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Housing, Regeneration and Planning

Interim Report from the Scottish Renewables Heating Pilot

This summary paper, produced by Scottish Government analysts from interim pilot and evaluative reports, describes progress from a two year pilot study of the viability of including renewable technologies in the mainstream Central Heating Programme. While it provides stakeholders with information on progress so far, findings should not be taken as definitive. A final report will be published once the pilot has concluded in mid-2008.

Key Points from the Pilot Programme and Evaluation to date

- Eighty-eight properties have received or are scheduled to receive a renewables heating system and, where required, Warm Deal insulation measures. Fifty-six properties (all in the social rented sector) took part in Phase 1 in early 2007. In addition, 32 owner-occupier properties are being included in Phase 2 of the pilot: all these installations will be completed by early December 2007. Please note that findings reported here relate only to Phase 1 social sector installations.
- The total number of installations is many fewer than the 170 initially planned, due to much higher than expected costs. In Phase 1, the average cost of a Ground Source Heat Pump (fully installed) was £16,691 while an average Air Source Heat Pump cost £8,168 (fully installed). Renewables-based systems are currently considerably more expensive than traditional systems, although costs appear to have reduced since Phase 1.
- The installation of renewable central heating systems improved National Home Energy Rating (NHER) scores in all households. The average NHER score of properties in the pilot **before** installation was 3.3. **After** installation of renewables plus Warm Deal (+WD) measures, the average NHER score was 6, slightly above the national average of 5.8.
- Oil-based systems +WD were projected to achieve higher energy efficiency ratings than renewables +WD based on current NHER ratings. However it should be noted that NHER software uses historical fuel price data. Revised NHER ratings, modelled with more recent fuel prices to be released in early 2008, are expected to show renewables performing better, and oil worse. The evaluation team suggests that, if modelled at current prices, renewables would outperform oil.
- Modelling based on current prices suggests that renewables are likely to be effective at lifting people out of fuel poverty, and that renewables perform better than oil or electric storage based systems. However, the difference between the technologies on this at present appears marginal (1% between renewables and oil and 2% between renewables and electric storage).
- Nearly nine in ten householders were very or fairly satisfied with their new renewables system, although in most cases, householders had only been using the system for 6 to 8 weeks – for most, a period of relatively mild weather. Renewable systems' contributions to the comfort of the home and to quality of life will not be fully apparent until they have been tested in winter conditions.
- NHER–based projections suggest that, before improvements, pilot households emitted on average 9.4 tonnes of carbon per annum. The installation of renewable heating systems +WD was projected to reduce this to an average of 3.6 tonnes, a better projected outcome than for oil +WD or electric storage +WD. These are projections only and a final assessment will need to take into account revised NHER parameters.

The Scottish Government

About the Pilot

The Scottish Government has provided £1m funding over two years (April 2006 - March 2008) to pilot the installation of renewables-based central heating systems in properties off the gas grid across the country. This pilot should enable Ministers to make informed decisions on whether to mainstream renewables technologies within the Scottish Government's Central Heating Programme (CHP) to target fuel poverty.

56 properties in the social rented sector and 32 properties in the private sector have been included in the pilot.

The pilot is being managed by the Energy Saving Trust (EST) and the independent evaluation of the pilot is being conducted by ClearPlan UK. A final report is due in Summer 2008.

The pilot is concentrated on three particular renewable technologies: air-source heat pumps, ground-source heat pumps, and biomass systems. These provide heat and hot water in the home and have the potential to have significant impacts on fuel poverty. Solar thermal and micro-wind - secondary, non-space heating technologies - are additionally being installed in a small number of pilot properties to assess their potential contribution to reducing fuel bills.

In addition to the renewables technologies, funding is being used to provide the full package of Warm Deal insulation measures so that the effects of the technologies can be accurately measured. Warm Deal measures include cavity wall and loft insulation where the house can take these along with draft-proofing and pipe/tank lagging.

The eligibility criteria set by the pilot were as follows.

