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UKERC Spatial Planning for Marine Renewable Energy Arrays Workshops

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Workshop Report

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Event organised and sponsored by the UKERC Meeting Place.

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This document is a report by the organiser of a technical meeting set up as part of UKERC's research programme. It is believed to be an objective record of the meeting but has not been separately reviewed by the participants

THE UK ENERGY RESEARCH CENTRE

Operating at the cusp of research and policy-making, the UK Energy Research Centre's mission is to be the UK's pre-eminent centre of research, and source of authoritative information and leadership, on sustainable energy systems.

The Centre takes a whole systems approach to energy research, incorporating economics, engineering and the physical, environmental and social sciences while developing and maintaining the means to enable cohesive research in energy.

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THE UKERC MEETING PLACE

UKERC also acts as a two-way portal for the UK energy research community for both UK stakeholders and the international energy research community. The National Energy Research Network (NERN), supported and facilitated by UKERC, acts as an umbrella network for energy researchers across all disciplines. The UKERC Meeting Place, based in Oxford, is a key supporting function of UKERC that aims to bring together members of the UK energy community and overseas experts from different disciplines, to learn, identify problems, develop solutions and further the energy debate.

Core Organising Team
Katie Begg, Edinburgh University (UKERC)
Annie Linley, Plymouth Marine Laboratory (PML)
George Lees, Scottish Natural Heritage
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Tim Norman, The Crown Estate
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Executive Summary

Introduction

Two workshops brought together around 40 experts including policy makers and advisors, scientists, businesses and civil society organisations to provide a neutral forum, under Chatham House rules, for full and frank dialogue to discuss measures for maximising the sustainability marine energy arrays within the UK government target timescales. The first workshop, "Marine Planning for Arrays: Social, economic and environmental issues and implications", examined the social, economic and environmental impacts and cumulative impacts relating to siting and deployment of arrays and how to integrate the assessment and management of these using a holistic approach that considers the entire marine and coastal system. The second workshop, "Marine spatial planning for the deployment of arrays", examined the marine planning policy context, simplification of consenting, locational criteria and models under development to aid decision-making.

Workshop Process

Workshop 1 was divided into three sessions. Session one was on deployment of arrays and socio-economic effects, while session two focussed on the environmental impacts of arrays. The third session looked at integrating environmental, social and economic issues. Workshop 2 was divided into four sessions with the first covering the policy context for sustainable marine spatial planning for deploying arrays. Session two focussed on locational criteria, session 3 on integrating models to support decision-making, and session 4 drew conclusions on key research related needs and issues for Marine Spatial Planning.

In both workshops, each session began with one or two short presentations. This was followed by facilitated group work or plenary discussions, or both. Group discussions were recorded on flip chart paper and notebooks, then summarised on pre-defined poster templates and power point presentations (see Appendices).

Main Recommendations for Sustainable Marine Spatial Planning

Most participants attended both workshops. As the workshops progressed, participants formulated conclusions and questions that were both general and specific in nature. The key recommendations are summarised below:

1. A 'whole system' approach which considers engineering, environmental and socio-economic factors is needed, so that a sustainable outcome is a clear objective for all stakeholders. Whole system thinking includes the project, the marine ecosystem, local communities and geographical region in which they are located, with implications for grid connections and supply chains.
2. To capitalise on the economic opportunities presented by MRE development, there is a pressing need for UK government vision and leadership, as well as integration across institutions i.e. research councils/government departments/ local government/quangos. However, the Scottish Government initiatives on regulatory simplification and locational guidance, with support for developers and communities indicate the way forward.
3. The current policy and regulatory frameworks do not adequately facilitate array project development, especially the tendency to large EIAs with lack of

auditing and feedback for improvements. Better quality baseline information is required, with monitoring strategies geared to adaptive management as new tools and knowledge emerge from research. There is confusion about MSP decision tools in development, their applicability and complementarity.

4. Knowledge exchange is poor across government, and between developers and researchers, and specific networks and initiatives are required to focus on the MRE sector. Partnerships with end users will ensure knowledge exchange with policy/regulation and device development communities.
5. Device design and project development needs to progress with *a priori* environmental and socio-economic considerations (e.g. collision avoidance, life cycle analysis) and remain open to feedbacks as research progresses.
6. A better model for engaging with communities and key stakeholders is needed to facilitate social and economic integration. Maximising the social and economic benefits of projects and promotion of sustainable marine space usage will improve public acceptability of marine arrays. Social and economic analysis needs to be included in Strategic Environmental Assessment (SEA) and experienced staff are required in government to support these processes.
7. There are significant gaps in knowledge of the effects of energy resource extraction on healthy ecosystem functioning. This understanding is needed for the whole range of ecosystem components, including water column ecology / processes, benthos and fisheries – not only species which the UK has legal obligations to protect. Also simple indicators of ecosystem function and methods for impacts detection against a variable baseline are needed.
8. There are important data gaps at both temporal and spatial scales (e.g. hydrography) and better mining of existing data, data exchange and greater public accessibility are required, as well as SMART objectives for data collection. Decisions about how data will be stored, accessed and maintained need to be made urgently to avoid silos developing and ensure access for all.
9. There is a need for ESRC / NERC to engage and recognise the requirement for applied innovative research, by integrating and using existing research activities to respond to the research questions and issues of the MRE sector.
10. 'Whole systems' thinking needs to be promoted if the UK is to realise the potential of this sector – both in terms of delivering low carbon energy to minimise climate change impacts and developing supply chains to support economic development. The RCs therefore need to encourage cross-disciplinary studies and develop appropriate funding opportunities jointly.
11. Marine Spatial Planning is progressing in advance of effective protection of marine ecosystems, and better coordination between these activities is urgently required. MPA and N2K planning needs to take account of conflicts with marine energy, and research on implications for ecosystems and biodiversity benefits of MRE is also needed to inform policy. Conservation and marine spatial planning particularly need to be integrated.
12. A common understanding of sustainable marine energy development needs to be promoted and embedded across all stakeholder organisations to ensure a sustainable outcome for the whole marine energy system.

The following table provides a summary of recommended actions for policymakers, regulators, developers and research funders to facilitate marine energy array development in future.

	Policy makers and regulators	Developers / energy companies	Research needs (Research councils, research scientists etc.)
Socio-economics	• Include socio-economic aspects in SEA/EIA and engage broader stakeholder communities (i.e. non-scientific) and include these aspects in a more strategic planned approach • Develop guidance for developers on dialogue processes for identifying wider socio-economic benefits • Communicate effectively urgent need for technology change to decision makers at all levels in the global context	• Explore and develop new ownership models directly with host communities (e.g. CICs) • Adopt best practice for dialogue processes with communities (not just consultation) • Design processes to capture local economic needs and mobilise local knowledge from the start of a project • Engage researchers in site based studies to identify and promote win-win outcomes with other sectors e.g. fishing	• Psychological / perceptual / socio-economic barriers to energy project implementation • Designing and implementing processes for sustainable energy communities for delivering benefits at local and strategic levels • Novel approaches to developing interactions with other sectors (e.g. fishing, navigation) • Compensation (i.e. not just financial), enforcement and conflict resolution
Environmental	• Drive best practice in EIA – promote quality prediction & analysis and relevant data collection • Ensure targeted & rational approach to monitoring to minimise burden on developers • Coordinate data sharing / meta data management for wider industry benefits • Promote transfer of knowledge from other marine sectors and research centres to policy and regulatory community	• Device design / site selection to take account of environmental impacts • Include device environmental assessment with engineering performance assessment • Promote information sharing with respect to common problems / cross-sectoral interests	• Funding focus on multi disciplinary 'whole' and healthy ecosystem research • Major gaps regarding whether energy extraction constitutes 'sustainable use', and mammal / bird interactions with technology • Development of risk management, cumulative impact assessment and decision support tools • Development of monitoring guidance with regulators to facilitate adaptive management
Integration	• Strategic planning is needed to avoid duplication of effort / clarity for developers • Leadership & innovation needed on development of marine spatial planning tools • Promote one stop shop for consenting with back up from experienced regulatory staff • Develop locational guidance for developers & review regularly • Develop common tools for MSP and consistent decision making processes for assessing sustainability	• Publicise through websites success stories for all industry to share • Make data available to others where possible for synthesis of best practice	• Strategic integration across funding agencies ie. research councils, UK and devolved government departments, NE, CE for optimal outcomes • Leadership from RCs to promote integration of environmental and socio-economic with engineering research (i.e. cross disciplinary calls & networks to avoid research silos) • Funding opportunities which promote whole system thinking at grass roots research community with focus on common measures of sustainability
Sustainable design	• Promote and communicate need for sustainable device / project design to minimise cumulative effects • Promote goal of optimising socio-economic benefits and sustainable use of marine space	• Optimise choice of site and device to mitigate impacts at project design stage • Maintain dialogue with research community to ensure knowledge exchange & rapid learning from demonstrator projects • Collaborate with researchers for feedback	• Promote sustainable engineering design which considers C footprint and environmental consequences of operation • Engage environmental and socio-economic researchers in developing appropriate design codes • Facilitate knowledge exchange between engineering, environmental and socio-economic researchers at all levels
Sustainable energy communities	• Promote best practice in stakeholder dialogue processes • Provide leadership and appropriate policy guidance especially regarding inter sectoral conflicts • Join up conservation and marine spatial planning in government • Research and rationalise use and accessibility of MSP tools being developed	• Recognise significance of 'host' community in long term sustainability of projects • Explore different ownership models • Maintain dialogue with 'host' community for avoidance of surprises	• Explore ownership, development/ control models in other cultures and sectors for sustainable energy communities • Explore / assess impact of change management in organisations / communities • Develop case studies and communicate 'lessons learnt' for benefit of all renewable industry

Contents

Acronyms

ADCP	Acoustic Doppler Current Profiler
CE	Crown Estate
COWRIE	Collaborative Offshore Wind Research into the Environment
CEFAS	Centre for Environment Fisheries and Aquaculture Science
DECC	Department for Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
EIA	Environmental Impact Assessment
EMEC	European Marine Energy Centre
EMF	Electro Magnetic Fields
EPSRC	Engineering and Physical Science Research Council
ESRC	Economic and Social Research Council
ETI	Energy Technology Institute
FLOWW	Fisheries Liaison with Offshore Wind and Wet Renewables Group
GHG	Green House Gas
ICZM	Integrated Coastal Zone Management
IEA	International Energy Agency
IPC	Independent Planning Commission
IPCC	Intergovernmental Panel on Climate Change
LCA	Life Cycle Analysis
MCT	Marine Current Turbines
MESPG	Marine Energy Spatial Planning Group
MMO	Marine Management Organisation
MOD	Ministry of Defence
MPA	Marine Protected Area
MRE	Marine Renewable Energy
MRED	Marine Renewable Energy Devices
MRESF	Marine Renewable Energy Strategic Framework
MSP	Marine Spatial Planning
MS	Marine Scotland
N2K	Natura 2000
NE	Natural England
NERC	Natural Environment Research Council
NIMBY:	Not In My Back Yard
NOREL	Nautical and Offshore Renewable Energy Liaison Group
OE	Ocean Energy

OREEF	Offshore Renewable Energy Environmental Forum
RAG	Regional Advisory Group
RC	Research Council
RCEP	Royal Commission on Environmental Pollution
SEA	Strategic Environmental Assessment
SMART	Smart, Measurable, Achievable, Realistic, Time-bound
SMMO	Scottish Marine Management Organisation
SNH	Scottish Natural Heritage
UNFCCC	United Nations Framework Convention on Climate Change

Organisation of the report

The report begins with an explanation of the rationale for the workshop. Short summaries of each presentation are given, with a link provided to any respective powerpoint presentations. Appendix 1 is the workshop programme, Appendix 2 lists participants, affiliations and email addresses. Appendix 3 is a summary of research gaps on environmental impacts identified at a NERC workshop, Appendix 4 contains a summary for Integration of issues and Implications for Policymakers and Developers, and Appendix 5 is a paper entitled, 'Practical Tools for Marine Planning: An Assessment of Cumulative Effects of Human Pressures on the Marine'.

