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Wave energy in the UK – is it dead?

13 Feb 2019 Dave Elliott

(Image courtesy: iStock/lleerogers)

The UK has a very good wave energy regime, with big swells from the winds rolling over long fetches of the Atlantic. In principle, this could generate the equivalent of up to 20% of UK electricity, or perhaps more. Back in 1978, Glyn England, chairperson of the nationalized utility the Central Electricity Generating Board, said that in theory wave power systems could “supply the whole of Britain with electricity at the present rate of consumption”. It may be worth looking back at what happened.

The Labour government had launched a major deep-sea wave energy programme in 1975, with a 2 GW reference design target. Several small-scale prototype devices were developed, including the Salter Nodding Duck. Some were tested in open water. In 1980, incoming Conservative energy minister John Moore claimed at the opening of a large wave energy test tank at Southampton, that “whatever other problems our wave energy researchers may face, lack of Government support will not be among them”.

However, evidently doubts were beginning to emerge about wave power. The new Conservative government required R&D spending cuts and in 1982, after around £15 million had been spent on wave power, a review was carried out. One of the results was that, on the basis of some high – and disputed – cost estimates, the deep-sea wave programme was abandoned.

For some that was very controversial. Quite apart from claims about errors in the data used in the assessment, it did seem premature, with little time having elapsed since the start of the programme. Wave energy pioneer Stephen Salter said it was like trying “to decide our aviation policy on the data available in 1910”. In 1984 the Select Committee on Energy also complained about what it saw as the premature closure of the programme. Wave energy was, it said, “effectively withdrawn before the race began”.

Nevertheless, the decision remained. In 1985 the wave energy programme results were duly written up in a report, which concluded that “there was only a low probability of any device achieving an energy cost below 8 p/kWh”. The programme target had been to get under 5 p/kWh.

> “ The more we deploy, the cheaper the technology will become
> RenewableUK

That was not to be the end of it, however. Some research teams continued and some progress was made with shore-mounted Oscillating Water Column (OWC) devices, like Wavegen’s 250 kW Limpet, installed on the Orkneys. What’s more, given the huge potential resource, the wave power issue, along with enthusiasm for tidal power, has regularly resurfaced in policy debates with, for example, in 2001 a Select Committee concluding that “given the UK”s abundant natural wave and tidal resource, it is extremely regrettable and surprising that the development of wave and tidal energy technologies has received so little support from the Government”.

After a new review in 1998, which reported “a considerable improvement in the costs of devices, so that there are now several with costs of 5 p/kWh (or less) at 8% discount rate", a new wave energy programme emerged, in part supported by the Scottish Government.

Still struggling

The programme revamp did push things on a bit but, despite continued efforts, the technology for exploiting this huge resource has so far been much slower to develop successfully than tidal stream devices. Costs are still high – too high for Contracts for Difference (CfD) support.

Why? The R&D funding has certainly been very limited and erratic but, even so, there may be more fundamental reasons. It does seem to be hard to design sea-going devices that can survive in – and extract energy from – the complex multi-energy vector interface between air and water. It's far easier to do that in the calmer tidal flows beneath the surface. Although we have, over the centuries, managed to develop ships that deal with waves, they do so by avoiding or minimizing energy transfer. With wave energy devices we want to do the opposite.

So energy extraction and survivability are two key opposing design issues. The wave energy field had taken something of a knock from the very visible loss of the EU-supported 1 MW offshore OWC prototype after a (summer) storm off the north of Scotland in 1997, while it was being positioned and filled with sand ballast for final near-shore sea-bed mooring. An Australian near-shore OWC prototype later suffered a similar fate.

Boosting survival

To improve survivability, most wave devices since then have opted to reduce energy take. For example, in the floating segmented Pelamis "sea snake" design, the nose of the long articulated device is tethered to the sea bed, so that waves hit it head on and move down its flanks, causing the "snake" segments to rise and fall, this motion driving air pumps and turbines. Most of the wave front passes by, with most of the energy thus being un-intercepted. But it survives, like a boat, by cutting into, rather than broadsiding, the waves.

Tethered Wave Buoys also have more survivability. We have after all used buoys at sea for a long time. The wave buoy systems have hydraulic links to the sea bed to generate power from the bobbing effect, but that is low efficiency.

As can be seen, there is a fundamental problem with sea-going wave energy. Mounting OWC-type systems on the shore is one answer, providing a secure and protecting base, but the wave energy resource there is much less than out to sea. Either way, the economics of wave energy suffers.

That is unfortunate, since not only is the wave resource large, but being in effect stored wind power, it is also less variable than wind power; waves continue for some time after the wind has dropped, adding to the value of the resource. The UK also has extensive access sites off Scotland and the south-west coast of England and has the marine engineering experience to develop them. It is a leader in the field and there could be a significant technology export potential. That is one reason why, despite the problems, projects are still going ahead.

However, this area of innovation is risky. Scotland has led the way but in 2014 its pioneering Pelamis sea snake and Oyster hinged-flap projects both ran into financial problems and progress has been halted. Nevertheless, developers keep trying, as for example with Wello's 500 kW Penguin floating device on test in Scotland, and many other designs are still being developed around the world.

Unwarranted gloom?

There have been some recent assessments of wave energy's potential in the UK, which mostly make for gloomy reading. Yet hope rises eternal and trade lobby group RenewableUK says that now is not the time to give up: "The UK is right at the forefront of a global race to develop wave power on a commercial scale. It's vital that we don't lose our lead to other countries, who stand to benefit from the years of investment and progress we've made. The more we deploy, the cheaper the technology will become."

So what's the bottom line? If the original 1970s programme had been allowed to continue, would we have large-scale wave power now? The assessments of wave energy that were made then have been subject to much debate and there does seem to be evidence of some errors and perhaps even bias.

However, subsequent programmes – albeit of a limited scale – have not led to very significant improvements. That may still happen, although it might take some time. At the moment there is very little UK funding available for this area, although work at EMEC on the Orkneys continues. In theory, wave projects can apply for support under the Contracts for Difference (CfD) system, but none have so far – their costs are still too high. Even tidal stream projects, which are somewhat more developed, have not so far been able to get support under CfD. So, barring more funding and some technological breakthroughs, sadly it doesn't look too promising for wave energy in the immediate future.

Though it would be unwise to write wave energy off just yet. For example, the novel sea-bed-mounted membrane-pad m-Wave system being developed by Australian developer Bombora, via its EU base in Pembrokeshire, has just won £10.3 m from the EU for a 1.5 MW prototype.

With no external moving parts, it should be more survivable.

The full wave power story is covered in my new book *Renewable Energy in the UK: Past, Present and Future*, published by Palgrave.

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