Energy Consumption Behaviour in Households

An Explorative Research on Consumption Behaviours, Influential Factors and Possible

Solutions

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Abstract: Sustainability is becoming an increasingly important issue. Through new technologies and modernizations, governments aim to increase energy conservation and sustainability. However, consumer behaviours are a major influential factor in the successful implementation of new sustainability measures. Thus, changing consumer behaviour is a crucial step in implementing new sustainable technologies. This study aims at identifying specific behaviours that hinder energy conservation behaviour, influential factors and possible solutions. Three data collection methods were used. Firstly, a diary study was conducted in order to quantify consumption behaviour. Next, an interview was conducted to identify specific behaviours. The last data collection method was a focus group based on the findings of the diary study and interview. The focus group was conducted to substantiate findings, identify more specific behaviours, influential factors and possible ways to increase energy conservation. Avoidable energy consumption behaviours were overnight charging, letting devices run without using them or never turning devices off. Possible influential factors identified were belief of cleanliness, comfort, habits and awareness. For behavioural change, a multidimensional approach was suggested.

Introduction

Throughout the years, economic growth highly influenced the standard of living. It enabled higher household income and changed work culture and time use. People are more efficient with time, but not in energy consumption. To save time, people increase their energy use with new technologies to complete household tasks, rather than doing it manually (Anker-Nilsen, 2003). For instance, people started using vacuum cleaners instead of manual tools, dishwashers and washing machines. Comfort and convenience become increasingly important consequently neglecting environmental concerns. Besides leisure activities and comfort, household energy is crucial for heating, cooking and lighting (Papachritos, 2014).

Overall, residential energy use is one of the largest contributors to energy consumption and accounts for approximately one fourth of the total energy consumption in Europe according to measures of International Energy Agency (IEA, 2017-a). In the Netherlands, the residential energy consumption also accounts for about 20% of the whole energy use.

New technologies were developed and are now in widespread use to increase energy conservation. The use of such energy-saving technologies alone is estimated to decrease energy use by 30% (Bertoldi, Ricci, & de Almeida, 2000). Industries, housing companies and policies in Europe and the Netherlands have also started to respond those technological changes to decrease energy consumption. For instance, the Dutch government is promoting energy-saving with the campaign „Save Energy now! ". Thus, the ultimate goal of the campaign is, to increase energy-savings to about 1.5 % a year. This policy encourages homeowners in implementing energy-saving elements, by rewarding them with loans or grants, when they undertake specific measures such as better insulation, solar water heating, heat pumps, ventilation with a heat recovery function and solar panels (Ministerie van Algemene Zaken, 2017).

Even though environmental activism and general awareness about sustainability was spread over the course of the last years (Pecl et al., 2017), there is still a gap between actual and potential energy efficient levels of the promising decrease through energy conservation technologies (Dimitropoulos, 2007; Ehrhardt-Martinez, & McKinney, 2009, IEA, 2017). Energy-efficient behaviour contributes to a great extent to realising efficiency measures. Thus, understanding and identifying energy consumption and behaviour of households can effectively increase efficiency and sustainability to increase energy saving (Dimitropoulos, 2007). It has even been suggested, that behavioural changes can be as effective as technological changes (Prindle & Finlinson, 2011). The aim of this research is to identify behaviours that hinder energy savings, influential factors and ways to increase energy savings.

Theoretical Framework

Different influential factors can be identified that may influence household energy consumption. One recurrently mentioned factor is the so-called 'rebound effect' (Bourelle, 2014; Dimitropoulos, 2007; Ouyang, Long, & Hokao, 2010). It generally describes increased energy consumption after the implementation of new, energy conserving, technologies. Thus, benefits of energy-efficient technologies can be undermined through inefficient consumer behavior. For instance, if technological progress increases energy efficiency by 1%, the actual reduction in energy consumption often lays under 1% (Zhang, Peng, & Su, 2017). Recent literature classifies three types of rebound effects (Greening et al., 2000).

(1) Direct rebound effects: Improved energy efficiency leads to cost reductions for energy services which in turn might motivate behavioural change and increased energy consumption. Consequently, reducing expected energy savings. *(2) Indirect rebound effects:* Cost savings through increased energy efficiency enable increased energy consumption on other goods and services. Subsequently leading to increased energy consumption to provision for these services. *(3) Economy-wide rebound effects:* Lower prices of energy services reduce the cost of other goods throughout the economy and lead to a change of economic growth which in turn increases energy consumption (Barker, Ekins & Foxon, 2007) Thus, making the 'rebound-effect' is a complex influential factor on energy consumption.

Mental accounting or moral licensing relates to the economic view of the indirect rebound effect (Seebauer, 2018; Tiefenbeck, Staake, Roth & Sachs, 2013). It describes how consumers justify increased consumption after an environmentally relevant action. Similar to how it would be done with incomes and expenses in a banking account (Tiefenbeck, Staake, Roth & Sachs, 2013; Seebauer, 2018). Thus, the belief of already having done their part in one domain and in turn consuming more in another domain. For instance, purchasing an e-car and then feeling allowed to consume more energy in another domain, like flying to a holiday destination (Seebauer, 2018).

Arguably, the most influential factor of energy consumption may be habit formation (Huebner, Cooper& Jones, 2013). Habits are beneficial for humans as they free mental capacity for other activities and enable the possibility to perform activities simultaneously (Wood, Quinn & Kashy, 2002). According to Verplanken and Wood (2006) 45% of everyday behaviours can be classified as habits. However, once these habits are formed, changing inefficient consumer behaviour becomes more difficult to tackle (Huebner, Cooper & Jones, 2013). Habits might also explain the lack of effectiveness of sustainability measures involving financial incentives (Maréchal, 2009).

Shove additionally (2003) explored three domains (three C's), influencing energy consumption. Namely, comfort, cleanliness and convenience. The concept of comfort has been subject of change and influenced by historical and cultural factors. New technologies and buildings now are typically designed to enable 'comfort conditions' for the consumer. In consideration of thermal comfort, maintaining comfort requires a high demand of resources due to differing outdoor climates. This gave high rise to the air-conditioning industry (Cooper, 1998, p-78) and resulted in now internationally applied standards. For instance, codes such as the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) Standard 55 design and engineer systems to meet thermal comforts which cannot be met by natural weather conditions (Brager & de Dear, 2000). These standards become comfort, when consumers acclimate to these conditions (Shove, 2003).

Additionally, the concept of cleanliness has also changed over the course of the last centuries. For instance, the average American Household now washes nearly three times the amount of laundry as compared to 1950 (Biermeyer, 2001; Shove, 2003). On the other hand, water heating significantly declined. Boiling and hot washes were considered essential, which is not the case anymore (Shove, 2003). Furthermore, bathing/showering norms also changed from weekly baths to daily/ twice daily showering (Shove, 2003).

Lastly, convenience expectations increased due to the increased value of time and freedom of time coordination, making it a crucial part of everyday life. Convenience food can be stated as a classic example of this concept. Besides nutritional aspects of convenience, convenience devices come in handy when bundling multiple activities to make multitasking, or time saving easier (Shove, 2003). A simple example are smartphones now in widespread use, that include many functions in one device.

