CASHING IN ON THE GREEN MACHINE: ARE DEVELOPERS MISSING OUT?

DR CLAIRE ROBERTS
Department of Real Estate and Construction
School of the Built Environment, Oxford Brookes University
Tel: +44 (0) 186548 3852 Fax: +44 (0) 1865 383927
Email: croberts@brookes.ac.uk

DR SALLY SIMS
Department of Real Estate and Construction
School of the Built Environment, Oxford Brookes University
Tel: +44 (0) 1865483459 Fax: +44 (0) 1865 383927
Email: ssims@brookes.ac.uk Contact Author

REF: 2007/No. 1

OXFORD INSTITUTE OF SUSTAINABLE DEVELOPMENT
INTERNATIONAL LAND MARKETS RESEARCH GROUP
(OISD-ILM)
ABSTRACT

In the light of recent market increases in the demand for post-construction microgeneration technologies, the research seeks to explore the reasons behind the apparent reluctance of UK residential developers to embrace microgeneration technology and adopt it large-scale across their developments. The study will explore the residential developers’ attitudes towards these technologies, their perceptions of drivers and barriers to sustainability, supply and demand issues and perceptions of the potential contribution that microgeneration technologies could make towards sustainable construction across the UK. The technologies in question are; biomass, bio-fuel, fuel cells, photo-voltaic (PV), water (including waves and tides), wind, solar power, geothermal sources and combined heat and power systems (CHP).

This paper reports on the findings of twelve telephone interviews with UK residential developers. These were carried out in May 2007. Findings revealed the biggest drivers towards sustainability for interviewees were legislation and affordable housing providers. Developer awareness of sustainability issues was considered high whereas occupier awareness was considered relatively low at present. Awareness was perceived to have risen in recent years as a result of increasing media attention and government activity. Housing Associations were seen as champions of sustainable construction. The most favoured micro generation technology amongst developers was solar thermal, as it was perceived to be the most established microgeneration technology. The barriers to the adoption of microgeneration technology were revealed to be as follows; the initial cost to developers, the initial costs to occupiers, long payback periods, and the current market immaturity, reliability and liability of micro generation products.

The DTI state that the use of microgeneration technology could be the only realistic way to reduce greenhouse gas emissions. The Energy Saving Trust suggested that, “despite the high cost of this technology and the long payback times,” microgeneration could provide 30-40% of the UK’s electricity needs…by 2050 [and help to] reduce household carbon emissions by 15 percent per annum”\(^1\). Interviewees revealed they were concerned that unless there are significant improvements in efficiency, reliability (both in supply and design), reductions in purchase costs and, guarantees that they will be free from liability when things go wrong, they will struggle to achieve this aim, certainly in time to meet the Code for Sustainable Homes Level Six ‘zero carbon’ rating in 2016.

Key Words: microgeneration, technology, wind turbine, solar energy, residential, developer, property

\(^1\) http://www.dti.gov.uk/energy/sources/sustainable/microgeneration/strategy/page27594.html
1. INTRODUCTION

According to Defra\(^2\) “Climate change is the greatest environmental challenge facing the world today” and since the late 1990s, the UK government has been committed to reducing greenhouse gases, in particular carbon dioxide (CO\(_2\)) known to be a major contributor to climate change (global warming).

In 2003 the DTI published the Energy White Paper which set a ‘very ambition goal’\(^3\) of reducing CO\(_2\) emissions by 20% based on 1990 levels by the year 2010 (and a target of 60% by 2050). Whilst transport is widely accepted as being one of the main CO\(_2\) producers in the UK, it is perhaps less well known that British homes are responsible for over 28 percent of our total CO\(_2\) emissions (Greenpeace 2007\(^4\)). This is largely through wasted energy. Part of the Government’s strategy is to reduce CO\(_2\) emissions from energy production\(^5\) by developing renewable energy technology from sources such as, wave power, solar energy, biomass fuel and in particular onshore and offshore wind. In addition, the introduction of the new Code for Sustainable Homes aims to achieve “zero-carbon status for new housing by 2016” (Mactavish 2007). This means that each new home “must generate all its energy, including energy for heating, hot water, lighting and appliances, without adding CO\(_2\) into the atmosphere” (Tebbit 2007). Achieving zero carbon status will rely, in part, on the use of small scale wind and solar energy, referred to as ‘microgeneration’.

Small wind turbines and solar panels have been available for a number of years through various internet sites. In 2006 B&Q, one of the UK’s largest DIY stores began to market small wind turbines and solar panels for around £1,500 each. However, whilst there appears to be a demand for this technology, residential developers are not yet incorporating microgeneration into mainstream residential schemes.

This pilot study therefore begins to explore the possible reasons for the failure of developers to embrace microgeneration and to establish whether there are any barriers towards incorporating this technology in residential developments.