Throughout the document there are process notes, highlighted in shaded boxes with the following symbol:

Throughout the report, spellings have been standardised, abbreviations spelled out and punctuation inserted where it may help to clarify meaning.

Background to workshops and key aims

Policy context
Given the urgency of climate change as well as ocean acidification problems and security of supply issues, targets have been adopted for the UK of an 80% reduction in greenhouse gas emissions. Within the EU, targets to increase energy supply from renewables imply a range of measures for the UK including deployment of around 25 to 33GW for offshore wind energy and 2GW for wave and tidal energy by 2020. The challenge is to achieve these targets within the required timescale, without significant detrimental impacts on the environment and with due attention being paid to social and economic implications. It is likely that the new proposed marine planning system under the Marine Bills will have to reconcile many conflicting interests and objectives. Processes will also have to be carefully devised to achieve desired goals, while developments in technology and deployment will need to be carefully designed to minimise problems.

Aims
In this context the overall aim of the two workshops was to contribute to maximising the sustainability of deployment of arrays of marine energy devices in the target timescales for avoidance of global climate change. Two back-to-back workshops were held. The first workshop, "Marine Planning for Arrays: Social economic and environmental issues and implications", examined the social, economic and environmental impacts and cumulative impacts relating to siting and deployment of arrays and how to integrate the assessment and management of these using a holistic approach for the entire marine and coastal system. Outputs from this first workshop fed into the second workshop, "Marine spatial planning for the deployment of arrays", which examined the marine planning policy context, simplification of consenting and locational criteria and models under development to aid decision making.

The aims of the first workshop, "Sustainable marine planning for arrays: Social economic and environmental issues and implications" were more specifically to:

- develop priorities for social, economic and environmental knowledge gaps/issues relating to deployment of arrays and planning, including cumulative impacts, with a view to feeding these priorities into the research agenda of relevant funding bodies and the development of environmental impact assessment processes.
- identify and discuss the implications for policymakers and developers of the sustainability issues identified and their integration in planning processes for achievement of deployment targets and timetables;
- discuss how decision-making processes can be supported in order to achieve an integrated and holistic approach to addressing/managing environmental, social and economic impacts/considerations across the whole marine and coastal system;
- network and engage with marine scientists, policymakers and developers and other stakeholders on cumulative impacts of arrays and latest research findings.

The aims of the second workshop, "Sustainable marine spatial planning for the deployment of arrays" were to:

- provide participants with an update on the policy context in Scotland and the UK;

- enable an in-depth assessment of spatial aspects of marine planning through discussion of simplification of consenting and locational criteria and their appropriate use for sustainable development of arrays in accordance with Scottish and UK government interests;
- inform participants of the latest decision support tools being developed for marine planning with discussion on how these tools will be used within the marine planning system;
- discuss findings and issues arising from the UKERC workshop, "Sustainable marine planning for arrays: Social economic and environmental issues and implications", held the previous day;
- facilitate dialogue and networking between marine scientists, policymakers and developers and other stakeholders with an interest in marine planning for arrays.

Format

Both workshops involved expert presentations and facilitated small group work with around 40 invited experts from academia, industry, NGOs and Government attending each workshop

WORKSHOP 1 - Sustainable marine planning for arrays: Social, economic and environmental issues and implications

Session 1: Sustainable deployment of arrays: socio-economic effects

Welcome and context-setting

Katherine Begg, University of Edinburgh.
Click here for Katherine's presentation

Katherine Begg welcomed participants, introduced the UK Energy Research Centre (UKERC) and Edinburgh University's Centre for the Study of Environmental Change and Sustainability (CECS).

She began by pointing to the key messages of the recent UNFCCC Conference of the Parties, held in Copenhagen:

1. Climatic Trends (extract): Recent observations confirm that, given high rates of observed emissions, the worst-case IPCC scenario trajectories (or even worse) are being realised. There is a significant risk that many of the trends will accelerate, leading to an increasing risk of abrupt or irreversible climatic shifts.
2. Social Disruption
3. Long-Term Strategy (extract): Rapid, sustained, and effective mitigation based on coordinated global and regional action is required to avoid "dangerous climate change".
4. Equity Dimensions
5. Inaction is Inexcusable
6. Meeting the Challenge: To achieve the societal transformation required to meet the climate change challenge, we must overcome a number of significant constraints and seize critical opportunities. These include reducing inertia in social and economic systems; building on a growing public desire for governments to act on climate change; removing implicit and explicit subsidies; reducing the influence of vested interests that increase emissions and reduce resilience; enabling the shifts from ineffective governance and weak institutions to innovative leadership in government, the private sector and civil society; and engaging society in the transition to norms and practices that foster sustainability.

Katherine then outlined key aspects of UK policy - climate change targets of at least 80% reduction in GHGs by 2050 and by 2020, the installation of up to 2GW wave and tidal and 25-33GW of offshore wind. Achieving this in such a short space of time while maintaining equity and enabling societal transitions to avoid destroying what we need to preserve, presents a formidable challenge. There exists evidence to

suggest major disconnects between perspectives of marine stakeholders and gaps in effort.

These workshops are intended to allow focussed discussions to facilitate communication between stakeholders for cooperative action and to identify and address gaps. Two key aims for the workshops are:

a) to construct integration strategies for sustainable device design, site selection, research integration and leadership governance and competence issues.
b) Formulate elements of an action plan for enabling sustainable deployment of arrays in timescale.

Workshop outcomes will be fed back to the Research Councils as well as other relevant decision-makers and stakeholders.

Understanding public responses to renewable energy

Claire Haggett, University of Edinburgh

Click here for Claire's presentation

In capturing lessons learnt from past developments, Claire opened her presentation with three key points:

1) People matter:
   - Importance of addressing socio-economic factors
   - Concerns have to be listened to and taken seriously
   - Reasons for support and opposition need to be understood and addressed
2) People are not 'Nimbys'
   - Lack of evidence for selfish parochialism, rational free-riders
   - Conceiving of people as a 'problem' is likely to lead to problems
3) Decision-making processes affect support and opposition
   - Pragmatic: likelihood of achieving desired outcomes
   - Democratic: people have a right to be involved
   - Expertise: local people as local experts

The key message is that socio economic issues have to be addressed. Involving people in the decision has several advantages:

- better policy,
- engagement of interested and affected
- groups, greater likelihood of support for the project, and of achieving long term sustainable solutions

Sustainable marine planning for arrays: timing and infrastructure,

B*ridget Woodman, Exeter University*

Click here for Bridget's presentation

Bridget began by pointing out that offshore wind is a key contributor to the UK's proportion of the EU target but plans are behind schedule and an unprecedented build rate will be necessary to meet targets. Bringing power onshore will involve a competitive bidding process for contracts which Bridget warned may lead to individual connections rather than networks. She also warned that the construction timetable is likely to lead to bottlenecks in both transmission and windfarms. Bridget summed up by saying that the regulatory regime would encourage more lines but

does not offer a strategic approach to setting up offshore infrastructure with limited scope for integrating future developments of wave and tidal technologies.

Session 1 Group work: Socio-economic knowledge gaps and issues relating to deployment impacts

Participants were asked to write down key gaps and issues relating to socio-economic effects of deployment of technologies. These were clustered and used to divide the group into smaller groups. Using pre-defined poster templates, the groups set out the following:

- Description knowledge gap or issue e.g. stakeholder
- How could the gap/issue be addressed (options)
- Implications for:
  - policy-makers
  - developers
  - integrated approach

Groups displayed outputs on the wall and then reviewed the outputs of other groups, adding comments and raising questions. At the end of the session, participants returned to their original outputs and responded to comments and questions raised by other participants.

Session 2: Sustainable deployment of arrays: environmental effects

Progress on environmental impacts and priorities of RAG,

Mike Elliott, Hull University and John Hartley, Hartley Anderson.
Click here for presentations

Professor Elliot provided a comprehensive review of approaches and research on environmental impacts including the ecosystems services approach. The complexity and range of possible environmental impacts over the life cycle of an offshore wind energy installation were explored and recent summary results presented. A key question was how to develop 'whole system' methodologies which yield environmental gains whilst meeting technological, social and policy goals in order to raise the profile of environmentally focussed research as opposed to that which is technology driven. The big issues identified were:

- What are the consequences of energy extraction by wind, wave and tidal devices for ecosystems and biodiversity? Is this a sustainable use of natural resources?
- What opportunities are there for ecosystem / biodiversity gains generally – both for bio-resources and marine biodiversity?
- Does energy extraction constitute sustainable energy use? Are there effects at the scale of individual devices/arrays and multiple arrays?

The presentation concluded that a comprehensive programme of bold and innovative research with priorities identified is required to:

- achieve integration research at grass roots (EPSRC / NERC / ESRC) to succeed in developing novel whole system approaches;
- optimise use of science and collaboration with others to ensure cost-effective outcomes;
- optimise use of demonstrator sites / existing projects in a coordinated way to address the key questions;
- fund research committed to longer time scales /finer spatial scales when these are often perceived as low priority (i.e. de-risking).

The presentation finished with a list of research needs for the natural and social sciences.

John Hartley began by setting out what RAG is and does. It is a pan-government Research Advisory Group on Marine Renewable Energy. It involves representatives of DECC, DEFRA, DfT, CE and also has links with devolved administrations & country conservation agencies. There are also links with DECC SEA, MRESF, COWRIE, OREEF, FLOWW, NOREL, EMEC, WaveHub, MCT Strangford and others. Initially, from 2003, RAG only covered wind, but it was expanded in 2005 to include wet renewables. There are 2 budget streams which are ring-fenced. There is an emphasis on collaborative projects and open access.

RAG outputs include the following:

- List of environmental issues and research topics for marine renewable energy developments RAG-RAG/COWRIE-RAG
- Range of guidance documents – navigation collision risk, and seascape
- Range of reviews and field studies – cabling, reef effects, sediment effects, effects on radar
- Maritime database, initially R2 then UK www.maritimedata.co.uk
- Wave & Tidal Stream Monitoring & Research Strategy 2006
- All on DECC website www.decc.gov.uk

RAG wave and tidal stream research priorities include the following:

- Energy removal
- Water column effects of energy removal
- Seabed effects of energy removal
- Faunal collision
- Noise emissions
- Important areas for mobile species
- Navigation impacts
- Fisheries impacts
- Recreational impacts
- Benthic ecology of strong tidal stream areas
- Strong tidal stream area ecology - mobile species

Wave and tidal stream projects include:

- Sonar system development for studies of turbine/animal collision
- Satellite & GPS tagging of seals
- Techniques for characterising tidal rapid benthos
- AIS data interpretation for navigation routes
- VMS data interpretation for important fishing areas
- Aerial surveys for water birds

Animal interactions with marine energy devices

Robert Batty, Scottish Association for Marine Science (SAMS)

Click here for Robert's presentation

Robert Batty explained that there will be significant numbers of encounters between some species and turbines if there are large numbers of turbines deployed. More information is needed on animal spatial and depth distribution and a model for acoustic detection and evasion needs to be developed.

