

Global prospects for airborne wind onshore

**A study by BVG Associates and KPS
AWEC, October 2019**

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BVG Associates

Our clients choose us when they want to do new things, think in new ways and solve tough problems

Who we are, and what we do



Founded in 2006



Over 300 Clients



170 years staff
industry experience



50 landmark publications



Economics

LCOE/NPV Modelling
Supply chain analysis
Economic impact



Business

Market assessment
Business strategies
Industry enablement



Technology

Due diligence
Technology support
Funding advice



Onshore wind



Offshore wind



Wave and tidal



Energy Systems

BVG Associates

Clients

Over 300 direct clients; supported double through frameworks

- Innovators
- Investors
- Suppliers
 - Oil and gas companies
 - Ports
 - SMEs
- Project developers
- Asset owners
- Enablers
- Governments
- Universities



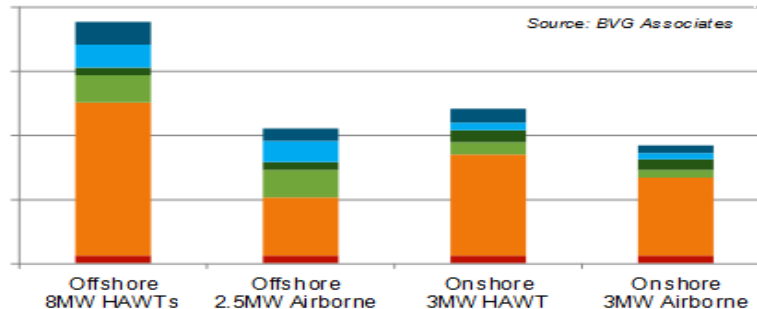
BVG Associates and KPS

A long-standing relationship

- KPS is a leading developer of AWE technology for offshore and onshore applications.
- Rationale for onshore:
 - Many areas of the globe without access to electrical power from a reliable grid
 - Provides opportunity to build volume and evolve technology
- In this study by BVG Associates for KPS, we characterised the global potential for AWE in comparison to three alternatives.

We have been advising KPS since 2015:

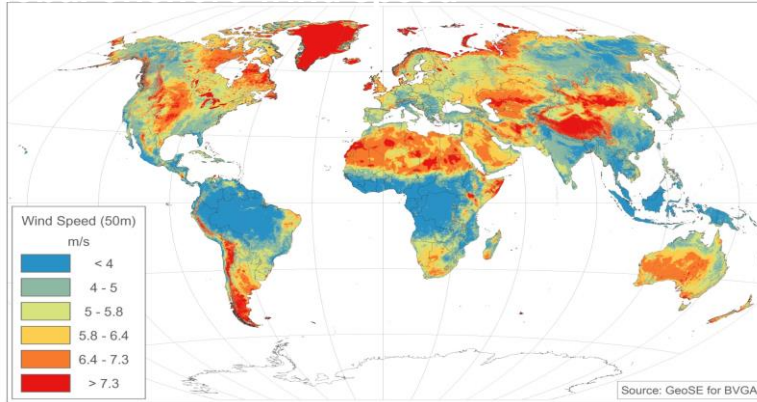
- In-series component and installation costs
- Aerodynamic performance and energy production
- Technical, economic and investment support



