Department for
Energy Security
& Net Zero

Hydrogen to Power

Consultation on the Need, and Design, for a Hydrogen to Power Market Intervention

Closing date: 22 February 2024

December 2023

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

Contents

General information

Why we are consulting

In the March 2023 Energy Security Plan, government outlined its intention to consult on the need and potential design options for a market intervention to support the deployment of hydrogen to power (H2P).

We expect the deployment of H2P to play a critical role in supporting both the decarbonisation of the power sector and security of electricity supply, alongside providing decarbonisation pathways for unabated gas generation. This consultation sets out government's overall strategic vision for H2P and seeks feedback on our minded-to position that a business model could be required to mitigate barriers to deployment and support H2P to come forward at pace. We are also seeking views on the most appropriate design option for a business model, including on our minded position that a design based on elements of the Dispatchable Power Agreement (DPA) would be the most effective option. We also outline our assessment of design options which we do not consider would be as effective.

Consultation details

Issued: 14 December 2023

Respond by: 22 February 2024 – 23:45

Enquiries to:

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Consultation reference: Hydrogen to Power: Consultation on the Need and Design for a Hydrogen to Power Market Intervention

Audiences:

We are seeking views from stakeholders with an interest in hydrogen to power. This includes (but is not limited to) the energy industry, project developers, trade associations, academia, policy think tanks and prospective investors or investment bodies.

Territorial extent:

The scope of this consultation is Great Britain only as we are not currently seeking views on how hydrogen to power could be deployed in Northern Ireland, given the Single Electricity Market (SEM) on the Island of Ireland is a separate electricity market to Great Britain. Decarbonising the economy is, however, of interest to governments across the UK and we will continue to engage with the devolved administrations as proposals are developed.

How to respond

Responses should be provided online where possible at:
https://energygovuk.citizenspace.com/industrial-energy/hydrogen-to-power-market-intervention

Alternatively, responses can be submitted via the email or postal addresses below:
hydrogenpower@energysecurity.gov.uk

Hydrogen to Power Team
Department for Energy Security and Net Zero
6th Floor
3 Whitehall Place
London
SW1A 2AW

When responding, please state whether you are responding as an individual or representing the views of an organisation. Your response will be most useful if it is framed in direct response to the questions posed, though further comments and evidence are also welcome.

Confidentiality and data protection

Information you provide in response to this consultation, including personal information, may be disclosed in accordance with UK legislation (the Freedom of Information Act 2000, the Data Protection Act 2018 and the Environmental Information Regulations 2004).

If you want the information that you provide to be treated as confidential please tell us, but be aware that we cannot guarantee confidentiality in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not be regarded by us as a confidentiality request.

We will process your personal data in accordance with all applicable data protection laws. See our privacy policy.

We will summarise all responses and publish this summary on GOV.UK. The summary will include a list of names or organisations that responded, but not people's personal names, addresses or other contact details.

Quality assurance

This consultation has been carried out in accordance with the government's consultation principles.

If you have any complaints about the way this consultation has been conducted, please email: bru@energysecurity.gov.uk.

Executive Summary

In the March 2023 Powering Up Britain: Energy Security Plan,[1] government announced its intention to consult on the need and potential design options for a market intervention to support the development of hydrogen to power (H2P). Government sees H2P – the conversion of low carbon hydrogen to produce low carbon electricity – as a key technology in supporting our commitment for a decarbonised and secure power system. Government analysis also shows that having hydrogen available in the power system could achieve lower emissions at a lower cost than scenarios without hydrogen.[2]

We commissioned external analysis on the need and design options for H2P market intervention – which is published with this consultation – and conducted extensive stakeholder engagement alongside this. Our analysis indicated that H2P plants, which are less CAPEX-intensive with relatively easy access to low carbon hydrogen fuel, should be able to deploy in the short term through existing markets. More CAPEX intensive plants, however, were found to likely struggle to deploy through existing markets due to the increased exposure to several barriers to deployment.

As a First of a Kind (FOAK) technology, H2P faces potentially higher investment costs driven by initial uncertainty in the technology and its future system role. H2P is also dependent on critical enabling infrastructure (i.e. hydrogen production, transport, and storage). In a nascent hydrogen economy, H2P developers may not be able to effectively manage the 'cross-chain' risks of delays or outages at any stage of the value chain which could limit their supply of sufficient low carbon hydrogen fuel. We expect that these barriers will largely fall away as technology understanding and confidence improves with H2P capacity deployment, and the expansion of the hydrogen economy increases the stability of low carbon hydrogen fuel access. Initially, however, our analysis indicates that these barriers will slow potential H2P capacity from deploying at pace and scale, particularly those plants which are CAPEX-intensive.

We committed to decarbonise the power sector by 2035 and reaching this whilst ensuring security of supply will require bringing forward significant volumes of new build low carbon flexibility to meet overall increasing demand for electricity and to replace older and retiring capacity.[3] H2P can provide low carbon flexible generation at a range of scales and provide a decarbonisation pathway for unabated generation to support this transition. Other hydrogen business models will support the development of various parts of the hydrogen value chain and help increase infrastructure maturity over time, however analysis indicates that, on their own, they will not be effective in mitigating the investment and market-related barriers present for H2P.

Our analysis indicates that some H2P capacity could be deployed through existing markets, primarily the Capacity Market (CM) and, in this consultation, we are seeking views on amendments to the CM to enable H2P participation. Analysis also indicates that market intervention is required to mitigate the identified barriers by de-risking investment in plants. This would enable H2P to deploy at an accelerated rate to positively impact our

[1] https://www.gov.uk/government/publications/powering-up-britain
[2] https://www.gov.uk/government/publications/modelling-2050-electricity-system-analysis
[3] https://www.gov.uk/government/consultations/review-of-electricity-market-arrangements

decarbonisation commitments and support security of supply. We are seeking views on this position through the consultation.

We are also seeking views on our minded-to position that, should a decision be made to intervene following consultation, a hydrogen to power business model ("H2PBM") based on elements of the Dispatchable Power Agreement (DPA), designed for Power CCUS but adapted to suit the needs of H2P, would be the most suitable design option for H2P market intervention.

With the intention of providing clarity to industry and wider H2P stakeholders, this consultation also outlines government's overall strategic vision for H2P, its role in the power sector, and wider hydrogen economy.

Chapter 1 sets the wider context surrounding power sector decarbonisation and security of supply, and the expansion of the hydrogen economy. It outlines government's view on the strategic role hydrogen can play in the power system as a critical low carbon flexible technology capable of playing multiple roles in the system, from mid-merit to peaking,[4] whilst creating a decarbonisation pathway for unabated gas power plants. H2P could be capable of operating for extended periods over days and weeks to provide capacity during long periods of lower renewable output and complementing shorter duration flexible technologies and services.

Chapter 2 outlines the market changes that we consider are required to support H2P deployment in the short and medium term. In this chapter, we also outline identified barriers to deployment and a rationale for introducing a market intervention to mitigate those barriers and so accelerate the deployment of H2P.

Chapter 3 summarises our approach to assessing potential market intervention options for H2P and the criteria against which we assessed the models to determine our shortlist of suitable options.

Chapter 4 expands on the detailed assessment of the three shortlisted options against four key criteria described in the previous chapter. The three shortlisted options are a split Capacity Market, a Revenue Cap and Floor, and the proposed lead option, a design based on elements of the Dispatchable Power Agreement (DPA), designed for Power CCUS, but adapted for H2P.

Chapter 5 describes our approach to alignment of a market intervention including the links with the Review of Electricity Market Arrangements (REMA) programme and outlines the interaction with four hydrogen support mechanisms (the Net Zero Hydrogen Fund, the Hydrogen Production Business Model, the Hydrogen Storage Business Model, and the Hydrogen Transport Business Model). The chapter also sets out considerations around the need for commercial arrangements for storing Hydrogen Production Business Model (HPBM) subsidised hydrogen in grid scale stores and the need to account for a future gas market design.

Chapter 6 explains the next steps and welcomes all feedback on the questions posed in this consultation. If feedback is in general agreement with our proposal that there is a need for a market intervention and our proposed lead option for a version of a Dispatchable Power Agreement, we intend to publish a further consultation in 2024 on the detailed design of such a business model, with a view to implementing as soon as practical thereafter.

[4] A mid-merit plant would operate quite frequently and would dispatch after the lowest operational cost technologies (generally renewables and large-scale nuclear). A peaking plant would tend to operate less frequently and dispatch during periods of high electricity demand.

In summary, in this consultation we are seeking views on our minded-to positions:

- That market intervention could be required to mitigate deployment barriers and accelerate the deployment of H2P to support the decarbonisation of the power sector, support security of supply, and provide decarbonisation pathways for existing unabated gas generation.
- That a business model based on elements of the Dispatchable Power Agreement but adapted to suit the needs of H2P (the H2PBM) is the most suitable form of market intervention for meeting these aims.
- To work across government and with Capacity Market delivery partners to enable H2P to compete in the Capacity Market as soon as practical.
- We recognise there are non-financial barriers to the deployment of H2P, and we will monitor potential risks and barriers and develop appropriate policy and guidance where needed.

Chapter One: Hydrogen to Power – Strategic Vision

1.1 Government's Vision for Hydrogen to Power

Government is committed to decarbonising the power system by 2035, subject to security of supply.[5] The combustion of low carbon hydrogen to produce electricity ("hydrogen to power" (H2P)), government believes, could play a key role in delivering this commitment. The deployment of H2P could provide key low carbon flexible generation capacity to ensure the power system remains balanced at all times – it can play multiple roles in the power sector, from mid-merit to peaking, whilst creating a decarbonisation pathway for existing unabated gas power plants.

Decarbonising the power system, whilst ensuring security of supply, will mean bringing forward significant volumes of low carbon flexible technologies and services. Alongside Carbon Capture Usage and Storage-enabled gas generation (Power CCUS) and Long-Duration Electricity Storage (LDES), government believes H2P is one of the key technologies to support the transition to a net zero power system through the long-term displacement of unabated gas generation and the provision of extended duration output to cover longer periods of lower renewable output. We outline our longer-term position for power sector flexibility needs, markets, and the interactions between them in the forthcoming second consultation for the Review of Electricity Markets Arrangements (REMA) programme.

Also, as one of the expected main users of hydrogen transport and storage infrastructure in the early stages of its development, H2P could provide demand certainty to support the development of the growing hydrogen economy.

This chapter outlines government's strategic vision for H2P in supporting decarbonisation of the power system and security of supply.

Government analysis indicates that H2P could deploy between 5 and 12 GW of low carbon electricity generation capacity by 2035, rising to between 20 and 90 GW by 2050. These ranges draw together external published deployment ranges (see Appendix 1 for more information on methodology used) and are impacted by potential load factors and assumptions regarding the volumes of unabated gas capacity on the system in the long term. At present, government is aware of a number of potential H2P projects, but for H2P to reach its potential as a key low carbon flexible technology, a step change is required. Government has previously expressed its commitment to exploring the role of hydrogen in the power sector in several recent publications.

- The UK Hydrogen Strategy,[6] published in 2021, set an ambition for a thriving hydrogen economy by 2030. As a potential key offtaker for hydrogen, power is likely to play a strategic role in the hydrogen economy. From the UK Hydrogen Strategy: 'Hydrogen is likely to play an important enabling role in a fully decarbonised power sector, through the system flexibility that electrolytic production and hydrogen storage can provide and the potential for flexible power generation using hydrogen as a fuel.'

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[5] https://www.gov.uk/government/news/plans-unveiled-to-decarbonise-uk-power-system-by-2035
[6] https://www.gov.uk/government/publications/uk-hydrogen-strategy

- In the March 2023 Powering Up Britain: Energy Security Plan,[7] government announced its intention to consult on the need and potential design options for a business model to support H2P.
- A consultation on updated Decarbonisation Readiness requirements was published in March 2023.[8] The proposals would require all new build and substantially refurbishing combustion power plants to be built in such a way that they could easily decarbonise by converting to either 100% hydrogen firing or retrofit carbon capture technology within the plant's lifetime. From 2030, the proposals would also require plants intending to demonstrate hydrogen conversion readiness to install generation equipment capable of firing 100% hydrogen from the point of initial construction. We intend to publish our response to the consultation and supporting legislative changes in Q1 2024.
- In the August 2023 Hydrogen Strategy Update to Market,[9] government reaffirmed its view that hydrogen is 'an important component of government's commitment to decarbonise the UK power system by 2035'.

Government's vision for H2P is informed by the growing interest in H2P that can be seen across industry. Key stakeholders including the Climate Change Committee,[10] the National Infrastructure Commission,[11] and the Royal Society[12] have assessed that hydrogen will play a key role in decarbonising the power sector. To best support H2P, government recognises the importance of setting clear policy and ambition for H2P in a similar manner to our approach with Power CCUS. We have developed the Dispatchable Power Agreement (DPA) funding mechanism and are in negotiations to deliver the UK's first Power CCUS project.

With that in mind, this consultation seeks to bring together government's vision for H2P as a key low carbon flexible technology and our proposals for supporting the accelerated deployment of H2P capacity. While market and infrastructure development will determine H2P's specific role in the power system, government nonetheless intends to enable a clear market framework for H2P to come forward.

