Written evidence submitted by Orbital Marine Power (REW0006)

1. Introduction

1.1 Orbital Marine Power is a leading developer of floating tidal stream technology. We have been developing our technology exclusively in the UK for the past 18 years. Our most recent prototype, the 2MW SR2000, generated more than 3.25GWh into the UK electricity grid during a 12-month and was built with over 80% UK content.

1.2 We are currently mid-way through the build of our commercial system, the O2, this system will produce clean, predictable electricity into the UK grid and was financed with £7 million of commercial debt finance through crowd funding platform Abundance. The O2 has over 80% UK content and from discussions with our supply chain we estimate that this could increase to 95%.

1.3 The UK has an estimated 6GW of exploitable tidal stream sites. Today there are over 240 MW of tidal stream sites under development in Wales. Orbital is a berth holder at the Morlais project and hopes that this site can be the location for the worlds first floating tidal energy array, support by the upcoming Allocation Round 4 (AR4) of the Contracts for Difference (CfD) auction.

1.4 To secure the global lead and a £25bn export market, encourage competition, drive down cost of energy to below £90/MWh and distribute economic benefits across the country, the tidal energy sector requires route to market. This can be achieved by providing a minima of 100MW to be established within AR4. To ensure the build out of this 100MW of tidal energy within AR4, an Administrative Strike Price of £250/MWh is required.

2. How can the UK Government best support the deployment of renewable generators in Wales?

2.1 At present the tidal stream sector is critically missing is a route to market. This could be created in the UK through changes to the CfD competitive allocation process, notably re-establishment of a tidal stream minima and a suitable strike price to support projects preparing to bid. Orbital participated in the UK Marine Energy Council working group that considered what technology minima and strike price levels would be required to support tidal stream energy within AR4 and reached a strong consensus on the type of support required, as outlined below.

2.2 The industry has an active development pipeline of almost 1GW of sites today; of which **124MW of sites are in an advanced stage** of development in Scotland, Wales and England, preparing to bid into AR4. The remainder of this development pipeline - the majority of which involves scaling up at sites, which have already secured agreements for lease, and initiated the grid connection and consenting process - will be ready to bid into subsequent auction rounds thereafter.

- To secure the global lead and £25bn export market, encourage competition, drive down cost of energy to below £90/MWh and distribute economic benefits across the country, the tidal energy sector requires a **minima of 100MW** to be established within AR4.

- To ensure the build out of this 100MW of tidal energy within AR4, an **Administrative Strike Price of £250/MWh** is required.

2.3 Combined with a signal of similar support structures in AR5 and AR6 and beyond, at the sites already under development alone, over 1GW could be ready to bid in the next few CfD rounds, with up to 4GWs in the 2030s as further sites are developed. Entering into the 2030's, this roll out trajectory would see tidal energy well on the way to deploying at sub £90/MWh and have secured the UK a £25bn global export opportunity.

2.4 A number of **secondary changes** to the CfD scheme that could further support tidal energy include holding **more frequent auctions**, **reducing the gap** between auction award and delivery years, enabling **CfD to be combined with grant funding** and **extending the delivery years** to minimise the stop-start nature of development that the current CfD regimes creates.

2.5 **100MW Minima for Tidal Stream** - A 100MW minima is a credible way of managing the uncertainty in the project pipeline whilst supporting the business targets for those whose projects are in development. When considering the proposed support approach to AR4, it should be considered that two of the locations within the 124MW of sites that may be in a position to bid into AR4 projects currently under development are designed to host multiple "sub-lease" projects, which increases the diversity of projects that are likely to bid into AR4. This clearly demonstrates that there will be healthy competition, allows projects to truly compete on price, whilst also providing a realistic prospect of projects being developed across all three UK administrations. The projects that have the lowest cost will see the largest rollout, which is in line with the CfD objective of driving down cost through competition. It is also important to note that creating a minima of less than 100MW runs the significant risk of only supporting a single project, eroding any potential for competition, nor will it provide a suitable pipeline of technology to enable competition within future auction rounds and diverse UK-wide supply chain development.

2.6 **Administrative Strike Price of £250/MWh** – in 2018 the ORE Catapult conducted extensive consultation across the wave and tidal stream sectors and gathered evidence on current and projected levelised cost of energy (LCoE) for the sector. This independent report determined that the LCoE for tidal stream would reduce to an industry average of £250/MWh after the first 20MW of deployment. The actual strike price will vary between projects, varying in relation to project sizes and different economies of scale, but it is believed that setting the ASP at the industry's average price point will ensure strong competition and guarantee delivery of the full 100MW, not just a subset of the projects.

