UK Marine Energy Council Response - Technological Innovations and Climate Change: Tidal Power

The UK Marine Energy Council (MEC) was formed in 2018 to represent the wave and tidal stream energy sector[1]. It is made up of the key technology and project developers operating in the UK, along with their trade associations (Renewable UK, Marine Energy Wales and Scottish Renewables).

The MEC welcomes the opportunity to respond to this timely consultation. By way of summary:

- There is an urgent need for policy support via CfD reform and introduction of an Innovation Power Purchase Agreement (IPPA).
- This will help unleash deployment of tidal stream technologies, which are already demonstrating at high technology readiness levels.
- This policy support will enable a realistic deployment target of 4GW in the UK by end of the 2030s, supporting the UK's 2050 Net Zero obligation.
- Achieve cost reductions through technology innovation, economies of scale, commercial factors and risk profiles which face investors.
- Embed UK supply chains through delivery of early projects, support the UK Government's 'levelling up' agenda and delivery of significant export opportunities.

The MEC would welcome the opportunity to meet you and Committee colleagues to discuss its views further.

Yours sincerely,

Sue Barr,
Chairperson, UK Marine Energy Council
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[1]For avoidance of doubt this does not include tidal lagoons and other use of tidal range technology.

What contribution can forms of tidal power play towards the UK's energy mix?

1. UK tidal stream resources are estimated at more than 30GW (roughly half of the European total). Current technology could enable more than 6GW from 30 key tidal sites across all regions of the UK[2], equivalent to approximately 11% of the UK's net electricity supply in 2019 of 307.6 TWh[3].

2. Tidal stream energy is entirely predictable, in marked contrast to other renewables such as solar and wind. A TIGER project modelling study will consider at what capacity this predictability becomes a valuable baseload supply to off fluctuations in solar and wind.

3. Tidal stream technologies already demonstrate high technology readiness levels, with turbines deployed at sites in the Pentland Firth and Shetland, with further prototype, pre-production and commercial devices deployed for extended periods at Orkney's European Marine Energy Centre (EMEC). These deployments utilise existing, predominantly UK-based supply chains and industrial facilities, with demonstrated UK content of over 80% for the Shetland Tidal Array.

4. The above can help facilitate 'scaling-up' if accompanied by appropriate commercial & economic conditions and site availability: deployment could be in the hundreds of MW by 2030 subject to:
   - Operational demonstration at the tens of MW scale to gain commercial confidence and so access to project finance for larger scale projects.
   - Long-term policy as detailed in paragraphs 15 – 23.

5. Success in AR4 will trigger investor confidence to help secure project finance for later CfD rounds, with a goal of 1GW of tidal power in the UK during the first half of the 2030s.

6. A further 5GW has been identified, so the UK is in a good position to deliver a significant portion of its power mix from this clean energy source.

7. Global potential for marine energy will follow suit: 100s of MWs out to 2030, with the IEA's technology perspective forecasting up to 337GW of global marine energy deployment by 2050. With realistic future costs falling below £90/MWh, tidal stream will be a viable renewable energy source where the resource exists in suitable density, as is the case in the UK.

8. These expectations are backed-up by the Ocean Energy Europe *2030 Ocean Energy Vision*, which states that tidal energy could deploy 1.3GW to 2.4GW worldwide by 2030 – much of it based on UK technology.

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[2]https://www.gov.uk/guidance/wave-and-tidal-energy-part-of-the-uks-energy-mix#:~:text=It%20is%20estimated%20the%20UK,4%25%20of%20overall%20supply). Viewed 26 September 2020.
[3]BEIS historical electricity data: 1920 to 2019 https://www.gov.uk/government/statistical-data-sets/historical-electricity-data Viewed 28 September 2020

Why, despite the considerable marine resources available, have relatively few developers established tidal projects?

9. There is huge interest the from investment sector subject to clear policy support signals from government. Otherwise, this investment will go to countries such as France, Japan or Canada.

10. Feedback from MEC members indicates some common themes that have hampered development to date:

    - Very limited number of technology neutral project developers and a slow pace of technology development due to insufficient government support.

