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The impact of installer business models on the uptake of residential microgeneration in the UK: Evidence from a nation-wide survey

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Abstract

This paper arises from a doctoral thesis comparing the impact of alternative installer business models on the rate at which microgeneration is taken up in homes and installation standards across the UK. The paper presents the results of the first large-scale academic survey of businesses certified to install residential microgeneration. The aim is to systematically capture those characteristics which define the business model of each surveyed company, and relate these to the number, location and type of technologies that they install, and the quality of these installations.

The methodology comprised a pilot web survey of 235 certified installer businesses, which was carried out in June last year and achieved a response rate of 30%. Following optimisation of the design, the main web survey was emailed to over 2000 businesses between October and December 2011, with 317 valid responses received. The survey is being complemented during summer 2012 by semi-structured interviews with a representative sample of installers who completed the main survey.

The survey results are currently being analysed. The early results indicate an emerging and volatile market where solar PV, solar hot water and air source heat pumps are the dominant technologies. Three quarters of respondents are founders of their installer business, while only 22 businesses are owned by another company. Over half of the 317 businesses have five employees or less, while 166 businesses are no more than four years old. In addition, half of the businesses stated that 100% of their employees work on microgeneration-related activities. 85% of the surveyed companies have only one business location in the UK. A third of the businesses are based either in the South West or South East regions of England.

This paper outlines the interim results of the survey combined with the outcomes from additional interviews with installers to date. The research identifies some of the business models underpinning microgeneration installers and some of the ways in which installer business models impact on the rate and standards of microgeneration uptake. A tentative conclusion is that installer business models are profoundly dependent on the levels and timing of support from the UK Feed-in Tariffs and Renewable Heat Incentive.

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1 Introduction

Residential microgeneration in the UK is in a critical moment. Microgeneration businesses must re-evaluate their strategies following recent cuts to Feed-in Tariffs for residential solar PV and ongoing delays to the Renewable Heat Incentive for home schemes. More than ever, the microgeneration industry needs to deploy cost-effective decentralised energy, while creating and safeguarding jobs, and inspiring consumer confidence.

Microgeneration is a form of decentralised or distributed energy supply where energy is generated close to the point of use, from community or district-level down to individual households (Allen et al., 2008a). EST et al. (2005) refer to microgeneration as having a capacity no greater than 50-100kW and being grid connected if electric. Currently, around 58% of centralised power generation is lost as waste heat, and a further 7% during transmission and distribution. Microgeneration is one way of reducing overall energy losses (Allen et al., 2008). The number of microgeneration installations in the UK was estimated at less than 100,000 at the end of 2007 (Element Energy, 2008a), but this mark has since been exceeded⁴ with an additional 250,000 (mostly solar PV) systems installed through the Feed-In Tariffs from April 2010 to June 2012 (Ofgem, 2012).

To have a substantial impact on electricity and heat supply, however, tens of millions of microgeneration units must be deployed (EST et al., 2005). Notwithstanding the costs involved, PV could generate half of residential electricity supply and solar thermal could produce a third of domestic hot water needs (Pollit, 2010). The latest Committee on Climate Change Medium abatement scenario suggests that air and ground source heat pumps could be installed in a quarter of UK residences⁵ by 2030, which is reliant on bringing 30-40 GW of new baseload-equivalent, low-carbon generation onto the grid during the 2020s. Heat pumps offer only marginal carbon emission savings compared to gas boilers currently, but savings as great as 100% could be achieved with a sufficient reduction in the UK's grid carbon intensity (Committee on Climate Change, 2010).

Demand side barriers to the uptake of residential microgeneration are well established. In the UK, up front, ongoing costs and payback periods remain key barriers for homeowners (Element Energy, 2008a & b; Faiers & Neame, 2006). Tenants are not in a position to contemplate the adoption of microgeneration – private and public landlords must bridge the gap here.

There is however a lack of systematic research on supply-side drivers and barriers to uptake, specifically in this paper, those factors which accelerate and constrain the rate at which microgeneration installer businesses can actually install systems, with associated impacts on the quality with which systems are fitted and maintained afterwards. Very little systematic evidence is available on microgeneration installer businesses themselves, for example, what size they are, how they are structured, and the nature of the business models that underpin them, either explicit or implicit.

It is likely that the rapid growth of microgeneration installer businesses in the last two years has been stimulated by the introduction of Feed-In Tariffs. Conversely, there is now huge uncertainty in the market created by the controversy surrounding the 12 December 2011 proposed drop in the Feed-in Tariff for domestic solar from 43p / kWh to 21p / kWh for domestic retrofits, and subsequent extension to 3 March 2012 following a court case brought against the Government, two unsuccessful Government appeals and final defeat in March 2012 (Guardian, 2012) This uncertainty is compounded by ongoing delays to the Renewable Heat Incentive for residential microgeneration heat, which is not due until at least summer 2013. These incentives have been intended to boost learning and experience effects by creating 'niche markets' for microgeneration, where favourable tariffs insulate supported technologies from selection by general market forces (Foxon et al., 2008; Foxon et al., 2010), but clearly the way they have been managed has created an unstable 'boom and bust' market.

⁴ The Low Carbon Buildings Programme provided grants for the installation of residential microgeneration between 2006 and 2011. 16,000 household and 3,200 community microgeneration systems were fitted, mainly solar thermal and PV, but also heat pumps, wind turbines and biomass boilers (DECC, 2012).

⁵ Mainly in households not connected to the gas grid (Committee on Climate Change, 2010).

A framework for categorising business models (Morris et al., 2005) can be applied to microgeneration installer businesses, validated against empirical data from the web survey and semi-structured interview methodology proposed below. This framework is consistent the definition of business designs in Slywotsky (1996, p.4) as 'the totality of how a company selects its customers, defines and differentiates its offerings, defines the tasks it will perform itself and those it will outsource, configures its resources, goes to market, creates utility for customers, and captures profit'. Variations in installer business models may range from companies which are locally-focused to those which install systems nationwide, potentially impacting on regional rates of installation. A particular business model of interest in existence when the solar FITs were at their highest level, is based on energy service contracts for microgeneration installation (Walker, 2008; Watson et al., 2006), for example, 'free solar PV' companies, which install solar PV systems for free on eligible, south-facing roofs in return for earning Feed-In Tariffs for generation and export (See: A Shade Greener, 2011; HomeSun 2012; Isis Solar, 2010).

