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Heat pump project background

Orkney Housing Association (OHAL) identified that some residents were having difficulty in using their heat pump heating systems, which was leading to inefficient use, dissatisfaction with the system and possibly higher energy bills. OHAL received funding through the Scottish Federation of Housing Association's Energy Ideas Fund to increase understanding of the NIBE exhaust air source heat pumps among residents through developing a pictorial heat pump guide that would present residents with concise, jargon-free information on heat pump systems and their operation. These guides would supplement heat pump manuals provided by the NIBE manufacturer that were seen as too lengthy and heavy with technical jargon.

To provide OHAL with concise information on the residents' experiences with heat pumps that would help with the development and evaluation of the guide, the James Hutton Institute conducted a 2-phase survey in 2014 and in 2016 (referred to as Year 1 and Year 2).

It is important to note that whilst the second survey was taking place, a substantial number of OHAL residents formed a group on Facebook to share their experiences with heat pumps and one resident set up their own survey. Local media reported on this event and thus the profile of heat pumps locally was heightened during the period of the second survey in January and February 2016. Local councillors and MSPs were also contacted by some residents. The rise in attention and sharing of experiences among residents could potentially have influenced responses to the second phase of the survey. Some respondents commented on these events and their neighbours' dissatisfaction with heat pumps in the returned questionnaires.

Findings and recommendations

Advice and information

- The vast majority of respondents had read the pictorial guide and almost three quarters of those who read it found it helpful in making better use of their heat pumps. One third made changes to how they used their heat pump since reading the guide. Respondents asked for guides to reflect their specific heat pump model and to contain more information on settings, cost-effective usage, reducing noise from heat pumps or what to do when access to heat pump is limited.
- In both Year 1 and 2 surveys, whilst the residents found information materials helpful, the majority expressed preference for personal advice. Personal visits and advice for new residents on moving into properties with heat pumps were requested, as were regular visits to heat pump households by trained service engineers.

Using the heat pump

- Whilst many found the guide helpful, more than half of respondents reported having limited knowledge of how to use heat pumps to reach desired temperatures in their homes. However, the number of those with good knowledge had risen significantly since Year 1.
- In both Years 1 and 2, the majority of respondents heated their homes according to the guidance, leaving the heat pump on constantly even when the house was unoccupied and heating all rooms during both colder and warmer months. Opening windows and doors was still a common practice, especially in the warmer season. This practice was generally discouraged by the heat pump guides as it might lead to the heat pump working

inefficiently. Given how common the opening of windows and doors was among residents, it could be desirable to provide more advice on how to run the heat pump cost-efficiently whilst continuing this practice.

- Several respondents asked for an explanation on inconsistencies between the new and the manufacturer’s guide in terms of guidance on closing inside doors (e.g. for households with pets where closing doors was difficult).
- Another inconsistency was found for advice on the frequency of cleaning the air filter, with the new guide suggesting to do it once a month instead of three months, the latter of which is practiced by most residents.

Satisfaction

- The majority of residents who responded to both surveys in Years 1 and 2 were satisfied with how the heat pump provided hot water but the satisfaction with space heating was lower. Overall, satisfaction with both dropped slightly between the two Years.
- Even though heat pumps performed reliably for most respondents, this perception dropped significantly from Year 1. Significantly more respondents found it easy to use heat pump controls and displays in Year 2, supporting the findings of improving knowledge on its operation. However, In Year 2, significantly fewer respondents found it easy to get their heat pumps repaired and serviced than in Year 1 which is reflected in requests for contacts and visits by service and repair engineers.
- Given nearly half of respondents find their heat pumps expensive to run, it is important to investigate the reasons behind the differences in running costs among residents and provide help to those with especially high fuel bills. One way could be to help navigate the type of tariffs residents are signed up to as 1 in 4 respondents said they didn’t know what their tariff was. Additional costs associated with repairs and servicing were a source of anxiety for shared owners who questioned the fairness of being solely responsible for covering these costs and asked for more dialogue with OHAL.

Heat pump survey and respondents

In both Years 1 and 2, all 282 OHAL households with a heat pump were sent a postal, self-completion questionnaire. The first questionnaire and a reminder were sent out in September 2014 to collect baseline data about residents’ satisfaction, preferences and knowledge of heat pumps before the roll out of the project. The results from the first questionnaire were used to inform the development of the pictorial heat pump guide that was sent to all household with heat pumps in January 2016. In February 2016, a second questionnaire was sent to all households with heat pumps to ask about the usefulness of the guides and to see whether there had been any changes in satisfaction and use of heat pumps from the baseline year 2014.



Table1. Breakdown of the number of contacted residents and received responses for Years 1 and 2.

	2014 – Year 1	2016 – Year 2
Total sample	282 residents who heat their homes with heat pumps	
Received	120 questionnaires	91 questionnaires
Responses by year	61 respondents sent back questionnaire in both years 1 and 2	
	59 responded only in year 1	30 responded only in year 2



Respondents

Table 2. Gender, age and work characteristics of respondents in Years 1 and 2.

	2014 – Year 1	2016 - Year 2
Gender	66% female respondents	68% female respondents
Age range	Between 20 and 87 years	Between 20 and 85 years
Work	41% working full-time 17% working part-time 42% not working ↓ 48% retired 22% looking after family 22% sick or disabled 8% unemployed	33% working full time 22% part-time 45% not working ↓ 58% retired 21% sick or disabled 11% looking after family 8% unemployed



Questionnaire

Topics covered in the survey were designed to reflect the needs and requests for information from OHAL for this project. Several questions were based on and adapted from a questionnaire developed for the UK Heat Pump Trial 2009-2010 by The Open University in collaboration with the Energy Saving Trust.¹

All Parts (2-9) of the questionnaire were almost exactly the same for Years 1 and 2, with the exception of Part 1. In year 1, this part covered questions about preferences for information materials and personal advice and requests for extra information to provide guidance on designing the guides and providing advice in the latter stages of the project. In Year 2, it mostly asked questions about the guide.



Analysis

The responses were analysed using SPSS and Excel. In the results section, we report frequencies for the whole Year 2 sample (n=91) in the following sections:

- Section 1 Guides and information (entire section, Figure 1 reports on frequencies from Year 1 survey)
- Section 2 Satisfaction (only Figures 4 and 5)
- Section 3 Using the Heat pump (entire section apart from Figure 6)
- Section 4 Previous heating (entire section)

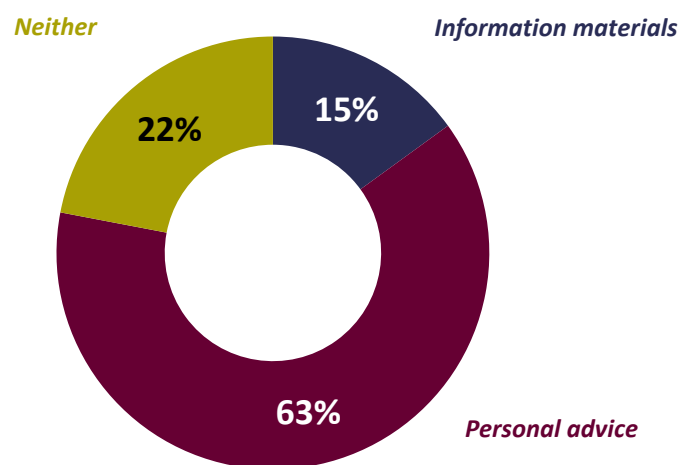
In Section 2 (Figure 3, tables 3 and 4) and Section 3 (Figure 6), we compared frequencies of answers for those residents who responded in both Years 1 and 2 (n=61) and ran Wilcoxon signed tests to test the significance in the differences between the responses to both surveys.

¹ Caird, Sally; Roy, Robin and Potter, Stephen (2012). Domestic heat pumps in the UK: user behaviour, satisfaction and performance. *Energy Efficiency*, 5(3), pp. 283–301.

In Year 1, the top sources of information about operating heat pumps were printed manuals, followed by personal advice.

In Year 1 (2014), the majority of respondents turned to printed manuals and slightly fewer had personal advice from housing association advisors (see Figures A1 and A2 in Annex). Nearly two thirds (63%) of respondents preferred personal advice to information materials (15%) and 1 in 5 (22%) found neither option helpful (Figure 1).

