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How to cite:

Caird, Sally and Roy, Robin (2010). Yes in my back yard: UK householders pioneering technologies. In: Devine-Wright, Patrick ed. Renewable Energy and the Public. London: Earthscan, pp. 203–219.

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Version: Accepted Manuscript

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<http://www.earthscan.co.uk/?TabId=102350&v=512280>

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Yes in my back yard. UK householders pioneering microgeneration technologies

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[a] Introduction

Following the 2008 Climate Change Act, in its first carbon budget the UK government set demanding targets to reduce the nation's CO₂ and other greenhouse gas emissions by 34 per cent by 2020 and 80 per cent by 2050 on 1990 levels. Households alone contribute 27 per cent of UK carbon emissions, with approximately three quarters of these emissions arising from space and water heating (DTI, 2007). Increasing low carbon and renewable energy supplies is a key element of the government strategy to achieve its carbon reduction targets. Also in 2008 the European Commission set the UK a target that 15 per cent of electricity, heat and transport energy should come from renewable sources by 2020, including small-scale microgeneration technologies in homes and other buildings (HM Government, 2009). The government's microgeneration strategy suggested that widespread adoption of microgeneration technologies – defined as the small-scale production of heat and/or electricity from a low carbon source – could reduce domestic carbon emissions by up to 15 per cent by 2050; a worthwhile contribution to the carbon reduction targets (DTI, 2006). But household adoption in the UK of microgeneration technologies is slow compared to other countries, despite government grant schemes such as the Low Carbon Buildings Programme (LCBP). A recent detailed report on the potential for microgeneration estimated that by 2007 that there were only 95,000-98,000 installations in UK homes, with solar thermal hot water (STHW or solar water heating) systems accounting for over 92 per cent of them. Even rarer are other microgeneration technologies, including heat pumps, wood-fuelled stoves and boilers, solar photovoltaic (PV) and micro-wind systems. It is estimated that there were only about 5000 such domestic systems in 2007 (Element Energy, 2008).

The total number of microgeneration systems installed thus represents a tiny percentage of the potential market. Element Energy (2008) calculated that the UK market for domestic microgeneration could reach 9 million installations by 2020 given an ambitious policy support framework, such as a subsidy of 2p/kWh for micro-generated heat, and prohibiting all off-site (non-renewable) electricity for zero-carbon homes except for low carbon systems such as heat pumps.

Before such policies can be effective, more needs to be known about public perceptions of and engagement with microgeneration, why currently very few UK consumers are installing the technologies and what would help boost their uptake. Existing studies have tended to focus on financial, regulatory and informational barriers to account for the slow adoption of microgeneration. For example, a survey of enquirers to a solar thermal hot water (STHW) promotion scheme in London showed that they were deterred by high capital cost, lack of trustworthy information, and difficulties knowing which brands were reliable (SEA/RENUE, 2005). Another UK study of the potential of solar PV, micro-CHP and micro-wind also identified the barriers of high upfront costs, long payback times and lack of information, in addition noting consumer scepticism regarding the performance and reliability of these technologies (Watson et al, 2006). Inadequate grants and subsidies to alleviate high costs are another main obstacle to adoption (DTI, 2006; Element Energy, 2008). Other reports point to the low level of consumer awareness; restrictive planning laws; and the complexities of selling electricity back to the grid (EST, 2007). Similar obstacles were identified in a UK Parliamentary Trade and Industry Committee report, which also highlighted the considerable technical knowledge required to decide whether to invest in microgeneration (House of Commons, 2007).

The government's Microgeneration Strategy progress report claims that many of the planning and technical barriers, plus consumer demand for independent certification of microgeneration technologies, have been addressed (BERR, 2008). This is important for extending the microgeneration market beyond the pioneer enthusiasts and 'early adopters' to many more consumers.

This chapter draws on two Open University-led collaborative projects that surveyed consumer perceptions and experiences of several microgeneration technologies for generating heat or electricity at the household level. These included:

[bl]

- ** solar thermal hot water (STHW) systems,
- ** ground source heat pumps (GSHPs),
- ** simple wood-burning stoves,
- ** wood-fuelled boilers and automatic biomass stoves;
- ** solar photo-voltaic (PV) systems
- ** micro-wind turbines.

