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Power on the board: Eon's Pelamis P2 during sea trials last month

Photo: Pelamis

Industrial giants including Siemens have taken stakes in the wave and tidal sector, opening the door for an elite group of early array projects due mid-decade in the UK to secure funding against future power revenues.



Living up to promise: Andritz Hydro Hammerfest's 1MW HS-1000 turbine has hit rated capacity during Orkney sea trials

Photo: Hammerfest

Debt financing is tallest step on path to maturity

Arrival of industrial heavyweights brings sharper focus on bottom line at coming early-stage arrays, writes Seb Kennedy

The marine renewables sector is headed for a profound restructuring prompted by a step-change in the capital requirements of the first array projects.

Industrial heavyweights have taken equity positions at leading device developers ahead of what promises to be a thorough shake-out of competing technologies.

The hitherto atomised wave and tidal market looks set to coagulate around an elite nucleus of devices proven at sea to stand the best chance of providing bankable returns by mid-decade.

Much-needed consolidation has been a long time coming as major investors waited patiently in the wings for endlessly delayed pilot projects to deliver positive signs.

That time is seen by many to be closer but the shape and vigour of the sector will be determined by how much

private capital it manages to leverage over the next couple of years.

While grant funding is available through various government channels, an impending equity crunch will place ever greater emphasis on early array projects to secure debt against future power revenues.

Industry leaders said the entrance of large OEMs will go a long way to drawing debt into



the ocean energy space by underwriting arrays with performance guarantees.

Ted Scheidegger (pictured), chief executive of Siemens' solar and hydro division, said governments must recognise that OEMs will expect proportionate reward for shouldering the bulk of the risk implicit in

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Jobs on the way: French metal-bashers may be in line for an employment boost under plans to fabricate OpenHydro tidal turbine support structures in Cherbourg

Photo: OpenHydro

2 backing pre-commercial schemes.

The ongoing availability of a generous revenue subsidy will be critical if arrays are to attract OEM equity and the “more venture orientated” investors and lenders suited to such projects, he said.

“We at Siemens are expecting to see a very similar development to other renewable technologies that have come to maturity over time, such as onshore and offshore wind. Initially more venture-orientated, there would be the requirement to balance this initial higher risk with higher returns.”

He added: “We are dealing with an emerging technology that is on the cusp of being commercial (and) government jurisdictions will have a keen interest in bringing this technology to maturity.”

“When a company like Siemens undertakes this type of investment (it bought developer Marine Current Turbines), which incorporates certain risks, it is very important for us to operate in a stable regulatory environment in terms of subsidy for power generation and potential grants,” he said.

The Siemens boss said the UK and other key markets have put in place the ingredients to enable the first arrays to get off the drawing board.

“We are expecting that with a favourable regulatory environment we will be able to bring investors and possibly even lenders on board willing to participate in these projects.

“We see that framework available in the UK where we can access five Renewables Obligation certificates per MWh and we are also hopeful and expecting to access grants, which will allow us to present these initial sites as attractive projects for investors.”

Tidal will “follow the pattern of solar PV and concentrated solar power”, where an initial phase of government programmes to support the first roll-out quickly dropped away.

“We expect the costs to come down rapidly. As the volume develops and we move onto future generations it becomes more viable on a stand-alone basis,” he said.

GLOBAL PROJECT RUNDOWN

Developer	Location, country	MW	Technology	Type
INSTALLED 2011				TOTAL 4.361 MW*
Aquamarine Power	EMEC, Scotland	0.8	Oyster800	Wave
Atlantis Resources	EMEC, Scotland	1.0	AR-1000	Tidal
Carnegie Corp.	Garden Island, Australia	0.2	Ceto 3	Wave
Columbia Power Technologies	Puget Sound, US	n/a	SeaRay	Wave
CORES (Pan-European FP7 collaboration)	Galway Bay test site, Ireland	n/a	Ocean Energy	Wave
CrestWing	Frederikshavn, Denmark	n/a	1:5 scale CrestWing	Wave
DexaWave	Hanstholm, DanWEC, Denmark	0.02	1:4 prototype	Wave
Ente Vasco de la Energia	Mutriku, Spain	0.296	Voith Wavegen	Wave
Free Flow Power	Baton Rouge, Los Angeles, US	0.04	3m diameter turbine	In-river
Gyrodynamics Corporation	Wakayama Prefecture, Japan	0.045	Gyroscopic wave power generation system	Wave
Harbin Engineering University	Zhejiang Province, China	0.01	Horizontal-axis Tidal prototype	Tidal
Korea Water Resources Corp., Daewoo	Sihwa Lake tidal barrage, South Korea	254	Andritz VA Tech Hydro	Tidal range
National Ocean Technology Centre	Daguan Island, Jimo City, Shandong Province, China	0.13	Isolated hybrid power system	Wave
OpenHydro, EDF	Paimpol, France	0.5	Open Centre Turbine 16m	Tidal
OPT	Moray Firth, Scotland	0.15	PB150	Wave
ORPC	Maine, Cobscook Bay, US	0.15	TidGen	Tidal
Pelamis, ScottishPower Renewables	EMEC, Scotland	0.75	Pelamis P2	Wave
Scotrenewables	EMEC, Scotland	0.25	SR250	Tidal
WET-NZ	Christchurch, New Zealand	0.02	WET-NZ half-scale	Wave

* Excluding Sihwa

ON THE BOOKS FOR 2012				TOTAL 16.505 MW
40South Energy	Seychelles, Indian Ocean	0.10	R38/50kW	Wave
40South Energy, Aqua Srl	North Tyrrhenian 3, Italy	0.15	R115/150kW	Wave
40South Energy, Korallion Lab	Vavvaru Island, Maldives	0.05	40South Energy	Wave
40South Energy, Prenerca Srl	North Tyrrhenian 1, Italy	0.2	R115/150kW & R38/50kW	Wave
Aquamarine Power	EMEC, Scotland	0.8	Oyster800	Wave
AW Energy, Bosch Rexroth, Eneolica	Peniche, Portugal	0.3	Waveroller	Wave
AWS Ocean Energy/Alstom	Moray Firth, Scotland	n/a	AWS-III single cell	Wave
Bluewater	EMEC, Scotland	1.0	BlueTEC, Ponte di Archimede	Tidal
Carnegie Corp.	Saint-Pierre, Reunion Island	0.18	Ceto 4	Wave
Chinese Academy of Sciences	Dawanshan Island, Guangdong Province, China	0.3	Isolated wave power system	Wave
Fred Olsen	Falmouth Bay, FabTest, England	0.1	Bolt 2	Wave
Hammerfest Strom, SPR	EMEC, Scotland	1.0	HS-1000	Tidal
Maritime and Ocean Engineering Research Institute	Yongsoo, South Korea	0.5	OWC	Wave
Nautricity	EMEC, Sound of Shapinsay, Scotland	0.3	Cormat	Tidal
Neptune Renewable Energy	Humber Estuary, England	0.5	Neptune Proteus	Tidal
New Energy Corp., Canoe Pass Tidal Energy Consortium	British Columbia, Canoe Pass, Canada	0.5	EnCurrent 250kW	Tidal
Nova Innovation	Shetland, Bluemull Sound, Scotland	0.03	Nova-30	Tidal
Ocean Energy	Wave Hub, England	1.5	OE Buoy	Wave
Oceanflow Energy	South Kintyre, Sanda Sound, Scotland	0.035	Evopod	Tidal
Oceanlinx	Pilot Zone, Portugal	2.5	blueWAVE	Wave
OpenHydro, EDF	Paimpol, France	1.5	3 x Open Centre Turbine (16m)	Tidal
ORPC	Maine, Cobscook Bay, US	0.18	TidGen	Tidal
Ponte di Archimede, Walinusa Energy	Lomboc Island, Indonesia	0.15	Kobold Turbine	Tidal
Rolls-Royce TGL	EMEC, Scotland	1.0	TGL (ReDAPT)	Tidal
Sabella Energy Inc	Montreal, Canada	TBC	SR-01 pilot river turbine	In-river
Seabased, Fortum	Sotenäs phase 1, Sweden	1.0	Seabased	Wave
Seatricity	EMEC, Scotland	1.0	Seatricity buoy array	Wave
Verdant Power	New York East River, US	0.11	Verdant Gen5 Free Flow	Tidal
Voith Hydro	EMEC, Scotland	1.0	Voith Siemens Hydro Tidal	Tidal
Wello Oy	EMEC, Scotland	0.5	The Penguin	Wave
WET-NZ	Wellington, New Zealand	0.02	WET-NZ 1:2 scale redeployment	Wave

Wave and tidal installations could reach double-digit megawatts for the first time this year, according to figures compiled exclusively by reNews.

As such as 16MW is scheduled for deployment in 2012, representing a four-fold increase on last year's tally of 4.3MW. The sector's stubbornly high project attrition rate of

Bridging the expectation gap

around 40% could cut the 2012 total below the 10MW mark, however, and many of these “deployments” are expected to complete only short spells in the water.

The flood of single device demonstrators will give way to larger projects resembling

commercial arrays in 2014 when 90MW is scheduled to come online. These projects will provide more meaningful insights into device capabilities.

