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| PP | Restricted to other programme participants (including the Commission Services) | |
| RE | Restricted to a group specified by the consortium (including the Commission Services) | |
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Executive Summary

The purpose of the project initiation survey is to create an initial understanding of the context into which the DEHEMS system is being deployed by surveying levels of understanding and attitudes of typical householders in relation to energy consumption and CO2 emissions of households and common household products. The survey is conducted using questionnaires with structured response format (multiple choices). 787 responses were received, all from UK participants, with the majority sample taken from Birmingham (614). The results of the survey is compared and verified against existing state of the art research in domestic energy consumerism, and provides better insight for conducting user surveys for the DEHEMS Living Labs.

Context

The survey provides information to support the initial requirements analysis and design of the initial prototype for cycle 1.

Deliverable

The deliverable is divided into 2 parts: (1) the document “results-survey 1 as at 2008-08-28.xls” containing the questions and the results from the survey done on 28th August 2008, with 787 responses, and (2) the analysis and the discussion of the survey, which is presented in this document.

Background

The objective of the survey is to obtain initial understanding of domestic energy consumerism in which the DEHEMS system is to designed and deployed. The survey is obtained through a questionnaire formatted for structured response (multiple choices and ranking). Table 1 summarizes the list of questions and the choices of answers posed during the survey. The survey itself was performed using SurveyMonkey[5], an online tool for survey authoring and response analysis.

Table 1. Summary of the questions and choices of answers.

| Questions | Answer choices |
|---|---|
| How important are environmental issues to you personally? | A. Extremely important B. Very important C. Quite important D. Slightly important E. Not important at all |
| How much have you changed your behavior in the last 3 years to reduce your impact on the environment? | A. A great idea; B. Quite a lot C. A little bit D. Hardly at all E. Not at all |
| How often do you recycle paper? | A. Never B. Occasionally |

| | |
|---|---|
| | <ul style="list-style-type: none"> C. Sometimes D. Regularly E. Often |
| How often do you recycle cardboard? | <ul style="list-style-type: none"> A. Never B. Occasionally C. Sometimes D. Regularly E. Often |
| How often do you recycle plastics? | <ul style="list-style-type: none"> A. Never B. Occasionally C. Sometimes D. Regularly E. Often |
| How often do you recycle glass? | <ul style="list-style-type: none"> A. Never B. Occasionally C. Sometimes D. Regularly E. Often |
| How often do you recycle metal/cans? | <ul style="list-style-type: none"> A. Never B. Occasionally C. Sometimes D. Regularly E. Often |
| Importance for individual people to change their behavior to reduce their impact on the environment? | <ul style="list-style-type: none"> A. Extremely important B. Very important C. Quite important D. Slightly important E. Not important at all |
| Responsibility for protecting the environment? Rank 1 to 4, with 1 being the most responsible and 4 being the least responsible. | <ul style="list-style-type: none"> UK Government European Union Private individuals Companies and organizations |
| Are you prepared to pay extra for items you buy if they are kind to the environment? | <ul style="list-style-type: none"> A. No B. Uncertain C. Yes |
| Spend an extra £100 on a new appliance today if it would save £200 over the next three years? | <ul style="list-style-type: none"> A. No B. Uncertain C. Yes |
| "If left on for 20 minutes, which of the following appliances do you think would use the most energy?" Rank 1 to 7, where 1 is the appliance that | <ul style="list-style-type: none"> Fridge freezer Washing machine |

| | |
|---|---|
| consumes the most energy, and 7 being the least. | <ul style="list-style-type: none"> Kettle Fan heater Gas central heating Microwave oven Television |
| How important is it to you to reduce your energy bill? | <ul style="list-style-type: none"> A. Extremely important B. Very important C. Quite important D. Slightly important E. Not important at all |
| Have you chosen a 'green' energy tariff from your electricity provider? | <ul style="list-style-type: none"> A. No B. Uncertain C. Yes |
| When would you decide to subscribe to a green tariff? | <ul style="list-style-type: none"> A. If it was cheaper B. If it was the same price C. If it was slightly more expensive |
| Speed of home Internet connection? | <ul style="list-style-type: none"> A. Dial up / Low speed B. Broadband / High speed C. I don't have an internet connection |
| How often do you shop or pay bills online? | <ul style="list-style-type: none"> A. Daily B. Weekly C. A few times a month D. Less than once per month E. Never |
| How often do you use a computer with Internet access? | <ul style="list-style-type: none"> A. Daily B. Weekly C. A few times a month D. Less than once per month E. Never |
| No adults in household? | <ul style="list-style-type: none"> A. 0 B. 1 C. 2 D. 3 E. 4 F. 5 G. 6 H. 7 |

