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EWGECO – HOME ENERGY DISPLAY TRIALS

Questionnaire, Interview and
Energy Use Comparison:

Summary Report

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THE QUEEN'S
ANNIVERSARY PRIZES
2009



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Executive Summary

Scope

The rollout of smart meters will play an important role in Britain's transition to a low-carbon economy, and help to meet some of the long-term challenges which will ensure an affordable, secure and sustainable energy supply. From the start of the mass rollout, currently envisaged to be in the second quarter of 2014, and scheduled to be completed by 2019, more than 50 million smart meters will have been installed (DECC 2011¹).

The smart meter will possess a range of benefits to the customers, with accurate billing being primary amongst them. However the real benefits to the occupant will take the form of being able to visually access their electricity and gas consumption in real time, and at any time throughout the day. An in-home display (IHD) is required to help occupants to understand their energy use.

The Ewgeco in-home display already works with the existing electricity and gas meters. This real time energy monitor involves and engages occupants providing them with the ability to better manage their own energy use. Giving consumers better information about their electricity and gas consumption in order to raise awareness and understanding of the benefits that controlling their energy consumption and reducing wastage will have towards protecting their interests.

The Trial

Over 2010 and 2011 a trial of installed Ewgeco dual-fuel smart monitoring energy display devices was undertaken over three housing association sites in Scotland.

- 65 properties took part in the trial providing qualitative feedback on their energy consumption, this information was collected through questionnaire interviews, which took place at the beginning and at the end of the trial.

¹ DECC. 2011. Smart Metering Implementation Programme, Response to Prospectus Consultation. London, Department of Energy and Climate Change

- 60% of occupants were “**key groups**” such as retired, unemployed or medically unable to work.
- 52 homes had electricity and gas consumption data for the 6 month trial period, 30 properties had the Ewgeco system on display located in a position where the participants could continuously access the device; the remaining 22 homes had no access to the hidden energy monitor. The Ewgeco system recorded the household’s hourly energy consumption, and periodic gas and electricity meter readings were taken to measure the difference.

Key energy consumption findings

- Across all the 52 properties in the trial, those with a Ewgeco energy monitor on display consumed 20% less gas compared to the properties with the hidden energy monitor.
- Analysis of dwellings consumption based upon occupancy levels larger improvements in gas consumption become apparent within the lower occupancy properties
- For the households with a Ewgeco monitor the improvement in gas consumption ranged between 7% and 23%.
- Interviewees with a Ewgeco monitor from larger occupancy dwellings had commented on the challenges that occurred from trying to regulate the use of gas due to the number of people who had access to the heating controls.
- Properties with a Ewgeco monitor consumed 7% less electricity compared to the other properties.
- Higher savings were made again by the lower occupancy dwellings.
- Improvements in electricity consumption amongst those properties with a Ewgeco became closer grouped.
- During the study it became apparent that the occupants were becoming more confident regulating their own electrical energy use
- Occupants utilised the Ewgeco as an instrument to reinforce their level of electricity awareness and consumption.

Conclusions from interviews/questionnaires

This document sets out the conclusion obtained from the questionnaire interviews carried out at the beginning and repeated at the end of the trial. A large majority of people (77%) said they liked to know how much energy they use; an even higher proportion (89%) said they liked to know how much money they spend on energy.

Most people said they tried to minimise the amount of energy they used. Reasons for this tended to be financial, rather than environmental:

- 84% said they minimised the energy they used because it saved money.
- 53% said it was because it was “good for the environment”.
- During the first survey 91% of the participants stated that the Ewgeco monitor was easy to use.
- A large majority also claimed that the Ewgeco made them more aware of how much energy they were using (94%), and how much money they were spending on energy (80%).
- Interviews identified that many of the participants with a Ewgeco, professed to have become increasingly confident about their utility bills.
- 73% of participants felt that the Ewgeco had made them reduce the amount of energy they used; only 7% reported that it hadn’t changed the way they used energy.
- All of the occupants wanted the device to remain in the property at the end of the trials.

The results presented in this document represent the conclusion of a TSB funded 6 month trial of electricity and gas monitor using a **coloured traffic light system** and digital numerical display to engage the household occupants and **alert them** to high levels of domestic energy consumption and wasted energy. This document highlights the importance in allowing occupants to transform instantly visual energy consumption data into actionable results to control costs over time and positively influencing domestic behaviour towards the use of electricity and gas.

1.0 Introduction

In December 2009 the UK Department for Energy and Climate Change (DECC) announced its intention to roll out 'smart meters' accompanied by dedicated in-home displays to all UK householders by 2020. This change to the domestic meter infrastructure will enable the development of a smart grid system, with the intention of handling large amounts of micro-generation and improved demand management.

The accompanying home energy display devices will provide consumers with real time information on their electricity and gas consumption with the objective to promote consumption control, reduced CO₂ emissions, and lower domestic utility bills.

Providing occupants with the means to view and comprehend their own energy consumption is seen as a crucial step to facilitate possible behaviour change within the domestic setting. Energy Display Devices attempt to serve this function. To further enable the potential behaviour change, a dual-utility smart energy monitor is used by the occupants to provide immediate feedback and information on their electricity and gas use in order to help make the necessary reductions.

Over 2010 and 2011 a trial of installed Ewgeco dual-fuel smart monitoring energy display devices was undertaken over three sites in Scotland. The study, funded by the Technology Strategy Board (TSB), involved recording the energy consumption of participants. This, alongside conducting social surveys at strategic points over the course of the trial, helped to identify how occupants perceived and used these devices; and in turn, how they related this information into their everyday lives and practices, allowing the possibility to relate this data back to their electric and gas consumption.

2.0 Summary of Methods and Sample

The Ewgeco home energy monitor (pictured in figure 1), measures electricity and gas consumption, then displays this information through the use of **coloured bars in a traffic light presentation**. The monitor displays the green coloured bars to represent low levels of consumption, as consumption increases so do the number of bars, amber and red bars become lit to indicate very high levels of energy use. Both electricity and gas use the same traffic light signal system in a graphic fashion. The information regarding the two utilities are monitored separately and are individually displayed on the same monitor. Furthermore a single coloured bar remains lit throughout the day which serves to indicate the peak energy use for that day, that bar will remain lit until it is superseded and replaced by another bar higher up the display, and will reset at the start of each day.

The electricity and gas consumption data is also represented as various numerical figures, these are as follows:

- Current consumption in kilowatts and pounds [£]
- Total daily consumption in kilowatts and pounds [£]
- Carbon dioxide emissions [kg/day]
- Ewgeco units [which is an accumulation of the figures above]

The monitor contains additional features, these include:

- **Individual Appliance Monitor function** allows the user to view how much energy any individual appliance is using, this can be displayed in kilowatts or pounds [£].
- **Alarm function** gives off an audible alert, attracting the users' attention when a pre-set level of daily consumption has been reached.
- **History review function** provides the user with total consumption of the past days.



