

07 February 2020

Dear Sir/Madam,

Invitation to Tender for the Floating Wind Yield Scoping Study project for the Floating Wind Joint Industry Project

You are invited to submit a proposal for the Floating Wind Yield Scoping Study which is part of the Floating Wind Joint Industry Project. The key objective of this project is to improve the understanding of floating wind yield, compared to seabed fixed, with a further aim of updating the leading software to enable accurate prediction of floating wind yield.

Please be aware that this process is a non-mandatory procurement process, published for transparency and best practice. All timescales are based, as near as possible, to the Open Procedure. However, 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 proposal be successful an Award Letter, the Scope of Work, the Carbon Trust Conditions of Contract ("**Conditions**"), and any clarifications agreed in writing, will establish the Contract for the Floating Wind Yield Scoping Study (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 that 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.

Clarification questions must be emailed to hector.wilson@carbontrust.com and FloatingWind@carbontrust.com any time before 21 February 2020. Answers to clarification questions will be communicated by email by 26 February 2020. Answers can be found at: <https://www.carbontrust.com/about-us/tenders>.

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

Please submit your proposal by 12:00 GMT 03 April 2020.

The timeline of this procurement process is as follows:

Deadline for clarification questions	21 February 2020
Clarification response date	26 February 2020
Submission of full proposal	03 April 2020
Bidder interviews	week commencing 4 May
Successful Contractor announced	May 2020
Project kick off meeting	27 May 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 (ITT) 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 proposal addressing these requirements. Issuance of this ITT 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 Floating Wind JIP Partners 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 ITT, 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. Furthermore, the Carbon Trust does not warrant or provide any undertaking with respect to the fairness, accuracy, adequacy or completeness of the information provided. The bidder should conduct its own due diligence and seek its own professional, legal, financial and other advice as appropriate.

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 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.

Floating Wind Joint Industry Project

Invitation to Tender for the “Floating Wind Yield Scoping Study” Project

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1. Introduction to the Floating Wind Joint Industry Project

- 1.1. The Floating Wind Joint Industry Project (“**Floating Wind JIP**”) is a collaborative R&D initiative between The Carbon Trust and participating industry partners EnBW, ENGIE, Eolfi, Equinor, Innogy, Kyuden Mirai Energy, Ørsted, RWE Renewables, ScottishPower Renewables, Shell, SSE, TEPCO, Vattenfall, and Wpd (the latter are collectively referred to in this document as “**Floating Wind JIP Partners**”), that aims to investigate the challenge and opportunities of developing commercial-scale floating wind farms.



- 1.2. The objective of the Floating Wind JIP is to investigate technology challenges for large scale floating wind arrays.
- 1.3. Contractors receive technical direction and data from Floating Wind JIP Partners through the Carbon Trust management team.
- 1.4. Please note, the term “Contractor”, where used within this document, refers only to successful bidders.

2. Objective of the Work

- 2.1. This project (Phase 1) aims to undertake a literature review and scoping study for a subsequent larger project (Phase 2) to improve the understanding of floating wind yield and sensitivities of drivers for wake loss, compared to seabed fixed, with a further aim of updating the leading software and measurement campaign strategy to enable accurate prediction of floating wind yield.
- 2.2. The main objectives of this Phase 2 project are:
- i) Quantifying wake loss and associated uncertainties, as well as their sensitivities to key inputs.
 - ii) Production of estimated yield (AEP) of turbines installed on floating platforms.
 - iii) Understanding of the controller optimisation and trade-off against dampening.
 - iv) Determine yield impacts for different floating foundation motions, and hence floating substructure types.

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 pre-condition is not satisfactory, the bidder’s tender will be non-compliant.

