Department for Energy Security & Net Zero

Price-based competitive allocation for low carbon hydrogen production

Summary of responses to the Call for Evidence

December 2023

Any enquiries regarding this publication should be sent to us at:
h2.competitiveallocation@beis.gov.uk

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Introduction

In the British Energy Security Strategy (2022)[1], government set out an ambition to hold annual electrolytic hydrogen allocation rounds, moving to price-based competitive allocation by 2025 as soon as legislation and market conditions allow. To inform the move to price-based competitive allocation, the Department for Energy Security and Net Zero (DESNZ) launched a Call for Evidence[2] on the future policy framework for the allocation of the Hydrogen Production Business Model (HPBM). The purpose of the Call for Evidence was to gather evidence to understand more about:

- market conditions needed for the UK to transition to price-based competitive allocation;
- the extent that price-based competitive allocation could incentivise projects to support broader outcomes beyond cost reduction of low carbon hydrogen production; and
- how price-based competitive allocation rounds should be designed.

The Call for Evidence was launched on 17 May 2023 and closed on 11 August 2023 with a total of 42 responses received from a range of stakeholders.

This document acts as a summary of the responses we received to the Call for Evidence. Alongside our wider research and the international context, the evidence and views provided in the Call for Evidence submissions have been used to inform the development of the future policy framework for the Hydrogen Allocation Rounds (HARs)[3], through which the HPBM is allocated. The Hydrogen Production Delivery Roadmap[4], which was published alongside this document, sets out government's plans for future allocation rounds of the HPBM for electrolytic and potentially other alternative technologies.[5]

This document is part of a wider package of policy documents on hydrogen published in conjunction with the Hydrogen Strategy Delivery Update:

- Hydrogen Production Delivery Roadmap
- Hydrogen Transport & Storage Networks Pathway
- Hydrogen Transport and & Storage Business Model Market Engagement Documents
- Hydrogen to Power: Consultation on the Need, and Design, for a Hydrogen to Power Business Model

[1] https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy
[2] https://www.gov.uk/government/calls-for-evidence/price-based-competitive-allocation-for-low-carbon-hydrogen-call-for-evidence
[3] Allocation rounds for the HPBM are abbreviated HAR followed by the number of the round, i.e HAR1 for the first HPBM allocation round etc.
[4] https://www.gov.uk/government/publications/hydrogen-production-delivery-roadmap
[5] As outlined in the Call for Evidence, CCUS enabled production technologies are expected to continue to be allocated support as part of the Cluster Sequencing Process.

Breakdown by type

The following table provides a breakdown of the respondents to the Call for Evidence by type.

Type of respondent	Number
Developers	22
Industry bodies	8
Supply chain/developers	2
Investor/fund managers	2
Universities, research and innovation bodies	2
Devolved administration	1
Energy system participant	1
Local government	1
Other government Department	1
Public body	1
Supply chain	1
Total	**42**

Methodology

This document summarises the information and views provided in response to each question in the Call for Evidence. There were 21 questions in total, set out across 3 chapters. Some notes and caveats on the methodology of this document are provided below:

- A number of respondents provided a general submission and did not respond to individual questions. Evidence from these submissions was included in the summary of responses to specific questions where the information was deemed to be relevant.

- Numeric categories are used to give an indication of the number of respondents that expressed certain views. These categories relate to the proportion of respondents who answered a given question, rather than the proportion of total respondents to the Call for Evidence.
    - ‘Majority’ is used when referring to more than 50 percent of respondents to a particular question.
    - ‘Many’ is used when referring to 25-50 percent of respondents to a particular question.
    - ‘Several’ is used when referring to 10-25 percent of respondents to a particular question.
    - ‘A few’ or ‘a small number’ are used when referring to <10 percent of respondents to a particular question.
- The summaries aim to provide an accurate sense of the weight of views. Nevertheless, this should be treated as a guide, given the open nature of the questions and the large number of varied suggestions we received.
- It is not practicable in this document to detail every single viewpoint or piece of evidence provided. However, all submissions have been reviewed and considered by government in full.
- The views expressed by stakeholders are not government policy, and the information provided by respondents has not been corroborated or independently verified during the production of this document.

Chapter 1: Government positions and the Call for Evidence

Firstly, DESNZ would like to thank all the organisations who took the time to respond to the Call for Evidence. The submissions we received have been valuable in informing the future policy framework for the allocation of the HPBM.

You can see details of our policy decisions on future allocations rounds on pages 15-19 of the Hydrogen Production Delivery Roadmap.

Chapter 2: Consideration of objectives for future price-based competitive allocation rounds

This chapter sought evidence and views from industry regarding the following proposed primary objectives that could underpin competitive allocation rounds:

- Cost reduction – Drive down the cost of low carbon hydrogen production between each allocation round.
- Deployment at scale – Enable deployment at scale of low carbon hydrogen production capacity in the UK to meet government ambitions and net zero targets.

We also sought to understand from industry the extent to which the allocation process could be designed to incentivise projects to support a range of potential broader outcomes, such as:

- Harnessing electricity system benefits – To ensure that electrolytic hydrogen producers play a positive role in the functioning of the wider electricity system.
- Economic benefits and supply chain development – The contribution the hydrogen plant will make to the development of hydrogen supply chains and the wider economy.
- Security of supply of hydrogen – To ensure a continuous supply of hydrogen is available for end users from a diverse range of technologies.

Overarching:

1. What should be the strategic objectives of future hydrogen allocation rounds beyond HAR2? Do you agree with the descriptions of the primary objectives and broader outcomes as set out in Chapter 2?

Number of responses: 38

Summary of responses:

The majority of respondents were in support of the primary objectives, there was slightly less support for the broader outcomes which many respondents were in support of. A few respondents noted the potential for tension between the primary objectives and broader outcomes, highlighting the need for government to consider trade-offs particularly between cost reductions and the broader outcomes. There were occasionally conflicting views from respondents on whether the primary objectives and broader outcomes could be achieved through natural growth of the hydrogen market or whether there was a need for a specific intervention.

