UKPIA Response to the Consultation on a UK Low Carbon Hydrogen Standard

Introduction

As outlined in the BEIS Hydrogen Strategy, low carbon hydrogen (LCH) has an essential role to play in delivering a Net Zero UK[1]. Whilst hydrogen is already used in many industrial processes as either a feedstock or energy vector, it is normally produced at the same site it is consumed at, with said site likely to be regulated for GHG emissions by the UK Emissions Trading Scheme (ETS), but no sustainability requirement associated with the hydrogen itself.

The UK downstream sector is currently the largest hydrogen-producing sector in the UK, responsible for almost half of UK production. The production processes are currently a mix of steam methane reforming (SMR), autothermal reforming (ATR), and as a by-product from catalytic reforming (CR) – the latter process accounts for approximately half of all hydrogen production in the sector (see Figure 1).[2]

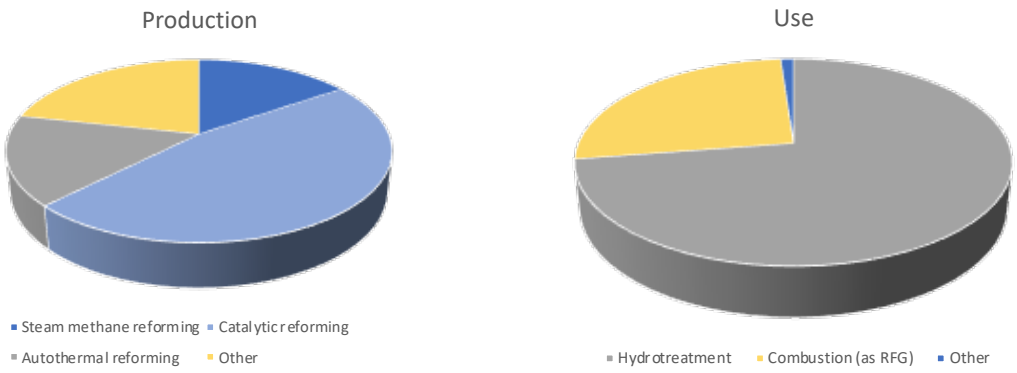

Figure 1: Proportions of hydrogen production methods and consumption processes in the UK refining sector

Unabated SMR and ATR are considered high carbon intensity hydrogen production processes with CO_2 emissions of around 7 tCO_2e per tonne of hydrogen produced. However, CR-produced hydrogen is often considered a by-product and has a significantly lower carbon intensity than that produced via SMR or ATR. It may therefore offer a suitable source of hydrogen for demonstrations and trials.

The vast majority of hydrogen used by a refinery is for the hydrotreatment of intermediate streams – the primary means by which sulphur is removed from the products. Hydrogen is also present in refinery fuel gas (RFG) in varying quantities, lowering the carbon content of the RFG used for firing/heating processes.

As such an integral part of the refining process, the downstream sector has decades of experience in producing and handling hydrogen and is already beginning to utilise this expertise for the deployment of LCH. Our sector is also highly experienced in energy vector well-to-tank accounting, with all of UKPIA's members obligated under the UK ETS and renewable transport fuel obligation (RTFO).

[1] UK Hydrogen Strategy, BEIS, August 2021
[2] UKPIA and BEIS data

Accordingly, the downstream sector is ideally placed to support the proliferation of LCH in the UK and looks forward to close partnership with the UK government in helping to deliver a LCH economy in the UK. UKPIA welcomes the UK Hydrogen Strategy and the opportunity to engage via the accompanying consultations. It is essential that the right policy foundations are laid in the early 2020s to support the rapid scale-up of the nascent LCH market.

1. Do you agree that the standard should focus on UK production pathways and end uses whilst supporting future export/imports opportunities? Yes/no. Please expand on your response.

The low carbon hydrogen standard (LCHS) should not include end-use in scope and must also be applied to hydrogen imported to the UK to ensure a level playing field for producers for the UK market. Appropriate boundaries for the LCHS are essential in meeting its policy objectives and will considered in more detail below.

1. Carbon Accounting of Supply Chain

The LCHS should adopt a well-to-tank (WTT) carbon accounting approach in a manner consistent with other energy vector production and provision policies such as the RTFO, Renewable Energy Directive (RED) in Europe, and Low Carbon Fuel Standard (LCFS) in California. End-use emissions are not regulated under these policies as such emissions are powertrain/conversion-specific and therefore subject to alternative regulation such as ETS and tailpipe CO_2 emissions regulation.

