



IEA-OES

annual report 2005

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INTERNATIONAL ENERGY AGENCY _ IMPLEMENTING AGREEMENT ON OCEAN ENERGY SYSTEMS

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by Katrina Polaski
2005 Chair of the IEA-OES

FORWARD

Great strides have been made towards the commercial deployment of ocean energy in 2005. Following a banner year in 2004, during which three of the leading devices in wave energy and two marine current devices were tested as prototypes at sea, policy makers responded with announcements of incentives to support initial deployments of multiple device arrays in a number of countries. Even more significantly, the first commercial orders for a wave farm took place this year, as Ocean Power Delivery signed a deal with a Portuguese consortium for an initial order of three 750kW devices and a Letter of Intent to purchase an additional 30 devices before the end of 2006. We may look back at 2005 as the year of birth of a new industry.

In the meantime, developments are continuing both in Europe, where ocean energy researchers and developers have been active for a number of years, and in countries outside Europe where ocean energy has more recently caught the attention of the public and policy makers. Energetech's first prototype wave energy plant was deployed in Port Kembla, Australia in October. Ponte di Archimede's Enermar vertical axis turbine device, operating in Italy's Straits of Messina, installed a grid connection to Sicily during the year. A number of other projects were at the stage of building prototype models for installation and commissioning in 2006 including Verdant Power from the US, the Pearson College EnCaNa tidal energy project on Vancouver Island, Canada, and Ireland's Wavebob Ltd. Galway Bay quarter scale model project. Finally, we expect to see the commissioning of a repowered Pico Plant before the year is out.

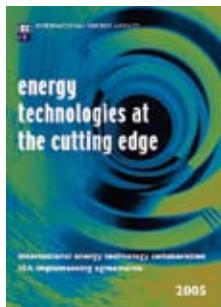
Major policy announcements in 2005 included consultation and announcement of the proposed details of the UK's £50M Marine Renewables Deployment Fund which aims to provide a combination of capital and revenue support to device development to fund the gap between prototype demonstration and commercial deployment. The Canadian government has also demonstrated a renewed interest in ocean energy technologies by requesting an ocean energy briefing for the energy minister's National Advisory Panel which is considering new innovation funding. Finally, ocean energy was recognized as an eligible renewable energy in the US in the 2005 Energy Policy Act which allows Congress to appropriate funds for ocean energy in the future.

As the technologies begin to show commercial viability, the need for companies, who are developing and selling the technologies, to organise increases. The European Ocean Energy Association was launched at the biannual European Wave and Tidal Energy Conference in September 2005. Its objectives include supporting market development, facilitating networks, promoting the benefits of the sector and acting as one voice representing the sector to EU policy makers. Similar developments in North America have led to the creation of the Ocean Renewable Energy Coalition in May. Both are welcome developments.

International Energy Agency

The International Energy Agency (IEA) was established as an autonomous body within the Organisation for Economic Co-operation and Development (OECD) in 1974 to implement an international energy programme.

The IEA provides a structure for international co-operation in energy technology research and development (R&D) and deployment. Its purpose is to bring together experts in specific technologies who wish to address common challenges jointly and share the fruit of their efforts.



The IEA's programme of International Energy Technology Co-operation includes a mechanism called an "Implementing Agreement". There are currently 40 Implementing Agreements under the IEA International Energy technology Co-operation Framework, grouped in the following domains: Fossil Fuels, Renewable Energies and Hydrogen, End-use Technologies (Buildings, Industry and Transport), Fusion Power and Cross-sectoral activities. Ocean Energy Systems is one of the nine IEA Implementing Agreements embraced by the Renewable Energy domain; the others being Bioenergy, Geothermal, Hydrogen, Hydropower, Photovoltaic Power Systems and Solar Heating and Cooling.

Recent activities of these Implementing Agreements are highlighted in the free publication *Energy Technologies at the Cutting Edge* (IEA Publication, April 2005, available at http://www.iea.org/Textbase/nppdf/free/2005/IAH2005mep_Full_Final_WEB.pdf)

IEA

Implementing Agreement on Ocean Energy Systems

Mission

This Implementing Agreement was established with the mission of enhancing international collaboration to make ocean energy technologies a significant energy option in the mid-term future. Through the promotion of research, development, demonstration and information exchange and dissemination, the Agreement's objective is to lead to significant deployment and commercialization of ocean energy technologies.