Solar hot water installers have previously had a reputation for aggressive 'cowboy' marketing strategies (Keirstead, 2007). Although the Microgeneration Certification Scheme (MCS, 2012) is now well established, it cannot be assumed that it is a comprehensive failsafe against systems being installed sub-optimally. One of the key problems for residential microgeneration customers is if more than one company is involved in different aspects of the installation process (e.g. surveying, electrical, plumbing etc.). From the customer perspective, this means that responsibility for such products in the event of a fault following installation is often difficult to assign when it is not known where installer businesses sit within this complex web of sub-contracted services (EST, 2010).

The overall research aim is to establish the role of UK microgeneration installer businesses in the uptake of residential microgeneration. This aim of the research presented in this paper is:

- (1) Establish the factors influencing UK microgeneration installer business formation and operation;
- (2) Identify a range of different business models underpinning installer businesses across the UK;
- (3) Compare the relative performance of different installer business models in delivering residential microgeneration uptake, both in quality and quantity terms.

These aims are achieved through two primary research methods: a web survey of over 300 microgeneration installer businesses across the UK, and semi-structured interviews with selected survey respondents to illustrate a range of business models and examine implications for rates of uptake and installation standards.

2 Methods

2.1 Introduction

A pilot survey of installation businesses was deemed necessary to optimise the survey instrument and ensure that it could effectively address the research aims. This section outlines the methodological approach for the pilot and final surveys, and semi-structured interviews.

2.2 Pilot web survey

The pilot web survey comprised 23 questions, covering the areas shown in *Table 1*, and ending with a space for comments including a question asking how the pilot survey could be improved:

Table 1 Question areas in pilot web survey, grouped by research aims

Research objective	Relevant question areas
Installer business formation and operation / basic business model	Installer business age; year business first started installing microgeneration; previous industry; business ownership; number of employees and proportion working on microgeneration.
Impact of business models on rate of microgeneration uptake in homes	Location(s) of business by region; building types of installations including non-residential; region of installations by each technology accredited by the Microgeneration Certification Scheme; number of systems installed by technology from April 2010 to March 2011; frequency of marketing activities; frequency of payment options offered to customers.
Impact of business models on microgeneration installation standards in homes	Most common manufacturers and products installed by technology; ease of difficulty of recruiting sufficiently skilled installers; preferred external training providers; internal training provision; job title and responsibilities.

A random sample of 300 businesses from the list of certificated businesses on the Microgeneration Certification Scheme website was selected. 65 of these had no email addresses and in most cases no website either, leaving 235 businesses to email the survey to. On 3 June 2011, an identical pre-notification letter was posted to all of them (an initial postal contact has been shown to raise response rates in other surveys according to Couper, 2011). A pilot web survey was emailed to all 235 businesses on 9th June using Smart Survey software. Three reminder emails were sent to non-respondents every eight or nine days up to the 9 July closing date. 72 responses were received, equivalent to a response rate of 31% of those e-mailed, or 24% of all 300 businesses in the original random sample.

2.3 Final web survey method

Following evaluation of the pilot survey, a parallel marketing question was added to determine success of marketing approaches in drawing residential customer enquiries. Questions on ease or difficulty of recruitment and internal training were removed as these proved less meaningful in analysis of the pilot survey. Questions were added on: previous experience of respondents; whether respondents had founded their business; sub-contracting of design, installation and maintenance; and guarantees / warranties / maintenance contracts. The question on numbers of installations by

technology from April 2010 to March 2011 was supplemented by a parallel question for installation numbers from April to September 2011. The main survey consisted of 31 questions.

A mailing list of 2,000 installer businesses was compiled manually from a total of 2,600 certified installers on 1 August 2011. This is because the Microgeneration Certification Scheme (MCS) would not send out a mailing list on request as a matter of policy. A random sample was generated after removing all businesses contacted for the pilot from the full list of certified businesses extracted from the Microgeneration Certification Scheme website on 1 August 2011.

The main survey was run from October to November 2011. Given that ten times the number of businesses were contacted compared to the pilot, on 6 October 2011, a pre-notification letter was emailed as a pdf to the sample of 2,000 businesses, with a covering email. The revised web survey was emailed out on 12 October. Three reminders were emailed to non-respondents, except for those who had asked to be removed from the mailing list, before the survey was closed on 9 November 2011. A response rate of 12% was achieved, significantly below that of the pilot. To boost the response, the survey was re-opened on 13 December 2011, with a final reminder on 20 December, raising the response rate to 16% (or a total of 317 responses). Including the pilot survey, responses were received from almost 400 microgeneration installer firms. The sample gathered is around 10 per cent of the total number of installer companies accredited through the Microgeneration Certification Scheme.

2.4 Approach to semi-structured interviews with installers

In the main survey, respondents were asked whether they would be willing to participate in a follow up interview. All survey respondents who selected 'Yes' or 'Undecided – I would require further information' were contacted by email between July and August 2012 inviting them to take part in such an interview. Follow-up telephone calls were made if necessary to finalise dates. For reasons of minimising travel costs, the aim has been to conduct around 10 face-to-face interviews in south west, south east England and London, complimented by a similar number of telephone interviews with installers based further away. The interview stage will be concluded once a sufficient range of microgeneration installer business models, across different parts of the UK, have been explored.

11 businesses have been interviewed so far between 20 July and 28 August (*Table 2*). Eight of these have been face-to-face, and three by telephone. Four of the face-to-face interviews have taken place at companies based in the South West, three in the South East and one in London. The idea of telephone interviews is to focus on businesses further afield - one business in Northern Ireland and another in the East Midlands have been telephoned - although a less accessible business in the South West was also contacted in this way. Two more face-to-face interviews are planned for South East-based businesses, and three more telephone interviews with companies based in East England, the West Midlands, North West and Scotland. Beyond this, it would be desirable to interview one or two very large installers, such as those who have been selling free PV, and at least another business in Northern Ireland, where the incentive structure is different.

All interviews have been tape-recorded. The tentative findings presented in Section 3.2 are based on note-taking and partial transcription to date. Interview questions use the survey data from each interviewee's business to customise a pool of fifteen potential questions which has usually been narrowed down to a maximum of twelve, with additional prompts if required. These questions ask about the areas set against the research objectives in *Table 3*.