Developer appetite exceeds 150MW in 2016 but much of this can be expected to fall by the wayside.

Tried and trusted turbines pull ahead in the tidal race

Leading tidal developers have been demonstrating the benefits of utilising proven turbine technologies over experimental power systems. Nacelles featuring the traditional set-up of pitchable blades, induction generator and gearbox have stolen a clear march on less conventional rivals.

Andritz Hydro Hammerfest is the latest company to report positive at-sea results from a tidal turbine with such a configuration. The HS1000 has "proved its technical capabilities" by hitting its rated capacity of 1MW for "short periods" during ongoing grid-connected trials in Orkney.

Further progress could see Hammerfest join the elite club of tidal players to generate significant quantities of power onto the grid. Marine Current Turbines and Tidal Generation Ltd are the only companies to achieve this milestone, with more than 3GWh and 250MWh produced by respective machines in Northern Ireland and Scotland.

MCT's 1.2MW SeaGen recently set an all-time record of 22.4MWh generated in a single 24-hour period.

These early success stories all feature conventional power trains proven in the wind sector and adapted for the tidal resource and environment. Experimental alternatives featuring seawater lubrication, direct drive, permanent magnet

Familiar technology seen as safer bet than experimental rivals, writes Seb Kennedy

generators or fixed blades are taking longer to reach the market.

One analyst in Scotland said the progress of "traditional" tidal systems could propel them towards a significant market share beyond mid-decade. "This dynamic could develop into a technology race akin to what happened with Betamax and VHS in home video.

"The experimental systems may over the longer-term prove to offer lower maintenance costs and other benefits, but the question is whether there will be enough capital available to sustain their development until they become commercial.

"It is hard to see technologies other than MCT, TGL or maybe Hammerfest offering bankable performance

guarantees in time for financial close on the first arrays in 2014 or 2015," he said.

The view held by some is that independent developers of complete tidal turbine offerings will find it increasingly difficult to mount a challenge as the sector battles to raise the funding for array projects.

A spate of high-profile bankruptcies could lead to a wave of consolidation and acquisitions in the tidal space, analysts predicted.

Those large manufacturers with a foothold in the market stand to benefit by picking up useful packages of intellectual property for less than the cost of development, and incorporating these into their own products.

MCT chief executive Andrew

Tyler said he expects the evolution of tidal to follow a pattern set in other technology sectors. "Look at companies like Microsoft or Hewlett Packard. Yes, they have their own R&D going on but they have acquired highly innovative niches of technology which then complement their core business.

"I don't think we will be any different in this market." Tyler said consolidation will foster ongoing innovation in tidal technologies by creating demand from OEMs for outsourced technological solutions.

"One would expect to see a hotbed of innovation in R&D companies. If this market takes off there will be plenty of room for lots of small and mid-size players innovating in different areas and creating value that they can either exploit in the supply chain or sell onto the major OEMs," he said.

Pelamis breaks out from the wave pack

Early wave energy demonstrators are beginning to offer a glimpse into the sector's potential but delivery of commercial quantities of power remains beyond their reach.

Even the leading technologies face years of loss-making prototype testing, and a lack of compelling performance figures continues to temper the enthusiasm of all but the bravest investors. The paucity

of publicly available data from real deployments is symptomatic of the sector's slow pace of development and, in some cases, aversion to scrutiny.

No wave technology has yet been able to prove irrefutably its long-term bankability but early signs from one or two pilot schemes suggest some concepts may eventually deliver on their promises.

Pelamis Wave Power's P2 converter, demonstrably the

world's most advanced wave system, has generated 270kW sustained over 30-minute periods and peaks of more than 400kW. These outputs, registered during "moderate" sea conditions in April, are a step forward from the 170kW average and 300kW peak reported in February.

They prove the P2's yield is increasing as it is exposed to more aggressive wave states. While a cumulative

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4 output figure has not been forthcoming, Pelamis said indicators suggest the P2 will deliver its estimated annual output of 1.8GWh.

The P2 test programme benefits from substantial advancement in deployment and retrieval methodologies, which allow the unit to be thoroughly assessed after each period at sea.

The device is believed to have made at least nine separate outings since October 2010 and the learning from each is fed back into the design for subsequent iterations.

The machine continues to evolve and Pelamis is hopeful it can take advantage of “significant commercial advantages” inherent in the line absorber principle to further scale up and drive down costs.

A recent paper published by the company suggests heaving point absorbers – such as those being developed by Fred Olsen, Ocean Power Technologies and many others – have a theoretical maximum power capture. Beyond a certain limit any increase in volume gives no additional benefit.

Line absorbers, by contrast, “have no limit on their power capture and therefore can be scaled up indefinitely”, the paper claimed. Pelamis’ slow but steady progress is in stark contrast to most of its wave competitors, and clear blue water is beginning to emerge between the Leith developer and its closest rivals.

The P2 has been developed under challenging financial circumstances, typified by what one source described as a “lurch from one crisis to the next”. Pelamis’ future remains uncertain but serious interest from Spanish heavyweights such as Abengoa and Repsol could lead to a decisive investment or acquisition. The wider sector is paying close attention as future investment in wave energy may well hinge on the fate of the industry flag-bearer.

Elsewhere, Wave Star Energy of Denmark reported modest but improving power outputs from its 50kW modular wave float system in Hanstholm last month. The two floats hit a record output of 35.7kW over 10 minutes and generated

FUTURE PROJECT PIPELINE				
Developer	Location, country	MW	Technology	Type
DUE IN 2013				TOTAL 13.720MW
40South Energy	North Tyrrhenian 2, Italy	0.45	3 x R115/150kW	Wave
40South Energy	Peloponnese, Greece	0.9	6 x R115/150kW	Wave
Alderney Renewable Energy	Channel Islands, Alderney	3.0	OpenHydro	Tidal
Alstom Power, Clean Current	Bay of Fundy, FORCE, Canada	1.0	Beluga9	Tidal
Aquamarine Power	EMEC, Scotland	0.8	Oyster801	Wave
Atlantis Resources	Gujarat, Gulf of Kutch, India	1.0	AR1000 Mk II	Tidal
Carnegie Corp.	Garden Island, Australia	2.0	Ceto array	Wave
DexaWave	Hanstholm, DanWEC, Denmark	0.25	Full scale prototype	Wave
Fri-EI	Strait of Messina, Italy	0.5	Fri-EI	Tidal
Kawasaki Heavy Industries	EMEC, Scotland	1.0	Kawasaki	Tidal
Mitsubishi Heavy Industries	TBC, Japan	TBC	Mitsubishi OWC	Wave
Nova Innovation	Shetland, Bluemull Sound, Scotland	0.5	5 x Nova-100	Tidal
OPT	Oregon, Reedsport, US	0.15	PB150	Wave
ORPC	Maine, Cobscook Bay, US	0.72	4 x TidGen 180kW	Tidal
Standpoint consortium (Wavebob, Vattenfall)	Pilot Zone, Portugal/EMEC, Scotland (TBC)	0.25	Wavebob	Wave
Tidal Energy Ltd, Eco2	Pembrokeshire, Ramsey Sound, Wales	1.2	DeltaStream	Tidal

COMING IN 2014				TOTAL 90MW
Aegir Wave Power (Vattenfall, Pelamis)	EMEC, Scotland	0.75	Pelamis P2	Wave
Atlantis Resources	Bay of Fundy, FORCE, Canada	1.0	AK-1000 Mk II	Tidal
AWS Ocean Energy/Alstom	EMEC, Scotland	2.5	AWS-III full scale prototype	Wave
Columbia Power Tech	TBC, US	TBC	Manta	Wave
DexaWave	TBC, Malta	0.25	3 x full-scale converters	Wave
Hammerfest Strom, SPR	Islay, Scotland	10	HS-1000	Tidal
Hyundai Heavy Industries	TBC, South Korea	1.0	MW Class Tidal Device	Tidal
MCT, Minas Basin Pulp & Power	Bay of Fundy, FORCE, Canada	1.5	MCT SeaGen U	Tidal
Marine Energy Ltd	Pembrokeshire, Wales	10	Seabased	Wave
MeyGen	Inner Sound phase 1, Scotland	20	Atlantis + Rolls-Royce TGL	Tidal
Nautricity, Argyll Tidal Ltd	Mull of Kintyre, Scotland	0.5	Cormat	Tidal
ORPC	Alaska, US	1.0	OCGen	Tidal
Pulse Tidal	Lynmouth, England	1.2	Pulse-Stream	Tidal
Rockhouse Mountain Energy, OPT	County Clare, Ireland	5.0	OPT PB500	Wave
Scotrenewables	EMEC, Scotland	2.0	SR2000	Tidal
SEAWATT	Saint-Pierre, Reunion Island	3.0	Pelamis P2	Wave
Snohomish County PUD	Puget Sound, Admiralty Inlet, US	0.3	2 x OpenHydro 6m Open Centre turbine	Tidal
Voith Wavegen	Siadar, Scotland	30	Voith Wavegen OWC	Wave
Voith Wavegen, SEDEP, Doris Engineering	Tahiti, French Polynesia	TBC	Voith Wavegen OWC	Wave

