Title: Hydrogen and Industrial Carbon Capture Business Models **IA No:** BEIS049(F)-22-HICCD **RPC Reference No:** RPC-BEIS-5173(1) **Lead department or agency:** Department for Energy Security and Net Zero **Other departments or agencies:** N/A	**Impact Assessment (IA)** **Date:** 16/05/2023 **Stage:** Final **Source of intervention:** Domestic **Type of measure:** Primary legislation **Contact for enquiries:** EnergyBill2021@beis.gov.uk

Summary: Intervention and Options

RPC Opinion: Green

Cost of Preferred (or more likely) Option (in 2020 prices)			
Total Net Present Social Value	**Business Net Present Value**	**Net cost to business per year**	**Business Impact Target Status**
n/a	n/a	n/a	Not a regulatory provision

What is the problem under consideration? Why is government action or intervention necessary?

The deployment of low carbon hydrogen (referred to throughout as "hydrogen") production, hydrogen transport and hydrogen storage infrastructure (referred to as "transport" and "storage"), and carbon capture for industrial users will be essential in decarbonising the UK economy. To overcome market barriers and realise the contribution these technologies can make to achieving the Government's statutory carbon emissions reduction targets, the Government has announced a number of measures aiming to accelerate deployment. This impact assessment considers the primary provisions that will underpin the delivery of these business models.

What are the policy objectives of the action or intervention and the intended effects?

The hydrogen production, hydrogen transport, hydrogen storage and ICC business models aim to provide funding for long-term revenue support which enables the private sector (and Government) to take Final Investment Decisions (FIDs) on a pipeline of decarbonisation projects, playing an important role in putting the UK on a pathway to (i) meet the 2030 deployment ambitions set out in the Net Zero Strategy; (ii) ensure the required emission reductions for the Sixth Carbon Budget; and (iii) reach net zero by 2050.

The primary objective of the primary legislation covered by this impact assessment is to allow Government to:

- Incur expenditure and provide financial assistance to support the establishment of hydrogen production, transport, storage and ICC through the business models;
- Designate and direct a counterparty to each business model;
- Enable the establishment of a competitive allocation process for hydrogen production and ICC business models.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

The policy options considered for meeting the business model objectives are:

Policy option 1: Do nothing/business as usual. Under this option there is no hydrogen production, transport, storage, or ICC business model.

Policy option 2: Legislate for financial assistance and counterparty powers to enable business model support.

Policy option 3: Legislate for financial assistance and counterparty powers to enable business model support, and powers which facilitate competitive allocation for hydrogen production and ICC.

Will the policy be reviewed? It will not be reviewed **If applicable, set review date:** n/a

Is this measure likely to impact on international trade and investment?		No		
Are any of these organisations in scope?	**Micro** No	**Small** No	**Medium** No	**Large** No
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)		**Traded:** -	**Non-traded:** -	

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible:  Date: 16/05/2023

Summary: Analysis & Evidence

Policy Option 3

Description:

FULL ECONOMIC ASSESSMENT

Price Base Year	PV Base Year	Time Period Years	Net Benefit (Present Value (PV)) (£m)		
n/a	n/a	2022-2050	**Low:** n/a	**High:** n/a	**Best Estimate:** n/a

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	n/a		n/a	**n/a**
High	n/a		n/a	**n/a**
Best Estimate	n/a		n/a	**n/a**

Description and scale of key monetised costs by 'main affected groups'

The estimated cost of this primary legislation, by itself, is zero. Costs are likely to be incurred through revenue support contracts which are entered into with hydrogen producers and transporters and industrial carbon capture and hydrogen storage entities. The scale of these costs will depend on policy decisions that go beyond the design of these primary provisions and is therefore out of scope of this impact assessment.