Table 2 Interview modes, dates and duration

Business reference	Business location	Interview mode	Interview date	Interview length
Installer A	East Midlands	Telephone	2 August	54 mins
Installer B	Northern Ireland	Telephone	21 August	47 mins
Installer C	South West	Telephone	13 August	1 hr 51 mins
Installer D	London	Face-to-face	20 July	1 hr 24 mins
Installer E	South East	Face-to-face	25 July	54 mins
Installer F	South East	Face-to-face	21 August	2 hr 45 mins
Installer G	South East	Face-to-face	28 August	50 mins
Installer H	South West	Face-to-face	8 August	41 mins
Installer I	South West	Face-to-face	9 August	1 hr 13 mins
Installer J	South West	Face-to-face	9 August	46 mins
Installer K	South West	Face-to-face	20 August	1 hr 32 mins

Table 3 Questions areas covered in installer interviews, grouped by research aims

Research objective	Relevant question areas
Installer business formation and operation / basic business model	<ul style="list-style-type: none"> • Reasons for setting up the business; • Ease or difficulty of market entry (Microgeneration Certification Scheme); • How responsibilities are split between staff and extent of sub-contracting.
Impact of business models on rate of microgeneration uptake in homes	<ul style="list-style-type: none"> • What technologies companies install, where they fit systems (i.e. locally, regionally or nationally), and why they have made those choices; • Marketing activities and factors which influence and constrain the number of systems they can put in homes over a given period of time; • How they have been affected by reductions in the UK Feed-in Tariffs and delays to the Renewable Heat Incentive for home installations.
Impact of business models on microgeneration installation standards in homes	<ul style="list-style-type: none"> • Choice of manufacturers and training providers; warranties and guarantees provided and offered; • What installers do to ensure sufficient standards, for example by how they carry out site surveys and specify systems for installations, and particularly where they sub-contract installation and maintenance. • Why interviewees chose a particular certification body and what their experiences of annual inspections under the Microgeneration Certification Scheme have been.

3 Results

3.1 Survey results: Introduction

Findings from the survey in the following two sections are grouped by two key research objectives: to evaluate the implications of installer business models for the rate at which microgeneration systems can be fitted, and implications for standards of installation and after-care.

3.1.1. Impact of installer business models on rates of microgeneration uptake

Most microgeneration installer businesses are still small scale operations and regionally-focused. Over half of the 317 businesses contacted in the main survey have five employees or less, while three quarters have 10 employees or less.

Three quarters of respondents are founders of their installer business, while only 22 businesses are owned by another company. 166 businesses are no more than four years old, while three quarters of respondents have only been installing microgeneration for two years. The regional focus combined with the small-scale nature of predominantly new businesses means low marketing power and ambition. Common across most businesses surveyed are two basic marketing strategies: word of mouth and their company website. Over two thirds said they never advertised their services on television or radio, and over a third of the businesses haven't used newspaper advertising. Around a half don't even use door drop leaflets. The results are part of the bigger picture of low level marketing and communication of microgeneration and patchy public awareness.

Lack of flexibility over payment methods continues to be a barrier to market growth. Customers usually pay a deposit up front for installations with the remainder paid on completion. 80% of companies surveyed indicated that they used this method of payment, while 50% of companies took full payments on completion for installations. Only 12 businesses provided for payments through mortgage additions, and only 16 businesses through low interest loans. 10 businesses indicated that they installed solar PV for free, financed from their business receiving the Feed-In Tariffs from generation over 25 years. 18 businesses installed PV for free but financed by a third party receiving the tariff payments. One business installed micro-wind for free, funded by a third party being paid the Feed-In Tariffs.

The findings suggest that installer business models are very much dependent on Government policy and support. This is an emerging and volatile market in which solar photovoltaics (PV) is the dominant technology, bolstered by the favourable Feed-In Tariff for small scale PV up until March 2012. 85 responding businesses installed just 1-5 solar PV systems (Modules and inverters – see *Figure 1*) in homes between April 2010 to March 2011, 60 fitting 1-5 solar thermal installations, and 55 installing 1-5 air source heat pumps (*Figure 2*). There are some exceptions: 14 companies fitted over 100 solar PV systems and 3 businesses installed more than 100 air source heat pumps. Between April 2011 and September 2011, the rush to maximise solar PV installations before the Feed-In Tariff reduction is reflected by the data - 30 businesses installed more than 60 solar PV systems each during these six months.

Fig. 1 Number of solar PV systems installed by certified businesses from April 2010 to March 2011