Figure 1. Photograph of Ewgeco Energy Monitor

Electricity use can be measured either via a current clip attached to the electricity cable that then leads into the meter or pulsed output, whereas the gas usage is measured from the pulsed output at the front of the meter. The information is sent wirelessly from the transmitter to the Ewgeco display. Figure 2 illustrates how the Ewgeco displays the information.

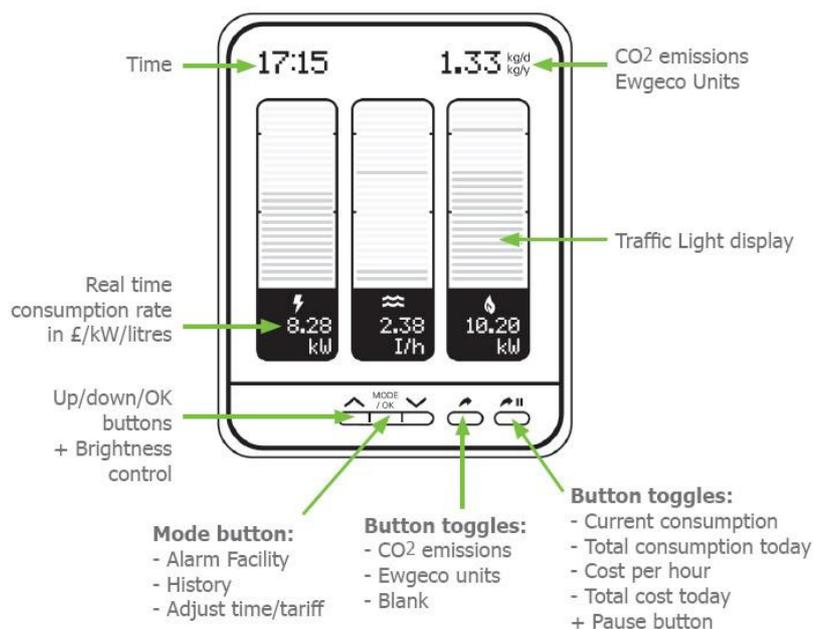


Figure 2. Ewgeco List of Features

2.1 The study

Over the 6 month study period, the Ewgeco system was installed in 52 properties, across 2 sites, where the electricity and gas consumption was monitored and recorded. The 52 properties consisted of 30 homes with a Ewgeco monitor on display, located in a position where the participants could continuously access the device; the remaining 22 homes were the non-Ewgeco 'control' sample, with no access to a monitor.

The selection of homes was made up of 31 (60%) flats and 21 (40%) two storey semi-detached houses, constructed in 2010.

The Ewgeco system recorded the household's hourly energy consumption over the 6 month trial period. The research team scheduled periodic visits to each of the participants to extract the data collected by that Ewgeco system. Interviews were then conducted with the bill payer, and then the gas and electricity meter readings were collected, as a means to validate the Ewgeco data.

2.2 Sample size

The opinions and views relating to energy use and of the Ewgeco energy display device were collected using questionnaires that formed part of a typically one-hour interviewing process.

This happened at two points during the trial, once in November 2010 and was then repeated in March 2011.

The sample of participants that made up the interviews was as follows:

- A total of 65 residents ("including the bill payer") took part in the study
- All properties contained one (22%), two (66%) or three (12%) bedrooms
- The number of occupants in each property ranged from 1 to 6. Total proportions were as follows: 1 (22%); 2 (40%); 3 (20%); 4 (11%); 5 (6%); 6 (2%)

- The age of respondents ranged from 18 - 68 years (mean = 39 yrs.; SD = 13.1 yrs.)
- Only 37 of the 65 respondents provided information about their household's annual income. Of these, 76% earned less than £20,000, and 3% earned over £45,000 per year. The mean annual household income for this group was £16,231 (SD = £9,022)
- The respondents' occupations were varied. The largest single categories were unemployed (31%); medically retired or disabled (18%); retired (11%); caring, leisure and other service occupations (11%); professional (6%); administrative and secretarial (6%)
- 60% of occupants were "key groups" such as retired, unemployed or medically unable to work
- Support tenants made up 22% of the sample. Support tenants are occupants who are physically/mentally disabled or are otherwise incapable of self-sufficiency. In this instance they required a part time or full time carer, this varied between independent care teams or the occupant's spouse/family member

All of the interviews were conducted face to face with an interviewer at the participant's home. During the interviews, participants were asked to comment on the following themes:

- *Their initial thoughts on the Ewgeco display;*
- *Their current understanding of their energy bill, consumption and supplier;*
- *If the device had affected their energy awareness or behaviour, and in what ways;*
- *Views and opinions and the myEwgeco web portal;*
- *Recommendations to improve the device and the myEwgeco system.*

Throughout this report quotations are used to illustrate particular points. Individual quotations chosen are representative of the wider theme under discussion and are used to convey a strong sense of how these devices are used in real life domestic settings.

The quotations are labelled as follow:

ID	Monitor on display	Gender	No. of occupants	Age of occupants	Household income (£) thousand	House type
E01	Yes	Female	2	46, 20	15-20	Semi-detached house
E02	Yes	Female	3	23, 20, 1	10-15	Semi-detached house
E03	Yes	Male	1	38	10-15	Top flat
E04	Yes	Male	3	62, 59, 29	10-15	Semi-detached house
E05	Yes	Female	4	29, 29, 4, 2	10-15	Semi-detached house
E06	Yes	Male	2	64, 61	10-15	Ground Flat
E07	Yes	Male	1	38	5-10	Mid Flat
E08	Yes	Female	2	42, 38	10-15	Ground Flat
E09	Yes	Male	2	50, 21	10-15	Bungalow
E10	Yes	Female	2	75, 63	10-15	Bungalow
E11	Yes	Male	1	35	10-15	Mid Flat
E12	Yes	Female	2	47, 45	45-50	Ground Flat
E13	Yes	Female	4	58, 33, 36, 3,	15-20	Ground Flat
E14	Yes	Male	1	62	15-20	Top Flat
E15	Yes	Male	1	41	20-25	Semi-detached house
E16	Yes	Female	1	54	10-15	Ground Flat
NE01	No	Female	2	29, 3	5-10	Semi-detached house

Table 1: Summary of Quoted Interviewees

3.0 Utility Bills

The first interviews found that 60% of all respondents indicated that they did not understand their energy bills, commenting on how they felt that the wording and format of the bill had become confusing and difficult to interpret. At the same time, many of those who were paying by standing order and direct debit commented that they felt removed from their bills, and had chosen that type of payment method out of convenience rather than consumption control.

