

## Gravity of recession ebbs marine energy progress

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23/06/2009

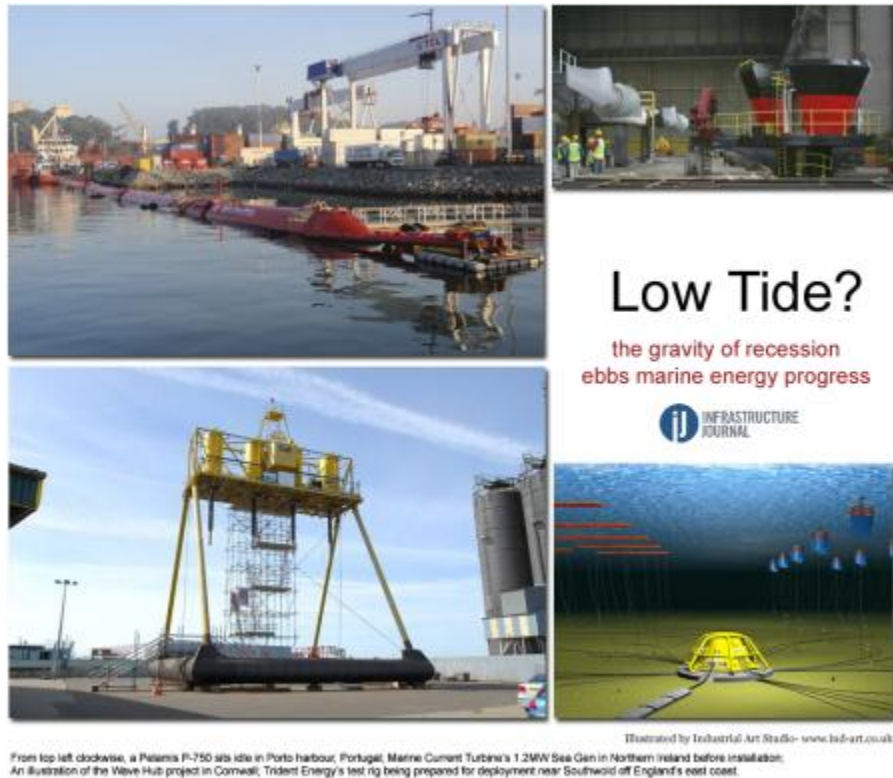
**The Wright brother's historic flight in December 1903 was a defining moment for the aviation industry. Northern winds blowing in off the Atlantic provided ideal flying conditions for Orville and Wilbur Wright to glide 20 feet above the beach at Kitty Hawk in North Carolina.**

From that humble but well-documented first flight to the commercial take-off of the massive Airbus A380 in October 2007, aviation has evolved from an amateur curiosity into an essential element of the global economy. Its rapid development over the last century is the model of any aspiring industry, and the Wright brothers themselves have become folk heroes in countless entrepreneurial analogies.

"Entrepreneurs are not as common as you would think," says Martin Wright, who is coincidentally not a relation of Orville and Wilbur. "If you blow them away, don't think they'll come back."

Wright is the current managing director of Bristol-based Marine Current Turbines in the UK. He is increasingly concerned that the lack of capital available to the nascent marine energy sector as a result of the economic downturn will not only delay, but might even suffocate the development of wave and tidal technologies for an entire generation.

In comparing his industry to aviation, Wright suggests wave and tidal technology has evolved from its own Kitty Hawk to the Second World War. It's an interesting and perhaps appropriate analogy. Coming out of a depression and facing a global threat, competing aeronautical engineers from countries at war expedited technical advancement against all odds and made great leaps towards the development of jet aircraft from 1939 to 1945. Is marine energy on the verge of such a leap?



## Complacent Threats

The world is certainly facing an energy and climate crisis. However, global warming and peak oil are complacent threats, more difficult to measure than an approaching army. Without a sense of scale or urgency, marine energy is in danger of being brushed aside as uneconomical and impractical.

"We need these technologies, perhaps now more than ever," Wright, a former petroleum engineer says.

Climate change is one issue, rising demand and aging energy infrastructure is another. In the UK and across the world, there are major decisions to be made about energy in the next few years. By 2015, Britain's generating capacity could be cut by a third as a generation of coal and nuclear power stations are closed.