Another influential factor on inefficient consumer behaviour may be ignorance. Thus, ignoring the complex issue of climate change and growing environmental concerns and disregarding personal responsibility (Kay et al., 2008). According to Stephard and Kay (2012) this can lead to an approach of 'ignorance is bliss' to arising societal issues which my hinder greater public attention. Thus, when confronted with an increasingly complex issue, people may assign the responsibility for solving these issues to the government (Kay et al., 2008; Stephard & Kay, 2012). Consequently, creating feelings of dependence towards those 'controlling' the system. Through these feelings of trust and dependency, people seem to be less motivated to learn new information about complex societal issues.

In terms of pro-environmental behaviour in households, a study found positive correlations between environmental values (the will to make a positive impact on

sustainability) and energy conservation. Environmental knowledge and energy conservation were also found to be positively correlated (Pothitou, Hanna & Chalvatzis, 2016). Behavioural measures to increase energy savings are generally associated with an increased effort or decreased comfort. Hence, with behavioural change comfortable behaviours and lifestyle have to be adjusted (Poortinga, Steg, Vlek &Wiersma, 2003).

The aim of this study is to investigate consumption behaviours that hinder energy conservation, influential factors of consumption behaviours and possible measures for increased energy conservation. In specific, this study thus investigates:

1. *What behaviours do consumers display that decrease energy conservation?*
2. *What behaviours do consumers display that influence energy conservation?*
3. *How can consumer behaviours be influenced to increase energy conservation?*

Method

Design

The study consisted of three separate qualitative data collection methods, in order to diversify the approach and research on energy consumption behaviours. Firstly, a diary study was implemented to investigate participants' energy consumption behaviour within their households, to quantify the energy consumption behaviour of the participants. Thus, aiming to answer the first research question. Secondly, a structured interview survey design was employed to further explore energy consumption and conservation behaviour of a different sample to investigate the consumption behaviours. This data collection method aimed at answering the first and second research question. Lastly, two focus groups were conducted in order to identify specific behaviours of a different sample that might not have been asked during the interview. In addition to that, possible reasons and ways to increase energy conservation were discussed. The focus groups aimed at answering the second and third research question.

Participants

All participants were recruited in a convenience sample and randomly assigned to one of the three data collection methods. During the selection process, care was taken to ensure that the sample is rich in diversity. In the diary study, 12 participants took part. The ages ranged between 21-53, with a mean age of 31.7. The participants included seven students, five employed, one self-employed and one working student. Eight female and four male people participated in the diary-study. In the Interview, 10 participants took part. The ages ranged between 21-52, with a mean age of 30. 8 of the participants are students and three are employed,

with four female and six male participants Lastly, in the focus group, 12 people participated. The focus group consisted of people, with a mean age of 22.76 and an age range between 22-26. Within the focus group four were female and seven male.

Procedure

Before starting the data collection process, ethical approval was requested and permitted by the ethical committee of the University of Twente. This had to be done in order to assure that the data collection was implemented according to ethical requirements. Once ethical approval was obtained, all participants received an email, in which the purpose and course of the research was explained. They were additionally informed about the data collection method they took part in. Prior to participation, the participants filled out a short questionnaire concerning their demographic data. The materials used were the diary study (see Appendix A), an interview scheme (see Appendix B) and prompts for the focus groups (see Appendix C). The interviews and focus groups were conducted via Skype and audio-recorded by a recording device. Depending on their assigned data collection method, participants got additional instructions.

With regard to the diary study, the participants received the diary document via email (see Appendix A). All instructions and explanatory information were included within the document. The participants filled out the diary-documents for five days, in the evening, after completing most of their usual daily habits. These were either filled out manually or digitally. Each day the researchers sent out a reminder via WhatsApp at 8 pm. After completing the diary study for five days, the participants had to send their documents back to the researchers.

The document started with a description and purpose of the research and contact details of the researchers. Next, each day the participants had to fill out the date and their participant number in the document. The diary consisted of several subparts for each room or activity. The first room was the kitchen, including the activities of using the dishwasher, washing the dishes by hand, cooking (using the stove and/or oven), water boiler and toaster. The bathroom included actives of taking a shower, bath, washing the hands, hair dryer or other hairstyling devices (such as hair straightener, curling iron).In the living room/personal room the activities listed were watching television, using laptop or computer, using printer, mobile phone, tablet, game consoles and using music systems. Then charging behaviours were listed, including mobile phone, laptop and tablet. Following the lighting and heating for each room. Then, cleaning/washing activities were listed, laundry, vacuum cleaner and dryer. Lastly, a self-assessment on the days' energy consumption was asked (Appendix A). All rooms included

columns for possible, additional activities. Before documenting their behaviour in the tables, a short instruction was provided. They were asked to document the frequency and duration of their energy consumption of different devices These devices were selected after conducting a pilot study, were participants indicated their most used devices in different rooms

The diary started with the kitchen and an additional column on whether or not the devices used in the kitchen have an energy saving option. Followed by the bathroom, living room/ personal room and charging. For the lighting behaviour, the participants also were instructed to give information on energy-saving options. For heating they were instructed to document the duration, heating during the night, heating regulation and energy-saving options. At the end of the diary-document, the participants answered three open follow-up questions.

For the interview study, participants indicated their Skype ID, for an online interview. In order to ensure anonymity, one Skype account was created solely for the research and deleted after data collection. The interviews lasted approximately 30 minutes for each participant. The interview was structured to collect information about behaviours in all rooms, starting with general questions about the participants' living situation and daily routine, followed by more specific questions about energy consumption and personal importance and willingness to change. After the general overview, specific questions included cleaning behaviours, charging and heating. Then, the personal importance of energy saving, their willingness to change their behaviour and their highest and lowest willingness to change specific behaviours.

Concerning the focus groups, participants were invited via email to join a collaborative Skype Call. During the Skype call, the researcher stimulated a discussion about possible new energy conservation methods and strategies. The focus group lasted around 30 minutes. The focus group was divided in two groups. The first group discussed specific consumption behaviours to stimulate about discussion about subconscious behaviour and possible reasons for it. First, the researcher explained the purpose of the focus group and provided information on the general of the study. To foster the discussion, different prompts were developed. These prompts included questions about personal opinion of energy consumption and how different devices are used. The second focus group discussed influential factors of their energy consumption and possible solutions. Both focus groups were recorded and transcribed afterwards.

Results

Diary Study

All data reported in the diary study is collected over the course of 5 days. In the first part of the diary, rooms have been divided into subcategories with different items. In the kitchen (see Table 1), the item that has been used the most hours in average was the dishwasher (M=4.45, SD=3.54), followed by cooking. The participants cooked an average of. 2.94h a week (SD=1.69). Cooking has also been done the most frequent during the week, with an average of 9.5 times (SD=2.00). In turn, participants spent the least time on the water boiler with averagely 0.27h a week (SD=0.2). However, it is the second most frequently used item in the kitchen.