Respondents who did not support the inclusion of the broader outcomes felt that these should be solved outside of the allocation process with their own policy specific interventions, e.g. the Review of Electricity Market Arrangements (REMA), and were sceptical about the extent the allocation process could deliver these outcomes alone without additional policy interventions. Two developers said that supporting the broader outcomes through the allocation process had the potential to create market distortions.

Primary objectives

- Deployment at scale – There was support for deployment at scale as a primary objective, but several respondents were concerned deployment at scale focused too heavily on the size of projects. Their view was deployment at scale should also mean numbers of projects, because smaller projects are seen to be able to deploy quicker, foster innovation and enable the decarbonisation of dispersed sites.
- Cost reductions – Although broadly in support of this primary objective many respondents were concerned it was too early to place so much emphasis on cost reductions and transition to price-based allocation, when the focus should be on hydrogen market development.

Broader outcomes

- Harnessing electricity system benefits – Several respondents were against using the allocation process to deliver electricity system benefits and felt that ensuring proximity to demand should be considered in the first instance. They thought that this outcome should only be supported through the allocation process when there is sufficient infrastructure to transport hydrogen to areas of demand. In contrast, several respondents thought it was important that broader electricity system benefits should be considered as part of the allocation process and complement the deployment of renewables. Three respondents indicated that additionality should be encouraged through the allocation process to ensure existing renewable energy generation is not diverted.
- Economic benefits and supply chain – Several respondents were of the view it is important to support supply chain development at this early stage of hydrogen market development whether through the allocation process or additional supply chain policy. A

few respondents felt supply chain development would be a natural outcome of hydrogen market growth and did not require a specific intervention.

- Security of supply of hydrogen – There were mixed responses on the benefits of including a separate broader outcome on security of supply and what would be needed to achieve this objective. It was felt by a few respondents that this would be resolved through hydrogen market development.

Several respondents recommended that the allocation mechanisms' main objective should be to stimulate the hydrogen market, taking into account production, demand and transport and storage. Respondents also suggested an objective which considers the whole system, including, not only electricity system benefits, but wider system benefits such as, water requirements or cost to transport the hydrogen to end users.

2. To what extent, and how, should a hydrogen allocation mechanism be designed to support the primary objectives and broader outcomes as set out in Chapter 2?

Number of responses: 38

Summary of responses:

There were mixed views on the extent to which a hydrogen allocation mechanism should be designed to support the primary objectives and broader outcomes. Several respondents felt that the objectives and broader outcomes outlined in the Call for Evidence should be the most important factors taken into consideration when designing the allocation mechanism. Others felt that the focus should be on deployment at scale and cost reductions either moving away from a focus on the broader outcomes or including them as part of an assessment of project deliverability.

Many respondents were of the view that the deliverability of projects should be a key focus of the allocation mechanism, which in turn should support deployment at scale. While there was some support for the focus on cost reductions, several respondents felt deliverability of projects was more important and that cost reductions would happen over time. Several respondents expressed the view that electricity system benefits should not be supported through the allocation mechanism, this should instead be dealt with through electricity market policy. A small number of respondents did not think the allocation mechanism should support economic benefits and supply chain development, but several respondents were of the view that it should be supported. A few respondents cited that supporting economic benefits and supply chain would in turn support hydrogen market growth. A few respondents did not think the allocation process should be designed to support security of supply as this would flow naturally from the development of a hydrogen market.

Several respondents thought the allocation mechanism should be designed to support specific end use sectors, such as hard to decarbonise industries, flexible power generation and dispersed sites. Three respondents also proposed that the allocation process should be designed to support the growth of future hydrogen transport and storage infrastructure. One developer suggested the use of hydrogen storage needs to be incentivised through specific criteria as it would otherwise not be an attractive proposition.

Applying weightings similar to the current approach was the most commonly suggested mechanism for supporting the primary objectives and broader outcomes, with two respondents proposing a higher weighting for costs. Concerns raised by a few respondents with applying weightings in the competitive allocation process included the potential complexity it might add to the allocation process and whether it could limit market development for innovative technologies. A few respondents were of the view that the split between the primary objectives and broader outcomes will need to be carefully considered and clearly defined, so that developers know what is expected of them. One developer raised the challenge of assessing all projects on objective metrics, with another proposing different criteria for different technologies. Three developers also raised the need for greater clarity from government on how we want the hydrogen sector to develop, and the role hydrogen will play in the energy system, as well as plans for transport and storage infrastructure.

3. How would introducing a price-based competition in 2025 for electrolytic projects, and potentially other non-CCUS low carbon hydrogen projects, impact projects investment decisions?

Number of responses: 34

Summary of responses:

The majority of respondents had concerns about the impact that introducing price-based allocation in 2025 could have on projects investment decisions. The focus of the small number of respondents who felt it would have a positive impact was on the revenue certainty provided by the contract rather than the allocation mechanism itself. Two respondents suggested it was too early to fully understand the impact a move to a price-based competition would have on investment decisions, without first seeing projects move from concept to final investment decisions with HAR1 and HAR2.

Many respondents mentioned that the transition to price-based allocation in 2025 would negatively impact their ability to secure investment. One of the reasons being the impact the downward pressure on cost might have on potential rates of return, making it a less attractive investment proposition particularly at this early stage of market development when projects are seen as riskier. Also mentioned was the need for the financial sector to see evidence of successful projects to gain confidence in the technology. At this stage of market maturity there is limited understanding of projects cost structures with investors feeling they cannot adequately price project risk.