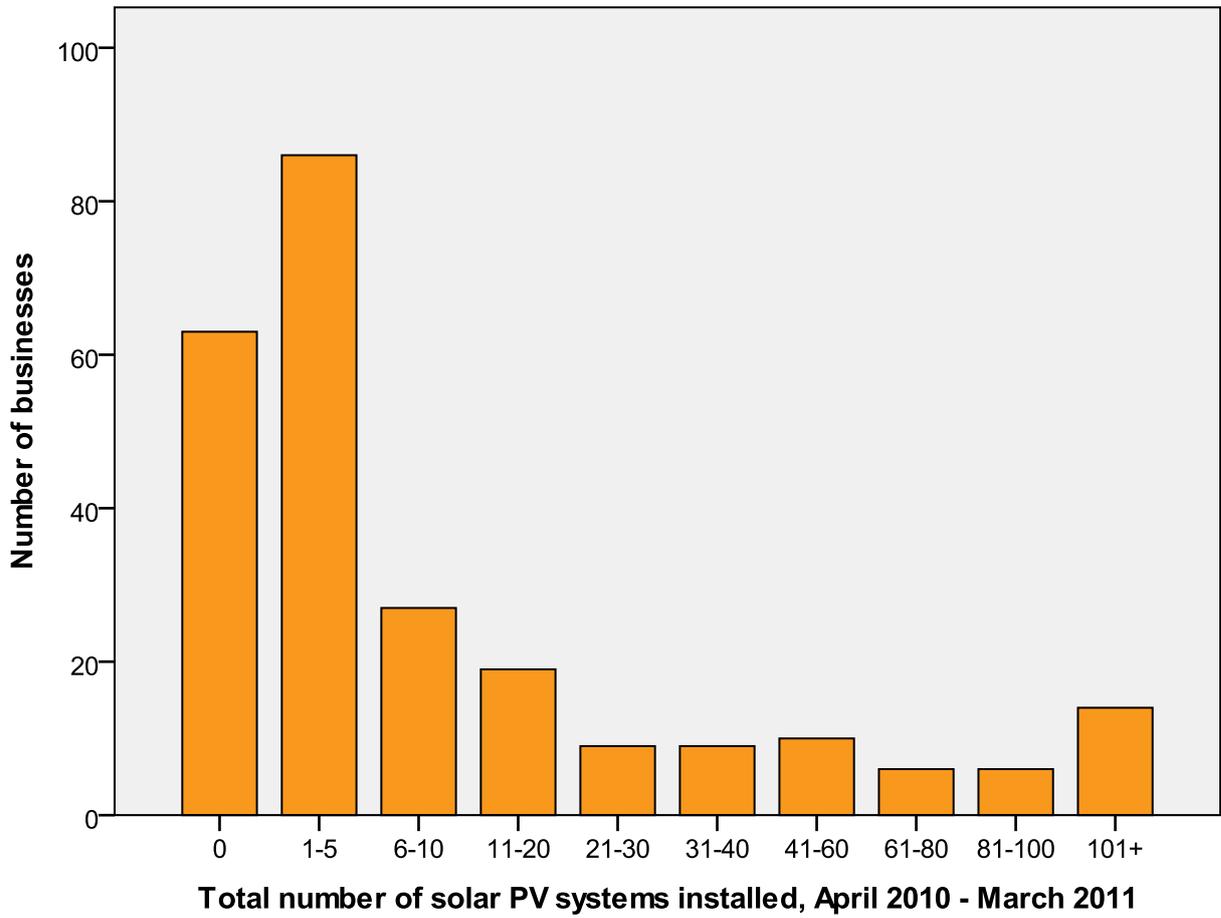
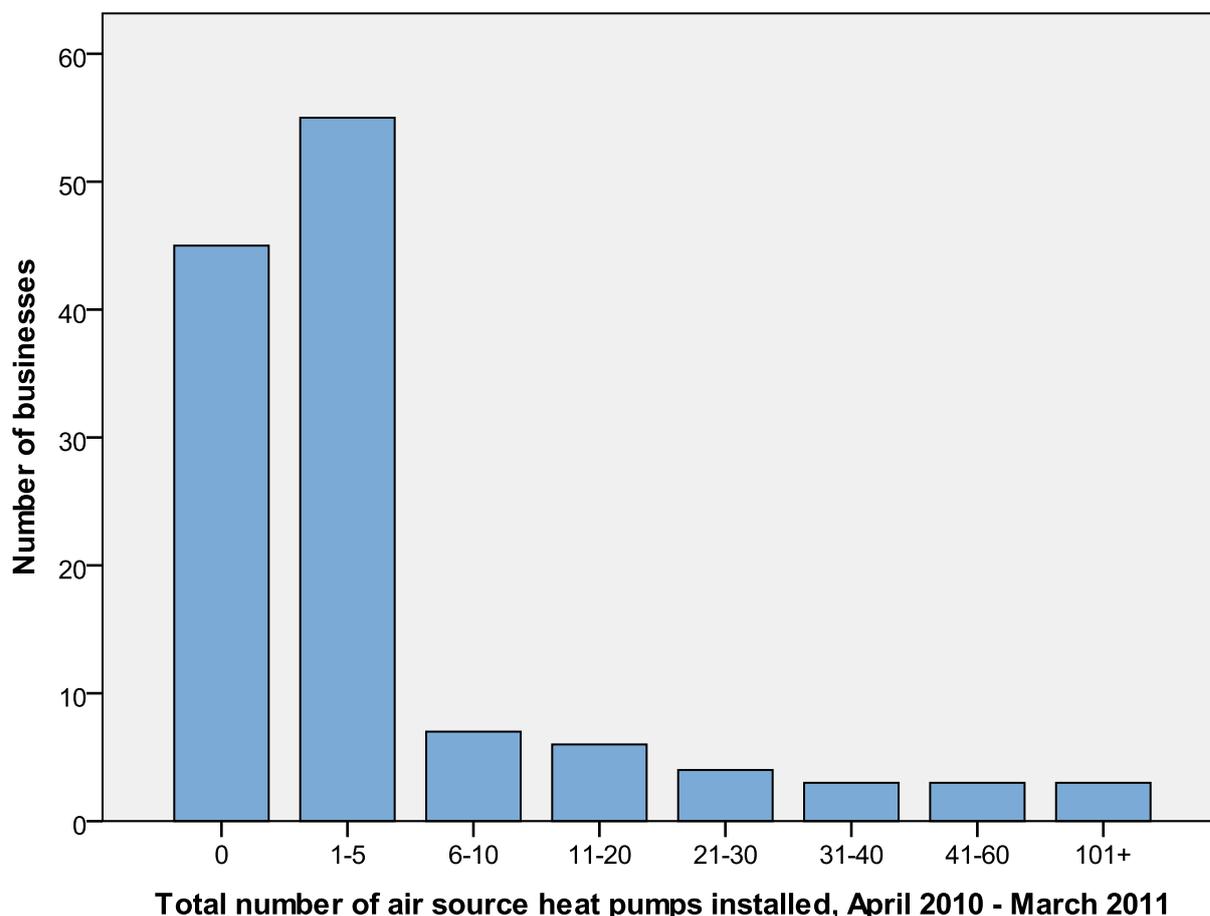


Fig. 2 Number of air source heat pumps installed by certified businesses from April 2010 to March 2011



3.1.2. Impact of installer business models on installation standards

More than half of the company representatives surveyed did not work in the microgeneration sector in previous jobs: most came from backgrounds in electrical and mechanical industries, plumbing, heating and gas, or other aspects of buildings services. 44% of all the companies started installing microgeneration from the outset: at least half their respondents were previously employed in building services or electrical professions. This means many of their employees initially possessed relevant or transferable skills, but may have lacked specific training on installing microgeneration and integrating systems with existing household heating or electrics. The survey found that three hundred businesses use at least a hundred different training providers, with the most common being NICEIC for electrical contractors and Ecoskies for renewable energy installers (*Table 4*). Manufacturer training is also frequently used.

Although Sanyo and Sharp were the most common manufacturers of solar PV modules, fitted by 38% of businesses who installed this technology, a further 55 manufacturers were also used (*Figure 3*). 60% of all solar PV installers fitted SMA inverters. This pattern of dominant market leaders and numerous, less-frequently used manufacturers is repeated across most microgeneration technologies. Three manufacturers were used by 40% of solar thermal installers: Kingspan,

Worcester Bosch and Vaillant while 30% of air source heat pump installers fitted Mitsubishi systems and 14% used Daikin (*Figure 4*). NIBE, Danfoss and Worcester Bosch were fitted by around half of ground source heat pump installers, while Windhager and MCZ were the most commonly purchased manufacturers for biomass boilers.

There is much variability in the extent, type and duration of warranties, guarantees and maintenance contracts provided or offered by installers. The extent to which such agreements are upheld, responsibility for repairs and quality of maintenance services will become increasingly important as the flurry of new installations begin to age and problems are experienced. Manufacturer warranties are typically 2-5 years for heat pumps, biomass and solar thermal. These warranties are notably longer for solar PV. 50 companies said product warranties for their solar electric panels last for 6-10 years, while another 28 installer businesses can offer product warranties of 21-25 year duration through their manufacturer. A third of firms said they do not provide extended guarantees or maintenance contracts at all.

