Solar pV

Wind

Hydro

Bioenergy

GSHP
Solar thermal
International

Farm Guide to Renewable Energy in Bridgend County Borough 2014

reach

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

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Introduction

This Guide presents a compilation of farm-based renewable energy installations. Most of the case studies are found within Bridgend County Borough but other examples of good practice, including highly innovative international developments, have been included to demonstrate the full potential. The Guide provides examples of developments at all scales and across a range of renewable energy technologies.

The main focus of this guide is on investments by farmers or landowners themselves but some larger projects which provide rental income have also been included.

Technologies are colour-coded and each case study is presented with straightforward facts and figures, to include a brief commentary from each farm on the reasons for pursuing renewables and the experiences, good and bad, during the development process. This includes the main considerations for each technology, which will serve to guide others who are considering renewable energy options.

The advice provided in this booklet is supplemented by practical advice from local farmers and businesses who have already installed renewable energy options. Contacts for these farmers and local businesses can be found in this Guide, along with links to the latest financial incentives and a rough guide to grid connection.

For planning guidance, farmers are advised to refer to the Renewable Energy Assessment of Bridgend Local Development Plan 2006 - 2021 which can be found at:
http://www.bridgend.gov.uk/web/groups/public/documents/report/089117.pdf

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Solar pV

Ground-mounted

Size	**25kW**
Cost	**£42,000**
Location	**Parc Newydd Farm, Nottage**
Date of Installation	**July 2014**
Date of Inception	**April 2013**
Siting	**Unproductive land**
Annual Output	**25,000kWh expected**
Annual Income	**£5,000 expected**
Payback Period	**8 years**
Feed-in Tariff Duration	**20 years**

Parc Newydd Farm, Nottage 25kW

On a small parcel of unproductive land near the farmhouse, the unobtrusive ground-mounted solar mono-crystalline PV installation is a good investment and improves the farm's power supply.

The farm business includes a caravan park, summer electricity consumption is therefore high, adding value to the solar contribution. The enclosed system provides a safe haven for chickens which in-turn provide free maintenance by keeping growth to a minimum.

The land is prone to low-level flooding, beneath the unaffected panels. A 3-phase step-up transformer was required for grid connection.

What site do I need?

- South or near-south facing field with good aspects.
- Unproductive land is best; area required ~8m^2 per kW.
- Development process may be slowed down to satisfy distances from public footpaths.

What are the costs?

- Development costs typically £1,500/kW but falling.
- Falling feed-in tariff support as a result of regular Government reviews which shadow falling capital costs.
- Payback typically 7-10 years and minimal maintenance costs.

What else should I consider?

- Minimal consultancy support required if quotes sourced from reputable companies.
- Grid connection to 11kV 3-phase.
- Very good long-term investment and very low risk development.

Solar pV

Roof-mounted

Size	**50kW**
Cost	**£53,000**
Location	**Ty Tanglwyst Farm, Pyle**
Date of Installation	**Autumn 2014**
Date of Inception	**2013**
Siting	**Dairy and Barn Roofs**
Annual Output	**41,000kWh expected**
Annual Income	**£9,300 expected**
Payback Period	**6 - 7 years**
Feed-in Tariff Duration	**20 years**

Ty Tanglwyst Farm, Pyle 50kW

Ty Tanglwyst Farm's dairy operation consumes large amounts of electricity for processes and cooling.

The 50kW solar PV capacity should maximise the investment within the tariff band and will be split between the dairy (10kW) and barn (40kW) and will offset the imported costs of electricity, including times of maximum consumption when milking.

Grid connection at 11kV is on-site behind the dairy. Excess generated by the solar PV will be fed into the grid and still maintain FIT payments.

What site do I need?

- South or near-south facing roofs with good aspects & structure.
- Area required ~8m2 per kW.
- No planning issues.

What are the costs?

- Capital costs typically £1,000/kW but this is falling.
- Falling feed-in tariff support.
- Payback typically 7 - 10 years.
- Minimal maintenance and costs and very good long-term investment.