The UK government has a good track record of verbally supporting renewables, and financially backing marine energy research. However, if more is not done, the progress achieved over the past decade could wash away in the tides of recession.

"The marine energy sector is not immune to the financial problems affecting the rest of the world," Wright says. "If the managing director of a cash-burning company isn't profoundly scared right now, he should be. Though the lack of capital may not be critical now, it will be if the conditions persist."

## A problem across the renewables sphere

According to Todd Woody, a Silicon Valley-based contributing editor at *Fortune Magazine*, lack of capital is a serious and growing issue for a number of cash-burning green technologies - not just marine energy. Through his environment and technology blog entitled *Green Wombat*, Woody has closely followed the development of the green economy with a keen eye on the thermal and photovoltaic solar sectors.

Woody says that emerging solar firms are hitting the same financial road blocks that wave and tidal companies are. As an example, he notes that despite a **550MW** power purchase agreement (PPA) with the California utility PG&E, OptiSolar couldn't raise enough capital to deliver the project and the company was sold to First Solar in March 2009.

For marine energy, the effect has been worse. Finavera Renewables **signed a PPA** with PG&E for a 2MW wave project in 2007. That project ended in 2008 when the California Public Utilities Commission rejected the contract as too expensive. This followed a previous setback for the developer when its US\$2 million AquaBuOY 2.0 wave prototype **sank** in trials off the Oregon coast in 2007.

Eventually, the Canadian firm issued a statement in February 2009 effectively shelving its marine energy aspirations. The company was seeking to **swap** US wave site licenses to allow it to focus on its near-term wind portfolio. Though it retains all intellectual property associated with the AquaBuOY technology, Finavera Renewables seems to have exited marine energy in the current economic climate.

## Babcock & Brown - Aguçadoura I

While Finavera's setback is a cautionary tale for all in the sector, Babcock & Brown's demise is a horror story.

When the Australian infrastructure firm **collapsed** in February 2009, the world's most advanced wave power project at Aguçadoura went with it - a humble victim of circumstance. Five months earlier in September 2008, Babcock & Brown was toasting the successful **launch** of three Pelamis P-750s off the coast of northern Portugal. The Portuguese navy escorted journalists and dignitaries out to the project site and the government's economic minister, Manuel Pinho made it clear that the country had something important to show the world - a 2.25MW wave farm.

As part of the inauguration, Babcock & Brown revealed a new partnership and ownership structure that included local heavyweights Energias de Portugal (EDP) and Efacec. The €9 million Aguçadoura project was intended to be a stepping stone for a larger 20MW array which itself would lead to other grander Portuguese wave power

projects. However, with Babcock & Brown in administration only a few months later, the partnership never happened and Aguçadoura's three Pelamis "sea snakes" were parked and remain static in Porto's harbour.

Nearly a year after they first went live, the future of these units remains in question. Max Carcas, the business development director at Pelamis Wave Power, says his company is keen to see the project continue with a new partner, particularly to focus on developing the 20MW phase using the next generation P-2 machine. Though Aguçadoura is not a Pelamis project - it sold the P-1A units to Babcock & Brown subsidiary Enersis - it is an important commercial demonstration and an operations & maintenance contract for the company. Ultimately, Pelamis wants to prove the efficiency and survivability of its units and this was the technology's largest test to date, albeit at what Carcas says is a sub-optimal scale for a marine project.

Babcock & Brown's current financial position makes the company unable to move the project forward. As part of its "strategic" divestment of assets, the firm moved the wave units from Enersis into the parent company. It then divided up the subsidiary and sold it off in chunks.

An investor familiar with the situation told IJ news a number of interested parties - such as EDF Energy, EDP, Statoil and AES - are interested in taking over the Aguçadoura wave project. Carcas would not confirm this, saying only that the list is inaccurate. He declined to comment further for reasons of confidentiality. For the moment, until a new owner can be identified and funding secured, the Aguçadoura trials in Portugal are likely to remain parked.

A further setback to the project - from this reporter's point of view - is the departure of former Enersis administrator Antonio Sa da Costa. He left Enersis in November, less than two months after the inauguration of the company's wave power project.