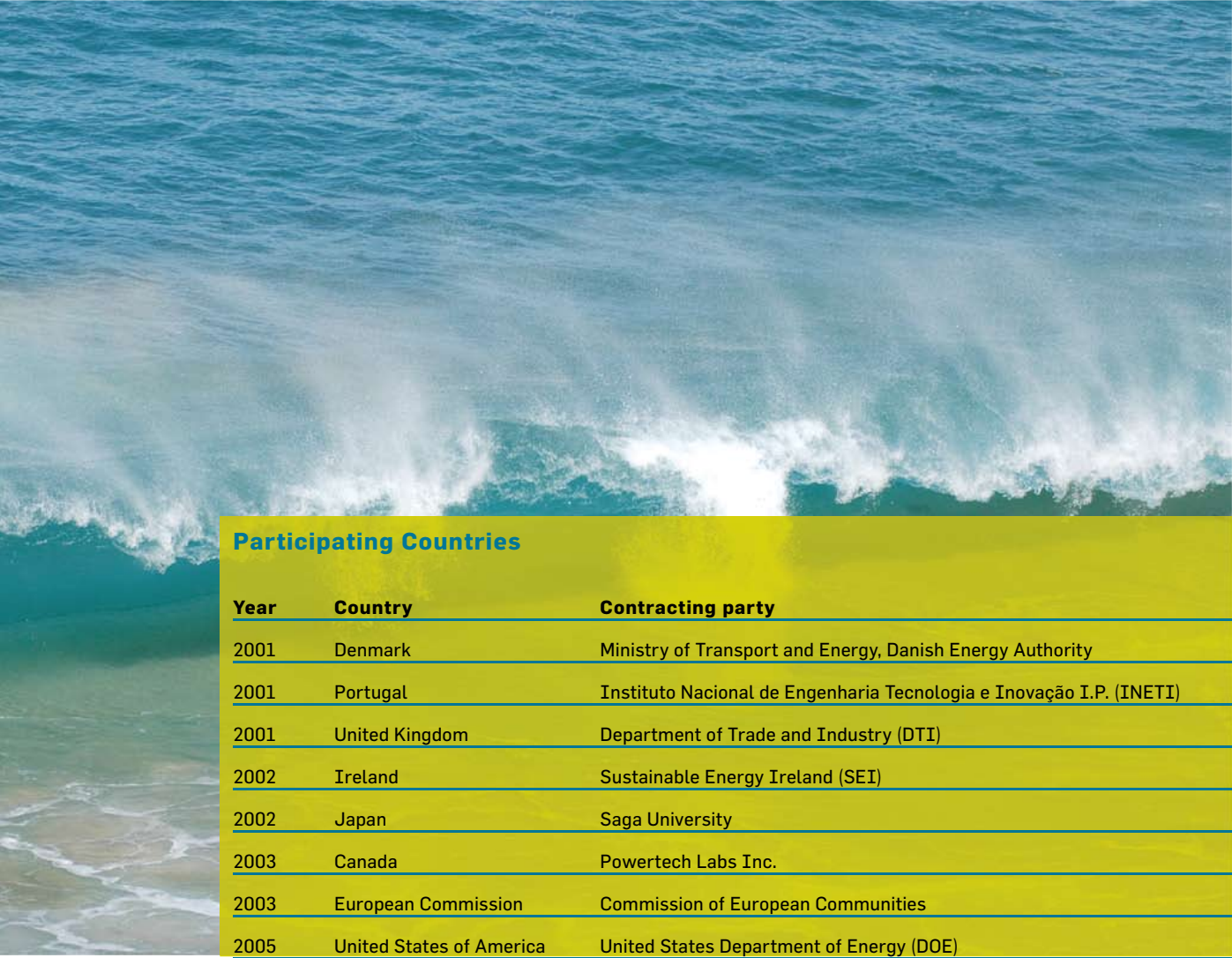
Strategic objectives

The present work programme focuses on ocean waves and marine currents which are the ocean energy technologies that have been the object of the strongest R&D and demonstration effort in the last fifteen years and are considered to present the best prospects for competitive deployment in the short- to medium-term.

The strategy of the IEA Ocean Energy Systems Implementing Agreement Programme is based on the following formal objectives:

- To actively encourage and support the development of networks of participants involved in research, development, demonstration, prototype testing and deployment, and to provide for the effective exchange of information on ocean energy.
- To promote the development and utilisation of technologies for enhanced sustainable energy production from the ocean.
- To promote the involvement of industry and utilities in the IEA Ocean Energy Systems Programme.
- To promote interactions with other global, multilateral and national energy implementation programmes.

OES



Participating Countries

Year	Country	Contracting party
2001	Denmark	Ministry of Transport and Energy, Danish Energy Authority
2001	Portugal	Instituto Nacional de Engenharia Tecnologia e Inovação I.P. (INETI)
2001	United Kingdom	Department of Trade and Industry (DTI)
2002	Ireland	Sustainable Energy Ireland (SEI)
2002	Japan	Saga University
2003	Canada	Powertech Labs Inc.
2003	European Commission	Commission of European Communities
2005	United States of America	United States Department of Energy (DOE)

Contracting Parties to the Agreement IEA-OES (status: end 2005)

Work Programme

The Work Programme is established under Annexes to the Implementing Agreement, setting out a Task and describing an agreed set of activities to be undertaken by the participants in this Task. Participants in the IEA-OES are currently working on two cooperative research Tasks:

Annex I: Review, Exchange and Dissemination of Information on OES

Operating Agent: Instituto Nacional de Engenharia Tecnologia e Inovação I.P. (INETI)

The objective of Annex I is to collate, review and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of ocean energy systems with a view to facilitating further development and adoption of cost-effective ocean energy systems through improved access to available information.

Annex II: Development of Recommended Practices for Testing and Evaluating OES

Operating Agent:

Ministry of Transport and Energy of Denmark, Danish Energy Authority acting through RAMBOLL.

The objective of Annex II is to develop recommended practices for testing and evaluating ocean energy systems and, in this way, to improve the comparability of experimental results. This is done by collecting and analysing information on testing facilities and testing procedures. Standards for presentation of technical design and data and for assessment of system performance are produced.

The Executive Committee

The work program within the Implementing Agreement is co-ordinated by an Executive Committee (ExCo) consisting of a Member and an Alternate Member from each Member-Country. The ExCo meets twice every year to exchange information on ocean energy activities, to review ongoing tasks under the Agreement, to discuss new Annexes proposed by participants and to approve the budget to administer the Agreement.

A secretariat assists the ExCo in planning the meetings, assisting the members, providing information to the IEA Secretariat and public in general, updating the website of the IEA-OES and preparing the annual report, the semi-annual newsletter, and any other material requiring dissemination. The ExCo secretariat is based in the Wave Energy Centre, Portugal, and is run by Dr. Ana Brito Melo.

During 2005, Mrs. Katrina Polaski from Ireland was the Chair of this ExCo and Dr. Teresa Pontes was Vice-Chair.

In the last 2005 ExCo meeting Mrs. Katrina Polaski was re-elected Chair for 2006, Dr. Gouri Bhuyan was elected Vice-Chair and Dr. Teresa Pontes was elected second vice-chair.

Fund Administration

All activities under the two Annexes of this Implementing Agreement are task-shared. Member Countries share the cost of administration for the ExCo through annual contributions to the common fund.

The common fund is managed by INETI, Portugal. To date this fund has been mainly supporting the secretariat and the Annex I programme concerning dissemination activities such the IEA-OES Newsletter, maintenance of the website, edition of reports and expenses of the Chair/Vice-Chair representing the IEA-OES in relevant meetings.

Total funds assigned in 2005 amount to 56,000 Euros with annual contribution of 7,000 Euro by each of eight members (Denmark, Portugal, UK, Ireland, Canada, Japan, USA and the European Commission). Total expenditures in 2005 were 32,872.44 Euros.

Highlights of 2005

New Members

In 2005 The United States of America joined the IEA-OES. The United States Department of Energy (DOE) was designated by the government of the USA to be the contracting party to this Agreement.

In November 2005 Belgium was invited by the IEA-OES Executive Committee to become a Member and procedures aimed at joining this agreement in 2006 are on going.

JAMSTEC, the initial contracting party from Japan, withdrew from this IA in 2004 and was officially replaced by IOES - Saga University in 2005.

Executive Committee meetings

The following ExCo meetings were held during the year 2005:

- 8th ExCo meeting: March 4, Paris, France, hosted by the International Energy agency
- 9th ExCo meeting: November 16-17, Brussels, Belgium, hosted by the European Commission

These meetings were also attended by Observers from Italy, France, Belgium, Norway and Germany; the latter being represented in the IEA-OES ExCo meeting for the first time.

Members and Observers at the 9th IEA-OES ExCo meeting in Brussels



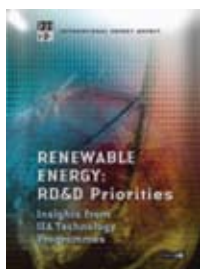
Participation on the IEA Seminar on Long-Term R&D Priorities

A Joint Seminar on Long-Term R&D Priorities “Catching Up: Priorities for Augmented Renewable Energy R&D” was organised by the IEA Renewable Energy Working Party (REWP) and Renewable Energy and Hydrogen Implementing Agreements at March 2005, in Paris.

