Generating Solar Homes

# Pathways to PV (Photovoltaics)



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THE BRITISH PHOTOVOLTAIC ASSOCIATION PV UK

THE HOUSING CORPORATION

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## PURPOSE OF THE GUIDE

This Guide has been produced for housing associations wishing to install PV (Photovoltaic) technology.

It is designed as a step by step guide to developing a PV scheme in a social housing organisation.

**SECTION ONE**
Introduction to PV technology

**SECTION TWO**
Planning a PV Project

**SECTION THREE**
Funding a project

**SECTION FOUR**
Case Studies


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## ACKNOWLEDGEMENTS

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**Kirk Archibald** – Energy Saving Trust
**Phil Beardmore** – People for Action
**Nicholas Doyle** – Practical Environment
**Debbie Jordan** - Nottingham Energy Partnership
**Inger Leach** – Plus Housing Group
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# FOREWORD

Not so long ago the notion of deriving energy from the sun in the UK was likely to evoke hollow laughs and little enthusiasm and encouragement. A number of companies took their ideas elsewhere to a friendlier environment. So I am delighted to write this foreword to a guide which should mark a step change in the development of photovoltaic energy in this country.

Since becoming an MP I have been glad to be associated with a variety of initiatives to raise its profile. Back in June 1997 my first Prime Minister's Question asked about the new Government's policy on solar energy and I drew attention to its exciting potential for local generation with associated social and economic as well as environmental benefits.

Installation of solar panels is still relatively expensive for individual householders. That is one of the reasons why the Generating Solar Homes project is so important, building as it has on the experience of the Housing Association sector and able to take strategic advantage of government funding. [I should like to take this opportunity to congratulate all those who have been associated with the project so far.]

I commend this Guide to all those seeking to benefit from the wealth of experience already accumulated and am confident that it will mean that solar technology will become much more widely used in the very near future.

And I look forward to the day when not to have solar panels on your roof seems as wasteful and irresponsible as not to lag your pipes or to insulate your loft does today.

**Helen Clark MP**

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# GLOSSARY OF TERMS

**AC** Alternating Current – current flows in both directions around a circuit

**BIPV** Building Integrated Photovoltaic – PV systems integrated into the fabric of buildings, for example through being built-in to roofs or wall cladding

**DC** Direct Current – current flow in one direction only around a circuit

**DNO** Distribution Network Operator

**Distributed generation** Generation connected to a distribution network. In England and Wales this means connections at 132kV and below (please note that in Scotland 132kV is a transmission voltage)

**DTI** Department of Trade and Industry - the UK government department that funds the PV demonstration programme and other renewable energy programmes

**EEC** The Energy Efficiency Commitment – legislation requiring energy suppliers to achieve energy savings among their customers; particularly favours social housing and can lead to generous grants for energy saving measures

**ESCo** Energy Service Company – a business created in order to sell energy services to customers, often small scale and often with environmental objectives such as energy efficiency improvements or renewable energy generation

**EST** The Energy Saving Trust – the agency responsible for administering the major PV demonstration programme, and with programmes to support the creation of ESCos etc.

**EU** The European Union

**kWh** kiloWatt-hour - the basic unit for measuring electrical or other energy kWp kiloWatt peak – the rated power of a PV system, measured as the electrical power output in maximum sunlight

**MWh** MegaWatt-hour – one thousand kWh

**Ofgem** The Office of Gas and Electricity Markets, the regulatory body for energy markets in the UK, and administering the RO.

**PV** Photovoltaic – the effect whereby sunlight is turned into electricity in PV 'cells' made from special semiconductor materials, usually silicon. Also taken to mean the modules (for example, glass panels) that incorporate the cells, or the whole system comprising several modules.

**RO** The Renewables Obligation - the current main mechanism in the UK for supporting the growth of renewable energy, requiring electricity suppliers to buy an increasing amount of electricity from renewable sources

**ROC** Renewables Obligation Certificate – a tradable certificate that can be given to the owner of a PV system for each MWh of output, bought by electricity suppliers to help meet their RO

**SHG** Social Housing Grant – provided by the Housing Corporation to housing associations to fund housing new build or purchases

# INTRODUCTION

## Generating Solar Homes

Generating Solar Homes is funded by the Housing Corporation. The project intention is to deliver a strategic approach to the development of photovoltaic (PV) schemes in the housing association sector. It brought together the experiences of housing associations to date in the development of PV as well as actively engaging the sector in funding regimes proposed by government.


The project helped create an overriding strategy for PV development in the housing association sector and:

- Established the level of activity on PV in the housing association sector
- Drew out the experience of sector pioneers who have already developed PV
- Raised awareness of the potential benefits/barriers to PV
- Engaged the sector in any programmes to develop PV in the UK
- Utilised the unique position of the sector to help develop PV production and installation capacity

# Frequently Asked Questions

## Is PV expensive?

Over the last 20 years the price of PV modules has fallen dramatically. The cost of a complete PV system - including power conditioning equipment and installation - can vary very widely depending on the application and system type, and so generalisations on system costs are difficult to make. An estimation, could be between £8,000 and £15,000 on a typical domestic installation of 1.5 kW.

## Is PV suitable for use in the UK?

PV has been used in the UK over the last 20 years or more for many applications, particularly in remote areas where grid connection is impractical, such as weather monitoring stations, marine navigation aids, etc. Over the last few years PV technology has also been introduced into urban areas, incorporated into the roofs and facades of homes, offices and factories. A modest sized domestic grid connect system can provide a substantial portion of a households electricity needs for over 6 months of the year.

## How long will a system last?

The average lifetime of a PV module can be over 20 years, crystalline silicon modules have a very long life span. In addition, they require very little maintenance.

## How much will I need to power my home?

A typical domestic system of 1.5 kW in the UK would produce around a third of the annual demand of an average family household. However, calculating the system size depends on many factors, for example whether the system is grid connected or energy demand of the household.

## How can I connect my system to the grid?

Connecting a PV system to the distribution network will require permission from the Distribution Network Operator (DNO). The DNOs in the UK have different policies when it comes to connecting PV systems to their networks, and so different rates will be paid for exported electricity. The system installer will make the necessary arrangements for grid connection.

# Government policy

*In Short*

## Government backs the development of PV by setting up the £20 million solar grant programme.

The Government heralded its intentions to kick-start solar PV industry in the UK in February 2001 in the White Paper .
*"Opportunity for All in a World of Change"*, a White Paper on Enterprise, Skills, and Innovation. The following month the Prime Minister announced an additional £100 million would be made available to support renewable technologies. The extra money would,

> *"Help us to promote solar PV, give a boost to offshore wind, kick start energy crops and bring on a stream of other new generation technologies"*

Most of the energy in the UK is derived from fossil fuels, gas, coal, oil; these are finite resources and are therefore not renewable. A further 20% is derived from Nuclear Energy with the problematic issue of disposal.

Energy derived from such sources as the sun or the wind is deemed as renewable sources of energy because there is no reduction in the energy that can be taken in the future. One of the major benefits of renewable energy is that it does not increase emissions of greenhouse gases in its production. Combustion of fossil fuels by contrast is the largest producer of emissions.

In February 2003 the Government published its Energy White Paper.

The focus is on

- Reducing carbon dioxide emission by 60% by 2050
- Putting £350m investment into renewable energy
- Aiming for 10% of energy to be renewable by 2010, and double that by 2020.
- New policies to increase domestic electricity prices by between 5 and 15 % by 2020.
- Britain's 16 nuclear power stations will all reach the end of their working lives in about 30 years.

One of the ways of achieving the target 10% of energy from renewables is through the Renewables Obligation (RO). This is discussed in more detail later in the Guide in Section Three "Funding a project."

Another way is by kick-starting the PV industry. The Government has committed £20 million for the development of PV roofs through the Solar PV Programme. Details can be found in "Public Funding Opportunities" section. The social housing sector is being actively encouraged by the offer of these grants to develop PV roofs in their stock and engaging their tenants in information surrounding energy from renewable sources through practical application in ordinary homes.

Already in Britain we have a rich heritage in architecture and innovative building design. Many of the most inventive PV applications have been pioneered by UK architects and social housing practitioners have been at the forefront of many of these developments.

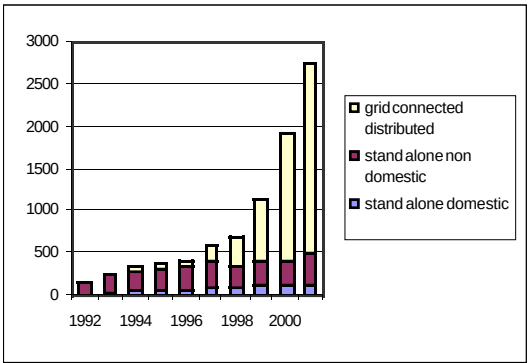
## DTI –Domestic field trials

The Department of Trade and Industry has set up the domestic Photovoltaic Systems Field Trials that gave financial assistance to those organisations wishing to develop PV. The key lessons learned in these field trials are about the design, construction and monitoring of a range of developments. The sites chosen represent differing locations, electricity supplier, and house type and are a mix of private and public ownership. The trials were a good opportunity to gather information on *"buildability, operating performance, reliability and maintainability of building integrated (BIPV) systems"*, (from "PHOTOVOLTAICS IN BUILDINGS Domestic Field Trial" newsletter no.3 November 2002 produced by DTI New and Renewable Energy Programme).

Several housing associations were involved in the field trials:

- BedZED – Beddington Zero Emissions Development, South London, Peabody Trust
- Machynlleth, Wales, Cantref Housing Association
- Green Lane, Nottingham Community Housing Association (features in the Case Study section of this Guide)
- Llanelli, Gwalia Housing Association
- Pinehurst Estate, Liverpool, Plus Housing Group
- Berwickshire – various sites
- Perthshire – various sites

For more information visit the DTI Renewable Energy Website www.DTI.gov.uk/renewable




Growth of PV Installed Capacity in the UK [1]

[1] Data from P. Cowley (2001) National Survey Report of PV Power applications in the UK. International Energy Agency Cooperative Programme on Photovoltaic Power Systems.

# The Housing Corporation view

*In Short*

The government, through the Housing Corporation is actively encouraging housing associations to become leaders in the development of sustainable housing.

The Housing Corporation has pledged to integrate Sustainable Development into their Regulatory Framework. As part of the national strategy there should be:

- **Effective Protection of the Environment**
- **Prudent use of natural resources**

Housing associations will be expected to:

- Adopt sustainable development principles and objectives into the day to day activities of the organisation
- Consider Sustainable Development in all new grant aided schemes
- Reduce CO2 emissions by increasing energy efficiency of housing stock
- Show improved efficiency in the use of natural resources in the development and repair of buildings
- Increase the standard of homes to ensure lower energy and water bills, reducing fuel poverty and improving the health of residents.

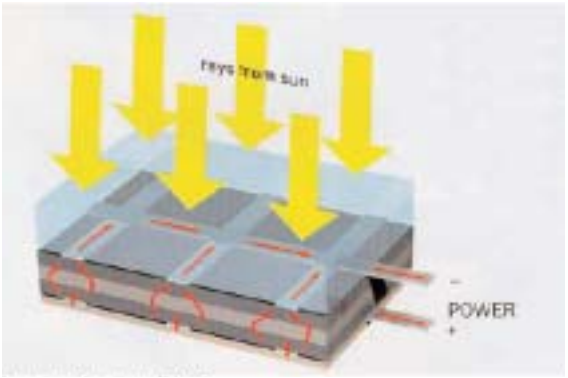
# SECTION ONE
# Introduction to PV

## What is PV energy?

*In Short*

How the PV process converts sunlight directly into electricity.

PV modules tend to be flat plates, often encased in a glass 'sandwich', and have a thin layer of specially treated semiconductor material, usually silicon. PV modules are available in a variety of forms, from glass facades for office buildings to 'slates' for domestic house roofs that mimic the appearance of natural slates. PV equipment has no moving parts and as a result requires minimal maintenance. It generates electricity without producing emissions of greenhouse gases or any other pollutant, and its operation is virtually silent.




Operation of silicon PV cell

A PV system on a domestic house roof could prevent over 30 tonnes of greenhouse gas emissions during its lifetime. An installation on a domestic property could comprise a PV system of 2kWp (kiloWatts peak), meaning that peak output in bright sunlight is equivalent to the electrical consumption of, say, a two bar electric heater. This installation would require between 15 and 40 square metres of PV modules, depending on their design, and would produce around 1,500kWh (the 'units' shown on an electricity bill) of electricity per year. Electricity consumption in households varies very widely, but such a PV system could contribute to about 20% of annual consumption of a general home, up to about 50% for a very energy efficient home, with an approximate energy saving of £100 per year, based on a typical electricity tariff.