“We have never questioned our bills before, actually I don’t think we actually ever looked at our meters, but I guess, when you pay by standing order, and you pay the same amount every month, and as it is now, now we were encouraged to pay by paperless billing. I can safely say that I haven’t looked at our quarterly statements since then.” (E06)

65% of the interviewees said they didn’t know, or weren’t sure what they paid for their energy (i.e. the tariff). However, most participants (77%) indicated it was important for them to understand their energy bill, while only 15% felt it was not important. From this sample, we can conclude understanding their energy bill is important to many people, even if they don’t check their readings very often.

A large majority of people (77%) said they liked to know how much energy they use; an even higher proportion (89%) said they liked to know how much money they spend on energy. The second interviews identified that many of the participants with a Ewgeco, professed to have become increasingly confident about their utility.

4.0 Displayed Consumption Information

In Table 2, respondents reported the following features of the Ewgeco monitor as being particularly useful (% stating “very” or “quite”).

Features	% in Nov 2010	% in March 2011
Coloured bars	95	87
Peak energy use	84	23
Energy usage in pence per hour	71	49
Total cost for today	71	51
Energy usage in kWh	27	17
Energy usage in T kWh	27	15
Household carbon footprint (Co2 / kg)	14	2
Directly reviewing the history	11	11
Audible alarm	5	4
Energy use in Ewgeco unit	5	0
Independent appliance monitoring	2	2

Table 2: User Preference to Displayed Information

4.1 Active ‘traffic signal’ display, £ and kWh

During the first stage of the study (November 2010), occupants professed a high level of favourability towards viewing their electricity and gas consumption represented by the coloured bars. The majority of interviewees commented on how the traffic light system continuously attracted their attention, and in many instances reinforced the need to take action to reduce wasted energy. Over the course of the study, the vast majority of users maintained a preference towards using the non-numerical coloured bar portion of the device which indicates their level of consumption based upon a three colour system, green, orange and red.

“Well we use the traffic lights the most, mostly because its bright, and I don’t know what kilowatts mean. When the monitor is out of the green we pay more attention, when the display is orange or red, I mean, when its showing an unusual number of coloured bars for that part of the day, we go hunting to see what’s been left on... if we don’t need that on, we switch it off.” (E01)

Additionally the interviewees described how they augmented the information from the active display with the monetary value expressed by the display.

“Yeah, my wife uses the colours to see what’s going on, but I find the pounds per day figure the most useful. It’s true that the coloured bars still attract my attention... I would walk past and see red, and I’d think, ‘how much is that costing me?’ then I would go over and look closer at the pound figures. After all that’s what matters, right? Everything we do is money. I want to see how much this place is costing to heat, after all at the end of the day, it’s the pound figure that my supplier is interested in, so, so am I.” (E02)

Notably, interviewees still maintained interest in the current consumption figures, as displayed in pounds. For some, viewing consumption in this manner appeared to be the preferred method of reading which particular electrical appliances around the home were costing the most to run.

“See... people always tell you, that this costs that and that’s costing that, but it’s not until we done this ourselves, now I am a believer. I don’t know about everyone else, but I would like the Ewgeco to show me a list of all my stuff and how much each of them are costing me.” (E03)

Many of the participants who used the device in this way described how they began to understand the cost associated with running household electricity appliances, and running the central heating and hot water. Similar to the comment above, others who used the device this way described a desire to continuously view all of their appliances energy consumption individually.

However of those users, very few had attempted to use the display’s independent appliance monitoring facility. Many continued to comment that they were not confident and did not

possess the 'required' level of knowledge to properly operate the monitor and were afraid of breaking the device if they tried any extended form of physical interaction.

A small group of those interviewed valued the display of current and total daily consumption expressed in kilowatt hours, 27% respectively. Throughout the interviews it became apparent that viewing daily or hourly consumption in kilowatts had been favoured by male occupants, and/or those who had, or were working in an occupation that required them to have an appreciation of the kilowatt hour value.

4.2 CO₂ and Ewgeco units

A smaller portion of interviewees appeared interested in viewing their consumption as Carbon Dioxide emissions (CO₂) (14%), or in Ewgeco Units (5%), however, this selection of interviewees began to view the CO₂ figures as meaningless and difficult to relate to, at the same time, many of the users criticised the Ewgeco Units reading as being too abstract. As a result the second questionnaire realised a 12% drop in those who saw the CO₂ and Ewgeco Unit as being particularly useful ("very" or "quite").

Several interviewees, who felt they had developed an adequate appraisal of their own CO₂ and Ewgeco Units consumption, explained how they had no means by which to compare their own figures. This led to interest in the figures tailing off due to the lack of an adequate motivator, or sense of accomplishment. Some went on to suggest the need to have these figures displayed in a comparative format, comparing the Ewgeco Units and Carbon Dioxide Emissions of their own domestic energy usage to that of other similar nearby households so they could connect the figures to the everyday aspects of their lifestyles.

Those who had not used the CO₂ figure went further; stating a need for more information to help them to visualise how CO₂ fits into particular everyday activities.

Most people said they tried to minimise the amount of energy they used. Reasons for this tended to be financial, rather than environmental: 84% said they minimised the energy they used because it saved money, while only 53% said it was because it was "good for the environment".

4.3 Peak energy bar

Many interviewees had commented that initially they were unaware of the purpose of having the single lit bar. After gaining an adequate understanding of the function for the peak bars, a large majority found the feature to be of particular use to help them budget. However, by the time the second interview was conducted, interest in this feature had dropped sharply.

“I didn’t even know why this single bar was lit above the rest, first I thought it was broken, when I finally read what it meant and I started looking at that bar more often, after a while it was meaningless again, definitely for the gas side, when I run the hot water in the morning, the gas peak bar flies away off to the top and doesn’t come back down, it just stays there all day... how is that fair?” (E04)

The above sentiment was expressed by a majority of interviewees. To improve this situation several interviewees had suggested a peak bar should display the collective average of each utility, this in turn would allow the peak bar to remain a visual descriptor of peak use throughout the day, avoiding it being pushed ‘out of sight’ by early morning energy demand.

4.4 Ewgeco in the homes

As mentioned earlier, those who favoured the display of consumption in kilowatts were predominately male: however, over the course of the interviews, it became apparent that both male and female respondents used the device.