1.2 Security of Supply and Power Sector Decarbonisation

As we transition to a net zero power system comprised of increasing levels of variable renewable generation, government is seeking to maximise investment in a range of low carbon flexible technologies and services, including longer-duration ones such as Power CCUS and LDES, that will be required to manage supply and demand at all times. Significant investment in an array of low carbon flexible and dispatchable capacity will be required, both to replace retiring generation, support abatement of exiting capacity, and to meet growing electricity demand; as outlined in the *Powering Up Britain: Energy Security Plan*.[13] By the middle of the next decade electricity demand could grow by up to 60% driven by the electrification of transport and heat.

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[7] https://www.gov.uk/government/publications/powering-up-britain
[8] https://www.gov.uk/government/consultations/decarbonisation-readiness-updates-to-the-2009-carbon-capture-readiness-requirements
[9] https://www.gov.uk/government/publications/uk-hydrogen-strategy
[10] https://www.theccc.org.uk/publication/net-zero-power-and-hydrogen-capacity-requirements-for-flexibility-afry/
[11] https://nic.org.uk/studies-reports/national-infrastructure-assessment/second-nia/
[12] https://royalsociety.org/topics-policy/projects/low-carbon-energy-programme/large-scale-electricity-storage/
[13] https://www.gov.uk/government/publications/powering-up-britain

The transition to a decarbonised power system will require more low carbon flexible capacity from a wide range of technologies and services but will also change the way the electricity system operates. Low carbon flexible technologies will need to be able to respond to more rapid variations in peaks and troughs in renewable output, replicate system services traditionally provided by fossil fuel generation, and be capable of continuous output to manage periods of extended wind droughts. H2P can offer those system benefits as a generation technology which can be deployed at a range of scales from larger mid-merit plants to smaller peaking capacity. Crucially, when connected to grid-scale hydrogen storage, H2P could provide inter-seasonal storage and extended duration operation to complement shorter duration flexible technologies and ensure the system can balance during longer periods of low wind output.

At present, many of the low carbon flexible technologies required including H2P, Power CCUS, and LDES are First of a Kind (FOAK) or emerging technologies. To mitigate non-delivery risks, government is intending to support a wide range of low carbon flexible technologies. The Power CCUS DPA process has entered negotiations to deliver the UK's first Power CCUS project, and we have recently consulted on the need for a support scheme to facilitate LDES deployment.

H2P is a FOAK technology and, whilst our analysis (see Chapter Two) indicates that some H2P plants could deploy through existing markets, plants which are more Capital Expenditures (CAPEX)-intensive may struggle initially due to potential deployment barriers. CAPEX intensity in these instances relates to where an individual plant would have great costs to deployment either because the plant is larger and/or where the plant is more complex in design. We would generally expect a larger plant to be more CAPEX-intensive than a smaller plant, and for a plant with easier access to hydrogen fuel to represent a less complex project. The Hydrogen Readiness report prepared for government as part of the development of the proposals for Decarbonisation Readiness requirements indicated that 100% hydrogen-firing generation equipment should have an approximately 10% cost difference to that of a comparable natural gas plant (i.e. a gas-fired Open Cycle Gas Turbine (OCGT) compared to a hydrogen-fired Open Cycle Hydrogen Turbine (OCHT)).[14] The uplift reflects the FOAK nature of the technology, with higher initial technology costs, higher investment costs, and uncertainty factored in. We would, however, expect the CAPEX for all H2P plants to reduce as deployment improves confidence in H2P's role in the system and technology costs fall.

To enable H2P to come forward, we propose in this consultation ways to facilitate the participation of plants in the Capacity Market (CM) as soon as reasonably practical. As the primary mechanisms for investment support in capacity, enabling participation in the CM is considered to be a key step in providing routes to deployment for H2P through existing markets, particularly for less CAPEX-intensive plants in the early stages of the hydrogen economy.

The accelerated deployment of H2P is advantageous to the power system and can help facilitate a lower cost system; government analysis shows that having hydrogen available in the power sector could achieve lower emissions at a lower cost than scenarios without hydrogen.[15]

To ensure H2P capacity can make a positive impact in supporting our decarbonisation commitments, this consultation seeks to test evidence that indicates that market intervention to

[14] https://www.gov.uk/government/publications/decarbonisation-readiness-of-electricity-generators-technical-studies
[15] https://www.gov.uk/government/publications/modelling-2050-electricity-system-analysis

support the accelerated deployment of H2P is likely to be required. This approach could support the mitigation of deployment barriers and the bringing down of technology costs, and improvement in both technology understanding and investor confidence, whilst supporting the hydrogen economy expansion. We will outline in Chapter Two our detailed assessment of the challenges to H2P deployment.

In line with our minded-to position outlined in the first REMA consultation[16] that bespoke intervention is not an enduring solution for low carbon flexibility investment support, we consider that any H2P intervention which might be brought forward by government should be short term. We would look to transition any bespoke support onto the enduring low carbon flexibility support mechanism, the proposed design of which we intend to outline in the second REMA consultation. This approach would provide competitive allocation of support across low carbon flexible technologies and services to place downward pressure on costs and for the market to drive the overall capacity mix.

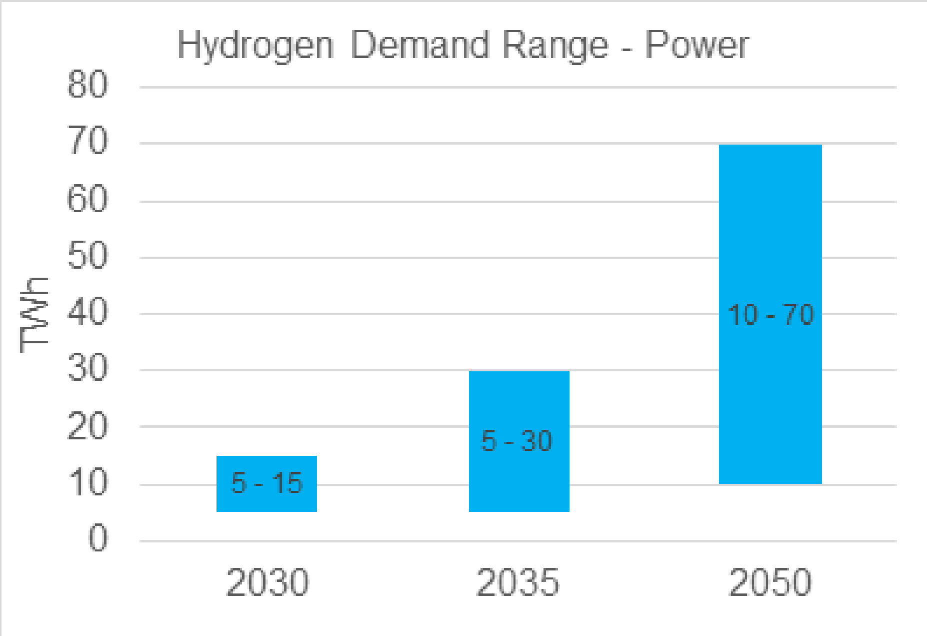
H2P can play a role in supporting the decarbonisation of existing and future unabated gas generation. Currently, the GB electricity system is dependent on unabated gas generation for flexible capacity and system services to help maintain system security and operation. Unabated gas will continue to play a role through the transition to a decarbonised power system as low carbon alternatives mature, particularly during peaks in demand and when intermittent renewable generation is unable to meet peak demand. We anticipate that some new build unabated gas will be required to enable this transition in order to maintain security of supply. We expect that as the hydrogen economy grows, increasing the availability of low carbon hydrogen fuel, more unabated gas generation will be able to transition to hydrogen-fired operation. Initially, this is likely to be in industrial clusters where potential developers have ready access to low carbon fuel and in locations closer to reliable supplies of hydrogen fuel, and then expanding out as the hydrogen economy expands.

Government analysis shows that the power sector could require significant quantities of hydrogen to meet decarbonisation targets (see Figure 1). The early ramp-up of demand will in part be driven by government's commitment to decarbonise the power sector by 2035, subject to security of supply, but also industries' own decarbonisation commitments. Beyond that, H2P capacity will likely continue to increase but load factors may decrease with time, reflecting the expected overall reduction in flexible technology running hours as renewable generation provides increasing volumes of electricity supply – as outlined in the case for change within the first REMA consultation.[17]

Figure 1 and Figure 2 illustrate demand and capacity ranges for H2P. The ranges are reflective of the uncertainty in the role hydrogen will play in the power sector, driven by overall and peak electricity demand levels, the mix of electricity generation technologies, and the relative costs and advantages of hydrogen relative to other forms of low carbon flexible capacity. Further details on the methodology used to estimate demand can be found in Appendix 1.

[16] https://www.gov.uk/government/consultations/review-of-electricity-market-arrangements
[17] https://www.gov.uk/government/consultations/review-of-electricity-market-arrangements

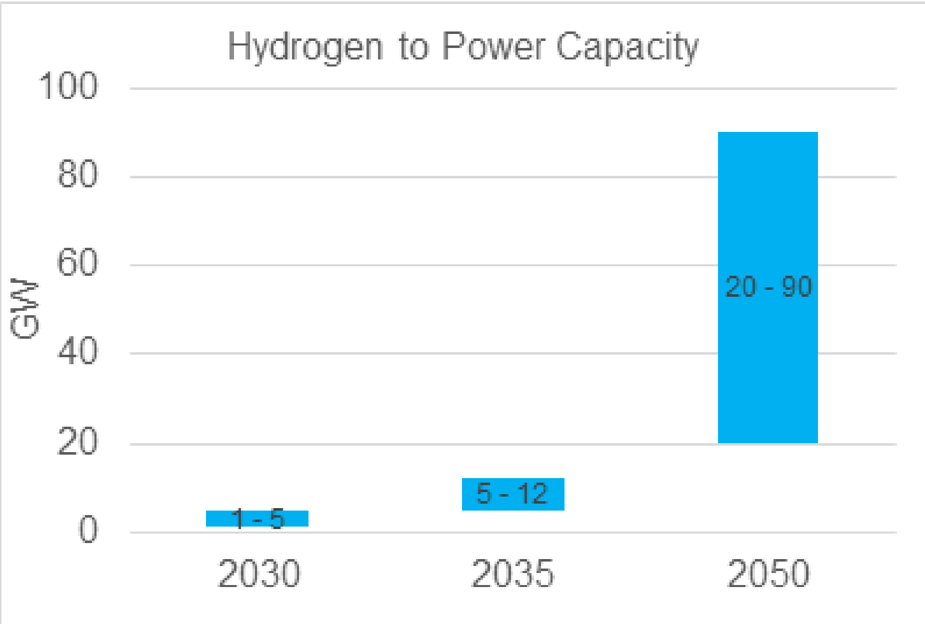
Figure 1: Illustrative hydrogen demand range in power



Alt text for Figure 1:

'Bar chart showing an illustrative increased hydrogen demand range in power increase from 5 – 15TWh in 2030 to 5 – 30TWh in 2035, and 10 – 70TWh in 2050.'

Figure 2: Illustrative hydrogen to power capacity range



Alt text for Figure 2:

'Bar chart showing an illustrative hydrogen to power capacity range increase from 1 – 5GW in 2030, 5 – 12GW in 2035, and 20 – 90GW in 2050.'

Our Decarbonisation Readiness proposals, which we consulted on in March 2023,[18] are intended to lay the foundations for ensuring future new build and substantially refurbishing combustion power plants are built ready to convert to being 100% hydrogen-fired or retrofit carbon capture equipment, depending on the individual circumstances of plants. We intend to publish our response to the consultation and supporting legislative changes in Q1 2024. From our external analysis and stakeholder engagement over a number of years, we expect less CAPEX-intensive new build and unabated gas plant conversions (for which we assume CAPEX costs to be half those for a comparable new build H2P plant) could deploy through the CM. These proposals are intended to complement those in the forthcoming second REMA consultation, which is intended to outline government's position on the future of low carbon flexibility and the enabling of clear decarbonisation pathways for unabated gas generation.

We see H2P as a critical technology to support a secure and reliable decarbonised power system. Market and infrastructure development will determine H2P's specific role and location in the power system, especially given initial deployment will be more critically dependent on hydrogen infrastructure availability. This consultation, however, seeks views on the need and potential design of government support required to facilitate the deployment of H2P wherever there is potential to do so, supporting the appropriate dispatch behaviour of H2P plants in the market, and ensuring value for money. Evidence and analysis to date indicates the most efficient support would be to enable less CAPEX-intensive H2P to deploy through existing markets and that a business model is likely required to support accelerated deployment of more CAPEX-intensive H2P plants, to deliver H2P's potential in power system decarbonisation.

1.3 Hydrogen to Power and Wider Hydrogen Economy

In the 2021 Hydrogen Strategy,[19] the UK set an ambition for a thriving hydrogen economy by 2030. As a key offtaker for low carbon hydrogen, alongside industry and transport, and one of the expected main beneficiaries of hydrogen transport and storage infrastructure, H2P relies on the wider hydrogen economy, including infrastructure build.

The peak rate of hydrogen consumption from larger sized power plants will likely require hydrogen to be delivered via pipeline. The consumption rate, as well as the highly variable load profile (due to its role as flexible source of low carbon generation) means that large scale geological storage will be critical to enabling large scale H2P capacities. The link between H2P capacity and storage availability will be especially important to ensure the appropriate build out of both technologies. Internal modelling shows that the lower the load factor for H2P plants (more peaking), the greater the hydrogen storage capacity required.