What else should I consider?

- Grid connection typically at 11kV 3-phase.
- Straightforward and quick development process, with quotes from reputable companies & minimal consultancy support.
- Very low risk development.

Solar pV

Ground-rental

Size	**500kW**
Cost	**approx £500,000**
Location	**Parc Newydd Farm, Nottage**
Date of Installation	**May 2014**
Date of Inception	**April 2013**
Siting	**Grazing land**
Annual Output	**500MWh expected**
Annual Income	**£60,000 expected**
Payback Period	**7 - 8 years**
PPA Duration	**20 years**

Parc Newydd Farm, Nottage 500kW

This small-scale solar farm occupies 2 acres of land next to an adventure centre.

As an external investment by a local business, the solar farm provides rental income to the farm as well as continuing to provide grazing land for 30 sheep from another farm. Three Bridgend businesses are therefore benefitting from a single field and the sheep are kept happy by the shading.

The Power Purchase Agreement for sale of solar electricity can be negotiated annually with the buying energy company, to reflect rising market prices.

What site do I need?

- South or near-south facing field with good aspects.
- Low visual impact and area required ~2 acres per 500kW.
- Development process can be complicated & held-up due to ecology, archaeology & footpath issues.

What are the costs?

- Development costs typically £1,000/kW but dependent on grid & planning process.
- Consultancy support required which can add thousands to costs.
- Falling feed-in tariff support and payback typically 7 - 10 years

What else should I consider?

- Optimum grid connection at 11kV 3-phase for <1MW.
- Minimal maintenance and costs.
- Very good long-term investment.
- Medium risk development.

Wind

Investment

Size	**11kW**
Cost	**£60,000**
Location	**Cwmrisca Farm, Tondu**
Date of Installation	**January 2011**
Date of Inception	**January 2008**
Siting	**Farmyard**
Annual Output	**26,000kWh**
Annual Income	**£7 - 8,000**
Payback Period	**8 years**
Feed-in Tariff Duration	**20 years**

Cwmrisca Farm, Tondu 11kW

Bridgend County's first small-scale private wind turbine is generating a good return on investment. The Gaia twin-blade system is located on the farmyard, close to the farm's 3-phase supply to minimise connection costs. Output is closely monitored on an accessible display, common to all renewable installations.

The wind turbine was installed as an investment, to shield against rising electricity costs and to also boost the farm's green credentials. With operational experience, the farmer learnt that the turbine should probably have been installed on higher ground to boost output which would have more than compensated for higher grid connections costs.

What site do I need?

- Clean fetch of wind resource in all directions will maximise output - avoid turbulence from buildings and trees.
- Negligible footprint and no disruption to farming.
- Planning can be straightforward at this small scale.

What are the costs?

- Development costs steady at typically £5-6,000/kW.
- Gradually falling feed-in tariff support.
- Payback typically 6 - 8 years.
- Very good long-term investment.

What else should I consider?

- Grid connection at 11kV 3-phase, the shorter the distance the better.
- Seek quotes and service from manufacturers with working examples.
- Low risk development but ensure manufacturer covers maintenance costs.

Wind

Rental

Size	**2 x Endurance 225kW**
Cost	**No cost to farmer**
Location	**Cwmrisca Farm, Tondu**
Date of Installation	**June 2014**
Date of Inception	**2011**
Siting	**N-facing plateau**
Annual Output	**1,100,000kWh expected**
Annual Income	**Typical rental values**

Cwmrisca Farm, Tondu
2 x 225kW

At over £1m, medium-scale wind turbines are beyond the investment reach of most farmers. Rental income provides a low risk alternative, with no disruption to farm activities.

Several developers had approached the farm over the years and the development process itself was long-winded due to planning issues. Although frustrating for the farmer, the costs and paperwork were done by the developer.

A benefit of the installation has been the straightforward upgrading of existing roadways which has improved access around the hilly farm.

What site do I need?

- Clean fetch of wind resource maximises output.
- Long-winded development process due to planning issues.
- Negligible footprint and no disruption to farming.