# Installing a PV system

*In Short*

A PV system generates its own electricity and emits no pollution and a system can be incorporated in buildings in various ways.

Installing a PV system means that electricity can be generated from the free and inexhaustible energy from the sun. A PV system never needs refuelling, emits no pollution, and can be expected to operate for over 30 years while requiring minimal maintenance.

Energy use in buildings accounts for almost 30% of the UK's energy usage. Installing a PV system is one of the ways housing associations can contribute towards a sustainable future for everyone.

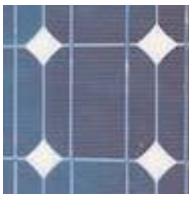
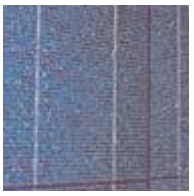
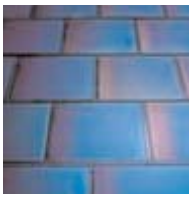
The key benefits of a solar roof are:

- Clean power source that helps reduce global warming
- Reduces electricity bills, since daylight is free
- Extremely low maintenance, with a long functional lifetime of 30 years or more
- Silent in operation
- Increases awareness of electricity use and encourages more energy efficient behaviour
- Increases the value of the property

## Where can PV be fitted?

Sloping rooftops are an ideal site, where modules can be mounted using frames. PV systems can also be incorporated into the actual building fabric, for example PV roof tiles are now available which can be fitted as standard tiles. In addition, PV can also be incorporated as building facades, canopies and sky lights amongst many other applications.

## Types of PV Cell

| | |
|---|---|
| **Monocrystalline Silicon Cells:**<br>Made using cells saw–cut from a single cylindrical crystal of silicon, this is the most efficient of the photovoltaic (PV) technologies. The principle advantage of monocrystalline cells are their high efficiencies, typically around 15%, although the manufacturing process required to produce monocrystalline silicon is complicated, resulting in slightly higher costs than other technologies. |  |
| **Multicrystalline Silicon Cells:**<br>Made from cells cut from an ingot of melted and recrystallised silicon. In the manufacturing process, molten silicon is cast into ingots of polycrystalline silicon, these ingots are then saw-cut into very thin wafers and assembled into complete cells. Multicrystalline cells are cheaper to produce than monocrystalline ones, due to the simpler manufacturing process.<br>However, they tend to be slightly less efficient, with average efficiencies of around 12%, creating a granular texture. |  |
| **Thick-film Silicon:**<br>Another multicrystalline 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 usually bound into a strong aluminium frame. |  |
| **Amorphous Silicon:**<br>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. Amorphous silicon can be deposited on a wide range of substrates, both rigid and flexible, which makes it ideal for curved surfaces and "fold-away" modules.<br>Amorphous cells are, however, less efficient than crystalline based cells, with typical efficiencies of around 6%, but they are easier 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:**<br>A number of other promising materials such as cadmium telluride (CdTe) and copper indium diselenide (CIS) are now being used for PV modules.<br>The attraction of these technologies is that they can be manufactured by relatively inexpensive industrial processes, certainly in comparison to crystalline silicon technologies, yet they typically offer higher module efficiencies than amorphous silicon. New technologies based on the photosynthesis process are not yet on the market. | |

## Typical PV system configuration

The components typically required in a grid connected PV system are illustrated below.

The PV **array** consists of a number of individual PV **modules** connected together to give the required power with a suitable current and voltage output. Typical modules have a rated power output of around 75 -120 Watts peak (Wp) each. A typical domestic system of 1.5 - 2 kWp may therefore comprise some 12 - 24 modules covering an area of between 12 - 40 $m^2$, depending on the cell type used.

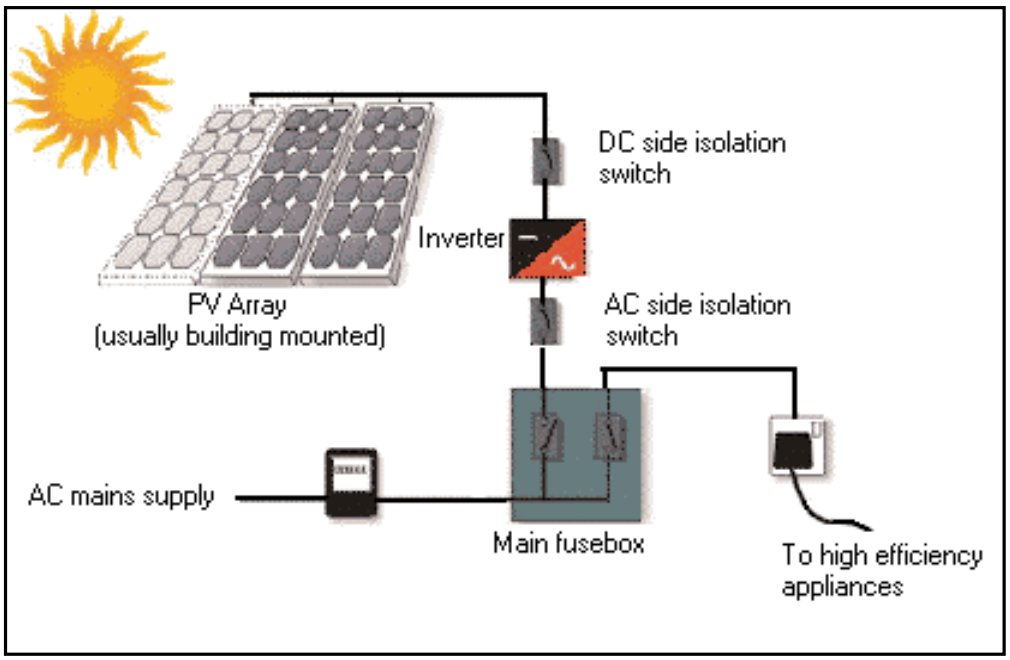
Most PV modules deliver direct current (DC) electricity at 12 volts (V), whereas most common household appliances in the UK run off alternating current (AC) at 230V. An **inverter** is used to convert the low voltage DC to higher voltage AC. Numerous types of inverter are available, but not all are suitable for use when feeding power back into the UK mains supply.

Good suppliers and installers of grid-connect PV systems will be able to offer advice on suitability of commonly available models.

Other components in a typical grid-connected PV system are the **array mounting structure** and the **various cables** and **switches** needed to ensure that the PV generator can be isolated both from the building and from the mains. Again, good suppliers and installers of grid-connect PV systems will be able to offer advice on these aspects of the PV system.

Finally, a **meter** will be required to ensure that the system owner can be credited for any PV power fed into the mains supply.

Suppliers will normally offer a 12 months warranty on the system, together with 2 years on the inverter and a performance warranty of 10 - 25 years on the modules.



## On what type of buildings can a PV system be installed?

Important questions to consider in deciding whether or not a PV system can be installed on a building and what type of system should be installed are:

- Is there a suitable place on the building where the solar array could be mounted (taking into account orientation, shade, and available area)?
- What type of PV system would be suitable?
- Is planning permission required?

PV modules can be placed on almost any building surface which receives sunshine for most of the day. Roofs are the usual location for PV systems on houses but PV modules can also be placed on facades, conservatory or atrium roofs, sun shades, etc.

The surface on which the PV array is mounted should receive as much light as possible. The more light the PV array receives the more electricity will be generated. The three issues which affect how much light a surface receives are:

**1. Orientation**: Due south is the best possible orientation. If the PV is to be mounted on a vertical façade the orientation should preferably be between South East and South West. If the PV is to be mounted at a tilt a wider range of orientations will still give a reasonable energy yield. North facing orientations should be avoided.

**2. Tilt**: A tilted array will receive more light than a vertical array. Any angle between vertical and 15º off horizontal can be used. A minimum tilt of 15º off horizontal is recommended to allow the rain to wash dust off the array. The optimal tilt angle is 30º - 40º for a south facing array in the UK. Shallower tilt angles are better for east or west facing arrays.

**3. Shadowing**: Shadows cast by tall trees and neighbouring buildings must also be considered. Even minor shading can result in significant loss of energy. If shading is unavoidable, a system designer can advise on how to minimize the effect of shade on the amount of electricity produced.

The area required for mounting a PV array depends on the output power desired and the type of module used. An area of around 8 m2 will be required to mount an array with a rated power output of 1kW, if monocrystalline modules are used (the most efficient modules type). If multicrystalline modules are used an area of around 10 $m^2$ will be required for a 1kWp system and if amorphous modules are used an area of about 20 $m^2$ will be required. These areas can be scaled up or down depending on the output power desired. 1 – 3 kWp is a typical power output for a domestic system, although smaller or larger systems can be installed.

There are various ways in which a PV array can be mounted on a building. The options offer different appearances and vary in cost. The most common way of mounting an array on a house is to place it on the roof either with modules mounted in a frame above the existing roof tiles or integrated into the roof. If the array is to be integrated into the roof, PV roof tiles may be used instead of modules.

PV arrays can also be mounted on flat roofs, on walls, in conservatory roofs, on sun shades or on other structures such as pergolas or car parking bays.

| Mounting Method | Pros | Cons |
|---|---|---|
| **Above sloped roof** | lowest cost option | noticeable on the roof |
| | | adds to roof weight |
| **Integrated into roof** | low cost | limited additional weight |
| | avoids need for roof tiles | |
| **Roof tiles** | very unobstructive<br>no additional weight on roof structure | higher cost |

# How much electricity will a system generate?

A system with a PV array tilted towards the south would generate approximately 750kWh/year per kWp installed. So a typical 2 kWp system (around 20 $m^2$ of multicrystalline modules) would generate around 1500 kWh per year. Output will be reduced by shade or non-optimal orientations or tilt angles.

## How much will a system cost?

A typical price for a grid connected, building integrated PV system is between £12,000 - £14,000 for a 2 kWp system for a house. There are a number of factors that will influence the cost of a system:

- Whether or not the system is being installed while the building is being built or as a retro-fit to an existing building. If the system is being installed on a new building some savings may be made, e.g. the number of roof tiles that need to be purchased could be reduced.
- The number of PV systems being installed at a time. A house builder installing systems on a group of houses can expect a price nearer the bottom of the quoted range than an individual householder.
- The size of the system being installed. A larger system may be cheaper per kWp, while a small system may be more expensive.
- How difficult or easy it is to access the area where the PV system is being installed. The typical price quoted applies to installation on a typical house roof, if the roof is a complicated shape or requires complicated scaffolding costs will be higher.
- The module type used will significantly impact on the costs. The typical price quoted is based on standard modules; tile type systems are somewhat more expensive. The most expensive systems use semitransparent glass modules in facades or conservatory roofs.

**Note** - VAT is not applied to new-build projects however for retrofit projects VAT must be charged at the current rate of 5%.

# Expected running costs over the lifetime of a PV system

*In Short*

## Operating and maintenance costs of a PV system.

The running costs of a PV system can be expected to be low. However no system has zero running costs and some allowance should be made for maintenance and repairs during the lifetime of the system.

The lifetime of a PV system is hard to predict because this is a relatively new technology with a lengthy expected life of between 20 and 30 years. The majority of the systems so far installed have not yet come to the end of their lifetime and most of those that have stopped operating were early systems constructed while the technology was much less developed.
In fact the PV modules will almost certainly still work at the end of this lifetime and it is likely to be other factors, such as change of use of the building or degradation of the wiring, that cause the system to be shut down.

Two types of costs should be allowed for: normal operating costs and costs for repairs.

Possible **operating** costs are listed below:

- **Array cleaning.** Most systems do not need cleaning, assuming the surface slopes more than 30° and allowing for occasional rain-fall. However sites near busy roads or other sources of sticky particulates may benefit from annual cleaning. Costs will depend on ease of access, array size and who does it. It is worthwhile keeping access and slope in mind when designing a system for a dirty location.

- **Insurance:** PV systems fixed to a building are normally covered by the building insurance. No instances of higher premiums have been reported however this should be checked with your building insurers.

- **Electrical Safety Check.** The PV system should be checked for electrical safety in the same manner as other electrical systems. Costs should be low or negligible if the system is checked as part of the standard electrical review.