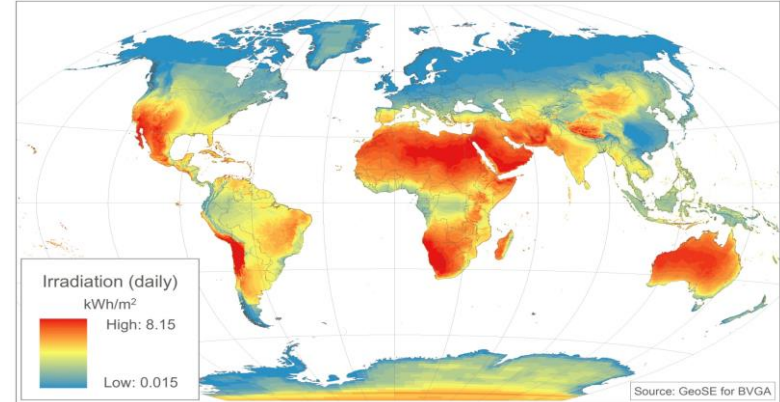
Inputs

Input: geospatial data

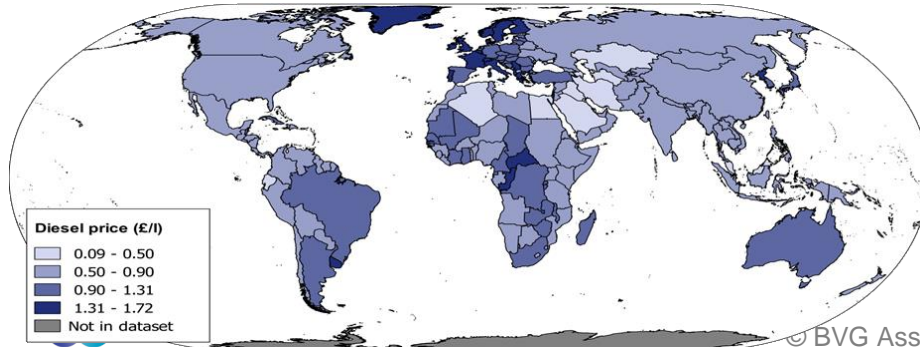
Global onshore wind



Global solar irradiation



Global diesel costs



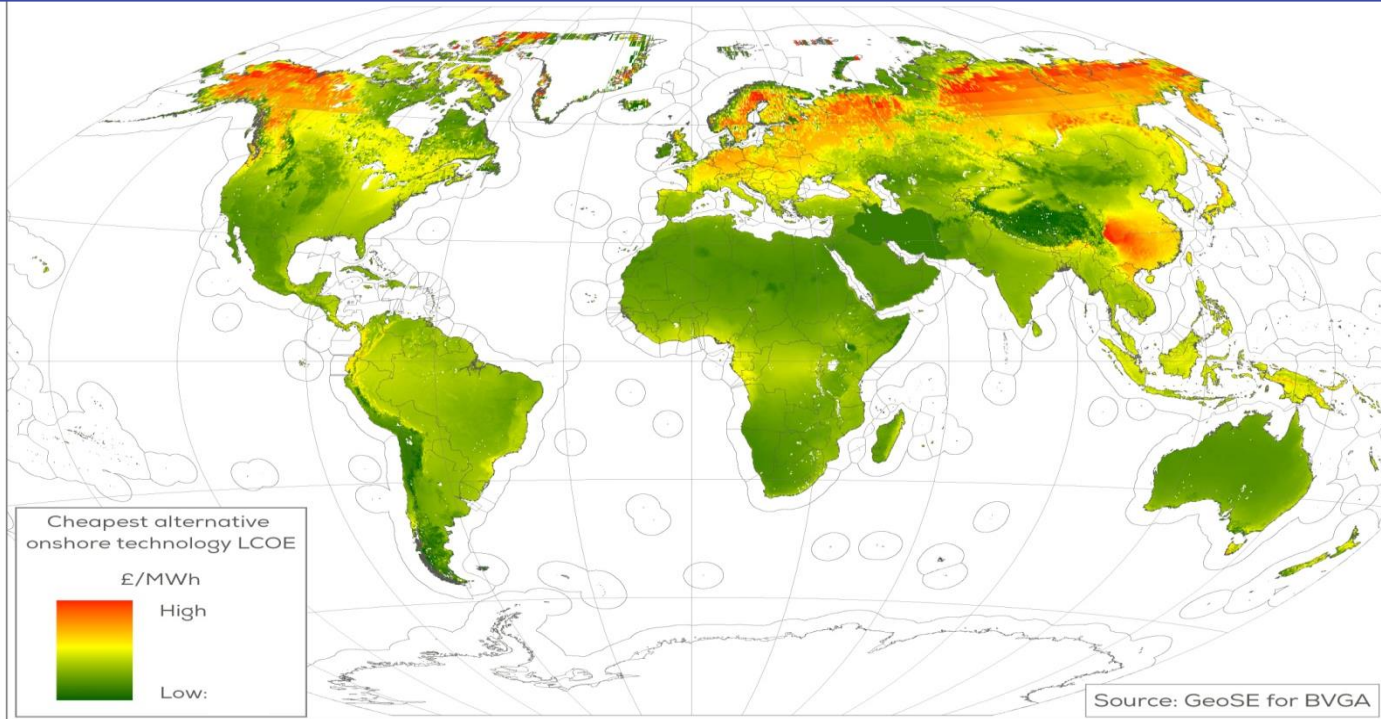
- This data used to calculate energy production and costs (for diesel) across the whole globe.
- Combined with costs for 500kW systems to obtain levelized cost of energy (LCOE) for:
 1. Onshore wind
 2. Solar PV
 3. Diesel genset

