Low Carbon Hydrogen Supply 2 Competition Application Form Stream 2

Proposal Summary

1. Name of Applicant Organisation This should be the lead organisation/co-ordinator for the proposed project
Environmental Resources Management Ltd.

2. Project Name
ERM Dolphyn - Commercial Scale Demonstration

3. To which technology theme(s) are you applying? Please refer to Section 2.3 of the Stream 2 Guidance Notes/ ITT for further information on themes. Select the most applicable theme(s) for your technology.
Zero Carbon Hydrogen Production Solutions

4. Stream 2 Estimated Start Date
* 04/10/2021

5. Stream 2 Demonstration Project Duration (months)
1 18

6. Stream 2 Estimated End Date
* 31/03/2022

7. Stream 2 Total Demonstration Project Costs (£) Please enter the total amount of BEIS funding for Stream 2 that you are applying for excluding VAT.
9963172.53

8. Please give a brief description of the project. (Maximum 400 words)

ERM Dolphyn is focused on the production of ‘green’ hydrogen at multi-GW scale from offshore floating wind. It is a modular design, integrating electrolysis and a wind turbine on a moored floating sub-structure to produce hydrogen from seawater using wind power as the energy source. The design has been developed and accelerated under the Hydrogen Supply Competition.
The project plan focusses on a rapid and efficient means of moving to large-scale deployment. It enables the technology to make a significant contribution to the Governments goal of 5GW of hydrogen production by 2030 and fully aligns with the Governments 10 point Plan for Net Zero and the recently issued UK Hydrogen Strategy. By delivering green hydrogen from renewables at large scale it provides the UK with a level of balance within the twin track approach of developing ‘blue’ and ‘green’ hydrogen. As the technology produces hydrogen directly from seawater and wind, it is a fully sustainable solution and does not put any additional load on the power grid, thereby avoiding grid constraint issues and grid access charges. In so doing it provides UK society with a degree of added redundancy in terms of reliable energy supplies.
This phase of the project looks to build on the successful delivery under previous phases of the Hydrogen Supply Competition with the following activities:

• Offshore demonstration trials to evaluate key systems. The trials will produce green hydrogen from seawater in an offshore floating marine environment. The trials will be conducted at the Marine Energy Test Area (META) in Milford Haven, South Wales
• Development of a Commercial Scale Demonstrator (10MW) sufficiently to enable private investment. [This information has been redacted] [redacted]

Development of the Dolphyn project under the Hydrogen Supply Competition have enabled the first commercial Dolphyn wind farm (200 MW) project to be identified. This is the 200 MW Salamander floating wind project in the North Sea, 35km north-east of Peterhead, developed by Simply Blue Energy in partnership with Subsea 7. The developers have now signed a memorandum of understanding with ERM for the use of the ERM Dolphyn hydrogen technology at the field. The aim is to have this project operational by the end of 2028.

9. Please explain why public sector funding is required to take this innovation forward. (Maximum 300 words)

Public funding will make a material difference to the actuality and pace of commercialisation, as summarised below:
• The financial modelling undertaken during Phase 2 of the ERM Dolphyn project (under the Hydrogen Supply Competition) demonstrates that ERM would not be in a position to progress this project at this stage without public funding. We would have to put the project on hold, because despite there being a clearly mapped route to low cost hydrogen production, the initial hydrogen cost associated with the 10MW Commercial Demonstrator project would be too high to interest offtakers and investors. These high costs are due to:
o The fact that the early stage commercial demonstrator comprises a single unit, which means the hydrogen produced by the 10MW project is expected to be initially more expensive than hydrogen produced onshore or by commercial scale projects.
o The Project has been developed to produce hydrogen at lower cost than onshore hydrogen production for wind farms far offshore (>80 km). However, for a short distance to shore as with the Commercial Demonstrator, there is a cost gap with the conventional hydrogen production onshore.

Public funding is therefore critical to bridge the gap between offtaker market expectations and the cost of production for this early stage project. This will enable us to successfully demonstrate the concept and move quickly to commercial scale projects, with their associated cost savings.
• A clear pathway to cost reductions for commercial scale ERM Dolphyn projects has been mapped, and public funding would underpin investor confidence in a similar way to the very successful acceleration of the commercial offshore wind industry in the UK, enabling these cost reductions to be quickly achieved, and the associated economic and decarbonisation benefits to the UK of large scale hydrogen production to be realised

Eligibility Criteria

1. Technology Categorisation The technology must be in scope of one of the themes described in Section 2.3 of the Low Carbon Hydrogen Supply 2 Stream 2 ITT.

	Yes	No
Is the technology in scope?	X	

2. Innovation and Technology Readiness This Competition is to support the development of innovative Low Carbon Hydrogen supply solutions. It is to support the development of technologies that are not yet commercial from Technology Readiness Levels (TRLs) 6 to 7 at the start of the projects. (Further information on TRLs can be found in Appendix 1 of the Low Carbon Hydrogen Supply 2 Stream 2 ITT).

	Yes	No
Will your technology / system be at TRL 6 – 7 at the start of the project?	X	

3. Technology Scope The focus of the Competition is to support the development and demonstration of innovative hydrogen supply solutions as detailed in Section 2.3 of the Low Carbon Hydrogen Supply 2 Stream 2 ITT. Exclusions: Funding will not be provided for projects where the technology development focuses on: Upstream energy production (power and fossil fuel extraction) End-use technologies (for example boilers, and other hydrogen appliances) Technologies where the core technology has previously been operated commercially (in UK or Internationally) Power generation from hydrogen (for example fuel cells or CCGT) Gas-grid systems (onshore) Novel CCUS technologies which aren't intrinsically linked in the hydrogen production process

	Yes	No
Does your application exclude costing/budget for any of these technology exclusions (listed above)?	X	

4. Project Status BEIS is unable to fund retrospective work on projects.

	Yes	No
Can you confirm that your application does not seek funding for retrospective work on this project?	X	

5. Additionality Projects can only be funded where evidence can be provided that innovation would not be taken forwards (or would progress at a much slower rate) without public sector funding.

	Yes	No
Can you confirm that this project would not be taken forward (or would progress at a much slower rate) without public sector funding?	X	

6. Contract Size Demonstration (SBRI) contracts for up to £10m per project with a total of £30m across the Stream 2 competition are available, with a maximum of £5m for engineering design. Stream 2 Projects must be completed by 1 February 2025.

	Yes	No
Can you confirm the funding requested from BEIS for your project cost for Stream 2 will be equal to or below £10m with a maximum of £5m for engineering design and is 100% of eligible project costs?	X	

7. Eligible Project Costs SBRI is aimed at organisations working on research and development (R&D) of an innovative process, material, device, product, or service prior to commercialisation. Funding is available for R&D activities only, including related dissemination activity. Projects requesting funding for commercialisation activities are not eligible. The full list of eligible project costs is set out in Appendix 3 and outlined in Section 5 of the Low Carbon Hydrogen Supply 2 Stream 2 ITT. BEIS must fund 100% of eligible project costs, no match or in-kind funding is allowed.

	Yes	No
Can you confirm that requested funding is for eligible costs and BEIS will fund 100% of those costs?	X	

8. Project End Date Projects must be completed and approved by BEIS by 1 February 2025. Projects need to allow time for the BEIS monitoring officer to review the project; this process can take up to a month and should be included in your project plan.

	Yes	No
Can you confirm that the project will meet the specified project end dates?	X	

9. Risk Benefit Sharing The sharing of risks and benefits is an important aspect to the SBRI approach. Projects receive financial support and retain any intellectual property generated, with certain rights of use retained by BEIS. Project outputs are also expected to be shared widely and publicly and project teams are not permitted to include profit in the eligible project costs.

	Yes	No
Do you agree to this approach?	X	

10. Delivering Multiple Projects If project consortium member(s) are part of multiple successful applications, they must be able to deliver on them and they must not have applied for funding for the same piece of work more than once.

	Yes	No
a) If you or your consortium are part of multiple successful applications, would you be able to successfully deliver all projects if necessary?	X	
b) If you or your consortium are part of multiple successful applications, could you please confirm that you have not applied for funding for the same piece of work more than once?	X	

11. Multiple Applications If you intend to submit multiple applications, you must comply with the following limits of entry into the competition: Lead organisations may only enter one application into the Stream 2 competition as the project lead. A technology provider/OEM are limited to one application for a particular technology/solution requiring development.

	Yes	No
a) If you are the lead organisation, as the project lead can you confirm only one application has been submitted for stream 2?	X	
b) If you or your consortium are part of multiple applications, could you confirm that the main technology being developed is different in each application i.e., only one application per particular OEM's technology has been submitted?	X	

12. Prompt Payment For contracts of £5m or more, if you intend to use a supply chain for this contract, you must demonstrate you have effective systems in place to ensure a reliable supply chain. If the application value is over £5m, and you intend to use a supply chain, please complete the document in Appendix 4, Declaration 7 of the Low Carbon Hydrogen Supply 2 Stream 2 ITT.

	Yes	No
If your contract size is greater than £5m, can you demonstrate you have effective systems in place to ensure a reliable supply chain?	X	

Contact and Lead Organisation Details

1. Primary Contact Details

[This information has been redacted]

[This information has been redacted]

3. The registered address of the Lead Organisation

Address Line 1	2nd Floor, Exchequer Court
Address Line 2	33, St Mary Axe
Address Line 3	-
Town/City	London
Postcode/ Zip Code	EC3A 8AA

4. County (If Applicable)

London

5. UK Region (If Applicable)

London

6. Country

United Kingdom

7. Project Location: Is this registered address the location where the main activity of the proposed project will be carried out? You will be asked to provide project location details in the separate BEIS Project Cost Breakdown/ Finance Form.

Yes

8. Lead Organisation Type

Private Company

9. Lead Organisation Size

Large Enterprise

10. Number of employees in Lead Organisation (including directors)

454

11. Lead Organisation Company Registration Number

01014622

12. Turnover Amount of Lead Organisation (in most recent annual accounts) Please include the currency of the amount in your response.

[redacted]

13. Turnover Date (in most recent annual accounts)

* 31/03/2020

14. Balance Sheet Total of Lead Organisation (total assets net of depreciation) Please include the currency of the amount in your response.

[redacted]

15. Balance Sheet Date (total assets net of depreciation)

* 31/03/2020

16. Is the Lead Organisation able to recover VAT?

Yes

17. Lead Organisation Maturity

>10 years

18. How is the lead organisation currently funded? (Choose all that apply)

	No Funding	Founders (including bank loans)	Friends and Family	Public Sector Grants	Angel Investment	Venture Capital	Private Equity	Stock Market Flotation
							X	

19. Lead Organisation Status: a brief introductory description of the company. (Maximum 400 words)

ERM is a global sustainability, environmental, health, safety and risk management consultancy that is increasingly helping clients to operate in a low carbon world. We have helped several blue chip companies develop sustainability strategies that define material issues, stakeholder engagement, goal setting and KPIs.

Our work on low carbon energy transition and hydrogen covers many of the UK's leading projects (e.g. H21, Hy4Heat, HyNet, H100, HyGen, Acorn). We have extensive experience on leading renewable projects, including major wind farm projects both offshore and onshore. We are the originators, developers and project manager for the ERM Dolphyn project, developing an innovative technical and economic solution for producing green hydrogen at scale from offshore wind. The Dolphyn project has been accelerated under the BEIS funded Hydrogen Supply Competition (2016-2021). ermdolphyn.erm.com.

