**Specification for analysis to determine the optimal UK rapid charging network for electric vehicles**

Tender Reference Number: ED/0217

**Specification of Requirements**

Invitation to Tender **Analysis to determine the optimal UK rapid charging network for electric vehicles**

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Deadline for Tender Responses: **12 pm** **1st March 2017**

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#  Preamble

The Committee on Climate Change (CCC) is an independent, statutory body established under the 2008 Climate Change Act. The CCC is tasked with:

* Providing independent advice to Government on setting and meeting carbon budgets and preparing for Climate change.
* Monitoring progress in reducing emissions and achieving Carbon Budgets.

# Background

The CCC’s recommendations on the level of the first five carbon budgets are based on a set of scenarios demonstrating how the CCC’s trajectories of emissions reductions can be achieved in each sector of the economy, through deployment of technologies to reduce greenhouse gas emissions. The CCC has a statutory duty to advise the Government on the most cost-effective path to decarbonisation, taking account of the range of criteria in the Climate Change Act.

The UK is legally bound by the Climate Change Act to reduce its emissions by at least 80% below 1990 levels by 2050. In some sectors of the economy, such as agriculture and industry, it is more challenging and costly to reduce emissions than in others, such as power. Some sectors, including transport, must reduce emissions by up to 90% to achieve an economy-wide 80% reduction. This implies that in the road transport sector the car, van, bus and HGV fleets would need to be almost entirely zero or ultra-low carbon by 2050.

For its advice on the Fifth Carbon Budget period (2028-2032), the CCC developed a central scenario (the Medium Abatement scenario) for road transport emissions. This scenario is designed to be consistent with the objective of delivering car, van, bus and HGV fleets that are almost entirely zero or ultra-low carbon by 2050.

Ultra-low emission vehicles (ULEVs) are vehicles with zero or near-zero tailpipe emissions which make use of electricity from an increasingly decarbonised power sector. Two types of ULEV are plug-in hybrid electric vehicles (PHEVs) or battery electric vehicles (BEVs), collectively referred to as electric vehicles (EVs). PHEVs have both an electric motor and an internal combustion engine. They can be recharged using a plug or refuelled using petrol or diesel. BEVs only use electric motors and derive all power from battery packs, which are recharged using a plug.

A survey of public attitudes towards electric vehicles by DfT in 2016 identified recharging as the most important factor deterring people from buying an electric car or van. 45% of driving license holders surveyed reported charging as a deterring factor. These license holders listed concerns about the availability of charging points, including lack of charging points in their area and lack of knowledge of where charging points are.

Currently available electric vehicle chargers can broadly be classified in 3 main categories: Slow chargers, Fast chargers and Rapid chargers. The naming scheme is indicative of the amount of time it would take each type of charger to charge a vehicle, with rapid chargers delivering the most power in the shortest available time. Cheaper slow chargers tend to be installed in places where cars are likely to be parked for long periods (i.e. home or workplace). Rapid chargers are significantly more expensive, but offer a valuable decrease in charging time, making driving long distances a practical option. Not all electric vehicles currently on the market can charge using rapid chargers, especially in the case of plug-in hybrids where it is generally accepted that long distances would be driven using the internal combustion engine. However, some plug-in hybrids (e.g. Mitsubishi Outlander) do have rapid charging capability, indicating that this is a desirable feature for some drivers.

A rapid charging network model was developed for the CCC in 2013 by Element Energy. This was based on a model developed for the H2Mobility Phase 1 report.1 This report assessed consumer reactions to hydrogen refuelling and the use of Fuel Cell Electric Vehicles (FCEVs). Local and national refuelling ability was identified as an important influence on consumer perceptions. Hence, a model was built to determine a suitable Hydrogen refuelling station (HRS) network to create accessibility for the maximum number of consumers and provide the best possible return on investment.

The H2Mobility model was a spatial and temporal GIS-based model, based on a traffic flow analysis. A key finding from the project was that the optimal roll-out strategy involved placing hydrogen refuelling stations in selected localities and along major roads, to ensure high population coverage and enable principal journeys between population centres. By 2030, the model identified that almost all of the UK population should have a hydrogen refuelling station in their local area, with the majority of the population having access to more than one locally.

The CCC-Element Energy report used a modified version of this model to determine the optimal number of rapid chargers across the UK. As the driving range of battery electric vehicles is shorter than for hydrogen vehicles and there is a consumer perception that frequent recharging will be required, the presumed coverage of each refuelling station/rapid charger was reduced.

