

14th July 2020

Dear Sir/Madam,

Invitation to Tender for the Radiometry and Atmospheric Profiling Scoping Study [RAP] project for the Carbon Trust's OWA Programme

You are invited to submit a tender for the Radiometry and Atmospheric Profiling Scoping Study [RAP] project which is part of the Offshore Wind Accelerator (OWA) programme. The key objective of this project is to undertake a study to investigate numerical weather profiling models and atmospheric profiling technologies, identifying knowledge gaps that could be filled through a measurement campaign.

Please be aware that dates referred to below may be subject to change where this is necessary in the interests of the project (such changes will be notified in advance).

Should your tender be successful an Award Letter, the Scope of Work, the OWA Conditions of Contract ("Conditions"), and any clarifications agreed in writing, will establish the Contract for the Radiometry and Atmospheric Profiling Scoping Study [RAP] project (the "Contract") between you and the Carbon Trust. The Conditions accompany this ITT for your prior review. Please note that in the interests of transparency and fairness, these Conditions are non-negotiable, although we will provide clarifications to any queries you may have prior to submitting your tender, answers to which will be distributed to all bidders as set out below. Bids which fail to accept the Conditions in their full un-amended form (other than changes explicitly accepted and agreed by the Carbon Trust on the clarifications page) at the time of submission will be considered to be non-compliant and will be excluded from the procurement process.

Please e-mail clarification questions to hector.wilson@carbontrust.com any time before 28th July 17:00 BST. Answers to clarification questions will be posted on our website by 4th August 17:00 BST. Answers can be found at: https://www.carbontrust.com/about-us/tenders/

For information about the OWA programme, please see the Carbon Trust's web site: www.carbontrust.com/offshorewind

Unless informed to the contrary, tenders and communications should be sent by e-mail to the following e-mail address: hector.wilson@carbontrust.com

Please submit your tender by 28th August 2020 12:00 BST.

The timeline of this procurement process is as follows:

Deadline for clarification questions Clarification Response Date Submission of full tender Bidder interviews Project kick off meeting 28th July 17:00 BST 4th August 17:00 BST 28th August 2020 12:00 BST September 2020 Late September 2020

If you have any questions about the timing, please let us know. We look forward to receiving your tender.

Yours sincerely,

Hector Wilson For and on behalf of THE CARBON TRUST



IMPORTANT INFORMATION FOR BIDDERS

Neither this document, nor any part of it nor any other information supplied in connection with it may, except with the prior written consent of the Carbon Trust, be published, reproduced, copied, distributed or disclosed to any person for any purpose other than consideration by the recipient of whether or not to submit a Tender.

Bidders should note that the Scope of Work described in this Invitation to Tender does not constitute an offer to contract with the Carbon Trust. It only represents a definition of specific requirements and an invitation to submit a tender addressing these requirements. Issuance of this invitation to tender and the subsequent receipt and evaluation of the tenders by the Carbon Trust does not commit the Carbon Trust to enter into a Contract with any bidder.

Bidders should also note that:

- depending on the progress and/or results of the project referred to in this Invitation
 to Tender and the views of the Carbon Trust and/or the OWA programme as to
 whether additional analysis or more in-depth work in respect of any or all aspects
 relating to the project are desirable in order to achieve the objectives referred to in
 the Invitation to Tender, the Carbon Trust may request such additional analysis or
 work. Any additional analysis or work agreed between the parties shall form part of
 Scope of Work and the Services to be provided by the selected Contractor under the
 Contract;
- the Carbon Trust reserves the right not to accept the lowest priced tender or any tender whatsoever;
- the Carbon Trust reserves the right to accept more than one tender;
- unless a bidder makes a formal statement to the contrary, the Carbon Trust reserves the right to accept any part of a bidder's tender without accepting the remainder;
- formal notification that a tender has been successful will be communicated in writing by the Carbon Trust;
- the costs of tendering are the full responsibility of the bidder; and,
- the pricing set by bidders shall be valid for a minimum of 90 days.

The information contained here, in the Scope of Work and in any documents or information it refers to or incorporates (the "**Disclosed Information**") has been prepared to assist interested parties in deciding whether to make a bid. The Disclosed Information is not a recommendation by the Carbon Trust. It does not purport to be all inclusive or include all the information that a bidder may require.

