Department of Energy & Climate Change

Green Hydrogen Standard

Government Response to Call for Evidence

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Executive summary

Developing a Standard for Green Hydrogen

Meeting our 2050 decarbonisation target will require innovation and the deployment of new technologies in traditional roles. Hydrogen, as a fuel, is not new – what is new are the innovative approaches British industry is taking to begin to produce hydrogen in such a way as to support our decarbonisation effort. In cars, heavy vehicles, in aircraft and even in domestic heating, low carbon hydrogen could play a strong role.

The Department for Energy & Climate Change is mindful of the opportunity hydrogen may represent for our decarbonisation plans and is working to find ways to develop a market in Green Hydrogen. A key step in this process is defining in precise and technical terms what Green Hydrogen is and finding a way of providing assurances to buyers of hydrogen that the product they are purchasing meets their environmental expectations. At this stage, DECC is interpreting 'Green' to mean low carbon and not considering other environmental impacts, while not excluding broader definitions later in the Standard's development.

DECC is of the view that the creation of the Standard must be an industry-led process, but that Government has a strong role to play in helping to facilitate efforts to develop it. We have established a Green Hydrogen Working Group with industry and other Government Departments to define a process for the Standard's development.

We issued a Call for Evidence to help develop our understanding of the position of a wider group of stakeholders on a range of matters related to the Standard. The original questions can be found in Appendix 1. We received thirty responses from a wide range of organisations (Appendix 2). This document summarises these responses and provides DECC's view on the questions following consideration of the responses provided.

DECC will now engage with the other members of the Green Hydrogen Working Group to identify a defined way forward for the Standard which will be put to wider consultation in the autumn.

Call for Evidence

1. Defining the scope of the energy system under assessment

This section covered the elements of the energy system involved in the production, transportation and use of hydrogen. Respondents agreed widely that the Standard should cover the entire energy system (Q1). There were a number of very specific provisos put forward on this statement, including an emphasis on those sectors that are at or close to commercialisation, the factoring in of hydrogen used as a feedstock, and the importance of transport.

The latter point was particularly important for answers to Q2, which focused on the difference between Point of Use (PoU) and Point of Production (PoP). The majority of respondents emphasised the importance of the Standard focusing on PoP as it substantially reduced the complexities associated with measuring emissions and enabled producers to sell a product without entering into the complexities of fuel blending. However, a number of respondents, while agreeing with the previous argument, claimed that transport is a special case: the additional processing required to pressurise hydrogen for use in vehicles represents a significant expenditure of energy which needs to be factored in. They variously advocated a well-to-tank or well-to-wheel approach, depending on their assessment of the relative complexity of factoring in the vehicle's drive chain. DECC favours the simplicity of a single PoP standard in its first iteration, which will still permit transport customers to purchase green hydrogen as an input.

Respondents proposed a variety of approaches to tackling the 'blending' (Q3) of brown hydrogen – hydrogen produced from high carbon sources, such as coal gasification - with green hydrogen to achieve a given carbon intensity threshold more cost effectively. These included a life cycle assessment (LCA) approach and a 'banding' model wherein hydrogen is allocated a colour or percentage depending on the relative share of brown hydrogen in the mix. DECC recognises that regardless of the level of the threshold, some blending to effectively 'game' is inevitable, and therefore permitting transparent blending at the offset through a LCA is preferable to producing unintended outcomes.

Respondents nearly universally agreed on Q4 and Q5, which covered emissions factors from electricity used to produce hydrogen, both from the grid and via private wire from a low carbon generator. The former is to use an annual grid emission average in line with current DEFRA methodology, while the latter is to use the actual carbon factor of the generator itself using an LCA of the carbon content of the electricity it produces. There were some responses that indicated that grid-connected producers should be able to factor in the grid benefits associated with providing balancing services which may enable greater penetration or use of renewable energy sources. DECC is of the view that balancing services represent part of the commercial model for hydrogen produced in this way, and that providing a double benefit through easier compliance with the Standard's threshold may not be appropriate. However, a virtual private wire approach that permitted these suppliers to benefit from the carbon factor of a low carbon generator if an exclusive provision contract was provided has merit.