The focus in this chapter is on how householders who have seriously considered purchasing a microgeneration system for their home – and the pioneer adopters who have actually installed one – engage with these technologies, what made them adopt or reject microgeneration and what would encourage these already interested consumers and the broader public to adopt these technologies more widely. The respondents to our surveys were self-selected and, not unexpectedly, were ‘greener’ and from higher socio-economic groups than the general UK population. Our respondents’ reasons for rejecting microgeneration systems, and any problems experienced by those who did adopt them, thus represent significant issues that need to be addressed before the less wealthy, less ‘green’ general UK population will decide to install microgeneration and thus achieve the worthwhile carbon reductions estimated to result from their widespread adoption.

[a] Aims, methods and outline

The two projects on which this chapter is based are outlined below:

[b] People-Centred Eco-Design (PCED)

This project involved a survey of the UK public who in 2006 had viewed a BBC/OU TV series on climate change and then accessed an OU online questionnaire via the BBC/OU or Energy Saving Trust websites. This produced 390 responses from people who had adopted, or had seriously considered but decided against adopting, a microgeneration system. The responses covered STHW systems (39 adopters; 151 non-adopters); solar PV (12 adopters; 130 non-adopters), micro-wind turbines (7 adopters; 128 non-adopters) and simple wood-burning stoves (63 adopters; 65 non-adopters). The project also involved in-depth telephone interviews with a different group who had sought advice from a National Energy Foundation scheme called

'Energy for Good', 15 who had adopted and 13 who had considered but rejected a STHW system (see Caird and Roy et al, 2007).

[b] YIMBY Generation (Yes In My Back Yard! UK householders pioneering microgeneration heat)

The OU and the Energy Saving Trust (EST) collaborated to conduct one of the largest surveys to date of UK householders in the process of considering or purchasing a microgeneration space heating and/or hot water system. The surveys covered four technologies, all eligible for government grants under the Low Carbon Buildings Programme (LCBP) – namely, STHW; ground source heat pumps (GSHP); wood-fuelled boilers (WFB); and biomass stoves with automatic pellet feed (BS) (see Roy, Caird and Abelman, 2008).

Online questionnaires produced over 900 responses from members of the public who accessed the EST or BBC/OU websites in mid 2007: The first survey covered 314 householders seriously considering buying one of these technologies (named 'Considerers', of which 221 were considering STHW; 50 GSHP; 28 WFB and 15 BS) and 64 householders who had considered but decided against purchase ('Non-adopters', of which 50 rejected STHW; 7 GSHP; 2 WFB; and 3 BS).

Further surveys were conducted with 546 UK householders who had been awarded a LCBP grant to install a microgeneration heat technology (named 'Adopters', of which 413 had adopted STHW; 89 GSHP; 36 WFB and 8 BS). 285 of these adopters had already installed and had experience of using their system. The LCBP grant-holders also included 70 householders who were counted as non-adopters of a microgeneration technology that they had rejected in favour of another for which they received the grant.

[b] Chapter outline

This chapter outlines selected results and conclusions of these two studies focusing on the following questions:

[bl]

- ** Who is interested in adopting microgeneration technologies?
- ** What motivates the pioneers who adopt microgeneration?
- ** What influences the adoption process?
- ** How do microgeneration adopters engage with their system?

** Why do most people decide against adopting microgeneration?

** What measures would encourage more people to adopt microgeneration?

Further results, including more detailed feedback from the pioneer adopters on their experiences of using their system and ideas for improving it, may be found in the final reports on these projects (Caird and Roy et al, 2007 and Roy, Caird and Abelman, 2008).

[a] Who is interested in adopting microgeneration technologies?

The People-centred Ecodesign (PCED) project found that people interested in microgeneration (both adopters and non-adopters) typically are from environmentally-concerned households where the main earner's occupation is professional, managerial, or in education/medical services, with a significant proportion retired. The adopters are mainly older couples living in three or four bedroom houses and only about a quarter had children under 16 years living at home (Caird and Roy et al, 2007).

The YIMBY Generation surveys provided similar results. Two-thirds (66 per cent) of all surveyed households (considerers, adopters and non-adopters) include a main earner with (or retired from) a professional or senior managerial occupation. Over 60 per cent of respondents live in households without children or where children have left home. Up to half of respondents from all groups claimed they usually took actions to reduce their environmental impacts, such as walking, cycling or using public transport instead of driving whenever possible.

