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Why Marine?

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WHY NOT?

WHY? MARINE

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Malcolm Wicks MP
Minister of State for Energy

As an island nation the UK is blessed with having one of the best marine resources available anywhere in the world and we are leading the world in developing the technology to harness the power of the seas. Although these technologies are prospects for the longer term, they have the potential to make a meaningful contribution to the UK's energy goals, and to create significant industrial capability.

Increasing the contribution of renewable energy is a major plank of our energy and climate change policies. BERR (Department for Business, Enterprise and Regulatory Reform) has already provided over £35 million to UK wave and tidal developers - leading to the development of a number of full scale prototypes - and through the Marine Renewables Deployment Fund is providing a further £50 million to support the continued development of this industry. BERR is also working to overcome other barriers to this promising sector.



Jonathon Porritt
Founder Director of Forum for the Future and Chairman of the UK Sustainable Development Commission

There was a time, not so long ago, when cynics argued that wind power would never amount to much here in the UK – despite the UK being one of the windiest places in the world! Today, the UK wind industry is burgeoning, and making an ever greater contribution to our total energy needs year on year.

Predictably, we now hear the same cynics out there disparaging the potential contribution that wave power and tidal stream could make to our energy supply in the future – despite the fact that we have a huge amount of coastline to work with!

These people have held back the UK for long enough. There is a new industry in the making here, potentially creating thousands of jobs, generating a lot of new wealth, and delivering significant amounts of an increasingly precious commodity – namely, very low-carbon, environmentally friendly energy.

Not to seize hold of this opportunity with vigour and urgency would be insane.



Maria McCaffery MBE
CEO, BWEA

With the challenges of addressing the global issue of climate change come opportunities for individuals and companies willing to engage in the search for solutions.

Renewable energy is one such solution for reducing carbon emissions from the electricity sector, and one in which the UK can lead by example on the global stage. Given the huge natural strengths in our winds, waves and tides this country is uniquely well placed to develop technologies designed to harness them for clean energy production.

This booklet is the first step towards raising awareness of what wave and tidal stream energy could mean for the UK and is intended to provide an introduction to what the future may hold.

With such a great resource on our doorstep and exciting technologies at our disposal the future is bright for this emerging industry. It is up to all of us to ensure this becomes a reality.

Our climate is changing

we can no longer take our environment for granted we must work together to protect it

Climate change

Our climate is changing. The majority of the scientific community agree that the main cause of climate change is the release of greenhouse gases such as carbon dioxide (CO₂) from the burning of fossil fuels to heat and power our lives.

Unless the global community changes the way it uses and generates its energy, climate change and its impacts such as floods, droughts, heat waves and hurricanes may completely disrupt the global economy in years to come, along with the loss of countless lives. We are now witnessing some of the first signs of these disturbing changes.

Climate change needs to be tackled. We need to reduce our reliance on fossil fuels through better and more efficient uses of energy. Renewable energy systems generate electricity without producing harmful emissions from fossil fuels. Efficient use of renewable resources can help meet our energy needs and protect our planet from the threat of global climate change.

The challenge

There is no single answer to replacing fossil fuelled generation. The world needs a range of different technologies to meet its energy requirements. It is because of this need that more and more emphasis is being placed upon the development of sustainable forms of energy generation.