| | |
|----------------------------|--|
| No children in household? | A. 0 B. 1 C. 2 D. 3 E. 4 F. 5 |
| Income category household | A. Less than £10 000 B. £10 001 - £20 000 C. £20 001 - £40 000 D. £40 001 - £80 000 E. More than £80 000 F. Prefer not to say |
| Where do you live? | A. Birmingham B. Bristol C. London D. Manchester E. Other |
| Interested in pilot study? | A. No B. Yes C. N/A |

Summary findings

Our observation and discussions are aligned along several areas; (A) environmental awareness of domestic consumers, (B) awareness of domestic energy consumption, (C) the use of internet in everyday lives, and (D) the demographics of the consumers surveyed.

A. Environmental awareness

- Respondents claim to attach a high level of importance to environmental issues and believe there is a need for individuals to change behavior. 93% of users responded “quite important”, “very important” and “extremely important”.
- Recycling appears to be widely adopted, though recycling of plastics and metals is less prevalent than paper, cardboard and glass. In average, around 80.8% of users tend to recycle (“often” and “regularly”).
- Responses suggest that UK government should take the bulk of responsibility for protecting the environment, closely followed by companies. Opinions were divided regarding the importance of individuals in this (in average, only 20% of users consider individuals play primary role in environment protection). The role of the EU was considered to be quite low.

- 42% users would be willing to incur additional costs in order to improve their impact on the environment, while 39.3% are uncertain of their stand. However, if actual cost savings is demonstrated, a marked increase (64.7%) in willingness is observed.
- Only 15.2% of users have moved to a “green” energy tariff, but a majority of users (67.3%) are willing to do so if there is no associated price increase.
- More than half (almost 53%) agreed to take part in future pilot study.

Discussion

- It is apparent that the domestic energy consumers that were surveyed have a high level of positive attitude towards an ecological behavior, as demonstrated by their motivation and willingness to recycle. However, the fact remains that although they are keen on environmental issues concerning energy use, a majority of them have not actually moved to a green tariff, and have shown uncertainty on their willingness to incur additional costs for improving their impact on the environment. This pattern of ecological behavior has been observed by Kaiser et. al.[1] who identifies the following three factors as the constraints for behavior change, which can also be attributed to the users that we surveyed:
 - Economic constraints, e.g. a person may not be able to afford new equipment and have to resort to buying second hand equipment, or the person may not be able to afford higher environmental-friendly energy tariffs.
 - Social pressure by family and friends, e.g. a person is discouraged from replacing energy inefficient equipment or making home improvements to improve the energy efficiency of their property
 - Lack of opportunity to carry out ecological behavior, e.g. a person may be interested to reduce their energy or carbon footprint but have no means of observing their own consumption.
- To successfully change the behavior of domestic consumers, it is clear that the technology has to take into account the three factors mentioned above, and the results of our own observations. The technology should not be overly expensive and should present the right amount of energy use information to the user, so that energy savings can be demonstrated for effective behavior change, and to attract the domestic community towards collective responsibility towards environment protection.

B. Awareness of domestic energy consumption

- There appears to be some confusion regarding the energy consumption levels of individual household items. Washing machine seems to be thought off as the highest consumer of energy (the list of appliances presented to users also include fridge freezer, kettle, fan heater, gas central heating, microwave oven and television).

Discussion

- Consumers tend to think that washing machine is the highest energy consumer. This observation is also supported (and validates) the study by Mansouri-Azhar et. al. [2] which concludes that a large majority of domestic energy users consider washing machine as the first, second and third most energy consuming appliance. In actual fact, lighting, fridge freezer and dishwasher are the top three energy consumers in the UK. Our observation also concurs with the study by Dennis et. al. [3] that states that consumers do not know the relative energy costs of the various energy using systems in their households. Meanwhile, to add to this observation, study by Baird and Brier [4] conclude that many people assume that the larger the volume of the appliance, the more energy it uses per hour!
- The fact that users have overlooked the fridge freezer in favor of the washing machine as the highest energy consumer further reaffirms that consumers do not have a clear basis for estimating the energy costs of appliances. Consumer ignorance has direct negative impact on prioritization of energy-saving actions. Therefore, information on actual consumption is most likely to be helpful in raising awareness on relative energy consumptions, especially information on appliance-level consumption.

