Introduction to Feed-in Tariffs

NHBC Foundation

Housing research in partnership with BRE Trust

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January 2011

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Acknowledgements

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NF23
Published by IHS BRE Press on behalf of the NHBC Foundation
January 2011
ISBN 978-1-84806-165-1

FOREWORD

The 2008 Climate Change Act set a legally binding target to reduce greenhouse gas emissions by at least 80% by 2050 and 34% by 2020. These are very demanding targets which will only be met by a concerted effort in all sectors and on all fronts. This will require a step-change in the energy/carbon performance of most homes and buildings in the UK. One of the ways in which this can be achieved is through the extensive application of small-scale renewable technologies which can make a significant contribution to the emissions reductions.

Small-scale renewable technologies depend on individual households or small communities installing local energy generation capacity to provide their home or homes with heat and/or power. A range of different options is available, including photovoltaics, wind turbines, and domestic combined heat and power (CHP) systems. One important factor for those considering installing such technologies is the scope for offsetting some of the costs and indeed generating future income through re-selling surplus energy. This is where Feed-in Tariffs come in.

Introduced through legislation in April 2010, Feed-in Tariffs provide significant financial encouragement to the uptake of renewable technologies. However, the scheme is not yet widely understood. Intended particularly for the smaller house builders and housing associations, this guide explains what Feed-in Tariffs are and how they work. Using some worked examples, it also explores the financial returns that can be expected.

The guide looks at experience of other countries which have had similar policies in place for some years. Of particular interest is the effect that a decade of Feed-in Tariffs have had in Germany which currently accounts for 47% of the world's total installed capacity and where it is estimated that its renewables industry now employs 300 000 people.

As we head towards the zero carbon future for new homes, and indeed begin to address the huge challenge of improving the energy efficiency of our existing stock, small-scale renewable technologies will play an important role. This guide will help you to build an understanding of the useful financial incentives that Feed-in Tariffs now provide to encourage their implementation. I hope that you will find it useful and informative.

Rt. Hon. Nick Raynsford MP

Chairman, NHBC Foundation

ABOUT THE NHBC FOUNDATION

The NHBC Foundation was established in 2006 by the NHBC in partnership with the BRE Trust. Its purpose is to deliver high-quality research and practical guidance to help the industry meet its considerable challenges.

Since its inception, the NHBC Foundation's work has focused primarily on the sustainability agenda and the challenges of the government's 2016 zero carbon homes target. Research has included a review of microgeneration and renewable energy techniques and the groundbreaking research on zero carbon and what it means to homeowners and house builders.

The NHBC Foundation is also involved in a programme of positive engagement with government, development agencies, academics and other key stakeholders, focusing on current and pressing issues relevant to the industry.

Further details on the latest output from the NHBC Foundation can be found at www.nhbcfoundation.org.

NHBC Foundation Advisory Board

The work of the NHBC Foundation is guided by the NHBC Foundation Advisory Board, which comprises:

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1 Introduction

The Climate Change Act 2008 includes a legally binding target of at least an 80% cut in greenhouse gas emissions by 2050, to be achieved through action in the UK and abroad, and a reduction in emissions of at least 34% by 2020. Both these targets are against a 1990 baseline.

As one of a number of measures to help achieve these targets, the Department of Energy and Climate Change (DECC) has used used powers in the Energy Act 2008 to introduce a system of Feed-in Tariffs (FITs) to incentivise small-scale (less than 5 MW) low carbon electricity generation. The scheme came into effect on 1 April 2010.

This guide aims to inform social landlords, housebuilders, and all those who wish to understand the FIT scheme and its implications. It covers the eligible technologies and how the scheme works, illustrates financial returns and carbon dioxide emission savings through a number of worked examples, and identifies key issues and opportunities related to strategic implementation.

2 Feed-in Tariffs: what are they?

2.1 Policy context: what is the aim of Feed-in Tariffs?

Until the recent introduction of FITs, the principal financial incentives for investing in small-scale renewable energy technologies have been a number of capital grant schemes (most significantly the Low Carbon Buildings Programme) and the Renewables Obligation (RO) – a requirement on electricity supply companies to obtain a proportion of their electricity from renewable sources.

FITs work alongside the RO, which will remain the primary mechanism to incentivise deployment of large-scale renewable electricity generation, and the forthcoming Renewable Heat Incentive (RHI), which aims to incentivise generation of heat from renewable sources at all scales and is due to be introduced in April 2011.

FITs are intended to encourage the uptake of small-scale low carbon technologies through tariff payments made on both generation and export of produced renewable energy. UK legislation is based on FIT schemes that have operated for some time in various versions in many other countries, most notably in Germany, Spain, and Italy.

The scheme policy and tariff rates are set by the Government, with the scheme itself administered by energy suppliers and the Office of Gas and Electricity Markets (Ofgem). The Energy Saving Trust and the Carbon Trust have been nominated by the Government to provide public information on the scheme and advice on how to apply. FITs is funded through a modest increase in all consumers' electricity bills.

2.2 Technologies and scale of systems that are eligible

Small-scale low carbon electricity technologies eligible for FITs are:

- wind
- solar photovoltaics (PVs)
- hydro
- anaerobic digestion
- domestic scale microCHP (with a capacity of 2 kW or fewer)*.

* The domestic scale microCHP pilot will support up to 30 000 installations which will be reviewed when the 12 000th installation is completed.

Wind, solar PV, and hydro projects of 50 kW or less and microCHP (Combined Heat and Power) projects supported through the pilot programme will have to use Microgeneration Certification Scheme (MCS) certified products and installers in order to be eligible for FITs. Refer to section 2.4 for further details.

2.3 Feed-in Tariff rates and how long they will be paid for

FITs will consist of two elements of payment. The first element is a generation tariff that varies in amount according to the type of technology and scale, and will be paid for every kilowatt hour (kWh) of electricity generated. This generation tariff will be paid regardless of whether the electricity is used on-site or exported to the local electricity network.

Examples of FIT generation rates up to 2013 are detailed in Table 1.

Table 1

FIT lifetime and generation tariff to 2013 for selected scales

Technology	Scale	Tariff level (pence/kWh) for new installations in period (pence/kWh)			Tariff lifetime (years)
		Year 1: 1/4/10–31/3/11	Year 2: 1/4/11–31/3/12	Year 3: 1/4/12–31/3/13	
MicroCHP pilot	<2 kW	10.0	10.0	10.0	10
Photovoltaic	≤4 kW (new build)	36.1	36.1	33.0	25
Photovoltaic	≤4 kW (retrofit)	41.3	41.3	37.8	25
Photovoltaic	>4–10 kW	36.1	36.1	33.0	25
Photovoltaic	>10–100 kW	31.4	31.4	28.7	25
Wind	≤1.5 kW	34.5	34.5	32.6	20
Wind	>1.5–15 kW	26.7	26.7	25.5	20
Wind	>15–100 kW	24.1	24.1	23.0	20

The second element is an export tariff, which will either be metered and paid as a guaranteed amount that generators are eligible for, or will, in the case of very small generation, be estimated based on a proportion of the total generation. This will avoid the need for a meter that measures how much electricity is exported, which could be relatively expensive compared with the cost of the system (Figure 1).

In respect of the export tariff, generators have a choice: they can either opt to receive a guaranteed payment of 3 pence per unit (the current Government-set tariff) for electricity they export, or they can choose to opt out of this set figure and enter a contract with a power purchaser and receive a price for their exported electricity based on the market rate. It is likely that the smallest generators (below 6 kW) will find it simpler to opt for the set price of 3 pence per unit as the amount of electricity they will be exporting is likely to be very low.

All generation and export tariffs will be linked to the Retail Prices Index, which ensures that each year they follow the rate of inflation.

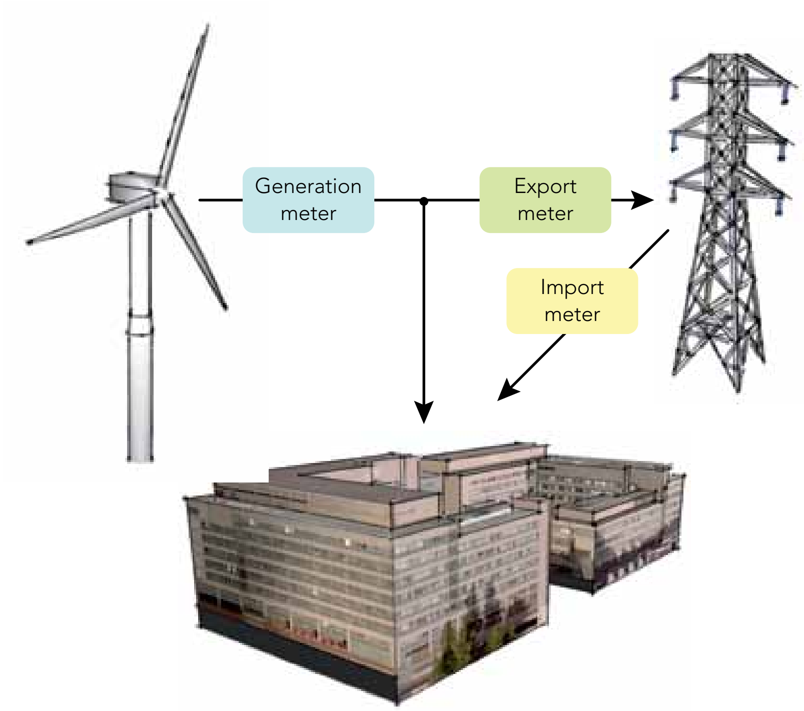


Figure 1 Schematic showing metering requirements.

