

Focus on: Solar PV

‘Solar farming’ is on the rise as technology, economics and environmental issues drive renewable energy generation. To meet our future needs we need to harness energy from a range of renewable sources and the sun is one of the most abundant sources available. The energy of the sun has been used by farmers for centuries for growing and drying crops. Now with fossil fuel energy resources escalating in price, farmers are adding a new dimension to their relationship with the sun. Solar photovoltaics (PV) are a particularly simple solution for generating your own electricity, reducing your energy bills, and reducing your carbon footprint.

INTRODUCTION

By 2020 the UK has committed to supplying 15 per cent of its energy from renewable sources, equivalent to about 31 per cent of our electricity. Solar PV is an attractive option owing to the generous Feed-in Tariff (FIT) it has been given since the scheme was launched in April 2010. Farmers are particularly well placed to benefit from solar PV systems due to the large amount of roof space available on farm buildings and their situation in open spaces – reducing problems of shade.

DID YOU KNOW?

- The total amount of energy from solar radiation received by the earth’s surface is 10,000 times our global energy consumption.
- You can now earn 29.3-41.3p/kWh of electricity produced by solar PV compared to just 9p before April 2010.
- Solar PV cells will pay back the energy used in their manufacture within 1.5-2 years of their 25 year lifetime.
- Over 95 per cent of solar cells are produced using silicon, which is the second most common element in the Earth’s crust.
- PV production has doubled every two years since 2002, making it the world’s fastest-growing energy technology.

Importantly for the UK, Solar PV produces energy from daylight, not direct sunlight, so cloud cover and our variable weather is not prohibitive. However, the greater the intensity of the light, the greater the current that is generated.

Solar PV benefits are dependent on how many kilowatt hours (kWh) you can generate per kilowatt peak (kWp). The kWp is the value of power generated by a system under full solar radiation, defined as 1000 watts per square meter. In the UK one kWp will generate roughly 750kWh per year (higher in the South West), due to the number of hours of daylight that we get.

The electricity produced is direct current (DC) that flows across the surface of the panel and is converted by an inverter to alternating current (AC) so that it can be used in appliances or exported to the Grid. Modern inverters are generally highly efficient, converting 92-96 per cent of available energy into power.

WHAT IS SOLAR PV?

Solar PV cells use silicon semi-conductors to convert energy from the sun into electricity (whereas solar thermal is for space and water heating).



Courtesy of Solarsense.

GETTING SOLAR PV ON YOUR FARM

Before you start

- Do a comprehensive energy audit. There's no point investing a lot of money in renewable energy if you're wasting it – efficient lighting and appliances could double the cost savings associated with generating your own solar electricity. See Farming Future's [energy efficiency factsheet](#) and the [Carbon Trust's agriculture pages](#) for more.
- Carry out a renewable energy appraisal to assess which technology would best fit your business. See [Farming Futures' factsheets](#) on other technologies. Talk to your NFU, CLA or FWAG advisor or a business consultant to evaluate options.
- If you think solar PV could work for you, get an installer to estimate the solar radiation available in your location in kWp and consider a range of systems.

Getting started

- How much power you want to generate? If your business uses 40,000kWhs of electricity every year, do you want to produce all of that through solar PV or just half?
- How much area do you have for an array? If you want to produce 20,000kwhs per year, you will need a system size of roughly 23-27 kWp, which equates to about 160-200 m² of panels.
- How much will it cost? A 23-27 kWp system will cost around £70-90k, with a return on investment (ROI) of about 10 per cent and payback of 8-11 years.
- How much control or investment risk do you want? Do you want to lease roof or field space, do a joint venture or simply use a supply-and-install service?

Types of system

There are broadly three solar PV options available:

- PV panels mounted on existing roofs, or integrated into new roofs and buildings
- Ground-mounted panels deployed on unplanted areas, e.g. around field margins
- Large arrays of panels deployed across entire fields

Grid-connected systems allow you to use some of the electricity you generate, with the rest feeding directly into the National Grid. By exporting excess electricity back to the Grid, you are guaranteed an extra 3p/kWh (export tariff), although it may be possible to negotiate higher rates (up to 4.5p/kWh) depending on your supplier. A generation meter would monitor the total amount produced and a separate export meter must be fitted if your installation's capacity is greater than 30kW.

Roof- or ground-mounted arrays?

A roof-mounted array is more efficient in terms of land use, because it uses an existing surface area that is not currently adding value to your business and farms usually have plenty available.

However roofs are not always south facing or at the optimum angle, so ground mounted arrays are an alternative. These systems are not as limited by space and orientation and can be designed to maximise solar gain (sometimes through use of tracker systems that enable the panels to follow the path of the sun). However, ground mounted arrays could mean diverting land use away from food production to energy generation, which raises the food vs. fuel debate.

