IWG Ocean Energy & IWG Wind

Joint workshop: R&I needs for co-location of offshore wind and ocean energy

18 October (10:30-12:30)

Brussels and Online

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Concept of the workshop

The IWG for wind and the IWG for ocean energy (OceanSET) wish to bring together representatives from their respective ETIP and IWG communities to discuss Research & Innovation aspects on topics from their respective Strategic Research and Innovation Agendas identified as being of common interest.

The first topic to be addressed was: **Co-location**

Through consideration of the following questions:

- What are the benefits and concerns of co-location from an **economic** perspective?
- What are the key **technical** opportunities and challenges associated with co-location?
- To what extent does the current **regulatory** landscape support or hinder co-location?

the workshop sought the following outcomes

- **Common challenges / barriers** faced by both the wind and ocean energy industries are identified.
- **Research & Innovation topics** that could be tackled by both sectors working together are defined, topics that could be the subject of a call for proposals (e.g. Horizon Europe, Sustainable Blue Economy Partnership (SBEP), Clean Energy Transition Partnership (CETP), etc.).

Agenda

Timing	Topic	Speakers
10:30-10:45	Welcome and introduction of the joint ETIP Wind / ETIP Ocean report on offshore renewables	Lotta Pirttimaa, Ocean Energy Europe Capucine Vannoorenberghe, WindEurope
10:45-11:15	Thematic presentations	Emilie-Marie Mercier, European Projects Director, EDF Tim Hurst, Wave Energy Scotland & IWG Ocean co-Chair Ozlem Ceyhan, Wind expert, IMDC
11:15-11:50	Breakout sessions	Moderated discussions exploring the main issues, benefits and potential barriers for co-located projects
11:50-12:00	Report from breakout sessions	Moderators
12:00-12:25	Open discussion on potential R&I topics	Inc. feedback from European funding partnerships (SBEP, CETP) and European Commission
12:25-12:30	Closing remarks	Gianmaria Sannino, Head of modelling, observations and scenarios for climate change, ENEA & OE-IWG co-Chair

Clarifying terminology

The need for clear common terminology emerged as some terms are being interpreted differently.

"**Co-location**" was being used as a both a collective sense, referring to the various ways in which technologies may be brought together, and a specific sense, referring to one of those instances. The following terms are recommended to distinguish the various ways technologies might be brought together (as suggested at the workshop's introduction).

Co-location: Technologies deployed individually within the same zone (i.e., technologies are interspersed in the same space in some manner).

Close-location: Technologies deployed in separate (but neighbouring) zones and potentially using shared services or infrastructure (i.e., technologies don't share the same space).

Hybrid platform: Multiple technologies integrated on the same platform/structure (wind/wave/solar PV).

Versatile platform: A common platform/structure design which can be used by any technology with minimal adaptation.

"**Time-value**" refers to the time-value of energy, the concept that the value of energy can vary depending on the time it is produced.

Summary of breakout session

Four breakout groups were used (three virtual and one in-person). Each breakout group involved participants self-declaring as being associated with either the ocean (wave) sector, with the wind sector, and in some instances as being associated with both sectors.

The following is a consolidated presentation of the themes raised during the conversations, presented as an aide-memoir rather than an exhaustive record of the points raised. Statements are not linked to specific participants.

General aspects

The prevailing view is that co-location is an attractive proposition (in both its general interpretation and its specific interpretation) that warrants further investigation, with a potential for reduction in CAPEX and OPEX and more effective use of space.

A small, but notable, number of participants expressed scepticism in varying degrees. However, they remained open to the potential of co-location pending greater clarity on areas of concern (e.g., claimed economic and practical benefits; demonstration of technical solution feasibility).

Strong public leadership and funding is needed to address the areas of concern (areas of uncertainty) in the next few years to introduce more confidence in the market.

	Theme	**Summary**
General	Opportunities	The principal of a time-shift in generation profiles is noted as beneficial (time value of energy). Technology and process aspects perceived as presenting opportunities: • Shared anchor systems (cost reduction; optimisation of installation process). • Logistics (installation, O&M, operational monitoring) Near end-of-life offshore wind projects and repowering projects could offer an opportunity for demonstration – stakeholders may be more open to accommodating co-location with wave energy technologies (willingness to accept the additional risk of wave energy). Re-use of existing structures would need careful consideration, e.g. to understand fatigue (past and future) and load capacities (potentially less than the original design capacity due to deterioration over existing life.
	Stakeholder engagement	Stakeholders for the constituent technologies (wind and wave) are different. An action to create more opportunities for collaboration between stakeholders to strengthen the mutual understanding of solutions and integration requirements. Involve policy makers and advocate for collocation to move the topic forward. Even if co-location doesn't happen immediately, shared use-of-space will become an inevitable factor in the future given the pressure on seabed space and resources. Establishing collaborative links now can encourage design decisions and development of offshore systems to be as compliant as possible with facilitating future co-location. The sharing of technology could progress organically (e.g. anchor, cable, mooring, etc).
	Contractual	Offshore wind projects will have contractual requirements regarding power delivery (quality and quantity). Does combining output affect this? How is insurance and warranty influenced by co-location. How are the responsibilities allocated to various parts of a co-location project?