Robert pointed out some knowns:

- Expected encounter rate declines with increasing body size – fewer larger animals. But as a proportion of the population, encounters are much greater: a relative "Risk" estimate.
- When the looming rate exceeds a threshold, animals make an escape response. Looming rate depends on size and velocity and increases as the object gets nearer. Fish anti-predator behaviour research is being applied to develop a model to understand and predict collision evasion. Evasion depends on fish size, temperature and blade thickness but thinner is not better.
- Killer Whale "Carousel feeding" on herring fits model predictions well. Evasion not possible at similar fluke velocities to maximum turbine blade tip velocities of some turbines.

And there are opportunities for mitigation:

- Device design
- Depth in water column of devices
- Increasing visibility
- Optimising sound levels above background

Plenary Discussion

Comments and questions following the presentations are summarised below.

Impacts on mammals:
One participant stated that there exists a research gap on the effect of noise on mammals but in spite of this the participant pointed out that some evidence shows fish and mammals can be driven away by noise, while at the same time there exists a noise range which fish and mammals find attractive. Proposals to alert mammals to the presence of tidal or wave devices through sound need to be based on information regarding mammals' responses to sound and the sound produced by the devices. It may be the case that some mammals learn that the device is dangerous while fish may not. COWRIE is working with CEFAS on noise characterisation from pile driving in the sea and the effect on cod.

Evidence and uncertainty:
There was some discussion around the problem that not all information will be available to make evidence based judgements and some impacts may have to be judged not only in terms of whether they have an effect but also whether or not that effect is serious. This might necessitate a "What if/So what?" approach. A participant pointed to the case of EMF impacts where the seriousness of the issue is not clear as there is not enough evidence. One participant mentioned that EMF from cables is being studied in the US but believed that more needs to be done.

Identifying and prioritising research questions:
There was discussion on the need to highlight priorities with a limited budget. What are the specific sector questions and what are the generic ones? What do you need

to know in shore waters or international waters and what has been the experience elsewhere? It was suggested that generic research was best done by UKplc and specific research by working with industry. Another point made was that we do not know what we don't know and that some work is being repeated.

A question was asked as to how priorities for expenditure of the RAG budget of £500,000 are decided. RAG have a strategy where the issues are identified and ranked depending on what other work is going on and whether there are opportunities to link to other projects.

Effectiveness of EIAs and environmental protection measures/legislation:
Some comments were made surrounding the effectiveness of EIAs with criticism of their size (eg 1200 pages for London Array) while the Dutch experience is 30-50 pages. One participant pointed out that once zones are allocated e.g. Round 3 wind, the final location has still to be negotiated and this is an opportunity to take EIAs forward on relative effects across an area and develop new ways of working on the EIA and improve governance. Other problems discussed related to conservation policy and Round 3 wind zones which are not integrated into other spatial plans, with some taking the view that environmental compensation should be encouraged rather than direct compensation, depending on the situation. It was suggested that guidance be given to ensure that local level negotiations are not overruled as this can cause real hardship (e.g. for fishermen's livelihoods).

A participant spoke of the need for an effectively functioning environmental protection system, making reference to issues resulting from implementation of the Water Framework Directive (WFD). Focussing on the site level rather than strategic level was suggested, supported by the point that the Habitat Directive requires proof there is no effect. This raises problem of being able to detect an effect above background variability and leads to a situation where as one cannot say there is any effect then the precautionary principle dictates no development. Learning from the WFD and Habitat's Directive experience it was suggested that to be effective any system would need to be based on 1) realism 2) existing data and 3) it should be left to the people on the ground to implement.

Session 2 Group work: Environmental knowledge gaps and issues relating to deployment

Participants were provided with a rough categorised summary of research gaps identified from the NERC workshop held in February 2009 as a starting point for discussions (see Appendix 4). These categories were used to divide the group with participants joining the group of greatest interest to them. Participants were asked to discuss the NERC workshop output and whether they were in agreement with the gaps identified and if there was anything missing. The group was then asked to identify priorities according to criteria important to group members (e.g. urgency; potential impact).

Using pre-defined poster templates, the groups set out the following:

- Description knowledge gap or issue e.g. stakeholder
- How could the gap/issue be addressed (options)
- Implications for:
  - policy-makers
  - developers
  - integrated approach

Groups displayed outputs on the wall and then reviewed the outputs of other groups, adding comments and raising questions. At the end of the session, participants returned to their original outputs and responded to comments and questions raised by other participants. The group outputs are available in Appendix 5. A summary of the group output for sessions 1 and 2 is provided in the Table 1 immediately below.

Table 1 Summary for social/economic and environmental aspects and implications for policymakers, developers and an integrated approach

A. Socio/Economic Issues				
Gap/Issue	**How to address**	**Implications for**		
		Policymakers and regulators	**Developers**	**Integrated**
1. Fisheries: • Space use Conflict eg with marine conservation/energy etc • Consequences of displacement • Lack of data/knowledge to inform management or policy eg on space use by small fisheries	• Learn from oil industry experience? • Use local knowledge of resource /working in area • Address research gaps on spatial/temporal and methodological issues,	• Join up governance structures • Catch up with Crown Estate initiatives • Proactive • Strategy for multiple uses rather than historical right	• Proactive to consult and get local knowledge • Near shore marine interaction with static gear fishermen consultation needed	Cross-disciplinary research needed on gaps by research councils
2. Ports and harbours Strategic plan to support developments as available facilities can restrict device design, deployment, maintenance etc	• Leave to market? • Initial study of potential sites and competing interests • Strategic plan at regional and national level • Funding package to support	• Identify regional/national responsibility • Fund an initial study • Deliver strategic plan and budget for investment • Iterative to reflect industry state	• Fund/Support and feed in • Potential for shared facilities	• Integrate with facilities for other economically important industries • UK and Scottish government liaison • Coordinate marine energy differing requirements for best fit overall
3. Public Perception • Who are stakeholders • What are their values • What info do they need • How aid interpretation of info	• Local dialogue for local knowledge and experts • Case by case for key local issues • Learn lessons from successful/unsuccessful projects • Understand value conflicts	• Allow a bottom up approach and input to research agenda • Combine consultations e.g. coastal forums, local plans , MSP	• Engage people in right way and right stage in process • Understand their key issues • Is a more cost	• Research must feed in to development process • Cross communication improved between academics, developers policy makers communities and

• Gap between perceived and actual • Is all offshore perceived the same? • Whole system approach	• Understand scale of project • Educate on : 1 How to sell this essential technology 2 How make people see need (local vs global?)		effective approach	government
4. Shipping and navigation • Compatibility of shipping and fisheries with marine renewables • By area • Vessel type • Device/development	• Decision by government, based on engagement with all relevant marine interests, within the context of marine spatial planning structures (e.g. Marine Scotland) • Avoid dangerous precedents eg compensation agreements • Case specific issues to be taken into account	• Need information in support of decision-making process • Express priorities clearly and INFORM	• AVOID SETTING DANGEROUS PRECEDENTS • Express site requirements clearly and INFORM • Be flexible (within reason) in site selection, mitigative measures	• Yes! Seek opportunities for satisfying multiple interests (e.g. wave development arrays and marine protected areas)
5. Stakeholder Engagement 1) Early communication + awareness raising o Strategic plan, feedback, justification o Benefits o Local plan feedback o Empowerment 2) Best practice o Flexible o Different community types o Inclusivity: o national/regional o local	• Activities to improve stakeholder engagement are listed in 1) 2) and 3) • link successful communities to communities facing new developments • Early engagement with stakeholders including recreation and tourism	1)Enable and require early communication and awareness raising with stakeholders Better communication strategies IPC/MMO/MS 2) Enable development of BP but also flexible IPC/MMO/MS 3) Fund existing networks/forum to convene 4) Develop system for dissemination of lessons learned on and offshore from other developments for developers and communities	1)Early communication and awareness raising with stakeholders Many developers doing, but make sure all is problem 2)Improve credibility + consistency 3) Shared database network/forum 4) Disseminate lessons learned and learn from others	1) Problem share confidential info for developments (pay) need government but gain credibility: how do across developers? 2) Consistent approach required 3) Do 1&2&3

○ timing ○ continuous ○ how manage large numbers of small groups of stakeholders ○ How can remote communities be protected 3) System for dissemination of lessons learned from other developments (all other developments, on + off shore) and large rural developments eg Sullum Voe				
6. Planning process • Cannot have perfect knowledge before marine development occurs • Need to till basic physical data gaps before SEA • Consistency in EIA guidance across UK, Regions, statutory agencies, <12nm • Should social/economic issues get covered in SEA? • EIAs becoming too large?	1.Bring together SEAs around UK and map to identify data gaps and who should fill. 2. Consistency in legislative approach and scientific guidance on SEA but flexible approach but also allow feedback as development occurs 3. Suggest 2 stage EIA ; a) location issues within R3 and b) relative impacts within planning areas 4. More consistent survey methodologies but recognition some device dependence 5. Guidelines for monitoring requirements being developed by SNH 6. Best practice guidelines rather than minimum for legislation 7. Identify potential positive impacts eg fish reserves, habitat diversity, coastal and flood defences	• Enable identification of data gaps • Enable funding to fill • Develop consistency of approach but also incorporate feedbacks • Consider 2 stage EIA and consistency in EIA across UK etc • Commission study for Consistent survey methodologies/device dependency • Integrate across conservation policy R3	• Enable identification of data gaps • Enable funding to fill	• Integration across UK, Regions, agencies and with developers and researchers

	8. Integrate conservation policy, R3 zones and other spatial plans 9. Encourage environmental compensation rather than direct depending on circumstances eg livelihoods	and spatial plans • Explore environmental compensation possibilities		
B. Environmental Issues (in addition to gaps identified at NERC workshop)				
Gap/Issue	**How to address**	**Implications for:**		
		Policymakers and regulators	**Developers**	**Integrated**
7. Energy Extraction: • Resource understanding • Improve existing technologies and design new for improved energy capture • Resource assessment needed • Future proofing resource assessment	• Resource data collection • Feedbacks for device design	Facilitate resource data collection as major barrier is understanding resource eg tidal Fund research to understand resource Enable system for developer feedbacks for design process	Major barrier is understanding resource eg tidal Share knowledge (see 5 above) Improve existing technologies and design new for capture and future proof	Collect data and Research needed on understanding resource eg tidal and future proofing. Developer design feedbacks as new information on impacts and resource becomes available
8. Healthy Ecosystems • Create understanding of ecosystem functioning and physical environment • Define health at levels of biological organisms and focus on fitness for survival/sensitivity to harm • Assess functional habitat	• Studies on ecosystem functioning (rather than structure). Use to parameterise models and link to risk analysis and risk management framework for policymakers • Link to Good environmental status research • Quantify ecosystem resilience • Field experiments • Map feeding grounds, nursery areas, and diurnal and seasonal migration routes of a variety of species above, on and below the water line • Focus on functioning	• Policymakers to support risk management framework • Clarity of goals • Introduce ecological/operational realism • Link to Good environmental status research	• Clarity of objectives and introduce ecological operational realism	• Research to Focus on functioning of ecosystem acknowledged ability to absorb change
9. Monitoring and adequate baselines	• Ensure baseline is appropriate: problem how to	• Define standards and	• Developers to	• SNH already providing