Respondents provided an exhaustive list of those industrial processes which produce hydrogen as a by-product (Q7), including those intended to produce:

- Chlor Alkali
- Ethylene
- Styrene
- Syn Gas (Steel Production)
- Acetylene
- Cyanide
- Semiconductors

Multiple ways of accounting for the hydrogen produced as a by-product from these processes were presented (Q6), including allocating it zero emissions, allocating emissions as a share of the energy content of the final products, and in some cases not permitting its inclusion at all. DECC agrees with several respondents who offered an approach based on the value chain of the hydrogen produced: effectively, the relative share of the economic value of the hydrogen as part of the total value production of the process should be used to determine its emission factor. This means for a given industrial process, the carbon content of the hydrogen produced is determined by its sale value relative to the total sale value of all the products produced by the process. This approach has the merit of dis-incentivising over-production if hydrogen becomes a more valuable product: the emissions from the process will be automatically allocated to the hydrogen instead, rendering it less likely to meet the Standard.

Respondents tackled the question of the inclusion of biomass in the Standard in several broadly similar ways, including using existing sustainability requirements as part of an LCA for those production processes involving it. The Standard would therefore make reference to these, without including them within.

2. Setting the level of the Standard

The Standard is intended to be a tool to help us use hydrogen to decarbonise the economy, and therefore the carbon content of hydrogen produced and used is crucial. At the same time, a new industry requires a market for its product, and setting the Standard at a stringent level out of the gate may hamper its development. Respondents offered a wide range of responses on this issue, beginning with the question of a single intensity threshold (Q9). Some argued for the simplicity of a single threshold and the relative ease by which it can be grasped and accounted for. Others argued that a single threshold would produce distortive effects on the market and result in the clustering of technologies just below that threshold. Instead, they proposed a banded or graduated approach. DECC views the latter argument to have considerable merit, but recognises the need to get the Standard up and running and hence to minimise the areas about which there can be disputes. The Department therefore favours a single threshold, albeit with the proviso around separate thresholds for transport and for other uses.

In responses to Q10, several respondents made the point that excluding hydrogen production from fossil fuels should be the ultimate aim of the Standard. DECC continues to advocate for a technology-neutral position on decarbonisation, and does not wish to exclude options that reduce emissions even if they still rely on fossil fuel use. Other respondents again highlighted the role that banding or tiering involving a range of thresholds could play, by facilitating a continuing market for hydrogen produced by existing processes where its use represents carbon saving. This includes, for example, hydrogen produced for fuel cell vehicles using the Steam Methane reformation (SMR) process, which can be lower carbon than fossil fuel Internal Combustion Engine vehicles. DECC believes the greatest potential for the latter is in transport, and that this can be handled using separate thresholds as described above.

How the threshold develops over time is highly significant, but also highly complex to plan now without greater knowledge of how the market will develop. This point was made repeatedly by respondents to Q11, and DECC is in agreement. The Standard should have no clear trajectory at the beginning but have clear timings for reviews, potentially tied into carbon budgets as many responses to Q12 advocated.

Responses to Q13 on the initial level of the threshold were highly diverse, ranging from 0.1kgCO_{2e}/kWh to 0.25kgCO_{2e}/kWh, although it was in many cases unclear whether these referred to higher or lower heating values. Different ends of these ranges would permit different technologies to participate. DECC has yet to take a view on the appropriate level. Similarly, there were a wide range of opinions on the eventual target of the threshold (Q14) and DECC holds the view that this is best dealt with through regular reviews rather than setting a target at the start.

3. Technologies

DECC's view is that the Standard should be technologically neutral, only making judgements on the carbon emissions resulting from production, transport and end-use technologies as determined by the selected system boundary. However, different technologies will require different approaches to technical assessment that will need to be defined within the Standard. Defining which technologies are considered first is therefore of importance. There was common agreement on the following set of technologies as being appropriate to focus on initially (Q15):

- Electrolysis, using electricity either from low carbon sources or from the grid;
- SMR, either from natural gas or biomethane/biogas and with or without Carbon Capture and Storage.

