UK Hydrogen Strategy

Regen response: Consultation on a business model for low carbon hydrogen

25th October 2021

About Regen and our recent hydrogen experience

Regen is an independent, not-for-profit centre of expertise in sustainable energy with nearly 20 years' experience in transforming the energy system and we have extensive experience delivering independent expert advice and market insight on all aspects of sustainable energy delivery.

We have spent substantial time engaging with successive UK governments to inform the creation of subsidy schemes and developing the Electricity Market Reform that introduced the Capacity Market and Contracts for Difference.

In the area of hydrogen, Regen has produced several insight papers focused on the key role that hydrogen could play to help decarbonise the UK economy in areas of industrial processes, heavy transport, marine and aviation.

Recent insight papers include an overview of the opportunities for hydrogen, hydrogen for industry, the development of hydrogen electrolysis and also policy measures to build a hydrogen value chain. Most recently, Regen has carried out a hydrogen opportunity assessment for Cornwall Council, focusing on the potential role of hydrogen as a low carbon fuel and as a driver for innovation and economic growth in Cornwall. Regen is also a member of the National Grid : Future of Gas steering group, which has working groups dedicated to future hydrogen market design and explores specific topics such as gas safety and quality.

Regen's major study Net Zero South Wales considered a number of hydrogen pathways including the development of core hydrogen clusters and hybrid hydrogen solutions. Regen has also produced extensive future energy scenario analysis for Scottish and Southern Energy Networks on the potential deployment of hydrogen electrolysis and hydrogen heating within their North of Scotland Licence area.

Looking specifically at hydrogen for heating we have produced a major paper on the Decarbonisation of Heat, which considered the role of hydrogen and biomethane, alongside other technologies. Building on that paper, Regen has recently published a thought piece on Hydrogen for Heat: Eight Critical Challenges which identifies a number of key areas of uncertainty and challenge that the industry and policy makers must address before a strategic decision can be made on hydrogen heating.

Summary response

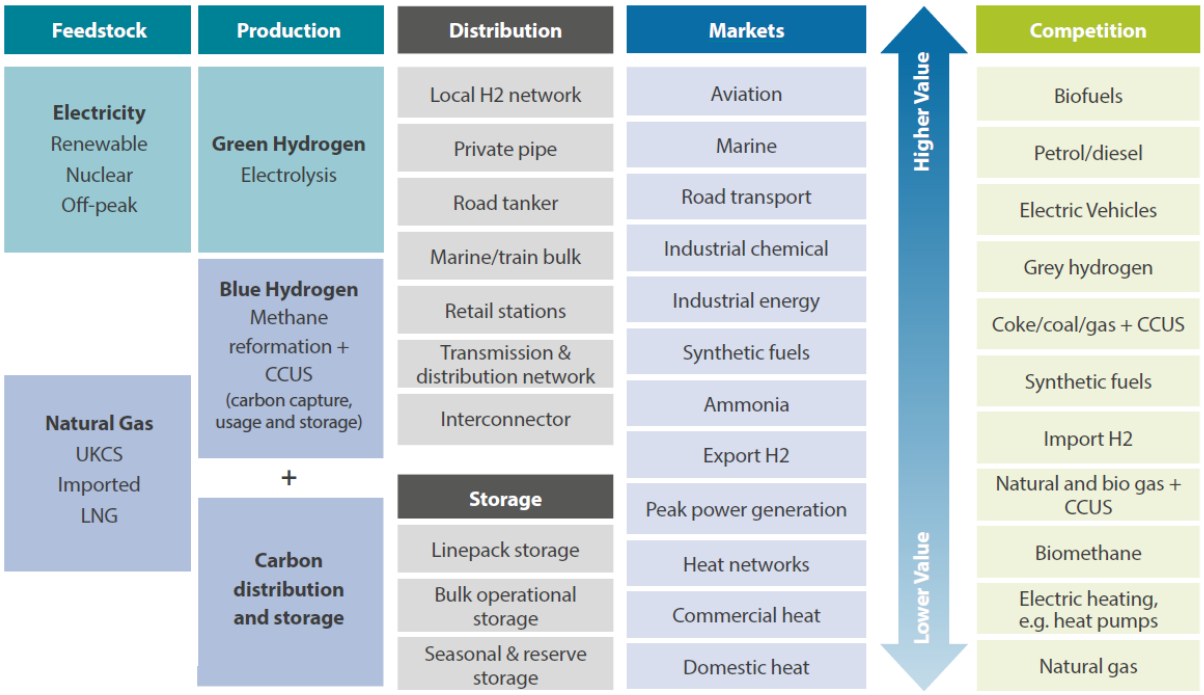
Hydrogen is set to play a critical role in enabling the UK economy to achieve net zero emissions. As well as providing a low carbon fuel for difficult-to-decarbonise sectors such as heavy transport, aviation and various industrial processes, hydrogen could also play an important role in system balancing as a multi-vector fuel, using very low-cost electricity during times of over-supply to convert, store and transport renewable energy for applications across the energy system.

