UX RESEARCH ON

ENERGY USAGE AT HOME

Team Members:
Lesley | Amit | Isaiah | Ritika | Edel



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TEAM BIOGRAPHIES



Edel Murphy

Edel comes from a business background having received a BSc Business Studies and a MSc Strategic Management and Planning and is currently working in the telecommunications industry as a Risk Manager, embedding a risk aware culture across the organisation. Previous experience from her 15 plus years' work history in varied managerial and transformation roles include people management; incorporating team building and conflict management, project and change management; ranging from department to organisational level initiatives, and process framework implementation & process improvement; involving data analysis and key strategic direction identification utilising various methods including Lean Six Sigma approach.



Lesley Anne Quinn

Lesley began her career with a brief stint in a garda station (office, not cells).....followed by 15 years in a number of roles within the insurance industry. Reducing working hours to suit family life, she subsequently decided to attend university as a mature student studying entrepreneurship, software development and currently, design innovation. Her varied interests include technology, iot, ecommerce, web development and digital marketing, helping small medium business to get online and reach a wider audience. Ideally, Lesley will become a digital/business nomad, take her nose out of her laptop every now and then and travel the world.



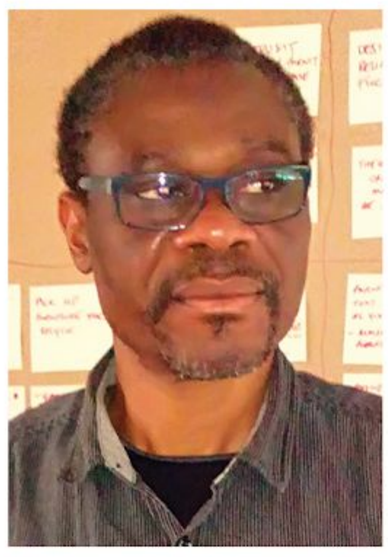
Amit Kumar Nayak

Amit is a recent Industrial Design graduate, specialising in product design. With a brief span of time working as a user experience designer in India, continues his further studies in Design Innovation. Amit has experience in user centred design, 3D modelling and photography. Although still young in his professional career, Amit has acquired experience in working with a wide range of projects both academically and professionally. With a knack for technology, he is always looking forward to designing better user experience to create things that matter. His work has a profound connection with research and delights in finding out imaginative solutions to complex problems.



Ritika Negi

Ritika is a design enthusiast with a specialising in user experience design having 4 years of industry experience with a bachelors degree in commercial arts/Graphic design and at present pursuing her master's degree in Design Innovations at Maynooth University. Her key skills include adobe creative suite, Invision, Sketch. Currently working with an automobile software company on creating a user-friendly digital platform for carsharing systems in Dublin. Her primary interests include travelling to different places a, exploring new things and reading medium. She aims to become a better designer and problem solver for the world using design thinking skills.



Isaiah Ikhimioya

Isaiah Ikhimioya is a designer specialising in Product, Furniture Design, Architecture and Timber Frame Design, He has a BA Honours in Creative Design. Since arriving in Ireland, he has worked with Century Homes and some Architectural Services Companies. Isaiah has acquired a long-term experience from working in different projects including the Remodeling of Central Reception Room, Pathology Department Sligo General Hospital, Interior Design and Architecture. He is passionate about delivering a user centred, effective and cost-effective service. His aims are to bring to life your ideas and visions, to suit your needs and those of your valued clients. Currently, he is in the process of starting his own company.

INTRODUCTION

INTRODUCTION

Among the significant problems, Europe is facing today are the failure to control increased energy consumption and the associated increase of greenhouse gas emissions. In response to this, the European Union has set a target to reduce its annual energy consumption and emissions by 20 percent by the year 2020 through a replacement to sustainable energy sources.

Under the Renewable Energy Directive Ireland has set a target of producing 16 percent of all its energy needs from renewable energy sources by 2020. Between 2005 and 2014 the percentage of energy from renewable energy sources grew from just 3.1 percent to 8.6 percent of total final consumption. By 2020 Ireland has a target of producing 42.5 percent of its electricity needs from renewable electricity; CSO have reported this has reached 22.7% in 2014.

In Ireland, as per our research, close to 26 percent of energy goes to residential homes. The household energy consumption in the form of electricity is highly reliant on residents' energy consuming behaviours. Timely feedback on the user's household energy consumption and a form of energy saving advisory is the key to energy saving. In this report, we will primarily focus on the user experiences, people's functional, emotional and quality requirements while managing household energy consumption. . For people interested in energy savings, lack of information is one of the leading issues, as they don't have clear and proper knowledge in this regard. People must understand the need of managing their energy consumption regarding what they are spending on. These differences are essential in understanding the behaviour of consumer buying market products and their psychology behind managing their whole energy consumption system at home.

The other research areas covered in this report along with our primary focus are, developing a smart innovation technology for managing household energy usage, Informing people about how they can plan their home architecture for reducing energy wastage, as it plays an essential role in overall consumption. Also understanding the need for generating their electricity at home, and the use of more sustainable resources. By generating own electricity using clean technology, users will be insulated from power price rises and also help to reduce Ireland's contribution to climate change. Users may even be able to sell electricity back to the power companies. In remote areas, where connections to the local lines can cost tens of thousands of dollars, generating self-power is likely to be the least expensive option both for upfront and ongoing costs. We can use our research to help everyday people to make use of most of the energy they are paying for, in their daily life and reduce the wastage.

The relationship between the case study and the research problem highlighted makes perfect sense as it saves money, reduces the carbon footprint and helps everyone lead the fight against climate change. The focus is on how to understand better the concept of con-

PURPOSE

This project focuses on the thematic area of energy, specifically domestic energy and looks to address how people manage their consumption in terms of what they are paying. The identified problem is the cost of energy and the ability of users to manage their usage levels in an effort to influence that cost. There are many factors which influence this problem including our basic need for energy, the impacts of traditional energy sources and plans to change these significantly, and existing energy efficiency measures ranging from architecture through to smart technology used on a daily basis.

METHODOLOGY

Having decided on the general thematic area of energy, secondary research in agreed subtopics was conducted to identify the key area of focus and define the final research questions. Primary research, both qualitative and quantitative, was used to understanding our target audience's key requirements and evaluating our final concept proposal.
Secondary research in the form of an extensive literature review provided a broad understanding of the energy industry and led to a focus on domestic energy consumption.
Primary research was conducted through targeted semi-structured interviews and distribution of a multi faceted culture probe, both providing valuable input into the emotional goal modelling and statement,
Emotional goal models were created based on the data from our primary research identifying key requirements for our audiences and led to the creation of an emotional goal statement used as a basis for the brainstorming.
Post concept development, comparative surveys were used to gauge users perceptions of the concept against existing options based on the identified variables in the emotional goal model.



SECONDARY RESEARCH

LITERATURE REVIEW FINDINGS

Psychology and Behaviours

Maslow's hierarchy of needs identifies energy as one of the basic, physiological needs which are "the most important.....[and a] major motivation. [When] gratified [they] cease to exist as active determinants.....[but] may emerge again.....if they are thwarted "(Maslow, 373 - 375). Giuliani, 2016 suggests how the bond identified in attachment theory can relate to places, such as the home, where energy is an integral component, and Darwin's evolution of emotion calls out how emotions motivate you to respond. Combining these and applying to domestic energy supply suggests the level of awareness and consideration is heightened if broken, or should it threaten another physiological need through high bills, and the emotion aroused as a result can motivate consideration of alternatives to eliminate similar events in future.

Focusing specifically on the domain of domestic energy use, interest in monitoring a consumer installed In-Home Displays (IHD) conveying energy consumption levels, was found to wain with users sometimes struggle to make sense of the specific monetary savings made (Buchanan et al, 2014).



Image: house showing energy usage

Hargreaves et al, 2013 express similar findings in a study of households and smart energy monitors finding they faded into the background, failed to increase knowledge of consumptions, fail to motivate a user to reduce levels, and, can cause householder to limit their conservation effort due to an absence of wider policy and market support. Goncalves Da Silva et al, 2011, conducted an online survey aimed at residential energy consumers where over 90% of respondents expressed a preference for a better overview of their energy consumption.

Energy Consumption

Climate change, the impacts of which are "global in scope and unprecedented in scale" (un.org, 2017), has forced a heightened awareness around energy consumption due to the link between burning fossil fuels and significant increases in greenhouse gases (GHG). In Ireland, the domestic sector is the third largest emitter of energy-related GHG emissions (DCCAE, 2015) and under the Renewable Energy Directive a target of producing 16% of all energy from renewable sources by 2020 is now in place.

Energy consumption levels for domestic users are continuing to increase due to population growth and the ever increasing standards of living and expected comfort levels (Anon, 2018) and is reflected in the expected 60% increase in electricity requirements to towns and cities by 2025 (Grid 25). According to Iana Vassileva 2012 (School of Sustainable Development of Society and Technology Report) domestic energy consumption is

highly dependent on the behaviour of the inhabitants and a deficiency in information on the levels of consumption is a significant barrier to those looking to save energy.



Image: Light bulb representing electricity usage.

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New and Emerging Technology

The fast pace of technology development and the fourth industrial revolution of digitisation have created an environment where extensive options are currently available to consumers to monitor and manage energy consumption. As Koskela points out "everyday objects and devices at home can be networked to give the inhabitants new means to control them" (2004).

This evolution can be seen from the transition of thermostats from those with slider bars, dials and analog displays to full touch screen interfaces (Peffer et al, 2011) to fully integrated devices with the purpose of reducing energy use like solar powered wireless keyboards or shower smart meters.
Further examples include owl electricity monitor, providing detail on what electricity use is costing throughout the day, window sensors advising if not closed, standby power saver lead, cutting power to appliances rather than using energy in a standby mode and heating remote controls like Hive and Nest, controlled from your smartphone to reduce energy waste, they learn your habits and automatically adjust temperatures to suit. Some of these heating controls / apps are intuitive and can adjust to optimal temperature based on the weather, by adopting 'If this then that technology (IFTTT)' . Linden Tibbets of IFTTT refers to three layers in the process of connectivity - connecting objects for novelty; building up the ecosystem around devices; and, the third layer of intelligence across the internet of things. "It's about giving people control over services and devices they use every day," he says. "In the physical world we have a kind of intuitive understanding of objects around us and are constantly modifying those for our needs, so there's an intuitive control we're after in the digital age, and that's especially important as those two are on a collision course to merge." (Kiss, 2014).
Smart meters are to be rolled out across Ire



Image: New Technology for smart homes.

land in a phased approach commencing 2019 (CER, 2017). These meters are expected to provide three primary information channels – In Home Display, easy and real time access to energy consumption detail, Smart Bill, periodic bill and energy usage explanation, and Downloadable File, web based interface to access non real time information (ER Smart Metering HLD, 2014).

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Home Architecture and Efficiency

There is a growing trend towards green buildings which are designed not only to reduce energy consumption by owners once installed, but also look to reduce energy utilised throughout construction (Shoubi et al., 2018). In 2013, the International Energy Agency (IEA) carried out a report titled Technology Roadmap; Energy efficient building envelope. The report identifies the building envelope as the primary thermal barrier between external environment and the interior of the building and that this building envelope includes "external walls, floors, roofs, ceilings, windows and doors [and] is critical in determining how much energy is required for heating and cooling" (IEA, 2013 Pg.7). Shoubi (2018) calls out that each of the building components has a role in thermal dissipation and encourages efforts to improve the quality of those components to reduce energy consumption within the building.



Image: House Architecture blue print.

Where an individual is considering an extensive remodel or for the construction of a new home, Shoubi (2018) states that a 'whole house systems approach' is required in order to optimise the energy efficiency of the building and could include components such as cool roofs, using highly reflective material to limit sunlight absorption and keep the home cool, and solar panels for absorbing heat and converting to energy.

Supply & Sustainability

Ireland's Transition to a Low Carbon Energy Future (2015) is the government strategy to secure energy supplies and meet the EU energy targets through to 2030 and focuses on improving energy efficiency at both domestic and industry levels and increasing the use of renewable energy sources.

Energy suppliers in the market have increased over the last 10 years, particularly with the introduction of pay as you go energy and all are bound by the CER Supplier Handbook (2017). 'Energy Poverty', whereby >10% of a household's income is spent on energy, is a concern which is driving the competitiveness of supply, particularly the ease of switching supplier to capitalise on cheapest prices (DCCAE, 2018). The Commission for Regulation of Utilities (CRU) Switching Report (2017) shows that approximately 25,000 electricity and 10,000 gas customers are switching on a monthly basis by providing their new supplier with some key detail to process.



Image: Solar Energy Panel.

Motivation for consumer electricity generation, using clean technology is greater than ever (Generating your own electricity Sustainable Homes Ireland, 2018). The transition to low carbon energy strategy (2015) includes a focus on electricity storage at both grid and consumer level which will improve the options for individual electricity generators to sell their surplus power to suppliers. Benefits of self-generation are improved cost effectiveness, guaranteed connection and supply, and positive environmental impacts through the reduction of GHG emissions (Generating your own electricity Sustainable Homes Ireland, 2018).

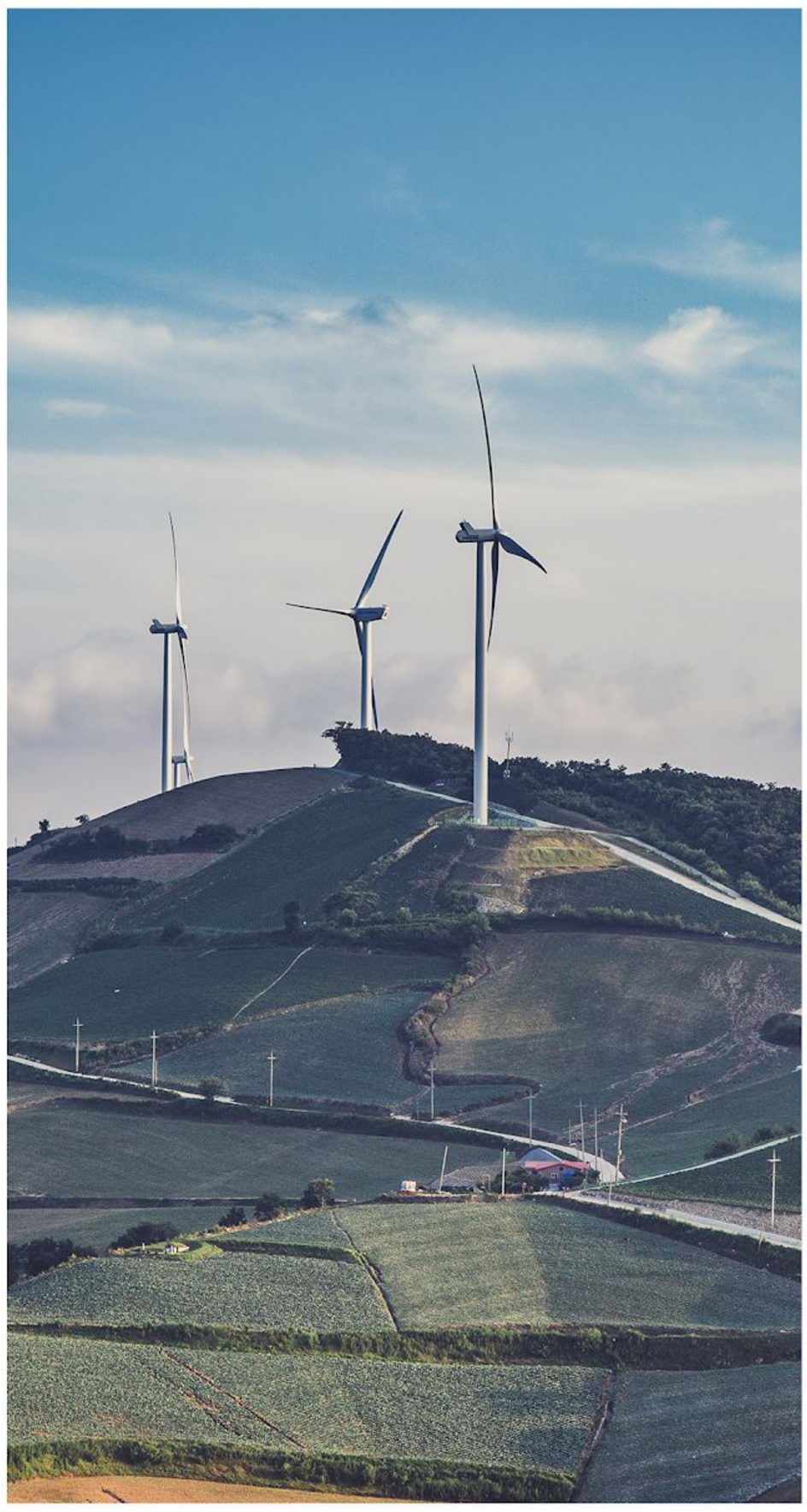


Image: Wind mill for electricity production.

PROBLEM STATEMENT

This detailed understanding of the existing situation in our chosen areas of focus resulted in the final definition of our research question and problem statement which directed the primary research which followed.

"How do people feel about, and when, they are interacting with their home energy systems?"



Image: Man Switching Off the electricity button

PRIMARY RESEARCH



What would you like to see in your bill?

An Electric Ireland bill contains 15 main details.

Please look at the re-creation below and cross out any sections you feel are useless in the current layout & amp; provide any details you can on why.

Maynooth University
National University of Ireland Maynooth



Do you ever compare prices among competitors?
Yes
No

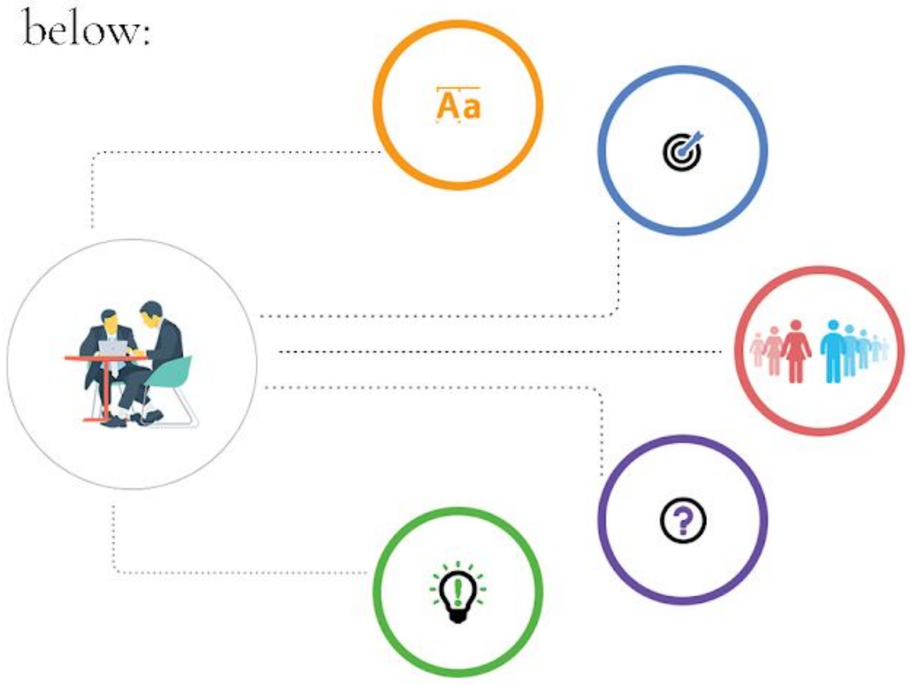
FLO GAS
Panda POWER
GREEN IS NOW
electric ireland
PINERGY
sse Airtricity
Bord Gáis Energy
PREPAY POWER.ie
just energy

Have you switched provider in the last two years?
Yes
No

INTERVIEWS

Two methods of primary research were utilised - interviews and a culture probe, with the expectation of creating an emotional goal model which would inform the final concept.

Interviews were conducted in order to probe participants on their energy consumption habits and requirements in the home. As suggested by Boyce and Neale (2006) an interview protocol was defined as per the list below:



Interview Process

Format - semi structured carried out with non formal approach
Target interviewees - homeowners responsible for paying bills who utilise non renewable energy sources was agreed.
Volume - equal split of two interviews per person to be conducted,
Topic Guide - focusing both the current situation and a preferred future state, the questions related to functional, emotional and quality aspects of managing energy consumption in the home. See appendix 1 for Topic Guide.
Interview Record - Interview audios recorded and transcribed.

In total eight interviews were conducted across multiple age groups, family circumstances (inhabitants and income) and rural/urban setting. Further probing naturally occurring during the interviews explored sources of interviewees energy, appliances and control mechanisms.

Interview data analysis involved a number of steps:-

Transcription
Each interview was transcribed and shared among the group, (see Appendix 2 for sample interview transcriptions).

"Well on some of the radiators we have a temperature valve which we can adjust on some of the rooms that we use infrequently, like for my wife's painting/sewing room which isn't used for five hours a day, so it doesn't have to be twice as warm as the sitting room or what we refer to as our den, our office, which is the room we use most in the evenings and where you would have a higher temperature to be warmer."

Current State - Do - Functional

"Oh.. in the future as said I will like to try get switches on most appliances so that I can turn them off they are not left on power standby that will save some money. Of course if one had the money you will have the smart home but dream on .. Em... I would like to have alternative sources of energy in my house. I would like to have Solar energy now we do have a back boiler which does heat the water and the radiators a bit but then that is quite an expensive way of doing it as well. So will like to look into Wind energy as well and I like to

Preferred State - BE Qualitative

"I feel like I'm giving even more back and would feel like I'm more educated and that you can pass that knowledge onto other people about how it all works"

"Relaxed and satisfied; Relaxed in that it is stress free; And satisfied in that I am managing the energy in my home without creating a huge carbon footprint and taking responsible for the environment."

Future State - Emotional FEEL

Data Clustering

Insights extracted from each interview and clustered together based on subject

Thematic Analysis

Specific themes identified based on individual clusters, as follows:

- General awareness of energy consumption.
- Cost evaluation and bill awareness.
- Improvisations or adaptations made by individuals in an effort to reduce costs.
- Active effort involved and expected in managing energy use.
- Future state, specific to desired future developments.