Description	Information required from Bidders
Conflict of interests	<p>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.</p> <p>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.</p> <p>The Carbon Trust reserves the right to require the provision of further information in relation to the bidder's response to this pre-condition.</p>
Conditions of Contract	<p>The Carbon Trust Conditions of Contract for this project are attached. The Contract will be constituted by the Award Letter, the Carbon Trust Conditions of Contract and the Scope of Work (including any agreed clarifications to it).</p> <p>Failure to accept these documents in their unamended form or requesting amendments to them means that a bidder's tender is a non-compliant tender. Submission of a tender shall constitute unqualified acceptance of the Carbon Trust Conditions of Contract.</p> <p>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.</p> <p>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.</p>
Further Conditions	<p>All documentation and correspondences must be in English with costs given in GBP (£). Staff employment rates must be quoted as hourly rates in GBP (£). All additional expenses must be included under Work Package B: Costs and Expenses.</p> <p>Bidders are requested to input the man hours involved in the project for each work package in table 1, section 5.7. 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.</p>



4. Contractor Requirements

Contractor Responsibilities and Support of Carbon Trust Resources

- 4.1. Hector Wilson of the Carbon Trust will serve as overall Project Manager and also as the main point of contact for the Contractor. If the Project Manager becomes unavailable for any reason, the Carbon Trust shall make reasonable alternatives available.
- 4.2. The Contractor shall be responsible to the Carbon Trust for discharging its responsibilities under the Contract to deliver the Floating Wind Yield Scoping Study project. The Contractor will also be responsible for the performance of all activities listed in this Scope of Work except where responsibility is allocated elsewhere in this document.
- 4.3. The Project Manager will be the Contractor's first point-of-contact for all matters concerning the Contract and shall be primarily responsible for providing the Contractor with all instructions, releases, approvals and the like. The Project Manager will review any project deliverables defined within this Scope or Work and will approve invoices accordingly if deliverables meet the agreed standard.
- 4.4. The Contractor shall, prior to commencement of the Contract, appoint a named person as the Contractor's Representative who shall be responsible for the overall quality and timeliness of the activities performed and deliverables created under this Scope of Work.
- 4.5. The Contractor engaged will manage and deliver the work packages as defined in Annex A. This role will involve working closely with the designated Project Manager and the Floating Wind JIP Partners.
- 4.6. The Contractor will be required to provide services in the form of one or more lead consultants as required by the Carbon Trust to lead delivery of the project to the required scope, within the given budget and in the allocated time. The Contractor will need to be flexible to the requirements of the workload.
- 4.7. 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.
- 4.8. The Contractor is expected to work at their own premises but also to meet regularly at the Carbon Trust's offices in London, probably around once a month, including attendance at Floating Wind JIP Partner meetings when required. In addition, a certain amount of travelling, both within the UK and overseas, may be required during the Contract in order to engage with relevant companies in the sector and to ensure the robust delivery of the project.
- 4.9. The core activity under the Contract is to manage and deliver the Scope of Work. The Contractor may be required to undertake a range of other tasks that fall within the scope of the Contract but that are not necessarily specified here, to enable the efficient and smooth operation of the Floating Wind JIP. The Contractor will be required to report regularly to the Steering Committee, complete schedule and budget reports each month (Flash Reports), convene the Floating Wind JIP Partners and draft a written report at the end of the different phases of the work, containing a detailed assessment of everything conducted and recommendations for future work. This report should be presented upon the completion of all activities as required by the

Contract. Without limiting the reference in this paragraph to the range of other tasks falling within the scope of the Contract, the Contractor may also be requested by the Carbon Trust to provide additional services with respect to additional analysis or more in depth work on any or all aspects of the project referred to herein. Such additional analysis or more in depth work shall form part of the Services defined in the Contract. The Contractor must be prepared to receive such requests(s) and provide such additional Services agreed between the parties.

- 4.10. The Contractor must appoint secondary “backup” resources in order for the Contractor to continue providing the services in the event that the primary consultant(s) is(are) unexpectedly unavailable for periods of more than 1 week (for instance, due to illness or vacation). The nominated primary consultant(s) must be available to work on the project for the expected duration of the Contract, and only in exceptional circumstances should a replacement be necessary.

Intellectual Property and Knowledge

- 4.11. All rights in and relating to pre-existing intellectual property and knowhow contributed by the Contractor, third parties or Floating Wind JIP Partners shall remain the exclusive property of the contributing party.
- 4.12. 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.
- 4.13. Results of this project, which the Contractor will be expected to keep strictly confidential in addition to all other information disclosed to the Contractor during the project, will be owned by the Carbon Trust for the benefit of the Floating Wind JIP Partners, who will be entitled to commercially exploit the Results.