- **Electrical production Check.** This can be done through meter readings, monitoring systems or just reviewing the electricity bills. There may be an associated manpower cost.

- **Maintenance contracts** are offered by the main PV installers. These tend to be expensive, upwards of £100 per system per year, due to costs for time and travel. These contracts are not normally used with organizations preferring to keep an eye on the system themselves. In any case the system will normally be covered by the installers warranty for the first year of operation, the inverter by the manufacturers warranty for the first 2 years and the modules by the manufacturers warranty re power output for 10 or 20 years.

## Possible costs for repairs.

■ **PV modules** are normally covered by the manufacturers guarantee to maintain power output for 10 or 20 years. In fact PV modules have very few failure mechanisms as they are solid state devices with no moving parts.

Failure rates are down to 0.01% per year. Modules may occasionally fail due to thermal stress cracking the glass cover pane, or hot spots caused by regular small areas of shadow. It may also be necessary to replace a module due to damage from accidents, lightning strikes, vandalism, etc. Any costs may be covered by the manufacturers warranty or the buildings insurance.

■ **Inverter**. This is the least reliable component. However, inverter technology has undergone considerable development over the past 10 years, and recent projects typically show trouble free operation for 10+ years. If an inverter fails it will normally need replacing at a cost of £600-£1000 for a standard 0.8-1.5 kWp system.

■ **Wiring** can degrade with age; connections can become loose or corrode. With good workmanship the wiring should last as long as conventional building wiring. If it needs repair or replacement, costs will be very dependent on access and surface finishes.

## Getting technical help

A PV installer can discuss the various systems they offer and how they could be mounted on a building before providing a quote for the total installed system cost. A list of companies offering installation services is available from the web site of the British Photovoltaic Association (PV-UK) (Trade Association) www.pv-uk.org.uk. Note If an application is to be made to the DTI Solar PV grant Programme then the installer needs to be DTI accredited.

The chosen installer may provide assistance in submitting applications for funding and contacting the electricity companies. Independent advice on the most appropriate design options for a building, assistance with submitting applications or in obtaining competitive quotes can be done by an experienced PV designer. PV-UK members include consultants and architects experienced in the design of PV systems. A list of companies offering design services is also available from the web site of the British Photovoltaic Association. www.pvuk.org.uk.

## Planning permission

Planning permission is not normally required for a building mounted PV array if the array does not project significantly beyond the roof slope. However, exceptions may apply for systems on listed buildings, conservation areas or in areas of outstanding natural beauty. In addition be aware of local planning regulations.

Planning considerations are described in more detail in a PV-specific annex of the Department for Transport, Local Government & the Regions' Planning Policy Guidance Note 22 (PPG22) available from:

www.planning.dtlr.gov.uk/ppg/ppg22/annex

In all cases it is best to contact your local planning department for advice and obtain confirmation that permission isn't required in writing.

# Connection issues

*In Short*

When installing a PV system to connect to the mains electricity supply network, it is important to ensure that you have certain approvals.

## Connection

It is clear that the network operators have moved to resolve the main issues of PV connection and are generally operating a similar set of procedures. This simplifies matters for new players in PV generation. However, it is also clear that early contact with the appropriate Distribution Network Operator (DNO) at the earliest stage is essential. The DNOs have developed a high level of expertise and knowledge and are a very important source of advice and guidance for any new installation, especially where multiple installations are likely.

In the UK generators have generally been large-scale coal, gas and oil fired power stations generating over 500MW of electricity. This electricity is delivered at high voltage (up to 400kV) through the National Grid. Before being delivered to individual homes and business the electricity is stepped down to 11kV and delivered on a distribution network, before being stepped down further to 240V delivered to homes. All generators must meet specific standards before they can export their electricity. Until recently small generators, such as individual homes with PV could be asked to meet the same standards as much larger generators. This approach obviously imposed onerous burdens on very small generators with significant cost implications.

The growth of **small scale generating technologies**, including PV and Combined Heat and Power (CHP) has led to a greater number of generators seeking to connect at **low voltage** onto the distribution network. The distribution network has been designed to deliver electricity to consumers, not to accept generated electricity.

The Government's policies encouraging renewable energy require the facilitation of this "distributed" generation, if targets for renewables are to be met.Most forms of renewable energy still generate significant voltages and are covered by **G59/1** engineering recommendations. Generators must be able to operate safely within these recommendations, providing electricity within the appropriate voltage and frequency levels. Generators must also be able to operate safely if disconnected from the network for any reason.

**PV generates at very low power**, so is less of a problem to connect safely to the grid. However, PV is a **DC generator**. So any electricity generated must be passed through an **inverter** to convert to **AC**. DC circuits must be isolated from AC circuits and there must be safe isolation of all circuits from the mains supply. Connection of PV to distribution networks at 240kV is possible with fewer restrictions and safety features than needed for higher voltage generators. The network operators have worked with the PV industry to develop specific guidelines that allow easier access to the network for small PV installations. These recommendations, **G77/1** are currently accepted by all **DNOs** as the basis for PV installations **under 5kW**. The G77/1 recommendations will be absorbed into the **new G83** recommendations in the near future, but this change should have little impact.
A PV installation that is in accordance with the recommendations in G77/1 and the relevant health and safety checks should be accepted.

## Distribution Network Operators

Telephone interviews (see next page) with each of the DNOs conducted during November 2002 showed that all of the DNOs now have experience of PV installations on their network and all are operating a policy of accepting single systems under 5kW under G77/1 regulations. Systems over 5kW are more variable. Most DNOs would expect them to meet the more onerous G59/1 recommendations, although some would try to apply G77/1 still. The draft G83 and G75 recommendations are likely to provide further clarity. Table 1 gives a list of DNOs contacted and contact details. Up to date contact details are available from PV-UK www.pv-uk.org.uk.

## Summary of results for interview with DNOs

| DNO | PV Installed | Under 5kW | Over 5kW | Multiple Systems | Other Obligations | Additional Equipment | Future Changes |
|---|---|---|---|---|---|---|---|
| Aquila | Yes | G77/1 | G77 if possible | Like to be informed so they can keep track | Letter of acceptance from DNO. Supplier owns connection agreement | None but meters checked to see that they run correctly | G83 |
| NEDL | Yes | G77/1 | G59 but assess individually | Treat individually, but need to check network. Any upgrade costs passed to new generator | None | May want metering if significant capacity | None |
| Western Power Distribution | Yes | G77/1 | G59/1, require relays etc, more expensive | Collectively assessed. Network assessment required. Upgrade costs to generator | Connection agreement. Inform DNO if changes | None | May be net metering. But issues on use of system |
| Manweb | Yes | G77/1 | Individual assessment then G77 if possible otherwise G59 | Collectively. This will be covered in G83 | No except regular maintenance | None | G83 – will simplify process for multiple connection |
| LPN/EPN | Yes | G77/1 | G59 for larger Generators | Collectively. Assessment if necessary (cost ~£150 each). But generally happy about effect of PV on network | None unless system changed | None as long as compliant with G77 | G83 – absorbing G77 |
| Seeboard | Yes | G77/1 (would check new installer) | G59 | Collectively. Require assessment and possible monitoring, depending on size. | Connection and technical agreement, maintenance and notification of changes | No. Metering with supplier | G83 |
| United Utilities | Not sure | G77 | G59 plus network studies | Collectively. Network study needed. May not be allowed if network weak | Connection agreement | May need multi-directional meter in future | Discussions re embedded generation with Ofgem, particularly in relation to micro CHP |
| YEDL | Yes not many | G77/1, but still clarifying processes | G59/1 | Collectively. Assessment required with small cost | Connection agreement. Maintenance and notification of change | No, but debates on metering question | G83 next year. Includes planned multiple installation. PV covered to about 3.7 kW in future |
| EME | Yes not much | G77/1 | Investigation. G59 if significant protection required | Collectively study required cost passed to generator | Maintained correctly | Nothing unless significant Generation | Small changes only |

## Multiple installations

Housing associations may decide to develop **several systems** on the same site. The development of a number of systems within close proximity is dealt with differently. In general most DNOs would accept multiple systems but may require an assessment of the ability of the network to accept generated electricity, in that location. The bill for this exercise may be approximately £300 for a housing association. Following the assessment multiple connections may not be allowed without upgrading of the local network, this cost may fall to the new PV generator and could be substantial. The process for multiple installations is likely to become clearer under the forthcoming G83 engineering recommendations. Multiple installations will be required to pass on plans to the DNO for assessment at an early stage in planning. The DNOs will be able to tell The new generators if their schemes would be acceptable, before significant costs have been incurred. The DNOs expressed the importance of early approach when installing multiple PV units, but had a positive attitude and felt in general no problems were envisaged in absorbing PV electricity on most grids. The main concerns were are in rural areas where the grid is "weak" and may not be able to deal with many installations.

Connection to the low voltage network is now comparatively straightforward, particularly if using a recognised and **reputable installer**, who will be able to navigate through the arrangements necessary to meet G77/1.

## When PV system has been installed

Once the PV system is installed to the appropriate standards the only other requirements are to **maintain the system** and to inform the DNO of any **changes** to the system. Maintenance is generally small on PV systems. Changes to the system may cover items such as **replacement of parts**. As long as replacement parts comply with G77/1 standards this should be straightforward.

On the whole the DNOs are not routinely performing any **monitoring** of systems and any metering would be agreed with the **supply company** rather than the DNO.
**Connection agreements** at the domestic level are agreed with supply companies not with the DNO so the procedures for agreeing connection with the DNO do vary across the operators. Procedures are also likely to change in response to the increase of household scale generation. Issues such as metering export electricity and charges for system use are all currently under discussion by all interested parties.

## Sale of electricity

The issue of sale of electricity generated at household level is part of an ongoing debate. The situation is likely to change in the future. The advent of micro Combined Heat and Power (CHP) that will generate and export more electricity is likely to drive the debate, rather than PV generation. Micro CHP may start to replace boilers in domestic properties in the near future.

The current situation in relation to electricity generation from PV on a domestic scale is that except where an agreement has been reached with the supplier any excess electricity generated from the PV is merely sent back down the lines, with **no recompense** for the PV owner. In a few cases some form of net metering agreement has been reached. **Net metering** means that you are effectively paid the same for any export electricity as you are charged for any imported electricity; this is around 7p/kWh.

The price paid per unit of electricity generated is more like 2p/kWh. There is a debate regarding the issue of net metering, any generator which **exports** as much electricity as it **imports** would effectively pay zero for any electricity supplied by the network. They would receive free use of the system. TXU (now Powergen) and London Electricity have been offering a scheme that effectively provides net metering. They estimate the likely **over generation** given the size of the householder's system and their electricity likely use and offer a **once a year payment**.

The cost of the use of the electricity network is effectively subsidised by them as part of their goal to encourage more PV. The scheme, as operated now, is possible, as there are comparatively few generators and the supplier is able to provide the subsidy. In the event of much higher take up, or indeed a withdrawal of support by the supplier it may cease to operate. The regulator for the industry, **Ofgem**, is engaged in debate with the industry over these issues.

If a PV generator wants to be paid for any exported electricity without these special agreements with a supplier, then the generator would have to pay for the installation of an **import export meter**, If the supplier wishes to trade this electricity in the market. The supplier would then also charge a fee for the administration of the account. This charge could be in the range of £1000 per year, and the price paid per unit would be around 2p/kWh. Given the high capital cost of the PV equipment and the administration fees, this is clearly uneconomic. Housing associations may have more options open to them than an individual householder.

## Negotiations

Housing associations may be able to negotiate individually with a supplier for the whole of their association, or for a specific project. This has the advantage of giving the housing association additional bargaining power. However it is difficult since householders are all able to change their supplier at comparatively short notice. It may be difficult to arrange suitable and binding agreements on behalf of a large number of residents.

## Ownership of local system

Housing associations may be in the position to negotiate for a **connection** to the distribution network upstream of all their local generation capacity. In this instance the association would set up a private network, with PV generation on various properties. The association would then be the supplier to all of those properties on the small private network.

The benefits of this approach are that the housing association can then act as an Energy Service Company (ESCo), providing energy efficiency works as well as electricity and/or gas supply to those properties. This approach would benefit from a mix of generation, for example including CHP on site.

CHP and PV are well matched for supplying heat and electricity. PV mainly generate when heat requirements are low, thus allowing the CHP to operate more optimally. There are examples of this kind of approach in BedZED and in the Black Country Housing Association in the West Midlands and Woking Borough Council, which owns much of its own network.

