C6534: SUPPORTING SERVICES TO THE OCEAN ENERGY FORUM

CONFERENCE REPORT: EDINBURGH, FEBRUARY 23-24 2016

Prepared by: Cefas

Produced for: The European Commission - DG MARE and EASME

Contents

1. Event Overview and Context

The fifth Open Session of the Ocean Energy Forum was held at Edinburgh International Conference Centre on 23rd-24th February 2016. A total of 143 people attended the plenary open session. A list of delegates is included at Appendix 1. The main purpose of the event was;

- to elicit input from the Forum and wider stakeholder interests on how the Forum's Strategic Roadmap Key Recommendations[1] can be taken forward (using draft implementation plan (proposal) documents prepared by the Steering Committee Chairs);
- to report on progress made in building the evidence base to support the Roadmap;
- to ensure that stakeholder input is captured and collated so that it can inform the next draft of the Roadmap;

In advance of the meeting, delegates were provided with the relevant session papers[2] for the draft implementation plans (proposals) discussion.

The purpose of this report is to provide a summary of the Edinburgh event, including headline outputs and next steps. This report will also be made available on the Forum website.

2. Event Structure

The Forum's event took place over two days and was co-located with the International Conference on Ocean Energy's (ICOE) 2016 conference[3], to allow maximum participation and attendance for stakeholders in the ocean energy sector.

The Forum's Programme (see Appendix 2) was developed and agreed with the Chairs of the Steering Committees, and was designed to make the best use of the time available, with a mix of plenary and group discussions. Care was taken to ensure that the event timetable integrated well with that of the ICOE event, organised and hosted by RenewableUK, which was taking place on the 23rd to 25th of February 2016 in the same venue.

With the exception of the opening plenary session in the morning of Day 1, which was given over to presentations, overviews and updates, the event was scheduled around a series of breakout sessions and discussions. These were designed to develop the implementation plans for each of the Key Recommendations of the Roadmap. Parallel workshops looked in detail at the work involved in developing and auditing the Roadmap's evidence base. Attendance at all of the breakout sessions was open and not restricted to Steering Committee affiliation.

The Key Recommendation breakout sessions were led by the Steering Committee Chairs with support, where applicable, from experts for a specific key recommendation. The University of Exeter led the evidence-base breakout sessions. Technical and administrative support was

[1] https://webgate.ec.europa.eu/maritimeforum/en/node/3819
[2] https://webgate.ec.europa.eu/maritimeforum/en/node/3894
[3] ICOE 2016 addresses current global marine industry challenges, enables successful sharing of good practice and encourages collaborative innovation - critical in supporting the industry to accelerate from concept to commercialisation. http://www.renewableuk.com/en/events/conferences-and-exhibitions/icoe-2016/index.cfm

provided by the Secretariat. Key notes and actions from the plenary and breakout sessions were produced (detailed notes from the breakout sessions can be found at Appendix 3).

3. Summary of Plenary Session of the Meeting

3.1. Welcome and introductions – Bernhard Friess and Stijn Billiet (DG MARE)

There is recognition of the amount of work delivered by the three work streams to get the Roadmap to this stage, with industry and the public sector coming together to offer solutions. Ocean energy is now on the map – but there is still some work to do. We are optimistic that the work of the Forum will be completed successfully. The main purpose of the next two days will be to address the challenges presented in the Roadmap via dedicated sessions based on the key recommendations. These recommendations will form the blueprint of business plans to move the sector forwards, so attendees are asked to focus on a concrete output. The Roadmap is looking to 2050 but the Commission welcomes thoughts on the priority timeline (e.g. now to 2030?).

The rest of the plenary session was chaired by Ronnie Quinn, Forum Finance Steering Committee Chair (The Crown Estate, Scotland).

3.2. Strategic Roadmap overview and update: Industry Perspective; Kieran O'Brien (Carnegie Wave Energy Ltd. and Ocean Energy Europe)

Outlined the need for the Strategic Roadmap – relevance of the ocean energy sector, to identify challenges and recognise different technologies and their stages of development; to identify tasks and timings, and the stakeholders to take these forward.

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Figure 1 Roadmap Key Recommendations & Commercialisation Phases (figure courtesy of Ocean Energy Europe)

Advised that a decade's work will be involved in realising all the commercialisation phases as set out in the Roadmap. Finance is a high risk and capital intensive. The recommendations for each phase (i.e. from R&D to industrial roll-out) are outlined in Figure 1 above.

The presentation concluded by giving an overview of what's next – feedback and critique of the key recommendations and plans today and tomorrow, finalise plans in Paris June 2016 and deliver a final Roadmap by October. Re-iterated that we must not lose sight of the prize – to ensure that in ten years' time Europe still has the leadership position in this industry.

3.3. Update on Roadmap consultation – Jon Rees (Cefas)

Reminded attendees of the current consultation[4] exercise, which is open until 29 February 2016. It is important that the Strategic Roadmap collectively reflects the ambitions of the sector but also that these ambitions are evidenced, realistic and achievable. As part of the further evidence-review process and refinement of the Roadmap document, the Forum Secretariat is seeking feedback on the Roadmap through a targeted consultation. Consultation responses and next steps / conclusions will be condensed into a small report.

3.4. Developing and auditing the Roadmap evidence base – Lars Johanning (University of Exeter)

The Forum structure and role of the University was outlined as per Figure 2 below. Linking in with the consultation exercise, the evidence-base work will ensure that relevant information (e.g. studies, projects, monitoring programmes) has been fully considered when finalising the Roadmap.

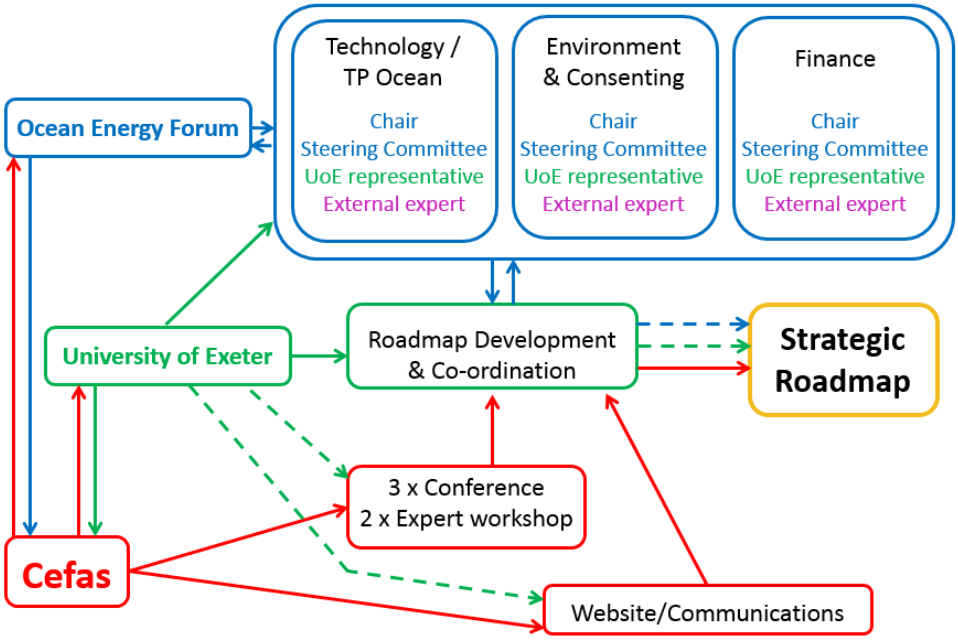


Figure 2: Ocean Energy Forum Structure

[4] https://webgate.ec.europa.eu/maritimeforum/en/node/3881

The evidence-gathering exercise looks both backwards on what has been done and forwards for what the Roadmap wants to achieve. The Roadmap is a set of key recommendations to policy makers so a good evidence framework is needed to ensure the recommendations can be taken forward with confidence.

The evidence-base work is considering:

- Levelised Cost of Energy of €100 per megawatt hour
- Representation of the Roadmap maturation phases instead of Technology Readiness Levels ensuring there is equivalence
- Proposed timeline for the development phase of ocean energy technology
- Private / public funding for the development phase
- Timeline for the key recommendations (2030) and the Roadmap ambitions (2050)
- Learnings from current and previous work – e.g. environmental monitoring

There will also be 3 separate workshops to provide detail on the evidence-base work done to date - structured to focus on the key topics of the Roadmap for Finance, Environment & Consenting and Technology - to provide an opportunity for stakeholders to comment and advise if any evidence gaps.

3.5. Overview of planned breakout sessions

Session 1; Draft Strategic Roadmap Key Recommendation 4.3 – Packaged Approach to Financing First Arrays

The Roadmap identifies demonstration projects as crucial to the sector's development and recommends that industry and EU Member States develop an approach to financing single demonstration/pre-commercial projects. It is proposed that a gap-funding model, proactively managed with a proposed budget of €250-300m, is used to lever private and other public sector funding. No minimum deal size, and the ability - where judged appropriate - to meet some or all of the reasonable deal costs (e.g. due diligence). Crucially, the Fund should be flexible enough to enable a variety of ocean energy projects to reach financial close.

The main objective is to deploy the first array and secondly to maximise leverage, supply chain development and collaboration. The scope is to demonstrate post-prototype demonstration farms. The session will address objectives' validation, determine scope, define budget, summarise the principles, discuss criteria for consideration/selection and consider where the funds could come from. A draft plan has been developed with further input welcomed.

Session 2; Draft Strategic Roadmap Key Recommendation 4.4 – Create an EU insurance fund to underwrite demonstration projects' risks

An insurance fund with a budget of €50-70m to underwrite demonstration projects is proposed. The main purpose of the fund is to de-risk the first arrays, and bridge the gap between device manufacturers and project developers. The scope is to realise post-prototype demonstration farms. The session will address which risks need to be covered, what financial exposure should be absorbed, what are the criteria for eligibility, how should the fund be structured / governed, due diligence for projects and level of risk sharing.

(Session 3, Developing the Roadmap Evidence Base, is previewed at 3.4 above)

Session 4; Draft Strategic Roadmap Key Recommendation 4.6 – De-Risking Environmental Consenting through an integrated programme of measures

Consenting of OE projects is complex with a high-risk risk of failure – new technologies come with potential unknown impacts and there is lack of knowledge and empirical data. In collaboration with the Secretariat, three scoping papers have been produced to outline potential projects that could help to resolve some of the key issues for environment and consenting:

- Project 1 - Minimise environmental monitoring costs (e.g. through sharing information – what and how?)
- Project 2 - Review best practice project consenting and promote efficiencies (e.g. through risk-based consenting);
- Project 3 - Produce EU advice on how to use strategic assessment techniques (e.g. to help steer developers with site selection?)**.**

The sessions will seek the views of the wider Steering Group / Forum on the scoping papers. In addition, two further projects are proposed:

- a socio-economics study to understand regional and local impacts and benefits
- development of a Demonstration Strategy to build generic data sets to produce project assessment methodology.

Finally, there will be an opportunity to hear from colleagues at the US Department of Energy on their approach to addressing the issues that they face.

Session 5; Draft Strategic Roadmap Key Recommendation 4.1 – An EU phase-gate technology process for components and devices

The session will consider the draft plan for R&D and prototypes. Phase-gating allows us to reduce risks and therefore the perception of risk with private investors. The first main action is to benchmark performance indicator testing - take existing industry standard indicators and build on them. Until these indicators are reached there will be no further funding for future phases. The session will develop a proposal to consider the structure, governance and funding needed with input welcomed on how to get to this stage.

Session 6; Draft Strategic Roadmap Key Recommendation 4.5 – Collaboration to reduce the costs and plan deployment

When development and costs were initially looked at it was not expected that costs would decrease in the short-term. To become viable, the machines must be proven to work. Co-operation, collaboration and standardisation is required if investors are to be attracted. Device standards are required and need to be appropriate/sufficient to use within the finance community. Co-operation, sharing best practice, vessels, understanding weather risks, and impacts will all help to make this work. Engagement with financiers and insurers is key and will ease access to public support. The Roadmap proposes creation of an industry working group to interact and increase knowledge and reduce financing risks. There is no draft paper on this yet so the session will be exploratory and input is strongly encouraged. Led by Tony Lewis, UCC.

Session 7; Draft Strategic Roadmap Key Recommendation 4.2 – Connect the most promising resource to the grid to enable first demonstration

Removing prohibitive grid costs, and thus lowering total capital costs, makes projects easier to finance. Capex is significant and cable connection is approx. 40% of project; could this be publicly financed and taken away from project costs? Simon Cheeseman of ORE Catapult will lead on the session. There is no draft paper on this yet so the session will be exploratory and input is strongly encouraged.

3.6. Committee of the Regions' perspective on the Strategic Roadmap

Mr Rhodri Glyn Thomas (UK/EA), Member of the ENVE Commission of the Committee of the Regions (CoR) and Member of the National Assembly for Wales commented on how the Roadmap is placed in the energy arena. The investment to date in the Ocean Energy sector, by EU Member States and in particular the Commission, was recognised. The Welsh Government has invested €100m in ocean energy (with progress in Wales – e.g. demonstration zones as well as turbines in the water in Pembrokeshire). A collective European investment could achieve so much. The CoR has also prepared an opinion on what could happen at state and sub-state level to ensure industry can move forward. There are opportunities to respond to the challenges ahead and to be at the forefront of the renewables industry – ocean energy is a reliable form of energy, forever to use. The negative aspect of the sector appears to be the costs, unless you have commitment and support through consent processes and monitoring (e.g. the Swansea lagoon project and other three projects in the pipeline won't go forward unless investment can be found).

3.7. Morning Session - Closing Comments

Mr Fergus Ewing MSP, Minister for Business, Energy & Tourism, welcomed all to Edinburgh and Scotland, citing Scotland's role as providing pioneering support to marine energy in Europe. Renewable energy has great potential, but is still a small proportion of the ocean energy mix. The journey from idea to commercial array is still ongoing. We must learn from previous experiences. He thanked the Commission for showing true leadership in its willingness to support the Ocean Energy Forum's Strategic Roadmap, helping to progress the journey, and wished all of those involved success in its delivery.

4. Summary of Outcomes from the Breakout Sessions

NB Breakout Session discussions are set out in more detail in Appendix 3.

Session 1 (Roadmap Key Recommendation 4.3);

Enable a packaged approach to finance for individual farms; a Gap Fund for first projects

Session Leads: Ronnie Quinn (The Crown Estate), Remi Gruet (Ocean Energy Europe)

Summary:

- Emphasise what makes this Fund different; highlight that Fund provides advice as well as funding (USP).
- Consider use /sharing of IP / know-how.
- Levering of private funding should be considered a primary objective.
- Be clear on where funding starts and stops but allow future flexibility; consider re-evolving the Fund.
- Must be pitched as infrastructure not technology Fund. Need to reference grid connection.
- Returns, acceptable levels of failure, risk profile, scoring system needs to be included. Portfolio approach to spread risk.
- First of a kind projects rather than ring-fencing. Be consistent with Roadmap timings for the different technologies. Estimate maximum projects ready for deployment.
- Understand level of private sector funding needed.

Session 2 (Roadmap Key Recommendation 4.4);

Create an EU insurance fund to underwrite demonstration projects' risks; design for a fund for first arrays

Session Leads: Remi Gruet (OEE), Michael Bullock (Renewable Risk Advisors Ltd)

Summary:

- Make deployment stage clearer in proposal
- Fund is covering gap – make this clearer
- Scope out alternative for decommissioning bond
- Check on OEM warranty limitations and State Aid issues
- Check if a Fund for prototypes is a solution for the Roadmap
- Integrate technology, decommission bonds and risk to revenue if possible
- Clarify model for what and when cover starts
- Consequential impact failure and Business Interruption is where the risk lies
- Due diligence – scope out risk matrix to show what is funded (including the current market and what this Fund aims to cover). Excludes weather risk. Understand maximum exposure by project (portfolio would spread risk).
- Avoid jargon; explain in basic terms for proposal

Session 3; Workshop on developing and auditing the Strategic Roadmap evidence-base

Generic open-door session, followed by three separate workshop sessions for the Forum's workstreams: Environment & Consenting, Finance and Technology.

