

Diversified renewable energy portfolios for the UK

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Introduction

- Scenarios
- Diversification
- Characteristics of a diversified portfolio

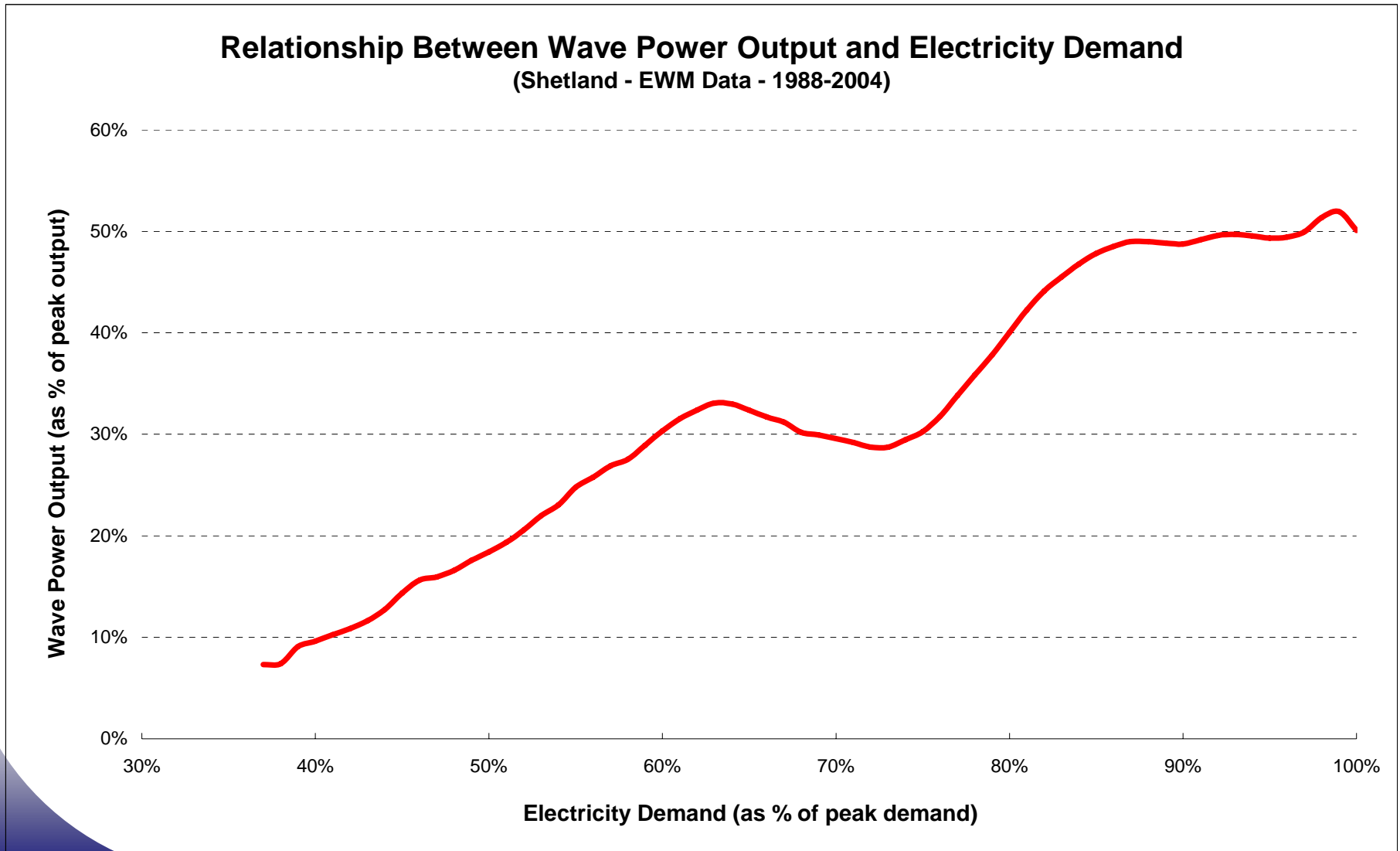
Renewable energy scenarios

- Scenarios are often used as a planning and development tool. However, while scenarios may include a range of renewables, analysis and debate is often centred around wind power.
- The current focus is on the “wind-only” scenario:
 - Proven technology
 - Cost-effective
 - Large UK resource
 - Provides a common basis for analysis, but doesn't reflect reality (now or in the future).
 - Considering just wind power may result in a pessimistic view of the impact of renewables.

