Wet Renewable Energy devices: Environmental impacts and Technical constraints mapping

Justine Saunders

(ABP Marine Environmental Research)

npower juice

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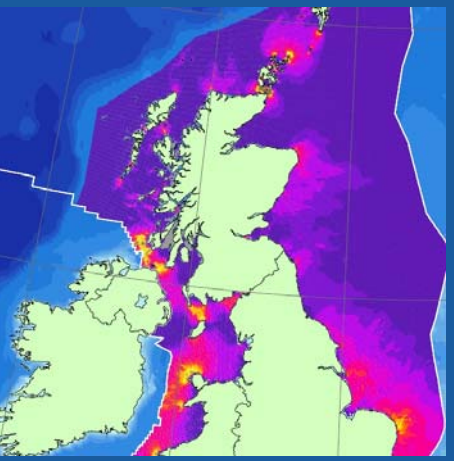
ABPmer - Renewables Life Cycle Support



Site Selection

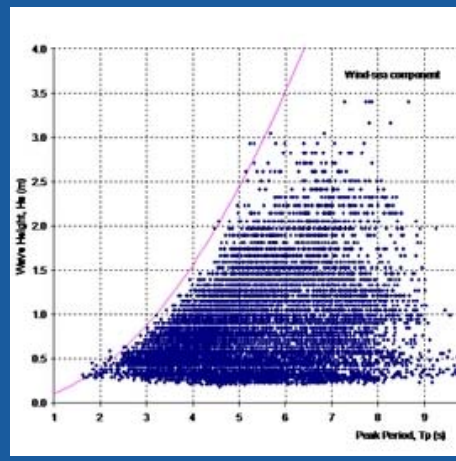
Project Development

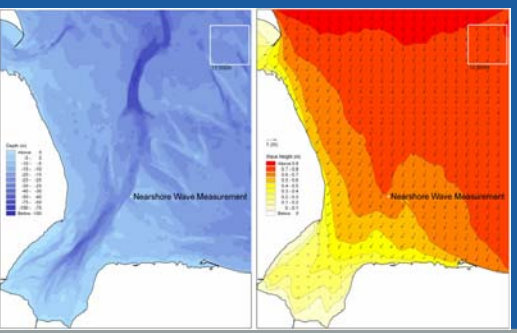
Detail Design

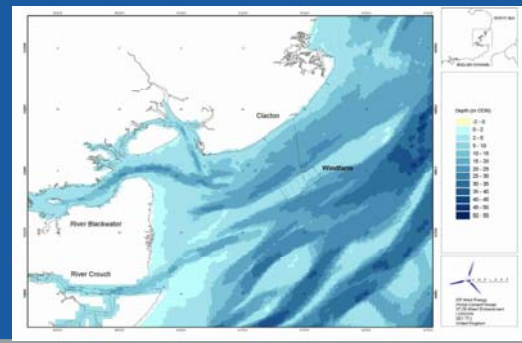
Operation

Decommissioning

Management and
Policy development







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ABPmer Renewable Energy Projects

- Potential nature conservation & landscape impacts for Wales – CCW (2005)
- The Path to Power: Delivering Confidence in the Development of Wave and Tidal Stream Energy Around the UK – npower Juice (2006)
- Potential nature conservation impacts – CCW & TCE (2006)
- Costs to business of nature conservation measures in the Marine Bill – Defra (2007)
- Implications of New Conservation Designations for Key Business Activities - The Crown Estate (2007)
- Quantification of Exploitable Tidal Energy Resources in UK Waters - npower Juice (2007)
- UK Marine Renewable Energy Resources Atlas with Met Office & POL – BERR 2008
- Developing strategies for management of the impacts of renewable energy – Juice (2008)

Outline of today's talk

- Resource mapping and constraints analysis
- Environmental impact assessment and management
- Summary