ERM provides advice to our clients that improves their sustainability performance, including services such as:

Response to Climate-Related Financial Impacts

ERM were the lead authors on behalf of the TCFD for the technical guidance for assessing climate-related financial risks and opportunities. Recognising our TCFD expertise leading industrial companies, who are typically heavy emitters of CO2, have appointed ERM to work with them to assess the financial drivers on their business from the energy transition and to define strategic responses to mitigate risks and capture new growth opportunities.

Advice on Low-Carbon Business Growth

ERM help clients to shape their strategic response to the Energy Transition; this usually follows a detailed options appraisal that has assessed the techno- economic feasibility of different strategies and/or technologies. ERM's expertise extends way beyond board rooms, we are fully equipped to support companies at a site-level delivering new innovative low-carbon projects, from advancing hydrogen and CCUS projects to supporting companies in reducing their overall product carbon intensity across their portfolio. ERM has current insights into CCS / CCUS policy from our work with the CO2 Capture Project (CCP). This presents a survey of CO2 storage regulations from a range of countries including the USA, Canada, UK, and Australia.

ERM works with the world's leading organizations, delivering innovative solutions and helping them to understand and manage their sustainability challenges. ERM is a founder member of the WBCSD and has contributed to their publications including several sector SDG Roadmaps. We have more than 5,500 people in over 40 countries with London being our Global HQ. www.erm.com

20. Does the lead organisation have a parent company? (If yes you will be asked to provide details)

No

Parent Company Details

1. Parent Company Details

Organisation Name	ERM Worldwide Group Ltd
Address Line 1	Floor 2, Exchequer Court
Address Line 2	33, St Mary Axe
Address Line 3	-
Town/City	London
Postcode/ Zip Code	EC3A 8AA

2. Country

United Kingdom

3. Number of employees (including directors)

4920

4. Company Registration Number

09631707

5. Turnover Amount (in most recent annual accounts) Please include the currency of the amount in your response.

[This information has b

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8. Balance Sheet Date (total assets net of depreciation)

* 31/03/2021

9. Organisation Maturity

>10 years

Criterion 1: Innovative Low Carbon Hydrogen Supply Approach

Criterion 1: Innovative Low Carbon Hydrogen Supply Approach This criterion will be used to assess the novel approach to Hydrogen Supply in the proposed demonstration project. Applicants should have already determined in outline, that their Hydrogen supply solution is technically feasible and meets, or has the potential to meet, the relevant industrial regulatory requirements, including health and safety and air quality. In their responses under this criterion, applicants are expected to justify that their project is sufficiently proven in terms of technical and regulatory feasibility to warrant funding for their proposed pilot demonstration. In making these justifications, applicants should reference any outputs from their earlier work, identify where further development is needed to confirm feasibility and explain how the pilot demonstration will be designed and executed to provide these confirmations. Highest marks will be awarded to the innovative low carbon hydrogen supply solution that best describes the design and the work expected to be carried out through the project. In the text box below, the applicant should: Describe what is innovative about your solution. Clearly state the aim of the demonstration trials proposed by, for example, stating what levels of performance constitute a successful trial. Describing how and why the demonstration will accelerate the development of low carbon hydrogen. Provide the latest evidenced justification for the technical and regulatory feasibility of the proposed demonstration pilot. This should reference any relevant earlier work, including engineering designs, engineering calculations and the outputs of other feasibility research and recapitulate the innovative nature of the solution. Clearly set out where there is remaining uncertainty about technical and regulatory feasibility and explain how your demonstration pilot will address these uncertainties. (Weighting for Criterion 1 – 5%) (Maximum 2,000 words)

Overview

ERM has developed ERM Dolphyn for the production of ‘green’ hydrogen at multi-GW scale from offshore floating wind. It is a modular design, integrating electrolysis and a wind turbine on a moored floating sub-structure to produce hydrogen from seawater using wind power as the energy source. The design has been developed and accelerated under the Hydrogen Supply Competition, funded by the BEIS Energy Innovation Programme, 2018/2021. A schematic of the design is shown in Figure 1.1.

During Phase 2 of the programme, completed June 2021 and summarised in Figure 1.2, the design has been progressively de-risked to allow the project to move forward confidently to a Commercial Scale Demonstrator (10MW), building from the previous Prototype Unit (2MW). This is to be installed at the Kincardine wind farm, 15km off Aberdeen by the end of 2024. This accelerated plan supports a faster development pathway for the first commercial Dolphyn wind farm (200 MW) and a first project has now been identified - the 200 MW Salamander floating wind project in the North Sea, 35km north-east of Peterhead, developed by Simply Blue Energy in partnership with Subsea 7. The developers have signed a Memorandum of Understanding (MOU) with ERM (see uploaded file 1) for the use of the ERM Dolphyn hydrogen technology at the field. The MOU is subject to the ERM Dolphyn concept being confirmed as deployable and technically feasible, which is the objective of the pilot demonstration trials described in this submission. The aim is to have this project operational by the end of 2028. This project has gained significant positive press attention : https://renews.biz/71396/simply-blue-signs-mou-over-200mw-scottish-floater/

A Rapid Route to Deployment at Scale meeting Society’s Ambitions

The ERM Dolphyn Development Plan (See Section 3) represents a rapid and efficient means of moving to large-scale deployment. It enables the technology to make a significant contribution to the Governments goal of 5GW of hydrogen production by 2030 and fully aligns with the Governments 10-point Plan for Net Zero and the recently issued UK Hydrogen Strategy. By delivering green hydrogen from renewables at large-scale it provides the UK with a level of balance within the twin-track approach of developing ‘blue’ and ‘green’ hydrogen. Being a floating, deep-water solution, it has the potential to fully exploit the extensive wind resources in the UK North Sea and Celtic Sea to the benefit of UK society. These significant benefits include security of energy supply, job creation, investment in ports and UK skills development. As the technology produces hydrogen directly from seawater and wind, it is a fully-sustainable solution and does not put any additional load on the power grid, thereby avoiding grid constraint issues and grid access charges. In so doing, it provides UK society with a degree of added redundancy in terms of reliable energy supplies.

A summary of the development plan for ERM Dolphyn is shown in Figure 1.3. The aim is to have first hydrogen production offshore by end of 2024 and the first commercial fields contributing a minimimum of 5% of the UK’s 5GW hydrogen target by 2030.

Offshore demonstration trials to evaluate key systems

The offshore ERM Dolphyn trials are being conducted to demonstrate the performance of key equipment items in appropriate operating environments and are key to enabling a fast-track development of the 10MW unit and subsequent commercial scale projects. In particular, this will include the production of hydrogen in a floating offshore marine environment, utilising a flat-bed barge.

The trials will be conducted at the Marine Energy Test Area (META) site in Milford Haven, South Wales. A 0.2-0.5MW hydrogen production system will be deployed with associated equipment including water desalination, electrolysis, control, metering, and vent systems. The primary objectives of the trials are to:

• Demonstrate production of green hydrogen from seawater in an offshore floating marine environment
• Test the performance of key elements of the marinised systems (e.g. the liquid/gas phase separator)
• Identify areas for further innovation or modification and early-stage troubleshooting
• Develop a generalised model for internal fluid behaviours suitable for application on all floating marine environments
• Develop of a digital process model to enable optimised control system definition at commercial-scale production for all floating marine environments
• Replicate variable power input to the electrolyser from the WTG and test overall reliability of system

Additionally, a section of flexible export riser will be tested to assess operational performance for hydrogen duty.
An illustration of the trials to be conducted is provided in Figures 1.4, 1.5.

Proving the commercial scale

The development of the 10MW demonstration unit has the following scope and objectives:

• Commercial demonstrator unit to be installed providing first green hydrogen – targeting production by the end of 2024
• Development of pipe route, landfall, and onshore facilities to enable export
[This information has been redacted]
• Unit to be designed to be suitable for a variety of deployment scenarios with minimal alterations including:
• Ease of EPCI
• Efficiency and reliability
• Optimised Operation and Maintenance
• Supply chain resilience (optimising UK content)
• Automation of control
• Work with regulators to develop a clear roadmap to consent
• Continued work to align the development pathway for key stakeholders and supply chain members
• Remain a zero-carbon project

The objective of the work proposed under the Hydrogen Supply 2 Competition is to develop the project sufficiently to enable an investment decision for the first 10MW unit.

A feasible solution

The design activities for the 2MW Prototype have been successfully completed, resulting in more than 300 engineering deliverables being produced, including a wide range of studies and engineering drawings such as layouts, 3-D models, Process Flow Diagrams (PFDs), Piping and Instrumentation Diagrams (P&IDs) and Single Line Diagrams (SLDs).

Development of the Detailed Design for the ERM Dolphyn 2MW unit has successfully enabled engineering activities to focus on de-risking the project. It has provided much of the necessary evidence to deploy all of the primary systems on a full-scale unit. No significant technical barriers remain that could prevent the development and deployment of the concept considered. An image of the current design is provided in Figure 1.6.

An Accelerated Timeline to Commercial Scale Demonstration

During the course of delivery of Phase 2, the project team were able to successfully identify and

evaluate a low risk route to accelerated deployment at scale. A series of offshore trials as described above will be conducted to suitably demonstrate the robustness of the overall system. This will negate the requirement for the smaller scale 2MW prototype planned under Phase 1 and enable the project to proceed to the first 10MW commercial scale unit approximately 4 years faster than originally planned.

A pre-FEED design activity has been undertaken for the 10 MW unit and has provided confidence that the ERM Dolphyn concept is technically and economically robust at the larger scale.

Working with World Leading Organisations

The ERM Dolphyn project has been developed with input from a wide variety of organisations with relevant experience and knowledge across a range of established sectors including oil and gas, renewables, chemicals, hydrogen production, energy, construction, trading, and marine operations. These include:

- Doosan Babcock
- Lloyd's Register
- Nel Hydrogen
- ODE
- Principle Power
- Tractebel
- Vestas

Design Independently Verified and aligned with Regulatory Expectations

A regulatory framework does not currently exist for the development of offshore hydrogen production facilities. The ERM project team regularly liaises with the UK HSE and other regulatory bodies to develop an appropriate path for appropriate consents and approvals. Offshore hydrogen production is a new area and the project is keen to contribute to the adoption of a clear, safe and sustainable design and development approach. We are confident that the approach adopted, which takes learnings from existing UK offshore safety case and environmental regulations, is in line with the highest standards of technical design and EHS risk management.
The design process for the ERM Dolphyn project has been critically reviewed and independently verified by Lloyd's Register to provide confidence that a robust hazards management process is being followed. Lloyd's Register has had unrestricted access to all design documentation developed by the project team.

The Optimal Site has been selected with a Roadmap to Consenting

Site selection exercises were completed for both the offshore and onshore components of the Project to identify sites that can be consented, and are least constrained by technical, safety, environmental and commercial considerations.

Broad search areas were initially identified in the North Sea considering a range of factors including access to an onshore hydrogen market, and wind and wave characteristics. Within the zones under consideration, the area south-east of Aberdeen city close to the existing Kincardine offshore wind farm was identified as the most advantageous for the first 10MW unit. The Kincardine field offers a number of project similarities to ERM Dolphyn; it is a floating wind farm, with 10 MW units, which utilises a similar substructure and mooring design. The general arrangement for the 10MW demonstrator at Kincardine is shown in Figure 1.7.