Economic aspects

	Theme	Summary
Economic	Core argument	Focus attention on establishing and strengthening the core economic argument for co-location. [What are the core economic arguments for co-location?]
	Time-value of energy	Can the time-value of energy opportunity be applied generally, i.e. in all instances of co-located wind and wave technology? The lead-lag characteristics of resource/energy production is expected to vary on a site-by-site basis … or possibly it is a sea-basin characteristic (e.g. is a North Sea site characteristic the same as an Atlantic coast site characteristic). Desktop studies of time value of energy for co-located wind and wave needed to quantify. Some exist. Would a meta-study be useful? Consider a theoretical type of co-location – multiple locations with associated environmental, socioeconomic and wind/wave resource characteristics. Apply theory to differentiate different energy potentials and time variance, and in turn establish possible solutions and site attractiveness.
	System integration	Lack of convergence in wave technology is a concern to the wind sector. Uncertainty over floating wind platform design, mooring and array layouts is a challenge for the wave sector making it difficult to identify credible opportunities to co-locate with floating wind. Uncertain how the whole system can benefit from integration. Greater certainty about the wave technology is needed for the planning of co-location projects. Minimum requirements necessary for co-location should be known. Alternatively, consider wave technology from a requirements perspective (i.e. what does a wave energy system need to do to enable co-location, or, to minimise risk?). This in turn could help to determine which wave technology will be most attractive. At this stage, is it best to keep things more general and consider different scenarios for different wave systems?
	Energy yield	Energy yield projections are key to determining a specific project's economic case. Projections for a co-located project are considered more difficult to quantify (linked to the greater uncertainty associated with wave energy yields).
	Technology cost	Wave technology is too expensive currently to be considered on purely cost basis. Cost will need to be reduced and brought closer to the cost of wind for co-location to be enticing on a purely cost basis. Convergence on the wave technology needed first before moving onto considering the practicalities of co-location (EIA, etc.) which follow. Should not consider the practicalities too early. Non-cost criteria could encourage co-location.

Technical aspects

	Theme	Summary
Technical	Anchoring/ Mooring	WEC mooring represents a technical challenge to be resolved particularly when co-locating with floating wind. The consequences of WEC mooring failure will need to be considered. Is it possible to design compatible mooring systems?
	Cables	The two sectors are working at different scales. Power output characteristics of the two technologies are generally very different (i.e. voltage levels) which makes cable requirements very different. Is it practical to share the same infrastructure in this situation? The benefits are not clear. Better understanding of combining such different outputs required. More project experience is needed to clarify benefits. Could this be a R&I topic?

		The ocean (wave and tidal) energy sector has a particular unresolved key issue with dynamic cables [An issue shared with floating wind?]
	Maintenance strategy	What are the maintenance strategies that result in reduced maintenance costs? No clear view of how to optimise vessel capacity.
	Technology maturity	The state-of-readiness of the technologies is considered to be very different: offshore wind considered to be mature; and wave considered to be immature. However, floating offshore wind technology is considered less mature than fixed offshore wind and still has issues to solve to be fully optimal. Floating offshore wind will need to prove its feasibility before considering integration with other technologies (wave, solar PV). Wave technology's lower readiness level does afford the opportunity for refinement through design and implementation. New technical solutions may result from pursuing a co-location function. Introducing ocean (wave) energy devices creates more risk. Consequently, the cost of a co-located project is expected to be higher as investors price-in the increased risk of an immature technology. Query: Could the sector subsidise or alleviate this additional risk?
	Hybrid platforms	Hybrid structures often result in compromised designs to accommodate both sets of requirements (i.e. sub-optimal compared to individual system designs) ... Is a compromise in performance acceptable to both technologies? Are the O&M requirements for hybrid platform systems understood? Hybrid platform systems have non-trivial challenges and may not be worth investigating in technical detail at this time. OPEX increases with distance offshore (for wind). Maintenance of offshore wind turbines is more involved and is likely to be associated with greater downtime, and therefore greater energy loss, than onshore turbines. Adding wave to this as part of a "shared system" is likely to increase failure risks and even more downtime. Having the operation of the systems dependant on one another would be even more risky.
	Compatibility	Not all existing wave technologies will be suitable for co-location. There is likely to be different technical issues and solutions when co-locating wave with floating OW and wave with fixed OW. Expectation that some WEC designs are more suited to fixed … some more suited to floating. Is it possible to determine which WEC 'types' are more attractive? Could wave technology system be considered from a requirements perspective, i.e. what does a wave technology system need to do to enable co-location and to minimise risk? This in turn could help to subsequently determine which solutions will be most attractive. [See Co-design] Could co-location be considered from a general perspective and consider different scenarios with different wave technology systems?
	Co-design	Co-design of technology to ensure compatibility from a technical perspective (dynamics, loads, etc). Co-design could also impact the cost-reduction for co-located projects.