A significant proportion of the WTT GHG emissions for hydrogen may be associated with its distribution due to the input energy required for compression and storage.[3] Therefore, it is important to account for GHG emissions associated with the distribution of hydrogen to incentivise the most efficient means of hydrogen distribution. A divergence in approach could result in a policy 'decoupling' where LCH is provided to applications with highest economic incentive independent of GHG emissions efficiency – counter to the policy objectives.

2. Defining the LCHS as a Climate Sustainability Standard

As outlined in the consultation document, the intention of the LCHS is to guarantee the GHG emissions sustainability of LCH projects and the LCH produced. This is a necessary requirement to ensure any hydrogen projects supported by the business model and Net Zero Hydrogen Fund (NZHF) are compatible with the UK's Net Zero objectives and simplify/safeguard carbon accounting considerations for LCH end-users/off-takers.

Accordingly, the LCHS must be suitably robust in its GHG emissions accounting, but not creep in scope by, for example, seeking to define other technical requirements such as purity. Hydrogen quality is independent of its sustainability and defined by chemical requirements outlined in dedicated quality standards. The provision of hydrogen under an appropriate standard (such as BS ISO 14687) is agreed between supplier and end-user to ensure product is supplied that meets the end-users requirements.

Such an approach is analogous to that utilised in the transport fuels sector, where the RTFO regulates the sustainability criteria of obligated fuel whilst separate quality standards ensure appropriate product characteristics for provision to the market.

3. Applying the Standard to the Market

UKPIA agrees with the BEIS approach to develop a LCHS that focuses on UK production to ensure the appropriate balance of ambition and feasibility for UK LCH production and supply. However, the same standard must also apply to imported hydrogen to prevent carbon leakage and ensure a level playing field for domestic LCH producers. An LCHS that applies

[3] Low Carbon Hydrogen Well-to-Tank Pathways Study, Zemo Partnership, August 2021

to domestic LCH production only would allow international hydrogen producers not bound by similarly strict/any WTT GHG emission requirement to import higher carbon intensity hydrogen, potentially at lower cost. Whilst the proposed business model is intended to provide support to domestic producers indexed to a producers input costs (such as natural gas or energy – see UKPIA response to the consultation on a business model for LCH), such costs will not be equivalent for hydrogen producers in other markets therefore a level playing field does not exist without the LCHS applying. An LCHS that leaves the potential for import of higher WTT GHG emissions hydrogen would not be compatible with the policy objectives.

2. Would there be benefits in developing the standard into a certification scheme? Yes/no. Please provide detail.

As LCH is a nascent market requiring development, a certification scheme would not provide any further level of assurance whilst simultaneously imposing an administrative burden on government and industry. LCH producers will already need to demonstrate qualification under the LCHS as part of their NZHF application and/or CfD contract negotiations with BEIS and also evidence ongoing compliance with the scheme.

When the UK LCH market is well-established, and direct UK government support is no longer required to grow or perpetuate LCH production and supply, a certification scheme for LCH suppliers may be an appropriate course of action to provide independent assurance to the market.

3. a. Is international consistency important, or should the UK seek to develop a low carbon hydrogen standard primarily based on the UK context and criteria set out above? Please provide detail.

Yes, integration with external markets must be as frictionless as possible for the UK to be able to meet its ambitions as a leading global/regional hydrogen trade hub. Whilst the UK will want to develop as ambitious an LCHS as possible, deviation from international standards will limit UK producers' competitiveness.

Establishing a LCHS that enables frictionless trade with key LCH export markets (such as northwest Europe) – even if it were of slightly lower ambition than an 'ideal' UK LCHS – may actually deliver greater overall GHG emissions savings as competitive UK production could ensure greater LCH use in the region. This would have the parallel benefit of driving greater economic growth in the UK and potentially establishing it as a regional LCH hub. Given the increase in atmospheric CO_2 concentration is a global issue, supporting GHG emissions decreases in neighbouring countries should be considered consistent with the policy objectives.

b. If elements of a UK standard differ to comparable international standards or definitions, would this impact the ability to facilitate investment in the UK or cause issues for business operations across borders? Yes/no/unclear at this stage. Please provide detail.

If elements of a UK standard differ to comparable international standards or definitions, UKPIA believe it to be highly likely this would impact the ability to facilitate investment in the UK and cause issues for business operations across borders. If there is no international demand for hydrogen produced according to the UK standard, the potential market for such hydrogen is immediately limited to the UK domestic market. Limiting the potential market for LCH production – especially in such a new market with a high degree of uncertainty – would be likely to limit investment compared to markets with more favourable trading opportunities.

