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COOPERATION

Equitable Testing and Evaluation of Marine Energy Extraction Devices in terms of Performance, Cost and Environmental Impact

Grant agreement number: 213380

EquiMar

Deliverable D5.7
Assessment of the present status and future scenarios of the supply chain for marine energy arrays

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Assessment of the present status and future scenarios of the supply chain for marine energy arrays

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Summary

This report details the issues associated with the generation of a dedicated supply chain for wave and tidal energy arrays. Specific weak or break points are identified and experiences of related industries such as offshore wind energy are used by way of example to inform stakeholders of potential problems.

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1. INTRODUCTION

2. SUPPLY CHAIN AND INFRASTRUCTURE REQUIREMENTS FOR ARRAYS

4.1 PRESENT STATUS OF MARINE ENERGY SUPPLY CHAIN

The marine energy supply chain is at an embryonic stage. Dedicated suppliers are not yet abundant due to the relatively small scale of the industry but suppliers in related applications may have the capacity to modify their existing products/services to supply the marine energy sector.

Present experience of the marine energy supply chain is that some major components such as gearboxes, blades, hydraulic generators etc. that would eventually be mass-produced are currently being manufactured as custom (one-off) units. Costs are therefore high with full design, development and custom tooling/fabrication often required. This increases costs and lead times for prototypes, both of which are likely to be reduced for arrays. An approach most device developers are trying to use for as many of their components as possible is to use existing (off-the-shelf) components either in a similar application or modified in some way (e.g. existing gear box modified sealing and material to resist corrosion). Whilst an approach might not provide the optimal solution for a component it provides a cost-effective method to accumulate operational experience of a device as a whole before moving to precisely-specified components once the technology is clarified and the market sector looks more secure. Figure 1 demonstrates an appropriate scenario for the continual development of the marine energy supply chain.

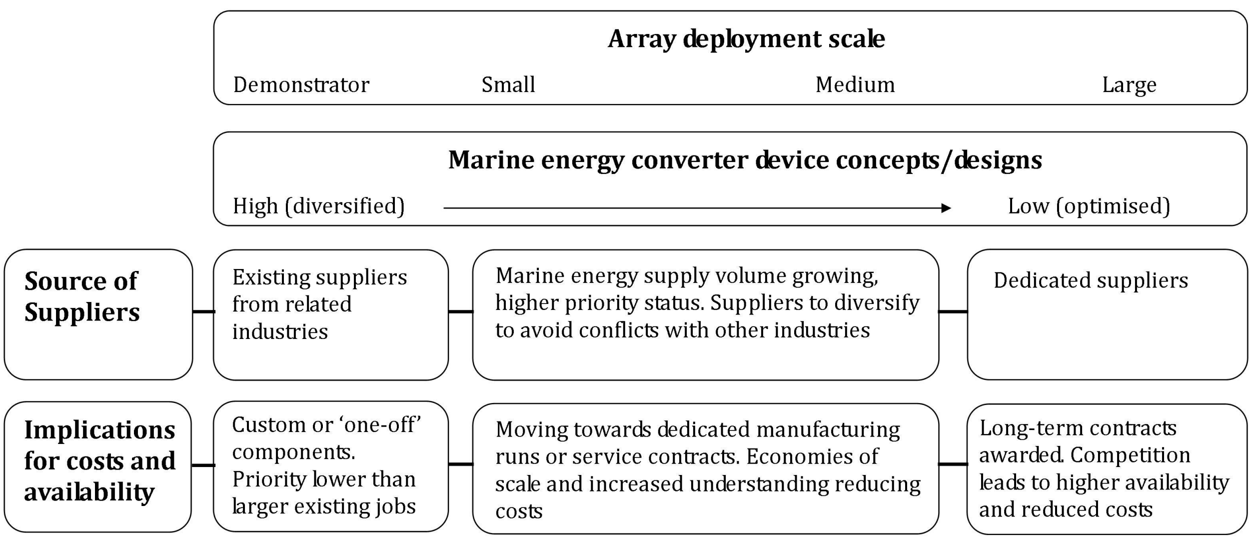

Figure 1 – Evolution of the marine energy supply chain

Aside from specific issues regarding technology components, planning etc. there are three further fundamental aspects that are hindering the marine energy supply chain – diversity of concepts, lack of standards and, above all, the small size of the sector at present.

