Global prospects for airborne wind onshore

A study by BVG Associates and KPS

AWEC, October 2019

Ciaran Frost

BVGassociates

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

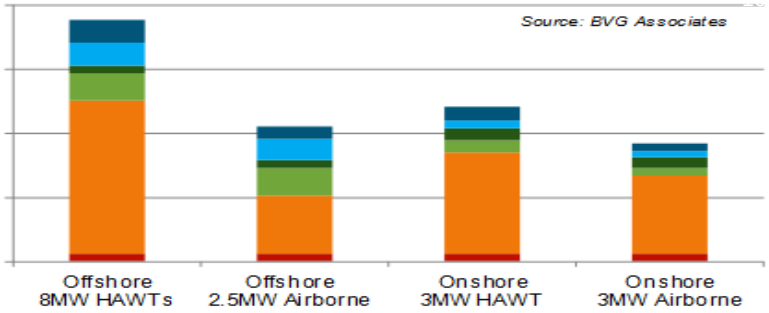
- KPS is a leading developer of AWE technology for offshore and onshore applications.

- 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:

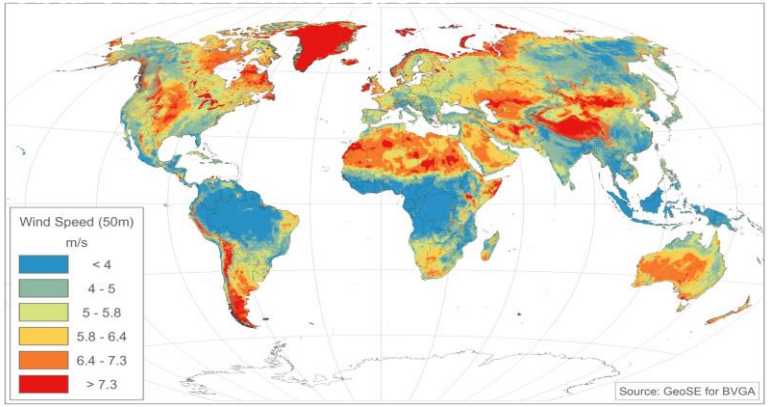
- In-series component and installation costs
- Aerodynamic performance and energy production
- Technical, economic and investment support



