Marine Renewable Energy Potential in Guernsey

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Renewable Energy Team Vision – Long Term Legacy

Overall vision: *"Guernsey will generate **local, affordable, renewable energy,** initially for local consumption, which is **low carbon** and will provide greater **energy security** and **independence** **while making a contribution to a lasting commercial, financial and environmental legacy."***

About the Renewable Energy Team

The Renewable Energy Team (RET) was formed by the States' Commerce and Employment Department and the work will be part of the new Environment and Infrastructure Committee.
RET's mandate is to investigate the potential for macro renewable energy projects and to facilitate and consent the development.

This leaflet provides summary information around renewables globally and their potential application in Guernsey to supplement the public poster display at the airport and Beau Sejour as part of the States of Guernsey's Renewable Energy Team (RET) Public Engagement work.

The leaflet is based on work undertaken by the States of Guernsey's RET and PhD research carried out by the University of Exeter on Guernsey.

Renewable Energy Team Mission

To prepare the groundwork for development of renewable energy in the near to longer term, RET will ensure that all the required political, legislative and commercial processes (including leasing) and approvals are in place by 2018, as well as a base line environmental and resource understanding of Guernsey waters, and continued public engagement to ensure local support and acceptance.

This is to enable at least the initial deployment of local macro renewable energy generators in the early 2020's if economically viable.

Renewable Energy Team Top 3 objectives for 2016

Effective public engagement and communication aligned to a developed communications strategy – look to ensure that the people of Guernsey are engaged and well informed of the local position with regards to renewables.

Undertake the next stage of feasibility work for a 30 megawatt (MW) offshore wind array in Guernsey waters, in conjunction with Guernsey Electricity Ltd, so that an informed decision on how to progress can be made.

Facilitate Guernsey obtaining control of the seabed and extension of territorial seas to 12 nautical miles.

For more information and to provide feedback please visit
www.guernseyrenewableenergy.com or contact: peter.barnes@gov.gg

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RET work – Past and Present

RET has undertaken a significant amount of work looking into the environment around Guernsey as well as the local renewable resources and the renewable industry, and continues to do so.

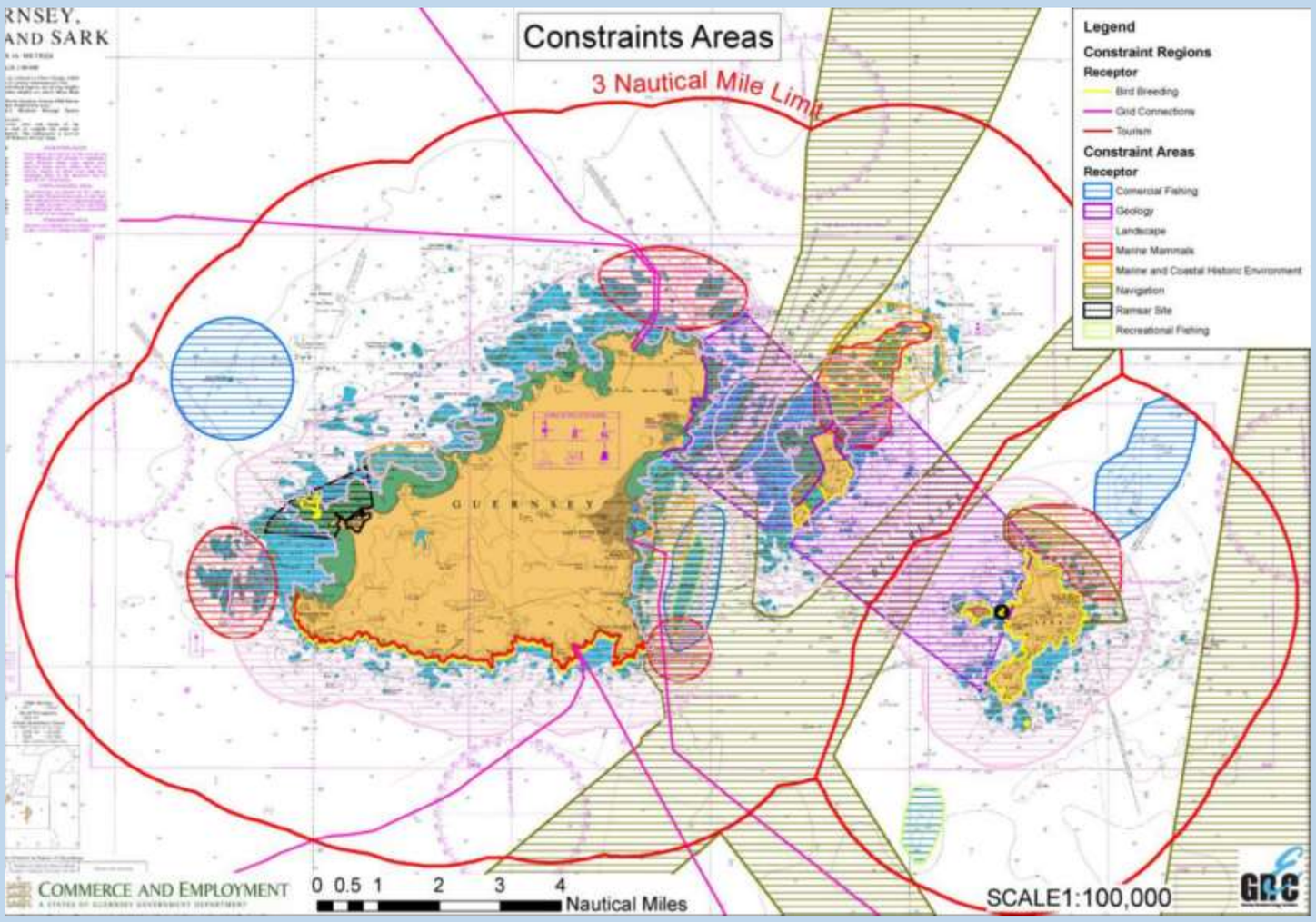
RET has published a number of documents on their website, including some of those listed below:

- Regional Environmental Assessment of Marine Energy.
- Benthic (seabed) Towed Camera Survey – Characterisation of the Benthos (seabed environment) in the Big Russel

Images from the Big Russel Survey 2010

- Wave and Tidal Prefeasibility Report
- Status of Wave and Tidal Energy Technologies
- Wind Wave and Tidal Resource Mapping for the Territorial Waters of Guernsey
- Feasibility of Offshore Wind Energy
- RET Strategy
- Provisional mapping of the marine environment using GIS


Anemometer at Chouet



- Public Engagement – Perception of Marine Renewable Energy
- Identifying feasible financing strategies
- How Renewables interact with other areas

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Frequently asked questions – When, How, Why, How Much

Q. ***When is marine renewable energy likely to be developed in Guernsey?***

- **Wind energy** is a relatively commercially mature technology and is most suited to near term development.
- **Wave energy** and **tidal stream energy** systems are currently pre commercial– with no established arrays.
- It is unlikely that wave and tidal systems will be developed in Guernsey until into the 2020s. If development accelerates Guernsey is well placed to react.

Q. ***How is RET developing marine renewable energy in Guernsey's waters?***

- RET is working with local, UK and French experts to improve understanding of Guernsey's environment and resources to aid informed decision making.
- The States has passed legislation that will enable Guernsey to regulate renewable energy and protect the environment within its waters.

Q. ***What are the costs of developing marine renewable energy in Guernsey's waters?***

- Renewable energy is generally more expensive than traditional electricity sources.
- Offshore wind costs are falling; wave and tidal costs remain high – costs should fall in the future as the industries mature.
- Many countries have subsidies/incentives for renewable energy – Guernsey does not.

Q. ***Why are RET looking to develop marine renewable energy in Guernsey's waters?***

- Renewable energy sources do not result in the release of greenhouse gases (e.g. carbon dioxide).
- 42% of Guernsey's electricity in 2015 came from fossil fuels
- Marine renewable energy offers greater independence regarding the cost and security of our energy.
- Fossil fuels are imported from foreign countries, increasing Guernsey's vulnerability to external forces.