The Renewable Energy Working Party and the related Implementing Agreements (Bioenergy, Geothermal, Hydrogen, Hydropower, Ocean Energy Systems, Photovoltaic Power Systems, Solar Heating and Cooling, Concentrating Solar Power and Chemical Energy Systems and Wind Energy Systems) agreed to define together R&D priorities and to provide a roadmap for mid- and long-term development. The IEA-OES provided a written document with a description of the current technology status on ocean energy conversion systems and a summary describing the synergy of the research

needs for ocean energy systems in terms of non-technical barriers common to all ocean energy technologies and technical barriers for specific technologies using Wave, Tidal Current, Salinity and Thermal Gradient resources. The main conclusion of this document is that the major challenges that ocean energy technologies face today are to prove their potential and to overcome the high technical (and financial) risks caused mainly by the aggressive marine environment. R&D funding requirements are substantial to help device developers to overcome the initial difficulties. The conclusions of the Seminar are presented in the R&D priorities for renewable energy technologies report available at:

http://www.iea.org/Textbase/work/workshopdetail.asp?WS_ID=209



The publication Renewable Energy: RD&D Priorities - Insights from IEA Technology Programmes is available at:
<http://www.iea.org/bookshop/add.aspx?id=282>

Roundtable Country Review

During the 9th ExCo meeting in Brussels (16-17 November 2005) the contracting party country representatives and observers were invited to present their countries' national activities in the ocean energy field. This was considered an important input to a report titled ***Ocean Energy Policies Review***, a task to be undertaken in 2006 under the Annex I, and commissioned by the contracting party from Ireland. These presentations, the titles and brief description of which are listed below, are available at the website www.iea-oceans.org/presentations.

DENMARK

National Ocean Energy Activities

By Kim Nielsen, Alternate Member from Denmark

Overview of existing support programs in Denmark and presentation of the developers in the wave energy sector with a brief description of the actual status of their devices, including WAVE DRAGON and the CA-OE coordinated action on ocean energy systems (both projects co-funded by the European Commission).

IRELAND

Ocean Energy in Ireland - IEA OES Country Review

By Katrina Polaski, ExCo Member from Ireland

Overview of the ocean energy activities in Ireland and the most relevant policy development activities, including a report on the Economic Benefits of Developing an Ocean Energy Industry in Ireland, a Tidal and Marine Current Resource Study and an Offshore Wave Atlas.

Presentation of an Ocean Energy Strategy Proposal aimed at securing long term government support to encourage the development of a national ocean energy industry and to utilize the indigenous wave energy resource.

CANADA

Canadian Current Policy, Developmental and Project Initiatives Related to Ocean Energy

By Gouri Bhuyan, ExCo Member from Canada

Overview of the technology developers in the Ocean Energy sector and institutions involved in Research, Development & Demonstration of Ocean Energy Systems.

Over the last year, a Federal Ocean Energy Working Group (FOEWG) comprised of eight departments and agencies with appr. 40 members was established. The Ocean Energy Sector has been identified as a promising emerging technology sector and as a priority for review and action by four coastal provinces.

JAPAN

Activity and Future on Ocean Energy in Japan

By Yasuyuki Ikegami, ExCo Member from Japan

Overview of the OTEC projects and activities in the Pacific islands. Among them the Collaborated Research Project with Palau & Saga University and the New Hybrid OTEC Experimental Plant at Institute of Ocean Energy, Saga University - an example of Combined Cycle with Desalination Plant were presented. Reference was made to a wave energy project at Niigata Prefecture starting in 2005.

PORTUGAL

Wave Energy – Portugal review 2005

By Teresa Pontes, ExCo Member from Portugal

Overview of market policy: in 2005 the feed-in tariff for wave energy was based on a case by case review of proposals and specific legislation is expected for 2006. Presentation of the actual plans for technology development and market activities with the investment of a Portuguese company in a pre-commercial wave farm of Pelamis technology in spring 2005.

USA

Overview: EPRI Ocean Energy Program

By Roger Bedard, Observer from USA

Overview of the institutions involved in ocean energy. Summary of the North America wave and tidal energy projects and presentation of the three EPRI/DOE/NREL collaborative projects starting in 2005.

EUROPEAN COMMISSION

Review of the European Commission's Activities in Support of Renewable Energies, in particular Ocean Energy

By Komninos Diamantaras, ExCo Member from the EC

Overview of 6th Framework funding for ocean energy and requirements for ocean energy in the context of the 7th Framework Programme planning.

Under the 6th Framework Programme (FP6) the European Commission has been supporting Ocean Energy through funding for Research and Demonstration projects and support to overcoming non-technical barriers (Intelligent Energy Europe Programme). In the context of the Commission proposal for the 7th Framework Programme (2007-2013) the following items are suggested as important for Ocean Energy :

- Need for a clear vision
- Define medium-long term R&D needs, including infrastructures, standards and terminology
- Improve efficiency
- Develop sector related indicators to monitor its progress, like installation targets
- Validate costs of energy including decommissioning costs
- Assess the environmental and ecological implications
- Involve larger industry to minimise technical and financial risks
- Include end-users or utilities within the consortia
- Disseminate and apply best practices, and
- Networking is essential.

European Ocean Energy Association

By Alla Weinstein, President of the European Ocean Energy Association

Presentation of the recent formation of the European Ocean Energy Association (EU-OEA) as a non-profit organisation with the aim to strengthen the development of Ocean Energy markets and technology in EU. The association will put high emphasis on wide information dissemination to the public and within the industry. EU-OEA is a spin-off of the coordinated action project (CA-OE), co-funded by the European Commission.

GERMANY

Country Review Germany

By Jochen Bard, Observer from Germany

Overview of the actual involvement of institutions and industry into research and demonstration projects. Although there is no present political priority to ocean energy there is a political interest to fund companies/institutes involved in international projects and to support development of sustainable energy technologies.

BELGIUM

National policy in Belgium

By Gabriel Michaux, Observer and Delegate for Belgium at the CERT

Overview of the national policy in Belgium and the wave energy research at Ghent University. Current research is being devoted to an offshore floating rig concept with a large number of point absorbers (SEEWEC project co-funded by the European Commission).

ITALY

Kobold Turbine activities in 2005

By Antonio Fiorentino, Observer from Italy

Overview of the activity during 2005 concerning the Kobold Turbine (KOBOLD and ENERMAR projects, both co-funded by the European Commission): Inclusion of the Kobold in the Horcynus Orca Technological Park; Selection of the Kobold turbine by the UNIDO program for electrification of some islands in the Philippines, China and in Indonesia.



Programme achievements 2005

ANNEX I

REVIEW, EXCHANGE AND DISSEMINATION OF INFORMATION ON OCEAN ENERGY SYSTEMS

Operating Agent: **Dr. João Campos Henriques**

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In 2005 the following dissemination activities were managed by the Executive Committee:

- Participation and presentation of the IEA-OES in ocean energy related events
- Maintenance of the IEA-OES website
- Publication of a newsletter
- Publication of an annual report
- Management of an information gathering exercise through the development and collection of responses to a questionnaire on national activities in ocean energy

Dissemination in relevant Ocean Energy related events

The IEA-OES Programme, under the Annex I, continued to strengthen its dissemination activities through conference presentations in events relevant to Ocean Energy. Members of the Executive Committee regularly participate at international conferences and present the activities of the IEA-OES whenever it is appropriate.

IEA-REWP Seminar "Catching up: Priorities for Augmented Renewable Energy R&D"

March 2005, Paris, France

Katrina Polaski presented a paper on the status and research and development priorities of ocean energy systems alongside the Chairs of the other IEA renewable energy Implementing Agreements. The presentations and discussions at this seminar contributed to a recent IEA publication titled 'Renewable Energy: RD&D Priorities, Insights from IEA Technology Programmes'.