What are the costs?

- None - development and planning costs including ecology, archaeology, biodiversity (time of year dependent), noise assessments, visual impact and radar/radio mast line of sight are borne by developer.

What else should I consider?

- Many developers operate in the market, do not be tempted by the first approach.
- Grid connection to 11kV is cheaper than 33kV.
- Very low risk development by farm.

Hydro

High-head

Size	**5.5kW**
Cost	**£16,000**
Location	**Hendre Ifan Goch Farm, Glynogwr**
Date of Installation	**2011**
Date of Inception	**2009**
Siting	**Valley side next to farm**
Annual Output	**20,000kWh**
Annual Income	**£5,000**
Payback Period	**3 - 4 years**
Feed-in Tariff Duration	**20 years**

Hendre Ifan Goch Farm, Glynogwr 6kW

With a good catchment area, no wayleaves and a steep flowing stream, the farm was well-placed for a hydro scheme. But such circumstances are common to farms across the hilly areas of Bridgend county.

Hendre Ifan Goch's advantage was in already holding an abstraction license to draw water from the stream. Gaining such approvals is now the main barrier to developing hydro schemes. The plant has already nearly paid for itself and will operate for decades. It's success is inspiring the farm to develop other renewables to reach energy self-sufficiency, with all the ensuing benefits.

What site do I need?

- High-head and good catchment provides maximum resource.
- No impact on farming activities.
- Development process can be difficult, costly and long-winded due to planning and abstraction licensing affecting biodiversity & ecology.

What are the costs?

- Development costs variable at £3 - 5,000/kW.
- Consultancy support required which can affect development costs.
- Payback typically 5 - 7 years but can be lower.
- Steadily falling feed-in tariff support.

What else should I consider?

- Grid connection to single-phase possible.
- Low maintenance.
- Medium risk development.
- Lasts for decades, a very good long-term investment.

Hydro

Low-head

Size	**24kW Archimedes Screw**
Cost	**£235,000**
Location	**Penllergare, Swansea**
Date of Installation	**December 2013**
Date of Inception	**2009**
Siting	**Wooded valley**
Annual Output	**85,000kWh**
Annual Income	**£15,000**
Payback Period	**15+ years**
Feed-in Tariff Duration	**20 years**

Penllergare Valley Woods, Swansea 24kW

Penllergare Valley Woods is a large 19th century country estate to the north of Swansea. A pioneer of technological innovation in its heyday, the estate is now undergoing extensive restoration after decades of neglect.

The low-head hydro power plant recreates the pioneering spirit of the past, forms a centerpiece of the valley's waterways and will generate revenue for decades. This is not a project to undertake lightly. The visual impact on the landscape needs to be considered and considerable work is needed to develop the project from start to finish.

What site do I need?

- Year-round, consistent river flow required with 2m+ head.
- Good access to site required for substantial civil works.
- Long and costly development process to meet statutory requirements on flood management and obtaining abstraction licences.

What are the costs?

- Development costs up to £10,000 per kW but dependent on consultancy support required and non-capital factors.
- Long paybacks.
- Steady feed-in tariff support.

What else should I consider?

- Grid connection at 11kV 3-phase.
- Minimal maintenance, much of which can be achieved in-house e.g. avoiding blockages from leaves.
- Medium risk which lasts for decades, very good long-term investment.

Bioenergy

Anaerobic Digester

Size	**500kW**
Cost	**£2,300,000**
Location	**Pancross Farm, Llancarfan**
Date of Installation	**October 2012**
Date of Inception	**March 2009**
Siting	**Field, 500m from farm**
Annual Output	**3,800,000kWh**
Annual Income	**average 16.5p/kWh**
Feed-in Tariff Duration	**20 years**

Pancross Farm, Vale of Glamorgan 500kW

Pantcross Farm's medium-scale anaerobic digester (AD) was developed to solve the farm's waste management. The large dairy farm has the required volume and consistency of feedstock to supply the AD, generating a secure and reliable source of electricity and revenue.

