Feb 2014
Issue 100

atob

Price £2.50

A to B magazine

Available from selected outlets, free download at www.atob.org.uk
or by annual subscription on 01305 259998 or www.atob.org.uk
£15.00 (United Kingdom), £20 or US$32 (overseas airmail)

Issue 100 February 2014

A to B 40 Manor Road, Dorchester, Dorset DT1 2AX, England
ISSN 1460-0587 . **tel** 01305 259998
email *(subscriptions & advertising)* jane@atob.org.uk *(editorial)* atob@atob.org.uk . **web** www.atob.org.uk

Editor David Henshaw . **Administration** Jane Henshaw
Contributors Richard Ellam, Richard Peace, Julian Jackson . **Proof-reading** Peter Henshaw
Webmaster Jonathan Pattison . **Printers** Henry Ling, Dorchester . **Next deadline** 28th April 2014

So, we finally made it to our 100th issue, surviving what has been billed as the biggest communication revolution since Caxton. For a while, we wondered if the paper A to B really would see 100, but the tide seems to be turning in favour of paper and ink. As subscribers will know, we suffered a print hiccup at Christmas, and we also put an advertisement in the magazine offering free back-numbers on a first-come first-served basis. Yet despite hitting your lap-tops and devices four weeks before paper plopped through the letterbox, the three digital formats yielded only two enquiries about the offer, against 50 in the days following the paper magazine's arrival. As some readers who take both ruefully noted, they only ever glance through the digital issue.

This doesn't necessarily mean magazines will survive the march of digital communications, but our hunch is that digital magazines will not replace paper. Might be wrong on that.

And finally, it's a sign of changing times that our cover features two fossil-fuelled vehicles, and they're not even hybrids. Are we really getting close to the long-anticipated 100mpg car? DAVID HENSHAW

Contents

Ear to the Ground: *The Mole* 4
A to B Letters 7
Technology: ERS LED Corn Bulbs 12
A to B News 13
Book Review: *Cycling Science* 16
The Trial: *Kia Rio 1.1 CRDi & Honda Vision 110* 18
Technology: *Marine Energy* 28
The Trial: *Vélo Cargo* 34
Great Ideas: *Hydrogen & Hot Air* 43
A to B Smalls 47

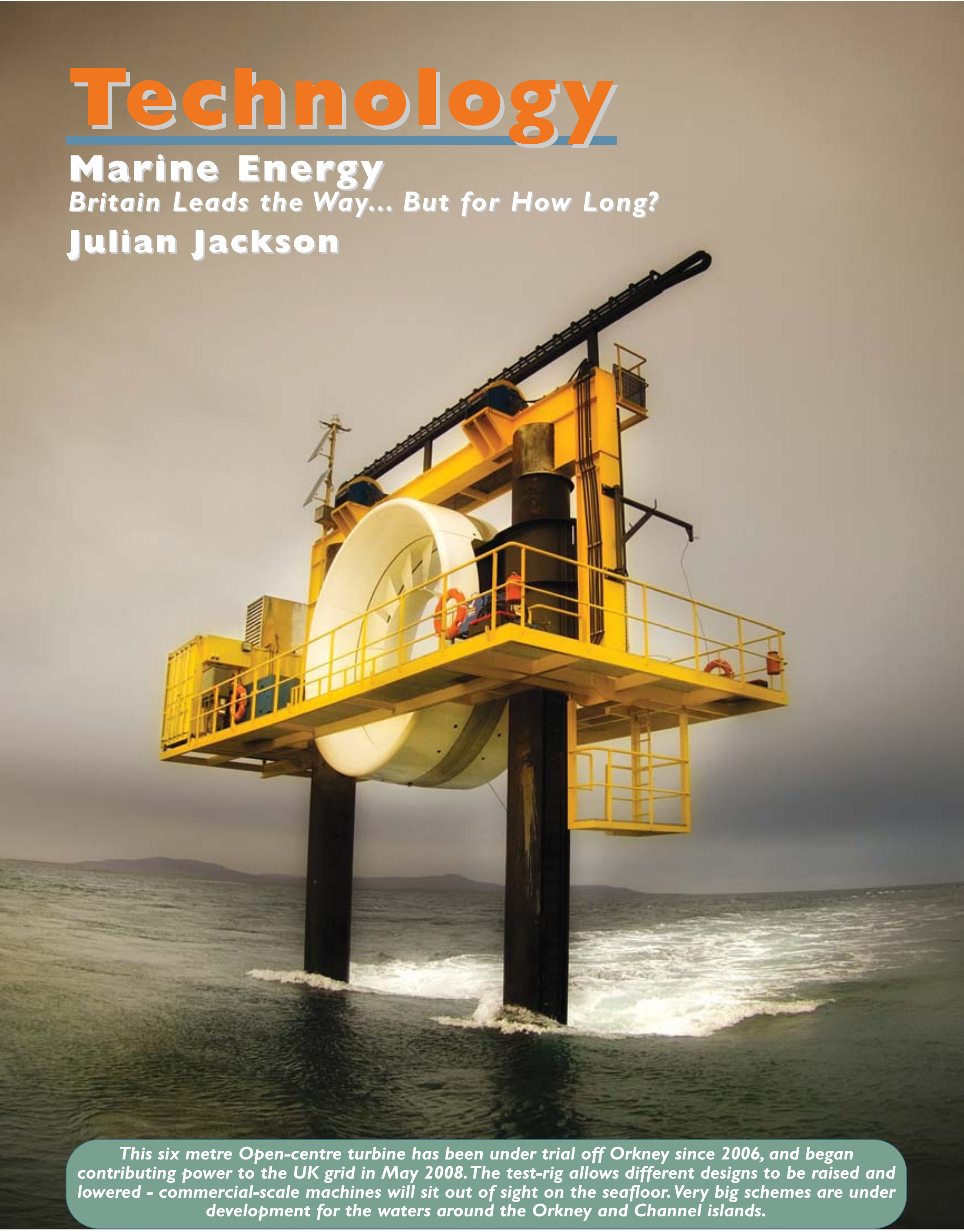
COVER: Kia Rio 1.1 and Honda Vision 110, Vicars' Close, Wells, Somerset, 12th January 2014

