		1 and 2	Lot 1 and 2 separately

The requirements apply in both England and Wales, therefore Welsh Government are key stakeholders to the project and will be involved in the project meetings with BEIS. The Environment Agency and Natural Resources Wales will be developing the guidance for industry based on the evidence gathered in these studies, and so they are also important stakeholders and will be involved closely in the project.

2. Aims and Objectives of the Project - Lot 1 – Hydrogen readiness

Aim: to create an evidence base which can be used to define the requirements for demonstrating hydrogen readiness and inform guidance.

Hydrogen readiness will likely be demonstrated through five different assessments, listed below.

1. that sufficient space is available on or near the site to accommodate any equipment necessary to facilitate hydrogen conversion;
2. that it will be technically feasible to convert the site to 100% hydrogen-firing.
3. that the site's location enables the transport of hydrogen to the site and/or that hydrogen can be produced and potentially stored at the site; and
4. that it is likely to be economically feasible, within the power station's lifetime, to convert to hydrogen combustion.
5. that the plant will be technically capable of firing a blend of hydrogen on the day it is put into operation.

Each of these assessments will require supporting evidence, therefore we have linked one objective to each of the five assessments, as set out below.

Objective 1 – linked to assessment 1

To identify the equipment which a hydrogen combustion plant will require that differs from a typical combustion plant, and the spatial footprint associated with each piece of equipment. This may need to be split out based on the combustion technology (e.g. engine, turbine, boiler, CHP) and the fuel (e.g. gaseous fuel, liquid fuel, biomass or waste).

Below we have provided a non-exhaustive list containing some examples of the additional space requirements which may need to be considered for a hydrogen combustion plant:

- Hydrogen storage equipment
- Increased pipeline infrastructure
- Increased road traffic / vehicle access
- Modifications to the combustion site to enable hydrogen combustion
- Potential safety requirements resulting from the use of hydrogen e.g. increased separation between pipelines and buildings.

Objective 2 - linked to assessment 2

To produce a checklist of the technical changes required to convert a plant to hydrogen combustion. This may need to be split out based on the combustion technology (e.g.

engine, turbine, boiler, CHP) and the fuel (e.g. gaseous fuel, liquid fuel, biomass or waste).

Below we have provided a non-exhaustive list containing some examples of the technical challenges which may need to be addressed for a hydrogen combustion plant:

- Hydrogen fuels have the potential to produce significant emissions of oxides of nitrogen, requiring additional modifications and / or abatement technology.
- Depending on the amount of hydrogen in the fuel supply, the resultant combustion may burn hotter than other fuels. Therefore, the materials of construction used for equipment associated with combustion may need to upgrade to handle the higher temperatures.
- Hydrogen combustion may require amendments to the operational routines or combustion systems to ensure flame stability.
- Hydrogen may need higher pressures than natural gas or other fuels due to greater volume flow.
- Hydrogen molecules can be more prone to leakage than other gaseous fuels. Therefore, additional safety and measurement process may be needed.
- Hydrogen has the potential to embrittle some material more than other gaseous fuels do, therefore piping may need to be modified or managed.
- The flow rate and air fuel ratio of the combustion process may need to be altered.
- Redesign of the combustion controls and software may be needed.
- The low lubricity and viscosity of hydrogen can cause additional problems in fuel systems.
- Additional safety measures may be needed for hydrogen combustion, compared to natural gas.
- Hydrogen combustion may lead to greater amounts of water vapour in flue gases, creating knock-on issues which require management e.g. more rapid corrosion of exhaust equipment.
- There may be increased safety requirements due to the use of hydrogen.

<u>Objective 3 - linked to assessment 3</u>

This bulk of the evidence base for this assessment, i.e. the likely location of a hydrogen network, is dependent on policy and therefore does not require research. But we are interested in the alternative options for hydrogen fuel access, beyond connection to a hydrogen network, to understand whether any of these options could be viable in the future.

Therefore the objective is to research the alternatives to pipeline hydrogen fuel access e.g. on-site production, on-site storage, transport by road etc. and to determine their potential for the future. This may need to be split out based on the combustion technology (e.g. engine, turbine, boiler, CHP).

