**Specification for Net Zero power and hydrogen: capacity requirements for flexibility**

Tender Reference Number: CN/1221

**Specification of Requirements**

Invitation to Tender for: Net Zero power and hydrogen: capacity requirements for flexibility

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Deadline for Tender Responses: 25 January 2022

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**1 Introduction and summary of requirements / Preamble**

This research is being commissioned by the Climate Change Committee (CCC). The CCC was set up as part of the Climate Change Act and is an independent body tasked with providing advice to Government on climate change issues, particularly the setting of carbon budgets for the UK and monitoring of progress towards meeting them.

The project focuses on understanding the range of options required to balance a renewable-based electricity system that is fully decarbonised by 2035. A particular area of focus is the interactions between power and hydrogen in enabling this.

# 2 Background

The Climate Change Act sets legally-binding targets for the UK’s greenhouse gas emissions. It includes a 2050 target for Net Zero emissions by 2050 compared to 1990 levels, and a series of five-yearly carbon budgets towards that 2050 target.[[1]](#footnote-1)

In 2020 the CCC advised the Government that the Sixth Carbon Budget, covering the period 2033-37, should be set at 78% below 1990 levels.[[2]](#footnote-2) And that the UK’s Nationally Determined Contribution (NDC) to the UN global process should be a 68% reduction in greenhouse aas emissions below 1990 levels by 2030.[[3]](#footnote-3)

The Government have accepted both these recommendations, and legislated the Sixth Carbon Budget in June 2021.

Underpinning the CCC’s advice on the Sixth Budget and the NDC was a set of scenarios for emissions from electricity generation to 2050.[[4]](#footnote-4) These informed a recommendation to Government, as part of the advice, that use of unabated gas for electricity generation should be phased out by 2035 - meaning all electricity generation would be low-carbon from that date. In its Net Zero Strategy the Government have now adopted that target.[[5]](#footnote-5)

A core duty of the CCC under the Climate Change Act is to publish an annual report for Parliament monitoring progress towards meeting carbon budgets.[[6]](#footnote-6)

The CCC has previously developed a set of tracking indicators to monitor progress on an annual basis. For the 2022 Progress Report the CCC will be refreshing these indicators, in light of the new Net Zero and Sixth Carbon Budget targets.

As part of this process the CCC would like to produce new indicators focusing on the capacity deployment pathway for schedulable low-carbon generation and for other sources of flexibility, including interactions with the production of hydrogen.

# 3 Aims and Objectives

This project focuses on understanding the range of options required to balance a largely renewables-based electricity system that is fully decarbonised by 2035. A particular area of focus is the potential for coupling of the power and hydrogen sectors in enabling this.

The outputs of the project will form part of the evidence base for the CCC’s next progress report to Parliament, which will be published in June 2022.

The aims of the project are to:

* Characterise the range of capacity required in 2035 for the full suite of flexible low-carbon solutions, including schedulable low-carbon generation, storage, and demand. This should be broadly consistent with the energy mix in the CCC’s Balanced Pathway (see section 4), including the phase out of unabated gas by 2035.
  + **Schedulable low-carbon generation:** Hydrogen-fuelled electricity production, gas with carbon capture and storage (CCS), and bioenergy with CCS (BECCS). This could also include nuclear generation, to the extent that makes economic sense to run flexibly.
  + **Energy storage:** Batteries, pumped hydro, and potentially other novel types of storage (e.g. Liquid Air Energy Storage (LAES), Compressed Air Energy Storage (CAES)).
  + **Hydrogen production from electricity:** Grid-connected electrolysers, and hydrogen storage requirements.
  + **Flexible demand:** The extent to which demand for electricity in different sectors can practically be shifted in time in light of variations in the availability of power from renewables.
* Understand the implications of a fully decarbonised power system for hydrogen production, storage and utilisation, including identifying the likely range of cost-effective deployment of grid-connected electrolyser capacity.
* Investigate sensitivity scenarios (to be agreed with the CCC) for security of supply and weather, to ensure pathways are robust to the range of potential outcomes for these. That includes wind droughts, and demand impacts of cold weather periods.
* Develop indicator trajectories for the capacity deployment of flexibility options on the pathway to 2035, including for the cumulative total and the capacity entering planning and construction, where appropriate.
* Identify the high-level policy milestones and timings necessary to enable delivery of these indicator pathways, along with any dependencies on enabling infrastructure.
* Identify any differences in approach required across the devolved administrations and their implications.