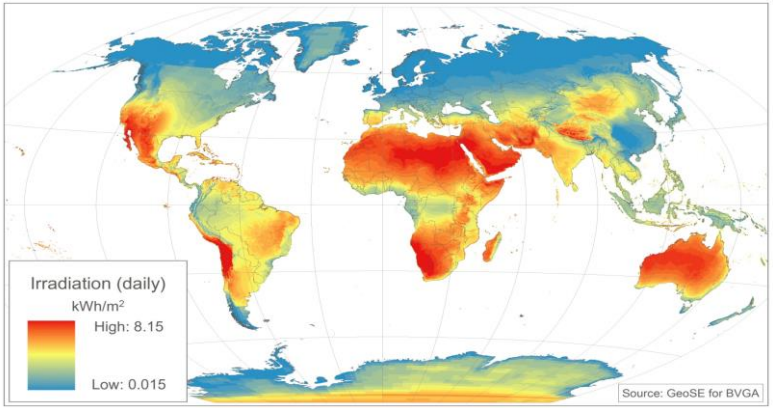
Inputs

Input: geospatial data

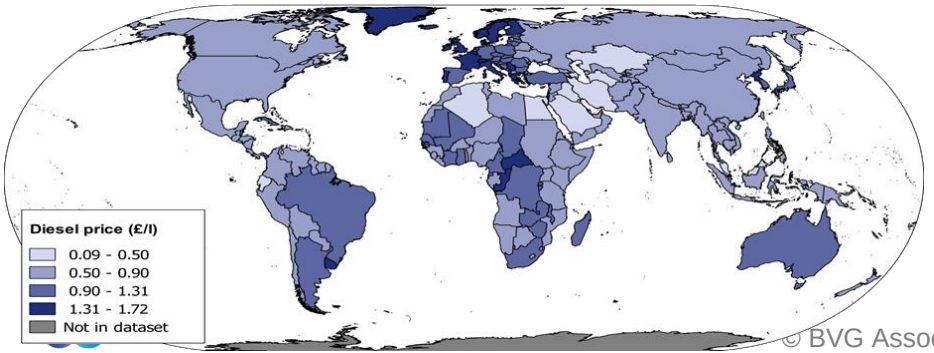
Global onshore wind



Global solar irradiation



Global diesel costs



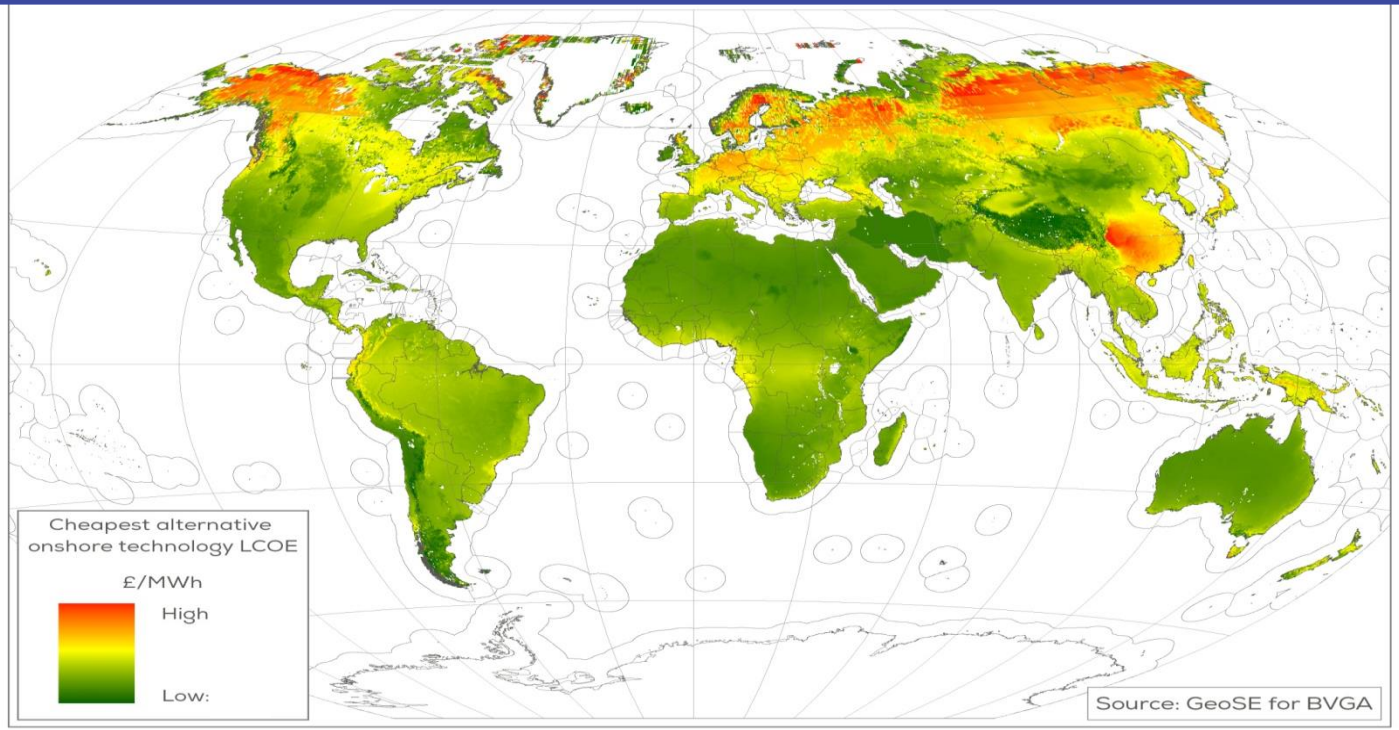
- This data used to calculate energy production and costs (for diesel) across the whole globe.
- Combined with costs for 500kW systems to obtain levelized cost of energy (LCOE) for:
    1. Onshore wind
    2. Solar PV
    3. Diesel genset