Session 3a: Environment & Consenting Workshop

Session Lead: Dr Helen Smith, University of Exeter.

Summary:

Discussions and responses during the workshop demonstrated the high level of engagement of stakeholders involved in environment and consenting (E&C) with the aims and content of the Roadmap. For E&C, it is less a question of identifying 'gaps' in knowledge and evidence as ensuring that appropriate conclusions are drawn from previous and ongoing studies. A number of specific projects were discussed during the workshop but it will not be possible to reference all of these in the Roadmap. However, the learnings from these projects are key drivers of Roadmap's E&C key recommendations. Need to make reference to Annex IV 'State of the Science' report, which provides an up-to-date and comprehensive overview of the current state of knowledge on environmental interactions with ocean energy technologies. Must monitor outputs from, e.g. the RiCORE project, to inform recommendations on risk-based consenting. A final important point raised was the need to incorporate socio-economic aspects into the Roadmap to ensure that work is done to promote the benefits of marine renewables for local communities; this will be added as an additional recommendation under Environment and Consenting.

Session 3b: Finance Workshop

Session Lead: Dr Philipp Thies, University of Exeter

Summary:

The review of the investment levels, finance options and realised recent projects that reached financial close, led to the following conclusions:

- Present level of deployment pipeline is in the order of 100MW by 2020 (57 MW tidal, 26 MW wave).
- Ocean energy project long-term investment and short-term risk profile requires the need for public financial contributions / backing either in grant or in equity form until the risk profile of the technologies is improved.
- Projects with recent financial close suggest a CAPEX of £8.55million/MW (MeyGen, tidal) to €8.2million/MW (Wello, wave) with a developer share between 31% / 21%.
- The suggested Roadmap instruments that allow a packaged financial approach to deliver ocean energy arrays, as well as efforts to reduce the risk exposure of investing parties (e.g. through a shared insurance fund) would help to facilitate and increase technology deployments.

Session 3c: Technology Workshop

Session Lead: Professor Lars Johanning, University of Exeter

Summary:

Supply chain, operability and component issues are still a large barrier to priority activities identified for ocean energy technology development via existing work. It was felt that the ETI development targets for CAPEX, O&M and LCOE by 2050 were presently still very challenging, with a whole system to address MRE targets needed.

OEF Session 4a, 4b, 4c Roadmap Key Recommendation 4.6; De-risking Environmental Consenting through an Integrated Programme of Measures (Draft)

Session Lead: Phil Gilmour (Marine Scotland - Chair of Environment & Consenting Steering Group).

Three projects have been proposed to help take this key recommendation forwards:

1. Minimise environmental monitoring costs on initial developers
2. Review EU best practice project consenting
3. Produce advice on how to use strategic assessment techniques and marine spatial planning to aid developers

To these three projects, another two pieces of work are now added;

4. a socio-economics study to understand regional and local impacts and benefits
5. development of a Demonstration Strategy to build generic data sets to produce project assessment methodology.

Project 1 Summary: Agreed on approach for information sharing portals. Must look at existing databases EU-wide (including international) to avoid duplication - interoperability, harmonisation and standards. Not just about data, understand papers / information, proposed monitoring needed resulting in outcomes that directly accelerate sustainable developments. Make data available if socialised funding and make sure project provides the information that delivers reduced monitoring costs for developers – information on what is needed and the upfront costs.

Project 2 Summary: Agreed to produce EU method for risk-based consenting guidance for new technologies and seek DG ENV acceptance. Needs to be proportionate and needs to reduce costs and barriers to entry whilst maintaining environmental status. Include comparison with precautionary approach, consenting process and interpretation in other countries and sectors; include example timelines, mitigation and compensation, case studies. Benchmarks – standard approach, an understanding of costs and timelines for developers. Be clear on who the guidance is for, what it aims to achieve and what is needed and what is not needed.

Project 3 Summary: Understand consenting process in other countries and sectors re Directives, and adapt guidance for the EU. Use existing work and example projects to outline the difficulties and sensitivities in the process. Project needs to capture level of detail and types of

data needed and strategic data made available so that it flows down to project level and available to everyone involved in the process. Consider audience - needs to aid developers.

Project 4 Summary: Agreed socio-economic opportunities should be included in Roadmap. A paper will be provided by the Secretariat and put to the Commission.

Project 5 Summary: Chair to produce a paper with recommendations and circulate to members for comments. Marine Scotland Licence Operations Team (LOT) can put in place a set of Standard Operating Policies (SOPs) and then a strategy.

OEF Session 4d; US regulatory process and analyses thereof, plus international standards beyond EU frameworks

Presented by: Samantha Eaves (US Department of Energy)

Summary:

- Various agencies involved depending on type, location and grid connection; no one-stop-shop
- Different authorisations that a project can obtain
- Have used experiences of environmental monitoring to devise Departmental strategy and reduce environmental costs
- Focus is on data collection, data sharing and improving environmental monitoring techniques

OEF Session 5 (Roadmap Key Recommendation 4.1); Establish a Europe-wide phase-gate procedure

Session Leads: Fiona Buckley (ENGIE) & Jacopo Moccia, Ocean Energy Europe (Chair and Secretary General of Technology Steering Committee)

Summary:

- Phase-gate process is not replacing existing R&D funding
- Make clear prototypes included and process starts at sub-system level
- Positive language – clear benefits – e.g. IP / know-how and long-term reduction in cost of energy; lessons learned from previous and how this is different; manage expectations (include risks and benefits section in plan)
- Need to develop a path to determine gates and pass mark
- Certain tests in water expected
- Element of flexibility (e.g. to enable gates to be accessed)
- Collaborative element should be included to reduce future uncertainties as well as a feedback mechanism to adjust future funding calls
- Amend Industry Advisory Group to Finance Advisory Board
- Timings 2017-2025, aligned with Roadmap

OEF Session 6 (Roadmap Key Recommendation 4.5); Collaboration to reduce costs and plan deployment

Chaired by: Tony Lewis (University College Cork), with representatives from relevant projects.

Summary:

- From the draft Roadmap, people liked the idea of sharing experience and data
- Denmark has good transparency examples
- WES further work on teasing out benchmarks
- TETHYS[5] environmental monitoring database Annex IV - US Department of Energy is a good example of a central repository *(already noted in Session 4 discussions)*
- Costs come down at industrial roll-out – industry players need to come together and there needs to be closer working with the banks and insurance sectors
- Sometimes good for a developer to maintain flexibility even if you have to pay for it
- Collaboration needs to help ensure the sector doesn't keep asking for "the same" especially from public money; public money cannot fund the same things
- Industry will collaborate if the cost and opportunity is high enough
- How do we ensure collaboration is linked across the Roadmap as a whole?

Session 7 (Roadmap Key Recommendation 4.2); Connecting the most promising resource to the grid to enable first demonstration farms

Chaired by: Simon Cheeseman, ORE Catapult (Wave & Tidal Sector Specialist)

Summary:

The meeting felt that there was merit in publicly funded demonstration zones though there is a need to define arrangements – e.g. funding, leasing, revenue, local supply chain and to define technology assessment requirements - as well as understand learnings from existing sites.

They would be very attractive to technology developers, but would need to be carefully laid out with flexible lease arrangements to act as a credible interim stepping stone for project developers. Grid access, revenue generating capability, port access and local supply chain are all essential.

Providing a level of infrastructure that is flexible to suit a range of developers' technology will be challenging and some compromise may be required. Learning generic lessons from existing test sites and early stage demonstration sites through a workshop would be very beneficial.

Shaping and aligning public calls to enable creation and population of demonstration sites will be necessary. Assessing technology to ensure it is sufficiently mature to deploy to a demonstration site will prevent berth blocking. ORE Catapult is prepared to support further work to define publicly funded demonstration zones and define technology assessment requirements.

[5] http://tethys.pnnl.gov/

5. Next Steps

The process for the final Strategic Roadmap production will continue in accordance with steps previously agreed with DG MARE and the Steering Committee Chairs. The key details following the Edinburgh event are as follows (see also Appendix 4);

- From March to May 2016, Key Recommendation implementation plans will be refined and completed using feedback from Edinburgh;
- By May 31 2016 - first draft critique of the evidence-base behind the Roadmap to be presented to DG MARE;
- 22 June 2016, Paris - meeting at which the final draft implementation plans (proposals) and the evidence-base findings will be presented and signed-off. Final updates and any further worked needed will be agreed;
- By 31July 31 2016 - all proposals and evidence-base work complete;
- By 30 September 2016 - draft final Roadmap by Cefas to DG MARE;
- 08 November 2016 (tbc); formal final presentation of Strategic Roadmap at open session in Brussels.

Appendix 1; List of Delegates attending

The following is a combined list of attendees bringing together details of attendees for all Forum sessions (plenary and breakout). Delegate numbers for each breakout session ranged from 10 to 25 per session.

Name	Organisation
Adrian De Andres	University of Edinburgh
Alan Owen	Robert Gordon University
Alex Gauntt	Siem Offshore Contractors UK Ltd
Alexandra Price	Wave Conundrums Consulting
Alicia Martinez	University of Strathclyde
Alison LaBonte	U.S. Dept. of Energy
Ana Novak Zdravkovic	ENGIE
Andrea Copping	Pacific Northwest National Laboratory
Andrew Smith	Scottish Investment Bank
Andronikos Kafas	Marine Scotland
Anne Marie O'Hagan	MaREI-UCC
Ben Kennedy	Wave Venture Ltd
Benat Sanz	APPA
Bill Russell	Wave Hub Limited
Bill Staby	Resolute Marine Energy
Brendan Cahill	Sustainable Energy Authority of Ireland
Bruce Cameron	NS Department of Energy
Caitriona Nic Aonghusa	Marine Institute
Callum Kenny	AlbaTERN Ltd
Carol Sparling	SMRU Consulting
Caroline Whybrow	Ocean Energy Forum Secretariat, Cefas
Chris Williams	Tidal Energy Ltd
Christiaan Roland Holst	B2BSure BV
Christoph Harwood	Sustainable Marine Energy
Claudio Bitterncourt Ferreira	DNV GL
Clemency Ives	Sustainable Marine Energy
Clodagh McGrath	DP Energy
Conchur O'Bradaigh	University of Edinburgh
Conor Haughey	Blue Power Evena
Corman Booth	SMRU Consulting
David Bould	University of Edinburgh

David Collier	MEYGEN
David Jones	Marine Energy Pembrokeshire
David Pratt	Marine Scotland
Diane Dhomé	SABELLA
Donald Naylor	Pelagic Innovation
Dong Hyun Lez	KIMM
Douglas Watson	The Crown Estate
Dujon Goncalves-Collins	Renewable UK
Duncan Gordon	JLT Specialty
Duncan Mather	Oceaness Ltd
Eamonn Confrey	Department of Energy, Ireland
Eduardo Quevedo	PLOCAN
Eliott Moreau	University of Strathclyde
Elva Bannon	Wave Energy Scotland
Eugene Nixon	Marine Institute
Fiona Buckley	ENGIE
Frank Fortune	Royal Haskoning DHV
Frank Neumann	IMIEU
Gareth Davies	Aquatera Ltd
Gemma Veneruso	Bangor University
George Mosomi	Aquatera Ltd
Gerry Sutton	UCC - MAREI
Giacomo Politi	Scuola Superiore Sant'Anna
Gordon Edge	BWEA
Greg Decker	Nova Scotia Department of Energy
Guillaume Coing-Roy	ERDF
Hans van Breugel	TOCARDO
Helen Smith	University of Exeter
Henry Jeffrey	University of Edinburgh
Ian Hutchison	Aquatera Ltd
Ines Machado	WaveEC Offshore Renewables
Isidro Garcia	Government of Canada
Jacopo Moccia	Ocean Energy Europe
Jan Erik Hanssen	1-Tech s.p.r.l.
Janine Kellet	Scottish Government
Javier Gonzalez	PLOCAN
Jochem Weber	National Renewable Energy Laboratory
Joe Hulm	Ocean Energy Advisors Ltd.

John Huckerby	Power Projects Ltd
John McCarthy	Ocean Energy
Johnny Gowdy	Regen SW
Jon Rees	Cefas
Jonathan Hodges	Wave Energy Scotland / Energy Technology Partnership
Jose Luis Villate	TECNALIA
Joseph Kidd	MarineSpace
Judith Hamilton	Aquatera Ltd
Karen Conroy	Enterprise Ireland
Karen Fraser	Scottish Enterprise
Kate Ng	North China University of water resources and electric power
Kate Smith	Natural Resource Wales
Kathryn Elliott	IDCORE – Black & Veatch
Keith O'Sullivan	Black & Veatch Ltd
Kelly Baker	Ocean Energy Forum Secretariat, Cefas
Keri Collins	Plymouth University
Kevin O'Farrell	Blue Power Evena
Kieran O'Brien	Carnegie Wave Energy
Lars Johanning	University of Exeter
Leuserina Garniati	Robert Gordon University
Lindsay Roberts	Scottish Renewables
Loic Piriou	SABELLA
Lucy Greenhill	SAMS
Luisa Wic	University of Seville
Marcus Kempe	SP Technical Research Institute of Sweden
Maria Sacristan	ICEX
Marimar Villagarcia	PLOCAN
Martin Murphy	Tidal Energy Ltd
Matthieu Blandin	NEOPOLIA (Valorem)
Max Carcas	Caelulum Ltd
Michael Abundo	Ocean Pixel Pte Ltd
Michael Bullock	Renewable Risk Advisers
Mike Crosby	Red Marine Ltd
Natalie Tiggelman	FUJIFILM Manufacturing Europe B.V.
Nichole Sather	Pacific Northwest National Laboratory
Nicki Hawkes	Ocean Energy Forum Secretariat, Cefas
Nicolas Wallet	Ocean Energy Europe
Owain Roberts	University of Edinburgh

Pablo Ruiz-Minguela	TECNALIA
Patsy Falconer	Ocean Energy Forum Secretariat, Cefas
Paul Mitchel	Offshore Renewables Institute
Paul O'Brien	Scottish Development International
Peter Coyle	Marine Renewables Industry Association
Phil Gilmour	Marine Scotland
Philipp Thies	University of Exeter
Pierre Ingmarsson	SP Technical Research Institute of Sweden
Ralf Starzmann	Schottel Hydro
Raphael Vambre	Pole Mer Bretagne Atlantique
Ray Hunter	ORE Catapult
Reenst Lesemann	Columbia Power Technologies, Inc.
Remi Gruet	Ocean Energy Europe
Rhodri Glyn Thomas	Welsh Assembly Government
Richard Linley	Oceanlinx UK Ltd
Richard Parkinson	Mojo Maritime Ltd
Rob Flynn	Ocean Energy Europe
Robert Cawley	UKTI
Ronan Costello	Wave Venture
Ronnie Quinn	The Crown Estate
Samantha Eaves	U.S. Dept. of Energy
Sarah Carter	Ocean Energy Forum Secretariat, Cefas
Siard Keyser	TOCARDO
Simon Cheeseman	ORE Catapult
Stephen Salter	University of Edinburgh
Steven Jermy	Mojo Maritime Ltd
Stijn Billiet	European Commission
Teresa Simas	WavEC Offshore Renewables
Timothy Whitton	SEACAMS
Tom Walsh	Atlantis Resources Ltd
Tony Lewis	University College Cork
Vidina Monagas	PLOCAN
William Dick	Trinity College Dublin Civil Engineering
William Lloyd	Renewable Risk Advisers
Young Cheol Kim	KIMM
Yung Xing Hao	North China University of Water Resources and Electric Power

