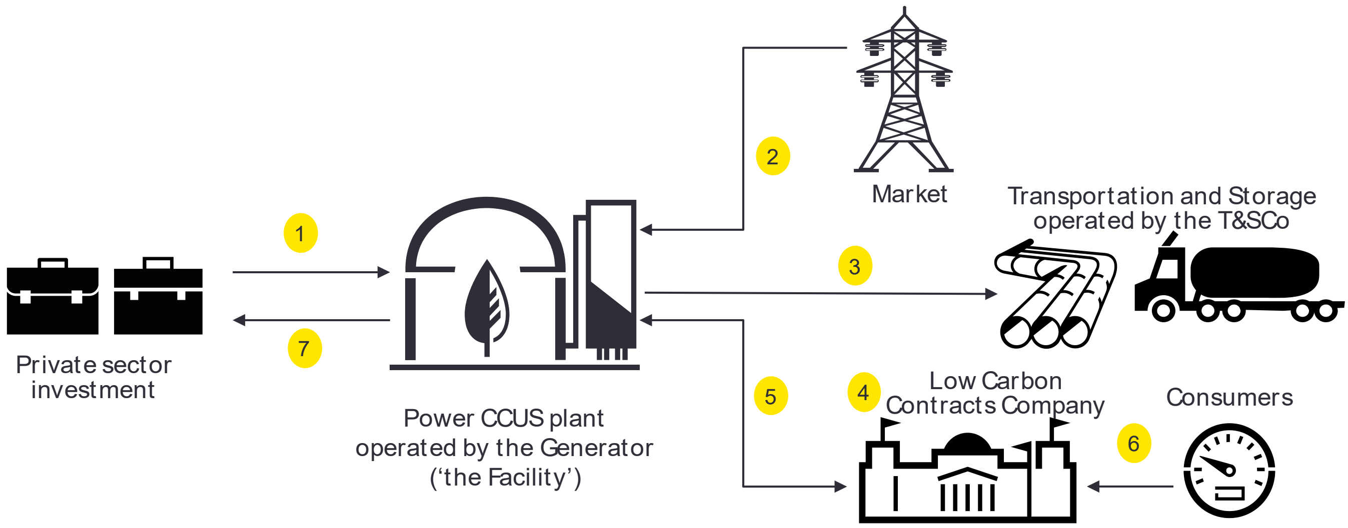
The Energy White Paper sets out the government's view of how to achieve a low cost, low carbon electricity system. A low cost system is likely to be composed predominantly of renewable electricity. Achieving a low cost system, which is also reliable, means renewables need to be complemented by technologies which provide power when the wind is not blowing or the sun does not shine. Power CCUS is one of the technologies that can provide this capacity.

Our objective is to develop a business model which enables power CCUS to play a valuable mid-merit role in our generation mix. We recognise that a plant acting in dispatchable mode will have multiple features which we need to consider in deploying a business model. As power CCUS plants incur fuel costs and, using current capture technologies, emit some residual CO_2, we believe they should be reactive to the electricity market and should not displace low- or zero-marginal cost, low carbon technologies such as renewables or nuclear power. However, if we are to allow power CCUS technology to follow market movements, we understand that at current carbon prices, power CCUS plants are unlikely to displace higher carbon alternative equivalent capacity. A key balance in developing the business model is to provide initial plants with sufficient support to give investor confidence, while ensuring that these projects are affordable and represent VfM for consumers.

The business model set out in this section is intended to cover technologies which have CCUS technology applied directly to a thermal power plant, including pre-combustion, post-combustion, and oxy-fuel technologies. This encompasses both new build CCUS power plants and retrofitted CCUS power plants. In addition, hydrogen-fired power plants which are standalone from hydrogen production infrastructure could be considered under the power CCUS business model discussed, however, this would be dependent on the development of an appropriate hydrogen business model.

We are currently considering a DPA which could be established between the power CCUS project company and the Low Carbon Contracts Company (LCCC), a government company, with subsidies which may be funded by consumers through the existing framework of the Supplier Obligation. The structure of this mechanism is intended to address key risks and challenges associated with deploying CCUS.

Figure 5: a holistic overview of the DPA



1. Private sector investment and construction of facility with carbon capture technology

2. The Power CCUS Plant provides dispatchable, low carbon power at the market price in the wholesale and balancing markets and provides ancillary services to the Electricity System Operator

3. The Generator pays T&SCo T&S fees for captured carbon

4. LCCC acts as counterparty to the DPA

5. DPA provides the Generator with payments comprising of an availability and variable payment

6. Consumer subsidy funds availability and variable payment

7. Return on investment back to private sector

Work undertaken by BEIS, in consultation with expert working groups from industry and supporting advisers, has identified a high-level concept for the proposed DPA payment mechanism structure, consisting of an availability payment and variable payment. This was set out in the government's response to the consultation CCUS Business Models in August 2020.[12]

Objectives of the DPA for power CCUS

The following objectives are being used to guide DPA design and address the key challenges faced in establishing power CCUS:

- **provide sufficient investor confidence**: it is important to balance the inherent uncertainty of a dispatchable role with the need for power CCUS to be an investable proposition. The design of the DPA availability payment mechanism forms a basis for a

[12] https://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-business-models

level of revenue certainty, but investors will need to consider the revenues which they can make from the wholesale electricity market and other markets such as those for balancing and ancillary services when building a business case. The DPA is designed to ensure the investment proposition remains without removing the incentives of the CCUS project to participate efficiently in existing markets;

- **incentivising the plant to react to the wholesale electricity market**: by providing availability payments which are decoupled from dispatch, the plant should be incentivised to react to market prices and provide dispatchable output without incentivising the power CCUS project to generate at all times, which would displace lower-carbon sources of generation such as renewables and nuclear. The flexibility of power CCUS projects should allow it to complement the intermittency of renewables by adjusting output to meet changes in electricity demand, whilst still capturing emissions from generation;
- **displacing comparable unabated generation and reacting to carbon prices**: the variable payment should be designed to be sufficient to ensure that the power CCUS project dispatches ahead of the unabated equivalent reference plant by accounting for the difference in costs arising from installing carbon capture equipment. Incentivising a power CCUS plant to displace higher carbon alternatives will maximise the contribution of these plants to electricity system decarbonisation. The level of the payment should be reactive to carbon prices and power plant costs, meaning that it is only paid when necessary; and
- **ensuring affordability and value for money for consumers**: the link to energy bills means any spend should be efficient and look to deliver VfM for consumers through minimising unit costs, maximising competition and reducing barriers to entry.

We are considering the appropriate process for awarding DPAs to bring forward initial plants. This could be a negotiated or competitive process and will be dependent, to an extent, on the future deployment of CCUS clusters.

Regardless of the process followed for initial deployment, moving forward we will consider the introduction of a competitive award process which, if designed appropriately, could contribute to reducing the cost of deployment.

We will ensure that power CCUS fully participates in existing market frameworks where possible, while achieving our objectives for the technology. In future, this participation could include using wider market frameworks to drive deployment of power CCUS plants as required by the electricity system. We will set out a clearly defined methodology to assess the suitability of a potential market-driven approach against our objectives at regular periods.

Legal and Contractual Framework

The DPA is based on the contractual framework established for the standard Contract for Difference (CfD), but with specific amendments to ensure that the mechanism meets the challenges identified. We propose to replicate key provisions from the standard CfD, which could provide certain protections where these may be important for FOAK projects. An overview of the legal and contractual framework, highlighting key differences with the standard CfD, is given at Annex C. Alongside this document we have also published the draft Heads of Terms (HoT) for the DPA, at Annex D.

Roles and responsibilities of the power CCUS plant company

The Generator shall be responsible for the full lifecycle ownership of the power CCUS plant, including development, financing, construction (including retrofit, if applicable), operations, maintenance, and decommissioning. It is intended that the power CCUS plant shall include the power generation facility and carbon capture plant, including the associated auxiliary plant to enable dispatchable low carbon power generation.