Figure 1. Were information materials or personal advice more useful in helping you with using the heat pump? n=85



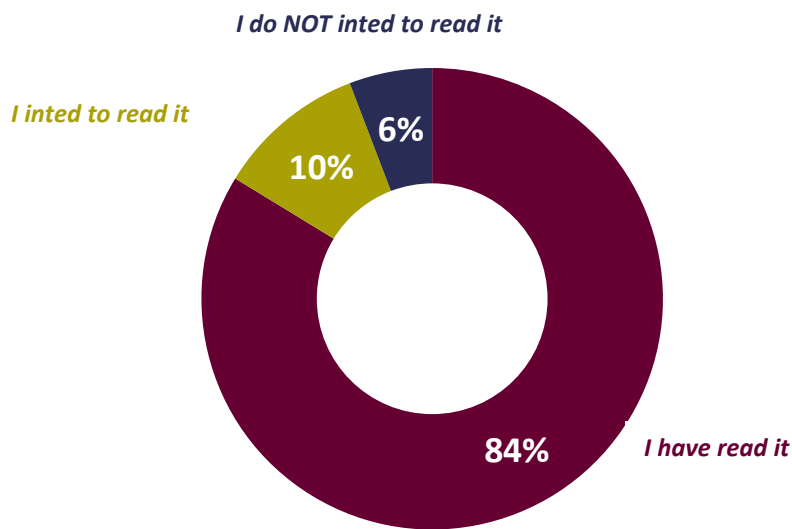
The residents primarily wanted information on the most efficient ways to operate the heat pump (n=86) and easy instructions on how to reach desired home temperatures (n=77). Slightly fewer (n=59) would have liked more information on electricity tariffs to save money on heat pump bills. Only 16 people said they had all the information on heat pumps they needed (See Figure A3 in Annex). The information was requested in simple, easy to follow instructions in plain, non-technical English.

The Year 1 survey findings about preferences for specific information on heat pumps were used to inform the design of the pictorial heat pump guide delivered to all residents in Year 2.

In Year 2, the majority of respondents read the new heat pump guide and three quarters found it helpful in making better use of heat pumps.

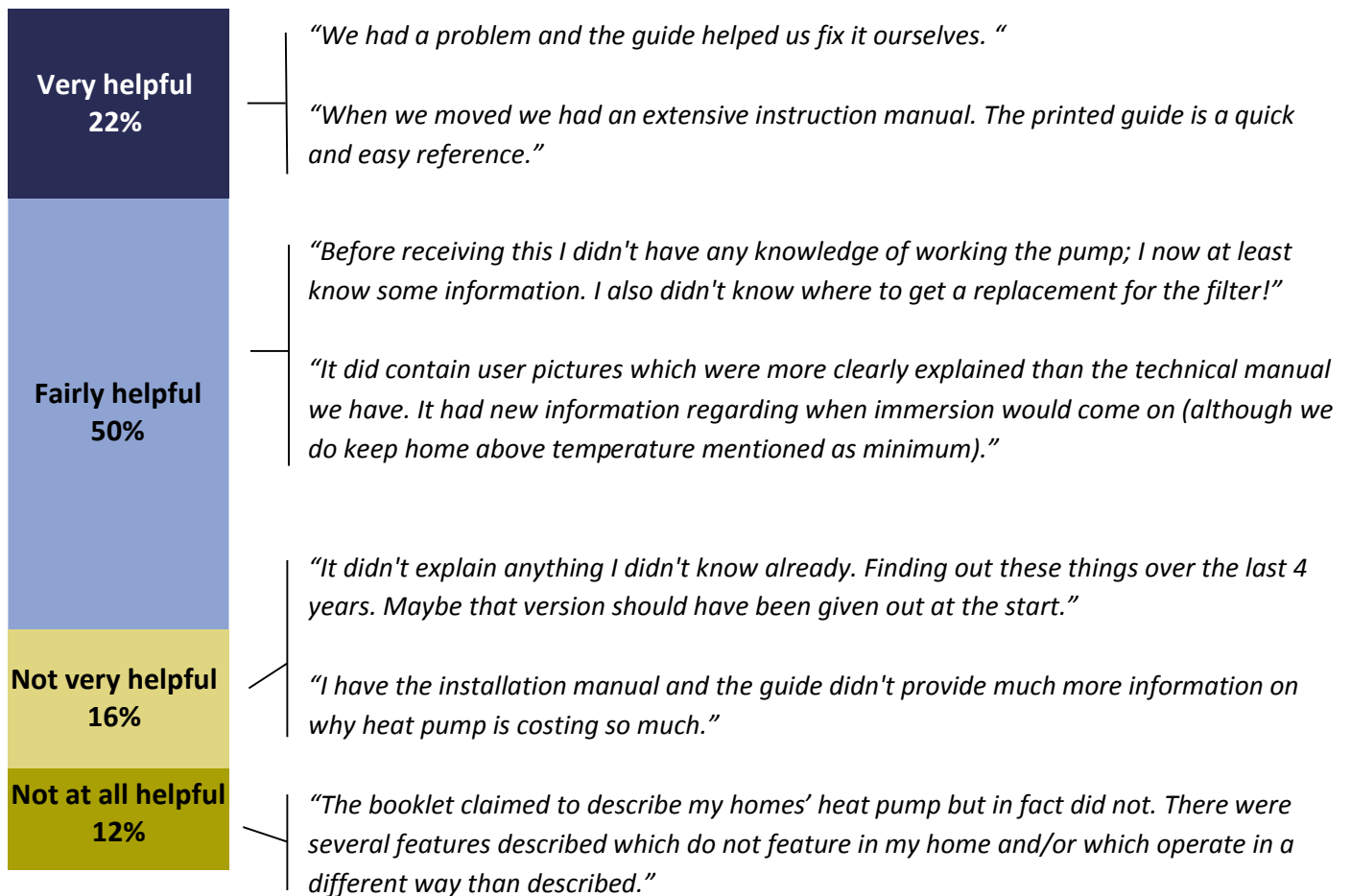
The vast majority of people read the pictorial guide (84%); a further 10% intend to read it and only 6% have no intention of reading it (Figure 2).

Figure 2. Recently, you received a printed guide to your heating system developed with input from OHAL residents. How would you describe your use of the guide so far? n=86



Among those who read the guide (n=68), three quarters (72%) found it helpful; one fifth (22%) of these indicated it was very helpful and a half (50%) said fairly helpful. The remainder of respondents did not find the guide very helpful (16%) or at all helpful (12%) (Figure 3).

Figure 3. Year 2 respondents' perceptions of the guide being helpful (or not) in making better use of their heat pumps. n=68



Several respondents said the guide provided them with new information:

“There were a couple of things I thought about heat pumps that were wrong e.g. that leaving all inside doors open was a good thing!”

Others found the information in the guide contradicted what they had previously been told about operating their heat pumps:

“Although the guide was fairly helpful there were areas that were inconsistent to what I had been told when I moved into the house, e.g. cleaning of filters.”

“Conflicting information from that I was told by servicing engineer, eg. keep bathroom & kitchen doors closed whereas booklet states keep all doors closed, also told to clean filter 3 monthly whereas booklet recommends monthly; also do not clean our ventilation devices whereas booklet recommends clean regularly.”

More information was requested about strategies and contacts to deal with repairs and servicing or about controlling room temperature. Limited access to heat pump was a barrier in making use of the guide:

“As we have no access to heat pump in attic we are not able to be involved in any way with controls.”

One third of respondents made changes to how they used their heat pump system as a result of reading the guide.

One third (30%) of respondents made changes to how they used their heat pump since reading the guide. These changes included cleaning or replacing the filter, changing the fan speed or the temperature, or keeping doors and windows closed.

“I have kept doors closed, windows closed, turned temperature dials to the same temperature.”

“I know how to turn heating up & down, have done this few times now.”

Even though for more than two thirds (70%) of respondents reading the guide did not lead to changing how they used their heat pumps, this results needs to be considered in the context of the second survey. The second phase of the survey was sent out only two weeks after the residents received the guide due to the project and its funding coming to an end, which is a short time to evaluate the impact of the guides on respondents' use of the heat pump.



More information and advice needed

The following statements are a summary of the responses from the residents to the following question asked in both Years 1 and 2:

What types of information and advice, if any, would be helpful to you in making better use of your heat pump?

This section also summarizes request for information from other sections of both questionnaires.