• Well defined quantitative end point needed and SMART objectives • Baseline acknowledging climate change effects and problem of detection of change • Monitoring guidelines/protocols/sops • Range of devices/moorings etc need to be covered	detect change • prioritise data for collection: marine features of interest • identify pilot areas • feedback from existing and new • Need for an uncertainty approach for decision making eg use scenarios • Problem of proof of an effect depends on detecting signal above background variability	methods • Funding plan • Define acceptable impacts • Reduce burden on developers • One stop shop for data and accessibility for all • Need incorporate scenario approach to deal with data uncertainties	feedback and collaborate Develop plans with stakeholders	monitoring guidelines • Integrate modelling with actual survey work to optimise/reduce future needs • Collaboration internationally
10. Specific Ecological Aspects a. Visibility/detectability of devices b. Behaviour and collision risk c. Habitat usage d. *EMF* • Gaps in information on a range of species and other life stages eg crustaceans • Ecological significance of responses • Electrical/magnetic effects on migratory species *e.* Noise • Effect of pile driving and other construction activities • Operational noise • Cumulative impacts and mitigation eg offshore wind f. Reef Effects	Research needed on: a. Visual auditory magnetic responses for surface-subsurface/species specific responses eg use of colour • lessons from other sectors • deterrent tools radar and sonar b. Behaviour: • size affected, -tank modelling, -array design, -shut down operation, • behaviour relative to single device compared to arrays over range of species • link hydrodynamics and behaviour for wet and wind flow for bird responses • bat collisions at night c. Habitat usage • Animal behaviour and impacts of arrays time and spatial dimensions in terms of life history d. EMF	• Fund research councils to gather the fundamental data eg hydrographic, noise responses for research topics identified. Current developments too site and device specific to answer fundamental issues • Enable developers to share sensitive data • For EMF - more funding for fundamental information to characterise and study effect and responses • Integrated research programme required on mammals to avoid problems with tidal and other devices	• Developers to help fund but financial risks already high. • Developers to feed back on design and mitigation • Developers to cooperate on research as much as possible and feedback to design • Developers to pool information and cooperate with appropriate monitoring	

Effect of artificial reefs and closed zones	• EMF from cables being studies but more needs to be done to judge seriousness of effect e. Noise • Noise behaviour not linear and can attract or repel. • Ability to learn varies with species. • More noise characterisation needed and mammal responses f. Reef effects • What happens when an area is closed or restricted • link to MPAs • possible major positive impacts for MRE for example increased biological productivity or alternatively there could be significant changes to ecosystem processes in the area. To be addressed through site specific studies.	(noise) • Noise - funding urgently to be enabled • Funding for research on effect on fisheries and habitats mammals etc (reef effects)		
11. Cross Cutting themes • Resource demonstrator sites to have a strategic approach to benefits impacts and monitoring • Processes of prioritising impacts	• Need independent body to facilitate adequate spatial data and best practices • Good integration of all different work streams in industries globally. • Cumulative impacts from devices/array configuration	• Need a clear steer to facilitate independent body eg role for EMEC/UKERC other to bring together knowledge and research • Comfort from incremental process but must have feedbacks on cumulative impacts and integration mechanisms for new knowledge in place to ensure lessons are learned and implemented		

Session 3: Integration of environmental, social and economic issues

Integration of research and policy for deployment of arrays

Annie Linley, Plymouth Marine Laboratory
Click here for Annie's presentation

Annie Linley's presentation was structured around four key topic areas:

1. Integrating engineering and environment for sustainable design;
2. Integration at project scale – MRE site sustainability;
3. Research integration – engineering, environmental and socio-economic research;
4. Governance, leadership, skills and competence.

As Annie addressed each theme in turn, the presentation was paused to enable 15-20 minute facilitated discussions.

Annie provided an overview of the current status of marine renewable energy development, noting that:

- Perception is that wind, wave and tidal technologies are benign, low impact and widely supported by general public
- Current challenge - to get devices deployed, tested and functioning whilst meeting regulatory constraints
- Socio-economic issues not perceived as important - except when local issue e.g. conflicts with fishing

Given our current commitments in the form of 2020 targets, the economic costs of not mitigating climate change (and conversely the savings if action is taken) and evidence of peak oil on the horizon, there is considerable opportunity for – and improvement by – the marine renewable industry. Annie went on to describe the Deltastream demonstrator project, which has had success in integrating environmental and engineering design.

The presentation was interspersed with plenary discussion, summarised below, prompted by the following questions put forward by Annie.

Integration for Sustainable Design: "Should there be screening of design concepts for marine energy devices on environmental sustainability at an early stage?"
There were mixed thoughts from participants on this question. Some felt this should not be done as the public and NGOs change their perceptions on what is acceptable especially as the biggest challenge is making the devices work. Another participant pointed out that changing engineering constraints may be problematic as current design codes are tried and tested. There are many areas where there is insufficient information (e.g. noise levels which cause problems) so it is practically difficult to influence or screen designs. The other problem is that cost efficiency and effectiveness have to be a consideration for any changes to design.

On the other side, a viewpoint was that some devices pose unacceptable risk (e.g. a breakaway risk) which is too great and they should not progress. Another participant

informed that there is still no mechanism for feeding in evidence or knowledge (eg visibility of devices) and more environmental design research is needed. Supporting the view of initial screening, a participant explained that this has been done before and opined that it is common sense to design a device with the environment in mind from the start, and there are lessons to learn from the oil and gas industry. Design engineers need to be given the environmental constraints. Considering the priorities of the developer, one participant thought that environmental sustainability would be less important for many developers given the bigger goal of a lower carbon future.

An additional point was that array effects should be incorporated into any screening criteria to prevent ruling out designs that could potentially perform relatively well in an array configuration. Mooring options are recognised as a major issue in terms of impact, and gravity devices have been shown in a US study to be the best.

Integration of environmental, social and economic benefits: "Are there ways to use marine space for socio-economic benefit in communities?"
In addition to the overarching question above, Annie put the following sub-questions to participants for discussion:

- Devices are made overseas and installation is at sea so what are the benefits for landward communities other than possibly cheap electricity?
- Are employment opportunities expanded as a result of engagement?
- Social is not included at the concept stage and preliminary site evaluation omits socio-economic aspects. Do we need to develop policy to integrate the socio economic aspects and are locational criteria needed?

Positive cases and situation-location dependency:
A participant explained that closing an area to allow MRE project development is a complex decision as it depends on what species are there, who has access and existence of fisheries has to be taken into account before decisions on site selection can be made. There exists some experience in the oil and gas industry on artificial reefs which is relevant. Closing an area does not automatically mean more fish. More research is needed on reef effects and what happens when an area is closed.

Some international contracts do not provide local jobs but one participant informed us that the Pentland Firth development has led to the generation of jobs through operation, maintenance and installation of activities – expected to continue even post 2020. An example of a positive outcome is where fishing was restricted but new opportunities occurred in boat trips for tourists to a wind farm. Monitoring will be needed.

Economic benefits are already being gained in the highlands and islands service sector where there is development of a knowledge economy through e.g. consultancy in resource assessment techniques which can be exported. This is as important as the electricity production and work for the mariners. The service sector is a real driver for change. This is also the strategy for the Wavehub development.

It was suggested that people should be asked what benefits they want rather than be given a 'one size fits all' template. There was also a comment that evidence is needed with respect to what circumstances deliver benefits.

A need for evidence:
While it is possible for Marine Renewable Energy Developments (MREDs) to create local jobs as well as local electricity, a participant voiced the need to capture and demonstrate success stories in order to shift public perceptions of MRED consequences. However, data will be needed to do this. A participant detailed the case of Orkney where there are limited data relating to stakeholders' views. Industry needs case studies to inform people.

A positive perspective:
It was suggested that exclusion zones could be seen as Marine Protected Areas. Positive benefits from coastal defence projects like the limpet device are clear.

Development or enterprise agencies are looking at how to leverage benefits especially how the high value part of the supply chain can be secured. This is a high level opportunity for Regional Development Agencies who need to work together on this.

Early consultation to prevent conflict and achieve optimal benefits:
One participant informed that conflict avoidance had to be the first priority as far as the fishing industry was concerned. Conservation is interconnected with wind farm development and high level government leadership is needed. An assessment is needed of the compatibility of different types of fishing equipment (e.g. trawling) in order to develop recommendations on what equipment is suitable to use in or near to wind farms. A shift to alternative fishing methods has implications for livelihoods and there is usually good reason for not practising the alternative method compared to current practise. Local issues need to be raised early in the planning process in order to deliver optimal benefits.

Research Integration: "What do we need to do, what do the Research Councils need to do and how we can integrate better?"
The need for user-led research:
Several participants pointed to the fact the Research Councils (RCs) traditionally ask academics what research they want to do and build a framework for a call from that but there exist real research gaps and it may be better to start with a research programme with the elements that need to be addressed. For example, the European programmes, FP7 and Interreg, are policy led initiatives.

A participant pointed to the problem where: a) the effect of the devices on marine systems is the concern of UKplc, while b) the effect of the marine system on devices is the concern of the developers; these two aspects need to be brought together so that we understand the system properly. The oceanographic community needs to look at the device effects on systems and the systems effects on devices.

Another disjoint is between the Research Councils and Central Government Departments e.g. RAG and NERC research on marine energy.

Institutional structures:
A participant stated that academics involved in EU projects already work in a cross-disciplinary way, and there are many such academics carrying out marine-related research in the UK. Another participant argued that the problem is not with academics but with the University and Research Council structures which impose silo-supporting institutional structures. It was suggested that a cross-Research Council community forum be set up to strengthen research communities, steer the science and select projects. It was also suggested that a bottom-up forum be established to enable feedback between academics, NERC and their referees.

Another participant thought that the engineering and environment disciplines are working closely but are not working closely with the social sciences, including economics. It was also suggested that silos are being established by politicians, which is not helpful as a shared but common vision is required to steer funding/selection of projects.

Encourage collaboration across borders and boundaries:
There was a suggestion to integrate by working across borders and international markets e.g. IEA/OE program. The environmental impact stream is being led by the US. Other countries/regions, such as North America, Canada, Korea and Taiwan, are also doing research in this area so there are many opportunities for collaboration.

To avoid silos but still have depth of research it was suggested that scientists need to get involved in placements in the wider system that they are studying (e.g. on fishing boats); funding is required for young researchers to do this as well as funding for academic research.

The Scottish Government have a strategic research plan and is commissioning research. This clearly needs to be complementary to other research efforts and care needs to be taken to avoid duplication. Stakeholders also need to be engaged in the development of this plan.

