Energy Policy 42 (2012) 78–88

Contents lists available at SciVerse ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Can premium tariffs for micro-generation and small scale renewable heat help the fuel poor, and if so, how? Case studies of innovative finance for community energy schemes in the UK

R.W. Saunders [a,*], R.J.K. Gross [a], J. Wade [b]

[a] Imperial College London Centre for Energy Policy and Technology (ICEPT), Department of Environmental Science and Technology, Imperial College London, South Kensington Campus, London SW7 2AZ, UK
[b] Freelance Energy Consultant, UK

ARTICLE INFO

Article history:
Received 25 February 2011
Received in revised form
5 October 2011
Accepted 14 November 2011
Available online 29 December 2011

Keywords:
Feed in Tariffs
Fuel poverty
Renewable energy

ABSTRACT

In the UK, the introduction of micro-generation Feed in Tariffs (FiTs) and a proposed Renewable Heat Incentive (RHI) for domestic and small scale schemes have re-energised the market for investment in domestic scale renewable energy. These incentives may provide financial opportunities for those with capital to spend but for the record numbers with low incomes in 'fuel poverty', these benefits may seem out of reach. This paper shows that with appropriate financial intermediaries it is possible for renewable energy incentives to be used to alleviate fuel poverty.

Simple financial analysis demonstrates the theoretical potential of FiTs to help those in fuel poverty. Two case studies of renewable energy projects in low income areas investigate how the incentives may be used in practice, what barriers exist and what success factors are evident. The analysis shows that local energy organisations (LEOs) are key if the poor are to access benefits from premium tariff schemes. Low interest finance mechanisms, good information sharing and community involvement are found as key success factors.

1. Introduction

In the UK, the introduction of Feed in Tariffs (FiTs) and proposals for a Renewable Heat Incentive (RHI) were welcomed by the renewable energy industry. These policies seek to encourage uptake of small scale renewable electricity generation and renewable heat (Pocock, 2009). However, some commentators have voiced concerns about high costs and argue that they provide generous returns to those who have the financial wherewithal to invest, while the costs are borne by all consumers, including those on low incomes (Monbiot, 2010). Fuel poverty levels in the UK have risen in recent years and with an expectation of continued energy price rises (Ofgem, 2010b), the outlook for those on low incomes appears difficult.

This paper therefore investigates what role FiTs and RHIs can play in alleviating issues for the least well off in UK society, and addresses two central questions: Do FiTs and RHIs have the potential to reduce the fuel bills of the least well off? If so, how can this outcome be realised through intermediaries such as local energy organisations and assisted through policy? It is based on new research that combines quantitative assessment with qualitative case study analysis to assess the potential for active support of renewable energy (RE) installation in low income areas as a means of tackling fuel poverty.

2. Research approach

The first question, whether FiTs and RHIs can help alleviate fuel poverty, is addressed using simple financial analysis. This considers the potential positive and negative impacts that FiTs might have under different assumptions about financing, ownership and how returns are shared between householders and financiers. The possible impact of the RHI is assessed in more qualitative terms, reflecting the uncertainty around the detail of this policy at the time of writing.

To assess the potential for policy to support positive outcomes, a more qualitative approach is needed. FiTs and RHIs are very recent policies and there is very limited prior research linking the effect of these policies to fuel poverty reduction. Also, the issues involved are complex, involving multi-layered social interactions. Semi–structured interviews with key actors in two case studies were therefore used to investigate the opportunities and barriers associated with enabling renewable energy uptake in low income communities.

* Corresponding author. Tel.: +44 7826 656129.
E-mail addresses: rws09@ic.ac.uk, mail.robs@googlemail.com (R.W. Saunders), joanne.wade09@gmail.com (J. Wade).

0301-4215/$ - see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.enpol.2011.11.045

Based on a review of the literature, a theoretical causal framework was built to help structure the research and analysis (Yin, 2009). Within the framework model we consider three key causal feedback loops that, if enabled, can have a positive impact on fuel poverty in low income areas. The case studies were used to test the significance of these factors in reality and identify other important causal factors.

3. Fuel poverty in the UK

A household is said to be in "fuel poverty" if the ratio of fuel cost to income is greater than 10%, based on modelled energy needed to achieve a satisfactory heating regime (Boardman, 2010; DECC, 2009a, 2009e). There is some debate over the need for a separate measure of *fuel* poverty when other equally essential costs of living are not singled out in this way, and the 10% ratio is somewhat arbitrary (Brinkley and Less, 2010). However 'fuel poverty' provides useful shorthand and proxy for the impact of energy prices on the least well off, particularly when combined with poor quality housing and low levels of energy efficiency.

The previous UK government launched its fuel poverty strategy in 2001 with the aims of eradicating fuel poverty in vulnerable households by 2010, and in all households by 2016 (DECC, 2009c). The 2010 target will not be met and latest progress reports show the 2016 target will also be missed unless radical new action is taken. Fuel poverty in both categories has increased since 2003 when fuel poverty was at its lowest (DECC, 2009e), and it is likely that the number of fuel poor households today will have topped 5 million (Boardman, 2010).

Fuel poverty results from multiple factors and most people experiencing the problem are affected by one or more of the following four main issues: low incomes, rising fuel prices, poor housing stock and under-occupancy (large houses occupied by one or two, frequently elderly, people) (Boardman, 2010; Brinkley and Less, 2010; Druckman and Jackson, 2008; Roberts, 2008; ACE et al., 2008). We discuss each of these in turn:

Low income correlates strongly with fuel poverty. Over 90% of the fuel poor are in the lowest three deciles of income (ACE et al., 2008; Boardman, 2010).

Proportionally, the poor spend the most on fuel (Druckman and Jackson, 2008), which means that socialisation of the costs of emissions reduction policies through energy bills is likely to be regressive (Roberts, 2008).

Fuel prices are the main underlying cause of the increase in fuel poverty since 2003 (DECC, 2009e). Brinkley and Less (2010) demonstrate a clear correlation between the two through the last decade and recent scenarios show price rises ranging from 20% by 2030 to 60% by 2020 (Ofgem, 2010b; ACE et al., 2008).

Housing stock energy efficiency, as measured by the standard assessment procedure (SAP), is more complex. Improvements in housing stock are clearly important, but this is unlikely on its own to be enough to overcome fuel poverty. Preston et al. (2008) calculate that even if all the fuel poor lived in housing stock at SAP 65 or better, 40% would remain in fuel poverty due to low income.

Under-occupancy clearly contributes to fuel poverty for some households (Boardman, 2010). It is however difficult to address as there are many factors that keep people in large homes despite the difficulty they may have with fuel and other ongoing costs.

Government fuel poverty policy has been criticised for being poorly targeted in its approach (Vaze and Mayo, 2009). The main programmes used to tackle fuel poverty are Winter Fuel Payments, Warm Front, Decent Homes, the Carbon Emissions Reduction Targets (CERT) and the Community Energy Savings Programme (CESP). Winter Fuel Payments for example, which account for over 60% of funding for fuel poverty reduction, are the least well targeted; only 18% of households receiving the payment are fuel poor (Brinkley and Less, 2010).