The focus of the project is on the period to 2035 (i.e. the Sixth Carbon Budget), but we expect any modelling to be undertaken to 2050. Bidders are invited to set out alternatives approaches if this is not feasible within their modelling framework.

# Methodology

This project contains two components:

* **Task 1:** Characterise the range of generation capacity, flexible demand and electricity production required on the pathway to 2035 for:
  + **Task 1.1:** The full suite of flexible low-carbon electricity options, including schedulable, flexible low-carbon generation, storage, and demand.
  + **Task 1.2**: Grid-connected electrolyser deployment and associated hydrogen storage requirements.
* **Task 2:** Develop indicator trajectories for these options on the pathway to 2035, addressing capacity development requirements and policy dependencies.

Task 1 is the primary focus of the project, and we would expect this task to comprise the majority of the project.

Task 1

*Modelling capability*

This task requires a coupling of power and hydrogen systems. That means:

* Using hydrogen in a way that helps integrate renewables in the power system by providing low-carbon schedulable generation that is capable of running flexibly, particularly at times of peak residual demand.
* Making use of ‘surplus’ electricity in a way that:
  + Helps roll-out grid-connected hydrogen production cost-effectively to meet wider hydrogen demand.
  + Contributes to the business case for development of hydrogen storage that can help meet short-term and seasonal hydrogen demand, particularly from hydrogen-fuelled electricity production.

As such, we expect the power and hydrogen analyses (Tasks 1.1 and 1.2) to be undertaken in parallel, in order to reflect these interactions. That could be within an integrated energy system model, or an electricity model accompanied by off-model hydrogen analysis and feedbacks.

We would expect the electricity analysis for this task to have the functionality to:

* Produce outputs including for GB electricity production from different sources on an hourly or half-hourly basis across the whole year.
* Incorporate feedbacks with hydrogen production and utilisation decisions, either endogenously or as a separate linked component (see Task 1.2).
* Output a range of additional information including on curtailment, wholesale electricity market and system costs, GB territorial carbon emissions from electricity production, and peak demand.

We would expect the following flexibility options to be explicitly modelled, including:

* **Schedulable, flexible low-carbon generation:** Hydrogen-fuelled electricity production, fossil gas with CCS, and BECCS, designed in a way to operate flexibly. We would not expect new-build unabated biomass plants, but these should be modelled to the extent they do not convert to BECCS or until they retire.
* **Energy storage:** Batteries, pumped hydro, and potentially other novel types of storage (e.g. Liquid Air Energy Storage (LAES), Compressed Air Energy Storage (CAES), hydrogen fuel cells).
* **Hydrogen production from ‘surplus’ electricity (see Task 1.2):** Grid-connected electrolysers and hydrogen storage requirements (differentiating between short-term and seasonal hydrogen storage).
* **Demand:** Including flexibility from heat pumps and electric vehicles.
* **Interconnection:** Via current and planned interconnectors.

The CCC will provide input assumptions for the analysis on:

* Annual demand for electrical energy broken down into different sectors including for buildings and transport (including the potential for demand shifting from these sectors). However, contractors will need to convert this into hourly or half-hourly profiles consistent with their model and to clearly demonstrate credible methods and data sources for doing so.
* Carbon and fuel prices.
* Future interconnector capacity.
* Annual demand for hydrogen (in sectors other than electricity generation, see Task 1.2).

*Task 1.1*

The aim of this task is to characterise the range of capacity and generation required on the pathway to 2035 for the full suite of flexible low-carbon electricity options, including schedulable low-carbon generation, storage, and demand.