Governance leadership skills and competence: "What can be done?"
In her presentation, Annie argued that the current institutional structures are causing confusion (e.g. RCEP/ETI/UKERC) and leadership is needed. Participants made the following comments:

- DEFRA is improving socio economic capacity by appointing staff in CEFAS;
- In Orkney there is leadership but not from the top but outside government;
- The Scottish Government has social and economic marine objectives which will become statutory with the passing of the Marine Bill.

WORKSHOP 2: Sustainable marine spatial planning for the deployment of arrays

Welcome and context-setting

Phil Gilmour welcomed the opportunity for the experts at the meeting to feedback into what the Scottish Government (SG) was doing to make sustainable marine energy deployment happen. Are we doing the right things and what else needs to be done were important questions for the coming sessions. Has the SG the right attitude for marine renewables? At that time the MESPG had only been operating for 6 months but progress had been made. The Marine Bill is seen as an opportunity to deliver marine planning and a simplified consenting process with Marine Scotland providing a one-stop shop. Critical will be a monitoring and research strategy. However developers must come forward on sites. Four offshore marine development areas are expected at Pentland Firth, Mull of Galloway, Western Isles and Islay.

Session 1: Policy context

UK Government marine policy

John Hartley, Department of Energy and Climate Change
Click here for John's presentation.

John Hartley outlined current UK energy policy, the renewable energy strategy and the impetus for both. Importantly, the UK must increase renewables by 10 fold by 2020. John noted that the target is achievable and provided a chart showing how 15% renewable could be achieved. In reaching this target, the following are part of the government strategy:

- Save energy
- Provide financial incentives (electricity, heat, transport and microgeneration)
- Remove barriers
- Ensure effective regulation
- Encourage innovation and business growth

The benefits of this strategy would be carbon savings, security of supply and economic/business benefits. Regarding UK wind capacity, a draft plan in 2007 offered 25GW of new offshore wind. Decisions are expected in June 2009 regarding the plan. To remove barriers, planning consent will speed up through the following four measures:

1. A new planning system
2. 9 month timeframe for decisions
3. New national policy statements on renewable and on networks
4. New infrastructure planning commission

Grid Access will be improved when the new Offshore Transmission Regime goes active in summer 2009. In terms of financial support, from April 2009 there will be increased support to offshore wind to 1.5 ROCs/MWh. The Renewables Obligation will be extended to at least 2037, giving future project return on investment of 17 years.

Innovation Support is available through four channels:

1. The Environmental Transformation Fund (£10m)
2. The Carbon Trust Offshore Wind Accelerator (£30m)
3. Energy Technologies Institute (up to £1bn)
4. Power Sector Skills Academy

Scottish Government marine policy

David Palmer, Scottish Government
Click here for David's presentation

David summarised the Scottish Marine Bill as follows:

- A new legislative and management framework for the delivery of sustainable economic growth in the marine environment
- A reduced regulatory burden by streamlining the licensing needed for marine development.
- Enhanced powers for nature conservation including ecosystem level powers
- New administrative arrangements to focus on marine issues

The Marine Bill is intended, at a policy level, to improve knowledge and understanding of marine policy, reduce potential conflict, improve the environment and respond to political objectives.

Plenary discussion

Institutions
A question was raised as to how the new Independent Planning Commission (IPC) will interact with the Marine Management Organisation with concern raised over possible confusion of responsibilities and overlaps with the Scottish Environmental Protection Agency and the Environment Agency. David responded that it was not yet clear how these two bodies would interact, however, the Scottish system is transparent with no IPC. In Scotland, the Marine Spatial Planning Group and the Marine Energy Group are two separate bodies.

Decision-making relating to location
David was asked who is taking the lead on where wind farms are located considering the zones which have been leased by the Crown Estate. David informed that a Strategic Environmental Assessment (SEA) will be carried out on all waters less than 60m deep and not just zones identified which have shifted over time. This will support more than Round 3 for offshore wind development. The Crown Estate may lease land but developers may not obtain consents. In Scotland, the system is simpler. The Marine Spatial Plan integrates SEA to get a balance. Science is the only basis for designating Marine Protected Areas or Marine Conservation Zones.

Consultation processes
A participant asked for information about the consultation process for the Marine Spatial Plan. David referred to the Pentland Firth consultation process which has been effective at regional and national level. He explained that as well as a Strategic Environmental Assessment carried out in parallel with the Marine Spatial Plan, wider input has been sought from sectors, NGOs and fisheries. A Marine Strategic Studies forum has been set up to enable stakeholders to comment and raise issues. There will be a comprehensive plan for the Pentland Firth and Defra is preparing a high level policy statement.

Timeframes
A participant asked David how processes would align considering there will be a draft marine Spatial Plan in Scotland by April and developers are already saying where they are interested. David informed that the Scottish Government is trying to get everything in place as fast as possible. There are 5 categories: absolute constraint; partial constraint; mixed use; opportunities and suitable opportunity. He added that hopefully this will accord with Environmental Impact Assessment results.

Session 2: Simplifying consenting EIA/AA and locational criteria for marine planning

Simplification of consenting and use of locational criteria for marine spatial planning to support SMMO decisions

Phil Gilmour, Scottish Government and Project Manager of the Marine Energy Spatial Planning Group (MESPG).

Phil began by informing that the Scottish Government is very active in the area of simplifying consenting and establishing locational criteria, and is trying to facilitate the sustainable development of marine energy and core activities:

- The formation of the Marine Energy Group (MEG) to develop a **route map** which covers;
  - construction and servicing,
  - inter-connector and grid;
  - vessel tooling and provision;
  - economic instruments,
  - ports and harbours etc. etc.
- The formation of the Marine Energy Spatial Planning Group (MESPG) to address the SEA findings using the following 4 theme approach
  - Develop Marine Planning/Locational Guidance
  - Simplify Consenting Procedures
  - Establish an Environmental Monitoring and Research Strategy
  - Link to/facilitate Regional Initiatives
- The Scottish Marine Bill will be used to deliver an **industry friendly** approach.

Four main theses were covered: SEA and environmental impact monitoring, simplifying consents, environmental unknowns, and regional initiatives.

Planning experience will be gained through taking forward a pilot in the Pentland Firth and Orkney waters to develop an interim spatial plan with consultation to develop a comprehensive plan and to integrate with SEA work.

Locational guidance will be developed for areas where there is developer interest and essential data collected as required. The consenting process will be simplified through the 'one-stop shop' approach for the Marine Scotland organisation and a single underpinning consenting guidance will be produced. An MESPG monitoring and research sub-group has been formed to address environmental unknowns. This is to be complemented by a Strategic Environmental Research Assessment prepared by the Fisheries Research Services and monitoring protocols to be produced by Scottish

National Heritage. Lessons from other deployments (e.g. Strangford Lough) are being learned and more deployment with associated intensive monitoring are needed to establish benign designs. Links to other regional developments besides the Pentland Firth are sought to facilitate development and for the recent 10 areas identified by the Crown Estate for leasing for offshore wind the Scottish Government will undertake SEA screening and scoping and seabed surveys.

Framework for a Marine Spatial Plan and Locational Guidance: Pentland Firth and Orkney Waters

Iain Bell, Faber Maunsell
Click here for Iain's presentation

Iain stated that the current study of Pentland Firth and Orkney Waters is being carried out to respond to planning for development objectives and in response to the emerging marine spatial planning legislation. As part of this study, the aim is to produce progress in marine spatial planning in advance of the Act by preparing a framework for marine spatial planning and preparing locational guidance for the area. This is meant as a step towards producing a comprehensive marine spatial plan for Pentland Firth and Orkney Waters.

The objectives of the current study for locational guidance are:

- To attempt to identify and map areas of opportunity for marine renewables
- Examine how we can allow multiple uses to co-exist and resolve conflicts
- Aid to developers
- Aid to regulators

The study time frame is as follows:

February 2009	Study commenced
April 2009	Framework Consultation Report
August 2009	Draft framework for the marine spatial planning and locational guidance
Sept-Oct 2009	Consultation
January 2010	Final framework and locational guidance

The approach to locational guidance is to resolve competing and/or overlapping interests. This will be sought through:

- Data collection
- Stakeholder consultation
- Vision and strategic objectives
- Developing guidance or protocols for specific sectors
- Enviornmental appraisal
- Cumulative effects
- Monitoring

Iain closed by proposing key issues for discussion by workshop participants, which were later addressed by a small group in the following session.

Plenary Discussion - Scottish Government Activities: Simplifying consenting and locational guidance.

One participant commented that the Republic of Ireland is already doing this sort of work and interpretation of research data is needed. It is necessary to build on the Integrated Coastal Zone Management work of 5 years ago. The participant suggested resolving problems by asking people in the first place and emphasised the importance of knowing who to talk to (e.g. Royal Yachting Association for recreational boating).

A participant asked what scale of development is being considered as so far 1 MW machines are being looked at but perhaps small 10-20 kW machines should also be considered because of local interest. It would allow a monitoring strategy to be put in place for small nursery arrays even in a limited area and provide a steer on locational guidance for the device type.

One participant detailed a case of poor dialogue and difficulties in relation to obtaining data. The participant cited a problem of one person opposing development in Orkney with potentially significant consequences for inshore fisheries. There is a sentiment felt in the fisheries industry where vessels are less than 50 m in length are not monitored, that there is no data and BMS is not involved in any negotiations. The participant believed that inshore fisheries are forgotten through lack of data coverage to identify sensitivities and that landing data are not useful for a Marine Spatial Plan. It was suggested that a strong liaison with the fishing industry is needed to interpret data. In round 3, fisheries are working with the process and are pulling together data layers with COWRIE and SEA. Boats shorter than 50 m find themselves in a special situation needing a direct liaison process. The participant took the view that if the Crown Estate would allow flexibility in zones then this would allow fisheries in the area to be planned and for consultation on sensitivities to take place. In absence of this, they are vulnerable to displacement and are concentrated elsewhere. The participant finished by stating that Round 3 is not integrated with conservation for the smaller sized fishing boats and the Crown Estate is not listening about which areas are sensitive, working solely with hard data. In response, Phil Gilmour pointed to Scottish Proposals which are put forward for consultation early for six months with nothing to stop a dialogue taking place.

Workshop 2, Session 2, Group Work: Simplification of consenting, locational criteria

Working in 6 groups, participants responded to one of the following questions.:

GROUP 1
How do we categorise our environment in a balanced way?

GROUP 2
Should MSP and SEA come together under a Sustainability Assessment?

- Explain reasoning. If yes, how?

GROUP 3
What sub-tools do we evolve for the Marine Spatial Planning tool?

GROUP 4
Should we keep in or take out fishing, aquaculture and shipping from the SEA process?

- Explain your reasoning.

GROUP 5
How do we handle ICZM and related land based activities in the MSP approach?

- Set out some options with pros and cons.