There are strong arguments to support policy intervention to encourage innovation, develop new consumer markets and to accelerate investment in hydrogen production and distribution assets. However, policy makers need to tread carefully and should not think of hydrogen as a direct replacement for fossil gas or akin to electricity, that can be supported through the same subsidy regimes.

Natural gas and electricity can, by-and-large, be considered as homogenous commodities: easily traded, fungible and with an easily discernible market price. The hydrogen sector, at least at this early stage of development, is better considered as a set of related but distinct markets and supply chains. Perhaps in the future an integrated hydrogen market will emerge, but this is by no means certain and will depend on the nature of its physical supply chain as well as its multi-vector tradability.

Its complex value chain, as well as its relative market immaturity, requires a more strategic approach that focuses on nurturing consumer demand-led markets that will continue to drive innovation, carbon reduction and cost efficiency, and enable the low carbon hydrogen to deliver its full economic and decarbonisation value.

The hydrogen value chain



There is a significant risk that policy interventions focused on achieving narrow objectives, such as 5 GW by 2030, will distort the market, inhibit innovation and could entrench suboptimal production and supply chain solutions. This could also lead to the UK missing out on the significant technical and industrial opportunities that hydrogen presents.

Regen's recommendations:

1. A narrow focus on production capacity may miss the wider hydrogen opportunity

While it is right to set a target, the narrow objective of achieving 5 GW by 2030, which underpins the business model consultation, misses the key point that the UK needs to develop the entire hydrogen value chain, including market demand, storage and distribution channels.

A lopsided policy approach that focuses on production capacity only will not succeed and will not realise the full potential of hydrogen. This is a key message of our recent paper Building the hydrogen supply chain.

2. A twin track, technology agnostic, approach is misplaced

It sounds sensible, given the uncertainty, to promote a neutral strategy between blue and green hydrogen. In reality, however, there is a clear strategic argument that the UK should prioritise the development of green hydrogen.

Green hydrogen, produced via electrolysis, has a better strategic fit with the UK's long-term energy strategy which is to shift from fossil fuels towards renewable energy and nuclear. Green hydrogen is also likely to lead to a net zero carbon outcome.

Blue hydrogen would lock the UK into a long-term dependency on fossil gas imports. National Grid FES 2021[1] has projected that, in a high blue hydrogen scenario alongside projected reduction in gas production from the UKCS, the UK could become 94% dependent on natural gas imports by 2045.

3. There should be increased support for green hydrogen

Production of green hydrogen, via electrolysis using renewable electricity, is likely to be more expensive in the short term, but is projected to become the least-cost hydrogen production method over time. It is also consistent with the UK's decarbonisation targets and a better fit with a future net zero energy system.

The UK Net Zero Strategy has indicated that:

- There is a target to support up to 1.5 GW of hydrogen capacity by 2025 through the IDHRS allocations.

[1] National Grid FES 2021 System Transformation Workbook SV.7: Annual gas supply in System Transformation

- In the first IDHRS allocation, "up to" £100m has been allocated to deploy "up to" 250 MW of green hydrogen in 2023.
- It is indicated that this is likely to be repeated in the second allocation in 2024, which would imply support for up to 500 MW of green hydrogen by 2025.
- This implies that up to 1 GW of blue hydrogen may be supported by 2025.

While the announcement of a separate, earmarked budget to support green hydrogen is welcome, we would suggest that:

- **£100m is not sufficient to support 250 MW of green hydrogen**
- **the target for green hydrogen should be increased to at least match that of blue hydrogen**

4. The business model design must encourage innovation and new entrants

Hydrogen production, as a technology, is still at an early stage of development and there is a significant risk that inappropriate support is given to less cost efficient, and less carbon efficient, blue hydrogen producers who are then able to use their market position and subsidy receipt to crowd out new entrants.

The business model design and implementation must encourage first-of-a-kind production sites, while also encouraging innovation and new entrants.

5. The hydrogen standard needs to align with net zero targets

We recognise that the definition of a Low Carbon Hydrogen Standard is subject to a separate consultation, but it is important to highlight that the level of subsidy support needs to be firmly tied to a hydrogen standard that is compatible with net zero.

