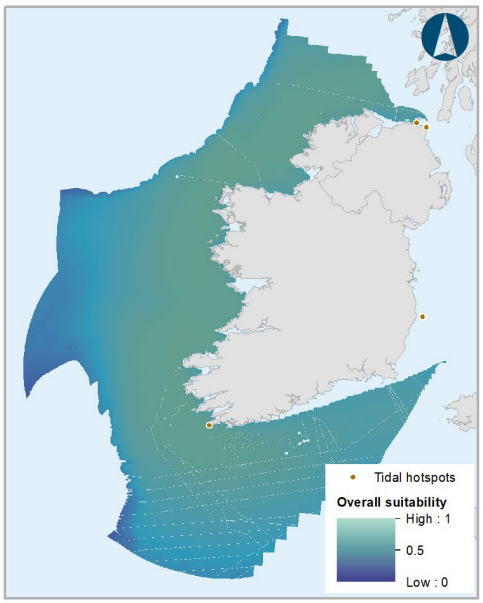
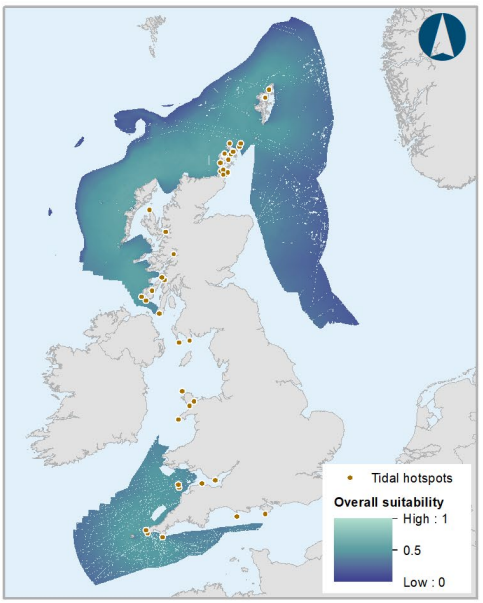
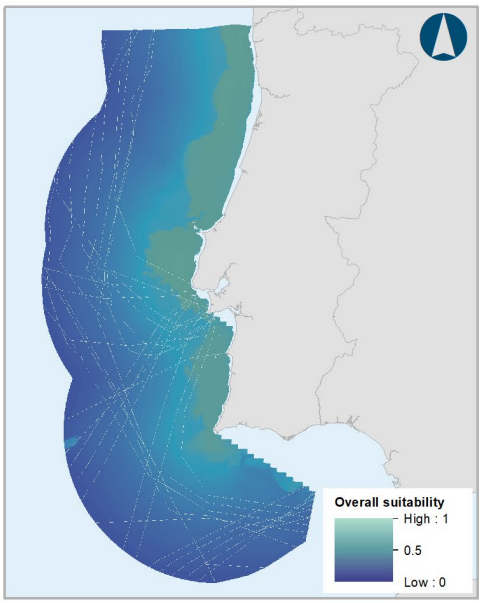
https://evolveenergy.eu/

Can ocean energy (wave and tidal) make an effective contribution to European energy systems and markets, with particular reference to where, what, when, how, and at what price?

EVOLVE is a transnational partnership between research institutions, technology developers and industry organisations, funded by the OCEANERA-NET COFUND project, and dedicated to building an evidence base for ocean energy as part of a diverse energy system. The project has quantified the benefits associated with integrating ocean energy in low carbon energy systems across Europe.

A REVIEW OF PRACTICAL DEPLOYMENT LOCATIONS FOR EUROPEAN OCEAN ENERGY PROJECTS

- The EVOLVE spatial modelling study focused on three regions: Great Britain, Ireland and Portugal, identifying close to 60GW of practically viable wave energy and 10GW of tidal stream energy. More specifically, results show resources of 34.8GW in Great Britain, 18.8GW in Ireland and 15.5GW in Portugal.
- Aquatera's RADMApp GIS modelling tool was used to identify suitable areas for the deployment of wave and tidal stream devices, with scoring criteria applied over four layers: technical, cost, environmental and other sea users. The final results are based on a multiplicative combination strategy of these layers to produce an overall suitability score.
- For tidal stream energy devices, areas of suitability have been found at specific points around the British coastline and around Rathlin Island in Northern Ireland.
- For wave energy devices, results reveal that northern and western Scottish waters, southwest England and Wales, the west of Ireland and around Lisbon and the northwest of Portugal have the highest suitability.

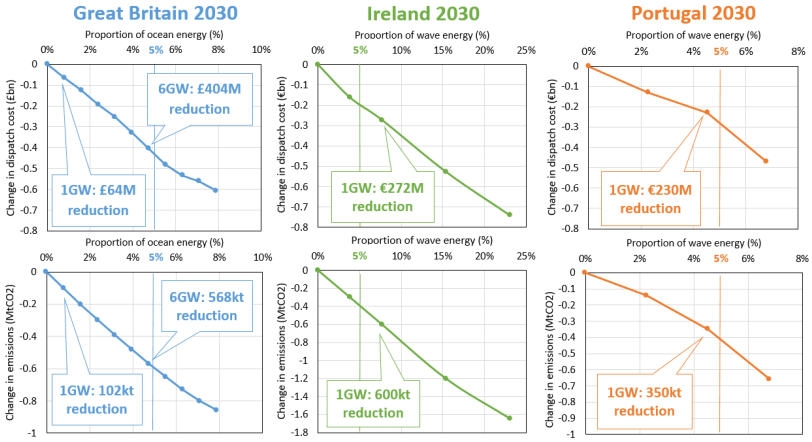
IRELAND	GREAT BRITAIN	PORTUGAL
		
Practical suitability		
Tidal Stream Energy **240-630 MW**	Tidal Stream Energy **10.4GW**	
Wave Energy **18.8 GW**	Wave Energy **24.8 GW**	Wave Energy **15.5 GW**