Some of the specific areas which the Generator will be responsible for include:

- construction and commissioning of the power CCUS plant, upon which payments under the DPA will commence;
- installation, configuration, registration, and maintenance of the electrical metering, CO_2 metering and gas supply metering in accordance with the relevant codes and standards;
- installation, configuration, registration, and maintenance of the CO_2 compositional analysis equipment; and
- supplying CO_2 at the entry point to the T&S network within the agreed limits of composition, temperature, and pressure and ensuring that any out of specification CO_2 is diverted to the atmosphere prior to entry to the T&S network.

For responsibilities of the T&SCo, refer to Section 3.

In order to ensure that out-of-specification CO_2 is not allowed into the T&S network, the power CCUS plant shall include continuous monitoring of the export CO_2 composition and emergency venting system design. The required CO_2 metering and compositional monitoring would be the responsibility of the Generator, with data interface also provided to T&SCo and DPA counterparty, for payment settlement purposes.

Payment Mechanism

The proposed DPA consists of two payments: an availability payment for low carbon generation capacity and a variable payment. The availability payment is intended to provide investors with a regular payment based on the availability of low carbon generation capacity.

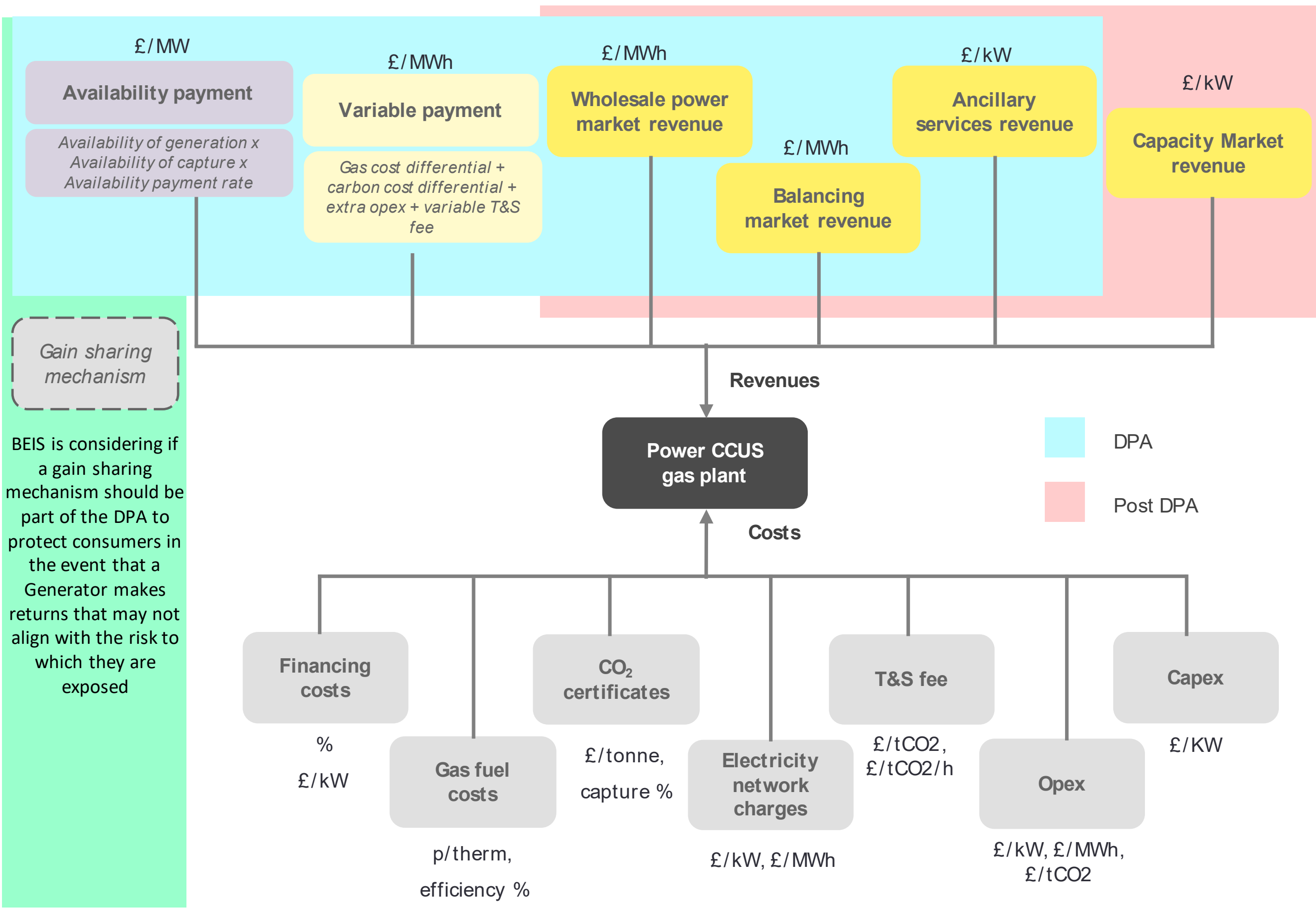
The proposed formula is based on a constant availability payment rate (APR), but the availability payment should be reduced in the case of outages of generation or capture equipment, or poor performance against the expected capture rate. The proposed formula can be found in Annex C.

The variable payment is intended to incentivise the contracted plant to generate ahead of an unabated equivalent plant when demand cannot be met by low marginal cost technologies such as renewables and nuclear, at times where the market would not provide sufficient incentive for dispatch ahead of such an unabated plant. The variable payment will be calculated by considering the difference in short run marginal cost between the power CCUS plant as agreed in the DPA contract and a theoretical reference unabated plant.

The proposed formula, which can be found in Annex C, achieves this aim by taking into account the higher gas costs, lower carbon costs, T&S volumetric fees, and other higher costs faced by the power CCUS plant, ensuring that its overall short run marginal costs are less than the short run marginal costs faced by an equivalent unabated plant in normal operations.

Further detail on the T&S fees can be found in Section 3.

Figure 6: the diagram below provides a holistic view of the costs and revenues associated with a power CCUS plant and their structure of payment



Gain sharing

A gain sharing mechanism could, in a set number of circumstances, allow for greater fairness of financial returns and risk sharing between power CCUS plant investors and consumers, provided that this is done in a way which aligns with fiscal rules.

The mechanics of such a mechanism are still to be explored but could be aimed at the following types of scenarios:

- where build costs are lower than projections, particularly for initial projects;
- where operational costs are lower than projections, due to the high level of technical and operational cost uncertainty with initial projects;
- where operational revenues from the wholesale electricity market and other energy markets (including ancillary services) are higher than projections and enable the power CCUS plant to recover a significant proportion of its fixed costs without the availability payment; and
- to prevent a generator accessing excess returns that may not align with an appropriate level of development risk.

Financing arrangements

It is important that the design of the DPA can unlock private sector investment, which will drive large scale deployment of power CCUS plants. We believe that the proposed DPA mechanism, comprising both availability and variable elements described earlier in this section, will be attractive to the private sector. This is because the use of the consumer subsidy provides a level of revenue certainty, mitigating the development risks associated with CCUS projects. Moreover, the DPA will be based on the framework of the standard CfD, which has a tried and tested commercial model.

In designing the DPA, we want to ensure that the roll out of power CCUS will have access to a broad pool of investment in order to maximise competition and innovation. Our expectation is that the DPA will attract investment from a range of different investment sources, such as power operators, energy companies, infrastructure funds, and debt providers. This reflects our experience of the standard CfD in attracting investment. The DPA has been designed to provide long-term revenue stability, as well as to provide a degree of certainty over dispatch in the wholesale market, both of which mitigate significant risks for potential power CCUS plant developers.

Trade-offs naturally exist between the various sources of finance due to their individual requirements and it is likely that the potential pricing available will vary depending on a project's risk profile and investors' appetite to take on risk. For this reason, the next stage of work on the financing approach is to engage with the market to understand the identified sources further and to consider the possible availability of each.

Consideration of risks

Since publishing the government response, we have been developing a risk allocation for power CCUS at each phase of the project. Risks are allocated to the party considered best placed to manage the risk. Where this threatens the other objectives, particularly in relation to power CCUS being financeable, deliverable, and VfM for consumers, some sharing of risk may be desirable.

In this section, we have considered the key risks for the implementation of power CCUS and possible mitigations within the business model design. Further discussion on the allocation of cross-chain risks is found later in this section.