The model identified that 20,000 rapid chargers at 2,100 sites would be required across all UK regions by 2030, although the majority of charging would be overnight in off-street parking spaces. This assumed that the real world driving range would reach 300km for large cars by 2030. It is important to note that this number reflects the perceived coverage required to overcome range anxiety, which is almost double the number identified as sufficient to provide an effective charging service.

Zap-Map, a UK-wide map of charging points, lists 958 rapid charging sites with a total of 2142 rapid connectors in November 2016.

Latest information on driving ranges shows that the Tesla Model 3 has a minimum electric range of 346 km (EPA) and the latest Renault Zoe has a range of 400km (NEDC). Both of these vehicles are likely to be available in 2017. The Chevrolet Bolt has a range of 383km (EPA) or 500km (NEDC) and is currently being sold in the US (although is not expected to reach the UK soon). The Hyundai IONIQ and the Nissan Leaf are planned to have an electric range of greater than 300km by 2018.

Even with the gap between the test cycle driving range and real world range, it seems that a 300km electric range will be reached significantly before 2030 for most cars. As the driving range will impact on the amount and type of charging infrastructure required, CCC wants to update the Element Energy analysis to take account of this and other recent developments to ensure its recommendations and assessments of progress are based on the latest available data.

# Aims and Objectives

The aim of the current project is to update analysis of the infrastructure needed to support the uptake of electric vehicles to 2030 and to consider progress towards that requirement. The key questions are.

* What is the latest evidence on potential EV buyers’ range anxiety concerns and how does this compare with those underlying the EV model?
* How many rapid chargers are required to overcome range anxiety given the latest evidence on range anxiety and expected range of EVs in 2020, 2025 and 2030? Where should the rapid chargers be located?
* How does the current number of rapid chargers in 2017 compare with the number of rapid chargers required in 2020, 2025 and 2030? Are the locations of rapid chargers currently installed representative of the locations that will be required in 2020, 2025 and 2030 (i.e. are there areas of the country that are not attracting sufficient investment)?
* Vans have different trip patterns and payloads to cars. An optimal rapid charging network would increase the share of fleet managers (of both car and van fleets) that consider a battery electric vehicle to meet their operational requirements. How does an optimal network for vans compare to an optimal network for cars in 2020, 2025 and 2030?
* How might ultra-fast charging affect this? Recently invented Ultra Fast chargers have a power output of up to 350kW, more than twice the capacity of the most powerful DC fast-chargers currently available. Currently, no passenger electric cars are capable of charging at such a high rate, with Tesla’s vehicles having the highest capacity of 120kW. However, if cars were designed with the capability to charge at this rate, around 300km of range could be supplied in about 20 minutes, an experience more comparable to a standard petrol or diesel station.
* How does the interoperability between EVs and the charging infrastructure grid affect the type of network required? What key issues around hardware and information exchange protocols would need to be resolved for an optimum network to be more firmly established?
* As an illustrative scenario, if electric vehicle owners living in homes without off street parking charged their vehicle using only rapid chargers (i.e. assuming they do not have access to on street slow charging or workplace slow charging), how many additional rapid chargers would be required and where? It is likely that the need for rapid chargers for this purpose would be concentrated in urban areas where there is a larger proportion of houses without off-street parking. This would be similar to the way conventional car owners refuel their car at petrol stations and would provide an upper bound for the number of rapid chargers likely to be necessary in urban areas (as it is likely some electric vehicle owners will have access to on-street or workplace charging).

Data from the Department for Transport (and Transport departments of the devolved administrations) should be used to define distributions of trips undertaken across the UK, to include the trip length, departure point and destination. As the project will need to take account of as many as possible uses of electric vehicles, averages of the distributions of trip lengths are not sufficient and the tails should be considered. Data from the transport departments should also be used to define the volume of traffic.

The project will need to take account of:

**Essential**

* Current and potential future distances travelled by electric vehicles on a single charge (to include both cars and vans);
* A range of scenarios of electric vehicle uptake (in line with CCC trajectories to 2050) and agreed with CCC at the kick-off meeting;
* A range of scenarios of proportions of plug-in hybrids and battery electric vehicles (in line with CCC trajectories to 2050);
* Current and potential future charging times (using a range spanning from rapid chargers to ultra-fast chargers).
* Any other factors that potential bidders think it is important to take account of.