2.3.1 Degression: what is it and why?

The tariffs are guaranteed and will apply for the lifetime of the tariff. However, the tariff rates will be reduced for newcomers and this is known as degression. Although the level of renewable energy take up in the UK is currently the lowest in Europe, the aim of FITs is to incentivise rapid growth over the next few years. With this increase, however, it is anticipated that market forces and competition will reduce the product and installation costs. Degression is the reduction in tariff rates in line with this, maintaining the return on investment as set out in the policy (Figure 2).

The level of degression may be changed throughout the scheme life, but it is predicted to be 6 to 8% per year from 2012 onwards. However, as mentioned above, it is only relevant at the point of entry to the scheme, so once an installation is registered the applicable rate will remain guaranteed throughout the life of the contract subject only to inflation indexation.

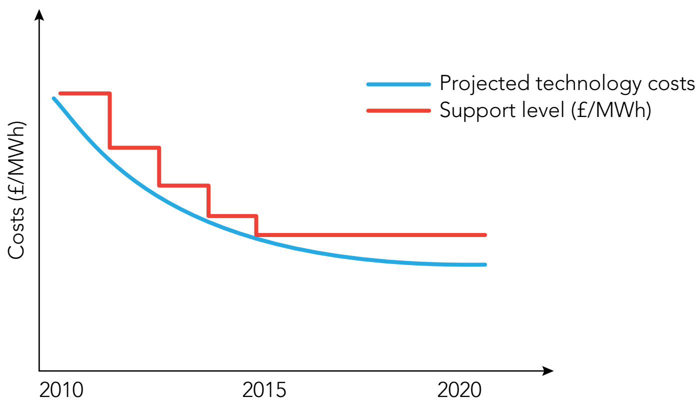


Figure 2 Degression of tariff rates in line with projected technology costs. (Graph adapted from *Design of Feed-in Tariffs for Sub-5 MW Electricity in Great Britain: Quantitative analysis for DECC*.[1])

2.4 Why are MCS-certificated equipment and installers required?

Installations of 50 kW or less that are the subject of an application for the FIT scheme are required to use MCS-certificated products and be installed by an MCS certificated installer. This requirement does not apply to anaerobic digestion installations or larger installations up to the FIT limit of 5 MW.

The MCS is designed to independently certify microgeneration products and services in accordance with a set of robust, industry-derived standards.

Also, as part of their MCS certification, installers are required to sign up to a consumer code that is approved by the Office of Fair Trading and is relevant to microgeneration.

2.4.1 Selection of suppliers

MCS technologies, certificated installers, or certificated products can be found at the MCS website (www.microgenerationcertification.org) where installers are sorted by technology and region.

2.5 The mechanism for payment: how will the scheme operate?

Payments are made by electricity supply companies in accordance with those outlined in Table 1 dependent on the amount of energy generated. Additional payments are available for energy exported to the National Grid. At present this is a guaranteed rate of 3 pence per kWh regardless of technology. However, some supply companies are offering rates in excess of this.

Generators may, if they wish, assign the rights to their FIT payments to another body through a contractual arrangement. This may be useful to secure a bank loan, for example.

It will be up to landlords and tenants of domestic or commercial property to come to an arrangement about the receipt of payments and on-site electricity use benefits.

2.5.1 Metering requirements

Most tariffs will require an Ofgem approved Total Generation Meter, which should be installed with the system. Total Generation Meters give a running total of the electricity generated by the system in kWh.

Larger scale installations will require an export meter. Currently it is not a requirement that import and export meters be installed for small-scale installations, as "smart meters" will fulfil this function in due course. Smart meters record generation and consumption data at least every hour and communicate this via a central data and communications entity back to the electricity supply company for monitoring and billing purposes. The Government has proposed mandatory use of smart meters for domestic customers by Autumn 2013.[2]

2.5.2 Deeming

DECC confirmed their intention that all FIT payments should be made on the basis of electricity metered in accordance with the strict requirements of the Electricity Act 1989 and subsequent legislation and regulations. This is because there is a need to ensure that all electricity flows benefiting from FITs, including exports, should be subject to accurate measurement to ensure value for money and the integrity of the scheme. However, in order to avoid the expense of providing export meters for small-scale generators and potentially wasted costs arising from the installation of export meters in advance of the roll-out of smart meters, the amount of exports for the payment of export tariffs can be deemed.

Strictly as an interim measure, payment of export tariffs to generators of 30 kW or less of total installed capacity will be made on the basis of deemed or estimated exports. The amount of electricity deemed to be exported will be based on a proportion of the metered generation output of these generators. The percentage of exported electricity generation that will be deemed from eligible technologies is as follows:

- 50% of exports for solar PV, wind, anaerobic digestion, and microCHP installations
- 75% of exports for hydro installations.

These arrangements will not apply if export meters exist already, or are provided at the generator's expense.

The arrangements will apply for the first year of operation of the scheme. Further consideration will be given to metering requirements in light of the detailed work emerging from Phase 1 of the smart metering implementation programme, which started in December 2009.

2.5.3 Registering installations for payment

The registration process differs according to the size and technology of the installation:

"Micro" installations (up to 50 kW)

Once a chosen installer has installed the generating technology, they will register the installation on the central FITs database and issue a certificate confirming FIT compliance. The generator's chosen energy supplier then requires the certificate to confirm that the generator is eligible to receive the FIT. The supplier will cross-reference the installation with the central FIT database, and payments will be made at agreed intervals. Meter readings to the suppliers may need to be provided if requested.

"Small-scale" installations (50 kW to 5 MW)

Technology and projects scaled between 50 kW and 5 MW have the option to receive support under either the RO or the FIT schemes. If they choose to receive FITs, then these installations become ineligible to receive Renewables Obligations Certificates (ROCs). Where support is applied for under the FITs, a process known as ROO-FIT must be followed and registration is required through Ofgem's Renewables and Combined Heat and Power Register. On completion of this process, generators will be required to contact a FITs supplier with their ROO-FIT details.

2.5.4 Where does the funding come from?

All electricity suppliers contribute to payment of FITs in proportion to the number and size of customers they supply. FITs will ultimately be funded by an increase in general electricity tariffs. The expected impacts are covered in section 8.2: Electricity prices: cost to consumer.

3 Renewable Heat Incentive

The Renewable Heat Incentive (RHI) is a proposal by the previous Labour Government to incentivise the production of heat by renewable energy technology. Consultation on the scheme ended in April 2010 and the present coalition government's response and publication of final proposals is awaited. While FIT schemes are in operation in many countries around the world, the RHI is a new concept and has not been tried elsewhere to date.

It is proposed that the RHI will support a variety of technologies, including solar thermal, air and ground source heat pumps, biomass boilers, and combined heat and power as well as several less well-established technologies.

A generation tariff will be received for every kWh of renewable heat energy generated. For larger scale installations, heat meters will be required to monitor output. At the small- and medium-scale, payments will be made on the basis of deemed reasonable heat requirement – after energy efficiency measures – rather than on actual metered generation. This is to avoid providing any perverse financial incentive to generate heat in excess of need, given:

- the greater impact of energy efficiency measures on heat demand
- excess heat cannot be easily exported to the National Grid as with electrical generation and is likely to instead be "dumped'.

Unlike FITs, an export tariff will not be paid, although at the larger scale any excess heat may be sold to third parties. It is considered that those selling heat would be professionals (eg ESCOs – third-party energy supply companies) for whom negotiation of terms of sale would prove no obstacle. This is particularly relevant to district heating schemes; however, further clarity is required on how these will be incentivised.

The schemes have been designed to yield a 12% return over the tariff's life (10–23 years depending on the technology) with a reduced rate for solar thermal of 6% to reflect its relative maturity – close to 100 000 systems have been installed to date.

At the time of writing it is proposed that payments under the RHI scheme will begin in April 2011; however, any suitable system installed from 15 July 2009 will be eligible for the tariffs when they begin. Smaller installations will have to be commissioned and registered by MCS-certificated installers, as for FITs.

Ofgem will administer and make payments under the scheme; however, the Government has yet to decide how the scheme will be funded – whether by a levy on fossil fuel suppliers or through a mechanism similar to FITs.

Currently only 0.6% of the UK's heat energy comes from renewable sources, which needs to be increased to around 12% by 2020 to meet the Government's target of 15% energy from renewables under the EU Renewable Energy Directive.

The cost of the RHI to the economy is projected to be £4 billion per year in 2020, an equivalent of £237 per tonne of carbon dioxide saved.

For further information refer to the DECC consultation and impact assessment documents.[3]

4 Financial returns

The following examples illustrate the potential of FITs in a variety of situations. Energy and carbon saved is calculated for each scenario along with expected financial returns. The sensitivity of key variables is examined to ensure relevance for different readers and identify the most cost- and carbon-effective scenarios.

4.1 Worked example: retrofit of detached house with 4 kWp photovoltaic array

4.1.1 Energy output

A single detached dwelling with sufficient unshaded south facing roof area, at a 45° pitch, to install a 4 kWp[4] solar PV array has been taken as a baseline example (Figure 3). This would require approximately 30 m^2 roof area (measured on the pitch rather than in plan). The average available solar resource across the UK can be estimated from SAP 2009 to be 840 kWh/kWp at this pitch with minimal shading.[5]

The 4 kWp array would therefore typically generate around 3360 kWh over the course of an average year. A proportion of this would be used on-site (at times when electricity is being used at the same time as it is being generated) – which would depend upon the season and occupancy pattern. It is desirable to maximise this proportion as the cost of purchasing electricity is greater than the income gained from exporting it. It may be increased by the intelligent use of appliances, such as running the washing machine or dishwasher during the day if electricity would otherwise be exported.

An initial assumption has been made by the Government that 50% of generated electricity will be exported, although where Ofgem-approved meters are installed the actual output may be used. Given the variability between households, this is a reasonable assumption over the life of the installation where specific occupancy patterns are unknown.