The mapping of larger power plants captured by the Digest of UK Energy Statistics (DUKES)[20] show that whilst plants are located across England and South Wales, many are in potential hydrogen or CCUS industrial clusters. Power plants closer to hydrogen or CCUS clusters may be more likely to decarbonise earlier due to the availability of infrastructure.

Power plants could potentially initially utilise a blend of hydrogen with natural gas. Onsite blending could be a useful stepping stone for plants to eventually switch to 100% hydrogen firing. We are intending to further assess the value of onsite blending in potentially supporting

[18] https://www.gov.uk/government/consultations/decarbonisation-readiness-updates-to-the-2009-carbon-capture-readiness-requirements
[19] https://www.gov.uk/government/publications/uk-hydrogen-strategy
[20] https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

development towards 100% hydrogen firing. Some industry stakeholders report that power plants linked to clusters could act as flexible offtakers due to their ability to take a variable volume of hydrogen to then blend onsite with natural gas prior to combustion.

UK government is planning to provide support across areas of the H2 value chain, including production, transport, and storage, through various business models and funds. Alignment across the landscape of support will be vital. Operators of H2P in receipt of government support will likely need to manage interactions across these support schemes, outlined further in the ‘H2 Support Mechanisms Interaction’ section of this document.

Questions:

Q1: What are your views on the vision we have set out for hydrogen to power?

Q2: In your view, what role should hydrogen to power plants be playing in the power system? Please provide details and an explanation of your reasoning.

Chapter Two: Case for Change

2.1 Introduction

As part of the evidence gathering process for assessing the need and case for H2P market intervention, government commissioned LCP Delta and Frontier Economics to assess the need for a H2P business model. Their analysis, published alongside this consultation, found that some smaller lower-CAPEX H2P plants could come forward through existing markets, particularly where they are expected to have ready access to lower cost hydrogen fuel. This analysis indicates that lower-CAPEX hydrogen fired generation such as OCHTs could displace unabated reciprocating engines and OCGTs in the short term as a more competitive and lower carbon technology.

The analysis indicated, however, that more CAPEX-intensive plants will likely find it difficult to deploy under current market arrangements as they would struggle to compete against lower-CAPEX technologies and could require CM clearing prices of up to £120/kW to come forward. Such high clearing prices, even if available in the CM, would likely significantly raise the overall CM costs. It would also likely represent poor value for money as lower cost technologies would receive a higher clearing price than they require, or inframarginal rents.

A decarbonised power system will require a range of flexibility provision and system services to ensure the power system is stable and demand and supply are balanced at all times. Different low carbon technologies and services have differing characteristics, and it is too early to determine what the mix or system needs will be as this will depend on wider technology deployment, overall electricity demand profiles, and the need to provide value for money for the system. H2P can play a range of roles in the system, not unlike unabated gas generation does today including smaller plants operating in a peaking configuration such as OCHTs, and larger mid-merit plants such as Combined Cycle Hydrogen Turbines (CCHT).

As we set out in the previous chapter, evidence consistently indicates that H2P has a key role to play in the transition to a decarbonised power system. On the basis of our analysis, we have considered what market frameworks may be necessary to realise that vision and support both early adopters of H2P, new build and converting unabated plants, and provide longer-term pathways for more H2P projects to come forward as the technology and enabling hydrogen infrastructure availability improves.

Our analysis indicates that bespoke support could be necessary to accelerate the deployment of H2P, in addition to clearer signalling from government on the potential benefits of H2P in a decarbonised power system. In this consultation we seek views on our minded-to position that potential changes to existing markets and the introduction of bespoke market intervention could provide the routes to market necessary to accelerate H2P deployment. We consider these changes could provide the optionality in routes to market needed for an emerging technology to have the opportunity to access potential support most suited to a H2P project’s needs, whilst increasing confidence and certainty in the technology as it develops.

2.2 Changes to Existing Markets to Support Hydrogen to Power

This consultation tests proposals to introduce changes to existing markets to lay the groundwork for H2P to deploy in the short term. Analysis to date indicates that, deployment of H2P through existing markets – primarily the Capacity Market (CM) – will likely be an option for less CAPEX-intensive plants. These initial plants would likely have lower overall CAPEX with ready access to hydrogen fuel and are expected to be located within industrial clusters or close to enabling hydrogen infrastructure. Initially, these plants could be new build or existing unabated generation plants converting to run on Low Carbon Hydrogen Standard (LCHS)-compliant hydrogen to decarbonise. As H2P deploys bringing down technology and investment costs, deployment barriers fall away, and the wider hydrogen economy expands, we would expect a wider range of H2P projects to come forward through the CM.

The CM is the government's primary tool for ensuring security of supply and has been successful in bringing forward nearly 17.5GW of new build capacity to date. New build and existing technologies and services compete to be awarded agreements through an auction, helping to act as an investment support mechanism. The CM could offer two main routes to market for H2P projects. New build projects could be supported to deploy as unabated gas plants have historically been successful in doing so. Our analysis and industry engagement indicates that H2P plants' CAPEX costs would be relatively comparable to equivalent new build unabated gas plants, noting initially higher costs reflecting the FOAK nature of H2P. As our analysis indicates, we would initially expect lower-CAPEX projects with easy access to lower cost hydrogen fuel to come through the CM, but as the technology matures, for a wider range of projects to compete.

We also expect the CM to be a viable route for unabated plants converting to H2P. From our analysis and industry engagement we anticipate the CAPEX conversion cost of a relatively new plant converting to H2P to be around half the CAPEX of a comparable new build H2P plant. Given the lower CAPEX costs, the CM could be a viable support pathway for early adopters of H2P conversion, likely to be plants located within industrial clusters or close to hydrogen infrastructure.

Enabling H2P plants to compete in the CM would complement our wider ambition outlined in Chapter One to enable clear decarbonisation pathways for unabated generation. This includes the Decarbonisation Readiness proposals and the proposed introduction of nine-year CM agreements. The October 2023 CM consultation on Phase 2 proposals and the Call for Evidence ten-year review[21] outlined proposals that these agreements would only be accessible for new build and refurbishing capacity which has an emission intensity limit of 100gCO2/kWh. These agreements could provide a viable pathway for unabated plants converting to 100% hydrogen-firing and which reflect the lower CAPEX needs of such projects, relative to a new build project.

To maximise the decarbonisation potential of H2P in the power system, and to enable H2P to begin deploying as soon as there is potential for projects to do so, we are seeking views through this consultation on our proposal to enable H2P plants to compete in the CM as soon as practical. Enabling participation in the CM would be subject to further consultation on finalising this policy proposal. Government would work with CM delivery partners and industry to understand and assess the role H2P can provide in security of supply and the system.

[21] https://www.gov.uk/government/consultations/capacity-market-2023-phase-2-proposals-and-10-year-review

The proposals above to facilitate H2P participation in the CM could initially enable less CAPEX-intensive H2P plants to deploy, whilst also providing potential deployment routes for a wider range of plant types and sizes as the technology cost for H2P decreases and deployment barriers fall away. To kick start the deployment of H2P to reduce costs and barriers, our analysis indicates there is a likely need for a bespoke business model, our assessment and proposals for which are outlined in the next section.

Questions:

Q3: Do you agree with our assessment that less CAPEX-intensive plants and/or plants with ready access to low carbon hydrogen fuel could deploy in the short term without bespoke support? Please provide an explanation of your reasoning.

Q4: What are your views on our proposal to enable hydrogen to power plants to compete in the Capacity Market as soon as practical?

Q5: Are there any additional changes to existing markets which could support the deployment of hydrogen to power? Please provide details and an explanation of your reasoning.

2.3 Need for Market Intervention

2.3.1 Barriers to Hydrogen to Power Deployment

As set out in the first Review of Electricity Market Arrangements (REMA) consultation published in July 2022,[22] our analysis to date indicates that it is unlikely that current market arrangements will deliver the significant investment in low carbon flexibility required to decarbonise the power sector, particularly at the pace required to meet government power sector decarbonisation commitments. Current electricity market arrangements are not designed to provide additional value to low-carbon flexible technologies, particularly those with higher investment costs and uncertain future operating profiles (driven by the intermittency of renewables), such as H2P. As such, these technologies are reliant on additional revenue streams outside of the wholesale market, including the CM, to act as an investment support mechanism and maintain viability, while also providing security of supply to the consumer.

The LCP Delta and Frontier Economics analysis commissioned by DESNZ indicates that whilst some less CAPEX-intensive plants could initially deploy through the CM, plants which are more CAPEX-intensive could struggle to deploy initially. This is due to the potential difficulty in securing a CM Agreement against lower-CAPEX low carbon flexible technologies. In the external modelling, H2P plants with both subsidised hydrogen and unsubsidised hydrogen were found to struggle to deploy, indicating that initially there is a challenge to securing the required CAPEX investment.

Our external analysis – published alongside this consultation – suggests that there are two key interlinked barriers which would need addressing to enable H2P to deploy at an accelerated pace – particularly in the case of new-build, more CAPEX-intensive plants – to fully enable H2P to support power sector decarbonisation and security of supply:

- Uncertainty and increased investment risk from H2P being a First of a Kind (FOAK) technology; and

[22] https://www.gov.uk/government/consultations/review-of-electricity-market-arrangements

- Dependence on nascent critical enabling infrastructure, i.e. hydrogen production, transport, and storage creating 'cross-chain risks', and hydrogen fuel supply risks and high costs of available low carbon hydrogen.

As a FOAK technology, CAPEX costs are likely to be approximately 10% higher compared to a similar unabated gas plant due to the uncertainty of immature technologies.[23] Furthermore, the uncertainty will likely increase the cost of raising capital initially. This creates a barrier to deployment whereby there is a disincentive to be a first mover in the H2P market as a later project could come forward with lower costs. Limited early deployment of H2P projects could prolong initial liquidity challenges. FOAK projects, therefore, may require de-risking of investment initially through government support to help investment confidence and incentivise early adopters of H2P.

The early years of the hydrogen economy will be when hydrogen fuel availability, infrastructure support, and technology readiness risks will be highest, with uncertain expected running hours compounding the commercial challenge for developers. H2P will rely heavily on the development of the currently nascent wider hydrogen transport and storage infrastructure. With limited hydrogen fuel supply infrastructure options, a H2P plant may not be able to effectively manage fuel availability risks. For example, in the event of an outage in one part of the storage network, the plant may not be able to switch to another storage provider. This risk may also be exacerbated by delays and/or outages in the cross-chain hydrogen infrastructure and supply as it develops over time.

Furthermore, H2P plants are expected to generally be intermittent offtakers of hydrogen i.e. accessing large volumes of hydrogen in response to changes in the power market, rather than in predictable patterns or a steady state. This is something that the nascent hydrogen economy is not yet optimised for – without sufficient large scale hydrogen storage or transportation, power plants would struggle to manage how much hydrogen they need. In the short-term, it may therefore be difficult for H2P developers to agree supply terms with producers, although we expect this challenge to be mitigated through the deployment of large-scale hydrogen storage. As such, developers are facing risks across the entire hydrogen value chain with much of these sitting outside the control of investors/developers and causing investment uncertainty.

We are aware that besides barriers to deployment which we have outlined in this section, there are also some non-financial barriers to the deployment of H2P which we will continue to consider when developing our H2P policy. Clarity over H2P policy, technology readiness, and hydrogen supply for testing and trials were highlighted by industry as the key non-financial barriers for government to consider following recent stakeholder engagement. Government is monitoring these risks and considering what might need to be done to address them. Appendix 2 contains more details on this and outlines other identified non-financial barriers.

Questions:

Q6: Do you agree with the risks and barriers to hydrogen to power deployment that we have identified? Please provide an explanation of your reasoning.

Q7: In your view, what should industry's role be in addressing the barriers that we have identified? Please provide details and an explanation of your reasoning.

[23] https://www.gov.uk/government/publications/decarbonisation-readiness-of-electricity-generators-technical-studies

Q8: Are there any other potential risks and barriers that we should be considering? If so, which ones? Please provide details and an explanation of your reasoning.

2.3.2 Rationale for Hydrogen to Power Market Intervention

As outlined in the previous section, through our analysis we have identified barriers to deployment which we consider could lead to a slower deployment of a wide range of potential H2P capacity. This would risk minimising the benefits of the technology in supporting power sector decarbonisation and security of supply. Government has considered the existing policy levers available to us in potentially mitigating some of the identified barriers.

One of the primary identified barriers is cross chain risks arising from H2P developers' ability to effectively manage risks to low carbon hydrogen fuel supply, which creates uncertainty for developers. Initially, H2P developers will need to access LCHS-compliant hydrogen fuel from a limited number of producers. However, over time we expect the number of hydrogen producers to increase and the HPBM will use natural gas as the reference floor price to support low carbon hydrogen production to be cost competitive. Alongside this, the Hydrogen Transport and Storage Business Models (HTBM and HSBM) are intended to address the infrastructure availability challenges, thereby easing some of the expected cross-chain risks.