**Optional**

CCC would also like to consider two additional scenarios in this project. However, these are more uncertain and depend on the availability of data and whether analysis in this area would provide useful insights into the design of the optimum charging network, or change any conclusions emerging from the essential analysis above. Tenderers should give an indication of whether they think these are feasible, given current understanding and evidence in these areas.

* Different types of rapid chargers (i.e. CHAdeMO, CCS, Type 2 AC, Superchargers) are not compatible with all cars. Assumptions must be used about when/if a unifying standard will be used and whether adaptors will be available for all car types.
* A scenario with some penetration of driverless automated vehicles post-2025.

# Methodology

The project should aim to construct a model or adapt an existing model to analyses the optimum charging infrastructure required, in different scenarios and with the ability to flex different assumptions. As part of your tender, you should set out your preferred modelling approach. The key features of the model should be set out.

**Task 1: Develop a set of scenarios of charging points to be modelled and agree with the CCC.**

The starting point of the modelling will be to define the set of scenarios that will be considered and a set of assumptions that can be flexed to deliver the scenario.

The scenarios should reflect levels of electric vehicle uptake in line with CCC trajectories. The proportion of electric vehicles in the model that are plug-in hybrids and the proportion that are battery electric vehicles should be defined for each scenario.

The latest evidence from CCC work, industry and academia should be assessed to define a range of flexible assumptions used to deliver the scenarios:

* **Current and potential future distances travelled** by electric vehicles on a single charge. A couple of different potential future distances travelled by an electric vehicle on a single charge should be defined and the model should be flexible enough that scenarios can be generated for each variation of these input assumptions.
* **Current and potential future charging times** (which will incorporate assumptions about the power transfer rate in kWh and battery size for both plug-in hybrid vehicles and battery electric vehicles). A couple of different potential future charging times for an electric vehicles should be defined and the model should be flexible enough that scenarios can be generated for each variation of these input assumptions.
* **The likelihood of electric vehicles having the capability to use rapid chargers in future.** (Differing assumptions should be used for plug-in hybrid vehicles and battery electric vehicles). Several different likelihoods should be used and the model should be flexible enough that scenarios can be generated for each variation of these input assumptions.
* **The number of chargers** required to combat range anxiety. The latest literature should be used to understand range anxiety. As a flexibility in the model, it should be possible to remove range anxiety.

Assumptions around the length of trips undertaken by cars and vans should be developed based on available data from the Department for Transport and the transport departments of the devolved administrations, as well as any other relevant data sources (i.e. academic literature). These assumptions should consider not just the average length of trips but also the tail of the trip length distribution. Different distributions will be required for cars and for vans. As a flexibility in the model, it should be possible to deal with the tail in multiple ways (i.e. including all trip lengths, ignoring 5% of the longest trips, ignoring 10% of the longest trips etc.) Data or projections from transport departments should also be used to define the volume of travel in each year considered.

Two different use cases of rapid chargers should be considered in the model:

1. Where the electric vehicle owner has access to charging overnight but will need to use rapid chargers on long trips.
2. An illustrative scenario, where the electric vehicle owner does not have access to overnight charging (i.e. they may live in a house without suitable off street parking) and will need to use rapid chargers for all their charging needs.

The model should be able to provide outputs for both use cases and for use case 1 only. For use case 1, it will not be sufficient to consider only the parts of the journey on the strategic road network (SRN), as the distance travelled to access the SRN or after departing the SRN must also be included.

For the illustrative scenario in use case 2, it should be assumed that all electric vehicle owners without suitable off street parking will use rapid chargers and do not have access to on street slow charging or workplace slow charging. Developing a model with these assumptions will provide an upper bound to the amount of rapid chargers that may be required in urban areas (as it is likely some electric vehicle owners will have access to on street charging or workplace charging). A simple model based upon the frequency these electric vehicle owners will need to recharge is preferable, with suitable assumptions about the locations of drivers without access to off street parking (likely to be in urban areas). The model should provide approximate locations where rapid chargers will be required for this purpose. Whilst we expect these rapid chargers to be placed at shopping and leisure locations, it is not necessary to provide potential locations and the general area they should be located is a sufficient level of detail.

Assumptions around the location of electric vehicle owners without access to off street parking should be developed using the latest evidence from government, industry and academia. Any bid should specify how precisely they are able to state the potential location of rapid charging hubs (i.e. at a city level, areas within cities, to within a 10 mile radius etc.)

Where there is conflicting evidence or there are gaps in the literature available, consultants should use their judgement to develop a set of assumptions for each scenario, setting out clearly the reasoning behind these assumptions.