1. Resource mapping

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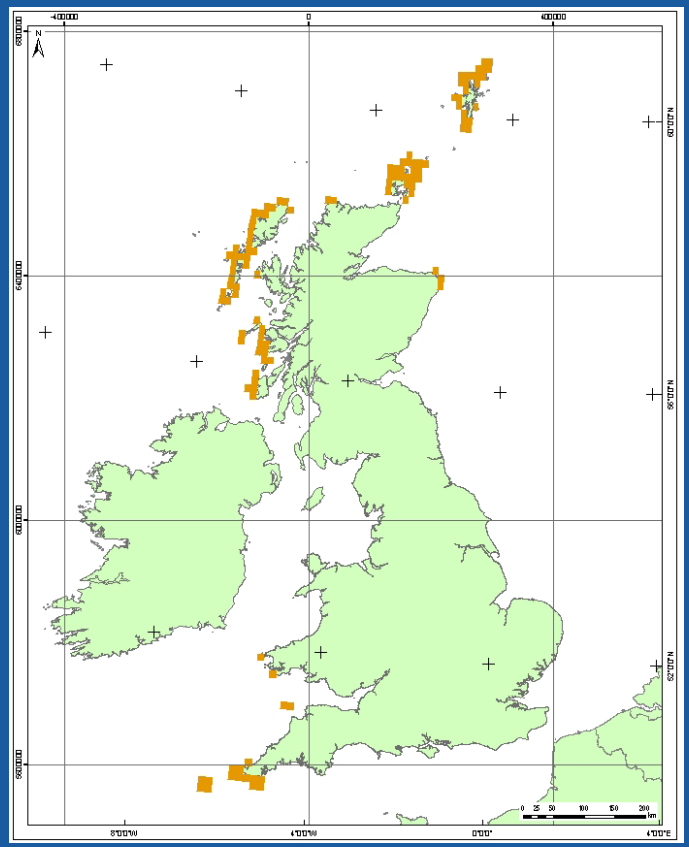
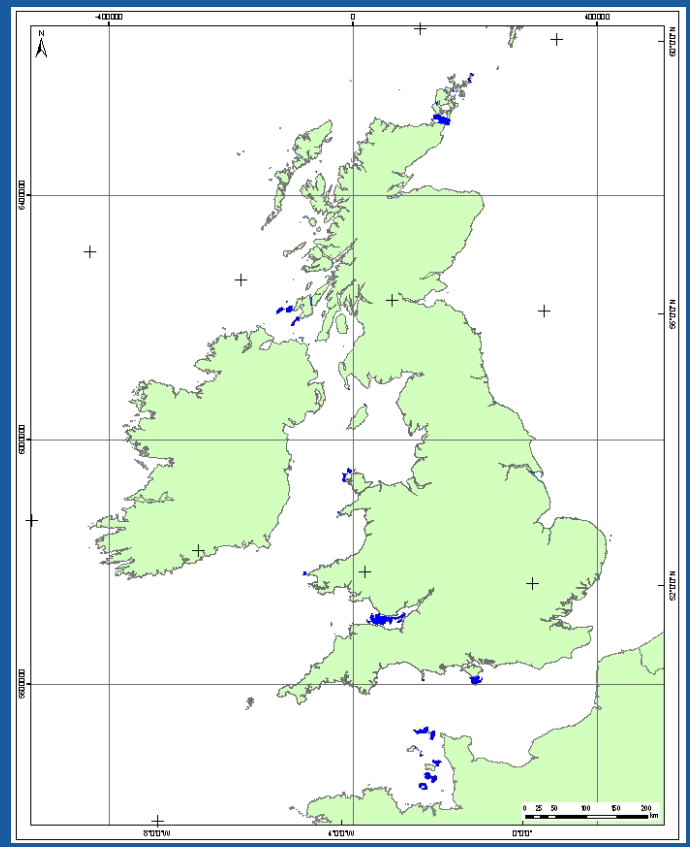
UK spatial requirements – renewable energy





Wave:

Annual Mean Significant Wave Height > 2m

Max distance = 12 nm from coast

Tidal:

Mean Spring Peak Current > 2.5 m/s

Max distance = 12 nm from coast

Small-scale mapping

1. Compile information on marine renewable energy technologies and potential operating conditions (water depth constraints, wind/water flow speeds, wave climate etc); tabularise key operating criteria;
2. Source best available regional datasets extracted from the updated Atlas of UK Marine Renewable Energy Resources, in-house modelling capabilities on wave and tidal stream (MPA Datalayers);
3. Apply the combined data criteria (e.g. depth, distance from land and specific resource parameters) to each resource GIS layer to identify potentially suitable resource locations
4. Take new layers with suitable resource locations and overlay onto constraints data layers (E.g. grid connection, designations, seabed features, navigation and BGS data)

Outputs

- Tailored GIS layers with UK Gemini compliant metadata for suitable resource location selections of tide, wind and wave data (as defined by criteria assessment).
- Brief report describing the process to define these new datasets, with figures to highlight constraints on suitable resource locations.

