



# Perspective

## The Future Wave and Tidal Energy



## Contents

Overview wave and tidal sector	3
Site feasibility	4
Licensing and consents	6
Project design realisation	8
Post installation support	10
The future	12
Royal HaskoningDHV's projects	14
Wave and tidal project map	15

## Overview wave and tidal sector

**Harnessing the energy generated by waves and tides to create clean, renewable electricity is a reality. The challenge for this burgeoning industry is to generate energy safely, reliably and at a commercially competitive scale and cost.**

Wave and tidal developments are located in challenging physical environments. As a result their tidal turbines and wave devices are at the cutting-edge of marine engineering technology. The industry has the potential to produce significant and predictable energy, locally, nationally and internationally. As an industry leader, providing environmental and engineering support to the wave and tidal energy market since 2003, Royal HaskoningDHV is at the forefront of the sector and well-known for its role in the assessment and consenting, as well as supporting the installation and operation of a number of world leading projects. These include SeaGen in Northern Ireland, the world's first grid-connected commercial scale tidal turbine, and the world's first tidal turbine array in the Sound of Islay, Scotland.

Royal HaskoningDHV is actively involved in the design and installation of smaller hydro electric projects and has implemented several such projects across Europe.

While best known for successful site feasibility studies, managing and delivering EIA processes, stakeholder engagement and supporting the consenting processes of large-scale wave and tidal projects, Royal HaskoningDHV's multidisciplinary team of engineers and environmental scientists is able to help developers and manufacturers at every project stage. From site selection through development and construction to post construction maintenance and monitoring, our extensive experience and creativity enable us to deliver dynamic, practical and cost-effective solutions for a wide range of wave, tidal and hydro engineering and consenting challenges.

The commercialisation of wave and tidal energy is progressing rapidly - made possible by government support and the availability of significant, accessible wave and tidal resources. Internationally, wave, tidal and hydro projects are also increasing in number, particularly in Europe, North America, South America, the Far East and Australasia.



## Site feasibility

### Identifying consent risks

Royal HaskoningDHV understands environmental risk management and the consenting processes internationally. Our technical expertise, coupled with local knowledge from our network of offices and long established relationships with key regulators and stakeholders, allows us to efficiently prioritise our efforts to address key consent risks from the beginning of the project.

Early identification of consenting risks is a vital part of effective development planning. Royal HaskoningDHV has developed specialist GIS analysis tools to collate numerous data sets in order to assess environmental sensitivity, data availability and consent risk. This 'heat mapping' analysis allows clients to rapidly assess known areas of risk on land and sea and modify their plans accordingly. This approach can be tailored to encompass a range of factors affecting development potential, including energy resource (tidal or wave energy), seabed conditions, sediment dynamics, conservation sites and protected species.

### Geophysical and geotechnical assessment

Assessment of the seabed, or riverbed, is important when assessing site suitability, as well as potential construction and installation methods. Royal HaskoningDHV has considerable expertise in data gathering and in methods of direct physical sampling and ground investigation as well as remote sensing techniques including acoustic survey.

### Logistical planning

Royal HaskoningDHV has extensive experience in the logistics of project design and management which can be applied to wave, tidal and hydro projects. Our team uses long-established skills in coastal zone management (including port and coastal planning), and our excellent working relationships with a range of policy makers, developers and contractors, to ensure success for our clients' projects.

### Resource assessment

Selecting a feasible site, capable of generating significant power, is a key requirement for all developers. Royal HaskoningDHV has the capability and skill to use a range of tools, including 3D computational fluid modelling and hydraulic modelling along with our extensive environmental expertise, in order to locate optimal development sites for wave, tidal and hydro projects.

Royal HaskoningDHV has a dedicated team of oceanographers and physical process modellers who provide a comprehensive consultancy and modelling service to marine industry clients worldwide. Our wave and tidal resource models can be used to provide regional information about seabed or riverbed areas for a range of design or operational parameters, which can then be included within a wider site appraisal. The outputs of the appraisal can help identify appropriate technologies for the scale of resource available, as well as opportunities for wider resource management.

## Innovation in assessment

"Royal HaskoningDHV developed a management strategy which has paid dividends to our understanding of the turbine's interaction with sea life in Strangford Narrows. The results of this work have put MCT at the forefront of knowledge which will have significant benefits in consenting future projects. We have found Royal HaskoningDHV's input invaluable."

**David Ainsworth, Project Manager – SeaGen Strangford Lough, Marine Current Turbines**

## Licensing and consents

**Royal HaskoningDHV has an exemplary record of successful Environmental Impact Assessment (EIA) and a reputation for high quality work and consent delivery for a range of projects in the marine environment, from large scale ports and harbours to tidal turbine arrays. Our high quality, science driven approach to EIA is gained from our excellent in-house skills, long standing relationships with regulators and stakeholders, a keen understanding of the requirements of wave, tidal and hydro projects and an involvement in the ongoing development of marine policy and legislation.**

Royal HaskoningDHV has a comprehensive range of in-house technical expertise, calling on the knowledge and experience of 8,000 colleagues in the UK, Netherlands and across our worldwide offices.