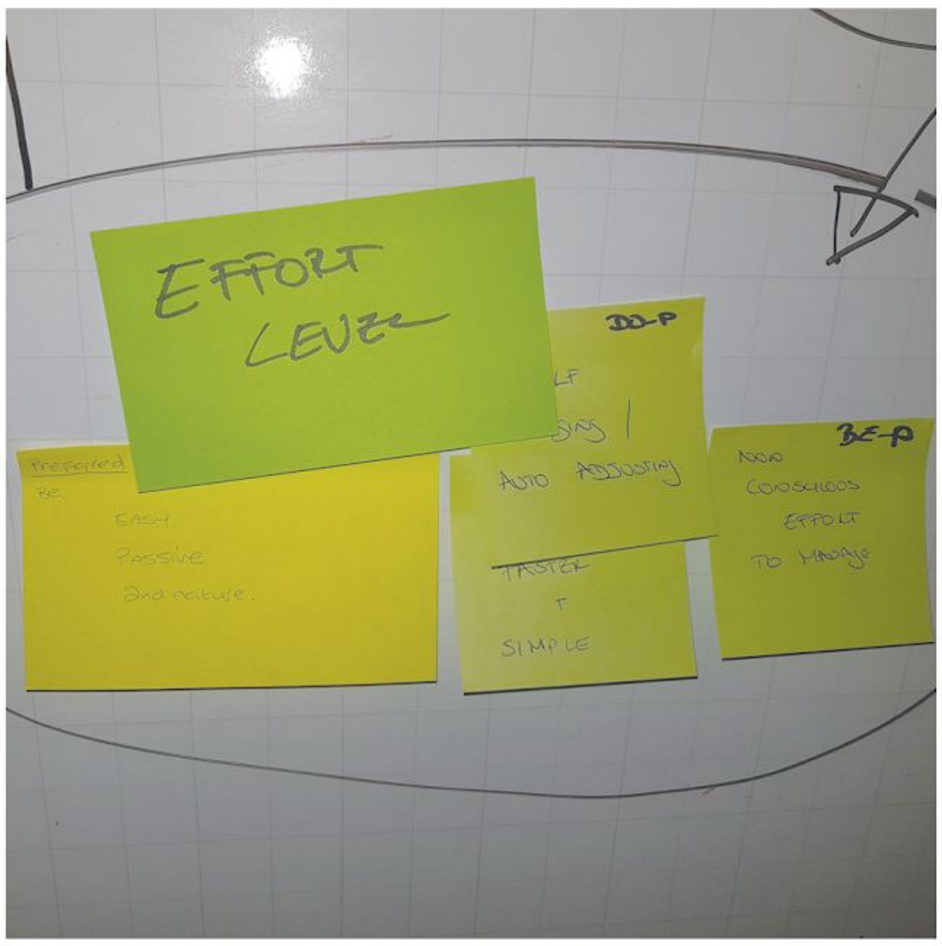
Interview data cluster



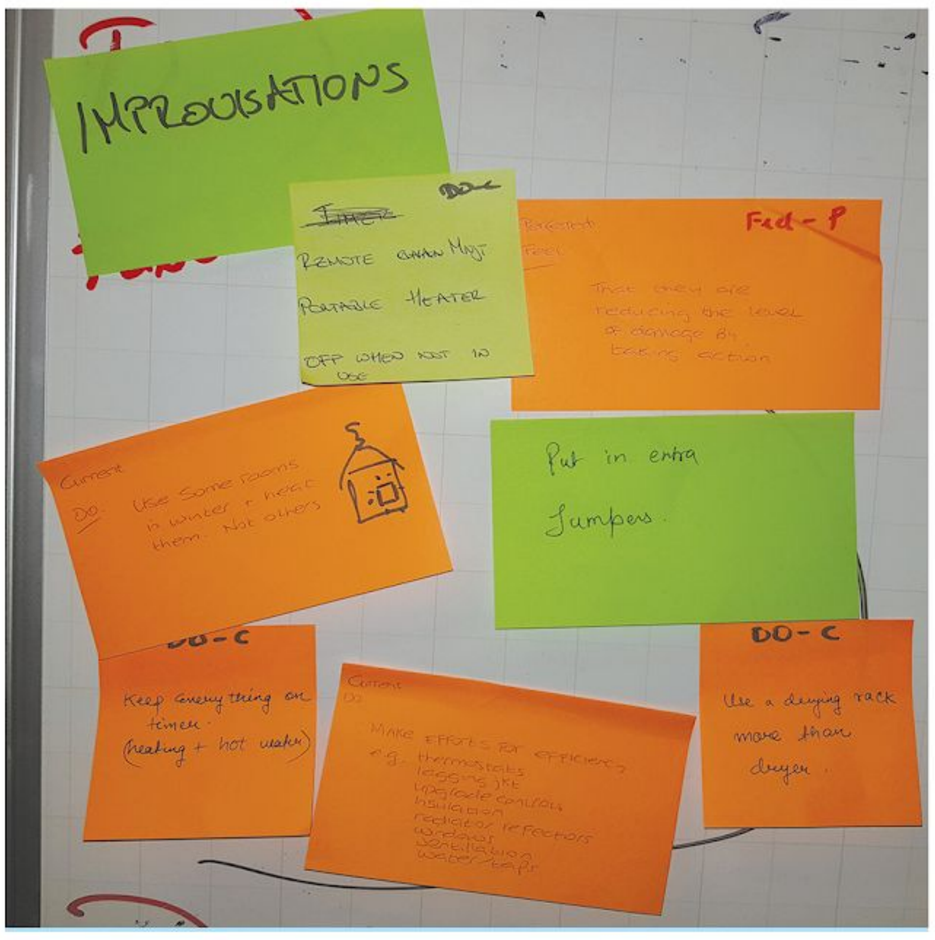
Cost evaluation & bill awareness



General awareness



Active Effort



Improvisations/ Adaptations

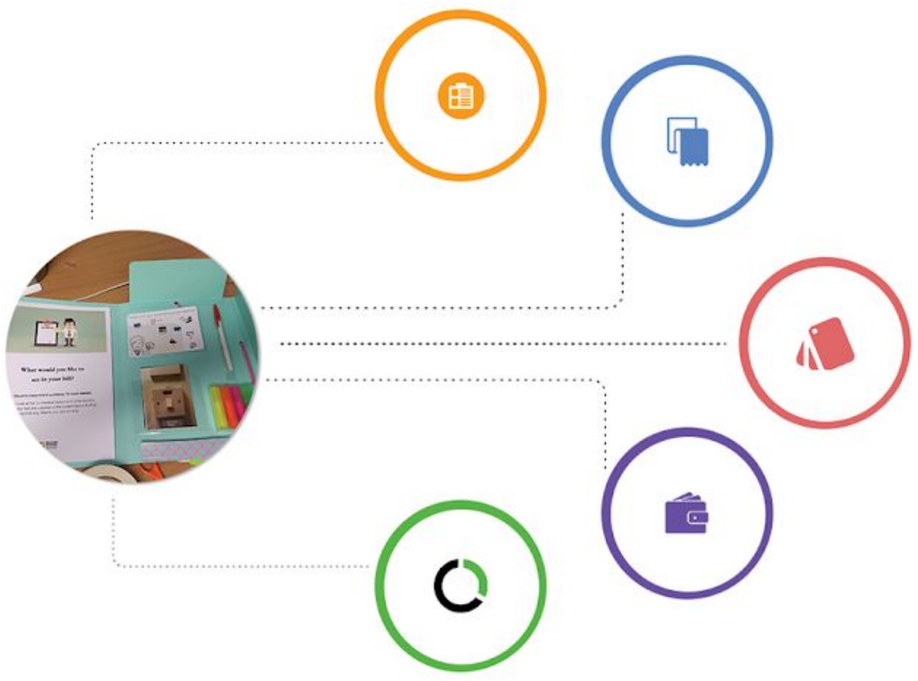


Future state

The qualitative data discovered through our interviews was used both as a primary input into our Emotional Goal Model and also informed the target areas for the culture probe to gain a deeper level of understanding around energy consumption in the home.

CULTURAL PROBES

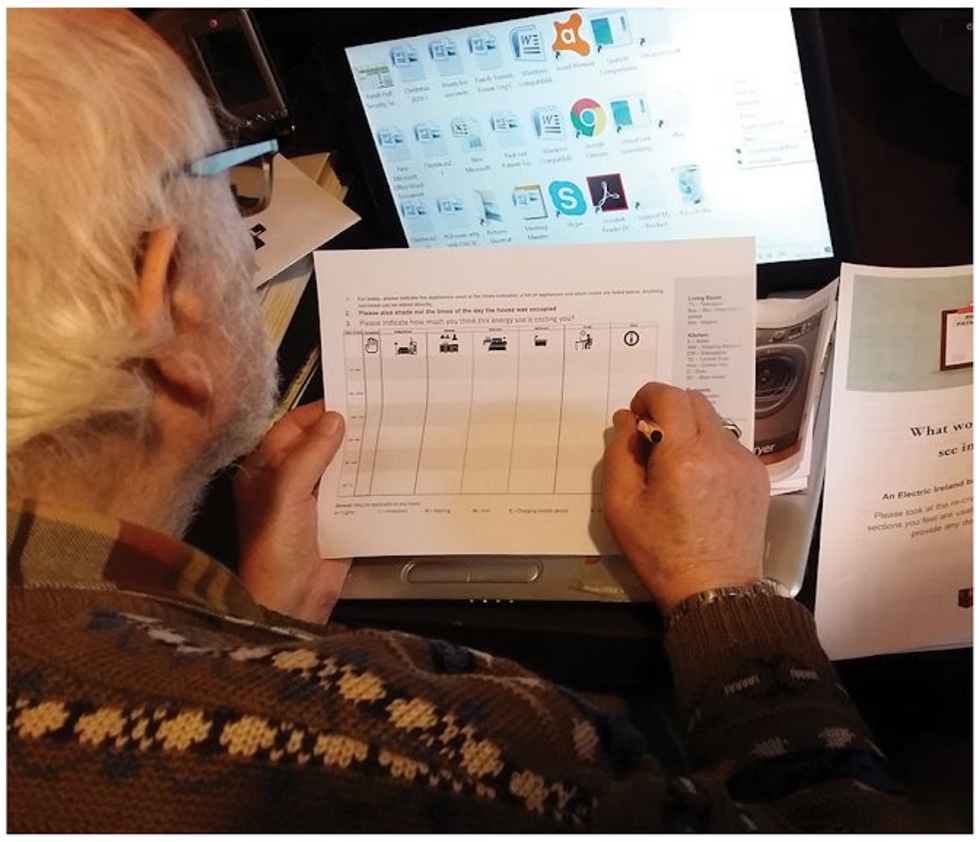
"Probes are collections of evocative tasks meant to elicit inspirational responses from people—not comprehensive information about them, but fragmentary clues about their lives and thoughts."(Gaver et al., 2004)

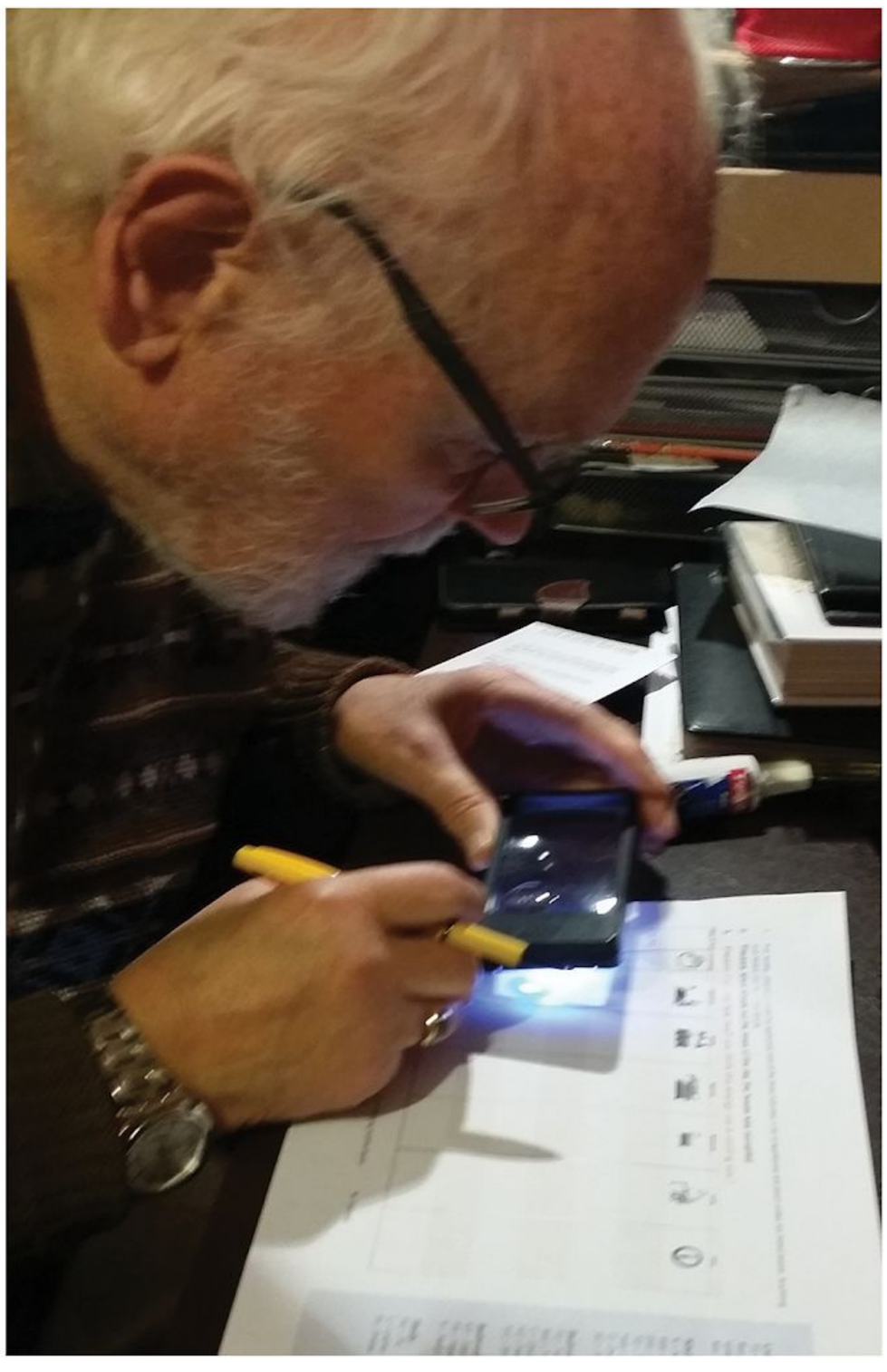


Cultural Probe elements

Questionnaire- Infographic sheet of paper with questions regarding energy costs and preferred method of payment.
Sample bills- A re-created sample energy bill handed out to participants.
Card Sorting- A card game designed for participants to test out their intuition of energy consumption at home.
Spending Sample- Participants were handed out cards and asked how much they think are spending on each appliamce.
Usage Record- Participants recorded their home energy usage according to tiime of the day.

The qualitative data discovered through our interviews was used both as a primary input into our Emotional Goal Model and also informed the target areas for the culture probe to gain a deeper level of understanding around energy consumption in the home.





The final culture probe was the result of a number of initial considerations and various iterations to hone the contents. It consisted of five elements each with a specific goal, which participants were asked to complete over a three day period. Activities (elements) were questionnaire, sample bills, card sorting, spending sample and usage record.

DAY 1- General awareness and cost information

QUESTIONNAIRE

We enquired as to the preferred payment methods (debit card, direct debit, post office, standing order, credit card, top up cards, cash, paypal). Additionally, we enquired as to whether price comparisons were made or switching provider had occurred within the previous two years. A question was posed on the timing of payment - early, on-time, later, and the regularity of their payments. Finally, recipients were asked to complete a short question on how they felt regarding the cost of energy.

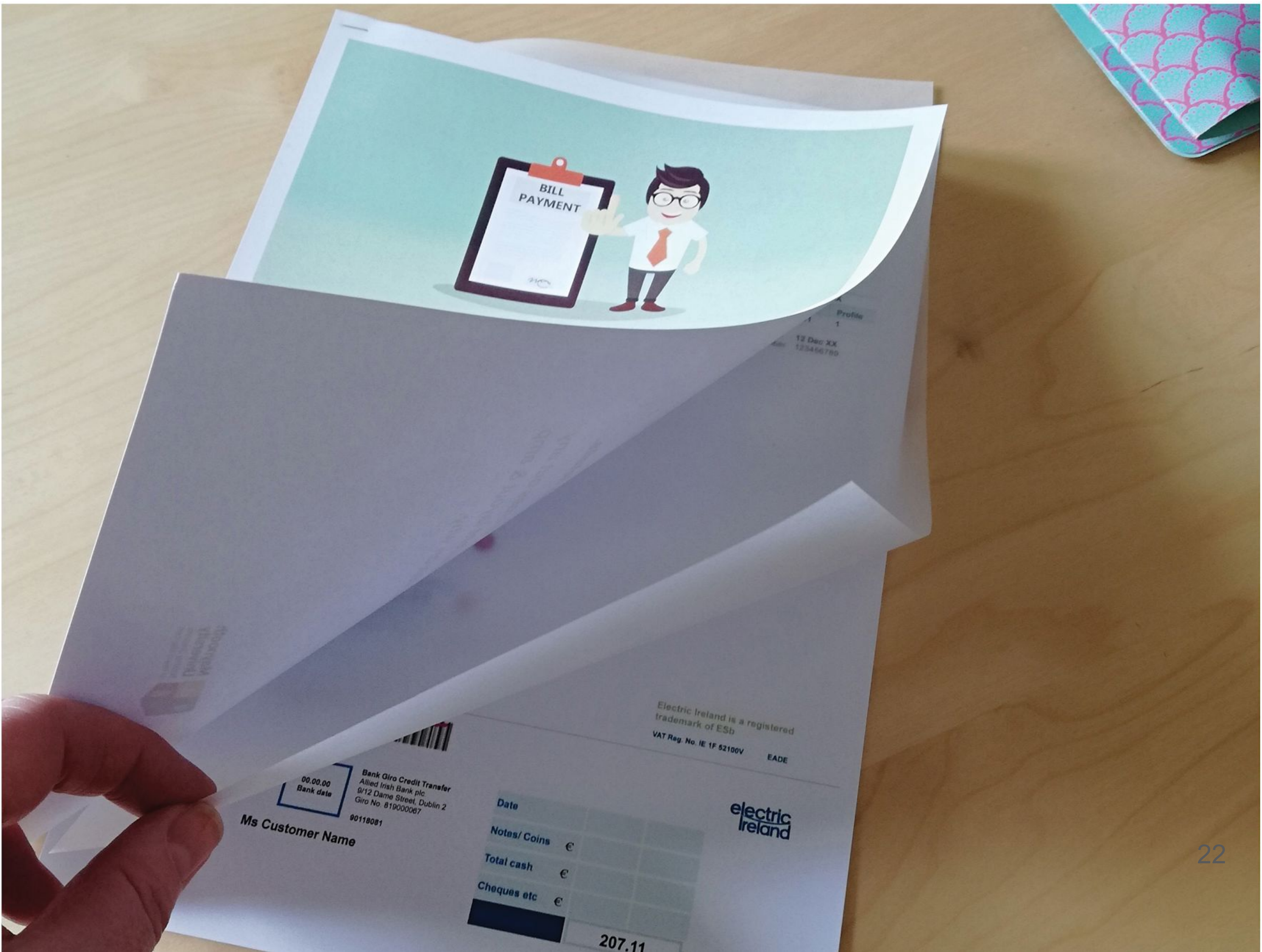
Goal: To gather basic information on the participants energy supply, source and payment.



SAMPLE BILL

Sourcing information on unnecessary information contained in the bill and on the information they would prefer to see to identify spending habits / practices and awareness in order to empathise with customer.

Goal: To identify spending habits / practices and awareness in order to empathise with customer.

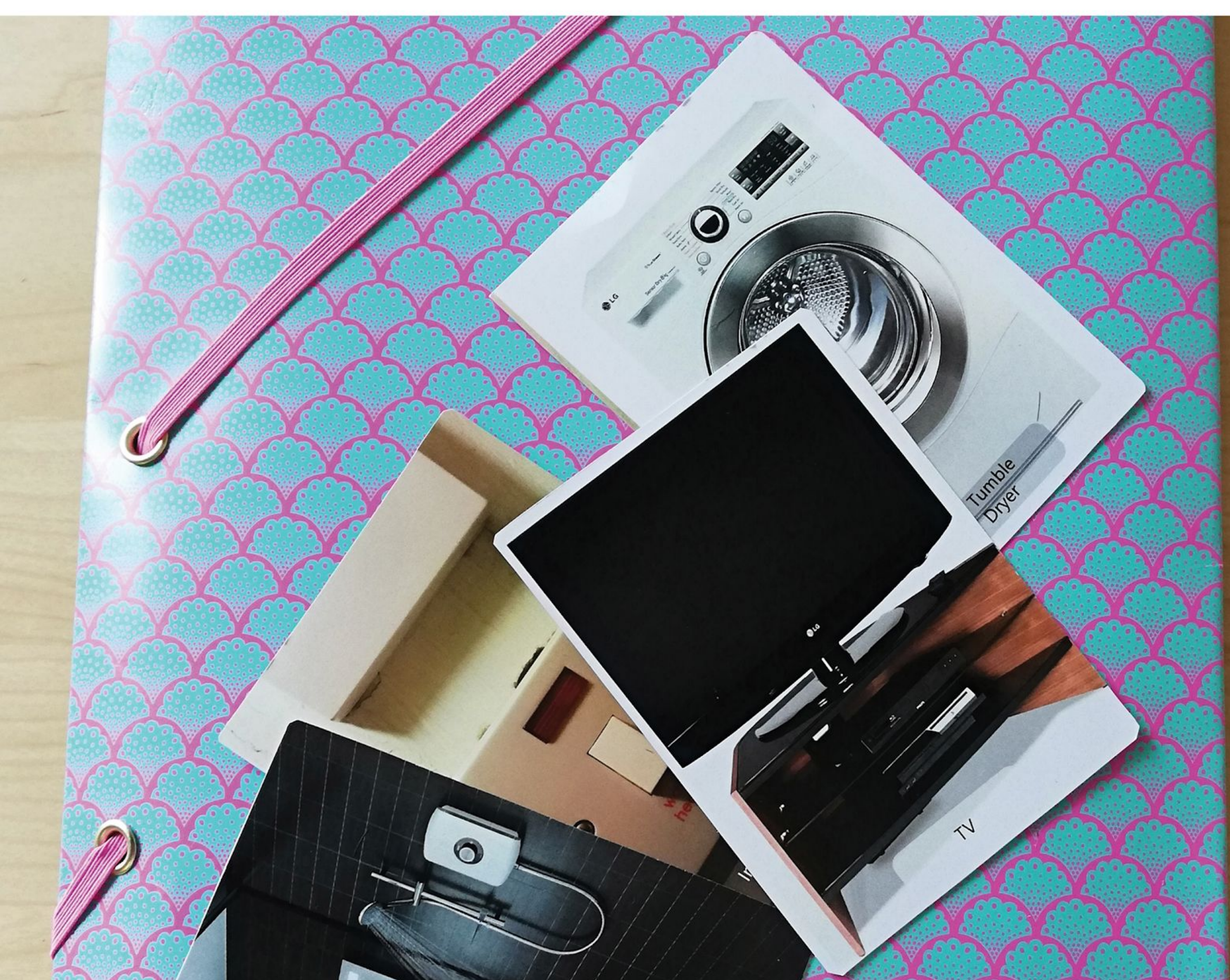


Day 2 - Awareness of energy usage and preferred spend

CARD SORTING

Ranking four appliances' energy usage for a specified period in order of highest to lowest to gauge the level of understanding of individual appliance energy use.