AD systems are capital intensive and require much maintenance. Development costs are high requiring lengthy consultations and external support. Located to optimise the distance from farm waste and the adjacent grid connection, the Pancross Farm system has improved in efficiency and output during its first 2 years, as a result of gaining valuable on-site maintenance experience.

What site do I need?

- Suitable for larger farms of co-operatives.
- A consistent, high quality and long-term availability of feedstock is critical.
- Good site access required for substantial civils.

What are the costs?

- Development costs ~£4,000 per kW but strongly influenced by construction costs and planning.
- Long and costly development process due to planning demands on issues such as waste management, noise, odours and visual impact.

What else should I consider?

- Grid connection at 11kV 3-phase.
- Steady feed-in tariff support and wholesale electricity sales possible.
- ~10 year paybacks but good long-term investment.
- Medium-risk development.

Bioenergy

Biomass Boiler

Size	**120kW Heat**
Cost	**£10,000**
Location	**Ty Tanglwyst Farm, Pyle**
Date of Installation	**July 2014**
Date of Inception	**2014**
Siting	**Next to farmhouse**
Annual Output	**100,000kWh**
Annual Income	**£8,000**
Payback Period	**Under 2 years**
RHI Duration	**20 years**

Ty Tanglwyst Farm, Pyle 120kW

Ty Tanglwyst can source a plentiful self-supply of wood fuel for its new boiler, the second of its kind to be installed at the farm. This effectively free fuel heats the central cluster of farmhouses. In common with most farms,

Ty Tanglwyst is off the gas grid and would otherwise rely on oil for all its heating, which continues to supply the holiday cottages on-site. Ty Tanglwyst is steadily reducing its overall energy consumption and moving towards energy self-supply for all its operations.

What site do I need?

- Availability of sustainable on-farm wood supply adds great value.
- Storage area not an issue on farms.
- Systems come in all sizes to suit individual buildings or clusters
- of farm buildings in a mini-district heating scheme.

What are the costs?

- Capital costs typically £100 per kW.
- Straightforward and quick development process, requiring quotes from reputable companies.
- Payback can be very low with self-supply of fuel.

What else should I consider?

- Good RHI support but accreditation process may require consultant.
- No planning issues at small-scale beyond flue and a high quality of fuel minimises maintenance.
- Low risk development and very good long-term investment.

Ground Source Heat Pump & Solar Thermal

Size	**16kW GSHP**
Cost	**~£10,000**
Location	**Tir Cethin Farm, Gower**
Date of Installation	**January 2011**
Date of Inception	**2009**
Siting	**Holiday Cottages**
Annual Income	**£1,800**
Payback Period	**6 years**

Tir Cethin Farm, Gower GSHP 16kW

Conversion of the barn resulted in a very energy efficient building which was important to the owner to keep running costs from holidaymakers' energy use to a minimum.

The heat pump and supporting solar system are integrated to supply underfloor heating which provides excellent comfort levels. The heat pump and storage cylinder are located in a central, small utility room. The green credentials were not considered as a positive impact on the planning process for the barn conversion itself. The RHI accreditation process has been long and difficult, relying on external consultancy.

What site do I need?

- South or near-south facing roof with no overshadow for the solar thermal.
- Field for the heat pump coil should be close as possible to the building.
- Works best with underfloor heating.

What are the costs?

- Capital costs typically £700 per kW.
- Straightforward and quick development process, simply requiring quotes from reputable companies with minimal consultancy support.
- Payback typically 6 - 7 years.

What else should I consider?

- Falling RHI support.
- Minimal maintenance and costs.
- No planning issues at small-scale.
- Very good long-term investment and very low risk development.