Table 1

Means duration and frequency (and standard deviations) of energy-related behaviour in the kitchen (n=12)

Duration	Dishwasher	Washing by Hand	Water boiler	Cooking	Toaster	Other
M	4.45	0.68	0.27	2.94	0.13	0.08
Mdn	5.90	0.55	0.3	2.50	0.01	0.00
SD	3.54	0.59	0.2	1.69	0.22	0.19
Frequency						
M	2.75	5.3	7.42	9.5	2.583	0.92
Mdn	3.00	5.00	7.00	4.00	1.50	0.50
SD	2.00	3.1	1.68	11.37	11.37	0.99

In the bathroom, the item that has been used the longest is the shower, with an average of 0.75h per week (SD=0.41) and also the second most frequent behaviour (M=4.08, SD=4.00). Showering was followed by washing the hands (M=0.48, SD=1.08), evidently due to governmental restrictions and recommendations and thus was also the most frequent behaviour in the bathroom (M=19.24, SD= 0.99). Additionally, hairstyling items have been used the least (M=0.25, SD=1.2) and for the least time (M=0.14, SD=0.01). The Item for bathing has been excluded, due to its the lack of use by the participants.

Table 2

Means duration and frequency (and standard deviations) of energy-related behaviour in the bathroom (n=12)

Duration	Shower	Hand washing	Hairstyling
M	0.75	0.48	0.14
Mdn	0.65	0.45	0.01
SD	0.41	0.33	0.20
Frequency			
M	4.08	19.24	0,25
Mdn	4.00	18.2	0.12
SD	1.08	0.99	1.21

The living room also included free time and work/ home office. The most item that has been used the longest is the laptop. Participants used the Laptop an average of 16.38h a week (*SD*=9.91). Following, participants spent 14.31h in average on their phone (*SD*=7.89). The other items have been used for a significantly less. Hence, participants spent the shortest amount of time printing (*M*=0.07, *SD*=0.15). Due to the fact that it is hard to measure the frequency of phone and laptop usage, the participants did not report this information. Regardless, the most frequent used item is the television with an average of 3.33 (*SD*=8.03).

In consideration of the high Laptop and Phone usage, charging behaviours have also been reported. A vast number of participants reported charging their devices overnight. For this analysis, charging overnight has been rated as a total of 8 hours for each night. Consequently, participants charged their phones an average of 22.57h a week (*SD*=13.27) and their laptops an average of 8.04h (*SD*=7.1). Even though laptops were generally used for a longer period of time, participants tended to charge them fewer hours (and not overnight) in comparison to charging their phones overnight.

Table 3

Means duration and frequency (and standard deviations) of energy-related behaviour in the living room/ personal room (n=12)

Duration	Television	Laptop	Phone	Game Console	Music	Printer
M	6.09	16.38	14.31	1.92	2.23	0.07
Mdn	2.80	17.00	15.10	0.00	0.25	0.00
SD	8.03	9.91	7.89	4.48	3.55	0.15
Frequency						
M	3.33			0.50	1.08	2.42
Mdn	3.50			0.00	0.00	0.50
SD	2.10			0.79	1.20	3.92

Out of these three rooms, participants spent the most time in the living room (*M*=41.01, *SD*=11.79) and the least time in the bathroom (*M*=1.38, *SD*=1.19). Accordingly, participants also had the light on the longest in the living room (*M*=9.6827, *SD*=7.33). Similar lighting times were reported in the kitchen (*M*=8.71, *SD*=6.56). Lighting was used less in the bathroom (*M*= 3.00, *SD*=2.58), bedroom (*M*=4.73, *SD*=7.89) and hall (*M*=3.27, *SD*=5.69).

To check, whether a correlation can be found between the time spent in rooms and the duration of lighting, the Spearman's rho correlation was computed. A moderate correlation, without statistical significance between the time spent in the kitchen and the lighting duration was found r_2=0.58, p> 0.05. Other correlations were not found (Appendix D).
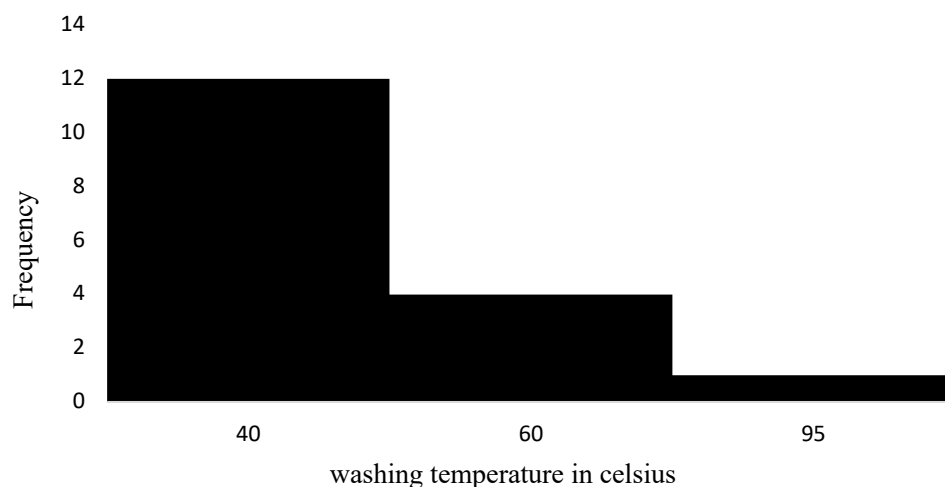
Figure 1. Consumer behaviour of washing machines, frequency and temperature (N=12)

As Figure 1 shows, in terms of the cleaning component, the participants did their laundry a total of 20 times and 1.6 times in average (*SD*=1.96). 12 of the wash cycles have been done by 40 degrees, four on 30 degrees, three on 60 degrees and 1 on 95 degrees.

With regard to the heating during the data collection period, little data has been found due to the weather conditions in the time period. Two out of 12 participants have automated thermostat without the need of manual regulation. In addition to that, five participants used their heating regulation and set their heating on three (out of five) on the heating scale and heated an average of (*M*= 138.8, *SD*= 9.80). The outside temperature was around 20- 26 ° Celsius. Heating all day was counted as 24 hours. The room that generally was heated the longest was the living room (*M=41.01, SD=11.80)*, followed by the bathroom (*M=1.38, SD= 0.74)*. Concerning additional remarks, five participants stated that they could save more energy by using less light. Other frequently mentioned ways to increase energy conservation were decreasing media consumption (either ps4, phone, computer or television). One participant also mentioned shorter showers, more efficient heating and charging the phone overnight.

Interview

All participants mentioned that their phone and laptop are part of their daily routines. Thus, using and charging it daily. These electrical devices seem to be the most essential. All participant mentioned that the devices of their daily routine did become a habit, meaning they did not consciously think about their energy consumption:" I would definitely describe the usage of those devices as a habit as I do not really think about its energy consumption.". Hence, the majority of participants did not seem to reflect on the energy consumption while using those devices.

