ENV-2E02 2004-2005

What stage is wave power at and is the technology and financial backing there to make it competitive in the future?

If wave power is to become a successful renewable in the future then developments need to be made in the technology to make it commercially viable, but to do this the market structure and financial support have to be there to guide it through the development stage. Without this the development will stall and it will not become commercially viable and a potentially huge resource could be wasted.

The history of wave power

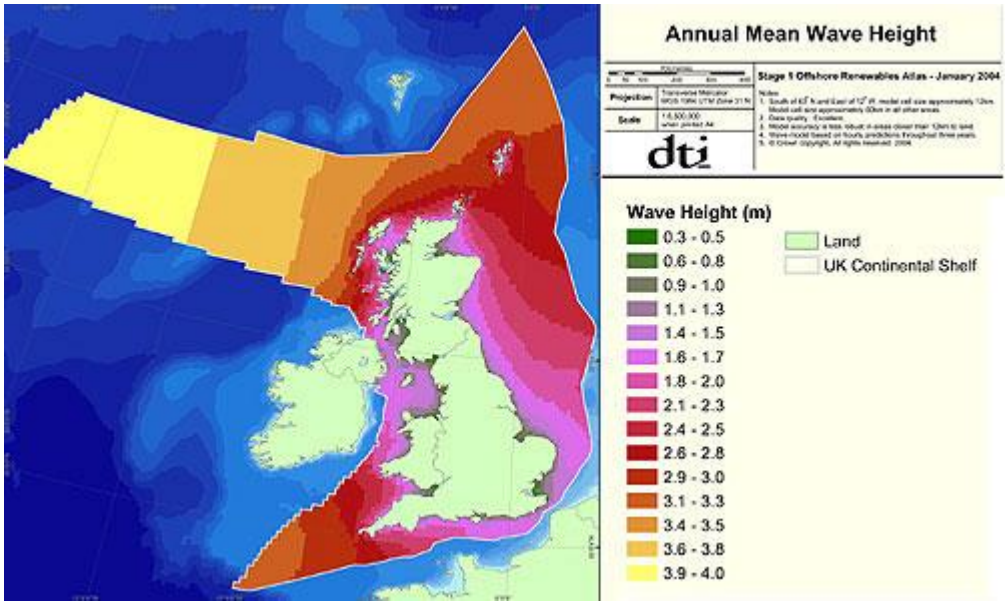
In order to fully understand where wave power is today, it is important to look at it historically. In the 1970's work began on wave energy devices as a response to the oil crisis. Although the advances in technology were considerable, they failed to deliver economic supplies of electricity, which severely dented the industry and its future. There was also very little industry led funding with most coming from the government which meant that the hard push for commercialisation wasn't really present in the industry. Also many of the prototypes were on a very large scale meaning they had huge initial costs associated with them, putting off investors.

What funding and support is there for the industry now to push it towards commercialisation?

In recent years wave energy has received renewed support from governments battling to meet renewable obligations. A Scottish commission has been formed to promote the development of a wave energy industry in Scotland, the area of the British Isles with the highest wave resource potential (figure 1). The commission comprises of members from the Scottish parliament, NGO's, and relevant industries and finance allowing integration across the key players in the wave industry within Scotland, but it's global integration that needs to be focussed upon as well as national integration. The international co-ordination of the wave power industry has now begun though, under the European thematic network on wave energy that was launched in 2000. This network focussed on co-operation with the power industry, social planning and environmental impact, financing and economic issues, research and design on wave

energy devices, generic technologies and promotion of wave energy. Using these six branches has allowed the industry to progress in a more co-ordinated centralised manner although it is still really in its infancy.

Figure 1: wave resource potential UK (www.bwea.com)



Also wave energy has been considered for the first time in one of the main mechanisms that promotes the renewable energy industry, the Scottish renewables order, who pay a premium price for electricity to help undercut the currently inflated costs of renewables compared to conventional means of generating energy. This alone has resulted in three successful applicants from the wave energy industry, a significant step in the right direction. Also the UK wave energy programme has been reopened which through the department of trade and industry (DTI) concentrates on those technologies which have significant industrial support. So it is clear to see that wave energy is currently riding on a wave of political support, but this must be maintained if we are to see it become successful. Also international co-ordination of the industry has to be maintained and worked upon as currently there are a number of small scale projects all working separately in different countries. Indeed under the UK wave energy programme a study was conducted on the research and design requirements of wave energy. The interim report from this study did not make easy reading for wave energy enthusiasts. With the acknowledgement that the industry was currently uncoordinated, a lack of developer confidence being present and hence a

lack of industrial support. However, it was concluded that there appears not to be any technological barriers in the way of developing the technologies, although there were gaps in the technology with regards to mooring and cable connections, but these are gaps which I think can be overcome in time.