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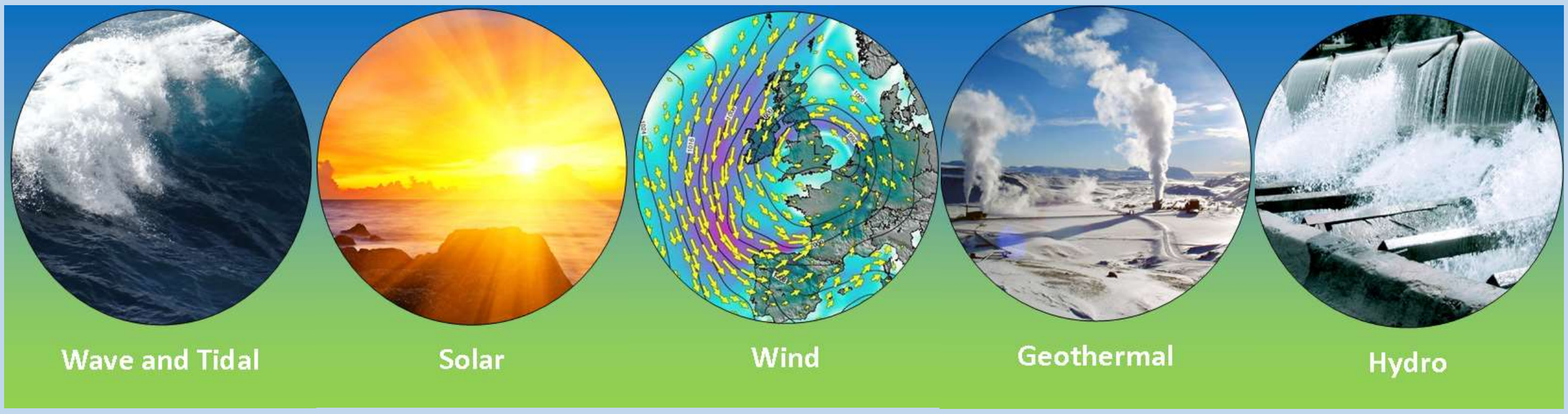
Marine Renewable Energy – an introduction

- **Renewable energy** comes from sources that are not depleted when they are used. They include solar, wind, hydro (river), geothermal (heat energy from the earth), wave energy and tidal energy.



- **Marine renewable energy** means power generated by wind, wave and tidal energies that come from coastal and sea areas (the marine environment).

- **Offshore Wind Power** technology is similar to onshore wind, with devices in offshore waters where they are more exposed, so greater power is available. Guernsey's prevailing westerly winds offer an opportunity – especially with the advancement of floating platforms.

- **Tidal Stream Power** resource is greatest (fastest) where there is tidal constriction, often between two land masses (e.g. the Big Russel) or around peninsulas.

- **Tidal Range Power** resource is best where differences between high and low tide are greatest. While Guernsey has a reasonable tidal range it would require significant wall construction to be viable.

- **Wave Power** involves converting the motion of the wave into electricity and it is more predictable than wind power. With 50m+ depths within a couple of miles of the shore, Guernsey can take advantage of this resource.

- RET aims for Guernsey to be in a position to take advantage of its natural resources.

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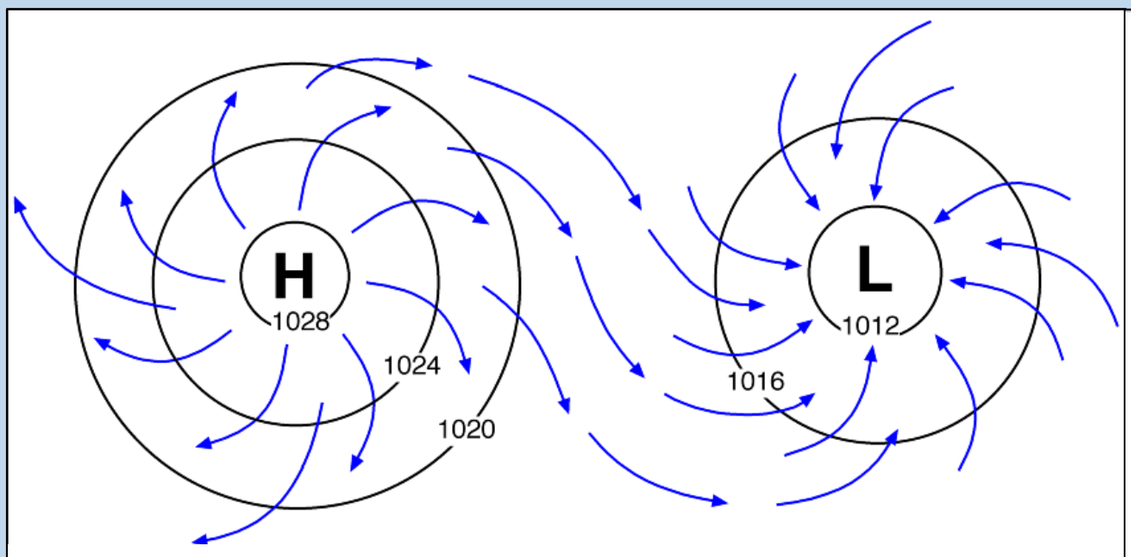
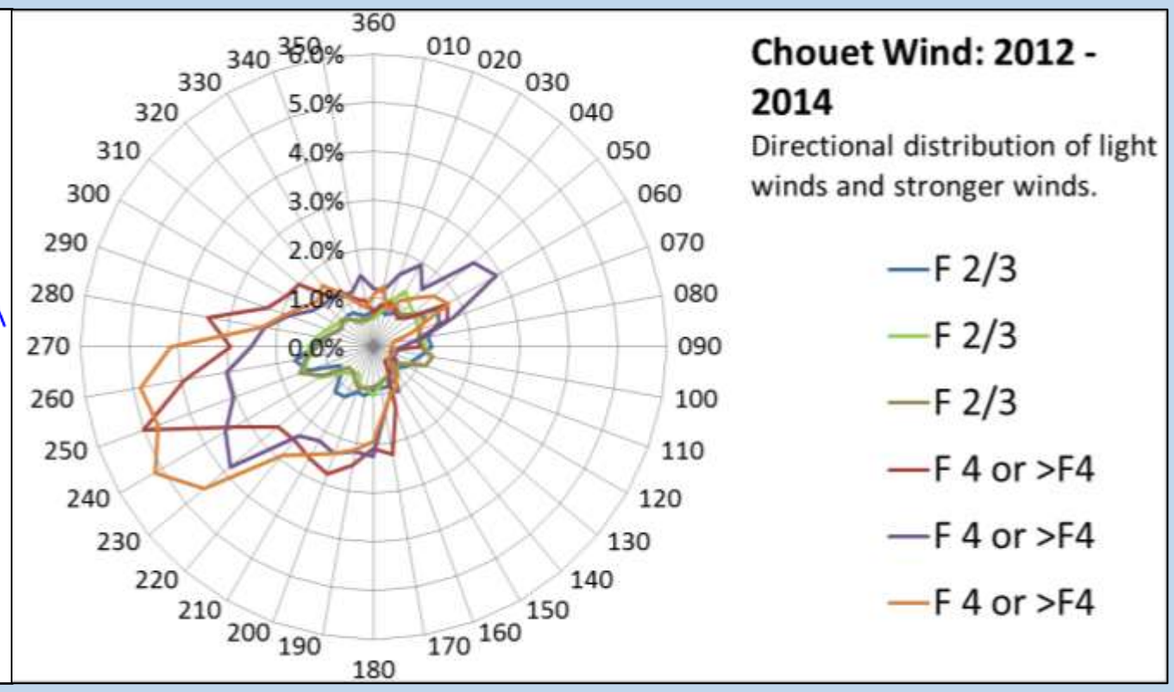
Offshore Wind Energy – an introduction

- **Offshore Wind Power** is created by differences in air pressure – caused by uneven heating of the air – with air moving from high to low pressure; wind direction is influenced by the rotation of the earth (the Coriolis effect).