2.7 It is estimated that this proposal will cost approximately £52.6m per year**, £26m per year less than** the £78.3m per year cost of subsidising 78MW[1] of **floating offshore wind** deployment that at present is showing very little UK content.[2]

3 How should the UK and Welsh Governments work together to support the development of renewable energy projects in Wales?

3.1 The creation of an Emerging Offshore Energy Programme Board that is inter-governmental and seeks to align common interests for the sector at the two levels of government activity would be helpful. Programmes and schemes to develop the supply chain's capacity and capability through clusters such as the South Wales Industrial Cluster and Celtic Sea Cluster will continue to enable cross-border working. Upgrades to infrastructure, notably grid will need to take places through cooperation. The tidal energy opportunities at the Morlais project that will hourly be supported by the North Wales Growth Deal can act as an anchor projects and avenues for UK and Welsh Government to work together.

4 What mechanisms can ensure that subsidies for renewable generators are good value for money?

4.1 Beyond the O2, Orbital is currently working on securing finance for follow on deployments. Investors have raised concerns around the path to market for tidal stream, especially where they are forced to compete with more mature fixed and floating offshore wind technologies, as is currently the case with the Contracts for Difference market mechanism. However, the UK has the opportunity to lead the world in this sector by creating a clear route to market at scale.

4.2 The message that Orbital has consistently received from investors is that, given the operational data we have now collected for our technology, subject to an appropriate revenue incentive being in place, their appetite for investment could, and would, change. It is clear that the current lack of route to market, primarily due to lack of a suitable revenue incentive, is having a significant detrimental impact on the number of private sector investment opportunities and is effectively paralysing the sectors development and value creation potential.

4.3 Overall, we would anticipate investors engaging in early stage projects with a view to supporting future phasing and scaling up of the projects and technology, hence the

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[1] Tidal energy cost calculation
MW deployed x 8760 x 30% capacity factor x (ASP – brown power) x 15 = cost to government
100 x 8760 x 0.3 x (250 – 50) x 15 = **£788.4m cost in total OR £52.6m per annum**

Floating offshore wind cost calculation
MW accredited x 8760 x 60% capacity factor x 3.5 ROCs x 20 = cost to government
78 x 8760 x 0.6 x 191 x 20 = **£1,566m cost in total or £78.3m per year for 20 years.**

[2] Projected UK content of 22-65% cited in
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/911817/electricity-generation-cost-report-2020.pdf - Viewed September 2020
Targeted UK content of >50% cited in
https://www.scottishrenewables.com/assets/000/000/475/floating_wind_the_uk_industry_ambition_-_october_2019_original.pdf?1579693018 - Viewed 25 September 2020

need to obtain clear visualisation of future government ambitions. This can all be achieved by creating a 100MW minima with an ASP for £250/MWh in AR4.

4.4 Renewable energy technologies have achieved exponential cost reductions in the last decade, outstripping all forecasts. Tidal stream has and will continue to benefit from lessons learned from what has driven successful cost reduction in renewables and other sectors. It is well documented that cost reduction will arise from three key areas:

1. Technology innovation,
2. economies of scale; and
3. commercial factors such as competition and risk profile.

4.5 Tidal Stream sector is on a trajectory to hit <£90/MWh with its first 1GW of deployment. This is notable given than offshore wind delivered a LCoE of £125/MWh after the first 2.5GW of deployment[3].

4.6 **Technology Innovation** – discreet reductions in LCoE can be achieved by reducing CAPEX, reducing OPEX and increasing yield. This complex interplay is further outlined in the carbon Trust Report, Accelerating Marine Energy.[4] Targeted areas for cost reduction in Tidal Stream energy are as follows:

1. Load reduction and increasing the swept area of the rotor, increasing yield.
2. Anchoring technologies to remove mass and decrease CAPEX
3. Optimisation of turbine configuration to reduced CAPEX and DEVEX considering:
    - Manufacturing at volume.
    - Standardization - dual impact with economies of scale and spares strategies.
    - Overall turbine rating.
    - Design for O&M.

4.7 **Economies of Scale** – these cost reductions arise from:

1. Alignment with established suppliers with existing capabilities to react to scaling-up of capacity.
2. Standardisation to maximise competitive drivers in as wide an available supply chain as possible.
3. De-risking facilities and construction and O&M vessel requirements to mitigate over reliance on low availability infrastructure (and associated market volatility).
4. Cost reductions from economies of scale are projected as learning rates, which for wave and tidal stream energy are regularly projects at c.15%.