GROUP 6: Further feedback on Iain Bell's talk (building on Q&A)

1. **Does the approach outlined in Iain Bell's presentation seem reasonable and pragmatic?**
2. The project is proceeding in advance of legislation, policy, guidance etc - **what limitations does this place on the ability to plan?**
3. Through this approach, the aim is to achieve spatial planning objectives through agreement / co-operation but **at what point is it necessary to prioritise and impose policy which may not meet universal agreement?**
4. This approach is based on both technical analysis (data gathering, mapping, appraisal etc) and stakeholder engagement and consultation. The two approaches may come up with different results. It is also necessary to consider both environmental objectives and socio-economic objectives, but these may conflict. Thus this approach has required creating a vision and objectives at the outset and using these to test alternative scenarios/ policies. **Discuss this approach and explore whether objectives should be prioritised or ranked and how this could be achieved.**

Group output is summarised in Table 2 below.

Table 2: Workshop 2, Session 2, Group Work Output: Simplification of consenting, locational criteria

For input to Scottish Government MESPG	
Gap/Issue	**How Address**
1. How do we categorise our environment in a balanced way?	• Whole system needs to be considered not just environment to include social, physical and natural environment and resources with absolute and negotiable categories. Each category is important and should be addressed. Will depend on area occupied by array surface and subsurface and zone of influence. • Unknowns and uncertainties should be transparent • Site selection could involve absolutes such as war graves, MOD sites and then negotiable areas of potential future designation/pristine areas, and current site users in terms of numbers and types or level which may need research and reference to strategic priorities. • Other considerations are that the ecosystem should be viewed as a stakeholder and fit for purpose monitoring. Monitoring should be precision/strategic and be publicly available. • Final decision depend on balance between opportunities and constraints.
2. What sub tools do we evolve for the Marine Spatial Planning tool?	1. Key data such as Hydrography with validated 3D model, inshore fisheries, bird and mammal data on a temporal and spatial scale are not available but needed by developers and regulators. Fund centrally to obtain eg by Research Councils, Government /MMO/MS. More emphasis on functioning is required. Central access to data eg ADCP data collected by developers. 2. GIS is well developed though requires expert input into objectives eg nature conservation, socio-economic policies, possible weighting of layers, industry technical constraints. 3. How GIS is used requires a) stakeholder input, which can then be used for engagement, and b) a political decision e.g. SG/CE initiative to coordinate approach to data sharing? 4. Tools are not just spatial e.g. matrices of compatibility/non compatibility among activities would be useful 5) Data availability is a problem as the pan government agreement on availability only goes so far and does not support

	developers and costs incurred for data licences are significant.	
3. Should we keep or take out fishing, aquaculture and shipping from the SEA process?	Fishing, aquaculture and shipping should be retained in a SEA study. Reasons: 1. There are too many unknowns in the marine environment at this stage 2. Impacts on these industries could be significant as they are primary sea users 3. These industries could have environmental impacts via activity	
4. How do we handle ICZM and related land based activities in the MSP approach?	Shore connection and grid tie in require land as well and marine considerations taken into account. Land based consenting and marine consenting are not joined up and this could be usefully done, perhaps through Local Authority Development Plans. Coastal forums could also be more visible in the process. Solution: • Roll out Shetland Model to all Scotland • Scottish marine regions as the basis for administration? Involving several local authorities and Marine Scotland tasked with interface issues.	
5. Questions raised by speaker Ian Bell: • **Approach seem reasonable?** • **Project in advance of legislation so what limitations does this place on ability to plan?** • **Though approach is by agreement and cooperation , at what point is it necessary to prioritise and impose policy?** • **Discuss approach of technical analysis and stakeholder engagement using objectives set out to test alternative scenarios and explore whether objectives should be prioritised and ranked and how this can be done.**	**Approach seem reasonable?** Yes as long as this is a framework and not set in policy and it should be iterative. **Limitations vis a vis timing of planning?** Policy or government could change priorities and plan then redundant but lack of baseline data may be more limiting **at what point is it necessary to prioritise and impose policy?** Need to learn more first. Regional policy could be helpful and more explicit *Further comments from participants in plenary session:* Don't confuse tools and objectives Political dimension Lowest common denominator issue	

Session 3: Integrating models to support decision-making from public, commercial and government perspectives

Practical Tools for Marine Planning: An Assessment of Cumulative Effects of Human Pressures on the Marine Environment

Janette Lee, Centre for Environment, Fisheries and Aquaculture Science
The processing framework and a description of the model are provided in Appendix 5.

Janette introduced the CEFAS model for ecosystem-based marine management. To better understand human pressures on the marine environment, human pressures are mapped and analysed in order to understand cumulative impacts. Using geo-data on human activities and combining pressure maps of combined activity together with sensitivity analyses, a preliminary picture of cumulative impact results can emerge.

Janette summarised her presentation by stating that:

1. Risk assessment framework highlights both range of possible modelled scenarios and range of uncertainty.
2. For decision making in the case of remaining uncertainty models with less strong assumptions should be used
3. The CEFAS tool can support sustainable Marine Planning and integrated ecosystem-based management.

Wet Renewable Energy: Developing Nature Conservation Strategies for Management

Justine Saunders, ABP Marine Environmental Research (ABM MER)
Click here for Justine's presentation

Justine began by stating that wet renewable energy is generally considered to be amongst the more sustainable forms of energy development if it's the right technology in the right place and carefully managed. Justine noted that the planning process for renewables is constrained by knowledge of where the best renewable resources are technical and operational realities, socio-economic issues and nature conservation planning. Of the latter constraint there is much uncertainty. ABPmer set out to explore these issues with industry and statutory nature conservation advisors using a Source-Pathway-Receptor model, APB MER's approach was four-fold:

i. Identify receptors of current statutory nature conservation interest and understand environmental change
ii. Map pathways between receptors and pressures
iii. Assess significance of potential impacts
iv. Manage impacts with suggestions for potential measures from the study's participants.

The study identified a number of key ecological risks for nature conservation that will require management and monitoring at various stages of development. However, there are also potential benefits for nature conservation, including:

1. Use of wave devices as breakwaters to protect people, economy and conservation features;
2. Use of devices for habitat enhancement;
3. Establishment of safety zones around devices and cables that also serve to exclude other extractive activities potentially allowing for recovery of natural resources.

Justine concluded with the following recommendations:

a. Clear indicators and targets for nature conservation are required
b. Existing standards need to be used
c. Potential deployment areas need to be well characterised
d. Take advantage of strategic data collection
e. Be clear on characteristics of devices as their environmental risks differ widely
f. Ensure proper site and device selection as this can reduce environmental risks and maximise opportunities
g. Provide a clear roadmap for commercial exploitation in light of nature conservation planning which is progressing ahead of renewable energy developments and broader planning initiatives.

MaRS Model from Crown Estate

No presentation was made of the Marine Resources and Sustainability Model developed by the Crown Estate however an information pack summarising the model was made available to the participants by the Crown Estate. The following is a brief summary of the information provided.

The model uses GIS technology and produces three main outputs; site suitability for potential business activity, sustainability value of the activity, and financial analysis of the potential revenue from the activity.

Registered users will have access to planning tools for application at detailed site level or up to national scale planning. The tools are Locational Activity Assessment, Financial Analysis, Area optimisation, Interaction Analysis, Conflict Analysis, Sustainability and Policy Assessment. The first step, the Locational Activity assessment uses multiple layers of data within GIS to build up aggregate scores of suitability for a selected activity displayed as a heat map. A report provides the detail of what data were used. Area optimisation allows exploration of boundaries of an activity using the financial analysis tool to assess the financial viability of the development area. The area can also be analysed for interaction, co existence or conflict with surrounding activities and populations through calculation of a quantitative measure of interaction or overlap. An iterative process can be followed to reach an optimum area. The model also provides quantitative and qualitative sustainability measures and indicators for the social environmental and economic effects of a proposal. No detailed information on how the trade offs and conflicts are resolved was available.

Plenary Discussion

Data and output quality:
A participant asked the speakers how data is managed in order to ensure comparable quality across the areas of interest. It was explained that fuzzy methods are used and that data are classified with potential errors and standard deviation errors.

One participant mentioned the NUSAP method for data quality assessment developed by Funtowicz and Ravetz, referencing the website www.nusap.net

Another participant pointed to emerging pressures, cumulative effects and the danger of double counting. The participant argued that careful weighting and an expert judgment approach is required. The participant went on to explain that there are several ways of defining significance. A pairwise comparison can produce generic weights that reflect views through a series of choices. Bayesian belief networks use a range of factors and derived outcomes to look at scenarios. The participant summarised by stating that robust data still need intelligent inputs.

A participant pointed to the dynamic nature of the marine system and that models need to reflect this. Further, marine planning has to be dynamic and predictive rather than static. Bayesian approaches can feed in to the model, as can scenarios. The availability of good quality data is an issue and GIS is useful to present output. The participant concluded that methods and options are still needed.

Importance of the human factor:
The importance of the human role in modelling was discussed. A participant made the case that a modelling tool is not enough to give an answer and must have human expertise involved in the process. Experts can give a view on data quality as statistical methods can be unreliable as well as interpretation. This is particularly important with respect to who uses the model and how (e.g. policy-makers).

Further comment:
The model uses ecological significance rather than statistical significance. MPAs versus Marine Spatial Planning (MSP) Conservation land grab and special areas but can MSP deliver conservation? There are other ways other than Integrated Coastal Zones and these are not necessarily no go areas.

Session 4: Knowledge exchange and research integration strategy for Marine Spatial Planning

In this final session, facilitator Sarah Keay-Bright presented a summary of key points that had emerged from both workshops. Nearly all participants had attended both days. The key elements of the presentation are summarised below, with discussion points integrated, reflecting the consensus of the group.

Effective governance and leadership necessary

Lack of vision and leadership from Central Government was an issue flagged by the group – clear vision and strong leadership are needed, and this is likely to involve some difficult but necessary decision-making, even following effective consultation. At the same time, the leadership and vision demonstrated by the Scottish Government was acknowledged. The Scottish experience will need to be shared as part of an effort to improve knowledge exchange across the marine research community. UKERC might potentially have a role to play in achieving this. More co-ordination across Central Government Departments will be necessary.

Need for user-led research in order to enable sustainable development that minimises impacts and maximises benefits and that realistically deals with uncertainty and the unknown.

- Participants identified numerous research gaps as well as issues that need to be addressed by policy-makers and developers. These are summarised in Table 1 of this report.
- There is much uncertainty in the absence of scale-up experience. Thus, the key questions to address are: What do we need to know about the environment in order to get devices into the water? Is a device benign? If not, is it tolerable? Compared with what?
- Research priorities must be informed by end-users of research not researchers. Link to developers needs. Provide data on nature and structure of flow for developers and government for an ecological model. Sea birds also included. Mobilise/enable/incentivise developers to help minimise impact.
- In order to proceed swiftly with development that minimises impacts and maximises the benefits, a basic fundamental understanding of the system based on system data is needed, and not just baseline monitoring. Inherent variability in the system makes detecting change very difficult, especially with climate change and acidification occurring. Baseline data, particularly physical and biological, are currently inadequate and limited data are available to apply to other areas. However, data collection should be based on prudent measurement that is linked to end users and the capability of making such measurements needs to be improved. A strategic approach to monitoring is also required, underpinned by SMART objectives that support consistent application of guidelines and effective feedback.

