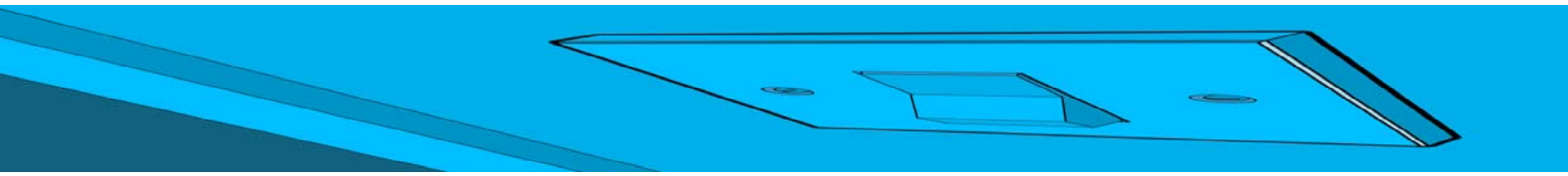

UKERC

EXISTING MARINE RENEWABLE ENERGY ROAD-MAPS

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UK Energy Research Centre

THE UK ENERGY RESEARCH CENTRE

The UK Energy Research Centre's (UKERC) mission is to be the UK's pre-eminent centre of research, and source of authoritative information and leadership, on sustainable energy systems.

UKERC undertakes world-class research addressing the whole-systems aspects of energy supply and use while developing and maintaining the means to enable cohesive research in energy.

To achieve this we are establishing a comprehensive database of energy research, development and demonstration competences in the UK. We will also act as the portal for the UK energy research community to and from both UK stakeholders and the international energy research community.

Future Sources of Energy (FSE)

Future Sources of Energy is a research and networking theme within UKERC. Activity focuses on a number of supply technologies which have yet to achieve commercialisation. Within these a range of issues are addressed, including technical development, appropriate policies and institutions for supporting innovation, and wider issues of social and community engagement.

To avoid duplicating research and development funded by other public and private sector programmes, much of FSE's efforts are on co-ordination and networking rather than original research.

1. DTI Technology Road-map – Wave Energy

The DTI Technology Route Map, published in 2001 (1), was developed in conjuction with a review of wave energy technology undertaken by Ove-Arup (2). The document identifies the current status of the technology in the UK and worldwide.

A number of R&D issues are highlighted in the document, but no detail is provided on the actual research required to tackle the challenges listed. The document stresses the need to provide a low risk and more economic path for the development of technology from model tank tests towards meaningful scale prototypes.

From the Ove-Arup report it was concluded that there are no technical barrriers to the implementation of wave energy devices, and that there is an opportunity for technology transfer from the offshore industry. Marine renewable devices have to be developed within much tighter financial margins than offshore oil and gas infrastructure, and hence the cost of suitable offshore technology needs to be reduced if this transfer is to take place. A roadmap of activities with proposed target dates is tabulated in the document. This roadmap is generic in nature to take into account the differences between devices, and it is designed to assist the DTI in the management of its own R&D funding programme.

Activities are divided according to whether the device is a well established concept currently being supported under the DTI programme or if it is a new concept. The tabulated road map is summarised in Tables 1 & 2. In terms of the established concepts some device concepts have fulfilled the target activities and more or less within the time-scale defined. It is not clear how many new concepts have met the targets, but this is very difficult because very little information on new devices being developed is available in the public domain, and it is a continuous process.

Although the roadmap in Tables I & II was derived for wave energy R, D & D a similar philosophy is applicable to tidal current energy systems, which has seen just as much industrial activity as wave energy in recent years. As with wave, some tidal energy projects have also completed the activities in Table 1 and others have progressed through Table 2 and are now being developed at full-scale.

Table I Established concepts

Activity	*Target Date*
Reduce risk and uncertainty of key components.	End 2002
1/10th scale (or larger) prototype testing in real, meaningful sea environments	End 2002
Evaluate potential of concepts for further development	End 2003
Develop ½ or 1/3rd scale prototypes based on evaluation above and test in an offshore environment. Include Electrical aspects and evaluate the long term performance.	End 2004
Further develop projects on components where innovation is required.	End 2004
Report on performance of prototypes & prospects for commercial development.	End 2010

Table II New Concepts

Activity	*Target Date*
Complete initial feasibility studies and design evaluations.	2003
Further evaluation at 1/50 to 1/20 scale, with more detailed design engineering and cost studies.	2004
Take forward attractive concepts to typically 1/10th scale tests in a realistic sea environment.	2006

2. World Energy Council (WEC) Road-map

In 2001 the World Energy Council published a Survery of Energy Resources, which included wave energy and tidal barrages, but not tidal current energy. The section on wave energy, by Griffiths (3), provides an excellent summary of the resource, the status of the technology at the time, and recommendations for the way forward in terms of R&D and commercial exploitation.

A road-map is presented to highlight the R&D needs for wave energy, reproduced in Figure 1.