Personal advice from trained advisors

Similarly to Year 1, Year 2 respondents expressed a strong preference for personal advice from fully trained engineers or housing association advisors. Respondents would also welcome face to face advice and regular visits to their property, especially a visit when moving into a new property to get inducted on setting up and operating the system.

“I don't believe there is any advice or information short of a trained NIBE engineer physically looking or talking through with me the settings/instructions ... specific advice/examination of the unit in my house.”

“I think an engineer should show you everything when you first move in, also a yearly visit to service and converse with residents would be more than helpful.”

Several respondents commented that OHAL staff had limited knowledge on how to use the heat pumps themselves or that they were dissatisfied with their assistance in dealing with heat pump issues.

“I'm less likely than ever to believe guidance given by OHAL who have been persistently unhelpful for almost 6 years now.”

Servicing and maintenance

In both Year 1 and 2 surveys, respondents identified a gap in information provided in relation to lack of contacts for the main service providers or the absence of any maintenance programme. There was uncertainty about how often servicing needed to be carried out and who was responsible for associated costs. This uncertainty was reflected in answers in Table 4 where more than two thirds (39%) selected response neither and 31% disagreed with the statement that they could easily get the heat pump repaired and serviced, suggesting that barriers exist for residents who want to service their heat pump .

“We are a little in the dark over the service plan for the heat pump. It was serviced towards the end of 2014, but hasn't been since. I imagine an annual service is recommended, are we responsible? We would also like to know where to get replacement filters as they need replaced twice a year too.”

“Who to contact for repairs or guidance on repairs where system isn't showing a fault even though there is one.”

Settings

There were request for some generic as well as specific advice on settings, including:

- Settings to be used when on holiday or away from the house
- Season settings - for example to save power or shut down the system completely in summer months
- Settings to provide only hot water, and seasonal settings to regulate hot water
- Thermostats controls and recommended temperatures – for example adjusting temperature on the thermostat or using the timer
- *“A crib sheet on the standard settings the unit should be at would have been helpful as no one seemed to know where to start.”*

Noise

Table 4 shows that nearly half (43%) of respondents found heat pumps too noisy, a perception often voiced in the open comments. Several asked for information whether anything can be done to reduce noise.

Guide

One respondent indicated a preference for a guide that referred to their own model of heat pump, rather than a more generic guide covering several different models:

“To have a definitive guide to the heat pump which is actually in my home would be very useful especially if included more information on heat pump settings, what they should be and how to set them.”

Cost-effective usage

Similar to Year 1 survey where residents wanted information about cost-effective usage of their heat pumps, the residents in Year 2 survey would like more information about the relationship between costs and effectiveness of the heating system. One respondent also asked for *“cost comparisons of alternative heating systems to be shown how expensive this [heat pump] system is.”*

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Satisfaction

Among the residents who responded to both Year 1 and 2 surveys, nearly three quarters were satisfied with how the heat pump provided hot water but the satisfaction dropped slightly compared to Year 1. Residents were less satisfied with space heating in both years.

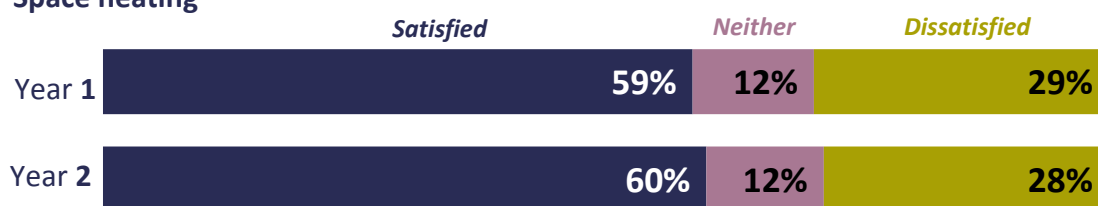
Among the people who responded to the survey in both Years 1 and 2 (n=61), satisfaction with how the heat pump provided hot water was higher than with how it heated the space of respondents' homes. 73% in Year 1 and 69% in Year 2 were satisfied with hot water heating compared to 60% in Year 1 and 59% in Year 2 satisfied with space heating (Figure 3).

Whilst satisfaction with space heating dropped only by 1% between both Years 1 and 2, there was a bigger shift for satisfaction with water heating. Even though 55% said they were very satisfied with water heating in Year 1, only 38% ticked this answer in Year 2, and responses in the category fairly satisfied rose by 13% (Table 3).

A Wilcoxon signed rank test comparing the ratings on a 5 point scale (very satisfied – very dissatisfied) did not reveal any significant differences between the satisfaction with space and water heating between Years 1 and 2 (Space heating: $z=-.43$, $p=.669$; water heating: $z=-1.54$, $p=.123$).

Figure 3. Satisfaction with how heat pump works to heat the space of residents' homes and hot water in Year 1 (n=60) and Year 2 (n=58).

Space heating



Water heating



Table 3. Satisfaction with water heating in Year 1 (n=60) and Year 2 (n=58).

	Very satisfied	Fairly satisfied	Neither	Fairly dissatisfied	Very dissatisfied
Year 1	55%	18%	8%	12%	7%
Year 2	38%	31%	10%	10%	10%

In Year 2, knowledge about using heat pump controls improved but fewer respondents found it easy to get heat pumps repaired and serviced. Nearly half associated high running costs and noise with heat pumps.

Table 4. Changes in agreement with statements on how heat pump works to heat residents' homes between Year 1 and Year 2. Changes shown as significant in Wilcoxon signed test

Heat pump	Year 1			Year 2			Y1	Y2
	Agree	Neither	Disagree	Agree	Neither	Disagree	n	n
Difficult to use controls/displays	54%	25%	21%	38%	30%	32%	58	57
Takes too long to heat rooms	31%	22%	47%	16%	38%	46%	57	56
Performs reliably	66%	22%	12%	56%	14%	30%	50	54
Easy to get repaired & serviced	40%	42%	18%	30%	39%	31%	53	55
Saving money on fuel bills	21%	34%	45%	15%	44%	42%	55	56
Expensive to run	44%	29%	27%	48%	27%	25%	55	56
Difficult to get advice on use	39%	30%	30%	36%	32%	32%	56	56
Too noisy	45%	21%	34%	43%	29%	29%	55	56
Takes up too much space	16%	36%	47%	18%	36%	46%	56	56

Significance tests

A Wilcoxon signed rank test comparing the ratings on a 5 point scale (strongly agree - strongly disagree) revealed a significant differences for the following three of the statements in Table 4.

There was a significantly higher agreement for those who found using controls and displays on heat pump difficult in Year 1 than in Year 2 ($z=-2.12$, $p=.034$) with a small size effect ($r=.29$).

A statistically significant decrease was shown for those who agreed heat pumps were reliable between Years 1 and 2 ($z=-2.57$, $p=.010$) with a moderate size effect ($r=.34$).

Between the two years, there was also a significant reduction in agreement that respondents could get their heat pumps easily repaired and serviced ($z=-1.98$, $p=.048$) with a small size effect ($r=.26$).

Ease of use, getting advice and servicing

The biggest change in responses between both survey times was found in relation to the difficulty of using controls and displays on heat pumps. In Year 2, just over a third (38%) of respondents found it difficult to use the controls and displays on heat pump compared to more than a half (54%) in Year 1, indicating improved knowledge (or confidence) on how to use heat pumps.

However, In Year 2 only 30% thought they could easily get the heat pump serviced and repaired compared to 40% the previous Year 1. There was a slightly bigger rise among those who disagreed it was easy, with 31% in Year 2, compared to 18% in Year 1. A high number of people in the middle category could indicate high uncertainty about this question. It is evident from other comments that the residents would like more information and contacts for service providers and would like more clarity on who is responsible for covering the costs of servicing and repairs, especially among shared owners.

Perceptions on the difficulty of getting advice on running heat pumps changed slightly between the two survey times. In Year 1, 39% agreed it was difficult and even though the proportion dropped slightly in Year 2, 36% still found it difficult.

Heating times

The second biggest shift in responses for the two survey years was on perceptions about the time heat pump takes to heat rooms. Agreement on the statement that it takes too long to heat rooms dropped by 15%, from 31% in Year 1 to 16% in Year 2. The majority of responses shifted to the category neither. Overall, nearly half of respondents in both years thought it did not take too long for the heat pump to heat their rooms (46% in Year 1 and 46% in Year 2).

Reliability

More than half (56%) of respondents thought their heat pumps performed reliably. At the same time, the proportion of those who found heat pumps reliable dropped by 10% from Year 1 (from 66%).