Other key non-monetised costs by 'main affected groups'

Secondary legislation may create administrative and familiarisation costs which have not been monetised in this impact assessment. These may include costs incurred by project developers, the counterparty in undertaking its role in managing revenue support contracts, the delivery body in administering a future competitive allocation process and any body dealing with appeals.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	n/a	n/a	n/a	**n/a**
High	n/a		n/a	**n/a**
Best Estimate	n/a		n/a	**n/a**

Description and scale of key monetised benefits by 'main affected groups'

The estimated benefit of this primary legislation, by itself, is zero. Benefits may be realised through revenue support contracts which stimulate the deployment of hydrogen production, transport and storage infrastructure, and ICC. These could include reduction in carbon emissions, potential cost savings to end users of displacing fossil fuel use, and wider economic benefits such as in the UK supply chain and jobs. These are not monetised in this impact assessment for reasons outlined above.

Other key non-monetised benefits by 'main affected groups'

The estimated benefit of this primary legislation, by itself, is zero. Revenue support contracts may also provide additional non-monetised benefits. These might include long term strategic benefits of cost reductions and the option value to use new technologies to further increase carbon savings beyond 2030. Further, having hydrogen transport and storage infrastructure in place will reduce the risks to producers, lowering production costs. Therefore, some additional transport and storage costs may be offset by lower production costs.

Key assumptions/sensitivities/risks	Discount rate	n/a

This impact assessment assumes this primary legislation by itself will have no impact on businesses and consumers.

BUSINESS ASSESSMENT (Option 3)

Direct impact on business (Equivalent Annual) £m:			Score for Business Impact Target (qualifying provisions only) £m:
Costs: n/a	**Benefits:** n/a	**Net:** n/a	n/a

1. Problem under consideration and policy objectives

1.1. Problem under consideration

1. The UK is committed to the legally binding target of net zero greenhouse gas emissions by 2050. In 2021, the Government enshrined in law a new target to reduce greenhouse gas emissions by 78% by 2035 when compared against 1990 levels, as part of the Sixth Carbon Budget. This will require emissions reductions across the economy.

2. Low carbon hydrogen (referred to throughout as "hydrogen") will be a key source of low-carbon energy as we decarbonise. It is especially useful in 'hard to electrify' areas like parts of industry and heavy transport including shipping, and aviation, and could provide flexible low carbon energy for the power sector and domestic heating. While in some sectors there is a degree of optionality (e.g., heating), significant hydrogen production is needed to achieve net zero even at the lower end of projected demand ranges[1].

3. For many key industries, such as chemicals, cement and waste management, there are significant challenges associated with reducing the emissions generated as a by-product from their output. Without carbon capture usage and storage (CCUS), emissions from current industrial processes cannot be reduced to levels consistent with net zero.

4. Deployment of hydrogen and ICC over the 2020s and 2030s is essential to meeting carbon budgets and net zero by 2050. While hydrogen production and ICC are technically proven and have been deployed successfully internationally, they have not been deployed at scale in the UK and remain pre-commercial. In particular, both hydrogen production and ICC (including application of CCUS in waste management processes as well as in traditional industry), are currently not cost competitive compared to the higher carbon and more technologically mature alternatives (such as using natural gas as a fuel vs hydrogen). Without viable commercial models that address key market failures and barriers, the private sector will not invest and deploy these technologies at the scale nor speed required.

5. Hydrogen transport and storage infrastructure are critical enablers for the growth of the hydrogen economy, necessary to meet carbon budgets and net zero. Alongside connecting producers and consumers, a well-developed hydrogen transport and storage network could be especially valuable for resilience, energy security and system balancing where excess renewable electricity could be used to produce hydrogen, which can then be stored over time. However, transport and storage infrastructure projects typically have lengthy development lead times, high capital costs, and uncertain financial investment returns in a nascent market. This infrastructure is therefore unlikely to be deployed at scale in the absence of commercial models which de-risk investment.

6. Government has set out its ambition in the Net Zero Strategy[2]. This included an ambition for 5GW UK low carbon hydrogen production capacity by 2030 and delivering four CCUS clusters, capturing 20-30 megatonnes of carbon dioxide ($MtCO_2$) across the economy, including $6MtCO_2$ of industrial emissions, per year, by 2030. To achieve this, the Government has committed to business models for hydrogen and ICC which are intended to overcome the significant market barriers faced across the value chain which inhibit their widespread deployment. The British Energy Security Strategy (BESS)[3] also committed government to "designing, by 2025, new business models for hydrogen transport and storage infrastructure, which will be essential to grow the hydrogen economy". BESS also doubled the 5GW ambition to 10GW of low carbon hydrogen production by 2030, subject to affordability and value for money. Higher levels of production increase the need for transport and storage infrastructure to connect producers and users.