- Householders had to:
- Be in receipt of a Warm Deal passport benefit;
- Not be eligible for the Central Heating Programme.

Properties had to:

- Be off the gas grid;
- Have no central heating system or one that was more than 15 years old or one that was inefficient and incurring excessive cost;
- Be physically suitable for installation of a renewables heating system.

Phase 1: Social rented properties

Installations in the social rented sector took place between January and March 2007. Thirty-four air source heat pumps and 22 ground source heat pumps were installed (56 systems in total). No biomass systems were installed in the social sector due to uncertainties about long-term pellet supply/costs over the installation period.

Social sector installations took place in 8 local cluster areas across Scotland, in partnership with 8 Local Authorities and Housing Associations. Most were largely rural, reflecting the pilot's emphasis on harder to treat properties off the gas grid.

The EST (using funding provided by the Scottish Government) provided 60% of total installation costs in the sector, with local authority and housing association partners contributing the remaining 40%.

Phase 2: Owner-occupied properties

Thirty-two privately owned properties are included in the second phase of the pilot, which is currently underway. Properties in this sector include a range of locations across Scotland. All heating system installations in this phase will be completed by the first week in December 2007.

All three main technologies are being installed in private properties, although biomass and secondary technologies are only being installed in small numbers. EST has recently reached agreements for short-term, reliable biomass pellet supply, which should enable some tentative conclusions to be drawn about use of biomass systems in the final report.

EST (again using funding provided by the Scottish Government) has met 100% of installation costs in this sector.

About the Evaluation

Clear Plan UK are conducting an independent evaluation of the pilot for the Scottish Government. The evaluation has the following three main aims:

To evaluate the impact of using renewable based solutions on fuel poverty;

To explore participants' experiences of and attitudes towards using the renewable technologies installed;

To assess the value for money of mainstreaming particular renewable based solutions into the Central Heating Programme, and identifying the circumstances where the other renewable options (micro–wind / solar water heating) could become part of the package to make it more effective in reducing fuel poverty.

The broad methods the evaluators are using to achieve these aims are summarised as follows:

- The impact of using renewable based solutions to address fuel poverty is being measured using the NHER software package which models the fuel consumption required to achieve a satisfactory heating regime. The research will also consider actual fuel costs in each of the pilot properties and compare this to previous expenditure on fuel.
- Participants' experiences of and attitudes towards using the renewable technologies installed are being explored using a combination of householder diary records, periodic questionnaires and telephone interviews.
- The final report will consider the value for money of mainstreaming the renewable based solutions into the Central Heating Programme

Key findings to date

The interim findings reported here relate only to Phase 1 social sector installations. The final report will take account of both social and private sector installations.

Installation costs

Installing renewables systems is currently considerably more costly than installing traditional systems. The average cost of a Ground Source Heat Pump, fully installed, in Phase 1 was £16,691, while the average cost for an Air Source Heat Pump, fully installed, was £8,168. For illustration purposes, this compares to £3,343 average grant paid under the CHP (NB this figure includes insulation measures, while the pump costs do not). These considerably higher costs have resulted in a reduced number of installations - from approximately 170 properties to 88.

However, the heat pump market is relatively young and the variables associated with the retrofit of heat pump systems to existing properties are complex, so it is currently difficult to forecast costs with any accuracy. Nevertheless, it is expected that prices will fall as the market for renewables systems develops, and indeed there has already been evidence of this since Phase 1 concluded.

Running costs and tariffs

Heat pumps work most efficiently on a particular tariff which is, at present, available from a single fuel supplier in Scotland. The Economy 10 tariff consists of 10 hours of off-peak electricity, which suppliers charge at a discounted rate. To benefit, an Economy 10 meter must be fitted. The 10 off peak hours are divided between 3 hours in the early morning, 3 hours in the early afternoon and 4 hours in the evening.

There have been problems and delays in transferring householders to the tariff and installing appropriate meters. This means that in the short term at least, several participants' fuel costs may have risen following the installation of the renewables system.

