UKPIA Response to the Call for Evidence on Hydrogen-Ready Industrial Boilers

Section 1

1. If you are responding on behalf of an organisation, please confirm the name and type of organisation you represent? (e.g., industrial site, original equipment manufacturer, academic, member of the public)

UKPIA represents the eight main oil refining and marketing companies operating in the UK. The UKPIA member companies – bp, Essar, ExxonMobil, Petroineos, Phillips 66, Prax Refining, Shell, and Valero – are together responsible for the sourcing and supply of petroleum products meeting over 85% of UK inland demand, accounting for a third of total primary UK energy.

2. What is your main interest in relation to this call for evidence?

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 Greenhouse Gas (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). [2]

Figure 1

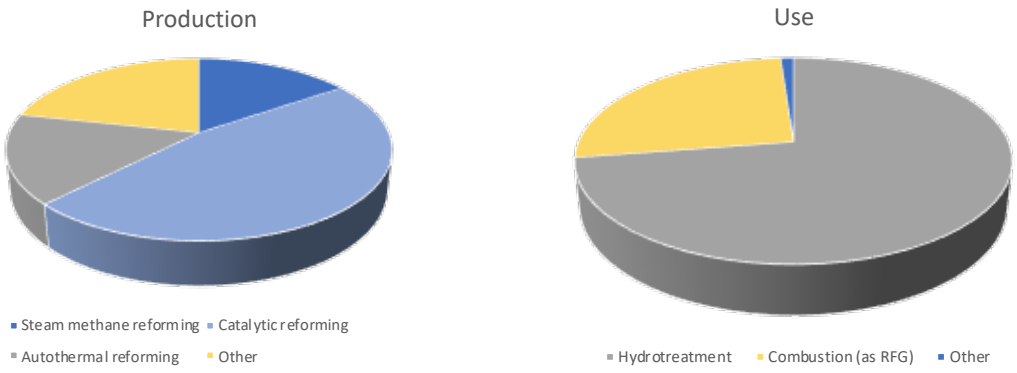

Figure 1: Proportions of hydrogen production methods and consumption processes in the UK refining sector

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

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 including boiler equipment.

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

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.

Section 2.1

3. What factors would impact the way an industrial site would decarbonise boiler processes?

In large scale petrochemical complexes, including those in which refineries [3] operate, produce, and optimise their fuel supply in order to produce the utilities they require for operation at the lowest possible cost. Factors which can affect the choice of fuels for utilities can include

- Available gas or liquid streams from processing units, and the alternative uses to which they can be put to. The quality of these streams may be unsuitable for sale as gases such as LPG supply without further significant processing or may require incineration.
- The consumption of these gas streams in fired heaters on refinery process units which can change depending on unit operations on a day-by-day basis, changing the volume of gas then available for utilities.
- The prevailing carbon price structure, increasing the cost of burning carbon containing material in the refinery and its associated utilities.
- The prices of other options for decarbonising utilities such as electricity, biofuels or Carbon Capture, Utilisation and Storage (CCUS).
- The decarbonisation strategy that the refinery has chosen to undertake which influences future utility requirements, and therefore demand for investment to decarbonise boiler process.

[3] https://www.conceptdraw.com/examples/crude-oil-refining-process-flow-chart

4. Do you think that low carbon hydrogen is a good way to decarbonise industrial boilers? Please give details to explain your view.

- Strongly agree
- **Agree**
- Neither agree nor disagree
- Disagree
- Strongly disagree

Hydrogen is one way with which to decarbonise industrial boilers. However incentivising hydrogen alone may not take into account the Life Cycle (LC) emissions of other potential fuel sources available in an industrial complex. These may also be low carbon particularly if they are waste gas streams that would otherwise require significant GHG emissions to process into useful products. Therefore, careful consideration of the counterfactual GHG emissions is required in order to make a technology neutral judgement on the suitability of low carbon hydrogen vs the alternatives.

5. Would other low carbon alternatives, including electrification, biofuels or CCUS, also offer a suitable way to decarbonise boiler processes? To what extent would changing energy prices influence your view?

As per our response to Q4, we agree that other alternatives to reduce GHG emissions associated with utilities are available and should be considered as part of a technology neutral approach to decarbonisation. A consistent LC analysis approach should be used when identifying the GHG reductions for the applications concerned [4] Refineries may be part of CCUS Clusters allowing additional options for decarbonising heat for utilities than using hydrogen fuel.

Section 2.2

6. How should hydrogen-ready be defined for industrial boilers? Do you have any views on the ways we have described hydrogen-ready for industrial boilers?