Figure 3 Detached house with photovoltaic array.

4.1.2 Annual income

For a detached dwelling, the average annual electricity consumption is estimated to be 4500 kWh.[6] However, 1680 kWh of the generated electricity is used on-site, such that the net demand is only 2820 kWh imported from the National Grid. FIT payments will be received for the 3360 kWh generated and further 1680 kWh exported.

The current retail price of electricity to domestic consumers is approximately 13 pence/kWh, although this is projected to increase beyond the rate of inflation in line with fossil fuel prices and other factors.[7]

The initial generation tariff at this scale for retro-fit PV is 41.3 pence/kWh and the export tariff is 3 pence/kWh.

Therefore the annual income that can be expected would be (tariff for generated and exported electricity) cost of imported electricity:

= (£0.413 × 3360 kWh + (£0.03 × 1680) – (£0.13 × 2820 kWh)
= £1387 + £50 – £367
= £1070

The electricity distribution company would pay the customer (supplier) £1070 per year (Figure 4).

If no panels are installed, the annual electricity bill would be:

£0.13 × 4500 kWh = £585

This is a differential of over £1650 per year.

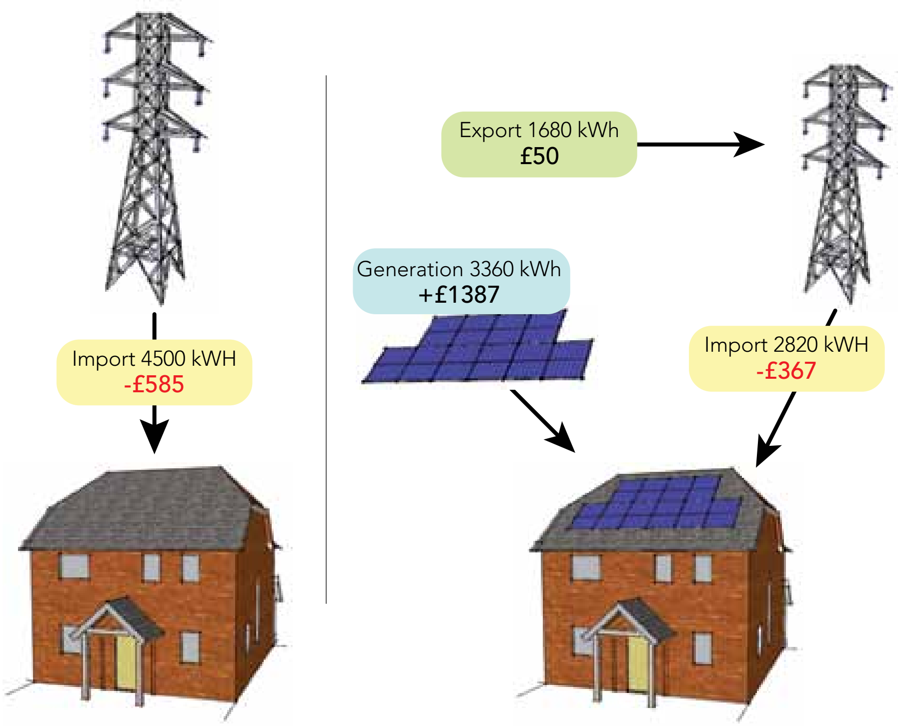


Figure 4 Schematic showing annual electricity and cash flows before and after installation of solar photovoltaic array for worked example.

4.1.3 Capital and operational costs

Capital costs are dependent on the size[8] and type of installation, for example hybrid crystalline/amorphous modules or solar PV tiles may carry a premium, although this may be offset due to improved performance or reduced materials cost. New build installations are likely to be less costly. It has been assumed that the installed capital cost of a 4 kW array is £16 000 for a one-off retrofit installation.[9]

The lifetime of the solar array is likely to exceed the 25 year tariff, although replacement of components may be required during this time, particularly the inverter, which is likely to have a lifetime of around 10 to 15 years. A PV system is low maintenance in most situations; active monitoring by the occupant or tariff-owner should ensure that any issues are picked up and remedied quickly. However, a full electrical check should be carried out at intervals of perhaps five years as well as annual costs such as insurance, administration, and potentially an annual inspection.

4.1.4 Simple payback

Allowing for operation and maintenance costs at approximately 1% of capital costs per annum, equivalent to £160 in this example, the net annual income would be £1440. In simple payback terms, the investment would pay for itself in just over 11 years.

However, when dealing with systems with such long lifetimes, simple payback as a measure can lead to unwise investment decisions. Instead, the cost of capital and residual value of any measures should be factored in to the equation. Since both generation and export FIT tariffs are index linked, their value is protected from future cost increases in line with inflation. However, aspects such as any decline in performance over the lifetime and above inflation increases in future energy prices should also be considered to provide a fuller picture.

4.1.5 Discounted cash flow

Discounted cash flow (Figure 5) reflects the fact that the value to a person or organisation of receiving £1 at some future time is less than that of receiving it now. Where investment options have different lifetimes and/or cash flows, the future returns must be "discounted" to their present value in order to compare them. The sum of all future income and expenditure discounted in this way is known as the Net Present Value (NPV).

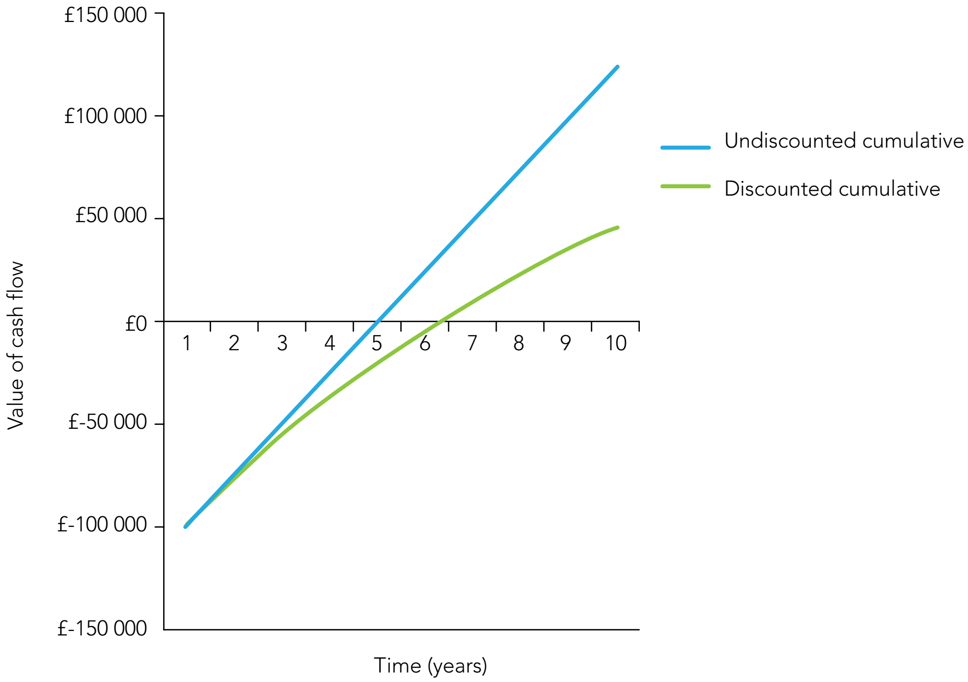


Figure 5 The difference between discounted and undiscounted cumulative cash flows.

NPV is an indicator of how much value an investment adds: where it is positive, the investment would add value and should be considered. When several alternative investment opportunities are being evaluated side-by-side, as will be done here, the NPV provides a metric to compare between them.

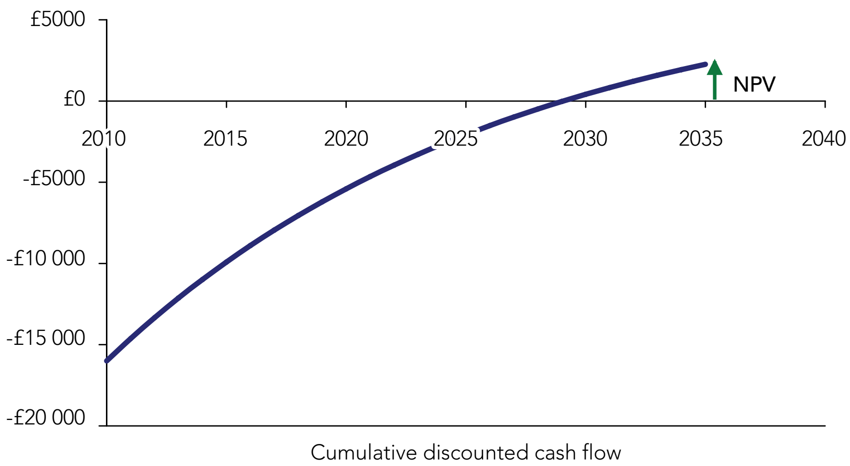


Figure 6 Cumulative discounted cash flow for worked example.

For the worked example, taking initially an 8% nominal cost of capital (also known as the discount rate), the discounted cash flow is shown in Figure 6. This shows that after 19 years, the investment has "paid back". Over the 25 year term, the NPV is £2470.

An alternative metric also often used is the Internal Rate of Return (IRR); this is defined to be the discount rate that delivers a NPV of zero over the investment term, as shown in Figure 7. Over the 25 year term, the IRR is 9.6%. This is analogous to the annual percentage rate or APR of a loan – it is the equivalent annual return each year throughout the life of the investment.

Key results calculated in this worked example are presented in Table 2.

