

Offsetting of wave and wind resource and resultant economic benefits: a GB case study



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UK Ocean Energy Review 2018

- Overview of developments in UK wave and tidal sector in 2018 in terms of:
 - Key sector achievements
 - Supporting policies
 - Research and development
 - Technology demonstration

Wave and Tidal Energy: The Potential Economic Value

- Potential of long-term economic benefits in terms of GVA of the wave and tidal sectors out to 2050 by exploring an ambitious future scenario.



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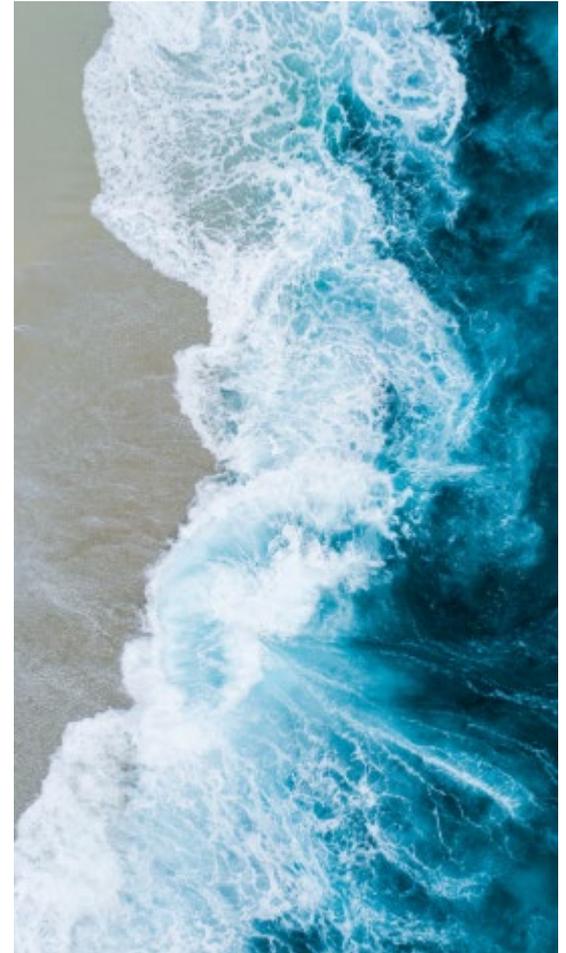
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Outline

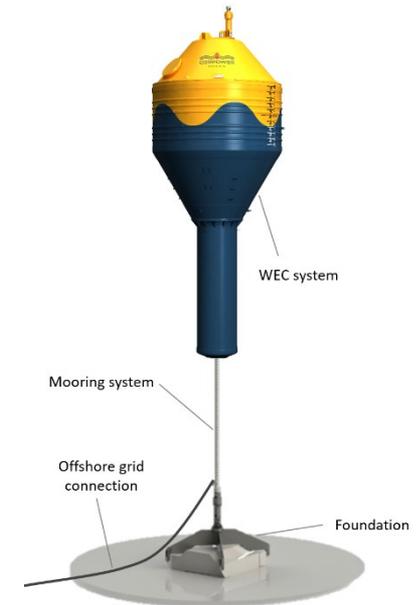
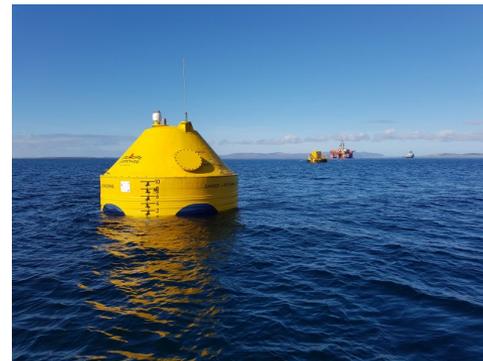
- Introduction
 - The WaveBoost Project
 - Additional benefits of wave energy
 - Wave-wind offsetting
- Methodology
 - Data
- Results
 - Hypothetical market revenues
 - Annual and seasonal patterns
- Discussion
- Conclusions and Future work



The WaveBoost Project



- European Commission funded research and innovation action, led by CorPower Ocean
- Development of an advanced PTO with high efficiency and reliability:
 - Increasing survivability within extreme sea states
 - Targeting a significant increase in AEP and reduction in LCOE



<http://www.corpowerocean.com/commercial-projects/waveboost/>



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Additional benefits of Wave Energy

Socioeconomic indicators (such as GVA) reduce with time as cost reductions are forecast within the marine renewable sectors

Additional benefits:

- Large potential global resource
- Temporal offsetting with wind resource
- Temporal correlation with GB seasonal demand – peaks in winter
- Sites often coincide with fragile coastal communities
- Jobs created and additional induced effects within these economies