2. MICROGENERATION

Microgeneration is defined as any technology which produces, ‘heat and/or electricity on a small-scale from a low carbon source’\(^6\) which does not exceed ‘50 kilowatts’ for electricity generation and ‘45 kilowatts thermal’ in relation to the production of heat (The Climate Change and Sustainable Energy Act 2006)\(^7\). Those sources of energy and technologies are-

- biomass,
- biofuels;
- fuel cells;
- photovoltaic (PV);
- water (including waves and tides);
- wind;
- solar power;
- geothermal sources;

\(^2\) http://www.defra.gov.uk/environment/climatechange/index.htm
\(^3\) Climate Change Communications Strategy Document prepared by Futurra Feb 2005 for DEFRA
\(^4\) http://www.greenpeace.org.uk/files/pdfs/climate/energywhitepaper_briefing2.pdf
\(^5\) CO2 is produced when coal or gas is burnt and is a major contributor towards global warming
\(^6\) DTI Microgeneration Strategy 2006
\(^7\) http://www.dti.gov.uk/energy/sources/sustainable/microgeneration/index.html
• combined heat and power systems (CHP).

The technology most widely available for installation into residential property is solar heating/hot water, PV and wind. CHP is not as widely available for individual properties and appears to be more suited to installation in buildings with multiple occupancy.

Solar heating/hot water uses heat from the sun to work alongside your conventional water heater. Cold water is fed through a collector, mounted on the roof and then back into the boiler. This reduces the amount of energy required to heat water (see Figure 1). Efficiency is dependent on the position of the solar panel and the type of boiler installed. Solar thermal can provide almost all your hot water during the summer months and around 50% of your hot water requirements annually and reduce your CO₂ emissions. Whilst this technology is reliable, the DTI (2005) suggests that it is not yet cost effective. Payback times vary considerably (between 6-20years) depending on which system you choose or where your information comes from (Eccleston 2007).

**Solar power hot water/heating system**

![Solar power hot water/heating system](image)

**Solar power hot water/heating system**

**Photovaltaics** Solar power is also used to produce electricity. This type of generation is referred to as Photovoltaics (PV)

**PV** depends on the electrical properties of certain materials, known as semiconductors, which allow them to transform sunlight into electricity. Silicon is most commonly used and when exposed to light, electrical charges are generated. This can be conducted away by metal contacts as direct current (DC). (Todd 2006) On a small scale, PV is widely used in watches, calculators and cameras (ibid). It has no moving parts and as a result, requires minimal maintenance, generates electricity without producing CO₂ emissions and its operation is virtually silent (Greenenergy.Com).

PV can be mounted on almost any building surface which receives sunshine for most of the day and can be used to supply all the electricity requirements of a single household. There are plans to use PV to generate electricity on a large scale. For instance, Stirling Energy Systems has announced plans to build two separate solar farms (see Figure 2); one with the capacity to generate 500 megawatts of electricity in the Mojave Desert near Victorville, California, for SoCal Edison, and a 300-megawatt plant in the Imperial Valley, near Calexico, California, for SDG&E. ‘The utilities have signed 20-year deals to buy all the juice the farms can turn out, and have options to expand the plants if they are successful. ’

---


Whist PV appears to offer the most reliable and efficient system, the main drawback is the high cost and subsequent long payback time; typically 18-30 years (DTI, 2006 Microgeneration Strategy).

MicroCHP (combined heat and power) is an efficient technology for generating electricity and heat simultaneously, by using conventional generation technologies (natural gas), fuel cells (currently very expensive) or sStirling engines within a CHP ‘plant’. Domestic or micro CHP systems can be installed in place of standard domestic boilers. A domestic CHP system not only provides heat for the home, but also a proportion of the electricity in the same process. Domestic systems have the potential to be as much as 90% energy efficient, reducing the energy bill for the home and reducing carbon dioxide emissions per household10.

Micro-wind turbines convert wind to electricity. The British Wind Energy Association (BWEA) states that, “wind energy on a large scale is now competitive with other sources of electricity on the national grid. However, small domestic-sized wind turbines (see Figure 3) have not yet reached this point”. This is because “small winds turbines are expensive in relation to what they produce, and cannot realistically compete with mains electricity”. Interestingly, despite this acknowledgment, there are many companies offering large reductions in electricity bills. For instance, B&Q claimed their wind turbine could reduce fuel bills by up to 30% which, according to Monbiot (2007), is more likely to be ‘closer to 3%’. Even the US government states that you can, “lower your electricity bills by 50–90%” by installing a small wind turbine (USA Department of Energy. June 2007)11.

One of the more worrying aspects associated with manufacturer’s marketing claims of large savings on domestic fuel bills, is the negative impact that this could have on the microgeneration industry when occupiers, fail to reap the promised benefits. As Martin (2005-6) explains, manufacturers’ claims of an average saving of “£400 per year” and predicted “payback times of 3yrs” are “likely to do a disservice to the wind industry.” He says that “even a payback time of 20yrs is unlikely, unless you get a substantial grant for the total package and the product remains maintenance free for that period.”

---

11 http://www.eere.energy.gov/consumer/your_home/electricity/index.cfm/mytopic=10880
The DTI\textsuperscript{12} says that “the electricity generated at any one time by a wind turbine is highly dependent on the speed and direction of the wind. The wind-speed itself is dependent on a number of factors, such as location within the UK, height of the turbine above ground level and nearby obstructions. Ideally, you should undertake a professional assessment of the local wind-speed for a full year at the exact location where you plan to install a turbine before proceeding.” Although in reality this would probably be far too expensive and time consuming for the residential market to undertake.