Another potential negative impact raised by many respondents was the impact on project deliverability. Respondents were concerned that by 2025 there will be very limited real-world data on construction and operational costs, increasing the likelihood of project failure which in turn might have an impact on investor and public confidence in hydrogen. Respondents felt that data sharing and lessons learned from HAR1 and HAR2 will be crucial to facilitating the transition to price-based allocation, because projects will have greater certainty on costs making it easier to price projects risk.

Several respondents were of the view that price-based allocation would deter investment in new technologies and novel project configurations which have strategic value but may not be able to compete on costs in the mid-20s. One respondent pointed to research that indicates price-based allocation at this early stage of market development would drive savings at the expense of critical investment in research and development and learnings for the market. A small number of respondents also highlighted that price-based allocation would favour established companies and the transition could hinder development of smaller companies/projects developers.

Also mentioned by a few developers as a barrier to projects making final investment decisions is the limited availability of hydrogen supply chains, hydrogen transport and storage (T&S) infrastructure and offtakers.

4. Under what arrangements will electrolytic projects purchase electricity? How would introducing a price-based competition in 2025 impact this, and are these arrangements likely to change over time?

Number of responses: 28

Summary of responses:

The majority of responses were from developers of electrolytic developers, that identified a number of options for purchasing electricity, mainly Power Purchase Agreement (PPAs) facilitated by the grid; procurement of power through agreements with licensed suppliers; and co-located private wire arrangements with renewable sources.

The majority of respondents indicated that in the near-term, projects' electricity purchasing arrangements will depend on the requirements of their end-user that generally require high load factors in order to be commercially viable, meaning that projects would look to enter into PPAs to enable the delivery of hydrogen on a consistent basis. Many respondents were of the view that this could evolve overtime and projects could operate with greater flexibility when they are able to access storage solutions and larger scale infrastructure. Some developers stated that flexible electricity consumption could only be possible alongside flexible end-use through Risk Taking intermediaries (RTIs), blending, and/or large-scale hydrogen T&S, and therefore, until this point, price-based competition should not fundamentally change the dynamic of purchasing agreements in the near term. One developer indicated that projects are already incentivised to secure low-cost electricity given the significant weighting to costs in the initial hydrogen allocation rounds.

In addition, one developer stated that another reason for early projects requiring high utilisation rates is that they will be CAPEX intensive, and therefore more reliant on amortising CAPEX.

Therefore, if this changed over time, later projects could become increasingly flexible due to having lower CAPEX intensities relative to electricity costs.

A few developers set out that in the future, price-based competition would incentivise them to explore private wire arrangements with renewable generators due to potentially offering one of the lowest costs of producing hydrogen, noting this is currently challenging from a commercial, legal and regulatory perspective. It was caveated that in the near term, early projects will need to prioritise co-locating with demand rather than with renewable generation. However, other developers noted that co-located arrangements which do not access grid power may suffer from challenges due to power quality and security of supply, which might impact overall economics.

Several projects noted that wider policies such as REMA could have a significant impact on their electricity purchasing strategy in the longer term. One trade association stated their members have indicated that the arrangements electrolytic projects will use to purchase electricity will likely be heavily influenced by the introduction of Locational Marginal Pricing (LMP). However, there is concern that it might incentivise electrolysers to situate in areas where there is arguably lower demand for hydrogen as developers seek to reduce their exposure to non-commodity costs, which would be exacerbated in a competitive auction where developers must compete on cost.

On additionality, one developer was in favour of this but recognised that price-based competition would favour companies that have access to existing renewable generation.

5. Which current and future electricity markets do electrolytic projects seek to participate in? How could changes to electricity markets or signals impact this?

Number of responses: 25

Summary of responses:

Many respondents to this question stated that in the near term, prior to projects being decoupled from end-users through rollout of infrastructure, the electricity markets in which electrolytic projects will participate will be driven by their expected offtake arrangements.

Current and future markets

Whilst it was acknowledged by many developers that there are various markets that electrolytic projects could potentially participate in – including the balancing mechanism, capacity market, stability market, ancillary services, and day ahead/intra day markets – the profile of end-users is typically baseload, therefore limiting options to run flexibly prior to hydrogen T&S or blending being available to create hydrogen demand flexibility.

One developer acknowledged that the benefit of accessing lower wholesale prices would need to be traded off against the lower electrolyser load factors, which could result in a higher cost of production.

Impacts of future changes to markets

Several respondents identified that the evolution of key government policies will impact their approach to electricity markets, including REMA, hydrogen T&S policy and blending. For REMA, it was noted that the design of existing and potential new market mechanisms, and a decision on locational marginal pricing, could have a significant impact on project decisions in the future, however it is difficult to assess at this stage.

A few developers stated that the extent to which participation in different electricity markets will become a consideration will depend on what opportunities there are, and the size of the financial opportunity will also matter. Two developers further stated that incentives to participate in the capacity market or balancing market may be diluted if locational marginal pricing is introduced.

6. How could electrolytic projects look to configure themselves and operate to deliver ‘harnessing electricity system benefits’ as set out in Chapter 2? Do you think these configurations/operating models could be feasible and commercially viable, and if not, why?

Number of responses: 33

Summary of responses:

Developers stated that electrolytic projects will remain focused on the offtake driven model until wider reforms take place. A few developers stated that hydrogen networks and storage would be needed in order for electrolysers to locate next to a renewable plant behind a network constraint to move the hydrogen to demand centres, and until then, additional hydrogen T&S costs could make such projects unviable.

A few respondents stated that a whole systems approach needs to be taken to ensure that electrolysers are located and operated in a way that best supports the electricity system and that costs of transporting hydrogen as well as electricity system costs are considered.

One respondent requested further clarity on how the Department expects the Contract for Difference (CfD) scheme for renewables and the HPBM scheme to interact, for example, whether an electrolyser could co-locate with a CfD subsidised renewable asset, noting that alignment between schemes would help projects align Final Investment Decisions (FID) and commercial arrangements. Another respondent stated that electrolytic hydrogen will not gain the necessary price advantage over blue hydrogen and fossil gas until electricity markets are restructured.