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

Results

Output maps

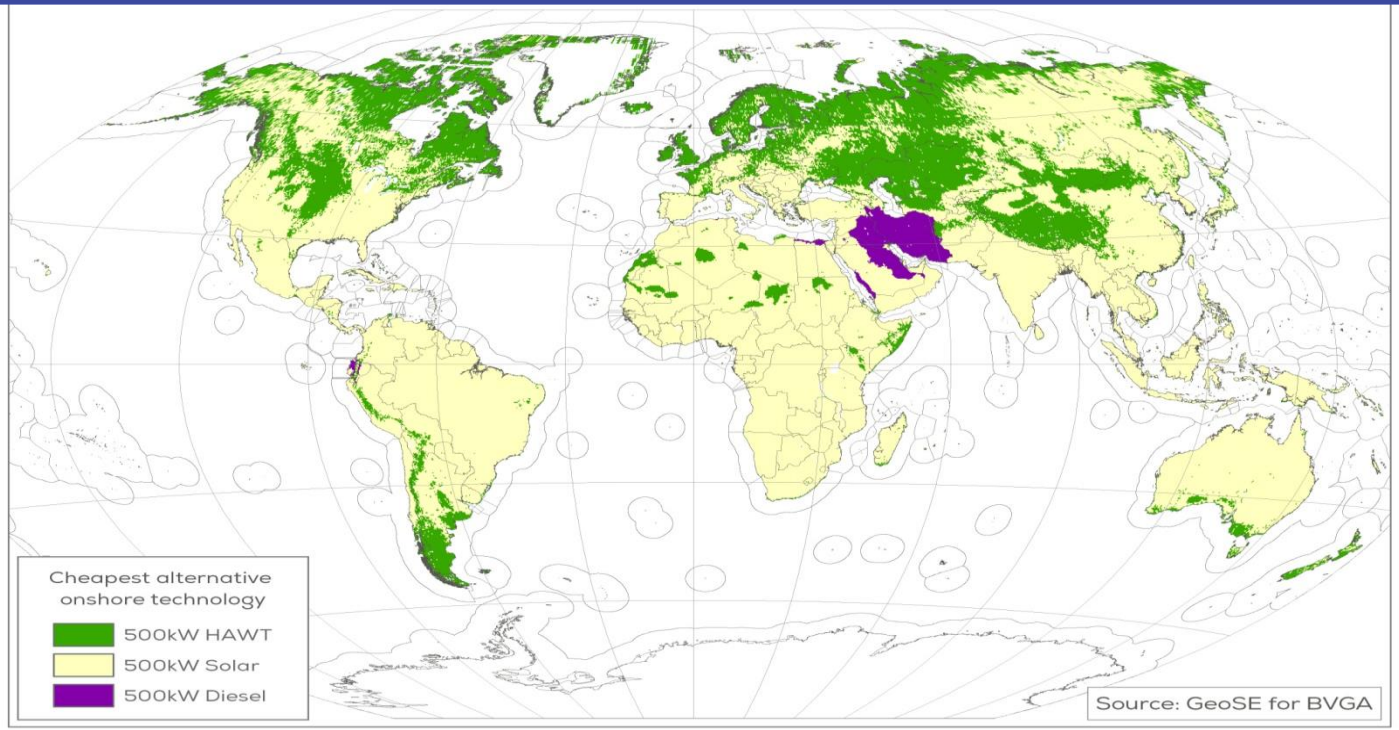
Cheapest alternative onshore LCOE



