REA clarifications on UK Low Carbon Hydrogen Standard

Purpose of document

This document collates issues arising from REA staff and members' analysis of the UK Low Carbon Hydrogen Standard (LCHS). It is focussed on issues relating to hydrogen made from wastes and/or biomass, as well as alternative pathways that are not covered in the standard. The arguments put forward in this document are primarily for the purpose of clarification on BEIS' published policy and do not necessarily represent a settled position of the REA and its members.

Terms used

'response': government response to the UK LCHS consultation
UK Low Carbon Hydrogen Standard: government response (publishing.service.gov.uk)

'guidance': UK LCHS guidance doc
UK Low Carbon Hydrogen Standard: emissions reporting and sustainability criteria - GOV.UK (www.gov.uk)

'Annexes A – G': annexes to the guidance
Low carbon hydrogen standard - greenhouse gas emissions and sustainability criteria: annexes (publishing.service.gov.uk)

Treatment of fossil waste

The response says that LCHS is not using counterfactuals for waste feedstock (ie what would have happened to the waste if not used for hydrogen). Reasons given are carbon impacts, lack of clear precedent to follow and complexity (p49). 'Fossil waste will therefore be treated in the same way as other fossil-based inputs such as oil or natural gas' (p49)

The response references DfT ongoing work on Recycled Carbon Fuels (RCFs), which **did** propose counterfactuals.[1] 'This approach is still under consideration following consultation but we will seek alignment wherever possible.' (p49)

[1] RTFO proposals were to start with current RED position on biogenic waste (ie that zero emissions up to the process of collection and zero emissions from combustion) on the basis that it would probably have been burned for power generation anyway. Emissions are added based on the assumed loss of power generation that results. This took grid average intensity as the basis for replacing that lost electricity. DfT has said they wish to proceed with inclusion of RCFs but has acknowledged their original proposals need substantial further work. Having said that, this part of their proposal was fairly uncontroversial. Targeting net zero – Next steps for the Renewable Transport Fuels Obligation (publishing.service.gov.uk)

The response states that evidence indicates that without a counterfactual approach 'the use of fossil waste without carbon capture and storage would not be compliant with the standard'. (p49)

Policy questions

1. *Does this effectively rule out non-CCS projects with feedstock a mixture of fossil and biogenic waste from policies requiring the standard? Since CCS is unproven in so many ways, isn't this effectively ruling out an entire class of project that we are likely to need?*
2. *How soon will BEIS consider the counterfactual issue?*
3. *Why will 'fossil waste will be treated in the same way as oil etc' (see above). Surely as a minimum, its upstream emissions should be regarded as much less and only beginning from the process of collection of the waste – the material has already been used for some other purpose before becoming available as a feedstock for hydrogen production*

Discrete consignments for mixed waste inputs

'All biogenic inputs (including wastes and residues) and fossil waste inputs shall have a discrete consignment size of 1 day (0500-0459) as a default.' (Guidance, p27)

Policy questions

1. *Why use the gas day?*
2. *Does this relate to the day of use or the day of arrival at site?*
3. *Given that material usually arrives and is stored before being used, why use a day at all? Mass balance systems for site are more usually used over a month or longer periods*
4. *How much freedom will operators have to use a different period rather than the 'default'?*

When stating that averaging will be allowed, the response says (p50) that:

> 'a discrete consignment is made with a single input and the hydrogen output will have an identical set of environmental characteristics… Single inputs would be considered as…waste with a measured fossil and biogenic content..'

This appears to say that a mixture of biogenic and fossil waste would form a single discrete consignment, all other things being equal. If that reading is correct, the more detailed text in the guidance on the same topic contradicts it:

> 'Where a mixed waste input has a biogenic and a fossil component (eg municipal solid waste), it should be considered as two distinct inputs to hydrogen production, split in line with the biogenic and fossil fractions of the waste. This would create two discrete daily consignments of hydrogen, despite the fact that the original waste input is mixed.

> Having separated the biogenic and fossil fractions of a waste stream, the biogenic waste inputs can feed into a single discrete consignment, as can the fossil waste inputs, provided that each consignment has a single set of identical environmental characteristics' (Guidance, p27)

We read this as meaning that all the notional biogenic inputs can become a single consignment and that all the fossil waste inputs can become a single (different) consignment. This is supported by the requirement to have a single set of identical environmental characteristics.[2]

This interpretation assumes that the text in the guidance more fully reflects the policy intent than that in the response. If averaging is allowed, this distinction doesn't matter much other than for record-keeping. If averaging is **not** allowed then it matters a lot.