**Warning** – setting up an ESCo may exclude an association from state aid. Check this before an application for government grants is made.

The drawbacks are mainly in relation to the maintenance of the private system and administration burdens that may fall on the association. Also need to investigate the legal and business implications.

# SECTION TWO
# Planning a PV project

*In Short*

There are many opportunities to incorporate PV in a development programme.

- New Build
- Refurbishment and repairs
- Re-Roofing programmes

Although PV may be an expensive technology the benefit can be reaped in socio-economic terms as well as public proof of an organisation's environmental credentials.

## Why develop PV ?

**PV contributes to Affordable Warmth, reduced CO2 Emmissions** and improvement of an asscociation's **environmental performance**. There maybe some criticism that extra money spent on PV could go on other priorities for low income groups in poor housing areas. However, the development of PV in the sector should be seen as part of development policies which in turn are part of the overall **sustainable communities** strategy for all, for social housing for the future.

The Housing Corporation is keen for housing associations to exhibit their **environmental credentials**.

## Who should be involved

**In the organisation**
It is important to decide at the outset of a project who should be involved. Housing associations should decide the nature of the finished project, who is likely to be involved and at which stage it is appropriate to consult. Include all departments which are affected and get **officers** on board at the beginning, for example, lay to rest the myths about maintenance requirements of a system with your Maintenance Managers. Consult with tenants, **local community** at the earliest possible stage.

**Outside the organisation**
Also you should consult with local authority about any required **lettings** criteria with the scheme, particularly if there is a nomination rights system already in place. In addition sort out any **planning** issues early and if planners are unfamiliar with these types of schemes then use examples of other developments in similar environments. Finally look to see if your scheme fits into the Local Authority **Agenda 21** requirements. Appoint **consultants, installer, contractor.**

## Process

Usually developments such as these work better if there is a **dedicated officer** to "project manage" within the organisation. If the experience is not there within the association it is advisable to use **consultants** on the project. It helps if you can get a **champion** at a senior staff level to drive forward these ideas as part of their portfolio.

**Securing Funding** - see Section Three for full details.

Put PV on **a popular scheme**. If you are developing a scheme which is in demand then you are less likely to come up against resident and community opposition. In all cases positively publicise the scheme as an asset to the community and ensure it is as attractive as it can be within its environment. Make it part of wider community objectives if possible.

# Making the case

Housing associations may have a number of reasons to install PV systems and a project champion may include the following when making a case for initiating a scheme.

### ■ Sustainable element to the development strategy.

A sustainable element to the development strategy, as it relates to energy, will target a reduction in the amount of energy consumed. Whilst the bulk of sustainable energy objectives are likely to be delivered through lower cost solutions, PV installations should complement less visible actions, such as loft or wall insulation, by providing carbon-free electricity and acting as a 'flagship' development.

### ■ Public relations value.

The profile of a housing association may be raised, and its commitment to environmental and sustainability objectives may be powerfully demonstrated, by one or more PV installations. PV technology is not common. Its high technology and clean and silent operation marks it out as cutting edge, and PR value may be maximised by linking a housing association with these values and by demonstrating an awareness of and commitment to future technology and environmental improvement.

### ■ Savings for tenants and alleviation of fuel poverty.

Electricity produced by a PV installation is generally consumed by tenants directly, thereby reducing electricity bills. The net effect is to effectively 'subsidise' the cost of electricity to tenants. In this way, a PV system delivers immediate and tangible value to tenants that are fuel poor.

### ■ Hedging against future energy price rises.

Electricity prices are lower now in real terms than they have been for many years. The Government has announced in the Energy White Paper (2003) a policy to increase domestic electricity prices by 5 to 15% by 2020.
The reduced supply of natural gas, crisis in the electricity generation sector in the UK, and instability in international oil markets may be felt in electricity price rises in the future. PV systems however provide certainty over the future production of electricity.

# Steps to Funding

The basic steps to funding are outlined below. At all or most of these stages, approval will need to be obtained at board level in order for the process to proceed. The benefits identified in this guide are the principal ones that may be used when making a case for investment in PV at board level.

### Step 1: Assess the potential for PV

a. identify possible sites
b. work out costs / obtain quotation (beware hidden extras such as scaffolding)
c. consider key issues e.g. performance, aesthetics, overall sustainability strategy

### Step 2: Assess housing association investment

a. consider what the association can afford
b. consider tenant benefits

### Step 3: Assess how to fill the funding gap

a. consider seeking nongovernment grant finance, soft loans and any other concessionary finance
b. consider setting up an ESCo (orientated or with a third party)
c. examine the potential role for ROCs to add value to the overall proposition (i.e. can the PV systems be linked to create a large enough capacity)

### Step 4: Apply for DTI funding

### Step 5: Implement scheme within 12 months (if using DTI funding).

# SECTION THREE
# Funding a project

## Options for funding

*In Short*

The way in which a project or business is structured can affect the options for funding.

There are two basic models outlining different approaches to project and business structuring for PV projects:

- The housing association as Project Sponsor
- Energy Service Companies (ESCos)

External providers of capital for a new project, whether in the form of loans or equity, will assess an opportunity based on some core questions:

- The creditworthiness of the principal sponsor.
- The expected costs and revenue flows.
- The magnitude of risks and ability of the participants to avoid or manage these.
- The balance of debt and equity
- The existence of guarantees and the underwriting of revenue flow.

Depending on the structure of the project, some of these considerations will be more important.

### The Housing Association as project sponsor

This model assumes that a housing association independently takes responsibility for the installation of PV panels, without the creation of any special purpose company or project structure. The housing association would apply for the principal grant funding from the DTI, and seek to fill the funding gap through a combination of approaches.

Any loan obtained will be secured against the assets of the housing association, and award of a loan will depend upon the credit rating of the association, amongst other factors. If a leasing arrangement is entered into, the lessor will assess the association's ability to keep up regular rental payments. The association may or may not be able to recoup some of the cost of the PV system through increased rents or by charging tenants separately for energy produced by the PV system.

| Advantages | Disadvantages |
|---|---|
| No new business partnerships to establish | The administration costs for closing the funding gap may be high |
| If association is in a strong financial position, it could achieve favourable loans | Little room for innovation in combining PV with other energy services |
| The association can start applying for funding immediately | Any loan finance 'uses up' part of association's borrowing capacity |

## Energy Service Companies

An 'Energy Service Company', or ESCo, is a broad term covering a range of approaches that can be taken to providing energy to customers[8].

The core concept behind most ESCo developments is that energy consumers do not generally wish to purchase kWh of electricity or cubic metres of gas. Rather, they wish to enjoy the services that energy provides – i.e. warmth, cooling, light etc[9].

An ESCo is generally taken to mean a business structure that is created to achieve this end, on behalf of a specific group of customers, and typically involves considerable innovation in commercial arrangements. An ESCo can encompass novel commercial arrangements for the generation and distribution of energy as well as its supply, usually on a small scale.

An ESCo structure can be very useful in the creation of a PV project. An ESCo is generally a limited liability company, enabling it to attract equity as well as loan finance.

An ESCo may be created with the single purpose of providing energy benefits to the tenants of one or more housing associations. As such, tenants would be able to enter into contracts with the ESCo for the provision of services, enabling the ESCo to be more creative in its use of revenues, opening up the possibility of including PV generation.

A good example of the use of an ESCo structure is provided by Woking Borough Council, which has successfully developed an ESCo for the provision of energy services to tenants of residential areas, community buildings and sheltered housing. The ESCo owns combined heat and power generation plant as well as PV panels, and makes electricity and heat available to tenants on a service charge basis (not charging for actual energy consumed, but rather for the constant availability of that energy). A major part of the value that has been created for the consumers of energy services comes from the ESCo being small enough to be exempted from the normal licences required for generation or supply of energy. Current licence arrangements would permit an ESCo owned by a housing association, or group of owners, to supply energy to around 2,500 households, without needing to be licensed.

An ESCo created and owned by one or more housing association could directly supply energy to its tenants. This makes it possible to optimise tenants' energy usage for example by reducing fuel costs, through a single billing system, or by installing energy efficiency measures in homes as part of the overall service charge.

ESCo business structures also lend themselves to ownership by a range of shareholders, potentially including major energy supply companies. An ESCo set up in conjunction with an energy supplier could offer a number of options to tenants and the housing associations involved, in addition to any energy generation projects:

- Affinity deals
- Competitive energy rates
- Home energy surveys
- Energy advice
- Access to Energy Efficiency Commitment (EEC) funding

Forming good relationships with an energy supplier can also increase the potential for negotiating net metering arrangements for PV installations.

An affinity deal is an agreement whereby a supplier pays a small fee whenever a tenant or a void property transfers to this supplier. Voids can be automatically signed up to the preferred supplier, and the funds generated in this way can be ring-fenced for specific

[8]For a fuller explanation of ESCo principles and to see case studies of successful ESCo developments in social housing see http://www.est.org.uk/business/ and follow links to energy services.

[9]For a list of Energy Services Companies refer to the Directory of Energy Services for Housing associations, produced by the Energy Saving Trust, Housing Corporation and Nottingham Community HA and available from all three organisations.

uses, and there are examples of ESCo structures created by housing associations using these funds for energy efficiency improvements. They could equally by used to part-fund PV systems.

It is the potential flexibility of ESCos that holds the key to their potential to unlock investment in a PV system, and to reflect the cost and benefit of a PV system in the energy services it sells to customers.

**Warning** – setting up an ESCo may exclude an association from state aid. Check this before an application for government grants is made.

| Advantages | Disadvantages |
|---|---|
| Opportunity to 'bundle' sustainable energy technologies of different sorts, eg PV and CHP, to help make PV more cost effective | Business agreements have to be established - this will take time & expense |
| If set up with other associations, admin costs to achive gap funding are spread over a number of HAs | Potential investors/tenders must be convinced of the ESCo, and the parents of the ESCo may still need to provide security |
| The potential to bulk purchase may help reduce capital and installation costs | Potentially increased administration of metering and billing |
| Potential for reduced energy bills for tenants, or static bills that still fund PV development | |
| Depending on arrangements, energy bills may be included in rent | |

# Public funding opportunities

*In Short*

No source of public funding offers 100% funding for PV projects. The public funding presently available for the purchase and installation of PV does bring the implementation of this technology into the reach of housing associations.

## DTI major photovoltaic demonstration programme

The Department of Trade and Industry Major PV Demonstration Programme was launched in April 2002 to subsidise the take up of solar electricity in the UK. £20 million is available in the first phase of this programme (2002 – 2005) in the form of grants towards the installation of solar electricity equipment for householders, businesses and social housing groups.

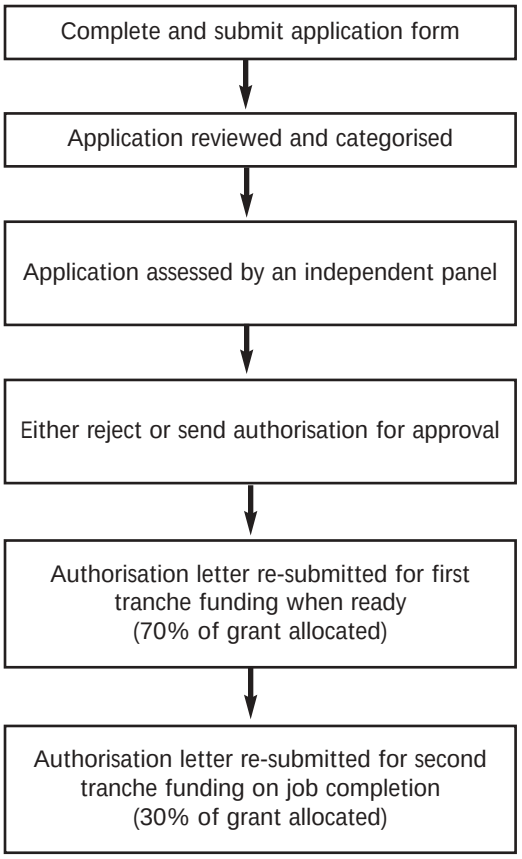
The programme is divided into two parts, one for small applications (from 0.5 to 5kWp), and one for larger applications (from 5 to 100kWp). The first is primarily applicable to individual householders; the second is most likely to be of interest to housing associations. Grants are available for up to 40% or 65% of costs, depending on the type of applicant.