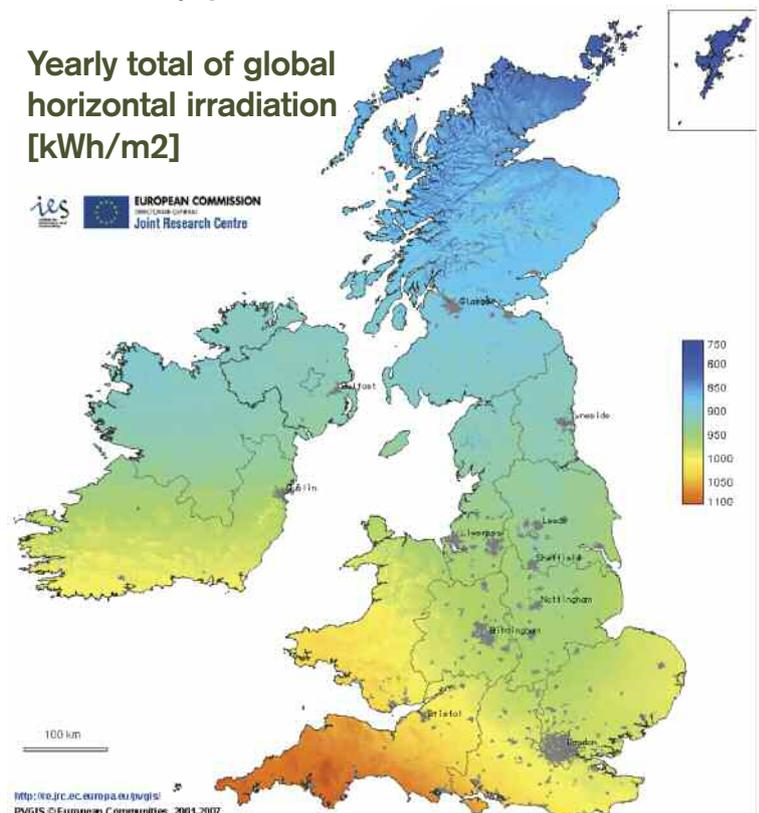
Things to consider

One of the great advantages of solar PV is the simplicity of its installation, and generally a certified installer will do most of the work for you. But do think about:

Orientation: Ideally, the surface should be south facing at a 30-40° angle. Most farm roofs aren't at this angle, but this is unlikely to result in a significant reduction in output.

Location: Avoid shade – although solar systems do not need direct sunlight to generate electricity, they will work much better the more they receive. The South of England is best suited because it is generally sunnier, but most parts of England have sufficient daylight to make it viable.

Yearly total of global horizontal irradiation [kWh/m²]



Accreditation: All equipment and installers for schemes under 50 kW must be registered with the Microgeneration Certification Scheme (MCS) to receive the FITs. Installations greater than 50kW capacity must be accredited by Ofgem via the Renewables Obligation process.

Planning

Currently most (there are some exceptions) domestic systems (<10kw) are subject to 'permitted development' (PD), which means you don't have to apply for planning permission. However, larger on roof farm-scale systems (typically 10-100kw) may also soon be PD.

In line with good planning practice, those considering large solar arrays should first consult with neighbouring farmers and their community. It may be helpful to consider setting up a community development fund using a small portion of the project income.

(Smart) Finance

FIT rewards solar PV up to 5MW capacity. The FIT is designed to enable a Return on Investment (ROI) of 5-10 per cent each year for well-sited PV installations.

Scale	Generation tariff			Export tariff	Tariff life time
	2010/11	2011/12	2012/13		
4 kW (new build)	36.1	36.1	33	3	25
4 kW (retrofit)	41.3	41.3	37.8	3	25
4-10kW	36.1	36.1	33	3	25
10-100kW	31.4	31.4	28.7	3	25
100kW-5MW	29.3	29.3	26.8	3	25
Stand-alone system	29.3	29.3	26.8	3	25

What to consider for solar PV finance:

Generation Tariff: the price your energy supplier gives you for every unit of electricity produced, irrespective of whether you use it or export it.

Export Tariff: a minimum of 3p/kWh for all electricity exported to the Grid – this can be more depending on supplier and if you enter into a power purchase agreement. As an interim measure, payment of export tariffs to generators of 30kW or less will be made on the basis of deemed or estimated exports. The amount of electricity deemed to be exported for solar PV generators will be 50 per cent – as a proportion of the metered generation output. (This will not apply if export meters are fitted).

Lower bills: account for the reduction in your energy bills if you use your own power.

Index linked: tariffs are linked to the Retail Price Index for electricity meaning your tariff will keep pace with inflation.

Tariff digression: the earlier you invest in renewable technologies, the greater the financial benefits. After 2012 the tariffs start to reduce, owing to the projected expansion of the PV market (up to 250MW of new solar capacity by 2011, compared to 22MW in 2009) which is expected to lead to lower technology costs.

Capital grants: the scheme generally prohibits recipients of grants from receiving FITs as this would mean they get a double benefit.