Government will initially play a strategic role going forward in assessing requirements for transport and storage (T&S) infrastructure, identifying priority projects, and using this to inform T&S business model allocation. This will help mitigate some of the risk of T&S infrastructure not being ready where and when required by H2P. From 2026, our ambition is that the Future System Operator (FSO) will take on responsibility for strategic network planning for hydrogen T&S. This is subject to progress being made on determining the scope of activities the FSO will undertake, which will guide funding arrangements and any regulatory changes needed to enable this. Further details are available in the Hydrogen Transport and Storage Network Pathway published alongside this consultation.

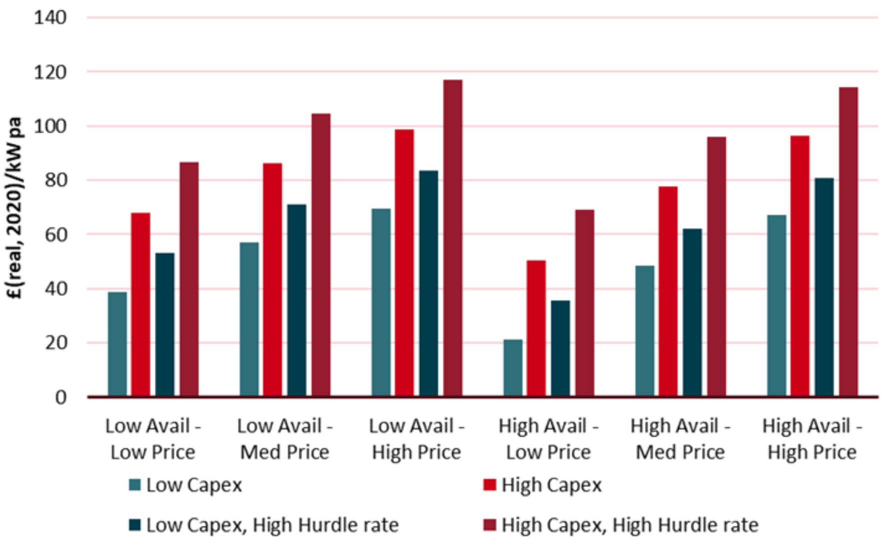
Whilst the policies we are implementing across the hydrogen value chain should reduce some of the cross-chain risks for H2P developers, e.g. through the HTBM and HSBM, the impacts of these will be felt primarily in the medium and long term. Our analysis indicates that the uncertainty created by cross-chain risks are likely most pronounced whilst the hydrogen economy is nascent and growing. Bespoke H2P market intervention could provide increased financial certainty that H2P developers would be supported in the event of challenges in the system which impact fuel and infrastructure. This could reduce investment risks in the short term and enable H2P plants to deploy sooner.

If government was to help de-risk H2P investment by mitigating cross-chain risks through bespoke H2P market intervention, alongside the HPBM, HTBM, and HSBM which will also work to reduce those risks over time, we would only take on a proportionate level of the cross-chain risk; industry must also carry an appropriate level of risk to drive competitive pressure and therefore value for money. It is not proposed that government would be subsiding fuel through H2P market intervention; we are expecting developers to ensure that they have the appropriate arrangements in place to support operation. As the HPBM provides subsidy support for the supply of low carbon hydrogen for use across the hydrogen economy, we will ensure that any bespoke H2P market intervention aligns with our domestic and international subsidy control obligations.

For H2P to be effective in supporting power sector decarbonisation, security of supply, and to bring down technology costs, it is key for H2P to be deployed quickly, particularly given government’s commitment to a decarbonised power grid by 2035 and the lead-in time to deliver H2P projects. To provide H2P developers with a clear route to deployment, they will require appropriate investment certainty and measures to support the initially higher CAPEX cost associated with FOAK technologies. To provide confidence and increased certainty to developers as the technology itself matures, it is critical that viable routes to deployment are created. We consider that a bespoke support mechanism would help to mitigate the commercial risks which developers will initially be exposed to and provide the foundation for investment certainty which in turn will incentivise further plants to come forward.

Our initial assessment is that we would expect that supporting more CAPEX-intensive H2P plants through a bespoke H2P market intervention is likely better value for money than through using existing markets i.e. the CM which is currently the primary support mechanism for new build capacity. As a security of supply mechanism, the CM is focused on procuring volumes of capacity, rather than services or types of capacity. Our analysis assessed the viability of H2P deployment through the CM and found that the required CM prices are high in comparison to CM prices we have seen in the most recent four year ahead (T-4) auctions (in the range of £20-65/kW a year). This is particularly the case for CAPEX-intensive plants, which were found could require up to £120/kW a year to deploy through the CM.

Figure 3: Modelled CM support required for new build CCHT commissioning in 2026 assuming 100% hydrogen-fired (LCP Delta and Frontier Economics)



Alt text for Figure 3:

‘Bar chart showing modelled CM support required for high CAPEX new build CCHTs versus that of low CAPEX plants, illustrating the increased government support these plants would need through a higher CM price.’

Figure 3 shows the support needed for a high CAPEX plant (Combined Cycle Hydrogen Turbines or CCHTs) to operate in the CM. Estimates of support depend on fuel price, fuel availability, CAPEX costs, and hurdle rates.[24] Under many combinations of fuel price and CAPEX, CCHTs would need support from government in addition to supporting fuel costs (via subsidised volumes of hydrogen) through a higher CM price. If more CAPEX-intensive H2P plants were successful in existing CM auctions, it would risk introducing high clearing prices (i.e. inframarginal rents) to other technologies which would likely raise overall costs of the CM and reduce its cost-effectiveness when compared to a bespoke mechanism.

From our analysis, it is indicated that bespoke H2P market intervention could help bridge this gap by reducing investment uncertainty and providing a clear route for H2P projects which may require deployment support. It could also help to bring down the cost curve for developers, improve technology readiness, and increase confidence in the technology going forward, mitigating the key barriers set out in section 2.3.1.

Question:

Q9: Do you agree with our assessment that bespoke hydrogen to power market intervention is required to mitigate our identified deployment barriers and accelerate the deployment of hydrogen to power plants, likely those which are more CAPEX-intensive? Please provide an explanation of your reasoning.

[24] The analysis shows an illustrative example of required levels of subsidy for CCHT and is based on a range of assumptions that may differ to assumptions used by other sources.

Chapter Three: Approach to Assessing Market Intervention Options

3.1 Analysis

To explore the need and potential design options for a H2P market intervention, we have commissioned external analysis from LCP Delta and Frontier Economics, supplemented by extensive stakeholder engagement. This section outlines our methodology and our assessment of the options for bespoke H2P market intervention.

Analysis and feedback from stakeholders, alongside wider strategic policy priorities for accelerating the deployment of low carbon flexibility to support power sector decarbonisation and security of supply, suggests a need for bespoke market intervention. The evidence from our analysis indicates that current market conditions, including existing schemes such as the Capacity Market, may not be sufficient to bring forward a wide range of H2P plants at pace to support our power decarbonisation commitments, especially more CAPEX-intensive H2P plants.

Analysis by LCP Delta and Frontier Economics focused on identifying barriers to deployment (as outlined previously in this document), assessing the need for intervention, and possible market intervention options that may help to mitigate these barriers. These intervention options were designed to target de-risking investment in H2P plants. To understand which intervention option may be most appropriate for H2P, LCP Delta and Frontier Economics narrowed down an initial long list of fifteen market intervention options (outlined in the report from LCP Delta and Frontier Economics accompanying this consultation) to the following six models based on the need to avoid dispatch distortions and promote simplicity in the market (see Appendix 3 for an overview of each):

- Capacity Market (CM)
- Split CM with a separate auction for low carbon dispatchable power technologies
- Deemed Generation Contract for Difference (CfD)
- Dispatchable Power Agreement (DPA) style mechanism
- Revenue Cap and Floor
- Unabated Fossil Fuel Ban

To further shortlist these six models, we have established criteria against which the interventions could be assessed. The criteria built upon those used by LCP Delta and Frontier Economics, while placing additional focus on strategic alignment with other government policies. These four key criteria were derived from the government’s ongoing Review of Electricity Market Arrangements, Power CCUS business model development, and the UK Hydrogen Strategy. They were chosen to ensure consistency across government, and have been based on comprehensiveness, ability to cover all main attributes of good market intervention design, and removal of duplication. This approach allows options to be differentiated by their merits when assessed against the criteria.

- **Effectiveness:** A market intervention should be adaptable to change over time and robust to different scenarios. The chosen model should provide a clear exit route, for example for when support is reduced, as bespoke intervention is intended to be short term for FOAK technologies. A market intervention should encourage H2P to dispatch appropriately in the market and likely ahead of unabated gas whilst not compromising security of supply.
- **Investability:** A market intervention should provide value for money. The chosen approach should make H2P attractive to investment from a range of sources through mitigating the key risks and barriers to deployment.
- **Cost effectiveness:** A market intervention should promote competition and innovation to decrease H2P deployment costs over time. The model should incentivise an efficient dispatch order, while avoiding incentivising over-investment in H2P.
- **Strategic fit and deliverability:** A market intervention for H2P should be compatible with existing and planned mechanisms and policies and should complement the wider REMA reforms. The model should aim to encourage accelerated H2P deployment as soon as practical to positively contribute to meeting 2035 power sector decarbonisation commitments.

Using the criteria listed above, three of the options that were assessed (the CM, a Deemed Generation CfD, and an Unabated Fossil Fuel Ban) were not considered suitable for supporting H2P deployment at pace and have been discounted. The reasons for which are summarised below. Assessments of the options against the criteria used by LCP Delta and Frontier Economics are outlined in the accompanying LCP Delta and Frontier Economics report.

- Capacity Market – While it may be sufficient for lower-CAPEX plants with ready access to fuel, due to the expected higher prices required for CAPEX-intensive H2P plants, successful participation in the existing CM by those plants would likely be challenging, or result in significant inframarginal rents for other technologies, reducing value for money for consumers. In addition to which, the risk of outages in hydrogen production or infrastructure are likely to have a significant impact on investability.
- Deemed Generation CfD – As it is not currently designed for dispatchable power, it exposes investors to support price and output risks. If the electricity capture price and the reference price diverge, and if metered output is less than deemed output when the electricity capture price rises, then operators could lose support revenue without a corresponding gain in market revenue. For H2P, as a dispatchable FOAK technology, this would bring additional complexity and risks to developers, therefore impacting investability when compared to the other design options considered.
- Unabated Fossil Fuel Ban – While this intervention option could help ensure decarbonisation of the power sector, it does not support investability or mitigate against the significant investor risks, and could lead to low value for money for funders (as it would need to be accompanied by the existing CM and therefore incurs the same challenges outlined above). In addition, banning unabated gas in the short-term could distort efficient dispatch and increase costs to society.

Therefore, we further narrowed down the shortlist to the following three market intervention options, which are discussed and assessed in more detail in the next chapter:

- Dispatchable Power Agreement (DPA) style mechanism
- Split CM with a separate auction for low carbon dispatchable power technologies
- Revenue Cap and Floor

We expect H2P to play a key role in supporting security of supply as a flexible low carbon technology. Any market intervention we introduce would need to consider how the capacity brought forward supports the CM in ensuring security of supply. For example, the capacity brought forward through the Power CCUS DPA is accounted for in the CM targets and its contribution to security of supply is appropriately considered.

Questions:

Q10: Have we considered all credible market intervention options for hydrogen to power? Please provide details of any design options you think we may have missed and explain your reasoning.

Q11: Do you agree with our shortlisted three market intervention design options? Please provide an explanation of your reasoning.

Chapter Four: Market Intervention Options

4.1 Introduction

In this chapter we outline our detailed assessment of the three shortlisted options (a DPA-style mechanism, Split CM, and Revenue Cap and Floor) which we assessed to be potentially viable bespoke market intervention options in supporting the accelerated deployment of H2P. We explore the design and implementation considerations of these options in detail to assess and outline which we believe to be the most effective at mitigating the identified barriers to deployment and de-risking investment in H2P.

Of these options, our analysis indicates that a DPA-style mechanism is the most suitable market intervention option to facilitate and accelerate the deployment of H2P. We are proposing to discount the Split CM option due to it not being well-equipped to manage the cross-chain risks and initial liquidity challenges, with the potential for increased system costs arising from the risk of introducing inframarginal rents. Similarly, we are also proposing to discount the Revenue Cap and Floor option due to the difficulty in capping revenue where OPEX fluctuates, and the risk of distorting the dispatch incentive.

If we proceed with an intervention, we will continue to develop the quantitative and qualitative evidence base, including a value for money assessment of the chosen intervention design. Crucially, we intend for any intervention that we may develop to apply support in respect of LCHS-compliant hydrogen only.

We welcome stakeholders' views on our assessment of these options, including any challenges or risks in implementing these options. We have outlined specific questions for each option below.

4.2 Dispatchable Power Agreement (DPA)-style Mechanism

4.2.1 DPA Overview

Analysis undertaken according to the methodology described in the previous chapter indicates that a DPA-style mechanism could be the most suitable bespoke market intervention option for supporting H2P deployment. This is due to design optionality and flexibility, and its ability to be implemented relatively quickly compared to the other two shortlisted options. As outlined in Chapter Three, we believe the existing suite of support mechanisms in the wider hydrogen value chain will be sufficient in bringing forward sufficient LCHS-compliant hydrogen fuel for H2P plants to access. We will need to consider the most appropriate mix of incentives to support H2P, including the potential of a DPA-style mechanism to provide operational support to effectively support the deployment of H2P capacity and ensure value for money.