The YIMBY surveys show that, unsurprisingly, microgeneration adopters are a wealthier group than considerers and non-adopters. But although they had above average household incomes, most adopters were not especially wealthy; just over a quarter had an annual household income more than twice the £30,000 UK average and less than 10 per cent had a household income above £100,000. They also are an older group, with 71 per cent of adopters aged over 45 years and a quarter retired (compared to 14 per cent of considerers and non-adopters).

One notable result is that over half of microgeneration heat adopters live in detached homes with four or more bedrooms and large gardens, located in rural areas, and off the mains gas network. This is not surprising given that currently GSHPs, wood boilers and biomass stoves are only cost-effective in properties previously heated by

oil, electricity or solid fuel, and are suited to larger properties with space for the equipment, heat pump ground loops or wood fuel stores.

STHW systems have a wider appeal, with only about half of installations without mains gas, and about a third of adopters surveyed living in smaller suburban properties. This reflects the fact that STHW is a lower cost, more compact and familiar technology worthwhile for properties with or without mains gas.

Generally our results show that existing UK consumer demand for microgeneration is largely confined to a niche market of environmentally concerned, older, middle-class householders, often living in larger properties off the mains gas network. By comparison, though considerers and non-adopters have similar occupational characteristics and environmental attitudes, more live in suburban homes in areas with mains gas supplies, and were more often considering retrofitting rather than installing a system in a new-build project.

[a] What motivates the pioneers who adopt microgeneration?

The PCED survey identified the three most frequently cited reasons for adopting STHW, solar PV and micro-wind systems:

[bl]

- ** saving energy;
- ** reducing fuel bills;
- ** concern for the environment.

For people buying simple wood-burning stoves, saving energy, money and the environment are important, but they are mainly bought because they offer the warmth and appearance of a real fire.

These findings were reinforced by the YIMBY study (see Table 1). This showed that the main reasons why some UK householders are seriously considering or have adopted microgeneration heat are environmental (to reduce carbon emissions) and/or financial (to reduce fuel bills). However, the survey showed that they desired a microgeneration system for the pleasure of using a low carbon energy source. A fifth of these considerers and pioneer adopters have jobs or hobbies related to the environment or low carbon technology and are often technology enthusiasts. Another

fifth said that they are using the opportunity of a new build or another major home improvement project to seriously consider or install microgeneration heating.

Table 1 *YIMBY Generation: What motivates householders to seriously consider or adopt microgeneration heat technologies?*

| Reason(s) given for serious consideration or adoption | Percent |
|---|----------------|
| To reduce carbon dioxide emissions | 75% |
| To save money on fuel bills | 72% |
| I wanted to use low carbon energy and will get pleasure from doing so | 61% |
| Allows me to visibly demonstrate my environmental commitment | 34% |
| The low carbon technology forms part of a heating system replacement or upgrade | 23% |
| Related to my job, hobby or interests in the environment/ low carbon technologies | 21% |
| Being innovative, a pioneer in using low carbon energy technology | 21% |
| The low carbon technology forms part of other home improvements e.g. home extension; loft conversion, new build | 20% |
| <i>Total responses: 'considerers' and 'adopters'</i> | 859 |

[a] What influences the adoption process?

[b] Information and advice

Only a minority (less than 10 per cent) of PCED respondents said they wanted better information and advice to help them decide whether and how to invest in microgeneration. However, several commented that the information provided by existing advice bodies is too generalised with the technical details of installations left up to the installers. A single body to guide people through the details of technology choice, grant applications, planning permission, installation, use and maintenance were suggested as ways of facilitating adoption.

The YIMBY surveys found that uncertainty about system performance and payback is one of the main barriers to adopting microgeneration (see Table 3 below); indicating the need for better impartial information for people considering investing in these technologies. Over 90 per cent of considerers looked first on the internet for

information, and then over half obtain manufacturers' or other literature. Advice from family, friends and neighbours is drawn on by a third – again indicating the difficulties consumers have finding impartial and informed advice – and from installers by a quarter. Many try to find information on more than one technology and gradually narrow their choice to what may be suitable for their home. This can be difficult as installers tend to specialise in a single technology or supplier. When choosing between technologies, purchasers generally choose the one perceived to be less risky, better established and more compatible with their existing or a new property. Together with their lower initial cost, this favours STHW systems.