Technology

Marine Energy

Britain Leads the Way… But for How Long?

Julian Jackson



This six metre Open-centre turbine has been under trial off Orkney since 2006, and began contributing power to the UK grid in May 2008. The test-rig allows different designs to be raised and lowered - commercial-scale machines will sit out of sight on the seafloor. Very big schemes are under development for the waters around the Orkney and Channel islands.

> *"...a five knot ocean current has more kinetic energy than a 220mph wind..."*

Britain is in a position to utilise its marine engineering capacity to consolidate its position as the world's leading nation in marine energy - wave and tidal power. As an island the UK has some of the best resources in the world. The Carbon Trust says, 'Sources of tidal energy may have the potential to generate approximately 20% of the current UK electricity requirement.'

However the reality is that progress in moving from small prototype units, through pilot projects, to commercial scale developments has been very slow. There are a number of reasons for this. Marine energy resources exist in places far from grid connections, such as northern Scotland, they generally need to be harvested underwater, and these are new and developing technologies, unlike say, solar photovoltaic panels, which have been on the market for 40 years and so are a mature and tested product.

There are two types of marine energy. Wave energy is generated by the wind moving the surface of the sea, so a generating device operates on the surface of the water, such as the floating Pelamis wave power device tested at the European Marine Energy Centre (EMEC) in the Orkneys, or the small scale array off Portugal. These sea-snake like objects move up and down and uses the motion to generate electricity which is fed to a shore station.

The other type is tidal stream energy, created by the constantly changing gravitational pull of the moon and the sun. Tides are predictable and never stop. This energy resource is at its best where there is a good range between low and high tide, and particularly where the effect is amplified in narrow streams and inlets, around headlands, and in channels between islands. Many devices are currently being developed, and most of them resemble squat wind-turbines placed underwater. Like wind-turbines, the horizontal, triple bladed design seems to be the best configuration, although the marine designs rotate slower than their above-water counterparts, as water is more energy-dense and slower moving.

Because water is 832 times denser than air, a five knot ocean current has more kinetic energy than a 220mph wind. Therefore ocean currents have a very high energy density and a smaller device is required to harness tidal current energy than to capture wind energy. Potentially the seas around Britain could be a considerable source of energy.

Research

The UK Government, along with the rest of the EU, is putting money into research and testing of prototype devices. At the 7th International Tidal Energy Summit at the end of 2013 it was revealed that the Government wants to move to larger scale arrays quickly and some delegates felt that this was too soon to sort out the inevitable 'bugs' in a new technology.