* Using the model of the electricity system described above, determine the capacity range for the flexibility options in 2035 that are required to balance the system, and their optimal deployment path, such that unabated gas can be phased out by 2035 while ensuring security of supply.
  + The optimal deployment path is one that minimises overall energy and system costs while phasing out unabated gas by 2035, subject to a carbon price and within feasible limits for build rates.
  + The analysis should be constrained around CCC assumptions for ‘non-flexible’ capacity and/or generation (e.g. renewables and nuclear) from the Sixth Carbon Budget Balanced Pathway. Bidders should propose a method for how this will be implemented.
  + The capacity range should be developed by flexing demand assumptions around this central supply-side scenario. The CCC will provide these inputs.
  + The security of supply standard should be a loss of load expectation of no more than three hours per year.
* Undertake a minimum of ten sensitivity scenarios on aspects of security of supply, to be developed in conjunction with the CCC and including on:
  + Different levels of electricity demand.
  + Resilience to wind droughts and weather impacts on demand.
  + Use of unabated gas, should this be required to ensure security of supply outside an average weather year.
  + Use of flexibility options and unabated gas in the context of limited hydrogen availability.
  + Solving for security of supply obligations on a generator (and potentially Supplier) basis, as opposed to at a system level.

Bidders should set out the cost of running additional sensitivity scenarios beyond the minimum of 10 specified above.

The modelling for this task should reflect the fundamental underlying costs of the different technologies and options, and should therefore be independent of the market arrangements in place at a given time.

*Task 1.2*

Understand the implications of a fully decarbonised power system for hydrogen production, which should include identifying a cost-effective level of grid-connected electrolyser capacity, use of hydrogen in electricity production, associated hydrogen storage requirements in 2035, and the pathway to that.

* The Sixth Carbon Budget analysis assumed electrolytic hydrogen is produced using ‘surplus’ electricity generation, complementing production of hydrogen from other low-carbon sources to ensure hydrogen demand is met on an annual basis. However, it did not estimate the precise level of hydrogen storage capacity that could be required.
* This task, in conjunction with Task 1.1, should identify the level of electricity production that could be used for hydrogen production, the level of electrolyser capacity required, and the potential volume of hydrogen to be used in production of electricity. An assessment should be made of the total hydrogen storage required to support that.
  + The optimal green hydrogen production pathway is one that cost-effectively utilises ‘surplus’ electricity within build rate limits.
  + The hydrogen production pathway and cost-effective deployment of electrolyser capacity should consider hydrogen production costs, given load factors associated with using ‘surplus’ electricity, relative to those of alternative hydrogen production approaches, such as methane reformers and dedicated renewable electrolysis paired with wind farms.
  + The modelling should identify the seasonal storage of electrolytic hydrogen required to meet hydrogen demand, particularly from the power sector and ideally on a half-hourly or hourly basis. Storage requirements would reflect hydrogen use and the profile of that use, as well as any excess of production over demand, within and across years. Bidders should suggest an approach to identify hydrogen storage requirements consistent with their modelling approach.
* The CCC will provide inputs on the wider hydrogen system, including:
  + Annual hydrogen demand for sectors other than power, and production delivered by alternative hydrogen production technologies. Consultants would be expected to convert this into half-hourly or hourly profiles in collaboration with the CCC, consistent with their modelling approach.
  + Outline assumptions on costs and main technical characteristics of hydrogen production technologies (i.e. electrolysers, methane reformers, and biomass gasification).
* The findings of this analysis should reflect the same sensitivities as outlined in Task 1.1.

Task 2

Develop indicator trajectories for the pathways identified in Task 1.1 and 1.2. The CCC indicator framework distinguishes between four types of indicator, of which the following two are the focus of Task 2:

* **Implementation indicators.** These measure the fundamental changes going on across the economy, either backward or forward-looking (e.g. the capacity of low-carbon electricity projects constructed or being constructed).
* **Policy milestones.** Enabling measures that need to be in place to support the implementation of low-carbon solutions in the economy, for example ensuring that a fair and sustainable funding mechanism is in place to support deployment.