Table 4 Most commonly-mentioned, external training providers used by survey respondents

Training provider	Number of companies who used training provider	% of all respondents to this question (216 / 317)	Coding category
NICEIC / PPL training	52	24	Industry training provider
Ecoskies	29	13	Industry training provider
Worcester Bosch	17	8	Manufacturer
Mitsubishi	15	7	Manufacturer
CAT	13	6	Industry training provider
Schuco	10	5	Manufacturer
Daikin	10	5	Manufacturer
NAPIT	9	4	Industry training provider
Logic	8	4	Industry training provider
Grant	8	4	Manufacturer

Figure 3 Proportions of all manufacturers mentioned for commonly installed products: Solar PV modules (Top chart) and inverters (Bottom chart)

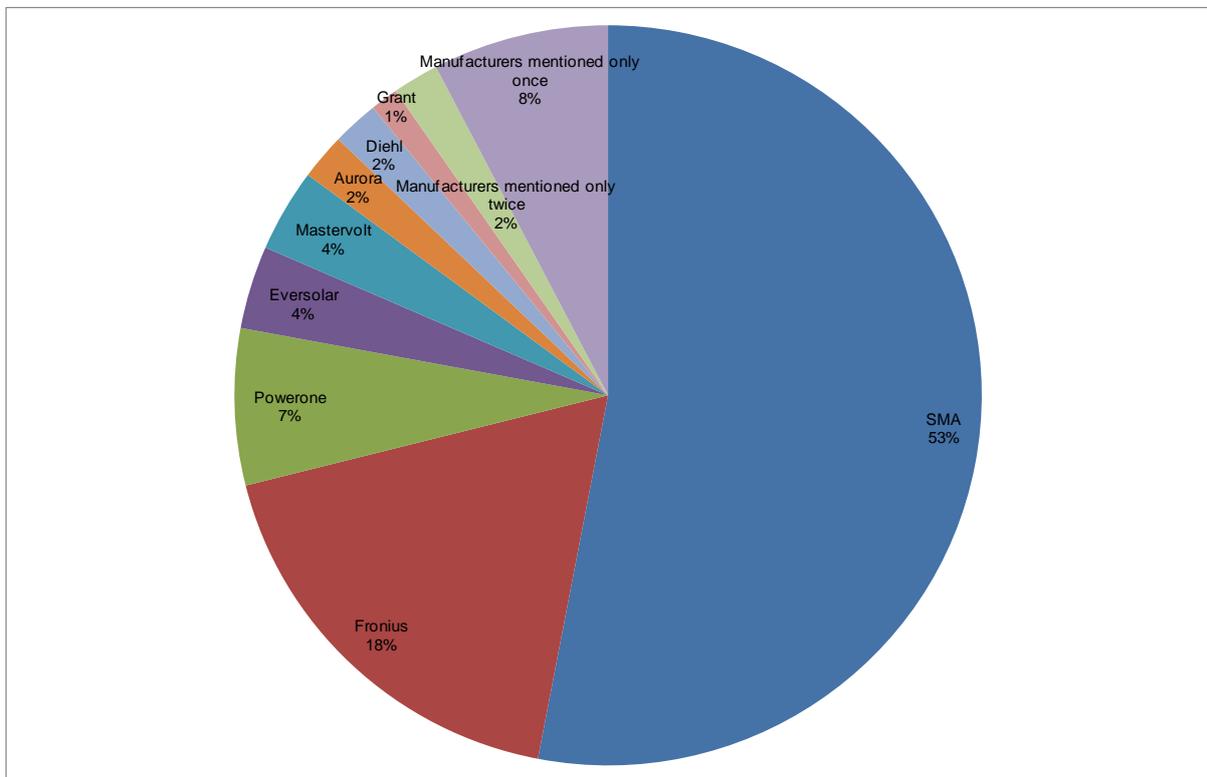
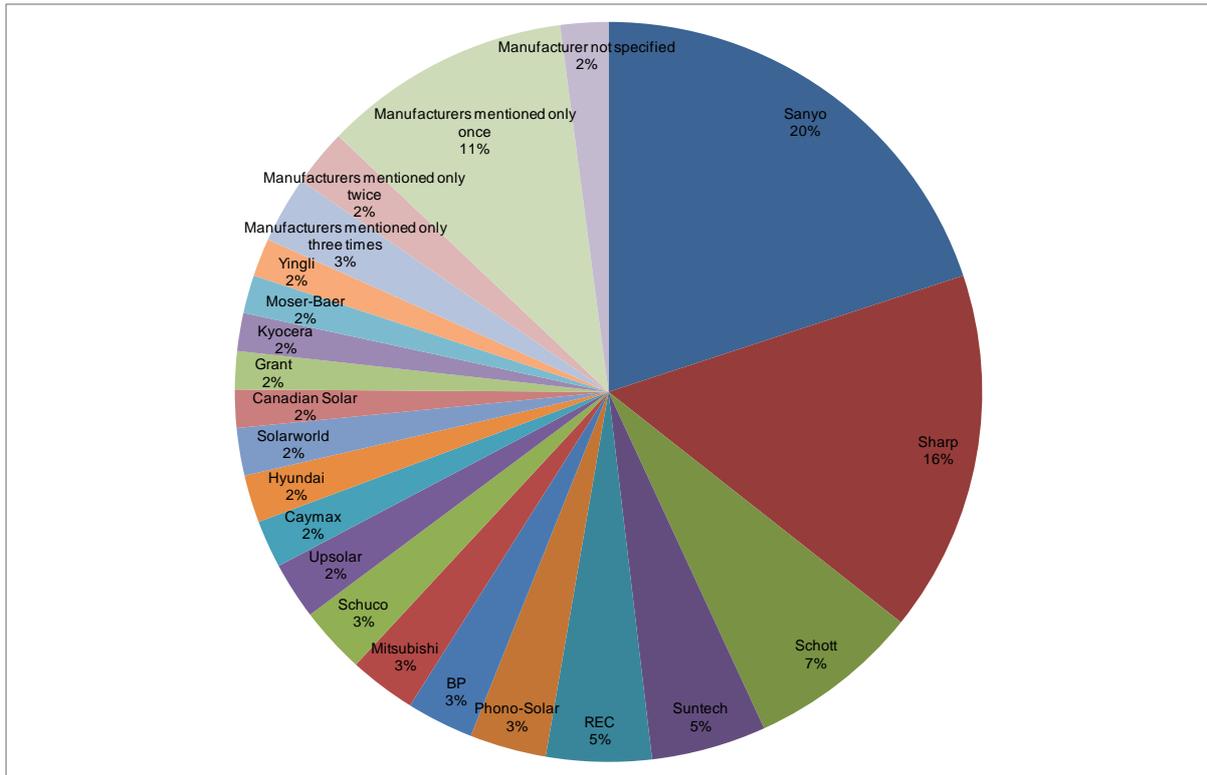