[1] https://www.gov.uk/government/publications/uk-hydrogen-strategy

[2] https://www.gov.uk/government/publications/net-zero-strategy

[3] https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy#hydrogen

7. The Net Zero Strategy announced the establishment of the Industrial Decarbonisation and Hydrogen Revenue Support (IDHRS) scheme which will fund these business models. Up to £140m was committed to establish the IDHRS scheme, including up to £100m to enable the deployment of the first electrolytic hydrogen projects, by awarding contracts of up to 250MW of electrolytic hydrogen production capacity in 2023, with further allocation in 2024. Further details on the funding envelope for ICC projects (including application of CCUS in waste management processes as well as in traditional industry) and CCUS-enabled hydrogen projects is expected in 2022, with the first contracts being awarded from 2023 through the Cluster Sequencing process[4].

8. The Net Zero Strategy also stated that from 2025 at the latest, all revenue support for hydrogen production will be levy funded, subject to consultation and legislation being in place. A separate impact assessment has been prepared for the hydrogen levy[5].

9. This impact assessment considers the primary legislation which is required to deliver the hydrogen, transport, storage, and ICC business models.

1.2. Policy objectives

10. This legislation is designed to support four specific policy objectives:

- **Provide revenue support for low-carbon hydrogen production and ICC projects** from 2023 to bring through investments and enable successful deployment of projects from 2024/5 onwards;

- **Provide revenue support for hydrogen transport and storage infrastructure** to bring through investments and enable successful deployment of projects. The timings for deployment of hydrogen transport and storage projects will be considered as the business model design progresses.

- **Provide funding certainty on a return on capital investment and operational costs for hydrogen production, transport, storage, and ICC projects** over their business model contract lifetime including by addressing technology-specific risks, helping to de-risk private sector investment and create a pipeline for future projects; and

- **Drive down deployment costs throughout the 2020s and 2030s** by supporting initial projects (subject to value for money (VfM) considerations) seeking to take final investment decisions (FIDs) in the 2020s and for hydrogen production and ICC, subsequently through competitive funding allocation and business model design.

2. Rationale for intervention

2.1. Rationale for intervention in the hydrogen market

11. There are a number of market failures and barriers inhibiting the production of hydrogen. The main barriers include:

- The **cost of hydrogen** is higher than most high-carbon counterfactual fuel alternatives. The lack of a fully developed market, imperfect investor information and the presence of a negative externality linked to carbon all contribute to this lack of cost competitiveness.

- Hydrogen technologies are **risky for investors** as they have not been proven at commercial scale in the UK. While some technology is already in use, many applications need to be proven at scale before they can be widely deployed. There is a first mover disadvantage, where project developers for the first at-scale hydrogen projects bear

[4] https://www.gov.uk/government/publications/cluster-sequencing-for-carbon-capture-usage-and-storage-ccus-deployment-phase-2

[5] https://bills.parliament.uk/bills/3311/publications

significant learning costs and risks but may not capture the full benefits of the investment, as market competitors capture their know-how.

- The **lack of a market structure** also means that coordination failures might lead to suboptimal market outcomes, for example undersupply, as lack of investment in one section of the market deters investment elsewhere. Uncertainty about future supply might deter end users to switch to hydrogen, in turn lowering the incentives for new producers to enter the market. At the same time, even if producers enter the market, they might still face uncertain demand for hydrogen they produce as a result of market's immaturity. This could lead to the producers having to sell at low prices or build-up stocks and could pose a risk to the economic viability of the project. Without government intervention, the expected growth of the hydrogen economy will likely be a suboptimal equilibrium. Market growth requires enough participants to enter at the same time (coordination) but the risks (e.g., technological, commercial, and imperfect information) deters new entrants. This barrier affects the deployment of hydrogen production plants as well as transport and storage infrastructure.