Some of the difficulties in transferring to Economy 10 appear to have arisen from the householders' incomplete understanding of the new system and inability to communicate clearly with the energy supplier. There was some evidence from householders, however, that the frontline staff of the energy supplier were unaware of the Economy 10 tariff and unable to advise customers of a suitable tariff for heat pump users.

EST have now provided support both to householders and energy suppliers in facilitating the switch to economy 10. A more efficient procedure has been developed for E10 referrals, and a single point of contact for householders has been identified within the energy supply company. This, and the development of simple advice notes for householders, may well resolve this problem for future installations.

Energy efficiency improvements

One of the evaluation's key tasks is to ascertain changes in the energy efficiency of pilot homes and to model differences between renewables and traditional central heating systems. No household participating in the pilot has yet experienced a winter with the new technologies installed and there is no evidence to date from fuel bills. Modelling has, however, been undertaken on the energy efficiency levels of the pilot's social sector properties using the National Home Energy Rating (NHER). This rating scale runs from 0 (least energy efficient) to 10 (most energy efficient), and includes space and water heating costs, cooking, lights and appliances, to give a comprehensive picture of energy usage in the home. The Scottish House Condition Survey classifies NHER ratings into three bands: 0-2 (Poor); 3-6 (Moderate); and 7-10 (good).

Modelling was undertaken to:

- determine the changes in NHER scores since the installation of the renewables systems;
- and establish modelled differences between renewable and traditional central heating system types – e.g. oil-fired and electric-storage.

The average NHER score of social rented properties in the pilot **before improvements** was 3.3. Ninety-six percent of these properties scored lower than the national average of 5.8. The installation of a renewable heating system plus Warm Deal (+WD) measures improved NHER scores in all households, to an average level of 6 points. No property in receipt of renewables (+WD) was rated poor. Sixty-three percent of pilot social sector properties were rated above the national average after improvements.

However, when modelled against more conventional heating systems - oil and electric storage heating - renewables' performance appears less impressive, at least at first sight. Using NHER ratings, oil (+WD) performed best, renewables (+WD) was a close second and electric storage (+WD) a poor third. However, NHER software bases fuel costs on the average of oil prices for the previous 3 years. During this period oil prices were relatively low, allowing them to perform well against the costs of electricity required to run a heat pump. At present however, oil prices are high, and revised NHER parameters to be released in early 2008 may well suggest that renewables could be more effective in that market context.

Impacts on fuel poverty

Another of the evaluation's key tasks is to establish how effective renewables systems are at tackling fuel poverty. A household is defined as living in fuel poverty if, in order to maintain a satisfactory heating regime, it needs to spend more than 10% of its income (including Housing Benefit or Income Support for Mortgage Interest) on all household fuel use.

As before, modelling was conducted but this time current fuel prices were used. Social sector householders in the pilot would have had to spend on average 11% of their household income to maintain a satisfactory heating regime before improvements. The average cost to maintain a satisfactory heating regime across the whole sample before improvements was £1157.00, with the highest annual cost being £1864 and lowest £676.00.

The proportion of household income required reduces to an average of 8% with the installation of renewables (+WD). Traditional systems do not perform as well: householders would have had to spend 9% of household income with oil (+WD) or 10% of income with electric storage heating (+WD).

However, insufficient data is available to test this hypothesis and, as previously stated, the data we do have is based on modelling not on fuel bills. Until the final report, the evaluation cannot be definitive about renewables' impacts on fuel poverty.

Carbon emissions

NHER *Surveyor 2* software produces projections of the carbon production associated with the various modelled scenarios. The table below shows that, before improvements, pilot households emitted on average 9.4 tonnes of carbon per annum. The installation of renewable heating systems +WD was projected to reduce this to an average of 3.6 tonnes, an average saving per household per annum of 5.8 tonnes. This compares to a saving of 4.6 tonnes which the installation of oil central heating would achieve and 3.1 tonnes per annum achievable from the installation of electric storage heating.