    - Investor concerns over an unclear route to market in the form of revenue support. Currently, tidal projects in cases are forced to compete with more mature offshore wind technologies.

    - Investors are prepared to get involved in pre-commercial projects c5-10MW but competitive finance access really begins at a larger scale.

    - More operational data to reduce the risk profile of the project: to date, most projects have deployed single turbines only, deploying a next generation turbine for the succeeding project. So, technologies still carry perceived risk, which can make them uninsurable and hence not bankable.

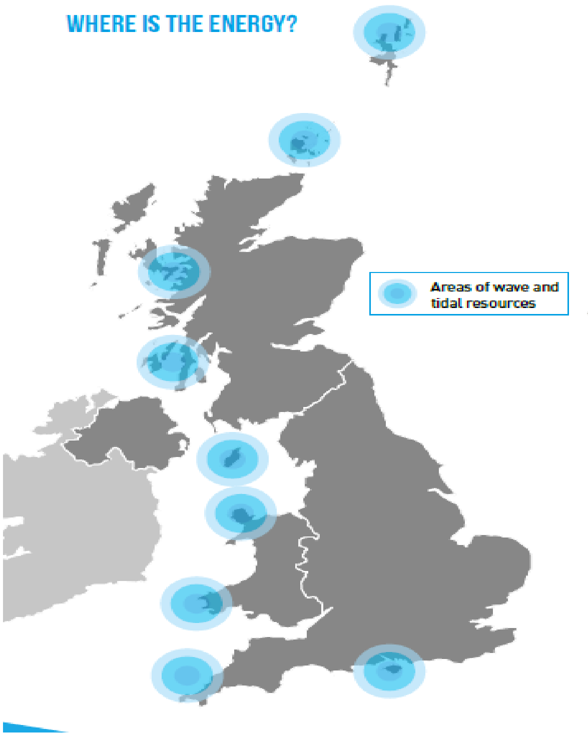
    - Limited information on the environmental impact on mammals, diving birds etc requires further monitoring & academic research programmes, rather than additional monitoring costs on early commercial projects. Regulators thus take an overly risk-averse approach, which in many cases might prevent projects from going ahead.

    - Other areas include a streamlining of the planning and grid connection processes (we welcome the recent Offshore Transmission Network Review and await next steps) and a more joined up approach to marine spatial planning would also be desirable.

Are there certain locations where one type of tidal technology is best suited?

11. Tidal stream devices are best suited to narrow channels where tidal currents are strongest. Most projects in the UK are located around Orkney, Caithness and the west coast of Scotland; Northern Ireland; Anglesey and in south Wales; and the south of England.

12. The future deployment locations for tidal stream (and wave) energy sites are shown in the map below.



13. MeyGen (north of Scotland), Morlais (Holyhead) and PTEC (Isle of Wight) projects have secured agreements for lease from the Crown Estate and are well progressed, both in terms of grid connection and consenting – potentially enabling participation in AR4.

14. Projects in other locations will be looking a little further down the line, ie. AR5 and AR6 but the critical issue is to attract project developers to the sector. Leasing, consenting and CfD timelines mean that large projects can take 10 years to deliver.

How could financial support be structured to assist technological and project development in this area?

15. A clear, strategic government commitment to project and technology developers is required to enable the UK to access the economic and low carbon benefits of the sector.

16. Moving an established technology such as offshore wind from CfD Pot 2 to a separate Pot 3 is a welcome move. However, with a development pipeline of c1GW, with 124MW preparing to bid in CfD AR4, further measures are required:
    - To drive down costs to below £90/MWh, a minimum dedicated capacity of 100MW for tidal in CfD AR4; and
    - An Administrative Strike Price of £250/MWh.

17. 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.

18. Entering the 2030s, this rollout trajectory would see costs well on the way to below £90/MWh and the UK securing a £25bn export opportunity.

19. Other CfD reforms required include holding more frequent auctions; reducing the gap between auction award and delivery years; and extending the delivery years to minimise the stop-start nature of development that the current CfD regime creates.

20. Projects should be able to combine CfD with grant funding to recognize the importance of generating research in demonstration projects - essential to drive innovation, which in turn delivers sector-wide cost reductions.

