Analysis of Experience from Environmental Impact Assessments of Wave Energy Test Centres: results from the SOWFIA project



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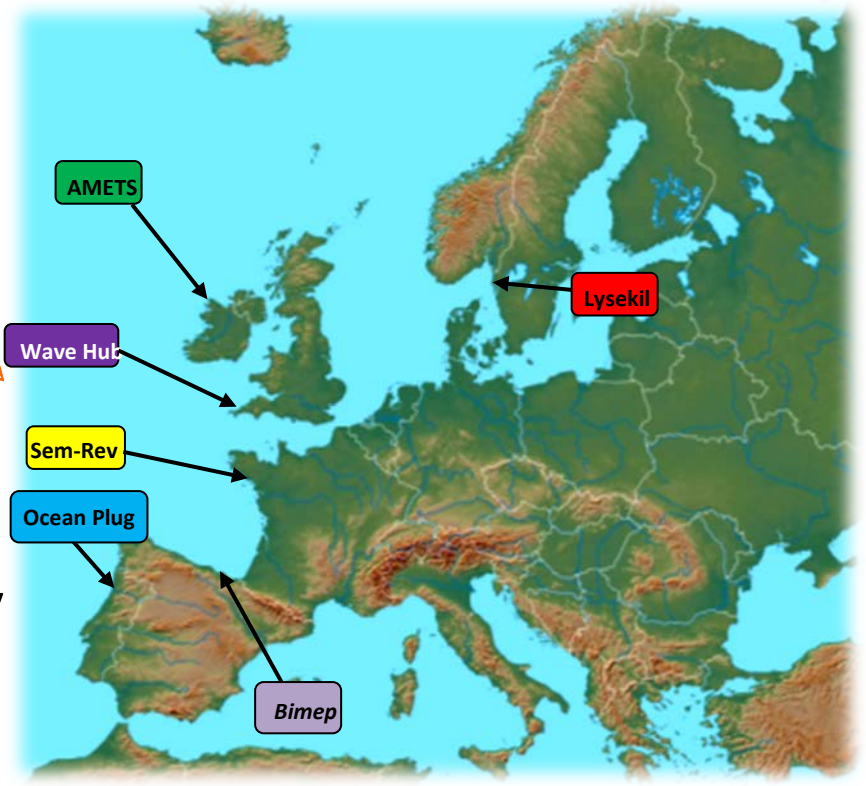
Introduction

- 10 EU partners
- Six Wave Energy Test Centres
- Collation of Environmental and Socio-Economic Information from EU Centres.

? Unknown Environmental and Socio-Economic Impacts of Wave Farms

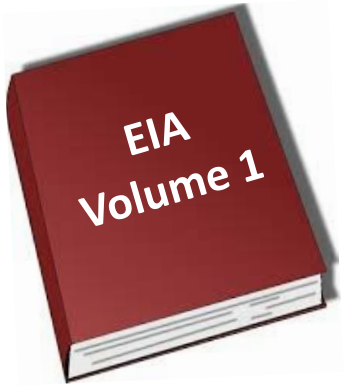
? Uncertainties on adapting regulatory process to Wave Energy

? Lack of coordinated IA policies



Aims of EIA Review

- Investigate whether/how environmental monitoring and EIA are barriers to the development of wave energy.
- Review environmental monitoring information from test centres to assess what monitoring was in place for different projects.
- Examine how monitoring is being done in different locations and identify areas if and where there is standardisation.
- Evaluate environmental monitoring data to assess what understanding, if any, has been gained about the impacts of wave energy devices.



EIA Parameters

Parameter	AMETS	*bimep*	Lysekil	OceanPlug	SEMREV	WaveHub
Bathymetry	X				X	X
Geomorphology	X			X	X	X
Hydrodynamics	X	X		X	X	X
Noise		X	X			X
Benthos	X	X	X		X	X
Fish/shellfish		X	X			X
Plankton						X
Marine mammals	X	X	X	X		X
Birds	X			X		X
Visual impacts	X					X
Archaeology						X
Navigation/ Shipping	X					X
Fisheries	X			X		X
Economics						X
Tourism						X

Methods Utilised (1)

	AMETS	*bimep*	Lysekil	OceanPlug	SEMREV	Wave Hub
Marine Mammals						
Desktop study	X			X		X
Land based surveys	X			X		
Boat surveys	X			X		X
Static Acoustic Monitoring	X	X	X			X
Towed Acoustics	X					
Aerial survey				X		
Birds						
Desktop study	X			X		X
Land based surveys	X			X		X
Boat surveys	X			X		X

Note: Information based on Magagna et al. (2013) 'Report on the analysis of Environmental Impact Assessment experience for wave energy' – SOWFIA Project Deliverable 3.5

Methods Utilised (2)

	AMETS	*bimep*	Lysekil	Ocean Plug	SEMREV	Wave Hub
Fish and shellfish						
Dive surveys		X	X			
Acoustic methods		X				X
Video surveys						X
Benthos						
Grab sampling	X	X		X	X	
Video surveys	X	X				X
Dive surveys	X	X	X			
Noise		X	X			X
Waves	X	X	X	X	X	X
Current	X			X	X	

Note: Information based on Magagna et al. (2013) 'Report on the analysis of Environmental Impact Assessment experience for wave energy' – SOWFIA Project Deliverable 3.5

Physical Environment (1)

Wave

METHODS

- Moored directional buoys also ADCPs or HF radar
- Should span 1-2 years
- Minimum temporal resolution of 3 hours

LOCATIONS

- Upwind of test berth
- Downstream also desirable (SEMREV and WaveHub)

Current

METHODS

- ADCPs in water depths <100-150m
- 1-2 months continuous recording
- Limited by battery life/memory

LOCATIONS

- ADCP deployed close to wave buoy
- Desirable to have upstream and downstream ADCPs

Physical Environment (2)

LESSONS LEARNED TO DATE

- No certainty that wave or tidal farms will impact significantly on wave and current fields;
- Methods used to answer the question still need major improvements;
- Preliminary studies conclude that changes in significant wave height alongshore should not exceed a few per cent (Miller et al., 2007);
- Largest effects will be experienced immediately downstream of the array;
- Net effect on distant shorelines are expected to be quite small.