Risk	Description	Allocation
Availability and use		
User construction delay	Risk that the construction is not completed to schedule. Delay to completion could lead to T&S having no utilisation if the delayed user is the anticipated first user (i.e. user timing mismatch risk).	Payments would not be made until certain milestone requirements as set out in the DPA are met. The Generator would agree a Target Commissioning Window (TCW) but can commission later during a long-stop window, though this would result in erosion to the term of the DPA (subject to any Force Majeure extensions of time). The T&S capacity fees would remain payable to T&SCo during any period of delay beyond the TCW where the T&S network has been commissioned. We are considering whether this cost could be met by consumers. If the delayed user is the first user, we are considering the feasibility of payment from the delayed user to cover T&S critical opex. See Section 3 for more details on T&SCo protection on user timing mismatch risk.
Development risk	Development expenditure is committed at risk before entry into the DPA.	The Generator would not be compensated for any development expenditure if the project is not awarded a DPA.

Risk	Description	Allocation
T&S timing mismatch	T&S timing mismatch risk will arise if the T&S network is not completed to schedule as agreed with the Regulator (i.e. T&S construction delay risk), with the Generator unable to inject CO_2 while waiting for the T&S network to be completed.	The Generator would be protected from commissioning timing mismatch risk by the DPA. Availability payments would be paid to the Generator if commissioned, available and performance requirements are met during the mismatch period. The variable payment would not be paid in this event and the Generator would be allowed to operate in the market as an unabated plant, and would be subject to normal carbon pricing arrangements. Alternatively, as the Generator's TCW may be extended (e.g. due to a T&S delay), the Generator may have the choice to instead delay its commissioning to match the T&S schedule (in which case the Generator will not see the DPA term commencing (and therefore will not receive any payments) until it commissions). T&SCo would bear the majority of T&S construction overrun risk. See T&S construction delay risk in Section 3 for more details.
Demand risk	Changes in generation mix and/ or system demand over time result in reduced operating hours.	The Generator would be protected against a degree of demand risk through the availability payment, structured such that the Generator would receive relatively stable revenue over the term of the DPA, subject to plant availability and performance. The Generator would take demand risk above this level.

Risk	Description	Allocation
Power CCUS plant availability risk	Planned or unplanned outage of power CCUS plant (generation and/ or capture).	The Generator takes availability risk. Availability payment would be calculated relative to availability and performance of the Generator (subject to any specific outage event relief).
T&S unplanned outage	Temporary unplanned or planned outage of T&S network.	The Generator would be protected from outages outside of their control through the DPA. Availability payments would not be reduced for qualifying third party outages. These could include those on the T&S network, the electricity transmission system, or the gas transmission system (except in instances where the outages are caused by the Generator). Variable payments will not be received. T&SCo would bear the majority of unplanned outage risk. See T&S unplanned outage risk in Section 3 for more details on the impact on T&SCo.

Risk	Description	Allocation
T&S capacity constraint	Lower than expected level of capacity (injection/ offtake rate or storage volume) available in the transport and/or storage facility either due to T&S network issues, or the Generator injecting CO_2 into the T&S network at a rate greater than agreed, leading to the user and/or other users being constrained.	The Generator would be protected from T&S capacity constraint by the DPA, where this is not caused by the Generator. The Generator will continue to receive the availability payment, subject to the power CCUS plant's availability and performance. The Generator would be subject to penalty (governed in the agreement between the Generator and the T&SCo) if T&S network capacity constraints are caused by over-injection by the Generator. T&SCo allowed revenue would be reduced if capacity level is lower than set target. See T&S capacity constraint risk in Section 3 for more details on the impact on T&SCo.
User stranded asset	If the T&S network fails to be constructed or is abandoned post-commissioning, then power CCUS plant would become stranded.	The Generator would be protected from stranded asset risk through the DPA. If the power CCUS plant is available, the Generator would continue to receive availability payments, but not variable payments. If the DPA is terminated, the Generator would be compensated for their investment at a pre-agreed pay-out rate as part of the DPA (compensation formula TBC). See T&S construction incompletion risk in Section 3 for more details on the impact to T&SCo.
Performance		

Risk	Description	Allocation
Operating performance risk	There is uncertainty over the performance of a power CCUS plant and the impact on variable costs. There is also uncertainty in how this performance may change over time.	The DPA would account for the higher gas costs and lower carbon costs of a power CCUS plant vs an unabated equivalent plant through the variable payment. However, the DPA will not account for any differences between the power CCUS plant operational performance and the performance parameters agreed in the DPA (see Reference plant capturability risk). We are considering whether the hypothetical reference plant could be updated to reflect ongoing technological improvements in unabated equivalent plants.
CO_2 quality	Poor performance of the power CCUS capture plant could result in CO_2 quality that is lower than the standard required by the T&S network.	The Generator would be required to operate continuous quality monitoring and emergency venting system to ensure that no out-of-specification CO_2 enters the T&S network. Any vented CO_2 would not be accounted for as captured CO_2 under the DPA payment mechanism and would be subject to carbon pricing.
Commercial		

Risk	Description	Allocation
Commodity price risk	Risk that the prices for carbon and natural gas do not follow expected trajectories and leave the power CCUS plant out of merit relative to the unabated equivalent plant.	The Generator would be protected by the DPA from impacts of commodity price risk on the short run marginal cost of the power CCUS plant when compared to the unabated equivalent plant. The natural gas price and carbon price will be referenced to market price indicators in the variable payment formula. The Generator would take commodity price capturability risk/ reward (see Reference price capturability risk).
Reference price capturability risk	Risk that the Generator does not capture commodity prices equivalent to reference price indicators.	The Generator would take reference price capturability risk/ reward. The DPA will not take account of any hedging arrangements, therefore there will be an incentive for the Generator to trade commodities effectively to capture the best possible prices.
Reference plant capturability risk	Risk that the power CCUS plant (and therefore the formulae which calculate the cost differential with the unabated equivalent reference plant) differs significantly from the asset defined in the DPA.	The Generator would take reference plant capturability risk. The DPA would incorporate the assumed parameters of the power CCUS plant under reference conditions, reflecting the final design of the plant.
T&S fees increase	T&S fees charged to users are increased.	The Generator would be protected from an increase in T&S fees by indexation of these fees in the DPA. The variable payment formula accounts for the T&S volumetric fees (unless covered by market revenues) and the availability payment for the T&S capacity fees.

Risk	Description	Allocation
General		
Regulatory and political risk	Change in government policy or change in law across construction and operation.	The Generator would be entitled to specified cost/ revenue protection from only Qualifying Changes in Law (e.g. specific/ discriminatory changes in law, with the precise scope to be determined) by the DPA.
Construction cost overruns	Risk that outturn construction costs are higher than expected at time of entry into the DPA.	The Generator takes construction risk/ reward. Availability payment rate set at point of entry into the DPA.
Construction incompletion	Risk that construction of the power CCUS plant is not completed.	The Generator takes construction completion risk. The DPA payments will not commence if the power CCUS plant construction is not completed.
Force Majeure risk	Extraordinary and unforeseeable risks that are beyond the control of the Generator (subject to certain exceptions).	The Generator would be entitled to an extension to key dates and relief from termination for Force Majeure events under the DPA.
Inflation risk	Risk that costs inflate more or less than anticipated.	The Generator would be protected from inflation risk under the DPA. We are considering full or partial indexation of the availability payment. Market indicators would be used for the input costs in the variable payment formula. Consumers would be protected from overpayment if inflation lower than expected.

Summary: A Power business model to meet our objectives

The business model will provide investor confidence

The DPA is designed to overcome the inherent uncertainty of operating in a dispatchable role, and to incentivise investment by providing a long-term revenue stream through the availability payment. The availability payment forms a basis for revenue certainty, which investors should consider in addition to revenues from participating fully in the wholesale market, and balancing and ancillary services markets, in building a business case for investment in a power CCUS plant.