Across the households, it transpired that the monitor was utilised in different ways according to age and responsibility. Several interviewees commented on the monitor’s ability to communicate with younger members of the family. The bright coloured bars, represented in the graphic ‘traffic light’ were easily translated, predominately due to the use of traffic lights in other common situations already familiar to their life style.

“Sometimes I think the kids use it more than I do. When I first told the youngest about it how it worked, she would stare at it, and scream the house down every time it went red. My eldest is in the eco council at school, oh she takes it very seriously, they learn all about this at school, so it’s good for them to have this.” (E05)

Many respondents felt that the monitor encouraged the whole household to save energy, and therefore money. There was a small, negative correlation between age and how easy respondents felt the Ewgeco was to use (a tendency for people to find it harder to use the older they got): however, this just failed to reach statistical significance in our sample ($p = 0.06$).

There was no significant relationship between respondents' age, and how much they thought about the energy they use, or whether they tried to minimise the amount they consumed for financial reasons. However, there was a significant tendency for environmental reasons becoming more important with increasing age [*Spearman's correlation 0.254; $p < 0.05$*].

At the same time, different behaviour was observed from similar sized families. Within this context, only one spouse would express energy saving behaviour, whilst the other held little value engaging with the monitor or conducting energy saving habits, neither of these roles were strictly gendered. In these instances, few interviewees spoke of arguments and conflicts that arose from one trying to enforce the information displayed by the device.

This type of device may be desired and used predominantly by an individual; however the device is then operated under a regime of very complex sets of social relationships. These issues clearly indicate that the monitor can become limited by the existence of an unsupportive spouse. This observation suggests that the devices should aim to engage whole households rather than single users. From the two stage interview survey it is suggested that the graphic 'traffic light' display has the greatest potential to engage whole households.

There was no difference in how easy respondents felt the Ewgeco was to use depending on whether or not they were support tenants [*independent-samples t-test; mean scores 4.26 vs. 4.56; $p = 0.48$*], or how interested they were in using it. Also, no difference between gender [*independent-samples t-test; mean scores 4.29 vs. 4.33; $p = 0.91$*],

Support tenants were as likely as non-support tenants to think about the energy they use and to try and minimise the amount of energy they used. Support tenants were more likely to consider environmental reasons for minimising energy use (rather than financial ones) than non-support tenants, but this just failed to reach statistical significance [$p = 0.09$].

Interaction with Ewgeco had only encouraged a small number of participants to look more frequently at their meters, or to re-evaluate their contract with their existing utility provider. This may suggest that people are content with using Ewgeco to simply help them understand and create awareness for their consumption and alter their consumption behaviour. However the study suggests that energy display devices may not stimulate users to think about changing tariff or supplier, or even to collect meter readings for accurate billing.

5.0 Change in Behaviour Attributed to the Ewgeco Energy Display Device

Of those respondents with a Ewgeco installed in their homes, 91% had not used an energy monitor before the study, 80% stated they had used the Ewgeco monitor during the study. Only 9% of respondents said they were not interested in using the monitor. In the follow-up survey (March 2011), 77% of respondents claimed to still be using it, with 37% checking the monitor at least once a month.

The questionnaire study conducted in November 2010, and again in March 2011, posed the same question concerning the frequency by which the occupant engages with the Ewgeco display. Between the two questionnaires, the results found a significant trend highlighting that people interacted less-often with the monitor less often during the day [$t = 10.66$; $df = 30$; $p = 0.001$]. This may be a factor of energy consumption behaviour change having already occurred during the period of the study, given the resultant energy savings found in accessible display properties.

People who reported not using the Ewgeco energy display device were significantly more likely to say they didn't think very much about the energy they used [$t = 2.50$; $df = 46$; $p = 0.016$]. Support tenants were slightly less likely to have used the Ewgeco (69%) compared with non-support tenants (84%), but this difference was not significant [$\text{Chi-square} = 1.38$; $df = 1$; $p = 0.24$].

Table 3 compares the proportion of respondents who stated they were more likely to conduct energy-saving behaviours after the first survey (% stating "a bit more" or "much more"), and those actually reporting that they had done so more in the second survey were:

Activity	% stating they would do this more in the future (Nov 2010)	% stating they have done this more since Nov 2010
Switch off appliances rather than put on stand-by	64	52
Switch off lights when leaving a room	59	52
Close windows / put on clothes before heating	48	53
Boil and cook using minimum amount of water	48	40
Keep thermostat / radiators low	36	44
Keep time in the shower to a minimum	30	31
Turn the temperature down on the washing machine	25	29
Use energy saving light bulbs	25	26
Hang clothes out to dry rather than tumble	24	24
Put less water in the bath	17	39

Table 3: List of Energy Saving Behaviour

Table 3 illustrates what home occupants thought they would change in their behaviour for the future versus what they actually did. It is interesting to note that what they did alter in their behaviour was linked to factors that would create some of the greatest savings. It is recommended that further research is needed in identifying specific behavioural change patterns.

6.0 Using Ewgeco

Most people (91%) reported finding the Ewgeco monitor easy to use in the first survey (November 2010). This figure was slightly decreased in the follow-up survey (79%). A large majority also claimed in the first survey that the Ewgeco made them more aware of how much energy they were using (94%), and how much money they were spending on energy (80%).

Less than half the respondents (43%) said they had used a lot of the functions in the first survey (November 2010), and even fewer (19%) admitted to doing so in the follow-up (March 2011). This may be due to interaction with new devices where over time people will focus on only specific functions that they find easy to interact with or which they may find most useful.

Most people in the first survey (73%) felt that the Ewgeco had made them reduce the amount of energy they used; only 7% reported that it hadn't changed the way they used energy. These proportions fell to 46% and 3% in the second survey, conducted in March 2011. The result of the second survey is after behavioural change has been enacted and before results of the Ewgeco versus non-Ewgeco dwellings has gone public. It would be very useful to go back to the individual occupants, now the study is completed, to give them a full update on their effective energy savings.

Interviewees commented how their attitudes towards Ewgeco had changed over the course of the trial.