Noise (1)

- No established instrumentation or methodology for measuring noise from WECs and their effects on marine animals (Copping et al., 2013);
- Little data of any sort available on the noise output from any type of wave energy device; some available for tidal;
- Only 'pockets' of baseline noise data available;
- Some guidance available (Austin et al., 2009; EMEC Lepper et al., 2012).

METHODS

- Depends on what is being asked…
  - Single hydrophones used to measure sound pressure;
  - Hydrophone arrays used for particle velocity measurements;
- Length of deployment varies according to equipment used.

Noise (2)

Noise Monitoring at Test Centres Associated with SOWFIA Project				
Test centre	**Monitoring requirements**	**Sampling stations and time period**	**Used methodologies**	**Type of data in the DMP**
Galway Bay (Ireland)	Research purposes	1 no. particle velocity detector and 1 no. hydrophone September 2012 for approximately 2 years	1 year baseline noise monitoring programme which it is planned to follow with a 1 year noise monitoring programme with a wave energy device in place for which additional sensors will be used. Frequencies covered: up to 160kHz.	Data not available at present
BIMEP (Basque Country, Spain)	Part of EIA	1 no. station to cover the extent of BIMEP area June 6 to November 29, 2012	1 no. hydrophone anchored at 40m depth, frequencies 1Hz-80kHz to measure ambient noise and the presence of marine mammals.	Data not available at present
Wave Hub (Cornwall, UK)	Academic research purposes by the University of Exeter	1 no.station a few hundred metres south of Wave Hub. Deployed February 2012 for foreseeable future.	Hydrophone with archival recording technology deployed 10m from seabed. Frequencies covered: several Hz to 48kHz.	Data not available at present
Lysekil (Sweden)	Part of ongoing EIA	Baseline noise monitoring at one location and noise monitoring with a device present at a second location. Both April 4, 2011 to May 28, 2011.	Both sensors SM2 recorder with a HTI 96 minute hydrophone. Baseline monitoring from seabed at 25m depth. Monitoring for noise from device, 20m from device. SM2 had a sampling rate of 44.1kHz Hydrophone had a flat frequency response range between 2Hz and 30kHz	Data not available at present

Noise (3)

LESSONS LEARNED

- Noise studies to date focus on attempts to measure the acoustic signature of different WECs – further studies required;
- At Lysekil analysis of noise measurements from a WEC was only possible for significant wave heights of less than 0.5m;
- Noise energy emitted by WECs expected to have frequencies of up to a few kHz;
- A number of noise monitoring programmes at test centres are on-going;
- Long duration noise monitoring measuring a wide range of frequencies covering the hearing ranges of all species will be necessary until more is known.

Marine Mammals (1)

METHODS

- Static acoustic monitoring methods are most commonly used at test centres to access effects on cetaceans;
- Method used is dependent on question to be answered;
- Few studies on actual impacts of devices on marine mammals.

LOCATIONS

- Range of methodologies utilised at test centres:
  - Methods, metrics, equipment required, survey design, monitoring interval and analysis of change;
- Most test centres have baseline information on marine mammals coincident to there site but many sites lack alternative additional locations (away from the berths) that could be considered as statistically relevant control locations.

Marine Mammals (2)

LESSONS LEARNED

- Land-based methods are cost effective but not suitable at every site;
- Data should be collected over an extended time period – at least two years - so that an albeit short baseline can be constructed for each season before any devices are installed;
- Data should also be collected from several locations;
- Before-After-Gradient (BAG) design may be more appropriate than Before-After-Control-Impact (BACI) design (Thompson et al., 2010);
- SAM data should be expressed in common units (e.g. DPH or DPM) at high encounter sites, per time unit (e.g. days, months, years) and waiting time between acoustic encounters.

Summary

Receptors		AMETS	BIMEP	LYSEKIL	OCEAN PLUG	SEM REV	WAVE HUB
Physical Environment	Water quality and ground water	MODERATE	COMPATIBLE	COMPATIBLE	N/A	MODERATE	COMPATIBLE
	Physical processes	MODERATE	SEVERE	COMPATIBLE	N/A	COMPATIBLE	COMPATIBLE
	Air quality and climate	COMPATIBLE	N/A	N/A	N/A	N/A	N/A
Flora and Fauna	Marine mammals	MODERATE	SEVERE	COMPATIBLE	SEVERE	COMPATIBLE	COMPATIBLE
	Seabirds	MODERATE	MODERATE	COMPATIBLE	SEVERE	COMPATIBLE	COMPATIBLE
	Fish and shellfish	N/A	Noise --> MODERATE EMF --> SEVERE	COMPATIBLE	N/A	COMPATIBLE	COMPATIBLE
	Benthos	MODERATE	Increased Turbidity -->MODERATE Anchors and moorings dragging --> SEVERE	N/A	N/A	COMPATIBLE	COMPATIBLE

Conclusions

- Air quality, climate and water quality were perceived as having lowest significance across all test centres;
- Across all guidance analysed a minimum of 2 years of baseline data is recommended;
- Cumulative impacts is still an area of concern (and further work);

Some questions persist:

- Is EIA fit for purpose?
- What have we learned…?
- Who should be learning from post-consent monitoring?
- Can we do more?