We expect Task 2 outputs to include:

* Indicators for annual cumulative deployment of technologies to 2035, reflecting the technology pathways developed in Task 1. This may be at an individual technology level (e.g. hydrogen production capacity) or may require aggregation (e.g. storage).
* Indicators for the amount of capacity entering planning and entering construction, on an annual basis to 2035 by technology or aggregated category.
* Indicators identifying the main policy milestones and timings required to support deployment of capacity in line with the pathways to 2035, along with any dependencies on enabling infrastructure such as electricity, hydrogen or CO2 networks.
* Identifying any implications for deployment in the devolved administrations (but not to develop separate indicators for them).

# Outputs Required

The key outputs from this research will be:

* A set of Microsoft Excel spreadsheets containing all results and quantitative data produced in Tasks 1 and 2, and any spreadsheet analysis used to calculate the results. These spreadsheets should be clear and accessible to CCC staff, and be designed in accordance with spreadsheet modelling best practice. For example, they should clearly reference all sources of data used and assumptions made as part of the analysis.
* A comprehensive final report that fully documents the research that has been undertaken and its findings. The final report should include the following sections:
  + An executive summary
  + A description of the aims and objectives of the research
  + A full explanation of and justification for the approach taken and the methodology used, including the data sources used and any assumptions made, and its key limitations
  + A full explanation of all of the results from tasks 1 and 2
  + A record of the quality assurance that has been taken undertaken (including a Quality Assurance log, see section 7).

The format and structure of the spreadsheets shall be subject to the agreement of the Project Steering Group.

The format, structure and content (the latter insofar as it relates to the presentation of the results of the research and interpretation of relevant policy) of the final report, and any other written deliverables that are produced under this contract (e.g. task reports), shall be subject to the agreement of the Project Steering Group. The proposed content of the final report should be agreed in advance at a Project Steering Group meeting.

Full drafts of the report and spreadsheets should be provided for the Project Steering Group to review. The draft reports and spreadsheets should then be revised as necessary following comments from the Project Steering Group and will not be considered finalised until agreed with the CCC Project Manager.

The final report, and any other written deliverables that are produced under this contract (e.g. task reports), must be clearly written in a way that is easily accessible to a non-technical audience as far as is possible. Technical jargon and terminology must be fully explained, and plain English must be used throughout.

The final report should be provided in an electronic format agreed with the CCC Project Manager, and formatted according to CCC publication guidelines and accessibility requirements.

The CCC intends to publish the final report.

# Ownership and Publication

The key deliverables will be supplied by email to the CCC project team, who may choose to publish these as supporting evidence on their website. Spreadsheets should be open access and unrestricted, to enable full QA of results and assumptions.

# Quality Assurance

This project must comply with the ‘CCC – Quality Assurance of Evidence and Analysis’ guidance,[[7]](#footnote-7) and bidders must set out their approach to quality assurance in their response to this ITT.

All research tasks and modelling must be quality assured and documented. Contractors should:

* Include a quality assurance (QA) plan in their response to this ITT that they will apply to all of the research tasks and modelling.
* Specify who will be responsible for quality assurance in their response to this ITT and ensure that this is done by individuals who were not directly involved in the research, analysis or model development.
* Provide a QA log in the final report to demonstrate the QA undertaken, including who undertook the QA and the scope, type and level of QA that has been undertaken (e.g. a log entry only stating ‘the data was checked’ will not be sufficient).

Sign-off for the quality assurance must be done by someone of sufficient seniority within the contractor organisation to be able take responsibility for the work done. Acceptance of the work by the CCC will take this into consideration. The CCC reserves the right to refuse to sign off outputs which do not meet the required standard specified in this invitation to tender.

The successful bidder will be responsible for any work supplied by sub-contractors and should therefore provide assurance that all work in the contract is undertaken in accordance with the quality assurance expectation agreed at the beginning of the project.

For primary research, contractors should be willing to facilitate CCC research staff to attend interviews or listen in to telephone surveys as part of the quality assurance process.

# Timetable

The proposed timetable for the project, including the key deliverables and meetings, are set out in the following table.

The project will be overseen by a project steering group to be established and chaired by the CCC. In addition to the meetings of the project steering group set out below, the CCC would expect to have regular scheduled discussions (weekly meetings or calls) with the contractor to ensure the work is progressing as expected.