<u>Objective 4 - linked to assessment 4</u>

To make estimates of the additional capital costs (including opportunity costs - e.g. outages whilst retrofitting) and the additional operational costs (e.g. plant machinery, increased costs of leakage monitoring, NOx abatement equipment, increased safety requirements) of converting the a plant to hydrogen firing.

The costs may need to be split out based on the combustion technology (e.g. engine,

turbine, boiler, CHP) and the fuel (e.g. gaseous fuel, liquid fuel, biomass or waste). They should also be provided in figures of £/MW so that they can be scaled. Or disaggregated into size categories of plants e.g. 0-50MW, 50-300MW, >300MW etc.

Objective 5 - linked to assessment 5

The proportion of hydrogen blend required as part of this assessment will vary depending on the date of construction. We need to gather evidence to set the trajectory.

Therefore, the objective is to estimate the dates by which combustion technologies that can fire increasing blends of H2 (e.g. 20%, 50%, 100%) will be available from manufacturers. This may need to be split out based on the combustion technology (engine, turbine, boiler, CHP or heat generation).

3. Aims and Objectives of the Project - Lot 2 – Carbon capture readiness

Aim: to update and expand the evidence base which is used to define the requirements for demonstrating carbon capture readiness and inform guidance

Unlike hydrogen, we have a pre-existing evidence base for carbon capture readiness that was develop to support the 2009 guidance. This evidence base needs to be refreshed and expanded, as plants below 300MW and new plant types (e.g. CHP, EfW and biomass) may now be assessed for carbon capture readiness.

Carbon capture readiness will be demonstrated through the five different assessments below. These assessments differ from the hydrogen assessments.

1. that sufficient space is available on or near the site to accommodate carbon capture equipment in the future;
2. that it is likely to be technically feasible to retrofitting their chosen carbon capture technology;
3. that a suitable area of deep geological storage offshore exists for the storage of captured CO_2 from the proposed power station;
4. that it is likely to be technical feasible to transport the captured CO_2 to the proposed storage area; and
5. the likelihood that it will be economically feasible within the power station's lifetime, to link it to a full CCS chain, covering retrofitting of capture equipment, transport and storage.

Three of these assessments will require supporting evidence, therefore we have linked one objective to each of these three assessments, as set out below.

Objective 1 – linked to assessment 1

To update and expand the land footprint estimates for a carbon capture site

Existing land footprint estimate for carbon capture plant >300MW will need to be updated. Estimates of land footprint will also need to be made for carbon capture sites <300MW. These may need to be broken down by the technology type (e.g. engine, turbine, boiler, CHP) and the fuel (e.g. gaseous fuel, liquid fuel, biomass or waste).

Objective 2 – linked to assessment 2

To update the checklists in the 2009 guidance document (Annexes 1A-1C), ensuring that

they cover:

- plant <300MW
- All relevant technology types (e.g. engine, turbine, boiler, CHP or heat generation)
- All relevant fuel types (e.g. gaseous fuel, liquid fuel, biomass or waste).
- Load factors and operating patterns (if relevant).
- Any new CCS technologies which have been developed since 2009.

Objective 3 – linked to assessment 5

To make estimates of the parameters which will be needed to model the economics of a plant fitted with CCS. In particular the capital and operating costs of:

- retrofitting CCS equipment
- transporting and storing CO_2
- additional operational costs arising from the operation of CCS equipment.
- Opportunity costs e.g. due to outages whilst retrofitting.

These costs may need to be split out based on the combustion technology (e.g. engine, turbine, boiler, CHP), fuel type (e.g. gaseous fuel, liquid fuel, biomass or waste), CCS technology (pre-combustion / post-combustion / oxy-fuel / other), size of plant and load factor/operating pattern. They should also be provided in figures of £/MW so that they can be scaled. Or disaggregated into size categories of plants e.g. 0-50MW, 50-300MW, >300MW etc.

4. Suggested Methodology

We anticipate that both literature reviews and qualitative research methods (interviews, workshops, focus groups etc.) will be needed in order to gather all of the evidence required to support the assessments. Suppliers are free to choose the methodology which they think is most appropriate for the task. Below is an indicative outline of one possible methodology which could be used.

Scoping - Identification of literature sources, stakeholders for interview and qualitative analysis methods.