The Salamander project, located 35km Northeast of Peterhead, has been identified as suitable for a 200 MW commercial Dolphyn wind farm. The location of this and the Kincardine field is shown in Figure 3.3 in Section 3. Initial engineering work for Salamander will be conducted by ERM and Simply Blue Energy over the coming months.

The consenting route for ERM Dolphyn is unusual as it is a first of a kind project and the regulatory regime is not yet fully established. Our engagement with the regulators (UK HSE, OGA, CES and MS) has been proactive and positive, and all are committed to working together collaboratively as the system develops. The pragmatic approach followed by all parties provides confidence that consent can be delivered in line with the project timeline.

Design developed to maximise UK Content

The project team has worked with key suppliers to maximise local content wherever possible. A good example of this is the floating sub-structure that has been designed by Principle Power. This has been modified for ERM Dolphyn as a modular system to enable competition in the supply chain and high levels of local content. The new design enables individual components to be manufactured by UK suppliers for best quality/cost efficiency (refer to uploaded file 2 for a technical note from Principal Power).

How this project addresses the remaining challenges

The key remaining challenges for the project and responses are as follows:

Technical. These include evaluation of system performance under offshore motion conditions, interface between desalination system and electrolysis, weather proofing of equipment and proving the control system. These are being addressed as part of the offshore demonstration trials to be held at Milford Haven next summer. Flexible risers have not yet been proven to operate safely under hydrogen duty and a trial to verify this performance is included within the scope.

Commercial. These include the need for a clear Government policy on green hydrogen and a business model for early green hydrogen projects to enable offtake agreements to be finalised. The ERM Dolphyn project is contributing to discussions with Government to develop an appropriate business model for early green hydrogen projects (by end of 2022). This will enable the project to finalise offtake agreements for the 10MW demonstrator and provide clarity to investors for the first commercial field. The project will continue to optimise the Dolphyn design to drive down cost, embracing new solutions in line with technological development.

Supply Chain. Supply chain and port facilities are needed to supply and handle fabrication of multiple Dolphyn units required for the first commercial field. This will be addressed through engagement and dissemination (discussed in response to Criterion 3) with requirements communicated clearly and early.

Regulatory. Developing a regulatory regime to be in place for offshore hydrogen projects and achieving consent on reasonable timescales. This will be addressed by the project team working closely with UK HSE on safety and with Marine Scotland, Crown Estate Scotland, OGA and local authorities on EIA and consent delivery.

Criterion 2: Performance and Cost Reduction of the Hydrogen Supply Solution

Criterion 2a: Performance of the proposed solution The applicant should provide a detailed explanation of the performance of the proposed hydrogen supply solution and compare it to the current state of the art solution and the applicable counterfactual parameters (see Appendix 2 of the Low Carbon Hydrogen Supply 2 Stream 2 ITT), define the assumptions made and the basis for those assumptions. Describe the impact of different operating conditions, for example if the hydrogen supply solution is operating at a variable throughput. Details of the impact on the efficiency of the process should be presented including impact on OPEX costs, longevity and performance. In the text box below, applicants should: Provide details of the performance and flexibility of the proposed solution at the demonstration site and when rolled-out across multiple, suitable sites in future. Explain how the demonstrator will be used after this project has been completed or indicate the decommissioning strategy. Provide evidence of how and why this solution allows performance benefits when compared to the current state of the art and applicable counterfactual parameters. Provide an explanation of the technical barriers to deployment and description of the plan during the demonstration to overcome/scope-out/understand these barriers better. Provide an overview of any relevant performance validation that has previously been conducted. Applicants should detail the approach of the performance validation process that will be followed during the demonstration phase. Provide an explanation of why it is believed that the hydrogen supply solution will be acceptable to the market in terms of ease of installation and reliability (Weighting for Criterion 2a – 10%) (Maximum 2,000 words)

Performance and flexibility

This phase of the project has been designed to enable investability through testing and validating performance, increasing technical readiness, and de-risking the project.

The 10MW ERM Dolphyn demonstrator unit is designed to export high purity hydrogen at a medium pressure to landfall. Production will be at ambient temperature, with a maximum production rate of ~150 kg/hr (~3,600 kg/day), suitable for transport use at the point of delivery and blending into the gas network. A hydrogen purity of minimum 99.97% is targeted, which compares well with the 99.9% counterfactual parameter in the ITT Appendix 2, associated with natural gas with CCUS.

The expected flow rate of the demonstrator unit is 5.51 MWth with landfall pressure at 30 barg and net efficiency (LHV) of 57.3%. This compares well with the counterfactual product flow rate of 300 MWth, hydrogen output pressure of 30bar and net efficiency (LHV) of 67.2%. Larger scale commercial projects have higher flow rates namely 55.1MWth for 100MW, 110.2MWth for 200MW and 2204MWth for a 4GW project.

The key ERM Dolphyn systems are based on proven technologies, with performance validated through their recent track record:

• The floating foundation/substructure is based on a proven design; a similar design is currently in operation on the Kincardine Offshore Windfarm.
• Thermal desalination is a proven technology already in use in many offshore applications.
• The electrolyser provided by NEL is a proven technology. Its commercial application offshore will be validated through the offshore trials planned under this proposal.
• Energy storage system, consisting of fuel cell, battery, and supercapacitors: fuel cells and battery packs are being increasingly used for high power output ‘motion’ applications (e.g. in hydrogen trains and buses). Similarly, large-scale capacitors are widely used to supplement power systems for short duration power peaks.

Equipment with a high technology readiness level has been selected for ERM Dolphyn to ensure a robust overall design. Novel approaches to combining proven and emerging technologies are explored to further improve production efficiency and reduce costs. This is particularly important as we move to the first commercial field application.

[This information has been redacted]

Technical barriers and how these will be overcome

Most of the key technical challenges associated with the ERM Dolphyn design have now been resolved. Remaining challenges are predominantly associated with evaluation of system performance under offshore motion conditions, improving interface efficiency, weather proofing of equipment and proving the control system. These are being addressed as part of the offshore demonstration trials proposed at Milford Haven. Flexible risers are expected to be able to operate safely under hydrogen duty although this this has not yet been proven in practice, therefore a trial to verify this performance is included within the scope.

The project philosophy is to use high technology readiness level equipment in a novel system configuration. Through the work completed to date, the project has progressively de-risked the design

to the extent that we can move forward confidently to a 10MW unit. The outputs of the pre-FEED design activities have provided sufficient confidence that the scaled-up topsides fully complement the scaled up floating substructure.

During the next phase of the project, work will be undertaken to overcome the remaining technical challenges and realise opportunities to optimise the project performance that have been identified during the work so far, including:

[This information has been redacted]

A value-engineering exercise will be carried out as part of the ERM Dolphyn 10MW FEED. This analysis will help to identify any overly conservative design elements.

Installation and Reliability

A construction and installation plan has been developed incorporating the methodology, schedule and potential locations for fabrication and installation. The installation plan has been developed considering the local supply chain and its evolution towards supplying the commercial scale field of ERM Dolphyn units, in order to facilitate UK content.

Key features of the installation methodology are summarised below:

• Potential sites for the construction and installation activities both in the UK and in Europe were assessed from a technical and economic viewpoint including a detailed assessment of ports located on the eastern coast of Scotland. The assessment confirmed that Scotland has the capacity to support the fabrication of the platform, supporting the local supply chain in its evolution towards the commercial scale fields.
• The ERM Dolphyn project is committed to maximising UK content as far as is economically practicable. The project team has an existing relationship with suitable port facilities in the UK and is keen to continue working with UK facilities during the next phase to explore options for fabrication optimisation.
• The hydrogen export pipeline installation will involve trenching, pipeline laying and backfilling. A pipeline construction philosophy has been developed, identifying the methodology for pipeline laying, riser and spool piece tie-in installation. The laying of pipelines is a well-established and mature industry in Scotland, the pipeline diameters expected for ERM Dolphyn projects are within the

boundaries of ‘standard’ pipelines commonly installed.
• Following pipelay, the pipeline trench will be backfilled for long-term protection from fishing and other potential seabed interaction. A preliminary pipeline on-bottom stability assessment has been completed indicating that the pipeline is stable at the ERM Dolphyn platform location for two installation windows of three months duration per year.
• The flexible riser, connecting the ERM Dolphyn substructure and the pipeline on the seabed, is designed in order to avoid the need for diving inside the anchor pattern of ERM Dolphyn. Potential optimisation of the riser installation methodology was identified during the design phase, to provide significant financial benefit on future larger array installations.

The proposed methodology includes significant benefits in terms of HSE considerations, UK content, development of the UK supply chain, and reduction of risk.

A fabrication strategy will be developed under this proposal in conjunction with the build sequence report. This strategy will take into account the existing arrangements and relationships with vendors and packaging or transport service providers, based on manufacturing point or port-of-origin. As the strategy will be highly dependent on the selection of construction yards and fabrication sites, these will be reviewed in order to define possible strategies.

Reliability is key to the project as it will reduce OpEx associated with maintenance activities and improve hydrogen output of the project. The reliability of the design will be maximised through the design process and on-going engagement with OEMs. The trial program will improve understanding of areas to target for increased uptime. In addition, RAM analysis will be carried out as part of the design work, identifying key equipment considered to be production critical, assessing the expected availability of each critical system and the overall availability.

Decommissioning

The 10MW demonstrator has been designed with a 20-year life, and given the anticipated growth in the hydrogen market during its operational lifetime (from 2024 onwards) it is expected that it would remain operational for the entirety of this lifetime with the potential to form the basis of future development and testing activities.

At the end of its lifetime, the commercial demonstrator would be decommissioned. This would involve disconnecting and removing the anchoring system and flexible riser, towing the unit back to shore and dismantling at the quayside. Floating wind is expected to have significantly lower decommissioning costs than fixed bottom offshore wind, largely because a heavy lift vessel is not required. Scrap value [This information has b

[This information has been redacted]

Following completion of the trial programme ERM will look to repurpose the test skid(s) to support other demonstration trials.

Criterion 2b: Lifetime costs of the proposed solution With reference to relevant prior work, describe the likely lifetime costs of the Hydrogen Supply solution compared with the applicable counterfactual parameters (see Appendix 2 of the Low Carbon Hydrogen Supply 2 Stream 2 ITT) including round-trip efficiency, providing the assumptions made. Costs should be broken down, where possible/relevant, into CAPEX (and financing at IRR 10% where applicable), OPEX (broken down into fuel, maintenance, labour, consumables), carbon cost, for main plant equipment. We also expect a current and estimated future (2035) levelized cost where relevant. Describe how demonstration will firm up these costs. Where applicable, include in this analysis the capture rates, the system benefit costs, the impact on the purity of hydrogen, accessibility to hydrogen and round-trip efficiency. How do these compare against state of the art? Highlight the main uncertainties associated with these cost estimates and explain how the design and execution of your demonstration pilot will address these uncertainties. Applicants should note the following: The applicable technical parameters should match those stated in the counterfactual including the relevant pressures, purities and flow rates. These boundary conditions should be used to develop costs of a counterfactual. If a different set of boundary conditions is more representative for your hydrogen supply technology, this can also be included, in addition, to help support your application, but would require justification. Compare and justify all costs and cost reduction of the proposed system to the current state-of-the-art hydrogen supply solution or closest comparable existing

solution. To calculate (and enable us to compare) lifetime costs, bidders should use BEIS's estimates for cost of carbon, electricity and natural gas prices in 2035 (assume these costs and prices do not change). These are provided in in Appendix 2 of the Low Carbon Hydrogen Supply 2 Stream 2 ITT. If a different cost assumption basis is more representative for your hydrogen supply technology, this can also be included, in addition, to help support your application. All units of measurement provided for the analysis should match those stated in the counterfactual. (Weighting for Criterion 2b – 10%) (Maximum 2,000 words)

Lifetime costs of ERM Dolphyn commercial-scale projects

The Commercial Development Plan for ERM Dolphyn targets a rapid move to at-scale deployment, while incorporating learnings from the project and from the sector more widely. Reflecting this, the project team has produced four financial models in order to further investigate and understand the lifetime cost reduction pathway for the technology, including the 10MW Demonstrator and larger commercial scale projects that are currently at development stage.