$$LCOE = \frac{\text{Total cost (discounted)}}{\text{Total energy (discounted)}}$$

Results

Output maps

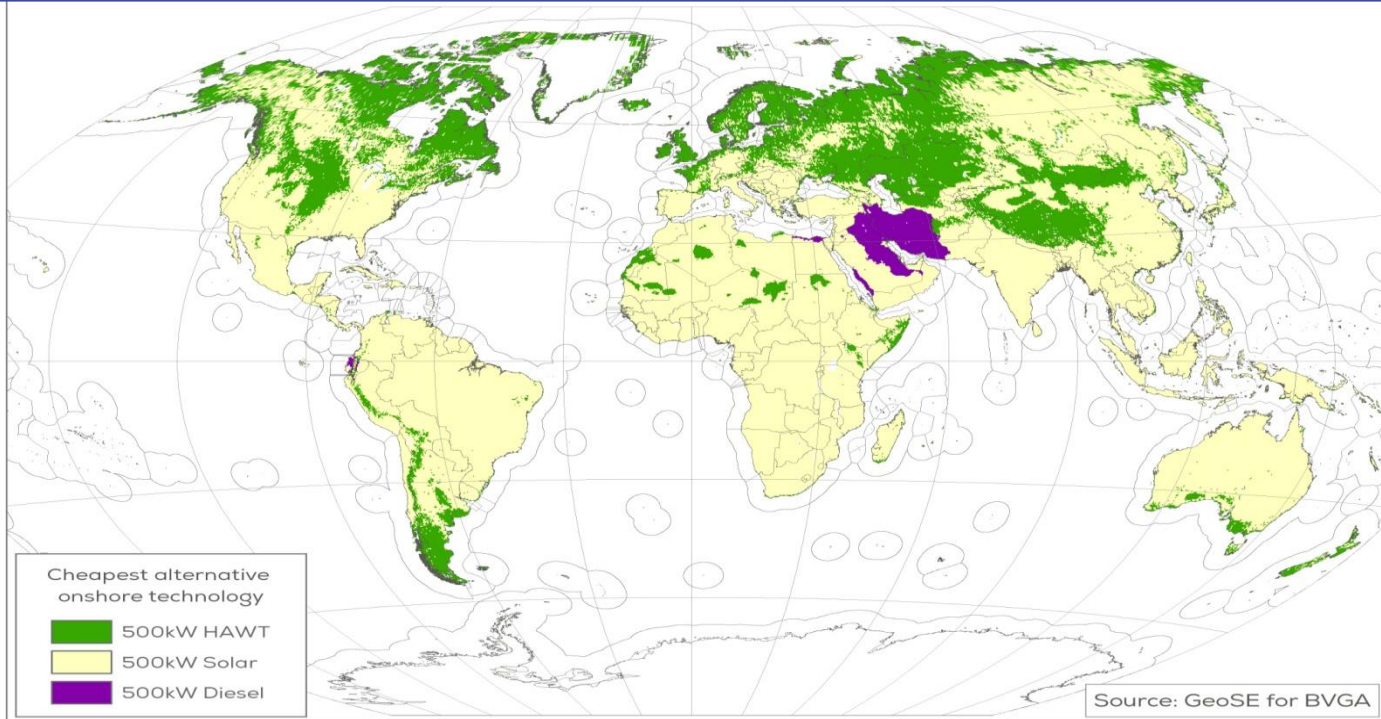
Cheapest alternative onshore LCOE