Sa da Costa had been one of the project's staunchest supporters. As the current president of Portugal's renewable energy association (APREN), he remains one of the country's most passionate voices for clean energy. While researching a feature on [Serpa Solar](#) and Portugal's renewable landscape in 2007, I met Sa da Costa in Lisbon for a midnight meeting - as it was the only time he could fit me into his busy schedule. The lasting impression I took from that meeting was not so much Portugal's unique power mix, but Sa da Costa's personal commitment to renewables and the Aguçadoura project in particular. I contacted him to comment for this article, but he declined saying - as he was no longer involved - it would not be inappropriate for him to make any statement concerning the future of the project.

## "We could be doing more ..."

Max Carcas and Martin Wright are in perfect harmony when discussing solutions to the capital crisis for UK marine energy companies - increased government support beyond the current ROC (renewable obligation certificate) structure.

"If we kill the emerging renewable technologies, we'll have to fall back on old technologies such as fossil fuels and nuclear power," says Wright. "If politicians fail to act, it will send a message to entrepreneurs - 'don't go into innovation'."

"Our technologies should be prioritised," echoes Carcas. "There is a strong economic, security of supply and climate case for government investment in this sector."

Marine energy is good for jobs and good for the environment - or so its proponents say. Pelamis currently employs over 70 people and has its headquarters in Edinburgh, Scotland. MCT is based in Bristol and launched its largest tidal project to date in Northern Ireland last fall.

Pelamis operates similar to a wind turbine manufacturer and sells its units to developers, energy companies and utilities. According to Carcas, it is the only wave company to have secured commercial orders for its equipment.

The company's current financial position is secure, but Carcas says it could be doing "much more and moving much faster" if it had that investment backdrop. MCT on the other hand is developing its own project and therefore has taken on the risk and the cost to prove the viability of its technology.

For investors, a general anxiety may exist in that a prolonged recession will delay the progress of this sector as a whole. Over the past decade, renewables and the marine energy have been nurtured by a new generation of talented engineers and entrepreneurs. People like Richard Yemm - the chief technical officer and founder of Pelamis - have laboured to turn interesting ideas into viable working prototypes. As a result, Pelamis and MCT have built what could be considered the carracks of wave and tidal technologies - allowing other firms to follow in their wake.

However, research and development is a costly venture. If capital dries up, there could be a mass exodus of talent. This fear is not without warrant. SgurrEnergy senior renewable energy consultant Gregory Dudziak noted that some renewable companies may have to lose people as a result of the weaker economy. In one recent example, he lamented the loss of potential recruits that were snapped up by EDF to work on nuclear development. Wherever there is investment, he says, the talent will migrate.

Pelamis and MCT say they are developing a British supply chain that could turn into a global industry akin to what Denmark has achieved in wind energy with companies

like Vestas. However, despite an attractive resource and the advancement of British technology, commercial projects have been slow to develop in the UK. MCT has its project in Northern Ireland, but Pelamis had to go to Portugal to sell its first commercial wave units.

The Aguçadoura project came to be because legislation passed in Lisbon was more attractive than the incentives set in London. In 2001, the Portuguese government outlined a permitting process, offered grants and set up a long-term index linked tariff of €0.23 per kWh. The legislation was amended in May 2007 and offers €0.26 per kWh for the next round of projects up to 20MW.

Meanwhile the UK government has just increased the ROC multiple for offshore wind from 1.5 to 2 - which is exactly the same as for wave and tidal.

"This is a no brainer for investors; conversations are very short," says Wright. "If government is serious about supporting green innovation, it should be a little more adept at recognising the consequences of policy changes. Offshore wind needs 2 ROCs - fine! It doesn't take Einstein to work out that wave and tidal must need at least twice that!"

## Costs

Marine energy currently remains an expensive venture. From concept to commercial operations, it has been a long journey just to get this far.

Pelamis chief executive Phil Metcalf said last fall that it has taken 10 years and £40 million to get his company where it's at. What that investment delivers, according to Pelamis, is technology that offers three times the power capture per unit weight or volume than other wave devices. The company suggests weight or volume is a good indicator of capital cost and hence its technology offers the potential for the lowest cost per kWh.

Still, when compared to other more mature generating technologies, marine energy lags behind. A report by PB Power released in March 2006 put the range of costs for marine technologies between about 10 pence per kWh going up to 34 p/kWh - far above offshore and onshore wind energy, which ranged 5 to about 10 p/kWh.

It should be noted that the PB Power figures are more than three years old and did not include solar technologies that have grown rapidly since 2006. SgurrEnergy says the cost of solar electricity appears to be about 0.225 €/kWh or around 20 p/kWh.