EMEC has trialled many devices at its 14 test sites, but no consensus has emerged as to a best design - each different product has strengths and weaknesses. Probably full results won't be known until a commercial array had been in operation for five years, and the UK is some way from that point. There is 9MW of wave/tidal energy devices deployed around our coasts at the moment and it is predicted that this will rise to 120MW by 2020, creating about 20,000 jobs directly in the manufacture, installation, operation and maintenance of these devices. Although this is a small beginning, the country which pioneers wave and tidal energy would have a large export and licensing potential to the rest of the world, so Britain has a lot to play for.

There are a number of significant problems to deploying large scale marine energy. The grid connection issue is a major one: new power lines are needed to bring the energy from thinly-populated areas around our coasts to the urban/industrial sectors where it is needed.

"...raising a turbine from the sea-bed in a racing tide might cost £100,000..."

This will involve substantial costs, as well as possible visual disturbance - it is hard to like the idea of marring beautiful skylines in Scotland or the Irish Sea with strings of pylons, although tidal energy could make good use of the existing transmission lines up to the decommissioned Dounreay nuclear power station, which are currently being upgraded. However, there are other questions that remain unanswered: how do you build devices strong enough to withstand the pounding of the sea? Of necessity the wave and tidal stream devices need to be in areas of high waves or strong currents to deliver the greatest output, but that means building robust, and therefore more expensive, machines.

Another difficulty is maintenance. If a wind-turbine is on land, and something wears out or breaks, it is relatively simple to send out a crew to repair or replace the part. Offshore wind maintenance is more expensive and weather-dependent than onshore, but the same in principle. Raising a turbine from the sea-bed in a racing tide might cost £100,000 and need a specialist vessel, just to replace a £1,000 part.

This issue was something that the Tidal Summit delegates were well aware of, but no-one has solved the problem. Several companies are attempting to create marine energy devices that need minimal maintenance, with few moving parts, perhaps lubricated by sea water, and with any advanced technology housed safely on land nearby.

Tidal turbine fabrication. The Renewables Training Network trains people to work in these challenging technologies. Without skilled engineers, Britain's early lead will be lost. *PHOTO: John Paul Photography*

A commercial-scale trial of Marine Current Turbines will begin later this year off the coast of Anglesey. Total installed capacity is expected to be 10MW

UK Skills Gap

There is also a skills gap - a problem for any developing industry - in both marine and wind energy personnel, so Renewables UK has created the Renewables Training Network (RTN) to train or retrain people to work in the sector. RTN Head Patricia Knightley says, 'We're helping to tackle the skills gap in fields such as mechanical and electrical engineering and project management. We're actively exploring innovative ways to create routes into careers in all areas for people with transferable skills.'

Despite these difficulties, the shear potential of the resource, and the opportunity it presents, means that the coalition Government is backing various schemes to fund the development of this technology, particularly as marine energy may well prove to be the most predictable of the present-day renewable technologies. Between them the UK and the EU are currently funding research and development to the tune of some £40 million annually, and there is some private capital being injected too.

At the Renewables UK conference, Climate Change and Energy Minister Ed Davey promised, 'The UK is one of the leading nations in the development of marine energy. And we are putting money behind our commitment: we will be investing £80 million in marine energy [between 2015-2016].' He also promised to work with key players in the industry to remove non-financial barriers to the deployment of the energy, which might include legal issues, permitting and insurance procedures.

Eco-Hazards

Are there any environmental hazards to the deployment of marine technologies? Although it may involve putting down concrete anchoring blocks on the seabed, these soon become loci for wildlife, and the tidal stream rotor blades turn too slowly to be a major danger to fish and other sea creatures. The devices themselves would mostly be deployed in areas away from fishing grounds or other sea-traffic, so would not normally pose a navigation hazard.

One of the most interesting systems in Britain is the Skerries Tidal Stream Array project by Marine Current Turbines, which will install twin turbine devices this year off the tip of Anglesey in Wales, half a mile from the coast, in approximately 20 to 40 metres of water. The proposed array will consist of up to nine SeaGen devices and have a total capacity of up to 10MW. The design life of the turbines is 25 years, and this area has both nearby harbour facilities at Holyhead and good grid connections, so will be an ideal test bed for the turbines, a prototype of which has been running in Strangford Lough in Northern Ireland since 2008 with no significant environmental problems.