**Task 2: To model the required rapid charging network in the years 2020, 2025 and 2030**

The model should demonstrate the number and location of chargers in a range of scenarios and sensitivities on key inputs. They should be presented in a transparent excel spreadsheet. The inputs should be all the factors considered to be important in determining the optimum charging points needed and the model should be capable of flexing the assumptions for a given scenario. For example the sensitivity of assumptions around key inputs such as driving range, range anxiety, distance travelled, should be capable of being flexed in the model.

Rapid chargers along the strategic road network should be located at existing or planned motorway service areas (including those along A-roads).

**Task 3: To compare the rapid charging network in 2017 with the modelled output**.

The comparison must include both a comparison of the number of chargers and the location of chargers. Underserved areas should be identified. This comparison should be presented in a transparent excel spreadsheet or an alternative format to be agreed with the CCC.

**Task 4**: **To develop an understanding of interoperability issues.**

This task should use existing information to identify the key issues around hardware and information exchange protocols which would need to be resolved to develop an optimum charging network, taking account of different types of chargers, manufacturers and charging systems.

**Task 5: Produce a technical report**

The report should set out the assumptions and scenarios used in the project and should summarise the outputs. The report should also highlight the key barriers to developing this optimum network.

# Outputs Required and Timetable

The outputs from the project will include:

* Presentation of the interim and final results of the project to members of the CCC secretariat and other interested parties
* Transparent excel spreadsheets with the output being the number of rapid chargers required in 2020, 2025 and 2030 for the different scenarios.
* A comparison to the current number and location of chargers in 2017.
* A technical report setting out the assumptions and scenarios used in the project and summarising the outputs.

The proposed timetable for the project is set out in the following table.

* At least 35% of the project should be completed by end March 2017, with the remainder to be completed by the end of May.
* Interim results and/or final results for a limited number of scenarios to be completed in time (i.e. late April) to feed into the CCC’s annual progress report (published end June 2017).

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| --- | --- |
| **Date** | **Action/Deliverable** |
| 1st March | Deadline for response to ITT |
| 6th March | Interviews |
| 9th March | Kick-off meeting |
| Early April | Interim meeting (presentation on progress and initial results) |
| Late April/Early May | Final meeting (further progress and results) |
| Early May | Circulate write-up of results |
| Late May | Final report |

Bidders should set out when it would be appropriate to meet during the project given the timetable above. At each meeting, we will expect a Powerpoint presentation covering progress and key issues for discussion.

# Quality Assurance

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

* Include a quality assurance (QA) plan that they will apply to the modelling
* Specify who will take lead responsibility for ensuring quality assurance. This responsibility should rest with an individual not directly involved in the research, analysis or model development.
* Provide a QA log to demonstrate the QA undertaken, which must identify who undertook the QA and the scope, type and level of QA that has been undertaken.

Sign-off for the 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 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 contact is undertaken in accordance with the quality assurance expectation agreed at the beginning of the project.

The CCC expects that:

* Economic analysis must be delivered in a simple, transparent Excel spreadsheet, where key assumptions (agreed with the CCC) can be varied. All assumptions and figures should be adequately referenced, and include any supporting workings. This spreadsheet will be the property of the CCC.
* Existing analysis and work regarding technical challenges and deployment constraints should be reviewed (e.g. including technology options and barriers developed by the CCC) and incorporated into this assignment.
* Analysis should appropriately reflect uncertainty regarding model inputs. Where appropriate, a sensitivity analysis of key parameters should be conducted.

# Challenges

Tenderers 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.

# Working Arrangements

The successful contractor will be expected to identify one named point of contract 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. A steering group will also give input to the project.

# Skills and experience

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 members 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 around £50,000 excluding VAT.

Contractors should provide a full and detailed breakdown of costs (including separate costing of 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 Department 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

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** | 15% |
| 2 | **MANAGING YOUR RELATIONSHIP WITH THE CCC** | 10% |
| 3 | **QUALITY ASSURING THE SERVICES YOU PROVIDE** | 10% |
| 4 | **PROJECT TEAM – SKILLS AND KNOWLEDGE** | 15% |
| 5 | **METHOD, ABILITY AND TECHNICAL CAPACITY** | 30% |
| 6 | **UNDERSTANDING OF REQUIREMENTS** | 10% |
| 7 | **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 |

**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 the top three suppliers with the highest marks from the written proposals. Interviews are provisionally expected to be held on 6th March. 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.