Literature review - A thorough literature review of, for example, academic journal articles and references documents.

Qualitative data gathering - Interviews / workshops / focus groups held with stakeholders to fill the evidence gaps in the literature review.

Analysis - Feedback from the stakeholders analysed and synthesised with the literature from the literature review.

Write up - The findings of the studies written up into concise and clear reports.

5. Deliverables

Bidders should note that BEIS will own the intellectual property rights of any and all intermediate products, including final deliverables, and in particular including presentation slide packs, reports and data.

In terms of deliverables, we expect the findings of each study to be summarised into a single report that will be submitted to BEIS for review in draft format halfway through the project, and as a final version at the end of the project. The findings should also be presented to BEIS at the interim and final meetings.

Below we have provided an indicative summary of what the report should contain at a minimum.

Lot 1 – Hydrogen readiness – indicative report contents

- Tables demonstrating the spatial footprint of each additional component of a hydrogen firing site.
- Checklists which can be used to assess whether it would be technically feasible for a site to convert to 100% hydrogen.
- A brief report on the feasibility of other forms of hydrogen fuel access.
- Tables containing estimates of the costs of converting a plant to hydrogen firing.
- A brief report estimating when combustion equipment capable of firing increasing proportions of hydrogen will be available on the market.

Lot 2 – Carbon capture readiness – indicative report contents

- Updated and expanded table showing the land footprint of a carbon capture plant.
- Updated checklists which cover the technical feasibility of carbon capture retrofit.
- Tables containing estimates of the capital and opportunity costs (i.e. outages) of converting a plant to CCS, and of any additional operational costs that may result from using CCS equipment. This may need to be broken down into technologies, fuels, size categories and load factors / operational patterns.

Meetings

For both lots, we expect regular catch-ups to be held between the BEIS project manager, Welsh Government, the Environment Agency, Natural Resources Wales and the contractor. We also expect there to be three formal meetings held for each lot:

1. An inception meeting at the start of the project, to agree the methodology and scope

2. An interim progress meeting halfway through to discuss the interim report

3. A final meeting to discuss the final report and conclusions

The supplier should be accessible throughout the duration of the contract.

Quality Assurance

Bidders must set out their approach to quality assurance (QA) in their response to this ITT with a QA plan.

Sign-off for quality assurance must be done by someone of sufficient seniority within the contractor organisation to be able to take responsibility for the work done. Acceptance of the work by BEIS will take this into consideration. BEIS reserves the right to refuse to sign off outputs which do not meet the required standard specified in this invitation to tender and/or the contractor's QA plan. QA should cover all aspects of the project undertaken by the contractors, including data collection, data analysis and reporting.

To demonstrate an effective process to produce high quality reporting, the contractor/s must ensure that quality assurance is done by individuals who were not directly involved in that particular research, analysis, or reporting process.

Bidders should note that BEIS may appoint its own peer reviewer(s) to QA publishable outputs. Consideration should be given to how the external peer reviewer(s) will be included in the QA process.

Where complex or innovative methods are proposed, bidders should specify how additional quality assurance will be provided. Where necessary, this should include the use of external experts. A BEIS-appointed peer reviewer will not be expected to provide detailed quality assurance as their role will be focused on higher level peer review.

Outputs will be subject to BEIS internal approvals, and the more substantive the output the longer the approval time required.

The successful bidder will be responsible for any work supplied by sub-contractors. For primary research, contractors should be willing to facilitate BEIS research staff attending interviews as part of the quality assurance process if appropriate.

Other useful sources of guidance and advice that will help bids and the resulting work be of the highest quality include:

- The BEIS Monitoring and Evaluation Framework, which sets out BEIS's ambitions and standards for monitoring and evaluation
- The Government Social Research Code, in particular those that relate to GSR Products
- Quality in Qualitative Research: A Framework for assessing research evidence provides a Framework for appraising the quality of qualitative research

Working Arrangements

The successful contractor will be expected to identify one named point of contact through whom all enquiries can be filtered. A BEIS project manager will be assigned to the project and will be the central point of contact.

Where a consortium or sub-contractors are in place, BEIS expect that they are included in relevant meetings, workshops and review points to ensure their full engagement in the project. All contractors and sub-contractors are responsible for the delivery of outputs to the appropriate time and quality. It is expected that the lead contractor takes an active role in oversight of all workstreams and bears the overall responsibility for the delivery of the evaluation activities and outputs.