Two participants described the devices as habitual behaviour, while still reflecting on the devices energy consumption:" (…) mobile phone not at all, only if I am wondering whether my battery lasts until the end of the day. I try to think about my consumption while watching TV (…).". In consideration of daily habits, smaller differences were found. For instance, 3 participants were frequently playing music and 2 other participants were gaming for entertainment:" the metronome for when I practice my instrument. (…) and also, my tuning machine. That is even more important than my laptop".

One participant that is gaming for entertainment, mentioned that they did not reflect on the devices energy consumption while using it because they game to escape reality: "I don't really reflect on the energy consumption that much, because it is entertaining. You play it to have fun and be in a different world, so I do not pay a lot of attention to the energy

consumption.". In addition to that, this participant also mentioned that emotions do influence their consumption behaviour: "I don't really reflect on the energy consumption that much, because it is entertaining. You play it to have fun and be in a different world, so I do not pay a lot of attention to the energy consumption.".

One participant mentioned a possible reason for the lack of reflection while using these electrical devices: "I think I am more conscious when I have to deal with things that are more real, not virtual, like turning the water or heating system off. I don't think I save a lot of energy when it comes to electricity, like a smartphone or laptop. It seems like it is a very abstract thing that you cannot see or feel. Which is the opposite of water light or heating.".

When it comes to laundry, most participants wash their laundry around once a week at temperatures between 30 and 60 degrees. 2 participants also mentioned to making a distinction between the washing machine temperatures depending on the clothes they are washing: "(…) underwear and duvet covers with 60°C that no bacteria and mites are still in
the clothes, everything else 30°C because it does not require a higher temperature
to be clean.". However, one participant mentioned doing the laundry 5 times a week at high temperatures:" five times a week depends on the colour, (..) white always 95 degrees, and the coloured mostly forty, well since the white ones lose their colour I want them to be clean so I use the highest possible to kill all the bacteria, the forty degrees so that they do not lose their colour but if it would be possible, I would also wash them on 95".

Additionally, saving water while showering was not most participants' priority, as five have stated that they like to shower long, because it makes them feel good or that they feel comfortable: "The shower feels nice after a long day or workout". However, this was not the case for every participant. One participant stated to have an uncomfortable shower, which hinders the enjoyment of showering:' I am quite fast, because my shower is very small and uncomfortable, and I want to go out as quickly as possible. It usually takes me around 6 minutes.'.

Regarding the charging behaviour of the participant, six out of nine stated that they regularly charge their electrical devices overnight. No participant had a smart thermostat. During the heating period, most participant set their heater on three, on a scale from one to five, with exceptions of putting the heater on five, when it was desired. Two participants stated to live in a poor isolated house with old heaters. These participants reported the need to put their heater on the highest temperature, because it will not work otherwise:" Usually, in this room five. Because it is leaking (…) so I have it on five, but it only has like 18 degrees in here.".

Factors that might influence the participants energy consumption could be (as stated by the participants), their current living situation. It seems to be easier to regulate energy conservation while living alone, because it ultimately means having more control over it.

While living with flatmates or family seems to decrease the perceived control.:" If it was only me, I would try to do it more environmentally friendly,(…) since I live with my parents, they decide what devices we have and how to use them.". Another factor that has been mentioned are emotions, for instance through boredom or negative feelings the media consumption might increase "When I am very emotional, more negative feelings. I tend to spend more time on my smartphone". Participants additionally stated that the growing media presence of sustainability and social environment could also influence their energy consumption.

Lastly, a participant also mentioned that they did not have to pay for the costs of their energy bill as it is a set cost for every month which is included in the rent. This might be a big factor why not a lot of attention was given to energy conservation:" I do not have to pay the electricity or water bill. It is a set fee for every month. So, it doesn't depend on my use. That is the problem if I would pay it myself, I would probably pay more attention". In terms of personal importance, the majority of participant indicated high ratings. Three participants rated the personal importance of energy conservation between one and five. Two participants indicated a range between six and seven. Three rated it an eight or higher.

Focus group

The focus group has been divided in two groups. In the first group, à three and four participants, specific behaviours about their energy consumption and conservation behaviour were discussed in more detail. In the second focus group à four participants possible ways to increase energy conservation were discussed.

First focus group

Six out of seven participants indicated that they believe their energy consumption behaviour in the kitchen is high. Two participants, living in shared homes mentioned that their energy consumption was high because everyone used the kitchen at different times: "(…)we cook a lot in the kitchen, since we are three people and everybody's hungry at a different time so we have different times for cooking.".

Another participant believed that their energy consumption is high due to the number of devices they own (e.g. fridge, freezer, oven). Additionally it was mentioned that especially in the morning a lot of energy is consumed because several devices are used simultaneously :"

(..) in the morning when I wake up, I use, for example, several things at once, like the water boiler, the stove, the toaster and the water boiler for tea (..)".The water boiler seems to be an important item in the consumption behaviour of the participants. Almost all mentioned that they payed attention to putting the approximate amount of water needed in the water boiler, though it occasionally might be too much with the exception of two participants.

Hence, one participant mentioned that they always put more water in it, due to the bad condition of the water boiler: "I put in too much because I think the bottom part is a bit dirty. Like there is chalk in it (..) I don't want that in my cup, so I spend more than half a litre for one cup.". Thus, making old kitchen supplies a reason for inefficient behaviour. The same participant also mentioned that their oven is very inefficient due to its old condition. The second inefficiency mentioned in consideration of the water boiler is that they put more water in the water boiler most of the time to put the remaining hot water in the dirty pans, so it is easier to clean. This is considered inefficient because it is first not necessary to boil more water then needed, second water does not have to be at boiling temperatures for cleaning.

Two out of four participants that owned a dishwasher in their household usually set the device on eco-function. One rationale for not putting it on eco-function might be the lack of awareness:" I am not even sure if we have an eco-function or not, we always have it on the same option." or that their device simply does not have an eco-function.

One common strategy mentioned for saving water while washing the dishes by hand and in bulk was filling up the sink or a pot with water to use this water for cleaning the dishes, rather than letting the water run while cleaning:" (…) I fill the water in the sink and then I wash so I don't waste too much water". However, one participant mentioned that they were aware of this strategy and that it saves water but reported not using this strategy. This indicated that it might be a habit:" I have to say, we never do that in our household. I would just always put it on hot water and let the water run, same for my family.". Additionally, three participants usually did not wash their dishes in bulk because they either lived in a shared flat:" (…) since there's seven of us, we're supposed to just clean our individual dishes." or they always just did it right away. These participants also either used hot or lukewarm water to clean the dishes, which also might be inefficient considering the high frequency and little quantity of dishes. Another inefficiency mentioned is that they first let the water run to get it warm to wash the dishes. This inefficiency may be unavoidable in most cases. However, it has to be considered how long the water takes to warm up and thus how long the water runs without being used. One participant also mentioned that in their household, they use a lot of glasses and cups even when it was unnecessary, rarely using cups and glasses more than once.