We have strongly recommended that the hydrogen standard is aligned with the Committee on Climate Change's target that low carbon hydrogen should have a carbon intensity of no more than 14 - 25 gCO_2/kWh.

Any support for new producers must be tied to that standard or, if the standard is tapered over time, this must be clearly set as a condition of future subsidy support. There should be no question of "grandfathering" the continued production of higher carbon hydrogen.

6. There should be a focus on developing higher value demand markets

The UK government has set a priority to encourage 5 GW of production capacity by 2030. Ideally, Regen would like to see an equal focus on both the production and demand sides of the value chain.

As the consultation document has identified, the "minded-to" business model risks encouraging producers to prioritise the lowest value and lowest costs to serve demand sectors, rather than responding to the needs of industry, transport and other hydrogen consumers. As well as the risk that producers will target low value demand customers, there is also a risk that they will prioritise the lowest cost (to the producer) distribution channel.

Although this risk is identified, the proposed business model carries a significant risk that producers will earn the same revenue, at a lower cost to serve, by blending hydrogen into the gas network, rather than selling hydrogen to a high value transport or industrial customer requiring a higher delivery service. This would distort the market away from high value customers. It would also mean that UK subsidies, paid by consumers, do not develop the full downstream value chain potential of hydrogen with the jobs, innovation and industrial investment that should bring.

7. The business model should target a rapid replacement of grey hydrogen

This consultation suggests that the government is considering implementing a form of protection for existing grey hydrogen producers, to allow them to continue to produce high carbon hydrogen. Regen would strongly disagree with this approach.

Regen recommends that the replacement of grey hydrogen, which has a carbon intensity of c.270 - 285 gCO_2/kWh, should occur as quickly as possible and should be an explicit objective of the UK Hydrogen Strategy.

The grey hydrogen market, which is mainly for the purpose of ammonia production and as a refinery feedstock, is estimated to produce c.20 - 30 TWh a year. This should be set as a prime target for low carbon hydrogen production. Any policy that seeks to protect high carbon hydrogen would be illogical in the context of the UK's net zero commitments, and the need to decarbonise the UK's industrial and agriculture sectors.

8. Determining the strike price requires careful consideration

The consultation document does not cover the process or methodology by which an appropriate strike price will be set, for example by bilateral negotiations or through an auction process. If set by bilateral negotiations, the process by which schemes would be selected to enter into such negotiations is also unclear.

This needs further and careful consideration.

It is not clear if the strike price and "achieved sales price" will be set as a factory gate price (excluding the cost of distribution) or whether different qualities of hydrogen would be offered different prices.

Determining an appropriate strike price will be extremely difficult given the early stage of the hydrogen market development, different production methods and multitude of potential hydrogen markets.

A decision to index the strike price to feedstock prices and to protect producers from input fuel price volatility would be extremely high risk. Hydrogen producers, whether using gas or electricity, should be encouraged to base their processes on the use of the lowest cost fuels.

9. The question of blending needs to be addressed

It is noted that a separate piece of work is underway to determine whether blending of hydrogen into the gas network is to be supported under the hydrogen revenue support scheme.

This is a very important question that could have a major impact on the design and operation of a hydrogen business model.

If some producers have the opportunity to blend, this would give them a significant advantage in the hydrogen market by effectively removing the volume risk. It would also provide an extremely low-cost distribution channel to increase hydrogen production, even if there is no explicit customer demand.

A major disadvantage of blending is that it would not create the downstream value chain for hydrogen applications in industry and transport. High levels of public subsidy could be used without creating the jobs, innovation and value that the hydrogen value chain could offer.

We would recommend that, if permitted under the support scheme, the level of blending should be limited and potentially earn a lower strike price.

Response to the consultation on a Hydrogen Business Model

1. Do you agree with our overall approach to introduce a contractual, producer-focused business model covering the proposed scope?

We agree with parts of the approach, particularly that:

- there is a need for production subsides to encourage investment in new production capacity
- the scope of the technologies is appropriate
- overall, the long term vision of a liquid and competitive low carbon hydrogen market is correct
- the exclusion of existing grey hydrogen manufacturing is appropriate and, in fact, the replacement of grey hydrogen should be a priority objective for the strategy
- production subsidies should be clearly tied to achieving the low carbon standard, which in turn should be set at a level consistent with achieving net zero emissions, suggested to be no higher than c. 14 - 25 gCO_2e/kWh.

