Improving the Welsh Dairy Supply Chain

Wind energy for dairy farms

Cronfa Amaethyddol Ewrop ar gyfer Datblygu Gwledig: Ewrop yn Buddsoddi mewn Ardaloedd Gwledig
The European Agricultural Fund for Rural Development: Europe Investing in Rural Areas

FARMING connect
cyswllt FFERMIO

Canolfan Datblygu Llaeth
Dairy Development Centre

DairyCo

Llywodraeth Cymru
Welsh Government

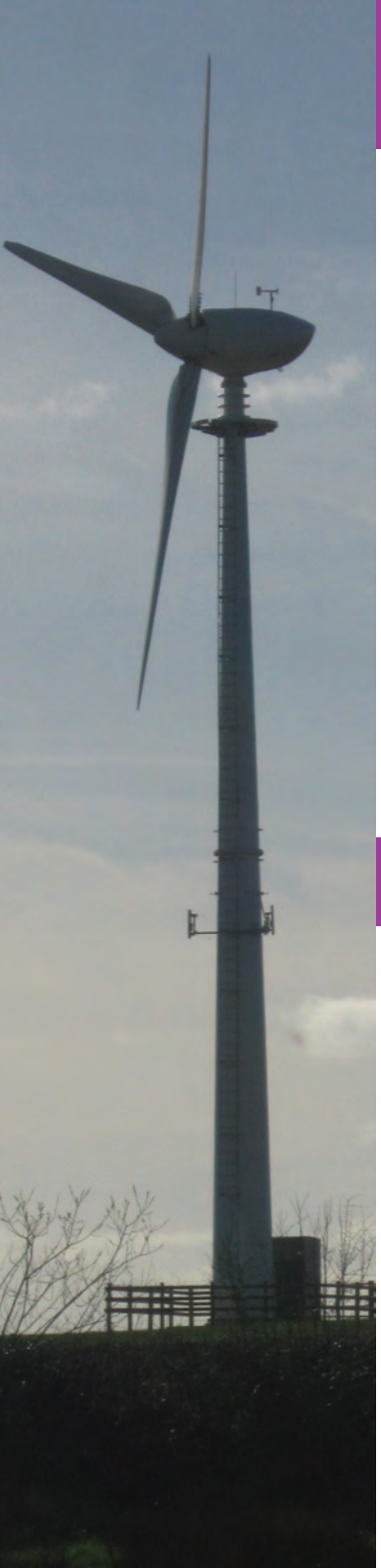
Dairy Development Centre
Gelli Aur
Carmarthen
Carmarthenshire
SA32 8NJ
Telephone: 01554 748570
E-mail: ddc@colegsirgar.ac.uk

www.ddc-wales.co.uk

October 2014

The Dairy Development Centre (DDC) acknowledges the contribution made by Farm Energy to the technical content of this booklet.

This project has received funding through the Rural Development Plan for Wales 2007-2013 which is funded by the Welsh Government and the European Agricultural Fund for Rural Development.



Contents

Wind energy for dairy farms	4
Basic technology	4
Generation potential	5
Outputs	7
Electrical connection	8
Planning permission	8

Terms and abbreviations

FiT - Feed-in Tariff

kW - kiloWatt

kWh - kiloWatt hour

MW - MegaWatt

m/s - metres per second

Power generation profile - this is usually a graphical representation of the amount of power generated over a given period of time.

Wind energy for dairy farms

Wind energy can be one of the most cost effective forms of renewable energy and Wales has one of the best wind resources in Europe. However, careful site selection is critical to producing satisfactory electricity yields. What has really made the difference to the economics of wind is the FiT which determines the price that is paid for the electricity generated. Small scale wind developments can be used to support on-site energy use, and larger systems can be used purely as an export facility.

Basic technology

A typical wind turbine consists of the generator/rotor assembly mounted on a steel tower. Rotors (usually with two or three blades) can be orientated on a horizontal or vertical axis, the most common being horizontal.

Conventional wind turbines contain a gearbox to match the rotation of the blades to the generator. However, some are now using a 'direct drive' configuration where the blades share a common drive shaft with the generator.

Most generators operate in parallel with the mains electricity either through a dedicated connection or through the farm supply. The latter is advantageous; especially for small machines, as energy generation can be used to 'offset' the electricity used on the farm.

Generation potential
The amount of power generated from a wind turbine depends on numerous factors as outlined here:

- **The site average windspeed**
  A guide to this is published by the Department of Energy and Climate Change (DECC) on their website and covers every square kilometre in the UK.

For further details visit:
www.gov.uk/onshore-wind-part-of-the-uks-energy-mix#windspeed-database

In order to obtain a more accurate prediction it is advisable to have your wind speed measured using an anemometer and benchmarked against known wind history in your area.

