Department for
Energy Security
& Net Zero

Hydrogen to Power

Government response to consultation on the need, and design, for a Hydrogen to Power market intervention

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Executive Summary

Making Britain a clean energy superpower is one of the Prime Minister's five defining missions. There are two parts to this mission, delivering clean power by 2030, and accelerating net zero. Delivering this mission means we will rely increasingly on a renewables-led system as a foundation for a decarbonised grid. This will result in a wholesale shift in the nature of our long-term power system and require accelerated deployment of low carbon flexible power, such as hydrogen to power (H2P), power with carbon capture, usage and storage (CCUS) and long duration electricity storage (LDES) to keep the system balanced and support the transition away from unabated gas. Unlocking low carbon flexible supply could add significant value to a clean power system and facilitate a secure clean power system. The National Energy System Operator (NESO) estimates that the GB electricity system could need around 40 - 45GW of long duration flexible capacity by 2030. H2P is one of the first-of-a-kind technologies that the NESO considers an important requirement for a clean power system in 2030. The value of low carbon dispatchable technologies, such as H2P, reduces the reliance on weather-dependent renewables and in the long-term, can be built up to replace the need for remaining unabated gas generation.[1]

H2P – the conversion of low carbon hydrogen to produce low carbon electricity – will be a key low carbon flexible technology in delivering and maintaining a clean power system. H2P can play an important role in our electricity system at a range of scales and is the primary low carbon technology capable of providing low carbon inter-seasonal storage, whilst also providing a decarbonisation pathway for unabated gas.

Between 14 December 2023 and 22 February 2024, government consulted[2] on the need for, and potential design of, a market intervention to support the deployment of H2P. This was informed by our external analysis – published alongside the consultation – which indicated that whilst some H2P plants in specific circumstances, with relatively easy access to low carbon hydrogen fuel, could come forward, current market conditions mean a full range of H2P plants would struggle to deploy. This analysis indicated two key interlinked barriers which would need addressing to enable H2P to deploy at an accelerated pace to fully enable H2P to support power sector decarbonisation and security of supply. These barriers were principally:

- Uncertainty and increased investment risk from H2P being a First of a Kind (FOAK) technology; and
- Dependence on nascent critical enabling infrastructure, i.e. hydrogen production, transport, and storage creating 'cross-chain risks', and hydrogen fuel supply risks

In the consultation, a strategic vision for H2P was set out and the case for change with a minded-to position that bespoke short-term market intervention could be required to mitigate our identified key deployment barriers and thereby accelerate H2P deployment. The consultation also presented an options assessment of a shortlist of three business models and

[1] https://www.neso.energy/publications/clean-power-2030
[2] https://www.gov.uk/government/consultations/hydrogen-to-power-market-intervention-need-and-design

a minded-to position that a Dispatchable Power Agreement (DPA)-style business model was the most suitable design option to mitigate our identified deployment barriers.

We received a total of 44 responses from industry stakeholders, trade bodies, and research organisations. Respondents were broadly in agreement with our proposals and supportive of our minded-to position to implement an H2P BM.

To support delivery of a clean power system and building on the positive stakeholder feedback received through the consultation, government is committing to introduce a business model to support H2P deployment – "hydrogen to power business model" (H2P BM). The business model affirms government's aim to support the accelerated deployment of H2P and we will be engaging with stakeholders on H2P BM design principles in Spring 2025.

Alongside the H2P BM we want to ensure there are clear and viable routes to market to maximise H2P's potential to support our commitment for a secure clean power system. Stakeholders agreed with enabling participation into the Capacity Market (CM) and we will enable participation as soon as practical.

We are also aware that critical interdependencies exist with enabling infrastructure such as hydrogen storage and production. This will require careful management to ensure cross chain risk protection is appropriately and efficiently allocated between H2P plants and the rest of the hydrogen network. The design of the hydrogen business models will need to ensure that we do not over subsidise across the hydrogen value chain.

The first chapter of this document presents our refined strategic outline for H2P following the December 2023 H2P consultation, announcement of delivering a Clean Power System by 2030 and work done in relation to the second REMA consultation. This includes our view on the role H2P can play within the wider hydrogen and power context as well as the next steps government will take to deliver its market intervention. The second chapter of this document summarises industry feedback to the H2P consultation and provides the government's response to the questions posed, based on this feedback

In summary, government commits to:

- Delivering a H2P BM based on a DPA-style mechanism to support the deployment of H2P. This is a key step in supporting our commitment for a secure clean power system.
- We will look to enable H2P to participate in the current Capacity Market as soon as practical.
- Publishing a H2P BM market engagement document in Spring 2025 outlining further detail on the proposed design of the H2P BM.
- We will establish the H2P Expert Working Group. This will provide a key forum to support H2P BM design and policy development.

Section One: Hydrogen to Power, Supporting a Clean Power System – Strategic Overview

1.1 Introduction

Government has committed to delivering a clean power system by 2030. This will require significant volumes of low carbon flexible generation 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 and replicate system services traditionally provided by fossil fuel generation. They will also need to be capable of continuous output to manage periods of extended wind droughts. The National Energy System Operator (NESO) estimates that the GB electricity system could need around 40 - 45GW of long duration flexible capacity by 2030. The NESO's Clean Power 2030 report**Error! Bookmark not defined.** states the need for clear pathways for the deployment of new low carbon dispatchable capacity, such as hydrogen to power (H2P) to deploy successfully as a way to enable clean power by 2030 and could be built up to replace the need for remaining unabated gas generation.

Our aim is for as much of this future long duration flexible generation capacity to be as low carbon as possible. However, the low carbon flexible technologies that will help to meet this need and deliver on our decarbonisation objectives, such as H2P and power CCUS, have not yet (or, in the case of LDES, not recently) been deployed at scale and need support to deploy in the short-term.

Government is working hard to bring forward these key low carbon flexible technologies. We have developed the DPA[3] for power CCUS. This business model will incentivise the mobilisation of private finance to enable power CCUS to play a valuable mid-merit role in our generation mix and incentivise power CCUS to run ahead of unabated gas but without displacing renewables. The DPA has been refined through an iterative process, working with industry, expert advisors, and professional partners since government published initial proposals in December 2020. Both government and developers have made significant progress over the last few years, with negotiations on what could be the UK's first ever power CCUS project aiming to reach a conclusion before the end of 2024.

Long Duration Electricity Storage (LDES) technologies, such as Pumped Storage Hydropower (PSH), can store low carbon electricity when abundant for use during periods of little wind and sun. In January 2024, government published a consultation outlining our proposal to introduce a cap and floor arrangement to support investment in LDES assets.[4] This consultation closed in March 2024, and our response was published in October 2024.[5] The response outlines our

[3] https://www.gov.uk/government/publications/carbon-capture-usage-and-storage-ccus-business-models
[4] https://www.gov.uk/government/consultations/long-duration-electricity-storage-proposals-to-enable-investment
[5] https://www.gov.uk/government/news/new-scheme-to-attract-investment-in-renewable-energy-storage

decision that an LDES cap and floor scheme should be introduced, with Ofgem agreeing to act as LDES regulator. We will now work with Ofgem and others with the intention of opening a scheme to applications in 2025.

Our view is that H2P, alongside other low carbon long duration flexible technologies, will be key to delivering and maintaining a clean power system by providing low carbon new build capacity, alongside providing a route for important gas capacity to convert to a low carbon alternative. By offering a longer-term future for unabated gas plants through conversion to H2P or CCUS, government can reduce the risk of stranded assets and reduced return on investment for operators. H2P will be important for transitioning existing capacity and deploying low carbon new build capacity to provide sufficient low carbon long duration flexible capacity for the power system.

1.2 The role of Hydrogen to Power

There was broad agreement from respondents that H2P can offer a range of power system benefits as a long duration low carbon generation technology. Stakeholders acknowledged the strengths of H2P as a low carbon flexible technology that can be deployed at a range of scales from larger mid-merit plants to smaller peaking capacity[6].

We see H2P as a critical component of the future energy mix. This would act to complement shorter duration flexible technologies, such as batteries, ensuring the system can balance during longer periods of low renewable output and/or high electricity demand. Additionally, load factors are expected to continue to decline over time as the quantity of renewables on the system increases[7] and there is a need to bring forward low carbon flexible capacity, such as H2P, that can operate effectively and perform economically in these conditions and maintain security of supply. As a form of dispatchable and synchronous generation, H2P can also offer system services similar to unabated gas plants, such as stability and voltage, to help ensure the grid remains secure and balanced at all times. These characteristics mean that H2P has the potential to provide a decarbonisation pathway for unabated gas plants, helping maximise use of existing assets and offer a viable route to decarbonised operation. 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.

Along with power CCUS, H2P has the potential to provide decarbonisation pathways for unabated gas plants through retrofitting to low carbon operation. The October 2024 Decarbonisation Readiness consultation response[8] and legislation will mean new build and

[6] 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.

[7] https://assets.publishing.service.gov.uk/media/657a2eeb095987001295e072/hydrogen-to-power-market-intervention-need-and-options-report.pdf

[8] https://www.gov.uk/government/consultations/decarbonisation-readiness-updates-to-the-2009-carbon-capture-readiness-requirements

substantially refurbishing combustion power plant developers must have credible plans to convert to either hydrogen firing or retrofit carbon capture technology within the lifetime of the plant. This will apply to plant operators submitting their environmental permit applications in England after 28 February 2026.

1.3 Hydrogen to Power Business Model

The December 2023 H2P consultation[9] sought views on the government's minded-to position that market intervention could be required to mitigate deployment barriers and accelerate the deployment of H2P. Alongside this, a business model based on elements of the power CCUS DPA, but adapted to suit the needs of H2P, was proposed to be the most suitable form of market intervention.