Results

Output maps

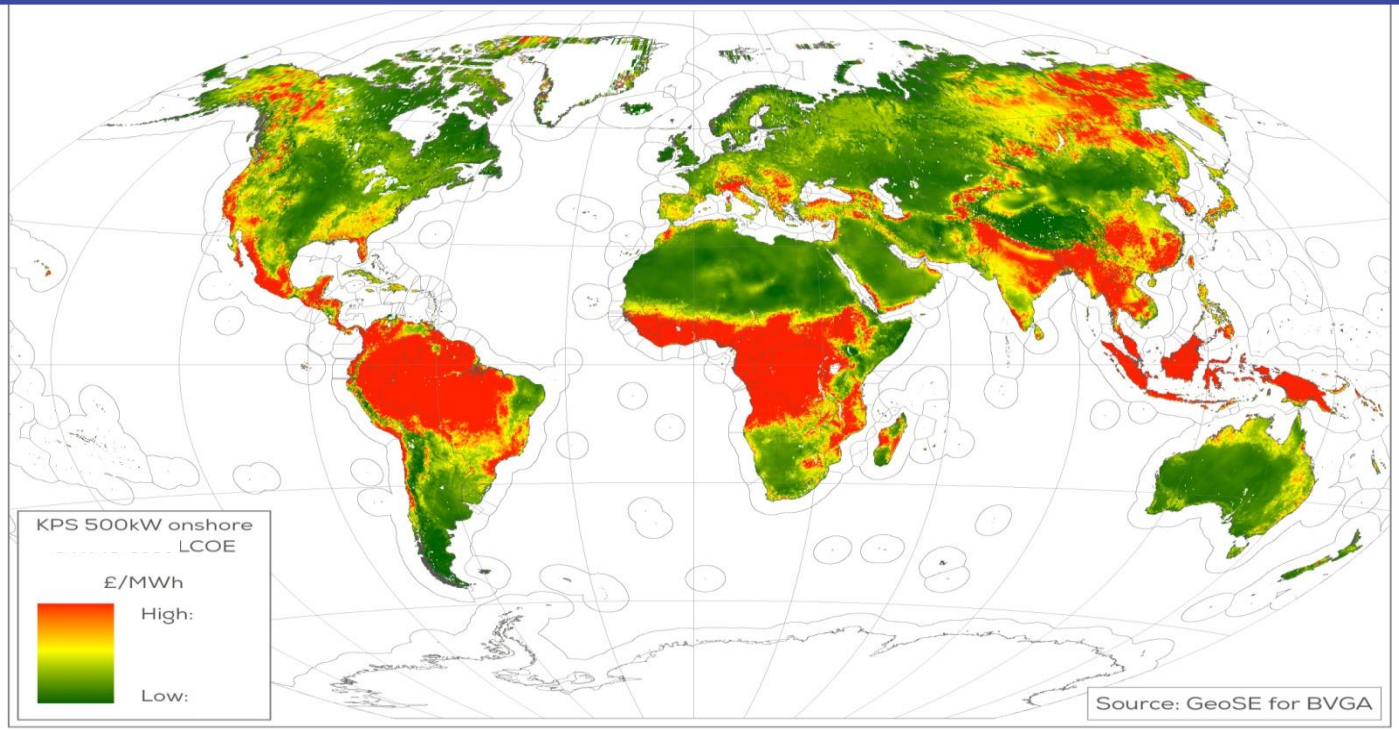
Cheapest alternative onshore technology



Results

Output maps

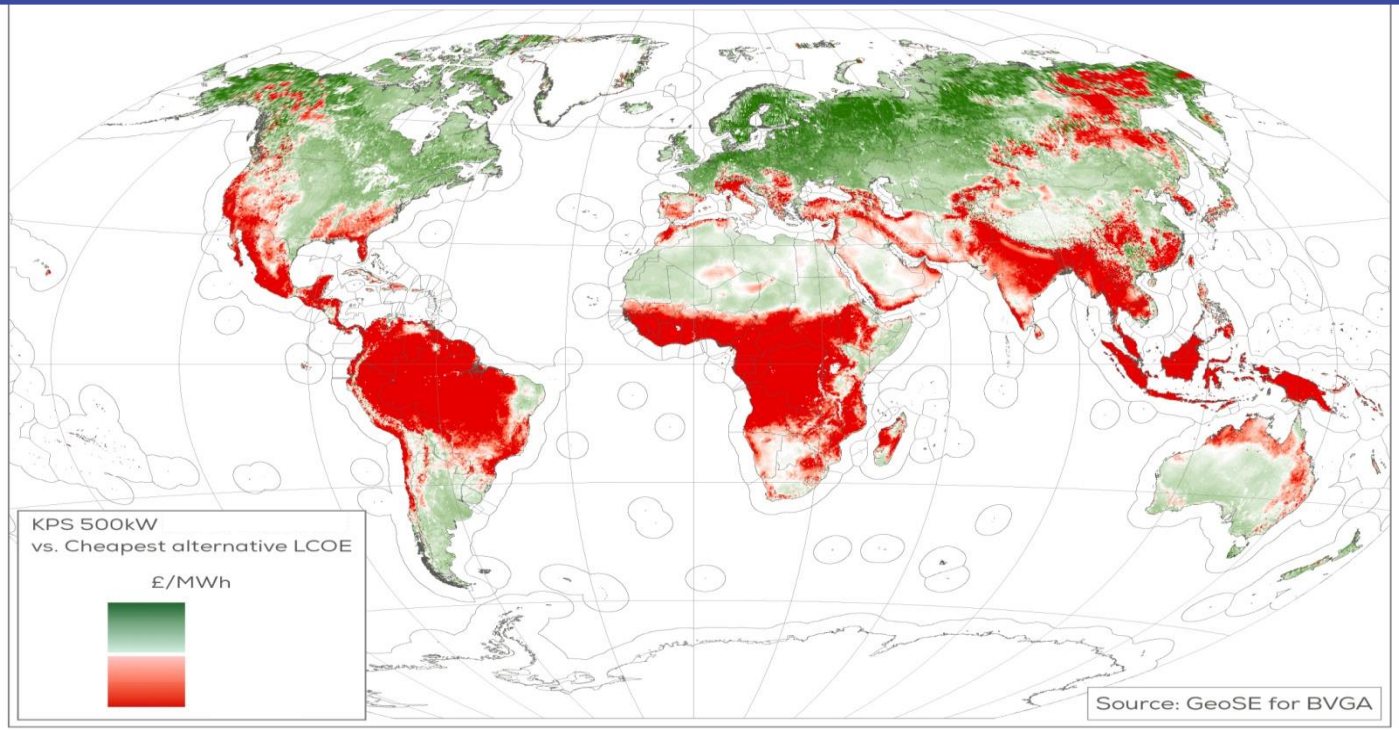