Results

Output maps

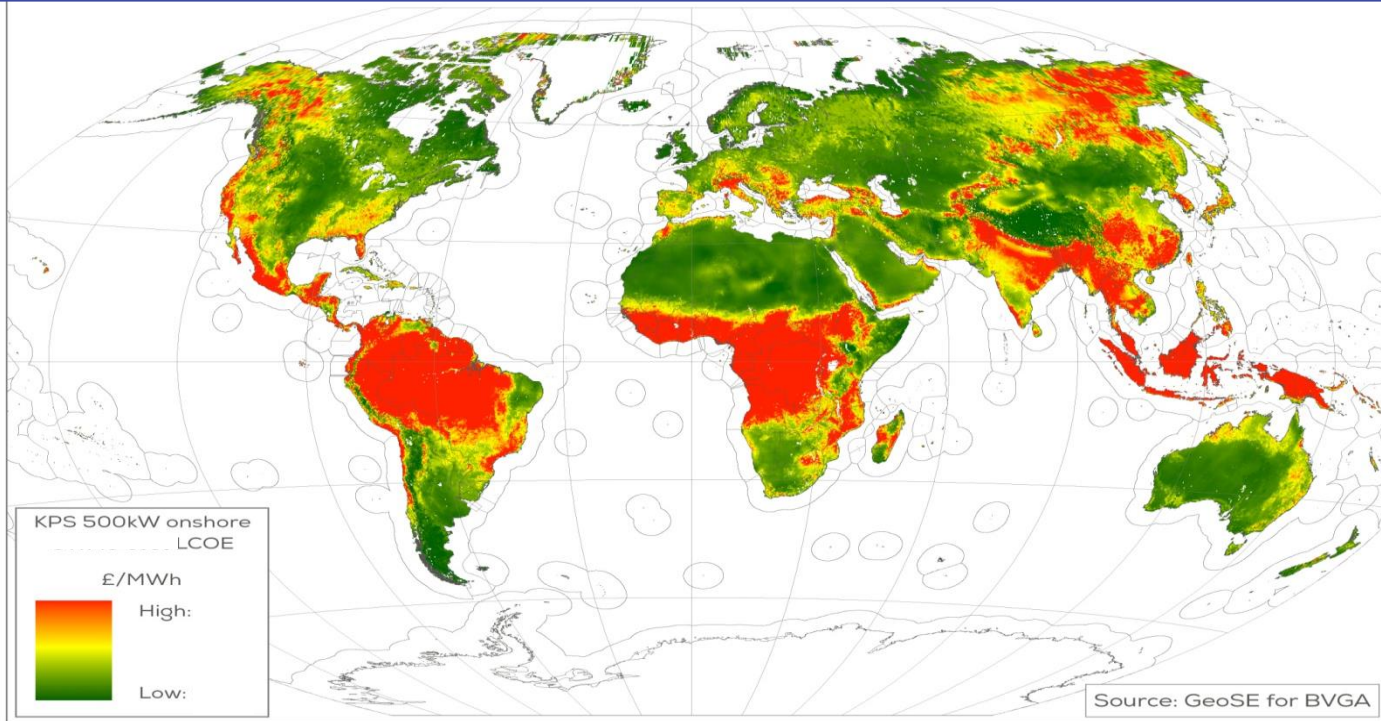
Cheapest alternative onshore technology



Results

Output maps