Following the positive feedback and support from respondents to these minded-to positions, we will be introducing a DPA-style mechanism for H2P (the H2P BM) as the investment de-risking mechanism to support H2P deployment. The aim of the H2P BM is to support H2P capacity to come forward, thereby supporting our security of supply and clean power objectives, whilst providing decarbonisation pathways for unabated gas generation.

The H2P BM will provide a stable support payment to give investors a level of revenue certainty. It is important for this model to incentivise an efficient dispatch order and ensure it is proportionate and limited to what is necessary to achieve the policy objectives of H2P.

Our view remains that bespoke support and market intervention for H2P, via the H2P BM, will provide a route to market initially and our expectation is that as the technology develops, enabling infrastructure matures, and CAPEX and financing costs reduce, H2P would be able to compete with other technologies and deploy through a more competitive support process. This includes the Capacity Market (CM) or the Optimised CM as the enduring revenue support mechanism. We also recognise the potential for a price-based competitive allocation within a H2P BM as a 'stepping stone' to an enduring multi-technology revenue support mechanism.

Next year, we intend to present more detail on the proposed design of the H2P BM and undertake a further market engagement exercise to invite feedback on these plans. We intend to set out our view on the following topics:

- The overarching design principles and structure of the business model.
- Key design features including whether there is a need for payment structures that incentivise effective dispatch and ensure VfM.
- The legislative framework to support the business model.
- Further detail on how the H2P BM will interact with the wider hydrogen economy.
- Further detail on how the H2P BM will interact with wider power markets.
- Further detail on how H2P BM may interact with Great British Energy (GBE) investment opportunities.

[9] https://www.gov.uk/government/consultations/hydrogen-to-power-market-intervention-need-and-design

- Our proposals for a H2P BM allocation approach and consideration of eligibility and assessment criteria.

Following this market engagement exercise, scheme guidance and application processes will be finalised in due course and published.

We will ensure that development of the H2P BM is supported through extensive market engagement. Much like the approach taken in the design and development of business models for power CCUS and the broader hydrogen economy, we will work closely with industry to develop the H2P BM and consider the design choices listed above in further detail. We are establishing a H2P Expert Working Group to provide a forum to pool knowledge from industry experts to seek feedback on policy proposals and support decision making. We intend to use these groups to discuss technical policy development, evaluate whether emerging policy proposals meet the needs of industry and are being implemented effectively.

We will shortly be commissioning external research to update our evidence base on the costs of different H2P technologies and plant types to help inform the design of the business model. This will ensure that the H2P BM is designed to effectively address identified deployment barriers, de-risk H2P deployment and ensure value for money.

1.4 Hydrogen to Power in the Capacity Market

Government acknowledges the consultation feedback that the Capacity Market (CM) may struggle to support H2P in the short-term, given its higher FOAK costs and especially the concerns about fuel availability in a nascent hydrogen economy in the context of CM non-delivery penalties.

By enabling H2P to compete in the CM as soon as practical, we will ensure clear pathways and sight for the long-term future of the technology. We would expect a limited number of plants to come forward through the CM in the medium-term, with this rising as the technology develops and deployment barriers fall away. There is also a strategic role for H2P in the CM as it offers a possible viable alternative pathway to transition (where appropriate) unabated generation into H2P, delivering cost-effective decarbonisation benefits for security of supply. Therefore, we will continue to progress work to enable H2P deployment through the CM as soon as practical to strengthen policy signals and unlock investment into H2P. See Section 2.2 for the summary of responses related to the participation of H2P plants in the CM.

In addition to bringing forward new build H2P capacity, the CM could provide a route for unabated gas generation to decarbonise. The second REMA consultation set out the government's intention to support the conversion of existing gas generators to low carbon by developing policy to ensure that unabated gas in the CM with long-term agreements has pathways to decarbonise through implementing "managed exits". In October, the government published a consultation[10] proposing to implement a first stage managed exit pathway to allow

[10] https://www.gov.uk/government/consultations/capacity-market-proposals-to-maintain-security-of-supply-and-enable-flexible-capacity-to-decarbonise

unabated gas generators to exit long-term CM agreements to transfer to the power CCUS DPA and explores the feasibility of this for enabling H2P through bespoke support in the Call for Evidence[11].

1.5 Hydrogen to Power and the Hydrogen Economy

We recognise that H2P will be dependent on critical enabling infrastructure in the hydrogen economy – the availability of hydrogen production, storage and transportation infrastructure at the right time, location and capacity. This dependency is recognised in NESO's Clean Power 2030 Report**Error! Bookmark not defined.** which states that delivery of transport and storage infrastructure required to support low carbon dispatchable power for 2030 is critical. We will consider the design elements of the business model alongside developments in the production, transport and storage business models to ensure there is a coherent investment framework for H2P offtakers to invest into. This will help ensure that H2P can effectively support the government in delivering on and maintaining its decarbonisation and security of supply objectives for the power sector.

In December 2023, government published an ambition for the first allocation round of the hydrogen storage business model to support up to two hydrogen storage projects to be in operation or construction by 2030, which was informed by internal and external analysis.[12] We are continuing to work to gather evidence to further inform storage policy and how it can support H2P and other hydrogen users. Work needs to be done by future network and storage operators, future hydrogen offtakers, and government to ensure storage technical/commercial arrangements help to realise the hydrogen economy as set out in the hydrogen strategy.

We recognise the feedback from stakeholders on the need for clarity on alignment between the H2P BM and the wider hydrogen economy and value chain. Government acknowledges that the alignment and co-ordination of business models is a critical issue for the developing hydrogen economy and will continue to focus on this and the commercial interactions between the respective hydrogen business models, including respective allocation processes. This includes ensuring business models align with subsidy control principles and that each business model focuses on addressing specific market failures in different areas of the value chain. We will set out views on how the H2P BM interacts with, and will align with, the wider hydrogen economy in our forthcoming market engagement exercises before the design of the H2P BM is finalised.

1.6 Next Steps

Delivering our clean power 2030 mission whilst ensuring security of supply will require bringing forward large volumes of low carbon flexible technologies alongside wider reforms to our

[11] https://www.gov.uk/government/calls-for-evidence/capacity-market-proposals-to-maintain-security-of-supply-and-enable-flexible-capacity-to-decarbonise

[12] Summarised in the Hydrogen Transport and Storage Networks pathway, within 'Timing of T&S requirements' section, page 41. https://www.gov.uk/government/publications/hydrogen-transport-and-storage-networks-pathway

electricity markets being delivered through the REMA programme. We recognise the need to bring forward these critical technologies at pace. Alongside committing to introduce market intervention, we are outlining our next steps to support delivering the business model and the deployment of H2P.

We recognise the complexity of this work and are committed to collaborating closely with industry stakeholders in developing this policy. This includes establishing a new H2P Expert Working Group which will support governments efforts to consider policy proposals for the design of H2P BM. If you are interested in joining the H2P Expert Working Group, please contact hydrogenpower@energysecurity.gov.uk to register your interest. In addition, we will also shortly be commissioning external research to update our evidence base on the costs of different H2P technologies and plant types to help inform the design of the H2P BM.

In July 2024, we published the founding statement for Great British Energy (GBE)[13] and the GBE Bill was introduced into Parliament. GBE will be an operationally independent company and the exact mix of technologies it chooses to invest in will be determined in due course and influenced by the available opportunities as well as the strategic objectives that government will set out.

DESNZ will also continue to collaborate across industry and government to ensure alignment between various hydrogen subsidies and wider electricity market reform. We intend to provide an update on this work in forthcoming H2P market engagement exercises which will be published in advance of launching the H2P BM.

As set out in the Executive Summary, the government will now focus on the following objectives:

- Delivering a (H2P BM) using a DPA-style mechanism to support the deployment of H2P. This is a crucial step in delivering on our commitments to a secure clean power system.
- We will look to enable H2P to participate in the Capacity Market as soon as practical.
- Publishing a H2P BM market engagement document in Spring 2025 outlining our approach to the design of the H2P BM in more depth.
- We intend to work closely with industry on proposals for H2P BM through establishing the new H2P Expert Working Group. If you are interested in joining the group, please contact hydrogenpower@energysecurity.gov.uk to register your interest.

[13] https://www.gov.uk/government/publications/introducing-great-british-energy/great-british-energy-founding-statement

Section Two: Summary of Consultation Responses and Government Response

The overarching strategic approach and next steps for H2P policy has been set out in Chapter One of this document. In this chapter we have summarised the responses that we received to the December 2023 consultation and outlined the government's position on these issues.

44 responses to this consultation were received. In summarising the responses to each question, we have used several terms:

- 'majority' indicates the clear view of more than half of respondents to that question.
- 'minority' indicates the clear view of fewer than half of respondents to that question.

The following terms have been used when summarising responses:

- 'some respondents' means any number between 3 and 10 respondents.
- 'many respondents' indicates between 10 and 30 respondents have shared this view.
- 'strong agreement' indicates that upwards of 30 respondents have shared this view.

Responses which did not explicitly express their support or disapproval for a given topic were logged but classified as neither supportive nor unsupportive.

When summarising responses to the consultation, all accompanying written text was analysed for each question. Where information provided by a respondent related to a different question, we have summarised it under that other question.

Where relevant, we have interpreted 'blue' hydrogen as CCUS-enabled methane reformation and 'green' hydrogen as electrolytic hydrogen from low carbon / renewable electricity.

2.1 Chapter One: Strategic Vision

Consultation position

In Chapter One of the consultation, government set out its initial strategic vision for H2P as a critical technology to support a secure and reliable clean power system.