KPS 500kW onshore LCOE



Results

Output maps

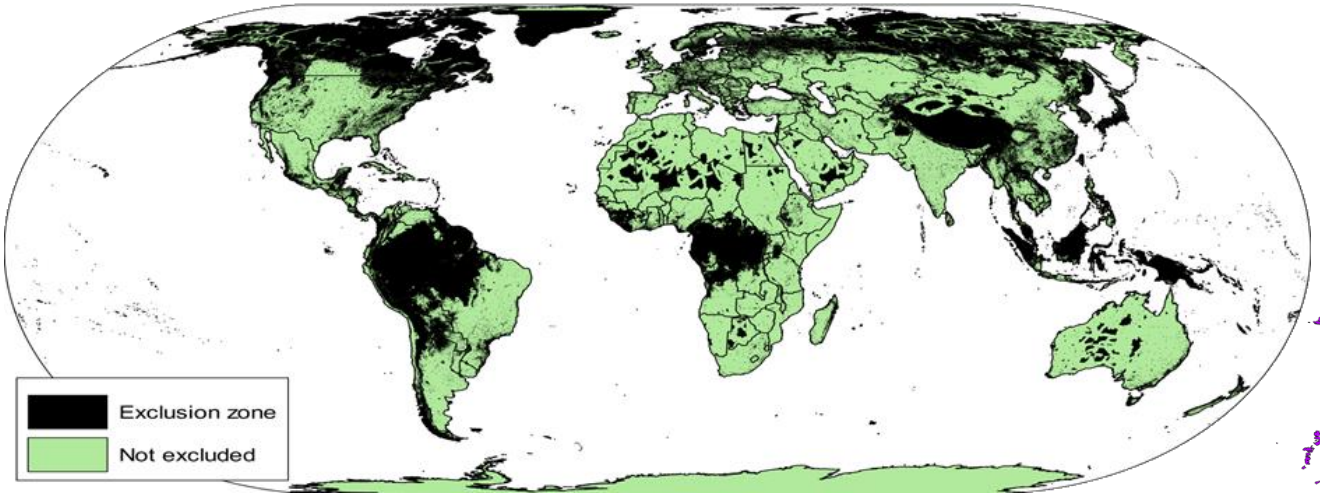
KPS 500kW LCOE vs. Cheapest alternative LCOE