However, there are parts of the approach that need consideration:

- the assumption that a production-led subsidy will in turn support new demand markets is over optimistic and it is likely that user-led support will also be required
- development of the overall hydrogen economy will require a much broader industrial strategy
- the objective to align hydrogen support with existing subsides, such as Contracts for Differences (CfDs), could be misplaced: the hydrogen value chain is different to both natural gas and electricity and will require a different solution
- the long term vision for hydrogen needs to be aligned with the long term vision for UK energy which is to shift from fossil fuels; therefore the long term vision must prioritise green hydrogen.

2. Do you agree with our approach to business model design?

Regen agrees that the approach and objectives outlined in this consultation are appropriate. It would be helpful for BEIS to provide more clarity and transparency on how the objectives and design principles have been applied to the business model design, and especially the "minded to" decisions. There appears to be a disjunction between the design principles and the "minded-to" decision.

The objectives should include more emphasis on:

- the development of the downstream value chain: storage, distribution channels and hydrogen consumer markets
- targeting hydrogen supply to high carbon industrial and transport applications helping to achieve the UK's "build back green" industrial strategy
- ensuring that low carbon hydrogen is genuinely low carbon, with a carbon intensity aligned with the UK's net zero strategy
- ensuring that the subsidy design does not lock-in less efficient producers or create a barrier to entry for new entrants, especially green hydrogen producers.

Consideration needs to be given to the extent to which the business model tries to protect producers against volume risks and how this is balanced with the objective to "incentivise producers to seek and develop sources of demand for hydrogen and promote its use".

There is a risk that excessive volume risk protection could:

- separate the producer from the end customer
- lead to suboptimal production, asset location and distribution channels
- lead to the dumping of unwanted hydrogen into the cheapest available and least valuable distribution channel e.g. via gas blending.

3. Do you agree with our minded to position for a variable premium for price support?

We agree this is a preferred approach, but the suggested minded to methodology is likely to be:

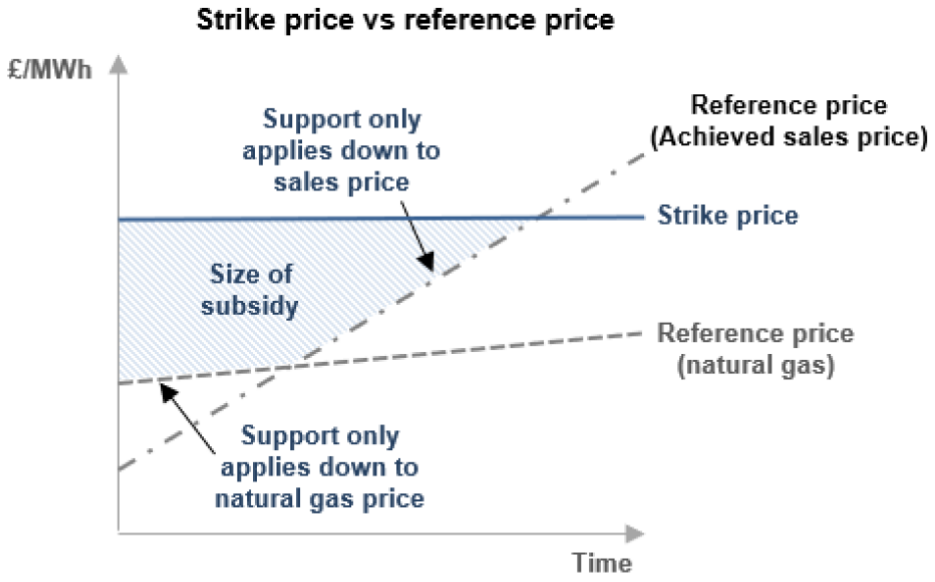
- extremely complex to set and administer
- relatively easy to game in various ways – including by cross selling/transfer pricing
- difficult to levy budget manage.

There are also risks of:

- embedding incumbent producers who are then able to set the market price and inhibit innovation and new entrants
- favouring large scale blue hydrogen producers ahead of green hydrogen.

4. Do you agree with our minded to position for setting the reference price? Please provide arguments to support your view.

Figure 12: Minded to position on reference price - highest of two inputs



It is understood that in the absence of a transparently-traded hydrogen wholesale market it is difficult to identify a Market Reference Price (MRP).

The MRP is defined as the higher of the achieved sales price or the natural gas price; thus meaning the natural gas price acts as a floor.

As the consultation document identifies, this approach carries a number of risks and disadvantages. It seems almost certain, without further design development, that these risks will come to fruition.