7. Do you have evidence on potential demand for low carbon hydrogen production in locations in the UK that are optimal from an electricity system benefits perspective? Please refer to the map in Chapter 2 (‘Figure 1’).

Number of responses: 27

Summary of responses:

Many respondents were of the view that wider policy reform would be needed, including development of large-scale hydrogen T&S, in order for electrolysers to be located in those areas identified as being optimal from a system perspective, and until then production would need to be situated close to demand.

Economic benefits and supply chain development:

8. How would introducing a price-based competition in 2025 for electrolytic projects, and potentially other non-CCUS low carbon hydrogen projects, impact economic benefits and supply chain development?

Number of responses: 31

Summary of responses:

The majority of respondents were of the view that cost pressures caused by a price-based allocation process would have a negative impact on the domestic supply chain. In contrast, a few developers mentioned that the transition to price-based competitive allocation will not change their existing plans for how they will be sourcing their supply chain.

Many respondents who thought price-based allocation would have a negative impact on the domestic supply chain also thought it was highly probable price-based allocation would lead to an increase in imports. Of those respondents, many noted the limitations of the UK electrolyser manufacturers' market and issues such as supply chain bottlenecks and higher costs of electrolysers which would be exacerbated by price-based competitive allocation. A few respondents raised concerns more generally about UK and global supply chain markets and their capacity to support the planned scale up of hydrogen production due to the nascency of the industry and limited production output. A few others noted that given the lack of delivery experience the supply chain might find it challenging to give realistic pricing.

A few respondents also considered the issue of market concentration and how price-based competitive allocation would favour a small number of well-established supply chain participants, who would consequently dominate the supply chain market stifling competition in the longer term. Several respondents were of the view that competitive allocation only favours large projects, and a mix of both small and large projects would be needed to maximise supply chain development and decarbonise dispersed areas. On the other hand, one developer said that large projects should be supported more than small projects through the allocation process given their benefits in terms of production and economies of scale.

Several respondents mention a potential 'race to the bottom' of costs as another negative consequence of price-based competitive allocation. A few referred to offshore wind as an example of this, where price-based competition squeezed returns on the supply chain side caused a shortening of the lifecycle of components and less investment in innovation. A few respondents also highlighted a potential risk that price-based competitive allocation might cause the submission of undeliverable bids increasing risks for supply chain producers as projects might fall away.

Several respondents were more positive about the impacts, primarily due to the idea of regular allocation rounds rather than the switch to price-based competitive allocation specifically. These respondents felt more regular allocation rounds would give more certainty to the supply chain, signalling a commitment from government to the deployment of hydrogen and the presence of a healthy pipeline of production projects. Several respondents felt that the growth and establishment of a hydrogen economy through deployment would support economic benefits. For that, ensuring the deliverability of projects should also maximise economic benefits.

Though opposed to it in the near term, several respondents specifically see competitive allocation as a way to increase deployment if introduced at the “right time” and beneficial in increasing the amount of supply chain opportunities.

Several respondents see the need for a specific policy intervention to provide incentives to foster UK supply chain and made several suggestions to that effect. The suggestions be summarised under question 9.

9. How should economic benefits and supply chain development be measured and how could this be incorporated into price-based competitive allocation?

Number of responses: 25

Summary of responses:

Several respondents were of the view that it would be challenging to measure and incorporate economic benefits and supply chain into a price-based competitive allocation process, agreeing that such metrics need to be clear, quantifiable and objective, and communicated to industry well in advance of an allocation round in order to be effective. A few respondents mentioned the importance of alignment of measuring benefits with existing schemes to enhance transparency, cross-industry collaboration and coherent reporting. A few respondents stated that price-based competitive allocation works best when it is clear what the support mechanism is purchasing and were concerned that including supply chain scoring could reduce transparency.

When considering metrics for measuring economic benefits and supply chain development, each of the following were mentioned once by separate respondents:

- Environmental Social and Governance (ESG) existing metrics for companies’ practices.
- Number of jobs created.
- Tax returns to see if skills are from outside the UK.
- Projects’ investments in infrastructure.
- Demand side impacts of projects such as allowing for fuel switching.

- Provision of surplus electricity.
- Credibility of offtakers – if offtakers are good and stable, the project is viable and the economy and supply chain benefit.

Several respondents set out how economic benefits and supply chain could be incorporated into price-based competitive allocation:

- Non-Price Factors (NPFs) Weighted Scoring – four respondents expressed the need for the use of local workforce and supply chain investment to be integrated in the scoring (whether as bonus or penalty for not meeting a minimum standard). One respondent expressed concern due to complexity involved.
- Supply chain plans – two respondents felt that introducing supply chain plans as currently required in the CfD scheme would encourage a competitive, productive and efficient supply chain. They could also enable a means to identify supply chain areas that need more attention and resources.
- Deliverability / evaluation criteria assessment – one respondent was of the view this could be incorporated into the scoring for deliverability. Another thought the current economic benefits criteria for HAR1 should continue and be refined over time, given the difficulty in defining precise metrics at this stage. However, one developer stated that the economic benefits criteria for HAR1 was confusing, time consuming, and that its impact was not clear.

10. How would introducing price-based competition affect developers' decisions on where and how to invest in supply chains?

Number of responses: 27

Summary of responses:

The majority of respondents stated that price-based competitive allocation would incentivise projects to seek the lowest cost solutions across their value chain, leading to increased investments in international supply chains: several respondents also highlighted the current constraints in the UK supply chain and the higher costs. In contrast, a few respondents said they would not expect their choice of supplier to change due to price-based competitive allocation and they would continue to prioritise technical capabilities above costs when making a decision about a supplier. A few respondents mentioned that the introduction of competitive allocation could bring underbidding and unsustainable pricing, and this could negatively impact supply chain investments causing increased uncertainty as projects might fail to deliver.