The diversity of concepts has prevented (or at least complicated) the development of series built components as different devices (which are almost all at present one-off prototypes) have very different requirements, meaning that suppliers are required to perform full checks and design reviews on every component produced.

Lack of standards is also hindering the development of series built products as suppliers cannot always use off-the-shelf equipment which may satisfy existing standards from other industries.

The small size of the industry ensures that small manufacturing runs or supply contracts receive lower priority from suppliers. Suppliers are less inclined to provide services, preferring instead to remain with established higher-volume orders.

As the industry matures these three aspects will evolve; consequently volume can be expected to increase attracting more suppliers, competition and security of supply in a self-accelerating process.

In order for the marine energy industry to grow in a sustainable manner there must be a degree of trust between device developers and the supply chain. Stability and reliability are key issues here as both customers and suppliers aspiring to build relationships whereby good, services and payment are all exchanged in a manner expected by all parties.

As the marine energy industry evolves the technical performance of devices is expected to increase whilst the unit costs of devices (over a whole lifecycle) are expected to fall. Figure 2 illustrates the varying drivers through which cost reduction can be achieved.

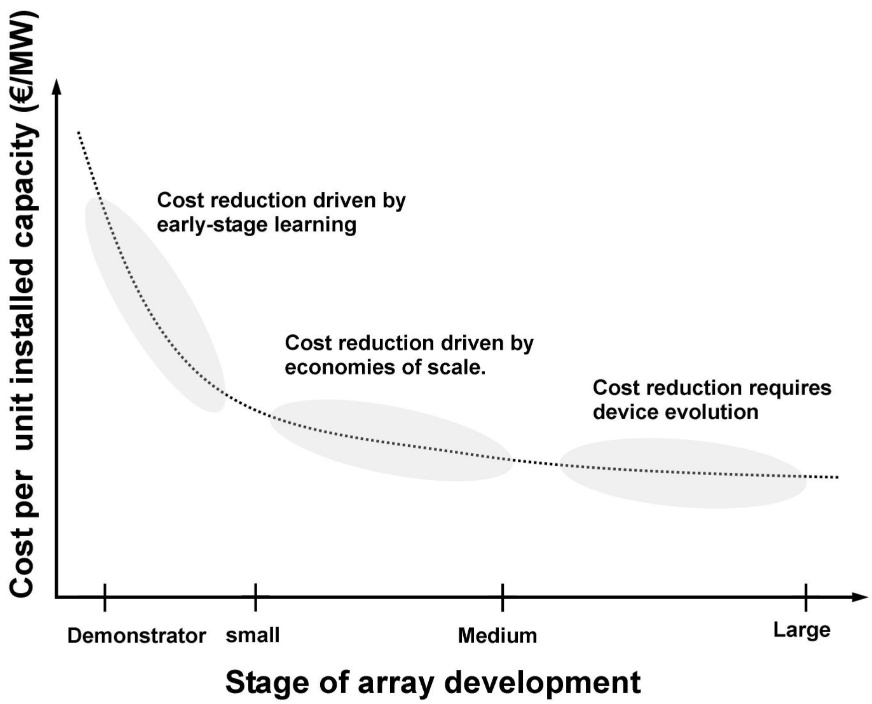

Figure 2 – Cost reduction for increasing deployment scales

4.2 SUPPLY CHAIN WEAKNESS

As the marine energy industry expands the supply chain may not grow at the same rate in order that marine energy deployment in arrays is conducted in the most efficient manner. For supply chain stakeholders there are 2 potential strategies: The first is to be in position to supply goods or services in advance of demand. If a supplier already has a production capability for the required components then there is likely to be minimal risk or delay in supplying at volume. The second route is to wait until demand for good/services is strong enough and move in to supply the industry. This late-mover approach will facilitate learning from any early-mover mistakes and potentially will enter a stronger and more stable industry.