Averaging between consignments – mixed waste

The rules are set out in the guidance (p24). The aim is 'to support the ambitious growth targets of the nascent hydrogen market by permitting the mixing of low carbon and higher carbon inputs'. In other words, the practical effect is that some production that would not otherwise meet the standard can be rewarded so long as the overall GHG levels are acceptable.

Within a calendar month, one consignment can be presented as averaged so that the average GHG value meets the standard. There is no limit to the number of discrete consignments that can be included in this way – it could be the total production. The discrete consignments do not need to be consecutive. Presumably the references to non-GHG criteria on p27 of the guidance are intended to ensure that this only relates to GHG – all hydrogen supported must otherwise be compliant with the non-GHG criteria as relevant.

There is nothing here to suggest that producers cannot average biogenic and fossil waste classified feedstocks[3] – but this is a ***critical point to have confirmed either directly or by worked examples.***

[2] Set out on p24 of the guidance. These include 'feedstock classification (eg biogenic waste, fossil waste, residue)..'

[3] The references to mixing of natural gas inputs (p27 guidance) would seem to be consistent with this. 'For natural gas reformation processes using fossil fuel inputs, specifically sourced and evidenced, biogenic inputs cannot be averaged in the same consignment and should be considered as separate discrete consignments. In each calendar month period, a maximum of one average consignment, that meets the GHG emissions threshold, can be considered as compliant under the standard..' So this appears to reflect an approach where these things are counted and classified separately but can then be averaged based on the rules set out.

Biomethane as feedstock

Although not spelled out in the rest of the document, Annex E is clear (pp45-46) that biomethane delivered by conventional gas pipelines cannot be counted as a consignment of biomethane because it has been mixed with fossil gas. Unlike the use of electricity delivered via the grid, guarantees of origin or similar are not accepted.[4] Nor are contractual arrangements similar to a PPA accepted. Therefore, any biomethane being used as a feedstock must either be produced at the same site as the hydrogen production or delivered to site (via road, dedicated pipeline or some other means).

This is a direct clash with the approach taken by the RTFO. This is not because the RTFO allows book and claim chains of custody but because gas grids themselves operate on a mass balance basis so that the total energy withdrawn balances with that put in. It is therefore possible to track contractually gas injected at one point of a network and taken out at another – and this approach is permitted for unsubsidised biomethane injected in other countries so long as the mass balancing system can document the progress from injection to supply to UK.[5]

Policy questions

1. *Why has the LCHS taken this approach for biomethane when it is so inconsistent with the treatment of electricity?*
2. *In the absence of a rationale, doesn't this raise the risk that electricity inputs will be assessed in the same way?*
3. *What consideration has been taken of the contradiction with the RTFO and potential distorting impacts on market behaviour? (Noting that the proposals in the 2021 RTFO amendment consultation would see the treatment of **electricity** in RTFO adjust to something broadly similar to the LCHS)*

Further details on consignments if using biomethane

'Biomethane inputs can be used to create daily discrete consignments, with the environmental characteristics associated with the biomethane input, as evidenced by the biomethane supplier. If the supplier provides biomethane produced from multiple inputs with different environmental characteristics, the biomethane input to hydrogen production should be considered as multiple distinct inputs, creating separate daily discrete consignments of hydrogen, with the volume of each distinct input corresponding to the volume of hydrogen output' (guidance, p27-28)

[4] 'Renewable guarantees of origin, commercial green gas certificates and other book and claim systems are not sufficient in and of themselves to evidence biomethane use under the standard since they do not prove that the biomethane has been physically supplied to the hydrogen production plant.' (Annex E, p46)

[5] Further details are set out in this dedicated guidance note: rtfo-guidance-for-biomethane-including-as-a-chemical-precursor.pdf (publishing.service.gov.uk)

Policy questions:

1. *Does this mean that biomethane as an input will have to break down into discrete consignments so that crops, residues and wastes are treated separately?*[6]
2. *Why is this needed since GHG savings can be averaged together later anyway and (assuming AD is the treatment technology) none of this will include fossil waste?*
3. *How will the standard and the policies using it ensure that the interaction with similar reporting under other schemes is as smooth as possible? (RTFO, RHI, GGSS, RO, CfD)*

At end of biomethane examples of classifying hydrogen production from methane using different sources into discrete consignments, which can then be averaged, Annex states (p28): 'Natural gas reformation processes cannot process biogenic inputs with CCS to offset emissions associated with hydrogen produced from fossil fuels. – eg any biomethane processed will result in separate biogenic hydrogen consignments to the fossil hydrogen consignments.'