### 5kWp – 100kWp

Up to 65% fixed grant funding is available for the supply and installation of PV projects of this size. This applies to social housing groups and larger scale public authority building projects. Up to 40% is available for commercial organisations. Applications may be made at any time and groups of applications are considered for funding at three month intervals.

### How to apply

Log on to www.solarpvgrants.co.uk for an application form and guidance notes.
The application procedure is summarised in the following flow diagram:



## TOP TIPS for a successful application

There is a range of information that needs to be provided for an application to be considered. Time can be saved by ensuring that relevant and clear information is provided.

Essential criteria

1. Provide a brief summary of the overall scheme concept including the purpose of the building. Its role in the local community, unique features of the project and why the building would be a good site for a PV system.

2. Design, refurbishment features, should include clear drawings showing buildings and clearly marking the siting of the photovoltaic system.

3. Include mechanical engineering details, showing how the PV system will be fixed to the building, any weatherproofing of the roof incorporating the PV system and any consideration of heat recovery or cooling of panels that will be carried out.

3. Electrical schematics, include panel and inverter set up, electrical protection system, wiring diagram and earthing connection to an appropriate standard.

4. Energy performance should include details of the PV performance and a description of the expected electrical load profiles. Also give details of BREEAM analysis or other building performance rating, if available.

5. Give details of main team members (including developer, builder, solar installer and agent). Along with any previous experience of solar and environmental projects (e.g. green buildings).

6. Detail any outstanding planning consent, funding or resource issues that may affect the progress of the project. Also, if new build, the stage of the building project should be indicated.

Desirable criteria

7. A cost-benefit analysis of the proposed scheme, e.g. environmental cost-benefits, findings from a risk assessment (e.g. security of other funding, partner commitment, supply of modules etc); indicate client use for the PV system and levels of any diversity.

8. Scheme promotion plans detailing publicity in the local area, or the level of public interest the scheme may generate.

9. Detail any sustainable development aims of the project, e.g low or 'zero energy' building design and other features including solar thermal collection, rainwater harvesting, use of recycled construction materials, high insulation standards and any other sustainable design features.

10. Give details of any monitoring by visual displays (e.g. connection to a large kWh meter display, linkage to computer for demonstration purposes).

## Installation

Once the application has been approved, 12 months is allowed to complete installation. Only accredited installers must be used to be eligible for the scheme (a list is available at www.solarpvgrants.co.uk).

## Further information

Further information on the DTI Major PV Demonstration Programme is available from the enquiry line on **0800 298 3978** or on the website www.solarpvgrants.co.uk

# EU programmes

Funding can be obtained through the European Union (EU) research and technology programmes, administered by the European Commission. Although there is no single programme for PV, the Sixth Framework Programme (FP6) offers some opportunities. Applications do need to be innovative to obtain funding, and must involve several partners from different countries.

Experience from previous applications to Framework programmes show that the application process is complex, time consuming and success is uncertain. Once funding is obtained, there are usually requirements for detailed project monitoring and reporting.

An example of a housing association securing EU funding is the Resurgence Programme at Peabody Trust. Details of which can be found in Section Four - Case Studies.

FP6 is to be organised differently to previous framework programmes and it is expected that responsibility for individual projects will be devolved from the European Commission to Networks of Excellence (NoEs) and Integrated Projects (IPs). The deadline for expressions of interest in setting up NoEs and IPs under FP6 has already passed (June 2002). However, it is expected that those setting up NoEs and IPs will be seeking additional partners in the future, and it is possible that housing associations could enter partnering arrangements through this route.

Unless a housing association is experienced in the process of applying for EU funding or has contact with other organisations involved in FP6 proposals, this is not a recommended funding route. Further details of the 6th framework programme may be seen at http://europa.eu.int/comm/research/fp6/

# Housing Corporation

This Guide does not go into detail on Housing Corporation funding since this is well understood by housing associations.

The eligibility criteria for costs covered by SHG appear not to exclude PV systems. Incentive arrangements agreed as part of a partnering approach to new build may permit shared savings in the event of the project being achieved under-budget, and that the housing association's share of such savings could be treated as a contribution to the cost of a PV system.

**Sustainability Multiplier**

A small uplift in SHG funding is available for achievement of the Good standard on the EcoHomes rating scheme (www.bre.co.uk/services/EcoHomes.html).

The rating process takes account of energy efficiency measures with maximum credits available in this category for schemes with zero carbon emissions. However the use of PV alone is unlikely to result in the achievement of a Good rating. The uplift may be a useful source of funding for energy and environmental improvements in general, it is unlikely to make a significant contribution to the cost of a PV installation.

# Filling the funding gap

*In Short*

Public grant funding for the purchase and installation of PV systems will not cover 100% of the costs. Other funding will need to be secured to fill the funding gap. 35% or more of the cost of the scheme.

A housing association could fill the funding gap directly, from reserves or other budgets as a demonstration of the commitment to renewable energy initiatives. If this is not possible, then need to look for other sources of funds, or for ways to ease the financing burden on the association. Three potential means of financing the 'gap' for PV systems are looked at in the following pages:

- Grant finance, grants from funds operated by electricity suppliers or from other corporate sponsors.
- Loans and equity, covering loans from banks and similar financial institutions that may have concessionary terms, investment funds that can take an equity stake in a suitable PV project, and leasing arrangments that may be viewed as a type of loan.
- Maximising revenues from electricity produced by the PV system.

Although these options are treated in isolation, it is likely that some combination of approaches will be necessary to close the funding gap. The opportunity to fund PV through these routes depends partly on the legal structure of the project and the companies or organisations taking part. This issue is described in more detail in a later section.

# Grant finance

## Renewable investment funds from electricity suppliers

*In Short*

Small amounts of grant finance available. Application should be fairly straightforward, and usually requires a social or community dimension. Not suited to long term or large scale financing.

Some electricity suppliers have small 'renewable energy investment funds' that could contribute grant funding to a PV project. Almost all electricity supply companies now offer 'green' or renewable energy, tariffs to their customers. These are generally divided into two types, 'fund' and 'supply'.

**Fund** tariffs work differently, and put the contributions from green tariff customers into an investment fund to develop renewable energy in the future. Some suppliers contribute to the fund to match customers' contributions, and all funds are administered according to a set of rules or guidelines, usually overseen by an advisory board.

**Supply** tariffs match the amount of electricity consumed by renewable electricity generated, over some appropriate averaging period (typically a year).

These renewable energy investment funds represent an opportunity for PV projects. Demonstrating local community and social benefits can be important in meeting some of the funds' selection criteria. These grants can be additional to DTI Demonstration Programme grants and, for small projects at least, could fully close the funding gap.

Funds are unlikely to be able to support a large scale rollout of PV in housing associations because the overall size of the funds are limited, and the terms of granting are likely to preclude large and on-going contributions to a single beneficiary. These funds are best suited to supporting relatively small pilot projects that test the operation of business and project structures designed to deliver more extensive, longer term PV projects.

## Which electricity suppliers have renewable invesment funds?

- **London Electricity** - 'Green Tariff' (supply + fund)
- **SWEB** – 'Green Tariff' (supply + fund)
- **Scottish Power and Manweb** – 'Green Energy' (fund)
- **SEEBOARD** - 'Go Green' (fund)
- **Scottish and Southern Energy** - 'RSPB Energy' (supply + fund)
- **TXU Energy** – 'Ecopower' (supply + fund) (now part of Powergen).

**London Electricity and SWEB**[3] are part of the same group, and their Green Tariff is administered as one. Funds are provided as grants, to projects that are assessed on the basis of relatively open criteria. As experience of administering grants grows, it is likely that the selection criteria will become tighter, although it is unlikely that this will preclude PV projects. There is an emphasis on supporting projects that bring value to local communities and PV projects are eligible. Single private household projects will not be supported, but this will not conflict with housing associations. The maximum grant size is approximately £50k, but most grants will be less than that. Grants may be available for feasibility studies as well as direct investment.

**ScottishPower and Manweb**[4] operate a Green Energy Trust that administers applications for grant finance through regular meetings. Selection criteria place an emphasis on achieving a positive impact on local communities, and achieving an educational outcome.
PV applications are not excluded, and housing associations are likely to be appropriate bodies to sponsor or coordinate applications. Grants may be awarded up to a maximum of 50% of the total cost, and up to a maximum of £20k per project. Guidelines for applications to the Trust, and a timetable of deadlines for application are made available on request.

**SEEBOARD** has not seen very much take up of their green tariff, and the investment fund is not large enough to support projects at the present time.

**Scottish and Southern Energy** have an arrangement with the RSPB whereby customers' contributions are channelled into an investment fund that RSPB manages. This investment fund is most likely to be used to purchase nature reserves and to install renewable energy equipment at premises owned and managed by the RSPB. It is therefore unlikely to be a suitable source of funds for housing association PV applications.

**The TXU Energy 'Ecopower'** investment fund[5] is one of the longer established funds, based on contributions from Ecopower customers plus matched funding from TXU. Although housing association PV projects have not been supported in the past they may be they supported in the future. Projects favoured are those that increase awareness of renewable energy and preferably have an educational element. Funding is provided for equipment (not labour or research), up to a maximum of £20k. The funding round is twice yearly.

[3]For further information on the London Electricity 'Green Power' and SWEB 'Green Electron' funds contact Adam Thomson, tel: 01454 452129,
E-mail Adam_Thompson@sweb.co.uk

[4]For further information on the ScottishPower and Manweb fund contact Gordon McGregor, tel: 0141 568 2000,
Email Gordon.McGregor@ScottishPower.plc.uk

[5]For further information on the TXU 'Ecopower' tariff contact Nadine Dooley, tel: 01473 554530,
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# The potential for corporate sponsorship

*In Short*

An uncertain funding route. Getting funding will depend on a firm relationship with, and a clear definition of benefits for, a corporate sponsor. No guarantees, and it could be time consuming. Unlikely to suit long term or large scale projects.

There is no quick or simple way to access grant finance from companies, and no guarantee that this approach will be successful. The following notes are intended to help housing associations wishing to be innovative in this area, to understand some of the issues.

Several large companies have invested in PV and other sustainable energy solutions as part of a general commitment to sustainability. In many cases such investment delivers value to the company in brand enhancement and public awareness of the company's corporate social responsibility agenda. Sainsbury's and BP are two examples.

It could be possible to form an alliance between one or more housing associations and a large company to access supplementary investment in PV. This approach offers opportunities to form 'winwin' linkages with corporate sponsors where the visibility of the PV investment, and therefore exposure and enhancement of the sponsor's brand, is maximised by installing it on the roofs of properties rather than, for example, on buildings such as corporate headquarters where it is relatively hidden from view.

The types of potential corporate sponsor could be very wide, including financial services, retailing, and local manufacturers.

As with other non-public grant finance, corporate sponsorship, if available, is unlikely to provide the long-term and significant finance necessary to make PV happen at a large scale. Furthermore nonpublic grant finance, wherever obtained, will not be automatically granted, sources are limited, and obtaining grants could be time consuming.

| What a corporate sponsor might want | Examples of how this might be achieved |
|---|---|
| The sponsor will want long term value from the project | Developing a long term relationship with a sponsor; being innovative in branding - eg meters displaying PV electricity production and consumption information to tenants |
| Association with an innovative, leading edge project | Focusing on innovative new build with other enviromental features rather than retro-fitting on exsiting stock |
| High profile, high media exposure | Developing a flagship project with the ability to attract media coverage during launch; think about a rolling programme of media exposure in the future |
| Links with the company's existing brand development and marketing objectives | Looking for links with eg supermarket loyalty schemes, energy company affinity deals etc. Consider the tenants demographic profile, ad potential sponsors that may wish to target these socio economic groups |
| Profiling as an exemplary local employer considering sustainable development and good relationship | Look for national companies for whom reputation is important; look for company headquaters or major manufacturing plants in the locality |

# Loan and equity finance

Once all grant and sponsorship opportunities are exhausted, it is necessary to close the gap on capital funding for a PV project through either or both:

- Using a housing association's internal capital budget allocation;
- Using external sources of capital (loan or equity).

A housing association may choose to apply for a loan and cover interest payments through an expenditure budget. Some universal principles will apply to any application for loan finance, for example relating to the credit rating of the applicant, the existence of unassigned assets to secure the loan, and the security of revenues to meet interest payments.

Equity finance involves a financial institution or other investor taking a risk by investing in a company or project, in the expectation of a large return from profits. Housing associations may not seek equity finance directly since they are regulated, non- profit businesses. To access equity finance a separate company or project structure would have to be created, and projected revenues would have to be sufficient to meet a required return on capital. This is described in more detail later in the guide.