Both routes involve an element of risk both for developers and suppliers and prompts the decision whether to be an early-mover supplier or a late-mover. The late-mover can learn from the negative experiences of others. The early-mover – assuming they are still in business – will have learnt from their mistakes, will have ideas for improvement and had the chance to build a relationship with the client. The client will be able to make an informed decision on whether the supplier is flexible and resourceful enough to be suitable partner in the onward development of a component whose evolution may well be critical.

The following sections detail specific areas of weakness. Issues such as timeliness, precedents and potential solutions are given in order to provide guidance for marine energy stakeholders.

4.2.1 Finance

As with any emerging industry financial support is required at the early stages in order to ensure that the low volume, high-cost products can mature into high-volume, low-cost industry. The technology developer must be able to claim with reason that cost reduction is feasible: in support of this they can point top-down examples such as the learning curves established in comparable energy industries, e.g. wind – but they should also be prepared to offer a bottom-up analysis of their own product to point to the key areas of cost reduction in order to substantiate the likelihood of a product that will ultimately be competitive in the energy market.

Also essential to this growth of the industry is the quality of the product, in this case the effectiveness of the marine energy devices in terms of it survivability in extreme conditions and performance in mean conditions.

Key constraints for marine energy converter development:

Device developers must prove technology is robust:

- By logging appropriate operational hours at sea trials (see IIB of protocol) and at subsequent array deployment scales
- Demonstrating reliability of all device subsystems (key to O&M actions for arrays)
- As the size of arrays increases reducing the cost of energy

Financial institutions that wish to invest in the industry will no doubt have their own definitions of 'operational hours' but it is likely to be heavily based upon power production and not simply having a device deployed at site. The risks must be both certain (accurately quantified) and below appropriate thresholds before private investment is made.

Governmental support is also vital for an emerging industry. Mechanisms and levels of support vary throughout Europe and the industry has already seen device developer's move towards regions with the most generous funding. Capital expenditure support is attractive for developers who face high costs with early low-volume products. Rewards-based support such as electricity generation subsidies are perhaps more attractive to the awarding funding body as only successful devices will be able to benefit thus de-risking the industry and promoting strength.

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4.2.2 Regulation and planning

Regulation might be a key bottleneck for the marine energy industry. IIC is not addressing marine spatial planning issues but stakeholders should acknowledge previous experience in related industries such as offshore wind energy. Regulation and planning requirements vary by country and sometime by region and this should be investigated as part of any pre-deployment action. Environmental issues are addressed in part IB of the protocol.

4.2.3 Land-based actions

Land-based action will include manufacturing, transport to the shoreline and onshore infrastructure. The following issues are considered in terms of disruption to the marine energy industry.

Issue:	Manufacturing
Specific restrictions:	Timeliness of supply, knowledge base for fabrication of unique components, conflicts with other industries
Timeliness:	Restrictions more likely for early arrays, approaching mass production.
Precedents:	Long lead times and gearing up for new supply typical for many fledgling industries
Solutions:	Device developers to place orders at earliest opportunity. Use of existing processes and components where practical. A successful industry at all stages will gain supplier confidence.

Issue:	Transport (to shoreline)
Specific restrictions:	Transit path from manufacturing point to shoreline egress. Transport of heavy or large parts of devices. Quantity of material required to transport.

Timeliness:	More applicable for large arrays where volumes are high.
Precedents:	Wind industry where longest blades cannot be easily transported by road network. Manufacturing relocated to waterside and boat transport.
Solutions:	As technology progresses relocation of key manufacturing closer to deployment site to minimise on-shore transport.

Issue:	Infrastructure at ports and harbours
Specific restrictions:	Space, conflict with other activities. Heavy lifting and transport equipment, dockside assembly, dry dock facilities.
Timeliness:	More applicable for large arrays where volumes are high.
Precedents:	European harbours (e.g. Hull, UK) expanding to accommodate large offshore wind manufacturing and deployment.
Solutions:	specific ports close to areas of high marine energy modified or created to prioritize marine energy device deployment. Modification could include expansion or reallocation of space for marine energy industry.