The DPA will incentivise the plant to react to and participate in the wholesale electricity market

Payment on the basis of availability, rather than generation output, means that the Generator does not have an incentive to constantly dispatch to maximise revenue, displacing other lower carbon, low short run marginal cost sources of electricity generation. Instead, it should be incentivised to respond to price signals and operate flexibly to generate in those periods in which supply from lower carbon alternatives, including intermittent renewables and nuclear, is insufficient to meet system demand.

The DPA will incentivise power CCUS plants to displace comparable unabated generation

The variable payment formula ensures that the power CCUS plant is incentivised to dispatch ahead of unabated Combined Cycle Gas Turbines (CCGT). The formula takes account of the variable input costs of each generator and covers the difference in costs arising from the operation of the capture unit. This includes the differences in gas cost, carbon cost, operation and maintenance, and volumetric T&S fees. Where the reference plant mechanism works accurately, the power CCUS plant should operate as though it were the most efficient unabated CCGT on the system, thereby displacing unabated CCGTs from the merit order.

Our approach to deploying power CCUS will ensure affordability and value for money for consumers

The DPA, and our ongoing approach to deployment of power CCUS technology, will drive value for money. The availability payment provides a long-term revenue stream, providing a sufficient level of confidence to investors and helping to lower the cost of capital. The variable payment will ensure that the plant can displace higher carbon alternatives in the electricity system but will only be paid when it is necessary to achieve this. Furthermore, as indicated, while initial contracts may be negotiated, we will consider the introduction of a competitive framework for awarding DPA contracts which we believe could further contribute to reducing the costs of deployment.

Section 5: Industrial Carbon Capture

Introduction

Industrial Carbon Capture (ICC) could play a vital role in decarbonising the industrial sector. It has the potential to secure the long-term competitiveness of energy intensive industries, support clean growth around the UK, protect existing jobs, generate new jobs and economic opportunities, and incentivise investment in new industrial sites. Decarbonisation of UK industry represents a significant challenge, with few viable options for large scale emissions abatement. ICC is seen as one of the most likely routes to providing significant emission reductions in the sector.[13]

ICC however imposes costs associated with capital investment and financing, ongoing operational costs for running the capture equipment and system costs including T&S fees to use the T&S network. These costs are combined with no corresponding increase in product value for being low carbon. This means that at present, the costs cannot be passed on to the industrial facility's consumers, although there are benefits in terms of avoidance of carbon pricing and being well positioned to take account of a low carbon products market, as it develops. As a FOAK application in the UK, ICC will initially have higher capital costs and a risk premium may be attached to it which creates further risks and uncertainties to potential investors.

In order to overcome these market failures and challenges, we are developing a commercial offer to industry through an ICC Contract to drive decarbonisation in the sector and support the competitiveness of our industrial base. This offer will be between the owner of the industrial facility (or a third party on behalf of the industrial facility) and a private counterparty, acting on behalf of the Secretary of State for the Department for Business, Energy and Industrial Strategy.

Our objective is to develop a business model that can incentivise: i) existing industrial facilities who have a viable future in the UK to invest in carbon capture to decarbonise, while maintaining their international competitiveness and delivering value for money for the taxpayer; and ii) investment in new industrial facilities in the UK, supporting our ambition to level up the UK's economy.

Building on our position in summer 2020, and in consultation with the Industrial Carbon Capture expert group, bilateral discussions with industry and with our supporting advisers, we are able to set out our 'minded-to' position on the commercial concept to incentivise FOAK ICC in the UK. This provides provisional detail on key commercial policy terms on which detailed contractual drafting will be based and which we will discuss in detail with potential projects and

[13] All scenarios of ambition in the Committee on Climate Change's Net Zero Technical Report cite CCUS as the largest single contributor to the decarbonisation of industry.

investors. It confirms that capex co-funding will only be available to support construction costs for initial projects.

The model outlined here is reflective of both the initial investment nature of ICC projects, and the current immaturity of the low carbon industrial market in the UK. Therefore, the model set out is for initial and early-stage ICC projects and we expect it to evolve as the technology, investment confidence and market for low carbon products develops, leading to later projects following a competitive allocation process and a market-driven reference price in line with that which has been established for the standard CfDs in the electricity market.

We are looking to put in place a commercial framework that is similar to the standard CfD, which has been allocated competitively since 2014, but with some alterations and specific features that accommodate the sectoral and structural differences. Indicative Heads of Terms (HoTs) for the ICC Contract, produced by LCCC at the request of BEIS, shows the initial framework for the commercial contractual arrangements. This is included in Annex E and development will now start on detailed commercial drafting of the HoTs.

The proposed business model has been designed to reward permanent storage of CO_2. As such, it will enable the export of captured CO_2 to the T&S network, paid for by T&S fees. This approach has been adopted on the basis that CO_2 produced from an ICC project should be exported to the T&S network. We consider utilisation of CO_2 to be outside the scope of this business model unless it leads to permanent abatement of CO2, although we do recognise that utilisation could still be important in supporting cost reduction and the economics of projects.

Key commercial components of the proposed business model for industrial carbon capture for initial projects
For early projects the reference price for the ICC Contract will be a fixed trajectory that will be defined in advance of contract negotiation and provide a stable analogue to the carbon market price so that industry can price for projected carbon costs. The agreement will see ETS free allowance certificates forfeited in line with capture volumes and monetised against the reference price[14], while residual emissions (and any remaining free allowance certificates) will remain subject to the ETS. As carbon capture is established and the low carbon market matures, it is intended that the reference price would evolve to a market-driven carbon price. The strike price will be negotiated bilaterally for initial projects, moving to a competitive allocation process as the technology matures, when more CCUS clusters are operational and project bid pools are sufficiently large to allow competition.

[14] Further detail on treatment of free allowances and how the reference price trajectory will be agreed will be set out in 2021

The ICC Contract will have an overall duration of 15-years. We are minded for this to be based on a 10-year initial period covering operational expenses for running capture equipment, T&S fees, and a rate of return on capital investment. Following the end of this initial 10-year period, there could be an additional period of 5 years that will only outlay operational costs and T&S fees. This could be delivered through either (i) an option for government and the industrial facility of a 5-year extension to the initial 10-year contract term, or (ii) an initial contract duration of 15-years, with a reopener on the strike price after the initial 10-year period which could take account of the carbon price and development of the low carbon products market in the UK by that time. Further work will follow in 2021 on the capex repayment period within the 10-year period as well as the process for the contract extension or reopener at year 10 to cover years 11-15.

Capital co-funding grants will only be available to support initial capital investment, with the remainder funded through private investment sources and/or by the industrial facility's owner balance sheet.

The industrial facility will take on risks associated with CO_2 leakage in its part of the network, decommissioning of capture plant, supply chain capability and commercial financing. The private law contract would protect the industrial facility from certain unforeseeable and material policy changes.

With respect to construction and operating risk, it is anticipated that the private sector will be able to manage these risks most effectively, with some provisions to mitigate the risks inherent in FOAK projects. For construction risks, this includes providing an element of capital grant funding structured on a last spend basis and establishing a Target Commissioning Window to provide sufficient flexibility on the operational start date. For operating risks, it is anticipated that a potential operating expenditure reopener early on in the project may be beneficial to both parties in FOAK projects. Further work will be undertaken in these areas. Additionally, the treatment of demand risk is being further evaluated, with measures to limit overall cost to the taxpayer as well as potential limitations on downside risk for the industrial facility being considered.

The ICC Contract will be a private law contract between a government-appointed counterparty to the ICC Contract and the owner of the industrial facility (or a third party on its behalf). This counterparty is anticipated to be the Low Carbon Contracts Company (LCCC), subject to agreement and any necessary legal and administrative changes.

The model laid out in this section is under development and represents the government's current 'minded-to' position on the commercial offer for, and handling of, the ICC Contract. This work is ongoing and further updates will describe additions and clarifications to the model during the formulation and drafting of commercial HoTs during 2021. This will build on the high-level and indicative HoTs that have been drafted by LCCC on behalf of BEIS.

The engagement with industry stakeholders is, and has been, welcome and essential to this process, and will continue throughout the development of the HoTs via our Industrial Carbon Capture expert group and bilateral discussions with individual clusters and projects.