Whilst purchase costs are relatively low (between £700 and around £3,000\textsuperscript{13}) and include installation, occupiers will still have to obtain planning permission. Another consideration is the cost of servicing and maintenance. Whilst a turbine should last 20 years it will need regular servicing (approx every 2-3 years), which will add an additional cost to your outlay (DTI-Low Carbon Buildings Programme\textsuperscript{2006}).

\section*{3. CURRENT NUMBER OF INSTALLATIONS}

In 2004, there were over 82,000 units installed in the UK (see Figure 4), of which most are solar water heaters installed before the year 2000.

\begin{table}[h]
\centering
\begin{tabular}{|l|c|}
\hline
Technology & Number of Installations \\
\hline
Micro-wind & 650 \\
Micro-hydro & 90 \\
Ground source heat pumps & 546 \\
Biomass boilers (pellets) & 150 \\
Solar water heaters & 78,470 \\
Solar PV & 1,301 \\
MicroCHP & 990 \\
Fuel Cells & 5 \\
\hline
\textbf{Total- for year 2004} & \textbf{82,202} \\
\hline
\end{tabular}
\caption{Number of Micro generation units installed in the UK 2004}
\end{table}

In 2005, the DTI published the results of an independent report on the feasibility of various microgenerating technologies (DTI, 14\textsuperscript{th} November 2005). The research, undertaken by the Energy Saving Trust, found that there was a high correlation between the level of grant funding available and the annual number of installations.

\textsuperscript{12} Wind energy Low Carbon Buildings Programme (DTI)
http://www.lowcarbonbuildings.org.uk/micro/wind/-12-04-07

\textsuperscript{13} B&Q offer a 1kW turbine complete with survey and fitting for £1,498, although planning permission still needs be obtained. Energistar are selling a 1kw turbine for £695 excluding installation
They concluded that, “Microgeneration could deliver significant efficiency and CO₂ benefits... [and] provide 30–40% of the UK’s electricity needs,” but only if the technology was “installed by consumers in their millions,” (DTI (2005). In November 2005, there were still less than 100,000 microgeneration installations within the UK which is a very small uptake when you consider that there are approximately "29Million electricity customers in the UK [and therefore the] potential for microgeneration is almost the same figure" (Microgeneration Strategy 2006).

4. GOVERNMENT POLICY ON MICROGENERATION

In 2006, the Government launched its ‘Microgeneration Strategy’. ‘The objective of this strategy is to create conditions under which microgeneration becomes a realistic alternative or supplementary energy generation source for the householder, communities and small businesses. (The Government’s Energy White Paper 14).

The government is providing grant funding for installation of microgeneration technologies under the ‘Low Carbon Buildings Programme’ (LCBP). Introduced in April 2006, the LCBP replaces ‘Clear Skies’ and the ‘Major PV Demonstration Programme’15, and now has an £80million budget over 3 years.

The Government states that it aims to take a “more holistic approach towards tackling carbon emissions by combining energy efficiency microgeneration technologies.” Rather than focusing on individual households or small community projects, their new approach aims to “engage the construction sector more widely and to increase the take up of microgeneration products in new-build and refurbished developments.” (HM Government Climate Change The UK Programme 2006:41).

4.1 Code for Sustainable Homes

To support the Government’s Climate Change strategy, the new Code for Sustainable Homes was introduced in December 2006, “which is the principle element of the most ambition sustainable housing policy initiative to date,” (Mactavish 2007). The Government states that it sets “the national standard for the sustainable design and construction of new homes” by providing a “flexible framework that enables developers to demonstrate the sustainability of new homes” (Communities and Local Government 16). In theory, the Code should cut CO₂ emissions from the construction and occupation of homes and, provide all new homes with a building energy efficiency ‘star rating’.

The Code supersedes the EcoHomes rating, where it was possible to achieve a ‘very good’ or even ‘excellent’ ratings “without making substantial reductions in a home’s carbon emissions” (ibid). The new Code rates the sustainability of housing on a scale of one to six and is pushing the residential development industry to achieve ‘zero carbon status’ on all new build by 2016 (we are currently on Code Level Three). Mactavish (2007) states that the code is less flexible than EcoHomes rating which has a number of performance criteria “from which the most cost effective are usually selected” (ibid).

To examine the likely impact of the new Code on development costs, English Partnerships commissioned Cyril Sweett to determine the likely cost for different house types. The report, published in February 2007, found that costs range from an

15 See ‘Global Renewable Energy Policies and Measures Database’ (www.iea.org)
additional 0.4% to 6.2%, depending on house type and technologies used. The benefit from achieving Level Three of the Code should be a 25% reduction in carbon dioxide emissions per home, and water-usage savings of 21 litres per person per day. Of course this only applies to new build. The additional cost therefore produces more efficient results and more sustainable homes. However, meeting Level Six of the Code requires developers to build a completely ‘zero carbon’ home which, “will have a substantial impact on development costs” and could add an additional £5,000 – £50,000 depending on the technologies used (£5,000 using large-offshore wind, to £50,000 with photovoltaic) (Mactavish 2007).

5. BARRIERS TO THE ADOPTION OF MICROGENERATION TECHNOLOGY

The potential barriers towards the incorporation of microgeneration are either, technical and cost issues relating to the products on offer, legislation (i.e. planning permission) or negative public perception towards this technology.