More detailed technical notes available at https://evolveenergy.eu/project-outputs

aquatera environmental services and products
ORBITAL MARINE POWER
WavEC Offshore Renewables
RISE
CorPower Ocean
THE UNIVERSITY of EDINBURGH School of Engineering
Policy and Innovation Group

THE SYSTEM BENEFITS OF OCEAN ENERGY TO EUROPEAN POWER SYSTEMS

- Including wave and tidal stream energy within European power systems leads to system benefits in terms of increased renewable dispatch, decreased carbon emissions, decreased dispatch costs and decreased curtailment volumes.
- Dispatch models have been created for three European regions of interest: Great Britain, Portugal, and Ireland. The study findings are consistent between these regions: increasing the proportion of ocean energy within the renewable mix of these power systems results in higher renewable dispatch for the same renewable energy availability, due to the offsetting of wave and tidal with wind and solar generation.
- The ability to dispatch more renewables results in lower fossil fuel and peaking plant dispatch, and thus scenarios including higher proportions of ocean energy result in lower dispatch costs and lower carbon emissions. **The annual cost reduction results presented are up to £1.46bn, from 10GW of wave in GB in 2040, and the annual carbon reduction results presented are up to 1.06Mt CO2 from 10GW of wave in GB in 2030.**

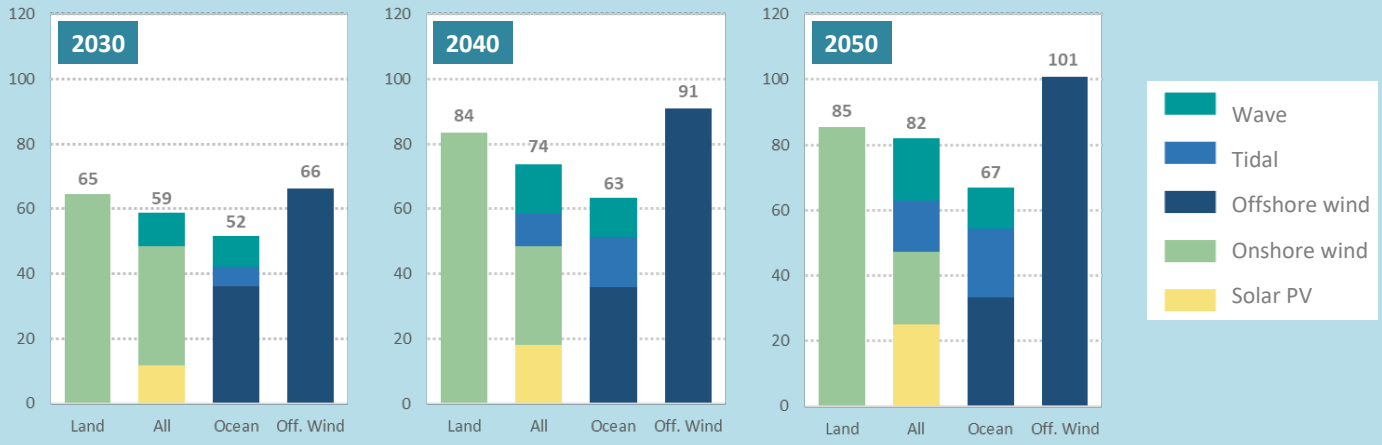


- It has also been found that ocean energy is able to capture over double the wholesale price of wind, as the offsetting in resource means that wave and tidal energy can capture high wholesale prices at times of low wind availability.

THE SYSTEM BENEFITS OF OCEAN ENERGY TO ISLANDED POWER SYSTEMS

- The integration of wave and tidal stream energy can lead to power system benefits for 100% renewable islanded systems, compared with only making use of more established technologies such as solar and wind.
- Using historical demand and renewable availability profiles from the Orkney Islands as a case study, it has been found that scenarios including wave and tidal stream require up to 30% less installed capacity and 50% less storage to meet demand, compared with scenarios only including wind and solar.
- **The total system cost (capital and operational costs) is up to 20% lower when including ocean energy within the 100% renewable mix, despite wave and tidal having the highest cost of all renewable sources, due to the additional value of their complementary generation profiles.**
- Grid efficiency is also improved when including wave and tidal stream are included within the mix, with lower excess generation needing to be stored or curtailed, and lower hour-to-hour variations in power production, quantified by the standard deviation.

INSTALLED CAPACITY (MW) RESULTS FOR DIFFERENT RENEWABLE SOURCES SCENARIOS



This collaborative project has received support under the framework of the OCEANERA-NET COFUND project, with funding provided by the following national/regional funding organisations: Scottish Enterprise, Swedish Energy Agency and Fundação para a Ciência e a Tecnologia. The OCEANERA-NET COFUND project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement [no.713200]