apse energy

# CAPTURING THE WIND

**Information on the potential for wind generation for Public Authorities**

Stewart Forsyth – Wind Energy Industry Expert

# Introduction

- independent consultant with over 25 years experience in the commercial wind industry

- became interested in wind farm development at an early stage as it made a lot of sense to me in relation to the free renewable energy resource and the CO2 savings

- identify, review and take forward sites through the planning system which have potential, working with experienced and professional industry experts when required

- developed over 300MW of wind energy development from concept through to pre-construction and many lessons have been learned in the process

- wind energy projects are now making a contribution of approx. 30%* of total electricity generation in the UK and is continuing to grow and over 100% of Scottish energy demand was met from wind during 2022

- transmission networks are full to capacity and there is a great opportunity to increase the amount of local/distribution connected renewable energy generation !!

- wind power is a commercially viable form of electricity generation and with demand expected to increase it should be seriously considered



*2024 figure

# Why is wind power more attractive now ?

- the energy crisis, clean power requirements and security of supply have increased the requirement for nationally based renewable energy generation (and other clean forms of electricity generation)

- it can fit in well with Public Sector de-carbonisation plans

- the current Scottish Government has always been a strong proponent of wind power and the fact that the current English Government has lifted its ban on onshore wind power indicates that the political climate is changing nationally in favour of renewables (including wind) and is becoming an essential part of the generation mix

- The cost of future energy is unpredictable and by using on-site wind generation can provide more certainty on the electricity costs

- battery technology is advancing and is now being reviewed to work alongside intermittent electricity generation (wind and solar) which could make it more financially attractive

# Location, Location Location !!

- there are good and bad examples of on-site wind generation in both public and commercial environments. We need to concentrate on only sites which look to offer decent wind energy generation and not token opportunities !

- optimal siting of a wind turbine is key to its generation and to the efficiency of the turbine itself

- correct siting of a wind turbine is key to not creating problems due to the noise, shadow flicker, visual influence etc

- the location of a successful wind turbine development will be the result of a combination of energy yield, environmental, technical and planning analysis

- the location of appropriate electrical connection opportunities will be key to the economics as this will determine the cost of connection, the capacity of the turbine and the potential export opportunities

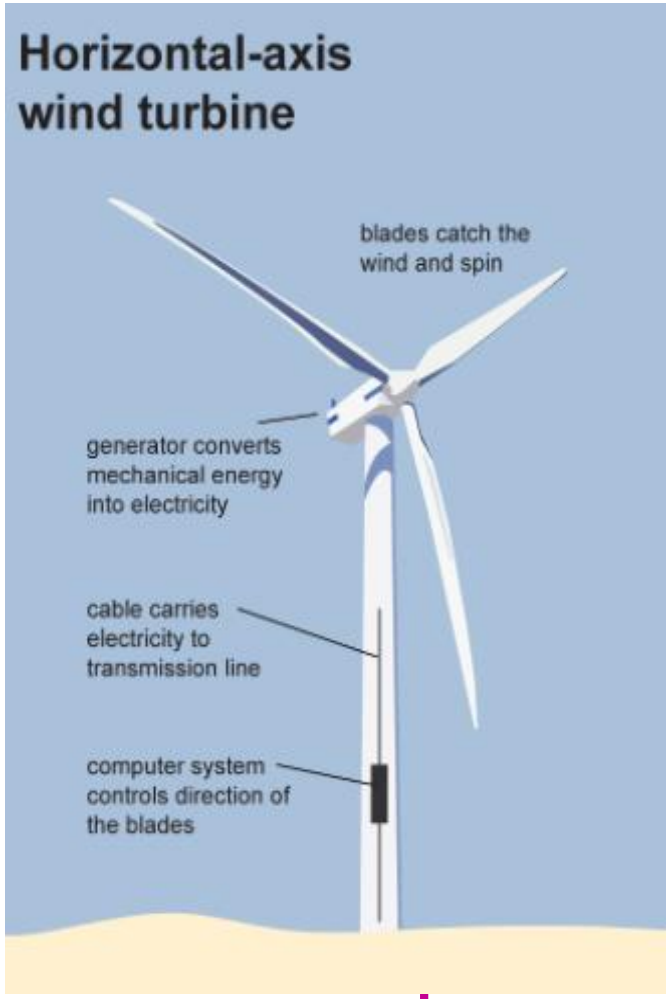
## Wind Speed calculations

Power (W) = ½ x $\rho$ x A x $V^3$

The 2 main factors are the swept area of the blade and the velocity of the wind, the wind speed (velocity) being the most impactful because it is cubed

| Wind speed (m/s) | Cubed value |
|---|---|
| 4 | 64 |
| 5 | 125 |
| 6 | 216 |
| 7 | 343 |
| 8 | 512 |

# Description of a wind turbine and how to maximise output




**Maximise the height !**
Turbine towers are becoming taller to capture more energy, since winds generally increase as altitudes increase. The change in wind speed with altitude is called wind shear. At higher heights above the ground, wind can flow more freely, with less friction from obstacles on the earth's surface such as trees and other vegetation, buildings etc

**Maximise the Rotor Diameter !**
Larger rotor diameters allow wind turbines to sweep more area, capture more wind, and produce more electricity. A turbine with longer blades will be able to capture more of the available wind than shorter blades—even in areas with relatively less wind. Being able to harvest more wind at lower wind speeds can increase the number of areas available for wind development

# Example of a good on-site wind generation project

- Good wind turbine location in central belt of Scotland.