Available presentation (at http://www.iea.org/Textbase/work/workshopdetail.asp?WS_ID=209):

K. Polaski and P. Schild, 'IEA Ocean Energy System Implementing Agreement: R&D Priorities', 2005

6th European Wave and Tidal Energy Conference

August 29th - September 2nd 2005, University of Strathclyde, Glasgow, UK

Katrina Polaski gave a brief presentation on the IEA OES Implementing Agreement and its activities and future plans. The Chair also attended the side event 'Development of Standards for Ocean Energy Converters', organized by the European Marine Energy Centre (EMEC), on behalf of the IEA OES.

Published paper: K. Polaski and A. Brito-Melo, 'The IEA Ocean Energy Systems Implementing Agreement: Its Status and Future Prospects', Proceedings of the Sixth European Wave Energy Conference, Glasgow, UK, 2005

World Renewable Energy Congress

22-27 May 2005, Aberdeen

and

WATTS 2005 - Wave and Tidal Technologies Symposium

25 May 2005, Aberdeen

The World Renewable Energy Congress (WREC) was organized jointly with All-Energy Opportunities an annual international fair focussing renewable energy technologies, and WATTS 2005 (Wave and Tidal Technology Symposium) a one day workshop where British policy and developments were presented and discussed.

The Vice-Chair Teresa Pontes presented in WREC 2005 the paper "The International R&D Collaborative Programme on Ocean Energy" which included a summary of the ocean energy sources, a presentation of IEA, the vision, strategy and objectives of the IEA-OES, the work carried out so far within this programme and further activities.

Published paper: T.Pontes 'The International R&D Collaborative Programme on Ocean Energy', Proceedings of World Renewable Energy Congress 2005.

SNAME Symposium on Ocean Energy

12 February 2005, Vancouver

The Canadian Delegate presented activities of the implementing agreement, specifically the Annex II, and discussed status of development of the various wave and tidal current technologies worldwide.

OREG Symposium on Mapping the Way Forward for Development of Canadian Ocean Energy Sector

20 October 2005, St. John's, Newfoundland

The Canadian Delegate gave an invited presentation on the activities of the implementing agreement as well as on the scope of the EC coordinated action project on ocean energy.

The IEA-OES has also been presented by the European Commission Delegate in all kick off meetings related to Ocean energy projects, at conferences and media events and at the European Parliament, whenever there has been a reference to renewable energies.



05
achievements



Website

The website www.iea-oceans.org is the first source of information about the activities of the IEA-OES. It provides easy access to its major IEA-OES documents: Annex descriptions, reports, newsletter, membership information as well as notification of upcoming events.



IEA-OES Newsletter

A printed newsletter is prepared and distributed by post and also via the website each six months. It has been widely distributed both within the Member Countries and at major conferences and seminars.

Members provide material of interest on planned and ongoing activities and programmes on ocean energy and ensure that the newsletter reaches its target audience in the respective countries. The last page of the Newsletter is dedicated to information on relevant events on ocean energy and includes the Member's contact details.

Issue 4 of the newsletter was published in February 2005 and issue 5 was published in December 2005. The following national developments in the participating countries were presented:

Coordination Action on Ocean Energy, Feb 2005 issue
Kim Nielsen, Denmark Delegate

Vessel-based AWS Testing, Feb 2005 issue
Frank Neumann, Wave Energy Centre, Portugal

Workshop on Grid Integration on Ocean Energy Systems, Feb 2005 issue
Ana Estanqueiro, INETI, Portugal

WAVETRAIN - Research Training Network Towards Competitive Ocean Wave Energy, Feb 2005 issue
António Sarmento, Instituto Superior Técnico, Portugal

Canadian Projects on Ocean Energy, Dec 2005 issue
Gouri Bhuyan, Canada Delegate

European Ocean Energy Association, Dec 2005 issue
Alla Weistein, president of the European Ocean Energy Association

UK energy policy, Dec 2005 issue
Gary Shanahan, UK Delegate



Questionnaire on National Activities

A set of standard questionnaires on National Activities were sent to each ExCo member or country observer and to be completed and delivered in the beginning of 2006. The standard surveys are on four topics: (i) national policy, (ii) resource (iii) organizations for research, development and dissemination of ocean energy and (iv) companies active in the development and commercialization of ocean energy technologies. Members and observers are asked to complete surveys (i) and (ii), and to facilitate the completion by relevant research bodies and companies in their country of surveys (iii) and (iv). The information received under the questionnaires will be used for the report Ocean Energy Policies Review under preparation and to be published in 2006.

ANNEX II
DEVELOPMENT OF RECOMMENDED PRACTICES
FOR TESTING AND EVALUATING OCEAN ENERGY SYSTEMS

Operating Agent: **Dr. Kim Nielsen**

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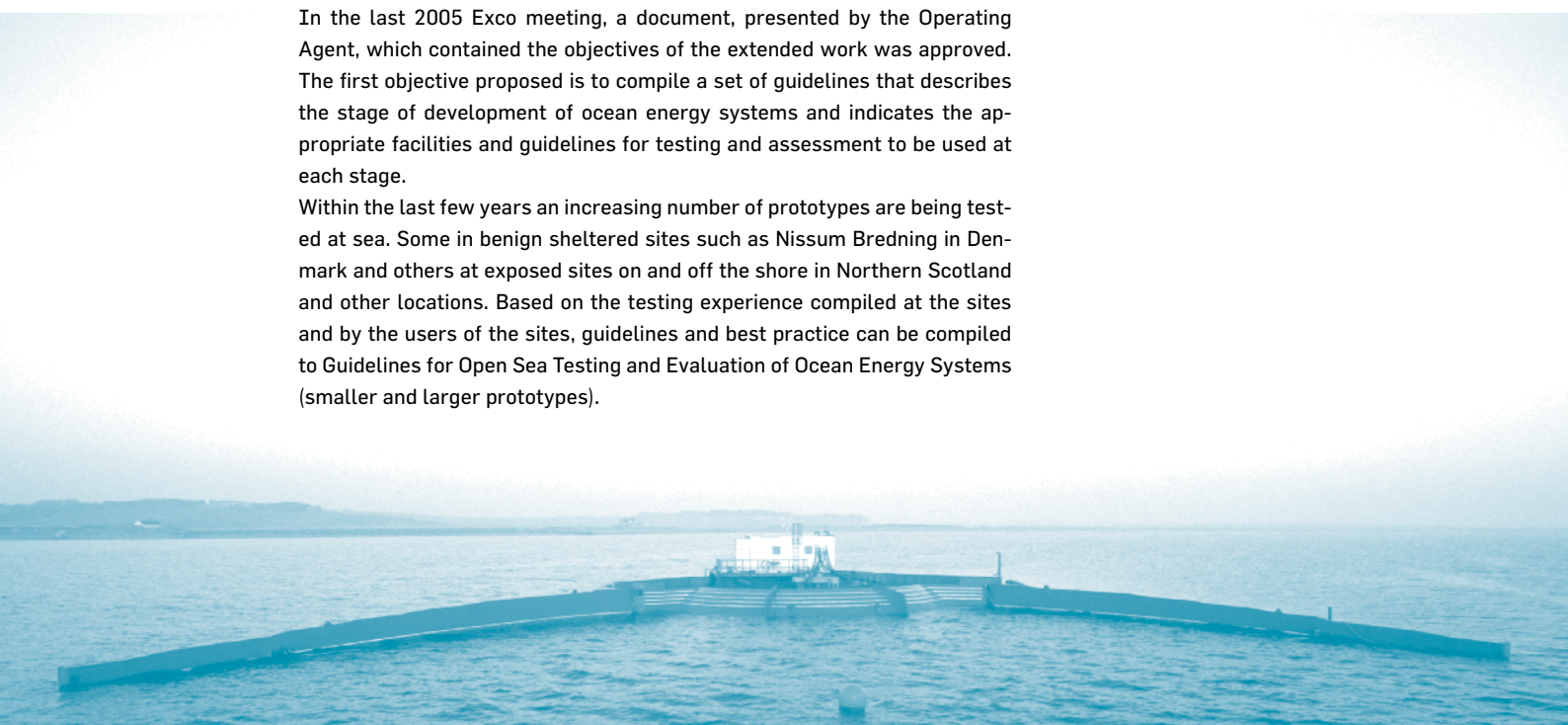
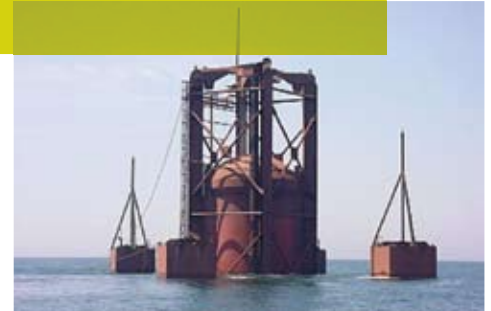
During 2005 the ExCo decided to pursue extending the work done for scale model tests under the Annex II, published in the 2003 report "Development of Recommended Practices for Testing and Evaluating Ocean Energy Systems", to prototypes. The ExCo Members agreed that the development of testing and evaluation standards that are applicable and acceptable to all stakeholders is a high priority for furthering the development and commercialisation of ocean energy. Work is ongoing to define a workscope and funding mechanism for this work programme.