In order to estimate the future costs associated with each project, the detailed bottom-up cost estimates for the 10MW model have been adjusted to take account of economies of scale and learning rates from comparable industries, with the resulting cost estimates then sense checked with suppliers and other industry experts.
The targeted cost reduction over time can be seen in Figure 2.1.

Reducing Capex and Opex, improving equipment performance, and economies of scale, all act to reduce costs significantly over time for ERM Dolphyn projects.

[redacted]

This is aligned with independent studies

[redacted]

[redacted]

Table 2.1.

[redacted]

[This information has

[This information has

[This information has been redacted]

[This information has bee

[This information has bee

[This information has bee

calculations underlying this analysis, see supporting spreadsheet “Criterion 2b Supporting Calculations”. As discussed earlier in this section, the assumptions required by the ITT may in practice be pessimistic, and hydrogen costs from ERM Dolphyn are expected to drop towards cost parity more quickly, as discussed below.

Future cost reductions

The work undertaken to date, including detailed supply chain engagement and market studies, indicate that significant cost reductions can be achieved. Bottom-up analysis has been undertaken on a component by component basis in order to realistically reflect these insights in the ERM Dolphyn financial modelling. The key drivers of future cost reductions are summarised below:

• The commercial demonstrator is a single WTG project, so does not benefit from economies of scale. As ERM Dolphyn proceeds through its Commercial Development plan and larger scale projects become operational in the second half of this decade, significant economies of scale are expected to arise, reducing Capex, Opex and Decex.

• The 10MW commercial demonstrator includes bespoke solutions, produced specifically for this project, and so with relatively high production and development costs. The extensive supply chain engagement undertaken so far indicates strongly that as OEMs move to serialised manufacture at scale, significant cost savings are expected.

• The 10MW project size reflects feedback from potential investors and other stakeholders, indicating the importance of rapid scale-up of the solution; however components at scale are not yet available for key technologies – [This information has been redacted] As the hydrogen supply chain develops and components scale up in size, significant cost reductions are expected.

• The commercial demonstrator project site has been selected with a priority focus on rapid deployment, rather than optimisation of LCOH through a high wind resource profile and optimised wind farm layout. The future commercial projects will be located on sites that have been selected with a priority focus on commercial viability, which will reduce the LCOH.

• For future projects there is the potential to repurpose existing pipelines and/or share the costs between multiple projects, rather than building new infrastructure. Similarly, there is also the potential to share onshore reception and storage facilities between several projects.
• The project is currently over-engineered with significant contingency included in many systems because it is a first demonstrator project. At least 24 areas with potential for significant cost savings and performance improvement have been identified; these will be focussed on in the next phase of design work, in order to optimise the lifecycle cost. In particular, the following areas are expected to yield significant cost savings, through optimisation of the;

[This information has been redacted]

The achievement of targeted cost savings and performance improvements for the 10MW commercial

[This information has

the first unit to be built and will reduce significantly when producing multiple units for a commercial field development.)

Reducing uncertainty

At this stage of the project, many of the financial modelling inputs have uncertainty associated with them. In order to analyse and understand the key drivers of the project lifetime costs and implied cost of hydrogen, Monte Carlo analysis was undertaken at the end of Phase 2 in addition to the base case financial modelling. As the project progresses and executes the trial at Milford Haven, the remaining financial modelling uncertainties will be addressed in the following ways:

• Design optimisation, including the choice and sizing of equipment. Through the detailed design process during the next phase and realisation of optimisation opportunities, financial modelling uncertainties will be removed. Additionally, targeted real world trials at Milford Haven are planned to validate the performance of key systems as discussed in the answer to Criterion 1, which will reduce uncertainty in the financial modelling. Detailed supply chain engagement, building on the activities undertaken in the previous phase, will also continue to reduce uncertainty in this area.

• Wind regime at the site. An energy yield analysis will be undertaken during the next phase in order to firm up power production expected from the site.

• Cost of onshore reception facility. During the next phase the shortlisted offtakers will be further engaged and a preferred solution selected, enabling the finalisation of the detailed design and associated cost estimates for the onshore connection arrangement to the final offtaker of the project.

[This information has been redacted]

• Maintenance strategy and associated costs. Detailed maintenance strategy will be developed during the next phase, which will inform O&M cost estimates.

• Installation strategy and associated costs. Detailed installation strategy will be developed during the next phase, which will inform the cost estimate for these activities.

• Decommissioning strategy and scrap value achieved. Detailed decommissioning strategy will be developed during the next phase.

Please enter the core content of your response to this criterion in the text box. Applicants who wish to support their response with figures (e.g. illustrations/PFDs/graphs/charts/schematics) may attach these as part of the Referenced Figures single attachment (max. 20MB allowance provided) in the Further Information section of this application form. Applicants must clearly label the figures in the attachment and reference the figures in their response within the text box to ensure they are assessed. Any further text submitted within the Referenced Figures single attachment will not be assessed. Additionally, applicants may use evidence of relevant earlier work (limit to 20 pages), all assumptions / calculations / references to respond to this criterion which should be detailed in the attachment below and will be assessed. To complete this section you may upload evidence of relevant earlier work, all assumptions / calculations / references with your application. Max upload size per file – 20MB Max number of files – 1

- File: Criterion 2b Supporting Cost comparison Rev0.xlsx - Download

Criterion 3: Social Value

Criterion 3a: Short term development plan. In the text box below, the applicant should provide a summary of the short-term development plan that comprehensively appraise the outstanding technical challenges of the solution and its commercial benefits and risks relative to the applicable counterfactual parameters. In the response, please cover the following: Present the plan for further development, commercialisation and exploitation of the hydrogen supply solution. What are the main technical and commercial challenges and risks to getting the solution to market; and how will you overcome them? A summary of the business plan must be presented that highlights the route to market and estimated time to secure market share. Applicants who wish to support their response with figures (e.g. illustrations/PFDs/graphs/charts/schematics) may attach these as part of the Referenced Figures single attachment (max. 20MB allowance provided) in the Further Information section of this application form. Applicants must clearly label the figures in the attachment and reference the figures in their response within the text box to ensure they are assessed. Any further text submitted within the Referenced Figures single attachment will not be assessed. (Weighting for Criterion 3a – 5%) (Maximum 1,000 words)

The development plan extends through to the development of the first commercial UK field targeted for start-up in 2028. (the plan/key activities are summarised in Figures 3.1/3.2)

Short Term Development Plan

The short-term development plan is focussed on key activities to be undertaken over the next 2 years including:

• offshore demonstration trials to be performed at Milford Haven next year (2022)
• FEED for the first 10MW demonstration unit
• reaching the Investment Decision gate to procure/construct/commission and operate the first 10MW unit.

The first unit is to be installed at the Kincardine Wind Farm, 15km off Aberdeen by 2024 and a signed copy of the MOU for this development between ERM the operators of the Kincardine Field, has been uploaded as part of this submission (Attachment 2). [This information has been redacted]

A detailed breakdown of activities for the first two years of the plan is provided in the Gantt chart (Project Plan) presented in Criterion 5. The estimated cost for procurement, construction and commissioning [This informati

Prior to reaching the Investment Decision gate, we intend to bring a private sector investor into the project. [This information has been redacted]

[This information has been redacted]

[This information has been redacted]

In the longer term, the ability of the supply chain to deliver multiple ERM Dolphyn units on time for a commercial field will be a critical challenge. Our engagement of the supply chain to highlight our likely requirements for unit construction and assembly, particularly for the first commercial field, is discussed as part of the long-term development plan.

Criterion 3b: Long term development plan. In the text box below, the applicant should provide a summary of the longer term development plan that highlights the route to market and estimated time to secure market share including highlighting the key

challenges to achieving commercialisation at scale (assuming there is a demand for bulk low carbon hydrogen), timescales, build rate, and estimated development costs, UK job creation and development of a supply chain to develop a future hydrogen economy. In the response, please cover the following: Discuss the timescales and development costs and any potential supply chain constraints to support a future hydrogen economy particularly focusing on the UK 2030 hydrogen ambition and 590 TWh by 2050 (based on National Grid's Future Energy Scenarios). This should include potential cost savings through learning by doing, UK job creation, the development of a supply chain to meet future demand, air quality impacts (NOx, amines, particulates etc.) and carbon (CO_2eq) savings across the economy (direct or indirect). Where possible, please separate emissions into Scopes 1 and 2 (direct and indirect), UK and international, and for theme 1 (Low Carbon Hydrogen Production) please include upstream emissions from natural gas (please see details in Appendix 2 of the Low Carbon Hydrogen Supply 2 Stream 2 ITT). The applicant should also detail the potential wider environmental impact (local and global) from the roll out of the proposed hydrogen supply solution and limitations in the supply of rare materials, and how they could be mitigated. With reference to the response against Criteria 5 (Project Delivery) how will these be mitigated? Route to market and market potential of the proposed solution discussing the alternatives and the competitive advantage, highlighting future innovations and learning rates and how the hydrogen supply solution could reduce the costs of achieving net zero. Explain how the demonstration will accelerate the development of low carbon hydrogen economy in the UK. Applicants who wish to support their response with figures (e.g. illustrations/PFDs/graphs/charts/schematics) may attach these as part of the Referenced Figures single attachment (max. 20MB allowance provided) in the Further Information section of this application form. Applicants must clearly label the figures in the attachment and reference the figures in their response within the text box to ensure they are assessed. Any further text submitted within the Referenced Figures single attachment will not be assessed. (Weighting for Criterion 3b – 10%) (Maximum 2,000 words)

Long Term Development Plan

The long-term development plan is focussed on building the first commercial scale hydrogen wind farms in the UK by 2028. The first field is likely to be in the North Sea and ERM has recently signed an MOU (Attachment 1) with developer Simply Blue Energy (SBE) in relation to the Salamander field [This information has been redacted]

[This information has been redacted]

In relation to the supply chain, we will continue to openly communicate and advertise opportunities for sub-contracting works as part of ERM Dolphyn via trade bodies such as Deepwind and SHFCA and on the ERM Dolphyn website – ermdolphyn.erm.com. We have built relationships with a diverse group of suppliers across the UK and further afield at a range of different sizes. This has included some who are actively seeking to leverage existing regional skill bases to combine service offerings and strengthen their hubs in coastal regions relevant to proposed ERM Dolphyn developments. These conversations have sought to identify where potential service and equipment supply challenges could be foreseen and in future will attract, focus and strengthen regional growth.