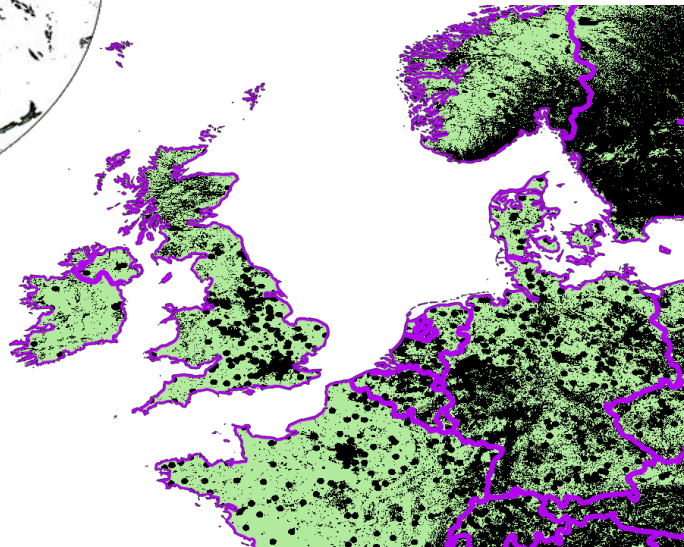
Results

Exclusion zones

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



Approximately 153,000,000 locations analysed globally

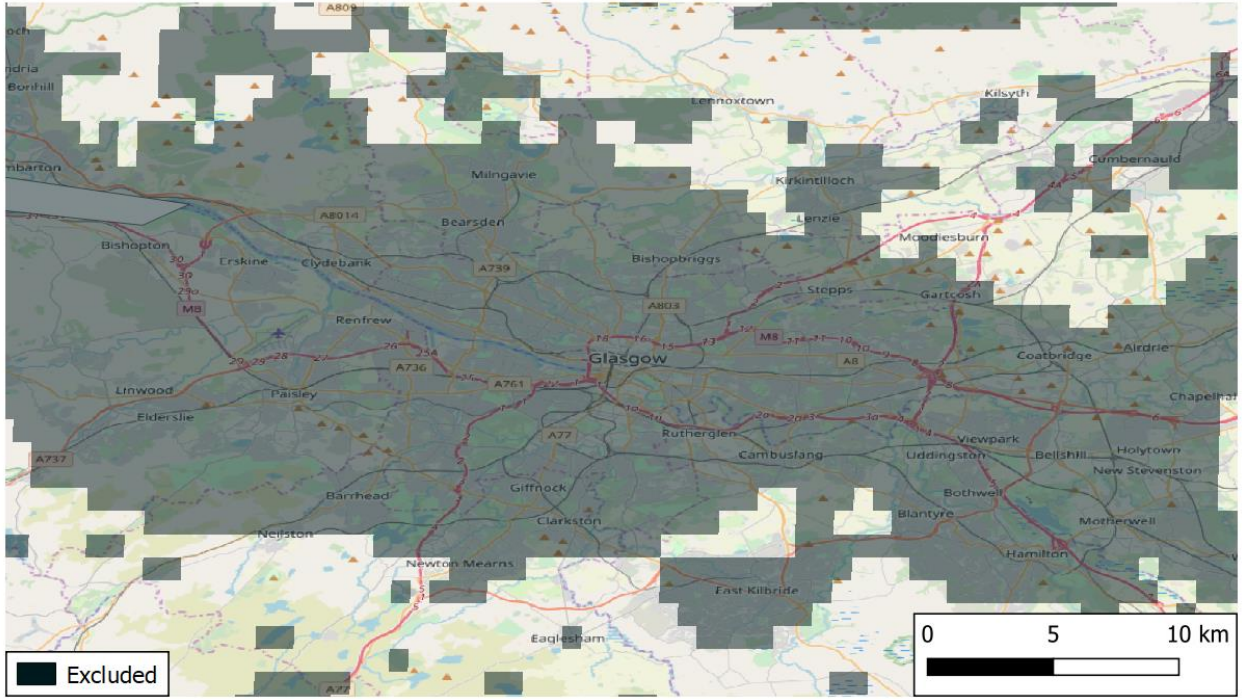


BVGassociates

Results

High resolution data

Glasgow



Conclusions

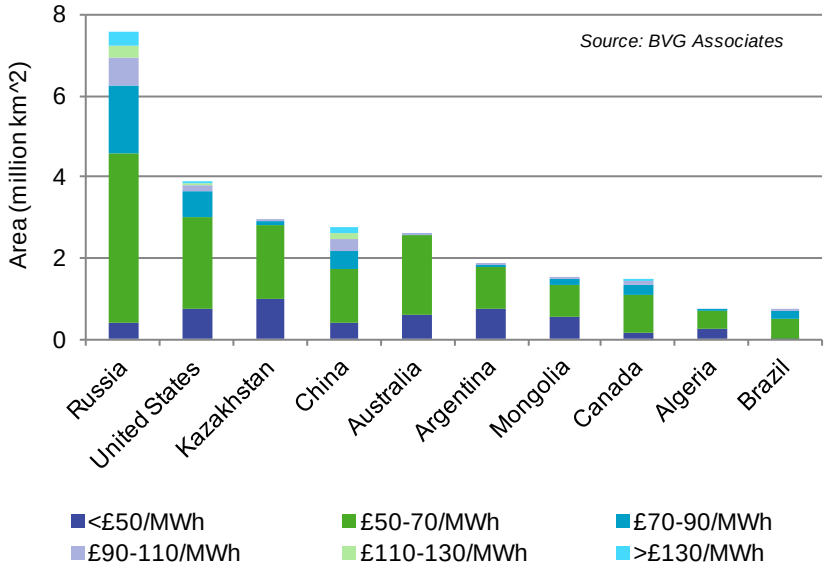
Airborne opportunity markets

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

BVG Associates Ltd
The Blackthorn Centre
Purton Road
Cricklade, Swindon
SN6 6HY UK
tel +44 (0) 1793 752 308

BVG Associates Ltd
Inovo
121 George Street
Glasgow
G1 1 RD UK
tel +44 (0) 44 212 0800

BVG Associates LLC
874 Walker Road
Suite C
Dover
Delaware
19904 USA
tel +1 (313) 462 0673

info@bvgassociates.com
Ciaran Frost: cjf@bvgassociates
www.bvgassociates.com