ON THE BOOKS FOR 2015				TOTAL 75.5MW
Aegir Wave Power (Vattenfall, Pelamis)	Shetland, Scotland	10	Pelamis P2	Wave
Aquamarine Power	Western Isles phase 1, Scotland	3.0	Oyster	Wave
Aquamarine Power, SSE Renewables	Brough Head phase 1a, Scotland	10	Oyster	Wave
DP Energy	Islay Energy Park, Scotland	5.0	Rolls-Royce TGL	Tidal
MCT	Anglesey, Skerries, Wales	10	MCT SeaGen S	Tidal
MCT	Kyle Rhea, Scotland	8.0	MCT SeaGen S	Tidal
Pelamis Wave Power	Bernera, Scotland	10	Pelamis P2	Wave
Seabased, Fortum	Sotenäs final phase, Sweden	9.0	Seabased	Wave
Wavebob	TBC, US	0.5	Wavebob commercial demo	Wave
WestWave (ESBI)	County Mayo, Ireland	10	Pelamis, Wavebob, Ocean Energy, Aquamarine	Wave

ON THE HORIZON IN 2016				TOTAL 159MW
Aquamarine Power, SSE Renewables	Brough Head phase 1b, Scotland	40	Oyster	Wave
Emera, Nova Scotia Power	Nova Scotia, Canada	40	TBC	Tidal
OpenHydro, SSE Renewables	Cantick Head phase 1, Scotland	30	Open Centre Turbine	Tidal
ScottishPower Renewables	Marwick Head phase 1, Scotland	9.0	Pelamis P2	Wave
ScottishPower Renewables	Ness of Duncansby phase 1, Scotland	30	Hammerfest Strom	Tidal
SSE Renewables	Costa Head phase 1, Scotland	10	Alstom/AWS	Wave

almost 5MWh in the month of March, bringing total cumulative power to 13MWh since September 2010.

Power production has been limited during the initial test phase but recent changes to the regulation strategy and control parameters for the machine

should see outputs continue to climb steadily. The mean power take-off efficiency was 58.1% and this should also grow as modifications are implemented.

Voith Hydro Wavegen is believed to hold the record for the largest amount of power delivered onto the grid by a

wave converter. The company’s Limpet plant on Islay has generated more than 213MWh since 2007.

This should soon be surpassed by Voith’s Mutriku plant in Spain, which stood at 160MWh as of December 2011 (see page 15).



Weather proof: Narec is putting the finishing touches to Nautilus ahead of Atlantis' arrival later this month

Photo: Narec.

Narec offers ultimate dry run for device developers

Narec is commissioning a 3MW drive train test facility that it hopes will boost the pace and reduce the cost of developing tidal technologies.

The Nautilus facility at the research centre's base in Northumberland offers device developers the chance to put full-size prototypes through their paces without the need for expensive offshore operations.

Director of major projects and assets Tony Quinn said Nautilus will fill a gap in the testing market.

"The traditional route is to test at component or subsystem level but not as a complete system, because the facility did not exist until now. You had to go through the validation

process and then you are pushed into deploying."

Nautilus could help identify and iron out any minor technical problems or bugs that tend to crop up during sea trials before the device goes into the water.

"If you deploy too early then the cost of retrieving and redeploying can be very expensive and damaging to investor confidence in the technology," Quinn said.

The team at Narec is drawing up the parameters for emulating loads created by both repetitive fatigue and extreme weather events.

The hope is to offer a system capable of revealing in a matter of weeks whether a turbine will withstand the forces of nature

over the course of five, 10 or 15 years.

"We can replicate extreme events and low level continuous fatigue events. The real challenge we have is accurately combining the two together," said Quinn.

The key ingredient is inputting real data gathered from tidal sites to reproduce accurately the typical forces experienced at sea.

Quinn conceded that the success of Nautilus hinges to an extent on the willingness of the leading tidal players to collaborate by offering proprietary site data.

"The test rig capability is so sophisticated it is almost in advance of where the market understands testing to be. To

understand its full capability we need to gather field data from machines that have been deployed.

"Data from the field is really important, not just the flows and forces that the tides exert but how those manifest themselves in the equipment (being tested)."

He added: "If we can maximise the capabilities of this test rig that would be of benefit to the whole industry."

Quinn said industry's response to Nautilus has been "very encouraging" and a number of companies are queuing up to book a slot.

The first occupant, Atlantis Resources, hopes to begin trials this month on its AR-1000 once Nautilus is fully commissioned.

UK challenge to go for gold

Serious support and tough qualification criteria for world's first array projects

The UK has cemented its position as the undisputed global leader in wave and tidal development over the past 12 months.

Technologies from around the world are queuing up to use unrivalled test facilities, tap into sources of R&D grant funding and make contact with a sympathetic utility customer base.

Project developers are attracted by a sophisticated seabed leasing programme and improving consenting regime, and the prospect of appropriate reward through the Renewables Obligation.

The proposed standardisation of RO support levels across the UK is beginning to influence development decisions.

Pulse Tidal has uprooted its

planned 1.2MW Pulse-Stream demonstrator from Scotland to England to take advantage of more rigorous meteorological conditions off Lynmouth compared to a site in Kyle Rhea.

Pulse said expertise offered through the newly established South West marine energy park (MEP) is another reason for relocating the EU-backed project.

The RO review, and to a lesser degree the establishment of the first MEP, revealed an apparently strong political will in Westminster to nurture the sector over the long term.

While some warn of a potential "cliff-edge" following withdrawal of RO certificates in 2017, others believe recent positive acts warrant faith in

Matching funds 'cast-iron grant funding guarantee'

Marine Current Turbines has set its sights on securing grant funding for its first array projects in Scotland and Wales and is so confident of success it has "no Plan B".

Chief executive Andrew Tyler said an allocation from MEAD or another pot is a near-certainty as few contenders will be able to secure the substantial matching funds required from the private sector.

"We feel we are in an extremely strong position to take advantage of the government money that is available," Tyler told *reNews*.

"Probably all of the companies that manage to get the private equity together will be able to get the necessary government support because there's not going to be that many.

"There is a limit to private equity available from utility

companies, specialist funds and so on, so in my view everybody who is viable will get funded."

The MCT boss said many will be tripped up by time constraints and state aid rules capping the government's capital contribution at 25%.

"There is a significant amount of it to be spent in a relatively short space of time, which significantly closes the opportunity for developers who would be (ready) in a few years' time but not right now.

"The biggest challenge for all of us beyond making the technology work is getting the private sector investment.

"Anybody who can convince the private market to put up 75% of the equity, essentially you need say no more about the viability of their project and therefore they will be the ones who attract the government funding," he said.



Ring of confidence: Fred Olsen became one of the few to install a wave energy converter in English waters earlier this year with the deployment of its Bolt Lifesaver

Photo: Fred Olsen

continued support in the electricity market reform era.

One device developer said: "It would not make sense for government to pull the rug out from under our feet. It does not seem imprudent to expect five ROCs to be replaced with

suitable support through feed-in tariffs with contracts for difference."

Another developer said the main risk with EMR is a collective failure of industry to deliver material progress before the boosted ROC

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TEL aims for quality not speed off Wales

Wales will have to wait until next year for its maiden marine energy demonstrator.

Tidal Energy Ltd is preparing to install a 1.2MW DeltaStream prototype in Pembrokeshire.

Project sources claimed TEL is taking extra time to ensure the supply chain can deliver without putting at risk its exacting standards on quality and health and safety.

All but three contracts for the fabrication and installation of the DeltaStream and subsea cables have been awarded. Initial onshore works at St David's Head were completed over the winter.

TEL said results from the monitoring programme, including some operational information from device trials, will be made available to the wider marine energy industry.

The site will be expanded to a 10MW pre-commercial array in 2016 or 2017. TEL secured a Crown Estate lease for the expansion last month.

Elsewhere in Pembrokeshire, wave developer Marine Energy

Ltd has postponed until late-2013 installation of an up to 10MW pre-commercial array at a separate site. The scheme will feature an array of Swedish-made Seabased point absorbers generating up to

50,000MWh per year from 2014, the company said.

Marine Current Turbines, meanwhile, has confirmed its Skerries tidal array will go ahead as planned despite the uncertainty surrounding the

Wylfa B nuclear reactor on Anglesey.

MCT said alternative options for future transmission capacity in the north Wales area will enable the scheme to be scaled up beyond the 10MW first phase.

UK challenges ocean energy industry to go for gold

7 period expires. "There's a lot of political goodwill in our field and we have to prove it was not misplaced," he said.

Analysts agree such goodwill will become more vital than ever as the world's first array projects edge towards installation in UK waters by mid-decade.

Two deployments will be supported by DECC through the £20m marine energy array demonstration (MEAD) fund. Stringent qualification criteria will rule out all but the most advanced technologies.

The projects will feature, as a bare minimum, at least three megawatt-scale devices generating more than 7GWh per year. Arrays of between 5MW and 10MW nameplate capacity

producing in excess of 10GWh annually "will be assessed more favourably".

Technologies must have been previously demonstrated at full scale in real sea conditions with comparable resource to the project site. Candidate machines must be "manifestly similar in scale and concept to devices that will be installed in future commercial arrays"

Applicants must hold an in-principle grid-connection, agreement for seabed lease, and consent applications in progress to enable energisation by the end of March 2016.