21. Early-stage *technology developers* are not at the stage where they can participate in the CfD process. They need a mechanism that can bridge the gap to when they can do so.

22. What is required is implementation of the MEC's *Innovation Power Purchase Agreement* (IPPA) proposal, which has been shared with BEIS on several occasions and is based around
    - A PPA between a generator and electricity supplier, based on a strike price set by BEIS; and
    - The supplier can claim the difference between this price and market prices against its tax bill.

23. The cost of the IPPA has been estimated at £50m pa for both tidal and wave. Crucially, these costs will not appear on consumer bills, unlike costs arising from the CfD process.

How might tidal schemes reduce costs to become commercially competitive with other low carbon or renewable options?

24. Tidal stream energy will continue to learn from successful cost reduction in renewables and other sectors. Costs could be <£90/MWh with the first 1GW of deployment. In contrast, offshore wind delivered £125/MWh after the first 2.5GW of deployment[4].

25. This demonstrates tidal stream's competitiveness vs mature offshore renewables in terms of cost after relatively low levels of deployment – providing energy security and UK supply chain resilience by adding diversity to the power generation mix.

26. **Technology Innovation**: reductions in costs can be achieved by reducing CAPEX, reducing OPEX and increasing yield. Significant R&D investment is required to ensure that the interplay between all three of these elements is balanced to deliver reduced costs overall. This complex interplay is further outlined in the Carbon Trust Report, Accelerating Marine Energy.[5]

27. **Economies of Scale**: these cost reductions arise from -

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[4]https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/windspeed_roadmap_final_publication_en.pdf

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

- Alignment with established suppliers with existing capabilities to react to scaling-up of capacity.
- Standardisation to maximise competitive drivers in as wide an available supply chain as possible.
- De-risking facilities and construction vessel requirements to mitigate over reliance on low availability infrastructure (and associated market volatility).
- Cost reductions from economies of scale are projected as learning rates, which for wave and tidal stream energy are regularly projects at c.15%.
- Project development costs do not adjust to the size of the project and any increase in project size will reduce the unit rate of these costs

28. **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. At present the tidal stream energy industry has only demonstrated the production of 32GWh of electricity to the UK grid, as such the perceived risks are still high.

29. Demonstration projects of multiple machine deployments will impact on the LCoE in the following ways:

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

30. The offshore wind industry demonstrates how the finance sector can gain confidence in a new technology. The Gunfleet Sands project was one of the first offshore wind farms to be consented in the UK: it grew from its original 30MW array in 2006 to 172MW in 2013 ie. over five times its originally consented capacity in seven years.

31. The ORE Catapult report shows that as the technology matures, costs will continue to fall with incremental innovation and continuing learning. Furthermore, ongoing reductions can be achieved over a relatively modest volume of deployment: forecast costs of £150 per MWh by 100MW installed, £130 by 200MW and £90 by 1GW.[6]