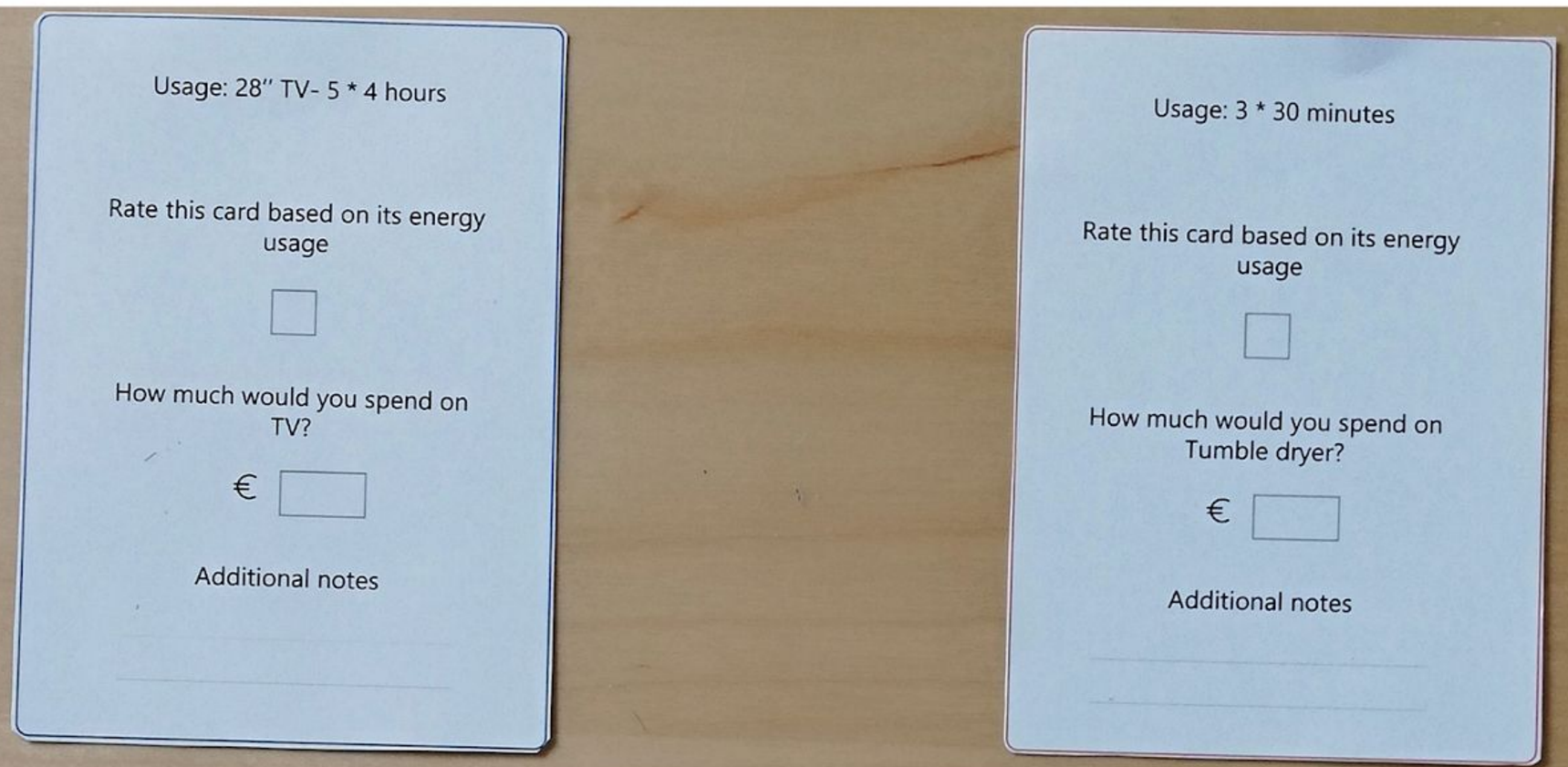
Goal: To gauge the level of understanding of individual appliance energy use



SAMPLE SPEND

Detailing the energy usage over the course of the day in specific time intervals and by source to gain a deeper understanding of user behaviour.

Goal: To see how participants will prioritise the spend.



Day 3 - Detailed energy usage

USAGE REPORT

Detailing the energy usage over the course of the day in specific time intervals and by source to gain a deeper understanding of user behaviour.

Goal: To gain a deeper understanding of user behaviour

1. For today, please indicate the appliances used at the times indicated, a list of appliances and short codes are listed below. Anything not listed can be added directly.
2. **Please also shade out the times of the day the house was occupied**
3. Please indicate how much you think this energy use is costing you?

Time of Day	Occupied	Living Room	Kitchen	Bedroom	Bathroom	Study	Other
12 - 7am							
7am - 11am							
11am - 2pm							
2pm - 4pm							
4pm - 8pm							
8pm - 12							

General: (May be applicable to any room)

Lt – Lights **I** – Immersion **H** – Heating **In** - Iron **C** – Charging mobile device **H** - Hoover

Living Room:
TV – Television
Box – Sky / Virgin box or similar
Mm - Modem

Kitchen:
K – Kettle
WM – Washing Machine
DW – Dishwasher
TD – Tumble Dryer
Hob – Cooker Hob
O - Oven
SC – Slow cooker

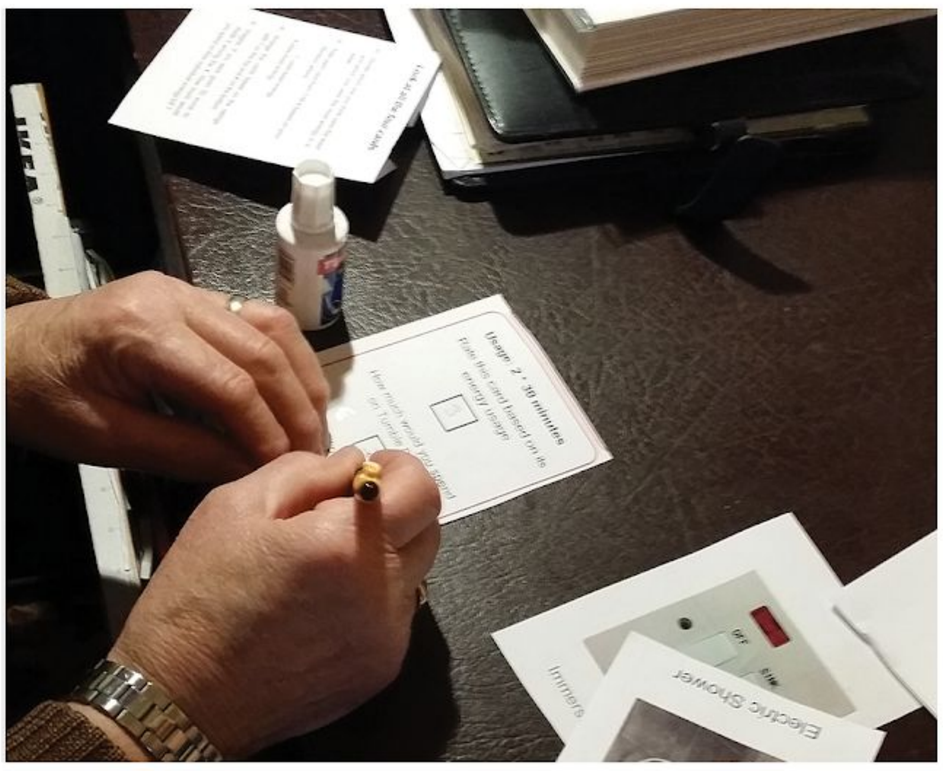
Bedroom:
TV – Television
Box – TV box
C – Clock
HD – Hair Dryer
S/C – Straighteners/Curlers

Bathroom:
ES – Electric Shower
PS – Power Shower
R – Razor

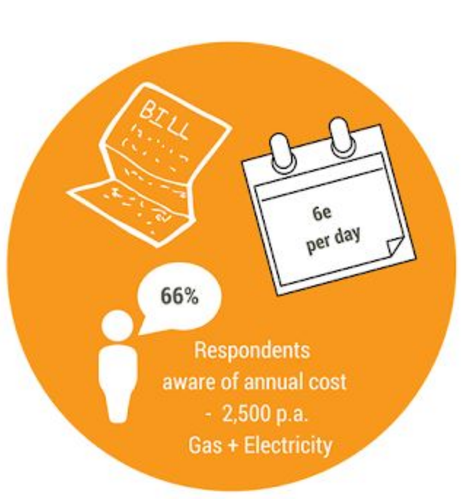
Study:
PC – PC
L – Laptop
Pr - Printer

CULTURAL PROBE RESULTS

In total, eight culture probes were distributed and returned for collation. Qualitative and quantitative analysis was performed on the results of the culture probe and displayed in the form of an infographic and graphs, providing key information for consideration as part of brainstorming and final concept development. The key considerations identified through the analysis are detailed below by culture probe element



USAGE REPORTS



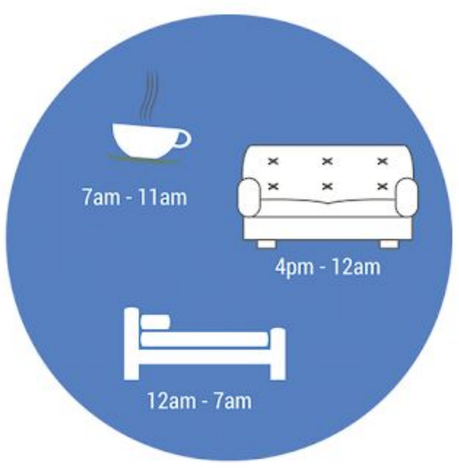
Cost



Most popular items



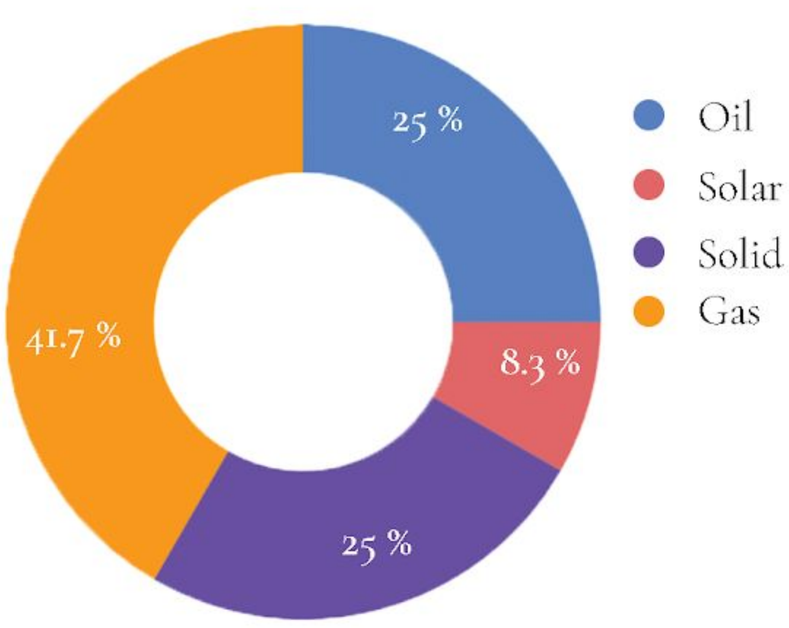
Items on Standby



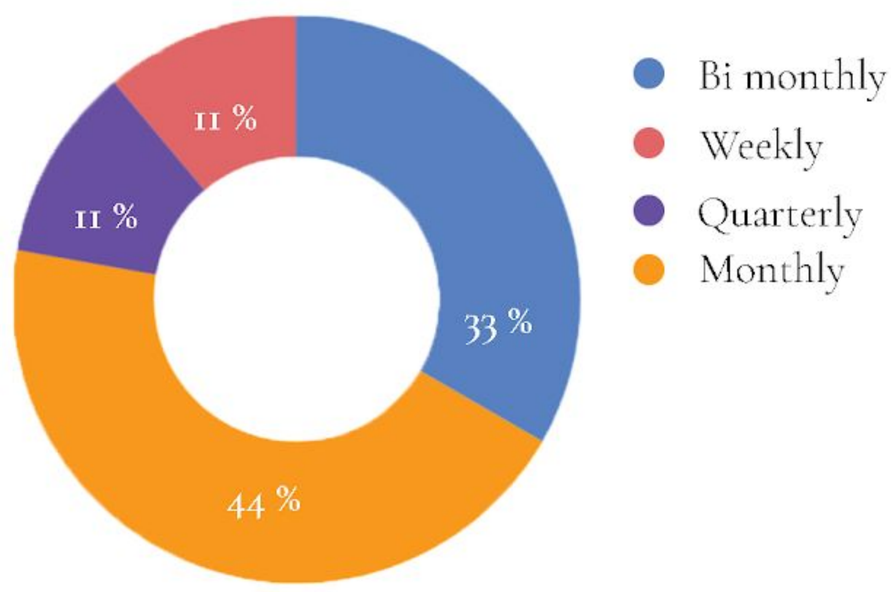
Occupied time

Respondents were asked to indicate the appliances they used, time used during the day and their sense of cost during a given day..
Insights
The majority of our respondents residences were unoccupied during the hours of 11am and 4pm. Items left on standby included TV's, kettle, stereos, laptops and washing machines. Respondents deemed the most expensive items to be washing, drying machines, dishwashers, TV, Wifi, cooker, heating, kettle, lights, and fridge.
Feedback indicated that consumers are aware of their costs.

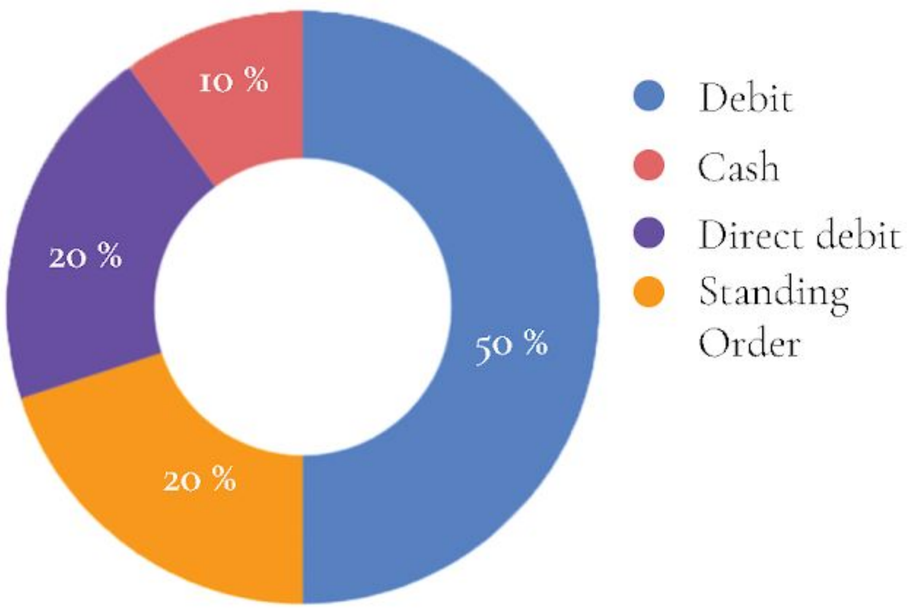
BASIC INFORMATION



Energy usage source



Bill payment frequency



Bill payment methods

Questionnaire
Graphs were used to display the data received from this probe with the following insights extracted:

Energy Source - Next to electricity, the secondary and tertiary sources of energy used by participants are unevenly dispersed, this led us to focus on a concept related to electricity supply and use to appeal to wider audience.

Payment Method & Frequency - Multiple options are utilised by participants for payment type and frequency encouraging us to include real time costs and expected bill costs into the final concept while providing the ability for configuration of same easily by the end user.

75% recently compared seeking better prices



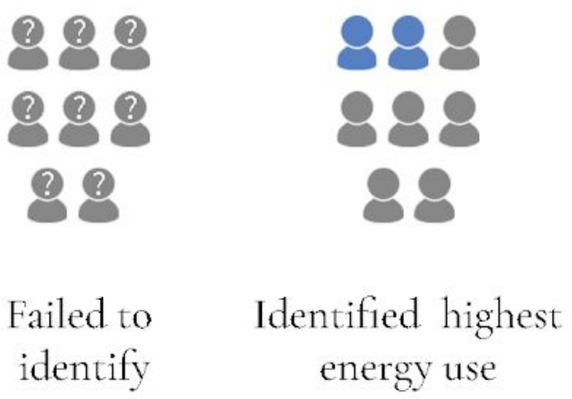
Compared-not switched | Compared-switched | Not Compared-not switched

Supplier Comparison - 75% of participants recently compared suppliers to look for better prices highlighting the importance of providing a mechanism to enable this comparison.

AWARENESS ENERGY USE

Card Sorting

On reviewing the order of returned cards against the correct order of highest consumption to lowest, we found no participant correctly identified the correct order. Further examination of the results revealed that 25% correctly identified the highest ranked and 25% the lowest ranked, but not both.
This provided a key insight that while participants may be able to judge the overall cost of their energy usage (as per information received in Usage Record element), there is very little awareness of how much energy is being consumed at an appliance level within the home.



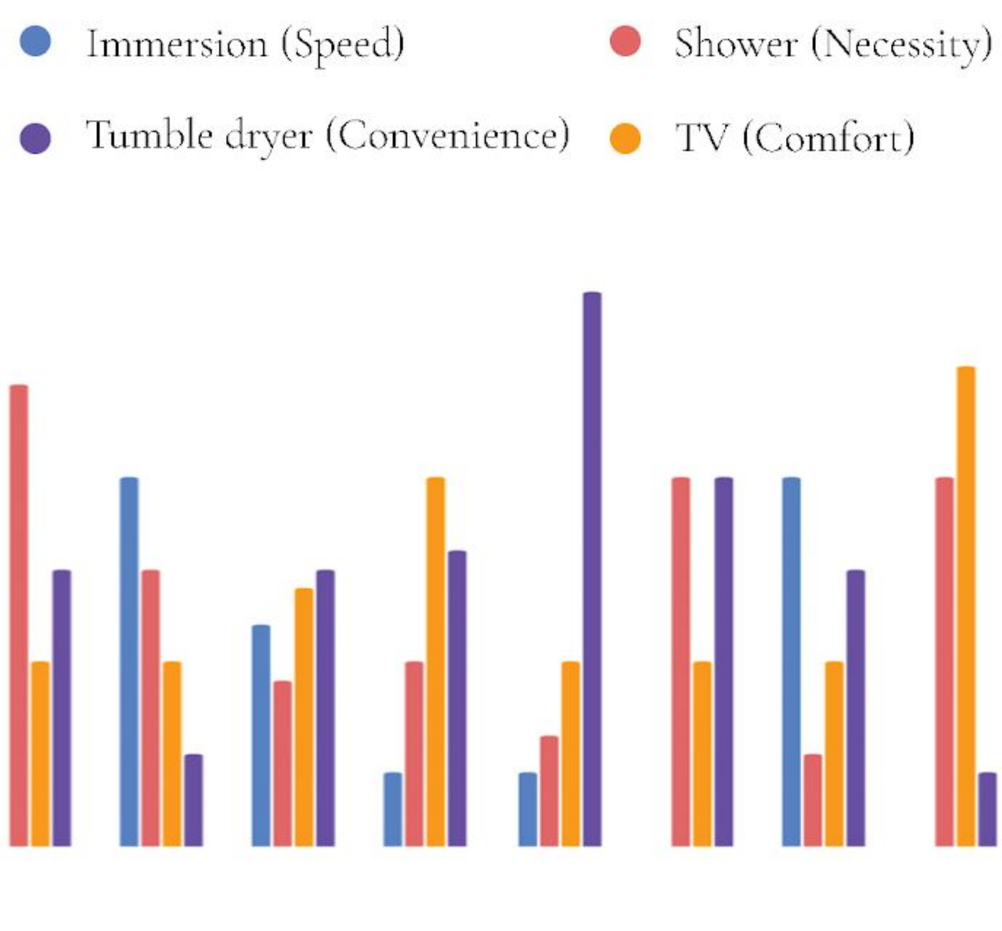
Failed to identify

Identified highest energy use

SPEND PRIORITIES

Sample Spend

Evaluating the sample spend involved the association of each appliance with a specific attribute; Immersion - Speed, TV - Comfort, Electric Shower - Basic Necessity, Tumble Dryer - Convenience. Percentage spend per appliance was then mapped and evaluation of the resulting graph showed 75% of respondents showed a bias towards spending on comfort and convenience rather than basic necessity or speed.
Aligned to the above reference to Maslow's Hierarchy of Needs whereby needs at a lower level are only considered when they are not met or threaten another need higher up.
An important input in considering the information provided to users by our concept - cost hugely significant as it is essential to meeting most physiological needs.



AWARENESS- COST

Sample Bills

Suggestions on unnecessary information and prefered information to be included in bills was analysed across all responses. The following two details were mentioned most
Clear visibility of total cost most important
Detail provided on usage not understandable (too high level)

This highlighted the requirement for prominent cost information, in real time and projected estimate, and providing information on usage at a more detailed level.

