

CHIP PHASE II

Clarification Question Responses

Clarifying the compressor market (compressors)

Hydrogen purification cost-benefit analysis (purification)

Economic and carbon appraisal of hydrogen distribution routes and buffer storage (distribution)

24th November 2023



| # | Type | Question | Response |
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| 1 | All projects | Are there any of the project deliverables that are intended to be made public? | The outputs of the reports are not planned to be released publicly. On completion of the Phase 2 projects the CHIP steering committee (SteerCo) will discuss whether they see value in sharing any information more widely. |
| 2 | All projects | Will answers to clarification questions be made public or will they only be shared with the bidder asking the question? | All questions will be made public to make sure the process is transparent as possible. |
| 3 | All projects | Could we provide an integrated proposal (for all 3 tenders), or would you like separate proposals? If integrated, does this increase the page limit accordingly? | Please submit separate bids for each project. This helps us to compare bids from organisations that will only bid for one of the three projects available. |
| 4 | All projects | Do you have an envisaged timeline for when you are expecting outputs of the tenders? | Expected timelines for delivery the delivery of each project is detailed in clause 4.6 of the Description of Tender document |
| 5 | All projects | Who is the intended audience and what is the expected distribution of the reports and findings? | The intended audience is our the CHIP SteerCo. Results will be limited to these organisations unless the SteerCo decide to publish these more widely. |
| 6 | All projects | Related to the audience - how likely is the SteerCo membership to change during the course of the work? | New members joining the programme is possible at any point during the delivery of these projects. |

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| 7 | All projects | The CHIP SteerCo will supervise the Project - how often do you expect that the CHIP SteerCo will meet to discuss the projects? | Carbon Trust will act as the nominal managers of the projects on behalf of the SteerCo and will therefore meet regularly with the successful bidders to discuss the projects and feed back and forth between the SteerCo and the successful bidder. However, projects presentations to the CHIP members typically at the end of each work package are a direct way of exchanging feedback between the SteerCo and the successful bidder. If SteerCo input is needed at specific points of the project, please detail in your bid when and what input would be needed. |
| 8 | All projects | The work requires the engagement of wide range of stakeholders in the hydrogen supply chain. Will the Carbon trust provide information of required stakeholders to engage? | We would expect the successful bidder chosen to deliver the work to exploit their own networks to find appropriate stakeholders. |
| 9 | All projects | The different project archetypes cover a number of options – are these the ones to focus on? | The CHIP SteerCo has provided the archetypes to contextualise the scope of each project and ground the work in what we think are reasonable case studies. We would expect each successful bidder as part of WP1 in each project to review these archetypes and challenge the SteerCo on in/exclusion of these archetypes. |
| 10 | All projects | Please could you clarify the units (MW) used for the hydrogen production in Doc <CHIP_P2_Project archetypes_v1(f)_24.10.2023> ? Is it renewable power input, electrolyser size or hydrogen output? | MWs in this context refers to electrolyser size. |

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| 11 | All projects | Could you please confirm the type of hydrogen production to be considered in this study? For example, Electrolytic H2, Blue H2, Methane Pyrolysis, etc.,. In the Doc <CHIP_P2_Project Archetypes_v1(f)_24.10.2023>, only archetypes 5 & 6 are specified as electrolytic, but not 1-4. | Effectively all types of hydrogen production that are able to provide hydrogen that meets the requirements of the Low Carbon Hydrogen Standard (i.e. "meet[s] a GHG emissions intensity of 20 gCO2e/MJLHV of produced hydrogen or less"). In practice the production technologies considered should be determined by market conditions and can be discussed in detail during WP1. |
| 12 | All projects | We will be developing one proposal for the three projects. Is this aligned with Carbon Trust's expectations? | Please submit separate bids for each project. This helps us to compare bids from organisations that will only apply to one of the three projects available. |
| 13 | All projects | In the 'invitation to Tender' documents, at section 6. Bid Pricing, Sub-chapter 6.1 its states that... the Total Budget for the delivery of this project is expected to range between £80k and £100k (excl VAT). Could you please confirm if this budget is allocated to each one of the projects or this is going to be the total amount allocated for all the projects? | Each project has its own budget. The compressors and distribution projects have budgets of between £80-100k while the purification project has a budget of £100-125k. The Phase 2 projects together have a budget of between £260k-325k. |
| 14 | All projects | Regarding the project duration, at the Carbon Trust website there is a timeline (figure below) that based on our understanding the projects are expected to be delivered over the course of 2024, but we couldn't find any further details for the project duration. Can you please provide some more details regarding the project duration and expected delivery dates? | Expected project duration is detailed in Clause 4.6 in each of the Description of Tender documents with key dates for the tender process shown on the first page. |