Any areas where a UK LCHS is more stringent would also need to be applied to imported LCH as outlined in question 3a or levelised via another policy mechanism such as a carbon border adjustment.

c. If answering yes to 3b, what elements of existing low carbon hydrogen standards or definitions are most important to ensure international consistency?

The most crucial areas to remain consistent are in accounting across the supply chain (well-to-tank) and ensuring consistent/easily mapped sustainability criteria.

4. a. Should the standard specify a list of hydrogen production pathways, which would be updated periodically or on request? Yes/no.

No, the standard should remain ends-focused on WTT GHG emissions and technology neutral to encourage innovation and allow emerging/novel technologies to enter the market. Producers should be required to demonstrate the WTT GHG emissions of their LCH production and provision process for BEIS to assess as part of any NZHF application or business model CfD contract negotiation.

A government curated list of 'approved technologies' could also risk providing false certainty to investors by shifting the burden of GHG accounting to the government. A possible but unwanted scenario could occur whereby BEIS 'approve' a given technology under the LCHS and subsequently discovers it no longer meets the LCHS (perhaps due to variables not previously accounted for) and therefore reverses the approval. This would create investor uncertainty and penalise investors who pursued projects for this technology in the meantime. The alternative, to maintain approval on the list, would result in lower overall GHG emissions savings from LCH production.

By avoiding an 'approved' list, and keeping the carbon accounting burden on producers, the government can have greater confidence in delivered GHG emissions savings by LCH projects.

b. If yes, we would welcome respondents' views on what production methods could have significant potential in the UK in the near term.

c. If no, we would welcome respondents' views on alternative options.

Producers will be required to demonstrate the WTT GHG emissions for their output hydrogen which may be verified via an independent organisation.

5. a. Do you agree that the standard should adopt one label of 'low carbon' hydrogen, or would it be valuable to have multiple categories?

One label with a clear set of qualifying criteria to claim "low carbon hydrogen" would be preferred to facilitate the establishment of a LCH market. As stated in UKPIA's LCH Business Model consultation response, exceeding the GHG emissions saving threshold of the LCHS should be financially rewarded via a premium/further credit. Producers that exceed the standard's GHG emissions threshold may also be able to claim comparatively 'greener' hydrogen or that their hydrogen 'exceeds' the requirements of the standard - provided this is done in a manner consistent with the CMA's Green Claims Code.[4]

[4] https://greenclaims.campaign.gov.uk/

An ambitious but feasible GHG emissions threshold should be set that can be met by a range of technologies where hydrogen with improved carbon intensity than the LCHS threshold not requiring specifically defined further categories (at least in the early phases of the LCHS). This would avoid a potentially unnecessary additional administrative burden for government and industry or potential confusion for prospective off-takers.

b. If multiple categories, what benefits would we get from adopting this approach in terms of emissions reduction and consumer confidence?

6. a. Do you agree that a UK low carbon hydrogen standard should be set at the 'point of production'? Yes/no.

Disagree, as outlined in question 1 the LCHS should account for GHG emissions on a WTT basis (from production to point of use) in a manner consistent with existing low carbon energy provision policies. Regulating solely at point of production omits the energy input and associated GHG emissions of hydrogen distribution.

b. If no, what would the advantages be of the standard making assessments at 'point of use' or 'point of use + in-use emissions'?

The standard should assess GHG emissions from production to the point of use to ensure the energy provision portion of a process or product lifecycle is accounted for appropriately without overlapping with existing end-use regulation.