Independent information on the true costs of marine energy is difficult to find. Dudziak says although the PB Power figures are from 2006, he would be inclined to still use them. He says they are similar to those quoted in a comprehensive Carbon

Trust report from the same year; as there has not been any significant deployment of wave or tidal farms since, "scale production" effects would have not kicked in.

Generally, cost projections do nothing more than ruffle the feathers of those developing wave technologies.

Carcas defends the wave sector saying costs are considerably below where wind energy was at a similar stage of development, and even below the current costs of solar PV power - which he noted was a US\$9 billion market last year, growing at 20 per cent year-on-year.

One of the challenges for the marine energy sector is that with so many different technologies under development, it's difficult to measure a universal cost per kWh as it varies from company to company. Even between wave and tidal, there is potentially a gap. PB Power's central case cost for tidal was nearly half that of wave power. This is an advantage not lost on advisers in the sector - though no clear technology winners have yet emerged.

"I definitely see the development of commercially viable tidal projects happening before wave," says Simon Currie, head of renewable energy at law firm Norton Rose.

Dudziak concurs. He says though the interest in marine energy as a whole is still there, a shift has occurred from wave to tidal as investors foresee tidal coming forward quicker.

Carcas disagrees. He says there are currently two camps in marine energy sector, those developing technologies and those operating full scale devices.

"If you compare real projects - for example MCT's capital costs for Strangford with [Pelamis], I think you get a different picture," Carcas says. "Projections from people yet to build anything at scale in a real marine environment are two a penny and worth little compared to those with actual experience."

Debating which sector will evolve first is a moot point in the current climate. Listening to Martin Wright, one wonders if we'll see either technology widely deployed anytime soon. According to him, unless the market signals are sorted, it is only a matter of time before companies like MCT are running on vapour.

In these challenging times, marine energy firms like Pelamis and MCT, with advanced technologies and full-scale commercial devices, cannot simply appeal to customers for more money as a utility might do. They must approach nervous investors who themselves are concerned about their own corporate balance sheets.

"There needs to be a reality check about available capital," says Wright, echoing a similar statement made by Todd Woody in regards to investors in Silicon Valley. "The

VCs have been through the financial equivalent of the Battle of the Somme, and they are conducting triage on their portfolios."

MCT's investors include BancInvest, Fugro Seacore, Guernsey Electricity and Olympic Consultants.

## Marine Current Turbines - SeaGen

Marine Current Turbines had its Kitty Hawk moment six years ago when they installed "the world's first" offshore tidal turbine near Lynmouth off the coast of Devon. The company followed its initial success and launched [SeaGen](#), a £20 million commercial demonstration project, in Northern Ireland's Strangford Lough last year.

The 1.2MW SeaGen project has been running regularly at full power, though there have been a couple of incidents that resulted in broken blades - once due to human error and another due to an unforeseen technical error.

Wright says that problems like this are to be expected when working with a new technology. He says the fundamentals of design are "absolutely right", but the company is still discovering issues while test piloting its device.

"We've been extremely pleased, and had a good running with the new blades," Wright noted.

MCT said is expecting to get its first ROCs soon - at which point the company will make a public announcement as it expects SeaGen to be the first and probably the only marine renewable energy system "to earn significant numbers of ROCs for some time to come".

The company is selling electrical energy to Irish utility ESB International, though it hasn't notched up an enormous output yet. This is partly because MCT is currently restricted by the terms of its environmental monitoring programme to daylight operations only with Marine Mammal Observers onboard. Also, because of the need for manned operation, the company can only safely move staff on and off the turbine at slack tide. Wright hopes that these restrictions will be progressively relaxed by authorities later this year so the company can run the system unmanned automatically as is intended.

Wright says MCT is gaining confidence by the day. The main thing right now is that the system easily achieves rated power and runs consistently so long as the tide runs. In short, they want it to do exactly what it was designed to do - run smoothly and seemingly effortlessly.

"The only thing I can guarantee is that we will break it again," Wright cautions. "It's all part of the development process."

Apart from SeaGen, MCT is also working with Npower Renewables on the planned [Anglesey Skerries](#) project. The companies have formed a joint venture company, SeaGen Wales, to carry out the first demonstration project which is expected to have 10.5MW capacity and cost circa £50 to 60 million, which Wright says is about twice the cost of offshore wind (£3.2 million per MW installed) according to the recent Ernst & Young report.