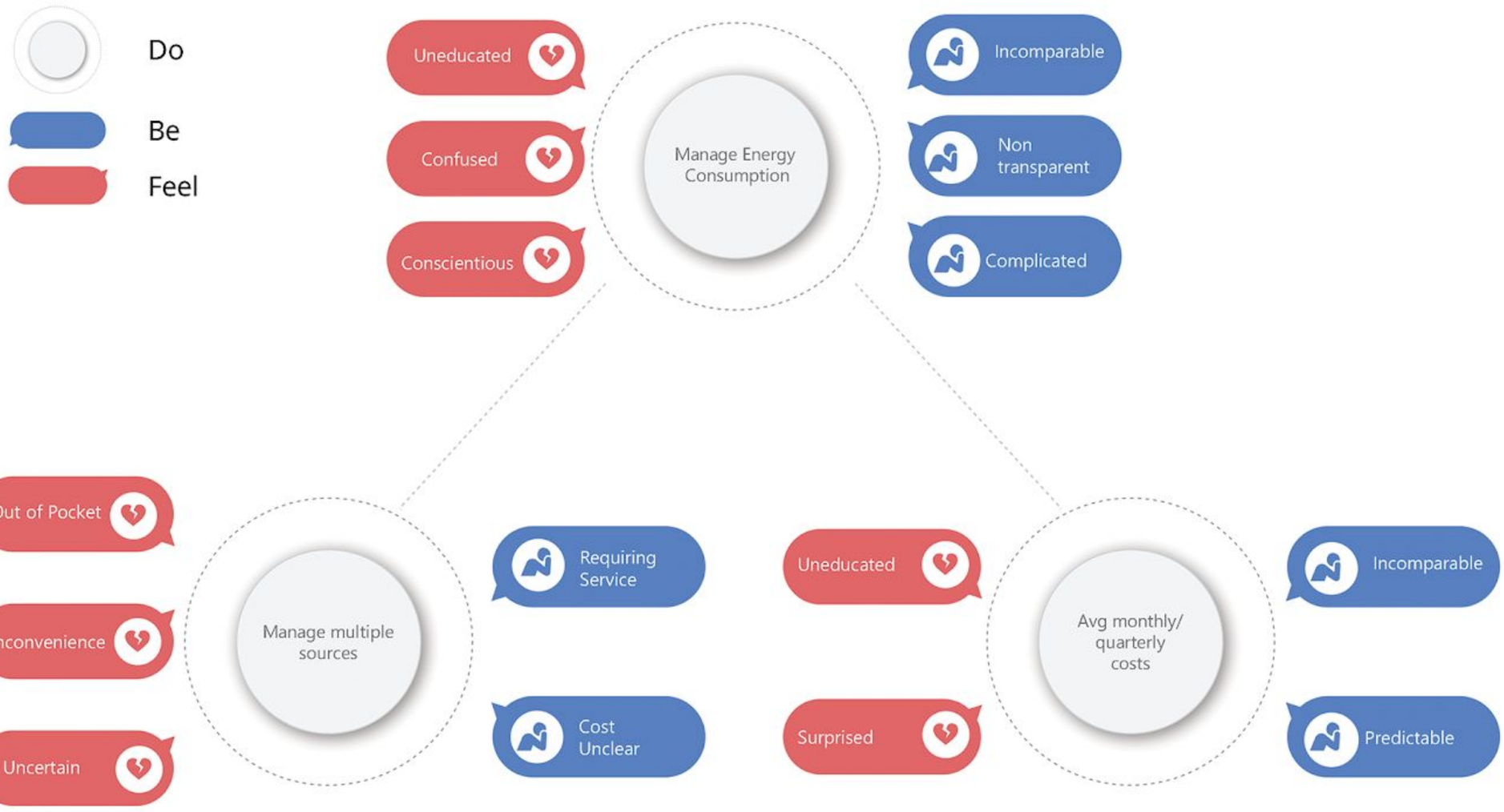


75% respondents show a bias towards spending more on comfort and convenience factors

EMOTIONAL GOAL MODELLING

As previously mentioned, the data gathered and analysed in the interview stage was used as a primary input into the creation of emotional goal models. Two models were created, the first looking at the current situation and a second focusing on the preferred state.
As our area of research was solely in the domestic setting, all detail provided below is in the context of the home. Full definitions for the emotional goal model can be found in Appendix 3.

CURRENT STATE

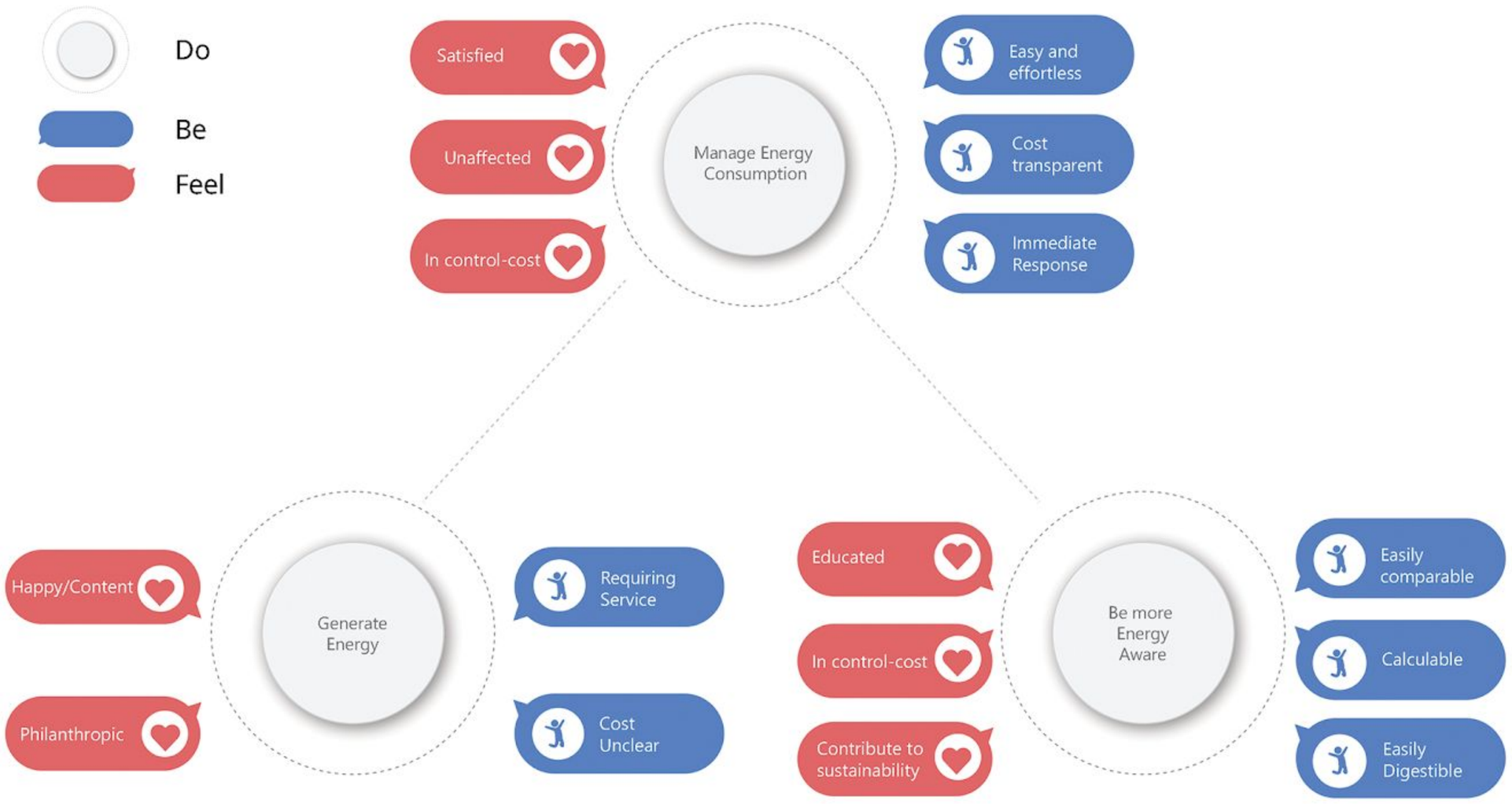


Current state of user

Information gathered on participant's existing situation identified two sub goals under the principle functional goal of managing energy consumption; managing the multiple sources of energy and understanding the average cost.
In managing multiple sources participants found challenges in the service required for maintenance purposes and that overall costs were unclear as they were spending across a number of suppliers. This left them feeling severely inconvenience, uncertain about the different options for energy supply and out of pocket from the seemingly constant requirement to pay for energy.

For the average costs, participants found that while there was a certain level of predictability across bills, ie higher in winter than summer, particularly high over Christmas period, it remained difficult to compare the costs to gain any real insight into how energy was being consumed. This resulted in feeling of surprise at bills on arrival and of being uneducated around energy use and associated costs.
Ultimately, participants found the management of their energy consumption to be non transparent, complicated and incomparable evoking feelings of confusion and conscientiousness.

PREFERRED STATE



Preferred state of user

Again, at a functional level, two sub goals were identified; home energy generation and increased energy awareness.
Participants expressed a desire to generate energy if it were cost efficient and the ability to transfer or easily transact excess easily, they felt this would result in feelings of contentment and philanthropy as they would be contributing to a sustainable future without incurring hefty costs.
A requirement to be more energy aware also came through from our participants suggesting that the information should be easily digestible to understand, easily comparable across suppliers and cost and volume calcula ble at an appliance level.
Overall, managing the household energy consumption should be easy and effortless, fully transparent in terms of cost and ideally a system which responds immediately to environmental changes. It should leave people feeling satisfied and in control of costs, but ultimately unaffected by a consistent need to intervene in managing use.

EMOTIONAL GOAL STATEMENTS

As "goal models are intended as high-level specifications for designers and developers to create a prototype" (Pedell et al, 2017), the preferred state goal model was used as a basis for the definition of emotional goal statements and brainstorming.

It was agreed that for the purposes of this project and the following brainstorming and concept creation, the focus would be on statement 1.

> Create a mechanism to increase awareness on energy consumption through easily accessible and digestible information which also provides the ability to compare suppliers and costs. It should leave users feeling educated and in control of costs while enabling them to contribute to environmental sustainability by making informed choices about their energy use.

> Provide an opportunity for energy generation by individuals which is cost efficient, with the initial layout recoverable in a short period, and which enables the transfer or sale of extra energy to other users. It should leave the user feeling content and philanthropic through their efforts to reduce negative effects of environmental issues from other energy sources and cost.

CONCEPT CREATION

IDEATION

Brainstorming of ideas took place individually and as a team effort resulting in a number of concepts, a selection of which follow:

1. Drag and drop solid fuel counter & estimator app (with an option to add their billed items) to enable consumers to get the full picture of their energy payments - related to the emotional goal for cost transparency and the cluster for awareness and knowledge.

2. Educational web page on consumption of items and their cost relative to each other.

3. As above but not a product, a (cheap) puzzle which can be used to educate kids via school.

4. Create a link between your meter clock MPRN no. and an app - independent of your provider) so you get your current, last and amt used in the selected timeframe... [cost and bills post its cluster .. I like to be billed for my actual usage...]



Image: Process of brainstorming



Image: Other Idea

FINAL CONCEPT

Overview

The concept is a device which transforms a fuse box into a smart fuse box. The purpose and objective of the design are to offer users the ability to measure and control energy usage and compare and switch suppliers for their electricity supply. The device is designed to help the users manage the electricity their appliances consume while providing them with easily digestible and simple information around their usage. The unit designed is essentially the main control centre for a home's electrical supply and consumption. This innovative device would be a new feeder upgrade to existing Residual Current Device (RCD) also known as Consumer Unit (CU) or the Fuse Box with an accompanying mobile application where detailed information can be easily accessed

The unit can be installed in a newly built home or as an upgrade to existing fuse boxes. This device is versatile, designed to be aesthetically pleasing and as an enhancement to a fuse box by incorporating a smart energy controller. It continues to act as a safety device, protecting against power surges/outages but also monitors energy consumption, specifically electricity, at a room, and in some cases, appliance level.

An accompanying mobile application includes features such as remote control of usage with an ability to 'trip' and stop supply from the unit, price comparisons across suppliers, electricity usage trends, bill information (shown in graphical format) and real-time notifications regarding unexpected/ abnormal electricity usage.

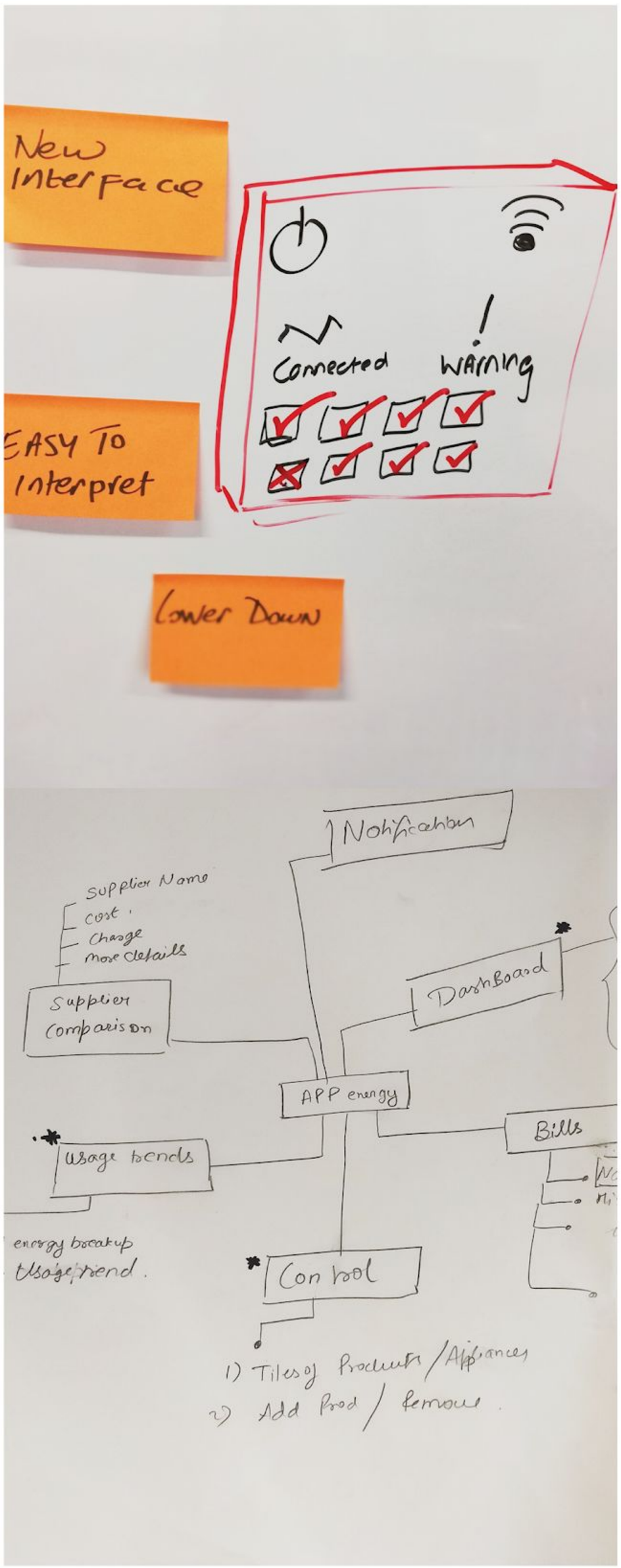


Image: Concept sketches

Detailed Description

Fuse boxes are designed to control the electrical flow into a home; they contain the main switch controlling power to the whole dwelling, and a number of other switches which govern supply to individuals circuits, ie sockets in the specific room, lights in a specific room. In the event of any surge or overload, a fuse will 'trip' causing the circuit to which it's attached to blow, cutting any electricity supply to that circuit.

This device is designed to read and relay the usage and supply which feeds through to each of the individual circuits. The primary unit is installed alongside the fuse box and connects easily to it while also providing a cover to the fuse box which helps create a more aesthetic presentation of existing units. The unit itself includes LED lighting which represents key status information with an overall system status in the centre indicating if the unit is operating as it should and three smaller lights to show if power is on, all circuits/ fuses are live and if a signal is sending information through to the accompanying mobile application.

While the unit interface provides the key information to users, the mobile application (app) is where the more detailed information can be accessed. In addition, the app allows the user to cease supply to any circuit remotely and provides additional value through live notifications to alert users on electricity usage levels.

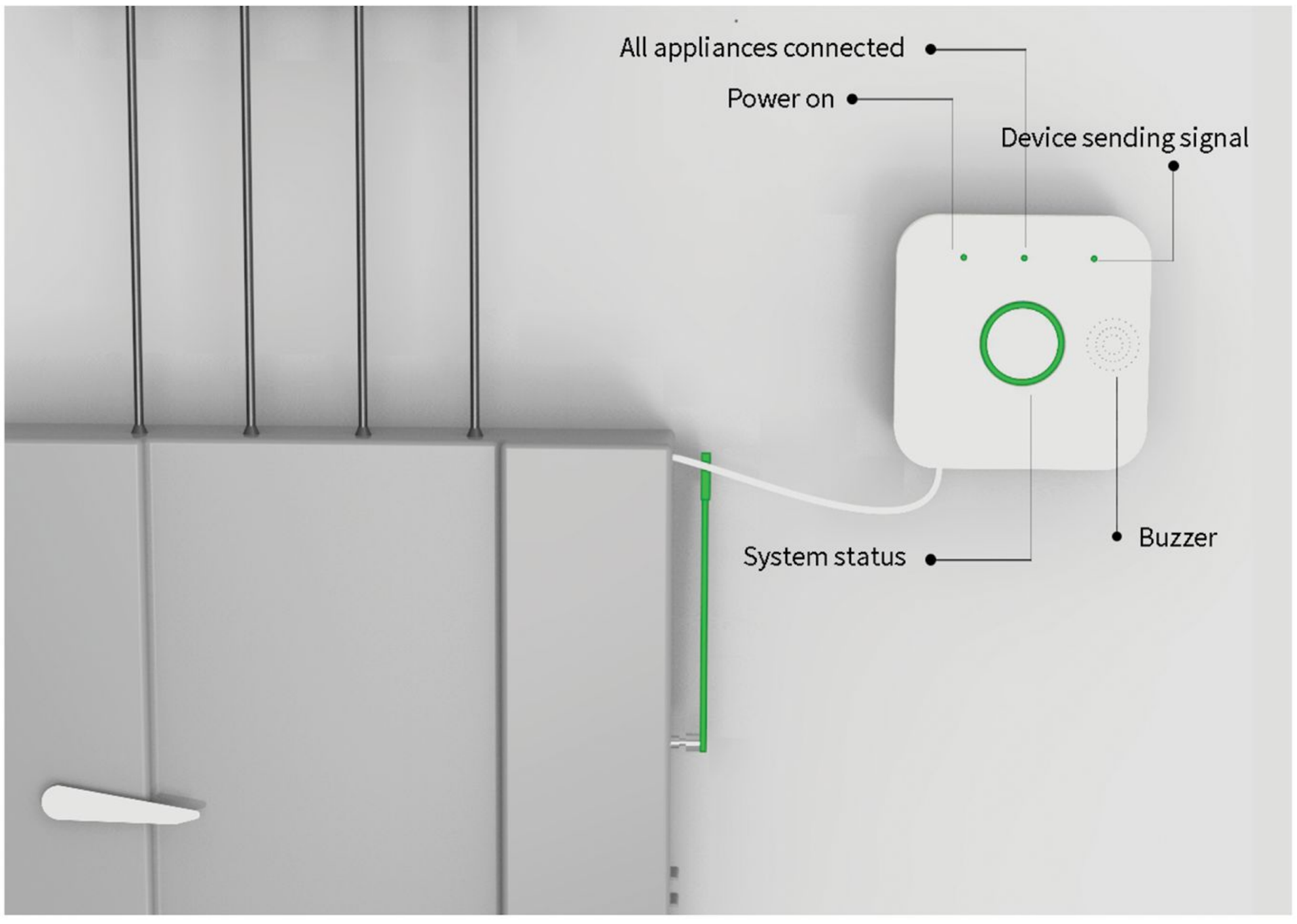
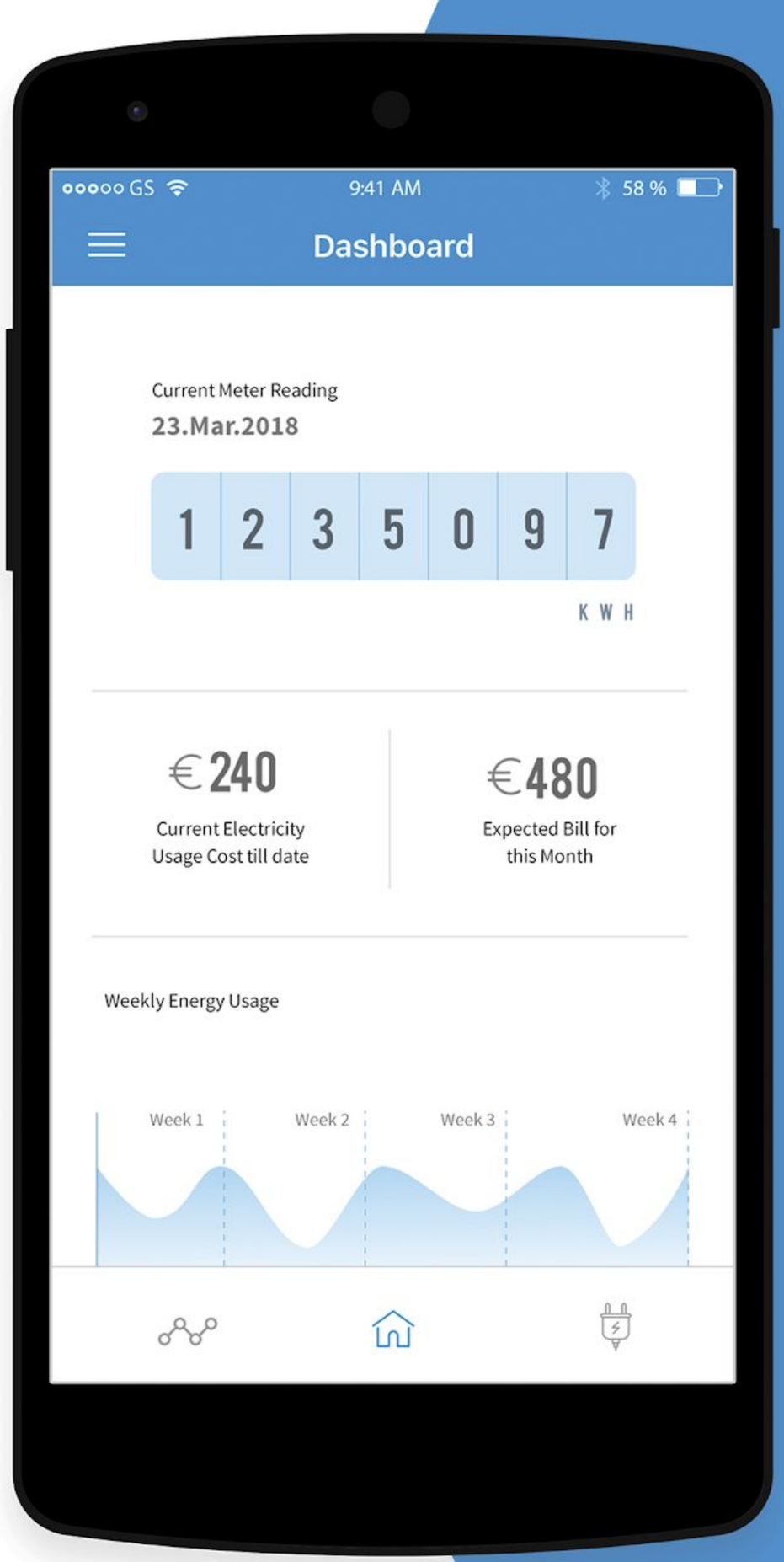