[6]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

Table 1 - UK tidal stream deployment and projected LCoE after installed capacity

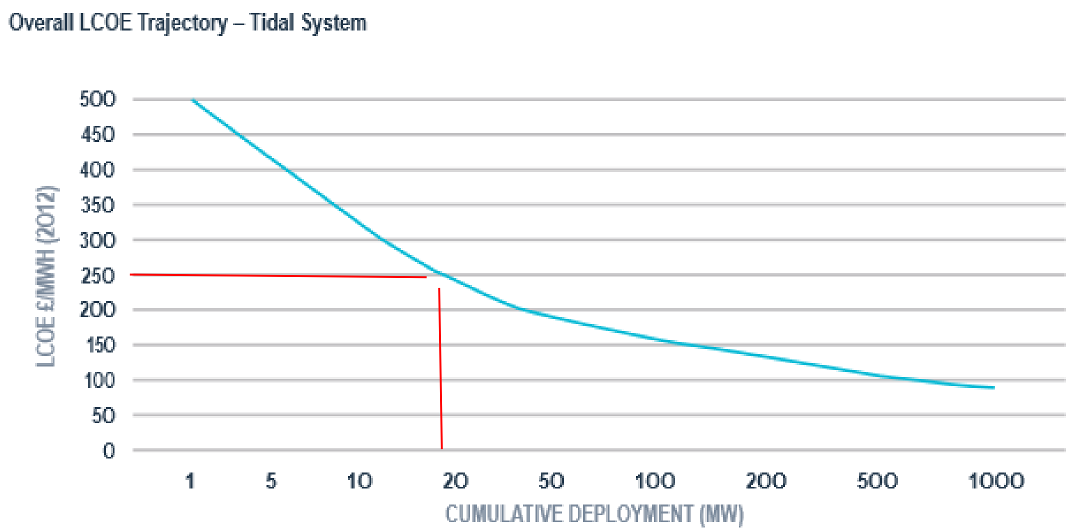

Figure 3 - Tidal stream estimated trajectory to 1GW[7]

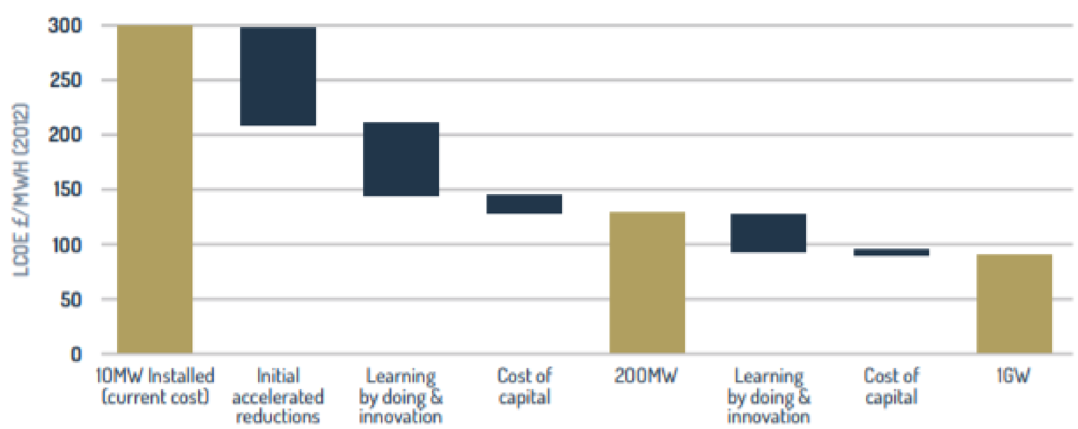

Figure 4 - Tidal Stream LCoE reduction[8]

32. The report goes on to describe realistic scenarios in which costs will fall further. For example, the report states:

'The overall learning rates are by no means aggressive and applying an overall learning rate on both capex and opex of 15% would result in LCOE by 1GW of £80 per MWh. There is also potential for cost of capital to reduce further, closer to the reductions implied by offshore wind auction bids and achieving a 5% cost of capital would also result in 1GW LCOE of £80 per MWh.'

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33. These projected figures are backed-up in the BEIS 2020 Electricity Generation Cost report that shows solid progress towards costs of £80/MWh by the 2030s.

We also welcome evidence of any successful approaches to cost reduction that have already been adopted.

34. Two different examples evidence success in this area. Firstly, in relation to UK technology developers:
    - Nova Innovation's direct drive turbine: removing the gearbox increased reliability and efficiency, boosting yield and cutting LCOE by 30%.
    - Through learning by doing, Nova Innovation cut the cost of offshore operations by 77% between the first and third turbines deployed in the Shetland Tidal Array.

35. Secondly, EMEC's significant cost reductions through operating cooperatively with multiple developers:
    - Achieving economies of scale by laying multiple cables simultaneously.
    - Undertaking site-wide environmental monitoring, navigational marking, stakeholder engagement, licencing authority education, site leasing, grid connection provision, PPA negotiation etc.
    - Re-purposing initial experimental equipment by working with the local supply chain to see opportunities for reuse and re-tasking.

36. EMEC has helped projects reduce costs, which on occasions has been the difference between success and failure. EMEC can also demonstrate the cost-effective approach taken has saved money for the funders and continues to believe that it has a pivotal role in stripping cost burdens from both the developers and their supporters.

What are the environmental impacts of tidal schemes and how can these be minimised?

