

Solar Photovoltaics: the basics^{v1.3 2/11/11}

Solar Photovoltaic (PV) technology works by converting sunlight into electrical energy using semi-conductor technology, typically made from silicon. Solar PV is well suited to an urban environment, and as the panels have no moving parts they are very low maintenance. Direct Current (DC) electricity is produced from the PV modules, which is converted into Alternating Current (AC) through the inverter, which harmonises the current to export to the National Grid.

How much energy can Solar PV provide?

1 kWh (kilo Watt hour) is the standard billing unit for electricity. An average UK house uses around 3,300 kWh on lights and appliances per year. Check your electricity bills to find out your annual usage. If you are energy efficient, then it's possible to use half of that, and you have the potential to be a net energy exporter.

System sizing

Solar PV modules are sold on a kW_{peak} (kW_p) rating, denoting the power the system will produce in bright sunshine. On cloudy days, the modules will produce about 30% of the electricity they would on a sunny day. In Oxford a 1kW_p system can provide around 850 kWh per year, and needs around 8m² of roof space. A typical domestic installation is around 2 kW_p, which will provide around 1700 kWh of electricity per year. Generally if your usable roof space is under 12m², it might be too small for PV, although not for solar thermal (hot water).

Energy payback

The current estimated energy payback time (the time it takes for a system to operate to recover the energy that went into making it) is around 2 ½ years, although this depends on the siting of the modules. Generally a well sited module will generate many times more energy than it took to produce [1]. Solar PV modules are guaranteed for 25 years. This includes a guarantee that after 10 years the worst case scenario is that the modules will be operating at 90% of their new peak potential, and 80% after 25 years.

Is your roof suitable?

Roof orientation and aspect: Roofs oriented from SE-SW with a pitch of between 20-50 degrees will give you 90% of the available solar resource. You need to be aware of potential shading from other parts of the house, chimney, trees etc. For optimal performance, the entire array needs to be shade free, as there is a non linear relationship between shading and the resulting decrease in electricity production. Further info:

<http://www.solarguide.co.uk/solar-pv-and-shading>

Planning Permission: Solar thermal and solar PV are considered 'permitted developments' even in conservation areas, so long as panels do not protrude more than 20 cm beyond the surface of the roof. If you have flat roof and want to pitch collectors, then you would need to contact your planning department. For further details see:

<http://www.energysavingtrust.org.uk/Generate-your-own-energy/Getting-planning-permission>.

Building regulations stipulate that 'the ability of the existing roof to carry the load will have to be checked and proven'. For further info see www.planningportal.gov.uk/permission/house. If you're an Oxford Resident and are considering solar PV / solar thermal, please check with Oxford City Building Control, who have recently drafted some guidance. You can contact the Building Control Surveyor, David Clayton: daclayton@oxford.gov.uk t. 01865 252332 http://www.oxford.gov.uk/PageRender/decP/BuildingControl_occup.htm.

Cost and Types of PV modules

Solar PV arrays cost around £4,000 for every kW_{peak} installed, plus allow a flat fee of around £2,000 for system installation such as scaffolding, roof fixings, etc.

The two main types of PV modules are 'monocrystalline' and 'polycrystalline' silicon. From a practical perspective, there is very little difference between the two panel types. Monocrystalline are slightly more efficient, and more expensive than polycrystalline, so whilst you can get a higher kW_{peak} rating per m² with monocrystalline, the prices for a similar kW_p rating are comparable for mono- and polycrystalline. You can also get solar PV roof tiles, which are cost effective if you are considering re-roofing your house.

Moving Home

Ownership of the technology is linked to the site and, therefore, in the case where a building or homeownership changes, the ownership of the technology would also transfer to the new owner [3].

Choosing which micro-generation technology is right for you

You can register your home details to get immediate advice about which technologies might suit you best on both the Energy Saving Trust and TZERO sites. You may wish to consider involving an energy advisor or auditor to assess your home and advise on the pros and cons of potential micro-generation technologies, and what other measures may be suitable for your home. Different advisors offer different services, so ask in advance what you'll get for your money.

FEED IN TARIFFS – UPDATED NOV 2011

At present (November 2011) the Feed in Tariff (FiT) is currently a combination of:

Generation Tariff: A new figure of **21p per kWh** will be introduced from 1 April 2012 and will affect all installations under 4 kW_p with an eligibility date on or after 12 December 2011. For eligibility dates falling on or after 1 April 2012, the UK Government propose that eligibility for the higher rate of 21p/kWh would be conditional on the dwelling meeting a specified minimum energy efficiency requirement.

Export payment of 3p per unit.

Avoided imports: If you use the electricity generated yourself, you're not buying electricity from a supplier, so you get an additional saving, seen as a cheaper bill.

How much money you'll save depends on how much 'avoided imports' you achieve.

If you use electricity whilst it's being generated (i.e. during daylight hours) you'd avoid more imports than if you run your electrical appliances during the evening. Use the EST's cashback calculator to get an estimate. **At present (Nov2011), the new tariff rate is designed to provide householders with a rate of return of around 4.5%.** For more details of the changes introduced in Nov 2011, see the EST and YouGen resources on the back page.

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Monocrystalline PV array



Polycrystalline PV array



PV roof tiles (Source: JoJu Ltd)



Figure 1: How Feed in Tariffs work



'Free' solar PV and 'Rent your roof' space deals

There are many companies offering to install free solar PV panels on your roof, in return for the Feed in Tariff. These are also referred to as "rent my roof space" schemes with the solar panel owner simply 'renting' the roof space from the customer. If you are considering this, then it's worth finding out as much as possible about the deal before you decide to proceed, and seeking advice. [4]

Q. Who's paying for the equipment? Is that in full? Who owns the equipment? (and is that all of the equipment – i.e. meter, wires inside building etc – or just equipment on the roof/in the back yard?)

Q. Is the electricity used onsite and/or exported going to be metered, or will it be assumed that 50% (the deeming assumption in FIT) will be used?

Q. Who gets (a) the generation tariff, (b) the export tariff, (c) the 'free' electricity?

Q. Is the electricity used onsite and/or exported going to be metered, or will it be assumed that 50% (the deeming assumption in FIT) will be used? Note use the EST Cashback Calculator to estimate your usage.

Q. Who pays for maintenance and repairs (e.g. if the DC/AC inverter fails after 8 years)?

Q. Who will insure the equipment? Against what?

Q. Who will be liable if the equipment causes damage to my family or my neighbours? Or if it causes damage to mine or my neighbours' building or electrics?

Q. Are you in effect lending me money to do this, either as a loan or a hire purchase deal? In which case: How long for? What is the annual equivalent interest rate (AER) on the money? Where is your consumer credit license? and; Can I have 7 or 14 days cooling off please (depending on whether the deal was done in person)?

Q. What happens if I decide I want to pay off the remaining costs early? Can I have the FIT re-assigned to me? This will depend on the contract drawn up between you and the company.

Q. Are the installers and product registered with the Microgeneration Certification Scheme (MCS)? See www.microgenerationcertification.org

Q. What happens if I move house and the new owners don't want to 'inherit' the deal?

Q. Are you giving any performance guarantees for the equipment? (and what happens if it stops working and generating FITs for you? Is that your risk?)

Q. Do I need to let my mortgage company and/or buildings insurer know that this installation has taken place? Will I need their permission?

Q. Who is responsible for addressing any planning issues or electricity distribution company notification requirements? Who pays any associated costs?

Q. Who pays for removing the kit and making good if (a) my roof needs repairing or (b) the kit is damaged beyond repair?

Q. What happens if the company which owns the equipment ceases to exist?

Questions to ask potential installers

- Ask if they are MCS accredited. This is essential if you are claiming Feed in Tariffs.
- Do they belong to the REAL assurance scheme and / the Solar Trade Association?
- Can they give you information about local planning permissions needed?
- Can they give you information about Feed in Tariffs, and guide you through the process?
- Does their product meet the requirements of the relevant BSI British Standard?

Other questions to help you choose between installers

- Ask a few potential installers to assess your home and give you a clear picture of what they are proposing, the breakdown of costs, what the cost includes or excludes (e.g. scaffolding, connection, planning permissions), who will be applying for any planning permissions necessary, and what maintenance is required.
- Do they have any testimonials or contacts from previous customers, or references on other websites?
- What are the straightforward parts of the job in your home, and are there any difficulties posed by the installations?
- What is the timescale, and what might get in the way of the timescale?
- A REAL company could provide you with written estimates of the anticipated performance of your system in an accepted format, and indicate clearly if this is based on estimates or is referenced to your actual energy use.
- You should expect clear information presented in a way you can understand. The REAL Assurance Scheme site is very helpful; an example of their advice: www.realassurance.org.uk/real-assurance-consumer-code

Aspects such as cooling off period, payment methods, guarantees, and the timescale for the work should all be made clear to you by the company.

You should be clear as to who is seeking planning approval (if required), or any other permissions or consents required. It should be made clear to you if you are required or obliged to carry out any duties, (such as providing information, or to operating or maintaining equipment).

FIND OUT MORE

See these householder experiences of Solar PV online:

- **Case study: Minster Road, Oxford:** Semi-detached property built in 1907, renovated in 2009 to include solid wall insulation, solar thermal and photovoltaics, underfloor heating, wood burning stove and more. <http://climatex.org/articles/eco-renovation/case-study-minster-road/>
- **Case Study: 1890s East Oxford Semi :** Took the opportunity of roof repairs to install solar PV and gain the grants which are available. Now in the testing phase but happy when the electricity meter runs backwards even in December. <http://climatex.org/articles/eco-renovation/1890s-east-oxford-semi/>

USEFUL RESOURCES

- **The Energy Saving Trust** is often a good starting point, with a section on Home Energy Generation on their website. You can also telephone to ask questions or for ongoing guidance and support on 0800 512012 www.energysavingtrust.org.uk/ . See their information on the Nov 2011 changes to FiTs here: <http://www.energysavingtrust.org.uk/Generate-your-own-energy/Financial-incentives/UK-Government-proposed-changes-to-solar-PV-Feed-in-Tariffs>
- **TV Energy** aims to provide education about renewable energy for communities, businesses, organisations and individuals within the Thames Valley and beyond. It has useful local case studies. www.tvenergy.org/ 01635 817 420.
- **United Sustainable Energy Agency:** a not for profit company providing services to the Public Sector, Business, and individuals to help them reduce carbon, adapt to climate change and tackle fuel poverty. <http://www.usea.org.uk/> . Their 'My Green Builder Section is useful.
- **Yougen:** Good blog and online information resource on renewable energy generation, plus rating for installers and products: <http://www.yougen.co.uk/> . See their info on changes to FiTs here: <http://tinyurl.com/5t2stt5>
- **TZERO** helps identify optimal low carbon solutions to your specific house type, and has details of local suppliers and installers together with technical questions to ask: www.tzero.org.uk/
- **The REAL Assurance site** has a list of suppliers who are members of the scheme www.realassurance.org.uk/search together with a consumer guide: www.realassurance.org.uk/consumer-guide
- **Centre for Alternative Technology (CAT):** Info about Solar PV, and much more <http://info.cat.org.uk/pv>
- **Solar PV calculator:** <http://info.cat.org.uk/solarcalculator>
- **Solar resource info:** <http://re.jrc.ec.europa.eu/pvgis/apps3/pvest.php#>

References:

[1] Source: <http://info.cat.org.uk/questions/pv/what-energy-and-carbon-payback-time-pv-panels-uk>

[2] Source: <http://www.energysavingtrust.org.uk/Generate-your-own-energy/Sell-your-own-energy/Feed-in-Tariff-scheme>

[3] Source: <http://www.energysavingtrust.org.uk/Generate-your-own-energy/Sell-your-own-energy/Feed-in-Tariff-scheme>.

[4] Source: <http://www.energysavingtrust.org.uk/Generate-your-own-energy/Solar-electricity/Consumer-guidance-on-free-solar-PV-offers>

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