Several respondents were of the view that NPFs, local content measures or supply chain plans have the potential to incentivise investment in the UK supply chain. A few respondents wanted to see the publication of a supply chain strategy document as it would give more clarity on where hydrogen markets will be developed and influence their investment decisions. A few others welcomed the work going on through the Hydrogen Delivery Council.

11. In a price-based competition, how could pots be designed to best support the 'security of supply of hydrogen'?

Number of responses: 26

Summary of responses:

The table below sets out potential options for pot design identified by respondents to support security of supply of hydrogen. Having separate pots for different technologies was seen by the majority of respondents as crucial to support deployment of technologies that are at different stages of commercial deployment so may not be able to compete on price but have a strategic benefit.

Ensuring a good geographic spread was seen as important by many respondents. One respondent said it is necessary to ensure that local disruptions do not impact end users, another respondent mentioned the need to ensure production is located close to demand.

To support the strategic build out of hydrogen T&S, many respondents suggested that pots could prioritise projects that could support this build out. Hydrogen T&S infrastructure is seen by these respondents as a key enabler of security of supply. Designing pots that target different offtakers, project sizes, feedstocks and electricity sources were also mentioned by respondents as a potential approach to ensuring security of supply by ensuring a diversity of projects.

Potential pot configurations	Number of responses
Technology	15
Location	11
Whether they can connect to a network/utilise storage	7
Offtaker	4
Size	4
Electricity source	4
Feedstock	2

Chapter 3: Transitioning to price-based competitive allocation

The third chapter of the Call for Evidence considered how allocation rounds could evolve from HAR1 and HAR2, which are currently department-led allocation rounds involving bilateral negotiations with projects, to a price-based competitive allocation process. It sought views on the market conditions that might be required to enable a transition to price-based competitive allocation.

12. What market conditions need to be in place for introducing price-based competitive allocation? Do you think these market conditions will be in place by 2025?

Number of responses: 39

Summary of responses:

Market conditions

The table below lists the most frequently cited market conditions from respondents. There was a general consensus that a mature, liquid, low carbon hydrogen market needs to be in place prior to the introduction of price-based competition between low carbon hydrogen producers, underpinned by a large-scale hydrogen T&S infrastructure and well-developed end-use markets. Further to this, several respondents advocated for a whole-system approach to be taken prior to its introduction to enable alignment of supply, demand, and hydrogen T&S infrastructure so efficiencies can drive whole system cost reductions (rather than just production costs).

A few respondents were of the view that a plan for hydrogen T&S infrastructure rollout and a government vision to get to the hydrogen steady state to guide investment decisions would provide the conditions for price-based competitions, prior to large scale hydrogen T&S being operational.

Many respondents were of the view that a positive blending decision and allowing RTIs as offtakers could accelerate the maturing of the low carbon hydrogen market and be an interim solution for strengthening demand for low carbon hydrogen prior to the rollout of large scale infrastructure, and such decisions could be prerequisites for the introduction of price-based competition.

Whilst it was recognised that large scale hydrogen T&S infrastructure might not be available in the 2020s, many respondents were of the view that at a minimum, lessons would need to be learned from the operational projects from the initial HAR rounds before projects could compete in a price-based competition. Reasons cited for this were mainly to enable developers to better understand operational costs and risks in order to be able to submit firm bids for future projects, and to build confidence in the sector to bring forwards demand and investment.

Some respondents felt that two years of operations were required from HAR1 and HAR2 projects, whilst others thought that just a few initial projects being in operation would suffice.

No.	Market condition	Responses
1	Hydrogen T&S infrastructure in place	15
2	Blending decision (positive) / RTIs as eligible offtakers	14
3	Learnings from operational HAR1/2 projects	12
4	Incentives for offtakers/hydrogen demand in place (& well developed end use)	10
5	Well-functioning, mature, and liquid low carbon hydrogen market	8
6	Fit for purpose planning system / expediate permitting	4
7	Clarity on funding mechanism	3
8	Pre-existing investment in supply chain at scale / supply chain protection policies in place	3
9	Government vision to get hydrogen market to steady state, including plan for hydrogen T&S infrastructure rollout	3
10	A different Low Carbon Hydrogen Agreement	3

Many respondents cited large scale hydrogen T&S as a prerequisite for price-based competitive allocation in order to decouple supply and demand. This was seen to solve a number of problems associated with the early stage of the hydrogen economy, when they argued was too early for price-based competition. These respondents felt large scale hydrogen T&S could:

- Lead to greater competitive efficiencies, as projects could focus on production costs.
- Create production and demand side flexibility which would enable producers to access cheaper electricity and better respond to market signals.
- Prevent distortions across different regions.
- Mitigate stranded asset risk and potential additional hydrogen T&S costs.

Many respondents compared the current context of low carbon hydrogen production to the international development of renewable energy schemes, noting that renewable technologies (such as onshore wind, offshore wind, and solar) benefited from decades of investment and successful scaling up of deployment prior to the introduction of auctions.

A few respondents noted that the primary driver of cost reductions for a technology is through deployment at scale, and that such reductions would occur naturally through creating policies to develop the economy, and cautioned that price competition could hinder, rather than help, growth of low carbon hydrogen in the UK. They stated that this incremental approach created conditions to enable successful price-based competitions that they did not think would be in place for a non-CCUS low carbon hydrogen auction in 2025, for example:

- cost certainty: decades of deployment of renewable technologies allowed developers and industry to gain a greater understanding of renewable assets' costs before competitive bidding was introduced internationally. Respondents contrasted this with the more nascent low carbon hydrogen economy, where they stated there would be a lack of projects in operation and therefore a lack of industry learnings if price-based competition was introduced in the mid-20s;
- enabling infrastructure: there was already national infrastructure in place for renewable generation prior to implementing auctions. This meant that price competitions could focus predominantly on generation costs, which respondents argued would result in more efficient outcomes.