Costs

Nearly half of the residents agreed their heat pump were expensive to run (44% in Year 1 and 48% in Year 2). The percentage of people who were uncertain whether heat pumps saved them money on fuel bills rose from 34% in Year 1 to 44% in Year 2. Overall, there was a slight drop among those who agreed they saved on fuel bills (21% in Year 1 to 15% in Year 2).

Noise and space

Opinions on the noise associated with the heat pumps changed slightly over the years, with nearly half of the residents finding the heat pump too noisy (45% in Year 1 and 43% in Year 2).

The residents were quite satisfied with how much space the heat pump took up in their homes, with nearly a half saying it did not take up too much space (47% in Year 1 and 46% in Year 2)



The gains and costs of heat pumps

Comments given in responses to open-ended questions provide further insights into respondents' experiences and satisfaction with heat pumps.

Costs

High costs associated with running the heat pumps, from servicing and repairs to high fuel bills, were common comments. This is illustrated in the following three comments which note the extent of costs experienced to a degree of frustration:

"The cost of running the NIBE unit/heating system is extremely expensive in a large property like ours. £70 weekly to have very little heat when required is not acceptable in today's society. Avoiding low cost social housing that a tenant is then unable to atone due to expensive heating is very unacceptable. Making sure a heating system is suitable for the size of property they are being put into would be a first step in the right direction."

"Very UNHAPPY with this NIBE system. Since moving in this property 3 years ago we had people out to see it numerous times and they say it's 'fixed' when they don't know what to do with it. It's costing us £8-£10 a day!! Absolutely outrageous! We are topping up our meter every 2 days and we cannot afford to keep doing this! We are really struggling with this unit and want it changed or we may have to consider moving, it's getting that bad! Cannot explain enough how angry & unhappy I am with this unit, its time it was fixed properly or taken out!!"

"I followed the guide given to me, the house did warm up to a comfortable temp, the electricity usage was stable but it was costing me £589 per quarter! It used approximately 8-10kw a day - 14kw when using electric convector heaters. Totally unaffordable & the guide did not alter the running costs of this unit from the previous residents time living in this house. I cannot see how the usage is so high, nor how it would be possible to bring it even close to financially viable. "

A much smaller amount of responses were in praise of the costs associated with heat pumps:

"I have no complaints- I cannot know what I pay for the heating but I do know it is not expensive compared to storage heaters. "

Costs and shared ownership

For shared owners of properties it was the added costs of maintaining and repairing the heat pump that led to dissatisfaction, anxiety and perceptions of unfairness that non-shared owners did not have to bear these costs. For some this was coupled with the difficulty of accessing the heat pump unit for servicing and repairs.

"I am shared-ownership tenant; in the 4 years of being in my house I have had to replace the expansion vessel in December, also the small tank that's at the end of the pipes coming from the system. Sorry don't know what it's called but it was leaking. Being shared ownership OHAL says it's my responsibility. I would have thought being a new build the system should be fit for purpose and not requiring new components every 2 years. I think the system could be running better that it is but I can't afford to keep calling out an engineer/plumber every time things go wrong."

“Very unhappy that unit is in attic. Unhappy that yearly, regular servicing, isn't offered to shared owners. Any repairs have to be paid for by shared owners when other residents with the same heating problems receive free. Having to buy filters. Hundreds of residents unhappy, some units not installed properly. Overall totally unhappy with system.”

“The worrying thing about this heating system is the fact that several neighbours have had serious breakdowns of the system. Repair of the units difficult (unit is in loft) and expensive.”

Heat pump system cost-efficiency

Several respondents questioned the cost-efficiency of the heat pump system. Having to have it switched on and running at all times was seen as potentially leading to high fuel bills.

“I am not convinced that the heat pump is cheap to run. As it runs all day I am not sure it is cheap. It takes in room air but if the room is not already warm I think it takes more to heat it and send it out again. To just heat water I feel it is efficient but as soon as you need more for rooms I think it uses a lot.”

“I live on my own (son at uni). I work 4x13 hour shifts at work a week - therefore not in house all the time. I feel leaving the heating system on all the time is costing me a fortune that I don't have. I would like to be able to turn it off for these four days - but obviously need hot water for showers. My electric bill is £160 a month (a fifth of my wages). I am not happy about the cost. Maybe I'm running it wrong.

“More information on fixing or servicing the pump would be helpful. I haven't really changed anything since moving in as it seems complicated and I worry about causing damage or inadvertently shutting it all off. Also, the type of heating does not work well with electricity tariff. I was told never to turn the pump off but the electricity has high and low peak rates. The pump is running constantly even at peak times!”

As well as finding it expensive and inefficient, some found the heat pump “difficult to control”, which in some cases led to perceptions that this was creating additional expense:

“Have no idea how my heating system works. I am therefore unable to change it. My electricity usage seems to be more and costing me around £30.00 in 5 days. I had a staff member come out to look at my heating and even he seemed a little perplexed. There is no manual that goes through and explains everything. It was cheaper using radiators in my last property. I'm highly disappointed with this heating system and would be grateful for a more energy efficient system.”

“We currently pay £130pm for all heating, water & appliances which I consider to be quite good. However the first 6 months living in house was very stressful. We had to buy an energy monitor to get a good idea of how much we were spending on a daily basis. Simply couldn't find anyone with good working experience with this unit. All advice given by OHAL was generic repetition of manual instead of professional knowledge that could cater to our specific house size. I was left to figure out & read up on this unit as much as possible so I could make this boiler work as efficiently as possible. Not as efficient, cheap & easy to use as stated but quite frustrating instead. I can see why so many residents would complain.”

Noise

Some residents singled out noise of the heat pump as the reason for dissatisfaction, despite considering it otherwise efficient:

“The heat pump is unbearable noisy despite being used correctly & being set correctly. Visitors have even commented on how noisy it is. The only peace in this house is during a power cut. The noise of it outweighs the efficiencies.”

“The heat pump is very noisy, reminds me of a ship that ran from Stromness to the mainland. The ship was called the OLA; when it started up the engine was very noisy in the bedrooms and outside - at night time the worst. The hydro we pay cannot be worked out to how much we pay as only been in the property 6th November 2015 (we have a credit meter).”

In Year 2, heat pump heated the home and water to the right temperature for more than half of all residents.

The following data apply to the whole sample (n=91) collected in Year 2, not just the selected sample of residents who responded in both years.

On a cold day

On a cold day, nearly two thirds of respondents (60%) found the temperature of their homes about right. But 1 in 4 (28%) thought their home was fairly cold and 5% found it very cold. Only 7% thought their home was fairly to very hot (Figure 4).

On a warm day

Similarly, on a warm day, for nearly two thirds of residents (60%), their homes were about the right temperature, a third (30%) found it fairly hot and 5% thought their home was very hot. Only 2% said it is fairly cold.

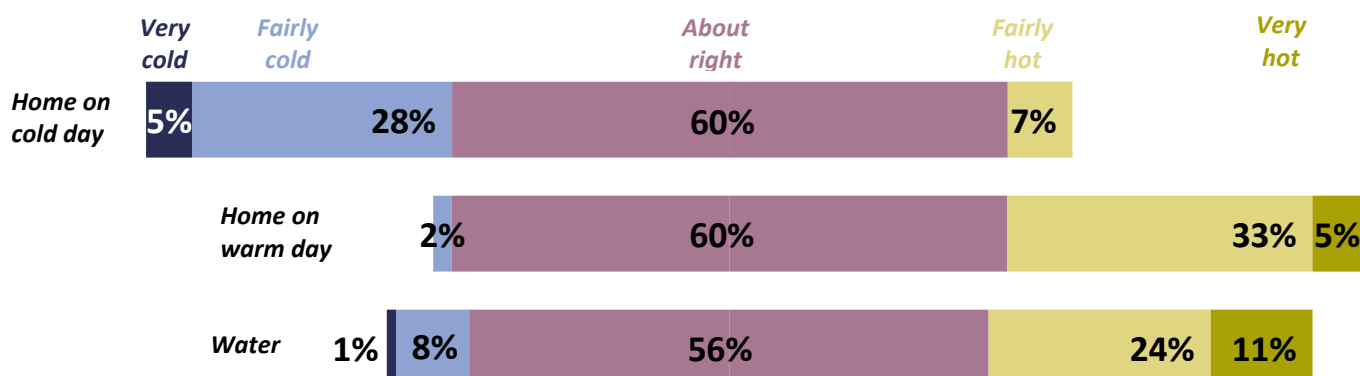
The following comment illustrates how some of the respondents find the temperature of their homes.