Given that improving the energy efficiency of housing alone is unlikely to solve the problem, the key issues of low incomes and high bills are of paramount importance. In theory, household or community use of micro-generation with income from the FiT and RHI can reduce bills and boost income. We now consider whether these theoretical benefits can be achieved in practice. Note that the paper is concerned solely with whether and how FiT or RHI income could accrue to the less well off. We do not consider how such income might be spent, or whether there may be a 'rebound effect' leading to additional energy use.

4. Feed in tariffs and renewable heat incentives

Since 2002, the UK has relied on the Renewables Obligation (RO) to stimulate uptake of large scale renewable energy (DECC, 2010g) and the Low Carbon Buildings Programme (LCBP) to supply grants to help with domestic scale systems (DECC, 2009d). Critics of this policy mix have noted that LCBP grants were rarely large enough to adequately reward RE investment while at the same time requiring home energy efficiency standards that added extra cost (Seager and Walsh, 2007).

The RO takes the form of a statutory obligation on electricity suppliers to meet a rising fraction of their sales from renewable sources. Compliance is demonstrated through the presentation of Renewable Obligation Certificates (ROCs), which are tradable (for a full description see Ofgem, 2010c). The RO has been argued to be unattractive to many potential small generators due to the cost, complexity and price uncertainty of participating in a full scale market mechanism (DECC, 2009f). Moreover, many small scale generation options are expensive relative to large scale wind and other renewables and the levels of support available through the RO may be insufficient to encourage investment (DECC, 2009f).

Following the 2008 Energy Act, FiTs were introduced in 2010 for small scale RE electricity generators (DECC, 2010b). Tariffs are banded by technology and scale to provide fixed prices per unit generated and per unit exported to the grid. The tariffs are designed to provide a return on investment of 5% to 8%, for a well designed and sited renewable energy installation (DECC, 2010b).

Several commentators point out that socialisation of the costs through consumer bills is inherently regressive in nature (see, for example, Monbiot, 2010) since this rewards those who can afford to participate at the expense of those who cannot. In addition, the cost per tonne of abated CO_2 appears high, especially for the high tariff technologies such as photovoltaics (PV). Other issues raised include the lack of impact assessment across different income deciles and household bands (Consumer Focus, 2008) and the potential that the rate of return is insufficient to encourage third party finance (Timms and Hume, 2009).

The renewable energy industry response to these concerns focussed on the expected price reductions in PV and other technologies, which would result from stimulating the industry; the potential for building an employment base in UK manufacturing and installation (Leggett, 2010), and the fact that the policy is forecast to add only £9.50 per year, or 1.5% to average consumer bills in the period to 2030 (DECC, 2010c).

DECC also make a case for FiTs as a way of enabling engagement of households in energy efficiency and energy use behaviour change (DECC, 2010c). Whilst this stance is criticised by some fiscal commentators analysing the economics alone (Less, 2010), it is a much needed outcome if we are to meet national carbon reduction targets.

At the time of writing, the Comprehensive Spending Review has committed to maintaining FiT until at least 2013, when

Table 1
Extra household incomes resulting from PV installation using three financing schemes.

Costs & Benefits (in 2010£/yr per household*)	2020 energy price same as 2010 in real terms	2020 energy price at +20% vs 2010 in real terms
Electricity bill saving	£105	£126
Generation and Export Tariff Revenue	£706	£706
Total FiT benefit (tariff revenue plus bill savings)	£811	£832
Simple payback time from full FiT revenue (yrs)	10	9[a]
Average socialised FiT cost per household in 2020	£10	£10
Net benefit for household taking full FiT revenue	£801	£822
Net benefit for household using PAYGen	£95	£116
Net benefit for household using a low interest loan, repaid over 25 yr life at 4% interest rate.	£150 (yr 1) £467 (yr 25)	£171 (yr 1) £488 (yr 25)

* 'Household' is used as shorthand for each domestic bill payer. The literature tends to use 'household' and 'consumer' interchangeably, though strictly speaking the number of the latter is larger than the former. The data are based on the number of metered bills, and for the most part each household in the UK will have a single electricity and gas meter.

[a] Assumes linear energy price increase 2010 to 2020 and beyond.

support levels will be reviewed, and to the launch of a reduced RHI in 2011/12 (DECC, 2010e). The details of funding for RHI, technologies that will be covered, and rates of return that will be achieved are currently unclear.

5. Potential financial benefits

5.1. The impact of FiTs

A simple financial analysis of costs and benefits can help understanding of the impact of FiTs on low income households. Table 1 considers the relevant finances of installing a 2 kWp PV system priced at £8,300 (an average price across three UK quotations) (Solar Century, 2011; Solar Guide, 2011; Which, 2011). Using a European solar resource model, this panel can be expected to generate 1650 kWh per year in a central UK location (Leeds) on a south facing roof (E.C., 2010). Solar installation in southern parts of the UK (also home to a larger fraction of the population) would be somewhat higher than in Leeds (output in London circa 1750 kWh/yr), and the performance of the system might thus be considered conservative.

Some of this power will be used in the home, attracting a generation tariff of 41.3p per unit (DECC, 2010b) while also saving on the cost of purchasing that electricity at the average UK retail rate of 12.7p per unit (DECC, 2010h). If the panel happens to be generating more than is being used in the home, then the excess is exported to the grid, attracting an extra 3p (DECC, 2010b) per unit. DECC model a 50% proportion of export, a high assumption for a panel of this capacity, but a conservative one in terms of financial payback (DECC, 2010b). These assumptions result in a FiT generation revenue of £681.45, an export revenue of £24.75 and an avoided electricity purchase cost of £104.78 (compared to an average UK bill of £500 (Ofgem, 2010a)); a total annual benefit of £810.98 per year. A household that makes every effort to switch use of appliances to a time when the panels are generating will avoid more electricity purchase and so save more money than a household with a higher proportion of demand outside daylight hours.

Table 1 illustrates three possible finance mechanisms:

- In the first instance the householder provides fully for the investment cost of purchase and installation, retaining the full value of the FiT income as well as saving electricity bills. This scenario is used as a reference, but is unlikely to be available to most low income households.
- In the second, we consider the 'pay as you generate' (PAYGen) schemes as being offered by some companies where PV is installed free of charge by a third party, the bill savings are kept by the household and the generation and export tariffs are taken by the third party as payment for the panel over the FiT lifetime.
- Thirdly a low interest (4%) loan is used to pay for the installation.

The year modelled is 2020 when the peak cost of the FiT is predicted in DECC's impact assessment at an additional cost of £9.50 per household (DECC, 2010c). In addition, two electricity price scenarios are considered.

The examples in Table 1 demonstrate the potential for FiTs to provide very real benefits to households installing renewable energy technologies, in this case PV. Performance will depend greatly upon availability of a suitable un-shaded and south facing roof for PV, and on other resource constraints for other micro-generation options. We assume that the installation is professionally undertaken, appropriate, and hence that output is aligned with expectations. The table is illustrative and pertains solely to the particular case.

Under a PAYGen scheme, a household might expect to benefit by £95–£116 per year (net of the socialised costs of the FiT scheme), a significant disposable income boost for those in the lowest decile of income receiving average total income after housing costs of around £100 per week (DWP, 2010). Access to low interest finance used to purchase PV panels enables net benefit, compared to the PAYGen case, to increase by 50% in year 1, and by five times towards the end of the life of the unit when the capital is almost paid off and more of the tariff is kept by the household.