A first attempt to define a roadmap for the workprogramme was made after the one-day Workshop 'Development of Standards for Ocean Energy Converters', at September 2005, in Glasgow Caledonian University, organized by the European Marine Energy Centre (EMEC). The Chair, Vice-chair and the Operating Agent of Annex II attended the one-day Workshop 'Development of Standards for Ocean Energy Converters'. A need for further work in the development of standards and guidelines for testing both at scale model and particularly in ocean trials has been identified by device developers, test centres, and those relying on assessment of prototypes to make funding decisions, attending the meeting. A number of specific areas were identified where further study and further discussion was required.

As a follow up to discussions, a letter was sent by the Chair to the meeting organisers to be distributed to all attendees of the meeting. This letter was intended to explain the Implementing Agreement Mechanism and how this mechanism could be used to facilitate further investigation in to issues around standards and guidelines for ocean energy systems.

In the last 2005 Exco meeting, a document, presented by the Operating Agent, which contained the objectives of the extended work was approved. The first objective proposed is to compile a set of guidelines that describes the stage of development of ocean energy systems and indicates the appropriate facilities and guidelines for testing and assessment to be used at each stage.

Within the last few years an increasing number of prototypes are being tested at sea. Some in benign sheltered sites such as Nissum Bredning in Denmark and others at exposed sites on and off the shore in Northern Scotland and other locations. Based on the testing experience compiled at the sites and by the users of the sites, guidelines and best practice can be compiled to Guidelines for Open Sea Testing and Evaluation of Ocean Energy Systems (smaller and larger prototypes).



Plans for 2006

Increase Membership

The IEA-OES has sought to increase its membership to help achieve its goal of advancing worldwide ocean energy development. As such, the IEA-OES is making efforts to extend invitation to other countries to attend ExCo meetings as Observers and to consider joining. In the last 2005 ExCo a formal action plan for recruitment of new members was discussed. Outcomes included proposals to prepare a list of important items concerning information about the IEA-OES to be sent to each invited observer along with the invitation, and to set up a list of contacts for further invitations.

The Tenth meeting of the Executive Committee that will be held in Vancouver, British Columbia, Canada 1-2 May 2006, will be in conjunction with a two-day international symposium "Canada and the World of Ocean Renewable Energy Symposium" in Victoria, British Columbia, and all members were invited to attend this symposium, as well as prospective member countries, including India, China, Mexico, Brazil, Germany, Italy and South Korea.

Ocean Energy on-line library - Additional activity under Annex I

An additional activity approved under Annex I in the last ExCo meeting was the development of an "Ocean Energy on-line library". The objective of this library is to provide an extension of the current website of the Implementing Agreement on Ocean Energy Systems, to host a location that would act as an on-line library on ocean energy, where authoritative research would be made available electronically to those interested in the area. The on-line library will promote the information exchange between leading academics and commercial researchers in the field. The Ocean-Energy on-line library will include public information available and the web links to the publishers.

The development of the Ocean-Energy on-line library will be based on the review of the papers published in journals, conference proceedings and public domain reports.

Ocean Energy Policies Review Report - Additional activity under Annex I

Under Annex I, an initial report was published in 2003 presenting the current status of the technical, economic, environmental and social aspects of ocean energy systems as well as current policies and activities in 19 countries and the European Commission. The report was intended to inform the Implementing Agreement participants of the research and development priorities that could be addressed by the Implementing Agreement.

In recognition of the many changes underway in the renewable energy and ocean energy policies of member countries, it was decided during 2005 to update the existing report in relation to policies and development trends. For this purpose Sustainable Energy Ireland (contracting party from Ireland) commissioned, for the IEA-OES, a review and analysis of policies impacting on Ocean Energy Systems development that would detail current policies and policy development activities in selected countries, identify trends in ocean energy activities, and where possible identify links between policies and trends.

This work will be based on the information gathered from the initial Annex I report, the Roundtable Country Review at the last 2005 ExCo meeting and the Review of Questionnaires sent to all Members and Observers.





Proposed Extension to Annex II

The ExCo decided to extend the Annex II and the following subtasks proposed by the Operating Agent were approved:

Subtask 1: Adapt from current literature and publish a 'Development and Evaluation Protocol for Ocean Energy Developers in Wave and Marine Current Energy'

- Hold an expert meeting attended by nominees from each Participant to the Annex to discuss current documents
- Drafting and publication of report

Subtask 2: Adapt from current literature and publish 'Guidelines for Open Sea Testing and Evaluation of Ocean Energy Devices'

- Hold an expert meeting (or series of meetings) attended by nominees from each Participant to the Annex to discuss current documents
- Drafting and publication of report

This work is expected to be done in straight connection with the Coordinated Action on Ocean Energy (CA-OE), an European project which includes most of the experts within Ocean Energy.

New activity on Power quality and Grid integration

During 2005 the extension of the IEA-OES programme to address the assessment of the power quality implications of the integration of ocean power in the electric grid was considered. The objectives of a new Annex on this topic would be to conduct cooperative research on the power quality implications of integrating ocean power with conventional power systems, and to provide a forum for information exchange. Achieving these objectives will require developing a good understanding of the operating characteristics of ocean power generators, their influence on power quality, their interaction with the power grid, and the synergies between ocean power and other renewable energy generation including hydroelectric or pumped storage generators and wind energy.