C. Internet usage

- Whilst the majority of respondents have access to the internet on a daily basis, it was significant that 10% did not have internet access at home. Of those that did, the majority (87.3%) have broadband connection.
- 62% of the users tend to shop or pay bills online, from a few times a month, weekly and daily. A non-trivial 38% almost never do so. On the other hand, almost 85% of users tend to use the internet daily, while the numbers of those who hardly use the internet is negligible.

Discussion

- The Internet is critical for the success of any domestic energy monitoring system that require servers, and which would like to provide community-level participation. The fact that a high majority have broadband connection is a positive indication for such a system. Nevertheless, energy monitoring system which does local processing (instead of depending on remote servers) may also become a necessity, to include users from remote areas that are not catered for by broadband service providers.
- The frequency of internet use is also critical to indicate the level of internet literacy. Since it is observed that internet usage is pervasive, community level participation is likely. Users may be inclined to compare their own household's energy usage to that of their local community members, or against households with similar configurations. Comparisons and competitions may provide additional behavior change motivation.

D. Demographic

- Demographic results suggested that the majority of respondents lived in a house containing 2 adults, with a smaller number having 1 or 3 and very few having 4 or more, and 71% lived in households that did not contain children.

- Almost half (40.7%) of the respondents live in households having an income of £20,000-£40,000, with a slightly smaller number (34.2%) having £40,000-£80,000.
- Of particular note was that 10% of respondents preferred not to say what income brackets their household fell into, despite the fact that they could respond anonymously. This seems to indicate that a small but significant number are concerned about privacy issues. On the other hand, 410 respondents provided identification in the form of an email address.
- By far the largest number of respondents was from the Birmingham area.

Discussion

- The most interesting point of observation is on the income bracket in relation to the number of persons per household. The fact that a high number of users surveyed come from medium income category (£20 000 - £80 000) where most of them live in households without children may indicate that users may have the necessary resource to purchase new environment-friendly technology. However, it is important to keep in mind that most of these households appear to have shared income, therefore costs need to be contained and reasonably priced, while long term energy saving benefits must be demonstrated in terms of monetary profits.

Implications for other Work packages

The findings from the initial survey impact on the use cases and therefore the user requirements identified for Cycle 1, which in turn influences the design of the Cycle 1 prototype.

The lessons learned from this survey should influence the design of the instruments to be applied and observations to be made in the Cyce 1 living labs work.

Next Steps

The next steps are:

- to carry out a more detailed survey specifically with living labs participants at the beginning of the Cycle 1 living labs work in order to establish a baseline and to inform preparations for deployment/installation of the DEHEMS system
- to use this data to help plan for focus group events to be held in the middle of the Cycle 1 living labs run.

References

1. F.G. Kaiser, S. Wolfing and U. Fuhrer, Environmental attitude and ecological behaviour. *Journal of Environmental Psychology* 19 (1999), pp. 1–19.
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3. M.L. Dennis, E.J. Soderstrom, W.S. Koncinski and B. Cavanaugh, Effective dissemination of energy related information. *American Psychologist* 45 10 (1990), pp. 1109–1117.
4. J.C. Baird and J.M. Brier, Perceptual awareness of energy requirements of familiar objects. *Journal of Applied Psychology* 66 (1981), pp. 90–96.
5. Survey Monkey. Homepage at <http://www.surveymonkey.com>