Considerably broader benefits than those shown are available if the operators of PAYGen schemes are able to benefit from bulk purchase and installation costs, which are significantly lower than those for individual, small installations. For those installing over 10 kWp of capacity overall, an equivalent cost of £5500 for a 2 kWp capacity scheme might be typical at the time of writing (South Facing, 2011) and at this level of outlay, an internal rate of return (IRR) of about 12% and an 8 year payback is likely. As an example, a similar financial analysis shows that a bulk installer such as a housing association, accessing a 4% interest loan to install panels while taking FiTs to pay off the capital and loan charges will make over £250 per year per 2 kWp capacity installed, an amount which might either be used to further subsidise household fuel bills or for reinvestment.

It should also be noted that if electricity prices rise, the benefits to households become greater as greater protection is afforded by the installed RE generation. For example, the net benefit of installing a PV system under a PAYGen scheme would enable our hypothetical household to offset a 19% rise in electricity bills. A 4% interest loan scheme could protect such a household against rises of 30%–90% over its 25 year life.

Compared with these benefits, the socialised cost per household seems relatively small. However, the size of the personal benefit compared with the socialised cost per consumer derives in part from the premise that only a small proportion of households will install the technologies: for every household accessing the benefit, many will pay the socialised cost. Thus, to have maximum impact on fuel poverty, it is important to facilitate the participation of low income areas in FiT schemes at as high a level as possible. Low interest funding will be critical to maximising benefits that the fuel poor are able to realise.

5.2. The potential impact of Renewable Heat Incentives

The RHI is proposed for introduction in 2011/12 and is essentially a feed in tariff for renewable heat (DECC, 2010f). Adequate heat provision is the critical service that those on fuel poverty often cannot afford, and on an energy use basis heat is three times as important in domestic use as electricity (DECC, 2009b). This makes the RHI very important to introduce but the extra use of heat also has the potential to make it a more expensive measure in terms of its possible impact on bills.

Following announcements about the RHI made in the October 2010 Comprehensive Spending Review (DECC, 2010e), and in March 2011 (DECC, 2011), there remains significant uncertainty around funding and RHI design for domestic deployment of renewable heat systems. It is not possible to adequately quantify the effect of RHIs but we must assume that an incentive similar to that of the FiT will be given to those who invest, and that access to low interest finance will be important in determining how much of that benefit ends up with those on low incomes.

However, making renewable heat financially attractive via third party financing may be more challenging than renewable power. At least for on-grid gas customers, the cost of heat energy is much lower than the cost of electricity and modern gas boilers offer very high efficiencies. The value of the energy displaced by a renewable energy system is therefore much lower for gas heating than for electricity. Moreover, many renewable heat technologies have significant running costs (for example electricity in the case of heat pumps or wood pellets in the case of biomass boilers) that may be similar to mains gas heating. In these circumstances, a PAYGen financing model as set out above in relation to FiTs where the full tariff is taken by the equipment supplier, may fail if there is little or no financial incentive to the household in the form of reduced bills. Without this there is no reason for a household to change their heating system.

RHI financing mechanisms will therefore need to be somewhat different to provide benefits from renewable heat to those households without the capital to invest themselves. This could happen in two ways:

- Firstly, if the payback rate of 10–12% return on investment, as proposed by DECC initially, (DECC, 2010f) is delivered in the final policy, this will allow some room for PAYGen operators to take a proportion of the tariff while returning the rest to the household as incentive for participation. This would allow the PAYGen operator to take a similar return rate to a FiT installation (e.g. 8%), while paying the household the remaining amount (3%). In a hypothetical £10,000 renewable heat installation, this might benefit a household by £300 per year.
- Secondly, if final RHI return on investment rates are lower than originally proposed, then low interest finance will be key to delivering a benefit to households not able to invest themselves. As in the example in Table 1 for FiTs, a low interest loan enables a significant portion of the tariff to be returned to the household, as long as the interest rate on the loan is lower than the return rate of the RHI.

For those without mains gas the situation is different because their heating fuel costs are currently significantly higher. In fact off gas grid properties have a significantly higher likelihood of being in fuel poverty, and rural properties are often hard to insulate or otherwise improve (Boardman, 2010). Offgrid therefore ought to be an area of focus and a standard PAYGen scheme is likely to still provide significant financial benefit to a group of fuel poor that can be difficult to assist.

There is also concern that the RHI may provide lower financial benefit than expected because many households in fuel poverty under-heat their homes to save money (Boardman, 2010). Thus, savings calculated on average bills or predicted energy usage are likely to overestimate actual financial benefit if that is reliant on fuel bills savings. The RHI is likely to be awarded on the basis of 'deemed' (estimated on the basis of standard performance rather than metered) energy output because of the difficulty in measuring heat provision. Therefore, the tariff paid will not depend on heat actually used, so if a proportion of the tariff is returned to the household as proposed above in a modified PAYGen mechanism or under low interest finance, then this concern is lowered.

The detail of the final RHI policy is needed to quantify these issues fully, but it seems clear that the fuel poor can be helped to benefit with the right policies, payback rates and finance mechanisms. Those off gas grid are likely to benefit most financially from it, while those on mains gas are likely to need low interest finance or adapted PAYGen schemes in order to access financial benefits from renewable heat.

The next element of the study considers the barriers and opportunities that exist for FiTs and RHIs to help low income households, and how such help can be enabled.

6. Enabling fuel poverty reduction through micro-generation: How to bring the benefits of premium tariffs to lower income households?

Having established that there is the potential for FiTs and RHIs to help in fuel poverty alleviation, we must now address *how* this might be achieved. Those in fuel poverty are unlikely to be in a position to invest directly in renewable energy for their homes (Boardman, 2010). Third party investment could be provided by an existing energy supplier or other private company but improved levels of participation and overall benefits to the community may be achieved if the investor is an organisation run by or for the local community (Walker, 2008). In this paper, this community owned / controlled investor will be called a 'local energy organisation' (LEO), a term which covers a range of possible organisations including charities, community groups, housing associations, local authorities and energy services companies. To investigate the means by which FITs and RHIs might benefit low income communities, two case studies (the MOZES project in Nottingham and Chale community project on the Isle of Wight) were selected: both involve installation of RE in low income areas, and each is relatively large and well developed compared to other UK initiatives in this area. Both are beneficiaries of DECC low carbon communities challenge (LCCC) grants and operate via a LEO (Box 1).

7. Method

A series of semi-structured interviews were conducted, face to face where possible, with a broad cross section of stakeholders in

Box 1–The case studies.