[b] Grants

Grants are a significant factor and there is evidence that potential adopters are deterred after their initial consideration of microgeneration because of the high cost and relatively small UK grants available at the time of the survey, which typically covered only 10–15 per cent of the price. Most who decided against purchase did so after looking at the grants information and then decided not to apply. For the pioneers who did proceed with the LCBP grants, although 70 per cent said the grant was an important factor in their decision to purchase ('The grant is the sugar that sweetened the pill') many down-played its importance in retrospect. Even so, the majority of adopters criticise the grants for being too small. A substantial minority (44 per cent) of the pioneer adopters say they probably would have decided to purchase their system without a LCBP grant, but the same is unlikely to apply to the wider market of considerers.

[a] How do microgeneration adopters engage with their system?

Pioneer microgeneration adopters tend to be enthusiasts for green technologies and so most want to use their system to reduce their household energy use and emissions as much as possible. It is known that the way that people use microgeneration affects performance (e.g. Guy and Shove, 2000). For example, when hot water is drawn from a STHW system, or the pattern of demand from a heat pump, can affect system efficiency (EST, 2001; Parker, 2007). The PCED results showed that nearly half (47 per cent) of interviewed STWH adopters tried to use solar heated water when it was available, for example showering in the afternoon or evening, when the water is hot, or in the morning if there was hot water from the previous day and a sunny day was

expected. But more than half (53 per cent) said they made no changes to their behaviour, perhaps needing better feedback from the system to enable its most efficient operation (Caird and Roy, 2008).

In the YIMBY survey the most common problems experienced by adopters, affecting about a third, were uncertainty about how best to operate the system to make most efficient use of fuel or energy (37 per cent), and difficulties understanding the system's, often complex, controls (28 per cent). It is therefore not surprising that the main design improvements desired by the adopters are more user-friendly controls and better instructions on their operation and improved feedback displays. For example, nearly half (48 per cent) of STHW adopters wanted easier to understand controls that minimise back-up water heating requirements and provide feedback on money and energy savings. Over half of GSHP (53 per cent) adopters would like controls that give more feedback on operating efficiency and energy saved – rather like a car computer. Such improvements should help users understand how to maximise energy, carbon and financial savings.

One of the most promising findings of the YIMBY surveys is the fact that the majority of 272 adopters with experience of microgeneration use claim that they are more aware than before of their household's energy use (74 per cent) and make greater efforts to save energy (72 per cent). It is perhaps less surprising that, having gone to such efforts to research and install their new technology, 71 per cent also say they are adapting their behaviours to make the most efficient use of the hot water or heat generated.

[a] Why do most people decide against adopting microgeneration?

The PCED survey found that just 20 per cent of those who seriously considered getting microgeneration actually installed a system. Like previous studies, the PCED survey found that high initial cost was the main reason for rejection of solar PV (85 per cent of non-adopters), STWH (73 per cent) and micro-wind turbines (53 per cent) (see Table 2). However, simple wood-burning stoves were more often rejected because of anticipated difficulties in finding the space to store fuel (45 per cent), controlling their heat output (43 per cent) and the extra dirt and labour they involve (40 per cent), rather than their cost (35 per cent).

As Table 2 shows, there were other deterrents to adoption, some technology-specific. For non-adopters of STWH, solar PV and micro-wind an obstacle for about a quarter

was the difficulty finding a trustworthy installer. Indeed several commented that there was a need for regulation to control ‘cowboy’ installers. This is being addressed by providing installer accreditation, for example through the Solar Trade Association and the government’s Microgeneration Certification Scheme. More than one fifth of non-adopters were also uncertain about the performance, reliability and durability of solar and wind systems and half were deterred by the low price paid for solar electricity exported to the grid. Additional obstacles to micro-wind adoption included getting planning permission, finding a suitable location and worries about noise and vibration.