MCT said it is continuing to explore further possibilities for future projects and it is doing some preliminary work on "Second Generation Technology". In January, the company announced a new partnership with Canada's Minas Basin Pulp and Power to demonstrate and develop tidal power technology in the [Bay of Fundy](#), Nova Scotia.

## Wave Hub

The difficulties of new technologies in the economic downturn are not limited to private ventures. Wave Hub, which is being developed by the South West Regional Development Agency, has also had its share of woes in the UK.

The project involves building a £28 million government-funded subsea "socket" to connect wave power projects to the National Grid via a 25km cable linked to an onshore substation. Wave Hub was designed to attract to the private sector by de-risking grid connection - an electrical equivalent to the *Field of Dreams* "if you build it he will come" strategy.

However, the private sector's initial enthusiasm for the project has waned and plans to build a full 20MW array of commercial wave farms off the Cornwall coast have been cast into doubt.

Max Carcas suggests that assessment is a bit too strong. He says there are currently three parties wanting to connect whereas before there were four. The latest blow was dealt this spring when WestWave, a joint venture between Germany's E.ON and Bristol-based Ocean Prospect, announced it would [withdraw](#) from the project.

The venture was to trial up to seven Pelamis devices off the Cornish coast, but opted instead to go ahead with a single next generation device - what Carcas referred to as the company's new "work horse" - at Scotland's European Marine Energy Centre in Orkney. That [project](#) should go live in 2010, a year ahead of the company's previous Wave Hub plans.

Carcas says Pelamis is still open to partner with another company at Wave Hub, but until the tariff framework is normalised, he says Scotland offers more attractive project returns to owner/operators.

WestWave's exit from Wave Hub follows one by Oceanlinx, which pulled out after securing a grant from the Australian government. The three companies still associated with the Cornish project are Orecon, Ocean Power Technologies and Fred Olsen. The South West Regional Development Agency is currently seeking a fourth.

Wave Hub received government [planning permission](#) in September 2007. The first devices should be able to connect to the device in 2011.

## Trident Energy

Despite the current economic outlook, developing marine power technologies need to take the long view that these devices will be in demand and part of a more sustainable and cleaner global energy mix.

While Pelamis and MCT have moved beyond the demonstration stage, there is a new generation of wave and tidal firms - like UK-based Trident Energy - trying to close the gap.

Trident is currently in the final stages of gearing up for the deployment of a fully functional test rig in the North Sea. Based in Southend on Sea and Lowestoft, the company was founded in December 2003 working in collaboration with the University of Cambridge and staffed by engineers, scientists and technicians. Its "Direct Energy Conversion Method" involves only one moving part and utilises floats placed in the sea to drive linear generators.

The company's [test rig](#) will be deployed near Southwold off England's east coast. The device does not require the use jack-up barges and will simply be floated out to the project site. Once installed, it will have the capacity to produce about 20-30kW in favourable wave conditions from eight full-scale linear generators. All operational data collected over the course of 12 months will be validated by NaREC.

Chief executive Steve Packard says "modestly" funded Trident is not yet burning cash and its investors remain supportive. With £2 million from two business angels and two funds, the company has enough capital to see it through its initial test phase of development.

Following three-months of its year-long offshore trial period, Trident will focus its attention next year on raising up to £25 million in finance to fund the scaling up of its device to 1MW followed by a second increase to a 5MW array. Trident is also keen to attract an equity partner - either a company with experience in production or a utility looking to expand its presence in marine energy.

However, given the constraints currently holding back the market, Packard admits Trident has had to adopt a more conservative approach going forward. He said the

company has been selective in procurement, where as if the market had been better over the past year, it may have accelerated the demonstration project.

Once data has been collected from the test facility, Trident intends to submit an application to the UK government for funding via the Marine Renewables Deployment Fund.

## Conclusion

The latest wave of progress for marine energy may have broken and quietly rolled back.