Government outlined the role H2P could play in supporting a secure clean power system. Government also commissioned analysis on the need and potential design options for H2P market intervention which indicated that while some H2P would be able to deploy through existing markets such as the CM, government intervention would be required to accelerate the deployment of more CAPEX-intensive plants. Market and infrastructure development was noted to determine H2P's specific role and location in the power system, especially given initial deployment will be more critically dependent on hydrogen infrastructure availability.

Chapter One of the consultation also set out the strategic role H2P can play in the UK's developing hydrogen economy. 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.

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.

Summary of responses

Question One received 43 responses, with strong agreement from respondents that the strategic vision which was outlined for H2P was accurate. Respondents agreed that H2P can play a critical role in a decarbonised power system by providing low carbon, flexible electricity generation capacity during extended periods of low wind and solar. Some of the critical roles highlighted by respondents included:

- Providing dispatchable power generation during extended periods of low renewable output and balancing electricity generation.
- Replacing some of the system service roles previously provided by unabated gas generation, such as providing ancillary services.
- Overcoming electricity grid constraints with hydrogen pipelines between regions and countries.
- Providing a pathway for unabated gas generation to decarbonise.

Some respondents argued that the role of H2P, and its position in the merit order should be determined by the market and its cost competitiveness compared to other forms of low carbon flexible technologies, such as power CCUS and Long Duration Electricity Storage (LDES). Within this group, some respondents noted that H2P should not provide baseload generation. They highlighted concerns with round-trip efficiencies involved in generating electricity to produce hydrogen, which is then used to create electricity. There were also concerns about the high cost of hydrogen fuel and that an expanded role for H2P could increase whole system costs. Another respondent argued that caution should be applied when considering the scale of H2P deployment due to the nascency of the technology.

A number of respondents highlighted concerns that the business model may create unintended incentives around the dispatch of hydrogen and care would need to be taken when determining its design to ensure it dispatched at the most efficient time for the system. Two respondents suggested that further consideration of the interactions between H2P and other technologies in the power sector is needed. These respondents requested more clarity on the role of H2P alongside other technologies, like power CCUS, within the system.

Question Two received 40 responses. A majority of respondents highlighted the critical role that hydrogen transport and storage infrastructure would play in enabling the deployment of H2P.

A few key themes were identified across the responses, including that:

- To enable the ambition to decarbonise the electricity system by 2035[14], the required hydrogen transport and storage infrastructure will need to start being deployed in the mid-2020s.
- Hydrogen storage must be deployed to enable H2P to play a flexible role while ensuring efficient operation of production capacity.
- Continuity and alignment across the transport and storage network is vital in ensuring industry has the confidence and clarity to invest. To this aim, government should provide more clarity on the interactions between the different business models.
- H2P generation will be highly intermittent and therefore it is critical that there is storage nearby. Government should develop the storage and transport business model in parallel with longer lead in times for storage.

In addition to the role of H2P in the power sector, some respondents also requested that government consider supporting on-site blending as part of any market intervention. They stated that Technology Readiness Levels (TRLs) are more mature for blending and that the cost of converting to burning a blend of hydrogen and natural gas is lower than burning 100% hydrogen. These respondents also suggested that blending could play a key role in supporting the rollout of hydrogen infrastructure in the short term, by providing a reliable demand for hydrogen. In contrast, one respondent suggested that the technology is mature and capable of running on 100% hydrogen, so the intermediate step of blending would be unnecessary and delay the reach of the net zero target.

Finally, some respondents recommended that the business model include support for Combined Heat and Power (CHP) plants. They outlined that the CHP plants can provide flexible and efficient generation, would be relatively easy to switch to hydrogen, and can help to decarbonise smaller, more decentralised forms of power generation.

Government response

As we set out in the strategic vision for H2P, and in the Capacity Market (CM) Consultation[15] and Call for Evidence[16] published in October 2024 on proposals to maintain security of supply and enable flexible capacity to decarbonise, government sees H2P as an important technology in delivering a clean power system, long-term net zero targets and ensuring security of supply.

As one of the main forms of low carbon, long-duration, flexible technology, alongside CCUS and LDES, H2P can replicate system services traditionally provided by fossil fuel generation. It can provide continuous output to manage periods of extended wind droughts when connected to large-scale hydrogen storage and transport. In doing so, H2P can act as a replacement for unabated gas for the residual and longer periods where renewable generation is not able to meet demand.

[14] The consultation responses to the December 2023 reference the previous government's ambition to decarbonise the power system by 2035. This ambition has now been superseded by the Government's announcement to deliver Clean Power by 2030.
[15] https://www.gov.uk/government/consultations/capacity-market-proposals-to-maintain-security-of-supply-and-enable-flexible-capacity-to-decarbonise
[16] https://www.gov.uk/government/calls-for-evidence/capacity-market-proposals-to-maintain-security-of-supply-and-enable-flexible-capacity-to-decarbonise

We will use this strategic role for H2P as the basis for the design of the H2P BM. It will help to develop the approach that we will take and ensure that it accelerates the deployment of the technology and incentivises plants to dispatch effectively and ensuring value for money.

Regarding H2P's specific role in the system, we agree with the majority of respondents who argued that the role of H2P should be determined by the market. We recognise the value of H2P to the system and in particular its ability to provide low carbon flexible generation.

Government believes that market and infrastructure development will be key to the deployment of H2P and will help determine its specific role and location in the power system, especially since initial deployment will be more critically dependent on hydrogen infrastructure availability. As set out in the December 2023 consultation, government believes that the peak rate of hydrogen consumption from medium to larger sized power plants will likely require hydrogen to be delivered via pipeline, will be heavily reliant on the availability of large-scale geological storage and accordingly large volumes of stored hydrogen.

We are committed to ensuring that there is alignment across the hydrogen value chain, including the production, transport, and storage business models. Section 2.10 of this document outlines a more detailed discussion on responses related to interactions with the other hydrogen business models.

Regarding eligibility of blending plants, we have not yet decided whether the business model will support blending as a short-term measure in the transition to 100% hydrogen firing and we will consider this further. Similarly, no decision has been taken on the inclusion of CHP plants. We intend to provide more clarity on eligibility for the H2P BM, including blending and CHP plants, through further market engagement as laid out in Section 1.3 of this document.

2.2 Chapter Two: Changes to Existing Markets to Support Hydrogen to Power

Consultation position

In Chapter Two of the consultation, government set out the evidence and analysis which underpinned the minded-to-position to introduce a H2P market intervention.

The commissioned analysis, published alongside the consultation, indicated that some lower-CAPEX H2P plants could come forward through existing markets – primarily the Capacity Market (CM) – if they had ready access to hydrogen fuel and were located within industrial clusters or closer to enabling hydrogen infrastructure. However, this analysis also indicated 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. The analysis indicated that more CAPEX-intensive H2P plants could require CM clearing prices of up to £120/kW to deploy. Government analysis indicated 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.

The chapter also sought views on proposals to enable H2P to compete in the CM as soon as practical to provide alternative routes to market.

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.

Summary of responses

Question Three received 39 responses, with 18 of these respondents disagreeing with our assessment. These respondents emphasised the lack of fuel availability and the nascency of the technology and enabling infrastructure as key barriers preventing deployment of H2P in the short term.

Of the respondents who disagreed, five also highlighted concerns regarding CM non-delivery penalties and the impact this would have on investor confidence. In addition to this, four respondents also stated that support would be needed for all H2P plants since CAPEX and maintenance costs would still be significant. Two respondents also suggested that a tiered threshold for determining support between lower and higher CAPEX plants should be avoided.

The 13 respondents who were unsure presented similar concerns to those who disagreed, noting challenges around the availability of fuel, existing infrastructure, and cross-chain risks, as well as concerns regarding non-delivery penalties in the CM.

Eight respondents agreed with our assessment, with caveats included however that deployment in the short-term may be dependent on the utilisation rate (one respondent), the cost and availability of fuel (two respondents), and the scale of potential modifications to plants (one respondent).

Question Four received 40 responses. 30 respondents agreed that H2P should be enabled to compete in the CM whilst three respondents disagreed with this position. Six responses were neutral and did not provide a definitive view.

The majority of those who supported the proposals did note caveats or challenges to enabling participation of H2P in the CM. Whilst many respondents noted the value of the CM as a route to market, they felt the CM would be more valuable in the longer term. They noted that the CM route was unlikely to adequately mitigate the key deployment barriers in the short term, notably the cross-chain infrastructure risks. Many of these respondents felt that in the short-term, only bespoke support could overcome the barriers and bring forward larger volumes of H2P capacity.

Numerous respondents noted that H2P plants would have higher CAPEX costs than assumed in the analysis.

Respondents who were opposed to the proposal to enable H2P to compete in the CM highlighted that the deployment barriers made bespoke support the only viable approach. One respondent noted the risk of CM market distortion if H2P set higher clearing prices and a risk of increased consumer costs. They also noted potential geographic distortions in the market with H2P deploying close to hydrogen infrastructure which could send a locational signal to viable plants from elsewhere in the system.

A number of respondents requested clarity from government on the timings and approach to the enabling H2P to participate in the CM to help provide investor confidence.

Question Five received 36 responses with respondents proposing a range of possible changes to existing markets.

Twelve respondents highlighted the need for a strengthened carbon price to support H2P deployment. Respondents noted that a stronger carbon price would make H2P more competitive in the market, and that it would help deliver the government's power sector decarbonisation objectives by making higher carbon technologies less competitive and therefore support the transition to low carbon alternatives. One respondent suggested that methane and nitrous oxide be included within the UK Emissions Trading Scheme (UK ETS)[17].