“Have found heating system slightly on warm side but have become accustomed to warmth. My son & I don't like warm bedrooms & prefer to sleep with a window open even in winter. The house is comfortable, usually at 20 & 17 in bedrooms.”

Water

Heat pumps heated water to the right temperature for more than half of all respondents (56%). 1 in 4 (24%) said their water was fairly hot and 11% thought it was very hot. Only 8% found it cold and 1% very cold.

Figure 4. Year 2 respondents' perceptions on the temperature of their homes, achieved by heat pump.
In respective order: n=85; n=84; n=85



Radiators

Because the number of responses related to the temperature of radiators is much lower than in Figure 4, we show the results separately in Figure 5. The lower number of responses is due to the fact that many houses with exhaust air source heat pumps use underfloor heating rather than radiators for heat distribution.

Similar to the above responses on temperature of home and water, nearly two thirds of respondents (63%) reported their radiators were about the right temperature. However, the radiators were fairly cold for one third of residents (31%). Only 4% thought they were fairly cold and 2% very cold.

Figure 5. Year 2 respondents' perceptions on the temperature of their radiators .n=69



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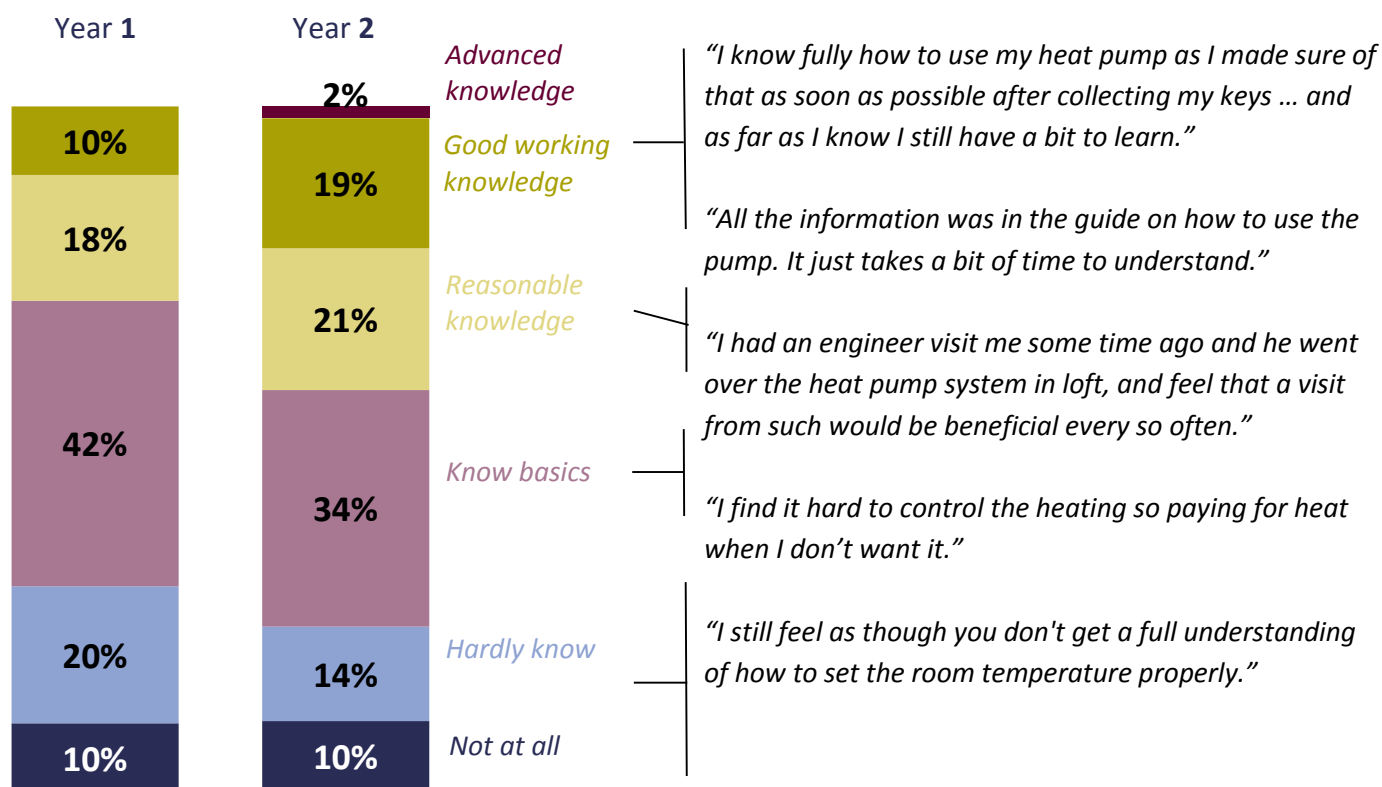
Using the heat pump

In Year 2, 40% of respondents reported having reasonable or good working knowledge of using heat pumps, a 12% increase since Year 1.

In Year 2, the residents who responded to both questionnaires reported having improved knowledge on using heat pumps. The most common answer was still "I only know the basics" with 34%, which dropped from 42% in Year 1 (Figure 6). However, there was a rise in responses towards the greater knowledge end of the spectrum, with 14% increase for those who reported having "reasonable", "good working" and "advanced knowledge". At the same time, the proportion of respondents with limited knowledge decreased by 6% (in the categories "not at all" and "hardly know").

A Wilcoxon signed rank test revealed a significant increase in knowledge between Years 1 and 2 ($z=-2.41$, $p=.016$) with a moderate size effect ($r=.32$).

Figure 6. Extent of understanding how to use heat pumps to reach desired temperatures in residents' homes in Year 1 (n=60) and Year 2 (n=58).



Knowledge gaps and requests

Among those who reported limited knowledge on working heat pumps, there were several requests for a real demonstration, by *“someone who knows the system to come and show me how to set it properly.”*

But similar requests were voiced by those with basic to good knowledge, especially in terms of regular servicing.

Gaps in knowledge identified from comments include;

- setting up room temperature
- features specific to different types of heat pumps
- the amount of water wasted before hot water comes into the tap
- effects of wind on the heating system, efficient way of operating heat pumps
- adjusting settings when out or on holiday or making the heat pump quitter

Type and model of heat pump

The housing association households in our sample have 4 different models of NIBE exhaust air source heat pumps with the following numbers: 360, 205, 410 and 370.

We asked the residents to select the type of heat pump they thought they had among the options in Table 5 and write in their heat pump model without being given options. The aim of these questions was to assess the residents' knowledge about the type and model of heat pumps they had in their homes rather than to obtain accurate data.

Table 5. Reported type and model of heat pump by respondents (in Year 2), compared to actual numbers of heat pumps in households in the sample.

Reported type			Reported model			Actual type		
Type	Count	%	Model	Count	%	Model	Count	%
Exhaust air	28	31%	NIBE 360	23	25%	NIBE 360	122	43%
Air-to-water	17	19%	NIBE 410	8	9%	NIBE 410	60	21%
Air-to-air	4	4%	NIBE F205	3	3%	NIBE F205	13	5%
Ground source	3	3%	NIBE F370	16	18%	NIBE F370	87	31%
Don't know	16	18%	Other	8	9%	Total	282	100%
Missing data	23	25%	Missing data	33	36%			
Total	91	100%	Total	91	100%			

In Year 2, the majority of residents preferred the heat pump to provide constant room temperatures and constant hot water.

Among the whole sample of respondents in Year 2, the majority (80%) normally tried to achieve constant room temperatures rather than variable temperatures from their heat pumps (Figure 7). Preference for constant hot water was even stronger, with 91% wanting hot water constantly, compared to only 9% who aimed to get hot water when the heat pump can provide it (Figure 8).