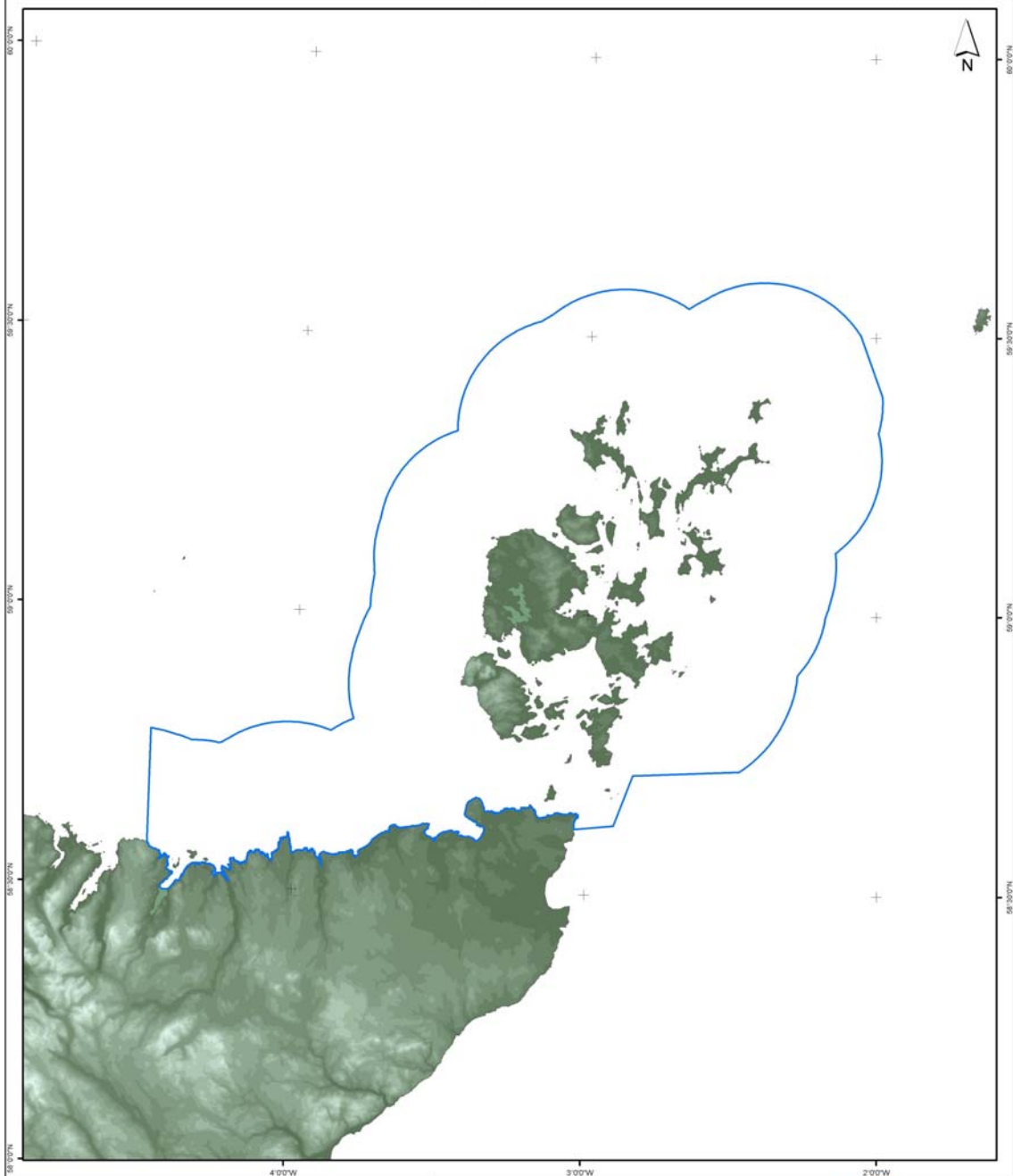
Though innovation will likely continue in the near-term, a lasting calm without investment threatens activity in the sector at this critical stage of development. Governments need to look at the following to boost confidence and private funding in the sector:

- update legislation and clearly outline the permitting process
- fast-track planning applications
- facilitate grid connections
- increase tariffs, ROCs or other incentive structures
- offer direct grants

Simon Currie says technologies that will survive the downturn will be those backed by government and supported by the large utilities. In the UK, nearly every major utility - including Scottish Power (using the [Lånstrøm](#) tidal device), Scottish and Southern Energy (with [Aquamarine Power](#)) and E.ON (with [Pelamis](#)) - have announced some kind of wave or tidal energy joint venture or development project. Meanwhile, the Scottish government has taken matters into its own hands and begun drafting its own [marine legislation](#). A bill that promises a simpler licensing system to cut bureaucracy was introduced to the Scottish Parliament in May.