Appendix 2; Conference Programme

DAY 1 – TUESDAY 23 FEBRUARY 2016

Time/ Location	Ocean Energy Forum Content	Presenter
08:45 - 09:30 Atrium	**Registration & Networking**	
09:30 – 09:45 Sidlaw Room Level 3	**Welcome & Introductions**	Stijn Billiet, DG Mare
09:45 – 10:00 Sidlaw Room Level 3	**Strategic Roadmap overview and update – industry perspective** • Where we are and how we got here • Where we want to be by October 2016	Kieran O'Brien, Carnegie Wave Energy
10:00 – 10:15 Sidlaw Room Level 3	**Update on further Roadmap consultation** (launched January 2016)	Jon Rees, Cefas
10:15 – 10:30 Sidlaw Room Level 3	**Developing and auditing the Roadmap evidence-base** With a focus on evidence (e.g. data reports, literature) to support the aims and ambitions of the Strategic Roadmap	Lars Johanning, University of Exeter
10:30 – 10:50	**Coffee Break**	
10:50 – 11:30 Sidlaw Room Level 3	**Forum Chairs' overview of event breakout sessions - plans to progress the Roadmap key recommendations will be outlined** • Enable a packaged approach to finance for individual farms *(Key Recommendation 4.3)* • Create an EU insurance fund to underwrite demonstration projects' risks *(Key Recommendation 4.4)* • Ocean Energy Development within the context of Maritime Spatial Planning *(Key Recommendation 4.6)* • Learning the lessons on environmental monitoring of ocean energy devices *(Key Recommendation 4.6)* • Guidelines on the implementation of environmental regulations on ocean energy devices *(Key Recommendation 4.6)* • A European phase-gate technology development process for components and devices *(Key Recommendation 4.1)* • Collaboration to reduce costs and plan deployment *(Key Recommendation 4.5)* • Connect the most promising resource to the grid to enable first demonstration farms *(Key Recommendation 4.2)*	Ocean Energy Forum Steering Committee Chairs
11:30 – 11:45 Sidlaw Room Level 3	**Committee of the Regions' perspective on the Strategic Roadmap** "How both Member States and Regions can maximise infrastructure funding for future projects / programmes thus helping ensure economic and social viability" Mr Rhodri Glyn Thomas (UK/EA), Member of the ENVE Commission of the Committee of the Regions (CoR) and Member of the National Assembly for Wales will outline how the Roadmap is placed in the energy arena.	
11:45 – 12:00 Sidlaw Room Level 3	**Closing Comments** from DG MARE and Fergus Ewing MSP, Minister for Business, Energy & Tourism	
12:00 – 12:45 Level -1	**Lunch**	
12:45 – 14:15	**Ocean Energy Forum Networking Session**	

ICOE Welcome, Keynote & A1	
14:15 – 14:45 **Level -1** ICOE P1	**Coffee Break**
14:45 – 16:30 **Menteith Room** **Level -1** ICOE A2 & B2	**OEF Session 1** (Roadmap Key Recommendation 4.3) **Enable a packaged approach to finance for individual farms** (Demonstration and Pre-Commercial) Ocean energy projects are innovative. Uncertainties in installation times or total electricity production mean that a significant level of financial risk remains, preventing access to debt from commercial banks. In Edinburgh, we will discuss proposal options for a model for combining different sources of funding into a single project. Chaired by: Ronnie Quinn (The Crown Estate), Remi Gruet (Ocean Energy Europe), Andrew Smith (Scottish Investment Bank)
16:30 ICOE P2, A3 & B3	**Finish**

DAY 2 – WEDNESDAY 24 FEBRUARY 2016

Time/ Location	Ocean Energy Forum Content	Time/ Location	Ocean Energy Forum Content
08:30 – 09:00 **Level -1**	**Arrival Coffee**		
09:00 – 10:30 **Lowther Room** **Level -1** ICOE A4	**OEF Session 2** (Roadmap Key Recommendation 4.4) **Create and EU insurance fund to underwrite demonstration projects' risks** Lack of empirical experience and deployment data results in uncertainties about ocean energy projects' operation and production. This means that ocean energies bear a higher technological and financial risk compared to more mature energy technologies. In Edinburgh, we will discuss the proposal for a new risk-sharing fund including guidelines on how to establish such a fund. Chaired by: Remi Gruet (Ocean Energy Europe), Michael Bullock (Renewable Risk Advisors Ltd)	**09:00 – 09:45** **Menteith Room** **Level -1** ICOE A4	**OEF Session 3** **Workshop on developing and auditing the Strategic Roadmap evidence-base** Generic open-door session prior to 3 separate workshop sessions for the Forum's workstreams: Environment & Consenting, Finance and Technology. Findings of initial evidence gathering and conclusions to support the aims and the ambitions of the Strategic Roadmap will be presented; with further discussion to allow stakeholders the opportunity to identify any outstanding gaps and suggest additional relevant literature. Presented by: Lars Johanning, Helen Smith, Philipp Thies, University Of Exeter
		09:45 – 10:30 **Menteith Room** **Level -1** ICOE A4	**OEF Session 3a Roadmap evidence-base** **Environment & Consenting Workshop**
10:30 – 11:30	**Grab & go coffee available**		
10:30 – 11:15 **Lowther Room** **Level -1** ICOE A5 & B5	**OEF Session 4a** (Roadmap Key Recommendation 4.6) **Ocean energy development within the context of Maritime Spatial Planning** Regulators, and consequently developers, need advice on how devices can be deployed. In Edinburgh, we will develop a proposal to better facilitate sustainable new ocean energy arrays to reduce risks of failed applications, exploring the interaction	**10:30 – 11:15** **Menteith Room** **Level -1** ICOE A5 & B5	**OEF Session 3b Roadmap evidence-base** **Developing and auditing the Strategic Roadmap evidence-base** **Finance Workshop**

	between existing environmental regulations on national and international levels and EU Directives. Chaired by: Phil Gilmour & David Pratt (Marine Scotland)		
11:15 – 12:00 **Lowther Room** **Level -1** ICOE P3	**OEF Session 4b** (Roadmap Key Recommendation 4.6) **Learning the lessons on environmental monitoring of ocean energy devices** Often environmental licences have associated monitoring conditions. In Edinburgh, we will develop a proposal to consider the best approaches to apply strategic monitoring at the regional scale, to enable regulators to recognise the sensitivity of the area to be developed, and the potential impact risks faced. Chaired by: Phil Gilmour & David Pratt (Marine Scotland)	**11:15 – 12:00** **Menteith Room** **Level -1** ICOE P3	**OEF Session 3c Roadmap evidence-base** **Developing and auditing the Strategic Roadmap evidence-base** **Technology Workshop**
12:00 – 12:45 **Lowther Room** **Level -1** ICOE A6, B6, C6	**OEF Session 4c** (Roadmap Key Recommendation 4.6) **Guidelines on the implementation of environmental regulations on ocean energy devices** Developers can be faced with multiple environmental regulations with ever-increasing evidence thresholds in order to gain consents/licence(s). In Edinburgh, we will develop a proposal on how to identify best European practice and develop a set of high-level guidelines that the European Commission, Member States and European Regions could use to improve regulatory processes. Chaired by: Phil Gilmour & David Pratt (Marine Scotland)	**12:00 – 13:30** **Menteith Room** **Level -1** ICOE A6, B6, C6	**OEF Session 5** (Roadmap Key Recommendation 4.1) **A European phase-gate technology development process for components and devices** To reduce the risk of significant device failures in the demonstration phase, device sub-systems and components should be tested and effectively validated prior to use on full-scale devices. In Edinburgh, we will discuss a proposal for a guide for creation of a new co-operative R&D funding instrument. Chaired by: Fiona Buckley (ENGIE) & Jacopo Moccia (Ocean Energy Europe)
12:45 – 13:30 **Lowther Room** **Level -1** ICOE A6, B6, C6	**OEF Session 4d** **US regulatory process and analyses thereof plus international standards beyond EU frameworks** Short presentation and discussion on international efforts to standardise consenting frameworks. Presented by: Samantha Eaves (US Department of Energy)		
13:30 – 14:45 ICOE P4	**Lunch**		
		14:45 – 16:00 **Menteith Room** **Level -1** ICOE A7, B7, C7	**OEF Session 6** (Roadmap Key Reccomendation 4.5) **Collaboration to reduce costs and plan deployment** Industrial roll-out enables a shift from investment support to revenue support. In Edinburgh, we will discuss options to derive a contract structure model (risk

			options, strategies, best practice codes etc.) and how to develop new mechanisms for co-operation between the ocean energy and banking sectors. Chaired by: Tony Lewis (University College Cork) including representatives from relevant projects.
16:00 – 16:30 ICOE P5	**Break**		
		16:30 – 17:30 **Menteith Room** **Level -1** ICOE A8, B8	**OEF Session 7** (Roadmap Key Reccomendation 4.2) **Connect the most promising resource to the grid to enable first demonstration farms** Removing prohibitive grid costs and thus lowering total capital costs of projects makes them easier to finance. In Edinburgh, we will discuss: 1 Existing sites - lessons learned and recommendations; 2 MW of grid connection needed for wave and tidal; 3 Used/needed support mechanisms to facilitate installation and grid investment and streamlining funding. Chaired by: Simon Cheeseman (ORE Catapult) including representatives from DCNS, Sabella and EDF Energy.
17:30	**End of OEF Event**		

Appendix 3; Notes from the Breakout Sessions

OEF Session 1 (Roadmap Key Recommendation 4.3);

Enable a packaged approach to finance for individual farms; a Gap Fund for first projects

Session Lead: Ronnie Quinn (The Crown Estate), Remi Gruet (Ocean Energy Europe)

Context:

Ocean Energy projects are innovative. Uncertainties in installation times and in total electricity production mean that a significant level of financial risk remains, preventing access to debt from commercial banks. The OEF draft Strategic Roadmap (October 2015) identifies demonstration projects as crucial to the sector's development and recommends that industry and EU Member States develop an approach to financing single demonstration/pre-commercial projects.

A proposal has been developed, detailing model options to combine different sources of funding into a single project (fund). The proposal is based around the Renewable Energy Investment Fund (REIF)[6] / European Investment Bank (EIB) InnovFin[7] model, a gap funder aiming to lever private and other public sector funding. Delivered by a team with direct experience of the Ocean Energy sector with an announced fund of about €300m and no minimum bid size, and the ability - where judged appropriate - to meet some or all of the reasonable deal costs (e.g. due diligence). Crucially, the Fund should be flexible enough to enable a variety of ocean energy projects to reach financial close and follow guidance objectives rather than rigid processes and threshold-based criteria. This Key Recommendation is seen as a priority by the Finance work stream. The original idea was looking at the "MeyGen project model" but this was deemed not to be a feasible approach. The main intentions of the Fund are:

- Deploy first ocean energy demonstration projects to kick-start the sector
- Bring sector closer to commercial financing
- Accelerate and secure growth of the sector (carbon reductions, security for EU energy generation mix)

This session looks at objectives, scope, principles (to allow developer to access the Fund), structure and criteria.

General Discussion, Objectives and Clarifications:

- What is the origin of the money that funds this recommendation? This still needs to be addressed but potential funding sources are mentioned in the Roadmap draft (Member States, Structural Funds, European Fund for Strategic Investments (EFSI)). This will be public money with additional private money. If we do not encourage private sector investment, then it could appear that this a purely public funded initiative.
- It is not just about supplying money but also about providing advice and direction.

[6] http://www.scottish-enterprise.com/services/attract-investment/renewable-energy-investment-fund/overview
[7] http://www.eib.org/products/blending/innovfin/

- The question is how big is the gap – we do not want to underuse funds so we should be specific and precise about our needs. EIB funding for project cost is 15-20% (this Fund has no minimum).
- Will it be a condition of funding that IP becomes more available? It isn't currently but, it could be considered. Offshore "know how" should be shared.
- Should maximising the leverage be upped into a primary objective as we are trying to incentivise private funding?
- At what point does funding start and where does it stop? Starts at first arrays but this point needs refining. The end point will be when the Fund is just advising and not using its own money. Leave the door open to a further fund for future phases – would that work? We could "re-evolve / commercialise" the Fund. If you could structure funding that extends wider than first arrays, then costs would be saved and investors could be lined up and ready to be moved along the different phases of deployment.
- We need to ensure we are not re-inventing the wheel. What differentiates this Fund from others? Look at the first projects the EIB invested in and how Ocean Energy Compares. The "advice-factor" is also a USP. Must be pitched as an infrastructure fund and not a technology fund. If we can't mitigate risks, then we'll only ever get venture capital investors, which won't sustain the level of funding we require. Stating that wider innovations could be funded in the future might encourage investment. We should not worry about, e.g. potential EIB encroachment – we could work in parallel or merge.
- Need a Fund manager capable of making demonstration assessments.
- Due diligence should be done for the project once and not at each deployment phase.
- Is Fund able to take a bigger risk or make less of a return? Lower return could be a principle; higher risk could be a criterion.
- Fund could be debt or equity but we need to move away from grant. Return could be linked to interest rates (5% above) to include a market element.
- Incentives are based on the success of a project – an acceptable level of failure must be factored in to the risk-profile.

Scope:

- **Geographic scope**. Whilst it may encourage reciprocity, justification to deploy outside of Europe will be questionable for EU initiative.
- **Project level.** Which projects can be funded? E.g. A "MeyGen 2" but not "MeyGen" 1 as this is already funded; until commercial funding is reached. A consideration to future funding should be in place upfront (e.g. declining funding as sector evolves). A scoring system should be in place to identify best use of funding. E.g. 2nd phase of project might be a lower risk. Using a portfolio approach with a geographical or technological spread reduces the risk. Keep flexible.
- **What size should the fund be?** Consistency is needed here – how would we size the fund? Focus on the combination of MWs and technologies to get there. Propose €1m for every MW installed (Roadmap proposes connect to at least 300MW). Project risk and technology risk need to be considered (no artificial budgeting) as well as budget cycles and budget reviews (i.e. at EU level). Funding packages should be designed to meet the project pipeline, not the other way round.
    - Do we ring-fence certain technologies? Should be first of a kind or whatever technology comes first. One technology shouldn't dominate at the expense of others (should be part of the criteria at least – e.g. is this unique, been funded before?). If we only focus on tidal stream for example, then some countries in the south Atlantic will

feel left out and this will not aid cohesive EU collaborations. Four sets of technologies and with different timelines associated (the framework will determine the timeline) – we need to be consistent with the Roadmap.

    - This is gap funding not whole project (100%) funding. Nor is it matched funding; it is to lever additional private funding.
- **How many projects will be financed?** Sensible judgements – this will be defined in the criteria but total budget envelope should be the deciding factor. Public officials will have control but have input from industry. Shouldn't we make an estimate of maximum projects ready for deployment within the next 5 years? Prototype will have been set up and working and a project will have already had development to be in a position to require this funding so you could look at the history of the project to make an informed judgement on whether to fund. Be careful on how we split the funding as we could potentially use it all on one large project – build this into the concept.

Principles:

- Fund should be reviewed every 5 years.
- Funding approach – differentiate the risk.
- De-couple risk from the rate of return – private sector funding incentivised by gap fund.
- Understand distance to financial close.
- Private funding needed – Horizon 2020 gives a marker and we need to be the other side of that.
- Adhere to Technology Readiness Levels (TRLs).

Structure and decision process:

- Could tender for an advisory board in the same way as a Secretariat. Make use of existing expertise (EIB, REIF and industry experience).
- A host rather than set up as own institution. Keep an open mind – keep the architecture light until we know how things will run. Less prescription until things start to evolve.

Criteria for project selection:

- Separate criteria could be used for having a look at projects (advice) initially and then those that we to fund.