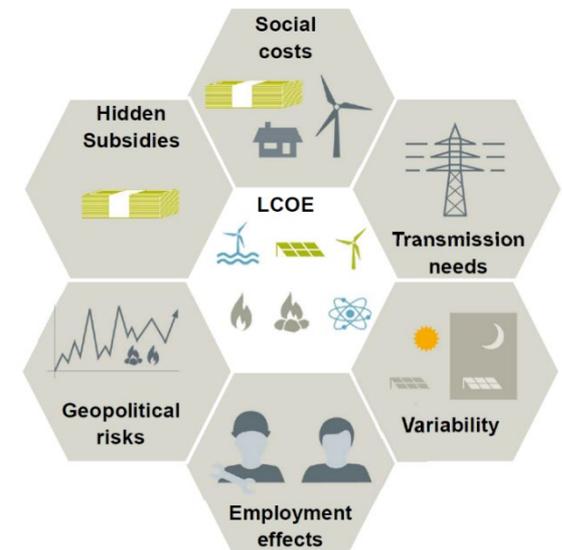


Figure: Example of externalities that can be considered in SCOE studies [1]

[1] Siemens, "SCOE - society's costs of electricity: How society should find its optimal energy mix," August, 2014.

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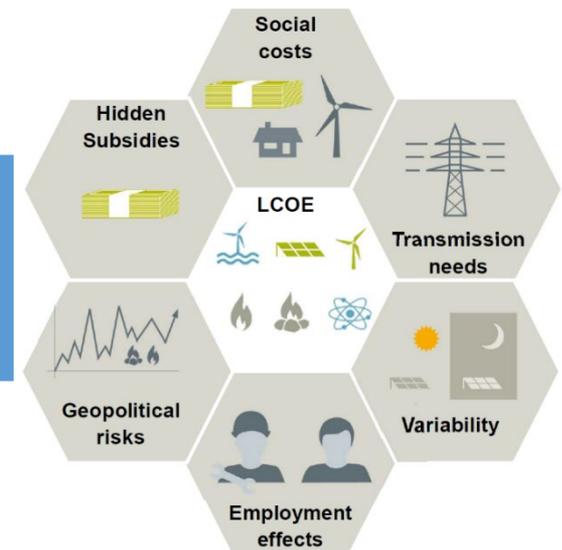


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Wave/wind resource offsetting

Aim:

Investigate if there is a clear offset in GB wind and wave resource which results in a significant difference in spot market revenues

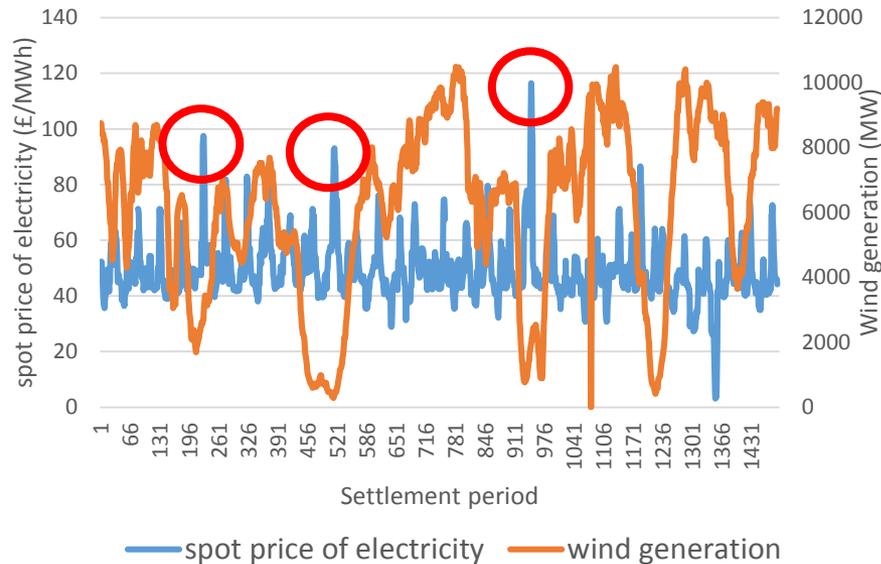


Figure: historical GB wind generation and spot price of electricity, January 2019, Source: BM reports

Methodology

Data:

- Wind [1]
 - half-hourly transmission connected GB wind generation from Elexon portal, 22nd Feb 2015 – 31st Dec 2017
- Wave [2]
 - half-hourly wave resource data from Cefas WaveNet database, 1st Jan 2015 to 31st Dec 2017
 - WEC power matrix from CorPower Ocean
- Spot prices [3]
 - hourly historical N2EX GB data, 1st Jan 2015 to 31st Dec 2017