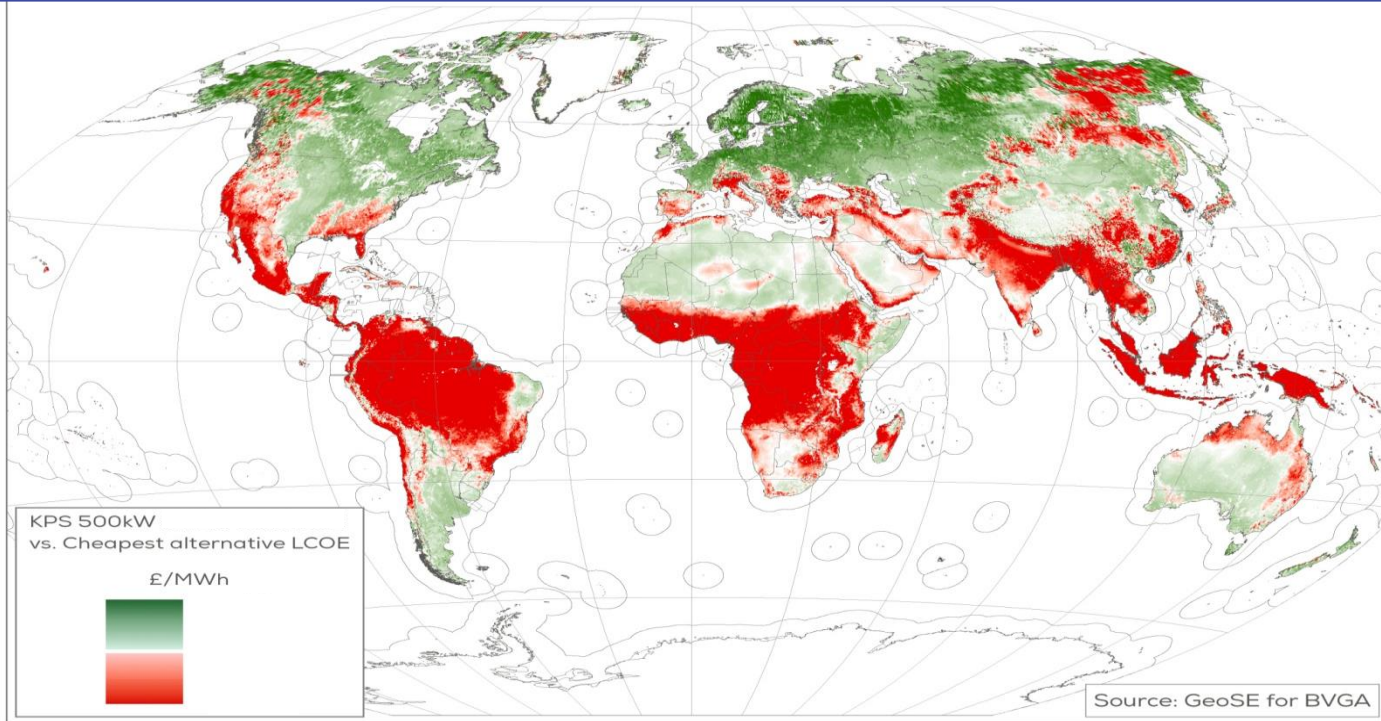
KPS 500kW onshore LCOE



Results

Output maps

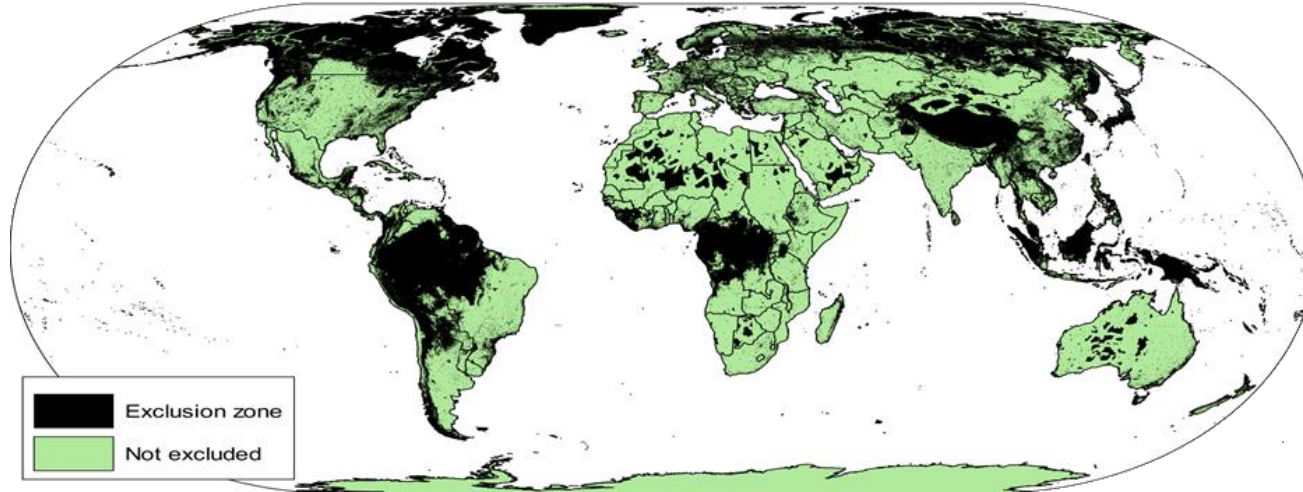
KPS 500kW LCOE vs. Cheapest alternative LCOE