"Royal HaskoningDHV has provided EIA and environmental survey expertise to ScottishPower Renewables over a number of years and they continue to produce high quality support to our developments."

**Dr Douglas Watson, Marine Development Officer  
Sound of Islay ScottishPower Renewables**

## The adaptive management approach

Licensing and consenting of wave and tidal developments requires innovative design and often novel operational and consenting solutions. Environmental impacts of wave and tidal devices are still unknown in many areas and, as a result, Royal HaskoningDHV has successfully developed a practical Adaptive Management Approach to EIA and consent negotiations including comprehensive mitigation and monitoring programmes, allowing our clients to gain consent for their developments. This approach is closely aligned with the 'deploy and monitor' approach to wave and tidal development suggested by a number of regulators internationally.

In this regard Royal HaskoningDHV is at the forefront of the assessment of environmental impacts, cumulative impacts and the consideration of impacts on designated sites and protected species.

This pioneering approach was used for Marine Current Turbine's 'SeaGen' project in Strangford Lough, Northern Ireland, now the world's first grid-connected commercial scale tidal turbine. The environmental management programme developed by Royal HaskoningDHV allowed the project to proceed with appropriate safeguards. After three years, in 2012 it was possible to draw the conclusion that no significant biological impacts on sensitive habitats or species had been observed.



## Project design realisation

### Cable routing

Exporting power from wave and tidal devices presents engineering and environmental challenges. The associated work, to plan, design and consent the laying of export cables from offshore generator farms to pre-defined grid connection points, can often present its own unique, environmental and consenting issues.

Royal HaskoningDHV has extensive experience of undertaking route selection and optimisation studies, which includes both offshore and onshore cable routing for complex renewable energy projects. We can provide technical expertise in cable assessments and strategic advice on consentability, based on an impressive track record of both HVDC and HVAC solutions for renewable projects.

### Supporting infrastructure

Royal HaskoningDHV is able to provide a comprehensive suite of supporting engineering and project management services to wave and tidal developers. Our civil and geotechnical engineers can assist clients in the selection and design of gravity and pile solutions. Our buildings and structural engineers can assist in the development of required service buildings, while our transport consultancy team is expert in planning and gaining permission to transport large components, as exceptional loads, to site.

### Port assessment and design

Installing wave and tidal power arrays is often complex, requiring a dedicated loadout port for deployment of specialist vessels, components and equipment.

Assessing the capacity of local and regional ports accurately is essential, and Royal HaskoningDHV's worldwide experience of port design and knowledge of facilities is invaluable.

We have a good working knowledge of most UK ports. Our maritime engineering teams can design suitable enhancements to port facilities for port operators, to ensure the capacity and facilities to handle installation operations for wave and tidal developments.

For multiple device arrays a dedicated operational and maintenance base, or bases, may be required. Royal HaskoningDHV's engineering teams can work with device developers to identify O&M base requirements, assess port options and consider requirements for any modifications to existing port infrastructure, such as constructing storage and services areas, strengthening quays, providing new lift capacity or dredging deeper channels for large vessels.

### Optimisation of support structures

Successful, cost-effective developments, with maximised electricity output, are reliant on effective supporting structures and grid connections. Drawing on 130 years of engineering excellence Royal HaskoningDHV is able to assess a range of factors, from the evaluation of suitable foundation options to the identification and design of appropriate control systems. Our team can then work with the developers to optimise the design of those structures.



## Post installation support

### Environmental monitoring programmes

Royal HaskoningDHV expects that all wave and tidal installations will require environmental monitoring after installation, and this is a significant aspect of Royal HaskoningDHV's post-installation services to the marine renewable energy sector. Our scientists are skilled and experienced at working with environmental regulators to develop a monitoring schedule, as well as including appropriate safeguards to mitigate risk and ensure minimal environmental impact.

### Consent compliance

Royal HaskoningDHV works with regulators and government advisors to ensure consent conditions are met throughout the design, installation and deployment processes. Our project team can act as client representative throughout the procurement process, to ensure suitability of equipment, methods and working practices.

"Aquamarine Power is pleased to be working with the team at Royal HaskoningDHV on our wave energy projects in the west of Scotland"

**Marc Murray, Lewis Wave Farm Project Manager**



## The future

**From prototypes to viable technology in just a few years, wave and tidal technologies are increasingly capable of making a significant contribution to the world's increasing energy requirements.**

Large-scale tidal and wave arrays have the potential to produce substantial renewable power supplies, while inland hydro energy projects can potentially make a real difference to local power supplies, particularly in rural areas and developing countries.

Royal HaskoningDHV is one of the few consultancies to have worked with the marine renewable industry through development of technology to fully-realised commercial installation. Alistair Davison, Renewables Business Development Director, Royal HaskoningDHV, comments:

“Royal HaskoningDHV is delighted to have had the opportunity to work on many leading wave and tidal developments throughout the UK. The UK is, and will continue, to lead the world in the development and deployment of wave and tidal devices.