5.1 Technical and Cost Issues

Solar heat and hot water panels require sunlight to be effective. There may also be an additional cost if your existing boiler is not compatible with this technology. There may also be objections to the visual impact of panels and pipes on your roof (see Figure 5). On the plus side, they often come with ten 10year guarantees. PV panels can be roof mounted, (in which case the roof supports may require strengthening), or integrated into the building (in other words, the solar panels are the roof). The initial cost of installing PV can be high. Green Energy states that, “the typical price for a grid connected, building integrated PV system...works out at £12,000 - £14,000 for a 2 kWp system17 for a house. Although under the current grant scheme an occupier may be able to claim up to 50% of this cost,”18 Roof or wall mounted wind turbines can experience considerable vibration which could damage an older property, where brickwork is often in a poor state of repair, and result in toppling chimney stacks and gable ends. Martin (2007) questions whether utility companies, who are likely to install this equipment, “will accept the potential consequences of such installation”.

Legislation also has an impact on the uptake of this technology. For instance, B&Q stated that 32% of all cancelled orders for their wind turbine was due to planning issues. However they declined to reveal how many orders they had received for either solar panels or wind turbines1.

---

17 A typical 2 kWp system (around 20 m2 of multicrystalline modules) would generate around 1500 kWh per year.

18 http://www.greenenergy.org.uk/pvuk2/technology/cost.html see also www.solarpvgrants.co.uk and the Energy Saving Trust for information on available grants. Most of the grants and offers you can benefit from are provided by three main groups; The Government. Energy Suppliers and Local Authorities.
5.2 Planning Permission

Removing the need for planning permission is something the Government are currently considering, although Askew and Edmundson (2007) question whether this will have the desired effect. They suggest that, “removing planning restrictions...may result in householders installing equipment simply because it falls within permitted development limits” rather than because it is the most “efficient generator” (ibid).

The high cost of meeting levels four to six of the Code will no doubt be seen as another barrier by many developers, particularly as there is no mandatory requirement for developers to apply the Code to new build; although planning permission and building contracts may be more difficult to obtain, especially if the client is an affordable housing provider. The Town and Country Planning Association, Friends of the Earth and Renewable Energy Association have also branded the Code as “…totally inadequate” adding that, “the Code will have to be strengthened considerably if it is to have a significant impact in tackling climate change,” which could include “Making the Code mandatory” (Friends of the Earth 200719).

By contrast, in Northern Ireland, “microgeneration systems are to be compulsory in all new houses in Northern Ireland from the 1st April 2008,” (Killip 2006). “Options include...small-scale wind turbines, biomass boilers and geothermal heat pumps” and in the public sector, “the Housing Executive is to install solar water heating panels in 600 of its 90,000 properties”. (Ibid).

Germany is even more forward thinking and is improving the energy efficiency of around five percent of its existing housing stock each year, rather than focusing exclusively on new build and refurbishment.

5.3 Public Perception

Payne (2005) states that, “public opinion towards sustainable energy continues to gain support.” Whilst there may be “…opposition to wind farming…” (ibid), the Sponge Report (2006) found that, “home owners are becoming increasingly interested in sustainable housing” (Sponge 2006). The report, commissioned by DEFRA on the desirability of ‘sustainable homes’ found that 80% of the 501 people interview believed that, “sustainable homes can help the environment” (ibid). There was also a “general willingness to adopt a more sustainable lifestyle with 52% stating they were prepared to pay more for homes built to a high environmental standard”. However nine out of ten people think the Government should “offer incentives to encourage demand”. The study found that the greatest barrier in driving demand was “a lack of information with over 70% of homeowners claiming to know little or nothing about sustainable homes.” (ibid). Monbiot (2007) also cited “a lack of knowledge” as one of the main barriers towards the uptake of microgeneration, in particular, the cost to install and subsequent savings on bills and more importantly, how our behaviour was a key factor in reducing carbon emissions. In addition to a lack of knowledge, ‘planning permission’ and the ‘high cost of installing this technology’ were also cited as the most commonly perceived barriers by The Energy Saving Trust (2005).

5.4 Commercial Investment

Although this paper is not considering commercial property at this time it is worth noting that the main barrier towards driving commercial investment was found by Payne to be the payback time (see Figure 6). “Many buildings, especially commercial buildings,

have a usable period of no more than twenty-five years although there are of course many exceptions….PV’s systems of all types require significant capital investment especially when compared to the energy cost savings that are made. Thus the payback periods are long…As this life cycle progresses, so the inclination of anyone to invest large amounts of capital steadily decreases… if occupiers wish to stay and renovate the buildings, then investment in PVs becomes more likely again” (Payne, op cit).

Approximate Break Even Time for Different Microtechnologies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Break Even Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV</td>
<td>18-30 years</td>
</tr>
<tr>
<td>Small wind</td>
<td>5-7 years</td>
</tr>
<tr>
<td>Solar water heating with electric</td>
<td>12+ years</td>
</tr>
<tr>
<td>Biomass</td>
<td>Currently cost effective</td>
</tr>
<tr>
<td>Ground source heat</td>
<td>2-3 years</td>
</tr>
<tr>
<td>Stirling CHP</td>
<td>2-3 years</td>
</tr>
</tbody>
</table>

Figure 6

Whilst the Government might not be in a position to reduce the cost of this technology, without some form of subsidy, it does controls planning legislation and is more than capable of disseminating information to the general public.