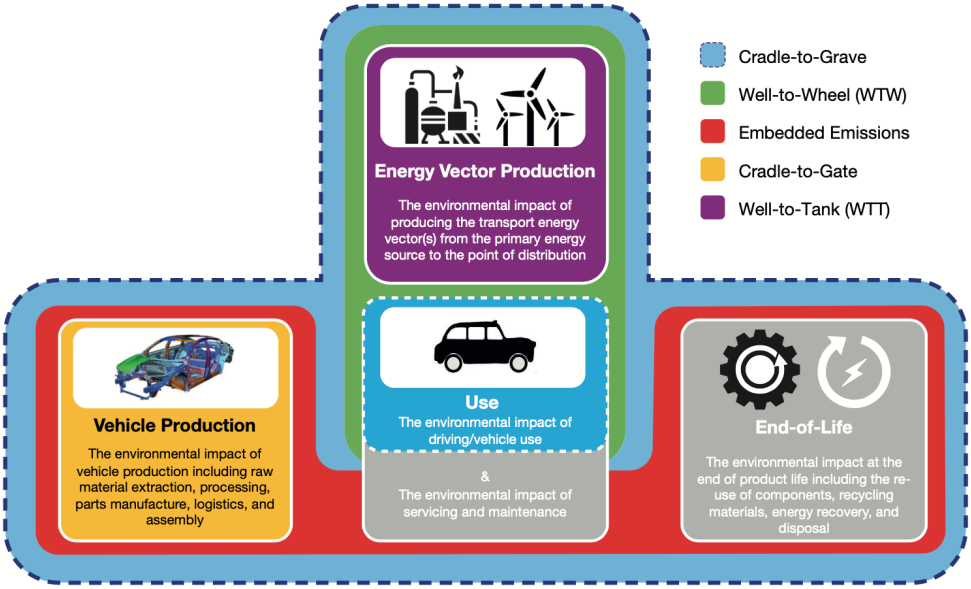

Figure 2: Schematic of cradle to grave lifecycle analysis and constituent analyses

Figure 2 illustrates the lifecycle analysis (LCA) framework from transport that could also be applied to a manufacturing asset utilising hydrogen as a fuel. The LCHS should apply to the 'purple' box – WTT GHG emissions – whilst the in-use emissions are accounted for by other regulation. In summary:

GHG assessment at point of production	GHG assessment up to point of use	GHG assessment up to and including end-use
✘ Excludes input energy and hardware of LCH	✓ Accounts for GHG emissions of LCH provision	✘ In-use emissions regulated under other policies and

distribution and therefore does not appropriately account for LCH supply GHG emissions. ✓ Simplest from an administrative perspective.	complementing in-use emissions regulation. - Administratively more complex than point of production only but feasible for producing entity.	independent of energy vector sustainability therefore does not provide additional carbon accounting. ✗ End-users and producers may not be the same entity therefore producers may not be able to appropriately account for in-use emissions.

7. Which chain of custody system would be most appropriate for a UK low carbon hydrogen standard: a mass balance or a book and claim system? Please explain the benefits of your chosen option.

LCHS chain of custody should be via mass balance to provide maximum supply flexibility whilst also being robust from a sustainability perspective. A mass balance approach will allow LCH to be blended with fossil-derived hydrogen or other gases if needed whilst claiming the renewable/LCH portion. This approach is consistent with the chain of custody approach under the RTFO: [a mass balance approach "ensures for every unit of sustainable biofuel sold, the corresponding sustainable feedstock has been produced."[5]

Such an approach is suitable for varying supply paradigms: from small-scale pipeline networks linking a single producer (most likely owned and operated by it) to a small number of off-takers to larger networks with multiple producers and off-takers. Upon market maturity, the standard could then evolve to a certificate trading system similar to renewable transport fuel certificates (RTFCs).

8. Should other CoC options be considered instead? Yes/no. If yes, please provide detail.

UKPIA has no further suggestions for a chain of custody approach – a mass balance approach is suitable and well-proven.

9. a. If the system boundary was set at the point of production, should there be defined reference purity and pressure levels for a UK low carbon hydrogen standard? Yes/no.

If preferred for pressure and no for purity. A defined reference pressure could enable more direct like-for-like GHG emissions comparisons (which may be calculated/modelled) as supplying pipelines may operate at different pressures depending on off-taker or broader network requirements.

A reference purity should not be defined as different off-takers/networks may have different purity requirements and different energy inputs to achieve the same/equivalent levels of purity. Therefore, direct comparison cannot be achieved via calculation and a mandated minimum purity should be avoided (see questions 9c and 10).

b. If yes, what should they be?

The actual supply pressure will be defined by the producer depending on their onward distribution requirements. The reference pressure is arbitrary to allow like-for-like GHG

[5] RTFO Guidance Part Two: Carbon and Sustainability, DfT, January 2021

emissions comparison, therefore there is no specific requirement for where this should be set.

c. If no, what are the benefits to not defining reference purity and pressure levels?

As reference purity cannot necessarily be calculated/modelled for like-for-like GHG emissions comparison, defining a reference purity would result in a purity requirement in the LCHS. Such a purity requirement may result in superfluous LCH quality for some off-taker applications. As increased purity correlates with increased energy input, unnecessary 'purity giveaway' should be avoided – purity requirements will be agreed between producers and off-takers depending on end-use and production economics.

10. a. Should there be minimum pressure and purity requirements for hydrogen to meet the standard? Yes/no.

No, pressure will be defined by the producer (or maybe distributor) based on operational suitability and purity will be agreed between supplier and off-taker.

b. What could the potential implications of setting minimum purity and pressure requirements be?