12. The Government has been working with industry to develop the hydrogen production business model to incentivise the production of hydrogen by overcoming these barriers and giving investors the long-term revenue certainty they require to invest. This business model was consulted on from August to October last year, and a government response was published on 1 April 2022: https://www.gov.uk/government/consultations/design-of-a-business-model-for-low-carbon-hydrogen.

13. There are a number of market failures and barriers inhibiting deployment of hydrogen transport infrastructure. The main barriers include:

- Uncertainty around **hydrogen supply and demand** and **imperfect information** means it is hard to predict when there will be sufficient hydrogen production to necessitate larger-scale transport infrastructure. Similarly, with demand, we don't know when consumers will have the technology to use hydrogen. Further, uncertainty around the locations of where supply and demand will develop make it hard to plan fixed transport infrastructure, e.g., pipelines. **Long lead times** for pipeline infrastructure exacerbates this barrier.

- The **up-front costs** for larger transport infrastructure will be very high and these costs cannot be passed onto hydrogen users while there are **few hydrogen consumers**. Natural gas is the main counterfactual to hydrogen and natural gas costs are passed onto a very large consumer base. There will be very few hydrogen consumers while the hydrogen economy is growing to pass costs onto.

- If a hydrogen network is built (or repurposed), this could be a **natural monopoly** where producers and consumers are only able to use one network, like the gas network now. Owners and operators could block potential users or reduce access for users of the network, which is likely if a producer or consumer owns and operates the network (a vertical risk). Further, owners and operators could charge excessive prices for using the networks if there are no or few alternatives (a horizontal risk).

14. There are a number of market failures and barriers inhibiting the deployment of hydrogen storage infrastructure. The main barriers include:

- **Demand uncertainty** is a barrier for hydrogen storage growth. It is hard to predict when and how much storage will be needed by users. Similar to hydrogen transport, uncertainty around the locations of where supply and demand will develop make it hard to plan fixed hydrogen storage infrastructure, e.g., salt cavern storage. The volume of storage required depends on the patterns and types of hydrogen production and demand, not just total production and demand. Because storage is tied to the types of production and demand, this increases the uncertainty around hydrogen storage requirements. Underground storage projects have long lead times due to planning procedures, environmental impact assessments and geological engineering work. Evidence indicates that underground storage facilities, in salt caverns for

example, have longer lead times that hydrogen production plants, further exacerbating this barrier[6].

- Evidence suggests that on-going storage costs could be relatively low but the **up-front costs**, for both new and repurposed sites, will be very **high**[7]. This, combined with long lead times and revenue uncertainty, impacts investor confidence.

- The lack of a clear and consistent long-term **policy and regulatory framework** for hydrogen storage deters investors as it adds risk to the investment process. Investors may not have the information available to fully consider the implications of the 2050 net zero target when making investment decisions and may also perceive a high risk of stranded assets if subsequent policy and regulatory decisions markedly change the operating environment for hydrogen storage. For example, the decision on the use of hydrogen in heating will impact the volumes of storage required to manage daily and seasonal fluctuations in demand.

- **Commercial frameworks** for hydrogen storage are highly uncertain. It is not clear who will own and operate hydrogen storage facilities, who will use these, and what governance arrangements might best serve the interests of providers and users.

15. The Government has been working with industry to develop the hydrogen transport business model and hydrogen storage business model to incentivise the deployment of infrastructure projects by overcoming these barriers and giving investors the long-term revenue certainty they require to invest. A consultation on proposals for hydrogen transport and storage business models ran from 31 August 2022 to 22 November 2022[8].

2.2. Rationale for intervention in the ICC market

16. There are a number of market failures inhibiting the deployment of ICC (including application of CCUS in waste management processes as well as in traditional industry). The main barriers include:

    - The presence of **negative externalities that arise due to the social costs from carbon emissions that** are not accounted for by industrial plants when operating their business. This is mitigated to some extent but not fully by application of the UK ETS to industrial sectors. The waste management processes in scope of the ICC business model as part of Phase-2 of the CCUS cluster sequencing programme are also not currently part of the UK ETS or any other carbon pricing mechanism[9].