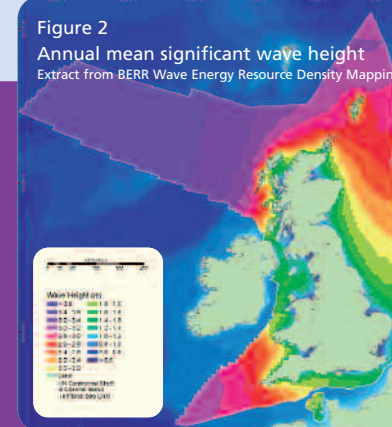
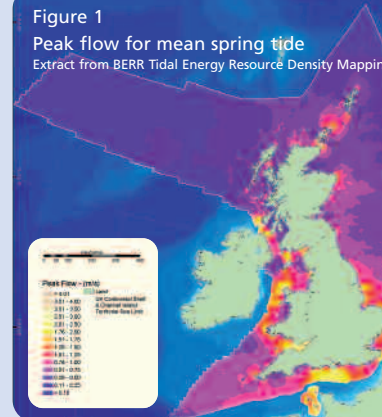
We already have hydro-electricity and growing wind and biomass energy industries but there are other opportunities out there too. Harnessing marine renewable energy, more specifically wave and tidal stream energy, is not new but it is only now that we are focussing on making it a reality.

Marine renewable energy can provide a significant contribution to our energy needs in the future. We have a huge untapped resource in the UK, but we need to put in place the technology, infrastructure and support to make best use of this clean inexhaustible energy supply.

These are challenging times for the wave and tidal stream industry but opportunities are being shaped to:

- Create a sustainable energy supply – Marine renewable energy is natural and inexhaustible, we will never run out of this clean renewable energy. By harnessing this resource efficiently, we will have a sustainable and environmentally friendly source of power for generations to come.
- Ensure security of energy supply – As competition for fossil fuels increases they will become harder to obtain. Using the marine energy around our own coastline will reduce our dependence on imported fuels.
- Build a new industry – Making marine renewables a reality will require us to establish new technologies, industries and skills that can be exported all over the world.

our challenge is to change the way we capture and use energy to protect the environment for future generations



The opportunity

Preventing climate change is in the interest of every person in the world. With governments supporting the development of new and sustainable energy technologies, there has never been a better time or stronger incentive to develop marine renewable energy systems.

The UK is well placed in terms of marine energy. There is significant tidal (see figure 1) and wave resource (see figure 2) around the UK, some of the best in the world. The UK's electricity consumption is around

350,000,000,000 kilowatt hours (kWh) per year. Given the available resource, marine renewable energy could perhaps produce between 15 and 20%¹ of this.

The UK has the opportunity to be a world leader for marine renewable energy systems.

The industrial heritage in the UK means that many of the skills required already exist and developing this industry now will mean the technology can be exported all round the world.

the opportunity is to create a new sustainable industry around clean energy production

What is wave and tidal stream energy?

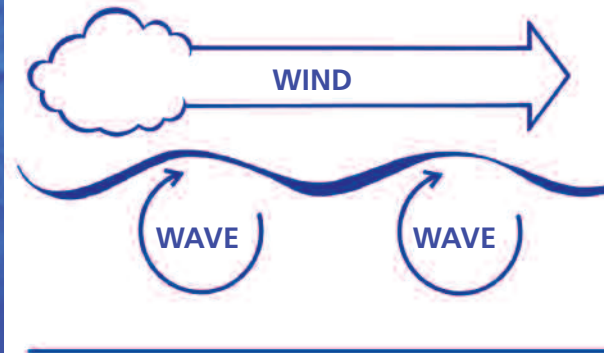
Wave energy

Wave energy occurs in the movement of water near the surface of the sea.

Waves are formed by the wind which effectively drags at the water as it blows across. The stronger the wind and the longer the distance over which it blows, the larger the waves and the more energy they carry. For this reason, waves on the west coast of the UK tend to contain more energy than those on the east coast as the wind can blow all the way across the Atlantic (approximately 4000 miles!).

As waves reach the shallower water near our coasts, they begin to lose energy through friction with the seabed and eventually break on the shore. This means that the greatest amount of energy is available in deeper well-exposed waters offshore.

Wind blows over the surface of the sea. This moves the water near the surface and creates waves.