Figure 7. Year 2, pattern of space heating provision residents normally tried to achieve. n=89

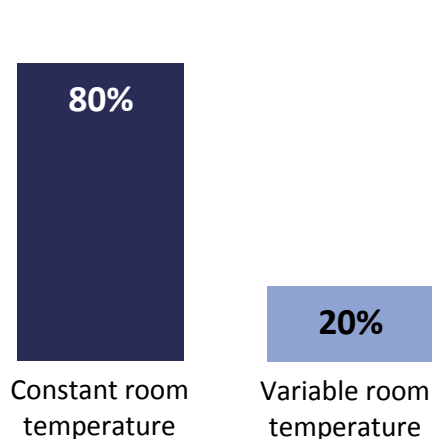
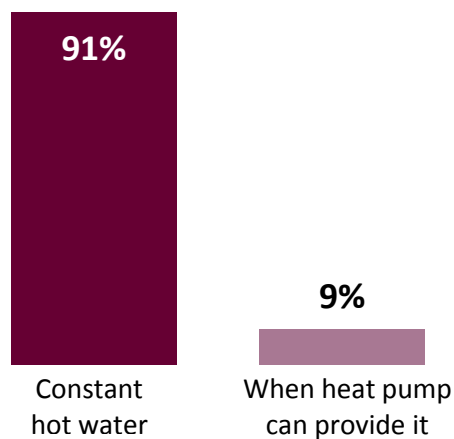


Figure 8. Year 2, pattern of hot water provision residents normally tried to achieve. n=88



The heat pump was running constantly in the majority of homes in both warmer and colder months.

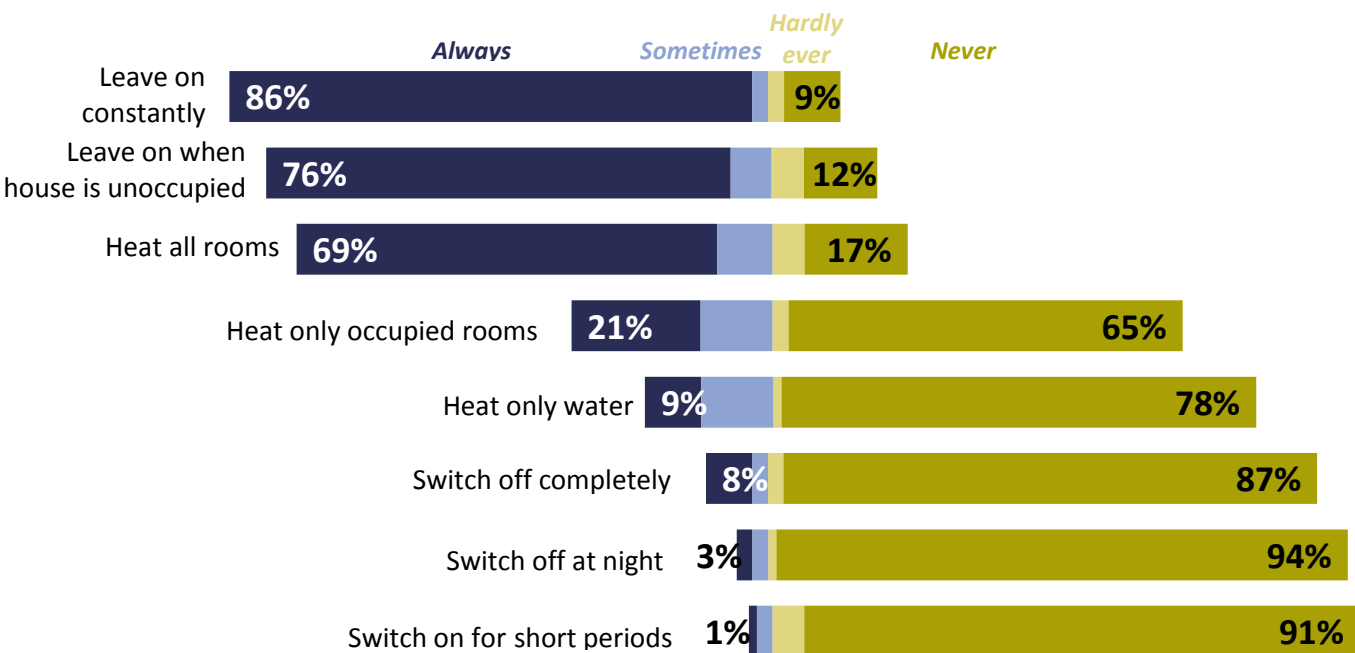
Residents answered questions about how they used their heat pumps at warmer and colder periods of the year.

In warmer months

During warmer months (Figure 9), the majority of residents (86%) left the heat pump on constantly, including at night (94%) and when the house was unoccupied (76%). Only 8% switched the heat pump off completely. Two thirds of homes (69%) always heated all rooms and just 1 in 5 (21%) always heated occupied rooms only. 1 in 10 homes (9%) always had the heat pump set to provide hot water only and a similar proportion (12%) used this setting only sometimes.

Figure 9. Year 2 respondents' usage of heat pumps in warmer months.

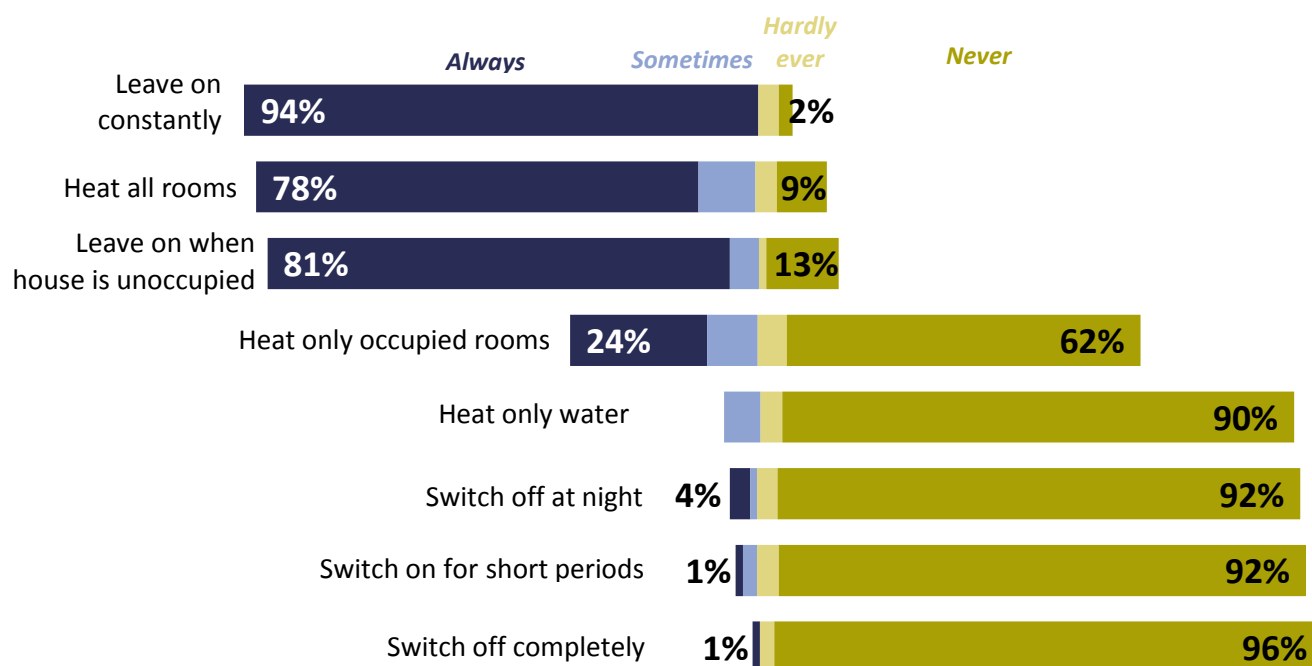
In respective order: n=76; n=75; n=77; n=76; n=76; n=79; n=77; n=77



In colder months

The pattern of using heat pump in the colder months was very similar to the usage pattern in warmer months (Figure 10). The majority of residents left the heat pump on all the time (94%), even when the house was unoccupied (81%) or at night (92%). Only 1% always had the heat pump switched off. In this light, we can see that more people left the heat pump on constantly than they did in warmer months, as could be expected in cold weather. Slightly more homes (78%) always heated all the rooms than they did in warmer periods (69%). 1 in 4 (24%) households had only occupied rooms heated. The seasonal difference is more evident when heating hot water. In cold months, just 6% had the heat pump on "sometimes" to provide only hot water compared to 18% using this option in warmer months.