2. Environmental Impact Assessment and Management

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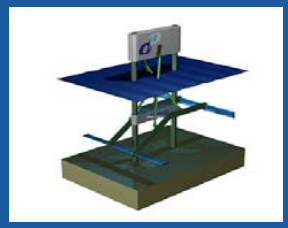
Overview of Juice-funded study: "Wet Renewable Energy and Marine Nature Conservation: Developing Strategies for Management"

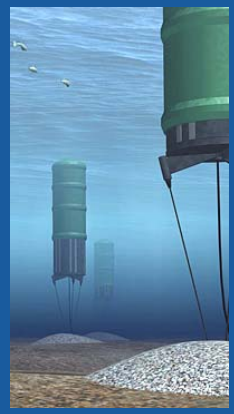
- Spatial overlap between the extent of renewable resources in the UK and conservation features
- Description of Environmental impacts
- Case studies to explore specific issues
- Confidence assessment of data and identification of key information gaps
- Exploration of mitigation measures
- Recommendations for future research and management

What's the problem?

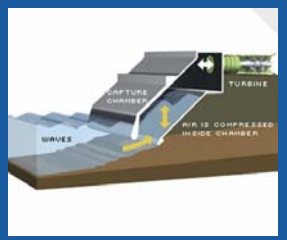
MCT

Pulse Generation





Archimedes



Limpet

Wave Dragon

Renewable Energy

?

1. **What is the overlap between the spatial requirements of the two?**
2. **What are the known environmental impacts of a range of wave and tidal energy devices?**
3. **What is our level of confidence in this assessment and where are the information gaps?**
4. **How can these impacts be managed?**

Marine Nature Conservation

Photos: Keith Hiscock, MarLIN; Nic Davies

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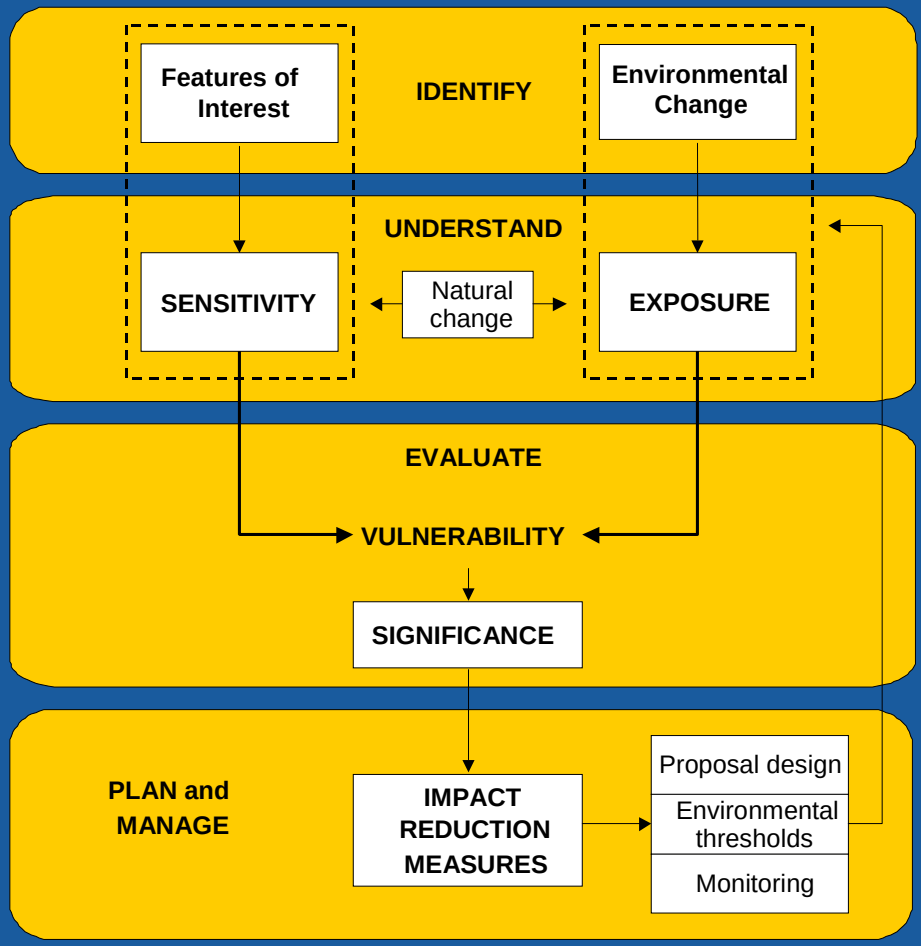
Environmental Impact Assessment Process