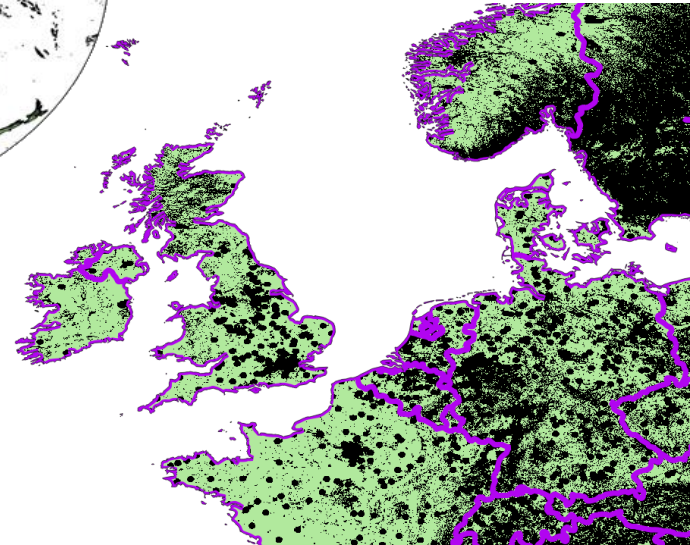
Results

Exclusion zones

Covers: inaccessibility, air traffic, altitude, gradient, land cover, urban, protected areas, low wind