	MOZES (Meadows 'Ozone' Energy Services)	Chale Community Project
Location	Inner City Nottingham	Rural Village Edge, Isle of Wight
Stated Aims of project	• Make the Meadows a 'Carbon Neutral' community • Counter fuel poverty increase in low income areas from rising cost of energy • Engender a sense of pride in the community again • Help low income residents in hard to treat (HTT) homes. • Establish a sustainable mode of operation by reinvesting income from installations.	• Provide a whole house energy solution to the social housing residents of Spanners Close. • Get everyone out of fuel poverty; cut the cost of fuel to the houses by up to 50% • Provide training and teambuilding for some of the residents to become renewable installers with the hope and expectation of helping them to find jobs in the industry later. • Providing training on the use of the renewable technology for other Chale residents, "Community Contacts" • Using the project as a message carrier to the IoW community and beyond.
Residents	'High' levels of fuel poverty	'High' level of fuel poverty 87% on benefits
Housing	33% Victorian terrace (hard to treat) 66% 1980s terrace (with cavity wall) Gas heated	100% 1970s terrace (with cavity wall) Off gas grid with electric storage heating
Size Covered	3800 properties	67 properties in Spanners Close pilot
Tenancy	Mixed: Privately owned, private rental and social housing	Social housing only
Local Energy Organisation	Community ESCo	Community Interest Co. (CIC)
RE Installations	PV × 55	PV x 65 (aim)* Air Source Heat Pump (ASHP) to wet (radiator) heating and hot water x 65 (aim)
Project Status	First installations May 2010 Installations ongoing	Installations May 2010 Installations ongoing
Other Activities	• Schools PV installation • Green community centre • Phase 2 planning (wind turbine) • Energy advice service and 0% interest loans for energy efficiency through local credit union	• Local skills training in RE installation (8 residents in training) • Broader community engagement projects • Phase 2 planning (wind turbine) • Energy use behaviour advice and training • Project 'blueprinting' as learning tool
Funding	• DECC LCCC grant £0.5 m for PV. Recycling of FiTs to ESCo. • Various other minor grants • British Gas Green Streets support for energy efficiency measures.	• DECC LCCC grant £0.5 m for ASHPs. • Recycling of ASHP RHIs to CIC from 2011. • Various other minor grants • Eaga clean energy programme funds PV. FiTs to Eaga as payment. • Ellen MacArthur Foundation (EMF) fund most project costs.
Installation Partners	British Gas	Eaga
Interviews Conducted	Eight in total including; • Residents of social housing • Residents of privately owned housing • MOZES board members • Meadows Partnership Trust (MPT) employees • British Gas employees	Eight in total including; • Residents of Spanners Close • Delivery team members & Steering team members • Parish Council Leader • Housing Association employees • Eaga employees • Ellen MacArthur Foundation employees • Partner Charity employees

*At the time the research was undertaken a small number of residents were still to agree to installations.

each case. These included residents, installers, LEO organisers, housing associations and local charities. Frank responses were encouraged by the maintenance of anonymity for the interviewees. The responses were analysed within a theoretical framework that is described below.

7.1. A theoretical framework

A systemic causal model was built prior to the interviews, based on a review of relevant literature and the financial insights generated above. This model was developed to help identify possible key factors and interactions that may aid fuel poverty reduction and was also used as a framework for analysis of the qualitative case study data. The model was developed to reflect the complexity of social systems, their adaptive nature and the resulting multiple interactions and strong feedback loops (Buckley, 1981). The model is not an attempt to 'define' the situation but rather it is to be used as a tool for further understanding of key effects (Mingers and Taylor, 1992) and to go beyond simple linear cause and effect relationships which are unlikely to be effective in this situation (Morris and Martin, 2009).

Three key feedback loops were identified in the theoretical model, each of which was thought to contribute to the desired output of reducing fuel poverty: RE economics improvement (i.e. cost reduction, performance improvement), LEO funding development and local social factors. Other feedbacks may be present but the authors took the view that these three are those of most significance, a view reinforced by interviewees from within the LEOs concerned. We explore the theoretical basis for each in turn:

Looking firstly at *RE economics*, upfront costs and slow payback are the biggest barriers cited by most recent studies (Caird et al., 2008; Allen et al., 2008; Walker, 2008; Watson et al., 2008; Walker et al., 2009; Williams, 2010). The improved economics brought about by FiTs and RHIs overcomes many of these barriers and may lead to the start a cycle of increased demand, scale-up of the industry (Legett, 2010) and resulting in reduction of costs with volume and learning (Milner, 2008), and thus further improvement in payback times. The availability of skilled installers is also cited as a barrier (Watson et al., 2008), and this also may be overcome as installation capacity is scaled up in line with the general expansion of the industry.

The *funding of LEOs* to date has largely been through pilot schemes such as the recent LCCC grants programme (DECC, 2009d). Grant funding is not sustainable beyond a few pilot schemes, and is often replaced by pay as you save (PAYS) schemes, examples of which are evident from the Energy Saving Trust (EST) pilot programme (EST, 2010). Successful pilots in low income areas should be expected to encourage more schemes to operate. Both grants and PAYS or PAYGen schemes encourage the formation of LEOs for whom operating finance is a key barrier to operation (Walker, 2008).

Finally, *local social factors* play a significant role in the success of LEOs. The limited access to capital of low income residents provides a significant barrier to RE uptake as discussed earlier. LEOs can take on the risk with the end user only having to sign up to reduced energy bills (and potentially excess FiT or RHI income if low interest finance is found). While this should reduce the barrier, other social issues are also at play. The LEO must earn trust in its leadership from the community in order to overcome social inertia and encourage participation (Walker, 2008; Rogers et al., 2008). An open approach and good accessibility of the organisers to the community are important in achieving this while ensuring there are no conflicts of interest (Walker et al., 2009; Consumer Focus, 2008). Absence of visible successes to follow may inhibit participation (Rogers et al., 2008), so the model assumes that increased trust is fostered by demonstration of success, which in turn generates more participation and therefore more success. Poor availability and dissemination of information are further key barriers to uptake (Watson et al., 2008; Allen et al., 2008), and the independence of the information is also crucial (Bergman et al., 2009). Social inertia is a known phenomenon; for example, the vast majority of householders in London see it as 'someone else's' responsibility to drive uptake of renewables (Sauter and Watson, 2007). In our model we assume that a LEO is able to provide relatively independent advice and to tailor information for maximum relevance to the area and audience, while overcoming inertia by providing solutions that don't require significant action from the end user.

Following case study interviews, minor modifications were made to the causal model as additional insights were revealed and the final version represented diagrammatically below (Fig. 1) with national policy objectives at the top and local issues towards the bottom.

8. Case study findings

The case study data were analysed by using the key components of the model as a framework, and the results of this analysis are discussed below in five sections: data showing evidence of fuel poverty reduction, data concerning each of the three key feedback loops, and other evidence gathered.

8.1. Evidence of fuel poverty reduction

Clear evidence of reductions in fuel bills was seen in both the case studies and these exceeded the 30% reductions predicted by the LEOs at the outset of the projects. For example:

> 'Most people are on key meters, so you can see how much is being spent easily. It can go up to £35/week or more for one couple with kids…[They] cut the bill in half in the first week [after having ASHP installed]' (IC02, 2010).

However, both projects are still within the first few months of implementation and a full picture of the savings achieved will only be possible if measurements are taken over a longer timeframe. In addition, there are concerns at Chale that monetary savings may not emerge at all because of the way storage heaters have been used in the past:

> 'Most people use one storage heater or none at all… because they're too expensive and difficult to control. Many have solid wood stoves or portable single bar heaters that are cheaper or easier to control' (IC04, 2010).

Even if the financial savings do not materialise, there is likely to be an improvement in thermal comfort at the same cost since many in Spanners Close manage their fuel poverty by heating their homes below safe comfort levels, having run out of money for the week (IC03, 2010), or choosing to trade off heat for other budget necessities. This has the potential to improve wellbeing for the households concerned:

> 'Many houses around here get very cold in the winter – and underlying health problems are really problematic in these circumstances.' (IC04, 2010).