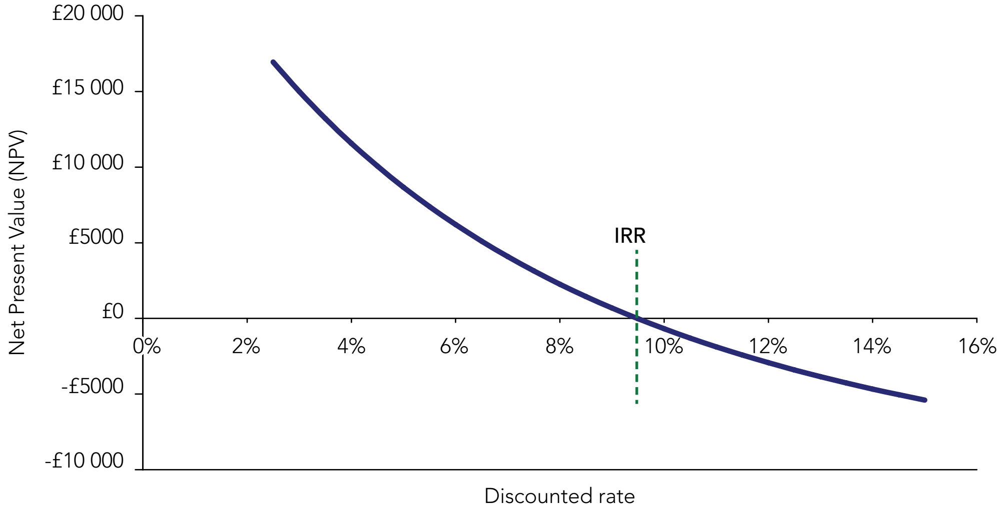


Figure 7 Variation of Net Present Value with discount rate for worked example.

Table 2

Summary table – financial benefit of FITs by technology			
Technology	PV (4 kW)	Wind (15 kW)	MicroCHP
Capital cost (£)	16 000	26 000	4000
Operational cost[11] (£/year)	160	260	160
Energy generated – first year[12] (kWh/year)	3360	7500	3500
Proportion exported (%)	50	50	10
Generation tariff (£)	1387	2000	350
Export tariff (£)	50	115	10
Avoided electricity charges[13] (£)	218	455	380
Additional gas charges (£)	–	–	–120
Net income – first year (£)	**1655**	**2570**	**620**
Tariff lifetime (years)	25	20	10
Discount rate (%)	8	8	8
Net Present Value (£)	**2470**	**1440**	**–462**
Internal Rate of Return (%)	**9.6**	**8.7**	**5.5**

4.2 Other technologies covered by Feed-in Tariffs

Since the FIT scheme began, the majority of all qualifying installations in the UK have been solar PV, according to the latest figures from Ofgem.[10] Solar PV is widely applicable to the built environment and is a mature and reliable technology, leading to its popularity; however, in some cases other technologies supported by FITs will be more appropriate – see section 9.1: Low and zero carbon principles: signposts to further reading. The following examples contrast the returns available for those alternatives particularly relevant to housebuilders and Registered Social Landlords:

- small wind – 15 kW pole-mounted turbine
- MicroCHP – 1 kWe boiler replacement unit.

5 Lifetime energy and carbon costs

Of course, in a wider context the reason for having FITs in the first place is to encourage uptake of renewable energy and therefore reduce our carbon dioxide emissions.

It is useful, then, to be able to compare between technologies with alternative carbon dioxide reduction strategies. The key metrics used to do this are the lifetime cost per kWh (levelised cost of energy equals the annual capital repayments and operating costs divided by annual energy production) and cost per tonne of carbon saved. These will also be discounted to present value as per the analysis in section 4.

5.1 Worked example: retrofit 4 kWp photovoltaic array

The whole useful life of any given technology should be taken into account. In all likelihood, the solar panels will continue to generate useful energy after the end of the FIT period. A lifetime of 30 years or more would be anticipated.

The 4 kW PV array should, on average, generate around 3360 kWh in its first year. However, during its lifetime, depending on its type, the performance of a PV module will deteriorate slightly. A linear degradation to approximately 80% of initial module performance after 30 years has been assumed in line with International Energy Agency guidelines.[14]

The total energy generated over a 30 year operational lifetime is 91 800 kWh. Using the SAP 2009 carbon emissions factors, the equivalent CO_2 saving can be calculated.[15] The lifetime carbon dioxide emissions saved (exported and used on-site) is 48 tonnes.

The total capital and operational cost discounted to 2010 prices is around £18 200 for the single retrofit array.[16] This gives a levelised cost of 20 pence/kWh and an average cost of £380 per tonne of carbon dioxide saved over the lifetime. Key results are presented in Table 3.

5.2 Other technologies covered by Feed-in Tariffs

The results in Table 3 can be compared with the average anticipated cost of electricity and carbon over this timeframe. For example, the cost of carbon mitigation through all FIT technologies examined is far greater than the Government's anticipated long-term traded price of carbon at £70 per tonne (±50%) in 2030. The predicted long-term price of carbon is shown in Figure 8; the anticipated range is shown between the dotted lines for the period beyond 2030.

There is potential for fabric improvements and other energy efficiency technologies to deliver more cost-effective carbon savings over the longer term. This remains a topic for further investigation.

Table 3

Summary of specific energy and carbon costs by technology

Technology	PV (4 kW)	Wind (15 kW)	MicroCHP
Equipment lifetime (years)	30	25	12
Electricity generated – first year (kWh/year)	3360	7500	3360
Lifetime electricity generated (kWh)	91 780	187 500	42 000
Additional gas consumed – first year (kWh)	–	–	3400
Lifetime additional gas consumed (kWh)	–	–	40 800
Lifetime discounted cost[17] (£)	18 230	29 360	6530
Levelised cost of electricity (/kWh) (£)	**0.20**	**0.16**	**0.16**
Carbon dioxide saved – first year (kg)	1760	3920	1140
Carbon dioxide additional – first year (kg)	–	–	670
Lifetime net carbon dioxide saved (kg)	48 000	98 000	13 700
Cost of carbon saved (/tonne) (£)	**380**	**300**	**480**

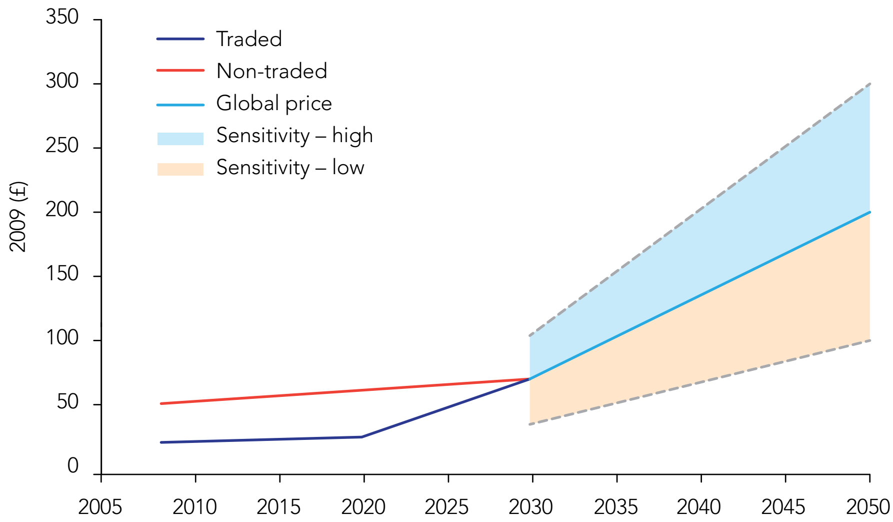


Figure 8 DECC estimates for traded and non-traded future carbon prices. (Graph adapted from *Carbon Valuation in UK Policy Appraisal: A Revised Approach*[18].)

6 Solar thermal and heat-generating technologies

With the likely introduction of the RHI next year, consideration should be given prior to installation of electricity-generating technologies as to whether financial returns, carbon reductions, and potential comfort improvements with heat-generating technologies would represent a better investment. Given the fact that roof space is limited, solar thermal has been taken as a pertinent example.

It should be noted that some of the information below – taken from the RHI consultation document[3] – is indicative only at this stage and tariffs may be subject to change.

6.1 Worked example: retrofit solar thermal

A typical 4 m^2 (2.8 kWth) flat panel solar thermal system would be expected to generate approximately 1600 kWh per annum.[19] For simplicity, it is assumed that a solar PV pump is incorporated such that there is no electrical requirement to run this.

Accounting for boiler efficiency of approximately 90%, approximately 1780 kWh gas fuel consumption would be avoided. Applying the SAP carbon emissions factor of 0.198 $kgCO_2$/kWh for mains gas, the annual carbon saving would be in the region of 350 kg. Assuming a 30 year lifetime, the total carbon saved would be 10.5 tonnes.

It is assumed that the installed cost is £4400 (Table 4).[20] The operational costs are minimal; it is assumed that a pump replacement every 15 years and fluid replacement every five years will be required. Operational expenditure is assumed to be approximately 1% of capital cost. Discounted to 2010 prices,[21] this is equivalent to £615 over the lifetime. Therefore, a saving of 10.5 tonnes of carbon dioxide is achieved from an outlay of £5015, which is equivalent to £478 per tonne.

With the suggested RHI tariff of 18 pence/kWh for a period of 20 years, an internal rate of return of 6% over a 20 year tariff would be achieved. This would be equivalent to a NPV of –£711 at a discount rate of 8%.