The second generation Pelamis Wave Energy Converter, called the P2, began trials at EMEC in 2010. The Pelamis machine consists of a series of semi-submerged cylindrical sections linked by hinged joints. As waves pass along the length of the machine, the sections move relative to one another, and a hydraulic system generates electricity, which is fed down an umbilical cable to the seabed, and thence to shore. Multiple Pelamis devices can be connected to a single cable, and plans are well advanced to construct a 10MW array off Bernera, Isle of Lewis, in Scotland in 2015-16.

The Pelamis turns uses a hydraulic system to turn wave motion into energy. *PHOTO: John Paul Photography*

Good News

Careful planning and siting of offshore wind and marine arrays can ensure that they work together in a complementary fashion, and use the same infrastructure and grid connections. The Scottish Government has approved the largest tidal turbine energy project in Europe in the Pentland Firth, with up to 86MW of power, which would power 42,000 homes. The first 9MW array of six turbines is part of a phased deployment up till 2020, which could end up generating 398MW of clean energy eventually.

MeyGen's AR1000 turbine is claimed to be the most powerful single-rotor tidal device in the world. The devices, which stand 22.5m (73ft) tall, weigh 1,500 tonnes with a rotor diameter of 18m (59ft), and could generate up to 1.5 MW of power. And these may soon look like tiddlers. The Scottish Government has estimated that tidal turbines in the small area around the Orkneys could generate half Scotland's power requirement. The potential for developing, using, and exporting marine energy has not been lost on the Scottish Nationalists.

The Economics

Wave and Tidal stream power are new and prototype technologies. This means there are considerable uncertainties about how they will perform when deployed at a large scale. This is exactly the dilemma faced by previous renewable technologies such as solar photovoltaics, onshore and offshore wind, and many others. These developments need to go through a slow cycle of design improvement, practical deployment and learning the lessons of the results, whether positive or negative. Britain has the largest wave and tidal resource in Europe, with about 50% of the potential energy. This is a result of the UK's exposure to Atlantic winds, ideal for wave capture devices and the existence of lots of headlands and islands, which concentrate tidal flows. The UK is also leading in the development of this technology, backed up by the UK's expertise in legal, financial and insurance matters.

The Carbon Trust has estimated that the global market for marine energy could be worth £340 billion (in 2050) and that the UK's share could be worth £76 billion. The finance for this new industry is expected to come from a combination of public and private sources, but private investors need to expect a return and do not like rapid changes of policy, as has been seen in the recent sudden changes in the solar Feed-in-Tariff. There are lessons to be learnt from the way Denmark overtook Britain as the leading provider of wind turbines and associated expertise in the 1980s.

Because marine renewables are still in the early stages of development, they currently represent an expensive way to generate electricity compared with existing forms of generation. The Carbon Trust has suggested that the baseline costs are likely to be in the range of 38-48pence per kWh for the first wave farms and 29-33pence per kWh for the first tidal farms. This compares with the current cost of 9-10.5 pence per kWh for onshore wind. Costs can be expected to fall considerably because of the economies of scale, and the infrastructure being built. To ensure survival, the mature marine industry would need to be competitive with other forms of power generation. That is still quite a long way off. The Low Carbon Innovation Group advised the government in 2012 that a target of 14 pence per kWh should be the goal for 2020.

The Energy and Climate Change Committee concluded in a recent report that, 'Although it is still very early days for marine renewables and it is unlikely that they will make a significant contribution to the UK's energy mix before 2020, the potential longer-term benefits associated with developing a thriving wave and tidal industry in the UK are significant'. JULIAN JACKSON

Overall the UK stands at a crossroads: there is the potential to reduce climate changing emissions, develop a new industry that would create jobs and exports and play to the UK's strengths in design and marine engineering. Or Britain could stumble along, missing this chance to lead, as other nations including the Dutch, Germans and Scandinavian countries power ahead towards the goal of a new sustainable energy technology.

Further reading: **www.renewableuk.com** • **www.emec.org.uk** • **www.tidaltoday.com**

Julian Jackson is a writer specialising in the environment. See ***www.julianjackson.co.uk*** *and* ***www.brightgreenpr.co.uk***