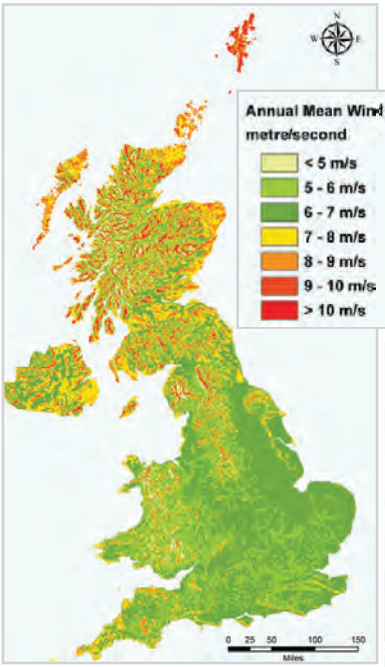
Anemometer

▪ Local conditions

Annual mean wind speed

at 25m above ground level (metre/second)

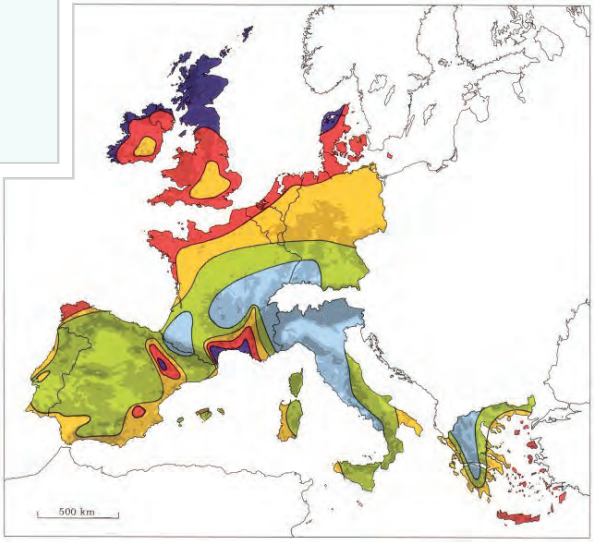
Source: UK Wind Speed Database/BERR



Wind resources

From the map below, Wales has one of the highest annual mean wind speeds in Europe.

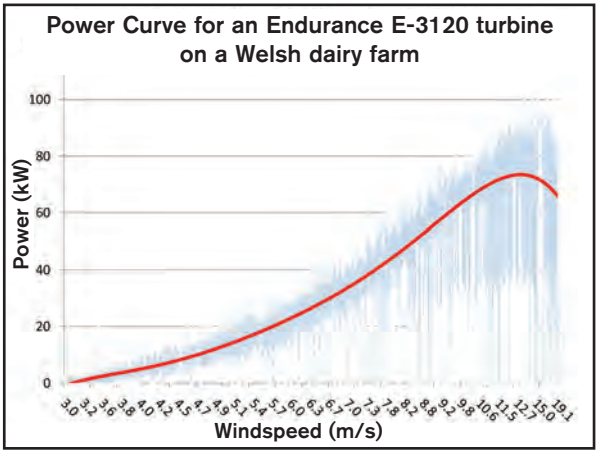
Source: DTU Wind Energy, formerly RisØ National Laboratory



Small topological features like hills, buildings and woods can have a significant effect on average wind speed.

It's always important to remember that the power output of a turbine is proportional to the cube of the wind speed. Therefore, if the wind speed is 10% lower than expected, the energy yield will be nearly 30% lower.

- **The power output rating over a range of wind speeds**
  It's important that the power generation profile of the wind turbine or 'rating curve' is appropriate to the wind speeds in your area. This will ensure that the turbine is working at its optimum efficiency according to the average wind conditions at that particular site.



Source: Aeolus Power (Wind Energy) Ltd.

- **Size of turbines**
  Some typical heights and diameters of turbines are shown in the adjacent table:

Rating (kW)	Hub Height (metres)	Rotor Diameter (metres)
20	15	13
50	26	19
100	31	27
400	34	34
800	65	62
1000	72	71

Outputs and expected income

The table below gives an indication of output and expected income at 2014 FiT rates - note that it is assumed that all energy is exported. When the energy produced is used on site this will increase the value by about 6p per kWh for that proportion of the energy produced. This is the difference between the amount you would normally pay for your electricity from your supplier and the payments received by selling any excess electricity back to the National Grid as the export tariff.

	Output at wind speed 5 m/s		
Size (kW)	Output (kWh)	Annual Income (FiTs + export) assuming all generated energy exported	Annual Income (FiTs + export) assuming all generated energy used on site
20	43,000	£10,010	£11.945
50	115,000	£26,772	£31,947
100	145,000	£29,464	£35,989
400	450,000	£91,440	£111,690
800	1,135,000	£153,679	£204,754

	Output at wind speed 6 m/s		
Size (kW)	Output (kWh)	Annual Income (FiTs + export) assuming all generated energy exported	Annual Income (FiTs + export) assuming all generated energy used on site
20	63,000	£14,666	£17,501
50	168,000	£39,110	£46,670
100	220,000	£44,704	£54,604
400	730,000	£148,336	£181,186
800	1,685,000	£228,149	£303,974

Electrical connection
Smaller turbines can be connected through the farm meter as long as they are within 300m of the farm electricity supply. A connection such as this reduces the need to purchase energy from your energy supplier, as well as attracting the FiT subsidy.

If the turbine is further away from the farm supply, a separate high voltage supply and transformer is normally required and this will add a significant amount to the installation costs. A wind turbine that is not connected to the electricity meter cannot be used to displace energy used on the farm because all the energy produced would be exported directly to the National Grid.

High voltage 3 phase supply and transformer

Planning permission
Any non-domestic wind turbine eligible to claim the FiT (<5MW) will require planning permission by the Local Planning Authority (LPA).

Wind turbine installations may also require environmental impact assessments, covering the following areas:

- visual impact
- ecological impact
- noise pollution
- shadow flicker
- archaeology
- hydrology
- geology
- aviation and radar assessments

For more information contact Neil Nicholas, Energy Efficiency Officer on:
neil.nicholas@colegsirgar.ac.uk
01554 748577.