Renewable energy scenarios

- Mixed renewables scenarios have more in common with the current range of renewable technologies:
 - Sources of renewable energy are varied, including variable (wind, wave, tidal, solar) and more traditional (landfill gas, biomass) forms of generation.
 - Generally considered in terms of resource and technology availability, not system benefit.
- Different renewable resources will have different electricity supply properties - the UK also has significant wave and tidal stream resources, and it is important to:
 - Understand the characteristics of renewable resources, and
 - Determine if there are benefits from including different renewable resources in a renewable energy portfolio.

Wave power

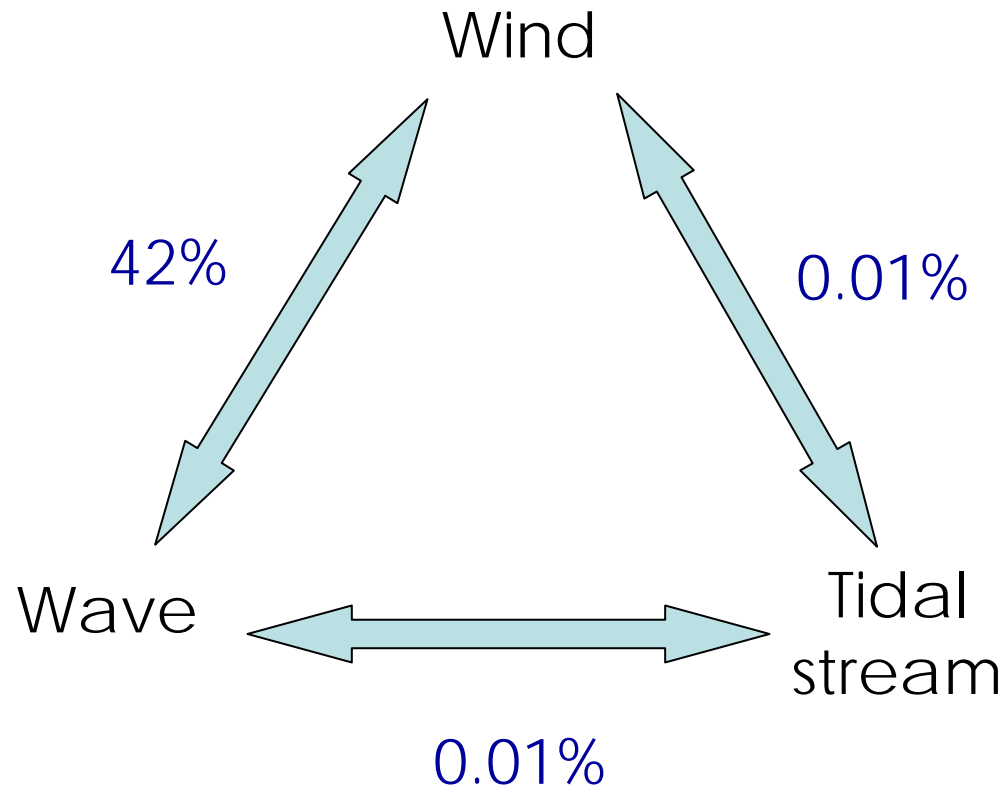


Diversified portfolios...

- Diversified renewable energy portfolios exploit the different characteristics of resources in different places.
- Diversity can:
 - Reduce the impact of extreme events
 - Lower the variability of power output
- Diversity can be achieved through:
 - Location – a technology is developed in a range of sites;
 - Resource – a range of renewable energy resources are developed, and
 - Both – by developing a range of technologies at appropriate locations.