Building on the response to question 9, setting minimum pressure and purity requirements may result in unnecessary energy input for some end-use applications and create an artificial threshold for entry. This could leave potentially viable producers out of the market if, for example, local demand in a small network only requires low pressure and/or low purity hydrogen. In addition, even if LCH production should prove viable in such a scenario, unnecessary energy would be expended to achieve the arbitrary pressure and purity minimum which would be inconsistent with the policy's objectives.

Any LCHS should enable producers to maximise GHG emissions reductions, guaranteeing a minimum level of GHG reduction, whilst allowing flexibility for producers and end-users/off-takers to agree physical provision parameters to maximise economic efficiency.

11. a. Do you agree that embodied emissions should be omitted from the calculation of GHG emissions under a low carbon hydrogen standard, to ensure comparability with global and UK schemes? Yes/no.

Agreed, as this would be consistent with international schemes such as the RED, however, should international regulations including LCH in scope be updated to include embodied emissions, the UK should update the LCHS accordingly to maintain frictionless trade of LCH.

b. If no, what are the benefits to including embodied emissions in the calculation of GHG emissions, and what should be done to ensure that hydrogen is on a level playing field to other energy vectors?

12. a. Do you agree that a UK low carbon hydrogen standard should include the global warming potential of hydrogen? Yes/no.

Disagree, it is not practicable to measure H_2 losses and these are kept to an absolute minimum in plants and pipelines. Modern standards and regulations necessitate minimal

losses and preventing H_2 losses is also economically favourable for producers as hydrogen is a non-trivial opex cost for most industrial applications/processes.

b. If no, are there other options for accounting for the GWP of hydrogen outside of a UK low carbon hydrogen standard that could support compatibility with existing standards/schemes?

H_2 could, in theory, be accounted for under industrial pollutant regulations, however, as outlined in question 12a, H_2 losses are minimised and very technically challenging to detect. Accordingly, environmental regulators have not sought to regulate H_2 emissions.

13. a. Should a materiality threshold for total emissions be included in the life cycle assessments of hydrogen pathways? Yes/no. b. If yes, what would the most appropriate level be and why?

Yes, in a manner consistent with well-established international standards.

14. a. Should CCU with proven displacement or permanence be included as an allowable benefit in GHG calculations under a UK low carbon hydrogen standard? Yes/no. b. If yes, what should a suitable minimum time be for proven permanence and which applications should be eligible?

Yes, with a minimum time for proven permanence considered on a project-by-project basis based on producers' feedback for current carbon capture, utilisation, and storage (CCUS) projects.

15. Should CCU credits only be allowed for biogenic carbon, and not allowed for fossil carbon sources? Yes/no.

CCU credits should also be allowed for fossil-derived sources as this will enable bringing blue hydrogen plants using fossil-derived hydrocarbon feedstocks to produce LCH online at scale in the short- and medium-term. Of course, these plants will need to meet the GHG emissions saving threshold specified by the LCHS.

16. As the grid is decarbonising rapidly, so will grid connected hydrogen production pathways. How should government policy take into consideration hydrogen production pathways using grid electricity as primary input energy now? Please explain the benefits to the approach you have suggested.

In its Net Zero Strategy, the UK government confirmed it will deliver a low carbon electricity grid by 2035 – even in the context of electricity demand set to double by 2050.[6] Therefore there will be a pipeline of significant renewable energy production through the 2020s. Given the timescales involved in deploying electrolysis-based LCH production at scale, it is likely that the commencement of asset operation will align with an increasingly low carbon intensity grid. Therefore, the LCHS should permit LCH production via electrolysis from grid electricity provided the WTT GHG emissions including the electricity grid GHG emissions factor meets the LCHS GHG emission reduction threshold.

[6] Net Zero Strategy: Build Back Greener, HM Government, October 2021

There is already government precedent for such an approach – the increased deployment of battery electric vehicles (BEVs) is assumed to be zero emission as the carbon intensity of the electricity continues to decrease.

17. a. What options should we consider for accounting for the use of electricity under a UK low carbon hydrogen standard? Do the options outlined seem appropriate? Are any of these particularly problematic? Please explain your reasoning.

UKPIA agrees with the methods for demonstrating renewable energy supply as outlined in the consultation document including via power purchase agreements (PPAs) and renewable energy guarantees of origin (REGOs) in the short-term. There may also be a need for temporal correlation, as identified, to demonstrate electrolyser use during periods of high renewable electricity generation/low grid carbon intensity. As aforementioned, it is expected that few electrolysis-based LCH projects will come online before the late 2020s.

b. Of the options considered, should further conditions be included to mitigate any negative impacts or potential unintended consequences, such as driving additional high carbon power generation, and what could these conditions be?