Image: Concept design (device)



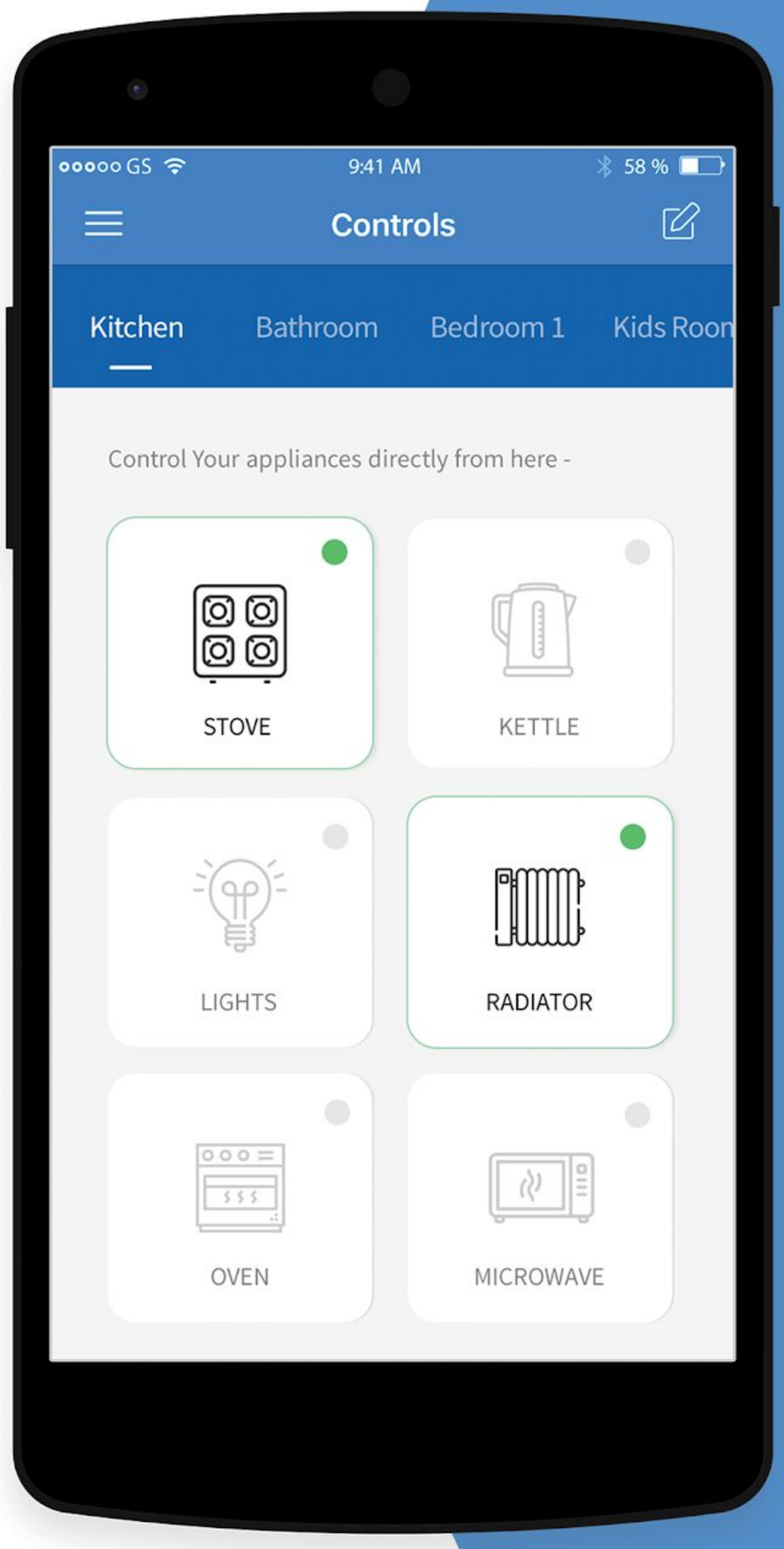
01 Dashboard

Function:

An interface displaying current meter reading, with the current electricity usage cost and expected bill for the month. They may also view their weekly energy consumption.

Benefit:

The home owner does not have to go outside to the meter box and unlock cover to view their readings. He feels more informed and aware of his upcoming bill.



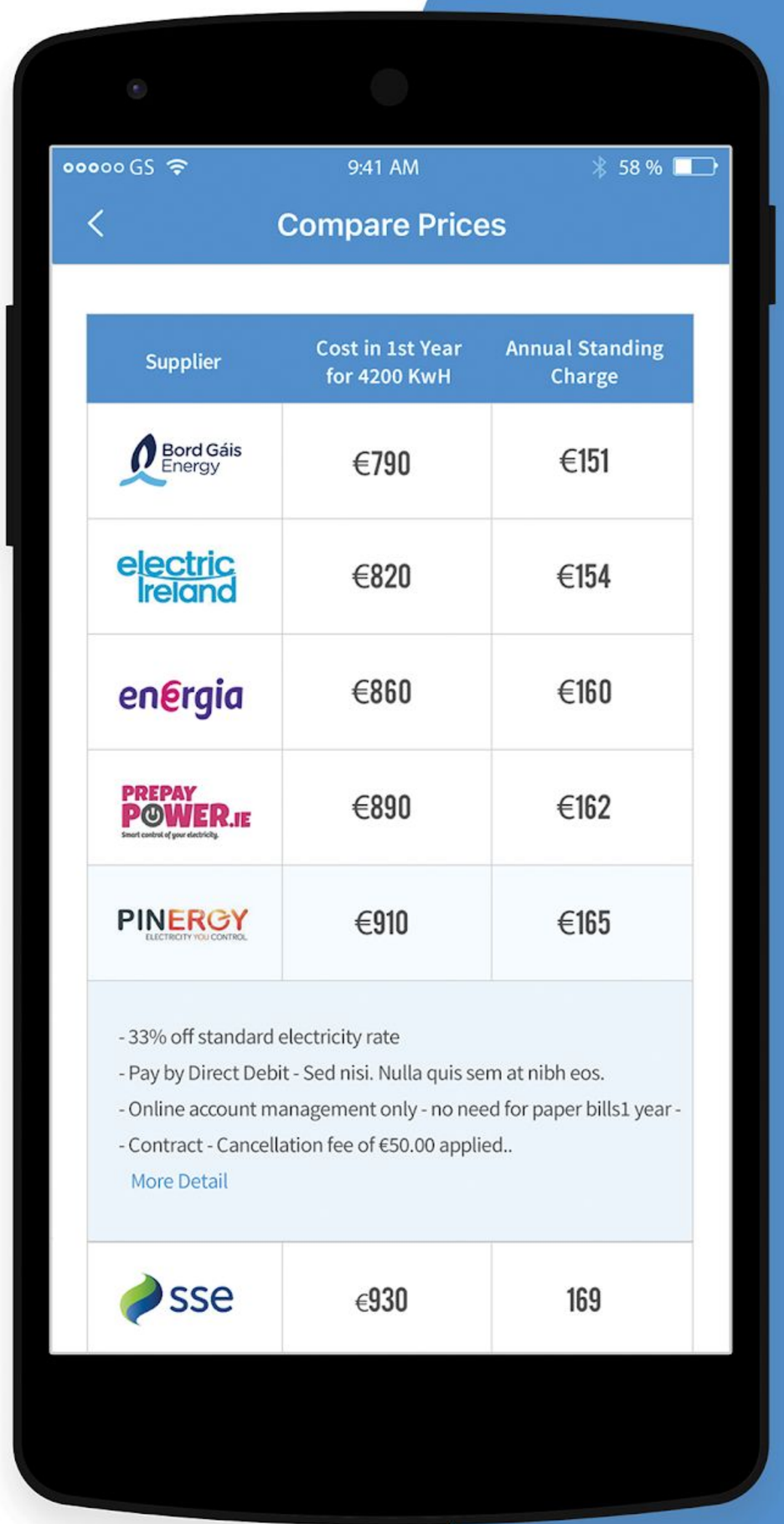
02 Control

Function:

You can check which appliances are in use currently and turn off/on at any time from anywhere using this application.

Benefit:

Since you can control your appliances and you know which is in use, you gain a sense of control over your energy consumption.



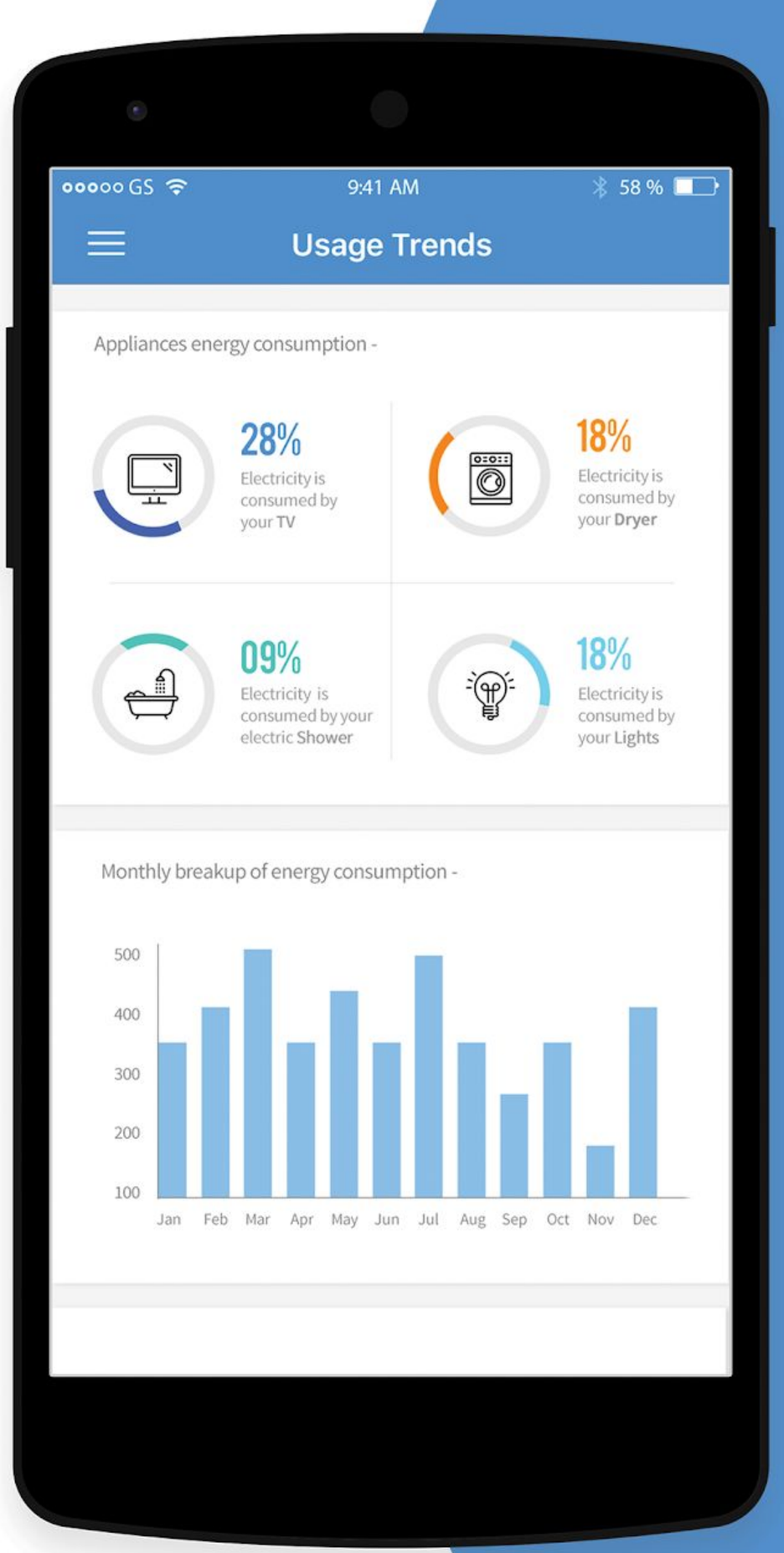
03 Compare Prices

Function:

This screen assists the user to compare prices from a number of energy providers and details of their offering in one easy to digest screen.

Benefit:

The process of comparing competitors is now made easier in addition to the user now being more informed and with the ability to make informed choices.



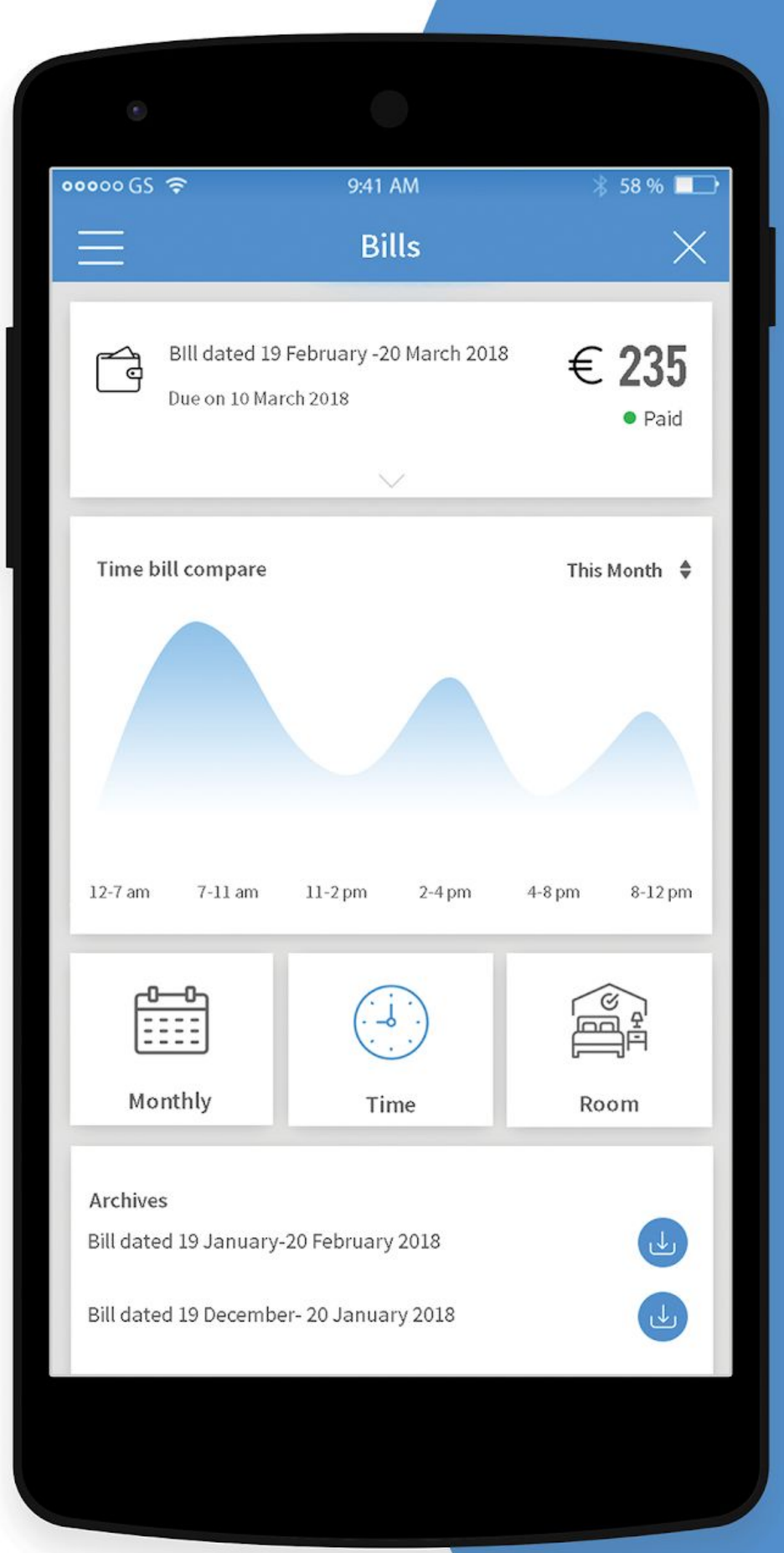
04 Usage Trends

Function:

Overall percentage consumption of each appliance at home with a monthly breakdown of energy consumption displayed graphically.

Benefit:

This functionality educates the user regarding their usage trends.



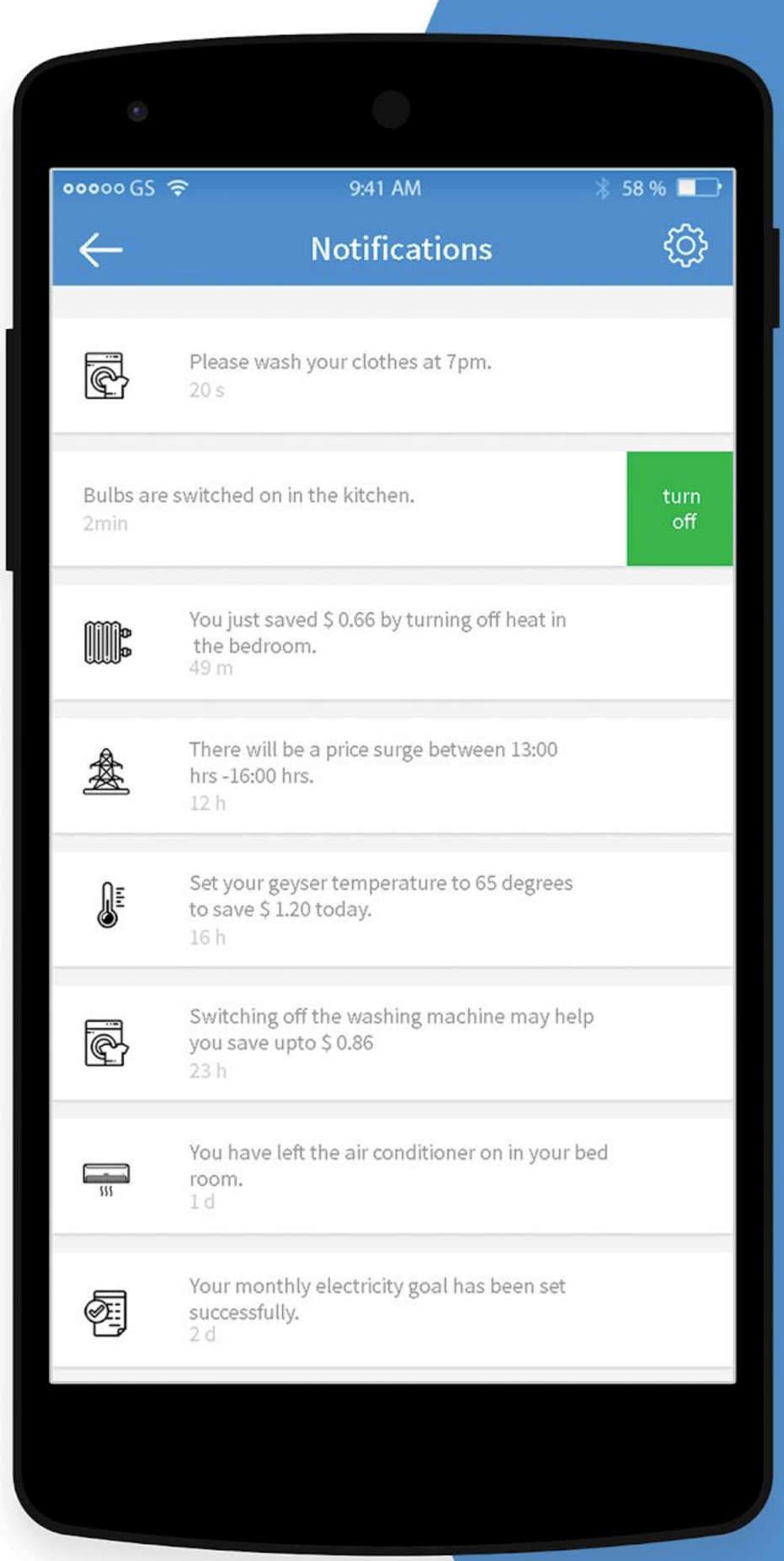
05
Bills

Function:

The bill is readily accessible and displays the total of the current bill. Consumption by price is displayed graphically at time intervals. The uses have access to their previous bills

Benefit:

Qualitative and quantitative data is displayed to inform the user of their energy use in an easily digestible interface.



06 Notifications

Function:

The notification interface gives shorthand information to the user which keeps him informed of his daily usage including current spend, items left on standby, successfully meeting his targets (pre-set) etc.

Benefit:

The user gains an increased awareness of his usage enabling him to make a more informed decision and adjust patterns of behaviour and usage.

Closing The Loop

The features of this product align with our emotional goal model as outlined below:

Easily Digestible & Comparable

Information is easily accessible though two interfaces, depending on the level of information the user seeks. A top level view that all circuits are active and that the unit is operating as expected is available from the installed unit, while the app provides a much more detailed level of information on electricity use throughout the dwelling.

The app is designed so the detailed information is easily digestible by anyone, not only those who have studied or researched electrical systems and units of use, and focuses on the key measure, as per our primary research, of cost.

Calculable & In control - cost
The app includes a feature which allows them to compare costs based on their own usage across suppliers and makes the switching process easier by recalling the required information for the user while in the supplier comparison screen.