Table 4

Summary of solar thermal example

Technology	Solar thermal (4 m^2)
Capital cost (£)	4400
Operational cost (£/year)	44
Energy generated – year 1 (kWh/year)	1780
Proportion exported (%)	–
Generation tariff (£)	290
Export tariff (£)	–
Avoided gas charges – 1st year (£)	64
Net income – year 1 (£)	**354**
Tariff lifetime (years)	20
Discount rate (%)	8
Net present value (£)	–711
Internal Rate of Return (%)	**6**
Equipment lifetime (years)	30
Electricity generated – first year (kWh)	–
Lifetime electricity generated kWh)	–
Gas saved – first year (kWh)	1780
Lifetime gas saved (kWh)	40 000
Lifetime discounted cost (£)	4970
Levelised cost of heat energy (/kWh) (£)	**0.12**
Carbon dioxide saved – first year (kg)	352
Carbon dioxide additional – first year (kg)	–
Lifetime net carbon dioxide saved (kg)	8800
Cost of carbon saved (/tonne) (£)	**560**

7 Sensitivity analysis: capital cost of photovoltaic systems

7.1 Installed cost trends

The "headline" capital cost of PV systems has shown a remarkable rate of decline recently, such that any figures used here are in danger of being out-of-date almost as soon as they are printed.

In general, as the cumulative installed capacity grows there is a "learning rate" that reduces the capital cost. For example, historical PV costs follow a learning rate of 18% (installed system cost), which means that for each doubling in capacity there is approximately an 18% decrease in capital costs[22] (Figure 9).

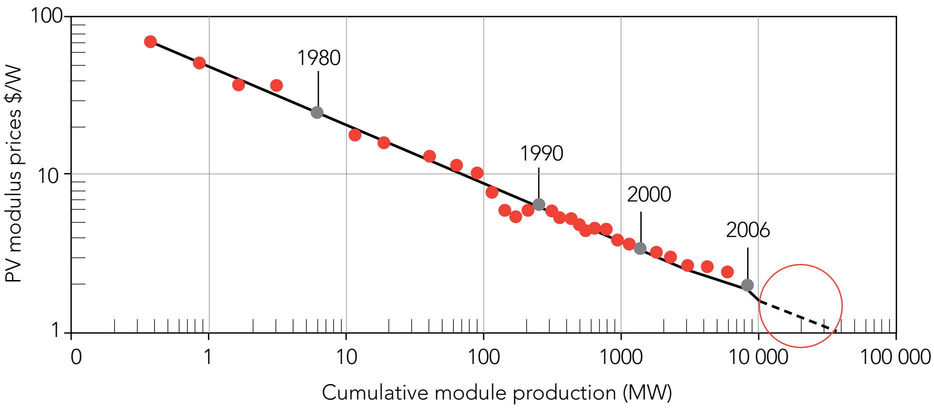


Figure 9 Historical price experience curve for photovoltaic module prices. (Graph adapted from *Solar Photovoltaic Electricity: A Mainstream Power Source in Europe by 2020*, published by EPIA.)

7.2 Economies of scale

For any given technology, in any year, unit costs will vary with the size of installation. Approximately 50 to 60% of the installed cost of a PV array is attributed to the solar modules themselves. The remainder is made up of the balance of plant and installation costs, which are less subject to variation with system size. Bulk-buying discounts of up to 20% could be expected for very large contracts – added to which fixed installation costs such as mechanical and electrical installation represent a lower proportion of the total. Conversely, a smaller array would be likely to cost slightly more per installed kWp. For example a 2 kWp array would cost between £8500 and £9000.[24]

There are also economies of scale, or vice versa, in terms of operational costs as the system size is varied. Although the cost of replacement inverters varies with power output, again there are economies of scale. Many of the operational costs, such as annual or electrical checks, would vary little with system size on the domestic scale.

The capital cost of PV is often expressed in terms of pounds per kilowatt peak (£/kWp).

It is instructive to chart the IRR as a function of capital cost per kWp (Figure 10). Figure 10 shows in the worked example, that if PV arrays could be sourced for £3000 per kWp (ie 75% of the cost assumed in the worked example), an IRR of approximately 13% could be achieved.

Depending on the cost of capital, the NPV can be estimated over the 25 year tariff life (Figure 11).

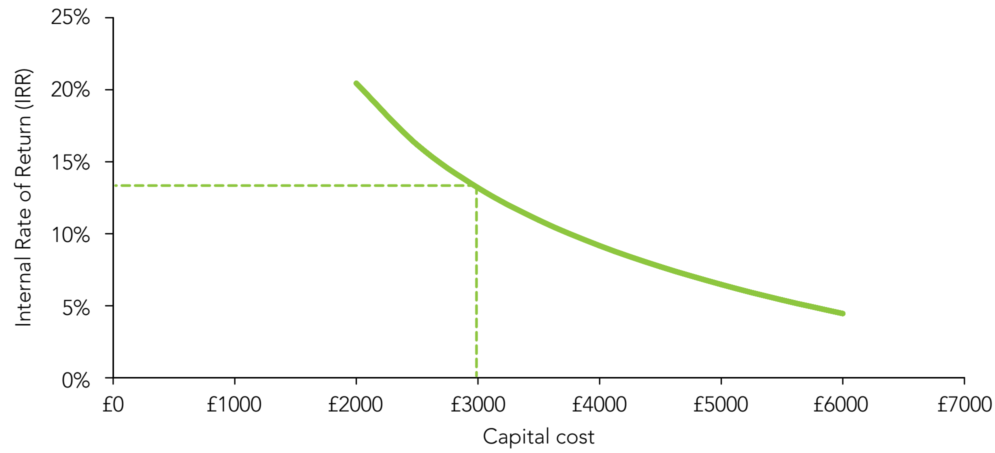


Figure 10 Variation of internal rate of return with capital installed cost of photovoltaic system per kilowatt peak.

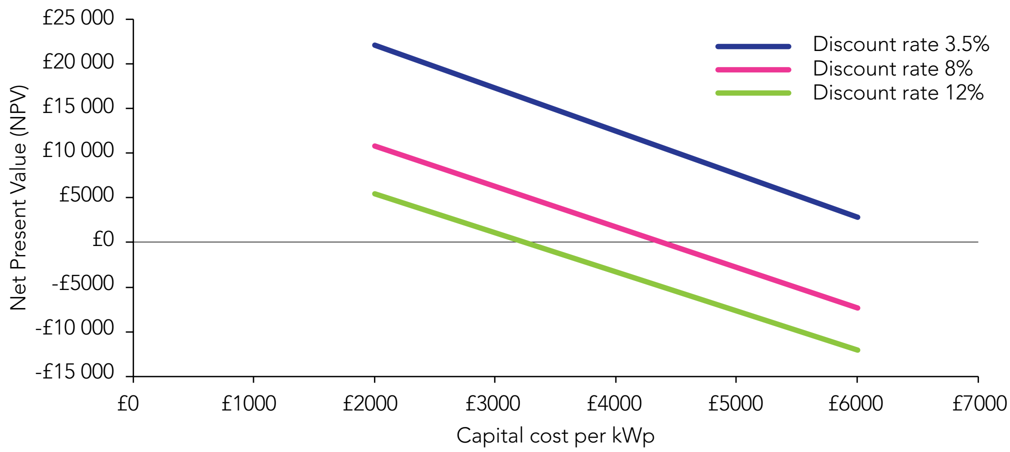


Figure 11 Variation of Net Present Value with capital installed cost of photovoltaic system per kilowatt peak at various discount rates.

8 Impacts: experience from other countries

8.1 Uptake of renewables

In 2008, a detailed analysis by the European Commission[25] concluded that 'feed-in tariff regimes are generally the most efficient and effective support schemes for promoting renewable electricity'. As of 2009, FIT policies have been enacted in over 60 territories around the world.[26]

Germany

The German Feed-in Law has been in development since 1990. The process of fine-tuning German legislation has been a long one, and many of the lessons learned have informed UK policy. The Feed-in Law has had a major impact on facilitating the development of Germany's supply of renewable energy. Whereas Germany's energy use has remained relatively stable, renewables have accounted for an ever-greater portion of the electricity consumed, helping to limit Germany's greenhouse gas emissions.

From 2000 to 2004, during the first few years of the Feed-in Law, there was a ninefold increase in electricity generated from PV systems, while energy produced from wind and biomass more than doubled in this period.

In 2009, additional solar PV capacity installed was approximately 3.8 GW, up from 1.5 GW the year before. The German market now dominates the world scene with 47% of the world's total 21 GW installed capacity. This, from a country at a similar latitude to that of the UK, demonstrates the potential for the UK solar PV market (Figure 12). It has been estimated that the Feed-In Law itself has directly saved more than 33 million tonnes of carbon dioxide since its inception.

The solar sector in Germany has also grown considerably as a result of the Feed-In Law. Germany is now the largest solar PV producer in the world with a 47% share of the global market. The German PV industry now employs 76 000 people (up from 20 000 people in 2006), and the renewables industry as a whole in Germany employs over 300 000 people.[28]

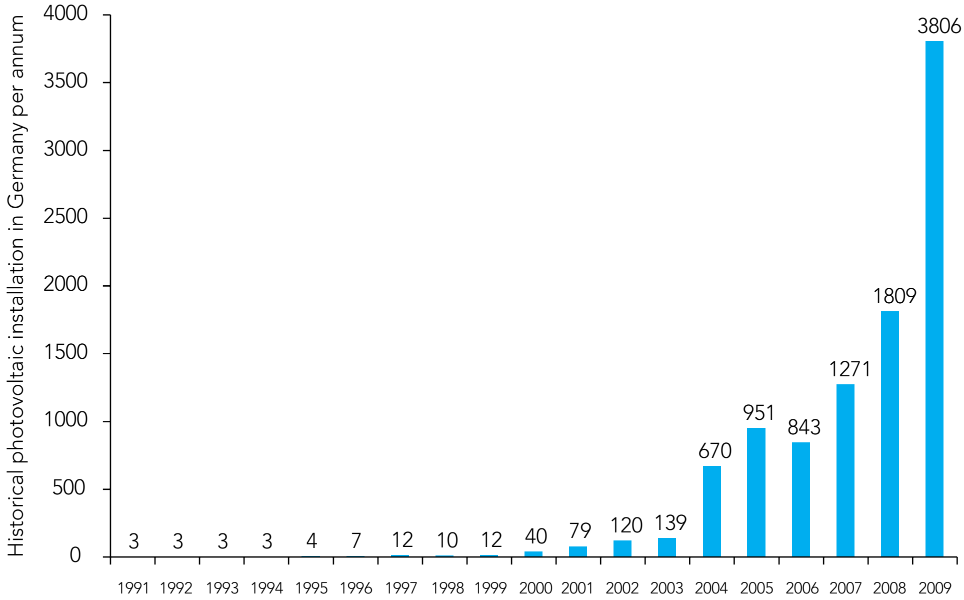


Figure 12 Yearly photovoltaic installation in Germany in megaWatts – EPIA.[27]