The existing literature, whilst scarce and derived mainly from government sponsored research, focuses on occupier demand and perceptions. There was no published research which explored current behaviour and perceptions of residential developers towards incorporating microgeneration into new build residential homes.

6. METHODOLOGY

To gather data for this pilot study, fifteen residential developers were selected from a list of property developers on the Find a New Home website. Large national developers were initially contacted because it was felt they would be more likely to build a wider range of house styles for both Housing Associations and private sale. Ten developers agreed to be interviewed. Nine of the ten interviewees were Technical Managers or Technical Directors, with one Managing Director also being interviewed.

All interviews were semi structured and conducted on the telephone over a two week period in May 2007. The interview schedule utilised closed and open ended questions to allow for expansion on the subject matter where appropriate. Questions were focused on current practice, barriers and drivers to microgeneration and the potential for incorporating this technology into large scale residential development. The semi structured interview schedule is shown in Appendix 1. Interviews were recorded, where permission was given, and subsequently transcribed for analysis purposes. Responses have been anonymised for confidentiality purposes. The results will be discussed thematically in the following section.

7. RESULTS

7.1 Developer Perception of Awareness

The discussion of awareness was split into two themes; awareness of sustainability issues and secondly, awareness of microgeneration and its potential contribution to sustainability. Interviewees identified three groups to whom these themes were relevant. These were; the developers themselves, occupiers (i.e. those purchasing the properties) and affordable housing providers. These will be discussed in turn.

20 http://www.findanewhome.com/property-developers/
Developers considered that their own awareness of issues around sustainability was high; further to this, it was felt that over the next few years, this awareness will increase even further. The reasons behind the perception of high levels of awareness were given as; the rise of media attention and government activity in the area. One interviewee said, “We really have had sustainability rammed down our throats for the last couple of years; the government really are pushing it in new build. Developers feel forced down that route; whether it’s right or wrong, we don’t have a choice” (Interviewee 5).

In terms of awareness of available technologies, interviewees felt that developers had a high awareness. One interviewee stated that, “Everybody is quite on board with this. I think you’ll find that most developers are more up to speed than the local authorities are” (Interviewee 6). All interviewees demonstrated an awareness of the key microgeneration technologies (identified as solar, PV, wind (macro and micro systems), CHP and ground heating). Although Further to this, varying opinions varied as to about the efficiency and viability of the more commonly used technologies and their potential for wider use in the sector. However, this variance was perhaps explained by the fact that most interviewees’ companies were not yet involved in large scale use of these technologies; the majority remain in the planning stage and a minority had ‘dabbled’ in their use (mainly in partnership with housing associations).

Interviewees perceived the awareness of occupiers (those purchasing homes) towards sustainability issues to remain at a fairly low at present, although public awareness was universally considered to have increased in recent years. This increase was attributed to government campaigns to increase awareness of environmental issues and the subsequent increase in media coverage of the subject. One further factor identified as driving an increase in awareness was the Code for Sustainable Homes. However, it was considered that occupier awareness, although increasing, had not yet translated into demand for sustainable homes or microgeneration technologies. One interviewee suggested that:

‘People are aware of the technologies but at the moment they aren’t actually asking for them. There is an interest in houses with more sustainable features but they don’t really know what they are asking for yet. And don’t expect them to pay for it!” (Interviewee 6).

Interviewees identified those homes that have been built to incorporate microgeneration as falling into two categories; either testing the market (and the long term efficiency of the technology) and/or built for an affordable housing provider. One developer stated that the perceived lack of demand was due to the cost of incorporating this technology. He said that, although there is a “fairly good level of awareness, they [the occupier] aren’t prepared to pay for it.” (Interviewee 7). One reason for this could be the fact that the “Payback for some microgeneration technologies are too long.” (ibid).

Occupier awareness of the availability of different types of microgeneration technologies was considered relatively high, particularly with the technologies that have a ‘market history’ for example, Solar Panels (Interviewee 3). Several interviewees identified that the selling of microgeneration technology by high street retailers could be damaging to the sector because product information had been found to be inaccurate, with the product ‘not doing what is says on the box” (Interviewee 7). This was considered to be a problem particularly with micro wind generators. Another developer said that,
‘People are promising too much from the systems they are selling on the high street. They are promising the earth. It is true that if you get the right system in the right building, with the right orientation, then you can save a reasonable amount of energy, however if any of these are not quite right, you are wasting your money” (Interviewee 5).

Problems cited with these ‘bolt on’ technologies included; vibration, damaging to structures, no facility to return electricity to the grid and a poorly placed system which can end up using electricity not creating it. The lack of a site survey on these systems was identified as a cause of several of the issues. This was considered potentially damaging for the viability of incorporating microgeneration technologies into the new build sector.

Interviewees identified the awareness of sustainability issues amongst Housing Associations as very high. One said. “they know about the issues and they are actually doing something about it, requiring that homes must incorporate these technologies” (Interviewee 2). Affordable housing providers were identified as a key driver towards sustainable housing in the UK (Interviewee 6 and 7).