Figure 10. Year 2 respondents' usage of heat pumps in **colder months**.
 In respective order: n=84; n=80; n=79; n=79; n=78; n=83; n=79; n=79



Opening the windows and doors

Heat pump manufacturers recommend to users not to open windows or doors when the heat pump is switched on and temperatures outside drop below a certain temperature (usually around 17°C). This is because cold air from outside can cause the heat pump's immersion system to switch on which in turn makes the heat pump run less efficiently and costs the user on fuel bills. It is, therefore, important to see how common an activity window and door opening is among heat pump users when their heat pumps are switched on.

There were seasonal variations in the activity among OHAL residents (Figures 11 and 12). During warmer months, half of residents tended to open windows or doors whilst their heat pumps were running and the other half did not. 40% never opened windows or doors and 14% hardly ever did so. Most of those who opened windows or doors did so only sometimes (44%) and just 3% said they always did.

In colder periods, three quarters (75%) tended to keep windows and doors closed whilst having heat pump switched on, with 40% never opening them and 1 in 4 (24%) hardly ever opening them. However, 1 in 4 (24%) said they sometimes opened windows or doors when the heat pump was on.

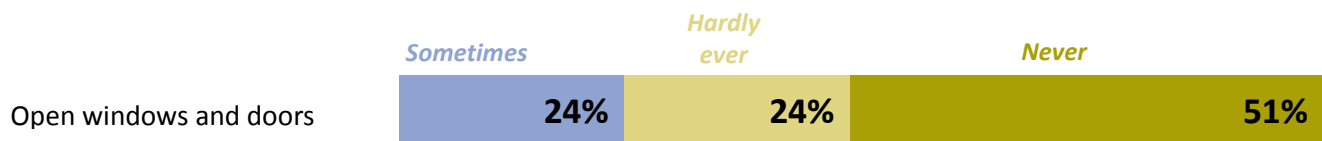
One respondent commented on possible challenges of having to keep the internal doors closed as was recommended in the new pictorial guide.

“Also having to keep every door closed while the system is on (permanently) is hardly practical, particularly with an animal in the house.”

Figure 11. Year 2 respondents' usage of radiators in **warmer months**. % do not add up to 100% due to rounding.
 n=78



Figure 12. Year 2 respondents' usage of radiators in **colder months**. % do not add up to 100% due to rounding. n=82

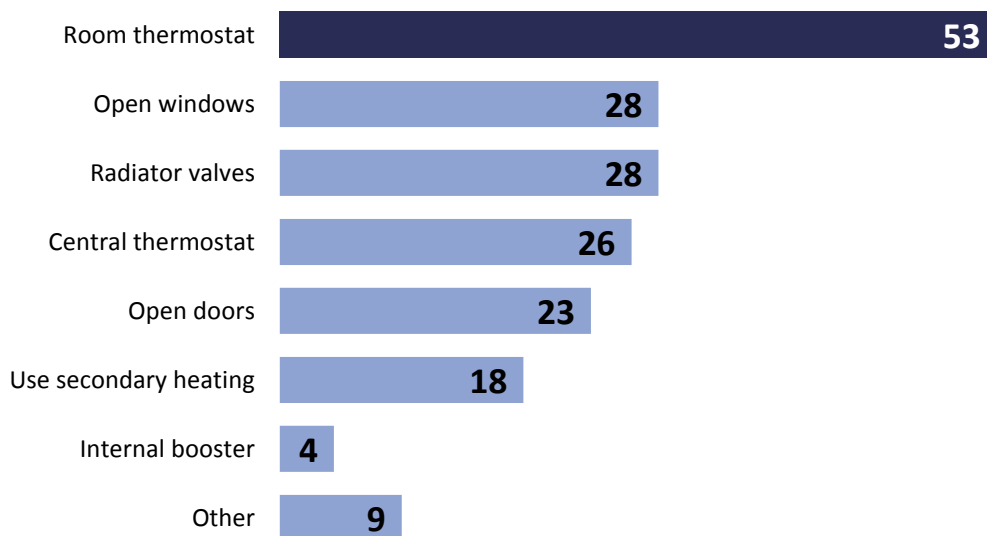


In Year 2, setting the room thermostat was the most popular choice for those who wanted to make their homes a comfortable temperature.

To heat their homes to a desirable temperature, most residents (53) opted for setting their room thermostats (Figure 13). However, 14 people ticked the answer N/A indicating they did not have room thermostats. The second most popular options were equally opening the windows (28) and adjusting radiator valves (28). The number of responses for adjusting radiator valves is affected by the fact that many homes in this survey did not have radiators (25 responses to category N/A). Adjusting central thermostat would be an option for 26 respondents, followed by those who would open doors (23) and use secondary heating (18). Only 4 respondents switched on their heat pump's internal booster.

Responses in the "other" category included putting an extra layer of clothing on, adjusting seasonal settings or opening inner doors to change temperature and air rooms.

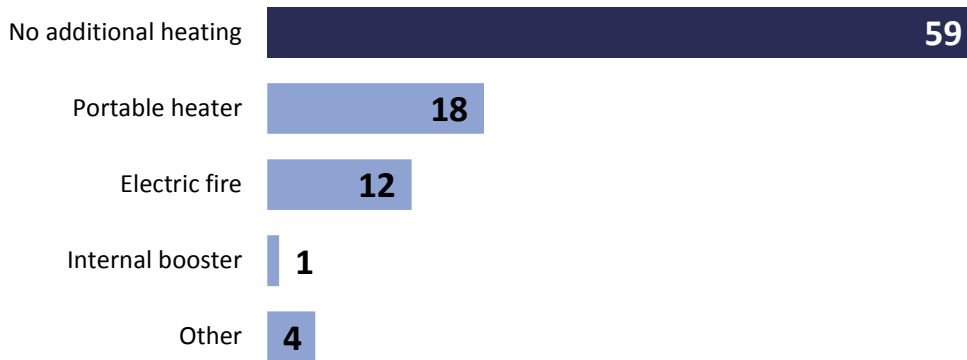
Figure 13. Year 2 respondents' actions to achieve a comfortable temperature in their homes. n=91; responses in counts



In Year 2, most residents said they had not use any additional heating in the previous 12 months.

Among the total sample in Year 2 (n=91), the majority of respondents (59) did not use any additional heating in the last 12 months (Figure 14). Those who needed extra heating used either portable heaters (18) or electric fire (12). Only 1 switched on the heat pump’s internal booster.

Figure 14. Year 2 respondents using additional room heating to increase the temperature of their homes. n=91; responses in counts

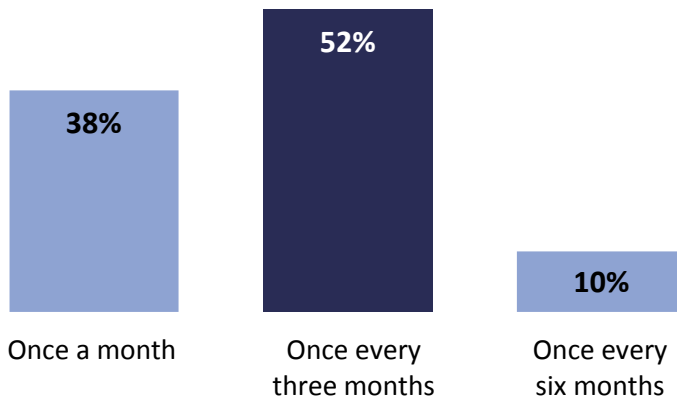


2 respondents said they could not afford additional heating. Hot water bottles and extra blankets figured in the “other” response category.

In Year 2, half of respondents cleaned the heat pump air filter once every three months, as advised by the heat pump manufacturer.

In Year 2, half of respondents (52%) cleaned the heat pump air filter once every three months, in line with the manufacturer’s (NIBE) instructions on maintaining the filter. 38% said they cleaned it once a month and 10% once every six months.

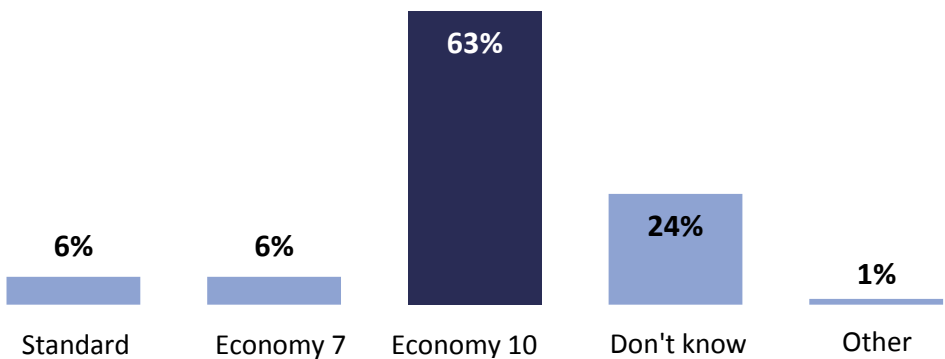
Figure 15. Year 2 frequency of residents cleaning heat pump air filters. n = 87



In year 2, the most popular electricity tariff with the residents was Economy 10. 1 in 4 were unsure about what type of tariff they paid for.