Mean Carbon Emissions (tonnes per annum)	
Without improvements	9.4
Renewables (+WD)	3.6
Oil Central heating (+WD)	4.8
Electric Storage (+WD)	6.3

These are projections only and final assessment will need to take into account revised NHER parameters. NHER software is currently seen to underestimate the efficiency of heat pumps and it is expected that revised NHER software in 2008 will suggest improved projected performance for renewables as opposed to comparison systems.

Householder satisfaction levels with the new system

The evaluation is also considering the satisfaction level of pilot households against aspects of their new systems. Six to eight weeks after installation, 88% of social sector householders described themselves as 'fairly satisfied' or 'very satisfied' with their new system. Satisfaction levels overall were higher than those reported for participants in the mainstream Central Heating Programme, although these may change when measured later, in different circumstances.

Almost half of householders reported that there had been one or more problems with the installation of the system, including:

- Failure to 'make good' after installation;
- Delays in installation process;
- Failures in communication with householders;
- Failure of contractors to turn up at appointed times;

Problems with faulty equipment, incorrect parts and incorrect settings.

Many of the above issues are likely to take place in any installation process and therefore may not be peculiar to renewables. It has not been possible to make an accurate assessment of the extent to which installation issues in the pilot are more or less frequent or serious than those associated with the installation of mainstream heating technologies.

Although householders did experience some initial problems operating the systems, nine in ten were very or fairly

satisfied with the system's ease of use. This finding needs to be treated cautiously, since many householders had made little or no attempt to change any settings on the system, so had had no opportunity to encounter difficulties in operating the system.

A small minority of householders also reported that the temperature on occasions felt low in comparison to the temperatures they were used to. Installer explained this as a common perception when heat pumps replace traditional systems: the 'nature of the heat' produced by heat pumps is lower, but more uniform throughout the house. For householders who are used to the extremes of temperature associated with solid fuels, this can take time to get used to.

Improvements in quality of life

The evaluation is also exploring whether the renewables systems will improve quality of life. Qualitative data from the evaluation suggests that householders perceived the following benefits from their new renewables system:

- Freedom from hard physical labour associated with solid fuels, particularly for older householders.
- Less time spent on cleaning;
- More mobility in the home;
- Improved social life – 24 hr heat allowing people to invite others to their home and stay out later because they know their home will be warm on their return;
- More constant heat having impact on health and mobility, e.g. on arthritis;
- Staying up later – getting up later;
- Lower levels of fear regarding presence of children and open fires;
- Able to use more rooms in the home;
- Reduction in levels of dampness.

It should be noted that these benefits are not dissimilar to those reported in the mainstream programme – in other words, they are not strictly related to receiving a *renewables* system. There has though been some anecdotal reporting of greater interest in environmental issues following installation and the evaluation team will be exploring in the final report whether any quality of life improvements can be specifically attributed to renewables.

Conclusions

On the basis of the available NHER data, renewables heat pump systems may be an effective technology for improving the energy efficiency of a range of hard to treat properties, and for lifting households out of fuel poverty. It also has carbon saving benefits over oil and electric storage systems, though there are some concerns about whether oil or renewables perform better on energy efficiency using current NHER ratings. Social sector households in the pilot appeared generally satisfied with how their new systems performed over the initial period following installation, and a number were able to point to concrete improvements in their quality of life. One key problem with renewables, currently however, is the cost: installing renewable systems at present is much more expensive than installing traditional systems.

A final report will be published in 2008 with fuller analysis, which will include:

- an updated assessment of the performance of renewables against oil and electric storage heating;
- an analysis of impacts on owner-occupied properties and householder views from Phase 2;
- an assessment of the winter performance of renewables systems across all pilot properties;
- an analysis of temperature data and fuel bills from households;
- an analysis of the performance of secondary renewables technologies (solar and micro-wind);
- a more detailed economic impact assessment, taking into account carbon savings.

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