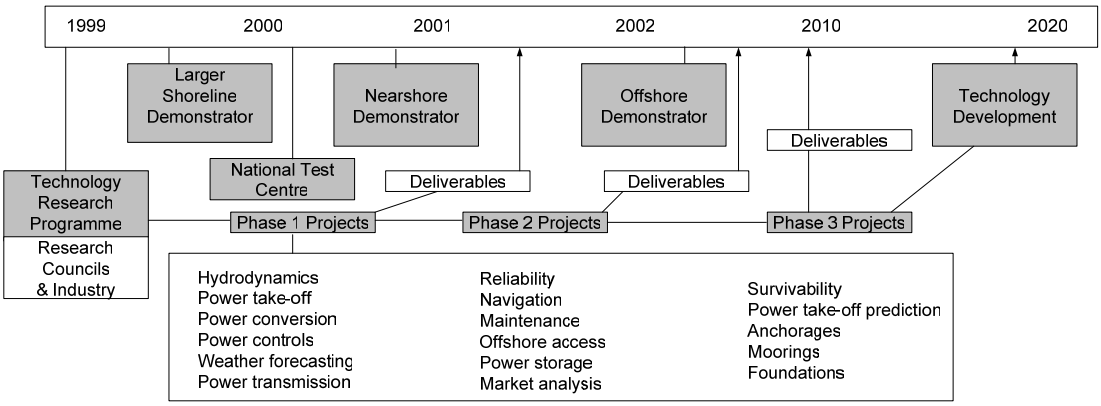

Fig 1 WEC R&D Road-map for Wave Energy, 2001.

Technology research programmes have been established – The EPSRC Supergen Marine Energy Consortium and the DTI R&D programme covers marine renewables. The former covers generic research and includes many of the topics listed in Figure 1. Funding from DTI and EU Frameworks has provided industrial funding for a large shoreline demonstrator and three offshore devices have been demonstrated at various degrees of operation. A National Test Centre has been established – the European Marine Energy Centre on Orkney provides offshore test facilities for wave devices, and a test site for tidal current devices is also being developed.

As well as these offshore facilities the New and Renewable Energy Centre (NaREC) in NE England can test up to 1/10th Scale. In SW England an offshore wave hub is being proposed for testing arrays of devices. As with the DTI road-map the activities relating to prototype development have or are being implemented. In terms of the R&D priorities listed there was no detail on the research required into the technologies for each item. For example in Power Transmission, issues to be addressed may include HVDC or AC transmission, electrical interconnection of arrays, offshore electrical infrastructure, power quality and power conditioning.

3. IEA Report: Status & R&D Priorities, Wave and Marine Current Energy

In collaboration with the DTI the IEA Ocean Energy Systems Group published a report in 2003 on the research priorities for wave and tidal current energy converters (4). The report includes a comprehensive review of existing technology, a review of global marine renewable activities and a detailed list of research priorities or tasks for both wave and marine current. The list of R&D priorities is divided into marine current and wave, with specific headings in wave related to the type of wave device:

Marine Current: Technology Information Centre, Resource Assessment, Operation & Maintenance, Biofouling, Impacts on Marine Life, Sealing, Weather and Wave Forecasting, Cavitation, Interaction with the Marine Environment, Turbulence, Installation foundations.

Wave Energy :

Overtopping devices: Overtopping Power Take Off Systems;

OWC: Design Standards, Market Development & Site selection;

Offshore: Control systems, floating device array configuration, mooring, electrical cabling, hydraulics.

Generic: Testing, proving, and certification methods and centres, fabrication, transport & installation, standards, monitoring systems, power smoothing and conditioning,

There are a number of topics which apply to both technologies even though they are only included within one category above. For example Weather and Wave Forecasting is important for wave as well as marine current; Resource Assessment still needs to be considered for wave; all the generic issues in wave are common to marine current. Until now the IEA report has provided the most detail in terms of research priorties, but it has not compiled them into a road-map with a time-line. A strategy for implementing the tasks was presented:

- *Task sharing* which relies on IEA members devoting specified resources and personnel to a common work programme.
- *Cost sharing* where members contribute to a common fund for conducting the work, which may be an experiment, an exchange of information or purchasing one piece of equipment.

4. BWEA Marine Group: “The npower Juice Path to Power”

Quoted from the BWEA Press Release, 23rd Sept. 2005 : “The project will examine the technical resource, environmental & regulatory constraints, grid capacity, and financing requirements for the marine renewables sector. The findings will help to take this exciting new industry from prototype deployment to commercial reality. The final report, due in May 2006, will provide the basis for a flexible strategic plan for commercial development of the sector, taking into account the needs of industry, regulators and environmental stakeholders.

Funding for the project will be provided through the npower Juice Fund4, which has been set up specifically to aid the development of emerging renewable technologies such as wave and tidal power."

This project is focussed on the commercial aspects of marine renewables rather than the research needs of the community.

References

1. http://www.dti.gov.uk/renewables/renew_techroutemaps.htm (last accessed in August 2005
2. DTI 2000, "Wave Energy: Technology Transfer & R&D Recommendations"
3. Griffiths, World Energy Council, 2001, "Survey of Energy Resources, Wave Energy".
4. IEA – Ocean Energy Systems Group & DTI, "Status & R&D Priorities, Wave and Marine Current Energy", 2003.