In Year 2, two thirds of residents (63%) were signed up to an Economy 10 tariff (Figure 16). Less popular were Economy 7 (6%) and Standard (6%). As many as 1 in 4 (24%) did not know which tariff they were signed up to. This level of uncertainty points to a need for more information on tariffs, which was also a common request in Year 1 (see Figure A3 in Annex).

Figure 16. Year 2 electricity tariff respondents were signed up to. n=84



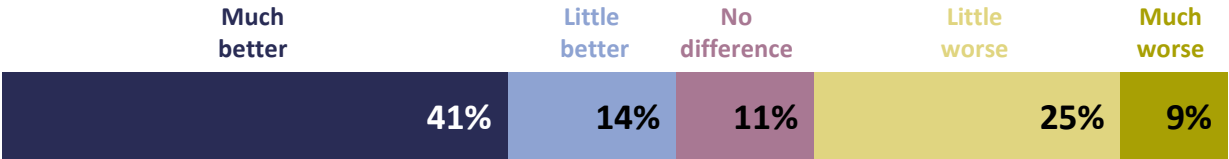
4

Previous heating

Most residents considered their heat pumps better at heating their homes than their previous heating system. But majority would switch to a different heating system if they had a choice.

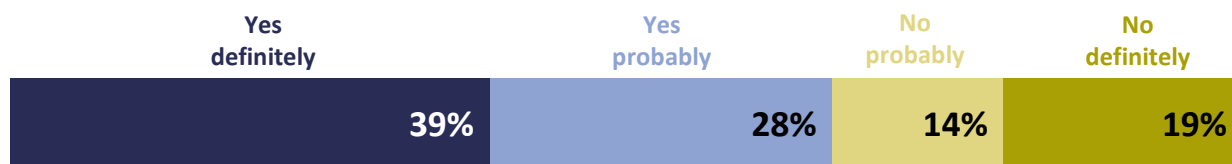
Among all respondents to Year 2 survey, the majority (55%) thought the heat pump was better than their previous heating system at heating their homes, with 41% saying the heat pump was much better and 14% thought it was a little better. One third (34%) said it was worse and 1 in 10 (11%) saw no difference (Figure 17).

Figure 17. Year 2 respondent's comparison between heat pump and their previous heating systems at providing heat for their homes. n=80



Among all respondents to this question in Year 2, two thirds (66%) would switch to a different heating system, with 39% giving a definite yes and 28% would probably switch. One third (33%) would stick with heat pumps (Figure 18).

Figure 18. Year 2 respondents who would switch (or not) to a different heating system. n=86



Among the different heating options, most respondents would opt for something cheaper to run and easier to fix. The desire for more control over heating times was also expressed.

“I would choose almost anything else! I can't afford to pay the amount of electricity the heat pump uses.”

“A heating system I can turn on and off, and have only hot water when needed!”

Several respondents would prefer oil heating or storage heaters as a more cost-effective and controllable option.

“Possibly oil heating so I can have it on at set times only and it doesn't take long to get up to temp when house is cold.”

“I would prefer storage heaters or radiators that I could adjust. I find my heat pump very expensive.”

Switching did not always mean a complete departure from heat pumps but a switch from exhaust air source to different types of heat pumps. Air to air heat pumps were seen as more affordable and easier to access.

“One that works effectively and efficiently, air to air, air to water, not exhaust air.”

“Air source heating - cheaper running costs and maintains a constant stability in temperature regardless of the weather.”

Noise was a determinant in switching for one respondent.

“Electric because I can't stand the noise of the heat pump turning on/off, running. I'd rather be paying for a less efficient but quiet system.”

Contact:

If you have any questions about this report, or would like a copy of the questionnaires or the report from Year 1 survey, please contact Liz Dinnie on: liz.dinnie@hutton.ac.uk, Phone: 01224395388
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Information and advice in Year 1

Figure A1 . What information materials have you used to find out how to use the heat pump? n=119; responses in counts

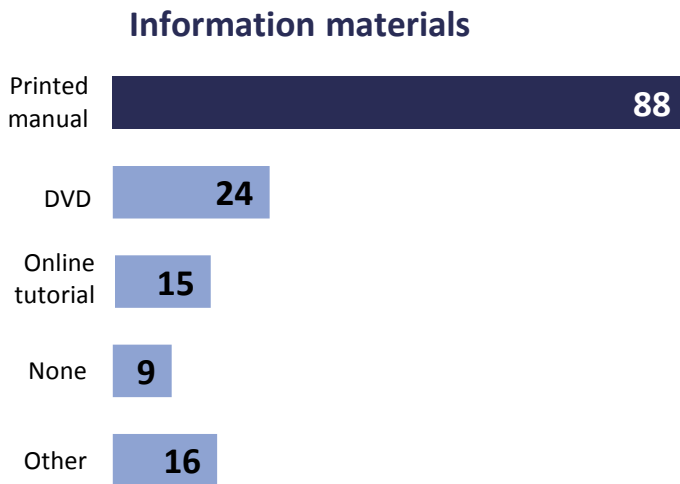
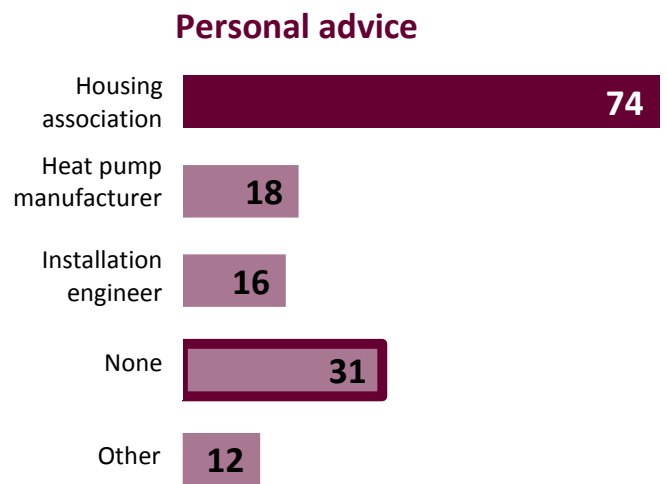
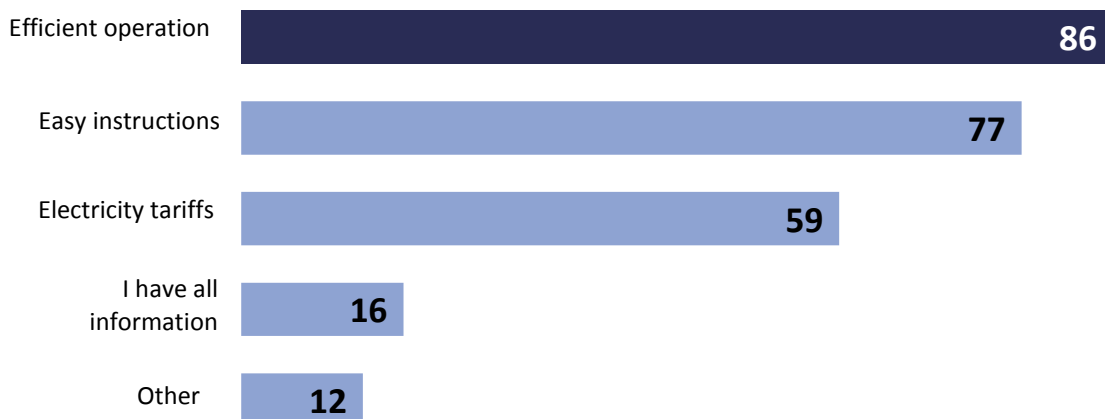


Figure A2. What personal advice have you received to help you with using the heat pump? n=119; responses in counts



The residents mostly wanted advice on efficient ways to operate the heat pump and easy instructions on how to reach the desired temperature of their homes.

Figure A3. What information and advice would be helpful to you in making better use of your heat pump? n=107; responses in counts



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