Regulatory

	Theme	**Summary**
Regulatory	Regulatory framework	A clear regulatory framework for collocated farm projects is required. Maritime spatial plans should recognise the need for co-location of power generation technologies (shared use-of-space)
	Consenting/ Permitting	Permitting is a key issue to be considered. The legal framework for developing offshore renewable projects is not the same in all EU Member States. Examples of consented co-located projects exist. Also, of collaboration that could lead to co-location: • Belgium: Look at the Mermaid farm for consenting of wind-wave.

		• Ireland: Consenting of sites for possible co-located wind-wave farm projects already done. • Netherlands: Inclusion of novel technology is a licencing condition. • Portugal: Working on site development for potential co-located wind-wave projects. • Denmark: Wavepiston and Orsted have a current collaborative project. Are there other examples, perhaps of wind-floating solar PV? What learning can be recovered?
	Capacity auctions	How can non-price criteria in capacity auctions be used to encourage the demonstration of feasibility in co-location (pilot projects)? For example, local community benefits, local employment, etc.
	Environmental impacts	Cannot presume environmental impacts of component technologies are independent. Additionality effects may be present. Appropriate environmental assessments are required.

Conclusion

The principles which make co-location an attractive proposition conceptually (time-value of energy, shared use of space and infrastructure, combined operation and maintenance, etc.) require further assessment to identify the circumstances in which they present a convincing practical and economic argument.

Offshore wind presents in two forms:

- Fixed (aka bottom-fixed) wind – an established technology with relatively low risk. Typically, shallow water sites with lower energy density wave resource (e.g., North Sea sites). Some fixed wind developments are nearing end-of-life and will be re-powering, decommissioning, etc.
- Floating wind – a less established technology with issues to be resolved to be fully optimal. Typically, deeper water sites, with higher energy density wave resource (e.g., Atlantic coast sites).

Wave technology presents in a diverse range of concepts, arguably driven by the mode(s) of motion being harnessed and the target wave resource energy density. The lack of convergence appears to concern some in the wind sector; however, the range of concepts also provides opportunity. Co-locating wave with fixed wind is likely to pose different technical issues and require different solutions to co-locating wave with floating wind. Some WEC concepts are likely to be better suited to fixed wind and some better suited to floating wind.

Could wave technology be considered from a general requirements perspective, i.e. what does a wave technology need to do to enable co-location with either fixed or floating wind, or minimise the risks associated with such co-location? Defining these requirements will require an understanding of the technical and operational challenges and could determine which existing wave technology solutions are attractive, or provide a basis of design for a compatible wave technology concept yet to be developed.

A regulatory landscape that facilitates co-location of offshore wind with other energy generating technologies (including wave) is also necessary.

Priorities

There is merit in running a set of longer and more focused discussion groups, each targeting a particular theme perhaps with a smaller group of participants, to tease out the details and underlying concerns behind the points raised.

- What needs to be considered to establish and strengthen the core economic argument for co-location, e.g.,
  - Can the time-value of energy opportunity be applied generally, i.e., to any location, or is it location specific?
  - What are the maintenance strategies that result in reduced maintenance costs?
- What are the practical aspects of co-location which require attention:
  - Compatibility of technology systems (devices).

  - Compatibility of technology sub-systems: cabling, anchoring, mooring.
  - Use of space requirements at the surface (access for installation, removal, maintenance operations, etc.) and at the seabed (mooring spreads, cable corridors, etc.)
- What are the barriers in consenting/permitting/connecting co-located developments? Gather learning from examples.
- Foster closer collaboration between relevant stakeholders: the offshore wind sector; the wave (ocean) sector; and policy makers.
  - an appropriate forum for the collaboration.

Proposed research & innovation topics

A desired outcome of the workshop was the definition of **research & Innovation topics** that could be tackled by both sectors working together and which could be the subject of calls for proposals in suitable programmes (e.g. Sustainable Blue Economy Partnership (SBEP), Clean Energy Transition Partnership (CETP), etc.). An initial set of topics is proposed:

- Quantifying the economic benefits of co-location of offshore wind and wave energy
- Solutions to permitting barriers for co-located offshore wind and wave projects
- Operation & maintenance: Solutions for optimising processes in co-located offshore wind and wave energy projects
- Cabling, anchoring & mooring: Solutions for cabling, anchoring and mooring systems in co-located offshore wind and wave energy projects

These topics will be refined further following the activities of the more focussed discussion groups.