Specific deadlines will be agreed as part of the kick-off meeting. In addition, prior to the work on each task commencing, a proposed project plan for the task should be provided for approval at the relevant project meeting. This should include a detailed explanation of the proposed approach and methodology (including data sources and assumptions) and timelines for the task, and the justification for the proposal.

|  |  |
| --- | --- |
| **Date** | **Action** |
| Dec 2021 | Publication of ITT |
| 25 Jan 2022 | Deadline for response to ITT |
| w/c 31 Jan | Interviews, award contract |
| w/c 14 Feb | Kick-off meeting: To agree project plan, methodology and assumptions, plus timings and deliverables |
| w/c 21 March | Project meeting 1: To discuss Task 1 results and analysis, and agree plan for Task 2 |
| w/c 11 April | Project meeting 2: To discuss Task 2 results and analysis |
| w/c 2 May | Deliverable: Full draft of final report |
| w/c 23 May | Final deliverables: Final version of report, reflecting comments, plus spreadsheets (where applicable) |

# Challenges

Bidders should highlight any challenges or risks that they envisage in delivering all the outputs of the project, whether in terms of scope of the work, resources, or timelines. Alternative suggestions will be considered if the risks are such that the project is unlikely to be able to be delivered in its current form.

# 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 ‘addressing challenges and risks’ criterion.

We expect contractors to adhere to the following GSR Principals:

1. Sound application and conduct of social research methods and appropriate dissemination and utilisation of findings
2. Participation based on valid consent
3. Enabling participation
4. Avoidance of personal harm
5. Non-disclosure of identity and personal information

# Working Arrangements

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

# Required Skills and Experience

The CCC would like you to demonstrate that you have the experience and capabilities to undertake the project. Your tender response should include a summary of each proposed team member’s experience and capabilities.

Contractors should propose named members of the project team, and include the tasks and responsibilities of each team member. This should be clearly linked to the work programme, indicating the grade/seniority of staff and number of days allocated to specific tasks.

Contractors should identify the individual(s) who will be responsible for managing the project.

# Consortium Bids

In the case of a consortium tender, only one submission covering all of the partners is required but consortia are advised to make clear the proposed role that each partner will play in performing the contract as per the requirements of the technical specification. We expect the bidder to indicate who in the consortium will be the lead contact for this project, and the organisation and governance associated with the consortia.

Contractors must provide details as to how they will manage any sub-contractors and what percentage of the tendered activity (in terms of monetary value) will be sub-contracted.

If a consortium is not proposing to form a corporate entity, full details of alternative proposed arrangements should be provided. However, please note CCC reserves the right to require a successful consortium to form a single legal entity in accordance with Regulation 28 of the Public Contracts Regulations 2006.

CCC recognises that arrangements in relation to consortia may (within limits) be subject to future change. Potential Providers should therefore respond in the light of the arrangements as currently envisaged. Potential Providers are reminded that any future proposed change in relation to consortia must be notified to CCC so that it can make a further assessment by applying the selection criteria to the new information provided.

# Budget

The budget for this project is £50,000 to £70,000 excluding VAT.

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

Cost will be a criterion against which bids which will be assessed.

Payments will be linked to delivery of key milestones. The indicative milestones and phasing of payments can be adjusted and agreed with the contractor and Project Manager. Please advise in your tender response how this breakdown reflects your usual payment processes.

In submitting full tenders, contractors 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 CCC aims to pay all correctly submitted invoices as soon as possible with a target of 10 days from the date of receipt and within 30 days at the latest in line with standard terms and conditions of contract.

# Evaluation of Tenders

Contractors are invited to submit full tenders of no more than 35 pages, excluding declarations and CV’s. Tenders will be evaluated by at least three CCC staff.

CCC will select the bidder that scores highest against the criteria and weighting listed below, see the ITT for further information.