MEAD arrays are expected to operate for at least two years although DECC optimistically hopes for 20 years of operation and a "commercial return based

on sale of electricity and revenue support".

The debate around UK capital support has shifted since the launch of the fund from grumbles over the quantity of cash on the table to the tough qualification requirements.

Some have speculated whether the "manifestly similar in scale and concept" clause will have to be revisited as developers seek to make significant leaps forward in device capabilities ahead of array projects.

DECC officials will be hoping MEAD criteria are sufficiently challenging without setting up a repeat of the previous £42m marine fund, which expired just as the first technology qualified to apply.



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Turning up the volume: Scotrenewables' 250kW tidal prototype generated power onto the Orkney grid for the first last month

Photo: Scotrenewables

Sparks flying at EMEC

Prototype testing programmes at the European Marine Energy Centre in Orkney, the centrepiece of Scotland's ambitions to lead the world in wave and tidal energy, are starting to deliver.

EMEC commercial director Richard Morris said that while beset by early delays the centre is now building to a crescendo a decade after first opening its doors.

"We are now contractually full and will be physically full in 2013, which will be a fantastic achievement.

"We already have the largest number of megawatt-scale devices installed in one place anywhere in the world, and having all these churning away delivering power into the grid is phenomenal," he said.

EMEC is tying up a consultation on expansion plans and is expected to seek a new seabed lease after the Crown Estate confirmed a relaxation of restrictions in the Orkney waters strategic area, as first

Orkney test centre underpins Scotland's claim to the global ocean energy crown

reported by *reNews* in March. Extra tidal facilities are deemed necessary as the Fall of Warness test site reaches capacity.

Andritz Hydro Hammerfest and Scotrenewables are the latest developers to generate power onto the grid via the Eday substation.

Scotrenewables' floating SR250 system exported power for the duration of a single tidal phase, around six hours, before being retrieved for inspection last month.

The company aims to achieve sustained grid-connected generation periods of up to three days within the next month, building up to two weeks by the end of summer.

Output figures from the 250kW-rated machine may be disclosed once it racks up the megawatt-hours. A follow-up 2MW device is planned for construction next year, pending a crucial equity raising round.

The hope is to test the machine at EMEC.

Rolls-Royce subsidiary TGL is on track to ship its 1MW tidal turbine to Orkney at the end of the month, following final assembly and onshore nacelle tests. The company will transport the device on a standard "roll-on, roll-off ferry" as a means of exploring a less expensive shipping option.

TGL will trial installation procedures in benign Orkney waters before deploying onto an existing support tripod at the Fall of Warness over the summer.

The test site will also host Voith Hydro's megawatt-scale tidal nacelle this year if the German outfit can ready the device before the summer weather window passes.

EMEC's Billia Croo wave test site is seeing slightly less action. ScottishPower Renewables is hoping to

Lease in bag for bigger and better Siadar

Scottish project development continues apace at sites beyond EMEC. Voith Hydro Wavegen has secured a new Crown Estate lease for an enlarged 30MW version of its Siadar active breakwater.

Voith significantly increased the power generation capability and footprint of Siadar to achieve economies of scale and a commercially viable project design, it is understood. The company said the larger facility could be delivered in 2014.

Elsewhere, GlaxoSmithKline has partnered with SwanTurbinen for its mini tidal array in the Esk Estuary at Montrose. GSK plans to install 15 units totalling 700kW of Swan's Cygnus inshore tidal turbine in two phases, feeding power into a nearby pharmaceutical facility.

The project is believed to be contingent on successful trials of the turbine concept at EMEC.

More than 230MW of Scottish wave and tidal sites are planned to come online by 2016 but much of this depends on reform of the grid charging regime and new interconnectors.

Aquamarine Power said island charges are "nearly eight times the cost" of connecting projects on the mainland.

"Early stage marine technologies cannot bear such a disproportionate cost of transporting clean energy to the south. Transmission lines should be viewed as a national asset, to carry green energy from the periphery of the UK to our main centres of population," it said.

10

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Brussels swings towards collaborative R&D

Developers behind a new raft of demonstration projects are hoping for a slice of funding next month under the European Commission's latest round of Seventh Framework Programme (FP7) awards.

This year's call for proposals is expected to result in grants totalling between €7m and €10m, depending on the volume and quality of applications.

UK wave and tidal projects involving technologies developed by Aquamarine Power and TGL are understood to be in the mix for possible 2012 allocations.

While the programme has

injected much-needed public funds into a few demonstrators, the European Commission appears to be cooling over future support via this route.

Next year's FP7 call is likely to restrict ocean energy funding to pan-European collaborative R&D initiatives rather than targeting more capital-intensive array deployments.

A draft copy of the 2013 FP7 call obtained by *reNews* proposes funding R&D at "all levels" rather than providing a slug of cash towards specific projects. It will support research into array moorings and foundations, operation and

maintenance, power take-off and electrical systems development, control system modelling and environmental impacts.

The resulting solutions "should be applicable to as many devices as possible", the draft call states. An industry insider said: "This is clearly a disappointment. There are now a number of projects across Europe seeking funding for first arrays.

"Around five or six of these will achieve funding through NER300, FP7 2012 and the MRCF and MEAD provided by the Scottish and UK governments, but this will leave some without any clear route to grant support for the next few years.

"Array funding still remains the major non-technical challenge for this industry," the source added.

The silver lining is that FP7 2013 will support the ERA-NET scheme, seen by some as an important step towards a European industrial initiative for ocean energy. This could lead to the inclusion of wave

and tidal in the EU's Strategic Energy Technology (SET) plan for reducing CO₂ emissions, which would open up significant new funding streams.

Elsewhere, renewables including ocean energy could stand to benefit, perversely, from a drop in the overall budget available through the EU's NER300 competition.

A recent slump in the carbon price has more than halved the estimated value of the NER300 pot. The drop may render carbon capture and sequestration bids unfeasible as individual schemes are restricted to 15% of the total budget.

Failure of CCS could liberate a large chunk of cash to the nine wave and tidal schemes known to have submitted to NER300. A clearer picture should emerge in the autumn once EU carbon allowances have been monetised.

Applicants still in the running are thought to include WestWave, ScottishPower, MCT, MeyGen, AW Energy, OpenHydro and Scotland's POWER group.

Sparks starting to fly at EMEC

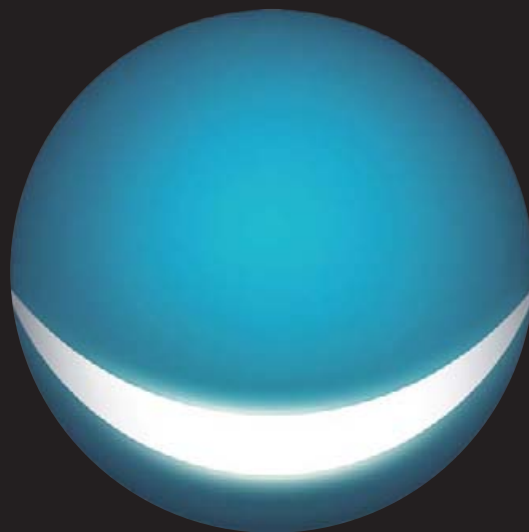
9 install its Pelamis P2 this month, more than half a year since the device was shipped to Orkney.

SPR declined to comment on the reasons for the protracted hold-up but confirmed the machine will be put through its paces in May.

Aquamarine Power has suffered an even longer setback

commissioning its Oyster 800 flap. The device was installed in August 2011 but poor weather prevented divers from commissioning the system.

The company said construction over-runs pushed commissioning into the winter. Future iterations of the technology will reduce reliance on diving operations.



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200MW lease round in the North open to all-comers

Tidal players are preparing bids for a limited seabed plot under the Crown Estate's Northern Ireland offshore leasing round.

The 200MW tender will divvy up the tidal race in the Rathlin Island and Torr Head strategic area among companies seeking leases for 10MW demonstration projects and up to 100MW commercial sites.

The area could accommodate various types of tidal technology despite its limited acreage, according to sources active in Northern Ireland. Shallow-water devices such as Marine Current Turbines' SeaGen-S, which has a notable track record in Strangford Lough, could win a role alongside deep-water alternatives.

MCT is expected to prepare a bid backed by parent company Siemens and, if successful, seek development partners at a later date. Greenore turbine company OpenHydro and utility partner Bord Gáis are expected to feature among those invited to tender for a commercial lease.

Rolls-Royce TGL may land a supply deal if either of its development partners, B9 Offshore subsidiary Thetis or DP Energy, comes up trumps in the competition. Invitations to tender are due as early as this month and lease awards are scheduled for September.

The 200MW competition will start Northern Ireland on its way towards a target of 300MW installed tidal capacity by 2020, as set out in Belfast's offshore renewable energy strategic action plan. The remainder may be provided by further opportunities through the Crown Estate's UK-wide 10MW demonstration project lease process, which operates outside identified strategic offshore areas.

Tidal resource zones identified in the Northern Ireland strategic environmental assessment "may be suitable for such developments", according to the ORESAP.