Government is using a DPA mechanism to support Power CCUS as part of Track-1 of the Cluster Sequencing process. The DPA, as designed for Power CCUS, is a private law, commercial contract, with the role of incentivising the availability of low carbon flexible generation capacity; it provides investment certainty and ensures that gas-fired Power CCUS facilities can dispatch ahead of unabated gas generation. The Power CCUS DPA model is adapted from the Contracts for Difference Allocation Round 4 (AR4) standard terms and conditions and is intended to be funded by the Supplier Obligation.[25] Our assessment is that a DPA for H2P could reflect elements of the Power CCUS DPA, but we would expect that detailed design could vary, to account for the variations between the two technologies.

Under the Power CCUS DPA design, facilities receive an Availability Payment, which is paid per unit of capacity that is available over time, regardless of dispatch. This is similar in form to a capacity or CM payment, but without the conditions related to security of supply which feature in the Capacity Agreement, and with a more detailed structure to test if various elements of the plant were available to flow and manage cross-chain risks, by more frequently assessing its availability and performance. This provides a regular revenue stream to cover CAPEX costs and to help build investor confidence to support investment.

The Power CCUS DPA also includes a Variable Payment, paid per unit of output, to help reduce the short run marginal cost of the Power CCUS plant when compared to a notional best in class unabated reference plant, and, therefore, to make it more competitive in the merit order.

4.2.2 Assessment of DPA-style Mechanism for Supporting Hydrogen to Power Deployment at Pace

We have considered how key design elements of the DPA relate to the barriers to deployment that have been identified. Providing an Availability Payment through a H2P DPA would be intended to provide investors with increased revenue certainty through a stable regular payment that is not linked to security of supply. This payment could cover fuel availability risk in the event that H2P plants are unable to access fuel to operate. The provision of an Availability Payment would therefore be the primary means for de-risking investment in H2P.

As outlined in Chapter Three, it is important that any market intervention provides the right incentives for investment in H2P and the appropriate dispatch behaviour in the market. We expect that H2P, as a low carbon flexible technology, will likely play a mid-merit or peaking role depending on the plant’s type and/or size. Although we do not believe government should determine a plant’s role ahead of time. H2P plants should therefore be incentivised to dispatch in a way which provides effective low carbon flexible generation to meet the power system’s needs, whilst being economically efficient and ensuring value for money. An availability payment alone may provide sufficient incentive for H2P deployment, with dispatch being driven by market signals. The DPA design does have the option of retaining a Variable Payment, alongside an Availability Payment, which could be provided as akin to the Power CCUS DPA.

We believe that the current suite of hydrogen value chain support should be sufficient to bring forward the necessary volumes of low carbon hydrogen fuel for H2P plants to access. We also expect that low carbon hydrogen fuel costs would reduce over time as the hydrogen economy expands. A Variable Payment could be paid when the supported H2P plant operates, however, this payment would differ for plants using subsidised and unsubsidised hydrogen. An additional Variable Payment for H2P plants could create market distortions by having H2P plants dispatch when it is not economically beneficial for them to do so. For example, if dispatch is driven by low fuel costs and a Variable Payment combined, it could have H2P plants running

[25] The Supplier Obligation mechanism is a compulsory levy on electricity suppliers to meet the cost of Contracts for Difference (CFDs).

higher in the merit order than is economically optimal through cumulatively high support costs to consumers in a DPA and HPBM. We are keen to understand what the right mix of incentives for H2P deployment and dispatch is through wider H2 infrastructure support and through an Availability Payment and potentially a Variable Payment.

The H2P DPA could be allocated, initially, through bilateral negotiation with government; this would allow for the strategic choice of H2P projects during a time when there are unlikely to be enough projects for price-based competition. As deployment barriers reduce and enabling infrastructure expands, DPA contracts could move towards price-based competitive allocation over time, similar to the competitive allocation being explored through the Power CCUS programme. Competition could potentially be between H2P projects or between H2P and Power CCUS projects in future if infrastructure roll out makes this possible.

As outlined in the 'Market Intervention Alignment and Interactions' section later in this document, price based competitive allocation within the H2P DPA could be a stepping stone to an enduring low carbon flexibility multi-technology support mechanism – we intend to outline this in the forthcoming second REMA consultation. Depending on the expansion of enabling infrastructure and wider market conditions, H2P support may be able to transition directly from a bilaterally negotiated DPA to multi-technology competition. Price based competitive allocation – whether single or multi-technology – will help to drive down costs; this is, therefore, the long-term intention, with bilateral negotiated allocation helping to get this FOAK technology off the ground.

Table 1: Assessment of the DPA-style mechanism

Criteria	Assessment
Effectiveness	A DPA-style mechanism providing an Availability Payment could support the deployment of H2P plants by providing a regular payment to de-risk investment. The Availability Payment in such a DPA-style mechanism could be adjusted between contracts to account for expected future changes to the market, and unexpected past changes to the market where the effects are still being felt. Negotiations and auction would likely reduce support required over time as the market developed. The payment would enable H2P plants to compete freely in power markets (likely excluding the CM whilst the plant is in receipt of a H2P DPA) to maximise revenue opportunities and provide capacity and system services to support the system to be stable and secure. A Variable Payment could be utilised to support dispatch, however, we're keen to understand the interactions of a Variable Payment and wider hydrogen support payments. We note there is a potential risk of economically inefficient dispatch if the payment mechanisms are not appropriately aligned which could result in poor value for money for consumers.

Investability	The DPA is a well understood scheme for Power CCUS developers. The Availability Payment is sufficiently flexible to mitigate the identified deployment barriers by providing a fixed revenue to de-risk investment. Support could continue to be provided in the event of disruption to the plant's hydrogen fuel supply – helping to manage the cross-chain risks, particularly as this payment would not be linked to security of supply. Through reducing revenue uncertainty, this could increase investability for H2P. A H2P DPA-style mechanism would offer support to H2P plants at a lower cost relative to the CM. The initial bilateral allocation could enable government to consider the most strategically significant projects for support to ensure the power sector and hydrogen economy benefits are considered. This option could also enable support to transition from bilateral to price-based competition.
Cost effectiveness	Bilaterally negotiated allocation of a DPA-style mechanism could address initial liquidity challenges; however, it may introduce potential inefficiency as it could lead to H2P plants dispatching too much/ little than is socially optimal and could lead to over/ under-investment in H2P. The bilateral negotiation option could allow for more innovative forms of H2P technology or configuration to come forward which might otherwise struggle to compete in open competition with more established and therefore lower-CAPEX technologies. However, as infrastructure matures, price based competitive allocation of a H2P DPA could reduce costs and increase value for money.
Strategic fit and deliverability	A DPA-style mechanism complements wider reforms as potential price based competitive allocation could be seen as a stepping stone towards participation in a longer-term technology-wide competitive market, as being considered by REMA, and therefore creating strategic alignment. The interaction between the Power CCUS DPA and a H2P DPA would need to be carefully considered, so efficient dispatch could be maintained. The Power CCUS DPA is an understood mechanism with an established framework. A H2P DPA could utilise this to design and implement a business model at pace, relative to the other two shortlisted options.

4.2.3 Summary of Position on DPA-style Mechanism

Our external analysis has indicated that a DPA-style model could be most suitable to mitigating our identified barriers to H2P deployment, and therefore supporting the acceleration of H2P deployment. When assessed against the criteria as detailed in the previous section, a DPA-style mechanism performs well across all categories. This is particularly the case when compared to a Split CM, where a DPA-style mechanism can better manage the cross-chain risks as there are not security of supply penalties to reduce investor certainty. Similarly, a DPA-style mechanism could better manage early market liquidity challenges as the mechanism could be allocated through bilateral negotiation at first before transitioning to price-based competitive allocation to better reflect the emerging nature of H2P.

The DPA-style model includes the option for a Variable Payment. We are keen to understand the value of such a payment mechanism, when considered alongside an Availability Payment and wider hydrogen support mechanisms, to incentivising investment and appropriate dispatch of H2P in the market.

Questions:

Q12: Have we accurately identified the benefits and risks of a DPA-style mechanism? If not, are there any further benefits and risks to consider? Please provide details and an explanation of your reasoning.

Q13: Do you agree with government’s assessment that a mechanism based on the Dispatchable Power Agreement is the most suitable option for bespoke hydrogen to power market intervention to support the accelerated deployment of hydrogen to power? Please provide an explanation of your reasoning.

Q14: What are your views on the need for a Variable Payment? Please provide details and an explanation of your reasoning.

4.3 Split Capacity Market (Split CM)

4.3.1 Split CM Overview

Another potential option for market intervention, as identified external analysis, is a Split CM, which would introduce a separate auction for low carbon flexible technologies. A Split CM, and the discussion below, is distinct from our proposals in Chapter Three on enabling H2P participation within the current CM. This market intervention option and discussion would be a reform of the current CM. This option was based, in part, on the Split CM design outlined in the first REMA consultation and our assessment of this. We note that the consultation also explored two additional auction designs (multiple clearing prices and multipliers) with a focus on whether an alternative auction design could help align the CM with wider decarbonisation objectives and better reward low carbon flexible capacity. The Split CM option for supporting the acceleration of H2P deployment specifically was the design we assessed against, although we believe our conclusions would apply to all variations of potential CM reform.

The Split CM option considered for our assessment of potential bespoke H2P support would involve dividing the current CM into two auctions that are treated independent of each other for capacity with different characteristics. In practice, this would be one auction for new build low carbon flexible technologies and one auction for all other technologies. Eligibility for a particular split would be determined for each technology type and the characteristics they provide. Auction splits would be considered mutually exclusive – i.e. capacity can only participate in one of the auctions – and capacity would receive the clearing price from the auction in which they clear.

The separate CM auctions would operate in much the same way as the current CM. Asset operators that clear in the CM would receive a monthly payment (i.e. a CM payment, 'Capacity payment' below) per kW of capacity they can provide, regardless of their level of output.

Our assessment is that competitive support for H2P against a range of other low carbon flexible technologies, often with lower CAPEX requirements, would limit the potential for more CAPEX-intensive H2P to be successful. Developing FOAK (H2P) plants and the associated diversity of risk is not the primary objective of the CM which is designed to bring forward sufficient capacity to deliver secure supplies of electricity to power GB. Furthermore, like our assessment for the current CM, analysis indicates that there is a risk of inframarginal rents if H2P was to be successful against lower-CAPEX technologies which could represent poor value for money for consumers. Finally, reforming the CM would be a significant change. This timing, alongside the four-year window post auction, would likely mean H2P capacity would not deploy in time to positively impact our 2035 power sector decarbonisation commitments.

4.3.2 Assessment of Split CM for Supporting Hydrogen to Power Deployment at Pace

Our external analysis by LCP and Frontier Economics has demonstrated that there are benefits of a Split CM as a route for a business model for H2P. The CM is a familiar concept; a low carbon auction would utilise this well-known and transparent auction structure. An auction which competes different technologies would help to ensure that it is the needs of the power system that determines what is procured, rather than this volume being pre-determined, as would be the case with a bilaterally negotiated allocation method in a DPA-style mechanism, for example. Furthermore, the auction structure of a Split CM is designed to promote competition, which in turn should reduce costs. In the short term however, the benefits of an auction may be hampered by a lack of market liquidity driven by initial hydrogen infrastructure roll out limiting the deployment of H2P capacity.

A Split CM would likely retain several of the risks associated with the current CM. Most crucially, a Split CM could not effectively mitigate the cross-chain risks, which are therefore likely to be placed on the H2P developer increasing uncertainty and/or risk. The Split CM (as with the current CM) would primarily be a security of supply mechanism and thus would likely retain non-delivery penalties. These penalties would increase uncertainty for developers when managing cross- chain risks, in particular those risks associated with fuel availability.

A Split CM may also be less suited to managing liquidity challenges with limited H2P plants potentially competing in the short term, particularly alongside other nascent low carbon flexibility technologies. The limited number of potential H2P plants could struggle to compete against cheaper alternatives, limiting the technology's ability to get off the ground and reduce system costs. Such an outcome could reduce system benefits in the longer term, if H2P does not deploy sufficiently to reduce deployment costs and compete more widely in the system. Reaching a decarbonised power system will require a range of technologies and services with different characteristics and H2P can provide a range of flexible capacity sizes and system services. To reduce the non-delivery risks of not reaching a decarbonised system, it's important that all viable low carbon flexible technologies are initially brought forward. A Split

CM could reduce deployment and potentially market confidence in the technology due to the intervention design, rather than due to any deficit in H2P's potential value as a low carbon flexible technology.

Conversely, the high clearing prices expected for more CAPEX-intensive H2P plants are likely to be above those required by other technologies within the low carbon auction, particularly lower-CAPEX technologies like Demand Side Response (DSR). If H2P was successful in the split auction, the high prices required could introduce inframarginal rents – capacity providers receiving higher clearing prices than they require – for lower-CAPEX technologies which would raise overall system costs.