Management of Progress

- 4.14. Work and expenditure under the Scope of Work shall be monitored throughout the duration of the Contract by the Project Manager. Flash Reports are to be provided by the Contractor to the Project Manager at the end of each month after the start of the project. The Flash Report template will be provided to the Contractor at the beginning of the project.
- 4.15. The Carbon Trust will be entitled, at reasonable notice, from time to time during the term of the Scope of Work (and for a period of 2 years following its termination for any reason) to inspect all of the Contractor’s book of accounts and records so far as they relate to the subject matter of the Contract.
- 4.16. Failure to submit deliverables in a timely manner at the end of a stage will be grounds for suspension or termination of the Contract as described in section 4.25. Any suspension, reinstatement or dismissal shall be solely at the discretion of the Programme Manager.

Contract Price & Commitments

- 4.17. The Contract price to be paid by the Carbon Trust to the Contractor under the Contract will be on a time and materials basis capped at the approved maximum cost specified in the Award Letter ("**Approved Maximum Cost**").
- 4.18. The total price and any expenses paid or payable under the Contract shall not in any circumstances exceed the Approved Maximum Cost. The Approved Maximum Cost shall be the maximum sum for which the Carbon Trust shall be liable under the Contract to pay the Contractor for all work and services. The Approved Maximum Cost may be revised by the Carbon Trust in order to accommodate any adjustment necessary in relation to any additional services required by the Carbon Trust and agreed between the parties.
- 4.19. The Approved Maximum Cost for the Contract shall be equal to the Contract price. The Carbon Trust Project Manager reserves the right to vary the Approved Maximum Cost by informing the Contractor of the revised Approved Maximum Cost in writing at any time.
- 4.20. It shall be sufficient authority for the Contractor to undertake services or work in accordance with the Contract if it has received a purchase order from the Carbon Trust.
- 4.21. Notwithstanding any other term of the Contract:
- i) the Carbon Trust shall not be liable to pay the Contractor for any service or work in connection with this Contract unless and until it is authorised in accordance with section 4.20; and
 - ii) the amount payable to the Contractor shall not exceed the amount stated in the purchase order; and
 - iii) in no circumstances shall the total amount payable by the Carbon Trust to the Contractor, for the work or services to be carried out under the Contract, including project expenses, exceed the Approved Maximum Cost.
- 4.22. If the Carbon Trust terminates or suspends the Contract under section 4.24 or 4.25 provided that such termination or suspension does not arise out of any default of the Contractor (or any of its employees, agents or sub-contractors) or any failure to perform to the Carbon Trust's satisfaction under the Contract, then subject to sections 4.21.iii) and 4.23, in such circumstances the Carbon Trust will pay the Contractor a proportion of the next instalment of the Contract price falling due for payment, pro rata to the proportion of the period allocated for the then current sub-phase that has elapsed at the date of the termination or suspension.
- 4.23. The Contractor shall, if requested by the Carbon Trust, deliver to it all work and deliverables (including work in progress and incomplete deliverables) that have been undertaken prior to the date of termination or suspension (as the case may be).

Contract Duration and Early Termination

- 4.24. The Contract will commence on the date specified in the Award Letter and shall continue until the project has been completed in accordance with the Contract, to the satisfaction of the Carbon Trust and subject to the rights of early termination and break under the Carbon Trust Conditions of Contract and under section 4.25 below,

but in any case shall be subject to termination upon 30 calendar days' notice by the Carbon Trust at the discretion of the Project Manager.

4.25. In addition, the Carbon Trust will have the right to immediately suspend or terminate the Contract without liability either in whole or in part after any of the sub-phases if:

- i) satisfactory deliverables are not submitted in a timely manner; and/or
- ii) activities agreed with the Project Manager are not being completed to the timescales and/or quality standards set out in the Contract or otherwise agreed between the Contractor and the Project Manager; and/or
- iii) the work or service is not likely to be completed within the Approved Maximum Cost.

Judgement as to whether these conditions are met will be at the sole discretion of the Project Manager.