    - Initial developers of **ICC will face higher costs** compared with subsequent competitors. Firstly, due to technology having higher capital costs for installation and operation until it is demonstrated more widely at scale. Secondly because initial investment requires a higher return to account for the risk associated with technology uncertainty. Industrials will be reluctant to be the first mover in carbon capture as they create knowledge and de-risk the technology for others and face the risk of stranded assets.

    - ICC requires **coordination of multiple actors**, each facing investment decisions with long lead times. Emitters require a functioning and accessible CO_2 transport and storage (T&S) network before installing capture technology. Similarly, CO_2 T&S operators require certainty over emission streams before appraising storage sites and laying pipelines.

[6] Market intelligence suggests that salt caverns purpose built for storage have a build time of 5-10 years and converted salt caverns have a build time between 3-5 years. The Hydrogen Production costs report assumes a three-year build time for hydrogen production plants: https://www.gov.uk/government/publications/hydrogen-production-costs-2021.

[7] For example, Figure 21 in the report Supply chains to support a UK hydrogen economy estimates the cost of developing salt caverns to provide the storage capacity requirements estimated for 2030 in National Grid's FES scenarios is between £1.2bn and £2.3bn: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1092371/supply-chains-to-support-uk-hydrogen-economy-wood-template.pdf (Viewed on 22 August 2022).

[8] https://www.gov.uk/government/consultations/proposals-for-hydrogen-transport-and-storage-business-models.

[9] A Call for Evidence on ETS expansion to the waste sector was published in March 2022: https://www.gov.uk/government/consultations/developing-the-uk-emissions-trading-scheme-uk-ets

These interdependencies lead to uncertainty around risk allocation in the event of a failure of a component within the CCUS value chain.

- ICC investors face **imperfect information**. The market mechanism fails to support CCUS on its own due to a competitive disadvantage relative to mature technologies, uncertainties surrounding the precise costs and challenges of operating the technology, and the level of future carbon prices.

17. Taken together, these market failures make it highly unlikely that ICC would be rolled out to the levels necessary to reach net zero emissions by 2050 without government intervention.

2.3. Rationale for primary powers

Financial Assistance

18. To address market failures, high start-up costs and uncertainty, powers are sought to enable the Government to incur such costs or liabilities and provide such financial assistance as the Secretary of State considers necessary and proportionate to incentivise investment in, and facilitate delivery of, hydrogen production, transport, storage, and ICC. For the hydrogen production business model, the taxpayer will provide funding for initial business model contracts and the duration of the ICC business model contracts. The hydrogen production business model will then transition to levy funding, subject to consultation and legislation being in place. The funding for hydrogen transport and hydrogen storage business models will be considered as the design of these business models progresses.

Powers to designate and direct a counterparty

19. The contractual nature of the hydrogen production, transport, storage, and ICC business models require a counterparty to manage the revenue support contracts and act as conduit for the funding. A private law contract with a counterparty that manages it in an operationally independent manner delivers a clear and transparent approach to hydrogen producers and transporters and ICC and hydrogen storage entities, with clear rules around how the contract will be managed, and any disputes handled. This in turn provides industry with more certainty about what its obligations are and that it will be treated fairly. The legislation includes powers for Secretary of State to designate and direct a counterparty to each of the business model revenue support contracts.

Powers to establish a competitive allocation process for hydrogen production and ICC business models

20. An important feature of the hydrogen and ICC business models is determining how support will be allocated. It is anticipated that support will be awarded through a series of allocation rounds and the format of these allocation rounds is expected to change over time to reflect evolving market conditions and policy objectives. Initial projects are expected to be allocated support through a bilateral process following an evaluation against set criteria.

21. In the medium term, the hydrogen and ICC business models are expected to move to a more competitive allocation approach (e.g., auction). Such a process can achieve similar benefits to the contracts for difference (“CFD”) auctions for low carbon electricity generation, which is seen as a key driver for cost reductions in low carbon generation, particularly offshore windfarms, and is underpinned by provisions in the 2013 Energy Act. Underpinning this process in legislation will provide important assurance to investors and encourages the continued to development of the project pipeline. More competition within the allocation process itself encourages projects to identify cost savings which can be passed through to government and consumers. For the hydrogen and ICC business models the transition to a more competitive process and the final design will depend on a variety of different factors, including (but not limited to):

    - Size of the project pipeline – large enough number of projects to facilitate competition
    - Sector maturity – (for hydrogen) a more mature market reduces demand risk

- Interdependencies – ICC and CCUS-enabled hydrogen projects are reliant on CO_2 T&S

22. The legislation includes powers for Secretary of State to establish, and set out the details of, a competitive allocation process in respect of each of the hydrogen production and ICC revenue support contracts. This includes the power to designate a delivery body to administer the competitive allocation process.