“As the UK industry continues to progress, we will begin to see deployment of multiple-device arrays. Royal HaskoningDHV is applying its experience of single device deployments to the development and consenting of much larger arrays, which will eventually produce up to 200MW. We are delighted to be assisting in ensuring the safe and sustainable deployment of commercial wave and tidal arrays.

“Most areas of Europe offer fewer available wave and tidal resources than we have in the UK. The future challenge for the European industry will therefore be not only to deploy at a fully commercial scale, but also to adapt the technology to exploit a wider range of conditions.

“As well as wave and tidal projects, Royal HaskoningDHV is also working on hydro projects in ports, fjords, canals and waterways in European countries and also internationally.

“Royal HaskoningDHV’s respected worldwide team has global reach and local knowledge, with unparalleled experience, knowledge and expertise in this sector.”

# Royal HaskoningDHV's wave and tidal projects

## Strangford Lough, Northern Ireland

Commissioned in 2004 by Marine Current Turbines Ltd to carry out scoping, EIA and consents processes for SeaGen, the world's first grid-connected tidal turbine. After deployment, Royal HaskoningDHV implemented a £3 million environmental monitoring programme allowing the project to proceed, and progressively demonstrated the benign nature of the development, concluding in 2012 that no major environmental impacts had been detected.

## Sound of Islay, Scotland

Appointed by ScottishPower Renewables in 2008 to undertake the EIA for the world's first tidal turbine array. In March 2011 the Scottish Government granted consent for the scheme.

## Isle of Lewis, Scotland

Working with Aquamarine Power Limited since 2010, Royal HaskoningDHV has completed EIA and supporting works for a project on Isle of Lewis, which, if consented, will be the world's largest wave array.

## Kyle Rhea, Scotland

Commissioned in 2010 to support MCT in the development of a proposed tidal array in Kyle Rhea. Royal HaskoningDHV is managing initial stakeholder consultation work, scoping studies, and EIA services.

## Pentland Firth and Orkney, Scotland

Alongside Orkney-based consultancy Aquatera, Royal HaskoningDHV has been providing EIA and environmental advice since 2010 to SSE Renewables for Cantick Head and Westray South tidal array sites.

## Port of Antwerp, Netherlands

Appointed in 2010, Royal HaskoningDHV's role was to investigate feasibility for tidal power in the Port of Antwerp, researching locations, technical possibilities, and completing concept designs.

## Hydro power, Ukraine

Commissioned in 2010, Royal HaskoningDHV has been working to develop a number of government-subsidised hydro power projects in the Ukraine. Encompassing dam and river turbines, our role has included initial feasibility studies, final investment decisions and project realisation.



## UK Projects

- 1 Seagen Array, Kyle Rhea Feasibility, Scoping, EIA and Consenting Support for a 5MW tidal turbine array and export cable **Client:** Marine Current Turbines
- 2 Westray South Tidal Array Feasibility, Scoping, EIA and Consenting Support for a 200MW tidal turbine array **Client:** Scottish and Southern Energy Renewables
- 3 Cantick Head Tidal Array Feasibility, Scoping, EIA and Consenting Support for a 200MW tidal turbine array and export cable **Client:** Scottish and Southern Energy Renewables and Open Hydro
- 4 Sound of Islay Tidal Array EIA and Associated Support Services for a 10MW tidal turbine array  
**Client:** ScottishPower Renewables
- 5 Seagen, Strangford Loch Feasibility, Scoping, EIA, Consenting, Monitoring and Support Services for the world's first commercial tidal turbine (1.2MW)  
**Client:** Marine Current Turbines
- 6 Whitby Pier Wave Power Feasibility Study Detailed feasibility study into the use of wave energy technology off Whitby Pier **Client:** Scarborough Borough Council
- 7 Wave and Tidal Capabilities Dorset Feasibility study in to the use of wave and tidal renewable technology off Dorset **Client:** Dorset Coast Forum
- 8 Potential for Offshore Wind, Wave & Tide in the South West A review of the applicability, resource and potential sites for offshore wind, wave and tidal power technology in the South West of England **Client:** Regen SW on behalf of South West Regional Development Agency
- 9 Offshore Renewables Capacity Study An opportunity and constraints analysis of current (wind, wave and tidal) technology with future predictions of future development and land-based infrastructure needs  
**Client:** Dorset County Council
- 10 Lewis Wave Power, EIA, Consenting Support for a 40MW wave device array **Client:** Lewis Wave Power Ltd.
- 11 Skerries Tidal Array, consenting support to a 10MW tidal array off the North Coast of Anglesey  
**Client:** Seagen (Wales) Ltd.





With its headquarters in Amersfoort, The Netherlands, Royal HaskoningDHV is an independent, international project management, engineering and consultancy service provider. Ranking globally in the top 10 of independently owned, non-listed companies and top 40 overall, the Company's 8,000 staff provide services across the world from more than 100 offices in over 35 countries.

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