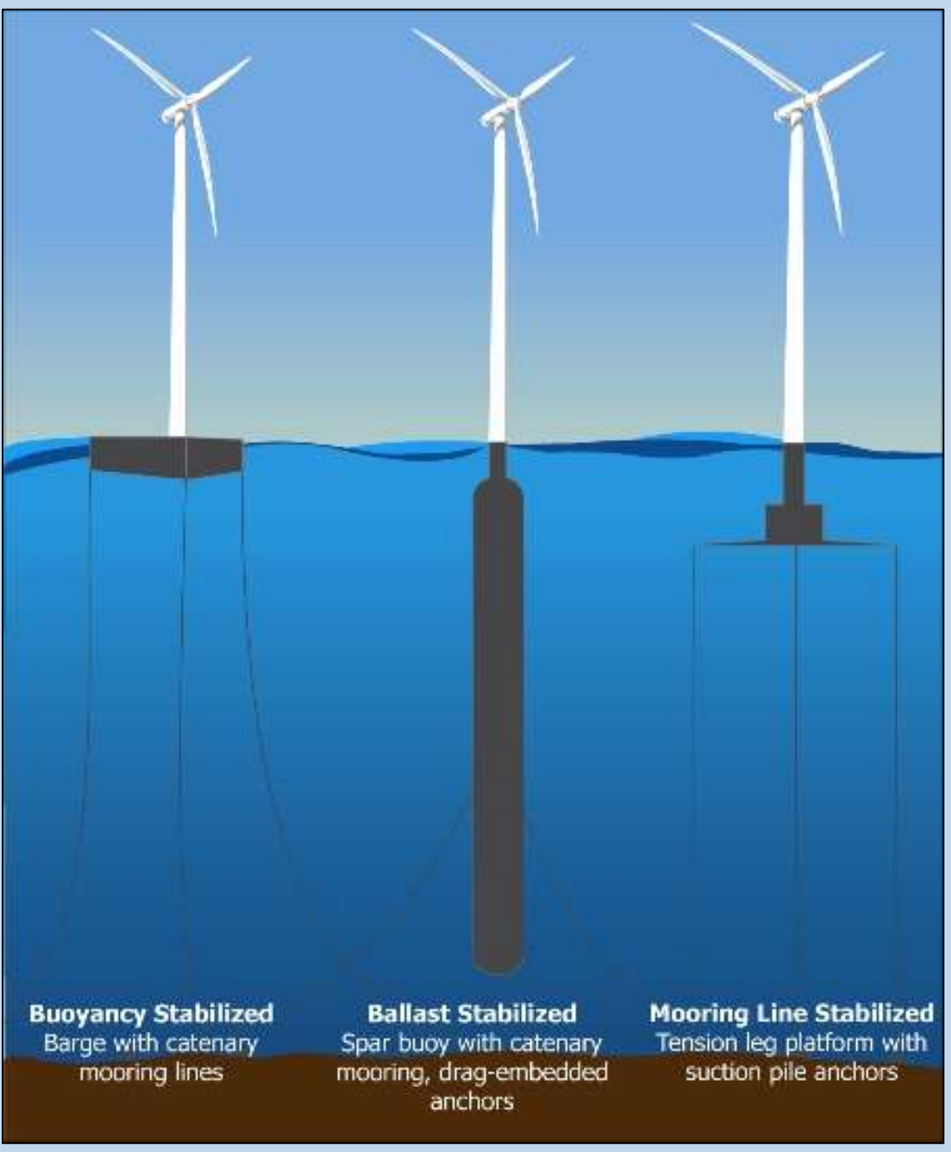
A high pressure and low pressure center with wind directions (northern hemisphere). Circles are isobars with pressure in mb.

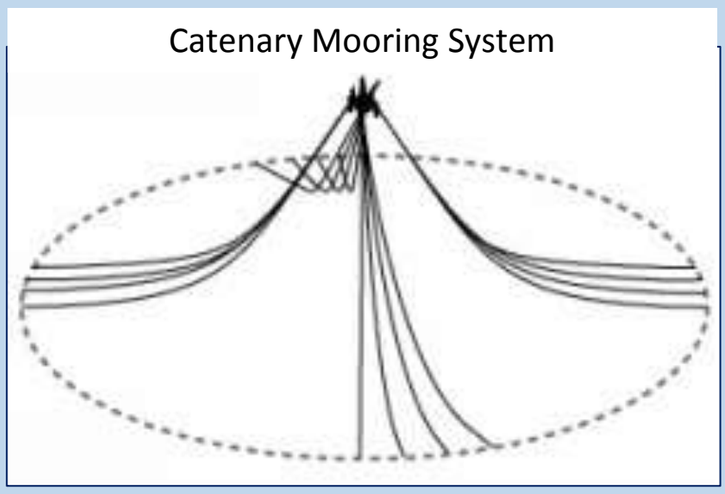


- Building wind turbines at sea is more expensive than on land – sea conditions mean devices have to be more durable.
- Wind farms can be larger offshore, with potentially fewer people directly affected than onshore.
- Research indicates that offshore wind can be controversial, with a high value given to the view out to sea.

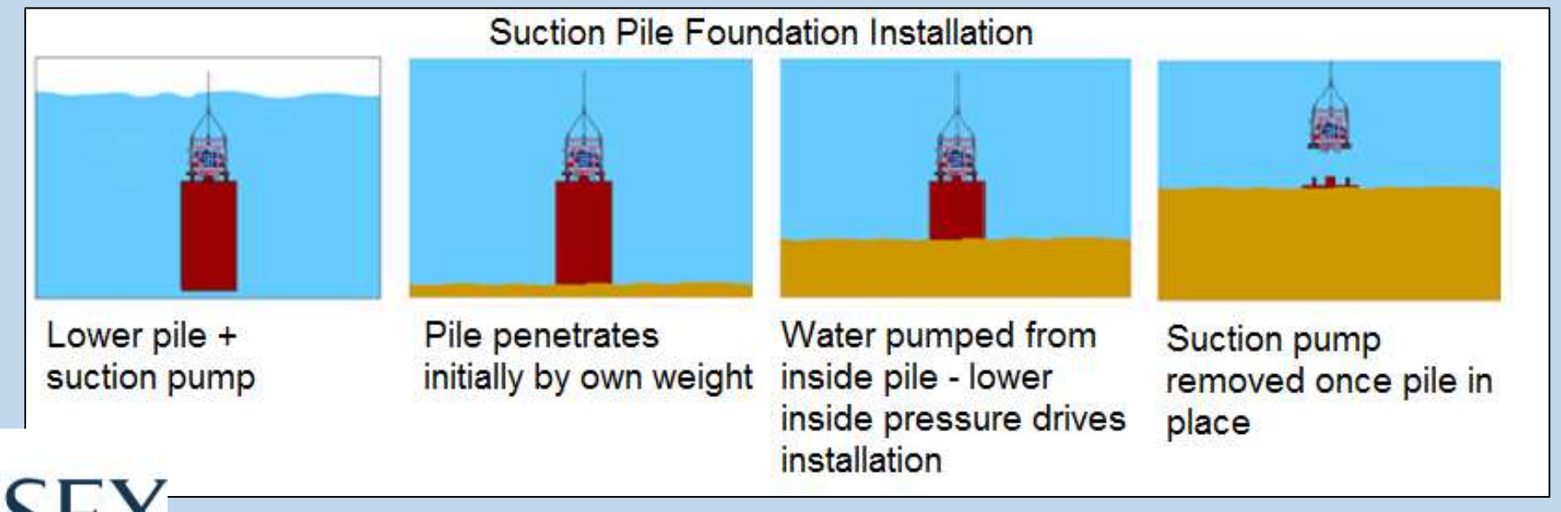
It's an engineering challenge to fix wind turbines to the sea bed. Newer designs aim to use floating platforms to allow access to deeper waters.