3. Option analysis

3.1. List of policy options under consideration

23. **Policy option 1: Do nothing/business as usual. Under this option there is no hydrogen production, transport, storage, or ICC business model.** Capital co-funding for hydrogen and ICC projects may still be available through the Net Zero Hydrogen Fund (NZHF) and Carbon Capture and Storage Infrastructure Fund (CIF), and industry would rely on market revenue once operational. In the absence of transport and storage business models the only capital co-funding available is through the NZHF for limited transport and storage infrastructure costs associated with eligible hydrogen production projects. Limited funding may be available for on-site transport and storage infrastructure that is deemed necessary, affordable and value for money to enable the deployment of production projects. There is currently no capital funding available for transport and storage projects not associated with one specific production plant, for example. There is a mix of market failures, set out in more detail in section 2, which means that without revenue support through the business models in addition to these funds and other interventions, it is likely that private investors would delay investment decisions, move investment abroad, or decide not to invest altogether, meaning there would be no large-scale hydrogen production, transport, storage or ICC deployment in the UK in the 2020s. This would make the ambition for 10GW of low carbon hydrogen production and 6MtCO_2 captured and stored industrial emissions by 2030 unachievable. There would also be insufficient deployment of transport and storage infrastructure to connect hydrogen producers and users. This is highly unlikely to deliver the levels of deployment to put the UK on a pathway to meet the Government's legally binding carbon budget and net zero targets. Therefore, this option has not been taken forward.

24. **Policy option 2: Legislate for financial assistance and counterparty powers to enable business model support.** Under this option, the Government would secure the primary provisions needed to provide financial assistance to industry through revenue support contracts. Government would also take powers to designate and direct a counterparty which would be responsible for holding private law contracts with industrial carbon capture and hydrogen storage entities and hydrogen producers and transporters. This contractual arrangement would provide investors and projects with the confidence they need to invest their upfront capital into a project. This option therefore has the potential to deliver on the Government's ambition for 10GW of low carbon hydrogen production and 6MtCO_2 captured and stored industrial emissions by 2030 and enable the deployment of the necessary transport and storage infrastructure required for the growth of the hydrogen economy.

25. **Policy option 3: Legislate for financial assistance and counterparty powers to enable business model support, and powers which facilitate competitive allocation for hydrogen production and ICC business models.** Under this option, in addition to the benefits of policy option 2 which are critical to achieving our 2030 ambitions, for hydrogen production and ICC it would be possible for the business models to be allocated on a more competitive basis in the future. This is seen as the best way to reduce costs to government and the consumer (when the hydrogen levy is in place). In addition to meeting the Government's decarbonisation ambitions, this policy option brings the additional benefits of driving down technology costs by improving competitive tensions in the allocation process. By legislating for competitive allocation now, the transition from the initial bilateral allocation process could take place as soon as possible. For hydrogen transport and hydrogen storage business models, powers to facilitate competitive allocation will not be introduced as a transition to an auction-based competitive allocation process is unlikely to be suitable for hydrogen transport and storage projects.

3.2. Preferred option

26. The Department for Energy Security and Net Zero (referred to throughout as "the Department") considers that policy option 3 is the most viable approach to achieving the policy objective set out in section 1.2. The Department assesses that securing this option will help to achieve the policy objective of deploying hydrogen production, transport, storage, and ICC at a scale sufficient to meet ambition for 6MtCO_2 captured and stored industrial emissions and 10GW of low carbon hydrogen production capacity by 2030, and to put the UK on a pathway to achieving the legally binding carbon budgets and net zero targets.