Issue:	Onshore electrical grid
Specific restrictions:	Capacity and distance from array location. Grid connection infrastructure, permission and cost for connection and time taken. Many aspects specific to individual countries.
Timeliness:	Applicable to all stages of arrays. Early arrays are small and might not be given priority. Later arrays might suffer from onshore grid strength.
Precedents:	Grid 'queues' have existed in most European at some time.
Solutions:	Strategic planning to be conducted involving electrical grid and marine energy stakeholders to identify bottlenecks and restrictions for deployment. Governments can often fast track or streamline certain regulatory issues to expedite array deployment.

4.2.4 Marine based actions

Issue:	Device Installation vessels
Specific restrictions:	Quantity, availability and functionality of existing vessels for deployment of marine energy converters. Existing industries (especially oil and gas) can afford to pay premium rates for vessel contracts. Vessels are often designed with these industries requirements not marine energy.
Timeliness:	Already an issue for devices at sea trial stage. Has the potential to delay deployment by several months which could be extended due to avoidance of winter deployment actions.
Precedents:	Tidal energy converter installation delayed and forced to use installation vessel with excess performance capacity.
Solutions:	Device developers to evolve devices to require less-specialist vessels or to develop their own vessels/components to expedite deployment. Aim to use the smallest, most numerous vessels in the largest sea states. Vessel construction takes time so supply side must be confident that marine energy industry will provide good investment in they expand their range of services. A high-level review strategy of existing deployments and predicted with possible conflicts/restrictions should be conducted with key stakeholders.

Issue:	Array site metocean quantification
Specific restrictions:	Time to gain consent for measurements, conflicts with other maritime stakeholders
Timeliness:	More applicable for large arrays where spatial and temporal resolution of measurement data is high.
Precedents:	No specific precedents. Consenting for offshore measurements in UK can take several weeks and is uncertain as many separate permissions are required.
Solutions:	Dependant upon country but not perceived to be a key bottleneck. Streamlining of application processes could be viewed as a positive step.

Issue:	Offshore electrical installation
Specific restrictions:	Cable laying in high currents (tidal), heavy sea states. Interconnection of devices within an array
Timeliness:	Technical issues likely to increase with scale of array deployment

Precedents:	Connection and cable delays with two recent wave energy projects
Solutions:	Strategic planning of projects, scheduling of cable laying actions to avoid conflict with other array actions and between related offshore industries.

Issue:	Operation and maintenance actions
Specific restrictions:	Vessel availability, suitability, metocean weather windows
Timeliness:	Maintenance frequency per device likely to be higher for demonstrator arrays. Potentially higher total maintenance load per array for large installations.
Precedents:	No specific but prototype open-sea tidal device could not be accessed over winter months.
Solutions:	Improved vessel designs to increase accessibility. Development of specialist vessels to best service arrays. Device design to minimise O&M actions and to more easily facilitate any potential O&M.

4.3 UPSCALING AND FUTURE MARINE ENERGY SUPPLY CHAIN

With the potential of many Gigawatts of power in the waters surrounding the EU a successful outcome would be an industry comparable to offshore wind in size, growing in a controlled and swift manner whilst learning from and not repeating the mistakes made by larger existing industries. The cost reduction per installed capacity and associated increase in knowledge will open up new markets for supply. These are likely to be outside the EU such as the Far East where costs associated with manufacturing are lower and factory production lines can be setup or modified at short notice. It is also worth remembering that there are other locations around the world with strong wave and tidal resource close to areas of high energy demand and these will require supply and service provision that could compete with EU-based industry. In the short term with demonstrator and small arrays it is not particularly likely that significant elements of the supply chain will be from outside the EU. However, as arrays increase in scale and the industry becomes increasingly global migration of certain elements is almost inevitable as has occurred with many other industries before marine energy.