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| 15 | All projects | Do you require our tender to be drafted in Word or is a Powerpoint-based proposal (PDF'd) equally acceptable? | We have no preference for whether you provide the bid in word or powerpoint format. |
| 16 | All projects | You suggest a project delivery time of 6 months, however are you open to shorter delivery timelines if we believe this is achievable for the deliverables you seek? | We are open to alternative timescales for these projects to that laid out in clause 4.6 of the Description of Tender document. |
| 17 | All projects | If a bidder were to win more than one project and would therefore expect to have economies of scale derived from a single working team across 2 or more projects, how should this be captured? | Please detail any expected economies of scale from delivering more than one project in an additional and separate bid calculation sheet on submission. |
| 18 | All projects | What are the timelines and process for bid evaluation? | The CHIP SteerCo choose the successful bidder based on scoring of the respective proposal documents. The proposals submitted are assessed based upon the evaluation criteria detailed within the ITT document. Once all bids have been scored those highest scoring will be shortlisted and invited to attend a tender interview. During the interview the contractor will present their bid and subsequent methodology in more detail to the CHIP SteerCo, this is designed to allow the CHIP SteerCo to get a better understanding for the proposal and raise any questions they have, this is also an opportunity for the bidder to raise questions. Following the conclusion of these interviews the CHIP SteerCo will decide as to who their successful bidder is. |

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| 19 | All projects | How is it best to reference past relevant work/experience with confidential clients? | Please reference as much of the scope of the projects as possible reference company type for which the study was conducted (e.g. national government, standards body, utility, energy retailer) as well as the region in which the study was carried out. |
| 20 | All projects | All three projects include definition of agreement of the archetypes as WP1. Will there be a need to coordinate between the three projects to ensure that compatible archetypes are used across the projects? | <p>The CHIP SteerCo has provided the archetypes to contextualise the scope of each project and ground the work in what we think are reasonable case studies. We would expect each successful bidder as part of WP1 to review these archetypes and challenge the SteerCo on in/exclusion of these archetypes.</p> <p>As a result, there is no requirement for each project to examine the same archetypes – only archetypes that will be most relevant to the project objectives.</p> <p>If a single successful bidder wins two or more of the projects, we expect some coordination to occur across the projects but this is not essential.</p> |
| 21 | Compressors | What is the significance of the site boundary? Should the hydrogen compressor within the site boundary only be considered? i.e., archetype 6 would require other compressors outside the boundary so can we assume that these would be included? | As the supply chain archetypes are used across all three projects, the site boundary can be more or less significant depending on the project. In this case we would be interested in the compressors used outside the site boundary. More generally we would expect the successful bidder to explore these definitions during WP1. |
| 22 | Compressors | In the Doc <CHIP_P2_Project Archetypes_v1(f)_24.10.2023> , Which industrial end-user is typically being taken into account? I.e. ammonia synthesis plant, methanol synthesis plant, gas boiler, furnace. | The CHIP SteerCo has provided the archetypes to contextualise the scope of each project and ground the work in what we think are reasonable case studies. If there are relevant differences in the compression needs between these industrial end-users we would expect this to be explored in WP1. |

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| 23 | Compressors | Please can you define the use of distribution pipeline - would the hydrogen be injected into the distribution network or a specific/designed pipeline? | Distribution pipeline refers to hydrogen distribution pipeline rather than natural gas distribution pipeline – i.e. blending is not the focus of these projects. Repurposed natural gas pipelines carrying hydrogen would be in scope. |
| 24 | Compressors | If this happens to be the electrolytic H2, which type of electrolyser would be preferred in this study? i.e., Low Pressure Alkaline or PEM, High Pressure Alkaline or PEM, SOEC. Different type of electrolysers will produce hydrogen at different pressures. | We would expect bidders to specify the technologies they think are most relevant to the archetypes and more widely to the project. Specific technologies can be explored during the project as part of WP 1. |
| 25 | Compressors | In the Doc <CHIP_P2_Project Archetypes_v1(f)_24.10.2023> , what is the max pressure that the hydrogen refuelling station needs to take into consideration in this study? i.e. 500 bar, 700 bar ? | We would expect the successful bidder to define how relevant the pressures expected at refuelling stations would be to the study during WP1. |
| 26 | Compressors | What definition of TRL 7 have you used? | We have used UKRI's definitions that can be found here . Close-to-market technologies should be the focus. |
| 27 | Compressors | We note that you describe the compressor use cases as being linked to small and medium scale assets. Given that NGT and SSE Thermal are two of the key CHIP partners, we would have assumed that they are much more interested in transmission-scale compressors. Can you please clarify the specific interest they are seeking given this? | The CHIP steering committee decided to focus on small to medium scale assets due to their applicability across all the members' areas of strategic interest. |