The definition for Hydrogen ready as detailed in page 14 of the "Call for evidence" document is adequate at present given the current infant development stage of the LCH economy. Without a real supply of LCH at scale, companies are only able to replace furnaces and boilers with brand new equipment that can burn Natural Gas or alternative fuel today, but designed and ready to take on 100% LCH as is or with minimum conversion once that LCH becomes available in the future. The definition of hydrogen for "hydrogen-ready" should be consistent with the incentives for hydrogen already in progress such as the Net Zero Hydrogen Fund [5] and the Low Carbon Hydrogen Standard[6].

[4] https://www.eea.europa.eu/publications/GH-07-97-595-EN-C/Issue-report-No-6.pdf
[5] https://www.gov.uk/government/consultations/designing-the-net-zero-hydrogen-fund
[6] https://www.gov.uk/government/consultations/designing-a-uk-low-carbon-hydrogen-standard

7. Do you agree it would be possible for equipment manufacturers to produce hydrogen-ready boiler equipment at scale and in the ways described above? Please give details to explain your view.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

Due to lack of relevant experience, UKPIA is unable specifically answer this question. However, given a suitable and appropriate low carbon hydrogen quality standard on which to base their designs, we would normally expect equipment manufacturers to be able to produce hydrogen-ready boiler equipment. This may be dependent on the applications in which the boilers are being used; there may be some occasions where the duty or footprint available are simply not suitable for the use of low carbon hydrogen as a fuel choice.

8. Is the schematic of a typical industrial boiler system accurate? Are there additional subcomponents that should be considered?

We agree that these may be typical components of an industrial boiler system. Additional components may be required depending on the duty of the furnace and these may need to be considered as part of the boiler design.

9. Are the descriptions of how subcomponents would need to differ to fire hydrogen accurate?

We agree that these descriptions generally capture key aspects of the design of components to fire hydrogen. However, the details may vary depending on the duty requirements of the furnace and these may need to be considered as part of the boiler design.

10. How would industrial boiler subcomponents need to be modified to be hydrogen-ready? Would this differ for the various types of industrial boilers, such as high-pressure steam boilers, low pressure steam boilers, and hot water boilers?

Due to lack of relevant experience, UKPIA is unable to comment on this question.

11. Do you have any views on how a hydrogen-ready definition for industrial boilers should relate to definitions for other types of equipment, including for other industrial processes, domestic and commercial heating, or electricity generation?

At a high level there should be harmonisation of approach between hydrogen-ready industrial boilers and other types of equipment. For example, if the design basis for boilers is to assume natural gas in the short-term and then moving to low carbon hydrogen hereafter then this should be adopted for other applications.

Section 2.3

12. Do you have views or evidence on what the costs of installing hydrogen-ready boiler equipment would be in contrast with equivalent costs for conventional equipment?

Due to lack of experience in this subject, UKPIA cannot provide any views or evidence in this regard. However, we agree that due to the more complex nature of the design, we would normally expect the costs of a hydrogen-ready boiler system to be higher than a conventional equivalent.

13. Do you have views or evidence on what the costs of converting hydrogen-ready boiler equipment to use hydrogen would be in contrast with equivalent costs for converting conventional equipment?

Due to lack of experience in this subject, UKPIA cannot provide detailed views or evidence on this question. However, at a high level we agree that given the fact that the use of hydrogen has been included in the design to some extent we would normally expect the costs of conversion to hydrogen to be lower than it would be for a conventional equivalent.

14. Do you have any views or evidence on the time and complexity of installing hydrogen-ready boiler equipment, when compared to installing conventional equipment?

Due to lack of experience in this subject, UKPIA cannot provide detailed views or evidence on this question.

15. Do you have any views or evidence on the time and complexity of converting hydrogen-ready boiler equipment to use hydrogen, when compared to converting conventional equipment?

Due to lack of experience in this subject, UKPIA cannot provide detailed views or evidence on this question. However, at a high level given the fact that the use of hydrogen has been included in the design to some extent we would normally expect the time and complexity of converting hydrogen-ready boiler equipment to use hydrogen to be lower than compared to converting conventional equipment.

16. How might the risk of not accessing hydrogen impact decisions to deploy hydrogen-ready boiler equipment?

Given that at a high level, we agree that hydrogen-ready boilers are likely to be more complex and costly than their conventional equivalents, there is a clear risk that if there is no access to hydrogen there will be no business case for investment in this technology. If hydrogen-ready boilers are mandated, then this simply increases costs for businesses with no environmental benefit.

17. Are there any other commercial, operational, or environmental factors that might affect whether a site installs hydrogen-ready boiler equipment?