Approach

- Identify receptors
  - Habitats and Birds Directives, OSPAR, UKBAP
  - Habitats (Biogenic, Intertidal, Subtidal, Offshore, & Bird habitats)
  - Species (Mammals, Birds, Fish, other invertebrates)
- Collate and review information on the environmental effects of wave and tidal devices:
  - Types of device (wave or tidal)
  - Location (coastal, offshore)
  - Mooring type (cemented, anchored, gravity base or piled)
- Stakeholder workshop 1 (9th Jan 2008) to agree case studies
  1. Wave/Coastal/Cemented
  2. Wave/Offshore/Anchored
  3. Tidal/Estuarine/Piled
  4. Tidal/Offshore/Piled
- Case study assessments and stakeholder review
- Development of impact matrices…

Table D1: Impact matrix for wave devices located on the coast; cemented

			Biogenic habitats (species/habitat)							Intertidal habitats					Sub-tidal habitats								Offshore		Speci
Development stage	**Activity**	**Environmental Impact**	Intertidal Blue mussel *Mytilus edulis* beds	Flat oyster *Ostrea edulis beds*	Horse mussel beds *Modiolus modiolus*	*Sabellaria alveolata* reefs	Maerl (*Lithothamnion corallioides*) beds	File shell beds (*Limaria* species)	Serpulid (*Serpula vermicularis*) reefs	Coastal Saltmarsh	Intertidal mudflats and sandflats	Seagrass *Zostera* beds	Intertidal boulder & chalk communities	Intertidal reefs	Estuarine habitats and Coastal lagoons	Large shallow inlets and bays	Submerged or partly submerged sea caves	Tide-swept channels	Subtidal chalk	Subtidal sands and gravels	Subtidal Reefs	Sea-pen and burrowing megafauna	Cold-water coral *Lophella pertusa* reef	Deep-sea sponge communities	Cetaceans: Dolphins, Porpoise, Whales
General	Spillage of oil, fluids and construction materials	Contamination & reduction in water quality	L	N/A	N/A	L	N/A	N/A	N/A	N/A	N/A	N/A	L	L	N/A	N/A	L	N/A	L	L	L	N/A	N/A	N/A	L
Pre construction	Side scan sonar and other geophysical surveys	Acoustic disturbance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L
Construction	Vessels travelling to and from the site	Noise, visual disturbance & collision	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L
	Construction machinery & vessels	Damage / disturbance of habitats & species from machinery & anchors	L	N/A	N/A	L	N/A	N/A	N/A	N/A	N/A	N/A	L	L	N/A	N/A	L	N/A	L	L	L	N/A	N/A	N/A	L
	Construction work: drilling, pile driving, seabed levelling.	Noise and Vibration causing damage and/or disturbance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	M
	Installation of structures	Increase in suspended sediment levels; decrease in water quality	M	L	L	M	L	L	N/A	N/A	L	L	L	M	L	L	M	L	M	M	M	N/A	N/A	N/A	L
	Installation of structures	Physical disturbance of substrata, local benthic habitat and species	L	N/A	N/A	L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L	N/A	N/A	L	N/A	L	L	L	N/A	N/A	N/A	L
	Installation of cables	Physical disturbance of substrata, local benthic habitat and species	Installation of shore cables not assessed here																						
	Deposition of construction waste	Smothering of benthic species & habitats	N/A	N/A	M	M	M	M	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L	N/A	M	M	M	M	N/A	N/A	N/A
	Placement of structures on the coastline	Loss of habitat and species from the footprint of the device	M	N/A	N/A	M	N/A	N/A	N/A	N/A	N/A	N/A	N/A	M	N/A	N/A	L	N/A	L	L	L	N/A	N/A	N/A	N/A
	Placement of structures on the coastline	Indirect impacts on species from loss of food resources & habitats	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L
Operation	Presence of structures and/ or devices	Change in sediment dynamics	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Presence of structures and/ or devices	Device-related mortality / collision risk / trapping	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L
	Presence of structures and/ or devices	New Habitat	L	N/A	N/A	L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L	N/A	N/A	L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Presence of structures and/ or devices	Potential physical barrier on movement and migratory pathways	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Presence of structures and/ or devices	Removal of wave energy, change in hydrodynamics & emergence regimes	L	N/A	N/A	L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L	N/A	N/A	L	N/A	L	L	L	N/A	N/A	N/A	L
	EMF associated with power export cables	Behavioural changes to electro- and magnetosensitive species	Power cables on land																						