5. Invoicing & Payment

5.1. 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 ~£30,000-£40,000 for Phase 1 and the allocated budget for the more detailed study in Phase 2 is ~£200k-£250k; refer to Annex A for the decision-making process for delivery of Phase 2. The Contract Price submitted with the tender must be derived from the cost breakdown table requested in section 5.7, 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.

5.2. 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).

5.3. Payments for the Contract price to the Contractor will only be made upon presentation by the Contractor of a valid invoice stating:

- i) The current purchase order number
- ii) The Contract number
- iii) The name of the Project Manager: Hector Wilson
- iv) Description of work completed and account for resources expended

5.4. All invoices are to be issued electronically to accountspayable@carbontrust.co.uk, with Hector Wilson (hector.wilson@carbontrust.com) on copy, or to another email address as advised in writing by the Carbon Trust to the Contractor.

5.5. The payment terms for this project will be within 30 days of the Carbon Trust's receipt of a valid and undisputed invoice from the Contractor. The Carbon Trust shall be

under no obligation to make any payment whatsoever to the Contractor in respect of any work or services not completed in accordance with the Contract.

- 5.6. Payments will be made when a Work Package has been completed and the Deliverables accepted by the Steering Committee.
- 5.7. The Contractor is required to fill in the following staff rate and project cost breakdown table as part of their tender. For consortia, the time and budget allocation of each consortium partner should be clearly stated. The project is expected to take approximately 12 – 14 months.

Table 1: Staff rates and project cost breakdown

Staff member	Time spent per work package (WP) in hours				Total time in hours	Staff rate (£)	Staff cost to project (£)
	WP1	WP2	WP3	WPA: Project mgmt			
Name (Role/Title)	hr	hr	hr	hr	hr	£	£
Name (Role/Title)	hr	hr	hr	hr	hr	£	£
Name (Role/Title)	hr	hr	hr	hr	hr	£	£
Etc.	hr	hr	hr	hr	hr	£	£
Total Time In hours	hr	hr	hr	hr		WPB: Expenses	£
Total cost of each WP	£	£	£	£		Total Cost	£

Note: Additional rows and columns should be added as appropriate for additional staff members and work packages.

- 5.8. All rates quoted in Table 1 must be in GBP (£) and represent the **Hourly Rate** for employment of staff members.
- 5.9. Bidders should be aware that the Carbon Trust and Floating Wind JIP Partners usually require at least 2 weeks for the review and feedback procedure after delivery of each WP. This should be taken into account when the project Gantt chart is completed.
- 5.10. Tender submissions should be limited to 15 pages of A4 in the main body of the proposal. Supporting information should be included in an Appendix.

6. Tender Evaluation Criteria

Bidders should take the following evaluation criteria into account when preparing and submitting their tenders.

Criterion 1: Approach to Work (Weighting: 40%)

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 [25%]	<p>Bidders are required to provide a detailed description on how they plan to develop each work package described in Annex A.</p> <p>The description should include an initial overview on the approach followed by a description on how each Work Package and task will be delivered.</p> <p>Also, bidders need to justify how their proposed approach meets the project objectives.</p>
Suggestions [5%]	<p>Suggestions of additional areas of work to those described in Annex A 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 floating wind projects.</p> <p>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.</p>
Project management [10%]	<p>Bidders are required to describe how they will manage the project utilising appropriate resources and describe how they will work with the various stakeholders to acquire information and manage potentially conflicting relationships.</p>

Criterion 2: Experience & Staff Skills (Weighting: 40%)

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

Description	Information required from Bidders
Experience in relevant projects and industries [20%]	<p>Bidders should elaborate on experience of the criteria described. Explain how these past experiences are relevant for this tender.</p> <p>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).</p> <p>Bidders are advised that experience is considered a key important criterion and partnerships with other companies to support certain areas of experience are welcomed.</p> <p>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.</p>

CVs/Resumes and applicable skills [10%]	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. Bidders should elaborate on the most relevant skills of the selected staff that will be applicable in the project.
Expert engagement [10%]	A close working relationship with key stakeholders, such as wind turbine OEMs and platform/substructure developers are seen as relevant to the success of this project. Please supply ideas of how these groups can be engaged and leveraged.