Summary:

- Emphasise what makes this Fund different; highlight that Fund provides advice as well as funding (USP).
- Consider use /sharing of IP / know-how.
- Levering of private funding should be considered a primary objective.
- Be clear on where funding starts and stops but allow future flexibility; consider re-evolving the Fund.
- Must be pitched as infrastructure not technology Fund. Need to reference grid connection.
- Returns, acceptable levels of failure, risk profile, scoring system needs to be included. Portfolio approach to spread risk.
- First of a kind projects rather than ring-fencing. Be consistent with Roadmap timings for the different technologies. Estimate maximum projects ready for deployment.
- Understand level of private sector funding needed.

OEF Session 2 (Roadmap Key Recommendation 4.4);

Create an EU insurance fund to underwrite demonstration projects' risks; design for a fund for first arrays

Session Leads: Remi Gruet (Ocean Energy Europe), Michael Bullock (Renewable Risk Advisors Ltd)

Context:

Lack of empirical experience and deployment data results in uncertainties about ocean energy projects' operation and production. This means that ocean energies bear a higher technological and financial risk compared to more mature energy technologies. A paper for a new risk-sharing Fund has been prepared, including guidelines on how to establish such a Fund – i.e. set-up, operational criteria and which private and public stakeholders would be required to participate.
The Fund, as per Key recommendation 4.3 of the OEF's *draft* Strategic Roadmap (October 2015) is envisaged to underwrite risks and fill the gaps in insurance and OEM warranty structures so as to make marine energy demonstration arrays more "investable". A presentation (October 2015) as part of a working group in Brussels, including representatives from DG Mare and the European Investment Bank (EIB), was organised, with positive initial feedback.
The main objective of the Fund is to take on the part of risk that an OEM would not guarantee and device developer could not take on. Short term demonstration stage – what the financers and project market would support.

General Discussion, Objectives and Clarifications:

The discussion was mainly focussed around specific questions in the paper – these have been noted where relevant.

- At what stage of deployment are you looking to insure? Same as the Key Recommendation for a Gap Fund, targeted at demonstration phase/first pilot/array. Will be made clearer in the scope.
- When would debt be raised as part of the project? Small amount of capital needed. The structure is trying to be sufficient to encourage commercial capital (lever private funds). Initial fund can be recycled after some years.
- Core outcomes – should be able to cover the gaps of a large amount of projects. Understand maximum exposure by project; portfolio approach would spread risk.
- How much can the OEMs realistically bear on a project by project basis? Funding would come in above that; majority of risk issued above OEM retentions.
- Decommissioning Bond – is this part of the limit? There is a longer term credit risk on this principle for ocean energy than for example, the Oil & Gas sector. Are you insuring the bond or replacing it? The model is to be defined but the expectation is that it will be replaced by a sufficient substitute. Subject to some premium – potential to reutilise funds. Can't be a free pass so must have costs associated with it. A developer must still decommission their project. It is suggested that the Fund would support this.
- OEM warranty - can we limit this in some way (will it trigger State Aid issues if underwriting performance status of projects?). **ACTION** Need to check.

Section 2 of paper – Risks to be covered:

Q1. What is the bottom line for scope of cover from warranties and insurances up to what level?

Q2. For OEM/device manufacturers: Which range of potential warranty support are you offering / willing to offer specifically to these first demonstration arrays rather than necessarily as a long-term commercial proposition?

- Fund is driven by the financial industry not by project developers. The “bottom line” depends on what the project is and what the technology is, and will differ from OEM.
- Guaranteed warranties cannot be defined now but need to be thought about carefully. OEMs use their warranties to protect themselves against liability so there is a tension here. First demonstration arrays are the focus so there may be a bit more appetite for risk-sharing. Depends on the magnitude of the opportunity. Testing is the key; the more testing the more confidence.
- The spectrum of risk can range from projects absorbing risks to projects stalling because they can’t come to a commercial arrangement on risks. Both are a barrier to get projects going, as if can’t get past the project level then financers won’t even get to consider.
- The paper addresses the needs of a mature Technology Readiness Level (TRL) project but most projects that are stuck have no OEM backing so will have difficulty getting insurance and the paper does not address this yet. Huge opportunities will be missed if we don’t address this. We are focussed on first commercial arrays but different levels of engagement by Fund will need considering. Not talking inventor level but looking at a level of existing equity with proven technologies at more mature stages. Is this scope broad enough? Not everyone agrees with this. It would send a mixed message – the Fund is to support the risk if the project can’t deliver to the customer and who is responsible for non-delivery; for commercial projects not innovation. The Roadmap’s Phase-Gate Key Recommendation will deal with technological development. **ACTION** Check if a fund for prototypes is a solution for the Roadmap.
- Clarity and communication is key to getting this paper accepted. Fund is to fill a gap. Technology risks, decommission bonds and risk to revenue. Which of these aspects do we include in the paper and ensure this is communicated succinctly. Loss of revenue is the key driver but there are links between the three things. Integrate if possible. Technology risk is the biggest risk to revenue loss so they are all linked.

When does cover start and what does it cover?

- When the machine is commissioned – at point of handover? There could be a time delay between handover and testing so it would be wrong to start it at that point. Inception of warranty should start when testing on site / first hour in water commences. Addresses any query on performance liability (a lot of risk is attached in getting equipment to the quayside).
- Need to decide on model. Lots of models out there. E.g. Active project models 60 days after device is connected and running etc. At what point do you want to intervene and what is the trade-off?
- A month after the machine has been put into the water – enough time to ascertain that the machine is working.

Section 3 of paper – What financial exposure should the fund absorb?

- What are you willing to give in terms of warranty and where does the appetite for risk stop? Financiers would be prepared to take all of the risk if the benefits are high but hive off as much risk as possible.
- Where can the risk be reasonably shared, what is considered minor risk and what is considered major risk? What is reasonable / what will the investors accept? No number is

acceptable or unacceptable. From a technical performance perspective – it depends on how the company could share the risk with the supply chain. Certification of machine parts, which gives developers some level of security, does not impress insurers. The only thing that does is guaranteed working whole devices. Consequential impact of failure is where the risk lies.

- Marine energy has a high tariff in some countries so exposure is greater in those countries due to the higher revenue support. For a new project in the water the concern is at any point a tweak/niggle could still put you back months. Lenders want to understand Business Interruption as much as possible (what revenues comes back to the project). If you only have cover for some elements, then it won't cover loss of revenue to the business.

Section 4 of paper – Which technology should be eligible / which due diligence procedures to validate

- Weather risk should be covered by project contingency and not this Fund. Larger loss and larger risks should be covered not short term delays.
- Loss/failure of cable could be a big thing – scope out how you would insure and what the conditions would be.
- A risk matrix could make what is funded clearer – what is currently insurable in today's market, and what would need additional funding (i.e. the gap that isn't covered by the insurance market at the moment). Trying to define whether minimum criteria has been met to justify due diligence.

Section 5 of paper – Geographical acceptance criteria:

- Whilst it may encourage reciprocity, justification to deploy outside of Europe will be much higher.

Summary:

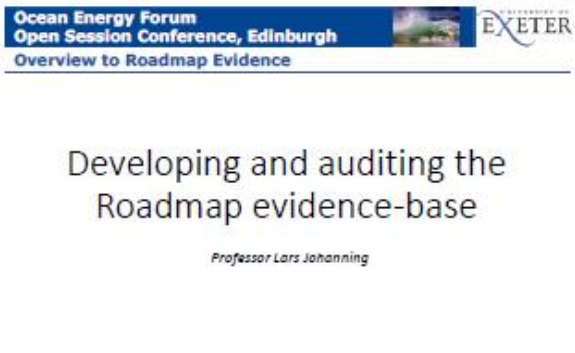
- Make deployment stage clearer in proposal
- Fund is covering gap – make this clearer
- Scope out alternative for decommissioning bond
- Check on OEM warranty limitations and State Aid issues
- Check if a Fund for prototypes is a solution for the Roadmap
- Integrate technology, decommission bonds and risk to revenue if possible
- Clarify model for what and when cover starts
- Consequential impact failure and Business Interruption is where the risk lies
- Due diligence – scope out risk matrix to show what is funded (including the current market and what this Fund aims to cover). Excludes weather risk. Understand maximum exposure by project (portfolio would spread risk).
- Avoid jargon; explain in basic terms for proposal

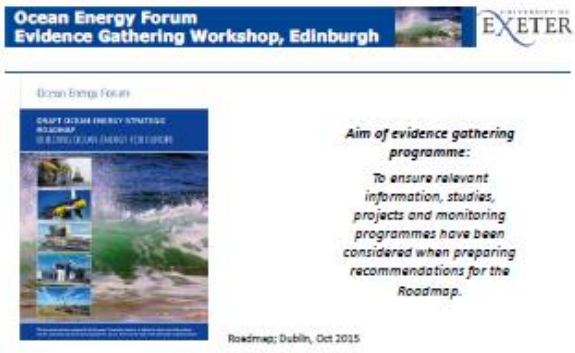
Session 3; Workshop on developing and auditing the Strategic Roadmap evidence-base

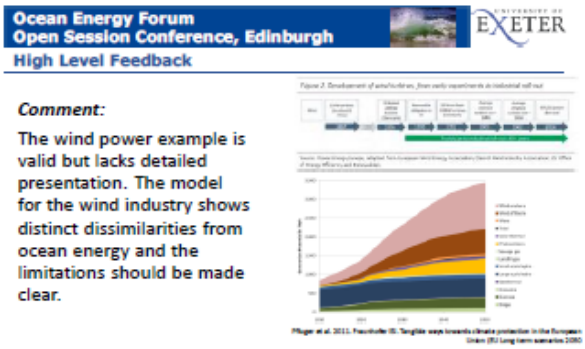
Generic open-door session, followed by three separate workshop sessions for the Forum's workstreams: Environment & Consenting, Finance and Technology. Where relevant for a particular session, presentations given by the University of Exeter have been included to provide additional context.

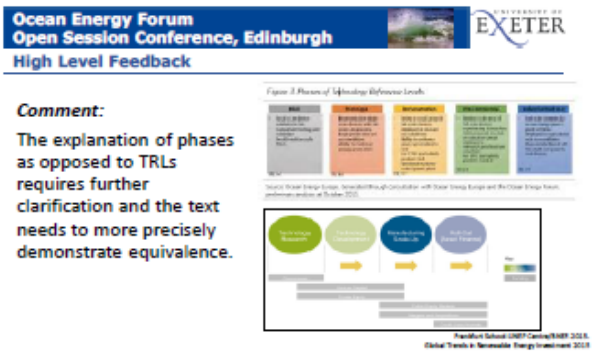
Findings of initial evidence gathering and conclusions to support the aims and the ambitions of the Strategic Roadmap were presented, with further discussion to allow stakeholders the opportunity to identify any outstanding gaps and suggest additional relevant literature.

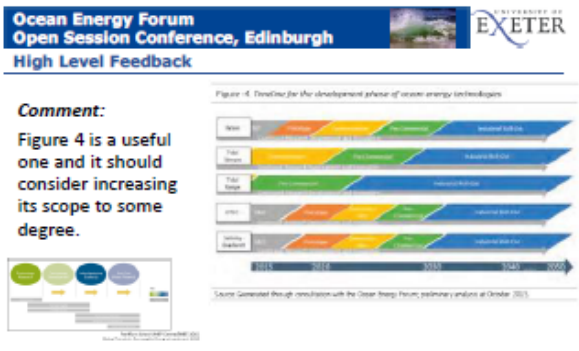
Presented by: Lars Johanning, Helen Smith, Philipp Thies, University Of Exeter

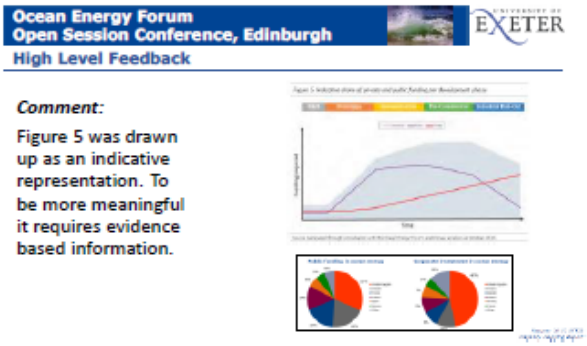


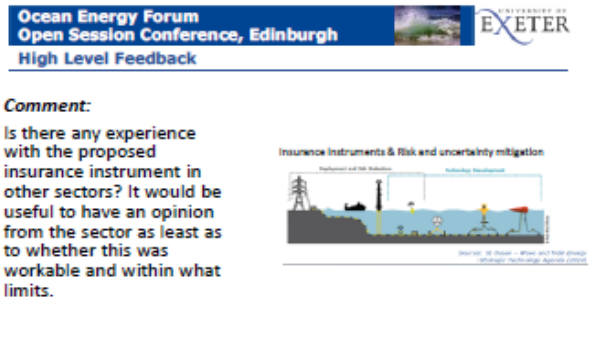












Session 3a: Environment & Consenting Workshop

Session Lead: Dr Helen Smith, University of Exeter.

Context:

Following the publication of the *Draft* Strategic Roadmap in October 2015, the University of Exeter are undertaking an evidence review to ensure relevant information, studies, projects and monitoring programmes have been considered. The review will inform the final version of the Roadmap due October 2016. This event was used to provide progress on work done to date and allow the opportunity for input and discussion by conference attendees.

Workshop Discussion:

A presentation was given to consider and discuss three key aspects for ocean energy that contribute to de-risking environmental consenting:

- What has been done / ongoing? Monitoring programmes, Guidelines, Reports, Databases.
- What can be learnt from previous work to inform the Roadmap's E&C work? Availability and dissemination of data, what worked well / did not.
- Where are the gaps? Data from the EU and outside, other project and sectors, OTEC and Salinity Gradient.

Workshop participants were asked to feedback on the following questions.

Question 1: *What is your level of awareness of the previous and ongoing work?*

- Generally good, but less on transatlantic work.

Question 2: *Are there any further studies/projects/programmes that should be included in this evidence review?*

- Key monitoring programmes (UK) are Strangford Lough (with the mitigation "shut-down" requirement / adaptive monitoring), TEL in Ramsey Sound[8] and EMEC[9]
- We need to track live progress – projects become dated very quickly
- Monitor outputs from the EU RiCore[10] project on risk-based consenting
- All key science is contained in US Department of Energy's Annex IV 'State of the Science'[11] report and the Tethys database, which is excellent at an international and cross-sector level for wind and marine renewable energy
- EMODnet[12] for oceanographic data.

Question 3: *How effective have these projects been in addressing the challenges relating to the consenting process from an environmental perspective?*

- Different projects have demonstrated separate approaches to consenting e.g. Strangford Lough, MeyGen[13] - Survey Deploy Monitor (Marine Scotland)
- Important to promote the information that is available
- Need more consideration of socio-economic aspects and opportunities e.g. supply chain, local benefits, etc. to increase political support for the industry.

Question 4: *What are the key learnings from these projects and programmes?*

- Management of risk through previous monitoring programmes, e.g. with Strangford Lough, where could intervention have happened earlier
- Don't get tied up with the precautionary principle of 'managing risk' – a rigid process is not adaptive enough
- Queries around the application of directives and conflicting directives in the face of scientific uncertainty
- Justifications are needed for a risk-based approach
- New EIA regulations are needed to include climate change and human effects
- Importance of signposting – tell people where the data are
- Developers don't want intensive monitoring if it interferes with performance.