Educated & Contributing to Sustainability
By providing information in this format, it enables users to educate themselves on energy use and costs with very little effort. Through understanding the level of energy use and providing a mechanism to remotely control that usage, as well as real-time notifications prompting consideration around the level of use, this product allows users to

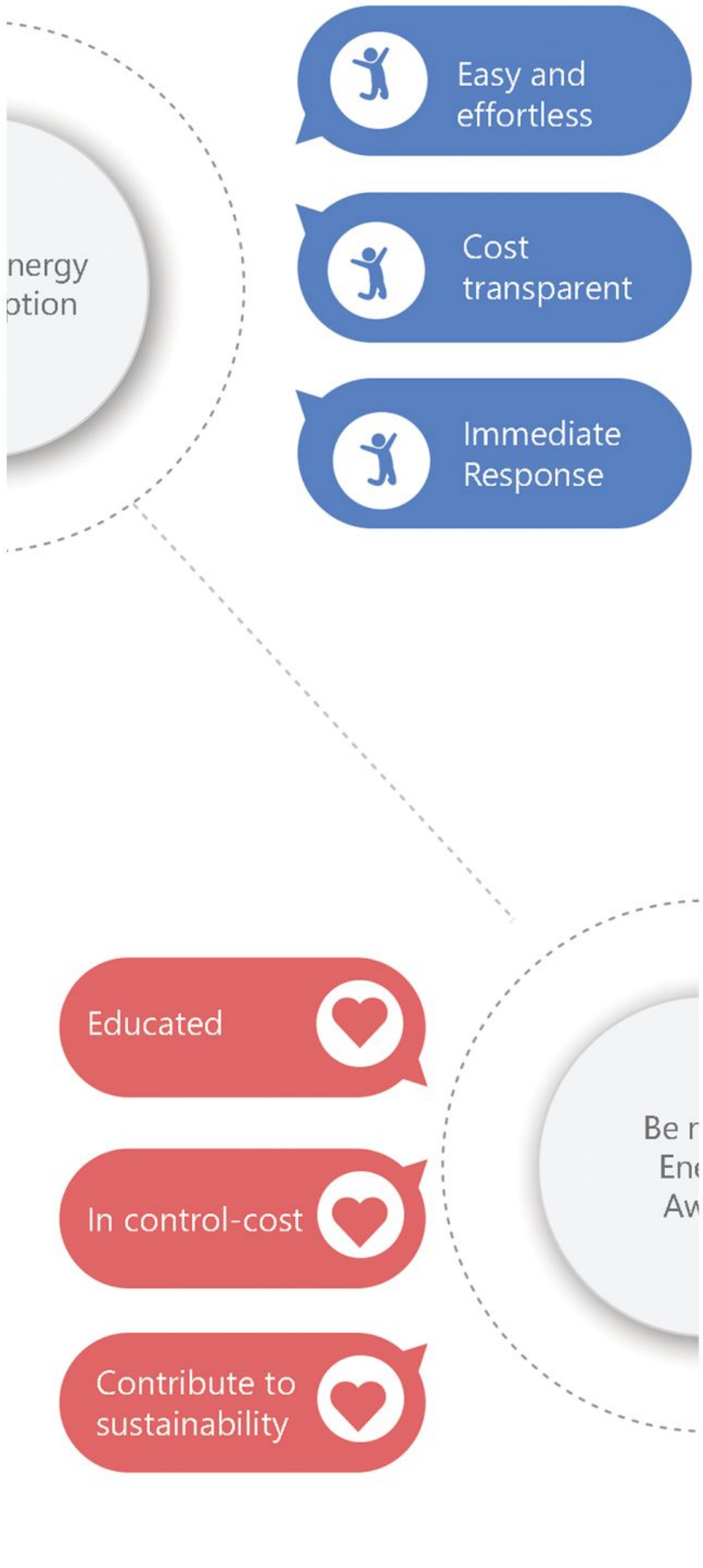
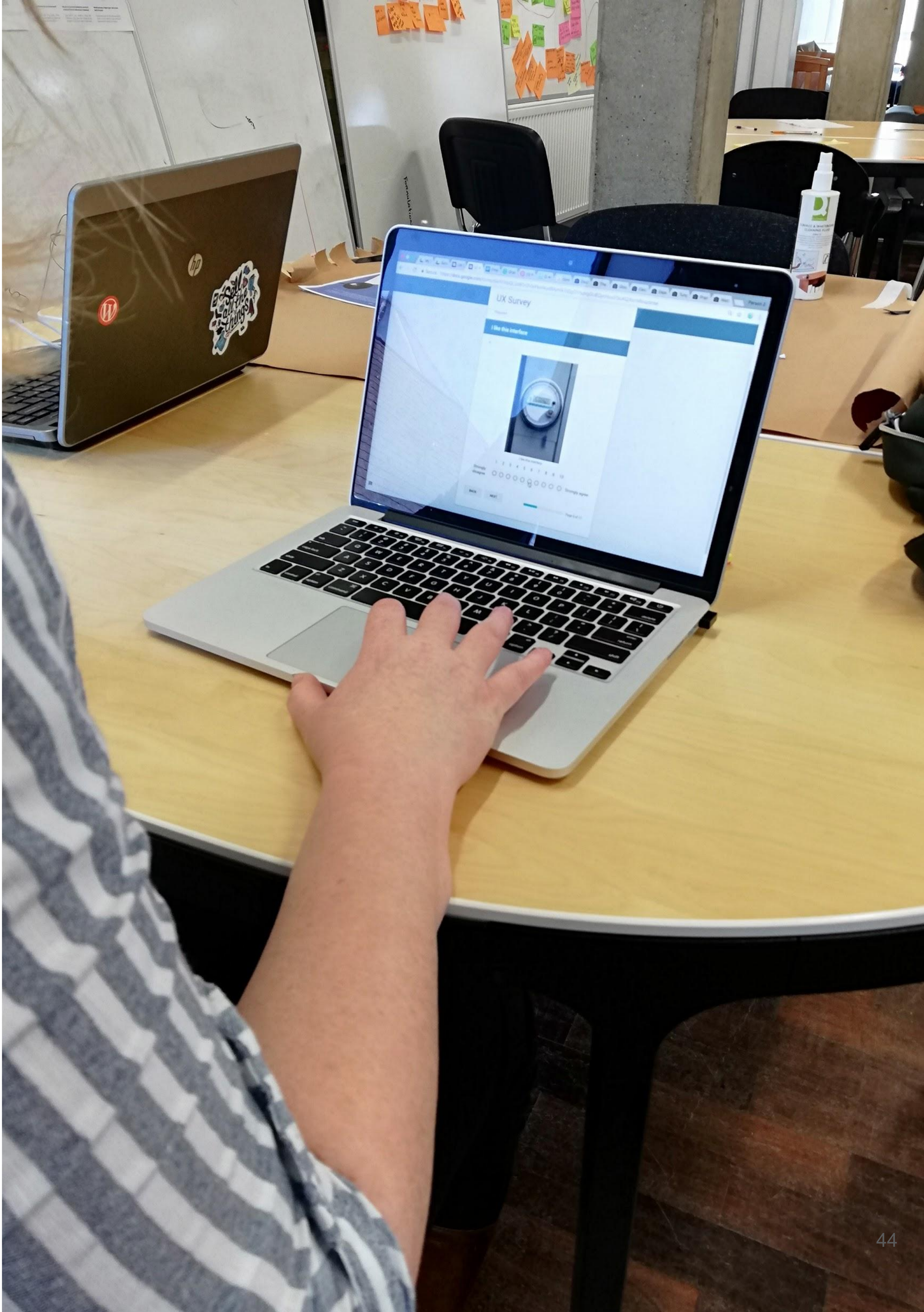


Image: Emotional Goal model


UX Survey
I like this interface

CONCEPT VALIDATION

COMPARATIVE SURVEY

Description

A comparative survey technique was utilized to test the final concept against existing options across markets. Three surveys were created providing stimuli based on the following:

Survey 1 - existing product in Ireland, (https://goo.gl/forms/gEiHgInkSOcGnMZC3)

Survey 2 - existing hybrid (EU, USA), (https://goo.gl/forms/EwJSDH5fmJ4BpdYx1)

Survey 3 - new concept. (https://goo.gl/forms/uSQ238zH5HuSWyIJ3)

Survey simtuli and associated questions can be found in Appendix 4

The survey was broken into four sections
Fusebox,
Comparison,
Trends/ Usage,
Meter.
Each section contained four questions which were derived in order to test specific variables based on the emotional goal requirements called out in both the model and emotional goal statement.

These variables were:

Informative - general awareness
Ease of use
Aesthetic Preference
Informative - manage costs

Within each section, an image was displayed (different image in each survey) with one question (same question in each survey).

All questions invited the respondent to rank their agreement on a 1-10 Likert scale, 1 being strongly disagreed and 10 strongly agree. Response to all questions was required

Distribution of the surveys resulted in a sample size of 23 for each category, each respondent only received one survey, with all responses collated in excel for the performance of Anova Testing.

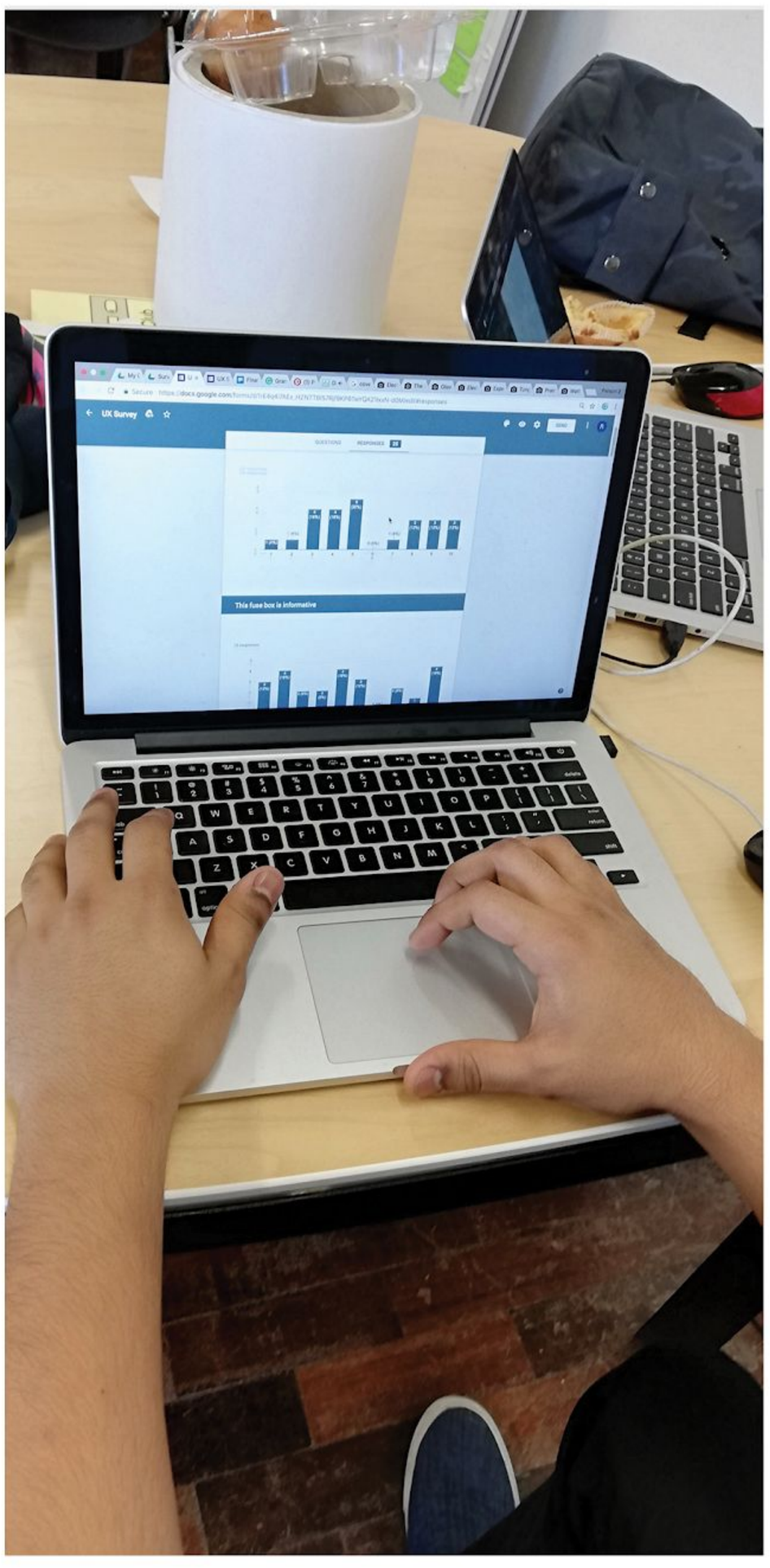


Image: Participant using the Survey.

ANOVA TESTING

Anova testing was conducted on the sets of data resulting from the three surveys to identify if there was a variance between the categories -

Ireland / Existing Hybrid / Concept.

The testing compared the means (average) of the three groups of categories and shows results which portray whether the differences occurred by chance and the probability of this happening. "If this is low, it will be represented by a large F value and a probability of less than 0.05($p<0.05$) and means there is a statistically significant difference" (Saunders et al, 2008:88). (see)

Standard deviation:

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

Figure 1 Pierce (2014)

Standard deviation is the distance or variation one item is from the mean (Figure 1). It is calculated as the square root of the variance. Variance is the average of the squared difference from the mean. Std Deviation is how far away the numbers are from the average piece of data. We want data as close to the average as possible – greater deviation implies the data is further apart. Low standard deviation indicates that data is close to the average, while high standard deviation indicates the further distance from the mean.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Q1	Between Groups	93.848	2	46.924	7.130	.002
	Within Groups	414.591	63	6.581		
	Total	508.439	65			
Q2	Between Groups	60.394	2	30.197	4.469	.015
	Within Groups	425.727	63	6.758		
	Total	486.121	65			
Q3	Between Groups	11.000	2	5.500	.861	.428
	Within Groups	402.591	63	6.390		
	Total	413.591	65			
Q4	Between Groups	54.212	2	27.106	3.244	.046
	Within Groups	526.455	63	8.356		
	Total	580.667	65			
Q5	Between Groups	158.758	2	79.379	11.762	.000
	Within Groups	425.182	63	6.749		
	Total	583.939	65			
Q6	Between Groups	96.939	2	48.470	8.136	.001
	Within Groups	375.318	63	5.957		
	Total	472.258	65			
Q7	Between Groups	85.848	2	42.924	5.105	.009

Image: Example of Anova F value results.

SURVEY RESULTS

FUSE BOX

Concept Vs Ireland

- Aesthetic Preference
- Informative (Awareness)

SUPPLIER COMPARISON

Concept Vs Ireland

- Aesthetic Preference
- Informative (Awareness)
- Informative (Cost)
- Easy to Use

BILL/USAGE

Concept Vs Hybrid

- Informative (Awareness)-
- Informative (Cost)

Concept Vs Both

- Aesthetic Preference
- Ease of Use

METER

Concept Vs Hybrid

- Informative (Awareness)-
- Informative (Cost)

Concept Vs Both

- Aesthetic Preference
- Ease of Use

ANOVA RESULT STATEMENTS

Analysis of the Anova test outputs, Appendix 5, provided the following statements on how our final concept was perceived in comparison to the provided alternative stimuli:

Fuse Box:
- The concept fuse box is liked more than the existing Irish fuse box,

- The concept fuse box is more informative in relation to general awareness than the existing Irish fuse box

Supplier Comparison:
-The concept interface is liked more than the existing manual option in Ireland.

- The concept interface is more informative on general awareness than the existing interface in Ireland.

- The concept interface is easier to use than the existing interface in Ireland.

- The concept interface is more informative on costs than the existing interface in Ireland.

Trends /Usage
- The concept interface is liked more than both the Ireland and Hybrid interfaces.

- The concept interface is easier to use than both the Ireland and Hybrid interfaces.

- The concept interface is more informative on general awareness than the Hybrid interface.

- The concept interface is more informative on costs than the Hybrid interface

Meter
- The concept interface is liked more than both the Ireland and Hybrid interfaces.

- The concept interface is easier to use than both the Ireland and Hybrid interfaces.

- The concept interface is more informative on general awareness than the Hybrid interface.

-The concept interface is more informative on costs than the Hybrid interface

Respondents preferred the Comparison concept over the existing Ireland in each of the questions posed, with no strong result over the existing hybrid.

Preference was depicted in the Usage category over Ireland and existing hybrid for all questions.

New Meter concept was preferred over both alternatives in each of the questions for this category.

Based on the above statements, the concept has been received well which is encouraging in deciding to progress further with development.

CONCLUSION

Description

This project focused on the thematic area of domestic energy, specifically, the report sought to investigate how people manage their energy usage at home, in terms of what they pay.
We initiated our project by conducting desk research looking at the existing situation and unearthed key findings which informed our primary user experience research which consisted of interviews, and the development of a cultured probe.
Five themes were highlighted during primary and secondary research: awareness and knowledge, improvisations and adaptations, ideal future state, understanding costs and bills, and, active effort.

The research provided an understanding of the existing situation and the preferred future state based on quality, functional and emotional requirements. This enabled the team to create emotional goal models of current and preferred stated which in turn resulted in the formation of emotional goal statements.

Ideation and concept proposals resulted in a final concept being agreed by the team. The chosen concept was selected as it surpassed other options in its alignment with the emotional goal statement and preferred state emotional goal model.
Six interfaces were developed from a smart fuse box extender enhancing the current Irish model. Each interface was derived from primary and secondary research, specifically preferred state emotional goal model. Screens included controls, price comparison, usage trends, bill, notifications and dashboard. The report identified the functionality and benefits of each screen developed. Surveys were created to validate the concept, and identify if there was a variance between the categories

- Ireland / Existing Hybrid / Concept. Anova statistical analysis compared the means of the three groups of categories. Overall, the output of the analysis, detailed in the report failed to reject the null hypothesis indicating that our concept is preferred over the fusebox, supplier comparison, bill usage and meter to varying degrees (either versus Ireland, versus a hybrid or both).

While the validation results show a preference for the designed concept, the real benefit of this project has been the experience gained in utilising a number of user experience research methods in order to identify user needs. The use of interviews specifically focused on the do, be, feel aspects of energy consumption in the home, paired with the culture probe which focused on key areas of concern, provided us with a wealth of information which guided our ideation process. The use of an emotional goal model to display the key information and user requirements provided not only a mechanism to capture detail from the primary research but also acted as effective goal setting and parameter check during the ideation process; ensuring we stayed on track to create a product which met user needs. Finally, the use of a comparative survey gave the group experience in effectively designing a survey to test the key variables of the concept based on the emotional goal model and existing alternatives to the designed concept. While no exact alternative to the concept was found in the market, the various interfaces whereby the same information can be accessed were used as a comparison.
A hugely beneficial experience providing practical skills applicable across most industries.

BIBLIOGRAPHY

1. Barry, Aoife,. 2017. Smart meters to be rolled out across Ireland in 2019 – a year later than anticipated. [ONLINE] Available at: http://www.thejournal.ie/smart-meters-roll-out-ireland-3607570-Sep2017/. [Accessed 15 January 2018]

2. Boyce, C. & Neale, P., 2006. Conducting in-depth interviews: A guide for designing and conducting in-depth interviews for evaluation input. Pathfinder International,

3. Buchanan, K, Russo, R, & Anderson, B 2014, 'Feeding back about eco-feedback: How do consumers use and respond to energy monitors?', Energy Policy, 73, pp. 138-146, Business Source Complete, EBSCOhost, viewed 18 January 2018.

4. CER (Commission for Energy Regulation). 2017. CER Announces Delivery Plan for Smart Meters in Ireland. [ONLINE] Available at: https://www.cru.ie/wp-content/uploads/2016/11/CER17279-National-Smart-Metering-Programme-Media-Releas e.pdf. [Accessed 15 January 2018]

5. CER (Commission for Energy Regulation). 2017. CER Electricity and Gas Suppliers' Handbook 2017,. [ONLINE] Available at: https://www.cru.ie/wp-content/uploads/2017/07/CER17060-Electricity-and-Gas-Suppliers-Handbook-April-2017.pdf. [Accessed 15 January 2018]

6. CRU (Commission for Regulation of Utilities). 2017. CRU How to Switch – Step by Step. [ONLINE] Available at: https://www.cru.ie/home/switching-supplier/switch-step-step/. [Accessed 17 January 2018]

7. CRU (Commission for Regulation of Utilities). 2017. CRU Switching Supplier. [ONLINE] Available at: https://www.cru.ie/home/switching-supplier/. [Accessed 17 January 2018]

8. CRU (Commission for Regulation of Utilities). 2017. Customer Switching Report for Electricity and Gas Retail Markets. [ONLINE] Available at: https://www.c-

9. DCCAE (Dept Communication, Climate and Environment). 2015. Ireland's Transition to a Low Carbon Energy Future 2015 – 2050. [ONLINE] Available at: https://www.dccae.gov.ie/documents/Energy%20White%20Paper%20-%20Dec%202015.pdf [Accessed 13 Jan-

10. DCCAE (Dept Communication, Climate and Environment). 2016. A Strategy to combat Energy Poverty 2016 – 2019. [ONLINE] Available at: https://www.dccae.gov.ie/documents/A%20Strategy%20to%20Combat%20Energy%20Poverty.pdf. [Accessed 14 January 2018

11. DCCAE (Dept Communication, Climate and Environment). 2017. Better Energy Program. [ONLINE] Available at: https://www.dccae.gov.ie/en-ie/energy/topics/Energy-Efficiency/citizens/Pages/Better-Energy-Programme.aspx. [Accessed 17 January 2018].

12. Eirgrid. 2008. EirGrid Grid 25 – EirGrid's Grid Development Strategy. [ONLINE] Available at: http://www.pleanala.ie/misc/PCI/PCI1/DAF2/Volume%203B/Reference%20Material/EirGrid%20(2008)%20Grid25%20Strategy.pdf. [Accessed 16 January 2018]

13. ER (Commission for Energy Regulation). 2014. CER National Smart Metering Programme Smart Metering High Level Design. [ONLINE] Available at: https://www.cru.ie/wp-content/uploads/2014/07/CER14046-High-Level-Design.pdf. [Accessed 15 January 2018]

14. Gaver, W., Boucher, A., Pennington, S. and Walker, B. (2004). Cultural probes and the value of uncertainty. interactions, 11(5), p.53.

15. Generating your own electricity- Sustainable Homes Ireland https://www.sustainablehomes.ie/generating-your-own-electricity/ [January 25, 2018]

16. Giuliani, M., 2016. Psychological Theories for Environmental Issues; Theory of Attachment and Place Attachment. 3rd ed. Oxon: Routledge

17. Hargreaves, T, Nye, M, & Burgess, J 2013, 'Keeping energy visible? Exploring how householders interact with feedback from smart energy monitors in the longer term', Energy Policy, 52, pp. 126-134, Business Source Complete, EBSCOhost, viewed 18 January 2018.

18. IEA, (2013), Technology Roadmap; Energy efficient building envelopes, [online], available:https://www.iea.org/publications/free-publications/-publication/TechnologyRoadmapEnergyEfficientBuildingEnvelopes.pdf.,[Accessed 16th Jan 2018].