Renewable Energy Village

Population	**2,500**
Generation Capacity	**9MWe**
Peak Demand	**3MWe**
Technologies	**Solar PV, Wind, AD, Hydropower, Biomass, Solar Thermal, Geothermal, District Heating, Passivhaus**
Cost	**£Multi-millions**
Date of Inception	**1999**
Annual Income	**~£5m**

Wildpoldsried Bavaria, Germany

Germany is lauded as the global leader in renewables, through its ambitious *Energywiende* (energy transition) plan. Deployment has boomed, embracing all renewable technologies. Several towns and villages have developed their own schemes for energy self-supply and export for major financial gain. Farmland supplies most of the resource. Wildpoldsried is one such community. Its success is down to pioneering individuals and a co-operative set-up which the farmers and villagers financed themselves, which spreads the benefits. The economic benefits and technical achievements of Wildpoldsried are held-up as a model for Germany's overall *Energywiende*.

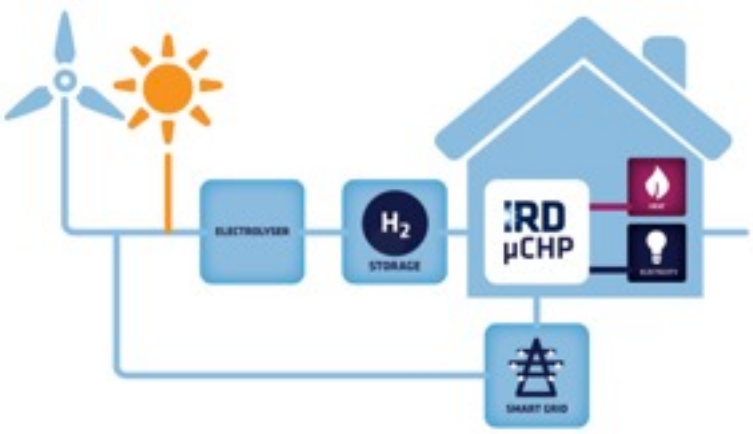
Only for the ambitious - Germany has a very supportive culture towards community renewables which Wales could emulate.
A strong structure is a critical first-step before embarking on arduous financing, planning, grid etc steps. Technologies can be developed on a rolling basis, with each stage used an investment for the next. Very long development process which will require resource, effort and funding with continuous consultancy support. Community buy-in is critical but expect controversy, no matter how strong the economic benefits. Excellent long-term investment which can transform communities - but must swim against the tide.

Hydrogen Village

Population	**200**
Technologies	**Wind, Electrolysis, Hydrogen Storage, Hydrogen Pipeline, Fuel Cells, Microgrid**
Date of Installation	**2012**
Date of Inception	**2009**
Siting	**Throughout village**
Households	**40**

Vestenskov, Denmark

Germany's *Energywiende* faces a major practical obstacle to its progress - intermittency. Renewable energy is plentiful but unpredictable and does not match energy demand. It also faces severe grid constraints, especially at large scales. Batteries provide one energy storage medium but another promising area is hydrogen which can be split from water via electrolysis. Versatile for building and vehicle applications using fuel cells to deliver predictable power and heat at the point of use, hydrogen is making rapid advances as a means of energy storage. Vestenskov hydrogen village has demonstrated this viability using excess wind as the primary energy source. Globally, several countries have ambitious hydrogen energy programmes in the transition from fossil fuels.



The Next Big Thing in energy? Maybe but progress will require demonstration projects which can showcase the new technologies' integration and performance.
At pre-commercial stage, so initial focus is on suitable and willing sites with multi-disciplinary partners including landowners, developments, technology partners, utilities and authorities.
Projects should be carefully planned to gain community confidence. Innovation funding required.
These microgrids have huge potential for rural communities and globally by providing a practical clean energy alternative to centralised grids.

Notes

FITs and RHI

The financial incentive schemes for renewables and low carbon technologies is administered by the UK Government's energy regulator, Ofgem. For the latest information, including regular rate reviews: www.ofgem.gov.uk/environmental-programmes.

Grid Rough Guide

Max Generator Size	Connection Voltage
10kW	230V or 400V
50kW	400V
1MW	400V or 11kV

Generators can be connected to the grid using single-phase supply up to approximately 10kW. Anything larger will require a three-phase supply.

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