27. The consultation on the design of a business model for low carbon hydrogen[10] set out this approach as the preferred option and sought stakeholder views. The Department published a government response to that consultation on 8 April 2022. This confirmed our intention to proceed with a contractual producer-focused business model, applicable to a range of hydrogen production pathways and able to facilitate hydrogen use in a broad range of sectors. The model will provide price support through a variable premium, which pays the difference between a strike price reflecting the cost of producing hydrogen and a reference price reflecting the market value of hydrogen. The model will provide volume support through a sliding scale in which the strike price will be higher if hydrogen offtake falls.

28. A consultation on proposals for hydrogen transport and storage business models ran from 31 August 2022 to 22 November 2022[11]. This sought views on high level business model design options to provide revenue support for hydrogen transport and storage infrastructure, which these primary powers will enable. The consultation gathered feedback on stakeholders' preferred business model design options and a government response to the consultation will be published later this year.

29. The Government consulted on CCUS business models in 2019[12] which set out the emerging findings from work on possible new business models and sought views from stakeholders. The Department published a government response to that consultation on 17 August 2020. This confirmed the Government's preferred approach to implement an industrial form of the CFD model with a counterparty to manage contracts. It was also stated that government envisages the allocation of business model contracts could transition from bilateral negotiations towards more competitive auctions.

30. The proposed powers will enable the Secretary of State to provide funding for the business models and designate a counterparty to manage the revenue support contracts. Subsequent regulations will be required for elements of the regime, for example to define who is eligible for support. For hydrogen production and ICC, it is anticipated that these powers will be exercised shortly after the Bill receives Royal Assent so that FIDs can be taken with hydrogen producers and ICC entities. For hydrogen transport and storage, it is anticipated that these powers will be exercised from 2025 onwards, as the Government's ambition is to design transport and storage business models by 2025.

31. For hydrogen production and ICC business models, work is underway on the design of a future competitive allocation process, which will aim to provide VfM to government and consumers by increasing competition and driving down technology costs. The establishment of a future competitive allocation process would be given effect through secondary legislation, following more detailed policy design and consultation. Any future decision to take forward secondary legislation will also be subject to consultation.

32. We have identified that a competitive allocation process will be unsuitable for the hydrogen transport and storage business models. This is because hydrogen transport and storage infrastructure projects are likely to be limited in number, be diverse and somewhat difficult to compare without a complex assessment and require adaptation or design inputs after initial

[10] https://www.gov.uk/government/consultations/design-of-a-business-model-for-low-carbon-hydrogen
[11] https://www.gov.uk/government/consultations/proposals-for-hydrogen-transport-and-storage-business-models.
[12] https://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-business-models

proposals are submitted. Therefore, an auction process is not a suitable means of allocating support, and instead we are likely to want to issue a request for proposals or invitations to tender, with any revenue support contracts negotiated individually.

33. Additionally, we consider it important that the allocation processes for the hydrogen transport and hydrogen storage business models are not limited to price considerations only. In particular, it will be important that a number of non-price considerations – such as interactions with the wider energy system - can be taken into account to inform the location, type and size/capacity of transport and storage infrastructure that is supported. The exact criteria and processes used to inform the allocation of business models is under development, but we do not anticipate that a price-based auction mechanism will be suitable to deliver an optimal build out of hydrogen transport and storage infrastructure.

34. Powers to facilitate the introduction of competitive allocation for hydrogen transport and hydrogen storage business models have therefore not been introduced.

4. Costs

4.1. Costs to Government

35. This primary legislation includes financial assistance powers which enable government to provide revenue support to hydrogen producers and transporters and ICC and hydrogen storage entities. The IDHRS scheme which will fund ICC business model contracts and initial hydrogen production business model contracts. No decision has yet been taken with regards to how the hydrogen transport and storage business models will be funded. At this stage of policy design, it is anticipated that the hydrogen transport and storage business models may need to be funded beyond direct users of the infrastructure in the near term – this may include via exchequer funding or a levy.

36. The legislation will not specify any direct quantum of funding which will be allocated through the financial assistance powers. The financial assistance powers grant the flexibility for government to provide financial assistance to the activities specified, with money which will be allocated through the normal budget and spending review processes. The funding will be subject to the usual spending controls, such as business cases, to ensure options appraisal and VfM considerations are fully evaluated. Decisions on how to use this power will be taken separately and an assessment of impacts will need to be taken at the point when the power is used.