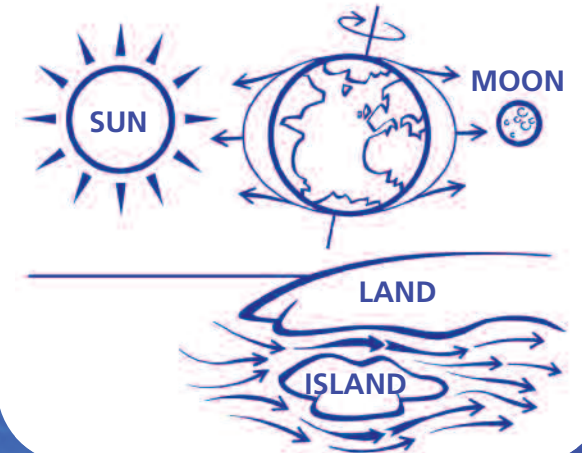
Tidal stream energy

Tides are caused by the gravitational effects of the sun and the moon on our oceans. In the UK this creates a twice-daily rise and fall in sea height. Since the motions of the sun and the moon around our planet are completely predictable, so are the tides. The amount of energy which can be extracted at any given time can be forecast accurately.

Tidal streams are fast-moving currents created as water flows between areas of differing tidal height. They are at their strongest in areas where passage is funnelled, such as occurs around headlands and between islands.

The UK has many sites with strong tidal streams around its coastline as well as exhibiting some of the highest tidal ranges in the world.

The tides are caused by the relative movements of the earth, sun and moon.



How do wave energy devices work?

There are several different types of wave energy device. All take energy out of the motion of the water near the surface. They all convert the action of the waves into movements that power generators to produce electricity.



Overtopping

A floating pool is placed in the sea. As waves arrive they are forced up over a ramp into the pool. The water then flows back into the sea through a turbine to produce power.



Surface following

Several floating structures are hinged together and follow the surface of the sea. The motion of the structures against each other produces power.



Oscillating water columns

A column of water is held in a tube. One end of the tube is open to the sea, the other open to the air. The waves make the water column move up and down. This in turn forces air back and forth through an air turbine to produce power.



Buoys

A floating structure is forced to move by waves which can move up and down or side to side. This motion can be used to produce power.



Terminators

A long line of floating structures are placed in the sea. As the waves arrive at one side of this line they cause the floats to move against each other, producing power.

How do tidal stream energy devices work?

Although there are many different designs of tidal stream turbine, there are only three main methods of harnessing the flow from tidal streams.



Cross-flow turbines

A cross-flow turbine is placed in a tidal stream. As water flows past, the turbine turns and produces power.



Axial turbines

An axial turbine is placed in a tidal stream. As water flows past, the turbine turns and produces power. This works much like a wind turbine.



Reciprocating hydrofoils

A set of hydrofoils are placed in a tidal stream. By controlling the pitch of the foils the water flow forces them to move up and down repeatedly. This motion is used to generate power.

These images are for illustration only and are meant to convey how energy is captured by the devices. They are not intended to represent any specific mooring or anchoring systems as these will be device and site specific.

What will marine energy projects look like?

As you have seen, there are lots of possible types of marine renewable energy systems.

Some wave devices will be installed near the shore, perhaps built into harbour walls. Others might be sited in deeper offshore areas. Some devices may be very large and installed on their own and others may be smaller and grouped into farms or arrays.

Tidal stream devices will be located where tidal streams are strongest. These are mostly found near headlands and in the channels between islands and the shore.

Electricity will be carried to shore using undersea cables. This electricity will then enter the existing electricity system and be carried to our homes on the existing electricity network.

However they work, marine energy devices will all convert the inexhaustible movement of the waves or tidal streams to electricity. This electricity will then be used to light and power our homes and businesses.



Image is for illustrative purposes and is not to scale.

What about the effect on the marine environment?

Installing new marine renewable energy systems will mean changes to the way we use some parts of the sea. These changes might affect some existing users of the sea and its environment. New technologies are carefully checked to ensure that their effects are minimal and balanced with the benefits they bring.