We are also continuing discussions with universities and research units to explore opportunities for

knowledge sharing and collaboration such as the IDRIC at Edinburgh University. Looking ahead to small scale trials planned for the next phase, we will be opening tender opportunities to give equal opportunity for these stakeholders to participate and gain insight to the project and contribute to overall technological advancement.

Our procurement strategy, including our supplier screening activities, has a focus on sustainability, seeking where possible to work with those who are similarly striving to improve the economic, social and environmental wellbeing of regions local to the project centres. This includes the involvement of universities and SME's who can help us to continue promoting innovation and knowledge sharing. We are particularly interested in research and development of new materials that can reduce the usage of platinum and iridium in PEM electrolysis.

We have been actively engaging with UK ports and harbours to share and discuss our anticipated requirements for Dolphyn fabrication, assembly, commissioning and operational needs. We are aware that space and expansion of construction areas is a key challenge for the UK and that by contributing our insight, and keeping stakeholders informed about progress and timescales, we can support stakeholders and businesses to navigate constructability challenges and attract investment in these areas, with subsequent benefits for local social growth. Investment in the supply chain and port facilities will be a key requirement if Dolphyn is to achieve its true potential. 'Production line' style assembly of units at dedicated ports (i.e. serial manufacturing) with high local content will be an essential requirement for commercial field development and maximising local jobs and skills.

We will continue to work closely with the range of existing stakeholders that are dedicated to supporting the UK supply chain, including those already working at a local and regional level across the UK such as NECCUS, Aberdeen Renewable Energy Group (AREG), Opportunity North East, SWIC and Deepwind – whom we have regular monthly calls and have participated in forums and supply chain webinars.

We are keen to demonstrate our support for industrial energy clusters and have recently contributed both written support and a video to the Scottish cluster website. Building on our project website and working with Aberdeen City Council and others, we will be seeking to go beyond regulatory compliance and will be holding public exhibitions, in person and virtually, to give opportunities for the community to participate in the journey of Dolphyn through to commissioning of the first commercial field.

We understand that ERM Dolphyn has a wider role through education and skill development. As an innovation project, generating societal benefit has scalability to stimulate interest in individuals and communities as well as supporting the UK to demonstrate its position as a leader and knowledge hub for the hydrogen and renewable energy sector. We are fully committed to this.

Scaling up ERM Dolphyn hydrogen production as quickly as possible will require ERM to set up a commercial and legal structure that can be replicated for future projects. One option for this would be to create a series of separate project companies for each future project housed under a holding company. ERM will work with its financial advisor and investors to create a structure that can most easily accommodate further projects and investment. This commercial structure will enable a wide range of investors to invest in Dolphyn projects both in the UK and overseas. There is the potential for more than 100GW of hydrogen floating wind farms in UK waters, sufficient to completely replace the UK's current natural gas requirements with green hydrogen (Figure 3.5). Additionally, there is similar potential in other parts of the World including the US and South East Asia. Exporting the technology to these markets will provide further opportunities for UK organisations, jobs and skills.

All of the hydrogen produced by ERM Dolphyn fields will be green hydrogen of high purity and with zero carbon emissions. It will be suitable for a wide range of applications from transport fuel through to industrial or domestic heating and power generation.

Potential Carbon Savings

The potential carbon savings from operating ERM Dolphyn facilities will depend on the scale of development and the end-use of the hydrogen produced. The hydrogen produced by Dolphyn will be of high purity and therefore suitable for fuel-cell applications in transport such as road vehicles, rail, aviation or marine. It can also be used for providing heat as a replacement for gas or oil in domestic and industrial applications.

As an example of potential carbon savings, the application of hydrogen from ERM Dolphyn for transport and heat applications is considered. Together these contributed over half of all UK CO_2 emissions in 2020 (20.8% domestic heating and 29.8% from transport). For transport applications we have considered buses as the baseline and for heat we have considered domestic gas consumption. For diesel buses, CO_2 emissions are typically 822g/km travel and 41 litres of diesel is required to travel

100km. This compares to 9kg of hydrogen required to travel 100km with zero carbon emissions. Therefore 1kg of hydrogen used in place of diesel results in a carbon saving of around 9 kg of CO2. For heating, natural gas (used currently in over 85% of UK homes) produces around 2.75 kg CO2 per kg of fuel. In terms of heat output 1kg of hydrogen produces the same amount of heat as 2.55 kg of natural gas. Subsequently, burning 1kg of hydrogen for heat instead of natural gas results in a CO2 emissions saving of around 7 kg of CO2.

[This information has been redacted]

[This information has been redacted]

[This information has been redacted]

Market Potential

The market potential for ERM Dolphyn is significant. Expansion of the first commercial field and subsequent fields in the UK North Sea could enable multi-GW capacity to be developed by mid-2030's with the ultimate potential for over 100GW capacity in total. Similarly, ERM Dolphyn field developments in the UK Celtic Sea off Wales/Cornwall have the potential to reach 70GW given the levels of wind resource in areas of low constraint for offshore floating wind. An additional 50GW capacity could be achieved if developments on the Irish side of the Celtic Sea were added. Additional capacity is also possible on the West Coast of Scotland and Ireland's west coast, but a route to market would need to be established for this. Overseas, the market potential for ERM Dolphyn technology also appears to be very strong with ERM already receiving considerable interest from Japan, and European countries (including Germany and Sweden). Globally, the available wind resources for floating offshore wind, within 300 km of the coast is in excess of 10,000 GW providing almost unlimited opportunity for ERM Dolphyn green hydrogen developments between now and 2050, refer to Figure 3.5.

We believe that ERM Dolphyn has the potential to put the UK at the forefront of Green hydrogen production, at a global level. This is a view supported by our financial advisor, and acknowledged by potential investors, who share our global aspirations.

Criterion 3c: Knowledge dissemination strategy. In the text box below, the applicant should explain the current plans for taking the knowledge and experiences arising from the demonstration pilot and ensuring that these are effectively communicated and shared within the relevant stakeholders. Applicants who wish to support their response with figures (e.g. illustrations/PFDs/graphs/charts/schematics) may attach these as part of the Referenced Figures single attachment (max. 20MB allowance provided) in the Further Information section of this application form. Applicants must clearly label the figures in the

attachment and reference the figures in their response within the text box to ensure they are assessed. Any further text submitted within the Referenced Figures single attachment will not be assessed. (Weighting for Criterion 3c – 5%) (Maximum 1,000 words)

ERM has an excellent track record of disseminating and promoting project work on behalf of projects for BEIS. ERM Dolphyn has the ability to leverage its knowledge to support social value and create lasting impacts on communities and the environment, particularly in:

• fighting climate change
• tackling economic inequality that may arise through a response to climate change
• improving wellbeing through improvement of air quality.

ERM has already given numerous presentations, conference papers and media articles on the Dolphyn project. We will continue discussions with universities, research units, and industrial groups to share innovation opportunities and knowledge, especially in Aberdeen and South Wales (the two regions of activity in this phase).

The project was also recently awarded the high profile 2020 Innovation Project of the Year by 'The Engineer' magazine. Over the last 18 months, our dissemination program has included more than 100 presentations to the energy industry, potential end users, supply chain companies, industry trade bodies, academia and government bodies both in the UK and Europe. We have presented papers at 8 different conferences during the project and have had the project covered by numerous media outlets (including BBC, Recharge, H2View and 'The Engineer' magazine). We are also working with BEIS to profile the project at COP 26.

To date, the project has identified and engaged more than 150 equipment providers, 200 Service providers and more than 30 manufacturing facilities with capacity to support the project. The project has developed an extensive Supplier Management Register (refer to Figure 3.4) and has developed a good understanding of the supply chain readiness for Dolphyn. Short-term procurement needs including seeking support for the trial in South Wales, which will include giving equal opportunity for local suppliers, academic institutes and research facilities to participate and gain insight to the project and future development.

Our procurement strategy, including our supplier screening activities will be carried out with a focus on sustainability, seeking where possible to work with those who are similarly striving to improve the economic, social and environmental wellbeing of the project areas. This supply chain is regularly updated with the status of the project and new potential suppliers engage through hosting 'meet the buyer' type events, and collaborating with industry groups.

ERM regularly present at Low Carbon Energy Conferences in the UK and overseas including through our work with the Energy Solutions Team at WBCSD, the Hydrogen Working Group at WBCSD, and the GHG Protocol team. We will be presenting several papers on the Dolphyn project over the next couple of months. We also expect to make presentations to potential investors in the project as well as to the supply chain at a local, national, and international level. This continues our dissemination program for Dolphyn which has included numerous conferences, webinars, and presentations to relevant industry trade bodies and key clients over the last 3 years.

ERM will be presenting on the Dolphyn project at 7 events over the next 3 months. These are:

• UK CCUS, Hydrogen and Decarbonisation Summit, Birmingham, 1-2 September 2021
• World Hydrogen Congress, Amsterdam, 4-6 October 2021
• Gastech, Hydrogen Carriers for Dolphyn Project Export, Dubai, 21-23 September 2021
• Global Offshore Wind Conference, London, 28-29 September 2021
• WindEurope, Copenhagen, 23-25 November 2021
• Hydrogen workshop, Society of Petroleum Engineers, November 2021
• Additionally, ERM would anticipate showcasing the project at the UN Climate Change Conference (COP26)

A social value champion for the project has been identified with the remit of maximising opportunities for ERM Dolphyn to support upskilling of local suppliers and encourage interest in contributing to industrial decarbonisation and innovation projects.

We will implement an extended dissemination plan which will focus on the supply chain as well as potential investors. The engagement with the supply chain will build on the webinars we presented through the NECCUS, AREG and Deepwind industry trade bodies earlier this year and focus on collaboration over technology development and support for the initial 10MW demonstrator and for the first commercial field. The engagement with potential investors is being co-ordinated through Green Giraffe and ERM will be expecting to make several follow-up presentations to interested parties

between now and year end.

The proposed plan is as follows:

• Presentations to potential investors for 10MW demonstrator, first commercial 200 MW Dolphyn wind farm development and subsequent projects (September – December 2021)
• Presentations to supply chain via industry trade bodies NECCUS and Deepwind regarding the 10MW demonstrator and the commercial field development at the 200MW Salamander field in UK North Sea (Nov – Dec 2021)
• Meetings with leading technology suppliers to discuss options for Dolphyn performance improvement and cost reduction (Jan – March 2022)
• Present at Industrial Cluster Group webinars in relation to hydrogen projects (e.g. NECCUS, Zero Carbon Humber, SWIC, Net Zero Teesside, North West Hydrogen Alliance). (April – July 2022)
• Presentation to key UK and European ports on role of hydrogen carriers for hydrogen storage and transport as a UK export option for green hydrogen (Sept 2022)
• Arrange team meetings with wider industry that could be interested in Dolphyn offtake options in Scotland, Wales, Northern Ireland and England to include Utilities, steel industry, glass industry, water industry, transport refuelling hubs, rail operators. (March 2022 – July 2022)
• Presentations to Scottish, Welsh and UK Government in line with progress (Quarterly update meetings to be held during FEED).

This will be a continuous dissemination program that will run through the entirety of FEED up to Stage Gate 1 of FID. Its purpose will be to inform the supply chain and potential investors of the Dolphyn project status and the significant opportunity it presents. They will be introduced to the technical and economic aspects of the solution and kept updated as the trials are conducted at Milford Haven. This will enable suppliers and fabricators to critically evaluate their equipment with a view to further refinement in preparation for supply to the initial 10MW demonstrator and beyond. In the long-term ERM Dolphyn will stimulate opportunities for suppliers and communities to benefit from its delivery and operation phases.