Conclusion:

Discussions and responses during the workshop demonstrated the high level of engagement of stakeholders involved in environment and consenting (E&C) with the aims and content of the Roadmap. For E&C, it is less a question of identifying 'gaps' in knowledge and evidence as ensuring that appropriate conclusions are drawn from previous and ongoing studies. A number of specific projects were discussed during the workshop but it will not be possible to reference all

[8] TEL has successfully installed a single DeltaStream unit off the coast of Wales at Ramsey Sound. The project will be used to demonstrate the capability of DeltaStream as a tidal stream generator and will provide evidence on how the device interacts with the environment around it. **http://www.tidalenergyltd.com/?page_id=650**

[9] The European Marine Energy Centre (EMEC) Ltd http://www.emec.org.uk/about-us/

[10] http://ricore-project.eu/

[11] Annex IV was established by the IEA Ocean Energy Systems (OES) in January 2010 to examine environmental effects of marine renewable energy (MRE) development. http://tethys.pnnl.gov/about-annex-iv#

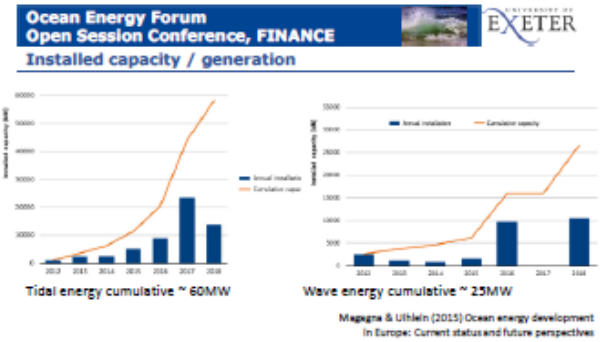
[12] http://www.emodnet-hydrography.eu/

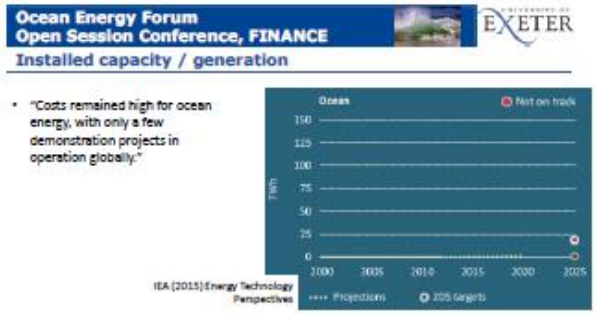
[13] http://www.meygen.com/

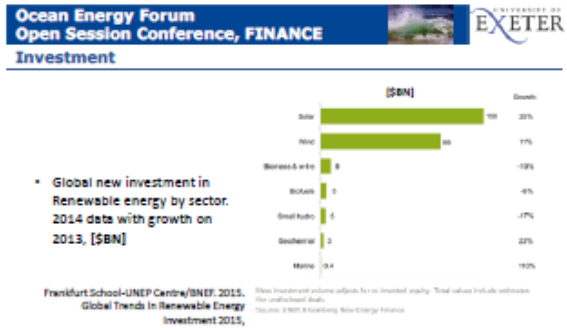
of these in the Roadmap. However, the learnings from these projects are key drivers of Roadmap's E&C key recommendations. Need to make reference to Annex IV 'State of the Science' report, which provides an up-to-date and comprehensive overview of the current state of knowledge on environmental interactions with ocean energy technologies. Must monitor outputs from, e.g. the RiCORE project, to inform recommendations on risk-based consenting. A final important point raised was the need to incorporate socio-economic aspects into the Roadmap to ensure that work is done to promote the benefits of marine renewables for local communities; this will be added as an additional recommendation under Environment and Consenting.

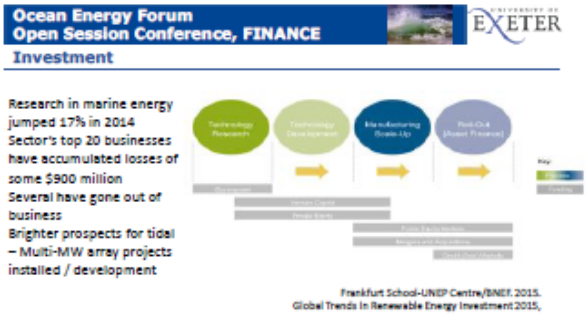
Session 3b: Finance Workshop

Session Lead: Dr Philipp Thies, University of Exeter





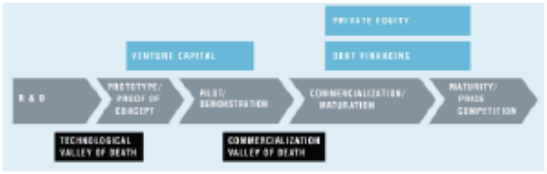




Ocean Energy Forum Open Session Conference, FINANCE

Investment

- Valleys of death caused by **mismatch of risk (perception) / matched risk capital**, in particular for energy technologies.
- Early-stage "Technological Valley of Death"
- Later-stage "Commercialization Valley of Death".



Jenkins & Masur (2011) Bridging the clean energy valleys of death

Ocean Energy Forum Open Session Conference, FINANCE

Investment

- Innovation in different sectors
- Energy:
  - Time & capital intensive
  - Risk profile suits short-time VC investors
  - Capital needed for commercialization needs traditional finance (debt equity) ASK: Low risk

	PHARMACEUTICAL	SOFTWARE & IT	ENERGY
Time Required to Invest In	10-15 years	1-5 years	10-15 years
Capital Required to Invest In	Medium to High	Low to Medium	High
How Products Primarily Differentiated By	Function/Performance	Function/Performance	Cost
Actors Responsible for Innovation	Large Firms Reinventing in R&D; Biotech startups, often VC & govt. backed; Govt. (NIH, NSF)	Dynamic Startups, often VC-funded; Large Firms Reinventing in R&D	Venture Utilities, Oil & Gas Cos.; Power Tech Co.s; Startups; Govt.
Typical Industry Risk Tolerance	High	High	Low
Innovation Intensity	High	High	Low
Intellectual Property Rights	Strong	Mixed	Mixed

Jenkins & Masur (2011) Bridging the clean energy valleys of death

Ocean Energy Forum Open Session Conference, FINANCE

Investment

- No set of actors or institutions with capabilities to address high-risk, high-capital technology category

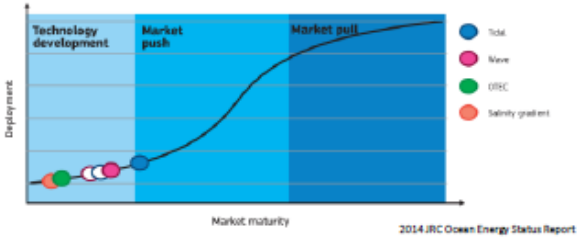
	SEED FINANCING	ANGEL INVESTORS	VENTURE CAPITAL	DEBT FINANCING	PRIVATE EQUITY	UTILITIES
Typical Investment Amount	Small	Small	Small-medium	Any size	Any size	Large
Technology Financing Stage	R&D, Prototype	R&D, Prototype	Prototype, Commercialization	Commercialization, Deployment	Commercialization, Deployment	Deployment
Expected Time for ROI	Long-term	Long-medium-term	Short-medium-term	Medium-long-term	Medium-long-term	Long-term
Risk Tolerance	High	High	High	Low	Low	Low

Jenkins & Masur (2011) Bridging the clean energy valleys of death

Ocean Energy Forum Open Session Conference, FINANCE

Funding/Finance Mechanisms

- 23 different mechanisms / schemes for Market Push/ Pull across Europe



2014 JRC Ocean Energy Status Report

Ocean Energy Forum Open Session Conference, FINANCE

Funding/Finance Mechanisms

- Tidal Energy – MeyGen project 6MW @ £51.3million
  - => CAPEX £8.55million/MW
    - 34% DEBT £17.5m;
    - 26% GRANTS £13.3m;
    - 42% EQUITY £21.5m;
    - 21% Developer share: £10.8m

- Wave Energy CEFOW Wello @ Wavehub
  - 3MW @ €24.7million
  - => CAPEX €8.2million/MW
    - EU H2020 grant: €17million
    - 31% Developer (project partner) share

Ocean Energy Forum Open Session Conference, FINANCE

Evidence gathering / discussion

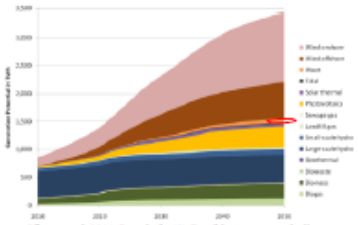
Investment:

...

Ocean Energy Forum Open Session Conference, FINANCE

Long term scenarios

- Optimistic scenario – 26 GW installed capacity Wave and tidal by 2050
- "(...) without technical breakthroughs, and at current learning rates, the technologies are (...) not competitive with other forms of renewable energies technologies."

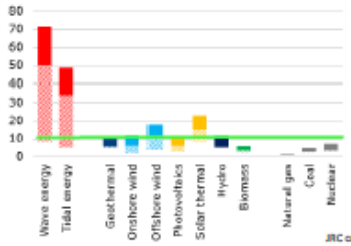


Pfluger et al. 2011. Fraunhofer ISI. Tangible ways towards climate protection in the European Union (EU Long-term scenarios 2050

Ocean Energy Forum Open Session Conference, FINANCE

Medium / Long-term Cost

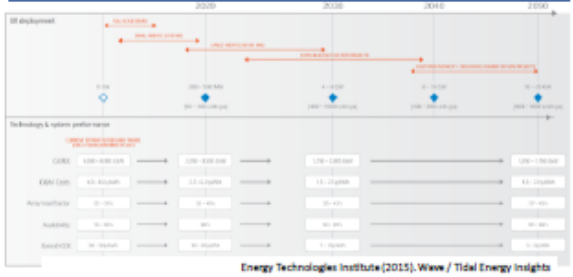
Levelised cost of electricity (cEUR/kWh)



JRC calculations based on ETRI 2014

Ocean Energy Forum Open Session Conference, FINANCE

Medium / Long-term Cost



Energy Technologies Institute (2015). Wave / Tidal Energy Insights

Ocean Energy Forum Open Session Conference, FINANCE

Overview

Medium / long-term scenarios

- ...

Context:

A presentation was given looking at the three key areas for evidence gathering that will underpin the draft Strategic Roadmap's Key **Finance** Recommendations[14] for a finance approach that provides revenue support and matches the ocean energy sector's risk profile and an EU-wide insurance fund targeted at first projects that underwrites various project risks. The key areas are as follows:

1. Installed capacity and generation
2. Investment and finance
3. Cost scenarios

Installed Capacity and Generation:

International Energy Agency (2015) Energy Technology Perspectives report states that costs for ocean energy remain high. The annual review of contribution to the 2DS[15] target was classed as not on track with costs still too high and few demonstration projects being deployed globally to date.

Tidal technology is perceived as ahead compared to Wave energy. This could be partially due to divergence in design technologies (wave 12 and tidal 2 to 3) but the 'prize' i.e. available resource is higher with wave technology.

Underlying message – Once something works and fits the market an inflection point is reached but it is hard to pinpoint at the outset when this will happen and therefore hard to gain support of policy makers.

Evidence-base is looking back at the pipeline. Taking into account the existing pipeline of ocean energy projects which have been awarded funds, Europe could see up to about 57 MW of tidal and 26 MW of wave energy capacity installed operational by 2020[16].

To realise the pipeline what do we need to do?

Investment and Finance:

$0.4bn was invested in the marine renewable energy sector in 2014, representing a growth of 100% from 2013[17]. The sector's top businesses have accumulated losses of €900m and several have gone out of business. However, prospects for tidal appear brighter with multi-MW array projects installed / in development.

Jenkins & Masur (2011) Bridging the clean energy 'Valleys of death' (mismatch of risk with available risk capital allowing entry into the marketplace and the ability to compete with established energy technologies). These can occur at two points in a technology life cycle: first (technological) is at the early stage between R&D and prototype and the second (commercialisation) between the pilot and commercial maturation.

There are several energy risks:

- Can be a long and capital intensive journey

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[14] https://webgate.ec.europa.eu/maritimeforum/sites/maritimeforum/files/OceanEnergyForum-report-v5.2_12-10-15_FINAL%20DRAFT.pdf

[15] 2DS describes an energy system consistent with an emissions trajectory that recent climate science research indicates would give an 80% chance of limiting average global temperature increase to 2°C. http://www.iea.org/etp/

[16] http://www.sciencedirect.com/science/article/pii/S2214166915000181

[17] Frankfurt School-UNEP Centre/BNEF. 2015. Global Trends in Renewable Energy Investment 2015

- The risk profile tends to suit short term investors
- The capital required for realisation needs traditional finance but appetite is low for risky projects

There is currently no set of actors or institutions with capabilities to address this high risk, high capital technology category on a purely commercial investment deal. – e.g. utility companies with a large investment amount often have a low risk tolerance. All current projects have some kind of public finance / grant mechanism. It was agreed that there is a need for public financial contributions / backing either in grant or in equity form.

Energy policy needs to be a mix of carrot and stick. At the moment the Marine Energy 'carrot' isn't big enough and the renewables obligation 'stick' has gone and the strategic desire is decreasing following the abolishment of the ROC[18] which encouraged utility companies to invest into marine.

Cost Scenarios:

Medium and long-term cost scenarios were presented as well as the level of funding needed. Optimistic scenario – 26 GW installed capacity wave and tidal by 2050[19]. Existing barriers are hampering the development of ocean energy, whose technologies are currently too expensive and unreliable to compete with other renewable and conventional technologies. Capital cost needs to halve between each decade, and operating costs must continue to reduce[20]. There was general agreement with the presented project cost figures using Tidal Energy MeyGen project and Wave Energy CEFOW Wello, which were thought to give a good indication of what cost levels are currently achieved;

Tidal Energy – MeyGen project[21] 6MW @ £51.3million	**Wave Energy CEFOW Wello @ Wavehub[22]**
=> CAPEX £8.55million/MW	3MW @ €24.7million
34% DEBT £17.5m;	=> CAPEX €8.2million/MW
26% GRANTS £13.3m;	EU H2020 grant: €17million
42% EQUITY £21.5m;	31% Developer (project partner) share
21% Developer share: £10.8m	

[18] The Renewables Obligation provides support for large scale renewables in the form of Renewable Obligation Certificates (ROCs) which are produced by renewable generators. ROCs have a market value, are tradable and electricity suppliers have to present a set amount of certificates to Ofgem at the end of each year, or pay a penalty. http://researchbriefings.files.parliament.uk/documents/SN05870/SN05870.pdf

[19] Pfluger et al 2011. Fraunhofer ISI - Optimized pathways towards ambitious climate protection in the European electricity system
(EU Long-term scenarios 2050 II)

[20] http://www.eti.co.uk/wp-content/uploads/2015/02/Wave-Insights-Stuart-Bradley.pdf

[21] http://www.meygen.com/

[22] http://www.wello.eu/en/ & http://www.wavehub.co.uk/latest-news/eu-horizon-2020-programme-grants-eur17-million-for-wave-power-research-proj

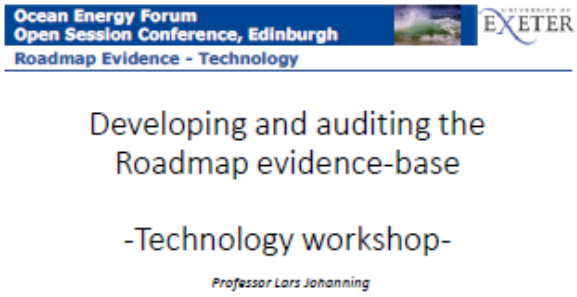
Conclusion:

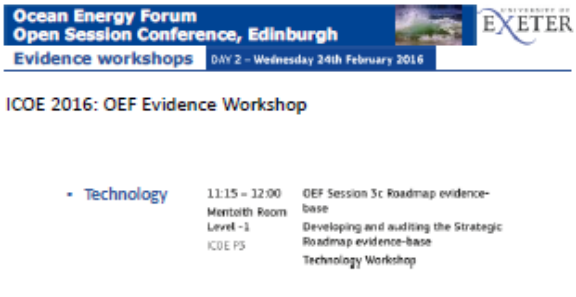
The review of the investment levels, finance options and realised recent projects that reached financial close, led to the following conclusions:

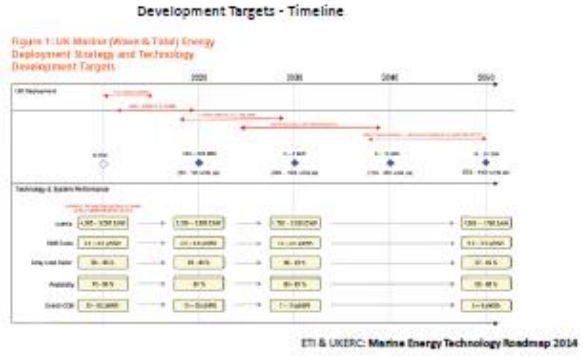
- Present level of deployment pipeline is in the order of 100MW by 2020 (57 MW tidal, 26 MW wave).
- Ocean energy project long-term investment and short-term risk profile requires the need for public financial contributions / backing either in grant or in equity form until the risk profile of the technologies is improved.
- Projects with recent financial close suggest a CAPEX of £8.55million/MW (MeyGen, tidal) to €8.2million/MW (Wello, wave) with a developer share between 31% / 21%.
- The suggested Roadmap instruments that allow a packaged financial approach to deliver ocean energy arrays, as well as efforts to reduce the risk exposure of investing parties (e.g. through a shared insurance fund) would help to facilitate and increase technology deployments.