Annex 1 - Survey Response Statistics

Survey Questions

| | |
|--|----|
| How important are environmental issues to you personally?..... | 13 |
| How much have you changed your behavior in the last 3 years to reduce your impact on the environment?..... | 13 |
| Recycle Paper | 13 |
| Recycle Cardboard..... | 13 |
| Recycle Plastics | 14 |
| Recycle Glass | 14 |
| Recycle metal/cans | 14 |
| Importance for individual people to change their behavior to reduce their impact on the environment? | 14 |
| Responsibility for protecting the environment? Ranking 1 | 15 |
| Responsibility for protecting the environment? Ranking 2..... | 15 |
| Responsibility for protecting the environment? Ranking 3..... | 15 |
| Responsibility for protecting the environment? Ranking 4..... | 15 |
| Are you prepared to pay extra for items you buy if they are kind to the environment? | 15 |
| Spend an extra £100 on a new appliance today if it would save £200 over the next three years? | 16 |
| If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 1 | 16 |
| If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 2..... | 16 |
| If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 3..... | 16 |
| If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 4..... | 17 |
| If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 5..... | 17 |
| If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 6..... | 17 |
| If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 7..... | 18 |
| How important is it to you to reduce your energy bill? | 18 |
| Have you chosen a 'green' energy tariff from your electricity provider? | 18 |
| When would you decide to subscribe to a green tariff? | 18 |
| Speed of home Internet connection? | 19 |
| How often do you shop or pay bills online? | 19 |
| How often do you use a computer with Internet access? | 19 |
| No adults in household?..... | 19 |
| No children in household?..... | 20 |
| Income category household | 20 |
| Where do you live?..... | 20 |
| Interested in pilot study | 20 |

Survey Results

How important are environmental issues to you personally?

| | |
|----------------------|------------|
| extremely important | 167 |
| very important | 327 |
| quite important | 244 |
| slightly important | 46 |
| not important at all | 3 |
| Total | 787 |

How much have you changed your behavior in the last 3 years to reduce your impact on the environment?

| | |
|---------------|------------|
| A great deal | 83 |
| quite a lot | 411 |
| a little bit | 251 |
| hardly at all | 33 |
| not at all | 9 |
| Total | 787 |

Recycle Paper

| | |
|--------------|------------|
| never | 23 |
| occasionally | 15 |
| sometimes | 38 |
| regularly | 669 |
| often | 42 |
| Total | 787 |

Recycle Cardboard

| | |
|--------------|------------|
| never | 48 |
| occasionally | 31 |
| sometimes | 53 |
| regularly | 601 |
| often | 54 |
| Total | 787 |

| Recycle Plastics | |
|-------------------------|------------|
| never | 115 |
| occasionally | 47 |
| sometimes | 72 |
| regularly | 491 |
| often | 62 |
| Total | 787 |

| Recycle Glass | |
|----------------------|------------|
| never | 45 |
| occasionally | 30 |
| sometimes | 43 |
| regularly | 626 |
| often | 43 |
| Total | 787 |

| Recycle metal/cans | |
|---------------------------|------------|
| never | 99 |
| occasionally | 40 |
| sometimes | 57 |
| regularly | 536 |
| often | 55 |
| Total | 787 |

| Importance for individual people to change their behavior to reduce their impact on the environment? | |
|---|------------|
| extremely important | 315 |
| very important | 322 |
| quite important | 120 |
| slightly important | 29 |
| not important at all | 1 |
| Total | 787 |

**Responsibility for protecting the environment?
Ranking 1**

| | |
|-----------------------------|-----|
| UK Government | 257 |
| European Union | 144 |
| private individuals | 225 |
| companies and organisations | 161 |

Total **787**

**Responsibility for protecting the environment?
Ranking 2**

| | |
|-----------------------------|-----|
| UK Government | 246 |
| European Union | 114 |
| private individuals | 140 |
| companies and organisations | 287 |

Total **787**

**Responsibility for protecting the environment?
Ranking 3**

| | |
|-----------------------------|-----|
| UK Government | 249 |
| European Union | 108 |
| private individuals | 142 |
| companies and organisations | 288 |

Total **787**

**Responsibility for protecting the environment?
Ranking 4**

| | |
|-----------------------------|-----|
| UK Government | 35 |
| European Union | 421 |
| private individuals | 280 |
| companies and organisations | 51 |

Total **787**

**Are you prepared to pay extra for items you
buy if they are kind to the environment?**

| | |
|-----------|-----|
| No | 143 |
| Uncertain | 310 |
| Yes | 334 |

Total **787**

Spend an extra £100 on a new appliance today if it would save £200 over the next three years?

| | |
|-----------|-----|
| No | 74 |
| Uncertain | 204 |
| Yes | 509 |

Total 787

If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 1

| | |
|--------------------------------|-----|
| Fridge freezer | 9 |
| Washing machine (on hot cycle) | 141 |
| Kettle | 142 |
| Fan heater | 299 |
| Gas central heating | 134 |
| Microwave oven | 35 |
| Television | 27 |