37. The primary areas of environmental impact are collisions between marine energy converters (MECs) and wildlife, underwater sound, damage/changes to seabed habitats, and alternations in the distributions or movements of mobile marine species.

38. Most analyses of the impacts of tidal stream deployment have reported low/minimal impacts; when considered alongside the benefit of zero-carbon energy production, the overall impacts environmental impacts are overwhelmingly positive.

39. At the Meygen site in the Pentland Firth, active turbine noise was found to be significantly below levels of other anthropogenic activities (e.g. piledriving, seismic surveys)[9]; work is ongoing investigating the fine scale movements of harbour porpoises in the immediate vicinity of an operating tidal turbine[10]. Elsewhere, it has been found that an operational tidal turbine does affect seal transiting behaviour but causes no barrier effect[11], and that most anticipated collisions between seals and turbine blades are unlikely to cause fatal trauma[12].

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[9]Risch, D., van Geel, N., Gillespie, D. and Wilson, B., 2020. Characterisation of underwater operational sound of a tidal stream turbine. *The Journal of the Acoustical Society of America*, 147(4), pp.2547-2555.

[10]Gillespie, D., Palmer, L., Macaulay, J., Sparling, C. and Hastie, G., 2020. Passive acoustic methods for tracking the 3D movements of small cetaceans around marine structures. *Plos one*, 15(5), p.e0229058.

[11]Sparling, C., Lonergan, M. and McConnell, B., 2018. Harbour seals (Phoca vitulina) around an operational tidal turbine in Strangford Narrows: No barrier effect but small changes in transit behaviour. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 28(1), pp.194-204.

[12]Onoufriou, J., Brownlow, A., Moss, S., Hastie, G. and Thompson, D., 2019. Empirical determination of severe trauma in seals from collisions with tidal turbine blades. *Journal of Applied Ecology*, 56(7), pp.1712-1724.

40. Work conducted at EMEC has revealed that seabed impacts can be limited (although are heavily dependent upon mooring system and MEC design), and other ongoing work as part of the SEAWave and FloTEC projects is investigating a range of environmental impacts at both the wave and tidal sites.

41. Future research priorities include continuing to improve our understanding of the fine-scale behaviours of mobile species around operational MECs, understanding the scaling up of effects from individuals to populations, and from single devices to arrays, as well as continuing to collect data on device specific impacts and characteristics as new project developments are undertaken.

What are the wider economic benefits and what potential disadvantages could tidal schemes bring to regional areas?

42. Tidal energy projects will be built out in the UK's peripheral & coastal areas, where there are traditionally less R&D-intensive activities. More broadly, we would anticipate specific benefits at the project deployment locations with the establishment of O&M bases.

43. Early work in the MEC to identify supply chain geographical distribution has shown that the marine energy sector will draw from an extensive suite of suppliers based in all regions of the UK.

44. EMEC demonstrates the significant impact of a company's R&D on a coastal community and beyond, which demonstrates the practical application of the levelling-up agenda. The following points are taken from EMEC's Socio Economic impact study:

    - A total GVA to the UK economy of £285 million, with over 4000 full-time equivalent (FTE) job years so far (1653 of which were in Orkney).
    - EMEC's innovation expertise has expanded into energy systems and green hydrogen, as well as exporting test centre consultancy with contracts in China, South Korea and the US, facilitating the development of a global export market
    - As of 2017, the total value of the R&D projects that EMEC has been involved in as a partner was around £50 million, with around £5 million of this accruing to EMEC from its inputs. Other businesses and organisations, locally and nationally, will have obtained significant income from participation in these projects as partners or through the supply chain.
    - This means higher earnings in Scotland and the UK with the direct jobs at EMEC representing high value employment. The average full-time salary for EMEC staff is around 40% higher than the median for the local Orkney and regional Highlands and Islands economies.

45. Another example would be Nova Innovation's Shetland Tidal Array, where 25% of construction expenditure went to Shetland companies. Moreover, during operation, 60% of supply chain spend has gone to firms in the Highlands and Islands region. The suppliers include companies active in the oil and gas industry, including Shetland Composites and engineering consultants Wood.

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