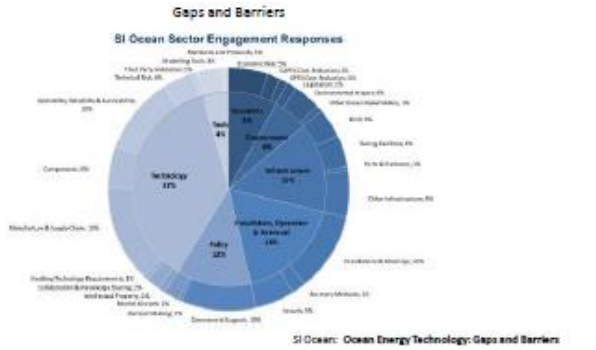
Session 3c: Technology Workshop

Session Lead: Professor Lars Johanning, University of Exeter








Gaps and Barriers
SI Ocean Sector Engagement Responses
SI Ocean: Ocean Energy Technology: Gaps and Barriers

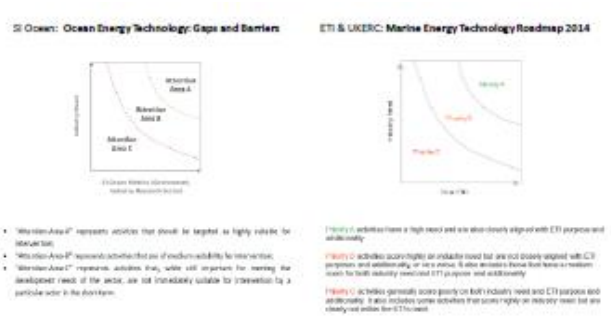
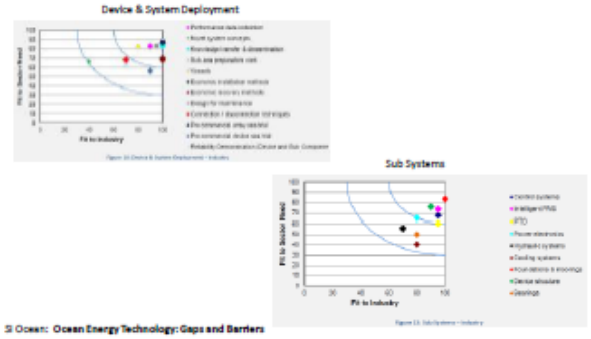
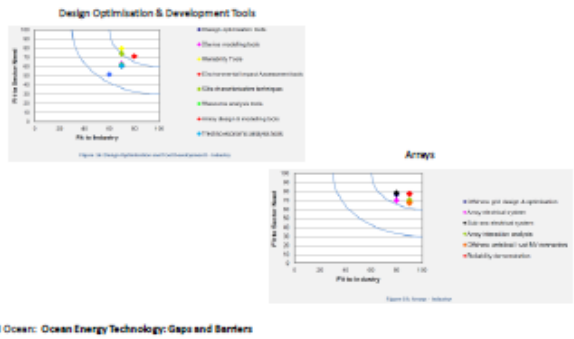
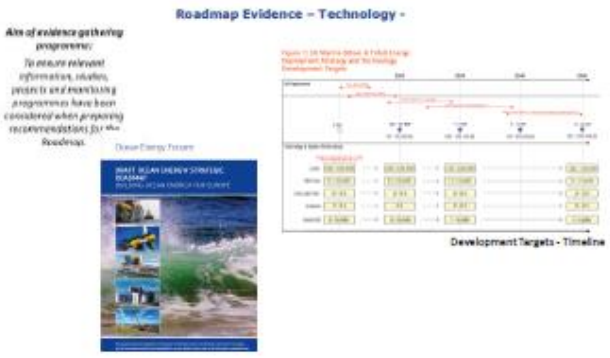

SI Ocean: Ocean Energy Technology: Gaps and Barriers
ETI & UKERC: Marine Energy Technology Roadmap 2014


Table 4: ETI Activity Prioritisation by Priority Category
ETI & UKERC: Marine Energy Technology Roadmap 2014


Table 3: Activity Prioritisation by Theme


Device & System Deployment
Sub Systems
SI Ocean: Ocean Energy Technology: Gaps and Barriers


Design Optimisation & Development Tools
Arrays
SI Ocean: Ocean Energy Technology: Gaps and Barriers


Roadmap Evidence – Technology -
Aim of evidence gathering programme:
Development Targets - Timeline


An aspect to think about
• Automotive is a mature industry
• A Car only has to run 9 months in lifetime
• Marine application is not mature
• MRE devices need to produce 10 to 20 years


Ocean Energy Forum
Evidence Gathering Workshop, Edinburgh
EXETER
Ocean Energy Forum
B: audience discussion
- Which are the important technology elements
- Why are these elements important
- How can this contribute to technology realisation
Roadmap; Dublin, Oct 2015

Context:

A presentation was given to consider and discuss three key areas for ocean energy technology development that will result in cost reduction / making ocean energy competitive.

- Which are the important technology elements (components, sub-systems)?
- Why are these elements important?
- How can this contribute to technology realisation?

Existing Evidence Presented:

- Development targets using UK Marine (Wave & Tidal) Energy Roadmap 2014[23]. Using modelling, this report presents cost and performance improvements to be demonstrated by the ocean energy sector to deliver technology deployment levels in the UK by 2050 to help meet carbon reduction targets. Recommendations are that the overall cost of energy will need to reduce from 20-50 p/kWh to 5-8 p/kWh by 2050.
- Ocean Energy Technology: Gaps and Barriers – SI Ocean[24] identified gaps in knowledge and barriers that are inhibiting technological development. A sector engagement process identified common findings for those gaps and barriers faced by the sector with 37% related to technology issues such as manufacturer and supply chain (13%), operability (10%) and components (6%).
- Both these publications recommend priority activities for ocean energy technology development. For the purposes of the workshop, focus was presented from an industry perspective, where the ETI and SI Ocean results were presented in tabular and graphical form, respectively, categorised in four themes of:
    - Device & System Deployment
    - Sub-systems
    - Design Optimisation & Tool Development
    - Arrays
- Further slides showed charts from the SI Ocean report identifying industry activities and priorities within the four themes outlined above. A link has been made to the identified targets from the UK Marine (Wave & Tidal) Energy Roadmap 2014 and questions raised of whether actions identified through the themes are suitable and timely to address required aspects regarding capital expenditure (CAPEX), operations and maintenance (O&M) and availability.

Comments raised during the discussion:

- Vessels (wave) - noted as a medium priority activity; but why spend so much money and time designing a vessel to deploy wave/tidal technology? This will only be feasible in later stages once arrays have been proven – it is too early to bring vessels into the equation. Vessel companies may well spot a gap in the market themselves and could fill this gap.
- Due diligence and funding off the back of R&D and demonstration projects – the development of commercial farms needs to be based on working elements capitalising on experience from completing and ongoing projects. Where there are already working elements established this needs to be recorded in a knowledge base as it will increase

[23] http://www.eti.co.uk/wp-content/uploads/2014/04/Marine-Roadmap-FULL-SIZE-DIGITAL-SPREADS-.pdf

[24] http://www.si-ocean.eu/en/upload/docs/WP3/Gaps%20and%20Barriers%20Report%20FV.pdf

confidence and therefore the chances of funding e.g. reliability and whole system design for developing cost-effective machines.

Conclusion:

Supply chain, operability and component issues are still a large barrier to priority activities identified for ocean energy technology development via existing work. It was felt that the ETI development targets for CAPEX, O&M and LCOE by 2050 were presently still very challenging, with a whole system to address MRE targets needed.

OEF Session 4a, 4b, 4c Roadmap Key Recommendation 4.6; De-risking Environmental Consenting through an Integrated Programme of Measures (Draft)

Session Lead: Phil Gilmour (Marine Scotland - Chair of Environment & Consenting Steering Group).

Context:

Following the publication of the *Draft* Strategic Roadmap in October 2015, Phil explained the current status and what we wanted to achieve from the discussions. Three projects have been proposed to help take this key recommendation forwards:

- Minimise environmental monitoring costs on initial developers
- Review EU best practice project consenting
- Produce advice on how to use strategic assessment techniques and marine spatial planning to aid developers

To these three projects, another two pieces of work are now added;

- a socio-economics study to understand regional and local impacts and benefits
- development of a Demonstration Strategy to build generic data sets to produce project assessment methodology.

The main environment and consenting challenges were outlined:

- Consenting of ocean energy projects is complex with high risk of failure
- Use of strategic assessment techniques or other strategic tools to steer developers
- New technologies come with unknown impacts and uncertainties
  Developers and regulators have to justify decisions based findings from Environmental Impact Assessments (EIA) and Habitat Regulations Assessments (HRA)
- Lack of knowledge and empirical data requires risk-based consenting otherwise projects will stall or fail

The 5 Projects Proposed:

Project 1:

Minimise environmental baseline data and monitoring costs on initial developers - review existing project and strategic monitoring requirements to maximise use for emerging projects and reduce the potential for excessive post-consent monitoring requirements.

Project Output: Establish information sharing portal(s)

Stakeholders were asked for views on taking this forward and on the resulting portals.

Key feedback from stakeholders (non-attributed):

- Like this idea; stakeholder had worked on different portals. Approach can be guided by initiatives already established and also standards for interoperability. Few do/s already in existence.

- National databases already available, need worldwide database (e.g. connect to US Department of Energy TETHYS[25])? Should avoid being too restrictive, but should have access to existing databases.
- Linked to environmental monitoring – make the data available and useable.
- There are lots databases and portals. Need to understand utility – need an action of making sense of databases and portals.
- For applications, ideally developers and scientists need access to papers produced on a global scale when assessing applications; likewise, for developers; we need to accelerate the science; design so it works for this.
- Aim should be to improve scope of existing systems, usefulness and ensure they are maintained. Focus is to minimise costs on developers. Developers want to be informed of upfront costs so they can build into consenting and what information is needed to get their planning through. This has to be simplified. Also, making sure there is a standard monitoring approach across the board that is fair and proportionate.
- Intellectual Property (IP) rights. Socialise so that monitoring paid for through the public sector (rather than burden first movers) and the results /data published and available. This is what Marine Scotland are doing; planning and consenting authority have ability going forward to keep this happening.
- Review site monitoring, look at strategic monitoring to propose "this is the type of approach we should have"; information sharing portals.
- Sharing across Member States? Project should look at this from an EU perspective. GB wind project standard for off-shore wind cited, encourage something similar in EU (e.g. INTERACT type project). Depends on how the project is being taken forward - Horizon 2020 project?
- Data harmonisation very important. Top down control approach. Getting into first principles idea – developers need to understand the process they need to go through.
- Consider a flexible expert group to assess quality (of work) by project contractor.

Summary:

Agreed on approach for information sharing portals. Must look at existing databases EU-wide (including international) to avoid duplication - interoperability, harmonisation and standards. Not just about data, understand papers / information, proposed monitoring needed resulting in outcomes that directly accelerate sustainable developments. Make data available if socialised funding and make sure project provides the information that delivers reduced monitoring costs for developers – information on what is needed and the upfront costs.

Project 2:

Review best practice project consenting of projects across EU Member States, promote streamlining and efficiencies through e.g. one-stop-shop regulator body, risk-based consenting policies and commensurate requirements based on project scale and interactions with the environment.

Project Output: Produce EU Guidance

Key feedback from stakeholders:

[25] http://tethys.pnnl.gov/

- Look at proportionate requirements - NOT telling people what to do, understanding what's best and highlight this to promote efficiency so that a developer understands the process. Developers want to minimise cost, but when they apply for consent they want to get it.
- Sow differences / explain risk based approach and adaptive management.
- Streamlining and efficiencies need to be built – e.g. Marine Scotland one-stop-shop now set up; provides liaison for all aspects. All to do with the number 1 - 1 manual, 1 process, making what was an overly complex process, more streamlined.
- Observations - depends on British issue. In the UK definitions are different and the process is complicated. EU practice on planning and consenting is simpler. Costs vary so much in EU and UK for the same process. Whole issue is the barrier of entry. How can we adopt EU method that will make it easier and reduce costs (e.g. reduced by 1/3 in Europe) and barriers to entry in the UK? Developers need an understanding of the consenting process to build it into timelines (e.g. could take 24months). Need good benchmarks that promote best practice. There needs to be a template covering Scottish waters, England and Wales and EU where developers can build consenting costs into financing, plus additional costs for specific areas where particular studies have to be carried out. Making sure there is a standard approach so that as professionals you can perform and demonstrate that anywhere in the UK you will get the same answer.
- Document and learn from experiences in different countries (Spain, Denmark, Belgium, the Netherlands) and consenting regimes - some work has been done already[26] including Pro-Tide Interreg EU project[27], interconnector work. Not reinventing the wheel. Mitigation and compensation should also be included as well as case-studies.
- Important to involve stakeholders from across Europe and DG MARE, DG Energy and DG ENV.
- Two distinct issues - consenting administration and how this is set up. This is difficult to understand; need to know the impacts before you can give consent. Monitoring programmes will focus on the technology being used and generate data that can be used in the future.
- Clear guidance on risk-based consenting approach for new technologies is key including comparison with precautionary approach. Need acceptance of this by the EU (DG ENV) for a sensible outcome (guidance implemented and change of behaviours).
- Need to understand who the guidance is aimed at - i.e. developers or higher up the consenting process?
- Issues are capacity and capability within the system – guidance could be informed by translating practice from other sectors – e.g. Marine Aggregates.
- A risk-based approach is included in the EU directives but the interpretation can be difficult. Under the Habitats Directive you need to show impact. DG ENV are sympathetic to issues (19th February 2016 Roundtable meeting Brussels with DG ENV, developers and Regulators) and risk-based consenting/adaptive management for new technology under the scope of the Habitats Directive, and acknowledge the need for guidance.

[26] Review of consenting processes for ocean energy in selected EU Member States (2015) - Simas, T; O'Hagan, AM; O'Callaghan, J; Hamawi, S; Magagna, D; Bailey, I; Greaves, DM; Saulnier, J-B; Marina, D; Bald, J; Huertas, C; Sundberg, J

[27] http://www.pro-tide.eu/analysing-data/ Crossborder sharing, analysing and gathering of new data

Summary:

Agreed to produce EU method for risk-based consenting guidance for new technologies and seek DG ENV acceptance. Needs to be proportionate and needs to reduce costs and barriers to entry whilst maintaining environmental status. Include comparison with precautionary approach, consenting process and interpretation in other countries and sectors; include example timelines, mitigation and compensation, case studies. Benchmarks – standard approach, an understanding of costs and timelines for developers. Be clear on who the guidance is for, what it aims to achieve and what is needed and what is not needed.