A proposal for a new Annex on **Power Quality Implication of Wave and Tidal Current Energy Conversion Plants in Distribution (Integrated and non-integrated) and Transmission Electrical Grids** was prepared by the Canadian Delegate and circulated among the members in November 2005. In order to further define the scope and formalise tasks for the proposed new Annex a one-day meeting will be held on April 28, 2006 at Powertech Labs., Canada.

Collaboration With Other Implementing Agreements

IEA-OES will consider collaborating with the new IA on Renewable Energy Technology Deployment that was established in 2004 by 6 countries (Italy, Denmark, Norway, France, Canada and Netherlands). The primary objective of this IA is to examine existing national policies with respect to their efficiency and success, in order to make recommendations on the background of required environmental and grid related regulations. Collaboration with this IA will consist mainly in the identification of barriers to the deployment of renewable energy systems in order to recommend improvements. These objectives are complementary with the work programme objectives of the IEA-OES.

End Of Term Report

An End-of-Term Report describing the first 5-year term (2001-2006) of the IEA-OES and a new Strategic Plan will be submitted to the IEA Renewable Energy Working Party by end of May 2006 as part of the process for extending the IEA Ocean Energy Systems Implementing Agreement for another 5-year term.

Ocean Energy Policy Developments

This section is based on the information presented by Members and Observers at the Roundtable Country Review, and surrounding discussions, of the 9th ExCo meeting, reported by Mr. Robin Murray from Future Energy Solutions.

PARTICIPATING COUNTRIES IN THE IEA OES

THE EUROPEAN COMMISSION

European Union (EU) energy policy aims to achieve sustainable, secure and affordable energy supply. In particular, the goals for 2010 are listed below:

- Renewable energy share of gross energy consumption at 12%.
- Renewable energy share of electricity consumption at 22%.
- Biofuel energy share of transport fuel consumption at 5.75%.
- Reduction of greenhouse gas emissions by 8%.

However, the European Commission (EC) think the energy targets are unlikely to be met unless significant further steps are taken.

EU renewable energy policies include the following:

- White Paper "Community strategy and action plan in the field of renewable energy sources" – COM(97)599.
- Green Paper "Towards a European strategy for the security of energy supply" – (2000)
- Directive on the promotion of electricity produced from renewable energy sources in the internal electricity market – 2001/77/EC.
- Directive on the promotion of the use of bio-fuels for transport – 2003/30/EC.
- Other EC directives e.g. on co-generation, energy efficiency and energy taxation.
- Communication "The share of renewable energy in the EU" – SEC(2004)547.

Total annual turnover from renewable energy sources has increased from 1.5 billion in 1990 to over 15 billion in 2004, and this is expected to grow to an estimated 80 billion by 2010. The EU has provided average funding of approximately 100 million per annum between 1995 and 2004 for the research, development and demonstration of renewable energy technology and support projects (e.g. resource assessments).

The EU's aim is to create a "single market" in research through integrated research programmes, and increased overall investments in research. The EU's strategy is to increase the spending on Research and Technological Development (RTD) to 3% of the EU GDP, of which 2% should come from the private sector. The EC's proposal for 7th Framework Programme includes a doubling of the annual RTD budget.

EU funded Ocean Energy Research under the Framework Programme

Research started in 1995 and the first kWh of electricity was generated from an EU supported ocean energy project in 2000. Based on figures from the IEA 2005, the total worldwide installed capacity is approximately 265 MW. However, the La Rance tidal barrage in France, which was completed in 1967, accounts for a large proportion of this total – 240 MW. Over the past 15 years the EC has allocated over 30 million to ocean energy projects.

The Framework Programme (FP) is the EU's main instrument for funding research and development. The FP is proposed by the EC and adopted by Council and the European Parliament following a joint decision. FPs have been implemented since 1984 and cover a period of five years with the last year of one FP and the first year of the following FP overlapping. The current FP is the 6th Framework Programme, which will be running until the end of 2006.

Total EC funding on ocean energy under FP5, including demonstration projects, was approximately 4.5 million.

Ocean Energy support under the 6th Framework Programme (FP6)

Under FP6, ocean energy projects can apply for funding for research via the Sustainable Energy Systems (SES) thematic sub-priority or through the Medium to Longer-term Research Objective (DG Research), if the research activity has an impact in the medium to long term.

Demonstration projects are funded via SES or through the Short to Medium-term Research Objective (DG Energy and Transport). The deadline for applications for demonstration projects was 22 December 2005.

The Intelligent Energy Europe Programme provides support for research attempting to overcome non-technical barriers.

To qualify for funding, each project must assemble the resources needed to achieve its objectives. Project activities may range up to several million Euros and there is no minimum threshold. Projects typically last for two to three years but there is no limit on duration, if justified to deliver the objectives.

A minimum of three participants from three different countries is required. However, in practice the number is likely to be more. The participation of small and medium enterprises (SME's) is strongly encouraged. Third Country participants may be included, with a possibility of Community financial support for certain groups of countries. For example, FP6 is open to:

- Member States and Associated Candidate Countries;
- Associated Countries;
- Third Countries including: Russia and Newly Independent States; Mediterranean Countries; Western Balkan Countries holding Science and Technology cooperation agreements.

Ocean energy projects have received approximately 7.2 million in support from FP6.

Ocean energy support under 7th Framework Programme (FP7)

On 21 September 2005 the EC approved the proposals for the 7th Framework Programme of the European Community. This proposed several research, development and demonstration programmes, named: Cooperation, Ideas, People and Capacities. Activities to be undertaken by the Joint Research Centre (JRC), as well as research under the Euratom treaty are also proposed. FP7 is proposed for the period 2007 to 2013, and will be the successor to the current FP6.

FP7 will include the Cooperation – Collaborative Research Programme. This will support a wide range of research activities carried out in trans-national cooperation, from collaborative projects and networks, to the coordination of national research programmes. International cooperation between the EU and Third Countries is an integral part of this action.

This action is industry-driven and organised in four sub-programmes:

- Collaborative research will constitute the bulk and the core of EU research funding.
- Joint technology initiatives will mainly be created on the basis of the work undertaken by the European technology platforms.
- Coordination of non-community research programmes.
- International co-operation.

Energy is one of nine thematic priorities of the Cooperation – Collaborative Research Programme. A total fund of 2,931 million is available for energy collaborative research. Ocean energy will be able to apply for funds under the renewable electricity generation category.

Ocean energy technology could possibly get support from the Capacities research programme.

The objectives of this programme are to:

- support research facilities, in particular for the benefit of SMEs;
- support research potential of European regions (Regions of Knowledge);
- stimulate the realisation of the full research potential (Convergence Regions) of the enlarged Union and build an effective and democratic European Knowledge society.

CANADA

In 2005 the Canadian Government began to reassess the potential for ocean energy technology after a gap of some 20 years. Ocean energy has been identified as a promising emerging technology, and as a priority for review and action by four coastal provinces of the Canadian Council of Ministers.

The Federal Budget of 2005 stated that innovation was an essential factor to move towards a sustainable economy. The Government will contribute \$200 million Canadian dollars over the next 5 years to the Sustainable Energy Science and Technology Strategy (SESTS).

The objectives of SESTS are to:

- identify technology opportunities and pathways;
- develop and advance promising technologies;
- generate energy knowledge to inform policy decisions and regulations;
- build national and international networks;
- disseminate knowledge and technologies.