Further updates will focus on detailed commercial drafting of the HoTs in the annex, in addition to answering extant policy and delivery questions, including:

- profiling of the reference price, including additional detail on treatment of free allowances and approach to indexation;
- further developed thinking on the strike price approach, including possible options for adjustments, T&S fee handling and sectoral banding;
- the quantum and form of possible capital grant support on offer such as expected sharing proportions, rate of return provisions and possible accelerations of return to maximise efficient use of capital;
- project allocation approach, criteria, and integration with wider cluster selection processes;
- providing guidance on delivery processes and timelines for these policies; and
- further detail on the proposed risk allocation, in particular on demand risk.

The following section outlines the current ‘minded-to’ position on the approach and structure to the proposed business model to support ICC in the UK.

Annex E published alongside this document provides an early, indicative outline of the HoTs that an ICC Contract could follow and has been developed by the LCCC, coordinating with BEIS.

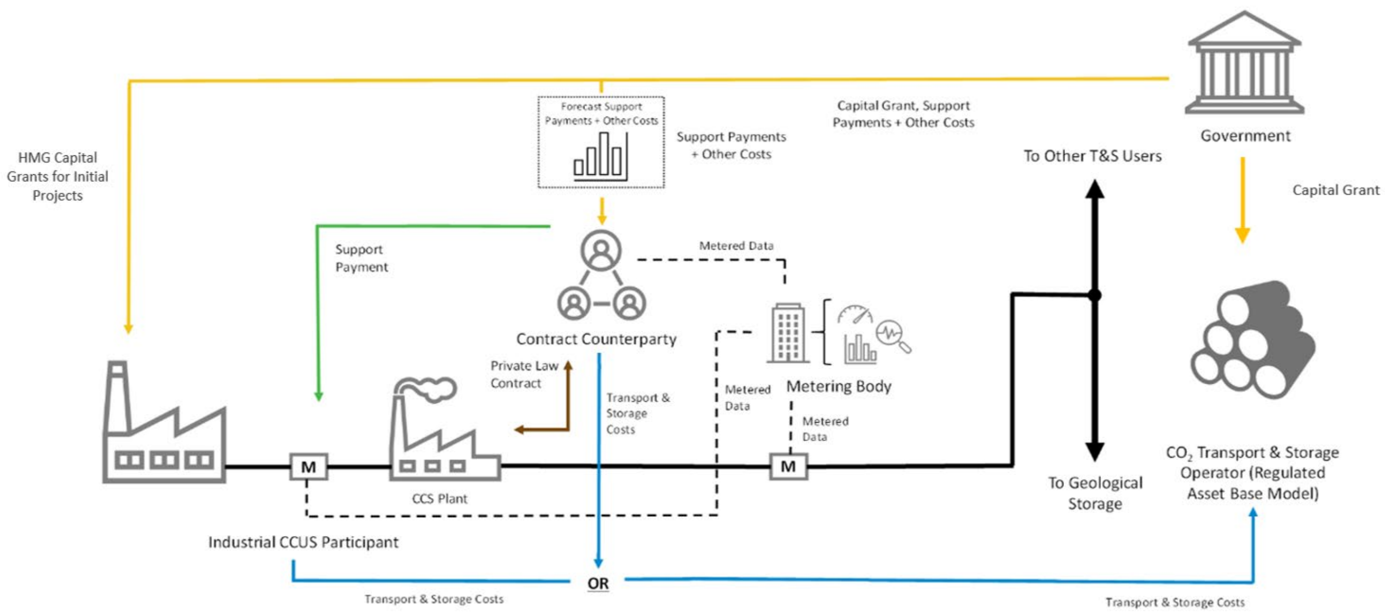


Figure 7: the diagram above presents a simplified illustration of the funding mechanisms involved in the delivery of early ICC projects:

- capital co-funding grants will be available to support capital investment for initial ICC projects;
- an ICC Contract will be agreed bilaterally (for initial projects) between the owner of the industrial facility (or third party acting on behalf of the industrial facility) and the defined HMG counterparty;
- support payments covering operational expenses for running capture equipment, T&S fees, and providing a rate of return on capital investment, are made to the industrial facility;[15] and
- metering of carbon captured at different stages will allow appropriate accounting for operational payments, and monitoring the quality of gas injected into the T&S network.

Business Model/Commercial Framework

Terms

The Contract: the ICC Contract whose proposed and provisional terms are laid out in this document and would be agreed between the owner of the industrial facility, or third party acting on behalf of the industrial facility, and the HMG appointed contract counterparty.

Industrial Carbon Capture (ICC): the on-site capture components of the industrial application of carbon capture and storage, not including T&S infrastructure.

Reference and Strike Price

Our ‘minded-to’ position is that the reference price will follow a fixed trajectory, defined before the start of negotiations. The price could be analogous to the projected carbon market price for the contract lifetime, though not necessarily directly derived from it. This will allow the contract to predictably imitate the ‘avoided’ costs of the carbon price (i.e. those costs that the industrial facility would otherwise pay to buy allowances for their unabated emissions) as well as providing predictability of income and outlay for the installation of carbon capture on the industrial facility and the government respectively. Detail on how BEIS will set the trajectory will be set out in 2021.

The industrial facility will be expected to give up some portion of its current free allowances under the ETS. This reflects that the plant should no longer need these allowances as the model offers protection from carbon market risks in respect of abated emissions[16]. Further work on treatment of free allowances will be set out in 2021.

The strike price will be, in the first projects, negotiated bilaterally and should be based on, and reflective of, expected costs of carbon capture for the project (including the T&S fees and a

[15] Decisions on routing of T&S payments routed are to be decided in 2021; the illustration of T&S funding via the emitter is purely illustrative and we have also shown that T&S payments may be routed directly to the T&S operator from the contract counterparty.
[16] Note that residual emissions and any remaining free allowances will remain exposed to the ETS.

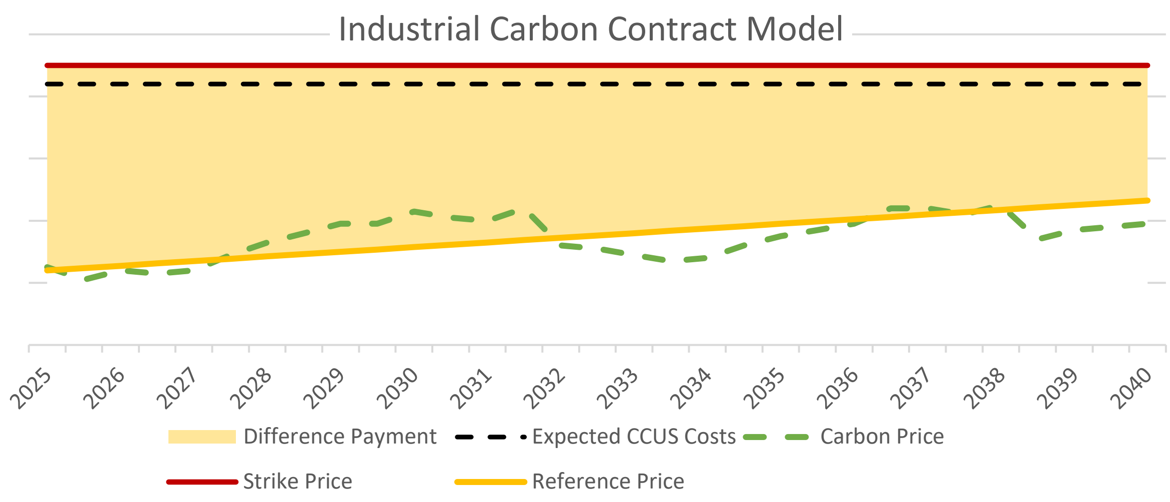
return on the capex investment). We will set out further details on this process, including pre-qualification criteria for entering into bilateral negotiations with BEIS.

In this way, the overall outlay of the contract will be predictable. In advance of negotiations, HMG may set out banded strike prices per industrial sector to guide bilateral negotiations (and in future competitive allocation processes).

We expect bidders to submit strike prices based upon the reference price, their costs of capture, avoided carbon costs and expected return for an investment of this risk profile.