Total 787

If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 2

| | |
|--------------------------------|-----|
| Fridge freezer | 29 |
| Washing machine (on hot cycle) | 222 |
| Kettle | 136 |
| Fan heater | 199 |
| Gas central heating | 111 |
| Microwave oven | 72 |
| Television | 18 |

Total 787

If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 3

| | |
|--------------------------------|-----|
| Fridge freezer | 63 |
| Washing machine (on hot cycle) | 210 |
| Kettle | 107 |
| Fan heater | 133 |
| Gas central heating | 125 |
| Microwave oven | 93 |
| Television | 56 |

Total 787

If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 4

| | |
|--------------------------------|------------|
| Fridge freezer | 95 |
| Washing machine (on hot cycle) | 142 |
| Kettle | 99 |
| Fan heater | 67 |
| Gas central heating | 136 |
| Microwave oven | 165 |
| Television | 83 |
| Total | 787 |

If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 5

| | |
|--------------------------------|------------|
| Fridge freezer | 161 |
| Washing machine (on hot cycle) | 51 |
| Kettle | 79 |
| Fan heater | 52 |
| Gas central heating | 118 |
| Microwave oven | 168 |
| Television | 158 |
| Total | 787 |

If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 6

| | |
|--------------------------------|------------|
| Fridge freezer | 209 |
| Washing machine (on hot cycle) | 16 |
| Kettle | 79 |
| Fan heater | 25 |
| Gas central heating | 82 |
| Microwave oven | 153 |
| Television | 223 |
| Total | 787 |

If left on for 20 minutes, which of the following appliances do you think would use the most energy? Ranking 7

| | |
|--------------------------------|-----|
| Fridge freezer | 221 |
| Washing machine (on hot cycle) | 5 |
| Kettle | 145 |
| Fan heater | 12 |
| Gas central heating | 81 |
| Microwave oven | 101 |
| Television | 222 |

Total 787

How important is it to you to reduce your energy bill?

| | |
|----------------------|-----|
| extremely important | 368 |
| very important | 291 |
| quite important | 114 |
| slightly important | 11 |
| not important at all | 3 |

Total 787

Have you chosen a 'green' energy tariff from your electricity provider?

| | |
|-----------|-----|
| No | 393 |
| Uncertain | 274 |
| Yes | 120 |

Total 787

When would you decide to subscribe to a green tariff?

| | |
|-----------------------------------|-----|
| If it was cheaper | 172 |
| If it was the same price | 530 |
| If it was slightly more expensive | 85 |

Total 787

Speed of home Internet connection?

| | |
|---|------------|
| Dial-up/low speed | 27 |
| Broadband/High speed | 687 |
| I don't have an internet connection at home | 73 |
| Total | 787 |

How often do you shop or pay bills online?

| | |
|--------------------------|------------|
| Daily | 27 |
| Weekly | 173 |
| A few times a month | 288 |
| Less than once per month | 179 |
| Never | 120 |
| Total | 787 |

How often do you use a computer with Internet access?

| | |
|--------------------------|------------|
| Daily | 668 |
| Weekly | 82 |
| A few times a month | 30 |
| Less than once per month | 2 |
| Never | 5 |
| Total | 787 |

No adults in household?

| | |
|--------------|------------|
| 0 | 1 |
| 1 | 140 |
| 2 | 473 |
| 3 | 104 |
| 4 | 53 |
| 5 | 11 |
| 6 | 4 |
| 7 | 1 |
| Total | 787 |

| No children in household? | |
|----------------------------------|------------|
| 0 | 559 |
| 1 | 111 |
| 2 | 94 |
| 3 | 17 |
| 4 | 5 |
| 5 | 1 |
| Total | 787 |

| Income category household | |
|----------------------------------|------------|
| Less than £10,000 | 11 |
| £10,001 - £20,000 | 76 |
| £20,001 - £40,000 | 320 |
| £40,001 - £80,000 | 269 |
| more than £80,000 | 41 |
| Prefer not to say | 70 |
| Total | 787 |

| Where do you live? | |
|---------------------------|------------|
| Birmingham | 614 |
| Bristol | 7 |
| London | 19 |
| Manchester | 20 |
| Other | 127 |
| Total | 787 |

| Interested in pilot study | |
|----------------------------------|------------|
| No | 205 |
| Yes | 416 |
| N/A | 166 |
| Total | 787 |