As well as incentives and funds for the research and design phase of wave energy it has become increasingly important for there to be subsidies in the energy market to guarantee purchase prices for the electricity they produce. In the UK at the moment the scope for this is limited, however, suggestions have been made that capital grants or feed in tariffs for wave energy should be added to the renewables obligation. A 'wet' equivalent of the renewable obligation certificates is being called for due to the current markets favouring wind power which is making it hard for wave power to break into the renewable energy market, due to the inherent advantages wind has over wave power currently. Compatibility with the renewable energy obligations though, appears to be a problem for all funding except capital grants. Any change in the renewable obligations could hamper the progress it is currently making in other renewable sectors such as wind and many people feel it would undermine the good work done so far. The uncertainties surrounding wave energy makes investment hard to find though, and the government must take the responsibility of trying to offset this uncertainty by trying to offset the risks potential investors face in investing in an as of yet unproven industry.

What technologies currently exist?

The device that is seen as the market leader for the next 5 years in terms of wave power is the pelamis device. Ocean power delivery was funded in 1998 in Scotland to fund the pelamis scheme. The first full size device had a capacity of 750KW although advancements in the technology may allow it to subsequently reach 1MW. In the summer of 2004 the prototype pelamis was connected to the national grid and successfully supplied electricity to the grid. There are plans to fund a pelamis wave farm off Cornwall although exact plans have not yet been finalised it is expected to have a capacity of around 50MW, there are also plans to try and develop a farm off the wave rich coast of Portugal. As well as the potential of this technology due to its stage of production it also has significant funding behind it to get it through the research and design stage and into commercialisation. In June 2004 Ocean power

delivery completed the first round of investment of over £7.5m, including £1.5m new investment from the Carbon Trust.

Another offshore technology currently undergoing trials and research and design is the wave dragon which was installed in Denmark, however, the potential capacity of this technology seems significantly lower than that that could be provided by a pelamis wave farm which may mean it struggles to become commercially viable.

The market leader in the UK as far as shoreline devices are concerned is wavegens limpet which was installed on the island of Islay in Scotland in 2000. The new technology that they are currently developing may allow turbines to be incorporated into sea defences, whereas other companies are focussing on future markets wavegen are focussing on areas and niche markets that they can apply there goods today. However, due to the much lower capacity of shoreline devices compared to offshore devices I think that the potential is only in niche markets in the future.

Will nearshore or offshore energy be dominant in the future?

A recent report on wave energy by the international renewable energy magazine highlights the recent successes of wave energy since the developments and political and financial backing mentioned previously. As a result they expect that in the next five years several wave energy devices will have progressed through to commercialisation. Although they do recognise that the high costs at present mean that for this to happen the financial support needs to be sustained and that their predictions may be unreliable due to the lack of large scale testing to combat the issues of reliability and efficiency. They believe there is potential for nearshore devices but that for wave energy to become commercial it will move offshore and multiple offshore units will typify wave energy as it moves into the next decade with 50MW offshore farms not being inconceivable. Although shoreline devices are already established there are little plans to install new ones due to there limited capacity, although they can be useful in niche markets such as small islands.

Will financial support be sustained in the future and will the initially high costs drop?

The UK is expected to be a dominant player in the wave energy industry and has forecast installations until 2008. This is partly due to the renewed support from the UK government that has allowed valuable grants to be applied at the research and design stage. This coupled with the undisputed vast natural resource that the UK could potentially tap into means there is vast potential for the development and subsequent commercialisation of a wave energy industry. However, the unpredictability of prototype devices means that future forecasts are notoriously difficult to make as represented in the various scenarios in figure 3. The forecasts in the amount of money spent in wave energy from 2003-2008 though highlights the financial support that the industry will be receiving at £72.2 million. It is forecast that as time progresses the initially high costs attributed to the research and design stage will decrease and individual technologies will become more cost effective with certain devices also having very promising future electricity generating costs suggesting that wave power will grow as technologies mature (figure 2).