UK

By comparison, in 2004, the UK employed some 57 000 people in the renewables sector with only a hundred or so in the PV industry. This is shown in Figure 13, where development (ie pre-construction), construction and operational phases are made up from direct jobs in projects and indirect jobs in the supply chain. Induced jobs arise in the wider context from economic activity stimulated by the industry – for example extra retail employment.[29]

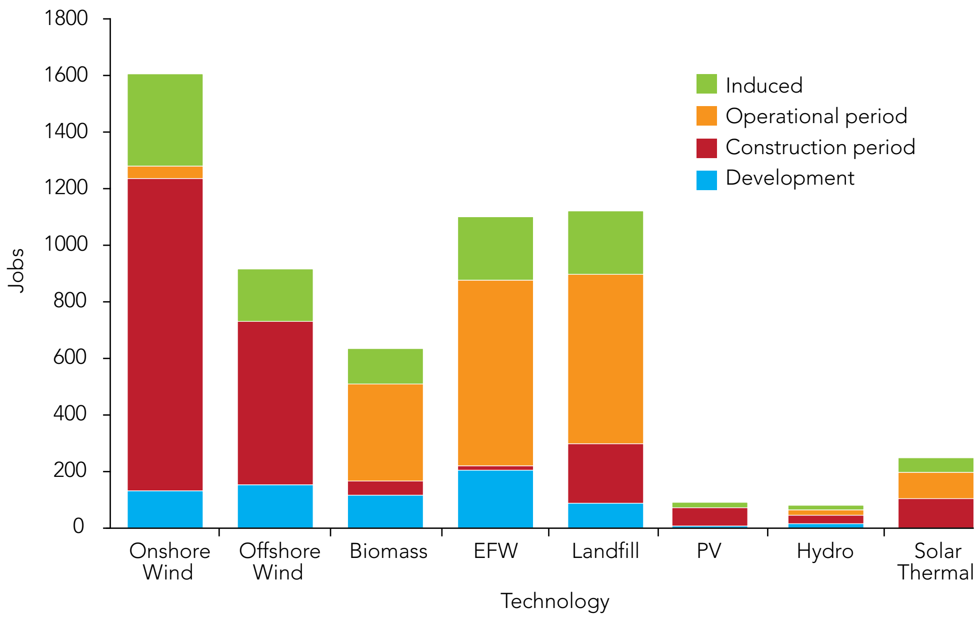


Figure 13 Total jobs in UK (except Scotland) by phase and technology. Source: DTI Renewable Supply Chain Gap Analysis.

It is anticipated that similar growth can be achieved in the UK. Market research firm iSuppli Corp have forecast[30] that up to 96 MW of solar PV installations could be installed by the end of 2010 (Figure 14). This can be contrasted with the 6 MW installed in 2009.

Initial figures released by Ofgem[31] demonstrate that installation rates are increasing month on month, with over 4.5 MW of installed capacity added in July 2010 alone (Figure 15).

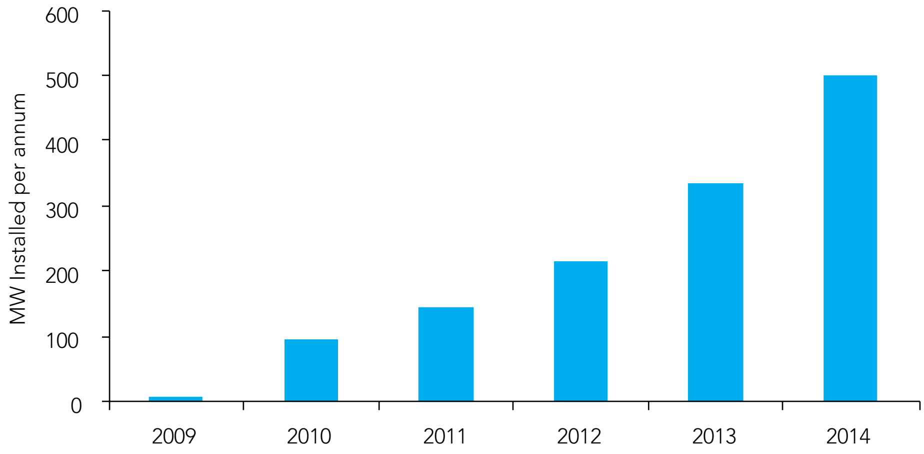


Figure 14 Forecast UK photovoltaic installations per annum.[30]

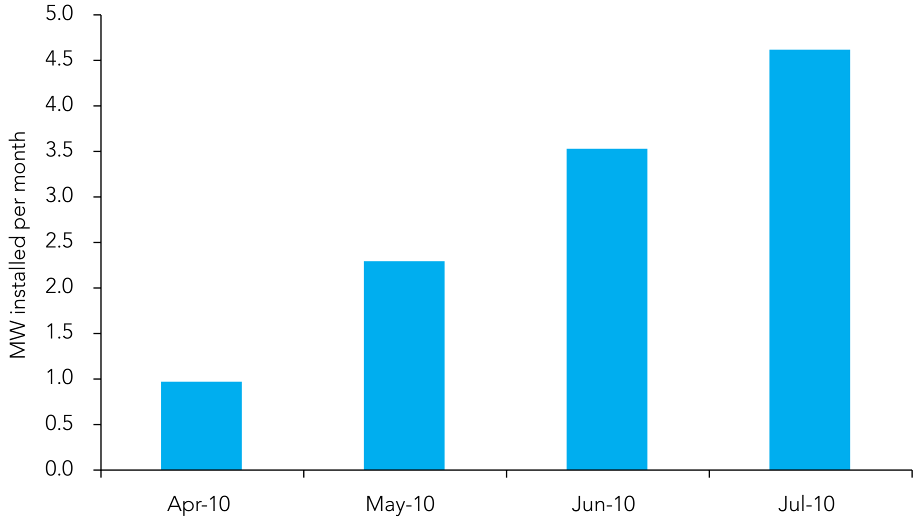


Figure 15 UK photovoltaic installations April through July 2010 (Ofgem).[31]

The *Impact Assessment of the Renewable Heat Incentive*s completed for DECC in February estimated that a total of 750 000 additional renewable installations could be completed by 2020, the majority of these on domestic properties. The subsidy cost is projected to be £3.1 billion cumulative to 2020, which will be passed to consumers via increased electricity bills.

8.2 Electricity prices: cost to consumer

In 2009, the Renewable Energy Sources Act was estimated to have contributed to an increase of approximately 5% on German electricity prices[32] – around 1.1 Euro cents per kWh.

DECC has estimated the impact that FIT legislation will have on domestic electricity bills to be around 1.3% in 2015 rising to 1.9% in 2020. Whatever the scale of the eventual increase, the least well off are likely to take the greater proportion of this burden because they spend a greater proportion of their income on fuel. This is illustrated in Figure 16.

The cost of FITs to the economy is projected to be around £200 per MWh of electricity generated, an equivalent of £460 per tonne of carbon dioxide saved.

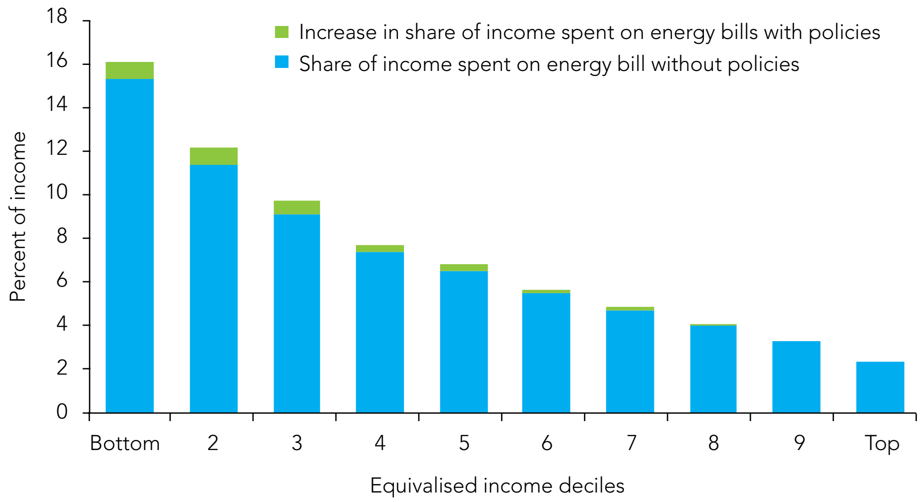


Figure 16 Energy bill as a percentage of income in 2020, with and without energy and climate change policies. (Graph adapted from *Estimate Impacts of energy and Climate Change Policies on Energy Prices and Bills*.[33])

8.3 Industry

The UK market for renewable technology is relatively undeveloped compared to that of Germany and several of our European neighbours. As such we have relatively little in terms of indigenous component manufacturing and installation capability.

In the case of PV, at present the UK market is heavily dependent on imported components such as inverters. When other markets are very active PV installers in the UK can experience lengthening lead times on components. Presently the German market is installing PV at record levels, and in 2009 over 60% of the world's solar panels were installed there and high levels of demand continue in 2010 in spite of the fact that German FIT tariffs have been adjusted downwards.