Table 2: Assessment of Split CM

Criteria	Assessment
Effectiveness	The Split CM could be adaptable to changes in the capacity mix by changing technologies included in separate low-carbon technologies auction and to expected carbon price increases for subsequent investments. The Split CM could allow support to be reduced over time for subsequent investments, as competitive bids in clearing price would reduce with required support.
Investability	The CM is a well-established mechanism so is likely to reduce uncertainty for low carbon developers. There are clear rules of operation (noting they would have been amended from the current CM Rules to allow for low carbon auctions) which investors would understand and can plan against. However, in a Split CM, the main risk that could affect support revenue is fuel availability risk, which is likely to be left to investors. This is paired with the risk of investors being penalised under the CM Rules for being 'unavailable' when there is an unexpected outage in hydrogen production or infrastructure. H2P plants with more CAPEX-intensive requirements may struggle to compete against lower-CAPEX technologies which limits the ability of H2P to help deliver a decarbonised power system and could lead to an overall less efficient system. If more CAPEX-intensive H2P plants were successful in auction, they could introduce 'inframarginal rents' which would raise overall auction costs and represent poor value for money.
Cost effectiveness	Auctions are good for cost efficiency as they promote competition, however there is a risk of low liquidity in early years, if not many plants are competing in the split auction. In contrast, a broad range of technologies in the auction could reduce the chances of H2P successfully securing an agreement. There is also a risk of inframarginal rents for other

	technologies if a more CAPEX-intensive H2P plant determines the clearing price of the Split CM. Splitting the auction reduces the number of participants who are eligible to participate in each and prevents any competition between the participants in separate auctions. This may increase the risk of strategic bidding behaviour from bidders who consider they may be able to influence auction outcomes.
Strategic fit and deliverability	Changes to the CM and its structure would need to be determined and aligned with the wider REMA reforms which are currently being considered. Separate low carbon auctions would make use of a well-known and transparent auction concept, meaning understanding of the mechanism is already high. However, reforms to the CM could take time to implement, which, alongside the four-year window post auction, may make it challenging for H2P plants to deploy early enough to have a positive impact on our 2035 power system decarbonisation commitments.

4.3.3 Summary of Position on Split CM

A Split CM mechanism would have strong potential to support the deployment of technically mature (nth of a kind) H2P plants where uncertainty risks are lower, and there is larger and more diverse hydrogen infrastructure for plants to access low carbon hydrogen fuel. A Split CM would, we assess, be less effective at supporting FOAK H2P plants, due to the required expected high clearing prices making it challenging for plants to compete against lower-CAPEX technologies. On the other hand, successful FOAK H2P plants could introduce high clearing prices to the CM with accompanying inframarginal rents which would raise overall system costs. As a result, we are proposing to discount the Split CM option.

Questions:

Q15: Have we accurately identified the benefits and risks of a Split CM? If not, are there any further benefits and risks to consider? Please provide details and an explanation of your reasoning.

Q16: Do you agree with our proposal to discount the Split CM as an option for bespoke hydrogen to power market intervention to support the accelerated deployment of hydrogen to power? Please provide an explanation of your reasoning.

4.4 Revenue Cap and Floor

4.4.1 Revenue Cap and Floor Overview

A revenue cap and floor has also been considered as a potential design option for a H2P business model. It is a market-based approach which aims to incentivise developers to deliver capacity by limiting their exposure to electricity market price risk. Under this option, the operator's market revenue over a certain 'reconciliation period' (often between one to fifteen years) is assigned a cap (maximum) and a floor (minimum).

This intervention aims to provide increased certainty on the revenue received by the H2P investor, within a defined range. The operator receives market revenue and, if this market revenue is below a minimum (floor), then the operator receives a top-up support payment to the level of the floor at the end of a defined reconciliation period. Similarly, if market revenue is above a cap, earnings are returned in whole or in part to customers. A revenue cap and floor is currently used for electricity interconnectors and so is well understood by investors. It is also being considered for LDES, where it has been identified by stakeholders as a potential option.

4.4.2 Assessment of Revenue Cap and Floor for Supporting Hydrogen to Power Deployment at Pace

While there are merits to a revenue cap and floor, this model has been successful for interconnectors and could benefit LDES, this may not be the case for H2P.

A revenue cap and floor would not incentivise increased dispatch of H2P beyond the order determined by its short run marginal cost. For power technologies with non-negligible operating costs, a revenue cap and floor could distort dispatch incentives and potentially limit dispatch. This could be caused if developers judge that they would fall outside of the cap and floor, providing a disincentive to dispatch which would create distortions that could increase market price and costs to consumers.

A limited time gap between the cap and floor reconciliation periods of the cap and floor is most likely to create these distortions, as operators would be more confident about ending the reconciliation period either above the floor or below the cap. Conversely, an extended time gap between reconciliation periods would reduce investability as investors would have to wait longer for potential top ups (if below the floor) to support debt finance.

There may be possible adjustments that could be made to a traditional revenue cap and floor to reduce this distortion. However, it would not be possible to fully mitigate and would add additional complexity to the model. Examples of adjustments include creating either a soft cap or soft floor, which would reduce the dispatch distortion if the H2P operator expects to end the reconciliation period above the cap or below the floor but would not remove it completely. The degree to which the dispatch incentive would be maintained depends on the revenue sharing rate. Like a traditional cap and floor, deciding on this level would nonetheless present either increased distortions or reduced investability.

Table 3: Assessment of Revenue Cap and Floor

Criteria	Assessment
Effectiveness	A cap and floor would not incentivise increased dispatch of H2P beyond the order determined by its short run marginal cost. It may limit dispatch of H2P below this level when the expectation is that revenue will be below the floor or above the cap at the end of the reconciliation period, which would remove incentive to dispatch. The level of the cap and floor could be adjusted at the end of the reconciliation period; however, this would require detailed measurement of fuel use, would add significant complexity to the market intervention, and could increase uncertainty of support from developers. This option would be less suitable to H2P as a FOAK technology.
Investability	Revenue would be fixed over a certain period which may address some uncertainty for investors. The higher the level of the floor or the shorter the reconciliation period, the more risks are covered for investors (and hence a lower cost of capital). However, a high floor would increase the likelihood that operators would end the reconciliation period below the floor, and hence experience dispatch distortions, and a shorter reconciliation period also exacerbates this issue. Hence there is a trade-off between increasing investability and reducing dispatch distortions.
Cost effectiveness	Similar to a DPA-style mechanism, a bilaterally negotiated allocation of a cap and floor could address initial liquidity challenges and allow for more innovative forms of H2P to come forward. Price based competitive allocation could help to reduce deployment costs and like the DPA-style mechanism, could be a ‘stepping stone’ to multi-technology competition. A cap and floor would incentivise efficient dispatch when revenue is between the cap and the floor but distorts dispatch from the societal optimum if revenue is above the cap or below the floor. This dispatch distortion is reduced the lower the level of the floor and the longer the reconciliation period. However, doing this undermines the investability of the business model, as investors would have to wait longer for top ups to support debt finance. There is also the possibility of over-investment as capacity is centrally determined based on expectations of future requirements. Having a cap provides some protection against windfall profits which could increase value for money. Overall, the funder’s

	payments could vary significantly (from zero up to the value of the cap).
Strategic fit and deliverability	The cap and floor is an already known and understood model and has been identified as a possible model for LDES. However, it does not seem best placed to manage the unique challenges associated with H2P. Furthermore, establishing a new regulatory system is likely to be long and administratively costly.

4.4.3 Summary of Position on Revenue Cap and Floor

Our analysis indicates that a revenue cap and floor is unlikely to be suitable for H2P. This is largely due difficulties for developers in ensuring they end their reconciliation period between the cap and floor and the fact that, in certain situations the cap and floor model may disincentivise dispatch. We therefore propose that this option is discounted.

Questions:

Q17: Have we accurately identified the benefits and risks of a Revenue Cap and Floor? If not, are there any further benefits and risks to consider? Please provide details and an explanation of your reasoning.

Q18: Do you agree with our proposal to discount the Revenue Cap and Floor as an option for bespoke hydrogen to power market intervention to support the accelerated deployment of hydrogen to power? Please provide an explanation of your reasoning.

Chapter Five: Market Intervention Value, Alignment, and Interactions

If government proceeds with a market intervention to realise the value of the intervention in accelerating the deployment of H2P, it would be critical to ensure any intervention design would work in the context of the wider power system and emerging hydrogen economy. As outlined above, our minded-to view is a design based on the DPA-style mechanism would be the most suitable market intervention design for supporting H2P – ("H2PBM"). The following chapter considers the value of such market intervention, and the interactions with a H2PBM specifically, although the need to ensure effective alignment across the power and hydrogen systems would apply to any of the market intervention options.

5.1 Value of Hydrogen to Power Market Intervention

To maximise the value of any potential government intervention, it is key that government targets support where the need is greatest from developers whilst ensuring value for money. Given the outcome of our analysis, we would expect support to be focused on plants that are least likely to be able to compete in existing markets, and therefore could benefit from additional support to help deployment. This could involve a wide range of H2P plants, but our analysis indicates they are likely to demonstrate similar profiles: those with more CAPEX-intensive requirements and/or an unreliable access to low carbon hydrogen fuel. It is also important that any intervention which might be brought forward would meet our domestic and international obligations, particularly in relation to subsidy control principles, given there are a number of other subsidy schemes within the hydrogen value chain.

Bespoke H2P market intervention would be intended to support the accelerated deployment of H2P, relative to not intervening, and ensure that we realise the benefits that the technology can provide to supporting power system decarbonisation and security of supply. There are already existing and planned support mechanisms (i.e. HPBM, HTBM, and HSBM) which are intended to facilitate the development and deployment of other parts of the hydrogen value chain. Our minded-to position is that the purpose of bespoke H2P market intervention would therefore be aimed solely at supporting H2P plants to be a form of low carbon flexible generation.

Our minded-to position is that we believe that the deployment of H2P could likely be best supported by de-risking investment in H2P plants. As such, we are seeking feedback on our proposals in this consultation that market intervention could support costs to reduce investment risks for developers, similar to that of other power sector business models such as the CM and Power CCUS DPA.

Market intervention to de-risk investment in H2P capacity could incentivise investment in H2P and bring forward capacity at an accelerated rate, relative to there not being intervention in place. Whilst having additional low carbon flexible capacity on the system would likely be beneficial for security of supply, it is important that any intervention considers the dispatch incentives to the plant. We do not believe it is for government to determine the operational profile of a plant ahead of time as this should be determined by markets and market participants. We would expect that as a low carbon flexible technology, H2P will likely play a mid-merit or peaking role depending on the plant type, and that generally H2P plants should run ahead of comparable unabated gas plants in the merit order, where they deliver value for money to consumers.

Government is also considering the value of onsite blending for the power sector. Onsite blending is when combustion power plants fire a blend of hydrogen and methane with the blending process taking place on site. This topic is distinct from hydrogen blending where low carbon hydrogen is mixed with primarily natural gas in pre-existing gas networks.

However, to maximise potential decarbonisation and reduce reliance on natural gas, 100% hydrogen fuelled power plants need to be the end state for H2P plants. This is in line with our wider decarbonisation ambitions, including the proposals for Decarbonisation Readiness requirements outlined in the March 2023 consultation[26] which would apply to combustion plants unless they were firing 100% hydrogen. We recognise that onsite blending might be a stepping stone to expanded H2P capacity in certain circumstances.

5.2 Alignment with the Review of Electricity Market Arrangements

In July 2022, we published the first consultation on the Review of Electricity Market Arrangements (REMA)[27] which outlined government's position that bespoke support schemes to drive investment in low carbon flexibility reduces the opportunity for competition between flexible technologies. Our view was, and remains, that bespoke support is not a long-term or enduring solution for low carbon flexibility support. It should be utilised to mitigate specific barriers to FOAK technology and deliver cost reductions through deployment enabling a transition to competitive support as soon as possible.

Longer-term, therefore, we would aim to develop a competitive route to market for H2P, potentially using a bespoke mechanism to bring forward initial H2P capacity before transitioning to eventual competition between all forms of low-carbon flexible technologies and services. In the forthcoming second REMA consultation, government intends to outline its proposal for a route to transition low carbon long duration flexible technologies away from any administratively awarded bespoke mechanisms, whilst offering continued investment support. It will be important for government to assess the criteria for transitioning from bespoke support to market-wide competition, therefore, as part of any intervention which government might bring forward, we would work closely with REMA to develop criteria for assessing when H2P technology and market conditions are suitable for transitioning to multi-technology competition.

The transition would be dependent on H2P being able to compete against other low carbon flexible technologies and so government would likely need to assess the technology readiness and maturity of the wider hydrogen economy to establish when a transition would be viable. Ensuring an effective transition would be key to H2P being a competitive technology in supporting the power sector decarbonisation transition. Transitioning H2P too early could risk it being uncompetitive in a wider market and not realising its potential power and hydrogen system benefits. Transitioning too late could represent poor value for money, as the cost of support could have been lower when driven by competitive pressures.

[26] https://www.gov.uk/government/consultations/decarbonisation-readiness-updates-to-the-2009-carbon-capture-readiness-requirements
[27] https://www.gov.uk/government/consultations/review-of-electricity-market-arrangements

As noted above, our analysis indicates that less CAPEX-intensive H2P plants could initially compete in the current CM (with appropriate changes to enable participation) without the need for bespoke support. We would expect that as H2P deployment increases and technology costs come down, a greater range of H2P projects would be viable without bespoke support.

We intend that the enduring mechanism for low carbon flexibility support, intended to be outlined in the forthcoming second REMA consultation, would be able to support such projects from its inception with the more-CAPEX intensive projects transitioning from bespoke support deployment routes as technology and enabling hydrogen infrastructure improves.