Earlier this year, the government also announced that it is planning to map out marine energy [opportunities](#) within its jurisdiction. The [Crown Estate](#) began considering lease applications for renewable energy developments in the Pentland Firth and sea around Orkney (see image on next page). Following the closure in May of the deadline for pre-qualified companies seeking leases, the estate said it had received 42 applications from 20 bidders for each of the lease types and all capacities made available "for the world's first large scale commercial wave and tidal energy leasing round".

# Pentland Firth Strategic Area of Interest (AOI)



 Pentland Firth Area of Interest  
 United Kingdom



**Pentland Firth Strategic AOI**  
 June 2009  
 **1:700,000**  
Positions shown relative to WGS 84  
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 Elevation data supplied by STRM.

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**MaRS**  
 Marine Resource System

The Crown Estate, which owns virtually the entire seabed surrounding the UK out to the 12 nautical mile territorial limit, also said it would [match](#) fund option fees paid by developers in order to de-risk and accelerate the development of tidal and wave energy projects in the Pentland Firth.

In other sector developments, US-firm Ocean Power Technologies announced earlier this month that its flagship PB150 PowerBuoy is nearly ready for deployment at the European Marine Energy Centre in Scotland. The company has completed construction of the mechanical elements of the power take-off system and awarded the steel fabrication contract. Once complete, the 150kW device will be fully assembled and ready for deployment by the end of the year.

In April, Yorkshire-based Pulse Tidal launched the Pulse Stream 100 in the Humber Estuary near Immingham. The shallow water tidal device operates in a mean water level of only nine metres with four metres of tidal range on either side of that.

Finally, the Danish firm Wave Dragon continues to [weather](#) the rough seas of finance two years after KP Renewables suspended its initial investment in the company.

Wave Dragon's UK manager Iain Russell says the financial crisis hasn't made things easier for the company which added chief executive David Kaner in December 2007.

Like MCT and Pelamis, Wave Dragon engineers already have their feet wet through testing a steel-built scaled down pilot unit at Nissum Bredning in Denmark. That project - which uses "a novel combination of existing technologies" - was deployed in 2003. All future commercial Wave Dragons will be built with reinforced concrete structural engineering not dissimilar to that used for Mulberry Harbours in the Second World War.

With Kaner now onboard, the company is trying to round out a consortium of investors. Russell says Wave Dragon is keen to proceed with a scaled up 7MW unit near Milford Haven off the south west coast of Wales, or any other projects that potential investors may view as a priority. Eventually, the company is eager to prove that its economics can compete with offshore wind power, and it aims to scale up as large as 12MW for a single unit.

"A full-scale Wave Dragon is expected to offer economics of installation and generation competitive with current generation large-scale offshore wind installations," says Kaner. "As ever, the cost of capital dominates the electricity cost for large capital-intensive schemes."

Wave Dragon plans to re-deploy its pilot with grant funding soon for final tests on critical elements of the design. This is prior commencing the detailed design of the first full-scale unit expected to be 7MW.

The company is also quick to point out that it was cited as the reference wave energy technology by the Irish Government in the recent *All Island Grid Study*, because of its "potential economy of scale from a utility perspective". Still, funding remains its greatest challenge.

"Many mainstream funders are rejecting investments with any significant technology risk," says Kaner. "My role has been to prepare Wave Dragon for bulk funding, despite the tough background. We are seeking £35 million to take us through to cash-positive trading - including overheads, professional fees, pre-breakeven trading and technical development as well as the capital cost of the demonstrator."

For marine energy as a whole, the struggle for finance is likely to continue. Russell says one of the difficulties for wave power is that people have a hard time getting their head around the idea - whereas he says it's easier for investors to understand tidal power.

Trying to communicate a new technology to the market will always be a challenge. The Wright brothers, for example, never quite built an empire out of their aviation success. Though they turned a profit on their venture, it was the generation that followed that revolutionised air travel.

In 1944, near the end of the Second World War, Orville Wright flew for the last time as a passenger onboard the second production Lockheed Constellation. Then in his 70s, the elder statesman noted, more than 40-years later, that the plane's wingspan was longer than the distance of his first flight.

Perhaps in the not to distant future, one of the pioneers of marine energy will look out to sea and gauge wave and tidal development with a similar amazement.