The industry has identified 3 basic methods of stabilising floating wind developments:





- ➢ Buoyancy stabilized platforms consist of a barge with catenary mooring lines (picture right). The curve of these lines raise the resistance of the anchors.
- ➢ Ballast stabilized platforms include a spar buoy (tall, thin buoy), catenary mooring, and drag-embedded anchors.
- ➢ Mooring line stabilized platforms consist of a tension leg platform with suction pile anchors (picture below).



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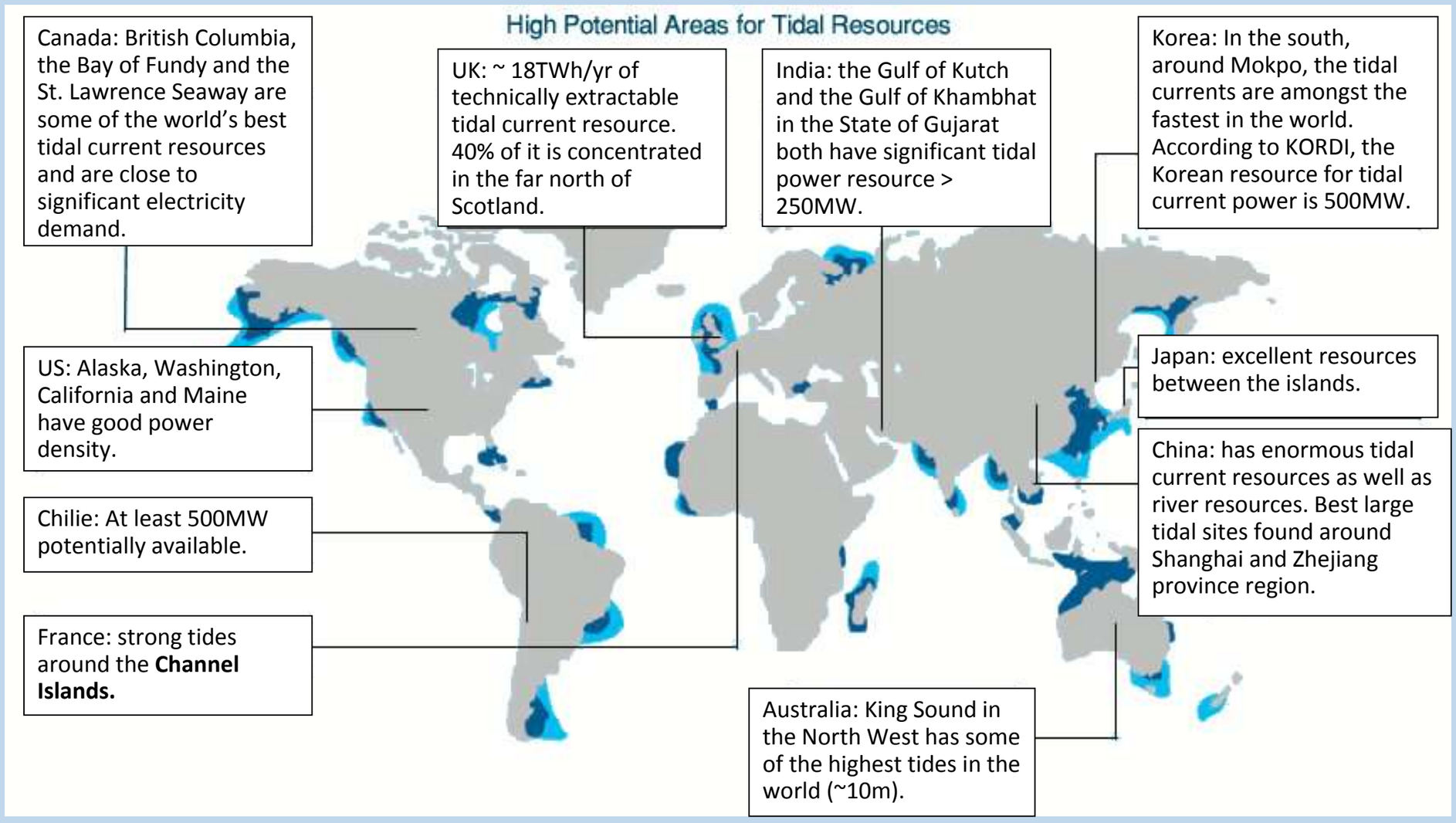
Tidal Stream Energy – an introduction

- Tides are caused by the pull of gravity exerted by the moon and sun on the Earth.
- The resource is greatest (fastest) where there is tidal constriction, often between two land masses (e.g. the Big Russel) or around peninsulas.
- **Tidal stream devices** use fast-flowing currents of water caused by tidal constrictions that are often caused by channelling through narrow seas such as the gap between two islands (e.g. Herm and Sark).