This model is designed to be applied to FOAK ICC projects in the UK; as the ecosystem for carbon capture in the UK is established and the low-carbon market matures, the model will similarly evolve to using the market price of carbon as the reference price for later projects. Similarly, for these later projects we intend that the strike price be set through competitive allocation, potentially via an auctioning process, though further work is needed to determine potential competitive allocation methods.

Figure 8: Industrial Carbon Contract Model



Our basis for considering this reference price approach was derived from a criteria assessment:

- **provides predictability for investors**: this reference price option provides predictability for both investors and government for the lifetime of the contract and mitigates the uncertainty risk that both parties would face were the contract based on a fluctuating carbon price;
- **subsidy reduces over time**: having the level of support decline over the lifetime of the contract will reduce outlay for government as the carbon price increases and low carbon products market develops and gradually normalise exposure to standard market conditions;

- **cost effective in order to reduce overall cost to HM Government**: the reference price should ensure that the minimum necessary level of subsidy is allocated to the industrial facility so as to achieve efficient allocation of public funds which represents value for money for the exchequer and should incentivise optimisation of technical and operational efficiencies;
- **provides a fair and cost reflective subsidy**: the reference price should avoid the risk of the industrial facility receiving excessive (or insufficient) subsidy;
- **supports and is compatible with carbon pricing policy**: the reference price approach should not contradict or undermine, in practice or principle, the UK's current or future carbon pricing approach;
- **simplicity of implementation**: basing the reference price on a pre-defined trajectory means that the payments are only dependent on the metered tonnage of CO_2 that is captured and transferred to the T&S network, simplifying the settlement process and reducing the administrative burden both for participants and the contract counterparty; and
- **provides cost certainty to the Exchequer**: where possible, the reference price should provide the Exchequer with a predictable and controllable outlay.

Payment

The Contract will be paid on the basis of metered output of CO_2 entering the T&S network. No payment will be included for the general availability of the capture equipment. We consider that a payment on the basis of metered output of CO_2, covering opex and capex, will be easier to administer over the lifetime of the contract.

T&S fees will be paid as part of the ICC Contract by the counterparty. In principle, the industrial facility will be protected from changes in T&S fees outside its control. Further work on T&S fees will be undertaken in 2021.

We considered the alternative option of a payment based on the availability of the capture equipment in respect of the capex invested by the industrial facility but concluded that the availability of a CCUS-enabled industrial facility would be more difficult to measure than a power CCUS plant and could be prone to gaming.

Contract Term

The generic ICC Contract will have an overall duration of 15-years. We are minded for this to be based on a 10-year initial period covering operational expenses for running capture equipment, T&S fees, and a rate of return on capital investment. Following the end of this initial 10-year period, there could be an additional period of 5 years that will only outlay operational costs and T&S fees. This could be delivered through either (i) an option for government and the industrial facility of a 5-year extension to an initial 10-year contract term, or (ii) an initial contract duration of 15-years, with a reopener on the strike price after the initial 10-year period which could take account of the carbon price and development of the low carbon products market in the UK by that time. Further work will follow in 2021 on the capex repayment period within the 10-year period as well as the process for the contract extension or reopener at year 10 to cover years 11-15.

Following the completion of the Contract period(s), the expectation is that the market price of carbon and a sustainable and thriving low carbon products market means that the ICC project will continue to operate without further subsidy support from government.

In considering contract length, we have taken account of a number of relevant factors, including the useful life of the asset and its possible accounting treatment, the potential timescale for transition to a subsidy free model, availability and cost of finance, value for money and affordability for government, and the implications for T&S. A 15-year term is the length of the standard CfD in the electricity market, providing a precedent for the overall duration of contract with which the government and the financial community are already familiar and comfortable. However, if we are accelerating capex repayment within the first 10 years, this may have an impact on optimum contract length. We will make a final decision on this in 2021.

Contract Counterparty

The Contract will be a private law contract between a government-appointed counterparty to the Contract and the owner of the industrial facility or third party acting on behalf of the industrial facility. This counterparty is anticipated to be LCCC, subject to agreement and any necessary legal and administrative changes. Award of the contract under bilateral negotiations for initial projects will be on the direction of the BEIS Secretary of State.

Subsidy Control

The form of the revenue support for ICC projects is expected to be modelled as a subsidy, with contractual terms similar to those in the standard CfD contract, to ensure that participating UK industry is able to accommodate the costs associated with carbon capture. As such, the policies outlined in this document are provisional on compliance with the relevant applicable subsidy control regulations, including those being developed.

Classification

The policies and approach outlined here covering revenue and capital support and risk allocation are minded-to positions and will undergo further policy development, including a detailed analysis of the government balance sheet treatment and may therefore be subject to change. It is intended that the balance of risks and rewards associated with the ICC policies should lie in the majority with the private sector, reflecting that this programme is fundamentally a commercial endeavour, incentivised and supported by government intervention.

Change in law

In principle, the ICC Contract will contain change-in-law provisions, the form and scope of which remain to be determined, though are anticipated to be similar to those in the standard

CfD in the electricity market. Further detail will be set out as the contract is developed during 2021.

Technical arrangements

Eligibility

Existing industrial facilities retrofitting carbon capture (including modular carbon capture technology) and new industrial facilities with carbon capture technology intrinsic to the process will be eligible for an ICC Contract. The intention is for all carbon capture technologies to be applicable under the process, this includes post combustion, oxyfuel, pre combustion and emerging carbon capture technologies such as calcium looping, membranes, and others. We would expect a capture rate (efficiency) of at least 90% of the total flowrate of the flue gas stream to be achievable; however, work with technical advisors will define this in more detail in 2021.

Metering

Accurate metering is important for determining the CO_2 capture rate, CO_2 quality and quantity of CO_2 captured from the industrial facility and sent for permanent storage. It is also important for ensuring accurate payments between parties across the CCUS chain. To meet these requirements, the quantity of CO_2 will need to be determined through metering at these points (whichever is appropriate for systems finalised upon):

- the interface between the industrial facility and capture plant (for post-combustion capture) – if required by the industrial facility or if owned by a third party; and
- the interface between the capture plant and the onshore transport network.

In addition to metering the CO_2 flow rate, it is important to monitor the composition of the captured gas entering the T&S network. Other components beyond CO_2 can be captured as well, and the presence of contaminants, such as water, oxygen, nitrogen, and other gases, can damage downstream pipelines and potentially create issues for the storage site performance. Mechanisms will need to be in place to prevent contaminated CO_2 entering the T&S network.

There will be further work to determine the specifics of metering requirements in 2021, particularly relating to specifics on the interfaces between the capture plant and the T&S facility and metering in other transportation methods.

Consideration of risks

Appropriate risk identification, mitigation, and allocation is critical to ensuring the success of ICC projects. This work has been undertaken with the central aim of achieving the right incentives, while ensuring that both the private sector and the government are not allocated risks that they cannot manage or price for.

Therefore, risks are allocated to the party considered best placed to manage each risk, noting that where this threatens the other objectives of CCUS, particularly in relation to ICC being financeable, deliverable, and providing value for money, some sharing of risk may be necessary. Our approach to risk allocation may evolve as the commercial frameworks mature.

Based on this we have identified 54 risks grouped into core risks below. The following section details key risks relating to ICC, and our 'minded-to' position on these risks. Where our 'minded-to' position remains outstanding, we have highlighted this.

Risk	Description	Allocation
Construction cost overruns	There is a risk that the owner of the industrial facility and the supply chain do not have the skills and experience to deliver the carbon capture plant efficiently to cost predictions. Furthermore, the novelty of ICC means that it is challenging for the industrial facility to accurately predict capital expenditure, although this may be mitigated by detailed FEED studies. Therefore, there is a risk that there are construction cost overruns or savings beyond those projected when agreeing the ICC Contract and grant funding.	Further analysis is ongoing, but our 'minded-to' position is, where HMG is providing capital co-funding, to provide it as "last spend" incentivising industry to fully exploit other sources of capital first, with the HMG grant filling any gap between that and actual construction costs up to a capped amount. If this cap has not been reached, the remaining portion of the grant would be available to repay other sources of capital, subject to the grant not exceeding a pre-agreed percentage of total capital spend.