Relationship between resources

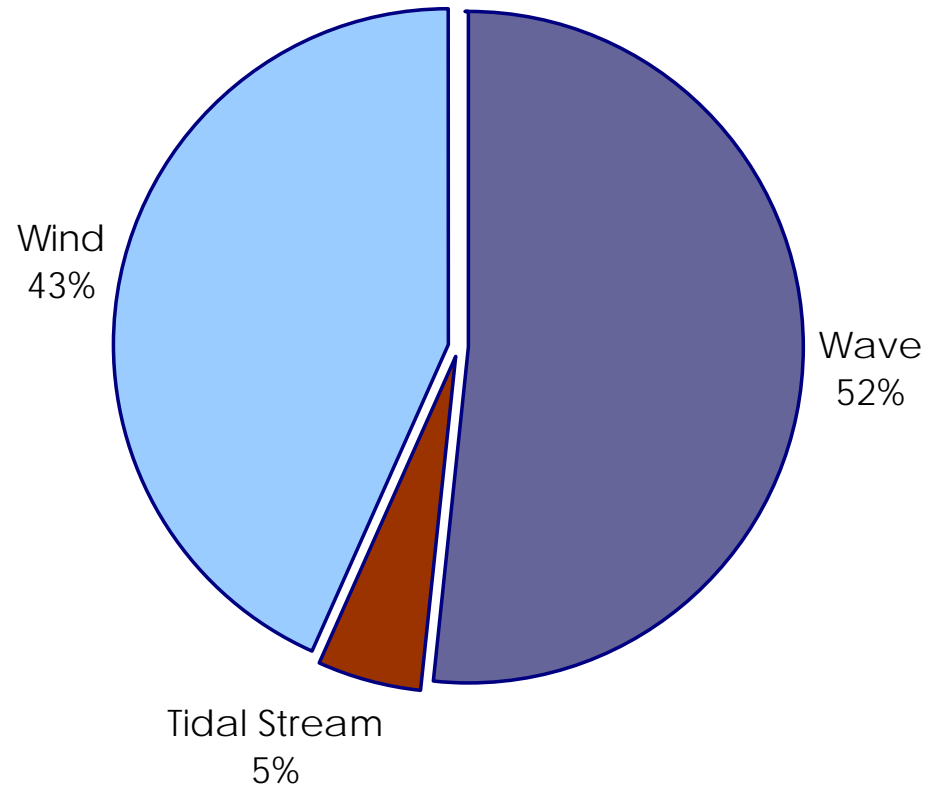
Correlation (r^2) of power output patterns



A portfolio of renewable resources

The UK Integrated Scenario

- Wind power – range of sites throughout the UK.
- Wave power – range of sites in three high-energy coastal regions in northern and south-western UK.
- Tidal stream power – range of sites throughout the UK.
- **The contribution of different sites and resources was modelled to achieve low variability in the overall renewable energy supply.**



The portfolio effect - variability

- The variability of the renewable electricity supply profile shows the degree to which electricity output changes from hour to hour.

Renewable supply	Variability – percent of installed capacity
Tidal stream power only	6.3% - 22.4%
Wind power only	3.2%
Wave power only	2.6%
UKI scenario	2.0%

The portfolio effect – capacity credit

- Capacity credit measures the extent to which renewables can reduce the need for conventional capacity. In this scenario, 20% of UK electricity demand is met by wind, wave and tidal stream power.

Scenario	Conventional Capacity	Capacity credit
Conventional system	84GW	---
Wind-only scenario ¹	79GW	5GW
UKI scenario	76GW	8GW

1 – from Dale et al, 2004

The portfolio effect – balancing cost

- Balancing cost arise from the need to respond to changes in renewable output – by reducing the variability of the renewable electricity supply, the additional balancing costs are also reduced.

Scenario	Additional balancing cost
Wind-only scenario	£2.85/MWh
UKI scenario ¹	£1.80/MWh

1 – analysis by Milborrow

Summary

- Scenarios for renewable energy will affect the overall characteristics of the renewable electricity supply
- By developing a portfolio of wind, wave and tidal stream resources in the UK:
 - Variability is reduced
 - Capacity credit is increased
 - Balancing costs are reduced
- The benefits of this diversified portfolio are achieved through a combination of all three renewable resources, despite the relatively high variability of some sites and resources.

The end

We are happy to acknowledge and thank the following organisations for providing data used in this work:

Met Office

British Atmospheric Data Centre

Proudman Oceanographic Laboratory

This work was commissioned by the Carbon Trust as part of the Marine Energy Challenge.

For further information on the UK's marine resource characteristics visit:

www.eci.ox.ac.uk/energy

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