As previously advised, other factors such as the choice of alternative low carbon fuels, the use of CCUS, or the footprint of plants in which to fit boiler equipment may influence the decision to install hydrogen-ready equipment. The main concern for industry is ability of the new equipment (burners) to meet current site's NOx allowances. The EA has indicated that it will not allow an increase in current site's allowances. This highlights the importance to deploy demonstration projects as soon as possible.

18. Overall, do you agree it could be beneficial for industrial sites to deploy new boiler equipment that is hydrogen-ready? Please give details to explain your view.

- Strongly agree
- **Agree**
- Neither agree nor disagree
- Disagree
- Strongly disagree

UKPIA agrees that it may be beneficial and allows sites to move forward with the energy transition. However, the final investment decision depends on many factors and other low carbon technology may be beneficial.

Having equipment which is not hydrogen ready may also delay replacement of older, less efficient equipment for more modern lower emission equipment where people are waiting for hydrogen to be supplied to an area.

Section 3.1

19. Considering the possible levers available, do you have any views on whether government should enable and/or require industrial boiler equipment to be hydrogen-ready?

We strongly suggest that a mandate for hydrogen-ready boilers may not be the most appropriate solution for decarbonising utilities in all situations particularly on industrial sites with access to CCUS. However, appropriate incentives such as grants may assist with investment cases making the uptake of this technology more likely against other available options.

20. How do you think the market for hydrogen-ready boiler equipment would develop without regulation?

Currently the largest barrier to hydrogen use is not the availability of boilers, but the availability of hydrogen. Given the appropriate incentives and access to low carbon hydrogen it is likely that the market for hydrogen-ready boilers will develop over time, without the need for government regulation. Whenever low carbon hydrogen becomes available, users of boiler equipment will have a financial incentive to switch over to hydrogen firing to reduce ETS compliance costs.

21. Do you agree with the benefits and risks presented of requiring boiler equipment to be hydrogen-ready? Are there any other factors to consider?

UKPIA broadly agrees with the benefits and risks of requiring boiler equipment to be hydrogen ready.

22. Overall, do you agree that it would be beneficial for government to require boiler equipment to be hydrogen-ready? Please provide details for your views.

- Strongly agree
- Agree
- Neither agree nor disagree
- **Disagree**
- Strongly disagree

As per our answer to Q19, we strongly suggest that a mandate for hydrogen-ready boilers may not be the most appropriate solution for decarbonising utilities in all situations particularly on industrial sites with access to CCUS. However, appropriate government incentives such as grants may assist with investment cases making the uptake of this technology more likely against other available options.

23. If government required industrial boilers to be hydrogen-ready, what would be the implications for other types of equipment used for combustion of fossil fuels? (e.g. domestic and commercial boilers, industrial kilns, furnaces, ovens, dryers, and electricity generating equipment.)

UKPIA is unable to comment on this question in detail. However as per our answer to Q11, at a high level there should be harmonisation of approach between hydrogen ready industrial boilers and other types of equipment. For example, if the design basis for boilers is to assume natural gas in the short-term and then moving to low carbon hydrogen thereafter then this should be adopted for other applications

Section 3.2

24. Do you have any views on what kind of regulatory approach might be suitable for requiring the deployment of hydrogen-ready industrial boiler equipment?

As per our answer to Q19, we strongly suggest that a mandate for hydrogen-ready boilers may not be the most appropriate solution for decarbonising utilities in all situations particularly on large industrial sites with potential access to CCUS. However, an appropriate incentive may assist with investment cases making the uptake of this technology more likely against other available options.

25. Do you have any views on whether we should consider the potential for regulating hydrogen-ready industrial boiler equipment separately from hydrogen-ready requirements for power generation?

UKPIA is unable to comment on this question in detail. However as per our answer to Q11, at a high level there should be harmonisation of approach between hydrogen ready industrial boilers and other types of equipment. For example, if the design basis for boilers is to assume natural gas in the short term and then moving to low carbon hydrogen thereafter then this should be adopted for other applications

26. Do you have any views on the possible exemptions presented? Are there other factors that should be considered when assessing potential exemptions?

Due to lack of relevant experience, UKPIA is unable to comment on this question.

27. Do you have any views on the potential timing for introducing any regulation requiring industrial boiler equipment to be hydrogen-ready?

It is probably premature to talk about introducing any regulation for Hydrogen-ready boilers when there is still many unknowns and LCH supply at scale is not anticipated to start until late 2026/27. For this reason, focus should be given to accelerate establishing a LCH economy (i.e.: supply at scale and demonstration projects) and as these develop, then, start introducing relevant legislation for Hydrogen-ready boilers should it be found that boilers are not being adapted quickly enough to utilise the supply of LCH. From the above and once evidence is gathered from early adopters, it appears more appropriate to kick off initial legislation at the end of this decade.