Two initiatives have been initiated to complement the development and implementation of SESTS:

- Appointment of a National Advisory Panel to provide advice on energy Science and Technology (S&T) priorities and national delivery mechanisms (a report is due in December 2005).
- Examination of federal investments in energy and environmental S&T (summer 2006).

The National Advisory Panel to the Ministers has requested a report on ocean energy. The amount of the funding that will be set aside for research; development and demonstration of ocean energy technology has yet to be decided.

The Ocean Renewable Energy Group, OREG (the Canadian ocean energy sector association) has requested inclusion of renewable ocean energy among the "strategic priorities" under the Government's partnership initiatives.

There are also several initiatives at provincial level. British Columbia Premier's Technology Council has established an Alternate Energy & Power Technology Task Force. The task force has identified ocean energy as a strategic opportunity for the region. The expanded energy plan will set a new vision for electricity, oil and gas, and alternative energy, with a greater emphasis on conservation, efficiency and innovation. Several opportunities have been identified for integration of ocean energy projects with other Renewables as part of the Non-Integrated Coastal Area Electrification Schemes.

The Federal Ocean Energy Working Group (FOEWG) was established in 2005. FOEWG consists of approximately 40 members including eight Government departments and agencies. A multi-year project - the Ocean Energy Atlas Project with an aim to comprehensively assess and map the Canadian tidal current and wave energy resource is in progress. This project is being carried out by the National Research Council – Canadian Hydraulic Centre, Triton Consultants Ltd and Powertech Labs Inc.

Projects covering the environmental issues, industrial supply-chain and the latest technology have also been commissioned.

DENMARK

In June 2005 Energinet.dk (Denmark's transmission network owner and operator) together with the Danish Energy Agency published a strategy for wave energy in Denmark. Energistyrelsen, Elkraft System and Eltra were also involved. Wave energy is the only ocean energy resource available in Danish waters

There are no quantitative targets or feed-in tariffs dedicated to support ocean energy systems in Denmark. The Danish Energy Agency strategy is to firstly complete successful demonstration of full scale (or nearly full scale) devices which are grid connected. The technology must first prove that it can survive offshore conditions and produce electricity at costs comparable with wind power.

The present policy in Denmark is that the renewable energy market shall expand with financial support from the EU Emissions Trading Scheme and a limited national subsidy on top of the market price per kWh. Developers can apply for investment grants from the renewable programme and a price of 0.08 cents per kWh of electricity produced is available. This is the same price available to other renewable electricity generators, for instance biomass gasification.

There are no dedicated R&D programmes in Denmark for individual types of energy technologies. The renewable energy R&D programme covers all technologies so funding decisions are based on a horizontal criteria applicable to all competing energy technologies. In 2005 there was little funding for wave energy research and overall Government funding for renewable R&D was less than in previous years.

IRELAND

The Marine Institute (MI) and SEI have been working together to propose an ocean energy strategy for Ireland. In November 2002, the two bodies launched a consultation on options for the development of ocean energy in Ireland. Research has been commissioned to inform the development of this strategy. The completed proposal was submitted to the Department of Communications, Marine and Natural Resources (DCMNR) in 2005 and Ireland's Government is expected to adopt the policy in the first quarter of 2006.

The MI commissioned the Hydraulics and Maritime Research Council (HMRC) in order to establish a development and evaluation protocol for ocean energy systems. This document is now being considered for use within Annex II of the IEA OES to help develop internationally agreed guidelines on the development of ocean energy technology.

The MI and SEI also commissioned a project to estimate the potential economic benefits of developing an ocean energy industry in Ireland. The report concluded that by 2025, the industry could support over 2,200 jobs (indirectly and directly). Based upon an assumed installed capacity of 485 MW of domestic commercial ocean energy systems and 7936 MW international systems, the value of the national market would be almost 800 million and the estimated export market would be worth almost €1,600 million.

A component of the process was an assessment of Ireland's ocean energy resource. SEI commissioned a study on the tidal current resource which was undertaken by RPS Group. This estimates an exploitable resource, identified as the technical resource available in a selected number of the most likely sites to be utilized within depths of 20m to 40m, of approximately 2.600 TWh/year utilising present technology. The majority of this resource is located off the east coast.

Previous studies have identified Ireland as having one of the most energetic wave climates in Europe. An unpublished 2001 study by the HMRC estimated a total nearshore resource of 18.6 GW giving annual output of 48 TWh/year. The MI and SEI are now funding the development of a wave energy resource atlas to assess the offshore resource. Initial indications from this work show a technical resource in the range of 2.4 – 28 TWh/year. This compares with annual predicted consumption of electricity in Ireland at 32.4 TWh/year in 2010.

As Ireland has one of the largest wave energy resources in Europe, SEI and the MI are aiming to secure long term funding to develop both a national ocean energy industry and to utilize the resource to contribute to domestic supply security.

The proposed strategy is a four phase programme estimated to require €26.6 million in government funding, as explained in the table below.

Phase	Year	Task	Cost (€ million)
Phase 1	2007	Prototype development	4.9
Phase 2	2008-2010	Pre-commercial devices	6.9 - 10.5
Phase 3	2011-2015	Pre-commercial Array	10.1 - 11.15
Phase 4		Commercial Deployment (if required provide market support mechanism).	

JAPAN

The Institute of Ocean Energy have been supported by the Japanese Government over USD40 million of public funding for OTEC. In Japan, there are some discussion on further OTEC and wave energy technology RD&D to realize the project.

IOES have started to investigate new OTEC (30kW) experimental system using ammonia/water mixtures as working fluid.

It has been started the project on Sea Trial of an Impulse Turbine for Wave Energy Conversion in Nigata, Japan.

PORTUGAL

Portugal launched the highest feed-in tariff to support wave energy projects of all IEA member countries initially offering 0.23/kWh for electricity generated from the first 20 MW of installed wave energy devices. However, feed in tariffs must now be agreed on a case-by-case basis between developer and the Government. These negotiations take into account commercial issues such as the ownership of the technology and where the machines are to be manufactured.

The Agência de Inovação SA is a Government enterprise which has an annual budget of 25.5 million to support technological innovation projects. The Agência de Inovação run the DEMTEC programme which provides financial incentives for pilot projects of products, processes and technologically innovative systems. The DEMTEC programme has provided a 1.25m grant to help fund the Pelamis project.

UNITED KINGDOM OF GREAT BRITAIN

Over the past five years the DTI's New and Renewable Energy R&D Programme (now the Technology Programme) has supported the development of a number of wave and tidal-stream energy technologies. Certain developers have indicated that R&D is nearly complete and that they are, or will soon be, ready to begin pre-commercial operation. The aim will be to gain more experience through accelerated trials of device arrays to discover whether cost effective solutions can be developed.

The electricity generation costs of these technologies, predicted by developers, are still much higher than those of many other renewable energy technologies. This means that they cannot operate profitably under current market conditions. However, it is hoped that experience gained during the early years of pre-commercial operation will enable developers to reduce electricity generation costs by:

- Reducing the capital cost of the devices themselves;
- Increasing power capture efficiency;
- Improving reliability;
- Economies of scale.

During the 9th ExCo meeting, the DTI referred to three policies that are under development which will have a major impact on the ocean energy industry in the UK: The Marine Renewables Deployment Fund; the UK Energy Review and the Renewables Obligation (Scotland) Review 2005/6.