Conclusion, can wave energy become commercially viable and if so how much energy could it produce?

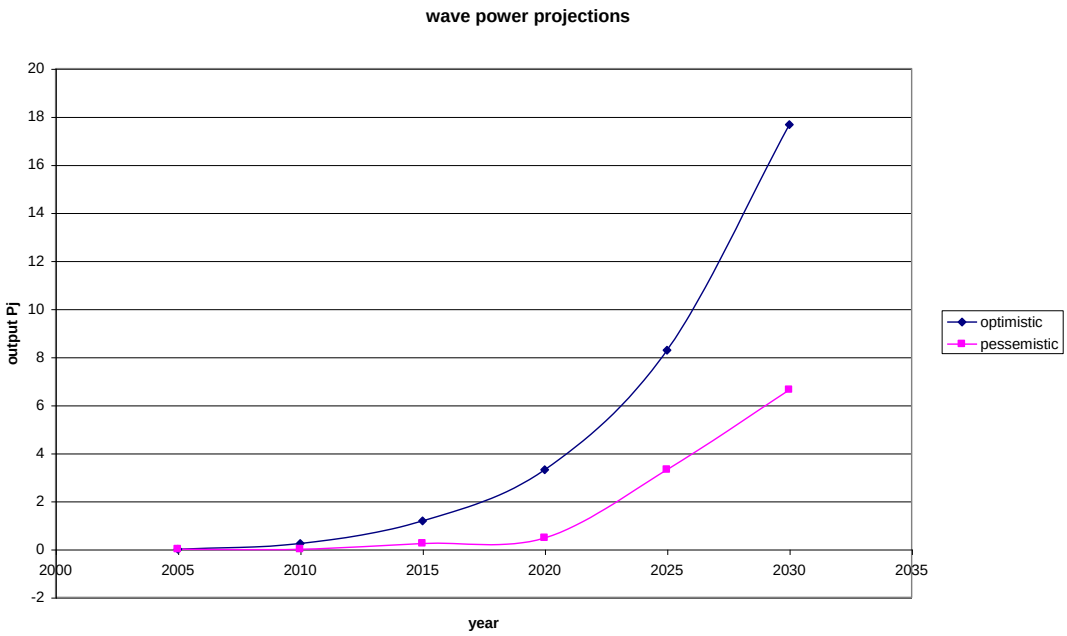
The renewed financial and political support with regards to the UK wave energy programme, the Scottish commission and the scottish renewables order, should allow wave power to become commercially viable. The major barrier financially seems to be the inability to alter the renewables obligation to help wave energy through its research and design stage. However, with more support from private companies such as OPD and Wavegen significant progress should be able to be made and by 2010 - 2015 I think the first wave farms will have reached commercialisation. After this the decreasing initial costs and electricity prices associated with commercialisation and the subsequent engineering industries that support it should guarantee a commercial future for wave power. However it is imperative to stress the potential errors associated with these predictions due to wave powers current research and design status. If everything goes to plan though wave power is a huge resource that could be hugely helpful in limiting carbon dioxide emissions. So from my review of the current status of wave energy and its future potential I have forecasted that it will have the following generating capacity in the future after it reaches commercialisation in 2010

– 2015. This is due to the renewed political and financial support it is currently receiving which looks set to continue into the future (figure 2).

Figure 2:forcasted output from wave energy in the future

year	load factor optimistic	load factor pessemistic	generating capacity a single wave farm optimistic	generating capacity of a single wave farm pessemistic	output from wave farms optimistic MW	output from wave farms pessemistic MW	output PJ/year optimistic	Output Pj/year pessemistic
2005	0.25	0.25	0	0	0	0	0	0
2010	0.25	0.25	30	30	7.5	0	0.24	0.00
2015	0.25	0.25	30	30	37.5	7.5	1.18	0.24
2020	0.3	0.25	35	30	105	15	3.31	0.47
2025	0.3	0.3	35	35	262.5	105	8.28	3.31
2030	0.35	0.3	40	35	560	210	17.67	6.63

Figure 3: graph of wave power projections



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