4.8 **Commercial factors and risk profiles** – when risks are high, investors price their cost of capital accordingly. The higher the risk, the higher the cost of capital.

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[3] https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/windspeed_roadmap_final_publication_en.pdf - Viewed 25 September 2020

[4] https://prod-drupal-files.storage.googleapis.com/documents/resource/public/Accelerating%20marine%20energy%20-%20REPORT.pdf – Viewed 15 September 2020

Demonstrating projects of multiple machine deployments will enable, in combination, powerful effects of:

1. Reducing cost of capital.
2. Increase access to scalable project finance.
3. Increasing access to standard commercial products of business interruption etc.

4.9 All UK tidal stream energy deployments are listed in Table 2 below, showing cumulative installed capacity since 2008. The key conclusion from this top down LCoE analysis is once industry reaches around 18MW of deployment capacity, then the average LCoE for the tidal stream energy sector will be £250/MWh.

Project Category	Project	Installed capacity	Year	Cumulative Installed capacity (MW)
Commercial Demonstration	O2	2	2021	17.95
Prototype	ATIR	2	2018	15.95
Commercial Demonstration	Blue Mull Sound	0.3	2018	13.95
Prototype	SR2000	2	2017	13.65
Prototype	Tocardo	0.2	2017	11.65
Commercial Demonstration	MeyGen (Phase 1a)	6	2016	11.45
Prototype	HS1000	1	2013	3.45
Prototype	AR1000	1	2013	4.45
Prototype	Deepgen	1	2013	5.45
Prototype	Voith	1	2011	2.45
Prototype	MCT	1.2	2009	1.45
Prototype	OpenHydro	0.25	2008	0.25

Table 2 - UK tidal stream deployment and projected LCoE after installed capacity

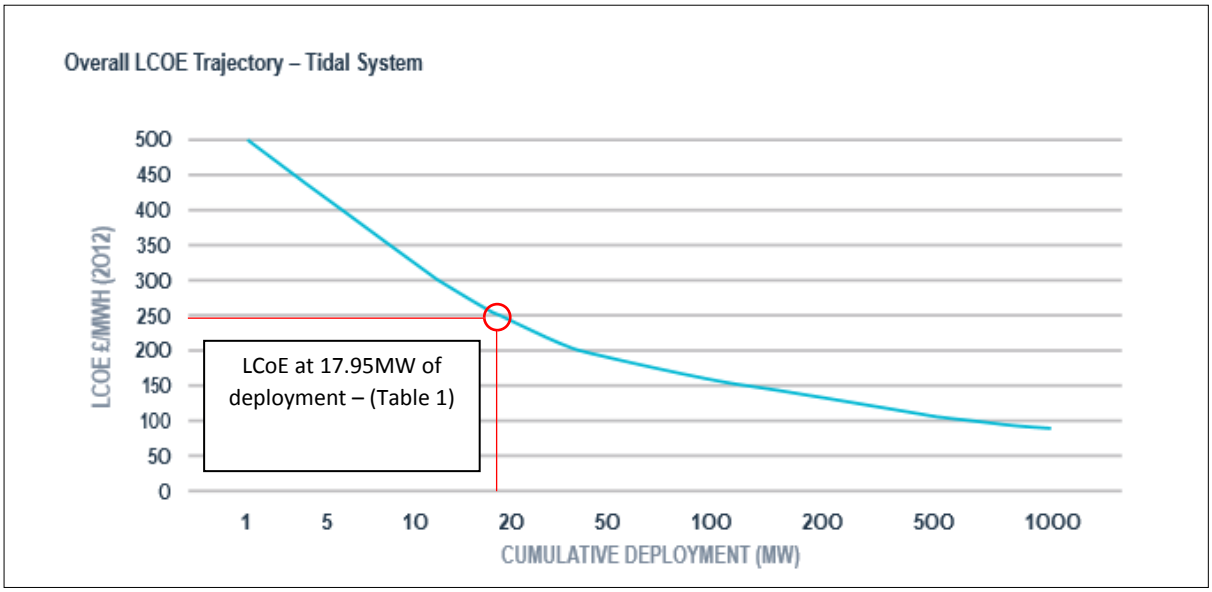

Figure 3 - Tidal stream estimated trajectory to 1GW[5]