## Institutions with environmental and social objectives

*In Short*

These financial institutions support sutainable energy projects and social housing, but interest rates will tend to be fairley standard. Loan repayments must be met from project revenues or housing association expenditure bugets. Attracting equity investment will need a robust business plan and strong revenues.

Because PV is seen to be an environmentally friendly technology, and because social housing has an obvious social benefit, certain financial institutions with environmental and social objectives will be receptive to applications for capital for PV projects, they may offer easier access to loan finance, or have investment funds designed to support such projects.
In addition some institutions may be able to offer preferential loan conditions. Financial institutions that target 'ethical investment' or which have social or environmental criteria may be valuable for a PV project for a variety of reasons (note however that not all of these will always be true for the financial institutions profiled in this guide):

- Lower interest rates on loans.
- Greater flexibility in loan repayment.
- Debt or equity finance ring-fenced for sustainable energy projects, increasing the likelihood of success.
- Fewer requirements for security on loans.
- Pro-environmental decision criteria leading to faster approvals.
- Valuable advice and assistance based on experience of similar projects, including access to grants from the same or other institutions.

There is limited capacity in the UK in loan or equity funds with specific renewable energy, environmental, social or similar objectives. The following three have a clearly expressed interest in investing in or lending to projects in this field. They are:

- The Co-operative Bank
- Triodos Bank
- The Ecology Building Society

All three institutions are willing to discuss with housing associations the possibilities of securing finance for PV installations that incorporate both environmental and social objectives. Information on these three institutions and contact details are contained in annex one. Other financial institutions may provide similar products and services to those identified in this guide and information gathered on these will be displayed on the website www.esd.co.uk/funding.

# Equipment leasing

*In Short*

Leasing means that someone else owns the equipment and rents it back to you, so you don't have to find the capital at the start of the project. A leasing company will be concerned with your ability to keep up rental payments, and lease arrangements must be approached with caution.

As an alternative to purchasing PV capital equipment directly, leasing, sometimes called asset financing, may have benefits for housing associations seeking to develop PV schemes. Leasing may be thought of as a form of loan finance. Purchasing entails a one-off capital expense, from which point the housing association owns the asset, in this case the PV system, outright. In contrast leasing involves ownership of the asset by financing company (the lessor), and use of the asset by the (the lessee) in return for regular 'rental' payments. There are many different forms of lease arrangement, and the basic options are briefly described here.

**Some advantages.** The principal advantage of leasing is that the lessee (housing association) has use of the asset without any initial capital outlay, so reducing the amount of working capital required. This will be important if the association's capital expenditure budget is limited or if its borrowings are already high. Spreading the cost of the asset over time reduces pressure on cash flow, and since some lease arrangements do not count as debt, the lessee's credit options can be preserved. Lease payments are usually a flat monthly charge, fixed in advance, which can make financial planning easier.

**Some disadvantages.** It is important to consider that, whilst lease arrangements are useful to ease cash flow and capital allocation problems, the final price paid for ownership or use of an asset will generally be higher through leasing than through an outright purchase. This reflects the interest on capital plus the risk premium that the lessor will charge. However, this calculation must also take account of the interest that would have to be paid on a loan in the event of an outright purchase, and the internal 'cost of capital' of the housing association. Leasing can cost less than some other forms of financing. Depending on the nature of the assets being leased, and the credit rating of the lessee, the lessor may need additional financial guarantees to reduce the risk of default on rental payments. Lastly it can be difficult or expensive to withdraw from a lease before the term expires.

**Terminology.** Various terminology is used in leasing. Some of the principal distinctions are given here.

'Lease purchase' arrangements enable the lessor to take title over (own) the asset at the end of the leasing period. 'Lease rental' arrangements preclude the lessor taking title, but various options exist after the end of the initial lease period.

There are broadly two types of lease rental arrangement – a Finance Lease and an Operating Lease.

In **finance leasing** the whole value of the asset is recovered over the term (the life of the lease contract), with various end-of-term options; the lessee can continue to use the asset for a 'peppercorn rental', the lease can be extended by negotiation, or the asset can be sold to an unconnected third party, with the lessee enjoying some of the value of the sale.

An **operating lease** usually has a shorter time frame than a finance lease, and works like a simple rental. It is suitable when a lessee only wishes to have use of an asset for a limited period, less than its full life. At the term of the lease the lessor would expect to sell the asset second hand, or continue to lease it to another lessee.

Lease arrangements can be entered into before the asset is purchased (sometimes called direct leasing), with the lessee requesting the equipment supplier to sell the asset direct to the leasing company. Alternatively a lessee can lease finance an asset it already owns (sometimes called purchase leaseback) by selling the asset to a leasing company and then renting the use of the asset to a leasing company and then renting the use of the asset.

Leasing arrangements are very common for business assets that are not fixed structures, such as vehicles and computers. In the event of a default by the lessee, the assets may be repossessed by the leasing company and their value recovered by selling them second hand. Whilst PV systems are more specialised, and there is less understanding of their characteristics amongst leasing companies, leasing remains a very viable route for housing associations to consider.

Some key issues to address in exploring leasing arrangements are as follows:

Leasing' is a term that can cover a wide variety of arrangements, and given the flexible nature of the contracts it is important to spend some time exploring options through a reputable financing company or broker. Some key issues to address in exploring leasing arrangements are as follows:

- **Interaction with government grants.**
  The current DTI capital grants for PV installations, up to 65% for housing associations, do not prevent housing associations from entering lease arrangements. This makes it possible for the PV assets to be owned by a third party (the lessor), in order to assist the financing of the remaining 35% (or more) of the total capital cost.

- **Fixed vs. transportable asset.**
  PV panels may be regarded as fixed if they are built in to the structure of a house roof, or transportable if they are retrofitted to a roof ('bolted on'). In theory, roof-integrated systems cannot be lease financed since they cannot be readily removed.In practice many fixed assets, such as buried district heating pipe networks, double glazing etc, are successfully lease financed, with rental payments representing an 'access charge'. In these cases the leasing company, in assessing risk, will be less concerned with the theoretical second hand value of the assets, and more concerned with the financial strength (balance sheet) of the lessee, and the lessee's ability to pay rental charges reliably for the duration of the contract.

- **When is a fixed asset fixed?**
  In a typical roof integrated PV system, the bulk of the capital cost is accounted for by the individual PV modules that are fixed in a supporting framework. The framework is designed to permit the easy removal and replacement of modules, making it likely that they would be treated as movable assets. Furthermore there is a second hand market for PV panels that are still 'in warranty', and the long power production warranties (up to 20 years) that are now available make it viable for a lessor to recover value from an asset in the event of the lessee's default. These facts may make it easier to negotiate traditional lease arrangements for PV modules.

- **Novel technology.**
  PV systems are still at an early stage of development, and there is relatively little experience of their large-scale application or long-term performance in this country. This need not prevent the use of lease financing however, since a typical lease term will be significantly shorter (perhaps five years) than the design life of the system (perhaps 20 years).

- **One big asset, or many small ones?**
  A typical PV scheme might involve the installation of PV modules on the roofs of several houses. This distribution of the modules should allow treating the overall system as being treated as a single asset and lease financing it in this way.

■ **Beware unfavourable terms in leasing contracts.** It is important to consider the full life of the asset when negotiating leasing arrangements. There have been examples (not relating to PV) of lessees being 'held to ransom' by lessors at the end of the initial lease period, especially when 'fixed' assets are involved, through unfairly high 'run-on' rental charges, or by imposing unreasonable conditions for the return of the asset to the lessor. Notice periods for run-on rental must be observed, and unnecessarily onerous maintenance requirements should be avoided. End of lease conditions must be clearly agreed before the lease contract is entered.

# Maximising the revenue from PV electricity production

*In Short*

'Net metering' is where the tenant gets paid the same for exported PV electricity as they pay for electricity taken from grid, and gives the highest value to PV production. If that's not available however, it may be viable to sell ROCs to get higher value for electricity from PV schemes, as long as the scheme is big, metering is in place, and an electricity supply company is involved. The ROCs route is not worth pursuing for small schemes though.

The electrical output from a PV scheme may be used within the building, and offset the cost of electricity that would otherwise have been purchased. Any electricity produced and not consumed can also be 'exported' to the distribution network.

Generally such exported electricity is of little value, perhaps less than 2p/kWh, unless it is exported under the terms of a 'net metering' deal with an electricity supplier, in which case the PV system owner can be effectively 'paid' up to the full retail value per unit, perhaps 7p/kWh. This type of arrangement retains the value of PV production, and represents the best return possible on the output of a PV scheme.

The best known, nationally available net metering arrangement is the SolarNet arrangement from TXU, but other companies

may be prepared to offer similar arrangements at a local level. If a net metering deal is not available, for example if the scheme is large and exports much more than the building consumes, then it may be possible to extract additional value by treating the PV electricity as a commodity that can be sold in the context of the UK's current renewable energy support mechanism, the Renewables Obligation (RO).

The structure of the UK electricity market and associated legislation means that renewable electricity is more valuable than non-renewable electricity. In order to access this value, electricity must be exported from the generation site (even if this 'export' is effectively a paper exercise only), and a contractual relationship must be formed with an electricity supply company. These arrangements are explored more fully in annex two.

Renewable electricity generated at a small scale has a market value defined by four components:

- Energy (the selling price of the exported electricity itself – but note that renewable electricity may, depending on the circumstances in which it is contracted and metered, have a very low value in the physical electricity market caused by the uncertainty (or intermittency or time of day) of the generation and the financial penalties imposed when generation on a half-hourly basis is either greater or less than a contracted amount);

- Embedded benefits (essentially the value of the avoided electricity losses because electricity produced and consumed locally does not pass through the high voltage electricity transmission system);

- LECs (the Levy Exemption Certificate, or the value to renewable electricity of being exempted from the Climate Change Levy (CCL), a general energy tax levied on non-renewable electricity or businesses at the rate of £4.30/MWh);

- ROCs (Renewables Obligation Certificates, which have a value due to the existence of the Renewables Obligation).

Of these components of potential value, the most significant is the Renewables Obligation Certificate (ROC) value.

The Renewables Obligation obliges electricity suppliers to obtain an increasing percentage of their total sales of electricity from renewable energy sources. This is achieved by suppliers purchasing ROCs. There are currently not enough ROCs to go round, and this situation will prevail for some years. This means that ROCs awarded to a PV system could command a high price in the market.

Annex Two contains details of how the RO works and how PV systems would need to be managed in order to benefit from the arrangements. In brief:

- PV systems need to be relatively large in order to gain benefit from the RO mechanism – about 15kWp minimum.

- A housing association or PV project company will need to register with Ofgem (the energy regulator) and an electricity supplier in order to get ROCs.

- There is significant administrative work to do (and costs to absorb) in obtaining and administering ROCs before the financial benefit can be realised.

- Exploiting the RO mechanism probably best suits groups of larger projects, where administrative costs can be diluted and expertise can be bought in to maximise the opportunty.

- Because the RO is a relatively new piece of legislation, and because government is keeping the operation of the electricity market under constant review, the rules governing the connection of small scale generators, which can affect their access to ROCs, may change in the future.

# SECTION FOUR
## Case Studies

*This section gives details of 5 case studies. These cover a variety of different PV projects from new build to retro fit and urban to rural situations.*

## Case Study 1 – Green Lane, Clifton, Nottingham

### Nottingham Community Housing Association

*In Short*

Green Lane, Nottingham Community Housing Association: A new build housing scheme in an urban area.

### Background

Nottingham Community Housing Association (NCHA) has had an active energy and environmental programme for a number of years. When funding was first announced to install PV on groups of domestic properties under the PV Domestic Field Trial, NCHA's Energy and Environment Officer met with consultants ESD to develop a project proposal.

The proposed project fitted in with NCHA's desire to be associated with sustainable energy systems and new technologies and it's commitment to energy efficiency for tenants. By undertaking the project NCHA wished to participate in the development of sustainable energy, promote NCHA as a pioneer in new domestic energy technologies and promote NCHA's commitment to Energy Services.
The project that was originally proposed and approved for funding was eventually cancelled and the PV funding moved to a completely different site. This was a fairly common occurrence with PV projects under the old funding arrangements. Most PV projects require additional funding to be obtained from outside the normal building budget. With infrequent calls to tender for PV funding this often led to difficulties in matching the timetable of the funding application to the build timetable.
By the time the original housing project had obtaining funding for PV, difficulties had cropped up due to unexpected ground conditions and the project was cancelled. Fortunately it proved possible to transfer the PV funding to the Green Lane site. However the design for the houses at Green Lane was fairly well advanced and the PV had to fit on to the existing design without any scope for modifying the roof designs to suit. Fortunately it is a fairly good fit although it does involve some slightly awkwardly shaped arrays.