Four respondents directly noted the need for greater clarity from government on the expansion of the hydrogen economy, especially key T&S infrastructure in supporting the deployment of H2P.

Amendments to the CM was a key theme for many respondents. Four respondents suggested that the CM clearing price cap should be updated. They felt this cap should be amended to better reflect changing market conditions, inflation, and the analysis published alongside the consultation indicating that CAPEX-intensive H2P plants could require up to £120/kW. These respondents maintained that higher CM clearing price caps would better reflect the costs of bringing forward FOAK technologies like H2P.

Three respondents noted the need for government to provide clarity on the role of the 'managed exits' policy which will enable CM agreement holders to leave their agreement early to decarbonise. Respondents requested clarity on how a CM agreement holder could leave the CM to secure a H2P DPA agreement. One respondent highlighted that leaving a CM agreement currently incurs significant termination fees, and that a plant who opts to leave should be allowed to re-enter the CM. For example, they could restart their previous agreement, if the proposed low carbon funding route did not commence, through no fault of the generator. One respondent suggested that unabated plants undertaking conversion should be eligible to bid into the CM up to the date of their conversion to support the investment case. A theme across a number of responses was the need for government to ensure join up across its

[17] The UK's Emissions Trading Scheme is a cap-and-trade system which caps the total level of greenhouse gas emissions, creating a carbon market with a price signal to incentivise decarbonisation. It applies to energy intensive industries, the power generation sector and aviation.

schemes and policies, especially those aimed at supporting the transition from unabated gas and the deployment of more low carbon flexible technologies.

Several respondents suggested that specific measures to support ‘retrofit-ready’ technologies be included in the CM. A number of respondents also highlighted that the CM should be updated to better support low carbon flexible technologies. The risks of the CM as an investment route for H2P was noted by several respondents who pointed to the non-delivery penalties within the CM being a risk due to the limited availability of low carbon hydrogen.

Two respondents noted the challenge of securing a grid connection as a barrier to deployment, with one respondent suggesting that when a plant receives a CM agreement, a guarantee is also provided that the plant will receive a grid connection.

Finally, several respondents highlighted the need for a specific technology class for H2P in the CM, and requested clarity from government on how one would be developed, noting that consideration would need to be given to 100% hydrogen firing and blended projects.

Government response

Government acknowledges the deployment challenges that lower CAPEX H2P plants will face and the similarities of those to more CAPEX intensive ones, in particular concerns regarding CM non-delivery penalties due to cross chain and fuel availability risks. We view the H2P BM as a short-term intervention and the CM as the long-term mechanism through which H2P plants can compete for funding, in recognition of the security of supply benefit they could bring, both in its current form and the Optimised Capacity Market proposed through REMA. We are open to supporting a variety of projects but remain focused on ensuring that we provide value for money. We expect the CM to bring forward some lower CAPEX plants alongside the deployment of plants through the H2P BM. This approach ensures that we establish routes to market via either the CM or the H2P BM.

We will shortly be commissioning external research to update our evidence base on the costs of different H2P technologies and plant types to help inform the design of the business model.

The UK ETS Authority will review the policy of expanding the scope of the upstream oil and gas sector in the UK ETS to include methane and nitrous oxide emissions and will consult in due course.

The Capacity Market

We welcome the feedback on the ability of the CM to provide a route to market for H2P in the short term, but we note the deployment challenges raised of FOAK risks and non-delivery penalties. Government believes the CM can provide a long-term route to market to support H2P deployment and we will look to enable H2P participation as soon as practical. In Chapter One of this response, we outlined the strategic approach for this work.

Enabling participation of H2P in the CM will be complex as we expect to make assessments of different H2P technology types including turbines of different sizes and engines. Government recognises the feedback from stakeholders and as such will prioritise which technology types

are developed first. From our analysis, we expect lower CAPEX plants could enter the CM earlier especially those with ready access to hydrogen fuel and located within industrial clusters or close to enabling hydrogen infrastructure, though we note this view is not shared by many of the respondents that have pointed out the CM penalty risk that comes from limited hydrogen fuel availability. From respondents' feedback and our analysis, we'd expect more CAPEX-intensive plants, such as large Combined Cycle Hydrogen Turbine (CCHT) plants to compete in the CM in the longer-term once deployment costs and wider risks have fallen.

We welcome the feedback to Question Five and as mentioned in section 1.4 of this document, government is considering changes to the CM required to facilitate the deployment of H2P, including the implementation of "managed exits". As outlined in the second REMA consultation, "managed exits" could enable unabated gas generators to exit an existing multi-year CM agreement to access a new CM or alternative support schemes to decarbonise. In October, government published a consultation proposing to introduce an initial managed exit pathway to allow unabated gas generators to exit their multi-year CM agreements to transfer to the power CCUS DPA.[18] A Call for Evidence was published alongside the consultation, seeking early views on a managed exit pathway which could allow unabated gas on multi-year CM agreements to exit the CM and transfer to the H2P BM, enabling conversions to H2P.[19]

As outlined in the second REMA consultation, in the long run, the CM provides a route for supporting investment in and the deployment of a competitive mix of low carbon flexible capacity by transitioning technologies away from any administratively awarded bespoke mechanisms, whilst offering continued revenue support. One route to enabling this could be to optimise the design of the CM auction to allow low-carbon flexible technologies access to different clearing prices by introducing minimum procurement targets (i.e. minima - an Optimised Capacity Market). The proposal is being reviewed based on the stakeholder feedback received via the second REMA consultation and within the context of the wider REMA policy landscape.

Grid connections can be a barrier to deployment of power generation projects, including H2P. The Connections Action Plan[20] published jointly with Ofgem in November 2023, set out a range of measures to free up network capacity and significantly reduce the delays faced by viable projects. Implementation of the plan is well underway with up to 40GW of accelerated offers issued, or in the process of being issued, since publication.

The NESO also plans to implement further reforms from 1 January 2025 that will ensure only projects that are ready to progress can enter and remain in the connections queue. The NESO is exploring how these reforms will interact with the development and funding timelines of different generation technologies, including those participating in the CM, to ensure the reformed process meets the needs of connection customers and the electricity system.

[18] https://www.gov.uk/government/consultations/capacity-market-proposals-to-maintain-security-of-supply-and-enable-flexible-capacity-to-decarbonise
[19] https://www.gov.uk/government/calls-for-evidence/capacity-market-proposals-to-maintain-security-of-supply-and-enable-flexible-capacity-to-decarbonise
[20] https://assets.publishing.service.gov.uk/media/655dd873d03a8d001207fe56/connections-action-plan.pdf

2.3 Chapter Two: Need for Market Intervention

Consultation position

In Chapter Two of the consultation, government also presented our identified barriers to H2P deployment. The analysis highlighted two primary barriers to H2P deployment: the uncertainty and increased investment risk associated with being a First of a Kind (FOAK) technology, and the dependence on nascent critical enabling infrastructure, leading to 'cross-chain risks' and challenges in securing low carbon hydrogen fuel supply. Other non-financial barriers include clarity over H2P policy, technology readiness, and hydrogen supply for testing and trials.

The chapter also explained that the highlighted barriers risk delaying the adoption of H2P, undermining its potential benefits for decarbonising the power sector. Therefore, government planned to address these risks by providing targeted support mechanisms to mitigate financial uncertainties for developers. A bespoke market intervention was proposed as a more cost-effective solution, compared to relying solely on existing markets like the CM to accelerate H2P deployment.

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.

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

Summary of responses

Question Six received 39 responses. A clear majority of respondents (22) agreed that we had accurately identified two of the key barriers to hydrogen to power deployment, namely the FOAK risk and the dependence on nascent critical enabling infrastructure, leading to 'cross-chain risks'. Four respondents partially disagreed as they were opposed to the idea of the FOAK risk being critical, describing it instead as low risk. One respondent stated that hydrogen plants are just the next iteration of gas turbine technology which is already advanced. 35 respondents to question six agreed with and pointed to governments view that a key risk faced by H2P plants is cross-chain risk with some going into detail on infrastructure alignment and or hydrogen supply. Four responses were submitted that did not definitively agree or disagree with the question.

Respondents also presented several additional risks to H2P deployment in their responses. Eight stated that the electricity market now, and changes as proposed in REMA, are a key risk for H2P developers, due to investment uncertainty. Seven respondents cited the Hydrogen Production Business Model's (HPBM) design as a key risk for H2P projects since they felt that incentives provided by the current drafting favour "baseload production" (or producers producing and selling hydrogen whenever they can). Respondents contended that this model

is therefore more suited to “baseload” offtake, which H2P is not. One respondent explicitly stated that the ineligibility of Risk Taking Intermediaries (RTIs) for subsidised hydrogen under the HPBM is a key barrier for the deployment of H2P.

Five respondents highlighted the limited availability of hydrogen for testing as a key risk for H2P development since this inhibits innovation. Five respondents mentioned grid connection delays as a risk to H2P projects as this slows down investment. Three respondents underlined the lack of health and safety regulations as a key risk, especially since the sector is nascent and therefore it is difficult to provide assurances to industry on specifics. One respondent noted the lack of appropriate skills as a key risk, encompassing planning, permitting, and construction roles. Two respondents highlighted NOx[21] emissions as a key risk since hydrogen combusts at higher temperatures than methane thus creating more NOx. One respondent listed planning and permitting as a key risk because there is no H2P plant operating in the UK today and the lack of market maturity would increase lead times for development.

Two respondents discussed the potential failure of hydrogen business models as a risk specifically highlighting the risk of inefficient allocation processes and the inability to make long term decisions on subsidised hydrogen price vs other fuels. One respondent specified the uncertainty in network planning as a key risk, particularly regarding how the decision-making process will be conducted in the sector. Another respondent cited the UK’s lack of supply chain and equipment for hydrogen as a risk to H2P deployment.