Since fuel poverty is defined at specific thermal comfort levels (Boardman, 2010), there will be a reduction in fuel poverty whether that be through monetary savings or improved thermal comfort.

These initial findings demonstrate that there should be some confidence in fuel poverty reduction from LEO projects. Improved health from better thermal comfort also seems a likely outcome, although longer term measurements are needed to confirm these early results.

8.2. Evidence for improvement of RE supply and economics

There is evidence that the improved financial situation resulting from FiTs is encouraging LEO operation. It is allowing LEOs to plan in the longer term and to be more ambitions in those plans. MOZES plans to use FiTs from their PV panels to feed back into their fund for future projects (IN04, 2010). Their second phase, a large wind turbine, will rely on FiTs to pay back their investment, one that would have been difficult previously. There is excitement at seeing the reality of recycling FiT revenue back into future projects in a sustainable way (IN07, 2010).

In Chale, despite future uncertainty over their future revenue support via the RHI, the installation of so many ASHPs in one location is seen as a sign of a new scale of demand;

> 'It's quite unique.... the number of ASHPs being put in one consolidated area' (IC07, 2010).

Eaga's clean energy programme, set up over just the last few months as a PAYGen scheme for social housing (Eaga, 2010) shows that some commercial organisations are already taking advantage of the new situation for their financial benefit, and that of low income communities. At least three other solar PV companies are offering similar deals to any suitable household in the UK (Vaughan, 2010). While Eaga's deal in Chale is an example which could be described as a win-win situation where all parties benefit, the scheme still causes some controversy:

> 'you can look at this in two ways – Eaga making a profit out of this [from PV FiTs] could be seen as a bad thing because it's profit that could be benefitting the community, but there's no way that it could happen any other way...the only way for householders to benefit from FiTs directly is for them to pay for them directly but that's just too much to achieve...only question to be asked is why housing associations aren't considering investing in this themselves. Lots of pension funds are doing it....' (IC08, 2010).

A non-profit LEO with access to low interest funding has the potential to overcome this tension between private profit and fuel poverty reduction, but a new source of funding will be needed to enable this outcome.

Local skills were not used on either project, due to lack of local capability, but overall skill levels are not seen as an issue by installers who are planning on large scale up of installation capacity in the next three years (IN07, 2010). While there is clear evidence of increased demand and financial certainty from FiTs, it appears too early as yet to see evidence of cost reduction, although all the conditions appear to be in place for the industry's cost reduction forecasts to occur (Milner, 2008).

8.3. Evidence for LEO funding improvements

Both case studies involve LEOs that emerged as a result of a funding opportunity. MOZES was set up to take advantage of grants made available for communities like the Meadows (IN04, 2010). In Chale, the DECC LCCC grant spurred the Ellen Macarthur Foundation to pull together the group of people needed to start the project there (IC08, 2010). However, it is clear that grants like this are unlikely to be continued (DECC, 2009d). PAYGen schemes

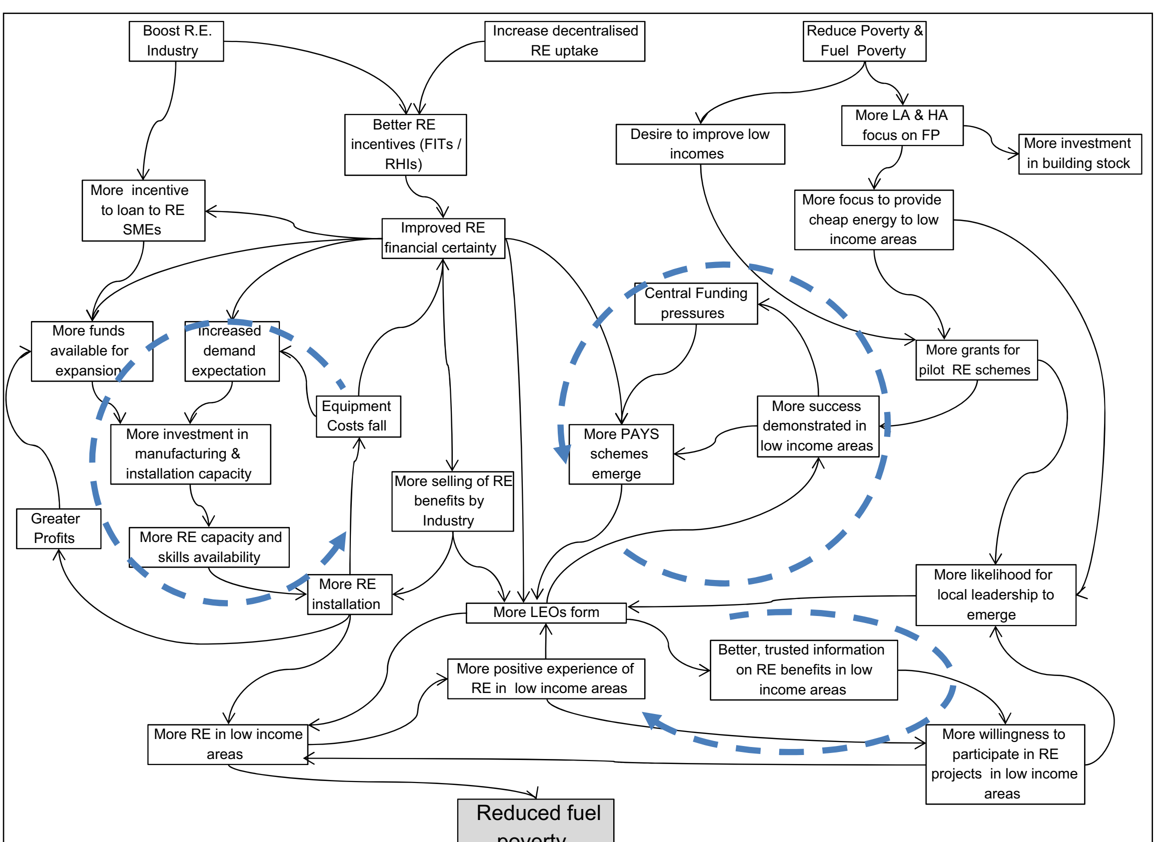

Fig. 1. Causal model showing FiTs and RHIs positively impacting fuel poverty. Three key feedback loops are represented with dashed lines (author's own).

are emerging to fill the gap but are emerging from private organisations fastest (Vaughan, 2010) while EST pilot PAYS schemes, (which could potentially be extended to PAYGen operation but are mainly designed for energy efficiency measures) are likely to deliver far behind commercial PAYGen activity (EST, 2010). Chale are also investigating 'social lending' as a potential source of low interest funding (IC03, 2010).

The sustainability of funding arrangements has a great impact on LEO operation. Grant funding of both LEO operations has been the driving force for their existence but also their biggest headache. MOZES and the previous 'Ozone' project in Nottingham have been chasing funding for many years and as one board member said, 'we can carry on being fortunate in winning money, but how sustainable is that?' (IN04, 2010). While the hope is that FiT and RHI will provide enough revenue to sustain a LEO, the reality is that this will only facilitate a very slow growth in activity. At 6.5% FiTs return on a grant scheme, if 50 units are installed in year 1, three more might be able to go in during years 2 and 3, with four more in years 4, 5 and 6. And by that time, as discussed earlier, there are many private companies that are likely to have got there first. With more grants unlikely and the inception of a 'green investment bank' some time away, LEOs face trying to find scarce low interest finance in order to maximise return of FiTs revenue to the community, or using commercial schemes which only pass on bill savings.