Five participants also first let the water run before getting into the shower, two were even indicating doing it for a couple of minutes and in the meantime choosing music to listen to: "I usually turn the shower on before I get in, and I know that's not good. I am listening to music or choosing the right song while waiting for it to get warm so it can be a few minutes." Additionally, mood might also influence the time people spend while showering, indicating that sad or lonely moods make them shower longer. This is also reflected inthe timespan and temperature they shower:" if it's a lonely day you have fifteen minutes, you know, like hot water running. You make it hotter and hotter.". One participant also mentioned bathing a lot, which might also be influenced by mood and comfort:" I love to use the bathtub. I do that often, especially during the winter (..)".

Two participants mentioned, having the TV run quite a large portion of the day, even when it was not used. All participants mentioned, never completely turning off their TVs, phones or Laptops, except of two participants. Due to the increased time spent at home one participant mentioned that they used the TV and Game consoles more often together as a family. Three participants also mentioned having their laptops on the charger most of the time while using it. In terms of devices, only the mobile phone seems to be charged overnight, one participant mentioned they sometimes did it with a tablet. Six participants did charge their phones overnight. Three mentioned that they did not do it, when the phone is charged over half of the battery. In terms of heating, the majority of participant reported quite efficient behaviour and being mindful with heating. One participant mentioned that they pay a lot of attention after they once got a high bill.

Second focus group

In this focus group, the participants first discussed specifically what they believe are factors influencing their energy consumption and then how they believe they could decrease their energy consumption.

One factor that has been mentioned is the awareness about how much energy they were consuming while using a device: "(…) to know how much energy a device consumes would decrease my consumption because I would pay more attention to it (…)". Next, the electricity bill was also mentioned as an influencing factor. However, a participant criticised the lack of effectiveness because in most households the final billing and information is given at the end of the year: "I think that it is in part difficult, because you only get the electricity bill once a year and you think wow that is a lot and I want to save but you do not get a clear overview because you only get it rarely (...)". A suggestion was made to get a bill to know what is

consumed the most and put it in comparison to other devices to understand the consumption better: "(…) to have a list that when you let the light on for six hours for example, it equals the same energy consumption like being on the laptop for one hour.". Money might also be a factor, as one mentioned that they do not believe that money is the primary reason to save money for wealthy people. Contrary, one participant mentioned that it is a big influencing factor for a lot of people.

Additionally, one participant mentioned that bills influence the energy consumption to a great extent, but it was also influenced by the personal attitude towards energy consumption. According to this participant, the strongest factor might be personal circumstances:" (…) and I think the strongest point is probably what is happening at the moment, for example if you are having a calm day at home you would look on how much you are consuming other than when you are in stress and have to go to work, I think then almost no one pays attention.".

Habits and upbringing were also mentioned as influencing factors. One participant mentioned that his consumption behaviour was especially influenced by behaviour that did become automatic and subconscious. The example the participant mentioned was their behaviour after waking up:" (…) things I do every day (…) that have become automatic like watching YouTube videos for 15 minutes to wake up (…). I think working on awareness would be very effective.". Then a participant mentioned that they did not save energy because of the environment or money but because their behaviours got taught, which could account for subconscious behaviour: " when I am looking at myself, I somehow often do not save energy because of the environment or money, but because I have been taught this way and I think that upbringing in that regard is a very important point.".

During the second half of the discussion, the first point to increase energy conservation was that the government gives fines, in addition to bills for unnecessary energy consumption. Another idea was the idea of a public campaign to save energy consumption with the punishment of community service: "what about a campaign that is aired on Television by the government, announcing new laws and the ones who do not follow have to do community service.". Opposing to that, a participant criticised the idea because it is influenced by many other factors like how many people are living in the household. Then, the idea of grants for household who live very efficient was mentioned, as it might be more effective then unfair punishments.

Next, one participant mentioned that it might be effective to display feedback on the devices to visualize how much energy is consumed: "I think it would be highly effective if displays on electrical devises are integrated to give direct feedback (…) to see how much

energy the device consumes (…) because I think it is difficult to estimate how much I am consuming while using it, but I think directly seeing it would increase my awareness. Again, awareness was a crucial part of the discussion with the addition of feedback integration.

Accordingly, another participant mentioned that increased knowledge about efficient consumption could be helpful to clear up misconceptions: "(…) to know how to use devices efficiently, for example I am still not sure if I save more energy when the coffee machine is constantly on or if I save more energy when I always turn it on.". Lastly, the participants came to the conclusion that a multidimensional approach and help of the government would be the most helpful. One mentioned that it would be helpful to promote renewable energies:" What I would like is when the government would support the implementation of renewable energies in households.". Similarly, energy efficiency and consequences should be integrated more in school education by the government: "I think it would have a great effect when energy saving, and consumption was more integrated in children's education. In school we never earned about it."

Discussion

This study aimed at identifying which consumer behaviours tenants display that decrease energy conservation, how these behaviours are influenced and how energy conservation can be increased. The data was collected in a convenience sample distributed on three separate data collection methods. The first data collection method was a diary study, aiming to quantify consumption behaviours to assess the quantity and frequency of consumption behaviours. During the second data collection method, the interview, these behaviours were discussed in more detail. Lastly, during the focus group, the aim was to identify patterns or consumption behaviours that were not identified during the prior data collection methods and to additionally gather insight on what measures participants suggested to increase energy conservation.

In order to answer the first research question:" *What behaviours do consumers display that decrease energy conservation?"*, all three data collection methods were used. The second research question:" *What behaviours do consumers display that influence energy conservation"* can be answered on basis of the second (interview) and third (focus group) data collection method. The third research question: "*How can consumer behaviours be influenced to increase energy conservation?* "can be answered with the second focus group.

The main findings were that for the kitchen, the device that has been used the longest was the dishwasher. Reasonably, because one wash cycle generally takes a couple of hours. Notably, using the dishwasher saves significantly more water than washing the dishes manually

(Richter, 2010). However, this can still decrease potential energy efficiencies. For instance, while using the dishwasher participants noted not being aware of eco-functions on the dishwasher and always putting the dishwasher on the same settings. This inefficiency can be explained through habit formation (Richter, 2010). Similar findings can be found in a study examining behavioural inefficiencies (Erhardt-Martinez & McKinney, 2009). Another potential habit mentioned was, using the washing machine when it is not completely full. Thus, decreasing efficient washing.

When washing the dishes manually, another inefficiency mentioned is that the dishes are not always washed in bulk and for each washing, new hot water is required.

The most frequent used device in the kitchen was the water boiler. One inefficiency mentioned using this device is boiling more water than actually needed. It was also mentioned that boiling water was used for the cleaning of kitchen appliances, which can be considered non-essential (Shove, 2003). In commonality of other studies (Coleman, Brown, Wrigt & Firth, 2012; Crosbie, 2018; Green & Ellegård, 2007), it has also been mentioned that especially in the morning, several devices are used simultaneously.