“I’m still using the monitor, but not as much, the coloured bars were very attractive, it was the first thing that ever attempted to explain energy to us. At first it was only the coloured bars now the coloured bars give us an overview of what’s going on, but I’m far more interested to see how much we are and have spent, you can’t see the financial impact just by the increase of one green bar” (E07)

“It gives you a clearer idea on how much money you are spending, even just moving the central heating by a few degrees, the house is still warm, you can quickly see the effects on the monitor, and the money is coming down, but once we knew that that was what we needed to do, that was it. Simply keeping it in the green now is what we constantly try to do” (E08)

“It was all useful when we moved in, in the beginning, I was always looking at it every day, now I don’t need to as much, I don’t find half of the stuff useful, but I still rely on it to keep reminding me.” (E10)

“I am using it less, but don’t think I can ever afford to completely stop using it, yeah in the beginning I was all over it, but in the past few months I have learnt that the kettle costs this and my heating costing so much depending on the temperature level, I don’t need to constantly look at it anymore, but I think it still needs to be here to keep on reminding me to be good, especially for the heating” (E11)

These comments and similar ones that came from the March 2011 interviews seem to suggest that the participants have started to use the device in a reduced and more focused capacity. Many used the monitor more intensively during the first days of the trial, and began to implement the information they gained into certain aspects of their lifestyle. Many participants felt they needed the presence of the monitor to periodically refer to; however it appears that those people who tried out the monitor’s features, decided quickly which functions they wanted to use, and rarely attempted to re-engage with functions that they initial feel to be of little use to them.

7.0 Energy Use Comparison

Gas and electricity consumption were monitored in all properties using the Ewgeco device (either on display, or concealed) for the 6-month study duration, and analysed together with utility metering data for further validation.

Data sample size:

- A total of 65 properties took part in the study
- At this stage only 52 validated data sets were obtained
- The 52 properties include 30 homes with Ewgeco display units, and 22 homes acting as non-Ewgeco dwellings. The non-Ewgeco dwellings consist of properties with no Ewgeco, or with one concealed

7.1 Gas consumption

The gas consumption (kWh) data from the trial properties has been normalised using individual heat gain/heat loss figures calculated for each of the dwellings using the Standard Assessment Procedure (SAP) methodology. SAP remains the UK Government's Standard Assessment Procedure for Energy Rating of Dwellings. SAP is adopted by Government as part of the UK national methodology for calculating the energy performance of buildings. It is used to provide energy ratings for dwellings and to demonstrate compliance with Scottish Building Regulations (and those of England, Wales and Northern Ireland). This method provides an indication of the percentage of energy gains and losses in each dwelling due to house construction, size and orientation.

Normalising the measured gas consumption by SAP values takes into account the energy use in the properties over an annual cycle based on orientation, heat loss, shading, heat gains, and U-values, this allows for a comparison across different site locations and construction detailing.

From the data in table 4, it can be seen that the number of residents in each property has an influence on gas consumption and the relevant differences in comparison between display and non-Ewgeco properties.

GAS						
	Gas consumption (kWh)			SAP normalised gas consumption		
	Non-Ewgeco properties	Ewgeco properties	diff%	Non-Ewgeco properties	Ewgeco properties	diff%
1 Person	2778	2284	18%	0.76	0.58	23%
2 Persons	5667	4402.5	22%	1.27	0.97	23%
3 Persons	5173	4895.8	5%	1.20	1.10	8%
4 + Persons	7610	6598	13%	1.49	1.39	7%

Table 4: Gas Consumption per Occupancy

GAS						
	Gas consumption (kWh)			SAP normalised gas consumption		
	Non-Ewgeco properties	Ewgeco properties	diff%	Non-Ewgeco properties	Ewgeco properties	diff%
OVERALL	5011	3995	20%	1.14	0.91	20%

Table 5: Total Gas Consumption

The energy consumption of the dwellings represented in Table 4 illustrates the differences between the two types of trial properties. Larger differences become apparent within the lower occupancy properties. Interviewees with a Ewgeco monitor from larger occupancy dwellings had commented on the increasing difficulty that occurred from trying to regulate the use of gas due to the number of people who had access to the heating controls. However, they had praised the gas display portion of the device, describing how they could for the first time see the benefits for turning the thermostats down.

Tables 4 and 5 show the difference in gas consumption compared across all the properties in the trial. Figure 3 illustrates the figures from table 4, which charts the gas consumption of the properties over a the 6 month trial period The results suggest, that those properties with a

Ewgeco energy display device on display have consumed less gas, on average, compared to those in the non-Ewgeco groups, and more so towards the lower occupancy properties [$t = 2.326$; $df = 50$; $p = 0.02$].

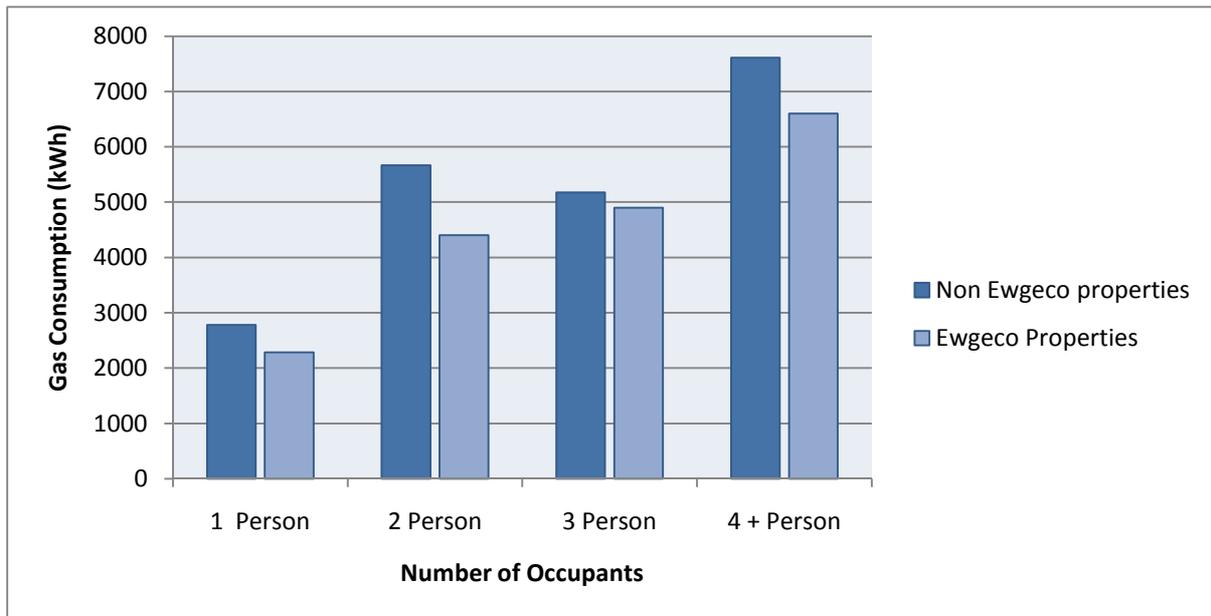


Figure 3. Chart of Gas Consumption

Collective views from the second interviews (March 2011) seem to suggest that the occupants within both the non-Ewgeco and the display groups felt they never used large amounts of gas over the winter period. However, display group interviewees mentioned how they have become more likely to interact with the various types of heating controls, for example, system thermostats and individual radiator thermostats.