Risk	Description	Allocation
Other construction risks	Risk to the effective construction of the carbon capture plant due to: • damage to process plant during construction; • difficulty of delivering capture technology at the relevant site; • timing delays; and • incomplete construction.	The industrial facility will bear the risk if there is damage to the process plant during construction of the carbon capture plant or if the carbon capture technology cannot be delivered at the relevant site. In the case of any timing delays, we are minded to provide flexibility through an appropriate Target Commissioning Window, with the industrial facility bearing the risks for any delays beyond this. Delay to completion could lead to T&S having no utilisation if the delayed user is the anticipated first user (i.e. user timing mismatch risk). If there are any delays as a result of unforeseeable circumstances, then a Force Majeure clause will allow an extension. The industrial facility will bear construction completion risk. The payments will not commence if the carbon capture facility's construction is not completed.

Risk	Description	Allocation
Operating risk: costs	The operating costs for capture plants are likely to be significant and challenging to predict, particularly for first projects. This creates a risk for industrial carbon capture if the operational costs are materially higher or lower than forecast. If the subsidy fails to cover the additional operating costs of running abated then the plant may be incentivised to operate unabated, especially once the capital portion of the ICC Contract has ended. Conversely, the ICC Contract also risks over-payment if forecasted operating costs turn out to be much lower once the project is operational.	Our 'minded-to' position is to provide a single operating expenditure reopener early on, once the project is in operation. This would incentivise management of this risk, whilst protecting against uncertainty in operating costs for FOAK ICC projects. The industrial facility will bear the risk of increased costs after the reopener, although consideration will be given to providing protection against inflation. Further work will be undertaken to determine the timing and process for the reopener.
Operating performance risk	There is uncertainty over the technological performance of the capture equipment and how this performance may change over time (linked to operating cost risk). For example, poor performance of the capture plant could result in CO_2 quality that is lower than the standard required by the T&S network. In addition, the CO2 capture rate and plant efficiency could be lower than forecast.	The industrial facility would bear this risk. The industrial facility would be required to operate continuous quality monitoring and emergency venting system to ensure that no out-of-specification CO_2 enters the T&S network. The industrial facility would also be responsible for ensuring minimum defined capture rates are met.

Risk	Description	Allocation
Demand risk	Risk that the industrial facility may have uncertain future demand for its goods and services, leading to uncertainty over the volume of carbon it will deliver to the T&S network. This includes where: • the industrial facility has lower demand for its primary goods or services than was forecast, resulting in less CO_2 delivered to T&SCo; and • the industrial facility has higher demand for its primary goods or services than was forecast, resulting in more CO_2 delivered to T&SCo.	We are looking at a variety of options including: • for lower demand, we could potentially adjust payments to ensure continued returns on capex; • for higher demand, we will consider the viability of a capture cap, restricting payments above this cap. We will also need to consider further the impact on the T&S network for both higher and lower than estimated CO_2 volumes being captured by the industrial facility. Further detail on our approach to demand risk will be set out in 2021, including the interaction with the forthcoming Industrial Decarbonisation Strategy and the development of the low carbon products market.
User stranded asset	If the T&S network fails to be constructed or is abandoned post-commissioning, then the ICC project will become stranded.	In the event that the T&S network is never completed, or completed to an unsatisfactory standard, the options are still being considered, but could include: • the industrial facility could be reimbursed for legitimate costs incurred, including the return of any carbon allowances forfeited.

Risk	Description	Allocation
T&S unplanned outage	Temporary unplanned or planned outage of T&S network.	In the event of a T&S network outage, preventing the industrial facility from using the T&S network and causing captured CO_2 to be emitted to the atmosphere, the options are still being considered, but could include: • the industrial facility could continue to be paid for capturing carbon as agreed in the contract; • the industrial facility could be paid the capex return payment if the capture facility can be turned off; and • the contract payments could be extended by the period that the T&S network is out. T&SCo would bear the majority of unplanned outage risk. See T&S unplanned outage risk in Section 3 for more details on the impact on T&SCo.
T&S fees increase	T&S fees charged to industrial facilities are increased.	The industrial facility could be protected from an increase in T&S fees through a variety of potential measures. Further work on T&S fees will be undertaken in 2021.

Risk	Description	Allocation
T&S timing mismatch	T&S timing mismatch risk will arise if the commissioning of the T&S network is delayed beyond the commissioning dates of the industrial capture plant, with the capture plant unable to transport CO_2 while waiting for the T&S network to be completed.	In the event that the T&S network is not completed in time for the completion of the capture plant, the approach is still under consideration, however, it could include: • the industrial facility could receive their payment for capturing carbon (post-commissioning and/or dependent on capture technology), as agreed in the contract; • the Target Commissioning Window could be moved as agreed with the industrial facility in order to match commissioning T&S timelines. T&SCo would bear the majority of T&S construction overrun risk. See T&S construction delay risk in Section 3 for more details.

Risk	Description	Allocation
T&S capacity constraint	Lower than expected volumes of CO_2 available in the transport and/or storage facility either due to T&S network issues, or the capture plant injecting CO_2 into the T&S network at a rate greater than agreed, leading to the industrial facility and/or other industrial facilities being constrained.	If industrial facilities are constrained by a fault in the T&S network, then industrial facilities could choose to either release CO_2 into the atmosphere (which would lead to a carbon cost) and/or have access to alternative injection route (e.g. onsite CO_2 storage vessels). The approach is still under consideration, but industrial facilities could be paid for the carbon captured in accordance with the contract. Industrial facilities will agree a capacity with the T&S network and a penalty will be applied to industrial facilities that cause a capacity constraint through over-injection. T&SCo allowed revenue would be reduced if capacity level is lower than set target. See T&S capacity constraint risk in Section 3 for more details on the impact on T&SCo.
Change in law or policy	Change in law that impacts the costs or deliverability of carbon capture.	The ICC Contract will set out appropriate provisions to protect the industrial facility from certain unforeseeable and material policy changes.

Risk	Description	Allocation
Carbon policy and pricing	Changes to the UK ETS or free allowances impact the commercial return of plant. Changes in carbon policies outside of UK.	The industrial facility will not be exposed to changes in carbon price or free allowance policy in respect of the carbon that it captures once the contract has been signed. It remains exposed in respect to any residual emissions.
Leakage risks	Leakage of CO_2 from the industrial facility.	The industrial facility is expected to be responsible for any leakage of CO_2 in their part of the network.
Supply chain risk	Supply chain does not have the capability or capacity to construct or operate the capture plant.	The industrial facility is responsible for ensuring that contractors have the capability and capacity to construct and operate the facility.
Decommissioning	Decommissioning costs are higher/ lower than forecast. The industrial facility is unable to carry out the decommissioning process.	The industrial facility is responsible for decommissioning capture plant in line with relevant industry standards.
Commercial risk	The industrial facility is unable to obtain financing on acceptable terms. The industrial facility has financial difficulties during the construction phase of the programme.	The industrial facility is responsible for obtaining finance and managing its cashflows.

Financing arrangements

The CIF is currently under development and it is expected that this fund will, in part, support the capital funding of some early ICC projects and CO_2 T&S networks. This funding would be delivered as capital grants to support, in part, the capital cost of capture projects, with the remainder funded through private investment sources and/or the industrial facility's owner balance sheet (or a combination of both).

Further details on the revenue mechanism to deliver industrial carbon capture through the ICC Contract will be set out in 2021.

Section 6: Update on hydrogen business models

As an energy carrier with a range of potential different applications, low carbon hydrogen is expected to play an important role in our plans to reduce the UK's carbon emissions and reach net zero by 2050. The Prime Minister's recent Ten Point Plan included a number of commitments to drive the growth of low carbon hydrogen including: working with industry, with the aim of delivering 5GW of installed low carbon hydrogen production capacity by 2030; confirmation of the intent to publish a UK Hydrogen Strategy in 2021 and a £240 million Net Zero Hydrogen Fund to provide capital co-investment in early hydrogen production projects. Commitments also include a consultation in 2021 on hydrogen business models and plans to bring forward, next year, further details on the revenue mechanism to support them.