Presumably, the above relates to the policy position of not using CCS to claim negative emissions: 'Averaging can be used for discrete consignments that are made using the same input to account for variability in the upstream GHG emissions… Averaging cannot be used to offset hydrogen production above the threshold using negative emissions processes' (response, p50). **Can BEIS clarify our understanding of this point is correct?** Since this really goes to a restriction on averaging between consignments rather than whether it results in discrete consignments, needs not to be a rule that restricts ability to average between fossil and biogenic waste more broadly.

Electricity as an input

Frequent references to use of 'off grid generation' where the alternative is importing electricity from the grid (either by using a PPA to tie it to specific generators or using the average grid electricity). No reference to the possibility of using on-site generation that, while providing electricity to the hydrogen production plant is also connected to the grid. Although the list given (guidance, p25)[7] states that it is 'non-exhaustive' would want this scenario to be clearly considered so as not to be inadvertently ruled out.[8]

[6] That would seem to be correct, given the example in Annex, p28

[7] See also Annex A, esp Figure 3 (pp13-15)

[8] By contrast, the RTFO does consider the use of renewable electricity provided to a (co-located) production site where the electricity generator is also connected to the gas grid. DfT consulted on changes to the current rules in 2021, with the outcomes yet to be published. See pp 42-44 of the link below:
Targeting net zero – Next steps for the Renewable Transport Fuels Obligation (publishing.service.gov.uk)

CO_2 sequestration

Only counted if stored permanently in geological storage (response, p20). Why not other forms of permanent sequestration if they otherwise meet the criteria set out? See example in the appendix.

Pathways not included in the LCHS

Page 10 of the guidance states:

This is not an exhaustive list and other pathways may also be able to meet the standard GHG emissions threshold and criteria where it is required by the criteria of a scheme or policy. Further hydrogen production pathways that can meet the requirements under the standard including the GHG emissions threshold, may be added to this standard guidance document through regular review points. Production pathways that are not included in this list but have the ability to demonstrate compliance with the standard are invited to submit this to BEIS for analysis, with the full methodology clearly outlined. Following sufficient scrutiny, we may then consider potential inclusion of these production routes in future standard publications, aligned with the wider review points. BEIS will need to model the likely GHG emissions from the pathway proposed and develop further detail on the methodology for inclusion as an annex. Production pathways for consideration should submit evidence that the pathway meets the standard methodology and GHG threshold to the Hydrogen Production team at hydrogenproduction@beis.gov.uk.

We would hope this means that a developer can still demonstrate that a project using a pathway that is currently not included in the standard meets the requirements of the standard, by setting out the methodology they have used to calculate the associated GHG emissions and show that the resulting hydrogen would comply with the relevant LCHS threshold.

However, the text could be interpreted as to mean that until the standard is revised and a pathway currently not included is added to it, a developer won't be able to show compliance with the standard for an application for the NZHF and the HBM, but we hope this is not the case and there is a way for a produce to demonstrate compliance with the standard even if the pathway is not included.

Appendix - Emissions associated with CO_2 sequestration (E_{CO2})

The standard states that '*these are emissions captured and permanently stored through use of carbon capture and storage technology. For emissions to be accounted for under this category, the following conditions need to be met:*

• *CO_2 emissions must be captured and stored permanently in geological storage. Avoided emissions (through a displacement or change in fossil fuel use) and carbon capture and utilisation of CO_2 does not meet this condition.*

There are however other ways to sequester carbon which are not geological storage. These include (but are not necessarily limited to) the production of solid carbon from a process called Thermal Plasma Electrolysis (TPE). While the chemistry of TPE is the same as for pyrolysis (i.e. $CH_4 => C + 2H_2$), the physics by which this is achieved is very different. There are no direct CO_2 emissions associated with the production process and, overall, TPE is anticipated to have a CO_2e emissions footprint roughly similar to SMR/ATR plus CCS. This technology is considered to be further advanced than pyrolysis: commercial pilots should run by the end of 2022.

The carbon output produced from this process is a solid, stable form of carbon, that is pretty much inert. In that form, in the absence of external stimuli, it is not expected to react with atmospheric oxygen to turn into CO_2. Carbon black is already produced for industrial purposes from fossil feedstocks via CO_2-emitting production methods (so if the output displaces that existing carbon black production, this would further cut the emissions caused by existing production routes).

Current markets for carbon black include vehicle tyres, coatings and printing inks. We understand these applications are only likely to result in the eventual release of carbon dioxide to the atmosphere if the products involved were burnt. However, any potential future GHG emissions should be an issue to be dealt with in relation to the end-of-life disposal of any such products, rather than in relation to production of inputs to them.

Companies are also looking into new end use applications for solid carbon, as a soil enhancer and as an additive for construction materials. In both cases we would then expect the carbon to be sequestered permanently.