Many of the interviewees within the non-Ewgeco groups had commented how they felt divorced from the control of their heating system and, as a result, they claimed to have possessed very little awareness of how much gas they actually used to heat their home or to run a bath.

“To be honest we use the heating when we want it, I am not going to sit in a cold house, the gas is either on or off, we couldn’t be using that much.” (NE01)

The majority of interviewees within the non-Ewgeco group displayed the same view and approach to the use of gas. Furthermore, fewer of the non-Ewgeco group interviewees were regulating their gas consumption via the heating system thermostats. This may suggest that the consumption data, if it had been available to the non-Ewgeco group, may have led to energy saving behavioural changes.

7.2 Electricity consumption

Electricity consumption for each property was collected over the 180-day study period and grouped by number of occupants in each dwelling - as there appeared to be an electricity usage correlation with occupancy (perhaps suggesting increased use and availability of consumer appliances). Table 6 shows electricity consumption for the non-Ewgeco and Ewgeco properties. Overall, there were some differences in electricity use between properties with a Ewgeco and those without, but differences were small, not systematic, and not statistically significant [$t = 0.25$; $df = 50$; $p = 0.98$].

ELECTRICITY			
	Electricity consumption (kWh)		
	Non-Ewgeco properties	Ewgeco properties	diff %
1 Person	932	885	5%
2 Persons	1674	1581	6%
3 Persons	1343	1387	-3%
4 + Persons	2229	2175	2%

Table 6: Electricity Consumption per Occupancy

ELECTRICITY			
	Electricity consumption (kWh)		
	Non-Ewgeco properties	Ewgeco properties	diff %
OVERALL	1479	1379	7%

Table 7: Total Electricity Consumption

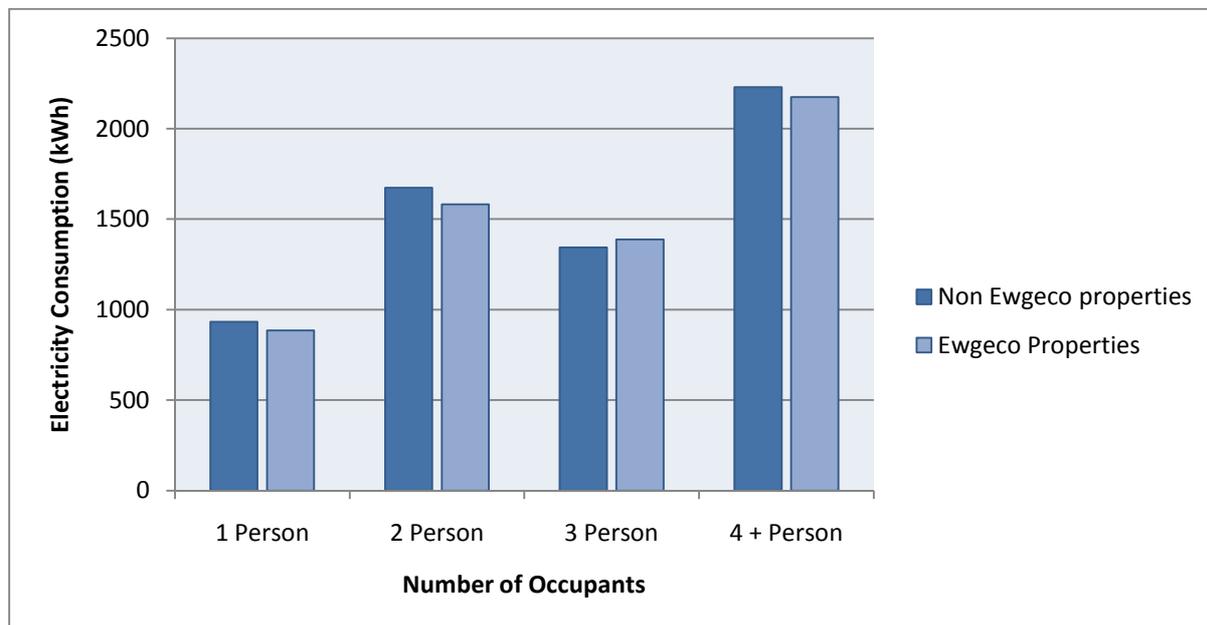


Figure 4. Chart of Electricity Consumption

Table 7 displays the accumulative figures for all the 30 Ewgeco properties in comparison to the 22 non-Ewgeco properties. On average, there is a 7% improvement from the Ewgeco properties. The results from table 6 are illustrated in figure 4, which visually identifies the similar trend that appears between higher occupancy levels and increased energy consumption.

The figures from tables 6 and 7 supplemented with the information provided by both sets of interviewees, suggests that people are more confident regulating their own electrical energy use. Those within the non-Ewgeco dwellings appeared to have found it as easy to control the electrical appliances.

Certain aspects of electricity consuming behaviour appears to be an existing part of routines and habits making it difficult for people to connect specific behaviours to the electricity they consume. In this respect, the monitor appeared to have become an instrument to reinforce peoples existing levels of electricity consumption. In these cases, the device tended not to be associated with reductions in energy consumption:

“I think that the monitor has helped me to prove to the rest of the family that we need to stop wasting electricity. In our last house I was forever chasing after everyone turning of light, I think I was always like that, definitely with electricity, I got that from my mother, she would scream and shout when I used to leave lights and stuff on. But yeah it’s helped me to convince everyone, I’m not wasting my breath anymore.” (E13)

“I guess I have always been extremely conscious with the electricity we use, it’s all over the TV and radio, turn this off, turn that off, and now I can’t find the old light bulbs anywhere, the monitor simply now reminds us when something electrical has accidental been left on.” (E14)

Interviewees regularly commented on the importance of having the monitor which can be quickly referred to, which also enables gas consumption to be more understandable and can be used to support and encourage those already conscious about the electricity they consume.

7.3 Improvements in energy consumption

Figure 5 charts the percentage figures presented in tables 4 and 6. The chart illustrates the differences made between the Ewgeco homes compared to those without a Ewgeco. Gas consumption across all levels of property occupancy, yielded higher improvement figures, with the largest improvements peaking at 23% in the 1 and 2 person dwellings and decreasing as occupancy increases.

The differences in electricity consumption made by the properties with a Ewgeco monitor are somewhat more stable across different dwelling occupancy, fluctuating only 9%. Again the higher improvements seem to appear amongst the lower occupancy dwellings.