Project 3:

Produce advice on how to use strategic assessment techniques and Maritime Spatial Planning to aid site selection to minimise risks of failed applications - consider how planning can aid developers with cumulative impact and in-combination effect assessments

Project Output: Produce EU Guidance

Phil outlined the planning process in Marine Scotland, aligned to EU Directives - integrated planning /consenting product. Consider environmental, industrial and social-cultural themes for how to best use marine planning to help reduce bureaucracy. Initial planning is all about what goes on in the different areas.

For this particular project, starting with four devices monitoring can be done intensively and seek to allow the developer to go forward from demonstration. Produce EU guidance and highlight what is best and promote efficiency. More efficient in that the member states are not being told what to do – sharing best practice by saying how marine planning techniques can aid developers. The strategic approach provides the foundation - understand what the gaps and knowledge are and develop strategic monitoring. Regional assessments can also help with cumulative effects.

The Chair asked - Is this something that would be wanted? The meeting concurred.

Key feedback from stakeholders:

- Situation is different in other countries – how Member States go about this is their choice. Need to understand legislation / legal context and adapt projects to the reality, e.g. no Strategic Environmental Assessments (SEA) in Portugal, but implementation of Marine Spatial Planning (MSP) directive including SEA. Sector-specific SEA in Scotland due to scale of ambition, but this project advocates SEA and MSP in general, not necessarily the Scottish model.
- Needs to be EU-centric. Some issues are common across countries, this helps unify.
- Strategic level processes gather info but this is not seen at project level - useful amount of information but not all that accessible to developers and third party managers. In Wales, strategic-level processes gather a lot of information but this doesn't translate to project-level applications. SEA work in Scotland not yet translating to projects. The Crown Estate in Wales licenses demonstration zones – not seen Crown Estate information coming down to project level in demonstration zones. Need to make sure you have all the right information in your design
- One of the things that needs to be captured is the level of detail and types of data that are needed. SEAs are done in many different ways. Need something fit for purpose that you can make the best judgement on. In marine aggregates view taken what level of detail and scale of information all thought out in advance.

- Often similar issues are recurring. Challenge for this group is to address all issues in UK and EU. Instead, select best practice examples, including "difficult" projects and EU court outputs and use in guidance.
- Draw on guidance from other sectors (marine aggregates) - Regional Environmental Assessment (REA) undertaken by industry and costs a lot of money.
- Socialising the cost is an excellent idea. However, because of the disparities around the EU in terms of the population in terms of the environment the cost is disproportionate. For Belgium/Netherlands socialising the cost for doing a survey for their continental shelf; it is an intensive monitoring project. Cost needs to be socialised across all countries.
- Risk is not just environmental – the risk is also with the developer. They are placing a bet there isn't a significant environmental impact of this device. Be good for a developer to have an understanding of what the sensitivities are in relation to the consenting process. Need to ensure planning aids developers.
- Consider audience - high level recommendations that the Commission can support that need to be in the consenting regime.

Summary:

Understand consenting process in other countries and sectors re Directives, and adapt guidance for the EU. Use existing work and example projects to outline the difficulties and sensitivities in the process. Project needs to capture level of detail and types of data needed and strategic data made available so that it flows down to project level and available to everyone involved in the process. Consider audience - needs to aid developers.

Project 4:

Review socio-economic practice and produce advice on how to maximise local and EU economic content from renewables development to maintain political and public support for development.

Project output; advice on assessment technique and policy development to maximise the economic and social consequence of ocean energy development for the citizens of the EU.

Phil outlined the approach:

- Establish an EU supply chain – used offshore wind supply chain as an example, showing low and high end projections
- Establish an EU O&M strategy
- Maximise local content, minimise project opposition

Key feedback from stakeholders:

- Facilitating sustainable development of the ocean energy sector is important. There will be benefits (e.g. carbon reduction) as well as impacts. Socio economic opportunities need to be understood – jobs/ training in the community, investments, supply chain. Helps industrial scale planning, the SEA process and builds political and social support that will filter down to the regulatory process.
- If communities are hosting development, O&M opportunities should be provided for the local region/area as a minimum (O&M typically 25% of project cost).
- Shouldn't lose sight of the smaller developers. Have to include the whole spectrum as well as the bigger picture.

Summary:

Agreed socio-economic opportunities should be included in Roadmap. A paper will be provided by the Secretariat and put to the Commission.

Project 5:

Establish a demonstration strategy for the EU which can be used to intensively monitor the environmental performance of early array developments to provide empirical data to determine if there are risks of effects on the ecosystem.

Project output; a programme of species and array monitoring using tagging, underwater video, sonars and strain gauge techniques to collect empirical data and allow analysis of data to establish if there are ecosystem impacts from small, medium and large scale developments.

Phil outlined the approach:

- Use MeyGen example for collision risk monitoring
- Build generic data sets to produce project assessment methodology for EIA and Appropriate Assessment – i.e. this is what happens when you put turbines in the sea.
- Socialise cost of intensive monitoring along European Atlantic coastlines
- Make a case for an EU strategy and the EU will sanction this, or will help / fund it
- Allows monitored info to be available to others developers throughout the world

Key feedback from stakeholders:

- Not to be seen as standard practice for post-consent but provides evidence – this is a strategy for the first projects, not sustainable to expect developers to pay for this approach
- Good approach for demonstration sites
- Different for grid connected sites – would it lead to State Aid complications?
- Would different guidance apply to different zones (as per SEA / Marine Spatial Planning)?
- Scotland zoning: highlight key features of sites for each technology to inform other countries
- Fine line between being too prescriptive and finding a way of being useful in terms of planning
- Grouping areas with colours is helpful; use the offshore wind areas and highlight the common features of those areas for each of the wave, tidal and offshore wind. Useful starting point where this could be applied – i.e. to guide on the best environment for each sector, and this would be useful to be applied.

Summary:

Phil to produce a paper with recommendations and circulate to members for comments. Marine Scotland Licence Operations Team (LOT) can put in place a set of Standard Operating Policies (SOPs) and then a strategy.

Jon welcomed comments on the three scoping documents that were issued ahead of the discussion. Phil encouraged attendees to offer further comments on these and today's discussion via the Secretariat.

OEF Session 4d; US regulatory process and analyses thereof, plus international standards beyond EU frameworks

Presented by: Samantha Eaves (US Department of Energy)

The Forum welcomed Samantha Eaves of the US Department of Energy, who gave a high-level overview of the US permitting processing and analyses on work undertaken in the regulation process and the strategy for addressing some of the issues. The overview demonstrated some similarities and learning /sharing opportunities for both the Forum and US colleagues but also the complex regulatory environment at both state and federal level.

Summary:

- Various agencies involved depending on type, location and grid connection; no one-stop-shop
- Different authorisations that a project can obtain
- Have used experiences of environmental monitoring to devise Departmental strategy and reduce environmental costs
- Focus is on data collection, data sharing and improving environmental monitoring techniques

Background to US Consenting:

There are a large number of laws and executive orders in the consent process and lots of agencies (federal and state) involved in the permitting process with specific responsibilities which were outlined. There isn't a one-stop-shop for permitting.

The agencies that are most commonly involved are The Federal Energy Regulatory Commission (FERC) which is responsible for siting and operation of hydrokinetic projects that are connected to the grid; the Bureau of Ocean Energy Management (BOEM) is responsible for issuing leases, easements and rights of way for renewable energy projects; the National Marine Fisheries service and US Fish and Wildlife Service are responsible for protecting marine mammals and threatened or endangered species; the Army Corps of Engineers is responsible for protecting all navigable waterways from pollution; the Coast Guard is responsible for siting navigational aids in coastal waters. The agency to be used depends on where the device is to be located.

Authorisations:

There are a number of different types of authorisation that a project can obtain. The type of authorisation, the overall process and the lead federal agency is dependent upon a number of different factors

- If a project is grid connected, regardless of location, FERC is the lead agency. If the project is not grid connected FERC is not involved.
- Length and scale of deployment influence the type of authorisation that is sought.
- If a developer would like to deploy a large array for an extended period of time, a commercial lease would be sought.
- In contrast, if the developer wants to deploy a single or small array of devices, for a short period of time, a pilot licence could be used.
- The location of the deployment also influences the agencies that are involved. If the project is located on the outer continental shelf (>3 nautical miles) then BOEM is

considered a lead agency along with FERC and a project lease must be acquired. If a project is located within 3 nautical miles of shore, these are considered state waters, BOEM is not involved at all, and the state agencies play a much larger role.

Coordination across agencies with the applicant is key to ensure efficiency, reduce sequential information gathering, and develop mitigation and monitoring programs that satisfy all agencies' needs. Uncertainties are a given, and require careful, thoughtful participation to navigate meeting regulatory responsibilities with scientific uncertainty.

Permitting Examples:

Examples of Grid connected on Outer Continental Shelf and Grid Connected in State Waters were presented showing who is involved and an overview of the process.

Project Examples:

Two example projects were showing the timeline and experiences from pilot licence to licence being granted - Snohomish Public Utility District and Ocean Renewable Power Company – Maine.

Environmental Monitoring Requirements:

Since there is relatively little data available regarding the environmental impacts of MRE devices, extensive environmental monitoring is often required as a stipulation of issued permits. An analysis of permitting documents for 10 projects (riverine, wave and tidal) was undertaken to determine the most common environmental concerns being raised by the regulatory community as well as to understand cost estimation for the various monitoring requirements. The environmental concerns and required monitoring that were most frequently noted include aquatic animal interactions with the devices, the acoustic output of the device, geophysical implications and sediment transport, avian monitoring and impacts of electromagnetic field. This information has shaped the Department of Energy's environmental research strategy.

Wind and Water Power Technologies Office (WWPTO):

The Department's WWPTO's mission is to accelerate the deployment of wind and water power technologies through improved performance, lower costs, and reduced market barriers. To assist with market acceleration and deployment a four-pronged approach has been developed.

- Data collection and experimentation, which utilizes laboratory experiments and collection of data from the field, to address environmental issues.
- To support monitoring and mitigation technologies and techniques. Often existing monitoring technologies are insufficient to provide the required environmental monitoring, so we are investing in improving the technologies.
- Information sharing and international collaboration – aggregating the information on environmental impacts that already exists, making it accessible and useable. Tethys Database and State of the Science Report on Environmental Effects of Marine Renewable Energy Development Around the World[28].

[28] http://tethys.pnnl.gov/annex-iv-2016-state-science-report-public-review-draft

- Baseline cost analyses for environmental monitoring and permitting.

Upcoming activities for the Department:

- Determine a baseline estimate of environmental monitoring and permitting contributions to LCOE;
- Determine ways to reduce costs associated with permitting and monitoring to reduce LCOE and make marine renewable energy cost competitive;
- Funding opportunity to test, improve and validate environmental monitoring instrumentation.

OEF Session 5 (Roadmap Key Recommendation 4.1); Establish a Europe-wide phase-gate procedure

Session Lead: Fiona Buckley, ENGIE & Jacopo Moccia, Ocean Energy Europe (Chair and Secretary General of Technology Steering Committee)

Context:

Where a technology or concept is unproven, it is difficult to stimulate private investment for demonstration projects due to the perception of unreliability. Accessing such risky private capital is particularly problematic amidst an unprecedented financial crisis.
Reducing the risk of demonstration device failures and, therefore, reassuring private investors is key for less mature ocean energy technologies – such as innovative wave energy concepts, OTEC and salinity gradient – and for game-changing innovations in the better understood wave concepts and tidal technologies.
To this end, before a device is demonstrated at full-scale in real sea conditions, it is important to ensure that critical components and sub-systems are tested and effectively validated. In parallel, validation of the interaction of the components and subsystems in the device as a whole need to progress at the same pace.
Taking a device to demonstration in real sea conditions with greater certainty over the capabilities of the critical components and how they interact within the device, reduces the risk of the latter failing and, therefore, reduces risk perception for investors.

A proposal has been developed to help guide the creation of a new co-operative R&D funding instrument and we are seeking opinion on the proposal and the basic structure outlined for the fund's operation:

- A Public-Private Partnership
- Industry Expert Committee
- Advisory Group
- Calls for proposals and allocating funding

Discussion:

The discussion has been split into the following topics for ease of reference.

Clarifications:

The following points were clarified during the discussion.

- Will this cause more bureaucracy for the developer? Before taking something to sea – not just looking at components. Looking at R&D not so much deployment. Money would be made to developers. Technology that can be commercialised so not every project Not all uncertainties can be addressed without putting devices into the water. **Needs to be made explicit that it includes prototypes.**
- Important to distinguish whether it is components or a machine that the KPIs are targeting – the ultimate KPI will come from proving the components in a machine (i.e. a single device). Only validate the concept if you've validated the whole sub-system. **This process starts at the sub-system level and not intended for components - will be highlighted in the paper. Components could be also included depending on the component and on the development stage of the device.**
- The question asked should be whether a "project" will lead to long-term lowering of the cost of energy – if it won't then why would we support it?

- Need to be mindful that this process could be interpreted by developers as another barrier to funding. Note: there will always be some criteria to meet in order to obtain any funding. This will not replace all R&D funding in Europe and does not replace Horizon 2020. Moving away from in-year funding and one-off projects – getting to a specific phase before further funding is allocated and before deployment. Developers will not be forced to go through this process – if other funding streams are available then it's fine to continue with that.

KPIs:

A phase-matrix was outlined to show where the phases would "fall".

- Example of a phase matrix

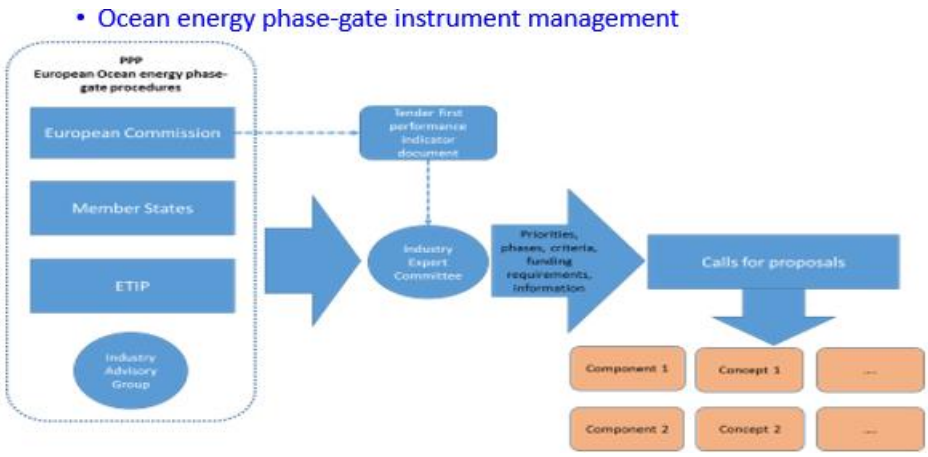
	Feasibility	Experimental modelling	Lab testing	Controlled/ sheltered sea test	Relevant sea condition	Validated concept
Array (If applicable)						
1 Full-scale device						
1 Medium-scale device						
1 Small-scale device						
Key components						

- Phase-gating is important and encourages a logical engineering approach to help ensure the developer follows a robust development path (e.g. ORE Catapult[29]).
- The question was asked "Would developer be *tied*-in before next stage? Yes – criteria needed to be met before moving from one phase to another. Developers can come into the phase-gate process at any time.
- Criteria / KPIs developed by industry experts to bring practical knowledge to the process.
- Each gate also needs to state what the pass mark is (helps with confidence for investors). The key will be to decide on a common approach that is then shared by different Member States which will progress the overall sector.
- Need to learn lessons from before and demonstrate why this is different (e.g. Pelamis). This approach not being set up to "reward" full scale devices at the end.
- Some might not want to discuss design. Openness and collaboration between developers is seen as key to this approach. Generic/common problems can be worked on without sharing IP. There needs to be a mechanism for feedback to reduce future uncertainties.

Structure, Funding and Timescales:

The following management structure was proposed. A Public-Private partnership. Member States may contribute as well as the Commission and companies.