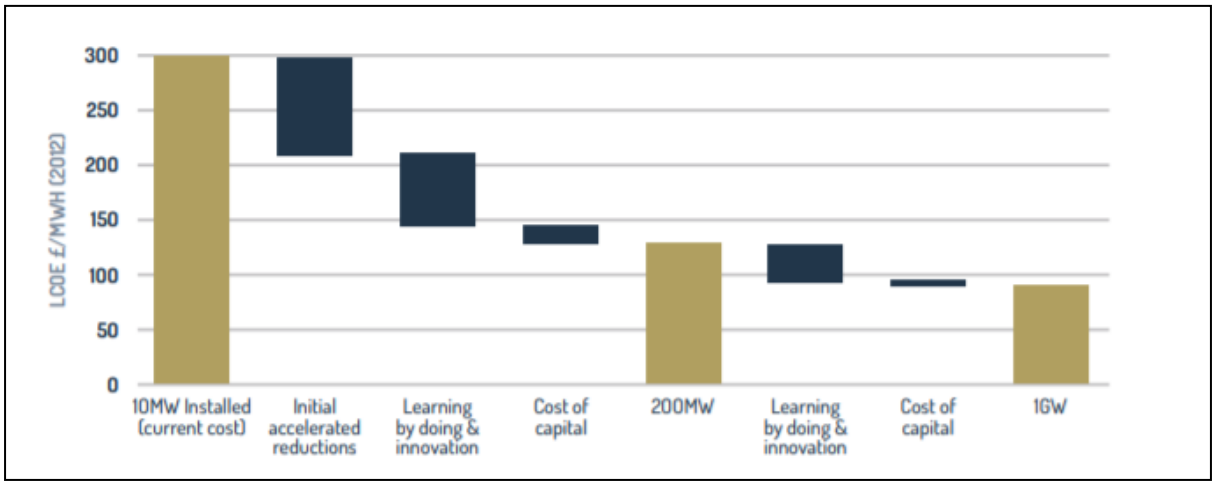

Figure 4 - Tidal Stream LCoE reduction

4.10 These projection's further corroborated in the BEIS 2020 Electricity Generation Cost project.[6] Figure 3 above, demonstrates that the industry is making solid progress toward delivering competitive as low at £80/MWh by the 2030s. OREC's 2018 report shows that as the technology matures, cost will continue to fall with incremental innovation and continuing learning (Figure 3 and 4). OREC sees ongoing reductions achieved over a relatively modest volume of deployment: a forecast LCoE of £150 per MWh after 100MW installed, £130 after 200MW and £90 after 1GW.

5 What opportunities are there for renewable generators in Wales of greater interconnection with other electricity markets?

5.1 Tidal energy is highly predictable; generation output can be forecast years or even centuries in advance. The net effect of adding more predictable and consistent source of renewable energy to our transmission system will be to smooth the overall power supply from renewables, which will enable higher penetration of renewables and help to maximise the asset value of Wales and wider UK transmission systems.

5.2 Due to its inherent predictability and more stable power output; coupling tidal stream energy with battery storage and green hydrogen production can lead to more stable hydrogen production and increased overall system efficiency. Green hydrogen has already been produced by tidal power in the UK[7] and plans are being developed to scale up these opportunities.

6 Has the COP26 Year of Climate Action had any significant implications for Wales?

6.1 There is the opportunity for the COP26 Year of Climate Action to have significant impact for Wales is BEIS enacts key policy change to the CfD AR4, as suggested above.

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[5] https://www.marineenergywales.co.uk/wp-content/uploads/2018/05/ORE-Catapult-Tidal-Stream-and-Wave-Energy-Cost-Reduction-and-Ind-Benefit-FINAL-v03.02.pdf - Viewed 28 September 2020
[6] https://interregtiger.com/ - Viewed 15 September 2020
[7] http://www.emec.org.uk/press-release-worlds-first-tidal-powered-hydrogen-generated-at-emec/ - Viewed 15 September 2020

7 What opportunities are there for renewable energy to aid Wales post-COVID-19 economic recovery?

7.1 Different projects and technologies will have different investment requirements; but using an estimated average cost of £5m/MW installed, a total investment level of £500 million will be required to bring the proposed 100MW minima of tidal stream energy to fruition. This could deliver more than £400 million of engineering contracts into the UK supply chain over the next 24 to 36 months, with significant content coming from Wales.

7.2 The profile of skills and supply chain resources required to develop a tidal energy industry are very well married to the Welsh industrial sector.

7.3 **Local fabrication** - The items that will most likely be fabricated locally include the steel super structure, the moorings, the anchors and the final assembly. The Welsh supply chain has delivered excellently into the existing UK built projects and proved itself.