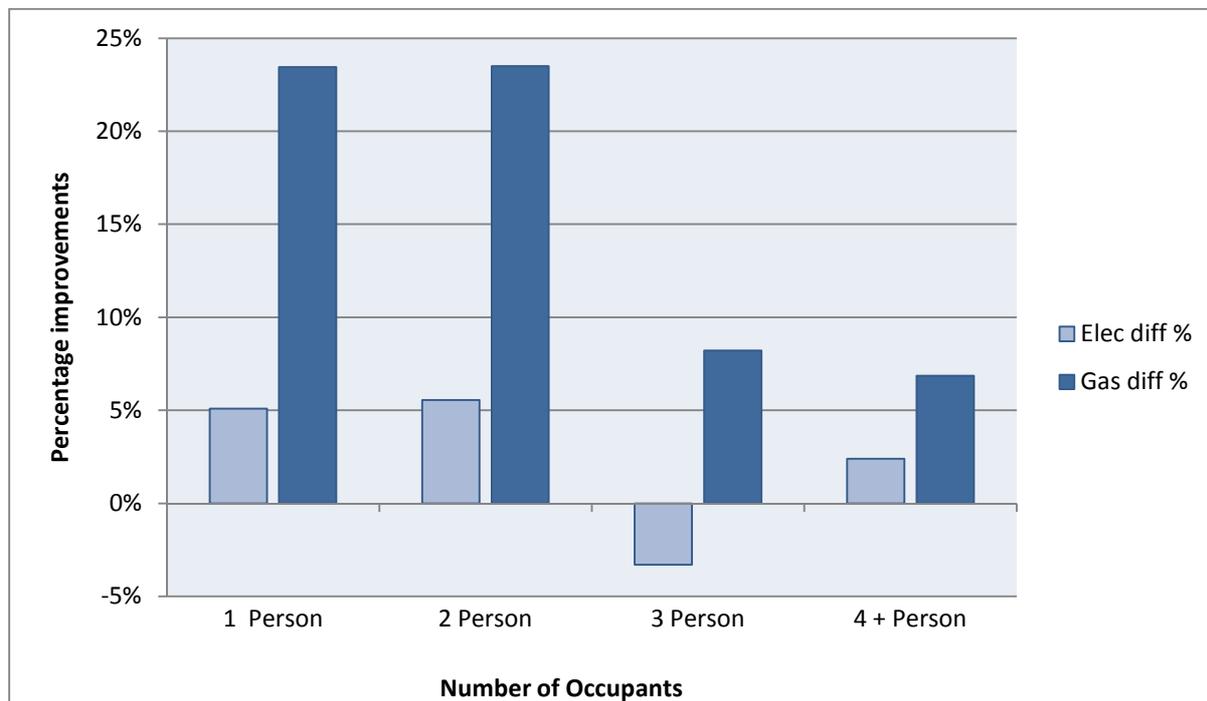


Figure 5. Electricity and Gas Consumption Improvements

When comparing consumption to occupancy, a trend appears which seems to suggest that the dwellings with the higher levels of occupants will consume higher quantities of both electricity and gas. However, when comparing the electricity and gas consumption differences between the properties with a Ewgeco to those without, the results indicate that the larger improvements in energy consumption occur in the properties with fewer occupants, which may be an indication of how priorities within homes begin to impact on energy consciousness as the number of occupants increase, especially when the additional members of the household are dependants. Furthermore, when comparing the differences in energy consumption made by the homes with Ewgeco, a divide becomes noticeable between the 1 and 2 person homes compared to the 3 and 4+ person properties.

The energy consumption improvements in the 1 and 2 person dwellings are both much higher and are of similar figures for both gas and electricity. With the exception of the electricity consumption in the 3 person properties; a similar occurrence in consumption difference happens for the properties with 3+ people. Energy consumption in the 2 person homes are slightly higher than that of the 3 person homes, and there is still a greater difference in

consumption amongst the 2 person dwellings. Whereas the addition of an extra person in the homes appears to have brought down consumption yet lowered the consumption difference between those with and those without a Ewgeco, this may be an indication of additional factors that play on larger occupancy households with relation to energy consumption and wastage.

8.0 Consumer Findings and Suggestions for Improvement

As mentioned in previous chapters, the level of engagement with Ewgeco tended to decrease over time - which may be a result of a learning process which takes place at the very early stages using the monitor thus focusing attention on a smaller group of functions. Interviews with respondents also yielded further insights into why people tended to use the monitor less after having it in their homes for 3 months.

8.1 Tariff

Many of those interviewed during the second questionnaire, stated that the single tariff structure in the device served to devalue the significance of the monitor's monetary display.

Over the course of the two interviews, the majority of the participants had received at least two utility bills, and a number of these demonstrated a new-found interest in scrutinising their bill. Those who conducted the comparison recognised that the cost figures were not entirely accurate:

“Yeah, the one tariff thing, that was a surprise, I guess if it wasn't for the monitor I never would of knew about the tariff, then I was told that I have two tariffs, I was like, were does my second figure go, which figure do I use. I ended up using the bigger number, better it giving me an over price than an under-price.” (E15)

This quotation represented a common theme that arose during the second questionnaire/interviews. However, viewing the energy consumption in monetary value still held an increased attraction compared to other numerical values offered by the device.

Several users emphasised the need for an additional tariff input option within the monitors set up menu. Others favoured a more autonomous tariff selection system. One which set-up the occupants' tariff structure based upon selecting from a list of drop down menus of existing supplier and their tariffs.

8.2 Temperature

A number of interviewees professed a desire to have the indoor temperature displayed on the monitor so it could be compared with the heating being used, and in turn, how this reflects on cost:

“I was hoping to have some sort of figure for the inside temperature... I think this would be so handy to be able to see how the use of gas compares to the temperature going up and down. It would definitely of help over Christmas. And I guess when it starts getting really hot, it would let me see what a couple of degree difference could make.” (E12)

Temperature data from the properties had been recorded by the monitor but was not displayed to the occupants. However the collection of this data from within the device and its location in the dwelling showed no significant correlation between those properties with large differences in gas consumption over similar dwellings sizes, occupancy types etc. The use of this function and implementation within the monitoring regime requires further consideration and analysis.

If available, the presence of accurate temperature data might give an indication of the levels of occupant comfort in each dwelling.

8.3 Installation location

The Ewgeco monitor was installed as part of the building’s internal fabric, and was in-place before any of the occupants took up residence. Several participants noted that the monitor was installed in unsuitable and unsightly locations within the property. Most commonly, the device was installed in the middle of a large wall; these occupants valued the level of engagement required benefit from the device, however many of these had intentionally covered the device with picture or similar wall art.

Alternatively, the monitor was installed in a cupboard. Occupants with this set up emphasised that they wished to interact with the device more frequently, commenting that the device would better serve them if it was installed somewhere more prominent.

