ICZM in the future has to consider off-shore, renewable tidal and wave energy generators - Europe

1. Policy Objective & Theme

- ADAPTATION TO RISK: Integrating coherent strategies covering the risk-dimension (prevention to response) into planning and investment
- SUSTAINABLE USE OF RESOURCES: Sound use of resources and promotion of less resource intensive processes/products
- SUSTAINABLE ECONOMIC GROWTH: Improving competitiveness

2. Key Approaches

- Ecosystems based approach
- Technical

3. Experiences that can be exchanged

Different possibilities of off-shore tidal streaming and wave energy installations that are available for Member States to help meet their 2020 energy targets as delineated in the EC Directive on the promotion of the use of energy from renewable sources.

4. Overview of the case

Various off-shore tidal streaming and wave energy installations are described which will need to be incorporated into ICZM and marine spatial planning regimes in the future.

5. Context and Objectives

a) Context

The EU is at a cross-roads concerning the future of energy. Climate change, increasing dependence on oil and other fossil fuels, growing imports, and rising energy costs are making our societies and economies vulnerable. These challenges call for a comprehensive and ambitious response. In the complex picture of energy policy, the renewable energy sector is the one energy sector which stands out in terms of ability to reduce greenhouse gas emissions and pollution, exploit local and de-centralised energy sources, and stimulate world-class high-tech industries. In accordance with Directive 2009/28/EC (23.4.2009), Member States must establish mandatory national targets consistent with a 20% share of energy from renewable sources. A Renewable Energy Road Map (2006), an integral part of the Strategic European Energy Review, sets out a long-term strategy for renewable energy sources in the EU establishing a mandatory target of 20% for renewable energy's share of energy consumption in the EU by 2020. It sets out the Commission's long-term strategy for renewable energy in the EU. An assessment of the share of renewable energy in the energy mix and the progress made in the last 10 years shows that more and better use can be made of renewables.

b) Objectives

The aim of the EU energy strategy is to enable the EU to meet the twin objectives of increasing security of energy supply and reducing greenhouse gas emissions.

6. Implementation of the ICZM Approach (i.e. management, tools, resources)

a) Management

National governments are responsible for meeting the Commission's renewables energy target through their relevant minsterial departments.

b) ICZM tools

There are many challenges to be overcome before wave and tidal power can make a significant contribution towards these targets and reach large-scale commercialisation, but the rewards will be great.

Wave Power Potential: Future Energy Solutions highlight that the global wave power potential has been estimated to be around 1000-10,000GW, which is the same order of magnitude as world electrical energy consumption. The best wave climates, with annual average power levels between 20-70 kW/m of wave front or higher, are found in the temperate zones (30-60 degrees latitude) where strong storms occur. However, the extent to which this will prove practical to harness will depend upon the successful development of both near shore and deep water technologies. Waves have the potential to provide a completely sustainable source of energy which can be captured and converted into electricity by wave energy converters from shoreline out to the deeper waters offshore.

There are six main types ofwave energy converters:

Attenuator: a floating device which works parallel to the wave direction and effectively rides the waves. Movements along its length can be selectively constrained to produce energy. Being developed by the UK and Ireland.
Point absorber: a floating structure which absorbs energy in all directions through its movements at/near the water surface. Being developed by the UK, Denmark, Germany, Sweden and Ireland.
Oscillating Wave Surge Converter: a device which extracts the energy caused by wave surges and the movement of water particles within them. Being developed by the UK, Finland, Denmark and Greece.
Oscillating water column: a partially submerged, hollow structure, open to the sea below the water line, enclosing a column of air on top of a column of water. Waves cause the water column to rise and fall, which in turn compresses and decompresses the air column. This trapped air is allowed to flow to and from the atmosphere via a turbine. Being developed by the UK, Portugal, Denmark, Ireland, Greece and Spain.
Overtopping device: adevice which relies on physical capture of water from waves which is held in a reservoir above sea level, before being returned to the sea through conventional turbines. Being developed by Ireland and Denmark.
Submerged pressure differential: devices which are typically located nearshore and attached to the seabed. The motion of the waves causes the sea level to rise and fall above the device, inducing a pressure differential in the device. The alternating pressure can then pump fluid through the system to generate electricity. Being developed by the UK.
Other Designs: devices which have a unique and very different design to the more well-established types of technology For example the Wave Rotor, is a form of turbine turned directly by the waves. Flexible structures have also been suggested, whereby a structure that changes shape/volume is part of the power take-off system. Being developed by the UK, Netherlands and Ireland.
Tidal Power Potential: tidal power has the advantage of being highly predictable with 3000GW of energy estimated to be available. However, it is very site specific. Tidal energy exploits the natural ebb and flow of coastal tidal waters. The tidal stream devices which utilise these currents are broadly similar to submerged wind turbines.