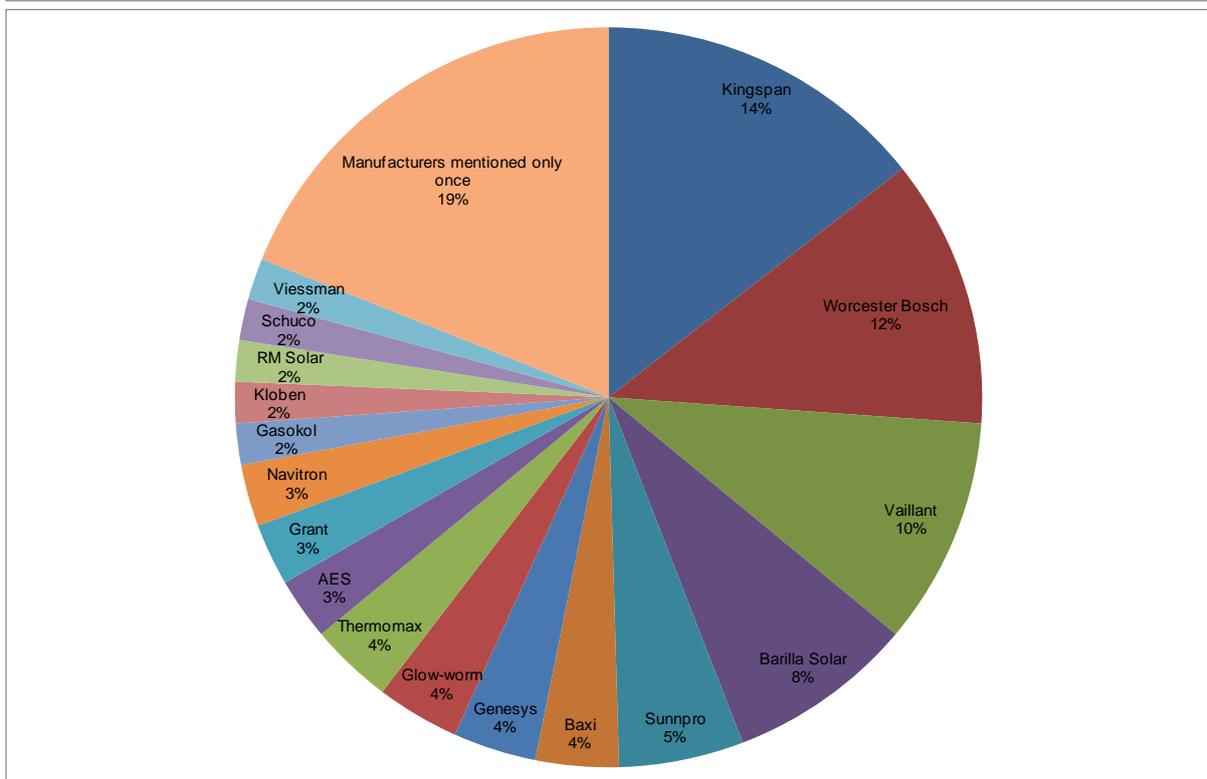
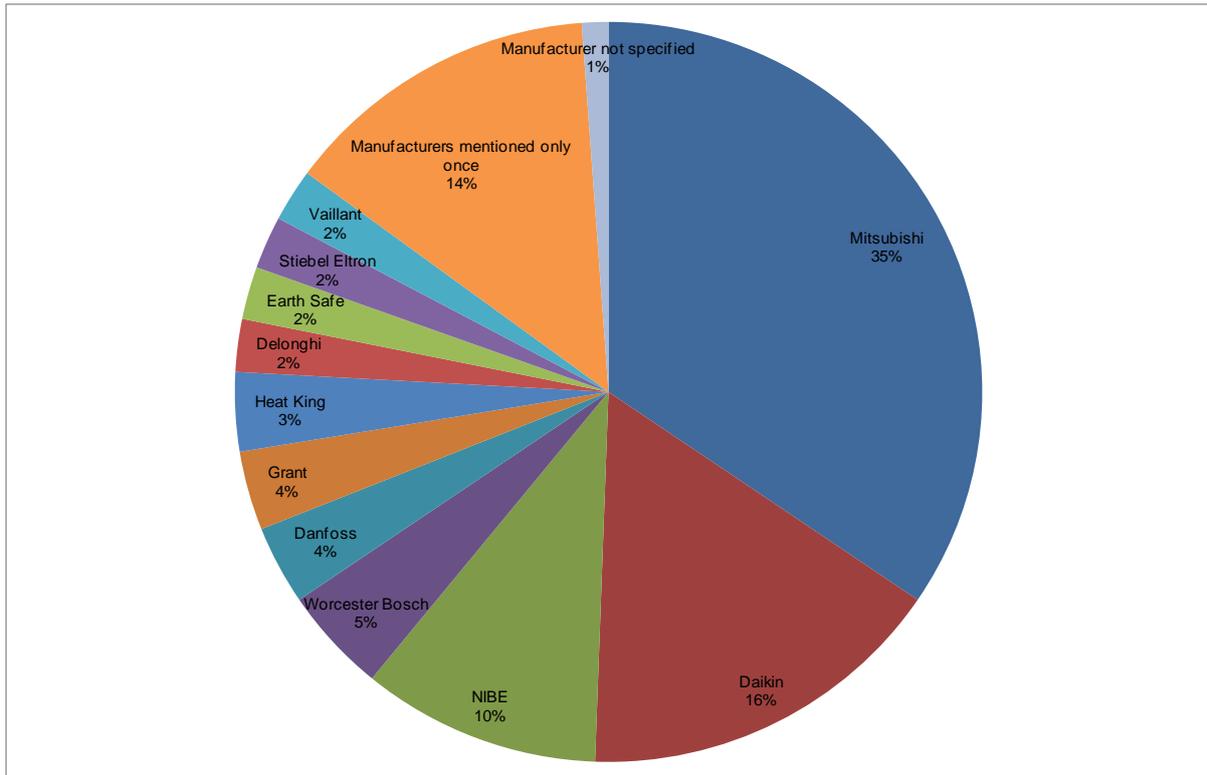


Figure 4 Proportions of all manufacturers mentioned for commonly installed products: Air source heat pumps (Top chart) and solar thermal (Bottom chart)



3.2 Installer interviews: Provisional findings

3.2.1. Introduction

All except one of the 11 installers interviewed were founders or co-founders of their business (*Table 5*). Only three of the businesses started installing microgeneration before 2009. Only two have more than five employees, with most wholly-focused on microgeneration-related work. Five of the interviewees install solar PV only, and one biomass only. The other interviewees install a range of technologies, including heat pumps and solar thermal.