Neither the Carbon Trust nor any of its directors, employees, agents or advisers makes any representation or warranty (express or implied) as to the accuracy, reasonableness or completeness of the **Disclosed Information**. All such persons or entities expressly disclaim any and all liability (other than in respect of fraudulent misrepresentation) based on or relating to the Disclosed Information or any subsequent communication. The bidder should conduct its own due diligence and seek its own professional, legal, financial and other advice as appropriate. The only information which will have any legal effect and/or upon which any person may rely will be such information (if any) as has been specifically and expressly represented and/or warranted in writing to the successful bidder in any written contract that may be entered into with the Carbon Trust.

Tenders and all supporting documentation must be written in English. This ITT, the Contract, its formation, interpretation and performance will be subject to and in accordance with the law of England and Wales.



The Carbon Trust Offshore Wind Accelerator

Invitation to Tender for the "Radiometry and Atmospheric Profiling Scoping Study [RAP]" Project

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1. Introduction to the Offshore Wind Accelerator

- 1.1. The Offshore Wind Accelerator ("OWA") is a collaborative R&D programme between The Carbon Trust, SSE Renewables Developments (UK) Limited, Ørsted Wind Power A/S, RWE Renewables International GmbH, ScottishPower Renewables (UK) Limited, Equinor ASA, Vattenfall Vindkraft A/S, EnBW Energie Baden-Württemberg AG, Shell Global Solutions International B.V. and innogy SE, and any amendment thereof and/or any deed of adherence thereto (the latter 9 collectively referred to in this document as "OWA Partners"), that aims to reduce the cost of offshore wind as well as provide insights regarding industry standard (and best practice) health and safety requirements.
- 1.2. The focus is on improving the economics of offshore wind farms in European waters through developing innovative technologies that can be deployed in planned and operational European projects.
- 1.3. The Offshore Wind Accelerator currently covers five research areas:
 - Offshore Foundations
 - Yield & Performance
 - Logistics & O&M
 - Electrical Systems
 - Cables
- 1.4. Contractors receive technical direction and data from OWA Partners through the Carbon Trust management team and through their respective Technical Working Group ("**TWG**") (see Figure 1).
- 1.5. This project will fall under the Yield and Performance research area.
- 1.6. Please note, the term "Contractor", where used within this document, refers only to successful bidders.

2. Background and objective of the Work

2.1. The OWA Yield and Performance working group would like to undertake an investigation on the subject of atmospheric stability. The investigation will review the suitability of mesoscale numerical weather profiling models for use within offshore energy yield assessments; describe the best technologies available for measuring atmospheric profiles (specifically microwave radiometers) and; design a detailed measurement campaign to test and validate microwave profile radiometers.

2.2. Background:

There are currently knowledge gaps in the state of the art of temperature profiling measurement instrumentation, and the suitability of mesoscale NWP models to capture atmospheric stability statistics. There is a need to better understand the performance and sensitivity of turbine interaction loss models for wind farm projects which are dependent on the characterisation of atmospheric stability, particularly within coastal gradients, and to standardize the modelling procedures and direct future model development. It may be that there is significant uncertainty in the use of mesoscale NWP models to define stability parameters may not be suitable and therefore better measurement of such parameters is needed. Atmospheric stability parameters are currently difficult to measure offshore without expensive met masts,



therefore there is potentially a need to investigate new profiling technology devices – one such key contender is microwave profiling radiometry.

2.3. The main objectives of this work are to:

- i) Gain an understanding of the suitability of mesoscale NWP modelled temperature profiles for use within offshore energy yield assessment, considering the impact of atmospheric stability on turbine wakes and interaction loss predictions.
- ii) Understand the best technologies available for measuring atmospheric profiles, specifically investigating microwave profile radiometers.
- iii) Design of a detailed measurement campaign to test and validate microwave profile radiometers, and gain confidence in atmospheric stability statistics provided by mesoscale NWP models.
- iv) Investigate opportunities for future research and provide recommendations for further work.