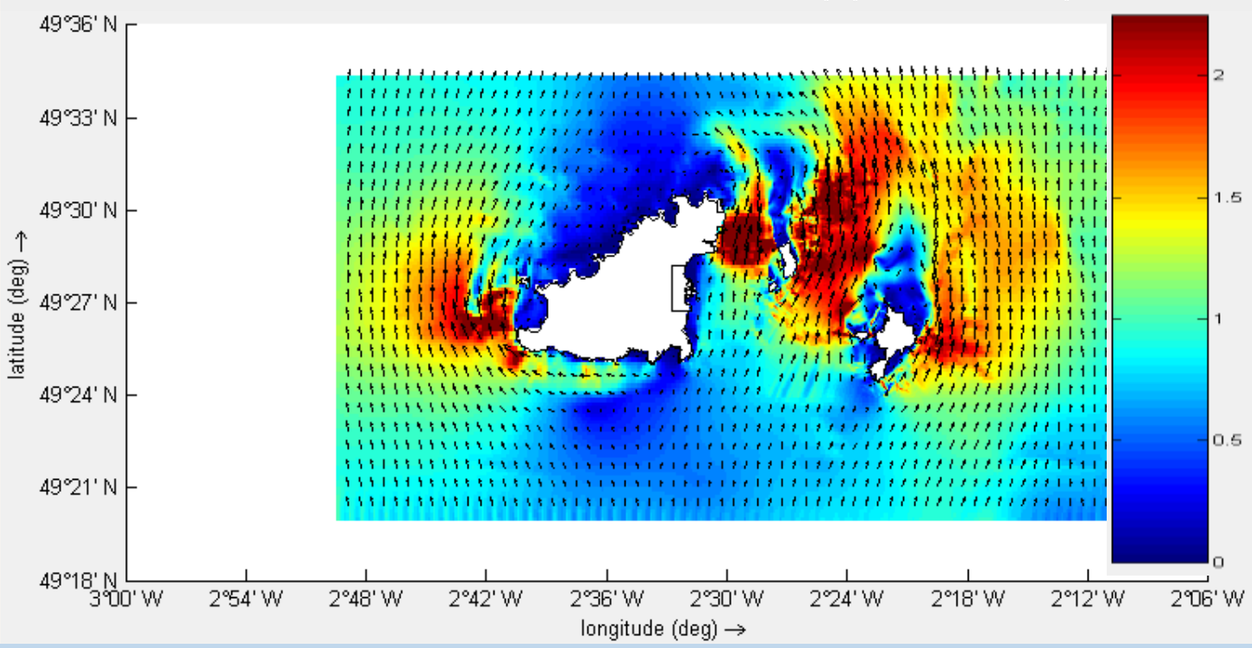


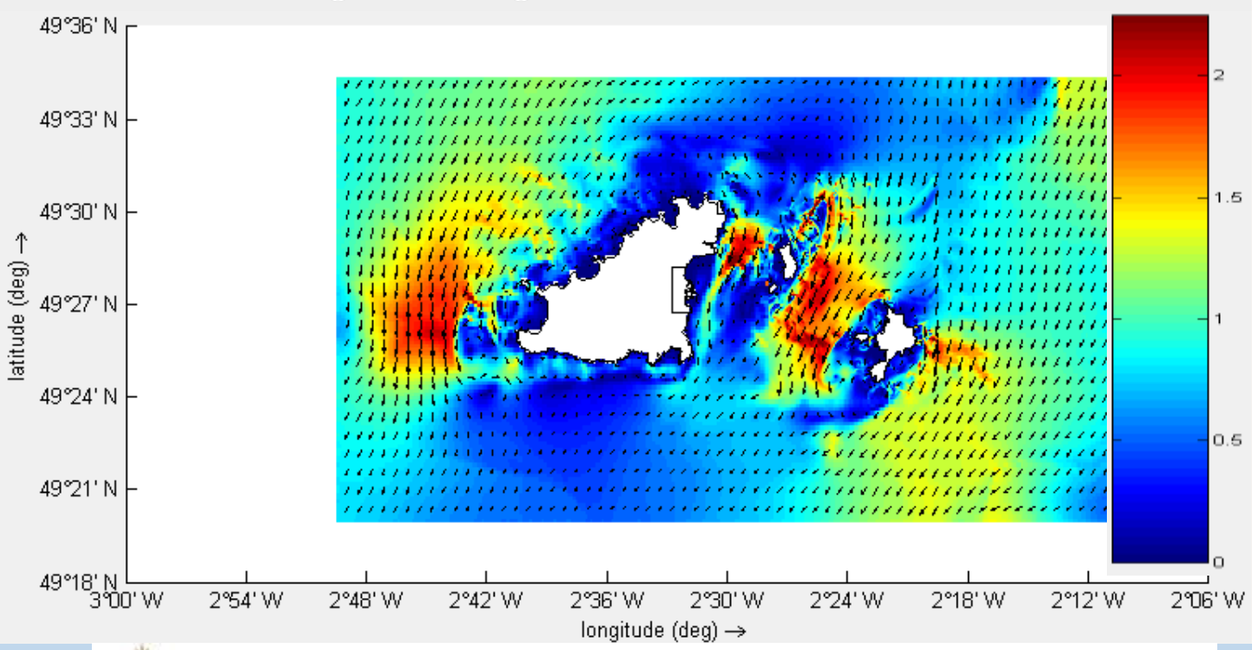

Tidal resources



- Global resource estimates vary; tidal stream energy may supply more than 150 TWh annually.
- The UK's resource is estimated to be more than 20 GW (excluding the Channel Islands).
- Other areas with significant resource potential include Canada, China, Australia, New Zealand, North America, Argentina, Russia, France, India & South Korea.

Identification of Guernsey peak tidal speeds and direction – averaged through the water column





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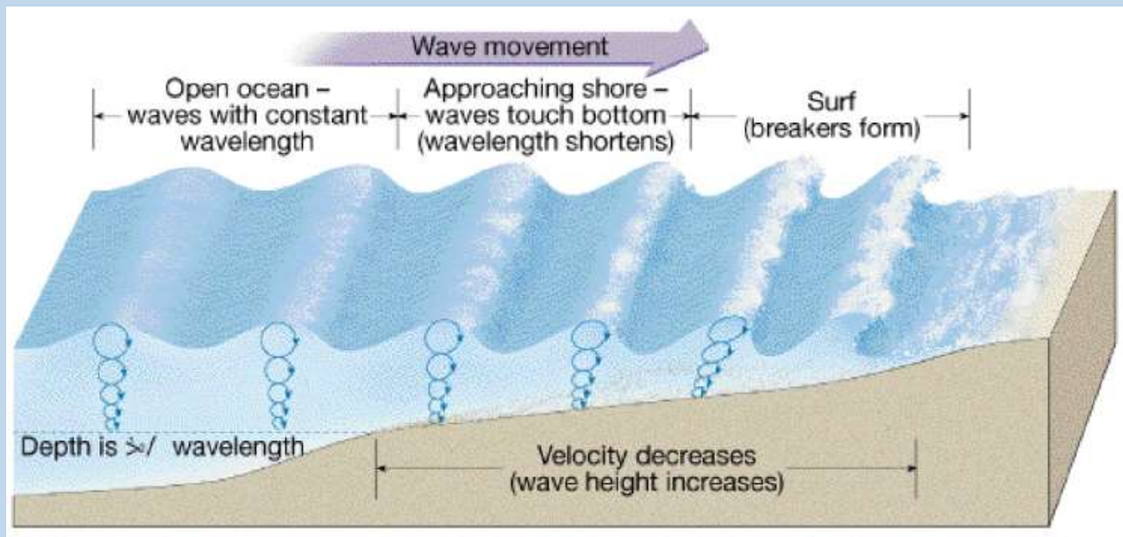
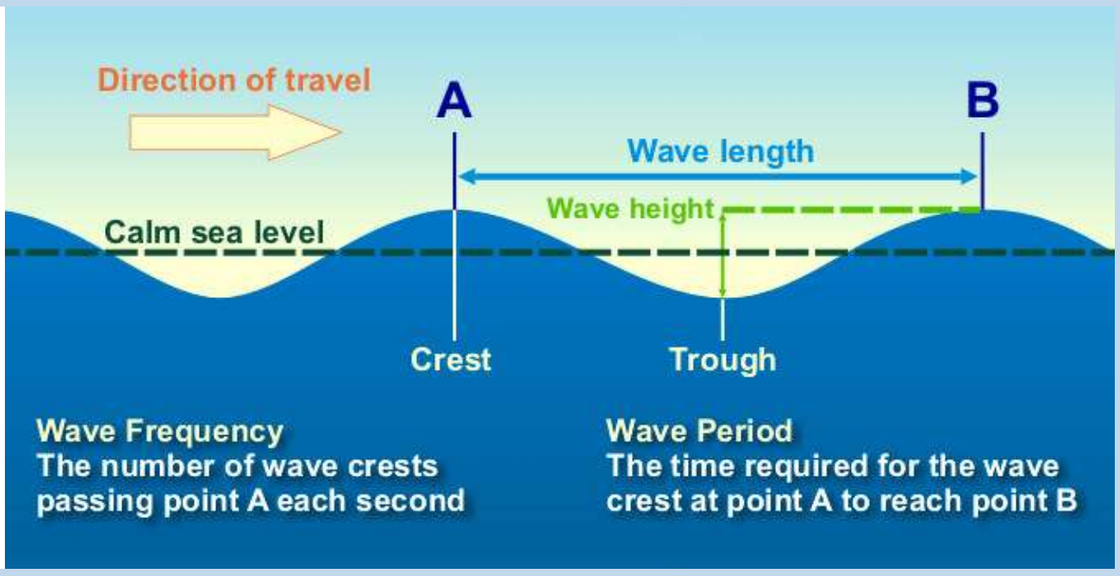
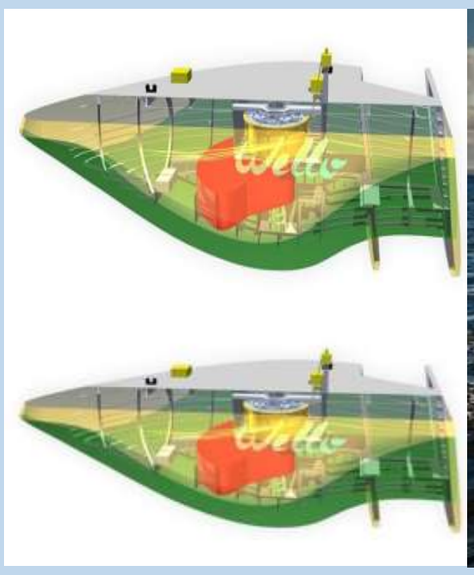
Wave Energy – an introduction

- **Wave Power** is created by the wind out to sea blowing over the surface of the water, creating a swell due to friction. Rotation of water particles within the swell causes the wave to move forward.