Government would intend that H2P be placed on a ‘glide path’ from bespoke support to multi-technology competition through REMA. For a DPA-style mechanism, this could allow for a clear transition. It may not, however, be the most cost-effective solution to have H2P move straight from an allocation of support determined by government (similar to how the CCUS DPA is currently determined) to a technology-wide competitive market, particularly if the enabling infrastructure has not matured enough. As an interim step, and depending on the design of any intervention introduced, price-based competitive allocation of bespoke support could be a ‘stepping stone’ to market-wide competition. This could help to introduce price-discovery and drive value for money by creating price-based competition between potential H2P projects. If a DPA-style mechanism for H2P is taken forward (please see further details in Chapter Four), for example, it could also be possible to compete low carbon electricity generation technology projects within or between DPA frameworks. Price-based competitive allocation of the Power CCUS DPA has previously been explored in the July 2022 call for evidence.[28]

Questions:

Q19: What is your view on the need for price-based competitive allocation within/between bespoke business models versus moving assets straight to a technology-wide competitive market? Please provide an explanation of your reasoning.

Q20: How should a bespoke hydrogen to power business model be evolved to promote competition between low carbon flexible technologies? Please provide details and an explanation of your reasoning.

5.3 Hydrogen Support Mechanisms Interaction

H2P is critically reliant on enabling production, transport, and storage infrastructure. If government progresses with a H2PBM, it will be important to ensure alignment between support mechanisms and policies for hydrogen infrastructure and H2P. Until a market intervention approach for H2P has been finalised however, it is too early to say what the details of the interactions with the wider hydrogen value chain would be. If, further to consultation, it is decided to proceed with developing a H2PBM, government would aim to come forward with detailed design proposals, supported with stakeholder engagement, in due course. There are, however, core principles on interactions which we outline below and would welcome stakeholder feedback on how alignment of support and policies could best enable the deployment of H2P capacity.

[28] https://www.gov.uk/government/calls-for-evidence/future-policy-framework-for-power-with-carbon-capture-usage-and-storage-ccus-call-for-evidence

Government's approach is to promote every aspect of the hydrogen economy. Key support mechanisms for the H2P value chain include capital and revenue support for hydrogen production (the Net Zero Hydrogen Fund (NZHF) and the HPBM) and we have committed to design further business models for hydrogen transport and storage by 2025. See Appendix 4 for details.

HPBM support will be provided through Hydrogen Allocation Rounds (HARs) for electrolytic, and potentially alternative technologies, and the Cluster Sequencing process for CCUS-enabled hydrogen. The first allocation round, HAR1, has announced the final list of successful projects who will be awarded a Low Carbon Hydrogen Agreement, and HAR2 has opened, with application submissions due by April 2024.

Government is working on the design of both the transport and storage business models. We envisage a coordinated allocation process between them, to ensure hydrogen networks develop in a coherent way. The current suite of business models will be vital for bringing forward H2P at the pace and scale required.

The hydrogen economy and value chain are complex and need to be carefully considered. Government considers that the existing and developing suite of mechanisms (HPBM, HTBM and HSBM) should sufficiently support the production, storage, and transport of hydrogen. It will be important to ensure complementarity across all the hydrogen business models, including any potential H2P business model. As our policy on any H2P market intervention develops we will consider these interactions in more depth. Key priorities would include:

- Alignment of any H2P business model with existing hydrogen support mechanisms to help ensure the role and commercial/physical boundary of each business model is distinct and there is no duplication in funding/gaming risk. This will be vital both for the design and build of infrastructure but also for its physical and commercial operation of H2P plants.
- Sequencing of FIDs and construction for hydrogen projects is key to ensuring investor confidence that supply and demand will meet.

Coordination and planning in the early years of the hydrogen economy will be vital to reduce cross-chain risk and accelerate deployment. However, cross chain risk between the power plant and the rest of the chain will still exist as infrastructure could still see construction delays and unexpected outages. If government goes ahead with a bespoke H2P business model, we would likely put coordination at the centre of development but are aware that this would not come without its challenges. Currently, we cannot say how the proposed H2P business model would interact with other hydrogen support mechanisms pending detailed design.

Question:

Q21: What are your views on the alignment of hydrogen support and policies needed to enable the deployment of hydrogen to power capacity. Please provide details and an explanation of your reasoning.

5.4 Future Hydrogen Markets

Hydrogen is a gas for the purposes of the Gas Act, which was established to facilitate the privatisation of a mature gas industry. The hydrogen economy is at an earlier stage and may be for some time, so the arrangements that serve natural gas may not be suitable for hydrogen. Developing a H2P business model may, therefore, need to account for both a future hydrogen and gas market designs and any transitionary states.

In an ideal system, a liquid market with exchanges for hydrogen would allow power plants to purchase hydrogen in advance as well as at short notice if required. This market-based approach would allow power plants to, as they do with natural gas currently, manage the electricity and hydrogen market spreads to ensure profitability. However, this end state will not materialise in the short term and therefore power plants will have to work with government, the wider industry, and regulators to ensure they can access hydrogen when required and provide the power system with flexible low carbon power.

In keeping with government's ambitions to deliver a thriving low carbon hydrogen sector in the UK, it is our intention to keep the market framework and industry commercial arrangements under review, with a view to introducing timely amendments where they are warranted. This review will include ongoing work taking place through the Hydrogen Delivery Council's Transport and Storage working group in the first instance but is likely to encompass further engagement with stakeholders, for example via a call for evidence and/or consultation on more specific proposals at a later date. Understanding the requirements of power offtakers will be vital for this work.

5.5 Commercial Storage Arrangements

We are continuing to work on solutions for commercial storage arrangements to allow all users to benefit from hydrogen storage. Government and industry need to work together to understand and consider appropriate arrangements for storing HPBM subsidised hydrogen in grid scale stores. The sale of hydrogen volumes to Risk Taking Intermediaries (RTIs) is currently ineligible for subsidy under the HPBM. By Risk Taking Intermediary, broadly we mean a person that purchases hydrogen for the purpose of resale. This reflects the need to enforce HPBM conditions regarding the end use of hydrogen (including that volumes exported for use outside the UK are not eligible for HPBM subsidy and that volumes used for feedstock purposes attract a different level of HPBM subsidy). It also reflects government's view that, at this early stage of the hydrogen economy, subsidising sales to RTIs would not provide value for money. This is specified in the Low Carbon Hydrogen Agreement (LCHA) Standard Terms and Conditions.[29]

Through this position, government is not seeking to exclude non-Risk-Taking Intermediaries from playing a role in the market. Such parties may charge a fee to a hydrogen producer (or end user) for a service (e.g. brokerage or hydrogen storage) but would not take ownership of the hydrogen sold by a hydrogen producer. Therefore, if a hydrogen storage operator takes ownership of the hydrogen sold by a hydrogen producer and passes such ownership on to a purchaser(s) of the hydrogen, the hydrogen storage operator will fall within the definition of an RTI and so will be classified as a Non-Qualifying Offtaker under the LCHA. This means the

29 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1177336/low-carbon-hydrogen-agreement-standard-terms-and-conditions.pdf

Producer will not receive HPBM subsidy in respect of hydrogen sold to such hydrogen storage operator. Government will consider the need to review the HPBM position on RTIs in the future, for any contracts that are already in place as well as future allocation rounds.

Questions:

Q22: Do you have any reflections on the feasibility of hydrogen producers, or qualifying offtakers, to facilitate the volume of storage required for hydrogen to power – for example, regarding sourcing finance/capital? Please provide details.

Q23: What are your views on the feasibility of developing commercial arrangements between hydrogen producers, storage providers, and electricity generators that meet the HPBM requirements relating to Risk Taking Intermediaries (RTIs)?

Chapter Six: Summary of Government Position and Next Steps

Government is committed to supporting H2P to come forward so it can contribute to meeting power sector decarbonisation and supporting security of supply as soon as there is potential for projects to do so. As such, we are seeking views on our proposals to enable H2P to compete in the CM as soon as practical. Enabling participation in the CM would be subject to further consultation on finalising this policy proposal.

Our external modelling indicates that some H2P capacity may be able to deploy through existing markets in the short term. We expect this capacity securing CM agreements to likely be mostly lower-CAPEX plants, such as OCHTs, and/or those with ready access to low carbon hydrogen fuel, likely located within industrial clusters or close to hydrogen infrastructure. These projects may be both new build H2P and unabated gas generation converting to H2P and could displace unabated gas generation.

Our analysis did indicate that H2P plants – especially those which are more CAPEX-intensive – could face barriers to deployment. These were increased CAPEX and investment costs as a First of a Kind (FOAK) technology, and effectively managing the cross-chain risks arising from H2P plant operators not being able to effectively manage outages in a nascent hydrogen network. Our assessment is that some H2P plants would initially struggle to compete in the current CM due to these barriers and the high clearing prices potentially required.

To ensure that H2P can deploy at an accelerated pace necessary to positively impact our 2035 power sector decarbonisation commitments and to support security of supply, our minded-to position is that market intervention could be required. This potential intervention would be in the form of bespoke support (expected to be for more CAPEX-intensive H2P plants) alongside our proposals to enable H2P (expected to initially be less CAPEX-intensive plants) to compete in the current CM. This is to ensure a wide range of H2P projects have viable routes to market.

Any market intervention brought forward could mitigate the identified barriers by de-risking investment in H2P. This approach could enable a wider range of H2P projects to deploy, improving confidence in H2P technology, reducing technology and investment costs, and supporting government's power sector decarbonisation commitments, whilst supporting security of supply. In line with our minded-to position outlined in the first REMA consultation, we do not see bespoke support schemes for low carbon flexibility as an enduring solution as this limits competition. We would therefore aim to transition away from any H2P-specific market intervention brought forward, as soon as H2P technology was ready, towards a technology-wide competitive market. We would intend to transition support to the enduring mechanism for low carbon flexibility support we intend to outline in the forthcoming second REMA consultation.

A Split CM, a Revenue Cap and Floor, and a DPA-style mechanism have been identified as possible interventions to address the barriers currently in place. However, we are seeking feedback on our minded-to position that a H2P business model (H2PBM) based on elements of the Power CCUS DPA and adapted for H2P could mitigate the identified barriers through de-risking investment.

This consultation will be open for written responses for 10 weeks during which DESNZ intends to hold open stakeholder engagement sessions. Following the consultation, we will review stakeholder feedback and we intend to publish a response to this consultation in Q2 2024.

If, following stakeholder feedback to this consultation, government decides to progress with developing a H2PBM, we would intend to:

- Establish expert industry working groups to help with wider policy development; we would want to engage with industry to work through the complex investment landscape.
- Continue to develop the quantitative and qualitative evidence base on this and a value for money assessment on the chosen intervention option.
- Following the design consultation, we would intend to implement the chosen intervention as soon as reasonably practicable to maximise the deployment potential of H2P to reduce technology costs, improve confidence, and support the decarbonisation of the power sector.

Consultation Questions

1. **What are your views on the vision we have set out for hydrogen to power?**

2. **In your view, what role should hydrogen to power plants be playing in the power system? Please provide details and an explanation of your reasoning.**

3. **Do you agree with our assessment that less CAPEX-intensive plants and/or plants with ready access to low carbon hydrogen fuel could deploy in the short term without bespoke support? Please provide an explanation of your reasoning.**

4. **What are your views on our proposal to enable hydrogen to power plants to compete in the Capacity Market as soon as practical?**

5. **Are there any additional changes to existing markets which could support the deployment of hydrogen to power? Please provide details and an explanation of your reasoning.**

6. **Do you agree with the risks and barriers to hydrogen to power deployment that we have identified? Please provide an explanation of your reasoning.**

7. **In your view, what should industry's role be in addressing the barriers that we have identified? Please provide details and an explanation of your reasoning.**

8. **Are there any other potential risks and barriers that we should be considering? If so, which ones? Please provide details and an explanation of your reasoning.**

9. **Do you agree with our assessment that bespoke hydrogen to power market intervention is required to mitigate our identified deployment barriers and accelerate the deployment of hydrogen to power plants, likely those which are more CAPEX-intensive? Please provide an explanation of your reasoning.**

10. **Have we considered all credible market intervention options for hydrogen to power? Please provide details of any design options you think we may have missed and explain your reasoning.**

11. **Do you agree with our shortlisted three market intervention design options? Please provide an explanation of your reasoning.**

12. **Have we accurately identified the benefits and risks of a DPA-style mechanism? If not, are there any further benefits and risks to consider? Please provide details and an explanation of your reasoning.**

13. **Do you agree with government's assessment that a mechanism based on the Dispatchable Power Agreement is the most suitable option for bespoke hydrogen to power market intervention to support the accelerated deployment of hydrogen to power? Please provide an explanation of your reasoning.**

14. **What are your views on the need for a Variable Payment? Please provide details and an explanation of your reasoning.**

15. **Have we accurately identified the benefits and risks of a Split CM? If not, are there any further benefits and risks to consider? Please provide details and an explanation of your reasoning.**

16. **Do you agree with our proposal to discount the Split CM as an option for bespoke hydrogen to power market intervention to support the accelerated deployment of hydrogen to power? Please provide an explanation of your reasoning.**

17. **Have we accurately identified the benefits and risks of a Revenue Cap and Floor? If not, are there any further benefits and risks to consider? Please provide details and an explanation of your reasoning.**

18. **Do you agree with our proposal to discount the Revenue Cap and Floor as an option for bespoke hydrogen to power market intervention to support the accelerated deployment of hydrogen to power? Please provide an explanation of your reasoning.**

19. **What is your view on the need for price-based competitive allocation within/between bespoke business models versus moving assets straight to a technology-wide competitive market? Please provide an explanation of your reasoning.**

20. **How should a bespoke hydrogen to power business model be evolved to promote competition between low carbon flexible technologies? Please provide details and an explanation of your reasoning.**

21. **What are your views on the alignment of hydrogen support and policies needed to enable the deployment of hydrogen to power capacity. Please provide details and an explanation of your reasoning.**

22. **Do you have any reflections on the feasibility of hydrogen producers, or qualifying offtakers, to facilitate the volume of storage required for hydrogen to power – for example, regarding sourcing finance/capital? Please provide details.**

23. **What are your views on the feasibility of developing commercial arrangements between hydrogen producers, storage providers, and electricity generators that meet the Hydrogen Production Business Model (HPBM) requirements relating to Risk Taking Intermediaries (RTIs)?**

Appendices

Appendix 1 – Demand and Capacity Ranges for Hydrogen to Power Methodology

The ranges (see Figure 1 and 2) are illustrative scenarios meant to highlight what demand and capacity government expect could be needed in 2030, 2035 and 2050. They are based on evidence sources (see methodology section below) which consider the different roles that H2P could play in the power system. For example, some sources point to H2P as a key peaking solution which could also be used for security of supply while others think it could have more of a mid-merit role at higher load factor.[30] We think there is value in considering various scenarios and assumptions when thinking about how much H2P could be needed, as this allows us to understand the uncertainty in hydrogen demand for power.