In the bathroom, most time was spent on showering. No substantially long durations of showering have been reported. However, participants mentioned often letting the water run before getting in the shower. All participants also mentioned generally showering at higher temperatures. In combination of a potential habit of letting the water run before getting in, another influential factor might be comfort. Waiting before getting in and showering warm are all aspects of comfort (Shove, 2003). This can be further substantiated with the interview, as one participant mentioned having a very uncomfortable and old shower which makes them shower less, which decreases comfort. Bathing has been excluded from the diary study and was mentioned only once during the data collection. Considerable amount of time also has been spent washing the hands. Thus, during the data collection period (April 2020) a global pandemic encouraged increased sanitary precautions. Considering that the concept of cleanliness is a concept of change at influenced by social and cultural factors (Shove, 2003), this concept might be changing now due to the given circumstances.

In the living room, participants spent most time with electrical devices. Notably, this category also included home office and entertainment. Due to the pandemic and governmental regulations, most people worked in home offices. In relation to that, participant spent most time on their laptops, followed by mobile phones. When using these devices, the majority of participants mentioned never turning their electrical devices completely off. Especially phones, laptops or Television. Televisions were also mentioned as a device often being on when it is

not in use. In addition to that, participants also mentioned charging their phones overnight. A study indicated that in the UK, 23% of domestic energy consumption can be assigned to Information, communication and entertainment appliance use. In addition to that, 7% of that energy consumption can be accounted to devices being in stand-by mode (Coleman, Brown, Wright & Firth, 2012).

The majority of participants also do not seem to reflect on the electronic devices' (mobile phone, laptop, TV) energy consumption while using it. For instance, a participant mentioned that while using devices for entertainment (TV, gaming consoles) the focus is on entertaining oneself rather than reflecting about energy.

Different influential factors can be identified for these inefficiencies. One factor is the global pandemic during the data collection, making individual studying and home offices part of participants daily routine. Thus, with the increase of home offices, working hours become more flexible work hours increase energy consumption and the demand for other appliances (e.g. printer). In addition to that, the need to communicate likely have been fulfilled trough social networks. For instance, a study found evidence for 'social television'. Hence, communicating with a friend through social networks and simultaneously watching a television show together (Coleman et al., 2012). Generally, there has been an increase in European countries in the consumption of consumer electronics over the past years (International Energy Agency, 2009). Also, participants mentioned phones and laptops being part of their daily routine. Hence, indicating habitual behaviour.

Contradictory, participants spent more time charging their phones than laptops, even though laptops have generally been used for a longer period of time. Participants charge their phones more frequently overnight than their laptops. This phenomenon could be due to a more deeper rooting issue. For instance, findings of a survey indicate that the majority of people fear having a low battery on their phone. LG proposed the term "Low-Battery Anxiety", which describes the anxiety and fear of losing battery power especially when it is already at a low level (LG, 2016). It may further trigger "no-mobile phone phobia" which describes the fear of being unable to communicate with the mobile phone (King et al., 2014). In contrast to these findings, a study showed that the participants believed that the required charging duration is less for mobile phones than for laptops (Saxena, Sanchez & Pecht, 2017). Thus, charging behaviours and beliefs require further scientific investigation.

In terms of lightning, participants also kept the lights in the living room on the longest. The room, where participants forgot the lighting on the most often was the hall. Similarly, another study found that 17% of participants always turned the lights off when leaving a room

and the commonality of leaving lights on. Thus, making cosiness, safety a habitual behaviour of easily moving in and out of rooms and therefore leaving the lights on (Lindén, Carlsson-Kanyama & Eriksson, 2006).

Heating behaviour was also not considered in the diary study due to the weather condition during the data collection period. However, during the interview it became apparent that especially participants with bad isolation and malfunctional heating systems put their heater on a high scale during the heating period.

In terms of cleaning behaviour, most participants do their laundry below boiling temperatures, which is in line with current research suggesting that there has been a significant decrease of high temperature washing (Shove, 2003). Thus, indicating age as a potential cofounding variable to be further explained in future literature.

In relation to psychological theory, the theory of planned behaviour (Ajzen, 1991) may also explain some behavioural inefficiencies and the lack of energy conservation. The theory encompasses three factors that influence behavioural intention: attitude, subjective norm and perceived behavioural control (Ajzen, 1991). Participants mentioned that living with other people complicate energy conservation. For instance, it was mentioned that, when living with family the parents make the major decision about the use of commonly used electrical devices, such as the dishwasher. This factor influences the perceived behavioural control of individuals, which describes the extent to which individuals believe that they are able to perform a certain behaviour. Thus, the latter named example lowers the perceived behavioural control. In terms of attitude about the topic (sustainability and efficiency) most participants rated their personal importance rather high (from a scale of one to ten). However, this study did not measure subjective norm and thus a full conclusion cannot be made. Subjective norm describes how individuals believe other people would evaluate their behaviour (Ajzen, 1991).

Lastly, another potential influential factor on energy consumption as it was mentioned that not having to think about energy costs due to a set monthly bill, makes them pay less attention on energy consumption. A study also found that set monthly bills increase energy consumption, though very little (Levinson & Niemann, 2004). Thus, also indicating a rebound effect. Through 'savings' in the energy bill, more energy can be consumed.

Different points were subjects of discussion during the focus groups, to enable behavioural change. Increasing awareness and integrating feedback while using electrical devices were mentioned to increase energy conservation. Research also indicates the effectiveness of immediate feedback on energy consumption behaviour (Darby, 2006). A national survey also indicated that concerns about environmental and thus awareness increased the willingness to

purchase energy-saving light bulbs (Thornton, 2009). However, a study also indicated that respondents who already installed energy-saving light bulbs, were discouraged to purchase additional ones due to reasons of practicality and comfort (Whitmarsh, et al., 2011).

For behavioural change, participants concluded in a multidimensional approach, using education about energy consumption of specific devices for adults and children and integrating feedback in the technologies to increase general awareness. Research also indicates the effectiveness of immediate feedback on energy consumption behaviour ultimately also increasing education and awareness (Darby, 2006). Another point was including financial incentives to motivate sustainable consumption. According to findings, it may be a way to increase energy conservation (Mizobuchi, Takeuchi, 2013). Participants concluded in a multidimensional approach, using education about energy consumption of specific devices for adults and children and integrating feedback in the technologies to increase general awareness.

Strengths, Limitations and recommendations

Strengths of this study are the multiple types of data collection, enabling insight in different perspectives and greater detail.

A major limitation of this study was the global situation during the data collection period. The factor of comfort may have influenced the findings, as more time is spent at home and people generally enjoy a slower paste of living. It would have also been useful to ask the participants to what extent the situation influenced their energy consumption behaviour.

Additionally, the diary study has been used as a data collection method, which includes subjectivity in documentation. Hence, some participants filled out the diary in more detail, while others only filled it out briefly. The level of detail varies substantially in some cases as some participants indicated ranges of durations and some participants exact durations.