Sections 3.2.2 and 3.2.3 present some provisional interview findings, which illustrate the relationship between installer business models, rates of uptake and installation standards.

Table 5 Summary of interviewees to date: business history, employees and technologies

Business reference	Business location	Job title of interviewee / Business founder?	Year created / year started installing microgeneration	Number of employees / % working on microgeneration (At time of survey, late 2011)	Number of technologies installed in homes from April 2010 to September 2011
Installer A	East Midlands	Managing Director / Yes	2009 / 2009	20 / 100%	ASHPs 2-10 Biomass 1-5 GSHPs 1-5 Solar PV 82-110 Solar thermal 2-10
Installer B	Northern Ireland	Business Development / No	2004 / 2004	15 / 100%	ASHPs 37-50 Biomass 17-40 GSHPs 2-10 Solar thermal 131-40+
Installer C	South West	Proprietor / Yes	1996 / 2010	1 / 100%	Solar PV 2-10
Installer D	London	Director / Yes	2007 / 2009	4 / 100%	Solar PV 162+
Installer E	South East	Director / Yes	2005 / 2005	5 / 100%	ASHPs 22-35 GSHPs 12-25 Solar PV 2-10 Solar thermal 17-30
Installer F	South East	Director / Yes	2005 / 2009	3 / 20%	ASHPs 2-10 GSHPs 1-5

					Solar thermal 1-5
Installer G	South East	Proprietor / Yes	2000 / 2002	1 / 70%	Solar PV 7-15 Solar thermal 2-10
Installer H	South West	General Manager / Yes	2011 / 2011	2 / 100%	ASHPs 2-10 GSHPs 2-10 Solar PV 11-15 Solar thermal 7-15
Installer I	South West	Director / Yes	2003 / 2011	4 / 100%	Solar PV 17-25
Installer J	South West	Director & Engineer / Yes	2010 / 2010	1 / 100%	Solar PV 42-60
Installer K	South West	Director / Yes	2010 / 2010	3 / 100%	Biomass 2-10

3.2.2 Impact of installer business models on rates of microgeneration uptake

Geographic focus

All the businesses interviewed who install residential microgeneration heat technologies fit them in homes which are local or within the region that the installers are located. This is due to the regular need for servicing requirements of heat pumps and biomass boilers in particular. However, installers A and D install PV nationally, due to a lesser need to service PV systems. Of the eight PV installers interviewed, these two businesses installed the most number of PV systems between April 2010 and September 2011 (See Table 2). Installer J, based in the South West, had decided to install PV locally only after the inverters twice developed faults in a system he had installed in Norfolk. Installer I felt that there was sufficient demand to satisfy his business in his local city, and going further afield to fit PV systems would simply lose time.

Marketing

Word of mouth is the most common form of marketing, particular with very small installers, aided by the strength of community connections in more rural areas. Installers I and J used a local magazine and local free paper respectively to compliment their basic word of mouth strategy. Amongst those interviewed, company websites did not lead to much business by comparison. Installer H described how delivering 3,000 door drop leaflets in a local area led only to two complaints about those contracted to deliver the leaflets. Even for installer A, with 20 employees, TV and radio marketing was seen as unaffordable.

Impact of market uncertainty created by Feed-in Tariff changes and delays to Renewable Heat Incentive

The extent to which installers have been affected depends on the technologies that they install – so that PV installers are the most directly impacted, but renewable heat installers do not yet benefit from subsidies other than the Renewable Heat Premium Payments, which are insufficient to genuinely

offset high upfront costs. Since March 2012, installer K had fitted just two biomass systems in homes, while installer E was all set up to diversify into biomass installation but could not do so without certainty on the RHI scheme for residential microgeneration. Northern Ireland is an exception, because the Renewable Heat Premium Payments (RHPP) are more generous (e.g. £2500 in Northern Ireland versus £950 in the rest of the UK for biomass boilers). Without the residential RHI, installer K could not realistically hope to expand his business beyond three employees. Combined with this market uncertainty, the cost of certification for individual microgeneration technologies may be prohibitive for many small installers who cannot be sure whether the Renewable Heat Incentive will even be introduced at all, or at least on schedule in summer or autumn 2013. Conversely, installer F took the view that air source heat pumps (ASHPs) were already cheaper than oil heating alternatives, and therefore the RHI for domestic ASHPs was unnecessary and would attract installers more interested in profiting from such a scheme than in maximising installation standards.

3.2.3 Impact of installer business models on installation standards

Choice of manufacturers and products

Both installers A and I subscribed to Photon International (Photon International, 2012), which they viewed as one of the most reliable and independent sources of comparative information on PV module performance, by manufacturer and model. For installer B, service and back up both to his business and the customer, cost and brand reputation were key factors in choosing manufacturers from whom to purchase biomass boilers, heat pumps and solar thermal.

Installer F related an example of when he was contracted to install council-specified air source heat pumps in a block of flats in the South West in 2010. He had no say in choosing which manufacturer and product to install which the council had selected as it was cheap to fit. The heat pumps had very high running costs, and only half of them worked properly. As a result, he got negative feedback from the residents.

Most of the PV installers interviewed purchased systems from UK-based suppliers, although installer D still bought some modules from China because this worked out cheaper. Installer C had to turn to a Scottish-based supplier and install Chinese panels that he would not normally have chosen during the rush to the initially proposed 12 December 2011 deadline for the halving of the residential PV Feed-in Tariffs. In consequence, he had to fit these panels to a given roof rather than the other way round.