The ranges reflect the high levels of uncertainty associated with the H2P sector, especially in 2050.

Key enablers such as fuel availability and hydrogen transport and storage infrastructure coming forward can affect how much H2P is deployed onto the system and therefore impact the suggested ranges. Overall and peak electricity demand levels as well as H2P costs and benefits compared to other forms of low carbon flexible technologies are also factors which could impact H2P deployment.

We expect to update these figures in 2024 as we improve our internal analysis on the role of H2P in the energy system.

Methodology

The ranges draw on recent literature from various external and internal sources, including DESNZ analysis on net zero and the power sector;[31] the Net Zero Strategy analysis;[32] LCP analysis on the need for market intervention to support hydrogen to power; National Grid's Future Energy Scenarios (FES);[33] AFRY analysis on the benefits of long duration electricity storage;[34] and CCC analysis on delivering a reliable decarbonised power system.[35] The ranges also consider market intelligence on H2P rollout. The figures for all years are drawn from the studies listed above, but with some adjustments:

- 2030: figures from the CCC analysis are excluded as available market intelligence suggests the hydrogen capacity and demand modelled in 2030 could be too high. Figures from the AFRY analysis and some of the FES scenarios are also excluded as

[30] This is why the highest/lowest capacity figures may not correspond to the highest/lowest demand figures. For example, in 2050, LCP analysis suggests that about 90GW of H2P capacity could be needed, while their demand range is comparatively quite low (i.e. between ~ 10 to 35TWh)
[31] See Annex O of the Energy and Emissions Projections, https://www.gov.uk/government/publications/energy-and-emissions-projections-2021-to-2040
[32] https://www.gov.uk/government/publications/net-zero-strategy
[33] https://www.nationalgrideso.com/future-energy/future-energy-scenarios
[34] https://afry.com/en/newsroom/news/benefits-long-duration-electricity-storage

[35] https://www.theccc.org.uk/publication/delivering-a-reliable-decarbonised-power-system/

available market intelligence suggests these estimates are too low compared to the pipeline of projects we are aware of. All of the DESNZ scenarios are included.

- 2035: Only the lower figures of the CCC scenarios were included. This is because we think assumptions used for H2P could be too optimistic and levels of Power CCUS deployed appear too low. All of the DESNZ, AFRY and net zero consistent FES scenarios are included.
- 2050: the CCC analysis does not include numbers for 2050. We only included the high resource and high innovation scenarios from the Net Zero Strategy as the high electrification scenario did not look at H2P.The Net Zero Strategy only includes figures for 2050. All of the DESNZ, AFRY and net zero consistent FES scenarios are included.
- We have removed LCP’s high price scenarios for 2030, 2035 and 2050 as well as the medium price scenarios for 2030 and 2035. This is because, under these scenarios, a CCHT would dispatch after a CCGT; since LCP have not looked into emissions intensity in their report to government, we think there is a high risk that these scenarios will be inconsistent with the government’s commitment to decarbonise the power system by 2035, subject to security of supply.

Appendix 2 – Non-Financial Barriers to H2P Deployment

Key non-financial barriers to H2P deployment

Based on our market research and stakeholder engagement, we believe that there are three primary non-financial barriers to consider:

- **Clarity over H2P policy** – government is committed to helping support the deployment of H2P, including by developing appropriate policies and continuing to collaborate with relevant government bodies and the H2P value chain.
- **Technology readiness** – we are keen to fully understand what R&D is needed to further develop H2P technologies – we have recently commissioned research on this.
- **Hydrogen supply for trials and testing** – we are continuing to work on potential solutions for hydrogen supply for trials and testing.

Other identified challenges to H2P deployment

We are also aware there are other challenges which should be considered as we develop H2P policy, including:

- Hydrogen combustion's potential to release more NOx than natural gas due to higher flame temperatures. We expect this could be an issue especially for existing power plants converting to hydrogen-firing.
- Difficulty and time spent navigating the environmental permits and planning regimes.
- Health and Safety regulations and construction standards might need to be adapted to H2P.
- Skills and availability of experienced staff.
- Difficulty in getting an electricity grid connection quickly for new build power plants.
- Public perception of hydrogen.
- Insurability of hydrogen projects/added risks.
- Water availability and water regulations.
- Interactions between low carbon hydrogen certification and the Emissions Trading Scheme (ETS).

Government is monitoring these risks and is happy to hear feedback on whether there is a further role for government in addressing them. However, at this stage, we do not think these barriers would prevent or deter developers from pursuing hydrogen as a way to decarbonise their plants.

Appendix 3 – Intervention Options Overview

Capacity Market ('CM') – The CM is an auction process. Investors bid to receive a Capacity Agreement, which provides them with a fixed monthly payment per kW of capacity, independent of their level of dispatch (except during stress events). All successful bidders receive the auction clearing price in a given year. Investors can receive a contract for a period of up to 15 years for a new plant, and up to three years for refurbished plants.

Split CM with a separate auction for low-carbon dispatchable power technologies ('CM+') – This alternative business model (outlined in the first REMA consultation)[36] represents changes to the current CM that could reduce the problem of excessive inframarginal rents. It involves splitting out a separate auction. There are numerous ways which technologies could be separated out into separate auctions, but the approach assessed in the external analysis was to group less mature low-carbon dispatchable power technologies. As with the counterfactual CM, successful bidders would receive a Capacity Agreement for up to 15 years, which provides them with a fixed monthly payment per kW of capacity that is available, regardless of how the asset dispatches (except in system stress events).

Deemed Generation CfD – This option (also outlined in the first REMA consultation), builds on the current Contracts for Difference ('CfD') in place for renewable generation. It involves support paid per unit of 'deemed output' rather than per unit of metered output, alongside the similar concepts of strike price and reference price. This means that operators are exposed to market prices when making dispatch decisions and are incentivised to dispatch efficiently (when market prices are above their marginal costs), because the level of actual dispatch does not affect the support payment they receive. The level of support per unit of deemed output is similar to a regular CfD and is based on the difference between a strike price which is fixed for the length of the contract, and a reference price which changes over time.

Dispatchable Power Agreement ('DPA') – The DPA is being put in place to support Power CCUS projects and this option would involve adapting it to support H2P projects. It includes two possible payment streams. First, an availability payment is paid per unit of capacity that is available over time, regardless of dispatch. This is similar in form to a CM payment but without the conditions related to security of supply which feature in the Capacity Agreement. Second, a variable payment could also be paid per unit of output. For Power CCUS plant, this has the objective of reducing marginal costs such that it dispatches just ahead of unabated gas in the merit order.

Revenue Cap and Floor – This intervention could provide increased certainty on the revenue received by the H2P investor, within a defined range. The operator receives market revenue and if this market revenue is below a minimum (floor), then the operator receives a top-up support payment to the level of the floor at the end of a defined reconciliation period. Similarly, if market revenue is above a maximum (cap) defined by the regulator, then the operator pays back the 'excess' at the end of the reconciliation period. This builds on the regime in place for interconnectors.

Unabated Fossil Fuel Ban – This intervention would define the maximum level of unabated gas to be used in power generation over a specified time period. The maximum level could be set at zero from a certain date or could reduce to zero over a specified time horizon. We assume that the current CM is still in place under this intervention.

[36] https://www.gov.uk/government/consultations/review-of-electricity-market-arrangements

Appendix 4 – Hydrogen Business Models

The Hydrogen Production Business Model (HPBM) will provide revenue support to hydrogen producers to overcome the operating cost gap between low carbon hydrogen and high carbon fuels. It has been designed to incentivise investment in low carbon hydrogen production and use, and in doing so deliver the government's ambition of up to 10GW of low carbon hydrogen production capacity by 2030, subject to value for money and affordability. Support is provided via a variable premium price support model. Volume support is also provided.

The Net Zero Hydrogen Fund (NZHF) announced in the Ten Point Plan, will provide up to £240m of grant funding to support the upfront costs of developing and building low carbon hydrogen production projects. To ensure NZHF funding is available to projects seeking revenue support through the first HPBM allocation rounds and those who are not, NZHF funding was split into four distinct 'strands'.

- Strand 1: DEVEX (development expenditure) for Front End Engineering Design (FEED) studies and post FEED costs. Strand 1 provides up to 50% co-funding support.
- Strand 2: CAPEX (capital expenditure) for projects that do not require revenue support through the HPBM. These are likely to be smaller electrolytic projects that are able to access revenue support through the Department for Transport's Renewable Transport Fuel Obligation (RTFO). Strand 2 provides up to 30% co-funding support.
- Strand 3: CAPEX for projects that require revenue support through the HPBM and sit outside of the Phase 2 cluster sequencing process. This first allocation round was limited to electrolytic projects, with projects able to bid for up to 20% CAPEX support.
- Strand 4: CAPEX for Carbon Capture, Usage and Storage (CCUS)-enabled hydrogen projects that require revenue support through the HPBM and are part of the Track-1 Phase 2 Cluster Sequencing Process.

We announced in March 2023 the first successful applications to strands 1 and 2 of the Net Zero Hydrogen Fund (NZHF), as well as shortlists of those CCUS-enabled and electrolytic hydrogen projects which were invited to the next stage of the CCUS Cluster Sequencing process (Track-1) and first electrolytic Hydrogen Allocation Round (HAR1) respectively. We announced a list of projects in August 2023 that were invited to the next stage of negotiations and we announced the final list of successful projects who will be awarded a Low Carbon Hydrogen Agreement in December 2023[37]. We plan to publish a list of further successful projects from round two of the NZHF strands 1 and 2 in early 2024.

The British Energy Security Strategy sets out government's intention to design new business models for hydrogen transport and storage infrastructure by 2025. These business models set out to encourage investment in and the development of hydrogen transport and storage infrastructure in the UK. This is because increasingly larger transport infrastructure will be needed to link hydrogen producers with consumers (e.g. in industry, power, transport and potentially heat) and storage facilities.

Following a consultation on hydrogen T&S business models launched in August 2022, we published the response to that consultation on 2 August 2023. Here, we set our minded-to position for the high-level designs of the hydrogen transport and storage business models. We

[37] https://www.gov.uk/government/publications/hydrogen-production-business-model-net-zero-hydrogen-fund-shortlisted-projects/hydrogen-production-business-model-net-zero-hydrogen-fund-har1-successful-projects

have established the following minded-to positions for the high-level design of the Hydrogen Transport Business Model (HTBM):

- The initial focus for the business model will be on large-scale pipeline infrastructure, which transports hydrogen as a gas.
- A Regulated Asset Base (RAB) will form the basis of the business model.
- An external subsidy mechanism will be created alongside a RAB to ensure that charges to users of the pipeline(s) and/or network(s) are not prohibitive, whilst allowing hydrogen transport providers to make a reasonable return on their investment.
- The external subsidy mechanism can be used in conjunction with or separately to a RAB.
- Strategic planning will form the basis of our allocation process for the business model, and it will help inform the nature and timing of support for early hydrogen transport projects.

We have established the following minded-to positions for the high-level design of the Hydrogen Storage Business Model (HSBM):

- Storage providers will be the recipients of business model support for at least 15 years.
- Geological storage will be the primary focus to begin with, retaining optionality for other types of storage.
- There will be a single enduring business model compatible with the evolving hydrogen economy.
- The business model will be to mitigate demand risk for storage providers by providing a revenue floor. Most other risks will be borne by facility owners.
- There will be a financial incentive for facilities to sell storage services to users (a sales incentive).

This consultation is available from: www.gov.uk/government/consultations/hydrogen-to-power-market-intervention-need-and-design

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