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| 28 | Compressors | <p>We would like to clarify the approach regarding large-scale compressors. Archetypes 4 – 6 in the accompanying document include large scale salt cavern storage, which requires large-scale compressors to operate.</p> <p>Assessing the market for these large-scale compressors would be important to understand the viability of these archetypes. However, the WP2 description states that the study should focus on ‘small-medium scale applications’ and that compressors for ‘transmission scale applications’ should be excluded.</p> <p>Please could you confirm whether the large-scale compressors required for hydrogen storage in salt caverns should be included in the project scope?</p> | <p>The CHIP SteerCo has provided the archetypes to contextualise the scope of each project and ground the work in what we think are reasonable case studies. We would expect each successful bidder as part of WP1 in each project to review these archetypes and challenge the SteerCo on in/exclusion of these archetypes.</p> |
| 29 | Distribution | <p>What is the expected use of the excel outputs from the study and how widely will these be distributed?</p> | <p>The expected benefits of the project are stated in clause 2.6 of the Description of Tender document. The provision of excel cost models for distribution and storage (D03 and D06) should enable CHIP members to use these models for internal work in future.</p> <p>The results will be limited to our Steering Committee members unless the Steering Committee decide to publish these more widely.</p> |
| 30 | Distribution | <p>Will any data for input into the CBA analysis be proposed (eg from earlier studies) or offered by the CHIP stakeholders or must the successful bidder generate all of this information?</p> | <p>We would expect the successful bidder to generate the required inputs for the CBA analysis. Provision of data from the CHIP members is not guaranteed but could be negotiated if our members see extra value in providing this.</p> |

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| 31 | Distribution | How should geography [be considered] as a variable in WP2 – is this purely on the cost of pipelines or restriction on land or will other H2 distribution options such as shipping or rail tankers need to be considered? | <p>Geography should be considered in terms of the possible effects on distribution distance and capacity. For example, consideration of the limits of road infrastructure for tube trailering and how they might impact tipping points with other distribution technologies would be useful.</p> <p>The main distribution technologies considered should centre on pipelines and tube trailering (road), but if shipping or rail tankers could be viable / competitive in certain locations consideration of these options at a high level would be beneficial.</p> |
| 32 | Distribution | Several of the CHIP Supply Chain Archetypes mention increasing demand implying a growth in H2 production or usage – does the Carbon Trust have a timescale in mind for the period to be modelled in the CBA and an idea of the scale of growth to be modelled? | <p>CHIP is focussed on the near-term innovation in the three projects scoped and therefore we are most interested in the next 3-5 years, with 2030 being the maximum timescale of interest.</p> <p>We would expect successful bidders to appraise the archetypes based on these timeframes to select archetypes that are appropriate to the project aims and based on expected market development over this period.</p> |

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| 33 | Distribution | <p>We would like to understand better the scope and aims of the study's objective: "To understand the commercial case for onsite buffer storage of compressed hydrogen, provided by either tube trailer, compressed gas storage tanks or other relevant technology."</p> <p>We are unclear to what extent we should assess and compare underground and chemical storage technologies within the scope of 'buffer storage'. For example, Archetypes 4 – 6 all consider H2 storage in salt caverns available to provide ~10,000 tonnes of storage. There are alternative underground and chemical storage options that could provide c. 100 – 1,000 tonnes of storage to serve scale needs between the ~10,000 tonne salt caverns and < 5 tonne compressed hydrogen storage included within the draft archetypes. Should these options be considered within this study?</p> | <p>The CHIP SteerCo has provided the archetypes to contextualise the scope of each project and ground the work in what we think are reasonable case studies. While WP1 will present an opportunity to refine the archetypes used in the study, other storage technologies can be considered at a high level but the focus of this project should be the storage of gaseous hydrogen.</p> |
| 34 | Purification | <p>What technologies are being considered for hydrogen production? Green hydrogen or blue hydrogen or both. The production method will influence the type and concentration of impurities that will impact on purification options. We note that in the INA report the main production considered is Autothermal Reforming and electrolytic systems. Are these the main two to consider?</p> | <p>Effectively all types of hydrogen production that are able to provide hydrogen that meets the requirements of the Low Carbon Hydrogen Standard (i.e. "meet[s] a GHG emissions intensity of 20 gCO2e/MJLHV of produced hydrogen or less").</p> <p>In practice the production technologies considered should be determined by market conditions and can be discussed in detail during WP1.</p> |