Developers and deliverability

As large-scale field arrays of solar PV are rare in the UK, there aren't many developers you can go to who will have proof of project deliverability. But there are some key questions you can ask:

- What experience are they bringing to your project? This will usually be from European projects.

- What is the financial standing of the developer and how do they plan to get access to funding? The cost of applying for planning permission for a 5MW solar farm has been estimated to be around £60-70,000 and the installation costs around £10-15m.

- Can the developer guarantee supply of the solar panels and inverters? With demand likely to surge in the UK, intermittent shortfalls in supply are possible.

Opportunities from solar PV

- Reduce your electricity bills and 'future proof' against rising prices.

- Solar PV has no moving parts and requires very little maintenance.

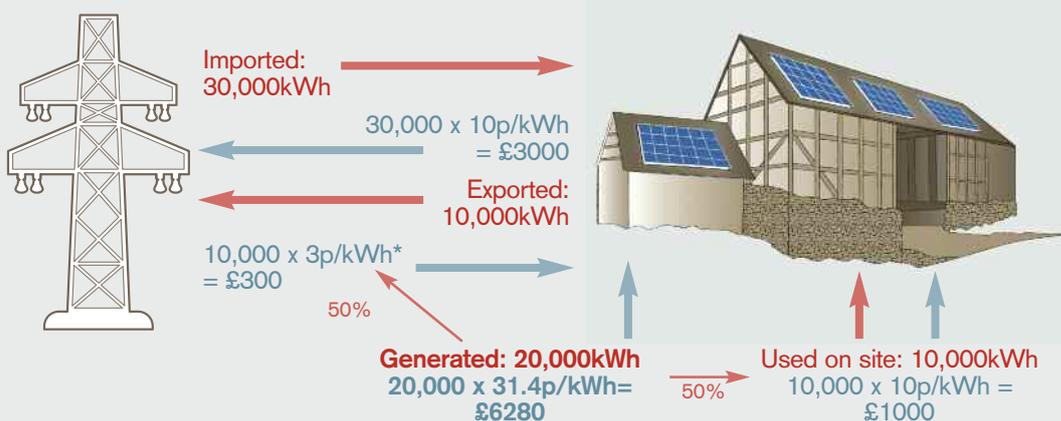
- By exporting to the Grid you get an additional source of guaranteed income.

- It can be used very effectively in new builds – doubling up as a building material – an 'energy roof' – as well as a source of energy.

- Some proposed leases promise to hand over ownership of the system to the landowner after 25 years. Since the solar modules could last for up to 50 years, this might be an important farm asset.

- Power Purchase Agreements with third parties guarantee the sale of electricity at a higher price than the standard export tariff for a fixed period (typically 5-25 years).

Electricity and cash flows for small 23kWp (£85k) farm solar PV system



SYSTEM: Size: 23kWp • Surface area: 160m² • FIT Tariff: 31.4p/kWh • Payback: 10-11 years**
 • Annual Return on Investment: 9-13%**

*Unless you have a Power Purchase Agreement, in which case it could be 4.5p/kWh.
 **Depending on Retail Price Index and energy price inflation (calculated range 1%-5%).

Financial Balance Sheet – Year 1

Annual cash flow without solar PV = -£4000 (40,000kWh)

Annual cash flow with solar PV = +£3120

Energy savings = +£1000

Energy earnings = +£6580

Maintenance costs = -£460

Over 25 years

Revenue = £222,000 - £375,000

Net profit = £124,000 - £267,000

Risks

- Make sure roofs are strong enough to support a retrofitted system.
- For roof-mounted systems, ensure that lifetime of the building is matched to the lifetime of both the solar cell (up to 50 years) and the FIT (25 years).
- Consider what percentage of your farm electricity bill is displaced. Demand in farm businesses may peak at different points in the day (or after dark).
- Taking good land out of production for ground-mounted solar arrays would feed food security concerns. However, they can be compatible with small-scale livestock farming (sheep and outdoor poultry) if designed properly.
- Be aware of the performance of DC/AC power inverters – power losses range from three to eight per cent, and they may require replacement every 10 years.
- Permission to connect to the Grid is needed from the District Network Operator (DNO). Work may be needed to upgrade the line and could result in unforeseen delays and potentially very significant costs for higher power outputs so it is worth making contact early.

Find out more

www.decc.gov.uk/fits

The CLA is shortly to publish an Advisory Handbook on solar energy: contact the publications department on 0207 235 0511.

<http://www.nfuonline.com/Our-work/Environment/Renewable-energy/Feed-in-Tariffs-explained/>

<http://www.nfuonline.com/Our-work/Environment/Renewable-energy/Our-guide-to-solar-power/>

Visit Farming Futures for factsheets on other renewable energy technologies

<http://www.farmingfutures.org.uk/resources/factsheets>

Case studies:

http://www.ownergy.co.uk/for/farmers/case_studies/

<http://www.solarsense-uk.com/glastonbury.asp?CaseID=31>

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For news, events, and links to stories about how other farmers are managing climate change on their farms, please visit: www.farmingfutures.org.uk

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