7.4 **High value readily exportable subsystems** - Within the tidal stream sector Wales well positioned to secure the high value readily exportable subsystems, which are almost exclusively manufactured overseas across all other clean energy technology industries. Notably these are the power take off or nacelle, the blades and the electrical control systems. In wind energy none of these subsystems (with the exception of very few blades) are manufactured anywhere in the UK. Rather the bulk of this work is completed in Denmark and Germany, when exported around the world. The UK, with Wales at the heart, could replicate Denmark and Germany's lead for tidal stream energy as these subsystems are readily transportable and ideally suited to existing Welsh supply chain capabilities. To further increase Welsh content and economic benefit, inward investment opportunities from global OEM's forming part of this emerging supply chain is also a very real possibility.

7.5 **Expertise in project development** - Development expenditure contracts are generally placed with experts that have developed skills on early path finder projects, once developed these can readily be exported. A good example of this is the offshore oil and gas industry. The industry developed in Aberdeen, companies grew up around this nascent home market and were exceptionally well placed to export their services to projects around the world. The same opportunity exists for tidal stream and wave energy, which is currently home to the most experienced professionals across all aspects of the supply chain for marine energy projects.

7.7 The Orbital O2 provides a good example of the scale of opportunity presented by the tidal stream sector. In total Orbital's supply chain for the O2 covers 157 companies across the UK. Figure 5 provides a highlight of the supply chain involved in the fabrication of the O2. Table shows the geographical spread of the supply chain for the O2, broken down by subsystem, demonstrating 80% UK content of the O2 CAPEX.

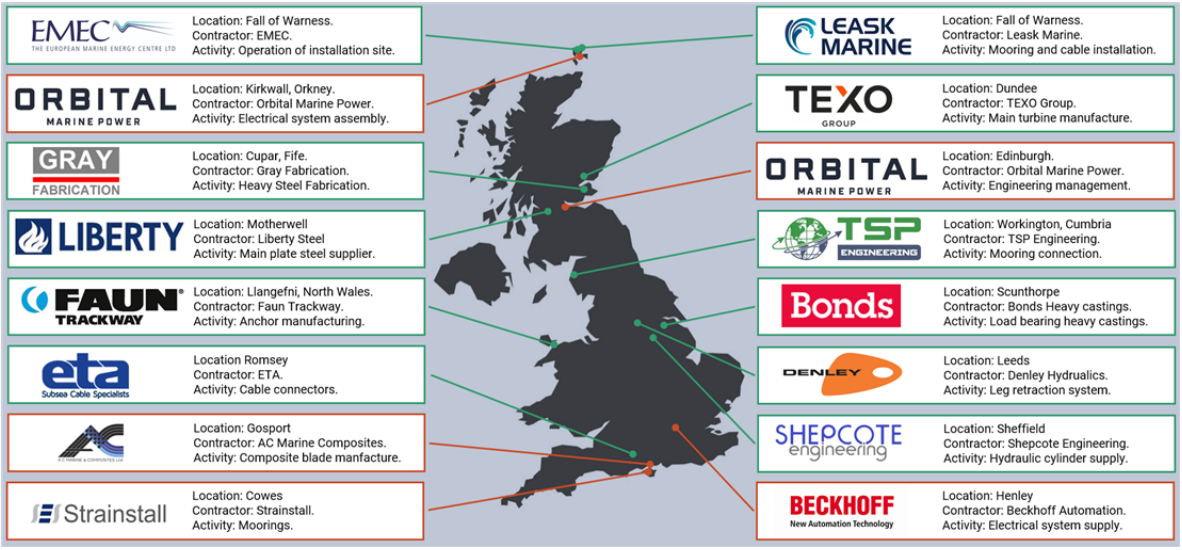

Figure 5 - Orbital Marine Power O2 supply chain map

Work package	Total spend	Non-UK	Scotland	Wales	North England	South England	UK
Blades	9%	0%	0%	0%	0%	9%	9%
Pitch & Hub	11%	0%	0%	0%	11%	0%	11%
Nacelle	17%	17%	0%	0%	0%	0%	0%
Electrical skids, C&I, Aux Systems and Outfitting	9%	0%	2%	0%	1%	6%	9%
Leg Retraction System	5%	0%	3%	0%	2%	0%	5%
Structure	30%	0%	29%	0%	0%	0%	30%
Moorings	10%	3%	0%	4%	3%	0%	7%
Dynamic Cable	1%	0%	0%	0%	0%	1%	1%
Marine Operations & Logistics	7%	0%	7%	0%	0%	0%	7%
Ancillary	2%	0%	1%	0%	1%	0%	1%
Total	100%	20%	42%	4%	18%	16%	80%

Table 3 - Orbital O2 supply chain analysis

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