Although the diary was standardized, it could have given too much weight on the devices the researcher chose as important. The given columns might have motivated participants to only fill out the given options. Considering that a lot of the behaviour is also habitual they might not actively think about it. Also, not a lot of information could be found on the heating behaviour of the participants. During the data collection period, the weather did not require heating in households. Thus, also not being part of the diary study. Similarly, participants also might have missed sharing information during the interview and focus group because heating is not part of their activities at the given moment.

A recommendation for future research would be including more devices in the standardized diary study. Another factor worth analysing would be the connection of behaviour and

interpersonal factors like norms or social comparison and how these factors influence energy consumption. Lastly, participants provided the feedback that documenting their behaviours increased their general awareness. Hence, a pre-post measurement of awareness might substantiate this. In addition to that, heating does account for a large part of energy consumption (Huebner, Cooper, Jones, 2013). Therefore, data collection during the heating period could further identify consumer behaviours. For instance, a longitudinal or comparative data collection between seasons, assessing behaviours during different circumstances.

Conclusion

Consumer behaviour plays a crucial role in energy conservation. This study has identified consumption behaviours influential factors and explored possible solutions. The main behaviours identified are the high consumption of laptops and phones and the corresponding charging behaviours, forgotten lighting and devices that are not in use (also including water). These behaviours are influenced by habits, comfort, cleanliness, attitude and perceived behavioural control. In order to enable behavioural change and sustainability, a multimodal approach should be implemented.

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Appendix A

Diary Study – Sustainable Homes

Introduction & General Information

Dear Participant,

The present diary study aims at investigating your general and overall energy-use behaviour within your household. For this purpose, the researchers developed a document, to make the daily energy-use documentation for you as simple as possible. It is important to mention that you won't be judged on the amount of energy you consume. Your answers will be anonymized and data will only be discussed in terms of age, gender and socio-economic status. You will additionally receive an informed consent in which you will be informed about these privacy issues more in detail. However, to ensure anonymity and guarantee proper data collection it is necessary <u>to always indicate your participant number</u> at the beginning of each diary day.

Instruction & Explanatory information

You are asked to fill out the following document daily for five days. Preferably, you fill out this questionnaire in the evening, when you completed most of your usual daily habits and tasks. Therefore, you will receive a daily reminder by the researchers via what's app at approximately 8pm.

      As households are nowadays usually divided into several rooms, the researchers tried to assign typical devices and activities which consume energy to their typical position within households. To give an example, showers are usually located within bathrooms. For this reason, you can find the activity "taking a shower" in the "Bathroom" table.

      Moreover, it is really important that your answers are as honest and precise as possible. This is especially necessary when filling out the <u>duration of usage</u> of each activity.

      Being more precise, we ask you to fill out the duration of usage for each activity or device you used. Therefore, it is important to mention that we do not ask you to stop the time for filling in the duration of usage, however, please try to be as accurate as possible. In addition to that, when filling out the duration of each activity/device, you have the possibility to give your answer in minutes

and/or hours. Please, make sure that you clearly indicate if you mean hours (h) or minutes (min).

Furthermore, when looking at each table, you will probably notice that there is always a free row at the end. The intention behind this is that if you performed another activity which is not listed in the table you have the possibility to add it.

Lastly, it is up to you whether you fill out the following document on the computer or if you print it out and fill it out by hand. However, after the five days you need to send the documents back to the researcher. Therefore, you will also receive a reminder on Monday (20.04.2020).

If you face any questions while filling out the diary, please do not hesitate to contact the researchers:

Kira Bibic (k.bibic@student.utwente.nl)
Dilan Ince (a.d.ince@student.utwente.nl)

Start your Diary:

Dear Participant,

fill out the following tables.

Please indicate your **participant number** here: _____

Please indicate the **date** here: _____

Kitchen

Explanatory information:
While filling out the tables, please note that if you did not complete one of the following activities or you simply do not have one of the following listed devices, you can leave it free.

- **Energy saving option**: nowadays many dishwashers include for example an "eco-function", which is aimed at conserving more energy. If any of your devices include such an option, please indicate it in the last column.
- Please remember: the last row is left free so that you have the possibility to add a device you used, which is not included in the given table.

Activities	How often did you use it/ do it? (please give your answer by using simple strokes)	For how long did you approximately use it/ do it? (please give your answer in minutes and/or hours)	Does your device have an energy saving option? (If yes indicate what and if you used it?)
Using the dishwasher			
Washing the dishes by hand			
Cooking (using the stove)			
Cooking (using the oven)			

Water Boiler			
Toaster			

Bathroom

Activities	**How often did you use it/ do it?** (please give your answer by using simple strokes)	**For how long did you approximately use it/ do it?** (please give your answer in minutes and/or hours)
Taking a shower		
Taking a bath		
Using the toilet		
Washing hands		
Hair dryer		
Other hair styling devices (such as: hair straightener, curling iron)		

Living room/personal room (free time and work)

Activities	**How often did you use it/do it?** (please give your answer by using simple strokes)	**For how long did you approximately use it/ do it?** (please give your answer in minutes and/or hours)
Watching television		
Using Laptop or Computer		
Using the printer		
Using mobile phone		
Using Tablet		

Using Game consoles		
Using music system		

Explanatory information:
- Technological devices such as laptops, mobile phones or tablets etc. are working with a rechargeable battery. Please indicate whether you have charged your device and if yes for how long.
- Please remember: Extra lines were added, in case there are other devices which you might have charged today. Additionally, if you charged your device overnight, please indicate it in the last column by writing ("overnight").

Device	Did you recharge your device? (yes/no)	For how long did you approximately recharge your device? (answer in minutes/hours)
Mobile Phone		
Laptop		
Tablet		

Entire House/Flat

Light

Light per Room	How long did you approximately leave the lights on? (answer in minutes and/or hours possible)	Did you leave on the lights in any of these rooms even when you were not in it? (If yes, please indicate for approximately how long this was the case per room. If not, just leave it free).	Are you using any energy saving systems? (in this case for example: energy saving light bulbs, motion detector etc.; If yes please indicate what for the belonging room).
Bathroom			
Kitchen			

Living Room			
Bedroom			
Hall			

Heating regulation (Generating thermal comfort)

Heating per Room	**How long did you approximately regulate the temperature in the room?** (answer in minutes and/or hours possible)	**Did you regulate the temperature at night?** (answer: Yes/No)	**On a scale from 1 (low) to 5 (high), How low/high did you regulate your heating system?**	**Are you using any energy saving systems?** (such as: automated thermostats etc.)
Bathroom				
Kitchen				
Living Room				
Bedroom				
Hall				

Cleaning/washing

Did you do your laundry today? (yes/no)	If yes, how often? (once, twice…)	What temperature did you set for the laundry?

Did you use your Vacuum cleaner today?	If yes, for how long? (answer in minutes)	On which load did you set your vacuum cleaner? scale 1(low)-5(high).

Did you use your dryer today? (yes/no)	If yes, how often? (once, twice…)	What temperature did you set?