Environmental considerations – For all installations above a certain size, a marine renewable energy developer will be required to undertake a formal environmental impact assessment, and the Government and other consultees must be comfortable with the results. This process involves taking baseline information about the existing environment and estimating the likely effects the project might have. Where technologies have not yet been proven in some environmental circumstances, monitoring will be undertaken to ensure that there are only minimal effects upon the environment, and to help plan for future projects.

Pollutant-free – Wave and tidal stream devices produce no greenhouse gases unlike conventional fossil fuelled generation. The technologies under development have carefully designed moving parts and where lubricants and hydraulic fluids are needed, biodegradable and non-toxic liquids can be used.

Visibility – Most marine renewable energy devices sit beneath or very close to the surface of the water and take up a very small area. This means that they will often not be visible from the shore. In order to safeguard navigation, these devices will be coloured and their positions marked appropriately.

Wave energy displacement – Wave devices take energy out of the sea. They will not completely stop the waves and will not noticeably reduce the size of the waves reaching the shore. However, some devices could feasibly be designed to protect sensitive shores from erosion in the future. It is not expected that surfing, swimming or other watersports will be affected.

Effects on tidal streams – Tidal stream devices take energy out of the tides, but in practice will only take a very small amount of the energy available. This will ensure that the surrounding environment is not unduly affected.

Of course there are many environmental and personal considerations to be taken into account when developing marine renewable energy. Every time a new site is developed, you will have the opportunity to find out more about how it might impact on you through public consultation and information placed in the public domain.

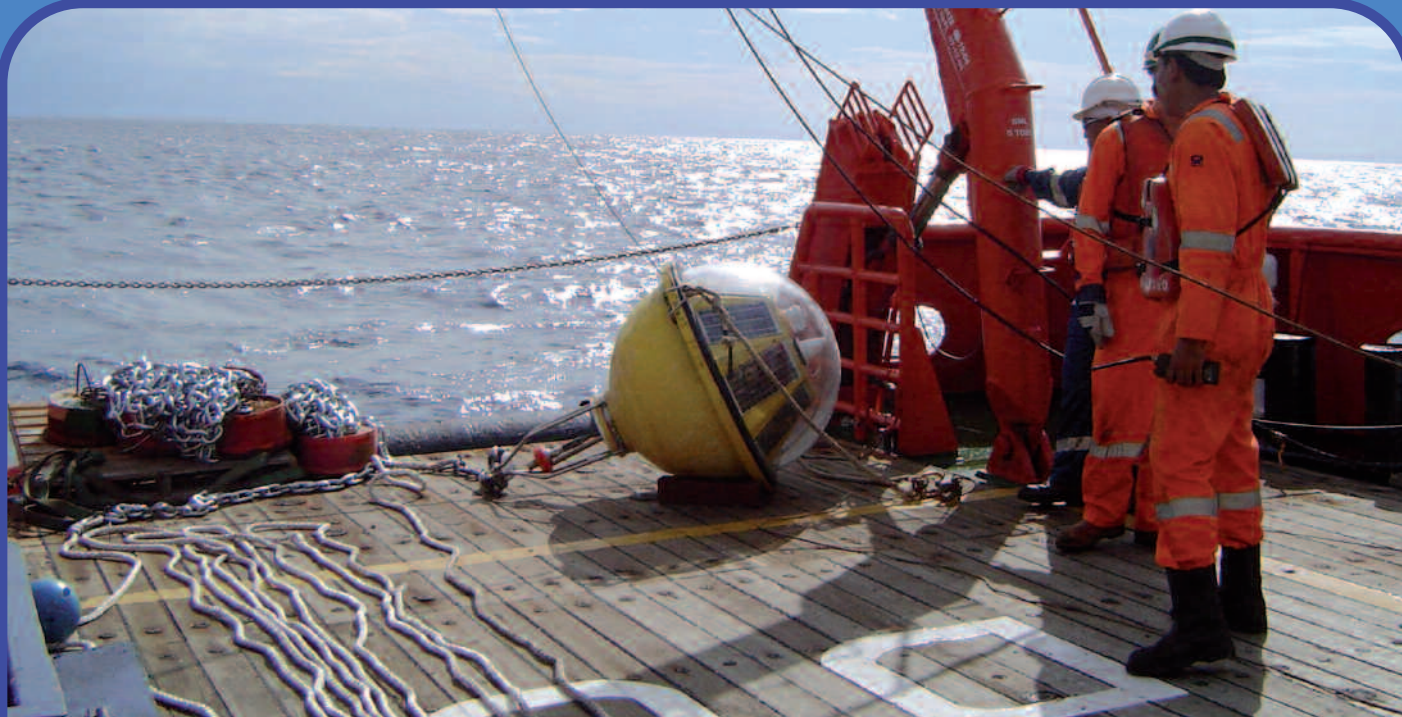
climate change is the biggest environmental threat we face, clean marine renewable energy is part of the solution