Figure: Locations corresponding to Cefas WaveNet wave data

Methodology:

- Created hourly normalised wind and wave generation time series
- Calculated hypothetical wholesale hourly revenues per MW

[1] Elexon, “BM reports – generation by fuel type” Available: <https://www.bmreports.com/bmrs/>

[2] Cefas, “WaveNet Database” Available: <https://www.cefas.co.uk/cefas-data-hub/wavenet/>

[3] Nordpool Group, “Historical Market Data – N2EX Day Ahead Auction Prices” Available: <https://www.nordpoolgroup.com/historical-market-data/>

Results

- Wave and wind resultant hourly revenues:

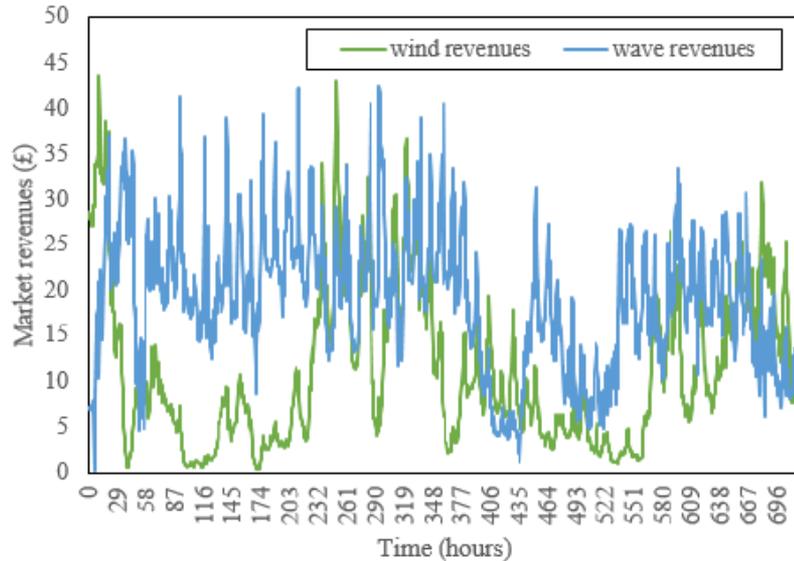


Figure: Resultant hourly revenues for wind and wave generation per MW, April 2015

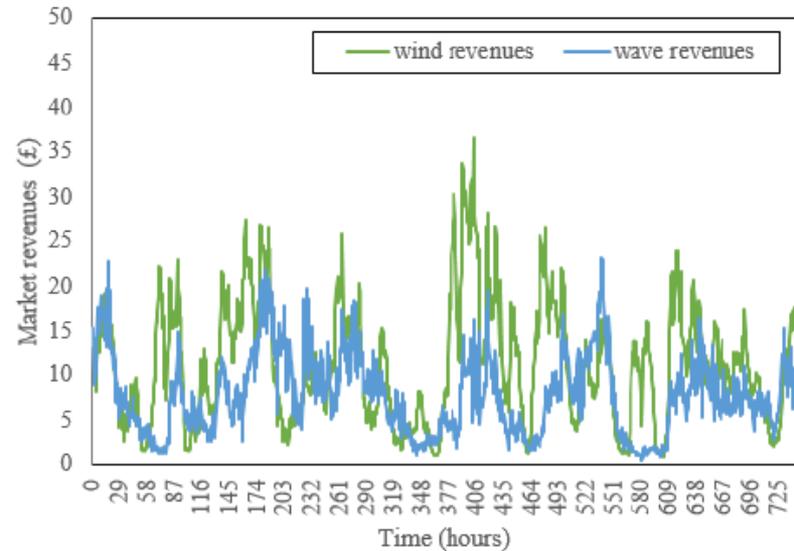


Figure: Resultant hourly revenues for wind and wave generation per MW, July 2015

- High variation in monthly percentage differences: 70.60% (April 2015) to -29.63% (July 2015)



Results

- Results show small amounts of wave gen could take advantage of price spikes when wind resource is low

Table: Total hypothetical spot market revenues per MW from wind and wave time series

Year	Total revenues - wind	Total revenues - wave	Percentage difference (wave – wind)
2015	£98.8k	£98.5k	-0.27%
2016	£122.1k	£126.0k	3.18%
2017	£126.9k	£131.5k	3.61%
Total	£347.8k	£356.0k	2.36%