Criterion 4: Project financing

To complete this section please upload a completed BEIS Project Cost Breakdown/ Finance Form for Stream 2 here. Max upload size per file - 5MB Max number of files - 1

- File: Criterion 4a Supporting project-cost-breakdown-form rev0.xlsx - Download

In the text box below, the applicant should: Provide justification of costs and ensure all costs are eligible. Applicants who wish to support their response with figures (e.g. illustrations/PFDs/graphs/charts/schematics) may attach these as part of the Referenced Figures single attachment (max. 20MB allowance provided) in the Further Information section of this application form. Applicants must clearly label the figures in the attachment and reference the figures in their response within the text box to ensure they are assessed. Any further text submitted within the Referenced Figures single attachment will not be assessed. (Weighting for Criterion 4a – 10%) (Maximum 1,000 words)

ERM has reviewed all costs put forward in this proposal against the eligibility criteria and can confirm they are all eligible and appropriate for the project scope and risk.

Prior to the submission of this proposal, a detailed evaluation of the scope of work and associated risks was carried out, together with a cost breakdown for all key activities. This was developed using a bottom-up approach - ERM costs together with costed proposals received from subcontractors for specific activities and roles. Where appropriate, tenders were provided by a number of suppliers to enable benchmarking prior to sub-contractor selection. This competitive process provides value for money from sub-contractors with the required skills and experience. This costing has been independently reviewed by ERM's finance and commercial team to verify appropriateness of costs and value for money. Detail of the costing is presented in the attached cost breakdown form with further explanation and a summary of % of total cost below.

Programme and Project Management

[redacted] The costs put forward are

[redacted]

This represents the

of trials.

Trial Program

[redacted]

[redacted]

[redacted]

[redacted]

findings.

[redacted]

The scope has been
All

The subcontractor's
All proposals are issued

[redacted]

requirements.

[redacted]

The

[redacted]

for continuing and enhancing engagement with the supply chain, and particularly increasing the awareness of opportunity for new UK suppliers. The estimate builds on the work completed during previous phases of the project to engage and develop the supply chain.

[redacted] The labour effort cost is based on resource estimates for the onshore part of the Dolphyn project to facilitate safe delivery of hydrogen to the end user. It is based on work completed in previous phases of the project and existing relationships with potential offtakers and local authorities which has enabled us to define the requirements reasonably clearly and provide an appropriate level of costing for this activity with high confidence.

Criterion 4b: Value for money to HM Government In the text box below, the applicant should describe why the proposal represents good value for money for HM Government. The answer should explain the following: How the availability of public funding makes a material difference to the actuality and pace of moving the solution towards commercialisation, and Qualify and quantify the savings that are being passed on to HM Government to reflect the asymmetric balance of risks and benefits accruing to the project consortium and HM Government. Applicants who wish to support their response with figures (e.g. illustrations/PFDs/graphs/charts/schematics) may attach these as part of the Referenced Figures single attachment (max. 20MB allowance provided) in the Further Information section of this application form. Applicants must clearly label the figures in the attachment and reference the figures in their response within the text box to ensure they are assessed. Any further text submitted within the Referenced Figures single attachment will not be assessed. (Weighting for Criterion 4b – 15%) (Maximum 1,500 words)

How the availability of public funding will make a material difference

Public funding is considered a critical component in towards commercialisation of ERM Dolphyn. The financial modelling undertaken during Phase 2 of the ERM Dolphyn project (discussed in the answer to Criterion 2) demonstrates that ERM would not be in a position to economically progress this project at this stage without public funding. The project would be placed on hold as, despite there being a clearly mapped route to low cost hydrogen, the reasons being:

• If the 10MW Feed costs were financed by investors, the Internal Rate of Return (IRR) would be below the level required by investors and the investment risk would be considered too high;
• With a quickly expanding hydrogen market and the public finance available in other geographies, e.g within Europe, investors are likely to look first to these geographies, which would significantly impair the UK's opportunity to gain first mover advantage through ERM Dolphyn;
• Investors see government support as a key measure of confidence for first of a kind projects, and this is a principal driver for their investment decisions;
• Offtakers also see government support for FEED as a critical component of building confidence around commercial agreements.
• All investors we have talked to clearly see significant potential for ERM Dolphyn to provide a potentially game changing solution to the production of economic, low cost, green hydrogen, but they also see that a stepping stone approach is required to achieve this, with government funding early stage FEED being a critical component of this. With such funding in place, there is a real appetite to invest in the short to medium term.

The ERM Dolphyn Project has been developed to produce hydrogen at the lowest achievable cost, lower than could be achieved with other solutions (as demonstrated by our earlier work). This will be realized when projects are developed at scale in deep water long distances offshore (>80km), where wind resource is the highest and scale of opportunity is the largest. Our potential investors and offtakers are very excited by this prospect, but they share our view that there is there is a cost gap for the demonstration project, which requires government support to bridge.

In summary, Public funding is considered critical to advance the technology and the opportunity, through the demonstration phase, but with this in place there would be a very significant opportunity to attract investment, and to accelerate green hydrogen production at scale. This could help establish the UK as a leader in green hydrogen production, with all of the supply chain benefits that would bring with it.

A clear pathway to cost reductions for commercial scale ERM Dolphyn projects has been mapped, and public funding would underpin investor confidence in a similar way to the very successful acceleration of the commercial offshore wind industry in the UK, enabling these cost reductions to be quickly achieved, and the associated economic and decarbonisation benefits to the UK of large scale hydrogen production to be realised.

Value for money to HM Government

The project represents excellent value for money to the UK taxpayer, with significant savings being passed on to HM Government. ERM has created a world-leading technology based in the UK. Accelerating the development though support from the HM Government has a number of positive impacts on the UK economy:

- It supports the attraction of commercial investments in ERM Dolphyn at an early stage, familiarising investors with the technology. This will reduce the perceived risk associated with subsequent projects and thereby increase the likelihood of capital availability for the required investments in future projects as well as the UK hydrogen economy in general. Availability of capital has played a major role in the reduction of costs for fixed bottom offshore wind and is expected to reduce the cost of floating offshore wind and hydrogen for the taxpayer in a similar way.

- It will provide the UK hydrogen industry with confidence that hydrogen can be produced at bulk from offshore floating wind at distance from shore, thereby enabling the roll-out of bulk hydrogen production in the UK, resulting in additional UK jobs in manufacturing and ports.

- ERM Dolphyn is a potential UK export product with a global market.

- It demonstrates the UK Government as a reliable partner for commercial parties for the decarbonisation of the UK economy.

ERM has invested internal development time for the project, outside of the funding already provided, [This information has been redacted]

The commercial development planning involves a key interim step of deploying smaller commercial ERM Dolphyn projects at a scale of 100-300MW towards the end of this decade, and the internal development of these fields has been undertaken outside of the funding for Phase 1 and 2. We estimate that Phase 1 and 2 costs to BEIS were reduced by £1.2 million due to the level of development work completed at ERM's own cost.
In addition, ERM has performed a large part of the 'dissemination plan' at our own cost. We regularly present at conferences and trade organisations as part of our project work and therefore have undertaken this aspect as part of our overall marketing programme. ERM has an excellent track record of doing this, as witnessed by our highly successful dissemination programme on Phase 2 of the ERM Dolphyn project, during which we successfully entered the project for an innovation award and presented at numerous domestic and international conferences and industry workshops.

Successful demonstration of ERM Dolphyn will provide the UK hydrogen industry with confidence that hydrogen can be produced at bulk from offshore floating wind, resulting in additional UK jobs in manufacturing and ports. It will also create an export opportunity to Europe and beyond. ERM Dolphyn has UK content as a key focus of the next phase, and has developed a balanced score card system to manage and optimise this. This successful realisation of the UK hydrogen market could be worth £18bn to the UK economy by 2035 (Hydrogen Taskforce EIA, 2020), representing a significant return on investment for early stage projects like ERM Dolphyn.

In conclusion

ERM Dolphyn is a highly credible, technically advanced concept with the potential to materially contribute to the development of sustainable jobs in the low carbon economy in the UK.
We have discussed the project with many highly credible UK and international organisations in the offshore wind and hydrogen space, as shown in Figure 4.1, and as such have strong confidence in the interest in the project, as well as insight into private sector investor requirements. The route to large scale commercialisation is clearly mapped out from demonstrator to first mid-size commercial project (MoU already signed for Salamander project, see attachment 1) to large-scale GW projects as shown in Figure 4.2. The support of HM Government is absolutely key to underpinning private sector investor confidence, facilitating commercial viability, and ultimately delivering the enormous economic benefits to the UK that will arise from a home grown UK bulk hydrogen production solution, using our abundant offshore wind resources.

Criterion 5: Project delivery

To complete this section please upload a completed Gantt chart (or Outline Project plan) and Key Work Packages with your application. Key Work Package document not to exceed 6 pages. Max upload size per file - 10MB Max number of files - 2

- File: Criterion 5a Supporting Gantt Chart rev0.pdf - Download
- File: Criterion 5a Supporting Project plan summary Rev0.pdf - Download

In the text box below, applicants are expected to: Explain how the project team, if involved in multiple Hydrogen Supply 2 applications will ensure they have sufficient capacity to deliver multiple projects. Applicants who wish to support their response with figures (e.g. illustrations/PFDs/graphs/charts/schematics) may attach these as part of the Referenced Figures single attachment (max. 20MB allowance provided) in the Further Information section of this application form. Applicants must clearly label the figures in the attachment and reference the figures in their response within the text box to ensure they are assessed. Any further text submitted within the Referenced Figures single attachment will not be assessed. (Weighting for Criterion 5a – 15%) (Maximum 500 words)

ERM Dolphyn is a flagship project for ERM with full support throughout the organisation including CEO level. ERM and our key project partners are committed to providing the necessary resource capacity to deliver the project safely, to a high degree of technical competence and in line with the proposed costs and schedule.

The project team and expected future workload, including potential future projects, have been reviewed and it is confirmed that there is sufficient capacity and that the project will be prioritised. There are a small number of personnel with specific experience who have been included in other Hydrogen Supply 2 bids, but the combined effort for all individuals is well within their normal overall availability. ERM

[redacted]

ample flexibility within the overall system. A review of staff availability relative to Dolphyn demonstrates that the combined utilisation of any work on other projects will not take them over the long term average utilisation target across the 18 month period of the project.

The core team from the previous phase of work will continue with this project and are committed to the delivery of the Dolphyn project as a key project for ERM.

Many of the core team members have worked on previous phases of the ERM Dolphyn project as part of the Hydrogen Supply Competition from spring 2019 to spring 2021. These work phases were successfully delivered in line with project schedule despite a changing working environment (COVID, rapid increase in the number and scale of hydrogen projects). This demonstrates the ability of the team to successfully manage workloads in changeable environments, mobilising additional resources when necessary.

The project team proposed, including our sub-contractors, are highly skilled and experienced, giving confidence in our ability to deliver the workscope described. ERM has over 5,500 people globally who are committed to the delivery of low carbon enabling projects, and so the pool of potential support in specific areas is vast. This includes personnel with considerable hydrogen experience within the existing team and capability recently enhanced with the acquisition of leading hydrogen consultancies Element Energy and E4Tech as well as offshore wind development specialists RCG and Arcus. This creates a team of more than 100 people with directly relevant experience for the Dolphyn project.