Austerity waiting game for Ireland's developers

The Republic of Ireland's wave and tidal sector is in hibernation while the wider renewables industry weathers the austerity storm.

Short-term cuts will postpone significant marine energy development until the second half of the decade. A grid-connected Atlantic test facility planned off Belmullet, for example, is now considered unlikely before 2015.

New money for front-end capital support and continued revenue subsidies has effectively been taken off the table. The Fine Gael-Labour coalition government's decision to pull the plug on the Refit feed-in tariff for offshore wind has sent a clear message to the marine sector that the only route to market will be via export to the UK and continental Europe.

Peter Coyle of Ireland's Marine Renewables Industry Association (MRIA) said the sector is biding its time until such opportunities become a reality.

"It is a game of two halves. The first is about the early support to companies, and Scotland is certainly ahead in that regard. But if you look beyond 2018 when technologies will begin to mature you will have a more even playing field.

"Our R&D facilities should be thriving by that stage and we will have much increased export opportunities into the UK and Europe on the horizon."

Coyle said the postponement of the Belmullet facility makes sense while there is "no wave device in the world" capable of withstanding the unbridled Atlantic climate. "Planning is being advanced and provided it isn't abandoned altogether we can cope with it being sidelined for a limited period," he said.

MRIA is lobbying Dublin to make available a limited pot for a marine energy Refit to enable the first 20MW of projects to get in the water. The group is calling for a boosted tariff with strict capacity limits, for which

Industry battens down hatches until power export opportunities become a reality

developers could compete in 5MW blocks. "It won't happen this year and doesn't have to, but we have suggested they have a competition next year.

"This should not be an open-ended commitment, it will just help the first arrays get off the ground. It has to be sustained by export (thereafter)."

Ministers in Dublin continue to drag their feet over the implementation of a new foreshore consenting framework, a key first step towards an Irish ocean energy leasing round.

Coyle said the long-awaited consultation documents are due out "within weeks".

A handful of foreshore licence applications are being processed before the new system gets up and running.

Carnegie Wave Energy is

seeking a permit to investigate a 5MW demonstration project between Freagh Point and Spanish Point off County Clare.

ESBI's multi-technology WestWave project holds exploratory licences off counties Claire and Mayo. The scheme has also passed the initial due diligence stage of assessment for the European Commission's NER300 funding programme.

Elsewhere, US developer Rockhouse Mountain Energy has set its sights on installing a 5MW pilot wave array off the west coast of Ireland in two years' time.

The project, a forerunner for a 500MW Irish farm in 2020, is contingent on Ocean Power Technologies' 500kW PowerBuoy entering commercial production in 2014.

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Eyes open for the financing tide

Scandinavian marine energy developers are chasing the project finance required to roll out full-scale devices.

Leading players are seeking equity agreements so they can take the next step with hardware proven in sheltered waters and expand into international markets.

Danish hybrid wind-wave company Floating Power Plant is refining its research and development platform Poseidon, which has been tested in calm conditions at Hanstholm.

The developer has completed the second of four test phases and is now revising the power take-off system on 37-metre-wide Poseidon in preparation for redeployment this spring

- Denmark has pledged to support development of renewables including wave energy with Dkr100m in capital grants over four years. A further Dkr25m will fund wave power demonstration facilities.

Scandinavian developer holds talks with industrial consortium, writes Ben Watson

under phase three. FPP chief executive Anders Köhler said the challenge is to gather a broad base of industrial support to build out a commercial-scale Poseidon measuring 80 metres in 2015.

He said the company is talking with a consortium of "strong" players including Siemens, Arup and the National Laboratory for Sustainable Energy.

FPP needs €17m to build and install the so-called P80, which will likely feature 1.6MW of wave capacity and 2.3MW of wind. It also seeking €5m in working capital.

"Most of this funding will be secured through private investments but the company will also use its own equity," Köhler said. "We'll put our money where our mouth is."

FPP has its eyes on the US, meanwhile, and has teamed up with Oregon-based BridgeWorks

Capital to create the Floating Power US joint venture.

Plans for a new 600kW deployment by fellow Danish developer Wave Star Energy remain on paper while the requisite finance and partners are tied down. The preference

remains to install the float array at the Horns Rev 2 offshore wind farm from late 2013, but this is subject to securing backing and a contract with site owner Dong.

Wave Star said it is in talks with Maersk subsidiary Odense Maritime Technology over a potential contract for the load design and construction of the device.



Scattergun approach: Fortum is bankrolling a 10MW first phase wave farm at Sotenäs using Seabased technology developed at Uppsala University

Photo: Fortum

Seabased to build swarm

Scandinavia's most significant wave farm will begin construction this autumn at Sotenäs in Sweden.

A 1MW first phase will feature 42 generating units supplied by Seabased AB, low voltage switchgear and a 10kV power export cable. First power is slated for mid-2013.

Sotenäs will be upgraded to a 40kV system ahead of an expansion to 10MW in 2014-15. The full array will feature 420 point absorbers each rated at around 25kW.

Seabased will supply equipment for the site from a self-funded factory in Lysekil with an initial production

capacity of between five and eight point absorber units per day.

Elsewhere, Norwegian tidal player Hydra Tidal has been stuck in the slow lane for a year during a corporate restructuring. The company was incorporated into Straum Group, part of industrial investment company NLI Utvikling.

Hydra Tidal is also said to have encountered minor structural issues on its 1.5MW Morild II tidal device. The floating turbine is undergoing modifications and will be redeployed off Svolvær once complete.

France shoots for supply chain prize

Suite of test sites and Cherbourg heavy manufacturing plant flag up the nation's industrial ambitions, writes Seb Kennedy

France is building a marine energy industrial base to service projects in the English Channel and rival market leader Scotland.

Paris is putting in place the requisite elements to keep workers busy churning out turbines for the domestic market and "to ensure that Europe's (marine) industrial base is established in France".

Industry and energy minister Eric Besson said the country is racing to establish itself as a frontrunner in time for the first major project tenders "in the next few years in Scotland".

Plans are progressing for grid-connected test sites around the coast, a subsea transmission tender and heavy manufacturing facilities in Cherbourg.

French naval specialist DCNS, which owns 11% of OpenHydro, plans to set up a plant to manufacture blades and subsea bases, and assemble turbines,

in the port of Cherbourg. The companies are putting together a turnkey tidal offering and hope to be able to roll out up to 100 turbines a year from 2018.

They have their eyes on commercial array projects in the Raz Blanchard, which are due to be the subject of a French government competition for grid capacity. The tender is intended primarily for sites in the English Channel and will be dovetailed with a proposed interconnector with Alderney.

Grid operator RTE will set out connection conditions by the year-end ahead of the official tender launch by early 2014.

Other ocean energy efforts are being co-ordinated through France Énergies Marines (FEM), a joint industry-government initiative headed by EDF and backed by up to €133.3m in private and public cash.

FEM will oversee conversion of EDF's Paimpol-Bréhat tidal

Wave partners mull joining FEM

DCNS and Swedish utility Fortum are weighing up whether to incorporate a planned wave development into the France Énergies Marines initiative. The partners will review the near-shore project's ownership structure "since FEM is becoming a major player in France".

"For the moment it's a standalone development but things will be reviewed shortly," DCNS said.

The partners are surveying the French Atlantic coast for "the best compromise" between resource, environmental constraints, grid availability and proximity to maintenance capabilities.

The project, which is currently at the site selection stage, may utilise a 500kW or 1MW version of AW Energy's WaveRoller surge technology.

DCNS said a definitive choice

over the use of WaveRoller will be made "in the coming two months" following commissioning of a 300kW pilot plant in Portugal. The scheme will seek a combination of French and European grants and private financing to enable an initial deployment in 2015.

France, meanwhile, continues to use its overseas territories as a test bed for wave and tidal energy prototypes.

Reunion Island is the location for a Ceto deployment by Carnegie Wave Energy, a planned 3MW array of Pelamis attenuators, and a shoreline wave energy converter to be built into a sea wall at Saint-Philippe.

In French Polynesia, Voith Wavegen and Doris Engineering are planning an oscillating water column installation on the island of Tahiti that could come online in 2014.



Le Croisic cable-laying: SEMREV is France's first grid-connected wave test site

Photo: SEMREV

project off Brittany to a full-scale grid-connected test facility following next year's installation of subsea cables.

The site will initially host four OpenHydro turbines and is earmarked for the debut of Alstom's Orca7 tidal offering.

FEM will incorporate five test sites due to come online in 2012 and 2013, including an estuarine tidal facility in Bordeaux and the SEMREV wave base in Le Croisic in the Loire-Atlantique.

Cable installation and directional drilling are underway at SEMREV but the facility may lie unused for a

number of years until device developers are ready to deploy.

SBM Offshore is aiming to be the first to install at the site in 2014 or 2015 when it produces a full-scale prototype of its S3 wave converter, based on electro active polymer (EAP) technology.

The system features a flexible tube lined with EAP generators that "convert wave induced deformations directly into electricity". SBM said it is "seeking strategic as well as financial partners" to develop further a concept proven at scale in a wave tank.





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Customers beat path to 40South's door

Wave developer 40South Energy is expanding across the Mediterranean and further afield on the back of orders for almost 2MW of hardware from international customers.