Table 2 *People Centred Ecodesign: Barriers to adoption of microgeneration*

| Reason(s) given for non-adoption * | Solar thermal hot water | Solar PV | Micro wind turbine |
|---|--------------------------------|-----------------|---------------------------|
| Too expensive | 73% | 85% | 53% |
| Likely fuel savings not worth the cost | 36% | 40% | 21% |
| Difficulty finding trustworthy installer | 25% | 24% | 25% |
| System not likely to last long enough to pay back | 24% | 28% | 15% |
| New technology with uncertain performance and reliability | 23% | 19% | 21% |
| Gaining planning permission | 13% | 13% | 37% |
| Difficulty finding space or suitable location for unit | 17% | 16% | 33% |
| Insufficient electricity produced | n/a ** | 28% | 19% |
| Noise /vibration | n/a** | n/a** | 26%** |
| <i>Total responses: non-adopters</i> | <i>149</i> | <i>123</i> | <i>126</i> |

* Notes: Results for the 69 non-adopters of simple wood-burning stoves are presented in the text. **n/a = not asked/applicable.

The YIMBY surveys again found that financial barriers – high cost (86 per cent), long or uncertain payback (68 per cent) and relatively small grants (60 per cent) – were major deterrents for the microgeneration heat non-adopters (Table 3).

Table 3 YIMBY Generation: Barriers to adoption of microgeneration heat

| Non-adopters responding that the following issue(s) are ‘very’ or ‘fairly’ important | Solar thermal hot water | Ground source heat pump | Wood-fuelled boiler | Total non-adopters* |
|---|-------------------------|-------------------------|---------------------|----------------------------|
| Purchase price | 87% | 95% | 76% | 86% |
| Pay back on the investment is uncertain or long | 75% | 70% | 48% | 68% |
| Grant(s) only cover 10-20% of the purchase price | 65% | 58% | 57% | 60% |
| Performance and reliability uncertainties | 57% | 63% | 57% | 58% |
| More cost-effective ways to reduce carbon emissions | 58% | 51% | 57% | 56% |
| Possible major modifications to existing heating, hot water or electrical systems required | 55% | 51% | 67% | 54% |
| Difficulties finding space or suitable location | 38% | 49% | 62% | 50% |
| Time and effort involved in investigating and installing | 42% | 51% | 62% | 47% |
| System unlikely to provide all household’s heating/ hot water demand | 42% | 42% | 38% | 42% |
| Uncertainties how much energy/CO ₂ system will save | 33% | 44% | 52% | 42% |
| Difficulties getting a grant | 48% | 28% | 43% | 40% |
| Difficulty finding a suitable installer | 22% | 28% | 43% | 26% |
| <i>Total responses: non-adopters</i> | <i>60</i> | <i>43</i> | <i>21</i> | <i>132*</i> |

* Note: results for non-adopters of automatic biomass stoves are not presented separately because of only 8 responses.

Table 3 also shows that, apart from the cost, there are other major reasons for non-adoption, especially the lack of consumer confidence in the performance and reliability of unfamiliar technologies (58 per cent); the frequent need to modify existing properties and heating systems when installing microgeneration (54 per cent), a lack of space to install equipment (50 per cent) and the time, effort and technical knowledge involved in choosing between technologies, selecting a system and getting it installed (47 per cent).

[a] What measures would encourage more people to adopt microgeneration?

Responses to both the PCED and YIMBY surveys identified a need for a variety of measures to lower the financial and other barriers to the wider consumer uptake of microgeneration systems. Table 4 shows some of the improvements that the non-adopters of domestic solar and wind systems in the PCED online survey considered would encourage them and/or others to purchase a system.

Table 4 *People Centred Ecodesign: Improvements that would encourage more widespread adoption of microgeneration*

| Improvement(s) chosen by non-adopters | Solar thermal hot water | Solar PV | Micro-wind turbine |
|---|--------------------------------|-----------------|---------------------------|
| Lower cost systems | 60% | 80% | 82% |
| System financed by energy supplier paid back via fuel bills | 56% | 55% | 59% |
| Mandatory standards for performance, reliability and durability | 47% | 46% | 48% |
| <i>Total responses: non-adopters</i> | <i>149</i> | <i>123</i> | <i>126</i> |