- More specifically, a better understanding of the following is required:
    - *natural high energy resources* (e.g. production, environmental function, extremes/limitations). In terms of extraction effects there is no linkage between the following key combinations of: a) coastal/pelagic ecosystems for tidal energy and high current velocity b) benthic ecosystems and fast wind speeds and c) pelagic ecosystems and high wave energy. There is considerable uncertainty regarding how much energy can be extracted before affecting these special ecosystems.
    - *ecosystem functioning*, so that the risks and environmental protection can be effectively managed. Simple indicators of ecosystem function are needed.
- There is a risk that NERC-funded fundamental studies on environmental impacts of marine renewables are creating an impression of problems rather than assisting with achievement of development with minimal impacts and maximum benefits. Research priorities need to be informed by end-users of research not just researchers. Such user-input to research needs to be funded by NERC – it should be recognised that fundamental science can also be applied science. This research area needs multidisciplinary research funding, supported by appropriate institutional structures and incentives. At the same time, clearer communication from all Research Councils is needed regarding their funding strategy and priorities which should be joined up with those of RAG.

Scope for improving Environmental Impact Assessments (EIAs):

- While there is much uncertainty in the absence of scale-up, there is always much uncertainty associated with complex systems. Very detailed Environmental Impact Assessments (EIAs) will not necessarily deliver effective system management.
- A consistent application of EIA guidance is required as experience to date suggests EIAs are not of consistent quality. The EIA industry is delivering increasingly large EIAs compared with other countries which are becoming a burden for developers.
- Positive as well as negative impacts need to be identified and socio-economic aspects need to be included.
- There exists a lack of appropriate valuation methods.
- The Institute of Environmental Management & Assessment (IEMA) and the Institute of Ecology and Environmental Management (IEEM)[1] should review the evaluation process of EIAs as currently the EIA process stops at the submission stage, so there is no opportunity to learn and improve by checking to see if the EIA was accurate.

The marine research community is in need of a knowledge exchange and research integration strategy

A key finding of both workshops was that there is poor knowledge exchange between ALL actors including developers, researchers, policy-makers, NGOs/representative bodies and people impacted by development. (Note there is a distinction between 'knowledge' and 'opinion' – stakeholder engagement was also highlighted as a key

[1]The Institute of Ecology and Environmental Management (IEEM) has just released guidelines for Ecological Impact Assessment in coastal and marine environments. http://www.ieem.net/ecia.asp

issue and this is covered in the next section). A knowledge exchange and research integration strategy is needed in order to achieve sustainable development across the whole system which minimises impacts and maximises benefits. Based on outputs from the two workshops, such a strategy would include the following elements:

A - Greater support for creation of user-led and interdisciplinary research:

- Engage end users in research funding decision-making e.g. industry and policy/Government representatives on research boards
- Encourage researchers to stop working in silos and better support integrative researchers and single discipline researchers needing to communicate/collaborate with researchers of other disciplines.
- Get researchers 'out there' into industry, local communities, decision/policy-making fora etc.
- Provide greater support to existing networks or fora to enable more effective knowledge exchange e.g. workshops; engagement processes, Knowledge Transfer Partnerships (KTPs), Knowledge Transfer Networks (KTNs).
- Fund and provide incentives for developers and organisations to provide placements, internships or secondments.
- Fund interdisciplinary Masters, Doctorates or other relevant training initiatives.
- Doctorates or KTPs are an economical way for a business to fund research. The Aggregates Sustainability Fund has proved to be a good model to bring together funds for relevant R&D. The Crown Estate receives rent for its land which it is prepared to recycle into research, and this my provide Renewable Energy companies a cost-effective way to work with students on applied projects.
- Demonstrate best practice in interdisciplinary research. Share methods, techniques and best practice.
- At present, inter- or cross-disciplinary research is down-weighted by Research Councils, there is no credit for them in the Research Assessment Exercise (RAE) and they do not receive enough funding support from the Research Councils. This barrier needs to be addressed.

B - Encourage and enable the sharing of data:

- The marine research community would benefit from a one-stop-shop internet-based data resource. Such a website could provide access to shared databases, information depositories, a social networking platform, tools, resources etc. Best practices in interdisciplinary research could also be shared. It would need funding for someone to set it up and maintain it.
- Data sharing is hampered by competition issues. When companies collect data, they see no reason to share the data when it has cost them to obtain it. Greater exchange of data might help overcome this problem, so that companies receive more data in recompense. The Government and Crown Estate are in a position to enable or facilitate greater exchange of data. Initiatives such as the Humber Data Centre are worthwhile.
- Common databases require quality assurance and data control schemes. Such standards could be incorporated into FEPA licensing requirements.

C - Better integration of research into decision-making and developments:

- get research into design and policy/decision-making processes early and use to update guidance

- streamline/combine consultation processes (i.e. Marine Bill, Marine Spatial Plan, local plans, coastal forums).

D - Streamlined and consistent processes:

- Enable consistent interpretation of legislative requirements.
- Maybe too early for Design Code or engineering guidance, therefore more effective knowledge exchange is essential.
- Define and effectively communicate the interface between organisations with potentially overlapping remit e.g. UK and Scottish Governments, NERC, EPSRC, ESRC, RAG, Crown Estate. This is necessary to at least avoid duplication and a coordinated approach to site selection and development.

E - Greater support for use of research to educate and raise awareness:

- Raise awareness of latest developments across whole stakeholder community i.e. what is happening where.
- Facilitate continuous learning and education for all stakeholders using real evidence and experience, especially best practice. Draw from success stories where local communities have benefited, as well as mistakes to avoid. Also use evidence from other sectors and industries (e.g. oil, onshore wind) and other countries). To achieve this, a research project (e.g. Masters; Doctorate) could follow through one good example covering social, economic and ecology aspects, including stakeholder engagement, for the whole system.
- Engaging developers in setting the research agenda will assist with raising awareness of developers and incorporation of knowledge relating to impact minimisation at the design stage.

Scope for higher quality stakeholder engagement:

The need for effective stakeholder engagement and management of public perceptions was raised several times during both workshops and addressed in detail during small group work in Session 1, Workshop 1. Key aspects relating to this topic and solutions to improve such engagement gathered from participants over the two days, are summarised below:

A - Improve consultation model and 'best practice' guidelines:

- Conflict avoidance and an improved consultation model is needed with better understanding of acceptable change allowable over the whole system. There needs to be realism as regards uncertainty, risk and data quality. Regulatory simplification is required at the same time as improving the quality of the consultation model. Such improvements should be informed by available research/evidence on effective consultation models/processes.
- Early local/regional community immersion is necessary to understand who will be affected and how, their values, information needs and interpretation of information. Early dialogue with stakeholders is necessary before site selection.
- Sound generic guidance is needed, incorporating best practice and possibly minimum standards, to help engage stakeholders in right way, right level and at right stage, enabling participation and empowerment. Efforts/mechanisms are required to ensure that the generic guidance is consistently applied. A consistent approach to data management is also necessary. However, there needs to be a degree of flexibility to allow for tailoring of the generic guidance to the community's specific needs. There needs to be continuous feedback of lessons learned so that guidance can be improved in a timely manner.

B - Provide supportive measures:

- For some stakeholders there is a inadequate capacity to engage effectively. Solutions to address this are needed as effective engagement requires fair representation across stakeholder groups.
- Support is needed to maximise benefits and ensure benefits are sustainable or maintainable for the local and regional economy.
- Support for the technical capacity and skills of the local/regional community may be needed.
- Demonstration sites might need and benefit from long-term support.

C - Institutional change to enable better engagement

- Regional Development Agencies need to work together more effectively.
- Better communication with stakeholders through the Independent Planning Commission and the Marine Management Organisation needs to be supported, though a flexible approach may be required.

Appendix 1: Workshop Programmes

WORKSHOP 1 Programme:

Sustainable marine planning for arrays:
Social, economic and environmental issues and implications
24 March 2009

A one-day workshop which aims to identify issues and priorities relating to social, economic and environmental impacts, discuss their implications for policy-makers and developers and identify ways forward to achieve an integrated and holistic approach to assessing and managing them across the whole marine and coastal system.

09:00 *Arrival and registration; refreshments*

Session 1: Sustainable deployment of arrays: socio-economic effects

09:30 Welcome and context-setting

09:45 Understanding public responses to renewable energy
Claire Haggett, University of Edinburgh

09:55 Socio-economic issues associated with marine technologies
Bridget Woodman, Exeter University

10:05 Panel Q&A and plenary discussion

10:40 *Refreshment break* (with brainstorm on social and economic issues during break)

11:15 Group work: Knowledge gaps and issues relating to deployment

12:30 *Lunch*

Session 2: Sustainable deployment of arrays: environmental impacts

13:30 Progress on environmental impacts and priorities of RAG
Mike Elliott, Hull University and John Hartley, Hartley Anderson.

14:00 Animal interactions with marine energy devices
Robert Batty, Scottish Association for Marine Science (SAMS)

14:10 Panel Q&A and plenary discussion

14:45 Group work: Knowledge gaps and issues relating to deployment

15:45 *Refreshment break*

Session 3: Integration of environmental, social and economic issues

16:15 Introduction

Annie Linley, Plymouth Marine Laboratory

16:30 Group work

17:30 Wrap up and close

Pre-dinner drinks from 7pm for dinner at 8pm.

WORKSHOP 2 programme:

Sustainable marine spatial planning for the deployment of arrays

25 March 2009

A one day workshop to provide a policy update, simplification of consenting and locational criteria and their application and discussion on how decision-making support models can be used.

08:45 *Arrival and registration; refreshments*

09:15 Welcome and context-setting
Phil Gilmour, Scottish Government and Project Manager of the Marine Energy Spatial Planning Group (MESPG)

Session 1: Policy context

9:30 UK Government marine policy
John Hartley, Hartley Anderson.

9:40 Scottish Government marine policy
David Palmer, Scottish Government

9:50 Plenary discussion

10:20 *Refreshment break*

Session 2: Simplifying consenting /EIA/AA and locational criteria for marine planning

10:40 Simplification of consenting and use of locational criteria for marine spatial planning to support SMMO decisions
Phil Gilmour, Scottish Government and Project Manager of the Marine Energy Spatial Planning Group (MESPG) and Iain Bell, Faber Maunsell.

11:05 Panel Q&A, discussion session

11:30 Small group work: Simplification of consenting, locational criteria

12:15 Groups give feedback to plenary

13:00 *Lunch*

Session 3: Integrating models to support decision making from public, commercial and government perspectives

14:00 The CEFAS Model
Janette Lee, Centre for Environment, Fisheries and Aquaculture Science.

14:10 ABPmer: A nature conservation approach
Justine Saunders, ABP Marine Environmental Research

14:20 Panel Q&A, discussion session

Session 4: Integration Strategy for Marine Spatial Planning

14:50 Implications of environmental and socio-economic aspects of arrays for developers, policy makers and integrating research?
Facilitator and Mike Elliot, University of Hull

15:50 Wrap-up

16:00 Close. Refreshments and networking opportunity.

Appendix 2: Workshop Attendee List

Sustainable Marine Planning for Arrays

24th and 25th March 2009, King James Thistle Hotel, 107 Leith St, Edinburgh.