It should be noted that the Ewgeco device can be a fixed installation or mounted in a cradle, thus allowing it to be portable within the house. Results of this survey suggest that any real time display should be in a clearly accessible location for repeated interaction capabilities and also should be portable to allow home occupants to assess the effects of energy usage of devices/equipment in different locations.

8.4 Perceived complexity

A small portion of the interviewees indicated that the monitor was complex and overwhelming, and even intimidating. As a direct result, these participants expressed negative feelings about using the monitor.

“We don’t use it, we don’t know how to, the only thing we do is try to keep the thing out of the red and in the green, but we haven’t used it”. (E16)

This suggests that the end user requires a certain level of engagement from a medium or information source they can relate to before they will attempt to use the monitor’s full functionality.

The group that did not use the Ewgeco monitor had commented on how the monitor currently holds a low priority within their daily routine. An element of unfamiliarity surrounding the unit’s presence, plus ambiguity relating to its functions, intensions, and advantages; combined with the lack of engagement documentation served to intensify perceived complexity, which resulted in the monitor’s neglect.

8.5 MyEwgeco

The wireless technology enabling the transfer of household energy consumption data from the Ewgeco monitor to the online “myEwgeco” web portal was installed after the interviews had been conducted. This section summarises the participants’ perceptions of the “myEwgeco” web portal, and self-reported likelihood they would engage with its features.

The number of residents interacting with the myEwgeco application was lower than anticipated (only 4% by November 2010, and 12% by March 2011). However, the handful of residents who did explore the application tended to be very positive – particularly regarding the monetary information display.

- Only 4% of respondents had used the MyEwgeco portal by November 2010. The two respondents who had used it agreed that they found it easy to use, useful, and liked being able to access their information over the web;
- By the second survey the number of people stating that had used the MyEwgeco portal increased to 8 (12%). Again, all these respondents felt it was useful, easy to use, and agreed that they liked being able to access their information over the web.

Similar to the behaviour demonstrated by the users interaction with the Ewgeco monitor installed in their homes, the [£] icon was the first feature on the “myEwgeco” web portal that each of the tenants wished to explore. As a result, the users soon highlighted an obvious limitation to the way the existing myEwgeco application analyses and displays their consumption.

Their comments and suggestions were as follows:

- The need to input a value for two tariffs, both for those with tariffs with change depending on the first kWh’s used and for tariffs governed by times of the day
- The need to input and display information for those with a standing charge associated with their tariff

A number of factors which influenced this result, including:

- All three sites were new-build developments: although the occupants had the facility to obtain a broadband service, the vast majority had not acquired the service at that stage in the project;

- For various reasons, obtaining broadband or a computer was not one of their priorities;
- The desired broadband supplier was not yet available to them;
- A number of the residents did not possess a desire to explore the online portal, whereas they were simply content with the functionality and information provided to them by the dedicated graphic traffic light display;
- Few attempted to explore the features of the online portal.

9.0 Summary and Possible Future Development

9.1 Summary

Many of the households in the trial described how existing billing and methods of payment have served to distance end-users from controlling their electricity and gas consumption. Therefore, by allowing everyone in the home to see and quickly understand the electricity and gas being consumed, it became a prominent strategy to facilitate increased levels of awareness to wasted energy. Energy Display Devices provide real time information about the level of energy being consumed and attempts to provide exactly this type of service in order to help occupants to reduce levels of consumption.

Findings from the trial seem to suggest that early interaction with the Ewgeco monitor generates a certain level of learning and awareness of electricity and gas use which allows users to reinforce existing energy efficient behaviour whilst also providing them with instantaneous cost information relating to their actions. This, in-turn allows conscious and rational decisions to be made about energy use behaviour patterns and how they might be changed in the future.

Over the course of the trial, a second questionnaire noted that the level of interaction with the monitor had reduced and people tended to be less positive about the monitor. This might be because the initial optimism died down and many felt that they had learnt all they could from the device. However they still maintained a desire and level of dependency upon a dedicated display so to periodically refer to the device to act as support to reinforce the lessons that had originally learnt.

The findings from the consumption data, augmented with the results from the questionnaires and interviews suggests that people are becoming increasingly self-conscious with the use of electricity, however many more of the occupants with a Ewgeco energy monitor were able to benefit from having their gas consumption levels on display.

The majority of participants with a Ewgeco on display used the Ewgeco monitor in some capacity. Primarily the coloured traffic light display appeared to be the preferred medium by

which many of the users chose to engage with the monitor. Numerically, features showing energy use in terms of money were the most frequently reported figure as being useful.

Those who had experimented with more of Ewgeco's features were those who professed to being 'very computer literate', who had little trouble setting up and interacting with their homes heating system, and using advanced features within other electronic domestic appliances, but this was not specific to any one gender or age.

There was a tendency for support tenants and older people to be more interested in saving energy for environmental reasons, compared with non-support tenants, and younger people. Otherwise, there were no significant differences in how they rated the Ewgeco monitor.

Several of the participants described the device as a learning tool, as it had assisted them in identifying which habits and appliances were costing them the most money; enabling them to make informed decisions which allows them to take the actions they see necessary to reduce energy waste. This form of interaction with the monitor makes energy consumption increasingly relevant to everyday lifestyles.

The report has summarised how interaction with the Ewgeco monitor has impacted upon the awareness and usage level of electricity and gas consumption, further adding comment towards the limitations that the trial participants have perceived as preventing them from taking further action to engage fully with the monitor.

Although the sample size used in this study was small, it still provides a valuable insight into how occupants perceived and used the information presented to them concerning their gas and electricity consumption. Several practical recommendations suggesting improvements to the device have been documented and added to the list outlined in the first report, dated January 2011.

9.2 Areas for possible development

The study was conducted over a 6 month period, future work would seek to monitor and collect electricity and gas consumption data over an annual period taking into account the heating and cool seasons.

A larger, more diverse population sample would provide further insight into the topics covered by the interviews and questionnaires.

10.0 Acknowledgement

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11.0 Appendix

11.1 Feedback on user manual

During the time when the first interviews were being conducted (Nov 2010), the user manual was distributed to all the participants with a Ewgeco on display, the results below were collected during the second interviews (Mar 2011):

- Most respondents (66%) admitted they had not read the manual supplied with the Ewgeco monitor;
- Of the 16 respondents who had read the manual, all (100%) agreed it was easy to understand; 88% said it contained enough information;
- 31% of respondents who had read the manual said it was good at explaining what to do when they got an error message. Only 25% said that they were encouraged to try more features after reading the manual;
- 31% of respondents reported that the energy saving tips were helpful.

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