Apart from the financial benefits, funding arrangements affect the way a LEO can operate. In Nottingham, constantly chasing grants causes constantly changing strategy, and has caused real questioning of whether to radically change their operating model in order to ensure more secure income:

> 'We don't know where the next funding is coming from, and therefore it's very difficult to set up a real "strategy" because the next funding may come from someone who wants you to do something different…' (IN04, 2010)
>
> 'We have big questions coming up. Should MOZES supply power [to Meadows residents]? Or do we continue to partner with British Gas and let them do the supply with MOZES the "persuaders"?…Taking on supply would enable a critical scale, a secure revenue stream and allow us to implement things like rising block tariffs to discourage over use – things that traditional supply companies can't easily do. We're at a crossroads in terms of next steps…' (IN04, 2010)

There remains some concern in the MOZES team that attempting to supply electricity to the community might endanger the high levels of trust afforded to them currently because of the negative opinion that many hold about electricity suppliers.

In Chale, grants forced the timeline of the project to go much faster than it would have otherwise (IC05, 2010) and meant that the feasibility assessment was very rushed and energy use baseline studies were limited (IC04, 2010). The Chale team see the future of the project as FiT and RHI funded where possible with social lending being used to aid larger scale installations like wind turbines (IC08, 2010).

Both case studies have shown that a stable supply of funding is important for LEOs to operate effectively over the longer term and that the degree of success in reducing fuel poverty locally will depend on the availability of low interest finance.

8.4. Evidence for local leadership and participation

In both case studies, local leadership emerged in response to the availability of grants, and local organisations led the initial grant applications. In the case of MOZES, the organisation emerged from the community directly via the existing partnership trust (IN04, 2010). At Chale, initial leadership came from a local RE consultant who saw the opportunity that LCCC competition could have for Chale and encouraged the Ellen MacArthur Foundation (EMF) to support the project. A group of key stakeholders was then drawn together under EMF leadership to apply for the DECC LCCC grant (IC05, 2010). While this leadership did not emerge from the community directly, the group ensured that they brought the community into the project very quickly and fully by setting up a steering team made up of community members to oversee the project and ensure that community needs were met (IC08, 2010). This community-controlled approach appears very important to both projects:

> 'It's essential that leadership comes from the community. People can be dismissive of outside influence. X [community group leader] has been working in this community for years and has the trust of the community' (IN06, 2010).
>
> 'People from the community must steer and drive it. It must be done by people that really care about the community' (IC06, 2010).

The way that information was initially communicated appears significant. Finding a route that people trusted has proved effective:

> 'I went to a neighbourhood watch meeting and they were offering free [PV] panels. I trust them because I've been going to them for years' (IN02, 2010).
>
> 'We got a letter but X went to the one stop shop [community advice centre] to check it was real and could be trusted' (IN03, 2010).

However, signing people up for participation still proved a slower process than expected due to a number of factors:

> 'The biggest surprise for me was that when people are offered something for free that's going to save 50% off their bills and they're saving the planet as well, why do they still say no? We have to acknowledge that it's invasive and people don't want strangers in their homes.' (IC05, 2010)
>
> 'There's a wait and see attitude from some – they don't like taking on new things' (IN06, 2010).
>
> 'Participation has jumped on the road since ours went in. They [others on the road] wanted to know how we'd got it and I said you had a letter about it…but they probably just threw it away because it looked like junk mail. Anyway they all wanted it. Now there's five going in on this road.' (IN03, 2010).
>
> 'Seeing is believing in this kind of project. It's like the iPhone – once you've seen it being used by other people, everyone wants one' (IC07, 2010)

The kind of message used was felt to be very important. Information must be tailored for individuals and their needs as much as possible (IC02, 2010). However, most focus in both projects was placed on financial savings and little made of environmental benefits, with the former seeming to be the main motivator for those participating:

> 'We got a letter from MOZES offering PV installation….and expecting 30% reduction in bills so we phoned up to take part.' (IN03, 2010)
>
> 'This project is very clear that it's not about being "eco-friendly" and changing lifestyles. It's very functionally about protecting against fuel poverty…[and we're] very clear about engaging people on this basis rather than eco-messaging.' (IC08, 2010)

The final part of the causal loop in social issues concerns the positive experience of one LEO causing other LEOs to form elsewhere. It is too early to see this occurring although the Chale project has an aim of using its project as a blueprint for other areas (IC08, 2010).

The case studies provided good evidence of the positive cycle of trusted information, and also that demonstration of success causes greater participation. It remains too early as yet to see evidence of more LEO formation caused by successes of other LEOs, but this remains an expected outcome that should be sought from future studies in this area.

8.5. Other evidence

In addition to evidence of fuel poverty reduction and the three key feedback loops, a rich body of data was found concerning how successful LEOs operate, and the local effects they can have.

The case studies demonstrate that an LEO is able to ensure the right deals are done by enabling the community to set requirements and steer projects while using its scale and negotiating power:

> 'we bought five PVs from the money we saved from the tender process [for ASHP installations] and persuaded Eaga to match fund the FiTs for those five…and Eaga have also signed up to install panels on South Wight housing all over the island…the Chale project gets 1% of all of those FiTs.' (IC06, 2010).

Participants in both case studies see this ability to provide best value from a project in the most locally relevant way as very important in being able to demonstrate success to encourage more finance and LEO formation.

While energy behaviour change is seen as important in both projects, it is too early to measure effects here. Anecdotal evidence is contradictory, with one resident explaining how they might run their appliances more during the day, when the PV output is most, to maximise savings (IN06, 2010), while another talked more about being able to run appliances more, now that her bills were being reduced (IN02, 2010). The scale of the challenge is appreciated in Chale: 'Behavioural work is often the biggest challenge – the hardware installation can be the easy bit but how to get it used wisely is trickier…' (IC05, 2010).

People in both case studies expect to achieve positive community cohesion outcomes from their projects, though again it is too early to measure this. In Nottingham it is hoped that the project will 'rebrand' the area and regenerate some pride amongst residents who are already a very tight community (IN04, 2010). In Chale, where Spanners Close exists as a social housing project added to a relatively affluent village in the 1970s, an opportunity is seen to better integrate the two halves of the community, but for those in wider Chale, seeing large amounts of government money spent in Spanners Close has been problematic:

> 'Unfortunately because all the DECC money is going into Spanners Close, it might reinforce barriers with wider Chale.' (IC04, 2010)

Other services that benefit the whole community (minibuses, energy advice, schools projects and special Eaga deals on PV) are being used to try to spread inclusion in the project (IC03, 2010; IC05, 2010). On a more individual level one resident commented that the simple action of having to go round and talk to people about the project 'has been good for getting people talking and more involved. It's helped to bring down barriers…' (IC02, 2010). It remains early in the project, and further investigation will be needed in the future to properly assess the long term social cohesion impacts of such projects.