Criteria 3: Price (Weighting: 20%)

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-hours for all staff grades [10%]	Bidders are required to provide day rates for all staff grades and to input the man-hours involved in each work package described in Annex A.
Fixed price for the project [10%]	Project cost breakdown by work package, time and rate of person completing the work as specified in Section 5.7. 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

Annex A - Scope of Work

Background – General

A detailed understanding of the Annual Energy Production (AEP) is a critical factor for the successful delivery of commercial scale floating wind farms. The actual AEP is a key unknown that needs to be better established for floating wind to increase investment confidence of future floating wind projects. The uncertainty is primarily related to the additional degrees of freedom and quality of yield modelling that could impact yield, but also controller modifications, additional downtime, and sustained pitch during operation.

The translational movement of floating foundation designs mean that fixed turbine layouts are no longer guaranteed; the motion of the turbines in general and particularly how motion differs between leading edge and waked turbines is not well understood or modelled. Searching for and investigating the dependencies affecting how floating foundations move within free stream and partially waked conditions will be an integral first step in being able to produce CFD and/or engineering models that can begin to quantify wake losses and their associated uncertainties.

The effects of movement and rotation in/around other degrees of freedom are known to impact turbine wakes, the pitching of a floating wind turbine platform can lead to unsteady aerodynamic effects. A better understanding of how both moorings and foundation design (spar, semi-sub, etc.) affect the extent of movement in the individual degrees of freedom of the platform, as well as associated coupled motions from the wind will be key to quantifying the sensitivities of platform design on wake loss.

This Invitation to Tender (ITT) covers an initial literature review and scoping study (Phase 1) that will be used to initiate a more detailed research study (Phase 2) in order to meet the project objectives. Once the scoping study has been completed, a decision will be made by the Floating Wind JIP Partners on whether to go ahead with the detailed study and how this will be delivered.

On completion of Phase 1, the following decision will be made by the Floating Wind JIP Partners:

- Award Phase 2, the detailed study, to the selected Contractor for Phase 1;
- Run a public tender process for delivery of Phase 2; or
- Cancel Phase 2, if felt based on the Phase 1 assessment there are other priority research areas for the Floating Wind JIP

Overall Objectives

The Floating Wind JIP would like to improve the understanding of floating wind yield and sensitivities of drivers for wake loss, compared to seabed fixed, with a further aim of updating the leading software to enable accurate prediction of floating wind yield.

The main objectives are:

- i. Quantifying wake loss and associated uncertainties, as well as their sensitivities to key inputs.
- ii. Production of estimated yield (AEP) of turbines installed on floating platforms.
- iii. Understanding of the controller optimisation and trade-off against dampening.
- iv. Determine yield impacts for different floating foundation motions, and hence floating substructure types.

It is expected that the objectives will be met through:

PHASE 1

- A comprehensive literature review.
- Scoping of detailed study.

Then, following agreement by the Floating Wind JIP:

PHASE 2

- Extensive engagement and close cooperation with relevant industry players, including turbine manufacturers, technology developers, CFD and/or other relevant wake model designers and platform/substructure developers.
- Robust understanding of fixed bottom foundation against floating platform with regards to wake effects using engineering models and CFD.

The Contractor should also suggest additional means of meeting the project objectives (e.g. relevant modelling tools that can add value to the study without compromising the ability to achieve the main study objectives within the allocated budget).

Note: It is envisaged that close engagement of relevant industry players, including turbine manufacturers, technology developers, CFD and/or other relevant wake model designers and platform/substructure developers will be a critical interface in this study. The Contractor should therefore include details in their proposal on their approach to ensure that suitable input can be achieved.

The Carbon Trust and the Floating Wind JIP partners can request deliverables from previous JIP studies as this will support the delivery of this work. The objective of this would be to ensure initial work packages can be delivered efficiently, with Contractors building on the findings to maximise additionality and concentrating effort on remaining knowledge gaps and analytical needs.

Contractors may also request relevant reports from the Carbon Trust Offshore Wind Accelerator programme that may be of use to the project, however, any access should **not** be presumed and will require the full authorisation of all OWA partner members.