Bids should assume that BEIS take an active role in review and quality assurance of research materials, analysis and outputs, beyond external peer review. It should be expected that research materials and outputs go through at least three iterations (i.e. two rounds of comments from BEIS). BEIS will expect more complex research instruments to be tested before going into the field fully. Additional amendments may be required for published outputs.

We expect the appointment offer to be confirmed in January 2022. Note that bidders must be available to attend an inception meeting in January 2022.

We envisage the need for close interaction between the BEIS Project Manager and

contractor throughout the process, to ensure that emerging issues are dealt with promptly and that BEIS fully understand the assumptions and approach taken. Bidders should assume that engagement with BEIS will include fortnightly project management phone calls, weekly progress updates, and any ad hoc meetings as required to design and deliver the project. Throughout the project, BEIS will review and sign off all final data collection instruments and analytical approaches (including key assumptions, surveys and interview questions) before they can be used. BEIS will also review and sign off all outputs.

Skills and expertise

BEIS require you to demonstrate that you have the necessary expertise and capabilities to undertake the project. Your tender response should include a summary of the project team's skills and capabilities, both in terms of evaluation skills and energy policy expertise.

Challenges

There may be a number of challenges in conducting this evaluation; some are detailed in the following section. Bidders must explain how these and any other challenges will be addressed through the project's design and delivery. Bidders must also set out any support that they will need from BEIS in delivering the aims and objectives of the studies.

Timing of outputs

Bidders should consider how they can deliver outputs to the proposed timetable. Bidders are welcome to propose innovative methods and outline a delivery plan which splits the required activities in stages to meet the requirement.

Engaging stakeholders

Bidders should explain how best to maximise the input from stakeholders

Ethics

All applicants will need to identify and propose arrangements for initial scrutiny and on-going monitoring of ethical issues. The appropriate handling of ethical issues is part of the tender assessment exercise and proposals will be evaluated on this as part of the 'consideration of challenges' criterion.

We expect contractors to adhere to the following Government Social Research (GSR) Principles:

- Research should have a clear user need and public benefit
- Research should be based on sound research methods and protect against bias in the interpretation of findings
- Research should adhere to data protection regulations and the secure handling of personal data
- Participation in research should be based on specific and informed consent
- Research should enable participation of the groups it seeks to represent
- Research should be conducted in a manner that minimises personal and social harm

Data security

No security clearance will be needed by the suppliers.

Price and payments

The maximum budget for this project is £80,000 excluding VAT. This is £40,000.00 excluding VAT for Lot 1 and £40,000.00 excluding VAT for Lot 2. Cost will be a criterion against which bids will be assessed. The budget must be spent before the end of financial year 2021/22

Contractors should provide a full and detailed breakdown of costs. This should include staff (and day rate) allocated to specific tasks.

In submitting full tenders, suppliers confirm in writing that the price offered will be held for a minimum of 60 calendar days from the date of submission. Any payment conditions applicable to the prime contractor must also be replicated with sub-contractors.

The Department aims to pay all correctly submitted invoices as soon as possible, within 30 days from the date of receipt, in line with standard terms and conditions of contract.

Timetable

Contractors must demonstrate that they can meet the following provisional timetable for the delivery of the evaluation:

Timeline	Details
2022 January	• Project scoping and planning completed • Inception meeting held
2022 February	• Literature review completed • Interim report to BEIS • Interim meeting held
2022 February	• Qualitative research completed
2022 March	• Analysis completed • Final report submitted to BEIS • Final meeting held

Terms and Conditions

Bidders are to note that any requested modifications to the Contracting Authority Terms and Conditions on the grounds of statutory and legal matters only, shall be raised as a formal clarification during the permitted clarification period.

Annex B – Bid Response.

For and on behalf of **AECOM Limited (The Supplier)**

Signed [redacted]

Name

Position

Date .....

For and on behalf of **The Department for Business, Energy and Industrial Strategy (BEIS) (The Contracting Authority)**

Signed [redacted]

Name

Position

Date

THIS IS THE LAST PAGE OF THESE TERMS & CONDITIONS