Neither project managed to use local workers in their installations because of lack of skills availability. Both have aspirations to change that, with the Chale project incorporating a training programme for six Spanners Close residents who see a big opportunity:

> 'Unemployment has been a big issue here since the 80 s when lots of industries packed up overnight …[this is] a great opportunity to re-skill and set up in the renewable energy business… and it's really boosted the confidence of some who have never had any qualification before' (IC02, 2010).

In Nottingham a shadow youth board has been set up to give experience of managing issues like these to young people and to attempt to help to 'break the cycle of intergenerational unemployment by setting up internships and apprenticeships and opening up the minds of the young' (IN04, 2010). Further longitudinal study will be needed to evaluate the long term results of these initiatives.

Both case studies demonstrated how LEO projects can negotiate improved and appropriate deals for local communities. They are also expected to help social cohesion and employment prospects locally, but these effects will need to be confirmed via further study in the future.

9. Discussion and conclusions

The analysis set out in this paper shows that where physical constraints allow, domestic renewable energy (RE) can, with the benefit of FiT (and potentially future RHI) revenues, play a significant role in reducing fuel poverty in individual households. For many in fuel poverty, improving the housing stock alone is not enough to offset substantial fuel price rises. At present the financial barriers to uptake for low income households mean that the policy has considerable potential to be regressive. Innovative finance is needed to address this; we consider both 'PAYGen' schemes where a third party owns the renewable scheme and a low interest loan.

Our analysis suggests that it is possible for the benefits to a participating household to far outweigh the additional costs of the FiT even if bill reductions are the only benefit to accrue to the household (i.e. through a PAYGen scheme). Benefits can be increased if social finance providers allow low income households to access low interest loans and share in the income generation offered by the FiT. Hence, innovative financing mechanisms that allow low income households to benefit from FiTs have significant potential to partially offset fuel price rises and to boost disposable incomes. Given the current difficulties in reducing fuel poverty and the desire to stimulate renewable energy uptake, additional support for this approach could offer considerable benefits.

The case for RHIs is expected to be similar, but further detail on the mechanism is needed to quantify the costs and benefits of this incentive. RHIs are very likely to have a similar potential to help fuel poverty but PAYGen schemes may not be effective for households already on mains gas. Low interest finance will be important in enabling access to RHI benefits for those in fuel poverty. Since the RHI has the potential to be a more expensive policy (DECC, 2010d), different funding mechanisms or flanking policies may be advisable to increase protection from high socialised costs for those on low incomes who cannot participate in renewable heat schemes themselves.

The research also found that RE installation achieves improved outcomes for those on low incomes when facilitated through a third party local energy organisation (LEO) since these organisations can: coordinate funding and investment in low income areas; ensure that local needs are met and that the best deals are made with suppliers; enable poverty reduction through RE; remove perceived investment risk through a trusted yet independent position with residents; engage the community and encourage participation by supplying reliable and relevant information; and potentially enable other positive social effects such as social inclusion, unemployment relief and improved health. LEOs are best steered by, if not run by, the community since this ensures relevant needs are specified. Consideration should be given to incentives to encourage LEO set-up in low income areas. This could include provision of setup funding to enable LEOs to get off the ground, information sharing from successful LEO projects and promotion of the LEO model through local government channels.

There is a need for future research to investigate longitudinal effects of these projects on financial savings, attitudes to renewable energy, energy related behaviour, and perhaps most crucially, the evidence for new LEO formation as a knock-on effect of the projects studied and others like them.

The size of benefit that an LEO project can provide to local households is largely determined by the interest rate at which it can borrow. Policy interventions that help LEOs access to low interest loans could increase opportunities for householders to benefit directly from FiT/RHI income and help provide greater protection against fuel price rises. Low interest finance could be enabled through loans to qualifying LEOs via the new green investment bank for example, or by encouragement of social lending to LEOs, perhaps via tax incentives to participating individuals or companies. Funding for such incentives would clearly be needed, but might offer a better targeted alternative to current mechanisms such as Winter Fuel Payments.

In summary, innovative financing and the encouragement of LEO operation could be key to ensuring that FiTs and RHIs can benefit, not hurt, the poor.

Acknowledgements

This paper is based on research undertaken during summer 2010 at Imperial College. The authors would like to thank Eaga Charitable Trust for bursary funds that helped to support this work, and the participants from the case studies in Nottingham and Chale who gave their time and opinions so generously.

References

ACE, Moore, R., Impetus Consulting & CSE, 2008. *Fuel Poverty in London: Figures and tables illustrating the challenge of tackling fuel poverty.* The Greater London Authority.

Allen, S.R., Hammond, G.P., McManus, M.C., 2008. Prospects for and barriers to domestic micro-generation: A United Kingdom perspective. Applied Energy 85 (6), 528–544.

Bergman, N., Brett, D.J.L., Brandon, N.P., Hawkes, A., Leach, M., Sudtharalingam, S., 2009. UK microgeneration. Part I: policy and behavioural aspects. Journal of the ICE 162 (1), 23–26.

Boardman, B., 2010. Fixing fuel poverty. Earthscan, London.

Brinkley, A., Less, S., 2010. *Cold Comfort.* Policy Exchange.

Buckley, W., 1981. Society as a Complex Adaptive System. In: Open Systems Group (Ed.), Systems Behaviour, 3rd edition, Open University Press.

Caird, S., Roy, R., Herring, H., 2008. Improving the energy performance of UK households: Results from surveys of consumer adoption and use of low-and zero-carbon technologies. Energy Efficiency 1 (2), 149–166.

Consumer Focus, 2008. *Consumer Focus response to BERR Consultation on Renewable Energy Strategy.* London, Consumer Focus.

DECC, 2009a. Addressing Fuel Poverty. [Online] Available from: 〈http://www.decc.gov.uk/en/content/cms/what_we_do/consumers/fuel_poverty/fuel_poverty.aspx〉 [Accessed 8/7/2010].

DECC, 2009b. Digest of UK Energy Statistics 2009. The Stationary Office, London.

DECC, 2009c. The Fuel Poverty Strategy. [Online] Available from: 〈http://www.decc.gov.uk/en/content/cms/what_we_do/consumers/fuel_poverty/strategy/strategy.aspx〉 [Accessed 9/7/2010].

DECC, 2009d. Low Carbon Buildings Programme. [Online] Available from: 〈http://www.lowcarbonbuildings.org.uk/〉 [Accessed 17/5/2010].

DECC, 2009e. The UK Fuel Poverty Strategy. 7th annual progress report. 2009. London, Department of Energy and Climate Change. Report number: URN 09D/353.

DECC, 2009f. Consultation on Renewable Energy Financial Incentives 2009. London, Department of Energy and Climate Change. Report number: URN 09D/677.

DECC, 2010b. *Feed In Tariffs.* London, Department of Energy and Climate Change. Report no: URN 10D/535.

DECC, 2010c. Impact Assessment of Feed-in Tariffs for Small-Scale, Low Carbon, Electricity Generation. London, Department of Energy and Climate Change. Report number: URN10D/536.

DECC, 2010d. Impact Assessment of the Renewable Heat Incentive scheme for consultation in January 2010. London, Department of Energy and Climate Change. Report number: URN 10D/547.