The London-based company, founded by Italian-born Michele Grassi, is ramping up to deliver 50kW and 150kW versions of its floating modular systems to six wave farms over the next 14 months.

40South has an order book totalling 15 modules of its R115 and R38 systems due for delivery and installation throughout this year and into the first half of 2013, Grassi told *reNews*.

The largest single project is a six-unit array of R115s off the Peloponnese peninsula in south-west Greece being developed by an undisclosed independent power producer.

Other sites include a cluster of small farms off mainland Italy and nearby islands in the North Tyrrhenian Sea, a 50kW unit off Vavvaru Island in the



'Low cost per MW': 40South Energy's growing order backlog follows successful tests of its D100t prototype off Tuscany Photo: 40South

Maldives, and a 100kW venture in the Seychelles.

Grassi said the key factor driving demand for 40South's technology is the low cost per MW, including operations and maintenance, "while keeping a reasonably high capacity factor even in Mediterranean conditions".

He said: "The fact that the smallest machine is very affordable is one of the keys of the commercial success of the line-up. The customer can install a first machine with little value at risk and then expand when it is more confident in the technology."

The list price for the 50kW R38 is €125,000 while the

150kW R115 comes in at €300,000. Operations and maintenance costs are listed as between 2% and 3% of capital expenditure per annum.

Capacity factors are estimated to range from 18% to 25% in Italy, increasing to a maximum of 35% in Greece and the Seychelles. Whether the numbers stack up will become apparent in the coming months.

Elsewhere, Italian tidal developer Ponte di Archimede has rescheduled to June plans to install a maiden vertical axis 150kW Kobold turbine off Lombok Island in Indonesia.

The project, funded by the United Nations and the

Indonesian government, and initially planned for 2009, is a forerunner to three pilot plants in Southeast Asia.

Ponte di Archimede is preparing for an imminent UK debut when it supplies four 250kW Kobold machines to Bluewater Energy Services' floating BlueTEC prototype. The technology neutral BlueTEC platform will undergo trials at the European Marine Energy Centre in Orkney from late 2012.

Fellow Italian tidal outfit Fri-El Sea Power is seeking permits to test a 500kW full-scale prototype in the Strait of Messina in partnership with the University of Naples.

Italy is meanwhile poised to slash its feed-in tariff for ocean energy systems to €194 per MWh. The figure is mentioned in draft legislation and would represent a major cut from the previous rate of €340/MWh.

Ocean energy systems are expected to have to settle for the new rate without the option of participating in Italy's new renewables auction system.

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Iberia off pace in competition for wave crown

Bureaucracy and technology hurdles trip up flagship projects in Spain and Portugal

Wave energy development around the Iberian peninsula has all but lost momentum over the past 12 months.

Single device demonstrations remain few and far between in both Spain and Portugal, two countries once eyed as potential global competitors in the race to commercialisation.

Endless bureaucracy over offshore consenting, faltering political commitment to renewables and technical issues have pushed back the timeframe for numerous flagship projects.

Spain's grid-connected wave testing facility Bimpe is stuck on the drawing board despite an agreement with Elecnor to install subsea cables by the end of 2011.

Basque energy agency EVE said it is awaiting two final offshore permits related to exclusive use of the sea acreage and navigational safety issues.

The outstanding paperwork is expected over the summer, EVE added, by which time it expects to be in a position to reserve cable-lay vessels for summer 2013.

Seville outfit Elimco has been roped to install an onshore substation, and terrestrial works such as horizontal drilling should get underway before then. The delays have prevented Bimpe from signing contracts with interested device developers, although this may change in the coming months.

Ocean Power Technologies is facing a similar permitting challenge at its Santoña wave site in northern Spain where a single 40kW PowerBuoy is planned by the WavePort consortium.

The company hopes to begin construction of the PB40 over the summer but said it is unable to gauge the timeframe for key

consents from the Spanish government.

Iberdrola, which was once thought likely to join the WavePort consortium, is assisting with permitting efforts at Santoña through a separate arrangement with OPT.

That joint venture is a "partner for the development of the site" while WavePort is the "partnership for the device", OPT said.

Galicia wave outfit PIPO Systems, meanwhile, is assessing the damage to a small-scale prototype point absorber that was washed up on the beach following deployment off the Canary Islands.

The device reportedly broke free of its moorings some time after deployment in March 2011. The company was unfazed, however, and is pushing ahead with a new Spanish government-funded

Mutriku breakwater offers learning but no profit

Basque energy agency EVE has reported positive performance results from its 296kW Mutriku active breakwater facility.

The oscillating water column installation generated 160MWh onto the Spanish region's grid between its official inauguration in July 2011 and last December. The tally represents around one quarter of the scheme's 600MWh annual target.

The Wells turbines supplied by Voith Wavegen are said to have achieved all guarantees on performance and availability.

Project manager Yago Torre-Enciso said: "We are satisfied with the output, which has not been as high as possible because we have been in a test phase. Performance will be better in the second year."

EVE is taking a cautious



Behind schedule: three hinges are being attached to the WaveRoller vessel in Peniche shipyard

Photo: AW Energy

deployment due by the year-end.

In Portugal, AW Energy's 300kW WaveRoller pilot plant is slated for a June installation off Peniche, several months behind schedule. The Finnish company said the delays were due to late arrival of certain parts of the power take-off system.

"AW Energy has required the

highest quality in the manufactured parts and some sub-contractors simply didn't meet the standard. Parts had to be redesigned and remanufactured," a spokesman said.

Final testing in Finland also suffered from "misfortune" as the test rig had to be repaired several times.

"Despite the delays,

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approach to operations at Mutriku after suffering structural damage and, more recently, flooding of the control room during storms.

Technicians are shutting valves manually to avoid exposing the turbines to the most extreme wave states. Despite the encouraging output figures, Mutriku is a loss-making plant and there are no plans for new breakwaters in the Basque region.

Construction costs would need to be partially covered by public funds to make all but the largest wave facility viable.

The Spanish government's current freeze on all renewables tariffs is a further disincentive.

Mutriku is currently selling power at €76.60 per MWh, "slightly below onshore wind", and this is unlikely to change

while Madrid stonewalls the country's irate wind and solar lobbyists.

Torre-Enciso said EVE is not deterred by the economic challenges of wave energy.

"The objective of Mutriku is not only energy production. It sends a message from the Basque government that we believe in this sector and we will put in place whatever is necessary to develop it here.

"The intention of the plant is to encourage developers to set up in the Basque country," he said.

As part of these efforts, EVE is offering to remove some valves at Mutriku to make space for developers of air turbines to test their products in real-life sea conditions. The initiative is part of the EU-funded MaRINET programme.

Iberia off pace in competition for wave crown

15 which are more a rule than an exception in pilot projects like this, the three (100kW) units have passed a very extensive testing programme and AW Energy has full confidence that they will deliver what is expected," the company said.

The WaveRoller is in its final stage of preparation in Peniche shipyard, where the vessel structure that houses three machine rooms is complete. The entire assembly will be floated out to Peniche harbour for a test deployment "when the first weather window arrives".

The system will then be connected to the grid before submersion at the final project location at the end of June.

Elsewhere, Portuguese developer Martifer's ambitions to develop an attenuator wave concept have fallen by the wayside. Project FLOW is officially "on standby, lacking the necessary financing".

Sponsors cheer on Ceto 4 performance at Carnegie

Australian developer Carnegie Wave Energy is leading the pack Down Under with its largest demonstrator device to date due to be commissioned over the summer.

The company is currently installing Ceto 4, its latest design, off Reunion Island east of Madagascar in a joint venture with EDF. Trials will last between three and six months.

Ceto 4 incorporates a larger buoyant actuator than its predecessor with a diameter of 10 metres instead of 7 metres. This will increase capacity from 80kW to approximately 180kW, Carnegie said.

The developer's first grid-connected array of up to 2MW will be installed and commissioned at its Garden Island test site in Western Australia by the end of next year.

The A\$31m scheme is backed

Largest buoyant actuator yet is gearing up for summer trials, writes Ben Watson

by A\$10m from the federal Australian Centre for Renewable Energy's (ACRE) Emerging Renewables Programme. A further A\$5.5m has been secured from the state of Western Australia.

New York-based institutional investor Australian Special Opportunity Fund LLP has offered A\$16.3m in flexible equity as match funding for the Garden Island array.

The project should deliver Carnegie's first revenues from the sale of electricity to the Australian Department of Defence and state-owned power retailer Synergy. This will require full balance of plant integration, including pipelines to carry pressurised water to onshore power generators

Pending successful

completion, Carnegie will then look to deploy larger commercial projects in the most "financially and regulatory attractive regions".

These include the UK and continental Europe as well as remote islands.

The A\$10m ACRE grant award bodes well for future demonstrators and array projects in Australian waters.

The wider Emerging Renewables Programme boasts a budget of A\$126m, which will be targeted at large-scale solar, geothermal and ocean energy out to 2020.