To complete this section on Project Team please upload a completed CV package and Organogram here. Max upload size per file - 20MB Max number of files - 2

- File: Criterion 5b Supporting Org Chart.pdf - Download
- File: Criterion 5b Supporting CVs.pdf - Download

In the text box below: The applicant should present their proposed governance

arrangements between the partners to ensure effective project delivery The applicant should list any external parties responsible for delivering goods or services worth more than 10% of the total project value and explain how they will ensure that these parts of the project do not give rise to delays in the delivery of the project. The applicant should provide details of the relevant skills, qualifications and experience of main project team members, including descriptions and evidence of previous relevant work carried out. Include brief details of relevant team member previous projects, including the date, location, client and project size. Applicants who wish to support their response with figures (e.g. illustrations/PFDs/graphs/charts/schematics) may attach these as part of the Referenced Figures single attachment (max. 20MB allowance provided) in the Further Information section of this application form. Applicants must clearly label the figures in the attachment and reference the figures in their response within the text box to ensure they are assessed. Any further text submitted within the Referenced Figures single attachment will not be assessed. (Weighting for Criterion 5b – 10%) (Maximum 3,000 words)

Project Organogram

A project organogram is presented in attachment. This shows the project structure, key personnel for each of the work packages and the interrelation between the core organisations. CVs for key personnel are provided by attachment.

Key Roles for each organisation

The project team and governance arrangements will build on the successful delivery of Dolphyn Phase 1 and 2 completed under the Hydrogen Supply Competition. The principal organisations involved in the project delivery to date will continue to support the project during HySupply2: ERM, Tractebel, ODE, Doosan Babcock, Nel Hydrogen, Principle Power, and Vestas. All organisations are committed to leveraging the expertise gained during the earlier stages of development, with consistent personnel maintained for the latest phase of the project.
ERM will be the contract lead and is responsible for the overall project success, as well as the delivery of regulatory compliance, consenting, financial modelling and maintaining a clear roadmap to scale in line with the UK Government's ambitions. The development and implementation of the offshore trial package is subcontracted to Doosan Babcock with Nel Hydrogen. Development of the engineering for the commercial scale demonstrator project will be subcontracted to ODE, Tractebel, Principle Power, Doosan Babcock with Nel, and Vestas.

The development of the trial and commercial scale demonstration project is organised into a series of work packages with clear delineation of responsibility as shown in the organogram. This approach brings a number of benefits:

• It reinforces shared key objectives whilst maintaining autonomy to promote innovation
• It decreases time and cost to develop the project by providing clear responsibility, accountability, and systems for flow of information
• It enables cutting edge technologies to be implemented and aligned with wider technology development programmes through a clear supply chain engagement process
• It enables interfaces to be focussed on key priorities for the project by having a central governance team with robust risk identification, review, and mitigation process
The role of each organisation is described as follows:

ERM

ERM will be the contract holder and project manager with overall responsibility for all work and deliverables. ERM has been the project lead and manager for the Dolphyn project to date including the successful delivery of Phase 1 and 2 under the Hydrogen Supply Competition. We will deliver the project in line with the agreed scope, timescale, and budget.

ERM will direct the development of the trial and demonstrator project, building on the scope definition work completed to date. We will continue to work closely with key subcontractors and stakeholders to successfully produce hydrogen in an offshore floating environment, as well as develop a commercial solution to large scale green hydrogen production in line with UK Government ambitions. ERM is responsible for conducting a safe trial producing hydrogen in an offshore floating marine environment.

ERM will lead and project manage the offshore hydrogen production trial in South Wales. ERM will coordinate all activities associated with the trial design, development and implementation on site, with responsibility for a safe trial completion and appropriate disposal of waste. This includes;

• development of the detailed trial delivery programme
• identification of potential local suppliers
• arranging scope, tender processes, and acting as the contract holder for all aspects of the trial
• engaging with the trial site and regulatory bodies to agree an appropriate approach to meeting requirements
• implementing a quality and safety assurance programme
• facilitating the flow of information required for a safe trial.

ERM will lead and project manage the development of the Commercial Scale Demonstrator project (10MW) at the Kincardine field in Aberdeen. ERM will coordinate all activities associated with the development of the project including;

• facilitating the development of an integrated design that is aligned with stakeholder innovation plans
• arrange for scope and contract for all aspects of the trial
• facilitate an independent review of the design including completing our own quality assurance process
• implement the safety in design process and articulate the case for safety
• drive safety culture to build a strong foundation for future project safety
• develop offtake contracts
• liaise with stakeholders to develop a overall project concept that integrates with local and national future development pathways
• liaise with regulatory bodies to develop a clear and robust roadmap for future offshore hydrogen development projects
• maintain an up to date cost model for current and future phases of the project
• engage with industry and public bodies to support development of a accessible hydrogen market

ERM will be the primary focal point for engagement with external parties, including supply chain and vendor engagement, and regulatory authorities. We will engage a wide range of potential suppliers to articulate the potential opportunity and achieve a constructible design. ERM will also be responsible for meeting all regulatory compliance and site consenting requirements. ERM has over 50 years' experience in gaining Safety and Environmental consent for offshore installations in the UK. The work will build on discussions with the regulatory bodies including the HSE, Marine Scotland, and Crown Estate Scotland successfully completed during previous phases.

ERM will lead all presentations to BEIS and stakeholders, supported by our subcontractors as appropriate. ERM will oversee all aspects of the design and operation of the scope. We will also be responsible for maintaining a costed development plan describing the key development steps to large scale commercialisation and acting as the interface point with commercial agreements for future developments such as the recently announced MoU with the Salamander project.

Doosan Babcock with nel Hydrogen

Doosan Babcock are providing engineering design support in collaboration with nel hydrogen providing electrolysis equipment and experience. During the previous phase of the Dolphyn project Doosan Babcock and nel collaborated to successfully demonstrate a low risk method of producing hydrogen in an offshore floating environment. Doosan Babcock and nel will continue working together with ERM with a particular focus on demonstrating the operation of electrolysers in an offshore floating environment.

Doosan will design, procure, construct and operate the offshore hydrogen production test skid based on nel electrolysis technology. The skids will be containerised in 20ft ISO containers and include seawater intake, desalination, hydrogen production, metering and instrumentation necessary for the trial. ERM has worked with Doosan and nel to develop an outline trial test skid which provides confidence in the feasibility of the scope, timescale and budget requirements.

Additionally Doosan and nel have responsibility for the development of the integrated commercial scale hydrogen production system.

Doosan has experience installing electrolysers for a number of projects, most recently installing two electrolysers for a hydrogen refilling station in Aberdeen as well as installation of 800kW of fuel cells for The Event Conference Aberdeen (TECA) building.

Currently Doosan is working on three BEIS-funded projects within the hydrogen sector, namely HyPer (Hydrogen Production by Sorbent Enhanced Steam Reforming), ReFlex Orkney (Reliable Flexibility) and lastly, HOP (Hydrogen Offshore Production).

Together with NEL Hydrogen, Doosan has delivered two projects under Dolphyn. A feasibility study was

produced for the 2MW PEM Electrolyser, this was then updated for the 10MW pre-FEED Study.

Tractebel Engie

Tractebel Engie is a leading multi-disciplinary engineering and consulting firm with particular experience in developing offshore floating wind projects, including the WindFloat Atlantic project utilising a Principle Power type substructure at multi-MW scale.

Tractebel will act as the lead engineer of the commercial scale demonstrator with overall responsibility for developing an integrated and optimised design, suitable for construction. They are responsible for developing global specifications, standards and managing interfaces between the engineering parties. As the lead engineer Tractebel will remain independent of the development of individual sub-systems. Their successful role managing interfaces between substructure, WTG, and topside technology providers during previous phases has demonstrated their skill as lead engineers.

Active in the offshore wind sector for more than 15 years and with experience gained on around 140 European and International projects, Tractebel has proven its multidisciplinary expertise in every phase of an offshore project, from siting and energy yield calculations, undersea foundations and transmission systems, to realisation, project management and more.

Since the start of the offshore wind farm (OWF) development in Belgium in 2001, Tractebel has assisted wind farm developers through the different phases of their projects, starting with permit applications, contracting, execution and operation and maintenance. Tractebel offers tailor-made consultancy services for offshore projects, whether wind or marine based.

Tractebel has been involved Project Dolphyn since the beginning, having assisted in the delivery of the 2MW scale proto-type FEED and the 10MW CSD pre-FEED. Other relevant projects include:

• Windfloat Atlantic, 25 MW floating offshore wind demonstrator
• Seamade Offshore WindFarm 490MW
• FEED for Offshore France Tender Round II Les Eoliennes en Mer 1GW

ODE

Offshore Design Engineering (ODE) is the UK’s leading offshore design engineering consultancy. ODE have proven themselves to have a wide range of engineering competency and for embracing the project’s shared goal of developing systems that meet the core objectives.

As the other lead engineering contractor, ODE is principally responsible for the design of the Dolphyn technology systems of the commercial demonstrator, including:

• Topside Structure
• Topside production systems (including water production, hydrogen conditioning, Back-up power, power distribution, emergency systems, auxiliary systems)
• Export pipeline and riser
• Onshore Reception Facility
• Construction, and operation engineering

ODE’s experience in the UK includes the very early Round 1, projects through to current Round 4 and Scotwind developments. Since then, ODE has significantly extended its offshore wind farm experience within the UK and internationally, progressing its relationships with its clients and is proud to have long-standing relationships with key clients such as Vattenfall, Iberdrola, E.ON, Equinor, LEEDCo, SSE, Avangrid, and Northland Power.
Within the UK, ODE is headquartered in London and has renewable business centres in Great Yarmouth and Aberdeen.

ODE has been involved in Project Dolphyn since the beginning, having assisted in the delivery of the 2MW scale proto-type FEED. Their involvement has continued through to the most recent work phase of Dolphyn, the 10MW concept design. ODE was responsible for integrating the systems for the topsides, in a series of workshops with the key interface partners on the project. They have identified during this process a number of attention points and actions to be addressed during the FEED stage of the development, reported to ERM and being formalised in their end of project stage report.

Principle Power

Principle Power's experience and ability to deliver is unparalleled in the floating offshore wind sector. A market leader in the offshore deep water market, Principle Power (PPI) has completed more engineering studies, deployed more units, and have more experience providing inspection, maintenance & repair services to more projects than any other company in the space. They are the only independent company to achieve Technology Readiness Level 9, which signals full readiness for deployment in commercial-scale projects.
Principle Power will develop the floating sub-structure for the commercial demonstrator project, including optimisation of stability and ballast and optimisation for UK construction.

Principle Power has a multi-gigawatt portfolio of projects in operation or development, including but not limited to:
• ERM Dolphyn (2MW), delivery of the pre-FEED design for the floating platform for the ERM Dolphyn 2MW project
• WindFloat Atlantic (25MW), the world's first bank financed floating wind farm. The wind farm utilises the Vestas V164 and has this project has been in successful operation since 2019
• Kincardine (50MW), the world's largest floating windfarm which first began production in 2018 at 2MW. As of July 2021 the remaining 5 Vestas V164 have now all been installed
• EFGL (30MW), to be commissioned in 2022 this project will be first floating windfarm to utilise the Vestas 10MW turbine. In addition to ABS certification Principle Power has achieved approval in principle from Bureau Veritas and Class NK

Vestas

Vestas is a leading supplier of wind turbines with over 70,000 wind turbines installed with combined capacity of over 140GW worldwide. Vestas has successfully integrated their wind turbine technology with Principle Power's floating substructure design at the Kincardine offshore wind farm.