DECC, 2010e. Renewable Heat Incentive. [Online] Available from: 〈http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/policy/renewable_heat/incentive/incentive.aspx〉 [Accessed 21/10/2010].

DECC, 2010f. Renewable Heat Incentive. Consultation on the proposed RHI financial support scheme. London, Department of Energy and Climate Change. Report no: URN 10D/542.

DECC, 2010g. Renewables Obligation. [Online] Available from: 〈http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/policy/renew_obs/renew_obs.aspx〉 [Accessed 15/5/2010].

DECC, 2010h. Quarterly Energy Prices. [Online] Available from: 〈http://www.decc.gov.uk/en/content/cms/statistics/source/prices/prices.aspx〉 [Accessed 06/12/10].

DECC, 2011. Renewable Heat Incentive (RHI) Scheme. [Online] Available from: 〈http://www.decc.gov.uk/en/content/cms/meeting_energy/Renewable_ener/incentive/incentive.aspx〉 [Accessed 01/09/11].

Druckman, A., Jackson, T., 2008. Household energy consumption in the UK: A highly geographically and socio-economically disaggregated model. Energy Policy 36 (8), 3177–3192.

DWP, 2010. Households Below Average Income 1994/95 – 2007/08. Chapter 2 – the income distribution (time series). London, Department for Work and Pensions.

Eaga, 2010. Eaga launches clean energy programme. [Online] Available from: 〈http://www.eaga.com/media/news/eaga-launches-clean-energy-programme〉 [Accessed 11/7/2010].

E.C., 2010. Joint Research Centre Solar Photovoltaic Geographic Information System. [Online] Available from: 〈http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php#〉 [Accessed 29/11/2010].

EST, 2010. Telephone interview with PAYS Manager, Energy Saving Trust. (4/6/2010).

IC02, 2010. Interview conducted in person with IC02 08/07/2010.

IC03, 2010. Interview conducted in person with IC03 08/07/2010.

IC04, 2010. Interview conducted in person with IC04 08/07/2010.

IC05, 2010. Interview conducted in person with IC05 08/07/2010.

IC06, 2010. Interview conducted in person with IC06 08/07/2010.

IC07, 2010. Interview conducted by telephone with IC07 08/07/2010.

IC08, 2010. Interview conducted by telephone with IC08 28/07/2010.

IN02, 2010. Interview conducted in person with IN02 28/06/2010.

IN03, 2010. Interview conducted in person with IN03 28/06/2010.

IN04, 2010. Interview conducted in person with IN04 28/06/2010.

IN06, 2010. Interview conducted in person with IN06 29/06/2010.

IN07, 2010. Interview conducted in person with IN07 29/06/2010.

Leggett, J., 2010. I accept George Monbiot's £100 Solar PV bet. [Online] Available from: 〈http://www.guardian.co.uk/environment/cif-green/2010/mar/09/george-monbiot-bet-solar-pv〉 [Accessed 5/5/2010].

Less, S., 2010. Green Bills. London, Policy Exchange.

Milner, A., 2008. Valencia. The Solar Industry within the SET-Plan. 5th European PV Industry Forum.

Mingers, J., Taylor, S., 1992. The use of soft systems methodology in practice. Journal of the Operational Research Society 43 (4), 321–332.

Monbiot, G., 2010. A Great Green Rip-Off. [Online] Available from: 〈http://www.monbiot.com/archives/2010/03/01/a-great-green-rip-off〉 [Accessed 20/4/2010].

Morris, R., Martin, S., 2009. Complexity, Systems Thinking and Practice. In: Stibbe, A. (Ed.), The Handboook of Sustainability Literacy. Skills for a changing world. Green Books Ltd, pp. 156–164.

Ofgem, 2010a. Electricity and gas supply market report. London, Ofgem. Report number: 73/10.

Ofgem, 2010b. Project Discovery. Options for delivering secure and sustainable energy supplies. London, Ofgem. Report number: 16/10.

Ofgem, 2010c. Renewables Obligation [Online]. Available from 〈http://www.ofgem.gov.uk/Sustainability/Environment/RenewablObl/Pages/RenewablObl.aspx〉 [Accessed 01/12/2010].

Pocock, S., 2009. Renewable Energy Association consultation response–Renewable Energy Financial Incentives – Feed in Tariff. Renewable Energy Association.

Preston, I., Moore, R., Guertler, P., 2008. How Much? The cost of alleviating fuel poverty in England Report to the EAGA partnership Charitable Trust. Bristol, Centre for Sustainable Energy.

Roberts, S., 2008. Energy, equity and the future of the fuel poor. Energy Policy 36 (12), 4471–4474.

Rogers, J.C., Simmons, E.A., Convery, I., Weatherall, A., 2008. Public perceptions of opportunities for community-based renewable energy projects. Energy Policy 36 (11), 4217–4226.

Seager, A., Walsh, F., 2007. Government cuts home green scheme funding. [Online] Available from: 〈http://www.guardian.co.uk/environment/2007/may/09/energy.greenpolitics〉 [Accessed 06/12/10].

Sauter, R., Watson, J., 2007. Strategies for the deployment of micro-generation: implications for social acceptance. Energy Policy 35 (5), 2770–2779.

Solar Century, 2011. Solar Century Intelligent Generation [Online] Available from: 〈http://www.solarcentury.co.uk/estimate/?postcode=Le1+1AA〉 [Accessed 01/09/2011].
Solar Guide, 2011. The UK' leading resource of Solar & Renewables Installation and Maintenance Professionals. [Online] Available from: 〈http://www.solarguide.co.uk/solar-pv-calculator#bestresult〉 [Accessed 01/09/2011].
South Facing, 2011. Price Guide [Online] Available from: 〈http://www.south-facing.co.uk/pricing/〉 [Accessed 01/09/2011].
Timms, D., Hume, D., 2009. MPs briefing. Feed-in tariffs for small scale renewable electricity. Friends of the Earth.
Vaughan, A., 2010. Be wary of 'solar for free' offers, householders told. The Guardian. [Online] Available from: 〈http://www.guardian.co.uk/environment/2010/aug/09/solar-photovoltaic-panels-homes〉 [Accessed 14/08/2010].
Vaze, P., Mayo, E., 2009. A new energy infrastructure. Consumer Focus, London.
Walker, G., 2008. What are the barriers and incentives for community-owned means of energy production and use? Energy Policy 36 (12), 4401–4405.
Walker, G., Devine-Wright, P., Hunter, S., High, H., Evans, B., 2009. Trust and community: exploring the meanings, contexts and dynamics of community renewable energy. Energy Policy 38 (6), 2655–2663.
Watson, J., Sauter, R., Bahaj, B., James, P., Myers, L., Wing, R., 2008. Domestic micro-generation: Economic, regulatory and policy issues for the UK. Energy Policy 36 (8), 3095–3106.
Which, 2011. Is solar PV a good investment? [Online] Available from 〈http://www.which.co.uk/environment-and-saving-energy/energy/guides/how-to-buy-solar-panels/is-solar-pv-a-good-investment/〉 [Accessed 01/09/2011].
Williams, J., 2010. The deployment of decentralised energy systems as part of the housing growth programme in the UK. Energy Policy 38 (12), 7004–7613.
Yin, R.K., 2009. Case study research: design and methods, 4th edn, Applied social research methods series. SAGE. Thousand Oaks, Calif.