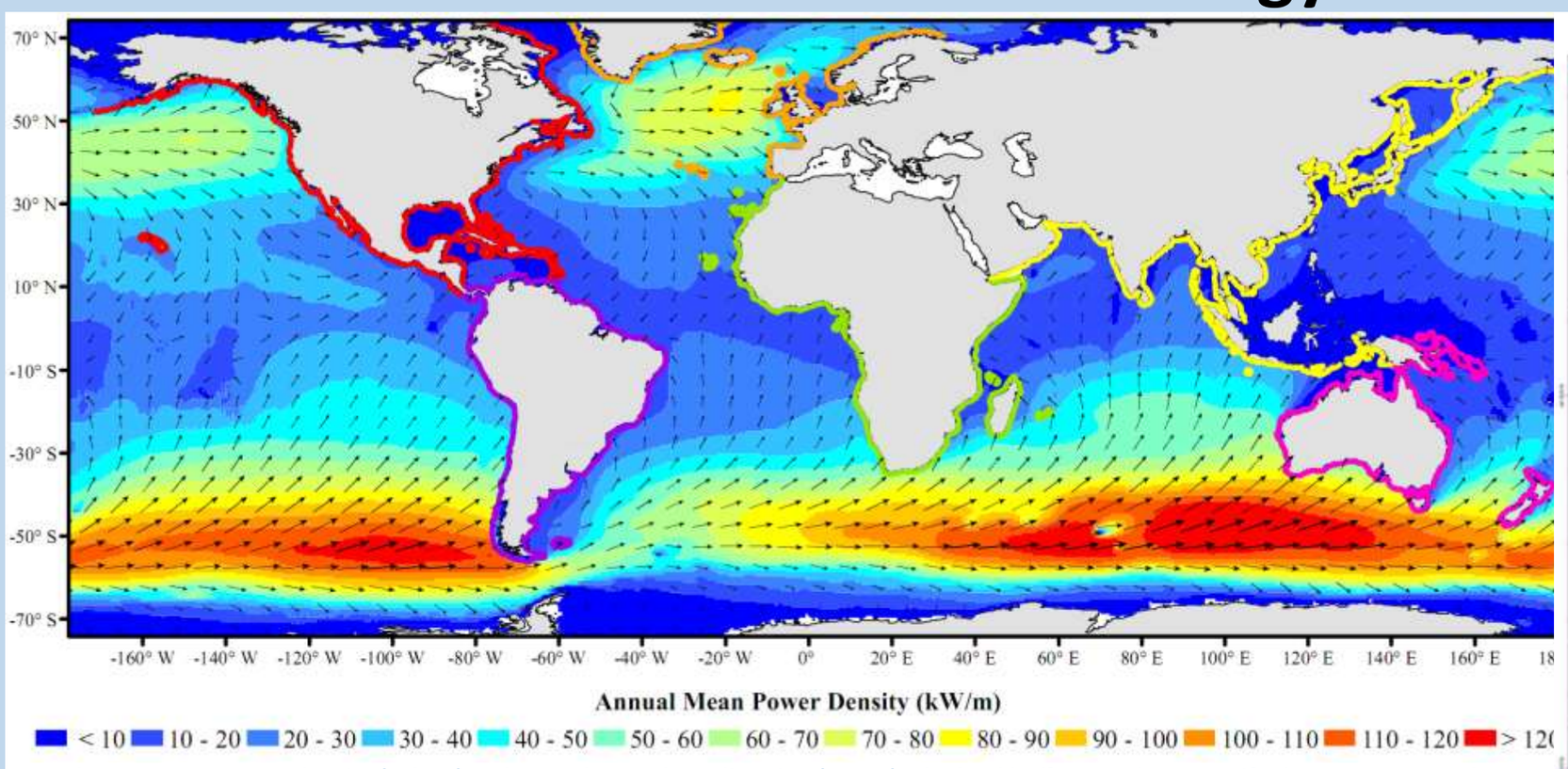




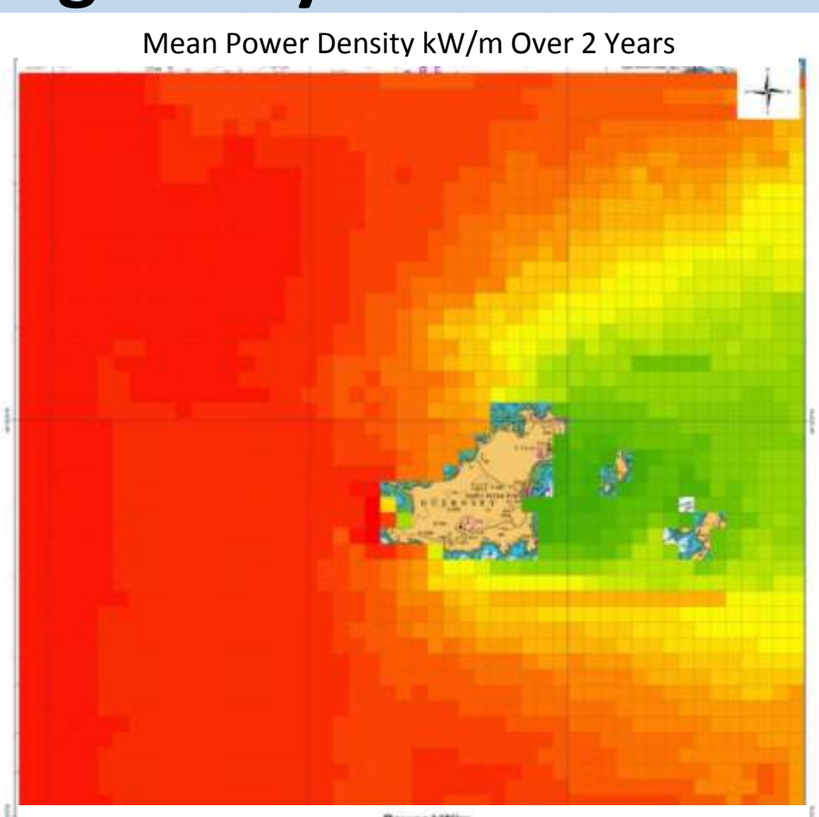
- **Wave energy devices** convert the motion of the wave into electricity. Currently, different technical designs are being trialled to do this as efficiently, cheaply and robustly as possible.



How much wave energy is there globally?



Annual mean wave power density (colour) and annual mean best direction (arrow). The land buffers used to quantify the resource are also shown, coloured by continent (Source - *Gunn and Stock-Williams 2012 - Quantifying the Potential Global Market for Wave Power/WaveWatch I*



The northern hemisphere wave climate is more seasonal than the southern hemisphere, with significantly more energy in the winter months than the summer. There is also a greater expanse of open water in the southern hemisphere. This is why the greatest annual resource is found in the southern hemisphere. The precise performance of a wave device depends on wave height and period.

Guernsey's west coast is exposed to the Atlantic and so has the highest wave resource. Early modelling suggests that there is a mean power density of at least 24 kW/m. This offers a suitable resource. More work is required to fully quantify the resource.