**EVALUATION CRITERIA AND SCORING METHODOLOGY**

|  |  |  |
| --- | --- | --- |
| **Criterion** | **Description** | **Weighting** |
| 1 | RELEVANT EXPERIENCE / DEMONSTRATION OF CABABILITY | 20% |
| 2 | MANAGING YOUR RELATIONSHIP WITH THE CCC | 5% |
| 3 | QUALITY ASSURING THE SERVICES YOU PROVIDE | 10% |
| 4 | MANAGEMENT STRUCTURE | 5% |
| 5 | PROJECT TEAM – SKILLS AND KNOWLEDGE | 15% |
| 6 | METHOD, ABILITY AND TECHNICAL CAPACITY | 25% |
| 7 | UNDERSTANDING OF REQUIREMENTS | 10% |
| 8 | RISK AND CHALLENGES | 10% |
|  |  | 100% |

**Scoring Method**

Tenders will be scored against each of the criteria above, according to the extent to which they meet the requirements of the tender. The meaning of each score is outlined in the table below.

The total score will be calculated by applying the weighting set against each criterion, outlined above; the maximum number of marks possible will be 100. Should any contractor score 1 in any of the criteria, they will be excluded from the tender competition.

|  |  |
| --- | --- |
| **Score** | **Description** |
| 1 | Not Satisfactory: Proposal contains significant shortcomings and does not meet the required standard |
| 2 | Partially Satisfactory: Proposal partially meets the required standard, with one or more moderate weaknesses or gaps |
| 3 | Satisfactory: Proposal mostly meets the required standard, with one or more minor weaknesses or gaps. |
| 4 | Good: Proposal meets the required standard, with moderate levels of assurance |
| 5 | Excellent: Proposal fully meets the required standard with high levels of assurance |

**Scoring for Pricing Evaluation**

Price will be marked using proportionate pricing. Please see the example below.

Marking proportionate to the lowest price.

Price will be scored as set out below.

There will be a maximum of e.g. 20 marks

The lowest priced bid will receive the full 20 marks, all other bids will then be marked as set out below.

Proportionate Pricing scoring example

If 20% = 20 marks

|  |  |  |
| --- | --- | --- |
| **Supplier** | **Price** | **Marks** |
| 1 (lowest bid) | £50,000 | 20 |
| 2 | £60,000 | 50/60 \* 20 = 16.7 |
| 3 | £75,000 | 50/75 \* 20 = 13.3 |

**Structure of Tenders**

Contractors are strongly advised to structure their tender submissions to cover each of the criteria above and supply a price schedule specifying the daily rates (ex-VAT) you will charge for each level of your staff.

**Evaluation for Interviews, if held**

CCC reserves the right to award the contract based on applicants’ written evaluation only if one candidate emerges from the evaluation stage as significantly stronger than the others.

Should interviews go ahead, CCC will shortlist suppliers based on their marks from the written proposals. Interviews are provisionally expected to be held in early February 2022. If this date changes, CCC will notify applicants.

The areas to be covered in the interview, and markings allocated to each topic area will be sent to the shortlisted supplier prior to interview.

Further details of interviews will be sent to successful applicants on selection.

**Feedback**

Feedback will be given in the unsuccessful letters or emails.

1. <https://www.theccc.org.uk/the-need-to-act/a-legal-duty-to-act/> [↑](#footnote-ref-1)
2. <https://www.theccc.org.uk/publication/sixth-carbon-budget/> [↑](#footnote-ref-2)
3. Excluding emissions from international aviation and shipping, whereas the Sixth Carbon Budget advice includes these. [↑](#footnote-ref-3)
4. <https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Electricity-generation.pdf> [↑](#footnote-ref-4)
5. <https://www.gov.uk/government/publications/net-zero-strategy> [↑](#footnote-ref-5)
6. <https://www.theccc.org.uk/wp-content/uploads/2020/10/CCC-Insights-Briefing-5-Monitoring-progress-in-reducing-the-UKs-greenhouse-gas-emissions.pdf> [↑](#footnote-ref-6)
7. https://www.theccc.org.uk/wp-content/uploads/2020/04/CCC-%E2%80%93-Quality-Assurance-of-Evidence-and-Analysis.pdf [↑](#footnote-ref-7)