Question Seven received 35 responses with respondents sharing their views on the preferred roles for industry versus government, as well as roles that they both should share.

On industry’s role, 13 respondents stated that industry should lead on innovation and technology by investing in FOAK technology. Five stated that it was industry’s role to be collaborative. Five respondents stated that industry should bring commercial experience to H2P learning from the roll-out of renewables. Three stated that it was industry’s role to bring down costs and reduce the need for support in the future. Respondents also suggested that risk mitigation, regulatory barriers, and hydrogen use should sit with industry.

Many respondents stated that industry and government needed to collaborate to create the policy necessary for H2P deployment. Three respondents stated that it was both industry and government’s role to address cross-sectoral risk, highlighting that both can draw in interrelated sectors to work collaboratively and derisk the wider hydrogen ecosystem. Three respondents stated that it was government’s role to take on the risks/partial risk of deployment of H2P due to the very uncertain rewards. One respondent stated that government and industry needed to take on commercial demand risks and policy-driven demand risks together to provide protection and ensure projects are investable. One respondent stated that infrastructure deployment was a role for both government and industry via our current suite of business

[21] NOx emissions refers to nitric oxide (NO) and nitrogen dioxide (NO_2), both of which are mainly formed during the combustion of fossil fuels. The dominant portion of these gases is nitric oxide (NO). NO can react with other gases in the atmosphere to form nitrogen dioxide (NO2) which is harmful to health.

models. One respondent stated that government should oversee the production of hydrogen to ensure the right strategic decisions are taken, rather than market-led decisions.

Question Eight received 27 responses. These responses highlighted the same risks as Question Six.

Government response

Government welcomes the feedback from a majority of respondents who agreed with our assessment of the two key barriers for H2P deployment. These are the increased investment risk associated with being a First of a Kind (FOAK) technology, and the dependence on nascent critical enabling infrastructure, leading to 'cross-chain risks' and challenges in securing low carbon hydrogen fuel supply.

There was strong agreement that the nascency of the hydrogen economy was the key risk that H2P faces. This was also noted in the context of Question Three with respondents disagreeing 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. Respondents cited nascency of hydrogen technology and infrastructure as a barrier to all H2P plants coming forward as opposed to just higher CAPEX-intensive plants.

There was some disagreement that H2P is subject to FOAK risk. However, the majority of respondents agreed with our position that FOAK risk is a key risk for H2P.

The response from industry agreeing with our understanding of the key risks faced by H2P, namely FOAK and cross-chain risk, will help inform how best a market intervention and business model is designed. The rationale for H2P market intervention is discussed in more detail below.

Many other risks were identified by industry, highlighting the regulatory and non-regulatory challenges that faces H2P deployment at scale. We are working across government and with regulatory bodies to review and address this. Industry must also play a role here with many respondents stating that the responsibility for technical development and R&D clearly sit with industry. However, government and industry will need to collaborate effectively to tackle many of the risks faced by H2P. We will shortly be commissioning external research to update our evidence base on the costs of different H2P technologies and plant types to help inform the design of the business model. Alongside this, we are setting up an H2P Expert Working Group to formalise this process. If you interested in joining, please contact hydrogenpower@energysecurity.gov.uk to register your interest.

2.4 Chapter Two: Rationale for Hydrogen to Power Market Intervention

Consultation position

Government considered the existing policy levers available to address the identified barriers to H2P deployment. It was acknowledged that barriers such as cross chain risks create uncertainty for developers and the risk of fuel availability is more pronounced during the early phase of the hydrogen network where H2P developers will need to access hydrogen fuel from a limited number of producers. Analysis indicated that bespoke H2P market intervention could reduce these risks in the event of challenges to the network which impact fuel and infrastructure. This could reduce investment risk in the short term and enable H2P plants to deploy sooner.

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.

Summary of responses

Question Nine received 40 responses. A large majority of respondents (37) agreed with our assessment that a bespoke hydrogen power market intervention would be required to mitigate the identified development barriers and accelerate the deployment of H2P plants.

The other three respondents disagreed with the assessment. One of these respondents believed that the current CM could be adequately reformed to enable the effective deployment of H2P. Another of these respondents believed that they had found an (undisclosed) alternative option, whilst the third respondent suggested that using blue hydrogen in natural gas power stations would be a relatively cheap way to introduce H2P and one that would not require additional government support.

Of the respondents that agreed with the statement, the principal barrier discussed was the cross-chain risk associated with a nascent hydrogen economy, as described in Question Six. Nine respondents stated that uncertainty regarding hydrogen fuel availability was a key consideration for why bespoke market intervention would be required, whilst seven respondents cited nascent infrastructure and associated cross chain risks more generally. Three respondents highlighted the high CAPEX costs of H2P plants as a key barrier whilst two noted the need to increase investor confidence, particularly since H2P is a first of a kind technology. Two respondents also discussed the impact on the current CM if H2P were to be introduced without bespoke market intervention.

Eight respondents explained that, although they agree that bespoke market intervention is required for high CAPEX plants, they also believe this to be the case for lower CAPEX plants. They note that both types of plants face many of the same barriers to deployment, including

cross chain risks and the nascent nature of the hydrogen economy. Two respondents stated that they would like to see support for plants which use blended fuel (natural gas and hydrogen), as well as 100% hydrogen-fuelled plants. One respondent expressed that, whilst the government had not accurately identified all the barriers to entry for H2P, they nonetheless supported the need for bespoke market intervention.

Government response

Informed by the findings of our external analysis, government presented its minded-to position that market intervention could be required to mitigate the identified development barriers and accelerate the deployment of H2P.

The overwhelming majority of respondents agreed with our assessment and, as such, government will pursue its proposal to introduce a bespoke market intervention and will implement a H2P BM. The rationale for this specific market intervention option is set in Chapters Two and Three of this document.

Government suggested that market intervention may be most necessary for plants with high CAPEX profiles. However, we acknowledge that several respondents had concerns with this assessment, with respondents contending that lower CAPEX plants would still face the barriers associated with cross chain risks and nascent critical infrastructure.

In Chapter One of this document, we outlined our initial approach to the H2P BM design. We will consider further the eligibility of potential H2P plants in accessing the H2P BM and how this can support effective deployment of H2P to support power sector decarbonisation and security of supply.

2.5 Chapter Three: Approach to Assessing Market Intervention Options

Consultation position

In Chapter Three of the consultation, government outlined it's assessment of the options for bespoke H2P market intervention, alongside our methodology for undertaking this assessment. Analysis by LCP Delta and Frontier Economics narrowed down a list of 15 market intervention options to six potential models. This included the CM, a Split CM with a separate auction for low carbon dispatchable power technologies, a Deemed Generation Contract for Difference (CfD), a DPA style mechanism, a Revenue Cap and Floor, and an unabated Fossil Fuel Ban.

These mechanisms were then assessed against four key criteria derived from the government's ongoing Review of Electricity Market Arrangements, -power CCUS business model development, and the UK Hydrogen Strategy. To ensure consistency across government to assess options according to their merits, the following criteria was adopted: effectiveness, investability, cost effectiveness, and strategic fit and deliverability. After assessing each of the six options, three were initially shortlisted as potential bespoke H2P market intervention options, namely a Split CM, a DPA-style mechanism and a Revenue Cap

and Floor. The Capacity Market option was not shortlisted due to the significant inframarginal rents and reduced value for money it would incur for consumers. However, we still see a role for the CM for enabling deployment of certain H2P plants in the medium-term, see [chapter 1.4] for further details around this. The Deemed Generation CfD was not shortlisted due to the complexity and risks it poses for developers of a FOAK technology and the limited investability the model provides. Finally, the Unabated Fossil Fuel Ban was not shortlisted as it would not support investability or mitigate against the investor risk, and it would increase costs to society.

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.

Summary of responses

Question Ten received 33 responses. The majority of respondents (27) agreed that we had considered all credible market intervention options for hydrogen to power. Only four respondents disagreed with this position, with a further two respondents stating they were unsure.

Of the four respondents who disagreed with the statement, one respondent believed that their own innovation should be included within the list. A second respondent urged for further consideration of a revised CM and a third stated that they would like to see a simpler mechanism than the ones that we had considered. The fourth respondent suggested that a Capacity Remuneration Mechanism which targets low carbon flexibility for adequacy, should be explored (in addition or instead of Split CM based on low carbon attributes only) with the respondent preferring a Reliability Option. Those respondents who were unsure believed that they needed further information to make a definitive assessment. Three respondents cited insufficient analysis, modelling, or engagement as barriers to forming a clear conclusion.

Despite broad agreement that government had considered the most credible forms of market intervention, several respondents suggested other options. Most notably, seven respondents suggested that further analysis into the impact of stronger carbon pricing would be beneficial, citing the fact that CO_2 emissions are the principal driver for exploring hydrogen. Some respondents suggested that stronger carbon pricing would reduce the need for government intervention across a range of sectors.

Question Eleven received 28 responses. The vast majority of respondents agreed that government had shortlisted the correct three market intervention design options with 27 out of 28 respondents supporting this position. One of these respondents noted that, although they broadly agreed with the shortlist presented, a CfD option should also be considered amongst these options. Respondents generally did not elaborate on their rationale for supporting the proposed shortlist of options, although some expressed some preferences for a specific model included in the list.

The one respondent who did not support the position that government has shortlisted the correct three options for market intervention suggested that a Split CM should be discounted from the shortlist. This respondent expressed the view that liquidity in the CM is already limited and that pursuing a Split CM to support the deployment of H2P would exacerbate this issue and damage investor confidence.