37. Secondary legislation may create administrative and familiarisation costs. These may include costs incurred by project developers, the counterparty in undertaking its role in managing revenue support contracts, the delivery body in administering a future competitive allocation process and any body dealing with appeals. An assessment of these impacts will be conducted for any secondary legislation which may follow.

4.2. Costs to business

38. This primary legislation provides enabling powers to facilitate the deployment and operation of the hydrogen production, transport, storage, and ICC business models. This does not, by itself, directly create any additional costs to businesses.

39. Secondary legislation may create administrative and familiarisation costs. These may include costs incurred by project developers, a counterparty in undertaking its role in managing revenue support contracts, an allocation body in administering a future competitive allocation process and any body dealing with appeals. An assessment of these impacts will be conducted for any secondary legislation which may follow.

4.3. Costs to consumers

40. This primary legislation provides enabling powers to facilitate the deployment and operation of the hydrogen production, transport, storage, and ICC business models. This does not, by itself, directly create any additional costs to consumers.

5. Benefits

41. The estimated benefit of this primary legislation, by itself, is zero. Benefits will be realised following the enactment of the full legislative package (primary and secondary), finalisation of the business models, implementation of the allocation process and the consequential construction and operation of hydrogen production plants, hydrogen transport and storage infrastructure and carbon capture entities once revenue support contracts are entered into. These could include a reduction in carbon emissions, potential cost savings to end users of displacing fossil fuel use, and wider economic benefits such as in the UK supply chain and jobs.

6. Other impacts

6.1. Potential trade implications of the measure

42. This primary legislation is not expected to directly impact international trade and investment.

6.2. Public Sector Equality Duty

43. A Public Sector Equality Duty (PSED) assessment has been completed for this primary legislation. The PSED gives due regard to meeting the three aims under Section 149 of The Equality Act 2010 including eliminating unlawful discrimination, the advancement of equality of opportunity among those with protected characteristics and fostering good relations between people with protected characteristics.

44. The primary legislation is not expected to have any impact by itself on the protected characteristic groups (PCGs). There are no disproportionate impacts currently identified for any of the PSED groups which include: Age, Marriage/Civil Partnership, Religion or Belief, Sex, Gender Reassignment or Sexual Orientation PCGs, Disability, Race and Pregnant/Maternity PCGs.

45. This assessment will be kept under review. A separate PSED assessment will need to be conducted, reviewed, and monitored for impacts associated with any secondary legislation which may follow.

6.3. Impact on small and micro businesses

46. This primary legislation is expected to have no impact by itself. Therefore, its estimated impact on small and micro businesses is zero.

6.4. Regional impacts

47. The deployment of hydrogen production, transport, storage, and ICC can play a vital role in levelling up the economy throughout the UK. Hydrogen production and ICC business model support is intended to be UK wide and has the potential to particularly benefit industrial regions which are to a large extent located in Scotland, South Wales, and the North of England. The geographical scope of the storage and transport business models is currently under consideration.

48. There are industrial clusters in England, Scotland and Wales where significant investment into CCUS-enabled hydrogen, transport and storage infrastructure and ICC will help to secure existing jobs whilst creating new jobs. Electrolytic hydrogen will often be co-located in areas of high renewable potential such as Scotland and coastal areas. The proposed industrial clusters and the known project pipeline is likely to see major projects delivered across the UK in England, Scotland, and Wales, with potential for plans for Northern Ireland in the future.

7. Monitoring and Evaluation

49. A monitoring and evaluation (M&E) plan is currently being developed in conjunction with the NZHF and CIF capital co-funding schemes.

50. The scope of the M&E plan will include a process, impact, VfM and ultimately a system evaluation. This is to capture all aspects of policy impacts alongside dependent policy interactions.

51. Through a process evaluation we will aim to understand the effects of the allocation process, and the transition to a future competitive allocation for hydrogen production and ICC business models, as well as aspects such as counterparty reporting.

52. Through an impact evaluation we will seek to understand aspects of business model design to allow for improvements between allocation rounds.