[b] Cost reduction

Reducing upfront costs is a clear priority. A majority of PCED respondents would like incentives to reduce costs, such as tax breaks, increased subsidies and grants, and reduced council tax for adopters. Energy suppliers have a role to play in reducing initial costs. In particular, more than half of non-adopters of STHW, solar PV and

micro-wind systems said they would be encouraged to adopt if energy suppliers offered schemes to install systems with repayment via (reduced) fuel bills (Table 4). The YIMBY surveys found price thresholds below which many more considerers and non-adopters said they would purchase. For example, £2500 to £3000 rather than the £4000 average price for a retrofit STHW and a maximum of £10,000 for a ground source heat pump system. Microgeneration systems have already benefited from a 5 per cent VAT rate, and costs could be brought down further by larger grants, through lower-cost production (e.g. from Chinese and Indian suppliers) or by subsidies from energy suppliers as required under the government’s Carbon Emissions Reduction Target (CERT). However, the most popular financial incentive was council tax relief, favoured by over half of all respondents (and three quarters of considerers), and the least popular was low-cost, long term loans (Table 5).

Table 5 *YIMBY Generation: Preferred financial measures to encourage purchase of microgeneration heat technologies (if all of equivalent value)*

| Financial measure | Percent choosing |
|--|-------------------------|
| Annual reduction in council tax after installation | 53% |
| Government or local authority grant | 39% |
| Reduced price system from an energy supplier | 32% |
| System installed free by an energy supplier and paid back via fuel bills | 24% |
| Low interest loan for the full cost paid back over several years. | 18% |
| <i>Number of responses: total sample</i> | <i>914</i> |

[b] Regulation

In the PCED survey, just under half of non-adopters of STWH, solar PV and micro-wind would like long-term guarantees if they bought a microgeneration system, including a stronger government role in establishing mandatory standards for product performance, reliability and durability (Table 4). Many respondents would also welcome the phasing out of inefficient domestic heating and electrical technologies as proposed in policies, such as the Code for Sustainable Homes and Zero Carbon Homes.

The YIMBY surveys found that two-thirds (69 per cent) of all respondents would support tighter building regulations that required householders to install low carbon energy technologies when undertaking major refurbishments or home extensions. However, only one-third (35 per cent) of all YIMBY respondents would support a carbon rationing scheme (e.g. in which each citizen is given an equal carbon ration and can buy and sell unused rations).

[b] Information and advice

The PCED survey respondents pointed to improvements in information and advice that should help those considering microgeneration make confident purchasing decisions. These include online comparisons of equipment specifications and independent assessments of how different manufacturer's systems perform. The YIMBY surveys also found that increasing consumer understanding and confidence in the technologies is needed to promote wider adoption (Table 6). Nearly three-quarters (71 per cent) of all YIMBY respondents would therefore welcome *Which?*-style independent tests showing the performance and payback of different manufacturer's equipment and systems. Such comparative information is becoming more widely available under the government's Microgeneration Certification Scheme, beginning with publication of accredited manufacturers' ratings of wind-turbines. YIMBY respondents also cited difficulties finding trustworthy installers, underlining the importance of accreditation and the value of a 'one-stop shop' for independent advice and information on the whole process of choosing, buying, installing and using a microgeneration system – something that the Energy Saving Trust is rolling out through its Green 'ActOnCO2' advice service.

Table 6 *YIMBY Generation: Desired information and advice measures*

| Information and advice measure | Percent choosing |
|--|-------------------------|
| Independent information on the performance and payback of different manufacturers' systems | 71% |
| One-stop shop assisting process of technology choice, grant applications, planning permission, installation, use and maintenance, and effective use. | 69% |
| On-line information to help assess suitability of home for low carbon energy technologies | 50% |
| More opportunity to see low carbon energy technologies installed in people's homes and public buildings | 46% |
| Installers who supply different low carbon energy technologies and advice on the most suitable | 41% |
| <i>Number of responses; total sample</i> | <i>914</i> |

There will always be properties unsuitable for microgeneration. For example, monitoring has shown that micro-wind turbines are generally unsuited to urban areas (EST, 2009) and STHW systems only suit properties having a mainly south-facing roof and space for a larger water cylinder. Improved online information to assess a home's suitability for microgeneration would thus be welcomed by half of all YIMBY respondents, and especially by the considerers. Multi-skilled installers able to advise on and install the different technologies are also desired by over 40 per cent of respondents, as is more opportunity to see working microgeneration systems in action (Table 6).