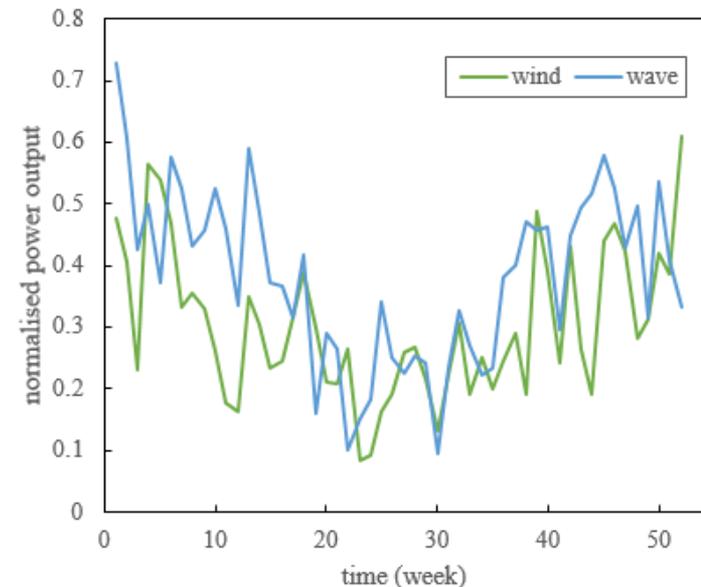


Figure: Normalised daily power output for wind and wave generation, 2016

Results

Interestingly:

- High variation in monthly percentage differences: 70.60% (April 2015) to -29.63% (July 2015).
- Clear pattern of higher revenues for wave compared with wind in spring and autumn months over three years of data.
- Could provide the basis for optimising planned maintenance strategies of WECs to maximise market revenues

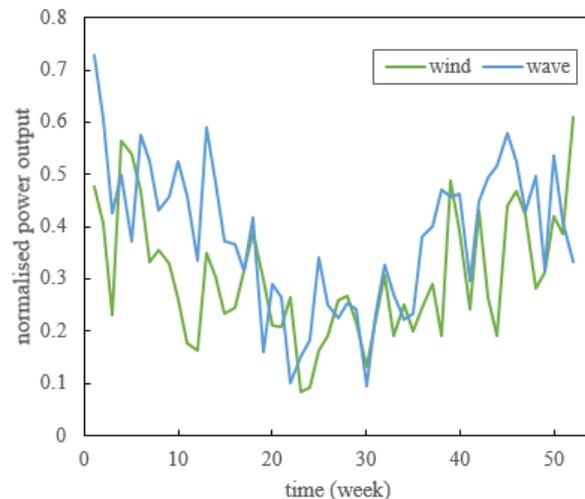


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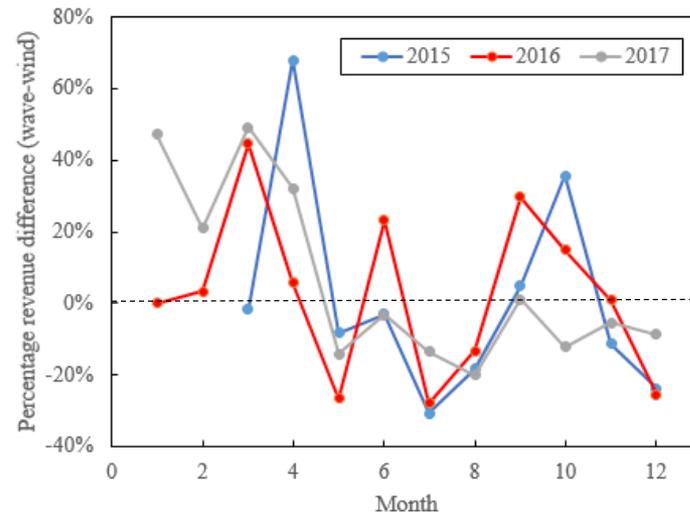


Figure: Percentage difference in wind and wave revenues



Discussion - Limitations

- <Three years of data not enough to draw robust conclusions
- Anything more than small amounts of installed wave capacity would impact on spot prices
- Other technologies capturing price spikes and also rely on these to cover long term costs
- N2EX spot market data doesn't represent revenues for generation with a PPA
- CfD framework currently means that low carbon generation is not incentivised to participate in spot markets or balancing markets
- Work so far is an illustrative piece on difference in resource rather than suggestion wave gen could gain significantly greater revenues than wind – presenting potential for future work



Conclusions and future work

- Conclusions

- Presented an illustrative case study utilising historical data
- Shown that offset in wave and wind resource in GB could mean that wave generation is able to capture price spikes in the short term

- Future work includes economic dispatch modelling of future scenarios – varying installed capacities of wind, wave and tidal

- Impact on marginal prices, price volatility
- Impact on system costs, balancing costs



Thanks for your attention

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