Government response

The majority of respondents agreed that the government has correctly identified all credible forms of market intervention to support the deployment of H2P. The majority of respondents also agreed that government has accurately shortlisted the three best market intervention options, namely a dispatchable power agreement, a Split CM and a Revenue cap and floor. This feedback supports our position that intervention will be required for H2P and that the most credible forms that this could take have been explored. While noting that one respondent suggested a CfD, based on the current renewables CfD scheme, should be considered further, external analysis has indicated that this would not be suitable for H2P, since the changing levels of support offered creates additional risks for dispatchable power operators.

We recognise the importance of carbon pricing, through the UK's ETS, in providing an incentive to decarbonise. We expect that carbon pricing will also play a role in increasing the competitiveness of alternatives to unabated gas. Government has set the ETS cap to be consistent with delivery of net zero, and recently published an auction calendar for 2024 to reflect this cap[22]. We acknowledge that H2P policy intervention will need to be supported by carbon pricing to drive forward the investment case for low carbon gas generation.

We recognise the interest by one stakeholder in considering Reliability Options (RO) to support an alternative market-wide Capacity Remuneration Mechanism which could support H2P. These ideas have been explored in the Review of the Electricity Market Arrangements (REMA) consultations, including both Centralised and Decentralised Reliability Options. The summary of responses to the first REMA consultation[23] confirm that these options will not be taken forwards for consideration as alternative capacity mechanisms. This is primarily due to concerns that an RO would not support the scale of investment required to ensure security of supply is maintained in a renewables-based system and any potential benefits would not outweigh the level of market disruption caused by moving to a new system. In addition, REMA's assessment found that the CM is a well-established and proven mechanism, which continues to deliver against its security of supply objectives.

The second REMA consultation explored retaining the CM but optimising the design by introducing a minimum procurement target ('minima') as an enduring mechanism for supporting investment and deployment of low carbon flexible technologies (such as H2P). This would introduce changes to the auction design to ensure the CM procures the optimal

[22] DESNZ, 2024, UK Emissions Trading Scheme markets policy paper. Available at: https://www.gov.uk/government/publications/uk-emissions-trading-scheme-markets/uk-emissions-trading-schememarkets

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

technology mix to support all future needs of a clean electricity system by better reflecting the role and value of low carbon flexible technologies.

2.6 Chapter Four: Market Intervention Options – Dispatchable Power Agreement

Consultation position

In Chapter Four of the consultation, government outlined our detailed assessment of the three shortlisted options (DPA-stye mechanism, Split CM and Revenue Cap and Floor). Following this assessment, it was concluded that a DPA-stye mechanism could be the most suitable option to facilitate and accelerate the deployment of H2P.

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.

Summary of responses:

Question Twelve received 26 responses, either from direct responses to the question or from respondents referring to their previous answers in lieu of a direct response. Of those that responded to the question, there was strong support for the assessment presented in the consultation with many respondents agreeing that government had accurately identified the risks and benefits of a DPA style agreement.

However, some respondents who generally agreed with the risks and benefits identified in the consultation nonetheless felt that the document didn't capture all of them and suggested some additional benefits and risks to consider. An additional benefit of the DPA-style option, highlighted by three respondents, was the simplicity achieved by aligning the design of a potential H2P BM with the existing power CCUS DPA. Some respondents also noted the potential value for money and associated reputational damage risk for government, if plants receive subsidies for being available, regardless of whether these plants generate in an optimal way for the power system.

Two respondents requested more clarity on the role of H2P before being able to commit to a view on the benefits and risks of a DPA style mechanism. Two other respondents felt that the bilateral nature of DPA contracts makes them too opaque. One respondent was unconvinced

about how a DPA could mitigate the fuel supply risks that a H2P plant would face whilst another expressed concern about the NOx emissions associated with hydrogen combustion. Some respondents cited the limited, nascent nature of the UK's hydrogen supply chains as a key risk which could result in increased costs for a business model.

Question 13 received 37 responses. Of those who responded 31 agreed with the government's assessment that a mechanism based on the DPA, bespoke to H2P, is the most suitable option for market intervention. 11 of these respondents described a bespoke DPA as an effective mechanism for de-risking investment in H2P by reducing cross-chain risks which may adversely impact deployment, thereby increasing investor confidence in the technology and resulting in more rapid deployment. Four respondents praised the relative simplicity of such a mechanism, which they felt could be introduced faster than other options and would allow for flexible support which is better able to bring forward a FOAK technology. Of those who responded, seven highlighted the ability of a DPA to gradually fall away, allowing H2P to compete in existing markets when established as a key reason for their support of the governments assessment.

Three respondents disputed government's assessment that a DPA bespoke for H2P was the most optimal market intervention, preferring other approaches like a more integrated business model which subsidised hydrogen production, storage, and power collectively. One respondent felt that a bespoke mechanism wasn't required for H2P and that any design should be based on the existing Capacity Market intervention. Another respondent felt that more clarity on how any bespoke H2P market intervention would interact with existing hydrogen business models was needed before they were able to endorse the government's assessment.

Question 14 received 30 responses. 15 respondents were unsure if a variable payment should be included in a bespoke H2P BM. Some respondents felt that more analysis on how such a payment would work in practice, and the form it would take, was needed before offering a view on whether it should be included. Likewise, they felt more clarity was needed on H2P's role within the market and position in the merit order before responding definitively.

Of those who responded, twelve felt that a variable payment should be included in any H2P market intervention. Five respondents referred to the high cost of hydrogen relative to natural gas when explaining why a variable payment may be needed. Some stated that including a variable payment would help de-risk investment in H2P even further, sending strong positive signals to potential investors. Nine respondents stated that a variable payment would be required to improve H2Ps position in the merit order if government wishes for it to dispatch ahead of high carbon unabated gas. Three respondents felt that a variable payment would provide additional flexibility in the design of our market intervention. Two respondents focused on interactions with the power CCUS DPA, believing that a variable payment within a H2P BM is necessary to provide parity with the CCUS DPA which does include this payment.

Three respondents were explicitly unsupportive of including a variable payment within the design of a H2P BM. Alongside those respondents who were unsure, seven in total agreed with the government's assessment that a variable payment could potentially cause market distortions. One respondent noted that a variable payment could artificially impact the merit

order and another respondent highlighted the risk that it could encourage H2P dispatch beyond what is economically efficient. A couple of respondents argued that a variable payment would complicate the overall mechanism, with one noting that the lack of a reference plant for H2P exacerbates this complication. These respondents also stated that the majority of any intervention should be weighted towards an availability payment.

Government response

Government notes the strong agreement from respondents that it has accurately identified the risks and benefits of a DPA-style mechanism and that this mechanism is most suitable to support the deployment of H2P.

There is a majority consensus between respondents and government that this is the most appropriate mechanism for a market intervention to support H2P in the short to medium term since it offers greater potential to manage cross-chain risks compared to other shortlisted mechanisms and can better manage early market liquidity challenges.

As such, government will proceed with a bespoke DPA-style mechanism for the H2P BM, based on power CCUS DPA.

Government recognises the differing views on a potential need for a variable payment within any bespoke H2P BM. We will continue to conduct our own analysis, while taking account of views given within the consultation to resolve this question. Details on specific design elements of any H2P market intervention will be developed through continued extensive engagement with industry and presented in due course. Further detail on the role of H2P and design elements of any H2P DPA can be found in Chapter One of this document. We will continue to develop the H2P BM alongside other hydrogen business models to understand how government can best mitigate cross-chain risks for H2P.

We are working closely with colleagues across government and industry to better understand risks and potential mitigations for NOx emissions that may result from the burning of hydrogen.

2.7 Chapter Four: Market Intervention Options – Split Capacity Market

Consultation position

The Split CM option market intervention design was an option that involved dividing the current CM into two auctions that would be treated independent of each other for capacity with different characteristics. Eligibility for a particular split would be determined for each technology type and the characteristics they provide – in practise this would create one auction for low carbon flexible technologies and one auction for all other technologies. 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.

Whilst analysis showed that there are benefits to a Split CM, this model 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 and, as a security of supply mechanism, would likely retain non-delivery penalties. A Split CM may also be less suited to managing liquidity challenges with limited H2P plants potentially competing in the short term, and H2P plants could struggle to compete against cheaper low carbon alternatives. As such, government discounted this option in favour of a DPA which is better suited to manage the aforementioned risks.

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.

Summary of responses:

Question 15 received 30 responses. Most respondents (21) agreed that the consultation accurately identified the benefits and risks of a Split CM. Most respondents did not expand on their reasoning for agreeing with the government's assessment. However, some respondents highlighted the risk of high clearing prices driving inframarginal rents.

Those who disagreed with government's assessment tended to express the view that there were further risks and benefits which had been overlooked. Generally, these respondents were not disagreeing with the risks and benefits presented in the consultation, rather they felt that this list was not complete or exhaustive. Several respondents suggested that ensuring an adequate supply of dispatchable power throughout the system would be a further risk of the Split CM. Other proposed risks included: the potential for issues arising from a lack of budget and revenue certainty, as this would be dependent on the outturn of the bidding process; the difficulty of unwinding a Split CM once it had been instated; and the potential for government to underfund the industry. One respondent raised a question about the purpose of the CM and whether it should be a decarbonisation mechanism, arguing that this may dilute its primary objective as a security of supply mechanism.

Three respondents challenged government's assessment of the risks and benefits associated with a Split CM option to support the deployment of H2P, suggesting that government had overstated some of the risks or benefits of the Split CM. One respondent expanded on this view to suggest that the risk of inframarginal rents could be reduced by greater specifying the technology classes eligible to access the scheme.