The quarterly round for the Major PV Demonstration Programme should alleviate this sort of problem making it easier to match the build programme and funding availability.
The only complication with the Major PV Demonstration Programme is the requirement to have the system installed within one year of funding being granted, this may again mean that PV is often added to an existing design rather than being incorporated into the design as it is developed.

## The Scheme

The Green Lane site is a complex of 2 bed semi-detached bungalows providing housing for low income tenants, including elderly and disabled people, within Nottingham. A total of 33kWp is installed, built into the roofs of 22 of the houses, an average of 1.5kWp per house. The arrays are integrated into the roof using PV Systems Roof Integrated System and the modules are BP Solarex Laminates.

A number of minor problems were experienced during installation which led to unexpected costs. The main cause of problems was the tight programme for building the houses with phased construction and handover. Delays to the building programme caused disruption to the PV installation. The phased construction and handover for the buildings meant that the PV system could not be installed in one go, but required a number of visits. Between installation phases the modules had to be stored on site. This involved extra insurance, double handling of modules into and out of a site store and an increased risk of breakages. Building regulations approval was relatively easy to obtain. However planning permission was less straight forward and pressure had to be placed on the local planning officer to gain approval of the system without wider delegated powers.

## Funding

The total project cost was £268,000. £238,000 of this was obtained from the DTI under the PV Domestic Field Trial. The remaining £30,000 was contributed by Powergen under the Energy Efficiency Commitment (EEC) programme. NCHA are pleased with the project, all of the project aims have been achieved and the tenants are happy with their reduced energy bills.

## Comment

The most important advice from NCHA to others planning a PV project is *"to plan the PV for a building project that has not advanced too far into the design phase. Then get all partners involved in discussions and pricing prior to submitting the bid, including the main building contractor, if known at that stage."*

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PV system supply and installation by:
PVSystem
PV consultancy by: ESD

# Case Study 2 – King's Cross PV Schemes, King's Cross, Islington, London

## Peabody Trust

*In Short*

King's Cross PV Schemes, PeabodyTrust: Two schemes for blocks of flats in London, one new build and one refurbishment. Integration of PV into both blocks is planned with funding agreed under the Major PV Demonstration Programme and from the European Commission.

### Background

The Peabody Trust is one of London's largest housing associations and is proud of its award-winning track record and reputation for quality and innovation. Peabody has pioneered the use of different techniques to encourage sustainable, environmentally-friendly building processes and aims to lead the way in showing how sustainability can be incorporated into existing housing estates. Peabody was the first UK housing association to have PV on its properties and is now working on a number of PV projects with a total projected generating capacity of 650kWp, the largest PV portfolio in the UK.

Peabody launched its comprehensive Sustainability Strategy in 2002 with a set of aims that they wish to achieve by 2010 including a specific aim that they produce enough clean electricity per annum to power 700 average UK homes. In 2000 a study by engineers Whitby Bird showed that installing photovoltaic panels on all Peabody estates would reduce carbon dioxide emissions by 12,600 tonnes and produce 20 times the current UK total of solar energy.

Peabody's involvement in PV started in May 1997 when PV panels were mounted by Greenpeace on the roofs of three Peabody Trust terraced homes in Silvertown, Docklands. Following on from that Peabody went on to incorporate PV into a number of innovative projects including the BedZED development in the London Borough of Sutton where 109kWp of PV has been installed feeding 82 properties. 25% of the funding for this project was obtained under the DTI PV field trial while another 35% was obtained from the European Commission. The Trust is also planning to incorporate PVs on its most ambitious new-build development to date; a 10 acre mixed tenure development called Ladbroke Green in West London.

### The Scheme

In 2001 Peabody secured over half a million pounds from the European Commission under the RESURGENCE project to fund the research, development and installation of photovoltaic panels on a number of its existing estates. The RESURGENCE project involves 17 partners installing a total of 1.3MWp of PV in 5 European countries: the UK, Denmark, Germany, the Netherlands and Switzerland. RESURGENCE aims to increase the use of photovoltaic technology to produce clean electricity as well as disseminating social awareness. As part of this project Peabody is planning to install 350kWp of PV over the next two years.

The PV installations will be split between 4 locations in the UK: Kings Cross, Whitecross, Winton House scheme and possibly one other estate, yet to be confirmed. Under the RESURGENCE project two PV schemes are being planned in the Kings Cross area. The first is at Priors Estate where a 4/5 storey block of flats is being refurbished including re-roofing and conversion from a flat roof to a mono-pitch roof. During refurbishment, it is intended that 157kWp of PV will be fitted on the roof by Solar Century using a steel standing seam metal roofwith thin film amorphous silicon PV modules bonded into each valley. The power generated will be fed into the local electricity network and Peabody will receive an income from the sale of the electricity. This income will be used to regain some of the capital expenditure involved in building the systems.

Photo courtesy of Solar Century

## Funding

26% of the required funding is being provided by the EC under the RESURGENCE project and 44% has been obtained from the DTI under the Major PV Demonstration programme. The remaining 27% will be provided by Peabody.

The second project in the Kings Cross area is the Winton School Housing Scheme. This is a new build scheme for a 5/6 storey block of 23 affordable flats for rent. It is on a greenfield site within an ex-council estate. A 49kWp PV system using BP Solar monocrystalline modules will be mounted on the shallow mono-pitch roof. Again the power generated will be fed into the local electricity network and Peabody will receive an income from the sale of the electricity.

The majority of the funding for this project (65%) was obtained from the DTI under the Major PV Demonstration Programme, in addition to funding under the EC RESURGENCE project.

## Comment

Neither project has encountered planning permission problems or objections from the local community relating to the PV.

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www.resurgence.info
PV Consultancy: Whitby Bird

# Case Study 3 – Burneside Energy Efficiency Demonstration, Burneside, South Lakes, Cumbria

## New Progress Housing Association

*In Short*

Burneside Energy Efficiency Demonstration, New Progress Housing Association: A retro fit project where PV and energy efficiency measures were applied to old mill workers cottages in rural Cumbria with funding under a local regeneration grant.

## Background

In 1999 New Progress Housing Association (NPHA) took over the ownership of 70 properties in the small rural village of Burneside, north of Kendal in the Lake District. For many years the properties had provided housing for the workers of the paper mill in the village. Unfortunately the properties had been neglected over the years, had fallen into disrepair, and were in need of major investment. When NPHA agreed to take over the properties South Lakeland District Council approached them to run a pilot scheme, initially for ten properties, in energy efficiency and renewable energy in the village. NPHA in partnership with South Lakeland wanted to promote energy efficiency within the community and generate interest to drive home the impacts and benefits of energy efficiency both in terms of the environment and towards the tenants. They wanted to use tried and tested technologies to demonstrate the financial and environmental benefits and to improve tenants' quality of life. Energy efficiency measures included provision of water-butts, additional loft insulation (using local sheep's wool), re-roofing, solar thermal hot water systems, photovoltaic panels and double glazing.

The provision of PV systems was an important part of the scheme. NPHA had heard of PV being used successfully by other housing associations and wished to see what lessons they could learn, evaluate how they could move forward with solar energy and create confidence in solar energy.

## The scheme

The 10 properties are a mixture of 2/3 storey terraced houses, bungalows, and semidetached houses, with the majority being solid walled dry stone construction. A total of 8.5kWp of PV has been installed, approximately 850Wp per property. The PV modules are integrated on the roof and fit straight onto the rafters in place of the conventional slate roofs.

The performance of the PV systems and the other energy efficiency measures is being monitored. After 6 months of monitoring the project is producing the results expected and the tenants are happy with their improved properties. They are generally unaware of the operation of the PV systems although hopefully appreciating the savings to their electricity bills.

The installation of the PV systems caused no real problems. Installation was carried out by a specialist contractor and there were no delays, possibly because the work was carried out during late October and it was essential the work was completed on time. NPHA would suggest that it would be better to carry out work during the summer months if possible.

Planning issues caused no problems either. NPHA worked closely with the local planning office right from the outset. As the PV units did not protrude much, no planning permission was required. Consultation with the local community addressed the issues people raised as concerns.

## Funding

South Lakeland District Council provided the majority of the funds (75%) for the refurbishment and energy efficiency measures, including PV, under their regeneration grant. The final bill per property was roughly £20,000. Following the success of the Burnside PV project, New Progress is planning further PV schemes. One scheme in the pipeline is a refurbishment project of some post-war prefabricated properties (Airey Houses) to improve energy efficiency; a crucial part of the refurbishment will involve PV.

## Comment

The most important advice from the Programme Maintenance Surveyor is to consult tenants, allowing sufficient time to do so fully. Due to a funding deadline all installation work had to be completed to a tight deadline, thus there was less time to consult tenants than was originally planned. With more time for consultation the selection process could have been improved, for example targeting properties occupied by families and avoiding under-occupied properties. There would also have been time to educate tenants better, ensuring they fully understood the energy efficiency measures and the PV system.

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PV system supply and installation by: PV Systems

# Case Study 4 – Dicketts Road Flats PV Scheme, Corsham, North Wiltshire

### Westlea Housing Association

*In Short*

Dicketts Road Flats PV Scheme, Westlea Housing Association: Another retro fit project where PV will be fitted to the roof of a block of flats during re-roofing using funds from the Major PV Demonstration Programme.

## Background

Westlea Housing Association in Wiltshire owns a 3 storey block of flats which is in need of re-roofing due to failure of the roofing felt. Westlea had been interested in the possibilities offered by PV for some years but had been unable to afford installation of a system. When the Major PV Demonstration Programme was announced at the same time as they were planning re-roofing the Dicketts Road flats, they took the opportunity to apply for a grant to provide the majority of the extra funds needed to cover the south side of the roof in PV rather than the original tiles.

## Funding

Their application was successful in obtaining a grant for 55% of the cost of installing the system. The remaining costs will come from the current budget provision for energy conservation and costs offset from the re-roofing budget.

## The Scheme

Re-roofing will be carried out in early 2003 and will incorporate a 30kWp PV array integrated into the roof covering on the south side while ordinary tiles are installed on the rest of the roof. The PV array will be filled using the RIS (roof integrated system) supplied by PV Systems. Monocrystalline PV modules (type BP 585) will fit into an aluminium framing system. PV power will be supplied to 16 flats within the block, each of which will be supplied by 1.87kWp of PV.

Westlea were keen to undertake the project in order:

- to provide tenants with direct energy cost savings
- to raise tenant awareness of renewable energy across the Association
- to learn from this pilot for possible future projects
- to reinforce their Environmental Policy (reducing CO2)
- to provide good PR for the organisation
- to explore innovative solutions to reducing tenants energy bills
- to educate and inform others in the local area on renewables via links to schools and the local community.

## Comment

The project was initiated and championed by the Westlea Housing Association, Building Services Manager. His advice to others considering PV schemes is: *"You need to have a 'champion' to move things forward but it is important to get the rest of the organisation, Senior Management, the Board and the tenants behind the project as early as possible.Payback is beyond project funding 'norms' with current costs so it is necessary to be clear that the reasons for doing schemes are not financial but for other issues such as environmental issues, tenant savings, PR and innovation/knowledge drivers. Consider overall project cost reductions by looking at the 'opportunity cost' of linking PV schemes to other planned maintenance work such as reroofing, or other work requiring scaffolding such as major external redecorations, rewindowing, external cladding, etc."*

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PV Consultancy by ESD
PV system supply and installation by: PV Systems

# Case Study 5 – Millennium Mews, Liverpool

## Background

Riverside Housing commissioned the Millennium Mews project in Liverpool to develop and implement a more sustainable house type. The project has been undertaken in two phases. Phase 1 included 14 dwellings which were a mix of houses and cottages, both semidetached and terraced. It was completed in 1999 and is home to a mixed community of families with children, single people and older households.

In Phase 1 the project team made the first use in the UK of integrated photovoltaic roof tiles. While the photovoltaic technology was installed as part of the construction process, it was not properly connected to the grid until early 2002.

Solar systems were selected as the energy generating technology most likely to meet two of the key project aims which were to:

- Reduce the cost of living for tenants
- Minimise CO2 emissions.