19. Ifttt.com. (2018). Home hubs, data flows, safety alerts & more — new on IFTTT. [online] Available at: https://ifttt.com/blog/2017/12/home-hubs-data-flows-safety-alerts-new-on-ifttt

20. Investopedia.com. 2017. Agency Theory. [ONLINE] Available at: https://www.investopedia.com/terms/a/agencytheory.asp. [Accessed 17 January 2018]

21. Kiernan, 2018, PD607 – Lecture Notes, Maynooth University Feb-May 2018

22. Kiss, J. (2014). IFTTT: ' We're building an intelligence layer for the internet of things'. The Guardian. [online] Available at: https://www.theguardian.com/technology/2014/-dec/31/ifttt-were-building-an-intelligence-layer-for-the-internet-of-things [Accessed 21 January 2018]

23. Kobie, N. (2015). How to turn your old house into a smart home. The Guardian. [online] Available at: https://www.theguardian.com/technology/2015/jun/09/old-house-smart-home [Accessed 23 Jan. 2018].

24. Koskela, T, 2004. Evolution towards smart home environments:
empirical evaluation of three user interfaces. Personal and Ubiquitous Computing, 8 (3-4), p234 - 240

25. Maslow, A. H., 2008. The theory of Human Motivation. Psychological Review, 50, p370- 396

26. McClelland, D, 2008. Power is a great motivator. Harvard Business Review, 81 (1), p117-126

27. McLeod, S. A. (2009). Attachment Theory. [ONLINE] Available at: www.simplypsychology.org/attachment.html) . [Accessed 17 January 2018]

28. Midlandrenewables.ie. (2018). What is Renewable Energy | News |
Midland Renewables. [online] Available at: http://www.midlandrenewables.ie/news/Detail/What-is-Renewable-Energy [Accessed 23 Jan. 2018]

29. Pedell, S., Keirnan, A., Priday, G., Miller, T. Mendoza, A., Lopez-Lorca, A., & Sterling, L., 2017. Methods for Supporting Older Users in Communicating Their Emotions at Differ-

30. Pierce, R. 2014,. "Standard Deviation Formulas". Math Is Fun. Retrieved 14 April 2018 from http://www.mathsisfun.com/data/standard-deviation-formulas.html

31. Saunders, M Brown, R.B. 2007. 'Dealing with Statistics : What You Need to Know'. Buckinham: Open University Press. Accessed: ebrary collections. 14 April 2014

32. Shoubi, M., Shoubi, M., Bagchi, A. and Barough, A. (2018). Reducing the operational energy demand in buildings using building information modeling tools and sustainability approaches.

33. Sustainable Energy Authority Of Ireland | SEAI. (2018). Home - Sustainable Energy Authority Of Ireland | SEAI. [online] Available at: https://www.seai.ie [Accessed 23 Jan. 2018]

34. Therese Peffer, Marco Pritoni, Alan Meier, Cecilia Aragon, Daniel Perry, How people use thermostats in homes: A review, Building and Environment, Volume 46, Issue 12, 2011, Pages 2529-2541, ISSN 0360-1323, https://-doi.org/10.1016/j.buildenv.2011.06.002 (http://www.sciencedirect.com/science/article/pii/S0360132311001739)

35. United Nations. 2017. Climate Change. [ONLINE] Available at: http://www.un-.org/en/sections/issues-depth/climate-change/index.html. [Accessed 17 Janu-

36. Wilson, C, Hargreaves, T, & Hauxwell-Baldwin, R 2017, 'Benefits

APPENDIX

TOPIC GUIDE

CURRENT STATE

How do you currently manage your home energy? (Functional)

What steps do you follow, can you give an example?

What is managing your energy like for you? (Quality)

How does managing your energy make you feel? (Emotional)

PREFERRED STATE

What are the barriers?

How do you want To manage your home energy? (Functional)

What should managing your home energy be like for you? (Quality)

How should managing your home energy make you feel? (Emotional)

INTERVIEW TRANSCRIPTS

Interview 1 - Brian
B- Brian - Interviewee
L- Lesley - interviewer

L: Tell me a bit about your circumstances / Demographics
B: Myself and my wife have been in this house for about 25 years - four bedroom house – fairly solidly built. Normally there are two of us in the house during the week, three in weekends when our son comes home. And we feel it is appropriate, and while we love living here, it is very convenient, to the village of Leixlip, we've got transport, local train 50 yards up the road, busses 50 yards down the road, village 100 yards away... church and shops it is all very compact and convenient. However we are considering, at this stage in our lives, downsizing...most of the week there is only one bedroom used etc. So that is where we stand at the moment. We are both in good health. Might move to a more manageable house.

L: What kind of energy systems to you have in you house?
B: OK we have natural gas supply. The heating runs off a natural gas boiler which is located in the utility room. We find that quite efficient. It is set for so many hours during the day. But you can adjust it manually, if you feel it is nice and warm and don't want it to come on, or if it is cold you can adjust the temp in the house?
L: Do you have other controls in the house?
B: Well you can just isolate the hot water or the heating. We find that handy as you don't have to keep a tank of water heated all the time. You can just turn it on 30 mins before you need it. Or you can have the central heating later.
L: What about temperature control?
B: Temperature control is on the boiler itself. We have it at the temperature appropriate to our circumstances and comfort factor. Now my wife and I will sometimes differ on what it regarded as a comfort factor. And while I suppose being a man, have a slightly more tolerance for a lower temperature than she might like, we have a sort of friendly rivalry on getting the temperature right to suit both of us.
L: Would you feel the cold?
B: Like everybody else, I feel the cold, but probably myself not impacted by it as much as some more sensitive people might be. But we manage – we have been married for over half a century. But we also, I am a firm believer in – Is it a necessary expense to put on the heating when putting on a nice woolly jacket would suffice for the time you need it and take it off later when you don't need it. So it is that balance between burning the gas and putting on a jacket, which at the end of the day is a lot easier.
L: Is it easy to manage your controls?
B: Is it easy to manage the controls? Well, you don't have to adjust them every ten minutes, if it was particularly cold you just go to the dial on the boiler and turn up the temp.
L: Have you other ways of managing temperatures?
B: Well on some of the radiators we have a temperature valve which we can adjust on some of the rooms that we use infrequently, like for my wife's painting/sewing room which isn't used for five hours a day, so it doesn't have to be twice as warm as the sitting room or what we refer to as our den, our office, which is the room we use most in the evenings and where you would have a higher temperature to be warmer.
L: What about a fire?
B: Fireplace? We have one fireplace in the house which is a gas fire, which again, a natural gas fire but we don't use that room all the

time really, unless we have guests in the house, or we have additional people around, in sitting in a big room with a fire burning and the heating on. or we are doing something different. With only two of us in the house, there is no point
in sitting in a big room with a fire burning and the heating on.
L: Is it easy to turn on and off?
B: Very easy?? I find it easy, but for certain people it wouldn't be easy. You do have to kneel down by the gate and turn a switch on it which lights the pilot light which lights the gas, and then the spark flashes and causes the burner to start. So it's not as easy as it could be but its not unmanageable.
L: So, this is the emotional questions...How does managing your energy make you feel?
B: Warm. Well I feel I have some control over it. That it isn't burning away all day and all night and I can't control it, then it is just costing me a lot more money. To feel I have some control over it is good. Now, the only problem is that I say if the people in the house have different comfort levels that could lead to conflict as I have already said....
L: These next few questions are about your preferred state, functional, quality, and emotional questions...so, functionally, how would you like to manage your energy?
B: We in light of recent advances in energy control that I see advertised, they sound very good and I have researched a little bit, but they are very expensive to install... um... and I haven't spoken to anybody, but, it could be easier I suppose...
L: Similar questions, how should your energy work for you – how should you feel
B: It should feel, I don't have to make adjustments in the day or things like that... It would probably react faster to changes in external temperature, whereas I would ...you know if it was a bit cold today but I won't go and change the settings.
L: IS it a chore?
B: Chore? No...slight chore, if you can have divisions of chores, it's a slight chore.
L: How should you feel, how would you like to feel?
B: When I look at the new systems of energy control that are being introduced by the various energy suppliers, I say to myself, that sounds like its good, but I'm not sure that it doesn't increase the cost and the usage, even though you maybe able to control it from your smart phone and switch on the radiator in the back room, when you are five miles down the road and then turn that off and switch on the other one... I'm not sure I think that at the end of the day could be more of a chore by not having it at a certain setting and people tweaking it all the time. So, I'm ambivalent – about the system or about talking to people who have already installed it. One is called Hive...
L: Have you made any improvisations around the house with regard to energy use?
B: Well apart from insulation that we got in 5 years ago – we got it in the walls and the attic; I don't think there has been any other innovations
L: Thank you very much,
B: You are very welcome, if that can be of any help to you in your investigations...

Interview 2 - Shauna
S - Shauna, interviewee
E - Edel, interviewer

E: General introduction, explanation of purpose and reasons for recording interview
E: How do you currently manage your energy consumption in your house?
S: What do you mean by manage?
E: Do you think about the amount of energy you use at any time?
S: I would tend to switch off lights in rooms when I'm not in them. I'm conscious when using kettle, I don't fill it right up cause I used to and I didn't even give it a second thought but now I would I wouldn't fill the full kettle just for myself. As regards heating I would tend to be a cold person so we'd tend to have the heating on quite a lot, I am a little bit paranoid about the effect of having it on all the time – on myself on my body and skin. With water I'm very conscious of, when brushing my teeth I'd turn it off rather than leave it running constantly.
We did have a hot tub and that was huge on electricity so we ended up taking it down, yes the electricity bills were through the roof and I'm just conscious of wasting electricity
E: Do you mind me asking was it all about energy use or was it also about money – the size of the bills?
S: It was both, a bit of both. Well the money, I wouldn't mind as long as it didn't get too expensive but it was the waste of energy. You have it sitting out there constantly and there's a lot of water used so it is a waste and I'm quite conscious of that.
E: On heating then, do you use anything in terms of timers or remote access
S: We don't have remote but we have been thinking about getting Hive. Generally, we have it on timer – this year we haven't had it on much in the mornings, normally we
S: I would like to be able to use the likes of solar panels and also conserve water through my own collection. I do intend to do it in time – particularly with water in the summer, would give a reserve for watering garden because I've seen the neighbours just leaving the outside taps on and it drives me mad.
I'd love to go down the route of solar. We'd tend to have it on all evening.
We also have a solid fuel fire, a stove in the fireplace – there's no back burner so it doesn't heat water but it is much more energy efficient as you don't have as much energy leaving the house.
E: Do you tend to have that on in the evenings or do you turn to that when you're particularly cold?
S: Now we'd light it most evenings, during the summer we wouldn't have it on at all but for the dark cold evenings we have it on.
E: What is it like to manage your energy consumption?
S: We don't really think about it, it's very easy for example before with the fire it would have taken forever to light up, with the stove it's just instant and instant heat.
E: How does managing your energy consumption make you feel? You seem quite conscious of your energy use
S: I suppose it makes me feel like I'm giving back a little bit, I don't like to waste things so it feels good to know I'm doing my part. I think I'm more and more conscious of these things as I get older.
E: So now we'll shift to a preferred state, so you're already quite conscious and have taken steps to manage your use but if money and time were no obstacle and it wouldn't cause you any inconvenience to get to a complete preferred state. Thinking of that preferred state, what would you want to be doing, how do you want to be managing your energy consumption?

S: I would like to be able to use the likes of solar panels and also conserve water through my own collection. I do intend to do it in time – particularly with water in the summer, would give a reserve for watering garden because I've seen the neighbours just leaving the outside taps on and it drives me mad.
I'd love to go down the route of solar
E: So if you had those in place, what do you think managing your energy consumption would be like? At the moment you've said it's already pretty easy
would be like? At the moment you've said it's already pretty easy
S: I think if you're heating with solar I think you'd need to be more conscious of your usage, you wouldn't have an endless supply like you do with gas so you'd need to be thinking more about what you use and what you have. I'm not 100% sure of how it stores energy but I think that conscientiousness would help with levels of use
E: And then finally how would it make you feel?
S: I feel like I'm giving even more back and would feel like I'm more educated and that you can pass that knowledge onto other people about how it all works.
E: Great Shauna, thank you so much for your help with this, I really appreciate it. Is it okay if I come back to you again if I need to clarify anything.
S: No problem.
E: Thanks

EMOTIONAL GOAL MODEL DEFINITIONS

Current State:
Feel / Emotions
Uneducated: Not fully briefed or aware of all aspects of energy use and associated costs, and an inability to easily access and digest information
Confused: Inability to fully comprehend options for managing energy consumption and associated costs of energy use
Conscientious: Cognisant of use of energy in various forms and costs which are associated with same. Inability to estimate costs of specific use increases awareness around decision to use or not
Inconvenienced: Feelings of being put out by the requirement to constantly monitor and change energy use settings and manage availability of various sources, particularly oil and solid fuels
Uncertain: Not clear on the differences between energy source options and how to compare to gain perspective on maximising efficiency and minimising cost
Out of pocket: Feeling that the cost of energy is disproportionate to other basic costs of living and displeasure at having to pay
Surprised: Sense of shock at bill totals and in some cases values of credit based on averaged bill throughout year
Be / Qualities
Incomparable: Differences between detail provided across both presentation and content of energy use make it difficult to compare across the various sources
Complicated: Details provided are based on supplier units and not easy to directly relate to everyday use. Systems in use, particularly for heating, can be difficult to operate and maintain ie checking oil level, bleeding radiators
Non transparent: Information provided on tforming action
Cost unclear: Bills are based on energy units which are not directly relatable to the energy use and appliances powered making it difficult to understand the key sources of energy costs
Requiring service: Maintenance requirements for systems to ensure efficiency, ie service boiler or solar panels
Predictable: As a basic necessity, a level of predictability of requirement of use exists, particularly during winter months

Preferred Sate
Feel / Emotions:
Unaffected: A feeling that this basic necessity is covered and does not need much intervention from users to operate and maintain
Satisfied: Happy that basic needs are fully met with minimum effort to achieve this,
In Control – Cost: Level of understanding available to empower individuals to make informed decisions on their consumption and manage associated costs,
Happy/Content: Satisfied that basic needs are fully met with minimum effort to achieve this,
Philanthropic: A feeling of contributing to the sustainability of our environment through conscious action taken in domestic energy consumption and source,
Educated: High level of understanding around options and associated costs and effects for energy supply and consumption,
Contributing to sustainability: Conscious of and motivated by decisions on energy consumption and source which will minimise or eliminate impact to the environment, preserving it for future generations.
Be / Qualities
Easy & Effortless: Minimum intervention by users required to maintain energy supply and use as required by residents,

Cost transparent: Easily understandable information on costs and ability to relate to evryday use.
Immediately Responding: A smart and self aware system which can update settings based on environmental changes and pre set requirements of users,
Cost efficient: Costs required to set up generation or sustainable supplies are lower than the expected cost saving over a short period of time,
Transferrable / Transactional: Ability to sell or transfer self generated energy back to national grid or share with other users, making it more cost efficient to generate your own
Calculable: Ability to easily transfer everyday use of energy into applicable supplier units to calculate cost,
Easily digestible: Information on energy consumption is provided in a non technical manner and easy to comprehend,
Easily comparable: Information provided on the energy usage from different suppliers can be evaluated against other suppliers and other sources for better decision making.

SURVEY QUESTIONS AND STIMULI

SURVEY 1

Fusebox -Ireland existing



Image [fuse box - Irish]

Statements

I like this fuse box
This fuse box is informative
This fuse box is easy to use
This fuse box can help to manage the cost of my energy use

SURVEY 2

Fusebox -Hybrid existing



Image [RCD - USA]

Statements

I like this fuse box
This fuse box is informative
This fuse box is easy to use
This fuse box can help to managing the cost of my energy use

SURVEY 3

Fusebox - New Concpet

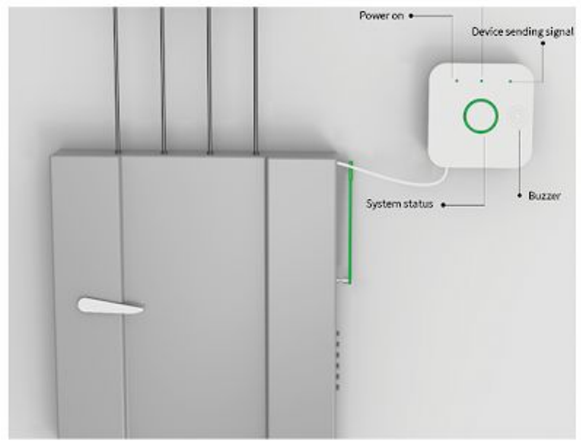


Image [fuse box - concept]

Statements

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Supplier Comparision- Ireland existing

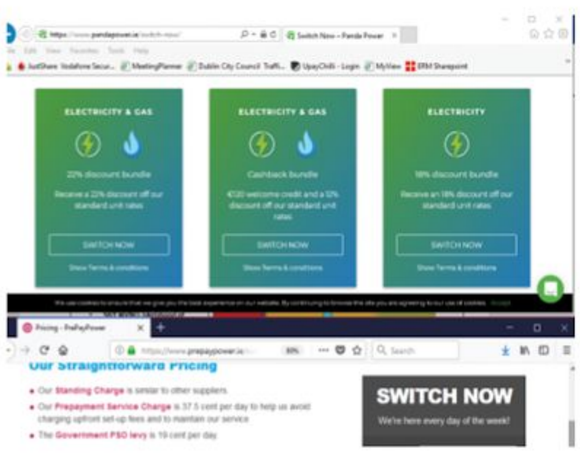


Image - comparing suppliers

Statements

I like this interface
This interface looks simple
This interface looks like it would help me control costs
This interface looks like it would help me make informed decisions

Supplier Comparision- Hybrid exisitng

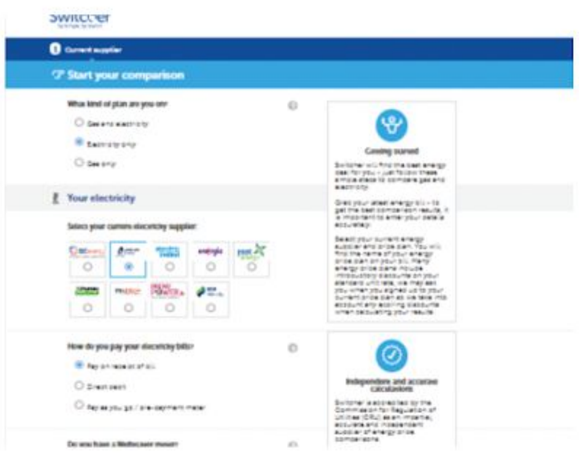


Image - Switcher.ie

Statements

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Supplier Comparision- New Concpet

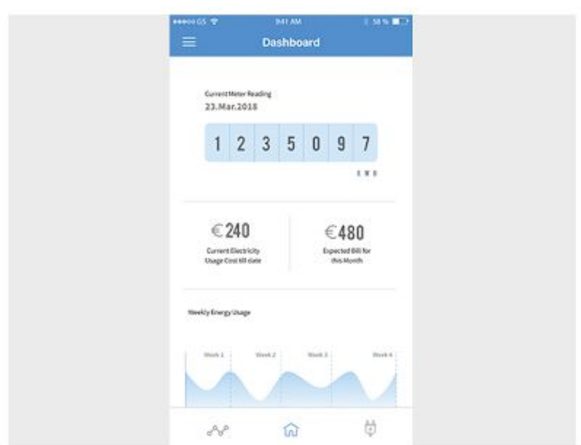


Image - concept

Statements

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SURVEY 1

Usage- Ireland existing



Image- Historical Use Info

Statements

I like this interface
This interface is accessible
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This interface can help to managing the cost of my energy use

Meter- Ireland existing



Image - Meter

Statements

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This interface looks like it would help me make informed decisions

SURVEY 2

Usage -Hybrid exisitng

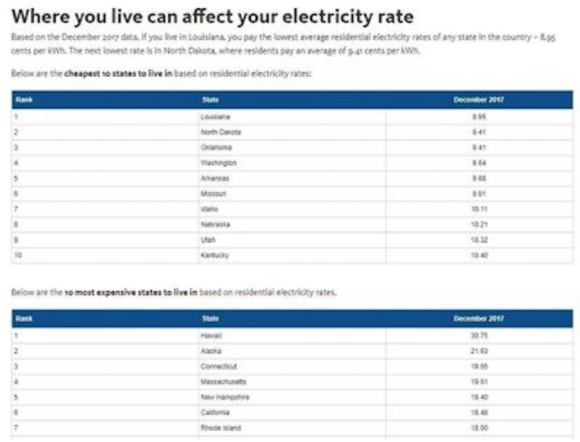


Image - Trends USA

Statements

I like this interface
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This interface can help to managing the cost of my energy use