As outlined in question 16, an additionality requirement should not be needed in the LCHS as the UK government has committed to a low carbon electricity grid well within the term of support under the business model. Even early LCH production plants will not come online until the carbon intensity of the electricity grid has further reduced according to the government's ambition and required trajectory.

18. What evidence should BEIS consider ahead of making decisions around the use of electricity as primary input energy for hydrogen production?

As identified in the consultation document, further study of the impact of electrolysis on the electricity grid would be prudent and should extend to include significant electricity demand, alongside assessment of other demand increases from electrification of road transport and heat.

19. How should low carbon electricity use in hydrogen production be accounted for in order to support the deployment of hydrogen production via electrolysis, whilst avoiding unintended consequences such as increased generation from high carbon power sources (impacting grid decarbonisation)?

As identified in the consultation document, implementing an additionality requirement for LCH production via electrolysis would significantly increase project costs and therefore restrict project scale/investment. In light of the government's commitment to a low carbon grid by 2035, it would appear that such an approach would add unnecessary complexity.

20. Should a UK low carbon hydrogen standard include a requirement on additionality and why? Please explain the benefits to the approach you have suggested.

No, as outlined in questions 16 and 17 the LCHS should not include an additionality requirement. The primary reasons such an approach is not an appropriate for the LCHS where it is, for example, in the RTFO is two-fold:

- Project timescales: a small-scale RFNBO project for deployment in few vehicles (as is available now) could be achievable in the near-term and therefore should demonstrate renewable energy generation capacity added to the grid where increased demand could result in material electricity grid carbon intensity increases.
- Other transport policy support: many transport modes can receive additional policy support (such as the zero emission bus regional areas scheme) that provides greater economic incentive to support additional renewable energy generation capacity.

By not including an additionality requirement in the LCHS, electrolyser project business case assessment is simplified.

21. Should additionality considerations also apply to renewable heat and other input energy vectors such as biomethane, in the same vein as for low carbon electricity and why? Yes/no. Please explain the benefits to the approach you have suggested.

Such an approach would only be required if increased demand of demonstrably renewable pellets, liquid fuels, and gases displaced such energy vectors elsewhere. This is not necessarily the case – in fact, increased demand can increase prices such that further biomass-derived energy vector production becomes economically viable. An additionality requirement would introduce unnecessary rigidity to the market and therefore dissuade investors from further projects.

22. a. Should waste fossil feedstocks be considered with counterfactuals under a UK low carbon hydrogen standard? Yes/no. Please explain the benefits to the approach you have suggested.

Yes, provided hydrogen derived from waste fossil feedstocks can demonstrate GHG emission reductions relative to the best alternative end-of-life (EoL) fate. The DfT are seeking to consult on recycled carbon fuel (RCF) support under the RTFO in early 2022. UKPIA would recommend that BEIS work closely with the DfT on this consultation and its conclusions as appropriate end-of-life GHG emissions assessment is essential for both standards.

b. What are the potential implications of supporting the use of any particular waste streams in hydrogen production?

23. What is the most appropriate way to account for hydrogen produced from a facility that has mixed inputs (high and low carbon)? Please explain the benefits to the approach you have suggested.

Accounting for inputs of varying carbon intensity is provided for under the RED – a weighted average carbon intensity approach is the stated practice for multi-batch or step processes.

24. What are the most appropriate units to calculate GHG emissions of low carbon hydrogen?

UKPIA has no concerns with BEIS' minded-to position of calculating gCO_2e/MJ LHV. However, it should be noted that for applications where hydrogen is a feedstock rather than energy vector (which is currently the majority of applications), gCO_2e/unit mass may be more widely reported by industry. Interchangeable use of mass and energy units is likely to be needed for project assessments.

25. What allocation method should be adopted for by-product hydrogen and why?

UKPIA is currently assessing methodologies for the determination of carbon intensity for by-product hydrogen and will respond separately to BEIS on this question.

26. Should the standard allow for negative emissions hydrogen to be reported? Yes/no.

Yes, for example if hydrogen is produced from SMR of biomethane with CCUS. This should be incentivised by a GHG emissions reduction threshold exceeding 'premium' as outlined in UKPIA LCH business model response.

27. a. Should non-GHG impacts be taken into account? Yes/no.