ACRE has yet to indicate how this cash pie will be shared out but a new marine energy association, Ocean Energy Industry Australia (OEIA), is expected to lobby for

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Off-grid trials: WET-NZ will reinstall its 20kW wave converter at Moa Point by the end of next month

Photo: WET-NZ

Kiwi cash cupboard stripped bare

New Zealand authorities are withdrawing early support for indigenous ocean energy technologies just as the capital grant programme is beginning to bear fruit.

The country's marine energy deployment fund (MEDF) has been exhausted following four award rounds and the government has kept quiet on any future allocations.

Two-time recipient Wave Energy Technology – New Zealand (WET-NZ) has completed fabrication and initial tests of a 20kW “half-scale” point absorber wave energy device.

The machine was retrieved

late last year and is due to be reinstalled at Moa Point, Wellington, before the end of June.

WET-NZ director John

Huckerby said trials will last at least two years and the site will remain off-grid “in the first instance”.

An export cable will follow

“in due course”. This could lead to Moa Point being transformed into a grid-connected test site for the benefit of other device developers.

Sponsors cheer

16 a healthy portion. OEIA plans to establish a sectoral development strategy and “best practice for ocean energy governance in Australia”, according to the International Energy Agency’s Ocean Energy Systems annual report 2011.

Elsewhere, New South Wales wave developer Oceanlinx is eyeing a “commercial-size project” in the south of the country that could reach up to 5MW in two phases.

Chief executive Ali Baghaei said the company has tied in “small investors” in the past couple of months without adding details.

Sydney-based BioPower Systems is planning a 250kW grid-connected wave device at Port Fiary in Victoria, followed by wave and tidal deployments in Tasmania.

Future sites in Spain and the US are also under consideration.

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Asia's big guns turn sights out over the seas

Key industrial players across Asia are competing to commercialise the first ocean energy technologies in a bid to corner regional markets before local and Western rivals.

The majority of these wave and tidal efforts are at the stage of proving devices rated in the tens or hundreds of kilowatts.

Ongoing government-backed R&D programmes have overseen a considerable number of deployments in recent years, and many more are set to follow.

In South Korea alone, no fewer than 15 diverse demonstrators are planned out to mid-decade.

The most advanced is a 500kW oscillating water column system currently being installed

First nation to open large-scale test site set to steal a march on regional rivals, writes Seb Kennedy

by the Maritime & Ocean Engineering Research Institute in Yongsoo.

In Japan, a number of laboratory and at-sea projects are at the planning and implementation stage with support from major players such as Mitsui Engineering, Kawasaki and Toshiba Corporation.

In China, medium-scale wave demonstrators are planned as part of isolated island hybrid renewables systems. In addition, 2MW-scale tidal arrays



'Floating duck': the 10kW Guangzhou device is one of the myriad technologies being pursued by Chinese research institutions

Photo: Guangzhou Institute of Energy Conversion

are being studied in the provinces of Zhejiang and Shandong.

Beijing is in the final lap of

preparing an ocean energy roadmap for publication this month. Input from government agencies and

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18 industry partners in the UK and China is being collated by consultancy ITP, formerly IT Power, under a contract with the British Foreign & Commonwealth Office.

The work involved studying wave and tidal energy resources around China, producing a status report on marine energy developments and programmes in China and the UK, and holding workshops on resource assessments and environmental impacts.

Across Asia, countries are expected to seek to harness their significant marine resources using equipment developed by local universities and fabricated by national industrial heavyweights, backed

by state funds. Central to these aspirations is the provision of adequate testing and demonstration facilities.

China and Japan are tapping into Scottish expertise in this field while South Korea is seeking to renovate and expand prototype projects into fully-fledged pilot zones.

The oscillating water column site in Yongsoo is one such facility earmarked as a future technology demonstration centre.

Richard Morris, commercial director of the European Marine Energy Centre in Scotland, said: "All these countries are very aware that whoever sets up the first Asian large-scale test site will capitalise on the market

and test devices from China, South Korea and others."

EMEC is assisting the Ocean Energy Association of Japan in its efforts to identify and develop one or more wave and tidal test sites, and to prepare bids for government support.

The Orkney-based facility has also completed some initial work for the Ocean University of China and is exploring research collaborations with the National Ocean Technology Centre in Tianjin.

Morris said the establishment of test centres in Asia will further benefit the sector by spurring on transmission infrastructure and offshore regulation.

"They see this as a catalyst

for grid and for electricity companies to buy (into the sector), and for consenting to start. Just by saying you are going to start with a test site makes everything else kick off and triggers regulators to think about the implications."

Morris said ongoing government enthusiasm will remain vital to Asian ambitions in wave and tidal. "In a lot of these countries the appetite for funding marine renewables is increasing.

"Wherever I have travelled in the Far East there has been a great deal of interest, and without that input nothing is going to be built. All of these universities and institutions need state funding to move forward," he said.

Korean gates open for Tocardo turbines

German renewables start-up Korwind hopes to begin importing tidal turbines from the Netherlands to South Korea as soon as this year.

The company is eyeing a number of sites for installation of devices supplied under an exclusive dealership arrangement with Tocardo.

Korwind and the Dutch turbine developer are targeting April 2013 to begin installing up to five 200kW turbines in sluice gates at the Saemankeum sea wall in western South Korea.

The deployment may move ahead in partnership with local developer Blue Ocean Power, subject to agreement over project design and a final contract. Blue Ocean's proposal envisages installing a 1MW turbine, which Tocardo is currently developing, at

Saemankeum. The partners will seek capital support in the shape of a government loan for up to 75% of the total costs.

Korwind project manager Stephan Huth said recent elections in South Korea may tip the scales for a hoped-for increase in the current feed-in tariff, which would accelerate commercial negotiations.

Huth said utilities are waiting in the wings to sign a power purchase agreement for Saemankeum but this will happen only if there is an improved FiT.

Elsewhere, South Korea's operational 254MW Sihwa barrage is being considered for an experimental expansion.

Blue Ocean, which has patented the concept of installing tidal stream turbines downstream from the outlets of

existing tidal barrages and sea defences, is proposing a Tocardo array at Sihwa.

The Seoul company claimed it could slash deployment costs by draining the area behind the barrage and installing turbines directly onto the dry sea floor.

Power yields would also be improved by the accelerated flows found in the tailrace, it said. Sihwa came online in

August 2011 and is generating around 552GWh per year.

Turbine supplier Andritz said recent site performance tests showed all units are in operation and all guarantees have been met.

Another major barrage project at Garolim is said to be proceeding with environmental permits and may reach the tendering stage by the year-end.

Atlantis to get ball rolling in Gujarat

Atlantis Resources is set to start building the first phase of a 50MW tidal array in Gujarat, India, this year.

The company is "in the process of finishing the necessary grid connection and environmental studies" to break ground at the country's maiden ocean energy initiative.

The Gulf of Kutch site is

expected to host a single turbine before subsequent expansion into an array.

Gujarat authorities recently approved 250 million rupees of support for the project this financial year. The state is reportedly eyeing the International Finance Corporation as a possible source of further project funding.

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It's payback time in Canada

Canada's early forays in the tidal sphere have allowed the country to "recapture" the lead from other nations, including the UK, claims industry association the Ocean Renewable Energy Group.

OREG said Canada is on course to become the global leader in the delivery of wave, tidal and river run-off power technologies, as set out in its recently launched industry roadmap.

Executive director Chris Campbell told *reNews* that federal and provincial support has been central to attracting

Ocean energy developers under pressure to deliver return on generous federal and provincial support, writes Ben Watson

initial investment in the sector but warned Canada cannot afford to take its foot off the pedal.

Marine technologies must return dividends for the political faith placed in them and transform into a competitive component of Canada's energy portfolio over the next few years.

"I'm terrified if we don't deliver an industry by mid-

decade investors and the government could lose interest," Campbell said.

Tidal take-up will begin with modest installations under Nova Scotia's community feed-in tariff initiative, which limits individual devices to 500kW.

To date, four tidal schemes totalling around 3MW have been approved to tap into the healthy COMFIT rate of 65.2 cents per kWh. Fundy Tidal Inc

is behind all four projects and is lining up technology partners.

Ocean Renewable Power Company of Maine is eyeing the largest site at Digby Gut, due in 2014.

The developer is looking further afield for other suppliers of small turbines.

Nautricity of the UK, Dutch company Tocardo and Verdant Power of New York may provide hardware at COMFIT sites in Petit Passage, Grand Passage and Barra Strait.

Alberta hydrokinetic outfit New Energy Corporation is also on the list.

The pace of larger-scale development in Canada hinges on talks over Nova Scotia's FiT for transmission-connected tidal arrays.

OREG said the initiative will likely have a cap in the region of 65MW, in line with the grid capacity at the Fundy Ocean Research Center for Energy tidal test facility.

Nova Scotia's Utility & Review Board will kick off the process for setting the array FiT in the coming months.

"Just as we saw with the 2011 Utility & Review Board hearings and decision on the small-scale tidal COMFIT, it will be challenging to determine the appropriate feed-in tariff design and set a rate due to uncertainties around these emerging technologies," OREG said.

"Attempting a cost-benefit analysis of an industrial scale development tidal energy project has to rely on assumptions and estimates that may make the results open to question."

OREG said officials must bear in mind the longer-term economic and strategic benefits to be harnessed by an appropriately generous tidal tariff.