Microgeneration Certification Scheme

One of the clearest findings of the interviews so far is that the annual inspection of microgeneration installers carried out by accreditation bodies focuses largely on paperwork trails, rather than effective audits of actual installations. Under the Microgeneration Certification Scheme (MCS), UK-based installers choose which of 16 accreditation bodies to register with (MCS, 2012). Most of the interviewees said that annual inspections lasted for a fairly full day, mostly devoted to office-based processes and with only a couple of hours devoted to visiting an installation. Technical expertise of inspectors varied across different certification bodies, so that some were more concerned with aesthetics and seemed to miss more crucial technical questions. In almost all cases it was left to the installer to choose either which system the inspector could visit (by arrangement with the customer) or to provide a list which they had self-selected. Installer H, whose first annual MCS inspection was overdue, remarked:

'Obviously if you had a disastrous one you wouldn't put that in the list, I would imagine ...'

Installer F, who fitted air source heat pumps in new builds mainly, said that his inspectors usually chose a partially-completed installation, which was a more effective way of assessing workmanship. Installer I concurred with this approach:

'I'd much rather they come and turned up when you're halfway through a job, unannounced sort of thing – said, just come and have a look at what you're actually doing... 'cause, one of the things I'll say

about any annual inspection, it's very easy to fudge ... erm, and a lot of contractors do that, they'll do two jobs they'll be perfect, you know the ones that get the qualities for the inspection, and all the other ones they cut corners on.'

Only installer B, based in Northern Ireland, registered with an accreditation body who selected an installation to inspect randomly from the MCS database of registered installations. Installer F admitted that he had installed several air source heat pumps without registering them through the MCS, to avoid costs in certification and increase profit margins.

4. Discussion

The research presented in this paper is in the first instance an exploratory analysis of the installation market across a range of microgeneration technologies, following the introduction of the Feed-in Tariffs in April 2010. The author is not aware of any research in academic literature which has performed a similar market analysis. This allows little potential for comparison with similar research, which is necessarily a limitation of the conclusions that may be drawn from this study.

Through the survey and interviews, the variability of installer business models has been demonstrated, whether this be in terms of business size and age, technology installed and choice of manufacturer, local versus national installation, and extent of sub-contracting (*Table 6*). Sub-contracting is not necessarily a cause of poor installation standards, it depends on the extent to which sub-contractors are known by those who manage them, and relationship between them and their manager (s). Sub-contracting is sometimes a response to high uncertainty and volatility of an emerging, niche market heavily dependent on government support.

The variations in business models across different technology types reflect the different economics, different level of subsidies and levels of market certainty that apply. Some installers may have the capacity to install PV nationally, with its relatively low maintenance requirements compared to microgeneration heat. Due to regular servicing requirements, renewable heat for residential applications often tends to be installed within the same regions that companies are based in.

Overall the results show the fundamental dependence of installer business models on government subsidies and the Microgeneration Certification Scheme in particular. Subsidies affect business models as they change over time, across different geographic subsidy regimes (e.g. Northern Ireland versus the rest of the UK), which in turn has implications for installation standards. There are exceptions, where some businesses are less reliant on subsidies. Industry confidence has been hit by the sharp reduction in Feed-In Tariffs for solar PV and the delay to the Renewable Heat Incentive for residential installations until at least summer 2013. Free solar PV schemes are no longer viable under reduced tariffs (HomeSun 2012). Nevertheless, government consultancy research established that the costs of installing solar PV in homes fell by 45% in the UK between 2009 and 2011 (Parsons Brinckerhoff, 2012). Providing the industry with greater clarity on and a clear timetable for introducing the Renewable Heat Incentive is crucial to capitalise on this momentum.

Table 6 Characteristics of microgeneration installer business models identified through the survey and interviews

Business model attribute (adapted from Morris et al., 2005)	Examples of attribute measured through installer survey	Examples of attribute measured through installer interviews
How the business creates value	Technology types installed and in which building types (e.g. residential / commercial); extent of sub-contracting.	Reasons for installing given technologies over others, or in residential / non-residential sectors; more details on sub-contracting and reasons why.
Who the business creates value for	Regions installed in; location of headquarters and premises; manufacturers of systems installed.	Reasons for local / regional / national focus; demography of customers targeted. Suppliers or distributors used to purchase products, whether sourced locally, nationally or within Europe or beyond.
Source of business competence	Preferred training providers; preferred manufacturers.	Reasons for choosing manufacturers and products, training courses and design software or techniques.
Competitive positioning	Preferred training providers and manufacturers; choice of technologies; marketing activities.	Approach to quoting and competition experienced; some interviewees disclosed whether they sold products at higher cost / higher quality or lower cost / lower quality.
How the business makes profits	Survey establishes some proxy data, e.g. number of installations / proportion of company focused on microgeneration.	Some interviewees have disclosed data on wholesale and retail costs and profit margins per installation.
Growth and time ambitions and business investment model	Not measured through survey.	Frustration about 'boom and bust' subsidy regime and market uncertainty. Often small, local installers interviewed could not cope with greater demand due to lack of capacity to respond. Proxy data from interviews on plans to continue installing certain technologies / install new technologies / or stop installing microgeneration.

5 Conclusion

The results have identified some of the business models underpinning microgeneration installers and some of the ways in which installer business models impact on the rate and standards of microgeneration uptake. Due to the emerging nature of the market, there is a lack of other academic research focusing specifically on UK microgeneration installer businesses. Microgeneration research has also tended to concentrate on the homeowner and customer perspective, rather than installers, manufacturers or suppliers. The results presented in this paper go some way towards building a picture of the volatile and vulnerable nature of the business landscape of microgeneration installers. Installer business models need to be viewed with respect to both their internal influences, such as the employment background of founders / directors and employees, and their external influences e.g. subsidies, grants and the Microgeneration Certification Scheme.

In terms of further research, there would be merit in repeating a combined survey and interview approach if and when the Renewable Heat Incentive for home installations comes into effect, perhaps later in 2013. The current methodology has the significant disadvantage of being self-selecting, both through the survey sampling and interview selection process, and there could be potential for a 'mystery shopper' methodology to be used to investigate hard selling and variations in quotations between installers. Beyond installers, there is potential for investigating learning through interacting between installers, manufacturers and distributors.

There are implications for government policy which must provide fiscal support in a way that maximises the number of installations of adequate standard, for technologies fitted in a way which also maximises carbon savings whilst allowing installer businesses to make sustainable profit over the long run. The government should take decisions on subsidies in a timely fashion, not increasing market uncertainty in times of austerity. At the same time, the Microgeneration Certification Scheme needs to ensure that its accreditation bodies streamline paperwork where unnecessary burdens can be reduced, but it should also bring in a truly random system of inspection, using the MCS database (Available on the MCS website only to installers). The requirements of different MCS bodies also vary and may impact on installation standards.

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