3. Pre-Conditions

3.1. Bidders should take the following pre-condition into account when preparing and submitting their tenders. The Carbon Trust may reject any non-compliant tenders without progressing such tenders through the evaluation phase. If the Carbon Trust, in its absolute discretion, considers that the bidder's response to the following precondition is not satisfactory, the bidder's tender will be non-compliant.

Description	Information required from Bidders
Conflict of interests	Bidders are required to state that they are free of any commercial interests, partnership arrangements or contracts underway or other matters which may present a conflict or potential conflict of interest in respect of the provision of these services.
	If a bidder thinks that they may have any conflict or potential conflict of interest, the bidder should describe the details of this conflict and provide details of whether and how it would propose to manage such a conflict in a satisfactory and robust manner.
	The Carbon Trust reserves the right to require the provision of further information in relation to the bidder's response to this pre-condition.
Conditions of Contract and Scope of Work	The OWA Conditions of Contract and draft Scope of Work for this project are attached. The Contract will be constituted by the Award Letter, the OWA Conditions of Contract and the Scope of Work (including any agreed clarifications to it).
	Failure to accept these documents in their un-amended form or requesting amendments to them means that a bidder's tender is a non-compliant tender and it would therefore be at the discretion of the Carbon Trust to accept such a tender.



	Submission of a tender shall constitute unqualified acceptance of the OWA Conditions of Contract. Bidders are required to submit a signed Form of Tender when submitting their tenders. The Form of Tender forms part of this Invitation to Tender. The failure by a bidder to submit a signed Form of Tender when submitting its tender shall mean that such tender is a non-compliant tender. Non-compliant tenders may be rejected without further consideration.
	If any bidder wishes to request an amendment to any term or condition, such amendment must be clearly stated and the exact wording which the bidder is requesting must be set out. No material changes will be considered.
Further Conditions	All documentation and correspondences must be in English with costs given in GBP (\pounds) . Staff employment rates must be quoted as hourly rates in GBP (\pounds) . All additional expenses must be included under Work Package B: Costs and Expenses.
	Bidders are requested to input the man hours involved in the project for each work package in table 1, section 6.3. Any additional information (e.g. CVs or References) that Bidders wish to provide must be included in the main bid document (preferably in PDF) as an appendix.

4. Scope of Work

- 4.1. The Contract will be constituted by the Award Letter, the OWA Conditions of Contract and the Scope of Work (including any agreed clarifications to it). This final Scope of Work document will reflect any updates, changes or improvements to the technical scope and Work Packages as suggested by the Contractor in its proposal.
- 4.2. Failure to accept these documents in their un-amended form or requesting amendments to them means that a bidder's tender is a non-compliant tender and it would therefore be at the discretion of the Carbon Trust to accept such a tender. Submission of a tender shall constitute unqualified acceptance of the OWA Conditions of Contract.
- 4.3. If any bidder wishes to request an amendment to any term or condition, such amendment must be clearly stated and the exact wording which the bidder is requesting must be set out. No material changes will be considered.
- 4.4. The following section provides a summary of the key points relating to the technical content of this project and the proposed scope.

Contractor Specification

4.5. The Carbon Trust appreciates that due to the breadth of skills and experience required for this project a consortium may be required to successfully meet the objectives of the project. It is envisaged that it will take a small team of mixed seniority $\sim 8-10$ months to complete. Contractors should use this scope to create a detailed project



plan and Gantt chart outlining how they will deliver this project on budget and within the allocated time. This will be agreed by the Technical Working Group & Carbon Trust before work commences. It is expected that simplifying assumptions will be required to complete this work in the given timeframe; all assumptions will need to be clearly stated and approved by the TWG.

Detailed Scope

- 4.6. The following Work Packages are the initial ideas on the key activities that the Contractor is expected to undertake during this contract. Contractors are encouraged to offer a different or expanded approach that fulfils the high-level objectives and deliverables. If a different approach is suggested, the Contractor is expected to explain / justify any intended deviation from the advertised work packages.
- 4.7. It is expected that the Contractor will report on interim deliverables (if applicable) to the Technical Working Group and that the final report will contain documentation of all deliverables.