First name	Surname	Email	Organisation
John	Allan	j.allan@csl.gov.uk	Central Science Laboratory
Sue	Barr	sue.barr@openhydro.com	OpenHydro
Robert	Batty	robert.batty@sams.ac.uk	Scottish Association for Marine Science
Katie	Begg	k.begg@ed.ac.uk	Centre for Environmental Change and Sustainability School of Geosciences University of Edinburgh
Iain	Bell	iain.bell@fabermaunsell.com	Faber Maunsell
Ian	Bryden	ian.bryden@ed.ac.uk	University of Edinburgh
Morna	Cannon	Morna@scottishrenewables.com	Scottish Government Marine Energy Spatial Planning Group (MESPG)
Ian	Davies	daviesim@marlab.ac.uk	Fisheries Research Services
Sarah	Dolman	sarah.dolman@wdcs.org	Whale & Dolphin Conservation Society
Mike	Elliott	Mike.Elliott@hull.ac.uk	Institute of Estuarine & Coastal Studies, University of Hull
Peter	Fraser	p.fraser@abdn.ac.uk	University of Aberdeen
Andrew	Gill	a.b.gill@cranfield.ac.uk	Cranfield University
Phil	Gilmour	Phil.Gilmour@scotland.gsi.gov.uk	Scottish Government and Project Manager of the Marine Energy Spatial Planning Group (MESPG)
Lucy	Greenhill	lucy.greenhill@jncc.gov.uk	Joint Nature Conservation Committee
Claire	Haggett	claire.haggett@ed.ac.uk	School of Geosciences, University of Edinburgh

John	Hartley	jph@hartleyanderson.com	Hartley Anderson
Henry	Jeffrey	henry.jeffrey@ed.ac.uk	University of Edinburgh
Sandy	Kerr	s.kerr@hw.ac.uk	ICIT Heriot Watt University
Janette	Lee	janette.lee@cefas.co.uk	Cefas
Annie	Linley	anli@pml.ac.uk	Plymouth Marine Laboratory
Robin	McGregor	robin@christiegriffith.co.uk	Christie Griffith
Geraldine	Newton-Cross	Geraldine.Newton-Cross@eti.co.uk	Energy Technologies Institute
Jennifer	Norris	jenny.norris@emec.org.uk	European Marine Energy Centre (EMEC)
David	Palmer	david.palmer@scotland.gsi.gov.uk	Scottish Government
Dale	Rodmell	Dale.Rodmell@nffo.org.uk	Association: Representative Body of the Fishing Industry
Graham	Russell	g.russell@ed.ac.uk	The University of Edinburgh
Justine	Saunders	jsaunders@abpmer.co.uk	ABP Marine Environmental Research
Beth	Scott	b.e.scott@abdn.ac.uk	University of Aberdeen
Emma	Sheehan	emma.sheehan@plymouth.ac.uk	PRIMaRE, University of Plymouth
Mark	Shields	mark.shields@thurso.uhi.ac.uk	Environmental Research Institute UHI
Jonathan	Side	j.c.side@hw.ac.uk	Heriot-Watt University
Aedán	Smith	aedan.smith@rspb.org.uk	RSPB Scotland
Louise	Smith	louise.smith@hient.co.uk	Highlands & Islands Enterprise
David	Toke	d.toke@bham.ac.uk	University of Birmingham
Jodie	West	jodie.west@plymouth.ac.uk	University of Plymouth
Matthew	Witt	m.j.witt@ex.ac.uk	PRIMaRE / University of Exeter
Bridget	Woodman	B.Woodman@exeter.ac.uk	University of Exeter

Appendix 3: Environmental Impacts - Research Gaps identified at NERC workshop (Workshop 1, Session 2)

Principles:

- whole system approach
- process from energy extraction to ecosystem impacts over life cycle of project
- different approaches for different groups eg observational for pelagic and modelling for benthic and spatial and temporal scales relevant to species/habitat

GAP Theme	Specific
Energy Extraction	
	Impact of flow change son local to bay scale coastal environments
	Sediment process and 3D rheology mixed sediment vs uniform sediment vs rocky substrate and implications
	Scouring round structures spatial and temporal effects for downstream
	Improved predictive models for resource prediction for RE with climate change at relevant spatial and temporal scales
Mammals	
Healthy Ecosystem	
	Improved predictive models for some specific ecological /biological components and for resource prediction for RE
	Assess value of practices from other earth systems eg fallow
	Proximity of species, communities under threat also benefits at different levels speicies communities to whole system
Exclusion zone impacts/opportunities	
	Quantitative data on positive and negative effects and different fisheries management options as a basis for policy eg existing sites
ICZM criteria	

	Define what is significant in ecological terms for all ecosystem components in water column (seasonal decadal random, 'effects paradox)
	Connectivity of OWF footprints in regional seas eg effectively act as ecosystem reserve/recovery area for whole region?
Monitoring, when how much	
	Monitoring plan to be agreed to facilitate adaptive management
	Use sites as monitoring hubs, act as control/ref points
Data availability	
	Need for long term observational data at different scales to support methods tools and technology development: major disconnect EIA baselines no good for modelling
	Historical and new data and access
	Data sharing essential ALSF BODC MDIP
Cumulative Impacts	
	Scouring round structures spatial and temporal effects for downstream for array
	Significance at different deployment scales
	Agreed framework for assessment of cumulative/interactive effects
	Which mesocosm lab scale questions can be addressed and which at device scale can be answered to inform cumulative
	Which questions can be answered by arrays/OWF field experiments
	Consider whole range of scientific and socio economic benefits at different geographical locations and range of spatial scales-connectivity for biodiversity benefits, proximity to population centres, to regenerate communities.
Cross cutting	Sediment /nutrient /food chain /ecological impacts on biodiversity in short and long term
	Resource properly demonstrator sites for benefit of industry
	Baseline issues for what is 'normal' on spatial and temporal scales in light of climate change and acidification
	Develop an agreed framework integrating all ecosystem components for assessing risk to populations/species for developers and regulators
	Include social and economic issues in framework for assessment of cumulative impacts for sustainability. Need tools for integrating assessment of multiple users of marine space
	Tools methods technologies for observing, recording and monitoring fro prediction analysis and decision tools AND improvement of current methods eg remote sensing but cost implications. Development of methods has to be integrated with decisions on scale of models
	Understanding of risks through supplying tools needed to stakeholders

Appendix 4: Summary for Integration of issues and Implications for Policymakers and Developers

Integration Issues			
Gap/Issue	**How Address**	**Implications for**	
		Policymakers/regulators	Developers
1. Integration for Sustainable design	Design device with environmental constraints in mind from the start Possible screening of design concepts eg breakaway risks, cumulative array effects but perceptions of what is acceptable changes over time and has to be in the context of the challenge of making it work Mooring options are a key factor to get right Do not rule out designs too early	Govt to encourage developers to design environmentally friendly devices from start bearing in mind possible cumulative effects and carbon footprint Fund research on environmental design eg noise levels which cause problems to incorporate in engineering design codes	Developers to incorporate environmental design Learn lessons from oil and gas industry
2. Maximise Socio- economic benefits from sustainable marine space usage	Integrate socio economic aspects at preliminary site evaluation stage Capture and demonstrate success stories a) to Inform other developments e.g. Can ensure local jobs through operation maintenance and installation activities e.g. Pentland b) to shift perceptions of consequences Research on What other benefits can accrue to local	Exclusion zones could be part of marine protected areas so integrate across activities Encourage activities to maximise socio economic benefits fund research on benefits and delivery of benefits Leadership on conflict avoidance between conservation, developments and fishing inshore and marine for good marine spatial planning. Research on e.g. types of fishing equipment suitable round wind	Industry to gather case studies to show people success stories design implementation to ask locals what they want and maximise delivery of local benefits

	communities and **how** enable delivery by asking locals what they want rather than assume all the same. Strong liaison with fishing industry required	farms, local livelihoods and alternatives, knowledge economy Regional development agencies to work together to maximise benefits	
3. Research across Physical, social economic and biological sciences -silos in research -insufficient true cross disciplinary studies funded by research councils -insufficient incentives in RAE and professional assessment processes -fast followers in US Canada, Korea and Taiwan -NERC are failing in this area and EU funding is small	Create research programmes through identifying gaps as well as asking academics what they want to do. Have a whole system approach from effect of marine systems on devices to effect of devices on marine systems as well as the on shore connections and implications for ports harbours etc for local communities/regions and life cycle requirements of developments A cross research council community forum to grow cross disciplinary communities and steer the science and select projects with an end user connection Avoid silos being created by politicians More funding of EU type cross disciplinary projects in the UK Join up initiatives across research	Avoid duplication between Scottish Government strategic research plan and Central Govt. Funding for placements for scientists in the wider system they are studying to avoid silos e.g. on fishing boats University and research council structures to be reviewed to avoid silos Research into how to encourage good science across disciplines Develop a shared vision for the UK so that politicians cannot create silos Support Research councils to fund more international collaboration projects	

	councils and government departments e.g. RAG and NERC research on marine energy Work across borders and international markets e.g. IEA/OE programme. Collaborate where can Bottom up forum to educate NERC and referees		
4. Governance, leadership, Skills and competence Current institutional structures and reorganisations in govt departments are causing problems eg RCEP/ETI/UKERC etc and leadership is needed	Ensure awareness of problem is raised with top level government Outside leadership can assist and support More socio economic skills required in government departments and laboratories	Leadership is needed from the top	

Appendix 5: Practical Tools for Marine Planning: An Assessment of Cumulative Effects of Human Pressures on the Marine

Stelzenmüller, V., Lee, J., South, A. and Rogers, S.I.

Worldwide increasing pressure on the marine environment requires integrated and ecosystem-based management and a sound understanding of cumulative impacts of human pressure. We are developing a geospatial modelling framework to group data on the spatial distribution and intensity of human activities by generic pressure. The impact of those pressures is mapped taking into account the sensitivity of UK marine landscapes. Using GIS, we are developing and testing different scenarios to quantify the risk of cumulative impact by varying the relative importance of the pressures. The sensitivity of the scenario outcomes to changes in input parameters will be assessed.

The study aims to develop a standardised framework to quantify the risk of cumulative impacts of human pressures in UK (E&W) waters although the focus is on the critical evaluation of the framework and the assessment of variability and uncertainty in the modelling outputs rather than the development of precise marine planning scenarios. Our list of human activities and pressures is not a comprehensive one, lacking data at a suitable scale on many activities affecting inshore areas such as inshore fishing, recreational angling, navigational dredging, or nutrient loading. As a consequence, our approach underestimates the relative risk of cumulative impact for inshore areas. Nevertheless, the framework could be applied at any spatial scale and adapted to different pressure categories where suitable data are available.

A measure of the sensitivity of ecosystem components to pressures from human activities is essential. We consider marine landscape categories as ecosystem components and convert respective measures of sensitivity from an ordinate scale to a numeric scale to derive sensitivity scores for each landscape category. Our algorithm computes impact on the landscape as a function of the intensity of a pressure and the measure of sensitivity. Consequently, an increased impact can be the result of either increased pressure intensity and a low level of sensitivity or a high level of sensitivity and the low intensity of a pressure.

Uncertainty exists across many components of our modelling framework, including data quality, model design and/ or parameters used. Nevertheless, management decisions must be made, even in the context of incomplete knowledge and we contend that our spatially explicit, standardised and repeatable approach to quantification of the risk of cumulative impact is a practical tool that can be used to support the sustainable use and development of marine resources.

The processing framework