"The countries and regions pursuing the early phases of marine renewables are doing so because of economic diversification and development opportunities rather than the immediate spin-off from the first project or its energy," the association argued.

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Nova Scotian grid to feel the FORCE

Canada is set to connect its utility-scale Bay of Fundy test site to the grid this summer.

The Fundy Ocean Research Center for Energy (FORCE) will be a jewel in the crown of the country's tidal ambitions and boast an export capacity of around 65MW.

Subsea cables were delivered late last year and are in storage awaiting installation some 1.5km offshore. Officials are planning an operational dry run in the spring involving tugs and barges.

Wires will go in the water "no sooner than necessary given the challenges of working at a site with this kind of power", a FORCE spokesman said. An onshore substation is complete and work on an overhead transmission line is expected to wrap up shortly.

Alstom will likely become the first to deliver tidal power onto

the grid when it installs its 1MW Beluga9 turbine in the bay next year.

The device is being manufactured and assembled at a facility in Nantes, where a full size test bench is installed and fully commissioned. The rig is loaded with power conversion and control algorithms to mimic the Bay of Fundy's highly energetic tidal rip.

Atlantis Resources is progressing with a "site-specific turbine design" and establishing a local supply chain for the build, assembly and deployment of its Canadian project.

However, its proposed 2012 deployment has been pushed back to "late 2013 or 2014".

Minas Basin Pulp & Power is studying current profiling data provided by FORCE in anticipation of installing a 3MW SeaGen-U turbine provided by Marine Current Turbines.

Design parameters and



Developing strategy: Minas Basin Pulp & Power hopes to install a 3MW SeaGen-U unit, the fully submersible version of MCT's surface piercing tidal system

Photo: MCT

deployment strategies are being worked up in tandem with MCT's development of a submersible SeaGen.

A request for proposals to find an occupant for the fourth berth at FORCE, which was vacated by Nova Scotia Power, is due later in the year following publication of the Nova Scotia Marine Renewable Energy Strategy.

The report will outline the key policy directions for tidal

energy and development of permitting legislation.

OREG's Chris Campbell said: "The FORCE berth is opening at a time where there will be feed-in tariffs, marine energy legislation and an industrial development strategy. Nova Scotia is open for business."

Future funding could come from the \$97m ecoENERGY Innovation Initiative, which will support clean energy projects including marine renewables.

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Brazilian university taps into wave potential

Brazil has entered the wave power game with the installation of the first utility-scale demonstrator in Latin America, writes Seb Kennedy.

The near-shore wave energy converter is undergoing commissioning at a shoreline site in Pecém in the north-eastern state of Ceará. First power could be delivered as early as this month.

The hyperbaric system features a pair of wave floats designed to drive a 100kW onshore generator.

The project is being spearheaded by the Ocean Engineering Department at the Alberto Luiz Coimbra Institute, part of the Federal University of Rio de Janeiro (UFRJ), which owns the patents to the wave converter.

Local GDF Suez subsidiary Tractebel Energy is supporting the scheme through an R&D initiative co-ordinated by power regulator Aneel. State officials have also lent essential support.

Ocean Engineering Department



Getting into the rhythm: the state of Ceará is home to Latin America's first wave energy converter

Photo: Coppe UFRJ

chairman Segen Estefen told *reNews*: "The state of Ceará has been a very important partner for implementing the prototype of the first Brazilian wave converter."

As in other renewables sectors, Brazil is blazing a trail for the rest of Latin America to

follow. Wave and tidal studies have been carried out in Chile, Mexico and Argentina, but there is a notable absence of significant project or technology development.

Chile is looking at importing South Korean expertise in tidal barrages and has floated the

idea of installing a tidal stream test site in the Chacao channel.

There is talk of including marine energy in Chile's new subsidy auction system for renewables, although this is regarded by some as too much, too soon for the nascent technology.

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Trio of developers set to deploy some serious hardware, writes Ben Watson

US wave and tidal developers will take an important step forward this year with the installation of three utility-scale prototypes.

Tidal players Verdant Power and Ocean Renewable Power Company are preparing to enter the water on the East Coast while Ocean Power Technologies is behind an imminent wave deployment in Oregon.

The deployments, while still relatively small in scale, represent material progress in a market beset by onerous federal and state permitting requirements and limited capital support.

Maine developer ORPC is leading the charge and has already installed a bottom support frame for the first grid-connected TidGen device at its Cobscook Bay test site near Eastport.

The substructure was deployed by offshore specialist Perry Marine & Construction in just 27 minutes and landed "within an inch" of its intended location, the developer said.

The lattice frame will accommodate four horizontal axis cross-flow turbines that will drive a single 180kW on-board generator unit. Installation work is underway and the site is slated for energisation in late summer. Environmental monitoring will run alongside testing.

A further four TidGen devices will follow in late 2013, creating a five-unit array with a rated capacity of 900kW at a total project cost of around \$25m. The site will eventually be expanded to 4MW.

ORPC chief executive Chris Sauer said the company is in discussions with investors and utilities over long-term power purchase agreements and backing for the project's later megawatt-scale phases.

Central Maine Power, Bangor Hydro Electric and Maine Public Service are negotiating a 20-year power deal for the scheme. The Maine Public Utilities Commission reportedly

Giant leap for America's wave and tidal pioneers

set the subsidised tariff rate at 21.5 cents per kWh at the end of April.

Development of ORPC's floating tidal system, OCGen, is said to be around two years' behind the bottom-mounted TidGen setup. Small-scale trials are slated for the autumn with a full-scale deployment at Cobscook by late 2014.

New York player Verdant,


meanwhile, is preparing for the first outing of its Generation 5 free-flow tidal turbine this summer.

The initial "wet-test" will take place at Verdant's Roosevelt Island tidal energy (RITE) project in New York's East River, following completion of ongoing rotor stress and longevity tests in a laboratory in Colorado. The summer trials

of the single device are a forerunner to an array of five Gen5 turbines in 2013.

Company co-founder Trey Taylor said Verdant has made "considerable progress" on turbine development since removing an array of Gen4 systems from RITE in 2009.

Nacelle support structures, cables and power conditioning equipment







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Giant leap for US wave and tidal pioneers

23 from the Gen4 trials remain in place at the site and will be reused for the first two phases of Gen5 installations.

Nine new triangular frames will be needed in 2014 and 2015 when the site is expanded to its full 1MW capacity.

Verdant's tidal turbines are being adapted for river systems, and future commercial project opportunities may arise through a collaboration with the New York State Energy Research & Development Authority. The partnership has identified more than 1GW of potential hydrokinetic sites across the state.

On the opposite side of the US, wave developer OPT has completed fabrication of the steel structure for its first 150kW PowerBuoy at the Reedsport project in Oregon.



Local content: major steel components for OPT's first US-made PB150 will be incorporated with power take-off by Vigor Industrial in Portland shipyard ahead of installation off Reedsport by early 2013

Photo: OPT

The company is now performing "rigorous" testing of the power take-off and control systems at its New Jersey facility. The PB150 will be assembled at Reedsport upon completion of assessments.

OPT said the device will be

in the water this year "weather permitting". Offshore trials will last one to two years.

Reedsport is earmarked for a further nine PB150s and could become the first grid-connected wave site in the US, pending permits from the Federal

Energy Regulatory Commission. The transmission tie is contingent on the first PowerBuoy's progression during trials, further funding for infrastructure build-out and commercial discussions with power off-takers.

Industry mourns PTC then moves on...

Wave and tidal developers in the US are maintaining a positive outlook for the sector despite the pending expiry of the Production Tax Credit incentive.

Verdant, ORPC and others are looking to other possible mechanisms such as the Business Energy Investment Tax Credit (ITC) and accelerated depreciation to draw future financing into the sector.

The consensus appears to be that while a PTC-shaped hole in the support framework for renewables does not bode well, it will not sound the death-knell for the sector as predicted by some a year ago.

ORPC president Chris Sauer

said: "The removal of the PTC won't spell the end of the marine sector. Continued support from the Department of Energy will keep on reducing research, development and deployment costs for marine technologies."

Sauer called for market-pull incentives to be "expanded, not eliminated" in order to maintain momentum at a critical stage in the early development of US ocean energy.

Grant-backed pilot and demonstration projects going into the water in the next 12 to 24 months should continue regardless of fate of the PTC but its absence could stymie commercial-scale developments further down the line. Sauer

said the policy uncertainty emphasises the need for technologies to keep driving down the cost curve.

"In five years we'll be at the point where we have confidence, have learned about the specific components of our technology and have upgraded these accordingly. Within this time the industry will be de-risked enough to become more mainstream and predictable."

Verdant co-founder Trey Taylor said it is essential to accept and manage the political risk inherent in any federal or state support mechanism.

He said the company "has always been concerned that economic incentives, which

help seed pilot projects, may not be there".

"But we will not allow that to deter us from continuing to press forward with solutions for generating hydrokinetic power at a low kWh cost and with added value."

Sean O'Neill, president of US association Ocean Renewable Energy Coalition, said technology progress will be the key to opening up new funding streams.

"Investments are expected to increase once the technology readiness level for marine (renewables) has improved (but) we haven't solved all the problems yet. More utility-scale funding is needed."

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