Whether market conditions would be in place by 2025?

The majority of respondents stated that they did not believe market conditions would be in place for price-based competitive allocation.

Answer	Responses
Yes	0
No	28
Depends on whether there is certainty on the following policies, prior to launching HAR3: • Vision of development of hydrogen economy to steady state. • Buildout of hydrogen T&S infrastructure (prior to launch). • Detailed design of a price-based competition in sufficient time. • Funding mechanism • Blending. • Success of other auction mechanisms outside UK (e.g. H2 Global).	6 • (1) • (1) • (1) • (1) • (1) • (1)
Not directly answered	4
Potentially for clusters where supply and demand are co-located (but not to enable deployment at scale)	1

13. When considering market conditions and the primary objectives/broader outcomes as set out in Chapter 2, what would be the impacts and likely outcomes of introducing a price-based competition in 2025?

Number of responses: 35

Summary of responses:

The table below sets out the most commonly referenced impacts of introducing price-based competition in 2025. The most common impact cited by respondents was the potential risk of non-delivery of projects, where projects would be unable to deliver at the prices they bid, particularly if deliverability was overlooked. Many of these respondents stated that this risk would be particularly high in a sector at an early stage of development, where a lack of operational experience from the initial HAR rounds would make price-only bids more challenging and uncertain, leading to overly optimistic bids and therefore increased financial exposure if costs are higher than expected.

No.	Impacts	Responses
1	Projects being unable to deliver at prices bid, with deliverability overlooked	12
2	Negative impact on supply chain development in the UK.	9
3	Loss of private investment through finite capital pool if price is driven down without corresponding cost reductions.	6
4	Stifle market growth.	4
5	Crowding out of smaller projects, favouring larger schemes in industrial areas over dispersed sites.	4

14. If market conditions are not in place by 2025 for price-based competitive allocation, how should further allocation rounds beyond HAR2 be designed?

Number of responses: 31

Summary of responses:

The majority of respondents that stated that market conditions would not be in place by 2025 were of the view that future allocation rounds in the 2020s should be based on the design of the initial HAR1 and HAR2 rounds. They preferred bilateral negotiations over competitive bidding in the near term and stated there needed to be shorter timeframes between launch and allocation of contracts. Some developers thought that through the HAR1 and HAR2 model, the costs weighting could incrementally increase over time before reaching full price competition.

One developer noted that such an increase could be accompanied by a reduction in administrative burden associated with bidding over negotiations. Another developer thought that implementing a transitionary approach would ensure that regional variation and project specifics could be accommodated in the allocation rounds, preventing the creation of an overly narrow H2 economy.

Many respondents stated there should be a continued focus on deliverability to maximise realisation rates of successful projects. Maximising realisation rates was seen as key to helping develop the low carbon hydrogen economy, deliver cost reductions, and strengthen the reputation of the low carbon hydrogen economy. Some respondents requested there be less focus on portfolio factors due to their lack of transparency, and to introduce RTIs, such as fuel aggregators, to help build demand for low carbon hydrogen.

A few respondents were of the view that HAR3 should be a steppingstone round to price-based competitive allocation and trial some of the broad characteristics we could expect for price-based competitive allocation rounds. One respondent suggested government consider other successful auction regimes and look to introduce high prequalification requirements with shorter lead-in times, where deliverability and price were weighted equally. Another respondent noted that not all elements of market conditions needed to be in place to introduce price-based competition beyond HAR2, caveating that further assessment is needed to test what conditions are required to move beyond HAR2.

A few developers stressed the need for future rounds to be designed in collaboration with industry, including prospective offtakers and investors, and that regular reviews of allocation rounds are in place to make adjustments/improvements to the evaluation framework to reflect evolving market conditions. Respondents also emphasised the importance of DESNZ setting out a clear timetable for future allocation rounds beyond HAR2, with planned capacity allocation targets, to maintain investor confidence, and that it should be aligned to the progress of the transport and storage strategy and electricity market reforms.

Chapter 4: Non-price factors and further design considerations for price-based competitive allocation

Chapter 4 set out the potential design considerations for evolving to price-based competitive allocation. This included the potential role of using NPFs in the allocation process to support objectives and broader outcomes beyond price. We also considered a number of other design features:

- Frequency and structure of allocation rounds
- Deliverability
- Delivery years
- Allocation body
- Technology scope and funding structure
- Winner selection process

15. Do you have views on how the design considerations as set out in Chapter 4 should evolve beyond HAR2? Are there any missing?

Number of responses: 29

Summary of responses:

The responses are structured around the main design features:

Frequency and structure of allocation rounds

Among respondents mentioning allocation frequency, the majority agreed with the annual approach as it provides certainty to developers in the long term and shows government commitment to hydrogen.

Deliverability

Among the several responses including deliverability in their answers, the majority considered it a key element to understand which projects have unrealistic delivery timelines, costings, and offtaker arrangements. Proposals on how to support this are:

- Eligibility criteria/physical prequalification – This consists of planning documents, grid connection, feasibility studies, agreements with offtaker and supply chain. Several respondents think eligibility criteria and physical prequalification are more suitable to future price-based competitive allocation and not to be employed in 2025.

- Deliverability assessment – Several developers set out that there is still a role for the current deliverability assessment model for HAR3. A few respondents would see deliverability points directly added to projects’ ranking in the allocation process with additional points given to the more deliverable options. As long as there is a continued focus on deliverability respondents felt the weighting applied to cost in each subsequent allocation round could be increased, as market and technology mature.

Delivery years

Among the four respondents mentioning delivery years in their submissions, the majority agreed with the approach to delivery years planned for HAR2. Some suggested they might require flexibility due to timings for construction but also for other external reasons such as planning, permits, grid connections and supply chain bottlenecks.