Image courtesy of tedleeming.com



we will build a new marine energy industry on our skills and strengths to meet our future energy needs

Image courtesy of Fugro GEOS



Creating good business

The UK has a great maritime foundation upon which we can build. The development of a marine renewable energy industry will bring economic benefits such as new jobs. Marine renewable energy will reduce our reliance upon conventional fossil fuelled generation and will become an important part of our energy industry.

Skills – We already have many of the skills needed to develop marine renewable energy systems. The technologies used are very similar to those in other industries such as in shipbuilding, exploring and drilling for oil in the North Sea. We have developed complex underwater robots, installed sub-sea cable systems, designed new floating offshore platforms and exported this technology all over the world. We can learn from this experience and create a world-wide market for these new systems.

Engineering – Marine renewable energy systems will be designed to operate for many years in the sea and can expect to see all sorts of weather conditions including storms. Their success depends on their ability to survive these. This is a tough engineering challenge which will need to be addressed in every design. However, this challenging environment is not new and we can learn much from our past seafaring experiences.

Regional benefits – As an island, the UK is well placed to use its numerous coastal harbour and dock facilities to build these marine renewable energy systems for domestic and global supply. This will create huge regional opportunities as well as enabling some of our once thriving shipbuilding areas to regenerate and be at the forefront of industry once again.

Tourism – There is increasing interest in new energy technologies and these new marine renewable energy arrays could become tourist attractions. We can expect local education centres to be built to demonstrate the systems and boat trips may be run for visitors to see the sites.

Other sea users – The sea is used by many different people and industries and we must share this space responsibly. The Marine Bill will help organise how this is managed. Most marine renewable energy devices take up only a small area and can be accommodated into our existing sea uses. For example a commercial wave array may only occupy a few square kilometres and a tidal stream array might use only a small fraction of a tidal channel.

Vision of the Future

Marine renewable energy provides us with an opportunity to take control of our future and to build a new industry. This will help reduce our dependence on fossil fuels, reduce climate change and enable us to create a sustainable future for everyone.

We have the imagination and the ideas to find the solutions, we have the skills and experience to build the technology and we have the incentive to make a difference.

**the future is in
our hands**



Sources of further information

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WWF: Marine Protected Areas and Marine Spatial Planning
www.wwf.org.uk

Renewable Energy Installation Farms and Fields
Provision and Maintenance of Local Aids to Navigation

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The Path to Power – Delivering confidence in Britain's wave and tidal stream industry, June 2006, published by BWEA
www.bwea.com/marine

Renewables

Building a **sustainable** future for generations to come

E.ON Renewables is committed to helping build the UK's marine energy capabilities to harness the potential of our seas.

We have a track record of developing successful renewable projects including both on and offshore wind farms and what will be the UK's largest dedicated biomass facility.

Utilising these skills and our own Marine Development Team, we will make a significant contribution to this industry in the UK.

www.eon-uk.com/renewables



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