[a] Conclusions

The widespread adoption of microgeneration technologies in existing and new homes could make a significant contribution towards achieving the UK's carbon reduction targets. Current demand is largely confined to a niche market of environmentally concerned, older, middle class householders, often those living in larger rural properties off the mains gas network. This niche market applies especially to ground source heat pumps, wood-fuelled boilers and biomass stoves. This is not surprising

given that these technologies are better suited to larger properties with space for the equipment, ground heat collectors or wood fuel stores. Microgeneration space heating systems are currently only cost effective in properties previously heated by oil, electricity or solid fuel. STHW systems have a wider appeal because it is a lower cost, more compact and familiar technology worthwhile for rural, urban and suburban homes with or without mains gas.

Solar PV also has the potential for widespread adoption, given the government introduction of a generous feed-in tariff in 2010 for UK householders who generate renewable electricity for their own use and for export to the National Grid; similar to the highly effective German scheme. This is something that 50 per cent of solar PV non-adopters in the PCED survey wanted. The planned introduction of a UK renewable heat incentive in 2011 should give a similar boost to STHW, heat pump and biomass systems.

Our surveys reveal that despite considerable public interest, indeed serious consideration, in adopting microgeneration the UK market is still at an early phase of the diffusion curve, mainly attracting 'pioneers' who are driven by conviction to reduce carbon emissions coupled with the hope to save money and enjoy the pleasure of using low or zero carbon energy. Nevertheless, there is considerable potential to widen the appeal of microgeneration beyond the small niche of technology pioneers. With the exception of the small sample of micro-wind turbine adopters, both the PCED and YIMBY surveys show generally high levels of satisfaction among householders who have installed a microgeneration system. Market segmentation by the EST of applicants to the LCBP shows that there are potentially 4.8 million homes (20 per cent of UK households) that could be targeted for installing microgeneration, namely affluent, middle aged and professional couples, many who live in off-gas areas. Government standards and policies should widen this niche significantly, as low and zero carbon technologies are increasingly required for new housing under the Code for Sustainable Homes and Zero Carbon Homes.

The government's Microgeneration Strategy Progress Report outlines relevant actions to achieve the market transformation required for more widespread adoption of microgeneration (BERR, 2008) which our survey findings complement. For microgeneration to expand beyond its current market niche, at least the following issues need to be addressed:

[bl]

** • Capital cost reduction: as the greatest barrier, this is probably the main way of widening appeal. It could be achieved with a range of measures including council tax relief for adopters, more generous government grants, financial incentives from energy suppliers such as the feed-in tariff and the renewable heat incentive, or via manufacturing solutions.

** Better advice –potential adopters want ‘one stop’, independent, trustworthy advice that offers comparative information on the suitability, performance and payback of the different technologies and manufacturers’ systems.

** Independent information on the performance and energy saving of different microgeneration technologies to increase consumer confidence in installing innovative or unfamiliar technologies.

** Improved system designs that are less disruptive to install, and require fewer modifications to existing buildings, heating, hot water and electrical systems.

** User-centred design improvements to controls, with improved feedback displays showing the energy generated, emissions and money saved.

Although the above measures should increase adoption of all microgeneration systems, our surveys also indicate that a strategy tailored to the different technologies is needed. An Energy Saving Trust report found that ‘...no single policy will encourage the kind of mass adoption of microgeneration that is needed to get results’ EST (2007). The views of adopters, those considering purchase or people merely interested in microgeneration can inform government policies, industry strategies and installer practices to increase the uptake of these technologies, and so help tackle the challenges of climate change.

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[a] Acknowledgements

This chapter draws on the Open University (OU) ‘People Centred Ecodesign’ project on consumer adoption of household renewables, conducted in collaboration with the National Energy Foundation and the Energy saving Trust (EST), and the OU and EST ‘YIMBY’ project, which evaluated microgeneration heat technologies for UK households, part-funded by the Higher Education Innovation Fund’s ‘Carbon Connections’ programme administered through the University of East Anglia. The YIMBY project forms the background for a technical field trial and user evaluation by the EST and OU of heat pumps in real UK domestic installations to be completed in 2011 with an interim EST report in Autumn 2010.

We would like to thank the following organisations for collaboration and support for this research:

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- ** The National Energy Foundation
- ** Milton Keynes Energy Agency
- ** The Energy Saving Trust
- ** Carbon Connections