Work Packages

Work Package	Description of work
WP1. Assessment of mesoscale NWP models	The contractor will be expected to initially undertake a detailed assessment of the current state of commercially-available mesoscale numerical weather prediction (NWP) models, such as WRF, and their derivatives which incorporate Large Eddy Simulation (LES). This will require engagement with model developers, commercial providers and users. Input/approval from the technical working group (TWG) should be sought as to the list of models that are investigated. The models should be assessed on their ability to provide key atmospheric stability statistics, including but not limited to: Virtual potential temperature vertical profiles including gradient/offset over the ABL; Richardson number; Monin-Obukhov (MO) length; and vertical profiles of turbulence components and turbulence intensity. Furthermore, the provision of these atmospheric stability statistics for use as inputs to CFD (or other) models for turbine interaction modelling should be investigated, including in near-coastal offshore wind climates. The anticipated sensitivity of the time-resolved and time-averaged wake and interaction losses to these statistics should be reviewed, with the aim of establishing which should be the most important statistics required from the NWP models for input into the CFD (or other) models. Again, this will require extensive engagement within the industry. A detailed report of the results from WP1 is to be produced, highlighting the comparative capabilities of each NWP model to provide required output statistics for turbine interaction loss modelling, and recommendations on the most important statistics required. At this stage, consideration should also be given to validation studies which should be conducted to gain confidence in the accuracy of the most important statistics from the NWP models which have been identified in this review. Deliverables: D01: Summary report of WP1
	D02 : Presentation (in person or remotely) of WP1 results to TWG.
WP2. State of the art of radiometry	To date, in order to characterise marine vertical temperature profiles (currently considered to be a key determinate of turbine interactions losses, pending the WP1 review), met masts featuring absolute or gradient temperature sensors at multiple heights have typically been required; little work has been carried out using alternative technologies such as microwave radiometer profiling technologies. Therefore, in WP2 the contractor will be expected to carry out a detailed analysis of the current state of the art and technology overview of microwave radiometer profile measuring devices. This analysis will provide information including, but not limited to: the applications of such devices; their advantages and disadvantages; typical TRLs; existing research, test cases and analysis; data



processing algorithms, communications, data output formats, OEMs and suppliers; and cost estimates.

In addition to temperature profiling, their ability to provide atmospheric stability statistics (as reviewed in WP1), and any other related data such as humidity and wind speed profiles, should be compared against more established technologies (such as met mast measurements) that are currently used to gather such readings. A comparison of bias and uncertainty in the measurements between different technologies should be made too.

The results of this work package are to be detailed in a written report and presented to the TWG.

Deliverables:

D03: State of the art of microwave radiometer profiling report

D04: Presentation of results to TWG

Having built a knowledge base through WP1 and WP2, the contractor will be tasked with designing a new measurement campaign specifically targeted at using microwave profiling radiometry device(s), possibly alongside LiDAR or met masts, to capture the necessary data to:

- Provide a validation of the data measured by microwave profile radiometry devices using more established technologies, such as LiDAR, anemometers and thermometers installed on met masts.
- Provide confidence in the ability of NWP models to provide atmospheric stability statistics for turbine interaction loss calculations and trends.

WP3. Measurement campaign design

In designing the measurement campaign, the contractor should identify a suitable offshore (or onshore, if appropriate) site or sites and appraise them against a set of agreed criteria (these could include ease of installation, accessibility, existing instrumentation, opportunity, and physics). It is anticipated that the measurement campaign's data collection would last six months.

A high level of detail should be given for the campaign design and should include aspects including but not limited to: Project management; site characteristics; equipment options and location appraisal; systems design, integration and acceptance; procurement; installation and commissioning; data capture, monitoring, acceptance and analysis. A risk and opportunity register should be produced alongside the design.

A proposed timeline for the entirety of the campaign is to be produced, this will also highlight the likely costs of each stage (with a detailed breakdown) of the campaign. Costs should be based on the contractor's own experience as well as engagement with equipment OEMs.