[29] https://ore.catapult.org.uk/who-we-are



- Need to include financiers. Replace industry advisory board with Finance – though experts set the indicators (criteria and pass marks) first. Financiers should build in the expectation that not all the projects will go through to the end of the process and that it important to learn from this.
- Allow mechanism within management structure for the indicators' work to be signed-off before calls for proposals.
- A feedback loop should be included in the phase-gate's management to ensure future tender calls are refined and robust. Rather than having questions for every project, have "flexible exam questions" that can be tailored to the funding mechanism. The setting of these could be the role of the advisory experts.
- A Secretariat would manage the fund.
- How much does this cost? ORE Catapult estimated private and public funding needed - £100m for wave and £200m for tidal[30] to get first arrays for financial close. Experience suggests that to take something through R&D to full scale (TRL 1-5) is approx. 100m euros.
- Timescales for this should be aligned with the Roadmap timings (2017 – 2025) - the length of the process could take approx. 5 years.

Other:

- A risks and benefits section in the proposal would help in selling plan to the Commission and Member States.
- Consider the language in the plan – make more positive. Sell the benefits of the IP/know-how.
- The benefits are not obvious to developers in the paper at the moment so these should be highlighted to get buy-in.
- KPIs will need to consider further if several companies with similar technologies can push through the system.

Summary:

- Phase- gate process is not replacing existing R&D funding
- Make clear prototypes included and process starts at sub-system level

[30] http://renews.biz/81112/catapult-calls-for-marine-lifeline/

- Positive language – clear benefits – e.g. IP / know-how and long-term reduction in cost of energy; lessons learned from previous and how this is different; manage expectations (include risks and benefits section in plan)
- Need to develop a path to determine gates and pass mark
- Certain tests in water expected
- Element of flexibility (e.g. to enable gates to be accessed)
- Collaborative element should be included to reduce future uncertainties as well as a feedback mechanism to adjust future funding calls
- Amend Industry Advisory Group to Finance Advisory Board
- Timings 2017-2025, aligned with Roadmap

OEF Session 6 (Roadmap Key Recommendation 4.5); Collaboration to reduce costs and plan deployment

Discussion of options to derive a contract structure model (risk options, strategies, best practice codes etc.) and how to develop new mechanisms for co-operation between the ocean energy and banking sectors that will enable the shift from investment support to revenue support associated with industrial roll-out.

Chaired by: Tony Lewis (University College Cork), with representatives from relevant projects.

Context:

When development and costs were initially considered it was not expected that costs would decrease in the short-term. To become viable, the machines must be proven to work. Co-operation, collaboration and standardisation is required if investors are to be attracted. Device standards are required and need to be appropriate/sufficient to use within the finance community. Co-operation, sharing best practice, vessels, understanding weather risks, and impacts will all help to make this work. Engagement with financiers and insurers is key and will ease access to public support.

How do we get to this stage? The Draft Strategic Roadmap proposes creation of an industry working group to interact and increase knowledge and reduce financing risks.

There is no draft paper on this Key Recommendation as yet, so the session is being used to share current examples and experiences of collaboration.

Session Structure:

Presentations followed by discussion.

Presentation 1: OCEAN ERA-NET; Karen Fraser, Scottish Enterprise

- **Ocean Energy European Research Area Network (ERA-NET)**[31], funded by the EU.
- Brings together 15 European research funding organisations from 8 EU Member States.
- The objective of OCEANERA-NET is to coordinate funding programmes between European countries and regions to support research and innovation in the **ocean energy sector.**
- 1st Joint Call for proposals 2014 to enable collaborative research, development and innovation projects to tackle current challenges for the development and competitiveness of ocean energy technologies; **9 proposals funded.**
- 2nd Joint call for proposals Feb 2016 - aiming to tackle current challenges and taking advantage of opportunities by enhancing access to transnational value chains, towards the development and competitiveness of ocean energy technologies.

[31] http://www.oceaneranet.eu/pages/new-page-5.html

Presentation 2: Wave Energy Scotland; Henry Jeffrey, University of Edinburgh

- Wave Energy Scotland (WES)[32] supports the development of wave technology through an extensive technology programme.
- Funding the development of innovative technologies to produce low cost, efficient and reliable components and subsystems which will form the basis of the cost effective generation of wave energy in Scotland.
- Annual funding budget iro £14m. Current programme includes 17 power take off projects and 8 novel wave energy converter projects together with 4 research projects in related fields.
- The programme will enable developers to take projects from the earliest stage of development through to proving and demonstration to help reduce the technical and commercial risk of further development and attract private sector investment.
- Looking to further increase quality of programme in the next stage of funding and currently landscaping topic. In particular, knowledge transfers from other sectors.

Presentation 3: Max Carcas, Caelulum Ltd.

- Emphasised need for collaboration, within sector – e.g. test centres and standards, and across other sectors – e.g. wind, solar and biomass.
- Collaboration is not an option – it is a must to overcome obstacles.
- Forced collaboration was mentioned - has limitations. Needs to be an appetite to work together.
- Collaboration doesn't always have to be formal (e.g. engineers will talk).
- Investment throughout the supply chain – doesn't always have to be investors; suppliers may be willing to invest as they are interested in the project. E.g. utility companies working in a machine to overcome O&M issues.
- Understand that sometimes collaboration might mean exclusivity.
- Standards help with insurance, weather and breakdown risks -> reduce costs through confidence in industry.

Presentation 4: John Huckerby, Wave Developer

- Worked in New Zealand 2003-2013
- Agree "financials" (e.g. split of money)
- Good:
    - Device within sea in 2 years
    - Certification DNV
- Not so good:
    - Time spent on IP – patents difficult to get

Presentation 5: John McCarthy, Ocean Energy

- "How has collaboration helped us?"

[32] http://www.hie.co.uk/growth-sectors/energy/wave-energy-scotland/

- Components for Ocean Renewable Energy Systems (CORES[33] EU project) – funding to help get to TRL 5-6
- For TRL 7-8 – finding matched-funding
- US Department of Energy test centre collaborating with US Navy infrastructure – DoE

Discussion:

- From Roadmap, people liked the idea of sharing experience and data
- Denmark has good transparency examples
- WES further work on teasing out benchmarks
- TETHYS[34] environmental monitoring database Annex IV - US Department of Energy is a good example of a central repository *(already noted in Session 4 discussions)*
- Costs come down at industrial roll-out – industry players need to come together and there needs to be closer working with the banks and insurance sectors
- Sometimes good for a developer to maintain flexibility even if you have to pay for it
- Collaboration needs to help ensure the sector doesn't keep asking for "the same" especially from public money; public money cannot fund the same things
- Industry will collaborate if the cost and opportunity is high enough
- How do we ensure collaboration is linked across the Roadmap as a whole?

[33] http://www.fp7-cores.eu/

[34] http://tethys.pnnl.gov/

Session 7 (Roadmap Key Recommendation 4.2); Connecting the most promising resource to the grid to enable first demonstration farms

Chair: Simon Cheeseman, ORE Catapult (Wave & Tidal Sector Specialist)

Context:

The Draft Strategic Roadmap (October 2015) proposes that before the ocean energy sector can reach bankability and commercial viability necessary for industrial roll-out, the fist ocean energy pilot farms must reach financial close. Due to high-levels of risk and uncertainty, demonstration and pre-commercial farms require a specific financing solution. One solution proposed is that of publicly funded pilot zones, possibly targeted at tidal range, helping to reduce the prohibitive costs that a single project may have to bear. The demonstration phase of technological and commercial maturation is characterised by multiple grid-connected devices, with deployment in real sea conditions. Devices are installed as pre-commercial arrays suitable to inform future large commercial farms. They should be connected to a hub or substation feeding electricity to the shore.

Session Structure:

Presentations followed by discussion.

Presentation 1: Sabella project overview

- Diane Dhome, Sabella[35]
- Sabella D10 was the first connected turbine in France (Brittany)
- Funded through a full-scale demo call – 30% public, 70% private funding
- Site chosen as grid nearby; connection to Ushant island grid through a 2km offshore cable; has strong currents; island offers some protection at the site
- Output limited to 250kw though produces more than 250KW on load bench
- Cable protected nearshore only

Presentation 2: ERDF High-Voltage Grid Ouessant

- Guillaume Coing-Roy, ERDF
- Grid connection requirements, the issues associated with periodic energy supply from renewables and nuances of the Ouessant grid were presented
- System stability provided by ERDF High Voltage Grid
- Extension of the HV grid to connect Sabella's substation must be realized => creation of 500 meters HV
- Due to the specific voltage (5,5 kV) and the distance between the 2 power plants, the grid cannot accept a high power input without reinforcements
- Ouessant (Sabella) grid (non-interconnected) specificities vs continental grid (connected) were shown

[35] http://www.sabella.fr/index.php?lg=gb

Presentation 3: MeyGen Project

- David Collier, MeyGen[36]
- Experiences and considerations were outlined: lots of issues with cables
- Planning: Environmental, Consenting
- Grid Connection: Agreements, Termination, Voltage, Auxilliary Supply
- Onshore base – site (leading, land, proximity to cable), equipment (security, noise)
- Installation – fatigue, loading

Discussion:

- Grid connection to a consented site (all publicly funded) is very attractive to a device developer but less important to a project developer. Project developers want to develop sites themselves but need public funding support to meet the initial costs until the site can generate revenue. Technology developers have shorter term needs and want to focus on device development without having to worry about site preparation issues.
- To develop a publicly funded demonstration zone, you require robust consultation with technology and project developers. There is no reason why, if the site is large enough, they cannot co-exist on the same site. Typically providing some infrastructure to support single or two, three device arrays on short-term leases to prove pre-commercial devices in larger arrays to gather performance, reliability data and optimise O&M process. Therefore, need to decide on technology / device / array scale and knowledge of industry development and planned route to market to make site commercially attractive.
- Need to have a robust commitment up front to justify infrastructure costs that the site would be used. The provision of local supply chain devices (e.g. offshore support, fabrication, berthing, HV qualified electricians, R&D facilities) will help generate returns for local industry and ease the pain of local disruption caused by movement of large devices and mobilisation of infrastructure.
- A clear upfront pricing structure will need to be put in place. Bespoke negotiations take too long and may block berths.
- Revenue generation is important to attract clients and it may be necessary to negotiate better rates for demonstration sites as devices will spend more time online generating than e.g. test sites, where devices may be continually switched on and off.
- A developer will need to make an allowance for downtime and unexpected losses (no revenue) – e.g. due to adverse weather preventing planned device development or hampering retrieval.
- For Wavehub, developers still have to put turbines there and cover the costs.
- For offshore wind, demo did not get buy-in from public sector.
- In France, every region has a plan and there is consideration of how to evolve the grid; drawing into a common pot to support development process.
- Wavehub[37] is still in the early stages of berth occupation; all berths are currently taken and developers' devices (Seatricity[38] and Wello Penguin[39]) have arrived. Important to share the generic learnings from test sites and carry the learnings through to inform European strategy.

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[36] http://www.meygen.com/
[37] http://www.wavehub.co.uk/
[38] http://seatricity.com/
[39] http://www.wello.eu/en/penguin

- Consider decommissioning at test site – e.g. Developer will need to lodge a decommissioning bond which needs to be enough to clear the seabed completely.

Conclusion:

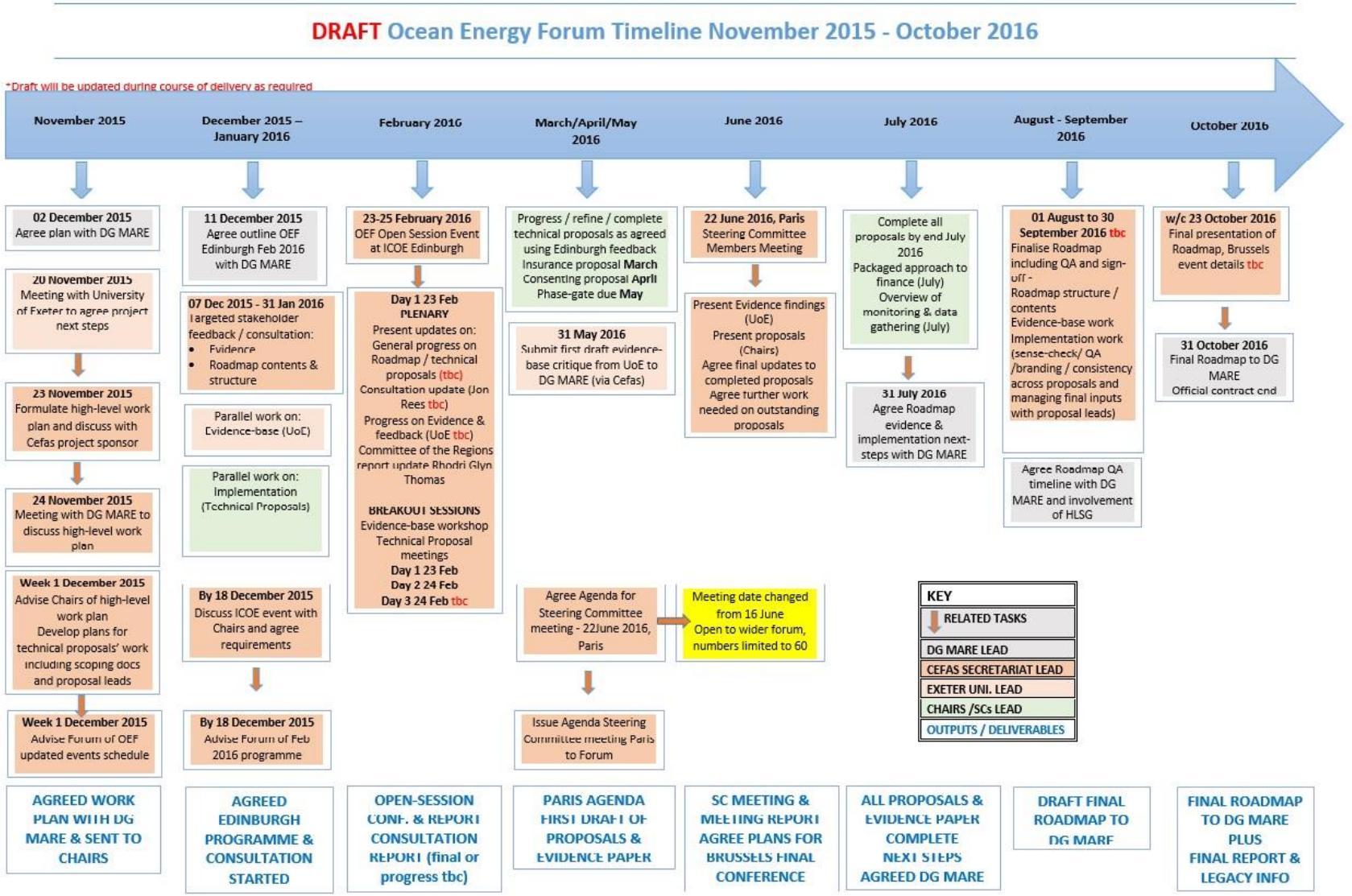
The meeting felt that there was merit in publicly funded demonstration zones though there is a need to define arrangements – e.g. funding, leasing, revenue, local supply chain and to define technology assessment requirements - as well as understand learnings from existing sites.

They would be very attractive to technology developers, but would need to be carefully laid out with flexible lease arrangements to act as a credible interim stepping stone for project developers. Grid access, revenue generating capability, port access and local supply chain are all essential.

Providing a level of infrastructure that is flexible to suit a range of developers' technology will be challenging and some compromise may be required. Learning generic lessons from existing test sites and early stage demonstration sites through a workshop would be very beneficial.

Shaping and aligning public calls to enable creation and population of demonstration sites will be necessary. Assessing technology to ensure it is sufficiently mature to deploy to a demonstration site will prevent berth blocking. ORE Catapult is prepared to support further work to define publicly funded demonstration zones and define technology assessment requirements.

Appendix 4; Process Map setting out next steps




Cefas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