In August 2020, the government published a response to the consultation on potential business models for CCUS. This confirmed our intention to develop business models to overcome the cost gap between low carbon hydrogen and higher carbon counterfactual fuels, one of the main barriers to adoption of low carbon hydrogen, and that business models will be aimed at supporting both CCUS-enabled and electrolytic hydrogen technologies. Alongside the consultation response, we published a BEIS-commissioned report from Frontier Economics into possible support mechanisms for large scale hydrogen producers[17]. Since then, we have been building on the work set out in both documents to identify a preferred way forward for low carbon hydrogen business model development.

In August, we committed to providing a short update at the end of 2020 on our work to develop the commercial frameworks to bring through low carbon hydrogen projects, ahead of our planned consultation in 2021. This update does not cover government's wider work on low carbon hydrogen, including development of the UK hydrogen strategy.

As of today, hydrogen in the UK is primarily used as a feedstock in certain industrial processes and is not low carbon. In future, hydrogen produced via low carbon technologies has potential for a wide range of additional uses, such as mobility, high temperature process heat in industry, heat in buildings, energy storage and electricity generation.

By 2050, we envisage a liquid, subsidy-free market for low carbon hydrogen competing with other low carbon energy technologies. However, in the intervening period, various market barriers will continue to exist. Overcoming the cost difference between low carbon hydrogen and the (higher carbon) counterfactual fuel is required to address some of these barriers and kick start creation of this potential future low carbon hydrogen market.

Despite being a nascent sector, various low carbon hydrogen deployment proposals are being considered by energy market participants. These primarily include large scale CCUS-enabled

[17] A link to Frontier Economics Ltd's Business Models for Low Carbon Hydrogen Production report to BEIS (August 2020) can be found at: https://www.gov.uk/government/publications/business-models-for-low-carbon-hydrogen-production

projects as well as standalone electrolytic hydrogen projects and as stated above our intention is to support the development of both technologies. Some deployment proposals have a high number of interdependencies making it important for projects and policies across CCUS, electricity and low carbon hydrogen to develop in a coordinated manner.

There are a range of policies aimed at decarbonisation across different end use sectors which could interact with any specific new commercial frameworks for low carbon hydrogen deployment. Examples include the Renewable Transport Fuels Obligation in the mobility sector, the Green Gas Support Scheme in the heating sector, and the standard CfDs for low carbon electricity generation. We are mindful of the need to ensure consistency across policies, both between any new framework(s) and existing schemes, and also consistency regarding the future of existing policies which do or could have a bearing on deployment of low carbon hydrogen.

Given the complexity of the low carbon hydrogen value chain, our twin track approach to supporting CCUS-enabled and electrolytic hydrogen, and the associated policy landscape, we intend to take a disaggregated approach to business model design. Different production technologies, project scales, and end uses have different technical and economic characteristics, and business model policy design needs to reflect these, i.e. there is unlikely to be a ‘one size fits all’ approach.

That said, we consider that different parts of the low carbon value chain will need to develop in tandem to enable supply and demand to develop jointly. This will be particularly important in the first phase of market creation where risks, including demand risk and offtaker risk, are highest. We are considering the available options for producer and end user support to enable construction to start on low carbon hydrogen infrastructure projects in the early 2020s. Policy interventions are likely to vary depending on the specifics of particular deployment projects, including their production scale and target end users and we expect commercial frameworks to evolve over time to adapt to market developments. A key aim throughout will be avoiding double subsidies and ensuring an appropriate level of financial support.

With respect to specific models, Frontier Economics concluded that producer subsidies through either a contractual or regulatory framework were most likely to incentivise investment in hydrogen production. Were this approach to be adopted, our view is that a contractual framework would be more appropriate than a regulatory framework, recognising the asset life of hydrogen production assets, the likely investor profile, and our long-term aim of a subsidy-free market for low carbon hydrogen.

We are aware of the different characteristics of large-scale centralised projects and small-scale distributed projects and are considering if separate mechanisms are needed for the latter and the feasible options if so.

This work is also considering options around business model support for distribution and storage of low carbon hydrogen where we expect early projects to locate. It will be important to retain optionality of future hydrogen deployment beyond initial ‘point-to-point’ applications by laying the foundations for establishment of a shared infrastructure to connect multiple producers and users (in addition to shared T&S networks).

Other regulatory interventions will also be necessary at various points along the value chain and these are being taken forward in parallel to business model design. For example, we are progressing work on defining low carbon standards and are exploring options to enable blending of hydrogen into the existing gas grid.

Any business models adopted will be subject to consultation with relevant stakeholders and compliance with subsidy control, fiscal rules and other relevant legislation.

We aim to consult on a 'preferred' hydrogen business model, or models, in Q2 2021, in order to finalise in 2022. Alongside this, we will bring forward further details in 2021 on the revenue mechanism to support the business model(s).

We will continue to engage with stakeholders via the Hydrogen Advisory Council, Hydrogen Business Models Expert Group, the investment community and directly with specific projects and organisations, and welcome stakeholders to discuss with us their considerations regarding business model policy development[18].

[18] Please contact us via hydrogen.businessmodels@beis.gov.uk

Section 7: Next Steps

This document reflects the work we have done to date to progress the business models design following publication of the business models consultation response document. We will continue to develop further the detailed structures and mechanisms of the power, T&S and industrial carbon capture business models in 2021 with the aim of having completed business models in place in 2022 as set out in the Ten Point Plan.

We will continue to engage with prospective developers of T&S and CO_2 capture projects to refine the business models set out in this document. Following publication of this document we will undertake a series of targeted engagements with the financial community as potential investors in T&S and CO_2 capture projects.

In order to provide further visibility on the intended development of the business models we are planning further updates during the course of 2021, set out below.

No	CCUS policies	Indicative date
1	Cluster consultation	Q1/2 2021
2	Hydrogen Business Model consultation	Q2 2021
3	TRI Model update (including revenue model, ERR and GSP)	Q2 2021
4	DPA model update	Q2 2021
5	Industrial Carbon Capture business model update	Q2 2021
6	Supply chain update	Q2 2021
7	T&S decommissioning regime	Q3 2021
8	Biomass Strategy Position Paper	Q3 2021
9	CCUS Regulatory framework update	Q3 2021
10	T&S connection arrangements	Q3 2021

Glossary

Term	Description
APR	Availability Payment Rate (£/MW)
BWACC	The average return on capital employed derived from a competition or determined by the Regulator in advance of Licence award.
CAG	CCUS Advisory Group
CCUS	Carbon Capture, Usage and Storage
CCS	Carbon Capture and Storage
CCC	Committee on Climate Change
COD	Commercial Operational Date
CfD	Contract for Difference
CIF	CCS Infrastructure Fund
CCGT	Combined Cycle Gas Turbine
DECC	The Department of Energy and Climate Change
DEVEX	Development expenditure
DPA	Dispatchable Power Agreement
ERR	Economic Regulatory Regime
EV	Economic Value
EfW	Energy from Waste

ESG	Environmental and Social Governance
ETS	Emissions Trading System
FEED	Front End Engineering Design
FID	Final Investment Decision
FX	Foreign Exchange
FOAK	First-Of-A-Kind
GSP	Government Support Package
HMG	Her Majesty's Government.
HoTs	Head of Terms
ICC	Industrial Carbon Capture
ICC Contract	Industrial Carbon Capture Contract
IDC	Interest During Construction
IDCF	Industrial Decarbonisation Challenge Fund
ISCF	Industrial Strategy Challenge Fund
LCCC	Low Carbon Contracts Company
OFTO	Offshore Transmission Owner
OPEX	Operating Expenditure
Regulator	The independent economic regulator of the Economic Regulatory Regime

RAV	Regulated Asset Value
RUI	Rolled Up Interest
RWACC	The RWACC is the regulated average return on capital employed, determined by the Regulator and adjusted by the Regulator from time to time according to market conditions
TCW	Target Commissioning Window
T&S	Transport and Storage
T&SCo	A company licensed to provide transport and storage services
TRI	T&S Regulatory Investment
VfM	Value for Money
WACC	Weighted average cost of capital

This publication is available from: https://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy

If you need a version of this document in a more accessible format, please email CCUSBusinessModelsUpdate@beis.gov.uk. Please tell us what format you need. It will help us if you say what assistive technology you use.