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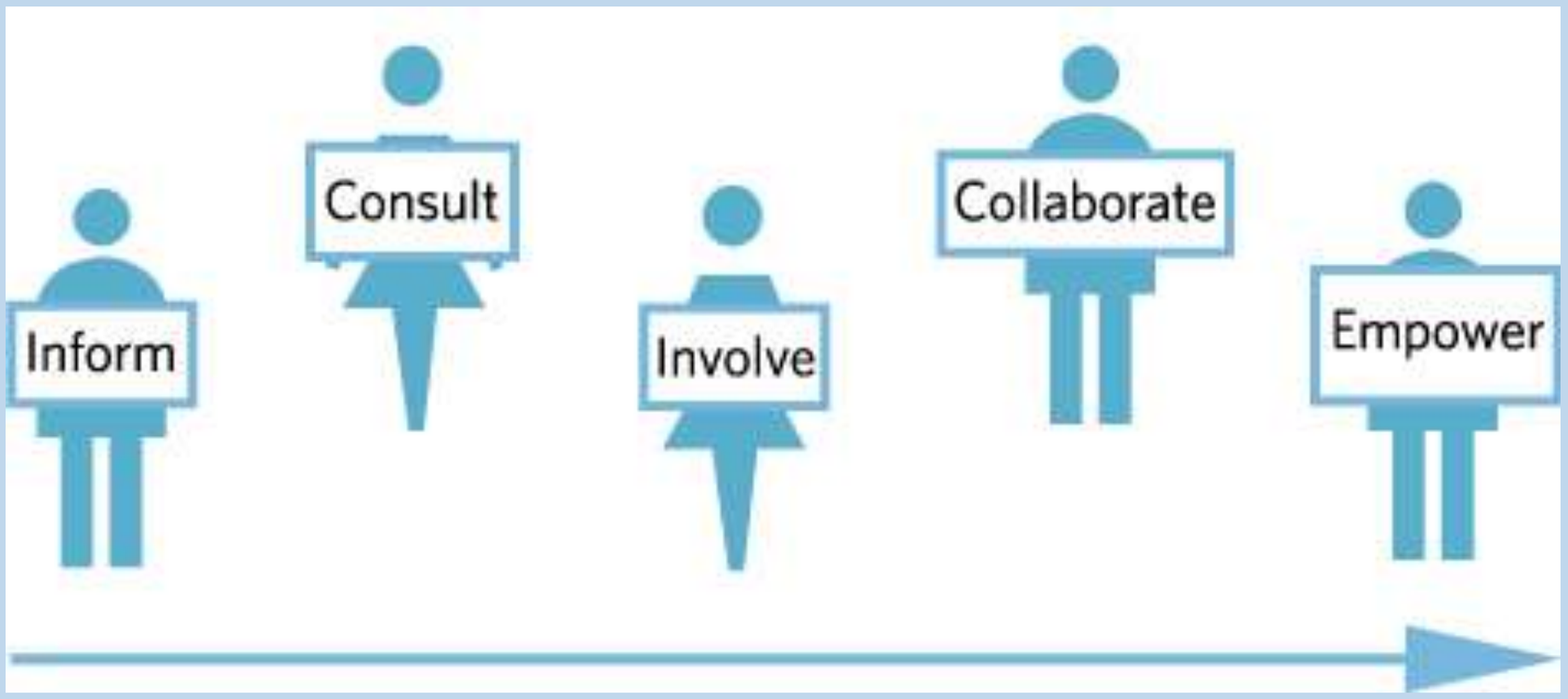
Engaging with the Public

Public engagement is common practice as part of any renewable energy project. It involves informing those affected by a project about what it will involve and gaining their feedback about these proposals.

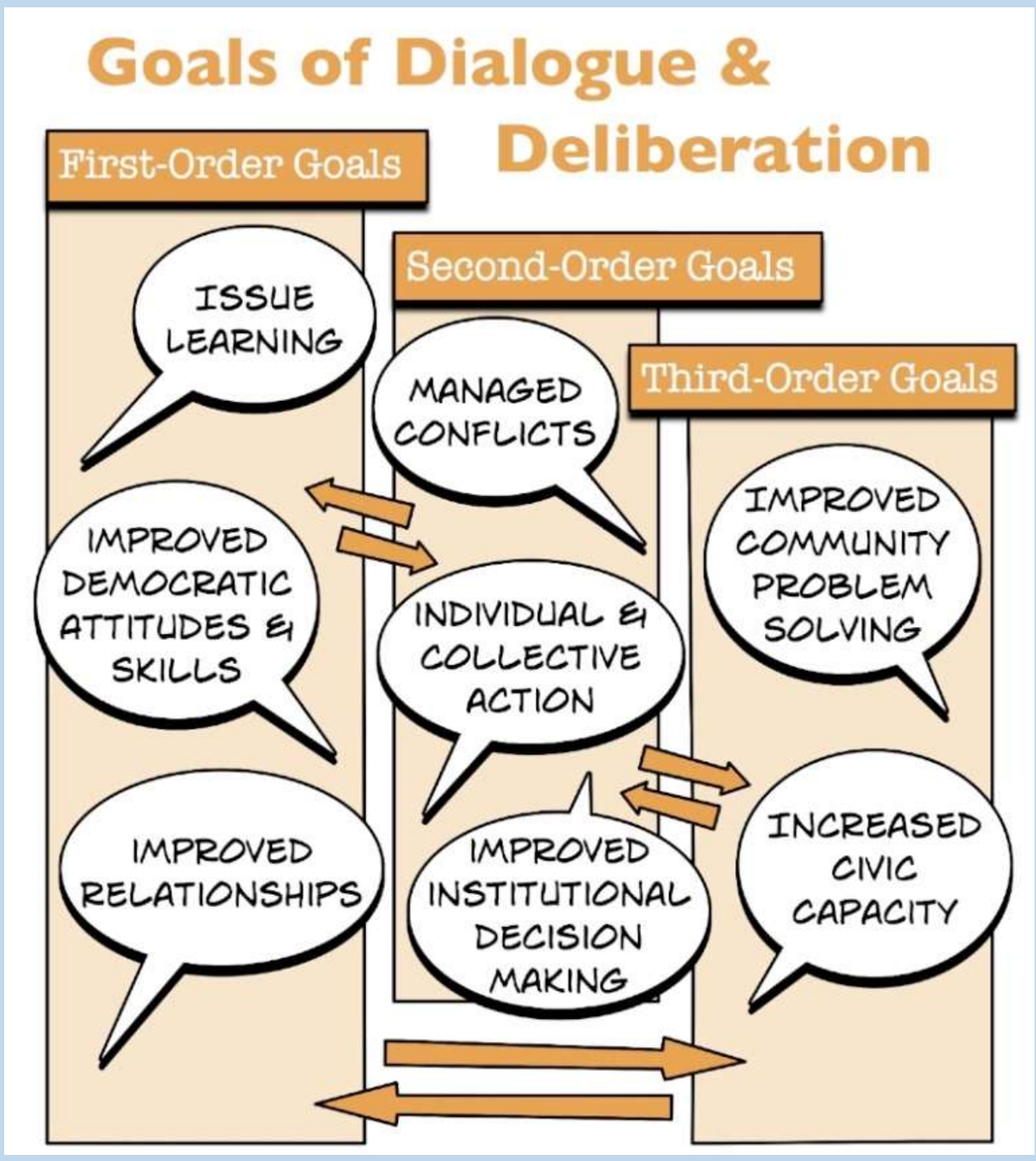
Why do it? Engagement has been prompted by the following motives:

- We want to gain public feedback which will lead to a better quality proposal
- It is morally right to inform those who will be affected by energy projects
- We are keen to work to avoid public objections or 'NIMBYism' (Not In My Back Yard)
- By engaging with the public we hope to build trust



Methods of public engagement

- **Information** (e.g. leaflets, displays, websites, Media releases) –a one-way flow of information to the public. RET is looking to actively engage in this way through the poster and leaflet displays in addition to ongoing media engagement.
- **Consultation** (e.g. questionnaires, focus groups, open days) – this involves some two-way communication between the parties. RET have worked with the University of Exeter to undertake a PhD that used these methods to understand view on marine renewable energy.
- **Deliberation** (e.g. citizens juries) – involves communication at a deeper level and leads to exchanges of opinions and capacities for all parties and can increase trust.



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Participant photography: Bringing local values into energy projects

Method

A novel way of gaining a better understanding of locally-relevant values is to ask local residents to photograph what they value about where they live, and to interview them about their photos. This was done with 28 Guernsey residents, who were asked to **take up to 10 photographs of what they value about Guernsey's coast and sea** within one week. 200 photographs were taken, some of which are shown.

Results

Energy projects that are seen as making Guernsey **"more unique"** by using a locally distinct resource (the tides) are more widely supported than those seen as making Guernsey more like everywhere else (e.g. wind energy)

Local people who represented the coast and sea as a space to be **utilised** (for leisure, to explore new places) were also more supportive of using such spaces for offshore energy development

Places used to enjoy Guernsey's **sunsets and sunrises** are seen as unacceptable locations for offshore energy development

Places associated with **wildlife** were seen as unacceptable locations for local energy projects

Places associated with **natural beauty** were less acceptable as locations for offshore energy development

Guernsey's coast was seen as a **quiet place** to escape the busy island itself – local energy projects that threaten such values may be less acceptable locally

Some places are **very special** to people – such places are likely to be less acceptable as locations for local energy projects

Energy projects seen as making Guernsey **more independent** and self- sufficient were well-supported

Conclusion

- Both local values associated with support (e.g. independence) and opposition (e.g. natural beauty) can be identified using this participant photography.