	A detailed report will be produced covering all aspects of the measurement campaign and expected key outputs from such a campaign.
	Deliverables:
	D05 : Detailed report covering the design of a measurement campaign to test and validate microwave profiling radiometers.
	D06 : Presentation of findings and campaign design to TWG.
WP4. Future research and recommendatio	Based on all of the work carried out within the prior three work packages, the contractor will be expected to produce a list of potential future research areas and opportunities for follow on work. This could include next steps for what is required to push the TRL of microwave radiometer profiling devices and what is needed for commercial acceptance of such a device, or actions which must be taken to more closely interface mesoscale NWP and turbine interaction loss models, using the data provided by microwave radiometer profiling devices.
ns	An aspect of future work that should be investigated is the next steps that need to be taken to develop a buoy mounted/floating radiometer system.
	Deliverables:
	D07 : A summary report of recommendations, avenues for further development, and future research ideas.
	The contractor should stipulate how they will manage the project efficiently and effectively. This should include specific costs for project management time, to include update calls with the Carbon Trust Project Manager and/or Technical Working Group as required.
	This should also include production of a one page executive summary for the whole project, for internal dissemination. Carbon Trust will provide the template for this. The budget should also accommodate production of a final presentation and time dedicated to presenting this in the form of a webinar to invitees from the developers of the OWA.
WPA. Project Management	Finally, if appropriate, resource should also be allocated to provide inputs into the 'OWA Cost Model'. The contractor is not expected to produce a cost model of its own, but rather provide guidance on the effect of the research on inputs to the 'OWA Cost Model'.
	Deliverables:
	D08: Monthly flash reports
	D09: Project executive summary
	D10: Delivery of webinar
	D11 : Inputs to OWA Cost Model
WPB. Expenses	The contractor should detail the capped amount of expenses it expects to incur throughout the project. Expenses will be paid as incurred and any unused balance will not be paid.



5. Intellectual Property and Knowledge

- 5.1. All rights in and relating to pre-existing intellectual property and knowhow contributed by the Contractor, third parties or OWA Partners shall remain the exclusive property of the contributing party.
- 5.2. In the event that bidders plan to use or rely on pre-existing intellectual property knowhow for the project, the Carbon Trust's expectation is that a premium will not be charged for leveraging this IP or knowhow.
- 5.3. Results of this project will be owned by the Carbon Trust for the benefit of the OWA Partners and OWA programme.
- 5.4. Full details of the intellectual property requirements and conditions can be found in the attached draft Contractor's Conditions.

6. Bid Pricing

- 6.1. To provide bidders with greater clarity on the nature, level and type of work involved in the various Work Packages (WPs), the expected total budget is between £70k and £80k. The Contract Price submitted with the tender must be derived from the cost breakdown table requested in Table 1, and must include the costs for optional work packages as well as all expenses. Suggestions (within budget) are welcomed. If the Contract Price exceeds the budget (including where the bid includes alternative suggestions), to avoid receiving a lower score for this criterion, please provide a clear and justified reason why the Contract Price exceeds the expected budget.
- 6.2. For the avoidance of doubt, 'suggestions' referred to in preceding paragraph means 'additional areas of work or alternative or substitute activities to those described in Annex A, that would further support the objective of the work' (see description of criterion 1).
- 6.3. The Contractor is required to fill in the following staff rate and project cost breakdown table as part of their tender. The project is expected to take approximately 7-9 months.

Table 1: Staff rates and project cost breakdown

	Time spent per work package (WP) in hours							Staff cost	
Staff member	WP 1	WP2	WP3	WP4	WP5	WPA: Project mgmt	Total time in hours	Staff rate (£)	to project (£)
Project Sponsor	hr	hr	hr	hr	hr	hr	hr	£	£
Lead Consultant	hr	hr	hr	hr	hr	hr	hr	£	£
Analyst	hr	hr	hr	hr	hr	hr	hr	£	£
Etc.	hr	hr	hr	hr	hr	hr	hr	£	£
Total Time In hours	hr	hr	hr	hr	hr	hr		WPB: Expenses	£
Total cost of each WP	£	£	£	£	£	£		Total Cost	£



As detailed in section 4, the work packages are as follows:

WP1: Assessment of Mesoscale NWP Models

WP2: State of The Art of Radiometry WP3: Measurement Campaign Design

WP4: Future Research and Recommendations

WPA: Project Management

WPB: Expenses

- 6.4. All rates quoted in Table 1 must be in GBP (£) and represent the **Hourly Rate** for employment of staff members.
- 6.5. Bidders should be aware that the Carbon Trust and TWG usually require 2-3 weeks for the review and feedback procedure after delivery of each WP with at least one round of review comments to be accommodated. This should be considered when the table is completed.