Yes, but not under the LCHS. As outlined in question 1, the LCHS is a GHG sustainability standard and should not significantly with other regulatory frameworks such as pollutant emissions and environmental regulations.

b. If yes, what criteria or factors should be taken into account and how?

c. If no, please set out your rationale for your answer.

This would become too complex to quantify for different LCH producing technologies and plants with many asset-specific considerations. Existing regulations should cover – or be evolved to cover – the non-GHG sustainability impacts of LCH production.

28. Given the many potential end uses of hydrogen, and the rapid expansion of low carbon supplies required, do you agree that an absolute emissions threshold be adopted, rather than a percentage saving based on a fossil comparator? Yes/no. Please provide detail.

Yes, an absolute emissions threshold is appropriate to provide certainty to off-takers under the LCHS' preferred one market, one label approach. This minimum GHG emissions threshold for LCHS qualification should be combined with a further GHG reduction premium/credit as outlined in UKPIA's response to the LCH business model consultation.

29. Should the standard adopt a single threshold or several, and why?

A single GHG emission threshold to qualify as "low carbon hydrogen" should be defined. However, this should be combined with scope for further GHG reduction premium/credit as outlined in UKPIA's response to the LCH business model consultation. This would incentivise producers to deliver GHG emissions reductions beyond the LCHS threshold without requiring multiple discrete categories.

30. a. Should the GHG emissions threshold be set at a higher level in the early stages of hydrogen deployment, with a trajectory to decrease over time? Yes/no. Please explain the benefits to the approach you have suggested.

The initial GHG emissions threshold should be set based on currently viable technologies proposed for deployment (FOAK plants). It may be appropriate to adopt 'phases' of GHG emission threshold as the growing LCH market becomes better understood, however, each new phase should only apply to new projects. These defined phases would require regular review – likely every 5 or 10 years to assess the state of the market and feasibility for further reductions in the gCO_2e/MJ LHV or unit mass threshold.

It may transpire that post-contract CfD support for a project becomes contingent upon meeting a newly established threshold but mid-contract threshold decreases must not be implemented as projects will be designed, and FID taken, based on meeting a specified LCHS GHG emissions threshold.

There is precedent for regular review of low carbon energy vector GHG threshold trajectories as per the RTFO and proposed for the new sustainable aviation fuel mandate.

BEIS may wish to consider that the LCHS could be used to incentivise UK-produced natural gas by setting a threshold trajectory commensurate with the evolving carbon intensity of natural gas production over the lifetime of the business model.

b. If yes, should this decreasing trajectory be announced from the offset? Yes/no. Please explain the benefits to the approach you have suggested.

Yes, the government's proposed threshold phases – based on current best available evidence – should be defined from the beginning of the LCHS to provide indication to investors on the government's 'minded-to' position for the evolution of the LCHS. However, the proposed phases should be reviewed every 5 or 10 years (as outlined in question 30a) to ensure an ongoing balance of ambition and feasibility.

31. What would be an appropriate level for a point of production emissions threshold under a UK low carbon hydrogen standard? Please set out your rationale for your answer.

As outlined in questions 1 and 6, the LCHS should be assessed up to the point of use and the GHG emissions threshold should be set accordingly. The initial LCHS emissions threshold should be based on what WTT hydrogen carbon intensity is feasible from existing LCH projects. The carbon intensities for production and distribution highlighted in the consultation document would suggest up to 30 gCO_2e/MJ LHV be set as a WTT threshold.

32. a. Could some net zero compliant hydrogen production pathways be disadvantaged by the introduction of an emissions threshold set at 15- 20gCO_2e/MJLHV? Yes/no.

If considering net zero compliant LCH production pathways in isolation, if a premium/credit is rewarded for exceeding the GHG emissions threshold of the LCHS, such production pathways should not be disadvantaged by the threshold as there will be financial incentive to pursue further GHG savings.

If considering net zero compliant hydrogen production pathways are dependent on the establishment of an inter-regional LCH market/network, the stated threshold may then result

in some longer-term disadvantage as, in the short-term (2020s), LCH produced via grid electrolysis or SMR of natural gas with CCUS may not meet the absolute GHG emission requirement (according to figure 2 of the consultation document). However, this threshold is stated for point of production only.

b. If yes, please explain which methods are likely to be disadvantaged and why.

33. a. How could we ensure that a low threshold does not negatively impact projects on a trajectory to net zero and learning by doing at the early stages of hydrogen market development?