7.2 Favoured Technologies

The most popular microgeneration technology amongst those interviewed was solar thermal, as it was “less constrained than other technologies” (Interviewee 6). It is considered more established than other technologies and is therefore more conventional. It is seen by the public as a proven technology because it has been around in the market for longer. One further benefit is that it doesn’t have such a major visual impact as other technologies (such as wind turbines). Those interviewed were focussing on this technology over others, one interviewee summed up ‘they are tried and tested, most cost effective and easy to sell. It’s a proven product that has some form of market history’ (Interviewee 2). The consensus on the other technologies discussed in this study was that they are, to different extents; ineffective, too costly, unproven, too experimental and too risky (in liability terms).

7.3 Drivers towards Sustainable Housingility

In exploring the drivers to achieving sustainability in residential development, legislation was universally identified as, “the biggest push factor to green our developments” (Interviewees 1 to 10)’. Although the Code for Sustainable Homes is not yet a compulsory requirement, it was suggested that some local authorities are making sustainability issues a high priority, including microgeneration. All developers stated that the main driver was legislation and although there was not a compulsory requirement to follow the Code for Sustainable Development or incorporate microgeneration, it was suggested that:

“Some local authorities are already twisting people’s arms through planning permissions; if you want planning permission, you have to do what they suggest. There are all manner of requirements; some less practical than others”’ (Interviewee 3).

As one developer states,

“It’s all stick and there is no carrot. We are being dictated to, for example, about parking” (Interviewee 5).

Another key driver identified by interviewees (as mentioned above) is Affordable Housing Providers. Those interviewees who have worked with affordable housing
providers (eight of ten interviewees) identified these developments as the only 'live' sustainable projects they have undertaken. These were considered a success because the homes are sold to the housing provider as soon as they are built. One interviewee said 'As soon as we complete the development, we get our money; there is no waiting around for buyers. That can only be of benefit to the developer' (Interviewee 3).

Other drivers likely to come to fruition in the future were identified as consumer demand as a result of a changing culture in the wider population. The consensus amongst interviewees was that use of these microgeneration technologies will become more widespread i.e. move into the private sales market as developers have to comply with the Code for Sustainable Homes.

7.4 Perceived Barriers to Microgeneration Sustainability

Interviewees identified a variety of factors which they perceive are acting as barriers towards the incorporation of microgeneration into large scale residential development. These barriers were identified (in rank order) as:

7.4.1 Initial Cost to Developers
Several interviewees identified the high initial costs (as well as limited availability) as barriers to adoption. As one developer explained, "at the end of the day we are a commercial organisation; we have to get a return on our investment as well as providing the buyer with a good deal’’ (Interviewee 5). Interviewees were adamant that the uplift in value of a home with the facility for microgeneration would not cover the initial payback. One interviewee said, “We don't actually make our money back on these technologies, so why bother? Initial costs are too high, and people aren't prepared to pay for it’’ (Interviewee 6).

7.4.2 Initial Costs to Occupiers
From the perspective of the occupier, one developer explained that:

‘It is not that people don’t want to pay for the technologies, it’s that they can’t. Because of current market conditions the initial cost of housing is so high, if you add six thousand pounds onto the cost of a home, people will then be unable to afford it” (Interviewee 3).

Another interviewee suggested that:

“if you are paying three or four thousand pounds more for a house because it has PV or solar; you want to know that you are going to get the payback from that. The affordability issue is very difficult, particularly for people who are trying to get on the housing market” (Interviewee 2).

Although at current lending rates, buyers could potentially add the additional cost of a solar panel, PV, or a wind turbine onto their mortgage; however the consensus amongst interviewees was that buyers no longer want to stretch themselves beyond their normal means to buy a home. Particularly in the light of recent interest rate rises, interviewees felt that people also want to be able to afford a good quality of life at the same time as owning a home. Owning a home (with or without microgeneration) isn't seen as the be-all-and-end-all. People don’t want to have their lifestyles constrained by increased mortgage payments. And they don’t really see the benefit; “unless these

---

21 Several identified individual projects undertaken for test purposes. These are currently under assessment.
technologies have a direct and significant impact on the running costs of their own home, the general public aren’t really going to be that interested” (Interviewee 3).

7.4.3 Long Payback Periods
Another issue was the fact that due to the high initial capital outlay, depending on the technology it could take between fifteen and thirty years to recoup the installation costs initial outlay through a reduction in energy consumption. Therefore, homes with this technology were unlikely to attract a premium since an occupier would have to live in the same house for at least 15-20 years to see a return on their investment. This investment is seen as too long term for occupiers in current market conditions.

One interviewee explained that,
“‘It is a lifestyle choice for people because of these significant payback periods. Even on a £1500 layout of solar panels, the payback is still 15-20 years. It is not an economic decision at the moment; it won’t be until the costs come down’ (Interviewee 5).

7.4.4 Market Immaturity, reliability and liability of products
The immaturity of the market was identified as a risk-related barrier to large scale adoption; developers were not happy dealing with such embryonic companies. One interviewee summarised the issues saying:

‘I “if I go with a particular occupier and the system breaks down in 5 years time, that supplier may no longer be in the market. If it happens on a large scale, I could be left with hundreds, possibly thousands of irate occupiers, all seeking replacement systems and/or compensation. I cannot take that kind of risk with my business. For this reason we have to use established businesses with an enduring foothold in the market; we need reliability and longevity”’ (Interviewee 8).