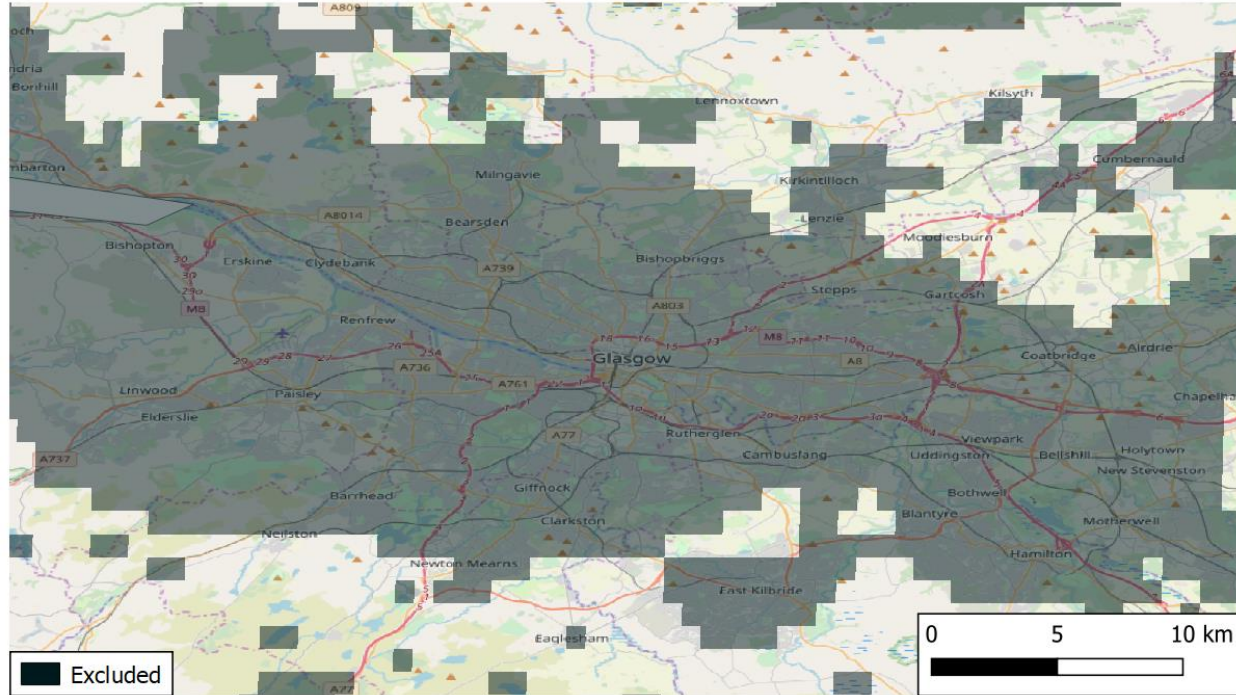
Approximately
153,000,000 locations
analysed globally



Results

High resolution data

Glasgow



Conclusions

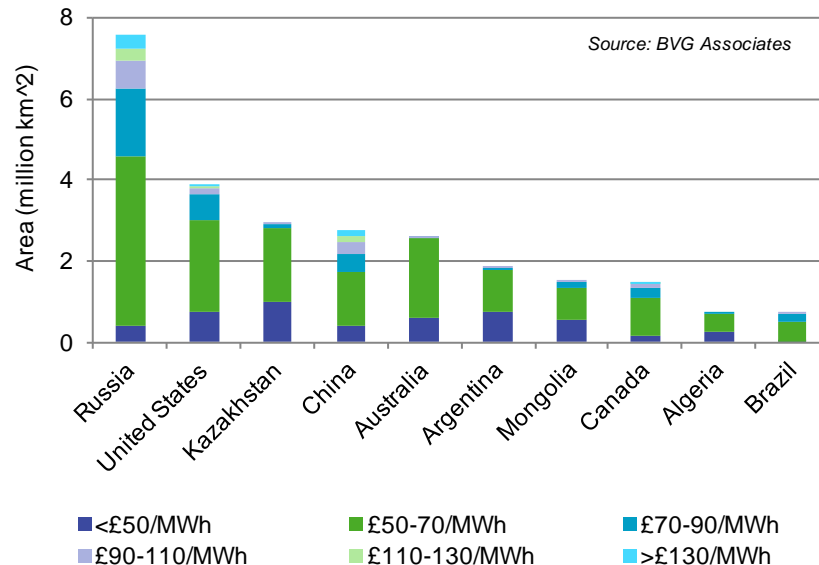
Airborne opportunity markets

Generic conclusions

- Airborne wind has wide potential application onshore
- Has application in areas currently best served by any of the alternative technologies
- Has large market opportunities that can enable technology development, scale-up and LCOE reduction
- GIS analysis: a powerful tool to identify market size and opportunities

Conclusions of this study

- Countries with large land mass appear to lead the market opportunity; however there are many countries with a significant area of the lowest LCOE band (including countries outside top 10)
- Results show very large areas available globally for the deployment of airborne wind energy



Thank you

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