Marine Renewables Deployment Fund

In August 2004 the DTI announced the setting up of the Marine Renewables Deployment Fund. The total amount of funding allocated under this scheme is up to £50 million. The scheme will fund the gap between R&D and pre-commercial deployment on wave and tidal current technology in UK marine areas. The aim is to encourage the development of a sustainable UK wave and tidal-stream industry, and to maximise successful development of cost effective marine technologies in the long-term. This will be achieved by enabling the early-stage pre-commercial operation and trials of a number of wave and tidal-stream energy devices. The scheme will support the deployment of multi-device wave or tidal-stream electricity generating facilities connected to the UK grid. It will do this through a combination of capital grants (25% of eligible costs) and revenue support (£100/MWh in place for a maximum of 7-years). In addition to this, projects are entitled to receive the market value of the electricity and Renewable Obligation Certificates (ROCs) that they generate.

In order to ensure that the benefits of the scheme are available to a number of different technologies, the total funding received by any project under the scheme will be subject to a cap of £9 million. The costs of grid connection are eligible for inclusion in project costs.

The scheme has been launched in 2006.



Energy Review

The UK Government announced in November 2005 a review of UK energy policy. A formal consultation phase will start in early 2006. The terms of reference of the review are broad in scope including aspects of both energy supply and demand and will focus on policy measures to help deliver UK objectives beyond 2010. The review will aim to ensure the UK is on track to meet the goals of the 2003 Energy White Paper in the medium and long term. These include:

- cutting the UK's carbon dioxide emissions by some 60% by about 2050 with real progress by 2020;
- maintaining the reliability of energy supplies;
- promoting competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve our productivity.

The Review will consider all options including the role of current generating technologies (renewables, coal, gas and nuclear power) and new and emerging technologies including wave and tidal current.

The Renewables Obligation (Scotland) Review 2005/6

The Renewables Obligation (Scotland), or ROS, is the Scottish Executive's (Scotland's devolved government) main policy instrument to support renewable sources of energy. The ROS creates an incentive for the development of new renewable electricity generating capacity by requiring licensed suppliers to supply increasing proportions of renewables electricity. The ROS was introduced, following full consultation, on 1 April 2002 in parallel with the identical Renewables Obligation Order 2002 (ROO) covering England and Wales. In 2005, the Executive commenced a review of the Renewable Obligation (Scotland). The consultation document published proposed potential changes exclusive to Scotland. The first of these was that the ROS might be amended to provide additional support to emerging technologies, notably wave and tidal energy. A large number of responses to this proposal were received. The majority were opposed to such a change, because it would be a departure from one of the key principles upon which the ROS is based (that of supporting the most economic forms of renewable generation). They also believed that it could have a negative impact on investor confidence. Those against the change did acknowledge that these technologies need support, but using a different technique. Those in favour explained that the renewable electricity generated from large scale wave and tidal projects should be awarded "multiple" ROCs (rather than just individual certificates awarded to wind farms). Supporters explained that multiple ROCs are essential to attract private and utility investment and drive down costs, and that current support would not be sufficient to achieve this. After consideration of the response, the Executive now believes that there would be merit in altering the ROS to provide increased support in the form of additional ROCs for output from wave and tidal energy systems only. Once the amount and duration of any support that might be awarded is established, limiting any potential impacts on investor confidence, the subsequent changes would take effect from April 2007.

UNITED STATES OF AMERICA

The Energy Policy Act of 2005 (Public Law 109-58) is a statute which was passed by the United States Congress on July 29, 2005 and signed into law on August 8, 2005. The Act provides tax incentives and loan guarantees for energy production of various types in an attempt to combat growing energy problems in the US.

The Act was intended to establish a comprehensive, long-range energy policy. It provides incentives for traditional energy production as well as for newer, more efficient energy technologies, and conservation. The act adds ocean energy sources for the first time as separately identified renewable technologies. It contains a number of provisions that apply to renewable energy. These include funding for research, development, demonstration, and commercial implementation support for renewable energy of \$2.2 billion until 2009, escalating from \$632 million in 2007 to \$743 million in 2008 and \$852 million in 2009. The 10-year production tax credit (incentives for investors) has been extended to resources not previously covered, including wave, current, tidal, and ocean thermal energy.

During the 9th ExCo meeting, the USA ExCo member explained that the United States Congress has "authorized" the development of an ocean energy support programme. This means that Congress has agreed to undertake a programme in principle. However, the funds must be "appropriated" by Congress for the programme to get approval. An ocean energy programme could be set up over the next 10 to 15 years to fund the R&D of wave and tidal current technologies. It is thought that this will be similar to the Wind Energy Systems Act of 1980 which provided an accelerated programme of wind energy R&D.

OBSERVERS

BELGIUM

In 2003, public funding of €33.5 million for Renewables RD&D was granted (€23.4million in Flanders and €10.1million Wallonia regions). The Belgium Government is now considering whether wave energy can contribute to the 8% Renewables target for 2010.

FRANCE

There is currently no political framework in France to support ocean energy technology. However there is significant discussion taking place.

Following the successful Renewable Energy workshop at the British Embassy in Paris in January 2005, the French Government has requested a further specialist workshop with the British marine energy industry. Their aim is to use the start that the UK has made in technical development, policy support and planning practices as they address the development of the marine energy sector in France. The event is being organised through co-operation of the British Embassy in Paris, DTI's New and Renewable Energy Programme, BWEA, French Ministries of Ecology and Sustainable Development and the French trade bodies Ifremer and Ademe (the French agency for the environment and energy management). This event will be of interest to all bodies involved with the development of marine energy resources, particularly for application in French waters and in third party countries in cooperation with French companies.

Government policy and development planning will be one of the key areas of discussion.

GERMANY

Germany has very little ocean energy resource in comparison to Portugal and Ireland. However, ocean energy is included under the existing renewable framework. Ocean energy projects have been eligible for the same feed in tariff of cent 7.67/kWh available to hydropower installations.

The previous tax incentives scheme, which offered investors 100% tax free investments in renewable energy projects, have been changed by the new German Government. There is no more special regulation for Renewables. However, a linear tax depreciation still applies as for any other "tangible fixed assets". The success of the previous scheme is illustrated by the size of the wind industry. According to figures in December 2005, there are: approximately 18.5 GW of wind turbines installed onshore and offshore. Licenses have been granted for 11 new offshore wind farms in the North and Baltic Sea.

The German Government is currently reviewing potential opportunities for German business and a report is due to be published in April 2006. As public interest in ocean energy has increased, the Government is beginning to listen to industry and take it seriously. The development of energy policy in Germany will be very much led by the industry. ISET believe German businesses could export components and sub systems to ocean energy manufactures. Germany already controls a large proportion (more than 50%) of the global market for wind turbine technology.

ITALY

Italy's Government does not have a strategy to support ocean energy technology. For example, the Enermar system is the only tidal turbine being demonstrated in Italy. The project has been funded by United Nations Industrial Development Organization (UNIDO) and has received no funding from the Italian Government.

Ocean energy developers can apply for annual grants through the MIUR (Ministero dell'Istruzione dell Università e della Ricerca) programme. These grants are awarded by the Italian Ministry of Education, University and Research.

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