Did you hang up your laundry today? (yes/no)

Follow up questions

You arrived at the last step of today's diary. Now please answer shortly the following questions.

Question 1: In your opinion, do you think your amount of energy consumption was high/normal/low today, compared to the general population? (Please explain why in 1-2 sentences)

Answer:

Question 2: Do you think you could have conserved more energy today? (yes/no)

Answer:

Question 3: If yes, what could you have done in order to increase energy conservation at your home?

Answer:

You finished todays diary. Thank you very much for your participation!

Appendix B

General questions (Overview questions)

1. Do you live in a shared flat/house and if yes how many people live in your home? / Do you live alone?

2. For you personally, which electrical devices are the most important?

3. Which electrical devices are part of your daily routine?

4. While using those devices, do you reflect on its energy consumption or do you use them intuitively? (Rephrased: Do you actually think about the device's energy consumption or would you describe the usage rather as a habit?)

5. How many electrical devices for entertainment (non-essential) do you own? (such as game consoles, sewing machines,tv etc.)?(please give some examples)

6. Which of these do you use most frequently?

7. While using those devices, do you reflect on its energy consumption or do you use them intuitively? (Rephrased: Do you actually think about the device's energy consumption or would you describe the usage rather as a habit?)

More specific questions with regard to energy consumption behavior

1. How often do you do your laundry (within one week)?

2. At what temperature do you usually wash your laundry? Why?

3. How often do you take a shower (within one week)?

4. How long do you approximately shower? Why?

5. Do you use tools to help clean your household, e.g vacuum cleaners, vacuum robots, etc.?

6. How often do you use these?

7. If you have a cell phone or a laptop-computer, how often do you charge it (within one week)?

8. Do you charge overnight?

9. Which activities do you perform that entail water heating (e.g. boiling tea, washing your laundry, doing the dishes)?

10. How often do you perform these activities (within one day)?

11. During the heating period, how many rooms are you keeping warm using your heating system?

12. Do you have a "Smart thermostat"?

13. If yes, at which daily setting?

14. If no, when do you heat and when not?

15. At what temperature do you usually set your heater?

16. Do you normally wear sweaters indoors?

17. At what stage do you usually adjust your heating system during the heating period? (stage 1-5)

18. Do you also use your heating system at night?

Interview questions with regard to energy conservation behavior

1. For you personally, how important is it to conserve energy at your home? (from a scale from 1 (low) to 10 (high)

2. Do you do something to conserve energy at home? (If yes, please explain)

3. By which devices/activities do you mostly pay attention to energy conservation? In other words, with which activities/devices are you most conscious about your energy consumption?

4. By which activities/devices do you have the highest willingness to conserve energy?

5. Do you have energy saving systems in your home (explanation: such as an eco-function on your dishwasher/ energy saving light bulbs)?

6. If yes, what kind of energy saving systems do you have?

7. If yes, how many?

8. By which devices/activities do you not pay attention to its energy conservation? In other words, with which activities/devices are you least conscious about your energy consumption?

9. By which activities devices do you have the lowest or least willingness to conserve energy?

10. By which activities do you find it most difficult to conserve energy?

11. If yes, please explain why?

12. Can you think of anything else that influences your energy conservation behaviour?

Appendix C

Prompts used for the first focus group condition:

1. Do you generally think you consume a lot of energy in your kitchen/ bathroom/ living room/ personal room?

2. How do you wash your dishes?

3. Do you use any other electric devices in the kitchen?

4. How do you use your water boiler?

5. Do you shower long?

6. Do you get into the shower right away?

7. What influences your showering behaviour?

8. Do you charge overnight?

9. What do you think about your cleaning and heating behaviour?

Prompts used for the second focus group condition:

1. What factors, influence your energy conservation behaviour?

2. What can be done in order to increase energy conservation?

Appendix D

Spearman's rho correlation between the time spent in each room and the amount of lightning

		Kitchen Duration	Livingroom Duration	Bathroom Duration	Lighting Bedroom	Lighting Livingroom	Lighting Kitchen	Lighting Bathroom
Kitchen Duration	Correlation Coefficient	1.00	-0.063	0.63*	-0.07	0.22	0.58	0.17
	Sig. (2-tailed)	.	0.85	0.03	0.86	0.52	0.06	0.61
	N	12	12	12	9	11	11	11
Livingroom Duration	Correlation Coefficient	-0.06	1.00	0.31	-0.47	0.16	-0.63*	-0.23
	Sig. (2-tailed)	0.84	.	0.34	0.20	0.63	0.04	0.50
	N	12	12	12	9	11	11	11
Bathroom Duration	Correlation Coefficient	0.63*	0.31	1.00	-0.01	0.40	0.18	-0.150
	Sig. (2-tailed)	0.03	0.34	.	0.98	0.22	0.60	0.669
	N	12	12	12	9	11	11	11
Lighting Bedroom	Correlation Coefficient	-0.07	-0.47	-0.08	1.00	0.12	0.61	0.35
	Sig. (2-tailed)	0.86	0.20	0.98	.	0.78	0.08	0.35
	N	9	9	9	9	9	9	9
Lighting Livingroom	Correlation Coefficient	0.22	0.16	0.40	0.11	1.00	0.15	0.48
	Sig. (2-tailed)	0.52	0.63	0.22	0.78	.	0.65	0.13
	N	11	11	11	9	11	11	11
Lighting Kitchen	Correlation Coefficient	0.58	-0.63*	0.12	0.61	0.154	1.00	0.35
	Sig. (2-tailed)	0.06	0.04	0.60	0.08	0.65	.	0.30
	N	11	11	11	9	11	11	11
Lighting Bathroom	Correlation Coefficient	0.17	-0.23	-0.15	0.35	0.48	0.35	1.00
	Sig. (2-tailed)	0.61	0.50	0.66	0.35	0.13	0.30	.
	N	11	11	11	9	11	11	11

Appendix E

Informed Consent

'I hereby declare that I have been informed in a manner which is clear to me about the nature and method of the research as mentioned before. My questions have been answered to my satisfaction. I agree of my own free will to participate in this research. I reserve the right to withdraw this consent without the need to give any reason and I am aware that I may withdraw from the experiment at any time.

If my research results are to be used in scientific publications or made public in any other manner, then they will be made completely anonymous. My personal data will not be disclosed to third parties without my express permission. If I request further information about the research, now or in the future, I may contact Kira Bibic k.bibic@student.utwente.nl) or Dilan Ince (a.d.ince@student.utwente.nl)

If you have any complaints about this research, please direct them to the secretary of the Ethics Committee of the Faculty of Behavioural Sciences at the University of Twente, Drs. L. Kamphuis-Blikman P.O. Box 217, 7500 AE Enschede (NL), telephone: +31 (0)53 489 3399; email: l.j.m.blikman@utwente.nl).

Signed in duplicate:

....

Name Participant   Signature

I have provided explanatory notes about the research. I declare myself willing to answer to the best of my ability any questions which may still arise about the research.'

....

Name researcher   Signature

Please indicate your gender and age here:

 O Male O Female Age: ___