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| 35 | Purification | Will H2 production scenarios need to consider variable/intermittent production? (eg green H2 from solar or wind) | Yes. |
| 36 | Purification | Definition of 'close-to-market purification technologies' – what TRL does this correspond to? | TRL 7-9. We have used UKRI's definitions that can be found here . |
| 37 | Purification | The purity level 99.999% is higher than current ISO-14687 specification. Is this higher purity grade a target for future or is 99.97% more pragmatic? | Reference to purity bands "likely to become industry standard" is made in the scope document and therefore this is exactly the type of question we would expect successful bidders to explore in WP1 to help scope and bound the study. |
| 38 | Purification | [Are] there any scenarios where hydrogen purification for rail or maritime applications should be considered? The archetypes appear to focus on road transport. | If the purification needs for these forms of transport are significantly different from those in road transport, then yes. |
| 39 | Purification | Pipelines are assumed to be repurposed from the existing natural gas network. Low level contamination is expected to be present in the networks for several years after conversion, does this impact on the purity range for archetypes that look at pipeline delivery options? | As part of WP1 we would expect the successful bidder to appraise the high-level implications of these type of issues to understand whether these impurities would effect the purity required by end users. |
| 40 | Purification | Is there a requirement to consider the environmental performance of purification technologies, as well as cost and efficiency? There may be waste or emissions that are higher for some technologies compared to others. | The Description of Tender documents states " <i>This review should assess the status of current technologies including (but not limited to)...</i> " – environmental performance would be a useful addition to the listed factors. |

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| 41 | Purification | <p>There's no mention of odorisation in the tender. Is the study focusing on transmission pipelines rather than distribution? We assume that hydrogen in distribution networks will be odorised in the same way as natural gas is at present. We note that in the INA report odorants were excluded by the Steering Committee, but we feel that purification systems should consider odorant removal.</p> | <p>The study is not focussing on one type of pipeline or the other. If odorisation is expected to cause issues with impurities, we'd expect this to be examined.</p> |
| 42 | Purification | <p>For the project No.2 'Hydrogen purification cost-benefit analysis', what is the origin of hydrogen? Is the project focused on a specific hydrogen production technology (such as electrolysis or Methane Steam Reforming) or the scope of the project is the understanding of the purification technologies for various hydrogen production methods? Or are we just focusing on hydrogen from water electrolysis?</p> | <p>Effectively all types of hydrogen production that are able to provide hydrogen that meets the requirements of the Low Carbon Hydrogen Standard (i.e. "meet[s] a GHG emissions intensity of 20 gCO₂e/MJLHV of produced hydrogen or less").</p> <p>In practice the production technologies considered should be determined by market conditions and can be discussed in detail during WP1.</p> |

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| 43 | Purification | <p>Related to Question 2, we would like to clarify whether we should consider chemical storage, especially in Archetype 5.</p> <p>The chart in the accompanying document seems to refer only to gaseous storage in salt caverns but the reference to "Power to X to Power" suggests you may be interested in other forms of storage, e.g. liquid organic hydrogen carriers, ammonia, methanol etc. The choice of storage medium has implications for the possible contaminants present in the hydrogen when extracted and may require the use of separation as well as purification equipment.</p> <p>Should these options be considered in the study and, if so, do you have a view on which storage media we should consider?</p> | <p>The CHIP SteerCo has provided the archetypes to contextualise the scope of each project and ground the work in what we think are reasonable case studies. While WP1 will present an opportunity to refine the archetypes used in the study, the focus of this project should be the purification of gaseous hydrogen.</p> |

carbontrust.com

+44 (0) 20 7170 7000

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