Question 16 received 32 responses. The majority of respondents (27) agreed with our proposal to discount the Split CM as an option for the bespoke H2P market intervention. Six respondents disagreed with our proposal to discount the Split CM as the preferred mode of

market intervention. The remaining respondents did not express a definitively positive or negative view of this proposal.

Respondents provided a wide range of reasons for supporting the proposal to discount the Split CM model as an option for a H2P market intervention. This included concerns about non-delivery penalties, cross chain risks, high CM clearing prices, high consumer costs, less business certainty, less flexibility, and the potential adverse impact on other technologies.

Some respondents who agreed with government's proposal to discount the Split CM option proposed suggestions or caveats in their responses. For example, one respondent suggested that a Split CM should only be discarded as an option provided that a dispatchable power agreement would support blended plants. One respondent suggested that a Split CM should be explored outside of H2P. Whilst three respondents stated that they agreed a Split CM scheme for H2P should be discarded as a bespoke short-term intervention, they nonetheless saw potential for a Split CM as a long-term mechanism to support H2P.

Of those that disagreed, one respondent suggested that government should design a Split CM that could better address these risks rather than discarding the option altogether.

Government response

In the H2P consultation, government assessed that a Split CM would not be the most appropriate form of market intervention for H2P and as such should be discounted. Most respondents agreed that government had accurately assessed the risks and benefits of a Split CM, with some respondents suggesting additional risks which should be considered. The vast majority of respondents agreed that this option should be discarded.

As such, government will formally discard the Split CM as a potential mechanism for the bespoke H2P market intervention.

However, REMA is continuing to explore options for reforming the CM, such as an Optimised CM, which could provide the long-term support route for H2P once FOAK barriers have reduced and H2P is able to transition from bespoke support to an enduring mechanism.

2.8 Chapter Four: Market Intervention Options – Revenue Cap and Floor

Consultation position

A Revenue Cap and Floor was designed as a potential market-based approach to incentivise developers to deliver capacity by limiting their exposure to electricity market price risk. This intervention design aimed to provide increased certainty on the revenue received by the H2P investor, within a defined range. The operator would receive market revenue and, if this market revenue is below a minimum (floor), then the operator would receive a top-up support payment to the level of the floor at the end of a defined reconciliation period. Similarly, if market revenue were to be above a cap, earnings would be returned in whole or in part to customers.

Analysis indicated that a revenue cap and floor is unlikely to be suitable for H2P. This was largely due to 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 would have disincentivised dispatch.

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.

Summary of responses

Question 17 received 28 responses. 24 respondents agreed that the government had accurately identified the benefits and risks of a Revenue Cap and Floor option. Six respondents specifically agreed with the view that a Revenue Cap and Floor option could disincentivise dispatch of, and investment in, H2P, with some agreeing that it would not be a cost effective or efficient option to pursue. Two respondents also noted that a Revenue Cap and Floor option wouldn't appropriately address the risks and barriers faced by H2P, identified in the consultation, which would need to be overcome to ensure accelerated deployment.

However, three respondents disagreed with the view that government had accurately identified all the key risks and benefits of a Revenue Cap and Floor, noting that there were some benefits to a Revenue Cap and Floor option which were not captured in the consultation. For example, one respondent noted that this option could increase investor confidence in the technology, while another stated that, contrary to the government's assessment, if implemented, this option wouldn't disincentivise H2P's dispatch. Another respondent highlighted revenue certainty and industry familiarity with the model of intervention as other benefits of a Revenue Cap and Floor model which was not captured in the government's assessment.

Question 18 received 29 responses with 27 respondents agreeing that the government should discount the Revenue Cap and Floor as an option for bespoke hydrogen to power market intervention. There was also strong agreement with government's rationale for discounting the option as presented in the consultation. Five respondents noted that this option could distort dispatch and five stated that it would not provide the required financial stability and certainty to attract investment and accelerate the deployment of H2P. One respondent supported discounting the Revenue Cap and Floor option because they did not believe any bespoke support to be necessary for H2P.

One respondent disagreed with discounting the Revenue Cap and Floor option entirely, believing it to be a better option than other options considered, specifically the Split CM option. However, they still expressed a preference for a DPA-style mechanism for H2P above a Revenue Cap and Floor-style intervention as things stand.

Government response:

Government welcomes the feedback from respondents to Questions 17 and 18. Government notes that the majority of respondents agreed with the government's assessment of the benefits and risks of a Revenue Cap and Floor option, including that it could disincentivise dispatch of H2P and reduce investor confidence in the technology. Government also notes that the majority of respondents agreed with government's proposal to discount this option for the bespoke H2P market intervention.

We will formally discount the Revenue Cap and Floor option as a potential mechanism for H2P market intervention.

2.9 Chapter Five: Market Intervention Value, Alignment, and Interactions

Consultation position

In Chapter Five, government presented the value of introducing a market intervention to support H2P and described our approach to aligning with other schemes, including with the Review of Electricity Market Arrangements (REMA) programme. The key value of introducing a market intervention would be to de-risk and incentivise investment in H2P thereby bringing forward capacity at an accelerated rate, relative to there not being intervention in place.

The market intervention is not intended to be a long-term, enduring solution for low carbon flexibility support and therefore we would aim to develop a competitive route to market for H2P. 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 brings forward, we would work closely with REMA to develop criteria for assessing when H2P technology and market conditions are suitable for transitioning to a multi-technology competition. 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. It may be possible to compete low carbon electricity generation technology projects within or between DPA and DPA-style frameworks.

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.

Summary of responses:

Question 19 sought views on the need for price-based competitive allocation versus moving to a technology-wide competitive market. There were 30 responses to this question with respondents divided on moving to price-based competitive allocation or instead to a technology-wide competitive market (53% unsure, 47% in favour of price-based competitive allocation).

Six respondents who were unsure stated that, while they were supportive of a move to price-based competitive allocation due to cost reduction benefits in the long-term, there could be 'cost-based risks' of moving too early as the technology is currently not mature enough. Six respondents also reiterated that bespoke support is needed first and that it is too early to consider competition at least until existing barriers and risks have decreased. Three respondents suggested that there is a need to wait for FOAK risks and barriers to decrease first, highlighting challenges related to the availability and cost of infrastructure and fuel. Three respondents also stated that it was important to ensure consistency with REMA.

Three respondents who agreed with moving to price-based competitive allocation first, stated that it would help to de-risk investment in a cost-effective manner. Three respondents also outlined the importance of setting conditions and milestones for a move to price-based competitive allocation rather than setting a time limit. A few respondents also highlighted the importance of creating a level playing field with other technologies first, taking learnings from the HAR process, and potentially setting deployment targets to 2035.

Question 20 sought views on how a bespoke H2P BM should be evolved. There were 32 responses to this question, with eight respondents stating that clarity around REMA proposals were needed first and then ensuring consistency with them is critical to evolving the H2P BM. Three respondents outlined the need to maintain a whole-system perspective and the importance of working together with the NESO to ensure coordination.

Three respondents also highlighted the need to consider interactions with other hydrogen business models and the power CCUS DPA, with a further three respondents supportive of the trajectory being undertaken by power CCUS. However, five respondents said that technologies should be separated to avoid creating competition distortion, with three respondents also stating that it is too early to consider competition and that the industry needs maturing first.

Government response:

Government recognises the challenges associated with bringing forward FOAK H2P plants and is therefore looking to implement the H2P BM to facilitate the deployment of this technology. We acknowledge the feedback provided by industry regarding a transition of the bespoke support mechanism to competitive allocation, either directly or via a stepping stone – noting the challenges highlighted by respondents.

Government sees merit in developing a glide path towards competitive allocation, whilst ensuring that this transition is made at an appropriate time. We will work closely with the power CCUS team, and with the REMA programme as they continue to reform the CM. We will

ensure coordination between programmes, with alignment on competitive allocation, and that lessons learnt are implemented across the various policy areas.

2.10 Chapter Five: Hydrogen Support Mechanisms Interaction

Consultation position

Government outlined the interactions between a H2P BM and the four hydrogen support mechanisms: the Net Zero Hydrogen Fund (NZHF), the Hydrogen Production Business Model (HPBM), the Hydrogen Storage Business Model (HSBM), and the Hydrogen Transport Business Model (HTBM). The chapter discussed the commercial arrangements which might be needed to facilitate storing HPBM-subsidised hydrogen in grid scale stores and noted the need to account for a future gas market design in determining these arrangements.

As set out in the consultation, coordination and planning in the early years of the hydrogen economy would be vital to reduce cross-chain risk and accelerate deployment. However, the cross-chain risk between a power plant and the rest of the chain would not be entirely eliminated through co-ordinated planning, since infrastructure could still be subject to construction delays and unexpected outages. In pursuing a bespoke H2P BM, coordination would be put at the centre of the business model's development.

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.

Summary of responses:

Question 21 received 36 responses (of which four respondents cited their answers to previous questions in lieu of a new response). Of those that responded directly to the question, 22 respondents specifically highlighted the alignment and coordination of business model subsidies across the hydrogen value chain as being a critical, high priority issue for the effective deployment of hydrogen to power in their responses. Eleven respondents explicitly highlighted the risk that hydrogen value chain infrastructure may not come forward in the right places, at the right time, and or at the right capacity to support the effective deployment of hydrogen to power.