UKPIA would recommend that BEIS seeks to extensively understand the status of existing LCH projects and understand gCO_2e/MJ LHV they are likely/able to achieve to ensure investment in LCH made so far may still be brought to deployment to support early GHG emissions reductions and growth of an early LCH market. GHG emissions abated in the near-term are more cost efficient and climate effective than in the longer-term.

b. What impact could this have on the UK achieving 5GW production capacity by 2030?

There should not be a risk of the UK achieving 5 GW of LCH capacity by 2030 if the first GHG emissions threshold is set by BEIS at a point that would allow existing/already committed-to LCH projects to qualify under the LCHS and business model accordingly.

34. a. Should the UK low carbon hydrogen standard provide for some limited leeway on the threshold for existing hydrogen production facilities? Yes/no. Please explain the benefits to the approach you have suggested.

Leeway should not be needed for the LCHS threshold provided it is well-evidenced and ambitious yet feasible.

b. If yes, is a 10% leeway suitable? Yes/no.

35. What would be an appropriate level for a UK low carbon hydrogen standard if it were considering point of use emissions? Please set out your rationale for your answer.

As outlined in questions 1 and 6, UKPIA does not believe in-use emissions should be in-scope of the LCHS.

36. Which type of organisation would be best placed to deliver and administer a Low Carbon Hydrogen standard? Please include examples where possible of effective delivery routes for comparable schemes.

Voluntary sustainability verification schemes such as the ISCC are extensively utilised to certify the sustainability criteria of renewable fuels and so could also provide a means of independent verification of LCH production. Ultimately, these certificates are then reviewed by a government administrator to confirm sustainability criteria have been met.

37. Should default data, actual data or a hybrid approach be used to assess GHG emissions? Please explain the benefits to the approach you have suggested.

The assessment of GHG emissions must be a suitable balance of pragmatism and confidence in the carbon accounting. In the early phases with small/contained LCH systems the GHG emissions are likely to be well-known. When pipeline networks become larger and part of a broader distribution system this may become a more relevant consideration. It is probable that a hybrid approach will be required when factoring production and distribution however evolutions in carbon accounting technology may improve the accuracy/confidence in larger system carbon accounting.

38. What should the options be for reporting and verification of low carbon hydrogen? Do any of the options outlined seem appropriate? Are any of these particularly problematic?

As carbon intensity of production will be closely scrutinised (by prospective producers and BEIS) as part of project FEED, FID, and negotiation, UKPIA would recommend self-reporting under agreed carbon accounting with BEIS regularly reviewing and feeding back to industry its level of confidence in GHG emissions reporting. Possible third party verification options can then be explored if needed.

39. Are any other options not listed here that are better suited for low carbon hydrogen reporting? Any thoughts on how possible trade-offs between accessibility and robustness or between accuracy and simplicity could be addressed?

As outlined in question 36, whilst not a reporting method, voluntary schemes may offer a means of independent verification to provide greater confidence in reporting to BEIS. Any mandated third-party verification of LCH assets would need to provide demonstrable market reassurance.

40. What would be an appropriate frequency for verification or audit?

UKPIA has no response to this question at this time and would recommend regular review of GHG reporting to determine whether third party verification is needed and at what frequency.

41. Over what period of time should the standard be introduced?

The requirements of the standard should commence from 2025 – simultaneous with the business model and other LCH policies. However, the LCHS should be published/confirmed *as soon as possible* to allow prospective producers to work-up suitable feasibility assessments and FEEDs for LCH production that meets the requirements of the standard. Delays to confirmation of the LCHS requirements may result in delays to project FIDs being taken.

42. Do you have any other comments relating to the carbon standard proposals set out in this document?

UKPIA has no further comments at this time but would welcome further discussion with BEIS on the carbon intensity accounting of various production and distribution methods.

43. Glossary

ATR	Autothermal Reforming
BEV	Battery Electric Vehicle
CR	Catalytic Reforming
EoL	End-of-Life
ETS	Emissions Trading Scheme
FID	Final Investment Decision
(I)CCUS	(Industrial) Carbon Capture, Utilisation and Storage
LCA	Lifecycle Analysis
LCFS	Low Carbon Fuel Standard
LCH(S)	Low Carbon Hydrogen (Standard)
NZHF	Net Zero Hydrogen Fund
PPA	Power Purchase Agreement
RCF	Recycled Carbon Fuel
RED	Renewable Energy Directive
REGO	Renewable Energy Guarantee of Origin
RFG	Refinery Fuel Gas
RFNBO	Renewable Fuel of Non-Biological Origin
RTFC	Renewable Transport Fuel Certificate
RTFO	Renewable Transport Fuel Obligation
SMR	Steam Methane Reforming
WTT	Well-to-Tank