A few developers mentioned wanting to know if future rounds would favour early delivery, if each year will target the same amount of deployment and at what point of the allocation process will the delivery year be fixed. Some developers advised caution when setting delivery years and considering the inclusion of incentives to make projects deliver at the earliest.

Technology scope and funding structure

There is a split of views regarding technology scope, with three respondents concerned other technologies will take away resources from electrolytic and hinder the ability to reach government targets. In contrast, four other respondents think pots should be used to support different production pathways if there is net zero potential and required technology readiness level. However, there was agreement among them in having different allocation mechanisms for CCUS and non-CCUS projects.

NPFs

Several respondents were of the view that NPFs have to be clearly defined, objective and measurable. Several respondents acknowledged there were potential trade-offs with the additional complexity of having NPFs causing more challenges than intended solutions. A few respondents stated that NPFs should not be introduced to mitigate certain outcomes of price-based competition, preferring for future allocation rounds to follow a similar approach under HAR1 for assessing projects on economic benefits. One respondent recommended to only use them if there is no other alternative to support particular projects’ qualities and in a structured targeted way.

Respondents generally did not engage on how to implement them with just one respondent suggesting a CAPEX top up.

16. In a price-based competition, how would you design and value non-price factors (NPF) to support any of the above objectives and broader outcomes as set out in Chapter 2, noting the above non-price factor design principles in Chapter 4?

Number of responses: 31

Summary of responses:

Several of the respondents were of the view that it was premature to consider the implementation of NPFs for HAR3, and several stated that they should not be included at all, with other mechanisms being better placed to deliver on objectives beyond cost reduction. Common concerns were: that they could be overly complex and practically difficult to implement, which could lead to distortions in competition; that targeting too many objectives could result in the diluting of competition; and that allowing the low carbon hydrogen economy to mature will allow a stronger understanding of how these can be best introduced.

Conversely, a few respondents were supportive of NPFs in principle to incentivise projects to deliver on broader objectives beyond cost reduction, provided they were well designed. One developer was of the view that well designed NPFs needed to be introduced as early as possible to help influence project development.

A few respondents preferred the top-up NPF model to the alternative options on the basis that it was the least complex and least susceptible to gaming, unlike the re-ranking model.

A few respondents stated that further analysis needed to be undertaken to understand the impacts of NPFs, and that lessons should be learned from CfD regime if they implemented NPFs, prior to introducing them for the HPBM. However, a trade association noted that whilst NPFs are being considered for both the CfD regime and for the HPBM, the solution may therefore need to be different due to the differing levels of maturity of the respective supply chains. It suggested that NPFs could be broadly split into:

- Sustainability & Biodiversity: reward projects with a recycling strategy; projects that work towards full circularity in the supply chain; projects with a greenhouse gas reductions plan that aligns with the Low Carbon Hydrogen Standard/certification scheme.
- System Integration: rewards projects that increase wind farm output through co-location; deliver balancing cost savings; reduce curtailment, etc.
- Supply Chain Development: ensure supply chain development in a coordinated manner; strong community engagement; reinforce workforce skills for green hydrogen, etc.

A few respondents said that NPFs needed to be developed in a manner that compliments existing policy instruments, rather than duplicating them, and will not introduce unnecessary complexity (to an already complex scheme). Examples given were:

- aspects such as planning & permitting considerations around safety,
- environmental impact and engagement with local communities, as well as
- adherence to the Low Carbon Hydrogen Standard, which includes information on life cycle emissions.

Harnessing system benefits

A few respondents, including a Trade Association on behalf of most of its membership, were of the view that 'harnessing electricity system benefits' was not suitable as a NPF, and that alternative policy mechanisms would be more effective in addressing system benefits.

Another respondent supported the idea of a locational incentive and set out that the Electricity Network Commissioner's recommendation for a Strategic Spatial Energy Plan could indicate the most beneficial locations for hydrogen production if the recommendation is taken forward.

NPFs to develop the hydrogen economy

Some respondents thought NPFs should focus on the development of the hydrogen market rather than the benefit to the electricity system. Examples included:

- linking of hydrogen networks – decoupling supply and demand;
- creating a new cluster,
- strong deliverability being rewarded through higher scoring.

17. Are there other more appropriate approaches for supporting these objectives and broader outcomes than through implementing non-price factors?

Number of responses: 23

Summary of responses:

There were limited suggestions for more appropriate approaches to be applied to the allocation process. Several respondents agreed with using NPFs to support the objectives and broader outcomes and did not propose other measures. Several respondents recognised challenges in designing effective NPFs, for example in finding the equivalent financial value across projects. To address this, they would only use NPFs on demonstrable elements for a project such as additionality, services provided to the grid, export of excess power and environmental factors. However, many respondents only see NPFs as helpful if they are part of a wider strategic context of government initiatives made up of investment measures targeting different key elements of the hydrogen economy. Examples included workforce development, skills, supply chain, innovation and security of supply. Two respondents said this should be done on the basis of a hydrogen production strategy document developed with industry and the supply chain strategy work undertaken with Hydrogen UK.

Different policy instruments were referenced in this context, alone or in co-existence with NPFs such as:

- strong qualification requirements by one respondent,
- supply chain plans by three respondents,

- funding pots by three respondents.

As measures external to the allocation process:

- grant fundings, tax incentives and planning reforms by the same one respondent

One respondent said in case these measures were to be applied, the allocation round should not be overloaded with objectives but only provide a targeted contribution that would be complemented by wider policy measures external to the allocation process. The most cited example for this is the harnessing system benefits objective, that is considered by several respondents something to be supported only externally through other measures such as REMA.

Another group of several respondents preferred supporting areas such as demand and hydrogen T&S deployment through direct support mechanisms or by enabling blending and risk-taking intermediaries.