Five respondents stated their support for the government's approach to coordination and alignment across hydrogen subsidies, as set out in the consultation. However, four respondents noted that they felt government should be doing more to strategically cohere and align support across the hydrogen value chain. Two respondents felt that the hydrogen subsidy programme is too siloed, ad-hoc and disjointed. Four respondents also highlighted the risk of creating market distortions through the stacking of various hydrogen subsidies. This included the risk of over-subsidising the price of hydrogen and thereby over-incentivising the dispatch of H2P plants, to the detriment of other technologies in the power sector and other end users' ability to access hydrogen as a fuel.

Respondents proposed a range of solutions that government could consider to mitigate risks relating to the alignment of various hydrogen support mechanisms and policies. Four respondents highlighted the option to support plants using blended fuel (natural gas and hydrogen) in the short term or 'build to convert' gas to hydrogen power plants. This would be a transitionary phase before the switch to 100% hydrogen-fuelled power generation, once the hydrogen economy was sufficiently mature and the fuel supply risk sufficiently low. Four respondents suggested that the government initially cluster hydrogen infrastructure together geographically, or that government consider location as a strategic factor in allocating contracts to projects. This could help to ensure a locationally coherent supply and demand picture, and de-risk investment.

Alternatively, three respondents recommended that the Hydrogen Production Business Model (HPBM) position on Risk-Taking Intermediaries (RTIs) be reviewed. They expressed the view that reviewing the decision to exclude RTIs as an eligible off-taker for subsidised hydrogen could help to reduce the fuel supply risk for H2P. Two respondents highlighted the option to set clear targets (short-, medium- and long-term) for each aspect of the hydrogen value chain infrastructure including storage and transportation. This could provide more clarity on future capacity, associated lead times, and stimulate investment in hydrogen more effectively. Two respondents expressed the view that HPBM design should be reviewed because it encourages hydrogen producers to produce hydrogen whenever they are able to, rather than in a deliberately intermittent fashion, which may not align with a 'peaky' hydrogen to power demand profile.

Government response

Government acknowledges that the alignment and co-ordination of business models is a critical issue for the developing hydrogen economy and will continue to focus on this as a principal risk as it refines the design of the H2P BM.

Government notes that some industry members support the approach taken by the government so far whilst some wish for the government to do more to strategically cohere and align the business models. Government notes industry concerns that hydrogen value chain infrastructure may not come forward in the right places, at the right time or capacity, and that the proposed collection of subsidy mechanisms could create market distortions. Government will continue to take these risks into consideration as it refines the design of subsidy mechanisms.

Government acknowledges the views expressed by some about the usefulness of blending projects, RTIs, setting targets for each aspect of the value chain, and clustering subsidies for hydrogen infrastructure together, to mitigate subsidy alignment risks. Government will evaluate the risks and benefits of the suggestions made and set out its view on these issues, as well as on aligning business models overall, in further market engagement exercises before the design of the H2P BM is finalised.

2.11 Chapter Five: Future Hydrogen Markets & Commercial Storage Arrangements

Consultation position

Government outlined that a liquid market of hydrogen which can be bought in advance and at short notice, if required, is an ideal end state for the hydrogen economy. However, government also acknowledged that this will not materialise in the short-term and that 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.

The consultation also reiterated the government's position on excluding Risk-Taking Intermediaries (RTIs) from purchasing hydrogen subsidised by the HPBM. This is to ensure that, at this early stage of the hydrogen economy, the HPBM subsidy will provide value for money, though government will review the HPBM position on RTIs in the future. The consultation clarified that government would not be seeking to exclude all 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 should not take ownership of the hydrogen sold by a hydrogen producer in order to avoid being classified as a risk-taking intermediary.

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)?

Summary of responses:

Question 22 received 25 responses. Of those responses, ten respondents specifically underlined the critical role that storage will play in the deployment of hydrogen to power. Seven respondents reiterated the view that this infrastructure required its own bespoke intervention i.e. the Hydrogen Storage Business Model (HSBM) to support the deployment of these facilities.

Regarding the challenges of facilitating the volumes of hydrogen storage needed, three respondents expressed the view that other types of hydrogen storage (for example tank storage or hydrogen carriers like ammonia or metal hydrides) should be considered within the scope of the HSBM. They contended that this may improve the feasibility of hydrogen storage deployment. Three respondents also recommended that Risk-Taking Intermediaries should be supported within the scope of the Hydrogen Production Business Model (HPBM) to make the process of trading, storing, and supplying hydrogen fuel for power plants more efficient.

Other suggestions were made about how the government could improve the feasibility of industry facilitating storage capacity for hydrogen to power. Three respondents noted that they felt government should do more to make clear which party was responsible for which costs and risks in the value chain as part of various subsidy mechanisms, including the commercial risk on the value of any stored hydrogen. These respondents noted that there were various risks associated with constructing and operating a hydrogen storage facility and that if these risks are properly assigned and understood across the value chain, then the market will be able to source finance and invest accordingly. The principal costs/risks were described as a) the capex cost of the hydrogen storage facility, b) the OPEX cost of running the hydrogen facility, c) the cost of the cushion hydrogen gas, d) the cost of the hydrogen inventory and e) the cost of risk on the value of the hydrogen stored.

Regarding the commercial feasibility of facilitating storage capacity in general, two respondents advised that the risks associated with securing storage capacity was largely dependent on the nature of the agreement between producer and offtaker, and the firmness and flexibility of this fuel supply contract. One respondent noted that H2P is likely to require more flexibility in its purchase and use of fuel and may therefore have to accept a higher price for this. Another respondent suggested that the easiest commercial model was for the H2P plant to also own their own storage facility and hydrogen. However, another respondent expressed the view that H2P plants were unlikely to be able to afford to own and operate their own hydrogen store. One respondent remarked that generators don't necessarily have the required capabilities to navigate storing their own fuel, from a commercial standpoint, with a further respondent noting that a third party will be needed for balancing supply and demand across the system. Two respondents suggested that a single integrated business model across production, storage, transportation, and power may be a more effective method for optimising the supply and demand of hydrogen.

On the practical deployment of hydrogen storage facilities, three respondents expressed the view that it was likely H2P plants would need to be co-located with a hydrogen storage facility. This was caveated by a few of these respondents who noted that this was their expectation unless the storage facility was particularly capacious. They also noted that the location of hydrogen storage facilities may not be aligned with the best location for power plants, according to the demand for their power and grid design.

Question 23 received 29 responses in total. On the one hand 14 highlighted the important role that Risk-Taking Intermediaries (RTIs) play in a market, helping to derisk investment and manage liquidity. These responses generally favoured RTIs playing a role in the hydrogen economy and underlined the risks associated with excluding them from the market. These risks included that the hydrogen market may develop more slowly and in a distorted fashion due to the complexities and inefficiencies created. However, there was some ambiguity from respondents about at what stage and in what capacity they expected RTIs to play a role in the hydrogen market from its early nascent stages to full maturity.

On the other hand, seven respondents noted that, even if RTIs are likely to play an important role in the hydrogen market in the medium- and long- term, it is possible to develop the

necessary bilateral commercial arrangements between hydrogen producers, storage providers, and H2P generators, to facilitate the deployment of this infrastructure in the short-term.

Three respondents provided suggestions for measures which could help to mitigate concerns around the introduction of RTIs. This included, but was not limited to, a) only offering a carve-out measure in the RTI rule for H2P, b) setting a cap on the overall number or proportion of RTIs, c) setting limits on RTIs being able to sell the hydrogen outside of the UK, d) limiting companies who have a HPBM contract also part-owning any RTI operations and e) introducing thorough book-keeping. Three respondents suggested that an integrated business model with a single application and allocation process across production, storage, transportation, and H2P could help to manage risks relating to the exclusion of RTIs as a qualifying offtaker.

Government response

Question 22: Government acknowledges the critical role that hydrogen storage will play in the deployment of H2P and the need for a bespoke business model to support this. Through the HSBM, government has already committed to support hydrogen storage projects to become operational at the earliest opportunity via a targeted market intervention.

Government acknowledges the range of suggestions from industry about how the hydrogen storage volume needed for H2P could best be facilitated. Government will evaluate the suggestions made about how to support the deployment of the required storage capacity.

Government also notes the desire for more clarity on the commercial arrangements across all the business models - where various risks and responsibilities relating to storage may sit between producer, storage operator, and off-taker. Government will continue to provide further clarity on these issues as the design of respective business models evolves, and in further market engagement exercises before these designs are finalised.

Question 23: Government acknowledges concerns raised by some stakeholders about the challenges and risks posed by the current HPBM position that sales of hydrogen to RTIs are ineligible for subsidy.

However, the government also acknowledges that some parties feel it is possible, in the earliest stages of deploying H2P, for this to be achieved through bilateral contracts between producers, storage operators, transporters and H2P generators. As set out in the consultation, non-risk-taking intermediaries 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.

Government's current view is that the HPBM position on RTIs reflects the present nascency of the hydrogen market, with limited production and demand. RTIs would also make it more challenging to monitor the use of hydrogen subsidised through the business model and to enforce the contractual measures regarding restricted and non-qualifying end users. Though government recognises the potential contribution of RTIs in a well-functioning market, government does not consider that allowing such entities to directly benefit from subsidy would represent value for money in the early hydrogen economy.

There are a range of policy options available, and government will review the HPBM position on RTIs in the future. This will take into account the risks for deploying H2P in the short term (in relation to any initial application window) as well as any future allocation rounds. Government will set out its view on this issue in forthcoming market engagement exercises before the H2P BM design is completed.

More broadly, in keeping with the commitment made in the response to the 2022 consultation on hydrogen transport and storage business models[24], we are keeping the hydrogen market framework under review with a view to introducing timely amendments where they are warranted. We are working with industry to consider the roles and responsibilities of market participants in the hydrogen economy as it is expected to evolve (including RTIs).

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

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

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