Research Questions

Key research questions include:

- How does selection of floating substructure type affect floating wind AEP?
- What will be the key factors driving AEP for future commercial scale floating wind farms?

Overall Programme

The Carbon Trust appreciates that due to the breadth of skills and experience required for this project a consortium may be required to meet the objectives of the project, although individual contractors are still highly recommended to bid. There will be two phases of work to this project: An initial phase (WPO) will include a literature review and scoping study, the second phase (WP1 onwards) will be designed and fully scoped as part of WPO.

It is envisaged that it will take a small team of mixed seniority **~1-2 months** to complete phase 1 and a further **~12 months** for phase 2 of the project. An approximate budget of **~£30,000 - £40,000** is expected for phase 1. Following on from the approval from the Floating Wind JIP, the detailed research study (Phase 2) has an anticipated budget of **~£200,000 to £250,000**.

Contractors should use this outline scope to create a detailed project plan and Gantt chart outlining a detailed project budget and scope that can be delivered within the allocated time. The scope is to be agreed by the Floating Wind JIP Partners & 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 Floating Wind JIP Partners.

Outline Scope

The following Work Packages are the initial ideas on the key activities that the Contractor is expected to undertake during this contract. A weighting has been assigned to indicate the expected level of effort on each work package. Contractors are encouraged to offer a different approach that fulfils the high-level objectives and deliverables. If a different approach is suggested, the Contractor is expected to explain and justify any intended deviation from the advertised work packages.

Phase 1

Literature review and scoping study for Phase 2 of works
WPA+B: Project management and Expenses

Phase 2 – suggested content (final approach and WPs to be defined within Phase 1)

- Analysis and understanding of single turbine motions and wake in different wind conditions
- Scaling initial findings to understand impacts of wake losses in floating wind farms
- Calculating AEP and sensitivities
- Investigating effects of controller optimisation of yield versus dampening
- Updating or adapting of existing software to enable accurate prediction of floating wind yield

A more detailed scope for each focus work package is outlined below.

Work Packages

WORK PACKAGE	Description of work
<p>Phase 1</p> <p>Literature Review and Scoping Study</p>	<p>This work package will focus on an initial detailed literature review, identifying other work that has been completed in relation to this study from both academia and industry. Also, a comprehensive study of the current available floating software offered in the market should also be covered with a focus on what gaps exist in the existing suite of commercial software tools. To avoid unnecessary duplication of work, the FLW-JIP will look to share with the contractor the recent JIP reports, which could assist in this exercise.</p> <p>The literature review should then direct the focus of phase 2 of this project, as well as identifying the key challenges and opportunities to be undertaken in the detailed phase of study.</p> <p>Based on the information provided within this ITT relating to main objectives, and the key challenges and opportunities developed within the literature review, the contractor will be expected to produce a scope of works for phase 2 of this project. The detailed scope of works should provide an overall approach to the project broken down in to work packages, with each work package fully scoped in terms of aims, overview to methodology and deliverables. Furthermore, a project timeline, Gantt chart and breakdown of costs should be produced.</p> <p>Deliverables: D01 Literature review report. D02 Presentation of findings to the JIP Partners D03 Detailed scope of works outlining approach, work packages, objectives, deliverables, project timeline and Gantt chart, and breakdown of costs.</p>
<p>On completion of Phase 1, the following decision will be made by the Floating Wind JIP Partners:</p> <ul style="list-style-type: none"> • Award Phase 2, the detailed study, to the selected Contractor for Phase 1 – this will be subject to the Contractor having successfully delivered Phase 1, meeting the expected performance of the Partners, and demonstrating the capability to undertake Phase 2; • Run a public tender process for Phase 2; or • Cancel Phase 2, if felt based on the Phase 1 assessment there are other priority research areas in the Floating Wind JIP 	