- High electrical demand (steel fabrication)

- Average of 1.3MkWh p.a demand compared with average of 1MkWh p.a supply from the turbine therefore the turbine capacity is fairly well matched to the demand which means that it displaces the expensive electricity normally being imported (average 20pkWh). Export onto the grid will achieve approximately 7pkWh which is relatively low compared to import cost

- No battery storage was installed as it was costed at approximately £1m – therefore a significant cost. Costs may have reduced since the turbine was installed

- Grid connection was a key consideration due to the high cost (however costs can be minimised if turbine is sized to fit the grid connection)

- Approximate payback of wind turbine and associated costs was approx. 7 years

# 5 things to consider for a wind project

- Good wind speed (as described earlier), decent hub height and an adequate buffer to buildings and trees to avoid turbulence and wind shear which can affect the turbine efficiency

- Lack of smaller turbines available of up to 50m to tip therefore the site needs to have the potential to accommodate a turbine of between 70m to 100m to tip which equates to a capacity of between 250kW and 1MW. The higher the hub height the better, remember $V^3$

- No significant effects of the proposed development on the environment including noise, shadow flicker and other environmental considerations such as landscape, aviation, ecology and ornithology etc. otherwise this will trigger an Environmental Impact Assessment which is expensive for a single turbine development

- The more the on-site generation displaces the expensive electricity imported the better. This could be difficult if the on-site demand is possibly not high enough and the turbine costs are too expensive. The local authority may take a longer term view on 'financial payback', as the turbine is designed to last for approximately 25 years

- Essential to get an estimated wind energy yield and an on-site offset analysis of the electrical demand carried out to determine the most optimal wind turbine suitable to displace the expensive electricity import. This would be followed up with a wind measuring device placed on-site to validate the estimated energy yield (which is derived from extrapolating historic data from meteorological masts in the area). Sites can be rejected if too turbulent.

# Definition of On-site offset energy analysis

An on-site offset energy analysis is a process to evaluate the energy generated at a site to offset energy used from an external source, such as the grid. It involves calculating the proportion of a building's energy needs met by on-site generation (On-Site Energy Fraction) and the proportion of on-site generation that is used on-site (On-Site Energy Matching). The analysis determines whether a building's on-site energy production can fully offset its consumption, often as part of a net-zero energy goal.

# Other considerations

- Being a good neighbour is essential and consultation with the locals is recommended. A robust assessment of noise and shadow flicker during the planning phase are essential to avoid issues when installed.

- There is an educational element to on-site wind generation and relays a strong message about climate change and the challenges ahead

- Battery storage is a good option for a wind turbine and current technology such as Valadium Flow batteries have a longer duration and are more environmentally friendly than traditional battery systems. These can be modularized to suit the capacity of the site and can be used as back up power supply during adverse conditions to provide limited community services

- Vertical axis wind turbines have been cited as an alternative technology for relatively small generation needs and may be become more common in certain locations (but not covered here)

- Installation costs of a wind turbine can be expensive and commercial operators require that their assets are paid off as soon as possible - however local authorities may accept a longer payback period due to the wider benefits. There is probably no ground rent payable therefore benefiting economics

- Health and safety considerations are essential to any development project and wind generation is no exception. H&S requirements are factored into the development from conception to operation

## Estimated high level financials when generation is equivalent to demand

| Economics of a 500kW Turbine | | |
|---|---|---|
| Installation cost | | £1.6m |
| Annual generation | 500kW x 8,760 x 0.3 | 1.3 mill kWh p.a |
| Equivalent value of displacement of imported electricity | 1.3 mill kWh p.a x £0.20pkWh (ave import) | £262,800 p.a |
| Estimated payback period | 1.6m/(262,800 – 30,000 O&M) | 7 years |
| Asset lifetime | 25 years | 18 years further running excluding O&M |

## Community Wind Farms

- Normally wind farms are developed by commercial operators due to the risks involved. They tend to build a portfolio of projects with varying degrees of risk and hedge their bets that there will be a proportion that will fail and progress to construction. It is a risky business !

- There are significant financial risks developing a sizeable scale wind farm relating to grid connection and development costs. This can easily be £1m without any guarantee.

- That is not to say that it would not work however it would still require large amount of studies being carried out up front to try to de-risk the project

## Further considerations

- To reduce capital costs pre-owned wind turbines could be considered. These have worked in other situations and there could be a good story regarding re-use of perfectly suitable technology

- Ground mounted solar can work with wind generation to create a hybrid system and maximise the grid opportunity

- APSE energy are in the process of reviewing an academy in south of Scotland to ascertain the viability of on-site wind generation in pursuance of the Councils green agenda commitments and reducing operating costs.

## To complete the workshop 3 things to consider !

- Do you agree that on-site generation could contribute to your green agenda in terms of reducing the carbon footprint and reducing energy costs over the longer term ?
- What do you think of re-using pre-owned wind turbines, is this something that would be considered ?
- As a Council are there landholdings, including brownfield sites that you think would be suitable for wind generation and is this something that you would be interested in being reviewed to maximise any potential opportunities ?

# Contact details

**Email:** stewart@fredrenewables.com

pbrennan@apse.org.uk

Or through APSE



**Association for Public Service Excellence**
3rd floor, Trafford House, Chester Road,
Old Trafford, Manchester M32 0RS.
**telephone:** 0161 772 1810
**web:**www.apse.org.uk