The project also set out to:

- Identify management issues for energy-generating systems in social housing
- Develop design guidance on roof-top integration.

## The Scheme

The Millennium Mews project team wanted to explore the integration of PV cells as part of the roof construction, rather than as a bolt-on addition. It was also interested in how to integrate PV:

- Into the whole operation of the home, rather than as an isolated innovation
- Within a broader framework of energy generation.

Due to cost only one house at Millennium Mews was equipped with PV technology. The PV array selected was 16m2 which is estimated to provide 835 kWh of electricity per year, enough to satisfy a quarter of the household's annual demand for mains electricity. It cost £13,000 in 1998.

The selection and installation of the system was straightforward however its connection to the National Grid was very delayed due to problems with introducing innovative technology and processes. It took two years to get agreement from the utility company Manweb to connect the system. Riverside presumed that purchase of the PV system would include connection to the grid which subsequently proved not to be the case. Efforts to involve the supplier and the utility company in resolving the problem were time consuming and were not undertaken with any sense of partnership. PVs therefore need to be recognised as being a hybrid product – they are not simply an element of construction but also a component of the electricity industry. The installation at Millennium Mews uses PV roof tiles. It comprises two 700 watt PV arrays, each with two 'strings' of ten glazed tiles. The coursing of the tiles gives a much smoother profile on the roof than bolt-on framed panels, and overall the visual impact is minimal. It was fitted to a roof of lightweight timber trusses – no special structural provision was required.

## Comment

Generally Millennium Mews is very popular and tenant satisfaction is high. More than half cited warmth as the single best thing about their dwelling. While the project team wrote and issued a 'move-in manual' to help tenants understand how the house was meant to 'work', it did not anticipate faults with the equipment or advise on how to decide whether equipment was faulty. While it became clear that some problems were a result of faulty equipment many were due to tenants being confused by the controller display.

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# REFERENCES

## Organisations and sources of advice

***Nottingham Energy Partnership***
www.nottenergy.com

Department of Trade and Industry (DTI)
***renewable energy programme:***
www.DTI.gov.uk/renewable/

The DTI's ***major PV demonstration programme:*** www.solarpvgrants.co.uk
Enquiry line: 0800 298 3978

For all other ***Energy Saving Trust programmes:*** www.est.co.uk/

For the ***Generating Solar Homes*** project
www.sustainablehomes.co.uk
e-mail to
andreagriffithsjames@nottenergy.com or
Telephone: 07876 356 559

***Sustainable Homes project***
www.sustainablehomes.co.uk/
Telephone: 020 8973 0429

***British Photovoltaic Association***
www.pv-uk.org.uk

***Energy for Sustainable Development Ltd***
(ESD) www.esd.co.uk
Telephone: 01225 812102

# Useful PV documents

***Photovoltaics in buildings: A Design Guide***. Max Fordham & Partners / Feilden Clegg Architects, March 1999. Reference: S/P2/00282/REP, available from www.DTI.gov.uk/renewable/

***Photovoltaics in buildings: A survey of design tools***. Studio E Architects Ltd, 1997. Reference: S/P2/00289/REP, available from www.DTI.gov.uk/renewable/

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***Community involvement in renewable energy projects: A guide for community groups.*** Rubicon Link. Reference K/GE/00014/36/REP, available from www.DTI.gov.uk/renewable/

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***PV in Buildings: A guide to installation of PV Systems***. Building Research Establishment (BRE) et al Reference F/P2/00355/Rep1, available from www.DTI.gov.uk/renewable/

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***Photovoltaics in Buildings: Safety and the CDM Regulations.*** Building Services Research and Information Association (BSRIA), 2000. Reference S/P2/00313/REP, available from www.DTI.gov.uk/renewable/

***Photovoltaics in Buildings: BIPV Projects.*** Studio E Architects, 2000. Reference S/P2/00328/REP, available from www.DTI.gov.uk/renewable/

***Planning Policy Guidance Note 22: Renewable Energy - Annex on Photovoltaics***. Available from the Office of the Deputy Prime Minister, www.planning.odpm.gov.uk/ppg/ppg22/annex

# Annex 1 – Financial institutions with social and environmental lending and investing criteria

## THE CO-OPERATIVE BANK

### Background

The Co-operative Bank is the only UK Clearing Bank to take a stand stating clearly and publicly what it supports as an organisation, and how it conducts its business. To guide its investment decisions, it has formulated an Ethical Policy which states how customers money will and will not be invested. The Co-operative Bank is committed to promoting long-term sustainable development, not only within the organisation, but also in the wider community as a whole. Subsequently, sustainable business can now benefit from a preferential banking arrangement with the bank.

### Services

The Co-operative Bank is able to offer preferential banking terms to environmental businesses and organisations, including lower interest rates on loans and overdrafts, reduced bank charges and special rates on funds deposited. Loans at preferential rates may be offered for environmental projects. The bank also provides a leasing arrangement titled 'Green Lease' that could be adapted to PV. Leasing generally depends on the ability of the lender to take title over the equipment, thus the way the PV modules are integrated in the building becomes important. If the modules are fully integrated into the fabric of the property they are regarded as a 'fixture & fitting', ownership rests with the property owner, and leasing can be precluded. If the modules are effectively 'bolted on' or fixed to a removable frame, then they are classed as movable equipment and this makes it possible for them to be owned by the lender and leased out. However see the more extensive treatment of leasing options in the main guide.

These preferential terms and financing arrangements are ideally suited to the purchase of PV systems and one of the bank's specialised staff would be happy to arrange the most appropriate and cost effective solution.
Due to the individual nature of PV projects, each development is treated on a case-by-case basis.

The bank also has a track record in financing activities in the social housing sector, for example they currently have an arrangement which offers housing associations and local authorities access to low cost funding to finance Affordable Warmth programmes and other energy efficiency initiatives.

### Further information

To discuss projects and finance opportunities,

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## TRIODOS BANK

### Background

Triodos Bank was founded in The Netherlands in 1980 to invest exclusively in organisations with social, environmental and cultural objectives.

### Services

A large proportion of Triodos Bank's customers are from social housing and renewable energy sectors, and a full range of banking services are available including current accounts, overdraft and loan facilities. Loans range from £20K to £10 million, with repayment periods up to 25 years. All lending needs to be fully secured and is usually taken as a mortgage over a property or in the form of personal guarantees. The impact of PV installations on the value of a property would be taken into account.

Triodos Bank works closely with each of its customers to find the most effective solutions for its financing needs and each project is assessed on an individual basis. A housing association applying for loan finance would need to submit a business plan demonstrating how repayments are to be made (for example from project or income), information about the organisation, the key people involved, past and forecast financial accounts and other points. Individual guidance is available to help provide the kind of information needed in order to assess an application.

The timescale for approval of funding applications can be short. Loans are assessed on a weekly basis. If all the required information is available from the applicant, then the process can take as little as one week.

### Further information

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Or visit: www.triodos.co.uk

## THE ECOLOGY BUILDING SOCIETY

### Background

The Ecology is a mutual building society dedicated to improving the environment by promoting sustainable housing and sustainable communities.

### Services

The Ecology Building Society can lend against PV projects on a "secured loan" basis, through a mortgage. This would involve the Society taking security in the form of rights over specific properties to an equivalent value to the loan. The potential distribution of PV over a large number of buildings would not affect the loan conditions, since security is taken over the properties mortgaged.

Application approval can be as quick as four or five weeks. On applying, a housing association would need to provide the last three years accounts, the annual report, and a detailed proposal for the project.

### Further information

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# Annex 2 - The Renewables Obligation: support for PV generation

## RO principles

The Renewables Obligation Order came into force in April 2002, requiring licensed electricity suppliers to demonstrate that they are supplying a growing percentage of total electricity sales from renewable sources, from a base of about 5% in 2003 to about 10% in 2010.

The suppliers' means of evidencing their compliance with the Order is the Renewables Obligation Certificate (ROC), issued monthly by Ofgem to qualifying renewable energy generators for each MWh of electricity produced. Renewable generators may sell ROCs to suppliers or to third parties at the market rate, defined by the normal forces of supply and demand. Suppliers who fail to comply with the Obligation by submitting ROCs may 'buy out' their obligation at a rate of £30 per MWh (effectively a penalty), and this sum is often taken as a benchmark of market price of ROCs. Other effects mean that ROC price may vary widely from this sum.

## The need for caution

The RO was not designed as a support mechanism for PV installations or other micro generators. The RO is suited to the market-based support of large scale, least cost renewable energy. The structure of the RO means that transaction costs are largely fixed, and therefore are particularly disadvantageous to small generators.

### Costs and benefits of the RO to small scale PV generators

There is no reason in principle why PV generators should not benefit from the RO through the issue of ROCs. Whilst under certain circumstances it may be worth seeking ROC support for PV, this needs to be carefully assessed. For individual PV systems the financial rewards are relatively small compared to the cost of installation, and the administrative burden is high.

The financial benefit is relatively easy to estimate. Assuming that 1,500 homes in the social housing sector are each equipped with a 2 kW peak system (delivering approximately 1.5MWh/year energy output each), the total energy output would be 2,250MWh/year (2.25GWh/year). If a five year contract can be struck for the sale of electricity, ROCs and associated benefits at a rate of £40/MWh, then the total revenue to the combined project would be some £90,000/year, or £450,000 over five years.

Revenue would of course continue beyond the five year point, but at an uncertain level, depending on ROC market prices.

On the cost side of the equation, excluding capital cost, is the administrative burden of taking part in the RO mechanism. Each installation has to be accredited with Ofgem, and must submit accurate monthly returns showing the amount of electricity produced. Each renewable generating station must be adequately metered. The ROCs, when issued, must be held in an account on the ROC registry operated by Ofgem. A buyer of ROCs must be found, and when a sale is agreed the ROCs must be transferred from the generator to the buyer account in the registry. It is easy to see how the costs of these transactions will easily outweigh any financial value the ROCs may have, especially when small generators may only receive one or two ROCs per month (i.e. a revenue of between £40 and £80 per month). If individual PV projects can be aggregated for the purposes of routine administration through a central body, then larger volumes of electricity will be produced and greater financial flows will ensue, hence diluting the transaction costs.

## Threshold energy output in the RO, and definition of a Renewable Generating Station

The minimum size of generating station is defined by the RO Order. Any generating station generating less than 0.5 MWh in any one month is ineligible for the issue of a ROC in that month. An individual 2kW peak system will not produce this output, whereas a system of about 12 or 15kWp is likely to. Systems must therefore be constructed to reach this minimum size in order to benefit from the RO.

ROCs may only be issued to a registered Renewable Generating Station. Provisional legal advice from Ofgem suggests that a number of small, widely dispersed but commonly-owned generators would not constitute such a Generating Station within the meaning of the Order. This ruling, which could possibly be revised in the future, prevents a housing association from grouping together a large number of small, dispersed systems in order to get RO benefits.

Thus in order to benefit from the RO, PV generators will need to be constructed with an installed capacity of 12 to 15kWp, or possibly comprise an installation of this total capacity made up of a number of smaller installations on adjacent buildings, if these can be electrically linked through a single metering point, and probably be installed simultaneously under a single planning application. The definition of a Renewable Generating Station would have to be cleared with Ofgem on a case-by-case basis, but does represent a route to obtaining ROC value.

At the Peabody Trust's BedZED development, PV cells totalling 109 kWp are linked to enable ROCs to be gained.

## Rounding effects in issuing ROCs

When Ofgem issues ROCs to generators, MWh outputs are rounded up. This seems to present an opportunity to small generators to benefit by gaining more ROCs, by sizing a system to produce just over half a MWh per month. However any output between 0.5 and 1.49 will have no extra financial reward. An output of 1.5MWh will be awarded two ROCs. Clearly this rounding is insignificant for large installations, but can have a distorting effect at the micro scale.

Whilst it would appear that there is benefit to be gained through this route, in fact the total amount of financial value from ROCs is still small relative to the cost of installation, and must be seen in this context.

## Evolution of the RO

It is unlikely that the RO will evolve to make conditions more favourable to micro generators. Any changes to make the mechanism more valuable or workable for micro scale generators would probably require changes to the primary legislation, and this is not foreseen.

# NOTES

**Photographs courtesy of**

Phil Angus
Bree Day Partnership
New Progress Housing Association
Nottingham Community Housing Association
Peabody Trust
Solar Century
Westlea Housing Association

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