In the UK a shortage of skills is also in evidence. Training courses for relevant trades such as roofing and electrical installation continue to grow; however, this is from a low base.

9 Implementation: delivery models

9.1 Low and zero carbon principles: signposts to further reading

It is important to remember that the suitability of the various low and zero carbon technologies to each specific site is paramount. For example:

- even slight shading, such as telegraph wires, can have a much greater impact on PV because of the electrical arrangement of the modules than it may have on solar thermal panels
- turbulence and reduced wind speed due to adjacent buildings, trees, or other obstacles can mean that energy yield from turbines is reduced significantly compared with large-scale average wind databases, so on-site pre-installation measurements should be carried out
- the plant size ratio – a measure of boiler capacity to heat demand – is a key variable when considering microCHP performance.

There are many other factors which come into play when assessing a building and deciding on the best course of action in order to save carbon. In all cases, it is recommended that a site-specific energy survey and assessment of the most effective energy efficiency measures, followed by an evaluation of the renewable energy options, is undertaken to ensure that only appropriate technologies are specified. Further information is available from the following publications:

- NHBC Foundation NF7 *A Review of Microgeneration and Renewable Energy Technologies*.[19]
- Energy Saving Trust CE317 *Domestic Low and Zero Carbon Technologies*.[34]

9.1.1 Tenant consultation and education

Tenant consultation should be carried out in advance of any installations to ensure the success of microgeneration installations. Aspects that should be considered include:

- energy efficiency – equipment and behavioural changes
- costs and charges
- quality of life
- maximising benefits from technologies through controls and advice
- understanding equipment energy displays
- troubleshooting and help
- maintenance.

Further information is available in the Housing Federation publication, *Lifetime Costs of Installing Renewable Energy Technologies*.[35]

9.2 Planning issues

The Government's key principles in respect of renewable technologies are contained in Planning Policy Statement 22.[36] Its starting point is that regional spatial strategies and local development documents should contain policies designed to promote and encourage, rather than restrict, the development of renewable energy resources. Regional planning bodies and local planning authorities should recognise the full range of renewable energy sources, their differing characteristics, locational requirements, and the potential for exploiting them subject to appropriate environmental safeguards.

Local planning authorities, regional stakeholders, and Local Strategic Partnerships are required to foster community involvement in renewable energy projects and seek to promote knowledge of and greater acceptance by the public of prospective renewable energy developments that are appropriately located.

Developers of renewable energy projects therefore should engage in active consultation and discussion with local communities at an early stage in the planning process, and before any planning application is formally submitted.

Development proposals should demonstrate any environmental, economic, and social benefits as well as how any environmental and social impacts have been minimised through careful consideration of location, scale, design, and other measures.

9.3 Capital grants: what is available and to whom?

The FITs scheme is intended to replace, not supplement, public grant schemes as the principal means of incentivising small-scale, low carbon electricity generation. Because of this, and to ensure value for money for consumers and compliance with EU law on state aids, it is generally not possible for a generator to benefit from both FITs and a grant from a public body except in specific circumstances. These are set out in the Feed-in Tariffs (Specified Maximum Capacity and Functions) Order and should be read alongside the additional clarification provided following the European Commission's consideration of the FITs scheme in relation to state aid (decision N94/2010).

Final decisions on eligibility are the responsibility of Ofgem. Ofgem may not accredit for FITs any installation that has received a grant from a public body except in certain circumstances. These exemptions are:

1 Permitted grants, ie those made before 1 April 2010 in respect of the costs of:
   - an eligible installation commissioned before 15 July 2009; or
   - an eligible installation on a residential property commissioned between 15 July 2009 and 31 March 2010.

2 Those complying under *de minimis* regulation.

3 Those who can demonstrate that a publicly funded grant is for justifiable

non-standardised costs, ie those additional costs incurred as a result of measures taken to reduce the environmental impact of an installation.

The primary programme for incentivising renewable technology was the Low Carbon Building Programme (LCBP), which provided grants of up to 50% of eligible capital costs for renewable technologies. This avenue closed in February 2010 for electrical microgeneration and in May 2010 for renewable heat technology.

9.3.1 Community Energy Saving Programme

The Community Energy Saving Programme (CESP) has been created as part of the Government's Home Energy Saving Programme. It requires gas and electricity suppliers and electricity generators to deliver energy saving measures to domestic consumers in specific low-income areas of the UK. CESP has been designed to promote a "whole house" approach and to treat as many properties as possible in defined areas.

CESP will also contribute to the Government's Fuel Poverty Strategy by requiring actions to be delivered in geographical areas that represent the 10% most deprived in England and the 15% most deprived in Scotland.

The CESP obligation period runs from 1 October 2009 to 31 December 2012. It will require some gas and electricity suppliers and electricity generators to meet a carbon emissions reduction target. DECC is responsible for setting the overall CESP target and the policy framework and Ofgem is responsible for administering the programme.

9.3.2 The Carbon Emissions Reduction Target

The FIT legislation requires all licensed gas and electricity suppliers that have at least 50 000 domestic customers and all licensed electricity generators that have generated on average 10 TWh/year or more in a specified 3 year period to meet a carbon reduction obligation.

The Carbon Emissions Reduction Target (CERT) (April 2008–March 2011) is the third, 3 year phase of an energy supplier obligation. It requires all domestic energy suppliers with a customer base in excess of 50 000 customers to make savings in the amount of carbon dioxide emitted by householders.

Under CERT, energy suppliers are required to deliver measures that will provide overall lifetime carbon dioxide savings of 185 $MtCO_2$ – equivalent to the emissions from 1 million homes each year. It is expected that energy suppliers will be required to invest around £3.2 billion in order for them to meet their obligation.

CERT requires suppliers to focus at least 40% of their activity on a "priority group" of vulnerable and low-income households including those in receipt of eligible benefits and pensioners over the age of 70 by increasing the energy efficiency of these households.

9.3.3 Renewables Obligation Certificates

ROCs have been the main financial support basis for renewable energy since they were introduced in April 2002. Power suppliers were required to obtain a specified proportion of the electricity they supply to their customers from renewable sources. The Obligation is guaranteed in law until 2027.

Those generating renewable energy are entitled to receive a ROC for each MWh of electricity generated. These certificates can be sold to suppliers in order to fulfil their obligation. Suppliers are required to produce evidence to Ofgem of their compliance with this obligation.

Each ROC represents 1 MW hour (1000 units) of electricity generated from eligible sources. Suppliers of electricity can either provide certificates sufficient to cover the required percentage of their output, or they pay a "buyout" price for any shortfall. All the monies received from buyout payments are distributed back to those suppliers submitting ROCs in proportion to the number they submit. The buyout price is set each year by Ofgem and is presently approximately £37.

From 1 April 2009, some technologies have been entitled to additional ROCs. These technologies are deemed to require greater financial support to secure viability and sensible investment returns.

Generators with installations of between 50 kW and 5 MW can make a once-only decision to opt into FITs. The one exception to this is where a generator is no longer eligible for FITs having added extra capacity to exceed the 5 MW maximum. In these circumstances the generator will be eligible to transfer to the RO for the remainder of their duration of support.

The variability of the price for ROCs compared to the certainty of payment under FITs and the guaranteed duration of payments are the main differences between the two mechanisms.

9.4 Energy strategy

FITs build on existing drivers to help meet the Climate Change Act targets. These include:

- the Merton Rule[37] (a policy which was named after the London borough that established it in 2003, requiring any new residential development of more than 10 units or any commercial building over 1000 m^2 to reduce its carbon emissions by a certain percentage through the use of on-site renewables)
- the Code for Sustainable Homes,[38] which measures the sustainability of a new home against nine categories of sustainable design, rates the "whole home" as a complete package. The Code uses a one- to six-star rating system to communicate the overall sustainability performance of a new home. It sets minimum standards for energy and water use at each level. The Code also supports the Government target that all new homes will be zero carbon from 2016 and the step changes in Part L of the Building Regulations leading to this.

Many developers of new build homes may have commitments to meet one or both of these and the FITs tariffs will greatly assist the economics of achieving these commitments. Increased output from renewables will improve the DER[39] and lead to additional credits under Ene1 – Dwelling Emission Rate and Ene7 – Low and Zero Carbon Technologies in the Code. There is a danger that the baseline specification will therefore be value engineered to the bare minimum. Many of the issues raised are similar to those raised by the introduction of Merton Rule policies – the balance of fabric and renewables approach to 10% reduction in carbon dioxide emissions is discussed further in NHBC Foundation publication *NF11 The Merton Rule: A Review of the Practical, Environmental and Economic Effects*.[40]

9.5 Financial strategy: potential mechanisms for housebuilders to share financial benefits with their customers

With the introduction of FITs, there is a clear opportunity for RSLs and housebuilders to benefit. However, it is not immediately obvious which business models will be the most successful. This section highlights some of the possibilities.

9.5.1 Private sale

The housebuilder installs renewable technology as part of new build or refurbishment, which is transferred as part of the sale to the buyer. A FIT compliance certificate is included with sale to allow the new owner to claim FIT payments. Effectively the NPV of the installation should be reflected in the ultimate sale price. The housebuilder maintains no interest post-handover.

9.5.2 Landlord – tenant

A private or Registered Social Landlord (RSL) installs technology on a rented property, and claims the FIT. PV output can be either donated free of charge to the tenant or sold at an advantageous rate through a power purchase agreement.

9.5.3 Energy services company

As above, but a third-party company or "special purpose vehicle" is set up to procure and operate a number of installations. This removes the burden of administration from the housebuilder or RSL, and isolates the debt and risk from the balance sheet.