18. From the mid-20s, what types of companies do electrolytic projects, and potentially other non-CCUS projects, expect to have as potential end users? Do you expect them to be geographically fixed, or flexible?

Number of responses: 29

Summary of responses:

The majority of respondents saw industry and transport as the main end use sectors for low carbon hydrogen in the mid-2020s. Seventeen respondents referred to industrial end use as a main driver of demand with iron and steel, petrochemical and fertilisers seen as being geographically fixed in clusters, with hydrogen projects planning to co-locate close to them. Sixteen respondents mentioned transport as the other main end use, with a focus on heavy goods vehicles, buses, aviation and shipping. Transport was viewed by several respondents as being more geographically flexible, whilst a few respondents saw it as an end use that is geographically fixed around logistics clusters, airports and docks. A few answers mentioned how sector policy signals will be key for further demand growth as well as the publication of a government strategy. The power sector was also mentioned by a few respondents as a potential end use sector, with projects being fixed in the location of the natural gas station that is substituted.

Several respondents expect the deployment of hydrogen T&S infrastructure to achieve more geographical flexibility. In the absence of this network, few respondents mentioned that projects would locate in the clusters or serve demand through road transport or tube trailers. A few respondents raised concerns that using road transport or tube trailers would incur additional costs and make some projects less competitive in a price-based allocation process. Blending was also seen by a few respondents as fundamental to ramp up demand more flexibly in the absence of a hydrogen transport infrastructure.

19. For selecting an allocation body to administer price-based competitive allocation, do you agree that these are the right factors to be included in the Secretary of State's decision?

Number of responses: 28

Summary of responses:

There was overwhelming agreement from respondents that the factors listed in the Call for Evidence are the right factors for the Secretary of State to consider when selecting an allocation body to administer price-based allocation. Respondents also raised other considerations that should be taken into account including resourcing, flexibility and economic proficiency.

20. If a price competitive process adopted the concept of 'Delivery Years', similar to the CfD regime, how should we approach designing Delivery Years for non-CCUS low carbon hydrogen projects? Please set out, with evidence, if certain types of projects might require longer lead-in times?

Number of responses: 27

Summary of responses:

The majority of respondents agreed with the approach to delivery years as set out for HAR2. The respondents cited various reasons for why flexibility is needed for projects with certain characteristics, including size, being backed by offshore wind farms, hydrogen T&S infrastructure needs and utilising particular technologies:

- Many respondents mentioned size as an important factor that may impact delivery years, as large projects take more time and tend to be more complex than smaller ones.
- Several respondents also mentioned that offshore wind backed projects are likely to need longer timeframes to deploy as new offshore wind farms require more time for environmental agreements, planning and consenting and to set up commercial arrangements. One respondent suggested it is especially challenging if the project integrates floating offshore wind stations with hydrogen production.
- A few respondents mentioned that projects in need of support infrastructure such as hydrogen T&S might require additional time due to potential delays outside of the developers' control. These projects might also require longer planning timelines.
- One respondent referred to technology differentiation and the possibility to have different delivery years for non-electrolytic non-CCUS technologies as their approval consent and building process has different regulations and timings. Another developer felt they needed a separate pot and that a different approach on delivery years was not necessary.

For designing delivery years, respondents thought it was important to consider a variety of factors that may influence a project's ability to deliver or potentially cause delays:

- Several respondents mentioned planning and consenting requirements, which are often different for different projects. One respondent explained that this could be related to project size but there are also other reasons that might slow down planning such as the lack of access to water mains or the need for water desalinisation.
- A few respondents mentioned securing a grid connection as something that impacts project delivery with a respondent estimating it can take up to 5 years for an electricity connection to be in place.
- A few respondents also mentioned supply chain as impacting a project's ability to deliver and how potential bottlenecks can cause additional delays. One respondent mentioned directly the UK supply chain and how projects taking the risk of contributing to its development are more exposed to risks than those using foreign suppliers.

A few respondents expressed concerns with government implementing delivery years. One concern raised by a few respondents was that in the presence of multiple delivery years projects would not try to deliver at the earliest but would take more time even if it was not necessary. To that end, one respondent mentioned potential penalties in case of non-delivery such as starting the support contract term even if the project is not ready yet. Others were concerned it will be more difficult to reach government ambitions in time with the proposed approach to delivery years.

Many respondents would find valuable to get clarity from government early on regarding how much capacity per delivery year will be made available, whether unfulfilled capacity will be rolled forward, and if early delivery will be positively evaluated in the competitive process.

21. For HAR1, there was a minimum size eligibility threshold for projects of 5MW. Do you think this threshold should increase for allocation rounds launching from the mid-20s, and if so, to what value? Should the same threshold apply to all non-CCUS enabled production technologies?

Number of responses: 29

Summary of responses:

The majority of responses were in favour for keeping the eligibility threshold at 5MW. Four respondents who supported keeping the threshold at 5MW mentioned that this could be reviewed once the hydrogen market is more developed. This was mainly due to the ability for smaller projects to facilitate learning and innovation and deliver price discovery. Several respondents mentioned that larger projects are already at an advantage in a price-based competition because they likely benefit from economies of scale so there is no need to increase the threshold.

Several respondents suggested that different sized projects could compete in different pots to bring forward a range of projects. A few respondents flagged that there is potentially a revenue gap for projects that are ready for commercial deployment but missed out on RTFO funding as they do not have transport as an offtaker. One respondent suggested smaller projects should be able to aggregate to apply for support.

Several respondents were in favour of increasing the eligibility threshold and a small number were in favour of decreasing it. The rationale for increasing it was to support government's production ambitions and the scale up of the hydrogen economy; for decreasing it, it was to enable more innovative technologies to apply for support and to ensure that supply is matched with demand.

This publication is available from: www.gov.uk/government/calls-for-evidence/price-based-competitive-allocation-for-low-carbon-hydrogen-call-for-evidence

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