There are also issues relating to around the medium to long term maintenance of any microgeneration systems. Interviewees were dubious as to whether occupiers would maintain the systems properly and whether there would be any long term liability issues. This leads onto issues of around reliability and liability. One interviewee highlighted the problem.

“‘If an occupier cannot maintain their boiler properly, which many don’t; all they have to do is get it serviced once a year but a lot don’t bother. How can we expect them to maintain even more complex pieces of equipment? If this microgeneration equipment is neglected and stops working, the occupier will come back to us rather than our supplier”’ (Interviewee 3).

Most developers were concerned about the issue of liability especially since new homes come with warranties of up to 10 years. This leads onto the question of responsibility for maintenance if something goes wrong several years down the line. The likely scenario was suggested to be that the occupier would come to the developer and expect them to liaise with the supplier, whereas the developer won’t want to take responsibility. In addition, the efficiency of this technology, solar and PV in particular, will rely almost entirely on keeping panels free from dirt and well maintained.

8. CONCLUSIONS
This study set out to explore the potential barriers and drivers towards the incorporation of microgeneration (in particular, solar panels, PV and wind turbines) into new build residential property. Existing literature suggested that the perceived barriers were, a lack of knowledge about the various technologies, the cost to install this technology
these produces and their efficiency, in addition to and difficulties obtaining planning permission.

The results of this study found that on average, purchasing an Eco-Home will cost you an additional £10,000 and a zero carbon home, which will include either, Solar, PV or Wind Power, will cost an additional £30,000. Currently, developers are expected to incorporate this into the build cost which will inevitably be passed on to the prospective buyer. This raises huge issues for the property market, particularly when you consider that a 2 bed starter home will have an average build cost of £50,000. The additional cost of incorporating microgeneration technology will increase house prices to well above the entry threshold for many more first time buyers.

Whilst all developers interviewed have built at least one EcoHome to the equivalent of Level Three of the new Code, not all have incorporated microgeneration technology. Those that have are either currently testing their performance or have incorporated them into affordable housing for local authorities and RSL’s (Housing Associations) who receive a government subsidy.

Regarding micro-wind, the general consensus was that this technology, in its current form, was inefficient and likely to do more harm than good to the potential microgeneration market. Another concern was the visual impact of this technology on mainstream private housing.

The consensus amongst interviewees was that Government has missed the biggest issue; existing building stock. The consensus was that Government should be focussing its energies on existing buildings, in addition to as well as new build. It was felt that there are considerably greater issues with energy efficiency in existing housing stock and that the Government is taking the easy path by focussing solely on new build rather than the 95% of homes in the UK which are over 10 years old. Houses built more than ten years ago are thermally inefficient – these should be tackled first. Developers can only deal with new build (Interviewee 7). However, interviewees did concede that it is understandable why Government would take this path, because legislation for new build is easy to implement and easier to both monitor and enforce; whereas there are considerable difficulties with enforcing energy improvements in existing building stock.

In terms of new build, the consensus amongst interviewees was that issues such as building design and the use of energy efficient products should be employed first to reduce carbon emissions prior to the consideration of microgeneration technologies. It was agreed that developers should:

“Work on improving the building fabric first; secondly issues outside the building itself, for example transport and commuting distances. Then maybe we should start applying renewable” (Interviewee 6).

One interviewee summarised:
‘You could add all the bolt on technologies you like to a building, but it wont necessarily yield a significant carbon reduction unless you get the basics correct. This is difficult to do without the specialist knowledge and an understanding of the technicalities – most of which the general public do not possess” (Interviewee 4).

This was echoed by the British Council for Offices who said that “It is entirely probable that we could have a building with solar panels and wind turbines that reduce its carbon output, but it will not be as efficient as one that instead incorporates low-energy lighting, cooling and ventilation technologies” (Morris Huw 2007).
The DTI state that the use of microgeneration technology could be the only realistic way to reduce greenhouse gas emissions. The Energy Saving Trust suggested that, “despite the high cost of this technology and the long payback times,” microgeneration could provide 30-40% of the UK’s electricity needs...by 2050 [and help to] reduce household carbon emissions by 15 percent per annum.”

Clearly there is concern amongst developer that unless there are significant improvements in efficiency, reliability (both in supply and design), reductions in cost and, guarantees that they will be free from liability when things go wrong, they will struggle to achieve this aim, certainly in time to meet the Code for Sustainable Homes Level Six ‘zero carbon’ rating in 2016.

This working paper has provided a foundation for a larger study of the residential property industry in the UK. Further research will focus on establishing measures to overcome the barriers to incorporating microgeneration which have been identified in the study.