9.5.4 Rent-a-roof

A third-party company leases an area of the homeowner's south-facing roof space, installs and maintains its own PV array and claims the FIT. The homeowner benefits from free electricity generated by the array. At the end of the 25 year FIT period, the third party removes the panels or leaves in place at the homeowner's choice.

9.5.5 Finance – install

A third-party company provides finance to the homeowner and installs a PV array. The homeowner claims FIT payments in order to service the debt. The risk here is with the homeowner: should the array under-perform for any reason, the debt remains.

9.5.6 Allowable solutions

Under the Government's definition of zero carbon homes,[41] a "hierarchy" approach to carbon reductions is likely to be followed, whereby a minimum percentage of carbon mitigation is required, firstly through high levels of energy efficiency in the fabric of the home and secondly through on-site low zero carbon technologies or connected district heat sources. Beyond this, there is recognition that developers will need recourse to other options in some cases due to site and economic constraints. These other options are termed "allowable solutions".

At present, the definition is still under development and there is uncertainty about exactly what these might be and how much they might cost – this is currently the subject of investigation by the Zero Carbon Hub. However, FITs will make installation of renewable technologies on a community scale[42] more commercially attractive and may be accepted as one of the routes for developers to meet a proportion of the operational carbon impact of a new development.

9.5.7 Strategic partnerships

Where construction or installations are on a large scale, strategic partnerships between RSLs/housebuilders, installers, and finance organisations may be realised.

9.6 Risks for those looking to take advantage of the scheme or choosing not to

Risks relating to the installation of renewable technologies and the uptake of FITs have been categorised as either financial, technical or reputational (Table 5).

Table 5

Risks relating to the installation of renewable technologies and the uptake of FITs

	Issue	Outcome
Financial	Cost of finance too high	Scheme makes reduced income or fails to achieve payback, payback period extended
	Cash flow	Difficulty in getting payment from energy users or suppliers
	Capital cost of installation unpredictable	Scheme fails to achieve payback, payback period extended
	Visual impact reduces scheme appeal	Lower capital value of assets
	Planning: resistance from residents and neighbours	Additional cost of responding to planning issues/redesign and resubmission of applications for consent
Technical	Choosing wrong technology	Reduced income compared to optimum technology
	Skills shortages drive up maintenance costs	Extra cost for specialist attendance, payback period extended
	Technology requires immediate expenditure to improve fabric before installation	Requires bringing forward maintenance expenditure
	Technology under-performs predicted service life	Scheme fails to achieve payback, payback period extended
Reputational	No installation	Housebuilder perceived as insufficiently engaged in sustainability issues

REFERENCES AND NOTES

1 Adapted from Design of a feed-in tariffs for sub-5MW electricity in Great Britain, report by Element Energy and Poyry for DECC, 2009, p57. Available from www.decc.gov.uk.

2 For further information refer to the DECC Smart metering implementation proposal prospectus: www.decc.gov.uk/en/content/cms/what_we_do/consumers/smart_meters/smart_meters.aspx.

3 Consultation of the Renewable Heat Incentive and impact assessment of the Renewable Heat Incentive available at: www.decc.gov.uk/en/content/cms/consultations/rhi/rhi.aspx.

4 kWp (kilowatts peak) is a measure of module output under standard insulation conditions.

5 This would be dependent on location and assumes a typical performance ratio of around 0.8 (ie a variety of loss factors such as inverter and cabling losses account for a 20% reduction in energy yield compared with an ideal "lossless" installation).

6 Ofgem has drawn together data that suggests the average household consumption to be around 3600 kWh per annum. See www.ofgem.gov.uk/Pages/MoreInformation.aspx?file=Review%20of%20typical%20domestic.%20consumption%20values.pdf&refer=Markets/RetMkts/Compl/Consumption.

7 This is covered in some depth in the DECC publication: Estimated impacts of energy and climate change policies on energy prices and bills. Domestic electricity prices are projected to increase by 31% in real terms between 2010 and 2020. A year-on-year increase of 2.75% above the base rate of inflation has been assumed in these calculations, extrapolated from the DECC estimates.

8 See section 7.2: Economies of scale.

9 Based on installer quotes, July 2010.

10 www.solarpowerportal.co.uk/news/uk_solar_inst45454245421245es_revealed.

11 Average per annum including replacement inverters.

12 Energy saved in first year. Assumed to decrease by 0.66% per annum due to module degradation.

13 Avoided electricity charges in first year; assumes electricity cost of 13 pence/kWh. This is projected to increase by 2.75% per annum beyond inflation.

14 Methodology guidelines on life cycle assessment of PV systems. Report IEA-PVPS T12-01:2009.

15 Note that this does not take into account potential changes in the National Grid electricity generating mix in future years (ie the National Grid is decarbonised with an increasing proportion of renewables feeding into it).

16 Capital cost £4000 per kWp, discount rate 8%.

17 Capital cost plus total discounted operational cost. MicroCHP includes cost of additional gas used given reduced thermal efficiency (75%) compared with an A-rated gas boiler (90%).

18 DECC. Carbon valuation in UK policy appraisal: A revised approach. 2009, p79. See www.decc.gov.uk.

19 NHBC Foundation. NF7 A review of microgeneration and renewable energy technologies. Milton Keynes, NHBC Foundation, 2008.

20 Power in numbers: the benefits and potential of distributed energy generation at the small community scale (Energy Saving Trust).

21 At discount rate of 8%.

22 Element Energy. Design of Feed-in Tariffs for sub-5MW electricity in Great Britain: quantitative analysis for DECC. (DECC, 2009).

23 Navigant Consulting Inc. A review of inverter technology cost and performance projections. (NREL, 2006).

24 Based on installer quotes, July 2010.

25 European Commission. Commission staff working document, Brussels, 57, 23 January 2008.

26 These include Australia, Austria, Belgium, Brazil, Canada, China, Cyprus, Czech Republic, Denmark, Estonia, France, Germany, Greece, Hungary, Iran, Republic of Ireland, Israel, Italy, Republic of Korea, Lithuania, Luxembourg, Netherlands, Portugal, Singapore, South Africa, Spain, Sweden, Switzerland, and in over 10 states in the United States.

27 Source: EPIA.

28 Renewables 2010 Global Status Report – REN21.

29 For a similar chart depicting Scottish figures, refer to the source report available at: DTI (2004), Renewable supply chain gap analysis.

30 www.isuppli.com/Photovoltaics/News/Pages/United-Kingdom-Becomes-Worlds-Fastest-Growing-Solar-Market-in-2010.aspx.

31 www.solarpowerportal.co.uk/news/uk_solar_inst45454245421245es_revealed.

32 Federal Ministry for the Environment. Nature conservation and nuclear safety – electricity from renewable energy sources: what does it cost? 2009. Available from www.bmu.de/files/pdfs/allgemein/application/pdf/brochure_electricity_costs_bf.pdf.

33 Estimated impacts of energy and climate change policies on energy prices and bills. www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/markets/impacts/impacts.aspx.

34 Energy Saving Trust. CE317 – Domestic low and zero carbon technologies.

35 Available from www.housing.org.uk/Uploads/File/London%20Housing%20Federation/Final%20Green%202%20Report.pdf.

36 ODPM. Planning Policy Statement 22: Renewable energy. Available from www.communities.gov.uk/documents/planningandbuilding/pdf/147444.pdf.

37 www.merton.gov.uk/living/planning/planningpolicy/mertonrule.htm.

38 www.communities.gov.uk/publications/planningandbuilding/codeguide.

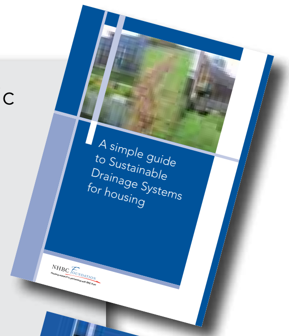
39 Dwelling Emission Rate as measured by SAP software.

40 NHBC Foundation. NF11 The Merton Rule: a review of the practical, environmental and economic effects. Milton Keynes, NHBC Foundation, 2009.

41 www.communities.gov.uk/publications/planningandbuilding/zerocarbondefinition and www.zerocarbonhub.org/definition.aspx.

42 Renewable installations on a larger scale tend to be more cost- and carbon effective, although FITs levels this out by offering greater incentives for small-scale generation.

NHBC Foundation publications



A simple guide to Sustainable Drainage Systems for housing This pragmatic guide is aimed at introducing the concept of SUDS and increasing the awareness of government policies and regulation in this area. Technical guidance is included for the differing options, their selection parameters, construction requirements and maintenance issues. The guide also covers relevant social and environmental issues, together with the health and safety considerations for incorporating these systems in housing developments. ***NF22*** July 2010

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NHBC Foundation publications in preparation

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- Zero carbon: Allowable solutions – energy efficient appliances and controls
- Zero carbon homes: Low and zero carbon cooking appliances
- Building sustainable homes at speed: Risks and rewards

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Introduction to Feed-in Tariffs

This guide aims to inform social landlords, house builders, and all those who wish to understand the FIT scheme and its implications.

It covers the eligible technologies and how the scheme works, illustrates financial returns and carbon dioxide emission savings through a number of worked examples, and identifies key issues and opportunities related to strategic implementation.

NHBC Foundation
Housing research in partnership with BRE Trust

The NHBC Foundation has been established by NHBC in partnership with the BRE Trust. It facilitates research and development, technology and knowledge sharing, and the capture of industry best practice. The NHBC Foundation promotes best practice to help builders, developers and the industry as it responds to the country's wider housing needs. The NHBC Foundation carries out practical, high quality research where it is needed most, particularly in areas such as building standards and processes. It also supports house builders in developing strong relationships with their customers.

NF23
Published by IHS BRE Press on behalf of the NHBC Foundation
January 2011
ISBN 978-1-84806-165-1