These risks include:

- the difficulty and challenge of obtaining and verifying achieved sales price data
- the potential for producers to game the achieved sales price data e.g. cross-subsiding hydrogen within a vertical supply chain or to partner companies, or excluding from the achieved sales price additional services such as distribution and (stock holding) storage functions
- it is not clear what would happen if the natural gas price exceeded the strike price
- the problem of producers setting the prices low to maximise subsidy payments, as a form of anti-competitive behaviour.

5. Does our minded to position create any other specific risks, incentives or disincentives which we have not already stated above? If so, what are they and how could the related risks be addressed – either within the model or outside of the model?

The biggest risk is the incentive for producers to under-price hydrogen or to sell hydrogen to lower value consumers via the lowest cost-to-serve distribution channel. There is no incentive within the business model design for producers to seek out higher value customers or to improve their customer service, product quality and distribution service.

The risk, as identified in this consultation, is that producer's "achieved sales price" will tend towards the natural gas price in order to maximise volume sales and discourage new entrants. This is an inherent problem of trying to implement a CfD-type subsidy without having a clear market reference price which is not itself subject to producer price setting.

Setting a natural gas floor price barely mitigates this risk.

The impact of this risk would be:

a) budgetary – levy subsidies will be higher and paid by the consumer
b) anti-competition – CfD holding producers can effectively out price new entrants.

6. What do you think is the most appropriate option (or options) for indexation of the strike price? Please explain your rationale.

We would suggest indexing the CfD strike price to inflation.

Indexation to fuel input costs (gas or electricity) would be inappropriate because it would:

- expose the levy scheme budget to very high risk, as seen by the recent increase in gas prices
- reduce the incentive for producers to harness low-cost feedstocks, which is a fundamental foundation for the future expansion and use of hydrogen as a low carbon fuel

Green hydrogen producers should have a strong incentive to utilise low cost, "off-peak" electricity at times when renewable generation is high. Removing, or diminishing, this incentive would reduce the overall system balancing benefits of green hydrogen production.

Blue hydrogen producers must also be encouraged to secure a low cost supply of natural gas, for example by hedging. If this is not possible then this is not a case for further subsidy and would signal that the future of blue hydrogen is not sustainable.

We note the consultation states that: "Natural gas prices are fairly stable. They are also less volatile than electricity prices because natural gas is easier to store and therefore the natural gas market does not have the same challenges as the electricity market". This statement has not aged well.

7. What are your views on whether price support for low carbon hydrogen should be constrained for applications using hydrogen as a feedstock to mitigate potential risks of market distortions? Please explain your rationale, including any suggestions both within and outside the business model to mitigate these risks.

We do not believe that support for low carbon hydrogen should be constrained for applications using existing grey hydrogen as a feedstock.

We recommend that the replacement of grey hydrogen, which has a carbon intensity of c.270 – 285 gCO_2/kWh, occurs as quickly as possible and should be an explicit objective of the UK hydrogen strategy.

The grey hydrogen market, which is mainly for the purpose of ammonia production and as a refinery feedstock, is estimated to produce c.20 - 30 TWh per year. This should be set as a prime target for low carbon hydrogen producers. A policy that sought to protect high carbon hydrogen would be illogical in the context of the UK's net zero targets and the need to decarbonise the UK's industrial and agriculture sectors.

8. Do you agree with our overall minded to position for price support? Please provide arguments to support your view.

We agree with the need to provide a support mechanism for hydrogen production. We also recognise that the consultation has sought to identify a best fit solution.

However it is clear from the risks and disadvantages identified in the consultation that a variable revenue support model, akin to the CfD approach used for offshore wind, is not a good fit for the hydrogen sector at its current state of development.

The consultation itself has identified that the workarounds to use "achieved sales price" and natural gas prices as a proxy for a market reference price will be extremely difficult to implement.

The "minded to" design does not appear to have been reconciled and scored against the design principles identified in the consultation.

If this approach is developed a lot more work will need to be done in the detailed design phase. For example, to determine how the strike price will be set and, if adopted, how a tapered strike price would be calculated.

While developing the minded-to model, we would recommend keeping in reserve an option to provide more direct support for first of a kind production through grant funding or an easier to administer fixed

9. Do you agree with our minded to position of sliding scale for volume support? Please explain your rationale.

Yes – paying a higher premium on initial volumes, which tapers off as volumes increase, makes sense.

However, this could be very difficult to implement. It will be difficult enough to calculate a strike price, let alone a tapering strike price that also requires a calculation of fixed costs, marginal costs and equity returns.

We would recommend that the government avoids becoming an off-taker of hydrogen.

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