Vestas is responsible for developing the wind turbine generator system for the commercial scale demonstrator.
The combination of Principle Power and Vestas' technology provides a TRL9 floating wind production system to provide additional confidence in the Dolphyn commercial scale trials. Vestas provides a proven wind turbine system at 10MW and is working towards development of larger systems that are well aligned with ERM Dolphyn's future ambitions.

No other parties (other than those described above) will deliver goods or services worth more than 10% of the total project value.

Organisation and Governance

Dolphyn will continue to use the same team as previous phases completed under the hydrogen supply competition. The governance processes, working relationships, and technical knowledge developed during previous phases will therefore be continued.

The project interfaces will be managed through a number of progress review processes already established:
• Stage-gate reviews – Key project deliverables are reviewed between all project organisations. These milestones are highlighted in the project plan attached. Examples include project decision meeting and safety review meetings. Stage-gate reviews are also conducted between ERM and BEIS to discuss progress.
• Steering committee meetings – Monthly meetings between the senior project leadership team to review progress and project risk mitigation.
• Project Management meetings – bi-weekly meetings between project management and workpack managers to discuss progress.

ERM's supply chain management tracking system commences with the selection of appropriately qualified subcontractors for the task to be assigned to them. This initial phase is governed by ERM's Global Contractor Management Program (GCMP) to provide assurance that our sub-contractors share our commitment to ERM's health and safety programme, our corporate governance, ethics and compliance programme and delivery of quality assured projects on time and on budget. Contractors must meet and maintain the standards we set in order to work on ERM projects or in ERM offices.

For the Dolphyn project, our subcontractors' performance will be monitored by the Project Manager throughout the project. Performance measures (KPIs) include quality of deliverables (right first time), risk and change management (early notification to allow agreed mitigation measures to manage the change), delivery to programme and monitoring and tracking of costs. We provide tailored training for each project (inductions and follow up training) so that suppliers can meet requirements on

environmental management, health and safety, technical assurance, document control and financial management. The KPI's for our main sub-contractors (ODE, Tractebel, Principle Power, and Doosan Babcock) were all met during the previous phases, providing confidence in our initial selection process and their performance during HydrogenSupply2.

On completion of the project, wrap up reviews are conducted to collate the lessons learned during the project and to identify ways of improving our collaboration and continually strengthening relationships with our subcontractors.

ERM is committed to a fair and transparent payment processes in order to maintain cash flow for our subcontractors to facilitate integrated, collaborative working throughout our supply chain. Payment terms are set out in ERM's contracts with our subcontractors and are developed for each project and as required linked to our payment terms with our Client.

Criterion 5c: Risk Assessment The applicant should provide a detailed risk register to outline the key project risks and risk mitigation techniques for the project (in the interests of thoroughness, we encourage you to think about risks and structure your risk assessment according to whether the risks are, or relate to: technical, legislative/regulatory, environmental, policy, economic, commercial, financial or project management). The risk register should include: Description of risk; cause of risk; risk owner; overall risk rating (probability x impact), mitigation action, and residual risk after mitigation action. Description of any contingency planning. Applicants should attach a risk assessment table to this criterion, which will be assessed. (Weighting for Criterion 5c – 5%) To complete this section please upload a completed Risk Register for Stream 2 here. Max upload size per file - 10MB Max number of files - 1

- File: Criterion 5c Supporting Risk Register.pdf - Download

Collaborative Application

Is this a collaborative application? If yes you will be asked to provide contact and organisation details for each partner.

No

Additional Information

The answer to the following question will only be taken into account once the application has been fully assessed to ensure projects are not double funded. Have you applied, or are you planning to apply, for any other government funding for this project?

No

Programme Performance Indicators and Benefits

How would you describe the nature of your innovation project?

Product Development

State how many FTE jobs could be retained in your organisation as a result of participation in this project? (enter a number)

0

State how many FTE jobs could be created in your organisation as a result of participation in this project? (enter a number)

25

What is the number of Partner Organisations supported to deliver the project? (enter a number)

5

Will the project be conducting consumer trials?

No

Technology Readiness Level at Project Start

	1	2	3	4	5	6	7	8	9
						X			

Expected Technology Readiness Level at Project Close

	1	2	3	4	5	6	7	8	9
							X		

What do you think are the current market barriers to the commercial exploitation of your innovation? Please select all that apply.

Capital intensive demonstration phases

Further technical, scientific or engineering challenges

Lack of clarity on Government policy

The Low Carbon Hydrogen Supply 2 Competition will aim to realise the following benefits. Please select which benefits your innovation could potentially contribute to. This is not a scored section.

	Yes	No
Supply Chain Development **Help support the growth of 'clean growth' supply chain companies in key technology and engineering sectors.**	X	
Export Opportunities **Support development of domestic and export markets. Multiple countries are developing hydrogen strategies, which have low carbon hydrogen production targets of multiple GWs. A recent update to the Energy Innovation Needs Assessment (EINA) estimates that by 2050 an active UK hydrogen economy could generate a GVA of £11.7bn and support 100,000 jobs from both domestic and export markets. Without support for innovation projects the hydrogen economy is unlikely to achieve this market share.**	X	
Policy Insights **Provide insight into costs, performance and what is required to remove technology and market barriers to deploying hydrogen supply solutions.**	X	
Spillover Benefits **Result in knowledge spillovers, where discoveries made from advancing your innovation could enable developments in other sectors. The projects could also provide wider benefits supporting the development of a hydrogen economy.**	X	
Green Jobs **Increase number of jobs working on 'building back better' in the UK.**	X	
Carbon Savings **Increase carbon savings through improved efficiencies, greater capture rates or through enabling greater applicability for hydrogen to decarbonise the energy system.**	X	
Reduced Costs **Increase and de-risk the range of products on the market which could enable greater competition.**	X	

Public Description of the Project

The public description of the project should be a brief non-confidential description of the project that BEIS may use in online or printed publications. Please describe the project objectives, key deliverables and the expected project benefits. (Maximum 400 words)

ERM Dolphyn is focused on the production of ‘green’ hydrogen at multi-GW scale from offshore floating wind. It is a modular design, integrating electrolysis and a wind turbine on a moored floating sub-structure to produce hydrogen from seawater using wind power as the energy source. The design has been developed and accelerated under the UK Government’s Hydrogen Supply Competition 2016-2021.

The project focusses on a rapid and efficient means of moving to large-scale deployment. It aims to make a significant contribution to the Governments goal of 5GW of hydrogen production by 2030 and fully aligns with the Governments 10 point Plan for Net Zero and the recently issued UK Hydrogen Strategy. By delivering green hydrogen from renewables at a large scale, it provides the UK with a level of balance within the Governments’ stated ‘twin-track’ approach of developing ‘blue’ hydrogen from natural gas with carbon capture and storage and ‘green’ hydrogen from renewables. As the technology produces hydrogen directly from seawater and wind, it is a fully sustainable solution and does not put any additional load on the power grid, thereby avoiding grid constraint issues. In so doing it provides UK society with a degree of added redundancy in terms of reliable energy supplies.

This phase of the project looks to build on the successful delivery under previous phases of the Hydrogen Supply Competition with the following activities:

• Offshore demonstration trials to evaluate key systems during 2022. The trials will produce green hydrogen from seawater in an offshore floating marine environment.
• Development of a Commercial Scale Demonstrator (10MW) by 2024 producing hydrogen at a commercial price, sufficient to attract private investment.

Development of the Dolphyn project under the Hydrogen Supply Competition has enabled a site for the first commercial Dolphyn wind farm (200 MW) to be identified. This is the 200 MW Salamander floating wind site in the North Sea, 35km north-east of Peterhead, developed by Simply Blue Energy in partnership with Subsea 7. The developers have now signed a memorandum of understanding with ERM for the use of the ERM Dolphyn hydrogen technology at the field. The aim is to have this project operational by the end of 2028.

Further information on the project can be found at – ermdolphyn.erm.com

Further Information

Referenced Figures (will be assessed) The applicant’s response must be entered in the text box(es) where provided in the Assessment Criteria section. Applicants who wish to support their responses with figures (e.g. illustrations/PFDs/graphs/charts/schematics) may attach these here as part of the Referenced Figures single attachment (max. 20MB allowance provided). Applicants must clearly label the figures in the attachment and reference the figures in their response within the text box to ensure they are assessed. Any further text submitted within this attachment will not be assessed. To complete this section, you may upload referenced figures here Max upload size per file – 20MB Max number of files – 1

- File: ERM Dolphyn - Figures and Tables.pdf - Download

Supporting Information Additional letters of support or other supporting information can also be submitted here before you submit your online application form, where they add background/ supporting information (this could include but not limited to relevant papers, assumptions/ calculations to back up the assertions made in the application) to the application. However, the assessment will be based on the information directly written in the online application; you should not assume that any additional information will be cross-referenced or reviewed as part of the selection process. Applicants may upload up to 4 such attachments (max. 20MB per attachment). Upload further information documents here. Max upload size per file - 20MB Max number of files - 4

- File: Attachment 1 - MoU SBE - ERM Dolphyn.pdf - Download
- File: Attachment 2 - Dolphyn Substructure fabrication.pdf - Download
- File: Attachment 3 - MoU KOWL - ERM Dolphyn.pdf - Download
- File: Attachment 4 - South Wales ERM Dolphyn Study.pdf - Download

Declaration Forms

To complete your application, you must download, complete and sign where relevant and upload the following documents using the 'choose file' option below. Statement of non-collusion Form of Tender Conflict of Interest form Standard Selection Questionnaire Code of Practice GDPR Assurance Questionnaire Prompt Payment If convenient you can use e-signature to sign the documents. Max upload size per file - 5MB Max number of files - 7

- File: 1 ERM Statement of Non-Collusion.pdf - Download
- File: 2 ERM Form of Tender.pdf - Download
- File: 3 ERM Conflict of Interest.pdf - Download
- File: 4 Self Certifications for ERM and Contractors combined.pdf - Download
- File: 5 ERM Code of Practice.pdf - Download
- File: 6 ERM General Data Protection Regulation Assurance Questionnaire for Contractors.pdf - Download
- File: 7 ERM Prompt Payment Declaration.pdf - Download

Application Form Checklist

As well as the completion of this Application Form please check that, if required, you have provided the following information.

	Yes	No
Organogram	X	
CV package	X	
Stream 2 Gantt Chart or Outline Project Plan	X	
Stream 2 Key Work Packages	X	
Stream 2 Risk Register	X	
Project Cost Breakdown / Finance Form	X	
Declarations	X	
Attached supporting documentation ***Clearly Referenced***	X	

Signatory Page

Enter details below	
Name of Organisation	Environmental Resources Management Ltd.
Signature ***Please insert name***	[This information has been redacted]
Position in Organisation	[This information has been redacted]
Date (DD/MM/YYYY)	27/08/2021

Do you give BEIS permission to contact you/your organisation in relation to your application and to provide updates on its progress. We may also share with you further details on the Low Carbon Hydrogen Supply 2 competition when available? Consent is required for the application to be submitted.
Yes