7. Tender Evaluation Criteria

Bidders should take the following evaluation criteria into account when preparing and submitting their tenders. Tender documents should be no more than 20 pages excluding CVs.

Criterion 1: Approach to Work (Weighting: 35%)

Bidders are required to provide the evidence of the approach to work within the main body of the tender (not in a separate document).

Description	Information required from bidders
Proposed Approach	Bidders are required to provide a detailed description on how they plan to develop each work package described in Section 4.
	The description should include an initial overview on the approach followed by a description on how each Work Package and task will be delivered.
	Also, bidders need to justify how their proposed approach meets the project objectives.
Suggestions	Suggestions of additional areas of work to those described in Section 4 of the ITT that the bidder proposes looking at as part of this study in order to achieve the required objectives, maintain an industry focus and provide valuable insights into the potential for reducing costs and risks for Round 3 offshore wind projects.
	Bidders are required to differentiate which are their additional areas of work from the proposed approach. Besides, bidders should specify if the proposed additions affect to the total price and quote them separately.
Project management	Bidders are required to describe how they will manage the project utilising appropriate resources and describe how they will work with the various stakeholders, such as the OWA TWG, to get information and manage potentially conflicting



relationships. It is not expected that the Contractor will have
to run any workshops with stakeholders.

Criterion 2: Experience (Weighting: 35%)

Bidders are required to provide the experience evidence as an appendix, at the end of the bid document (not in a separate document)

Description (Projects of a similar nature)	Information required from Bidders
Experience in site acceptance testing for offshore wind array systems.	Bidders should elaborate on experience of the criteria described. Explain how these past experiences are relevant for this tender.
Experience assessing failure modes for offshore wind array systems, and access to relevant data.	In addition, the bidder should provide at least two examples (with reference to specific roles, responsibilities and activities the bidder undertook) of previous work which illustrates the bidder's skills, capabilities, and experience in all of these areas (bidders may wish to make reference to submitted examples of previous work for other clients)
Experience and knowledge of inter-	Bidders are advised that experience is considered a key important criterion and partnerships with other companies to support certain areas of experience are welcomed.
array cable terminations and earthing solutions.	All experience / case studies should be attached as an appendix to the proposal, but a summary of each case should be listed in the proposal main text.

Criterion 3: Staff Skills (Weighting: 15%)

Bidders are required to provide the staff skills evidence as an appendix, at the end of the bid document (not in a separate document)

Description	Information required from bidders		
CVs/Resumes	Detailed CVs/Resumes for any staff who will be involved with this Contract together with proposed project structure, intended position of staff in the project, and main responsibilities. CVs should include professional memberships of proposed staff working on this project.		
Applicable skills	Bidders should elaborate on the most relevant skills of the selected staff that will be applicable in the project.		
Prior experience form involved staff	Please include examples of similar work performed by the proposed staff members, explaining how is relevant to the work described in Section 4.		



Expert engagement	A close working relationship with key stakeholders such as banks' engineers, LiDAR OEMs, offshore wind farm developers, wind turbine OEMs, as well as the OWA Technical Working Group are seen relevant to the success of this project. Please supply ideas of how these groups can be engaged and leveraged.
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Criteria 4: Price (Weighting: 15%)

In the event that tenderers plan to use or rely on pre-existing intellectual property or knowhow for the project (e.g. existing O&M modelling tools), the Carbon Trust's expectation is that a premium will not be charged for leveraging this intellectual property or knowhow.

Description	Information required from bidders
Day rates and man-h for all staff grades	Bidders are required to provide day rates for all staff grades and to input the man-h involved in each work package described in Section 4.
Fixed price for the project	Project cost breakdown by work package, time and rate of person completing the work as specified in Section 6.3.
	Bidders are required to specify expected expenses apart from the estimated budget for each work package.
	Carbon Trust will reimburse reasonable expenses at cost and receipts may be requested. Pre-approval will be required for travel costs over £150 per return journey and combined hotels $\&$ subsistence cost exceeding £200 per day.
	Bidders will be required to confirm or comment on their ability to carry out the activities detailed in the Scope of Work within the initial term of the Contract and provide an outline plan of work