Respondents brought a wide range of new developing production technologies to DECC's attention (Q16). These included:

- Thermochemical water splitting;
- Photo-catalytic & photo-chemical processes;
- Fermentation from organics;
- Cyanobacteria;
- High temperature electrolysis;
- Large-scale electrolysis;
- Photo-biological-production from water;
- Microbial electrolysis of organic matter;
- Supercritical gasification;
- Plasma treatment of waste.

DECC has no strong view on these technologies, but thanks all respondents for bringing them to our attention.

4. Ancillary Benefits

While the Standard is focused on carbon emission reduction, other benefits including those relating to air quality are also significant considerations for expanding the use of hydrogen as a fuel. Respondents generally agreed (Q17-18) that these benefits were significant, but that they were already adequately covered by other regulation and that not including them in Standard would facilitate its delivery.

5. International

DECC is aware of initiatives in Europe to develop a similar Green Hydrogen Standard, including the existing TUV Standard, the 'Garantie Origine' approach being developed in France, and the EU-funded CertifHy project. While elements of these standards are likely to be helpful, the UK emphasis on technological neutrality means that it is likely any Standard developed as part of this process may include technologies not currently covered by these, with the exception of CertifHy as its scope has yet to be defined. Respondents to Q19-20 on this issue emphasised that while an EU-wide standard would facilitate trade, the current relatively limited potential for hydrogen import and export meant that the UK has considerable scope to press ahead with this agenda in order to further develop the industry here.

Appendix 1: Questions

Q1	Should the Standard cover heat, power, transport and other hydrogen applications? What sectors should it cover beyond these?
Q2	What is your view on the usefulness of the standard making assessments at Point of Use (PoU) or Point of Production (PoP)? Does this vary by end use? For example, might we require a different approach for hydrogen used in transport?
Q3	Assuming that regardless of whatever carbon intensity threshold is set by the Standard, some production will involve blending 'brown' hydrogen with 'green' in such a way as to meet the Standard, how should we account for this when defining the system to be assessed?
Q4	How should grid electricity used to produce hydrogen be treated within the Standard, given its temporal variation?
Q5	How should hydrogen produced using a low carbon electricity source via private wire be treated?
Q6	Should hydrogen produced as a by-product of industrial processes be included within the standard? If yes, how should we define system boundaries for reasonable allocation of its carbon footprint?
Q7	Which industrial processes produce hydrogen as a by-product in useful quantities?
Q8	How should biomass used to produce hydrogen be treated under the Standard?
Q9	Should one carbon intensity threshold apply to green hydrogen irrespective of its application?
Q10	Is there a risk that a single threshold will exclude hydrogen produced from fossil fuels

	from the Standard, when that hydrogen may represent a CO_2 saving compared to another fuel?
Q11	Should the Standard be set using an increasingly tighter trajectory of allowable emissions?
Q12	If yes, how should this trajectory be set? With reference to just our 2050 target or with reference to intermediate Carbon Budgets too?
Q13	What is an appropriate emissions level to begin at?
Q14	What is an appropriate emissions level to target, and when should the target be hit?
Q15	Which technologies should the Standard cover in its first iteration? These should be the technologies that are currently most widespread or have the most significant potential in the very near term.
Q16	Which developing technologies should the Standard look to include in its later iterations?
Q17	Beyond carbon emission reduction, should the Standard look to include other benefits within its first iteration, such as a reduction in airborne particulate matter?
Q18	If yes, how should these benefits be factored in?
Q19	Would it be an advantage to have a single EU standard, even if it was not technology neutral? Is international consistency important or could the UK develop a better Green Hydrogen Standard?
Q20	How should we treat imported hydrogen if there is not a common agreed EU or international standard??

Appendix 2: Respondents

Air Products
BOC
Ceramic Fuel Cells
Cgon
Clean Power Solutions
Commercial Group
Doosan Babcock
E4Tech
Ecotricity
Energy & Utilities Alliance
Green Hydrogen Consulting
H2-Patent GmbH
Hydrogenics
Iain Todd Consulting
ITM Power
National Grid
REA

RE Hydrogen
Scotia Global
Sequestra Power
SGN
Sustainable Environment Research Centre - University of South Wales
Swindon Borough Council
ULEMCo
UKH2 Mobility
UKHFCA
University of St Andrews
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Green Gas Certification Scheme
Tata Steel

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