<p>Phase 2</p>	<p>Phase 2 of this project involves the detailed study in to quantifying the AEP and wake losses incurred within a floating wind farm. This section of the work is to be fully scoped and detailed within phase 1 of the project. However, for guidance, a proposed approach has been given below. It is expected that the contractor will adhere to main themes and outcomes of the proposed approach but can suggest their own format and breakdown of work packages.</p>
<p>Phase 2 Proposed Approach:</p>	
<p>Single FWTG analysis Undertake an analysis of a single floating wind turbine through engineering models, CFD or otherwise to understand the primary factors affecting the wake loss from a single turbine. Factors may include substructure type, mooring type, scale of degrees of freedom, wind inflow, sea state, sustained pitch, and controller configuration/changes.</p> <ul style="list-style-type: none"> • It is expected that computer-aided engineering tools for simulating the coupled dynamic response of a floating offshore wind turbine along all of its components (such as OrcaFlex, FAST, ANSYS Wind Modeller, ...) will be supplied, if required, to the selected Contractor in order to provide consistency across the projects being delivered in the Floating Wind JIP. Any software solutions produced during the study should be packaged, if possible, and provided in order to allow the Contractor to replicate findings and facilitate learning. Also, the relevant training/courses/material should be given to the Contractor by the software package owners and/or experts. <p>Floating wind farm scale up Build upon work package 1 to understand turbine-turbine interactions and thus motions of individual turbines. This will include an analysis of how turbines move within the free stream and within partially waked flow.</p> <p>AEP and sensitivities Through modelling an entire wind farm, the contractor will be expected to produce a value for the AEP and compare this to that of a similar fixed bottom farm.</p> <p>A detailed summary report should be produced highlighting the differences in AEP between fixed and floating structures; and for a floating wind farm highlight the scale of wake loss and its uncertainties as well as the sensitivity of different factors (mooring type, substructure type, sea state) on AEP.</p> <p>Controller optimisation Once AEP has been determined and sensitivities understood, the contractor is expected to conduct a brief analysis in how best to optimise yield or facilitate floating capabilities through modifications to the WTG controller. A comparison should be made with other methods of energy yield optimisation, such as (but not limited to) increased/decreased dampening of turbine platform motion. Any modified controllers shall be provided to the Contractor and shared with JIP partners in a common format e.g. FAST or appropriate to the software solution provided.</p> <p>A brief summary should be produced highlighting the change in yield and wake losses thanks to AEP optimisation methods.</p> <p>Model update</p>	

It is anticipated that the contractor will provide an alternate methodology, model correction or module to a commonly used engineering, CFD wind/wake model (e.g. ANSYS WindModeller) or more complex fully coupled fluid/structure models for the accurate estimation/prediction of AEP for floating wind farms. This updated software will be produced for and shared with the FLW-JIP partners.

The necessary guidance material on how to implement/run the model will be produced alongside.

Stakeholder Engagement

Engage with relevant industry players, including turbine manufacturers, platform/substructure developers, technology developers, CFD/wake model developers and potentially windfarm technicians to better understand accessibility of floating offshore wind turbines.

Summary of findings

Summary of findings related to floating turbine wake losses and AEP.

<p>Overall WPA: Project Management</p>	<p>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.</p> <p>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 FLW-JIP.</p> <p>Finally, if appropriate, resource should also be allocated to provide inputs into the 'FLW-JIP 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 'FLW-JIP Cost Model'.</p>
	<p>D04: Monthly flash reports D05: Project executive summary D06: Delivery of webinar D07: Inputs to OWA Cost Model</p>
<p>Overall WPB: Expenses</p>	<p>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.</p>

*** Note on deliverables:**

All written deliverables should include a short Executive Summary (~2-5 pages) and larger deliverables should also include an extended Synthesis (~10-20 pages) of the key findings from the work undertaken.



Appendix – Key Information

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Project Details

Project title	Floating Wind Yield Scoping Study
Research area	Floating Wind JIP
Project Manager name	Hector Wilson
Project Manager email	hector.wilson@carbontrust.com
Key Objective is...	to improve the understanding of floating wind yield, compared to seabed fixed, with a further aim of updating the leading software to enable accurate prediction of floating wind yield.
Project duration (months)	Phase I: ~2 months / Phase II: 10-12

Key Dates

Date of issue	07 February 2020
Date & Time of submission (specify time zone – GMT/BST.)	03 April 2020
Clarification deadline	21 February 2020
Clarification response date	26 February 2020
Bidder Interviews	week commencing 4 May
Successful Contractor Announcement	May 2020
Project kick off Meeting	27 May 2020