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Marine Renewable Energy Potential in Guernsey

Using maps in questionnaire surveys

Method

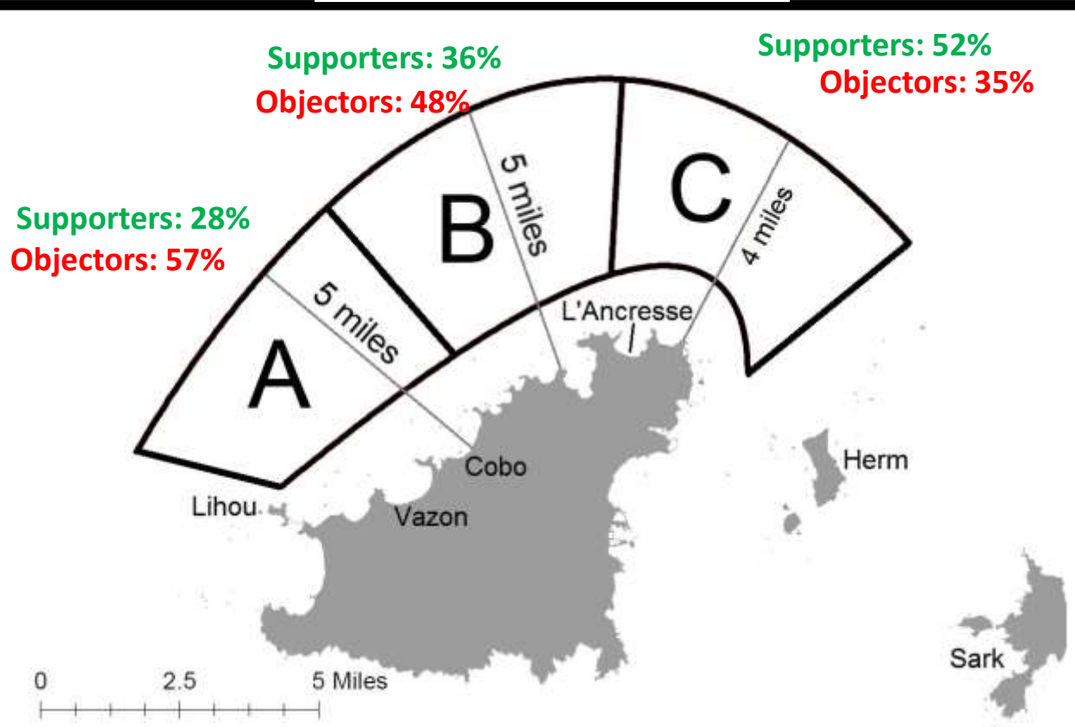
The PhD used a questionnaire survey to investigate public acceptability of offshore wind and tidal energy across the wider Guernsey population. Various options were investigated, including two hypothetical (but realistic) future energy projects for Guernsey were outlined

A 10-turbine offshore wind farm — **A 25-turbine tidal energy project**

Participants were asked whether they would support these two projects – without specifying the exact location where they would be located. Next, the questionnaire presented three areas around Guernsey that could be potentially suitable to host such a local energy project – see maps below. Participants were asked to what extent they would support such a wind/tidal energy project in each of these zones.

Results

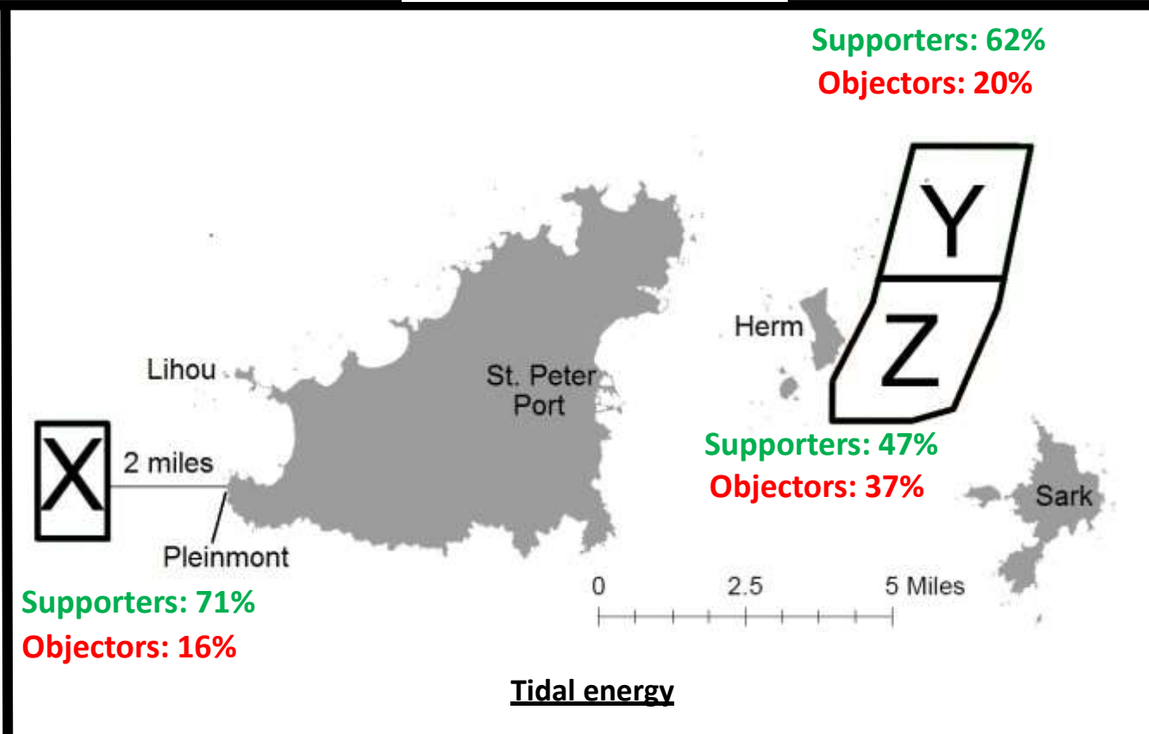
Offshore Wind



The offshore wind project was supported by 51% of respondents (29% objected, 20% neither supported nor objected).

However, depending on the location where such a project would be sited, levels of support change significantly (see figures above).

Tidal Energy



Tidal energy

The tidal energy project was supported by 62% of respondents (15% objected, 33% neither supported nor objected).

Only 47% would still support this tidal energy project if it were to be sited in zone Z – suggesting that (like for the offshore wind project) public support for tidal energy development depends strongly on *where* it is sited.

What this suggests is that a relatively less popular but well-sited energy technology (i.e. wind energy in zone C) is more widely supported than a better supported technology sited in a less desirable location (i.e. tidal energy in zone Z). It is therefore important to acknowledge such public preference at an early stage of the design of local renewable energy projects.

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Working with Others

The States of Guernsey Renewable Energy Team has been working with a number of academic and independent organisations in the UK and France. Those outlined below illustrate some of the historic and currently engaged organisations:

University of Exeter

University of Plymouth with Plymouth University

University of East Anglia

Cranfield University

La Société Guernesiaise

École Polytechnique Université Paris-Saclay

PML Plymouth Marine Laboratory

States of Alderney Channel Islands

Island of Sark Chief Pleas

States of Jersey

PRIMaRE Partnership for Research In Marine Renewable Energy

Halcrow

aquatera environmental services and products

Coastal Science Ltd

RGU Robert Gordon University Aberdeen

regensw delivering sustainable energy

ouest NORMANDIE Energies marines

South West Marine Energy Park

xodus GROUP

Guernsey Electricity

For more Information about renewable energy and the work in Guernsey please visit http://www.guernseyrenewableenergy.com/

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