There are four main types oftidal energy converters:

Horizontal axis turbine: this device extracts energy from moving water in much the same way as wind turbines extract energy from moving air. Being developed by the UK, Ireland and Netherlands.
Vertical axis turbine: this device extracts energy from moving in a similar fashion but the turbine is mounted on a vertical axis. Being developed by the UK.
Oscillating Hydrofoil: A hydrofoil is attached to an oscillating arm and the motion caused by the tidal current flows either side of a wing resulting in lift. This motion can then drive fluid in a hydraulic system to be converted into electricity. Being developed by the UK.
Oscillating Hydrofoil: A hydrofoil is attached to an oscillating arm and the motion caused by the tidal current flows either side of a wing resulting in lift. This motion can then drive fluid in a hydraulic system to be converted into electricity. Being developed by the UK.

Oscillating Hydrofoil: A hydrofoil is attached to an oscillating arm and the motion caused by the tidal current flows either side of a wing resulting in lift. This motion can then drive fluid in a hydraulic system to be converted into electricity. Being developed by the UK.
Venturi Effect: The device is housed in a duct to effect the concentratin of the flow past the turbine. The funnel-like collecting device sits submerged in the tidal current and the flow of water can drive a turbine directly or via the induced pressure differential in the system. Being developed by the UK.
Other Designs: Devices with a unique and very different design to the more well-established types of technology are being developed by the UK, France and Italy.
Tidal Barrages: Since 1966, The Rance Tidal Generation Plant in France is currently the only tidal barrage in Europe (and one of only three in the world). It involved building a dam 330 metres long, across the mouth of the river Rance, in which the turbines were housed, with a lock to allow the passage of small craft. The plant has 24 separate horizontal 10 MW turbines. The plant provides an overall output of 240 MW of power, enough to meet the electricity needs of about 300,000 homes. There are highly controversial plans to introduce the technology in the UK to the Severn and Wash estuaries because of the impacts on natural habitats and migrating species.

7. Cost and resources

The Rance tidal barrage cost €94m equivalent in 1966. Tens of millions of euros have been invested in the Research & Development of the various prototypes.

8. Effectiveness (i.e. were the foreseen goals/objectives of the work reached?)

In spite of the high cost of the project, the barrage's costs have now been recovered, and electricity production costs are lower than for nuclear power generation. First and second generation tidal stream and wave energy converters are expected to produce electricity at a saleable rate at the end of the installation's life cycle. The national grids of UK, Ireland and Portugal are already being supplied with these technologies.

9. Success and Fail factors

With most of these technologies still to be fully developed, funding for R & D is most important. A flexible or adaptive management regime for the prototypes and scaling up for commercial use is also required in order 'to learn by doing'.

10. Unforeseen outcomes

The long-term environmental impact of these new technologies is unknown. The barrage has caused progressive silting of the Rance ecosystem. Sand-eels and plaice have disappeared, though sea bass and cuttlefish have returned to the river. The barrage is, of itself, a tourist attraction with 200,000 visitors/yr.

11. Prepared by

A. H. Pickaver, Coastal & Marine Union (EUCC), The Netherlands

12. Verified by

Matthew Finn, Research Coordinator at the European Marine Energy Centre

13. Sources

- Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009
- on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

- Communication from the Commission to the Council and the European Parliament: Renewable Energy Road Map; Renewable energies in the 21st century: building a more sustainable future Brussels, 10.1.2007 COM(2006) 848 final
- www.aquaret.com

The Directive (1.28 MB)

renewable energy roadmap (127.36 KB)