Summary of key activities resulting in potentially medium to high impacts

	Subtidal and intertidal benthic communities	Fish	Cetaceans, seals and turtles	Seabirds
Construction	• Use of jack-up legs • Inc in suspended sediment levels • Loss of habitat & species from footprint of device	• Noise from construction • Inc in suspended sediment levels	• Noise from construction • Noise disturbance and collision risk from vessels travelling to and from the site	•Noise & visual disturbance from construction • Noise disturbance and collision risk from vessels travelling to and from the site • Indirect impacts on food resources
Operation	• Scour effects from mooring systems of devices • Change in hydrodynamics from tidal flow devices	• Scour effects from mooring systems of devices • Change in hydrodynamics from tidal flow devices • indirect impacts on habitat and food resources	• Device-related mortality & injury from collision • Presence of sub-surface structures presenting a barrier to movement and migratory pathways	• Indirect impacts on food resources
Decommissioning		• Noise from de-construction work	• Noise from de-construction work	• Noise from de-construction work

3. Confidence assessment & key information gaps

Key information gaps and uncertainties

- Information on the detailed distribution of marine features and functional use of areas (habitats, fish, marine mammals, sea birds)
- The magnitude of some environmental changes (e.g. hydrodynamic impacts, EMF, operational noise)
- The extent of exposure of receptors to environmental change (e.g. encounter rates for fish, marine mammals and birds with device)
- The response of some receptors to environmental changes (e.g., response of birds to noise, behavioural response of marine mammals and fish to EMF, structures and vessels).
- Cumulative impacts on habitats and mobile species from multiple devices (scour, noise, hydrodynamic effects and removal of wave energy)
- Cumulative impacts from other activities, e.g. construction, shipping
- Impacts beyond the immediate footprint (e.g. indirect effects on hydrodynamic regime and food resources)

4. Management of impacts

Management of impacts

	e.g. Use of jack-up legs during construction on subtidal benthic communities
1. Avoid	Cable route planning
2. Mitigate (project design)	Micro-siting of jack-up legs to avoid sensitive habitats
3. Compensate	
4. Monitor	Survey recovery of benthic community following construction

Summary

- Spatial overlap between requirements for renewable energy and marine protected areas is currently small but may increase significantly in response to proposed inshore SACs, extensions to SPAs and MCZs
- Key concerns: noise impacts of construction, loss of habitat from arrays of devices, scour effects, change in hydrodynamics, and responses of mobile fauna to devices
- Good amount of information on generic activities (e.g. construction and boat traffic) but some remaining uncertainties surrounding specific activities (e.g. EMF, collision risk) and indirect impacts on food resources
- The majority of activities can be managed in a number of different ways to avoid, minimise, compensate for and monitor impacts
- 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 if it's carefully managed