22 http://www.dti.gov.uk/energy/sources/sustainable/microgeneration/strategy/page27594.html
REFERENCES


Department of Trade and Industry March 2006 ‘Our Energy Challenge: Power From the People’ www.dti.gov.uk


Monbiot George (2007) (Lecture at Brookes University)


Websites

http://www.awea.org

http://www.defra.gov.uk/environment/climatechange/index.htm

www.dti.gov.uk


http://www.greenenergy.org.uk/pvuk2/index.html-12-04-07


http://www.eere.energy.gov/consumer/your_home/electricity/index.cfm/mytopic=10880

http://www.lowcarbonbuildings.org.uk/micro/wind/-12-04-07


http://www.greenenergy.org.uk/pvuk2/technology/cost.html

www.solarpvgrants.co.uk


http://www.findanewhome.com/property-developers/

http://www.dti.gov.uk/energy/sources/sustainable/microgeneration/strategy/page2754.html
APPENDIX ONE

PROFILE QUESTIONS
Company: _______________________________________________________
Name: ___________________________________________________________
Role: ___________________________________________________________
Operational location: ___________________________________________
Development type: [ ] Low cost   [ ] low/med cost   [ ] med/high cost   [ ] high cost   [ ]
Number of homes built in last 12 months: ____________________________

SUSTAINABILITY QUESTIONS
1. How does your company address the issue of sustainable development?
Measures to reduce carbon footprint.

<table>
<thead>
<tr>
<th>Location</th>
<th>During Construction</th>
<th>Product design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reducing transport costs and reliance on car</td>
<td>Waste disposal during construction</td>
<td>Reducing water consumption</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reducing energy consumption</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reaching renewable energy production quota</td>
</tr>
</tbody>
</table>

2a. How would you define Green development and
2b. Does your company engage in Green residential development

Yes [ ] No [ ]

3. What are the main technologies applied by your company to Green a development.

<table>
<thead>
<tr>
<th>Grey water</th>
<th>Solar panels</th>
<th>Passiv e solar</th>
<th>PV</th>
<th>Wind energy</th>
<th>CHP</th>
<th>Combination</th>
<th>Other?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>large</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>small</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. If you incorporate Green Technology then what proportion of your developments (undertaken in the last 2 years) incorporates the following

<table>
<thead>
<tr>
<th>Grey water</th>
<th>Solar</th>
<th>Passive solar</th>
<th>PV</th>
<th>Wind</th>
<th>Other</th>
</tr>
</thead>
</table>

5a. What, in your opinion, are the barriers to incorporating Green technologies within residential development?

<table>
<thead>
<tr>
<th>lack of developer awareness</th>
<th>lack of occupiers awareness</th>
<th>Poor access to info</th>
<th>Unreliable/unproven technology</th>
<th>High Cost poor benefit</th>
<th>Low of consumer demand</th>
<th>Unwillingness to pay additional cost of installation/incorporation</th>
</tr>
</thead>
</table>

5b. Why?
6. What, in your opinion, would encourage developers to build ‘green’ homes/developments

<table>
<thead>
<tr>
<th>WHY?</th>
</tr>
</thead>
<tbody>
<tr>
<td>legislation</td>
</tr>
<tr>
<td>Consumer demand</td>
</tr>
<tr>
<td>Media/ Good publicity</td>
</tr>
<tr>
<td>Competition from other developers</td>
</tr>
<tr>
<td>CSR/ company policy</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Top 3?</td>
</tr>
</tbody>
</table>

7. Where would you place current occupier awareness of green technologies?

<table>
<thead>
<tr>
<th>Current occupier awareness of green technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very little knowledge</td>
</tr>
<tr>
<td>Some knowledge</td>
</tr>
<tr>
<td>Quite well informed about some aspects solar/wind</td>
</tr>
<tr>
<td>Quite well informed in general</td>
</tr>
<tr>
<td>Very informed</td>
</tr>
</tbody>
</table>

8. Where would you place current occupier demand for this technology?

<table>
<thead>
<tr>
<th>Current occupier demand for this technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>No demand</td>
</tr>
<tr>
<td>Some demand</td>
</tr>
<tr>
<td>Some demand but only on mid to high range properties</td>
</tr>
<tr>
<td>Demand is increasing</td>
</tr>
<tr>
<td>Fairly high demand</td>
</tr>
<tr>
<td>Very high demand</td>
</tr>
</tbody>
</table>

9. Do you think occupiers are prepared to pay a premium for the green label?

<table>
<thead>
<tr>
<th>Prepared to pay a premium for the green label?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

10. If Yes, how much extra would they pay?

<table>
<thead>
<tr>
<th>Extra they would pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional 1-5%</td>
</tr>
<tr>
<td>5-10%</td>
</tr>
<tr>
<td>Or more?</td>
</tr>
</tbody>
</table>

11. Which technologies do you think would attract the most returns?

<table>
<thead>
<tr>
<th>Technologies attracting most returns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Being carbon neutral i.e. Bedzed</td>
</tr>
<tr>
<td>Wind power</td>
</tr>
<tr>
<td>Solar heating hot water</td>
</tr>
<tr>
<td>PV</td>
</tr>
<tr>
<td>CHP</td>
</tr>
</tbody>
</table>

12. Do you think using incorporating green technology (solar, PV and wind) into building design is the best way to reduce CO²?

<table>
<thead>
<tr>
<th>Best way to reduce CO²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

Are there other measures which should be addressed first? What are they?

- Reducing reliance on car use (location of development)
- Reducing energy consumption (through insulation, double glazing, energy efficient appliances, and light bulbs)
- Other: