enviko
renewable energy solutions

Solar PV Information Pack

zero carbon living

Introduction

Installing a Solar Photovoltaic (PV) system at your home or business is a rewarding achievement that will bring financial and environmental benefits to the users for many years to come.

There are many related products on the market and selecting the right equipment for your requirements can be a daunting procedure. The technical specification and associated performance of equipment combined with suitable selection of supporting components can be a complex and time-consuming process. Enviko provides the full assistance and advisory services required to make sure that your project is designed with optimum performance and operation from day one. We provide the technical expertise, choice of economic equipment and installation and on-going services such that your project can be successfully integrated to your home or business.

The two primary benefits of incorporating a Solar PV system are the production and consumption of free electricity and the consequent saving of carbon emissions and other greenhouse gases. As a technology it also has a number of other benefits:

- ✓ Straightforward to install as the panels are modular and light
- ✓ Reliable technology – panels are guaranteed to last between 20-25 years with significant actual lifetimes
- ✓ Avoidance of Climate Change Levy on electricity bills (approx. 8-10%) for non-domestic buildings
- ✓ Architectural integration - photovoltaics can be integrated almost invisibly to buildings and can be used as a design element or can lead the architectural concept of a building
- ✓ Marketing impact - a clear statement about renewable energy and environmental awareness
- ✓ Excess electricity can be sold to the grid. It is possible to achieve close to 7p/kWh of electricity export.
- ✓ Money can be saved where the PV panels displace other construction materials such as roof tiles, or prestige cladding materials such as marble. Thus, considering PV at a buildings design stage will not incur any great additional cost. It is possible, for example, to purchase solar tiles that have similar costs to conventional ones.
- ✓ Renewable Obligation Certificates and additional benefits having financial value can be obtained for each unit of electricity generated by the solar PV array hence offsetting upfront capital cost of installation on the project economics.

enviko
renewable energy solutions

This brochure outlines the processes involved and the various factors that need to be taken into account if you are thinking of having solar power system installed with Enviko. The brochure also seeks to answer any questions you might have about regarding the feasibility of investing in this increasingly popular technology to meet your particular requirement such as: is your building suitable, is planning permission likely, how much electricity will it produce, carbon saved and at what costs?

Enviko will help you through every stage of the project process from initial outline appraisal and consideration through to installation and commissioning of the system and electricity export; specifically Enviko will:

1. Undertake an energy resource assessment determining your energy requirements and carbon emissions
2. Determine the solar resource on-site to inform sizing of solar equipment
3. Assess the site suitability for solar PV via our site survey
4. Undertake an electrical connection study to your home and civils appraisal of mounting panels to the roof.
5. Design and develop a system to achieve economic production and saving of CO_2
6. Present a financial analysis of the proposed system and outline an appropriate Equipment Schedule for receiving quotes from industry
7. Educate and explain to our customers and present the available options to you going forward
8. Project manage, install and commission your system
9. Arrange grid-export sell-back of excess electricity generated.

Please read on to see how we can help mitigate risk and ensure the successful implementation of Solar PV and renewables during every step of your development enabling you to become a satisfied investor in solar PV energy generation.

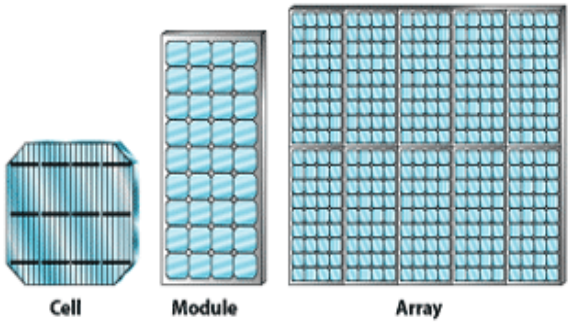
Basics – Understanding Photovoltaics

The photoelectric effect is the basic chemical process by which a PV cell converts the photons in sunlight into electricity. When light shines on a PV cell, it may be reflected, absorbed, or pass right through. That light which passes through (approx. 40%) contributes towards the generation of electricity.

The energy in the absorbed light stimulates the flow of electrons in the atoms of the PV cell (semi-conducting silicon). These electrons escape from their normal positions in the atoms of the PV material and create a current flow in an electrical circuit which provides the force, or voltage, needed to drive a current through an external "load," such as a light bulb.

Commonly known as solar cells, individual PV cells are electricity-producing devices made of semiconductor materials (amorphous silicon, polycrystalline silicon, monocrystalline silicon and cadmium telluride to name but a few). These PV cells come in many sizes and shapes — from smaller than a postage stamp (imagine calculators) to several inches across. They are usually connected together to form PV modules that may be up to several feet long and a few feet wide. Modules, in turn, can be combined and connected to form PV arrays of different sizes and power output.

The size of an array depends on several factors, such as the amount of sunlight available and the power requirements of the consumer.



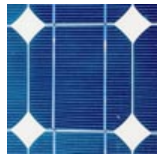
The modules that make up the array constitute a major part of the PV system, which can also include isolation switches, charge controllers, mounting hardware, power-conditioning equipment and batteries that store the solar energy for use at a later date.

These arrays or modules are connected to an inverter that converts the direct current (DC) produced by the panels into useful alternating current (AC) electricity that is delivered to your mains circuit board in your home/business for normal consumption from your wall sockets.

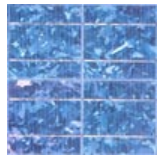
Types of Solar Cells

The various types of solar cells listed below comprise the majority of Solar PV modules available in the marketplace and just a selection of what we offer for our standard installations:

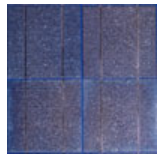
Mono-crystalline Silicon Cells: Made using cells saw-cut from a single cylindrical crystal of silicon, for standard installations this is the most efficient of the photovoltaic (PV) materials. The principle advantage of mono-crystalline cells are their high efficiencies (typically around 15%), however as the manufacturing process is more complicated this has resulted in slightly higher production and therefore retail costs than other PV materials.



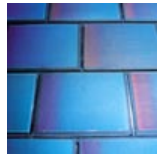
Multi-crystalline Silicon Cells: Produced from cells cut out of an ingot of melted and re-crystallised silicon. In the manufacturing process, molten silicon is cast into ingots of poly-crystalline silicon; these ingots are then saw-cut into very thin wafers and assembled into complete cells. Multi-crystalline cells are cheaper to produce than mono-crystalline ones, due to the simpler manufacturing process. However, they tend to be slightly less efficient, with average efficiencies of around 12%., creating a granular texture.



Thick-film Silicon: Another multi-crystalline technology where the silicon is deposited in a continuous process onto a base material giving a fine grained, sparkling appearance. Like all crystalline PV, this is encapsulated in a transparent insulating polymer with a tempered glass cover and bound into a strong aluminium frame.



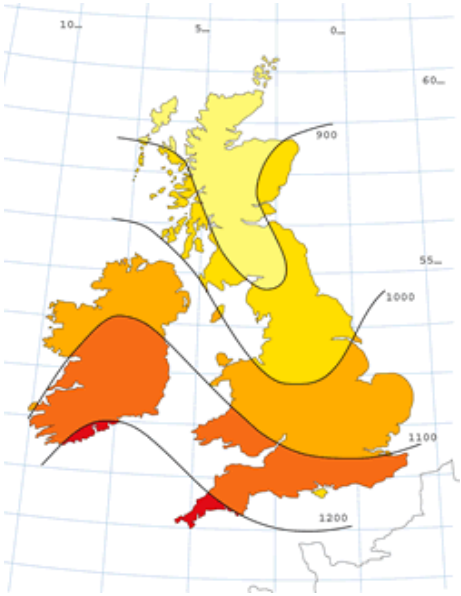
Amorphous Silicon: Amorphous silicon cells are composed of silicon atoms in a thin homogenous layer rather than a crystal structure. Amorphous silicon absorbs light more effectively than crystalline silicon, so the cells can be thinner. For this reason, amorphous silicon is also known as a "thin film" PV technology.



Types of Solar Cells

As amorphous silicon can be deposited as a thin-film on both rigid and flexible materials it makes it ideal for curved surfaces and "fold-away" modules. Amorphous cells are, however, less efficient than crystalline based cells, with typical efficiencies of around 6%, but they are easier to manufacture and therefore cheaper to produce. Their low cost makes them ideally suited for many applications where high efficiency is not required and low cost is important.

Other Thin Films: A number of other promising materials such as cadmium telluride (CdTe) and copper indium diselenide (CIS) are now being used for PV modules. The attraction of these technologies is that they can be manufactured by relatively inexpensive industrial processes, in comparison to other crystalline silicon material, yet they offer higher module efficiencies than amorphous silicon. Such is the chemical process of the semi-conducting device each of the Solar PV cells require photons – found in massive quantities in both overcast and direct sunlight conditions - to generate a current flow. The manufactured modules are generally blue/grey in colour and have been proven to have been successfully deployed in all parts of the UK, including the far most out-reaches of Northern Britain.



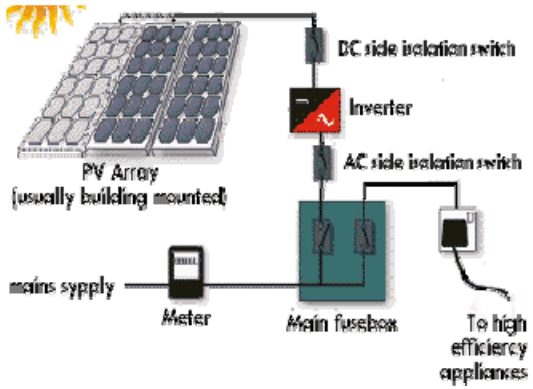
UK Solar Irradiation (kWh/m²)

Types of PV Systems

Grid Connected

The most popular arrangement of a Solar PV system for homes and businesses is one that is connected *via* your mains circuit board to the local electricity network allowing any excess solar electricity produced to be sent to 'the grid' and sold to any electricity supplier. Depending on your usage and electricity consumption profile electricity is consumed – for free. For example, during the day the home/business will consume power generated direct from the Solar PV array, in the evening it will consume direct from the stored energy in a battery bank, whilst should this renewable electricity be fully-consumed then during the night electricity will be imported from the grid under the cheaper night-time tariff. If, during the day, you have little requirement for power any electricity produced will automatically be sent to grid *via* an electricity meter for which you will be sent a monthly cheque from your electricity supplier for that which has been produced.

The Solar PV system produces power as direct current and is converted into useful AC current by an inverter for use either in the home or export. If you are planning a new-build or are not connected to the mains electricity distribution system (e.g. mobile homes) then much scope exists to introduce DC appliances such as fridges, lighting and TV's that will not require the use of an inverter within the system thus saving on the conversion losses associated with this power conditioning (up to 5% on some arrangements)



Basic Layout of Grid Connected PV System

Types of PV Systems

Grid Support

The Solar PV system is typically connected to the local electricity network and a battery-bank to store any excess energy. When you pay more for import of power (10p/kWh) than export (7p/kWh) it is sensible to have a certain amount of energy storage to offset the re-import costs. Additionally, this arrangement is ideal for those living in rural locations at the end of the electricity distribution and transmission network and liable for frequent power cuts and an unreliable supply. Power conditioning and control systems installed as standard will 'decide' when and where to send any power – no 'manual' user control will ever be required.

Enviko's grid connected systems comprise of a number of components which are outlined, for reference, in the diagram below including:

- PV generator (PV array – comprising of a number of PV modules connected in series/parallel)
- Installation kit (Roof integrated, on roof, flat roof, canopy, facade and ground mounted)
- DC isolator (safety switch/disconnector)
- DC cabling
- DC-AC Inverter
- AC cabling
- AC isolator (safety switch/disconnector)
- kWh meter (only required for export arrangements)

Types of PV Systems

Off-Grid

Completely isolated from the grid, the solar system is directly connected to a battery bank through charge controllers which maximize the electricity stored. From here your in house loads (fridges, TVs, computers, lighting) will be supplied from this DC current if enabled or powered *via* an inverter that produces AC current from the DC supply stored in the battery bank, enabling the use of normal appliances without mains power.

Hybrid System

It is very easy to connect additional sources of power to such a system such as a wind turbine or gasoline/diesel generator or hydro-power. In such an arrangement the low carbon energy is consumed as a priority before any fossil fuel power is called into action. These hybrid systems can just as easily be connected to grid or act in stand-alone (off-grid) mode.

Where can Photovoltaics be Used?

Photovoltaic systems can be used anywhere – with varying degrees of success – they can be mounted as 'solar tiles' in replacement of normal slate or roof tiles, they can be installed on vertical walls, we can install flexible panels to boats, cars and caravans and we undertake conventional installations fitted to the tops of roof that look similar to a Velux window or incorporated into glass windows for atria walls and roofs or used as cladding or rain screen on a building wall - this is particularly suitable for prestige offices.

They can also be attached to individual items such as street lights, parking meters, motorway noise barriers or the sides of bridges.

System Set Up

Enviko Roof Mounted

The PV modules easily align above the surface of the roof. These conventional systems have the advantage that the roof tiles will hardly need to be displaced in order to fasten the panel frame securely, ensuring that this type of installation is the most convenient and economic solution for the majority of existing properties.

Our roof mounted installation system offers the right fixing units and the right fixing anchors for every module construction type (500 different solar modules from over 60 manufacturers) and for every type of roof covering. The system components have been tested both together and individually for structural strength. A large range of modules, both grid tied and standalone, are available.

Enviko Roof Integrated

Our roof integrated photovoltaic systems are compatible with almost any roof covering. Aesthetically, they are less intrusive than our on roof systems. There are two methods of roof integrating our PV systems.

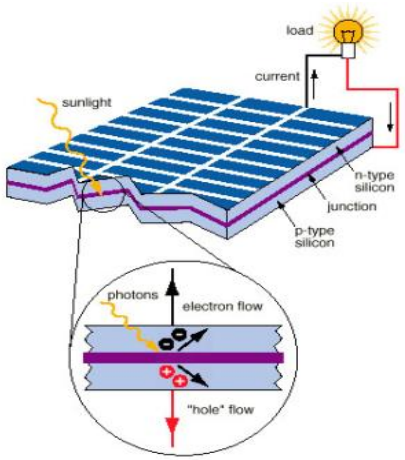
• Our PV tiling system. This system is best suited for new build projects or for buildings that are being re-roofed. It is the most expensive of our integrated systems.

• Our PV modules roof integrated system. Although it is slightly more intrusive than the tiling system it is equally efficient

System Set Up

Photovoltaic systems can be discreet through being designed as an integral part of the roof. An 'invisible' design using slates or shingles as opposed to an architectural statement is likely to be preferable if in a sensitive area.

Ideally photovoltaics should face between south-east and south-west, at an elevation of about 30-40°. However, in the UK even flat roofs receive 90% of the energy of an optimum system.



Schematic of a Solar Photovoltaic Cell

Retrofit Solar PV System

If a photovoltaic system cannot be installed at time of build, the electrical systems of the building (this is particularly relevant for dwellings) should be prepared to facilitate later retrofitting. This would include an extra 3 ways in the fuse board and an extra fuse spur extending into the roof space. The design of a building should always, where practicable, be suitable to support solar technologies at a later date.

System Set Up

Assessing your building is one of the most important steps to take when making the decision as to whether to purchase a PV system. It is important to know where on your site the PV equipment is to be placed. If this can be estimated accurately energy generation figures can be calculated for your project.

The following factors should be taken into account and will help you assess the feasibility of installing a solar energy system on your property:

Location: Systems should be in locations that will be unshaded at all times of day if possible. Gable roofs, chimneys, cables, TV aerials, trees and other buildings in the vicinity should be identified as potentially shading the modules, particularly in the early morning or early afternoon. The performance of a whole panel will be affected even if only part of it is shaded.

Orientation: Solar energy works on all roofs, but the modules should ideally face between south-east and south-west. In the UK, a north-facing PV roof will generate about 60% of the output of a similar south-facing one.

Tilt: Solar products are suitable for pitched, flat and curved roofs, although the optimal roof angle is 30 degrees - 40 degrees for the UK. Arrays should NOT be horizontal as the rain will be unable to wash them clean.

Available area: The more surface area available, the greater the power potential. For a grid-connected system the minimum required area is approximately 10m2. In some cases where suitable roof area is not available we can install a solar energy system on garages and out-houses or on a frame located close to the property. Please see section above for more details on areas for different types of cells.

Ventilation: Photovoltaics need to be ventilated (behind the modules) so that they don't heat up - their efficiency decreases as their temperature rises. Suitable ventilation is easier to ensure for bolt-on systems. Rear ventilation is less important for some thin film modules which can be mounted directly onto the roof cover.

Loading capacity: If retrofitting systems to existing buildings, the system must be carefully positioned on the roof to take account of the loading capacity of the roof.

Vandalism: The potential for vandalism should be assessed if the system can be seen from the ground or if it is accessible due to raised pavements or other buildings. Sometimes it is necessary to cover panels with heavy duty perspex to protect them from flying objects.

Meters: Care must be taken if the systems are to be fitted to social housing properties (or other properties) with pre-payment meters as some meters do not allow the export of electricity and can be damaged by attempted export.

Vermin: If the area is known for a bird population (e.g. seagulls) they may need to be discouraged from perching near the systems to prevent the need for regular cleaning.

Planning

For the majority of properties, solar panels typically fall within what are known as "permitted development rights". This means that, if a solar panel or system is more or less flush with an existing roof, the council will not ask for a planning application.

The planning authority will assess what visual impact, if any, solar photovoltaic systems would have on the local amenity. Systems can be designed so visual impact is minimised. For example, some systems can be integrated flush to the roof and when this occurs they are no more intrusive than a roof light (window in the roof). This is most cost effective when the system is part of a new build development rather than when being retrofitted on an existing building.

Planning permission may be required if the installation projects significantly beyond the roof plane where it faces a public right of way or the solar array so enlarges the roof or property that it exceeds the permitted development limit. Solar arrays that face away from roads and footpaths are unlikely to need a planning application. Permitted development limits are explained in the DTLR's, Planning - a guide for householders.

Building Control will need to be informed of the proposed changes. Unlike Planning, Building Control may charge if they decide to make a site visit. This charge varies from council to council.

A major part of each project is the planning application stage which may often take the largest part of the project duration. Fortunately planners are increasingly looking favourably to small scale renewables and we have much success in applying for planning permission on behalf of landowners and businesses. Dealing with the planning authorities is all part of the service we provide when you purchase a PV system from us.

Grid Connection

Before installing a PV system which you intend to connect to the mains electricity supply network, it is important to ensure that you have the following approvals:

· Permission from your local Distribution Network Operator (DNO) to connect to the electricity grid. Note that your DNO is the utility company responsible for operating the distribution network in your area and may not be your electricity supplier.

· Approved equipment for use within the UK, notably inverters.

These are mandatory requirements, largely to ensure that distributed grid-connected generation systems (like PV) will not cause safety risks to engineers working on the network, and that the electricity fed into the network complies with mains power quality requirements. It is important to appreciate that these permissions are required for all grid-connected generators. This includes 'plug-and play' AC-modules.

Note that reputable PV system installers will normally ensure that all the required approvals are in place for you so that you can have full confidence in your new system.

For small systems, the DNO must only be told about the installation at the time of commissioning but for larger systems or a number of small systems, discussion should start as soon as possible with the DNO to ensure the project goes to time. It is likely that DNO personnel would need to be present at the time of commissioning for larger projects. Again, Enviko will undertake all necessary paperwork and submissions regarding connection arrangements.

Since April 2005, the regulator has given an incentive to DNOs to connect embedded generation schemes to the grid. (Embedded generation schemes are energy generating systems such as small-scale renewable energy systems which will only export to the grid when they generate more than their base load requirement).

Costs

Installing a Solar PV system is a serious investment. An estimated cost breakdown of a range of system sizes is shown below:

Size of System	Footprint	Usable Free Energy Yield kWh/Yr	Gross Cost inc VAT@5%
1kWp Monocrystalline	8 m^2	850	£6,165
1.85kWp Monocrystalline	14.8 m^2	1,665	£9,810
2.2 kWp Monocrystalline	17.6 m^2	1,998	£10,178
2.96 kWp Monocrystalline	23.7 m^2	2,664	£12,446
3.33 kWp Monocrystalline	26.6 m^2	2,997	£12,508
3.7 kWp Monocrystalline	29.6 m^2	3,330	£13,702
4.07 Monocrystalline	32.6 m^2	3,663	£15,399

To help to minimise the costs involved, Enviko will help you to decide what you want to achieve with your system – the annual energy yield, or the space you wish to use – so the best size for your home can be installed.

We can also offer full maintenance & insurance packages so that we guarantee that your PV system will be in perfect working order for the whole of its life (the expected life of a typical installation is 15 years). These packages can include replacement of the major system components should any fail.

Funding

Solar PV has recently become a much more financially attractive technology with the introduction of Feed in Tariffs in the UK. Similar to the systems that have been in place in mainland Europe for a number of years. The finalized rates for Solar PV are detailed below:

Type of system	**Tariff Level (p/kWh) for installations installed:**			**Tariff Lifetime**
	Apr 2010 – Mar 2011	Apr 2011 – Mar 12	Apr 2012 – Mar 13	Years
≤4kW new	36.1	36.1	36.1	25
≤4kW retrofit	41.3	41.3	37.8	25
>4-10kW	36.1	36.1	33.0	25
>10-100kW	31.4	31.4	28.7	25
>100kW – 5MW	29.3	29.3	26.8	25
Standalone	29.3	29.3	26.8	25

Say that you've installed a 2.2kWp (kilowatt peak) power rated system onto your south facing roof at home; this would cost you an estimated £10,500 and generate approximately 2664kWh per year (dependant on climate data).

Assuming you use half of the electricity you generate and feed the half back into the grid, with a feed tariff of 41.3 pence per kWh you would make £1,140 in one year. That's a 10.9% annual return on your investment each year meaning that in approximately 10 years the system would have paid for itself.

Quote

Having read the preceding information and having made your own assessment into the merits of installing a PV system and you think you are ready to go ahead with things we will provide you with an initial quotation. Enviko will provide you with an accurate quotation when all the areas of uncertainty have been identified and resolved and we are confident that we can meet every aspect of the requirement. We can also provide a budgetary estimate so that you can make an early assessment of the level of funding that will be required. Enviko follows a very clear and simple process in order to be able to give you an all inclusive and accurate quotation for your PV installation.

1. Initial Evaluation. Based upon the information you provide Enviko will assess the suitability of your site and proposed project for a PV system. If there are any areas of concern we will discuss these with you and ensure they can be addressed before proceeding to the next stage.

2. Site Survey. A full site survey may be undertaken by a member of the Enviko team to both ensure that the site is suitable and to obtain all the information that will be required to generate a complete quotation and subsequent planning and funding applications.

3. Analysis. We will analyse all the information gathered from you, and possibly the site survey, and fully cost any special items that have been identified during the process. We will then produce a complete quotation for the installation.

Once you have obtained planning permission, and whatever funding you are entitled to, you are ready to place your order for your PV installation. Enviko will confirm your quotation, including any amendments that may have become necessary following the planning process, and provide you with a re-validated full quotation and estimated installation date for your turbine. If you are happy with the quotation and wish to proceed then all you need to do is sign the order confirmation and send it back to Enviko along with your deposit.

Installation

The installation is comprised of multiple aspects and it's possible that these will be undertaken by different engineers, possibly on different days. Enviko will always seek to minimise the disruption at your site and will discuss and agree with you the dates and method of each aspect of the installation.

The key steps in the process are:

1. **Site Preparation.** This includes scaffolding or ladders (where appropriate)
2. **Fixing Roof attachments and weather seal.**
3. **Mount PV modules**
4. **Fit related electrical equipment**
5. **Electrical Connections**
6. **Commissioning & Handover**
7. **Issuing Warranty & Completion Certificate**

The finished solar system is comprised of solar modules interconnected electrically in parallel strings of series connected modules. The solar modules are fastened to a support structure that is fastened to the roof of the property. Before practical installation work commences a health and safety assessment and method statement may be required.

Enviko will supply and install all the electrical components that enable the PV System to be connected to the grid and for you to claim your Feed in Tariff rates. It is also possible that the local electricity company will need to change your meter for a bi-directional one. Once all the elements are in place the system will be commissioned and will start generating power and saving you money.

Upon completion of the installation you will receive a completion certificate, a handover pack with all system specifications, a leaflet explaining what the system does and what to do in the event of a fault.

enviko
renewable energy solutions

Request A Quote.

We are more than happy to put a quote together for your green projects.

Call us or fill in the form you will find on our website! If our quote is in line with your expectations we will follow up with a site visit giving us a chance to measure up and discuss your project.

Take advantage of our Dedicated Resources.

If you are planning on installing several green technologies you might be better off working with a supplier who can work out the best integrated design of the different technologies.

You will also appreciate the advantage of reducing the number of installation teams working on your property. Additionally there is also a cost saving to be made. If we can carry out all the installations in one go, the installation becomes more efficient and we can share this advantage with you in terms of a multi-technology discount.

Get a Good Deal.

We believe in making it easier and more affordable to install green technologies.

Since we

- have a direct supply link to our technology partners
- install with our own staff
- offer multi-technologies, we can always give you a good deal.

enviko
renewable energy solutions

Tel: +44 (0)845 1899894,

Fax: +44 (0)208 1816300, Email: info@enviko.com

Head Office: Enviko Ltd | Erico House | 93-99 Upper Richmond Road | Putney | SW15 2TG | United Kingdom.

Regional Office: The Old Manse | Rothiemurchus | Aviemore | Inverness-shire | PH22 1QP | United Kingdom.

www.enviko.com