Meter-Hybrid exisitng



IImage - Meter USA

Statements

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SURVEY 3

Usage- New Concpet

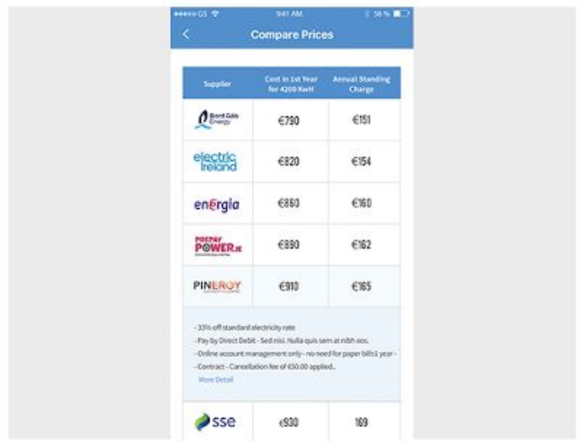


Image - New concept

Statements

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Meter- New Concpet

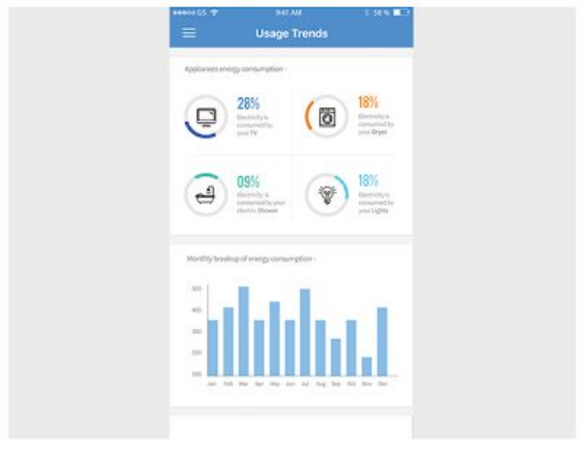


Image - concept

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ANOVA OUTPUTS

Oneway

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence ... Lower Bound
Q1	Ireland	22	4.2727	2.49154	.53120	3.1680
	Existing Hybrid	22	5.9545	2.90283	.61888	4.6675
	CONCEPT	22	7.1818	2.26014	.48186	6.1797
	Total	66	5.8030	2.79681	.34426	5.1155
Q2	Ireland	22	4.3636	2.12794	.45368	3.4202
	Existing Hybrid	22	5.2273	3.23569	.68985	3.7926
	CONCEPT	22	6.6818	2.29671	.48966	5.6635
	Total	66	5.4242	2.73474	.33662	4.7520
Q3	Ireland	22	5.7273	2.51058	.53526	4.6141
	Existing Hybrid	22	6.2273	2.92659	.62395	4.9297
	CONCEPT	22	6.7273	2.07437	.44226	5.8075
	Total	66	6.2273	2.52249	.31050	5.6072
Q4	Ireland	22	3.0909	2.36863	.50499	2.0407
	Existing Hybrid	22	5.2273	3.49056	.74419	3.6796
	CONCEPT	22	4.6818	2.69720	.57505	3.4859
	Total	66	4.3333	2.98887	.36790	3.5986
Q5	Ireland	22	3.9545	2.83645	.60473	2.6969
	Existing Hybrid	22	6.2273	2.99097	.63768	4.9012
	CONCEPT	22	7.7273	1.80428	.38467	6.9273
	Total	66	5.9697	2.99728	.36894	5.2329
Q6	Ireland	22	5.0000	2.91139	.62071	3.7092
	Existing Hybrid	22	6.7273	2.51058	.53526	5.6141
	CONCEPT	22	7.9545	1.75871	.37496	7.1748
	Total	66	6.5606	2.69546	.33179	5.8980
Q7	Ireland	22	4.0909	2.67099	.56946	2.9067
	Existing Hybrid	22	5.1818	3.26068	.69518	3.7361
	CONCEPT	22	6.8636	2.73070	.58219	5.6529
	Total	66	5.3788	3.07729	.37879	4.6223
Q8	Ireland	22	4.1818	2.53802	.54111	3.0565
	Existing Hybrid	22	5.4545	3.39085	.72293	3.9511
	CONCEPT	22	6.7727	2.58073	.55021	5.6285
	Total	66	5.4697	3.01391	.37099	4.7288

		95% Confidence Interval for ... Upper Bound	Minimum	Maximum
Q1	Ireland	5.3774	1.00	8.00
	Existing Hybrid	7.2416	1.00	10.00
	CONCEPT	8.1839	2.00	10.00
	Total	6.4906	1.00	10.00
Q2	Ireland	5.3071	1.00	8.00
	Existing Hybrid	6.6619	1.00	10.00
	CONCEPT	7.7001	2.00	10.00
	Total	6.0965	1.00	10.00
Q3	Ireland	6.8404	1.00	10.00
	Existing Hybrid	7.5249	1.00	10.00
	CONCEPT	7.6470	3.00	10.00
	Total	6.8474	1.00	10.00
Q4	Ireland	4.1411	1.00	9.00
	Existing Hybrid	6.7749	1.00	10.00
	CONCEPT	5.8777	1.00	10.00
	Total	5.0681	1.00	10.00
Q5	Ireland	5.2122	1.00	10.00
	Existing Hybrid	7.5534	1.00	10.00
	CONCEPT	8.5272	4.00	10.00
	Total	6.7065	1.00	10.00
Q6	Ireland	6.2908	1.00	10.00
	Existing Hybrid	7.8404	1.00	10.00
	CONCEPT	8.7343	3.00	10.00
	Total	7.2232	1.00	10.00
Q7	Ireland	5.2752	1.00	8.00
	Existing Hybrid	6.6275	1.00	10.00
	CONCEPT	8.0744	2.00	10.00
	Total	6.1353	1.00	10.00
Q8	Ireland	5.3071	1.00	10.00
	Existing Hybrid	6.9580	1.00	10.00
	CONCEPT	7.9170	2.00	10.00
	Total	6.2106	1.00	10.00

		N	Mean	Std. Deviation	Std. Error	95% Confidence ... Lower Bound
Q9	Ireland	22	5.0909	2.94245	.62733	3.7863
	Existing Hybrid	22	5.5909	2.71958	.57982	4.3851
	CONCEPT	22	7.3182	2.00918	.42836	6.4274
	Total	66	6.0000	2.72312	.33519	5.3306
Q10	Ireland	22	4.6818	2.27589	.48522	3.6727
	Existing Hybrid	22	4.8636	2.78252	.59324	3.6299
	CONCEPT	22	8.2273	2.06863	.44103	7.3101
	Total	66	5.9242	2.87328	.35368	5.2179
Q11	Ireland	22	6.0909	2.28680	.48755	5.0770
	Existing Hybrid	22	4.5909	2.53845	.54120	3.4654
	CONCEPT	22	7.4091	2.57569	.54914	6.2671
	Total	66	6.0303	2.69455	.33168	5.3679
Q12	Ireland	22	6.5455	2.42462	.51693	5.4704
	Existing Hybrid	22	5.0455	2.66328	.56781	3.8646
	CONCEPT	22	7.6364	2.34105	.49911	6.5984
	Total	66	6.4091	2.66589	.32815	5.7537
Q13	Ireland	22	7.1818	1.56255	.33314	6.4890
	Existing Hybrid	22	4.2273	2.87736	.61346	2.9515
	CONCEPT	22	8.5000	1.89611	.40425	7.6593
	Total	66	6.6364	2.80459	.34522	5.9469
Q14	Ireland	22	6.7727	1.84989	.39440	5.9525
	Existing Hybrid	22	4.7727	2.63551	.56189	3.6042
	CONCEPT	22	8.1364	1.93453	.41244	7.2786
	Total	66	6.5606	2.54878	.31373	5.9340
Q15	Ireland	22	6.9545	1.86387	.39738	6.1282
	Existing Hybrid	22	4.8182	2.64820	.56460	3.6440
	CONCEPT	22	7.9545	2.29860	.49006	6.9354
	Total	66	6.5758	2.61393	.32175	5.9332
Q16	Ireland	22	6.8182	2.17423	.46355	5.8542
	Existing Hybrid	22	4.6364	2.57359	.54869	3.4953
	CONCEPT	22	8.0000	2.00000	.42640	7.1132
	Total	66	6.4848	2.63259	.32405	5.8377

		95% Confidence Interval for ... Upper Bound	Minimum	Maximum
Q9	Ireland	6.3955	1.00	10.00
	Existing Hybrid	6.7967	1.00	10.00
	CONCEPT	8.2090	2.00	10.00
	Total	6.6694	1.00	10.00
Q10	Ireland	5.6909	1.00	10.00
	Existing Hybrid	6.0973	1.00	10.00
	CONCEPT	9.1445	1.00	10.00
	Total	6.6306	1.00	10.00
Q11	Ireland	7.1048	1.00	10.00
	Existing Hybrid	5.7164	1.00	10.00
	CONCEPT	8.5511	1.00	10.00
	Total	6.6927	1.00	10.00
Q12	Ireland	7.6205	1.00	10.00
	Existing Hybrid	6.2263	1.00	10.00
	CONCEPT	8.6743	1.00	10.00
	Total	7.0644	1.00	10.00
Q13	Ireland	7.8746	5.00	10.00
	Existing Hybrid	5.5030	1.00	10.00
	CONCEPT	9.3407	4.00	10.00
	Total	7.3258	1.00	10.00
Q14	Ireland	7.5929	4.00	10.00
	Existing Hybrid	5.9412	1.00	10.00
	CONCEPT	8.9941	4.00	10.00
	Total	7.1872	1.00	10.00
Q15	Ireland	7.7809	4.00	10.00
	Existing Hybrid	5.9923	1.00	10.00
	CONCEPT	8.9737	2.00	10.00
	Total	7.2183	1.00	10.00
Q16	Ireland	7.7822	2.00	10.00
	Existing Hybrid	5.7774	1.00	10.00
	CONCEPT	8.8868	3.00	10.00
	Total	7.1320	1.00	10.00

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Q1	Between Groups	93.848	2	46.924	7.130	.002
	Within Groups	414.591	63	6.581		
	Total	508.439	65			
Q2	Between Groups	60.394	2	30.197	4.469	.015
	Within Groups	425.727	63	6.758		
	Total	486.121	65			
Q3	Between Groups	11.000	2	5.500	.861	.428
	Within Groups	402.591	63	6.390		
	Total	413.591	65			
Q4	Between Groups	54.212	2	27.106	3.244	.046
	Within Groups	526.455	63	8.356		
	Total	580.667	65			
Q5	Between Groups	158.758	2	79.379	11.762	.000
	Within Groups	425.182	63	6.749		
	Total	583.939	65			
Q6	Between Groups	96.939	2	48.470	8.136	.001
	Within Groups	375.318	63	5.957		
	Total	472.258	65			
Q7	Between Groups	85.848	2	42.924	5.105	.009
	Within Groups	529.682	63	8.408		
	Total	615.530	65			
Q8	Between Groups	73.848	2	36.924	4.503	.015
	Within Groups	516.591	63	8.200		
	Total	590.439	65			
Q9	Between Groups	60.091	2	30.045	4.486	.015
	Within Groups	421.909	63	6.697		
	Total	482.000	65			
Q10	Between Groups	175.394	2	87.697	15.295	.000
	Within Groups	361.227	63	5.734		
	Total	536.621	65			
Q11	Between Groups	87.485	2	43.742	7.168	.002
	Within Groups	384.455	63	6.102		
	Total	471.939	65			
Q12	Between Groups	74.455	2	37.227	6.052	.004
	Within Groups	387.500	63	6.151		
	Total	461.955	65			
Q13	Between Groups	210.636	2	105.318	22.070	.000
	Within Groups	300.636	63	4.772		
	Total	511.273	65			

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Q14	Between Groups	125.939	2	62.970	13.388	.000
	Within Groups	296.318	63	4.703		
	Total	422.258	65			
Q15	Between Groups	112.939	2	56.470	10.742	.000
	Within Groups	331.182	63	5.257		
	Total	444.121	65			
Q16	Between Groups	128.121	2	64.061	12.519	.000
	Within Groups	322.364	63	5.117		
	Total	450.485	65			

Post Hoc Tests

Multiple Comparisons

LSD

Dependent Variable	(I) SURVEY	(J) SURVEY	Mean Difference (I-J)	Std. Error	Sig.
Q1	Ireland	Existing Hybrid	-1.68182*	.77347	.033
		CONCEPT	-2.90909*	.77347	.000
	Existing Hybrid	Ireland	1.68182*	.77347	.033
		CONCEPT	-1.22727	.77347	.118
	CONCEPT	Ireland	2.90909*	.77347	.000
		Existing Hybrid	1.22727	.77347	.118
Q2	Ireland	Existing Hybrid	-.86364	.78379	.275
		CONCEPT	-2.31818*	.78379	.004
	Existing Hybrid	Ireland	.86364	.78379	.275
		CONCEPT	-1.45455	.78379	.068
	CONCEPT	Ireland	2.31818*	.78379	.004
		Existing Hybrid	1.45455	.78379	.068
Q3	Ireland	Existing Hybrid	-.50000	.76219	.514
		CONCEPT	-1.00000	.76219	.194
	Existing Hybrid	Ireland	.50000	.76219	.514
		CONCEPT	-.50000	.76219	.514
	CONCEPT	Ireland	1.00000	.76219	.194
		Existing Hybrid	.50000	.76219	.514
Q4	Ireland	Existing Hybrid	-2.13636*	.87159	.017
		CONCEPT	-1.59091	.87159	.073
	Existing Hybrid	Ireland	2.13636*	.87159	.017
		CONCEPT	.54545	.87159	.534

Multiple Comparisons

LSD

Dependent Variable	(I) SURVEY	(J) SURVEY	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Q1	Ireland	Existing Hybrid	-3.2275	-.1362
		CONCEPT	-4.4547	-1.3634
	Existing Hybrid	Ireland	.1362	3.2275
		CONCEPT	-2.7729	.3184
	CONCEPT	Ireland	1.3634	4.4547
		Existing Hybrid	-.3184	2.7729
Q2	Ireland	Existing Hybrid	-2.4299	.7026
		CONCEPT	-3.8845	-.7519
	Existing Hybrid	Ireland	-.7026	2.4299
		CONCEPT	-3.0208	.1117
	CONCEPT	Ireland	.7519	3.8845
		Existing Hybrid	-.1117	3.0208
Q3	Ireland	Existing Hybrid	-2.0231	1.0231
		CONCEPT	-2.5231	.5231
	Existing Hybrid	Ireland	-1.0231	2.0231
		CONCEPT	-2.0231	1.0231
	CONCEPT	Ireland	-.5231	2.5231
		Existing Hybrid	-1.0231	2.0231
Q4	Ireland	Existing Hybrid	-3.8781	-.3946
		CONCEPT	-3.3326	.1508
	Existing Hybrid	Ireland	.3946	3.8781
		CONCEPT	-1.1963	2.2872

Multiple Comparisons

LSD

Dependent Variable	(I) SURVEY	(J) SURVEY	Mean Difference (I-J)	Std. Error	Sig.
	CONCEPT	Ireland	1.59091	.87159	.073
		Existing Hybrid	-.54545	.87159	.534
Q5	Ireland	Existing Hybrid	-2.27273*	.78329	.005
		CONCEPT	-3.77273*	.78329	.000
	Existing Hybrid	Ireland	2.27273*	.78329	.005
		CONCEPT	-1.50000	.78329	.060
	CONCEPT	Ireland	3.77273*	.78329	.000
		Existing Hybrid	1.50000	.78329	.060
Q6	Ireland	Existing Hybrid	-1.72727*	.73592	.022
		CONCEPT	-2.95455*	.73592	.000
	Existing Hybrid	Ireland	1.72727*	.73592	.022
		CONCEPT	-1.22727	.73592	.100
	CONCEPT	Ireland	2.95455*	.73592	.000
		Existing Hybrid	1.22727	.73592	.100
Q7	Ireland	Existing Hybrid	-1.09091	.87426	.217
		CONCEPT	-2.77273*	.87426	.002
	Existing Hybrid	Ireland	1.09091	.87426	.217
		CONCEPT	-1.68182	.87426	.059
	CONCEPT	Ireland	2.77273*	.87426	.002
		Existing Hybrid	1.68182	.87426	.059
Q8	Ireland	Existing Hybrid	-1.27273	.86339	.145
		CONCEPT	-2.59091*	.86339	.004
	Existing Hybrid	Ireland	1.27273	.86339	.145
		CONCEPT	-1.31818	.86339	.132
	CONCEPT	Ireland	2.59091*	.86339	.004
		Existing Hybrid	1.31818	.86339	.132
Q9	Ireland	Existing Hybrid	-.50000	.78027	.524
		CONCEPT	-2.22727*	.78027	.006
	Existing Hybrid	Ireland	.50000	.78027	.524
		CONCEPT	-1.72727*	.78027	.030
	CONCEPT	Ireland	2.22727*	.78027	.006
		Existing Hybrid	1.72727*	.78027	.030
Q10	Ireland	Existing Hybrid	-.18182	.72198	.802
		CONCEPT	-3.54545*	.72198	.000
	Existing Hybrid	Ireland	.18182	.72198	.802
		CONCEPT	-3.36364*	.72198	.000

Multiple Comparisons

LSD

Dependent Variable	(I) SURVEY	(J) SURVEY	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
	CONCEPT	Ireland	-.1508	3.3326
		Existing Hybrid	-2.2872	1.1963
Q5	Ireland	Existing Hybrid	-3.8380	-.7075
		CONCEPT	-5.3380	-2.2075
	Existing Hybrid	Ireland	.7075	3.8380
		CONCEPT	-3.0653	.0653
	CONCEPT	Ireland	2.2075	5.3380
		Existing Hybrid	-.0653	3.0653
Q6	Ireland	Existing Hybrid	-3.1979	-.2566
		CONCEPT	-4.4252	-1.4839
	Existing Hybrid	Ireland	.2566	3.1979
		CONCEPT	-2.6979	.2434
	CONCEPT	Ireland	1.4839	4.4252
		Existing Hybrid	-.2434	2.6979
Q7	Ireland	Existing Hybrid	-2.8380	.6562
		CONCEPT	-4.5198	-1.0257
	Existing Hybrid	Ireland	-.6562	2.8380
		CONCEPT	-3.4289	.0653
	CONCEPT	Ireland	1.0257	4.5198
		Existing Hybrid	-.0653	3.4289
Q8	Ireland	Existing Hybrid	-2.9981	.4526
		CONCEPT	-4.3163	-.8656
	Existing Hybrid	Ireland	-.4526	2.9981
		CONCEPT	-3.0435	.4072
	CONCEPT	Ireland	.8656	4.3163
		Existing Hybrid	-.4072	3.0435
Q9	Ireland	Existing Hybrid	-2.0592	1.0592
		CONCEPT	-3.7865	-.6680
	Existing Hybrid	Ireland	-1.0592	2.0592
		CONCEPT	-3.2865	-.1680
	CONCEPT	Ireland	.6680	3.7865
		Existing Hybrid	.1680	3.2865
Q10	Ireland	Existing Hybrid	-1.6246	1.2609
		CONCEPT	-4.9882	-2.1027
	Existing Hybrid	Ireland	-1.2609	1.6246
		CONCEPT	-4.8064	-1.9209

Multiple Comparisons

LSD

Dependent Variable	(I) SURVEY	(J) SURVEY	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
	CONCEPT	Ireland	2.1027	4.9882
		Existing Hybrid	1.9209	4.8064
Q11	Ireland	Existing Hybrid	.0116	2.9884
		CONCEPT	-2.8066	.1702
	Existing Hybrid	Ireland	-2.9884	-.0116
		CONCEPT	-4.3066	-1.3298
	CONCEPT	Ireland	-.1702	2.8066
		Existing Hybrid	1.3298	4.3066
Q12	Ireland	Existing Hybrid	.0057	2.9943
		CONCEPT	-2.5852	.4034
	Existing Hybrid	Ireland	-2.9943	-.0057
		CONCEPT	-4.0852	-1.0966
	CONCEPT	Ireland	-.4034	2.5852
		Existing Hybrid	1.0966	4.0852
Q13	Ireland	Existing Hybrid	1.6383	4.2708
		CONCEPT	-2.6344	-.0020
	Existing Hybrid	Ireland	-4.2708	-1.6383
		CONCEPT	-5.5889	-2.9565
	CONCEPT	Ireland	.0020	2.6344
		Existing Hybrid	2.9565	5.5889
Q14	Ireland	Existing Hybrid	.6933	3.3067
		CONCEPT	-2.6704	-.0569
	Existing Hybrid	Ireland	-3.3067	-.6933
		CONCEPT	-4.6704	-2.0569
	CONCEPT	Ireland	.0569	2.6704
		Existing Hybrid	2.0569	4.6704
Q15	Ireland	Existing Hybrid	.7549	3.5178
		CONCEPT	-2.3815	.3815
	Existing Hybrid	Ireland	-3.5178	-.7549
		CONCEPT	-4.5178	-1.7549
	CONCEPT	Ireland	-.3815	2.3815
		Existing Hybrid	1.7549	4.5178
Q16	Ireland	Existing Hybrid	.8189	3.5448
		CONCEPT	-2.5448	.1811

Multiple Comparisons

LSD

Dependent Variable	(I) SURVEY	(J) SURVEY	Mean Difference (I-J)	Std. Error	Sig.
	CONCEPT	Ireland	3.54545*	.72198	.000
		Existing Hybrid	3.36364*	.72198	.000
Q11	Ireland	Existing Hybrid	1.50000*	.74483	.048
		CONCEPT	-1.31818	.74483	.082
	Existing Hybrid	Ireland	-1.50000*	.74483	.048
		CONCEPT	-2.81818*	.74483	.000
	CONCEPT	Ireland	1.31818	.74483	.082
		Existing Hybrid	2.81818*	.74483	.000
Q12	Ireland	Existing Hybrid	1.50000*	.74777	.049
		CONCEPT	-1.09091	.74777	.150
	Existing Hybrid	Ireland	-1.50000*	.74777	.049
		CONCEPT	-2.59091*	.74777	.001
	CONCEPT	Ireland	1.09091	.74777	.150
		Existing Hybrid	2.59091*	.74777	.001
Q13	Ireland	Existing Hybrid	2.95455*	.65865	.000
		CONCEPT	-1.31818*	.65865	.050
	Existing Hybrid	Ireland	-2.95455*	.65865	.000
		CONCEPT	-4.27273*	.65865	.000
	CONCEPT	Ireland	1.31818*	.65865	.050
		Existing Hybrid	4.27273*	.65865	.000
Q14	Ireland	Existing Hybrid	2.00000*	.65390	.003
		CONCEPT	-1.36364*	.65390	.041
	Existing Hybrid	Ireland	-2.00000*	.65390	.003
		CONCEPT	-3.36364*	.65390	.000
	CONCEPT	Ireland	1.36364*	.65390	.041
		Existing Hybrid	3.36364*	.65390	.000
Q15	Ireland	Existing Hybrid	2.13636*	.69130	.003
		CONCEPT	-1.00000	.69130	.153
	Existing Hybrid	Ireland	-2.13636*	.69130	.003
		CONCEPT	-3.13636*	.69130	.000
	CONCEPT	Ireland	1.00000	.69130	.153
		Existing Hybrid	3.13636*	.69130	.000
Q16	Ireland	Existing Hybrid	2.18182*	.68203	.002
		CONCEPT	-1.18182	.68203	.088

Multiple Comparisons

LSD

Dependent Variable	(I) SURVEY	(J) SURVEY	Mean Difference (I-J)	Std. Error	Sig.
	Existing Hybrid	Ireland	-2.18182*	.68203	.002
		CONCEPT	-3.36364*	.68203	.000
	CONCEPT	Ireland	1.18182	.68203	.088
		Existing Hybrid	3.36364*	.68203	.000

Multiple Comparisons

LSD

Dependent Variable	(I) SURVEY	(J) SURVEY	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
	Existing Hybrid	Ireland	-3.5448	-.8189
		CONCEPT	-4.7266	-2.0007
	CONCEPT	Ireland	-.1811	2.5448
		Existing Hybrid	2.0007	4.7266

*. The mean difference is significant at the 0.05 level.

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