28. Do you have any views on how potential requirements for boiler equipment might need to evolve, as options for industrial sites to decarbonise change over time?

Due to lack of relevant experience, UKPIA is unable to comment on this question.

Section 3.3

29. Do you think these three criteria provide the right framework to assess the merits of hydrogen-ready regulation? Please provide details.

- Strongly agree
- Agree
- Neither agree nor disagree
- **Disagree**
- Strongly disagree

30. Are there other factors or criteria that should be accounted for?

As per our answer to Q19, we strongly suggest that regulation including a mandate for hydrogen-ready boilers may not be the most appropriate solution for decarbonising utilities in all situations particularly on industrial sites with access to CCUS. However, appropriate government incentives such as grants may assist with investment cases making the uptake of this technology more likely against other available options.

Section 4.1

31. Are the listed services the supply chain provides for the industrial boiler market accurate?

Due to lack of relevant experience, UKPIA is unable to comment on this question.

32. Do you agree that the existing supply chain would be able to adapt to meet potential regulation requiring industrial boiler equipment to be hydrogen-ready? Please give details for your views.

- Strongly agree
- Agree
- Neither agree nor disagree
- **Disagree**
- Strongly disagree

As per our answer to Q19, we strongly suggest that a mandate for hydrogen-ready boilers may not be the most appropriate solution for decarbonising utilities in all situations particularly on industrial sites with access to CCUS. However, appropriate incentives such as grants may assist with investment cases making the uptake of this technology more likely against other available options.

33. How could the government help supply chain participants to support the deployment of hydrogen-ready boiler equipment?

As per our answer to Q19, we strongly suggest that a mandate for hydrogen-ready boilers may not be the most appropriate solution for decarbonising utilities in all situations particularly on industrial sites with access to CCUS. However, appropriate incentives such as grants may assist with investment cases making the uptake of this technology more likely against other available options.

34. How much time would be needed between the details of regulation being provided and any new requirements coming into effect?

Typically, designing a new furnace, boiler or CHP of say greater than 25 MW from feasibility to commissioning can take 3 years with the addition of a further 2 years for DCO if greater than 50MW. Retrofitting may be faster, but assuming the worst-case scenario, 5 years would be needed to ensure that projects know what to comply from the start of the project.

35. By what date could supply chains enable industrial sites to meet potential new requirements for boiler equipment to be hydrogen-ready? Please give details for your views.

Due to lack of relevant experience, UKPIA is unable to comment on this question.

Section 4.2

36. How could hydrogen-ready requirements for industrial boiler equipment support the following objectives and maximise benefits to the UK economy:

- Jobs and investment
- Export opportunities
- Innovation, knowledge, and technology transfer
- Leadership for standards and regulation

The UK is a world leader in engineering design and construction. Providing appropriate incentives for investment in this technology to encourage uptake would allow this to be extended into the field of hydrogen-ready boilers. This maximises the benefits to the UK economy in all the areas covered above.

37. Do you have any views or evidence regarding work to develop standards or regulation in other countries which would be relevant if the UK were to require industrial boiler equipment to be hydrogen-ready?

The UK has a world class body in BSI which operates in partnership with all stakeholders including government and industry to produce fit for purpose standards. These also engage with stakeholders at a European level, for example CEN and ISO. We would therefore encourage government to adopt the same approach in this regard.

38. Are there any other final comments you wish to make regarding this call for evidence?

UKPIA has no further comments at this time. However, we look forward to receiving the government response to the 2021 low carbon hydrogen consultations in due course, as well as on-going engagement with BEIS in this area.

A description of an industrial boiler would be useful to ensure everyone is responding on the correct basis. The assumption is that an industrial boiler is a boiler used for providing process steam or hot water. All building and space heating including warehouses would be covered under commercial heating systems. This becomes important when considering large sites with self-produced fuels where the process fuel may be different to the non-process fuel supply. If all fuel to a site moves from say natural gas to hydrogen, then this would have wider implications and bring in a lot more package boiler equipment where having hydrogen ready equipment would be beneficial to prevent regretted capital expenditure.

Glossary:

ATR	Autothermal Reforming
CCUS	Carbon Capture, Utilisation and Storage
CEN	Comité Européen de Normalisation
CHP	Combined Heat and Power
CR	Catalytic Reforming
ETS	Emissions Trading Scheme
GHG	Greenhouse Gas
ISO	International Organization for Standardization
LC	Life Cycle
LCH	Low Carbon Hydrogen
RFG	Refinery Fuel Gas
RTFO	Renewable Transport Fuels Obligation
SMR	Steam Methane Reforming
UKPIA	UK Petroleum Industries Association